
Frio River Flood in Pleasanton, May 2015

Region 13 – Amended 2023 Nueces Regional Flood Plan

Texas Water Development Board

July 14, 2023

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July 14, 2023

REGION 13 - AMENDED 2023 NUECES REGIONAL FLOOD PLAN

Prepared for

Texas Water Development Board

Prepared by
Nueces Regional Flood Planning Group

With Administration by

Nueces River Authority

With Technical assistance by

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Nueces Regional Flood Planning Group
Amended 2023 Nueces Regional Flood Plan

<< insert photo from June 26th meeting>>

<< insert signatures by planning group>>

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Voting Members

Member Name	Interest Category	Organization
Barbara Canales* (Chairman)	Industries	N/A
Andrew Rooke* (Vice-Chairman)	Small Business	F.B Rooke & Sons
Robert Williams* (Secretary)	Public	Mayor, Jourdanton
Shanna Owens*	Counties	San Patricio County DEMS
Lauren Williams*	Environmental	The Nature Conservancy
Julie Lewey	River Authorities	Nueces River Authority
Debra Barrett	Agricultural	Barrett Ag
Larry Dovalina	Water Utilities	City of Cotulla
JR Ramirez	Water Utilities	Wintergarden GCD
Larry Thomas	Flood Districts	Bandera County River Authority
David Baker (resigned)	Electric Generating Utilities	City of Hondo
LJ Francis (resigned)	Municipalities	Consultant

***Executive Committee members**

Nonvoting Members

Member Name	Agency
Tressa Olsen	Texas Water Development Board
Jim Tolan	Texas Parks and Wildlife Department
Brian Hurtuk	Texas Division of Emergency Management
Kara Smith and Jami McCool	Texas Department of Agriculture
Kendria Ray	Texas State Soil and Water Conservation Board
Simone Sanders	General Land Office
Joel Anderson	Texas Commission on Environmental Quality
Open	Liaison to San Antonio RFPG and Rio Grande RFPG
Dave Mauk	Liaison from the San Antonio RFPG

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This Regional Plan is released for interim review on June 12, 2023, by HDR Engineering, Inc., 8404 Indian Hills Dr., Omaha, NE 68114, Texas Registered Firm F-754 and the following individuals presented below:

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Acknowledgements

Special thanks to Sky Lewey (1958-2022), who served as Resource Protection and Education Director for the Nueces River Authority for 22 years and was a dedicated member of the Nueces (Region 13) Regional Flood Planning Group. Her dedication and advocacy of river protection, riparian issues, and flood planning leaves a permanent legacy in the Nueces River Basin for which we are truly grateful. Tribute to Sky Jones-Lewey - Wimberley Valley Watershed Association (https://wimberleywatershed.org).

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<<after planning group approval… insert submittal letter from NRA to TWDB>>

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List of Abbreviations

2D	two-dimensional
ACE	annual chance event
ARPA	2021 American Rescue Plan Act
ATSDR	Agency for Toxic Substances and Disease Registry
BCA	benefit-cost analysis
BCR	benefit-cost ratio
BFE	base flood elevation
BIL	Bipartisan Infrastructure Law
BLE	Base Level Engineering
BMP	best management practice
BRIC	Building Resilient Infrastructure and Communities
CAP	Continuing Authorities Program
CCR	Choke Canyon Reservoir
CDBG-DR	Community Development Block Grant – Disaster Recovery
CDBG-MIT	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CIP	capital improvement project
CTP	Cooperating Technical Partners
CWMS	Corps Water Management System
CWSRF	Clean Water State Revolving Fund
DD	drainage district
DEM	digital elevation model
Dfund	Texas Water Development Fund
DHS	U.S. Department of Homeland Security
EAP	emergency action plan
EAS	Emergency Alert System
EPA	U.S. Environmental Protection Agency
EWP	Emergency Watershed Protection
FAFDS	First American Flood Data Services
FCD	flood control district
FEMA	Federal Emergency Management Agency
FIF	Flood Infrastructure Fund
FIM	flood inundation mapping
FIRM	Flood Insurance Rate Map
FIS	flood insurance study
FMA	Flood Mitigation Assistance
FME	flood management evaluation
FMP	flood mitigation project
FMS	flood management strategy
FMXs	Collective group of FMEs, FMPs, and FMSs

FRMP	Flood Risk Management Program
FWSD	fresh water supply district
GIS	geographic information systems
GLO	Texas General Land Office
HDR	HDR Engineering, Inc.
HMAP	hazard mitigation action plan
HUC	hydrologic unit code
HUD	U.S. Department of Housing and Urban Development
IIJA	2021 Infrastructure Investment and Jobs Act
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RTS	Hydrologic Engineering Center-Real Time Simulation
HHPD	Rehabilitation of High Hazard Potential Dam Grant Program
HMGP	Hazard Mitigation Grant Program
IPCC	Intergovernmental Panel on Climate Change
LCC	Lake Corpus Christi
LID	low income development
LOMR	Letter of Map Revision
LOS	level of service
LWC	low water crossing
msl	mean sea level
MUD	municipal utility district
NBI	National Bridge Inventory
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NFPR	Nueces Flood Planning Region
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRFP	Nueces Regional Flood Plan
NRFPG	Nueces Regional Flood Planning Group
NWS	National Weather Service
O&M	operation and maintenance
OCR	off-channel reservoir
PA	Public Assistance
RFC	River Forecast Center
RFP	regional flood plan
RFPG	Regional Flood Planning Group
RSLR	relative sea level rise
SFHA	Special Flood Hazard Area

SFP	state flood plan
SLC	sea level change
SLFRF	State and Local Fiscal Recovery Funds
SLR	sea level rise
STORM	Safeguarding Tomorrow through Ongoing Risk Mitigation
SVI	Social Vulnerability Index
SWCD	soil and water conservation district
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDEM	Texas Division of Emergency Management
TFMA	Texas Floodplain Management Association
TNRIS	Texas Natural Resources Information System
TPWD	Texas Parks & Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TxCDBG	Community Development Block Grant Program for Rural Texas
TxDOT	Texas Department of Transportation
UWCD	Underground Water Conservation District
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WCID	water control and improvement district
WRDA	Water Resource Development Act

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Executive Summary

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Executive Summary

ES.1 General Description of the Region

In 2019, the Texas Legislature adopted changes to the Texas Water Code Section (§)16.061 that established the regional and state flood planning process. Regional flood plans (RFPs) for 15 flood planning regions across the state will be compiled in the 2024 state flood plan (SFP). The SFP will be updated every five years. The Texas Water Development Board (TWDB) is charged with overseeing the development of the regional and state flood plans. The amended RFPs are due to TWDB by July 14, 2023.

TWDB appointed a regional flood planning group (RFPG) for each region and provided them funding to prepare their regional plans. The Nueces River Authority is the sponsor for the Nueces regional flood plan (NRFP). HDR Engineering (HDR) is the technical consultant for the NFPR flood planning effort. The Nueces Regional Flood Planning Group (NRFPG) is comprised of stakeholders from various interest groups, which include the public, counties, municipalities, industries, agriculture, environment, small business, electric-generating utilities, river authorities, water districts, water utilities, and flood districts. The members of the NRFPG for the first flood planning cycle are listed in Table ES-1 and Table ES-2.

Table ES-1. NRFPG Voting Membership

Member Name	Interest Category	Organization
Barbara Canales* (Chairman)	Industries	-
Andrew Rooke* (Vice-Chairman)	Small Business	F.B. Rooke & Sons
Robert Williams* (Secretary)	Public	City of Jourdanton
Shanna Owens*	Counties	San Patricio County DEMS
Lauren Williams*	Environmental	The Nature Conservancy
Debra Barrett	Agricultural	Barrett Ag
Larry Dovalina	Water Utilities	City of Cotulla
Julie Lewey	River Authorities	Nueces River Authority
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Larry Thomas	Flood Districts	Bandera County River Authority
David Baker (resigned)	Electric Generating Utilities	City of Hondo
LJ Francis (resigned)	Municipalities	Consultant

*Executive Committee members

Table ES-2. NRFPG Non-Voting Membership

Member Name	Agency
Tressa Olsen	Texas Water Development Board
Jim Tolan	Texas Parks and Wildlife Department
Brian Hurtuk	Texas Division of Emergency Management
Kara Smith and Jami McCool	Texas Department of Agriculture
Kendria Ray	Texas State Soil and Water Conservation Board
Simone Sanders	General Land Office
Joel Anderson	Texas Commission on Environmental Quality
Open	Liaison to San Antonio RFPG and Rio Grande RFPG
Dave Mauk	Liaison from the San Antonio RFPG

This RFP has been developed according to 39 guiding principles per Texas Administrative Code (TAC) 362.3. The overarching goal of the RFP is “to protect against the loss of life and property”. A detailed summary of how this RFP specifically addresses each guiding principle is included in Chapter 10.

The NFPR, also referred to as Region 13, encompasses the entirety of the Nueces River basin and borders the San Antonio River basin (Region 12) to the north and the Lower Rio Grande basin (Region 15) to the south (See Figure ES-1). The planning area spans 24,094 square miles and is diverse in nature. The basin includes five of the 10 major ecosystems identified in Texas and is primarily represented by the south Texas plains ecosystem with the Edwards Plateau dominant in the upper basin and the gulf prairies and marshes dominant along the coast. The major water bodies are represented by the Nueces River and its principal tributaries of the Frio and Atascosa rivers. The Nueces River feeds into Corpus Christi Bay. The basin includes two major reservoirs, Choke Canyon and Lake Corpus Christi.

The NFPR was sub-divided into four subregions to facilitate stakeholder engagement amongst the basin’s varying geographic areas (see Figure ES-2).

The planning area includes 31 counties, 57 municipalities, and 50 other government entities. The basin is largely rural in nature with a population of 1,140,000 in 2020. Corpus Christi is the major population center in the basin with a population of 325,000 in 2020. Other nearby population centers include Laredo and San Antonio. The region is expected to grow to 1,516,000 or by 33% between 2020 and 2050. This growth is anticipated to be focused near the major population centers of Corpus Christi, Laredo, and San Antonio.

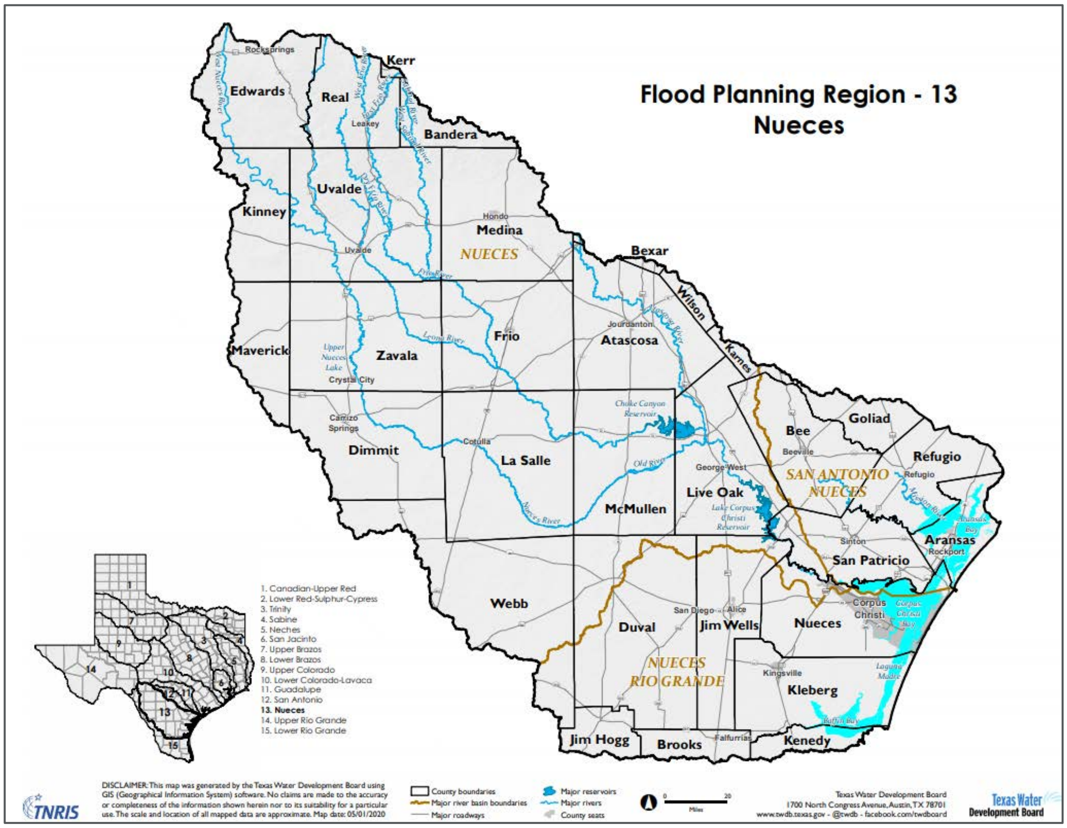


Figure ES-1. Nueces (Region 13) Flood Planning Region

Existing Infrastructure Assessment

The NRFP collected information on natural features and constructed major infrastructure and added this information to a geographic information system (GIS) geodatabase. This infrastructure was assessed as functional, non-functional, and deficient. Multiple dams were identified as non-functional (14) or deficient (22) per TCEQ Dam Safety program. One stormwater pump station in Aransas Pass assessed as non-functional. Being the first RFP, the condition of most constructed major infrastructure is still unknown and will be further described and assessed in future RFPs.

ES.2 Flood Risk Analysis

The flood plan determined the existing and future condition flood risk. The total flood risk is comprised of three components: hazard, exposure, and vulnerability. Hazard defines the location, magnitude, and frequency of flooding. Exposure defines who and what might be harmed. Vulnerability identifies vulnerable communities and critical facilities.

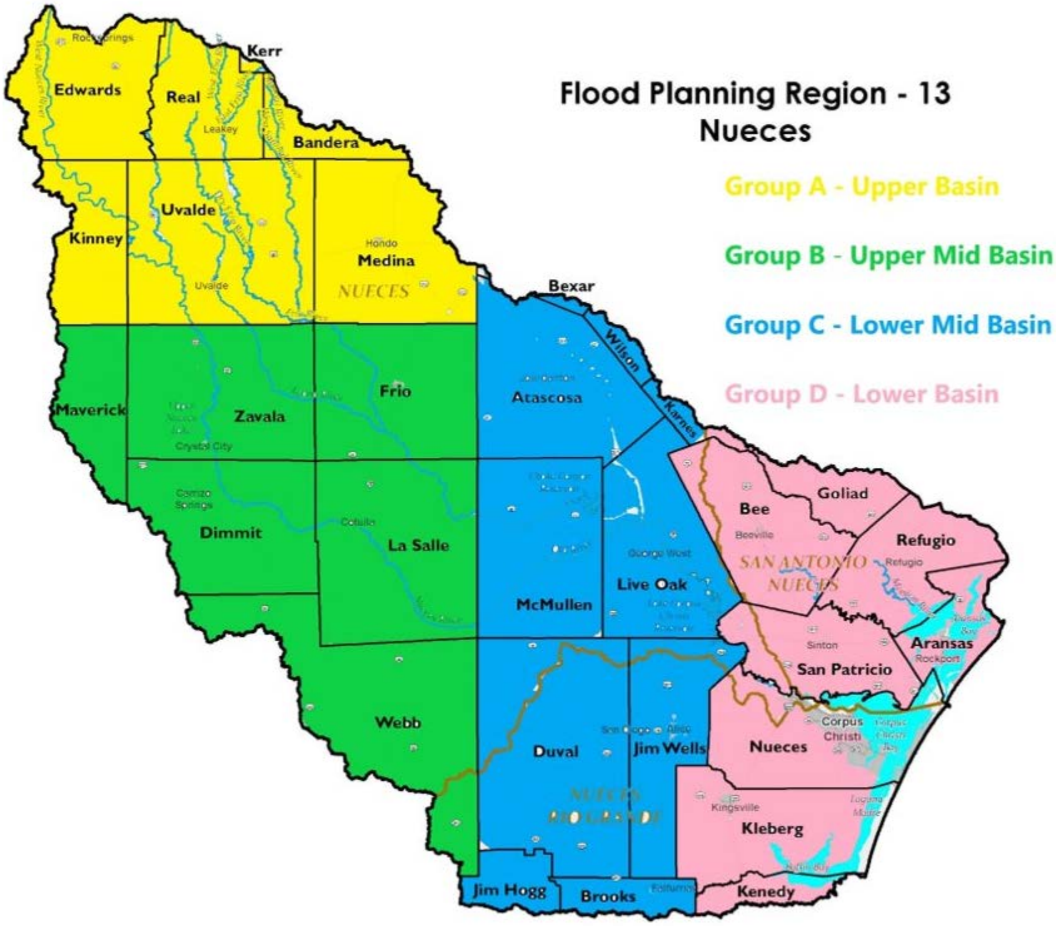


Figure ES-2. Nueces Flood Planning Area and Sub-Regions

Flood Hazard

The flood hazard is defined as the 1% and 0.2% annual flood risk inundation boundaries (i.e., 100-year and 500-year storm event floodplains) and known flood-prone areas. In total, 4,578 or 19.0% of all land in the basin is at risk of the 1% annual chance flood inundation in existing conditions with 71% of the 1% inundation occurring as the result of riverine flooding. This risk grows to 5,865 square miles or 24.3% of all land in the basin, for the 0.2% annual chance flood inundation.

Inundation Boundary Models

The flood inundation boundaries are defined for the entire region using best available data, including detailed and approximate modeling and mapping data. Detailed models used for inundation mapping include National Flood Hazard Layer (NFHL), Letters of Map Revision (LOMRs), and other project specific models. Other detailed models available and used for flood warning purposes include the U.S. Army Corps of Engineers' (USACE) Nueces and San Diego models and the U.S. Geological Survey's (USGS) Sabinal model. However, most of the basin is based on approximate data. Approximate flood inundation boundary data includes Base Level Engineering (BLE), NFHL approximate, First American Flood Data Services (FAFDS), and Draft Cursory Floodplain Data. BLE is estimated to be available for the entire basin by 2023 per the TWDB BLE status viewer. See Figure ES-3 for source of flood inundation boundaries used in the NRFP.

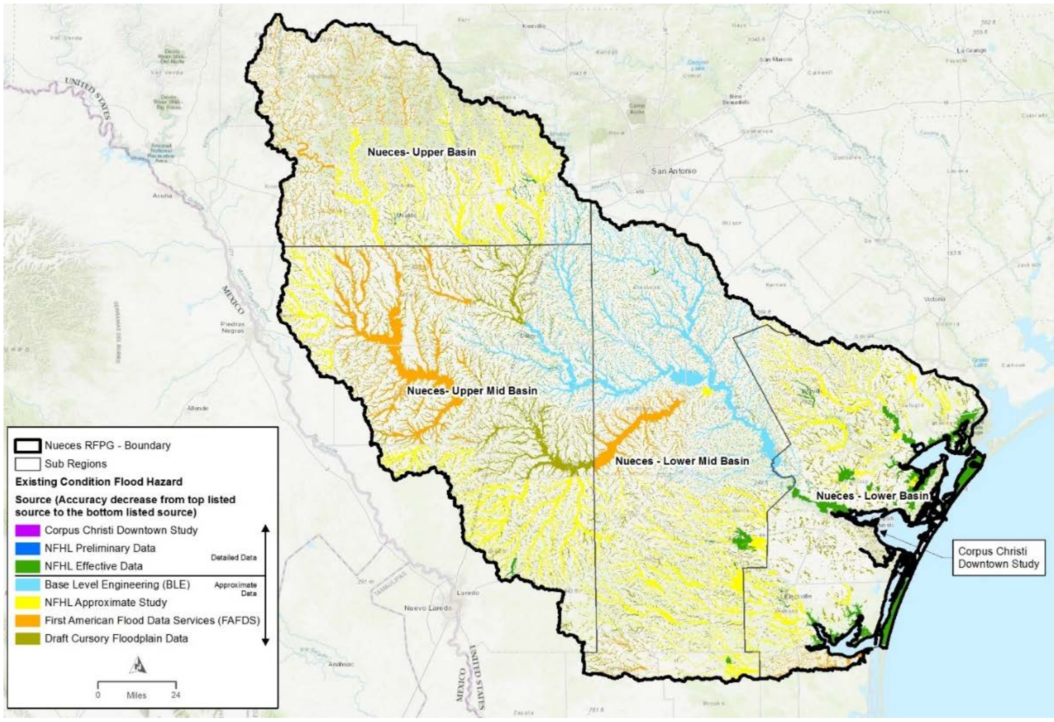


Figure ES-3. Source of Flood Modeling and Mapping Data (Map 5A)

Inundation Boundary Gaps

Many areas of the basin had no floodplain inundation maps (La Salle and Frio counties) prior to the regional flood planning efforts. Many other areas have potentially inaccurate or old mapping performed prior to 2010 (Edwards, Real, Kinney, Zavala, Dimmit, McMullen, Jim Hogg, and Kenedy). Other areas have mapping based on old rainfall data that differs from new rainfall data by more than 30% (Maverick, Uvalde, Bandera, Medina, Webb, Bee, Brooks, and Goliad). See Figure ES-4 for inundation boundary gaps.

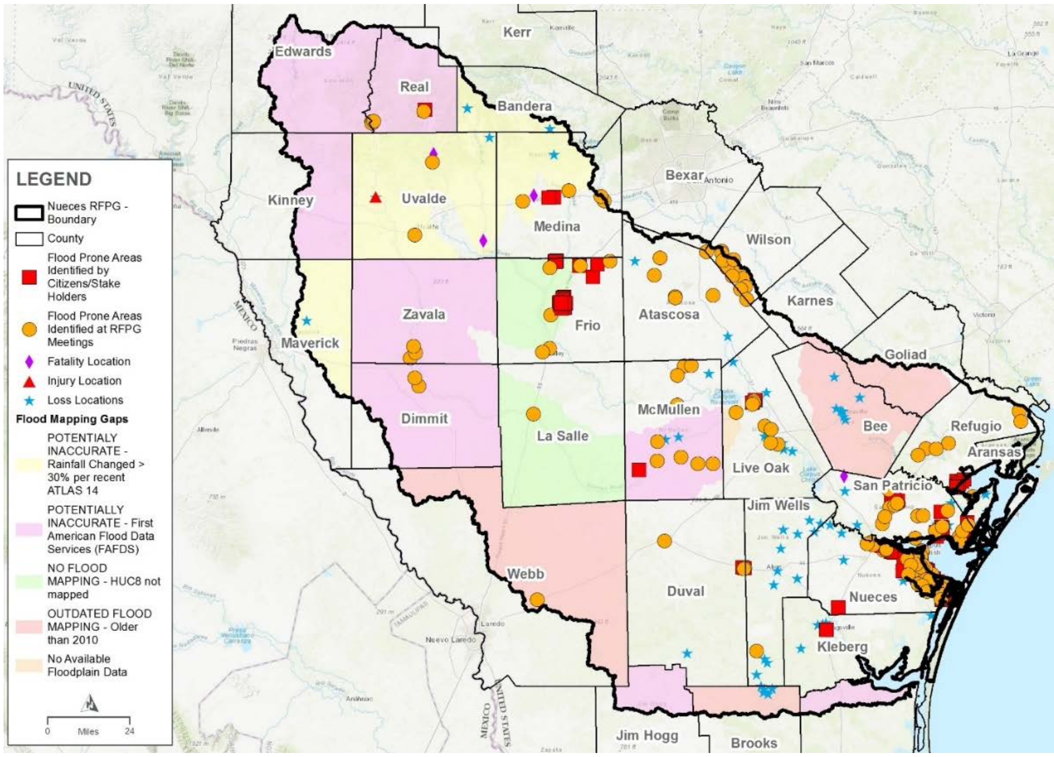


Figure ES-4. Inundation Boundary Gaps and Known Flood Prone Areas (Map 5C)

Additional Known Flood-Prone Areas

Additional known flood-prone areas were determined from historical flood data, local knowledge, and from low water crossing (LWC) data obtained from the Texas Natural Resources Information System (TNRIS). This data is depicted on a per county basis in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions.

- Historical data was gathered from the USGS, National Weather Service (NWS), and the Federal Emergency Management Agency (FEMA), and included information on property damage, fatalities, and injuries because of flooding. The most damaging flood event in the Nueces Basin was Hurricane Harvey, which caused $4.3 billion in damages in 2017.
- Local knowledge of flood-prone areas was obtained through public and stakeholder outreach, which involved posting an interactive online public comment map on the Nueces River Authority's Region 13 website, holding four subregional meetings during May of 2021, and performing additional outreach in February and March of 2022 where three subregional meetings and 20 interviews with stakeholders were held. The available flood hazard information was made available to the public at the June 28, 2021, NRFPG meeting to identify additional flood hazards that may not have been identified in the initial maps. A total of 274 flood-prone points from local knowledge were obtained for use in the NRFP (see Figure ES-5).

- Approximately 576 LWCs were identified from various sources but predominately from TNRIS LWC data.

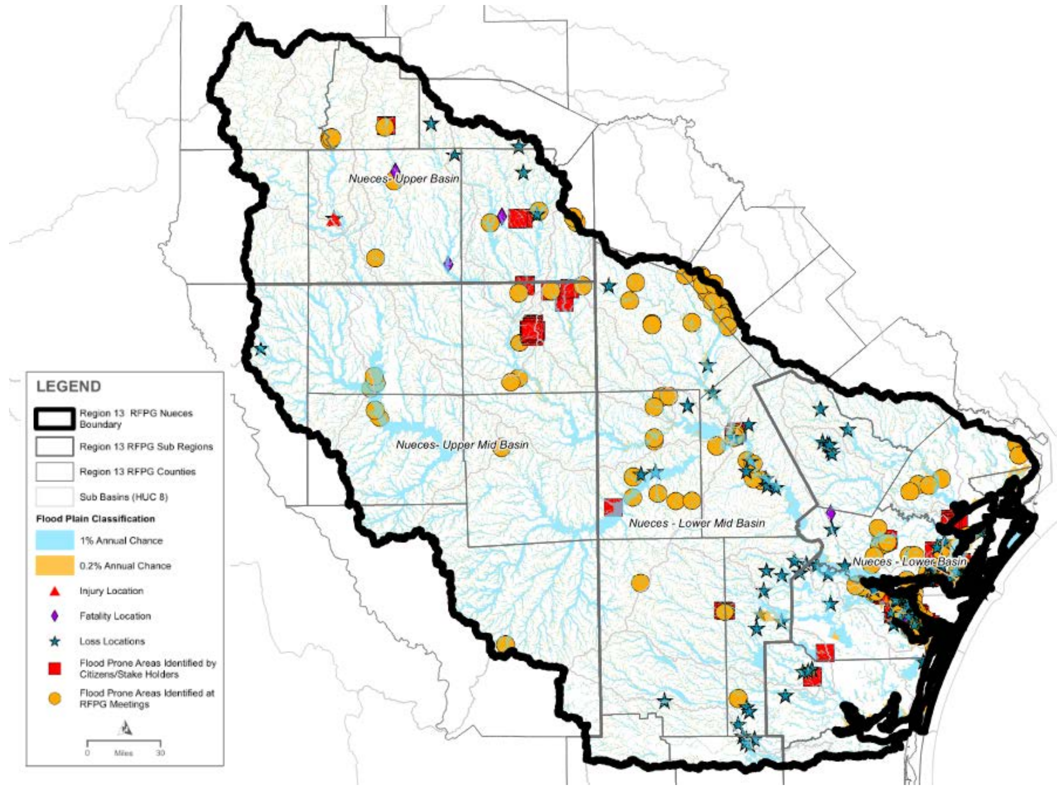


Figure ES-5. Additional Known Flood-Prone Areas

Future Condition Analysis

A future condition flood risk analysis was performed to approximate the flood hazard extents projected in 30 years' time, or the year 2050, based on a "no-action" scenario. In future conditions, an additional 51 square miles of land or 4,629 square miles (19.2% of all land in basin) is anticipated to be at risk of the 1% annual chance flood inundation as compared to existing conditions. This total grows to 5,912 square miles (24.5% of all land in basin) for the 0.2% annual chance flood inundation.

Inland Future Condition

Population growth over the next 30 years is considered a significant factor in the future conditions flood risk for the Nueces Region's riverine systems. A horizontal floodplain buffer was applied for areas with projected high growth, which for this flood plan were limited to areas surrounding cities and other concentrated populated areas.

Coastal Future Condition

Relative sea level rise is also considered a significant factor in the future condition flood risk along the coastline. Based on best available data from the National Oceanic and Atmospheric Administration's (NOAA) Global & Regional Sea Level Rise Scenarios for the United States (2022 update), a 1.1-foot relative sea level rise was adopted by the region on June 27, 2022, for the 2050 relative sea level rise condition. This sea level rise will be used to apply an appropriate horizontal buffer for the existing 1% annual chance (100-year) and 0.2% annual chance (500-year) storm event flood inundation boundaries. Due to timing, the future coastal conditions were evaluated but not applied to the future flood hazard layer in this amended plan.

Exposure Flood Analyses

In existing conditions, 61,000 structures, a population of 137,000, 3,200 miles of roadway, 5,400 roadway crossings, and 390 square miles of agricultural land are at potential risk of flooding from the 1% annual chance storm event. In future conditions, this risk is anticipated to grow to 78,000 structures, a population of 191,000, 3,500 miles of roadway, 5,500 roadway crossings, and 400 square miles of agricultural land. However, this does not include the potential for construction of new structures built in the floodplain in areas with unregulated development in the floodplain.

Hot spots for structural flooding in both the existing and future conditions include (1) the City of Corpus Christi, including Robstown; (2) the Rockport, Ingleside, and Port Aransas area; (3) cities in the lower basin, including Alice, Sinton, Kingsville, Falfurrias, and Beeville; (4) areas along the Nueces River from the City of Three Rivers to Corpus Christi; and (5) cities in the upper basin, including Crystal City, Knippa, D'Hanis, Uvalde, Hondo, Pearsall, Devine, Sabinal, and Dilley. Flood exposure for existing conditions is shown in Figure ES-6.

Vulnerability Analysis

Social Vulnerability Index (SVI) values from the Centers for Diseases Control and Prevention (CDC) were used to identify communities that may be less resilient and need more support before, during, or after disasters. SVI values were provided for all structures located in the region and an evaluation undertaken to determine where vulnerable structures are at flood risk in the basin. Additionally, the location of critical facilities at risk of flooding was also evaluated. Critical facilities include schools, hospitals, police stations, and fire stations. The analysis determined that 430 critical facilities are at risk of 1% annual chance storm event flood inundation. This increases to 560 critical facilities at risk in the future condition. Hot spots for structural flooding in vulnerable areas is shown in Figure ES-7. Not all hot spots for flood exposure are also hot spots for flood vulnerability, as some areas are considered more resilient. The most vulnerable areas to flood risk in both existing and future conditions are Corpus Christi, Robstown, Alice, and Crystal City. Other vulnerable areas to flood risk include Kingsville, Sinton, Falfurrias, Dilley, Pearsall, Devine, Uvalde, and Knippa.

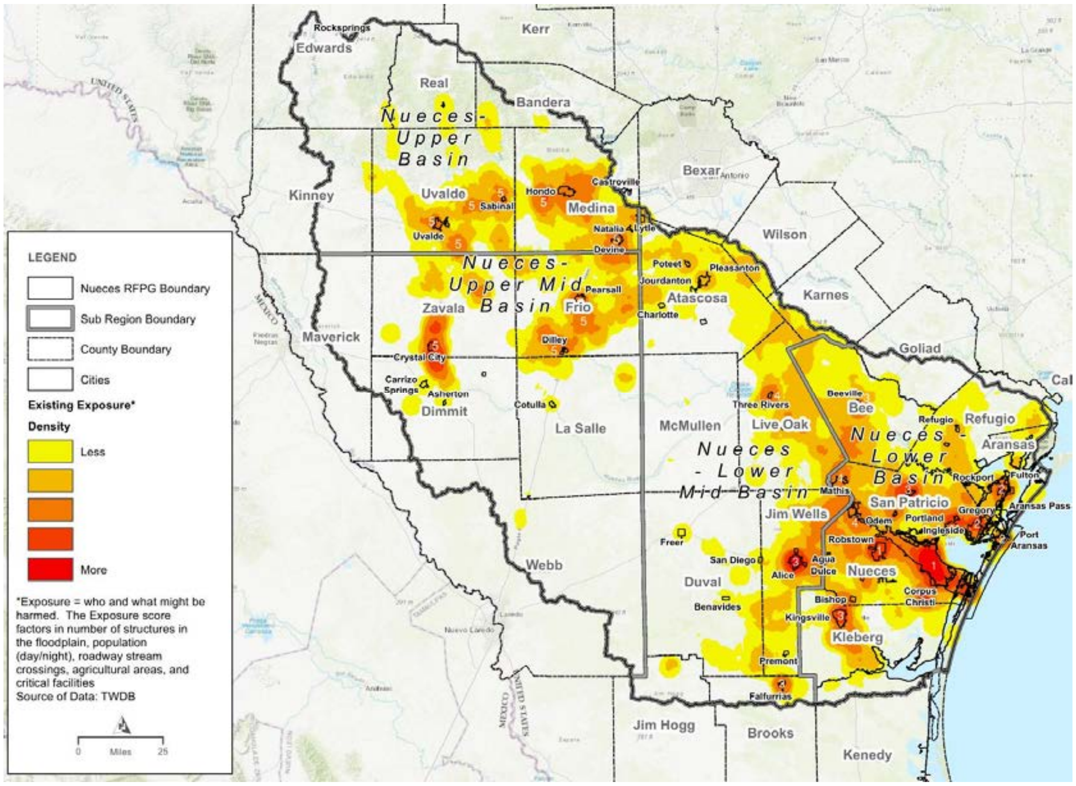


Figure ES-6. Existing Condition Exposure Heat Map (Map 6)

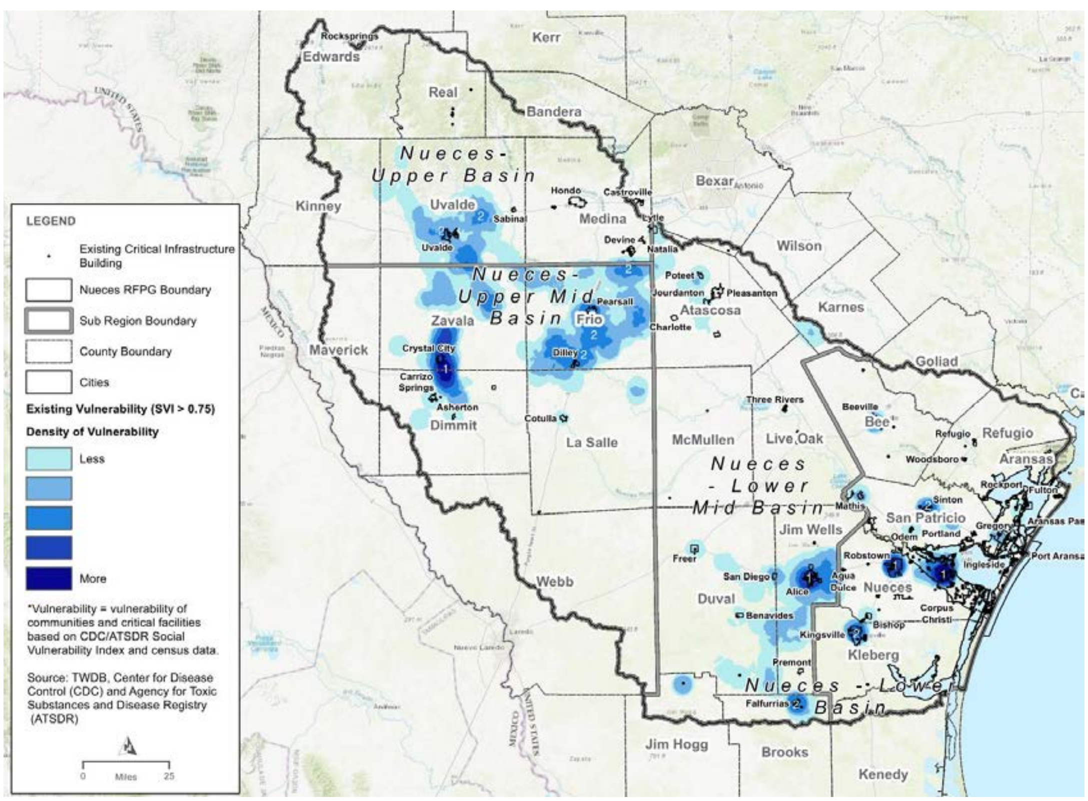


Figure ES-7. Existing Condition Vulnerability Heat Map and Location of Critical Infrastructure (Map 7)

ES.3 Floodplain Management Practices and Flood Protection Goals

Evaluation and Recommendation on Floodplain Management Practices

One of the goals of the NRFP is to evaluate and make recommendations on forward-looking floodplain management, land use, and economic practices. These practices play a key role in preventing the creation of additional flood risk in the future.

Extent of Local Regulations and Development Codes

A survey of entities with flood-related authority was conducted during the regional flood planning and confirmed 13 of 31 counties (42%) and 12 of 57 cities (21%) have floodplain management regulations. Of these, 11 counties and 11 cities were found to have moderate or strong floodplain management practices and enforcement (see Figure ES-8).

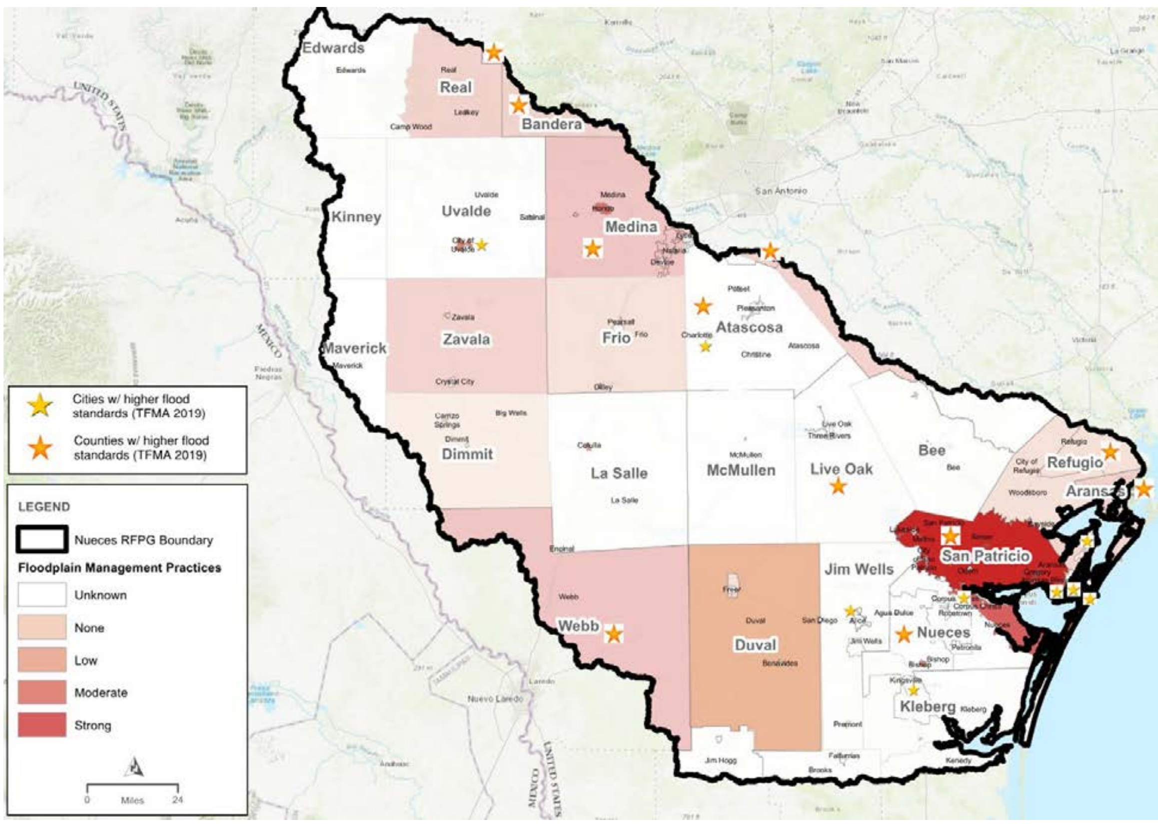


Figure ES-8. Degree of Floodplain Management Standards (Map 13)

Most entities with flood-related authority have minimum floodplain management regulations while adoption of higher floodplain management standards is less common. These elements are discussed further below.

Minimum Floodplain Management Standards

Minimum floodplain management regulations include compliance with Texas Water Code § 16.3145 and FEMA's National Flood Insurance Program (NFIP) participation. Section 16.3145 requires the adoption of necessary ordinances or orders for a city or county to be eligible for participation in the NFIP. NFIP participation is a wide-spread practice in the Nueces Basin with 85 of 86 reporting cities and counties participating.

Higher Floodplain Management Standards

Higher floodplain management standards can include an assortment of practices to further reduce flood risk above and beyond minimal standards. The Texas Floodplain Management Association (TFMA) produced a guide for higher standards in 2018 that describes 32 higher standard practices that, if implemented, would reduce flood risks. According to the TFMA 2019 higher standard survey, 10 counties and 9 municipalities in the basin have adopted higher standards. This list includes the counties of Aransas, Atascosa, Bandera, Bexar, Kerr, Live Oak, Medina, Nueces, Refugio, and San Patricio and the cities of Alice, Aransas Pass, Charlotte, Corpus Christi, Ingleside, Kingsville, Port Aransas, Rockport, and Uvalde.

Recommended Floodplain Practices

The NRFPG does not have the authority to enact or enforce floodplain management, land use, or other infrastructure design standards. Thus, the NRFPG aims to encourage implementation of recommended floodplain practices by local entities in the region with flood-related authority.

Of the high-standard practices, the implementation of freeboard requirements was listed as the single most effective means for reducing flood risks. Freeboard is the standard for placing the first floor of a structure above the elevation of the calculated 1% annual chance (100-year) storm event flood level to allow for nature's uncertainty and future changes in the watershed that will increase flood levels.

The NRFPG recommends minimum finished floor elevations be set 1 foot above base flood elevations (BFEs; i.e., 1% annual chance storm event flood levels) or above local ordinances, whichever is higher, in the basin. The NRFPG strongly encourages cities and counties in the Nueces Basin to actively consider minimum 2 feet above base flood elevations, consistent with upcoming 2025 FEMA ordinances. Such higher standards build more resilience for the homeowners in the future. The NRFPG did not adopt region-specific minimum floodplain management, land use, or other standards that impact flood-risk that each entity in the flood planning region must adopt prior to inclusion of any of their flood mitigation actions in the regional flood plan.

Implementation of this recommendation along with defining accurate floodplain limits through the development of detailed hydrologic and hydraulic models and mapping in areas of anticipated high development and population growth is the best approach to address future development and population growth and to limit exposure of new development to the existing and future flood hazard.

Other high-standard practices that should be considered include participation in the NFIP's Community Rating System (CRS), requiring new development to mitigate adverse impacts to other properties throughout the watershed, providing standards and restrictions for the placement of fill or development activity in a floodplain, and the use of setbacks, which limit use/development areas along waterways.

Floodplain mitigation studies in the Nueces Basin are encouraged to consider natural systems and beneficial functions of floodplains, including flood peak attenuation and ecosystem services when identifying projects to reduce flood risk. Flood mitigation design approaches that work together with natural floodplain patterns is advised. Most natural flood mitigation features, including floodplains, are in need of maintenance and can be improved with land use management.

Floodplain Mitigation and Floodplain Management Goals

The regional flood plan developed short- and long-term goals with the objective to protect against the loss of life and property. The short-term goals have a target date of 10 years or 2033 and the long-term goals a target date of 30 years or 2053. These goals identify specific and achievable flood mitigation and floodplain management goals that, when implemented, will demonstrate progress towards the overarching objective to project life and property. The NRFPG formed a sub-committee to discuss floodplain priorities and prepare the goals for NRFPG consideration. The following 10 flood mitigation and floodplain management goals are defined under four major categories.

Protect against loss of life caused by flooding

1. Improve safety at LWCs
2. Reduce risks at high-hazard dams
3. Implement flood warning systems and improve regional data collection

Protect against property damage caused by flooding

4. Perform flood mapping evaluations and update floodplain maps
5. Reduce the number of structures within the 1% annual chance floodplain

Floodplain management

6. Prepare minimum flood management standards
7. Implement nature-based practices through land conservation and restoration programs
8. Develop public information campaign

Funding

9. Increase funding for maintenance of drainage systems
10. Identify funding for community outreach and for permit support

These goals were discussed during the September 27, 2021, NRFPG meeting, and comments received with a public comment period remaining open for 30 days after the meeting. The goals, if implemented, would not remove all potential flood risks and thus residual risks remain.

ES.4 Flood Mitigation Needs Analysis

The regional plan performed an assessment and identified flood mitigation needs. This analysis identified where the greatest flood risk knowledge gaps exist and where known flood risk and flood mitigation needs are located within the NFPR. This analysis resulted in information that guided the identification of recommended flood mitigation actions.

Greatest Flood Risk and Flood Mitigation Needs

The areas of greatest known flood risk and flood mitigation needs in the NFPR are defined as areas with elevated levels of risk to property and life. The level of risk is defined by looking at the location and magnitude of flooding from the 1% (100-year) and 0.2% (500-year) annual chance flood event (flood hazard), who and what may be harmed (flood exposure), and what communities and critical facilities may be vulnerable (flood vulnerability).

An analysis of known flood risk data was performed based on 627 hydrologic unit code (HUC)-12 individual watersheds. The flood risk data related to property damage and life loss risk was evaluated for each watershed in the basin. This included assigning weighting percentages to data on historical property damage, historical life loss, property damage in terms of exposure and vulnerability, and life loss potential at LWCs and downstream of hydraulically inadequate or deficient potential hazardous dams. As a result of this analysis, each watershed was assigned a score of 0 to 5 with no risk represented by a score of zero and the highest risk represented by a score of 5 (see Figure ES-9).

Greatest Flood Risk Knowledge Gaps

The greatest flood risk knowledge gap considered the following three conditions:

- Where the flood inundation boundaries are either not defined or considered inaccurate. Without accurate flood inundation boundaries, the existing flood risk is not well understood; therefore, controlling future risk through floodplain management regulations is difficult. The availability of detailed modeling and mapping in the basin is very limited in the Nueces Basin, as shown in Figure 2-4. Detailed modeling is generally only available for Nueces County, select watersheds along the coast, the City of Cotulla, downtown Corpus Christi, along Nueces River from Corpus Christi up to near Choke Canyon, City of San Diego, and along Sabinal River upstream of Utopia.

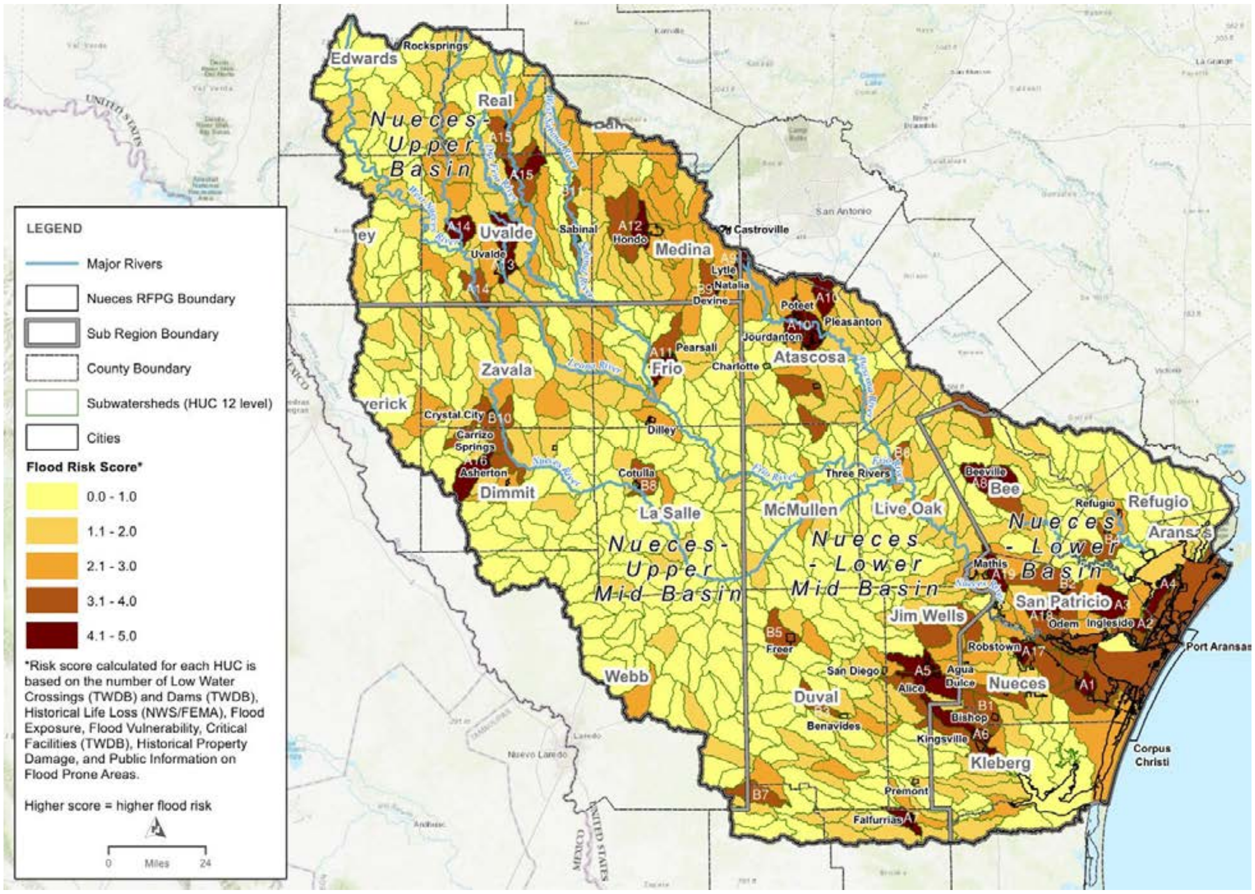


Figure ES-9. Overall Flood Risk per HUC 12 Watershed (Map 15)

- Where flood studies or projects have not occurred in the recent past or are on-going. Flood studies are used to identify existing and future flood risks and often recommend mitigation or corrective solutions to reduce those risks. Without a flood study, it is difficult to implement actionable steps to reduce flood risk. For the NFPR, generally, flood studies have occurred or are occurring for counties near the coast. Major flood studies include the General Land Office (GLO) Regional Flood Study, and various county-wide flood studies for the counties of Duval, San Patricio, Nueces, Jim Wells, Kleberg, and Bee. A list of 93 proposed and on-going flood mitigation projects for cities, counties, and Texas Department of Transportation (TxDOT) were also considered.
- Where flood management practices do not exist or are not effectively enforced. Without effective flood management practices new development activity may place additional property and population in flood hazard areas. There are many potential gaps in flood management practices, as shown in Figure 3-1. Moderate to strong floodplain practices tend to be prevalent for entities with flood-related authority located near the high growth areas of Corpus Christi, Laredo, and San Antonio.

These three gap considerations were overlaid with the areas of greatest known flood risk and flood mitigation needs as shown in Figure 4-3, Figure 4-4, and Figure 4-5. Then the greatest flood risk areas were listed in Table 4-2 with indication of whether the areas are located within exposure/vulnerability hot spots and the three knowledge gap areas. This table summarizes the greatest flood mitigation needs in the basin and can be used to prioritize future investments in detailed hydrologic and hydraulic models, flood studies, and enhancement of flood management practices.

ES.5 Identification, Evaluation, and Recommendation of Flood Mitigation Actions

The regional flood planning efforts identified, evaluated, and recommended flood management actions, which include flood mitigation projects (FMPs), flood management evaluations (FMEs), and flood management strategies (FMSs). Flood management actions were identified to reduce the risk identified in the existing and future condition flood risk analyses, to address flood mitigation and floodplain management goals, and to address the greatest flood risk and flood mitigation needs.

An FME is a proposed flood study of a specific, flood-prone area that is needed to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs. An FMP is a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring costs and, when implemented, will reduce flood risk and mitigate flood hazards to life or property. Identifying FMPs is one of the primary objectives of the NRFP. A FMS is a proposed plan to reduce flood risk or mitigate flood hazards to life or property and typical includes flood mitigation education and outreach, buyout programs, and flood management regulations.

Process to Identify, Evaluate, and Recommend Flood Mitigation Actions

The NRFPG developed a process to identify, evaluate and recommend flood mitigation actions. The Initial draft process was developed by a subcommittee and presented and approved by the NRFPG at the September 27, 2021, regional flood planning meeting. To identify flood mitigation actions, a review of previous relevant flood studies was conducted, stakeholder outreach was conducted, and an evaluation performed to determine additional studies needed to address the greatest known flood risk, flood mitigation needs, and unmet floodplain mitigation and floodplain management goals.

While there is an abundant need across the Nueces Region and the State of Texas for data collection, strategy implementation, and project construction to reduce or remove risk of flooding, not every flood mitigation action can be recommended in the NRFP or included in the SFP. The NRFPG considered recommendations on flood mitigation actions through a multi-step process. The NRFPG created a Technical Subcommittee tasked with establishing a selection methodology, implementing the evaluation and selection process, and reporting their findings and recommendations back to the

NRFPG for formal approval. The methodology included screening all potential flood mitigation actions considering TWDB requirements for inclusion in the flood plan and any other additional considerations established by the Technical Subcommittee. The reasons for not recommending a particular flood mitigation action were clearly documented as part of the evaluation and recommendation process.

Recommended Flood Mitigation Actions in the 2023 NRFP

On May 6, 2022, the NRFPG voted to recommend FMEs, FMPs, and FMSs as presented, for inclusion in the 2023 NRFP due January 2023. This meeting was held in accordance with the requirements of the RFPG bylaws, the Texas Open Meetings Act, and the general requirements of the Texas Water Code and the flood planning process.

This resulted in the recommendation of 163 FMEs. No FMPs were recommended due to the high level of detail required for consideration as an FMP. A total of 40 FMSs were recommended across the region. In all, 203 flood mitigation actions were previously recommended in the 2023 NRFP.

Additional Evaluations Performed to Amend the 2023 NRFP

Multiple FMEs from the 2023 NRFP were selected by the NRFPG to be further evaluated to identify additional FMPs and advance FMEs for inclusion in the Amended 2023 NRFP. The process for identifying FMEs for further evaluation included prioritizing FMEs in the highest flood risk areas, seeking FMEs in areas where there are no on-going flood studies, and identifying FMEs that were close to qualifying as FMPs. On September 26, 2022, the NRFPG voted to approve the list of additional evaluations, as presented. This list is summarized in Table 5-2 and encompassed additional evaluations in 19 high risk flood areas across the region and identified the potential for over 30 FMPs. Upwards of 70% of the additional evaluations were focused in the highest flood risk areas to evaluate potential flood risk reduction solutions for places that did not previously have on-going or proposed flood mitigation studies, including in and within the vicinity of the cities of Crystal City, Devine, Jourdanton, Pearsall, Pleasanton, Poteet, and areas of Uvalde and Real counties.

Summary of Additional Evaluations

The additional evaluations were performed from October 2022 through May 2023. As part of this process, additional outreach to identified potential sponsors occurred, which resulted in additional refinement and advancement of new potential flood mitigation actions. In total, additional evaluations were performed for 36 entities with flood authority in the Nueces basin, which resulted in the identification of 31 new FMPs and 54 new FMEs. One-page summaries of these new FMPs and FMEs and supporting technical memorandums documenting assumptions and findings of the evaluations are provided in Appendices C9, C10, and C11.

Recommended Flood Mitigation Actions in the Amended 2023 NRFP

On May 15, 2023, the NRFPG voted to amend the 2023 NRFP list of recommended FMEs, FMPs, and FMSs, which included removals, refinements, and additions of flood mitigation actions. This resulted in 269 recommended flood mitigation actions for the Amended 2023 RFP, of which 31 are FMPs, 198 are FMEs, and 40 are FMSs. This is an increase of 31 FMPs and 35 FMEs when compared to the 2023 RFP (note 19 FMEs identified previously in the 2023 NRFP were removed). The list of recommended FMSs from the 2023 NRFP was not changed with the Amended 2023 NRFP. The list of recommended flood mitigation actions can be viewed on an individual county level in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions.

The costs of the recommended 31 FMPs, 198 FMEs, and 40 FMSs are estimated to be $1,205 million, $285 million, and $20 million, respectively. This represents a combined flood mitigation action cost of about $1.510 billion across the entire basin.

ES.6 Impact and Contribution of the Regional Flood Plan

The RFP evaluates the impacts and contributions of implementing the plan would have on reducing flood risks and on water supply development.

Impacts of Regional Flood Plan

Impacts are determined before and after RFP implementation of recommended flood mitigation actions relative to existing and future flood risk. The comparison of before and after RFP implementation estimates both how much the region’s existing flood risk will be reduced through implementation of the plan as well as how much additional, future flood risk (that might otherwise arise if no changes are made to floodplain policies etc.) will be avoided through RFP implementation, including recommended changes/improvements to the region’s floodplain management policies.

The evaluation estimates the full implementation of recommended FMPs and minimum floodplain management standards would reduce the future 1% annual chance flood risk for structures by 23% (-17,000), for population by 30% (-55,000), for square miles of land by 1% (-52), for critical facilities by 1% (-118), for miles of roadway by 10% (-322), and for low water crossings by 32% (-173). Most of this flood reduction benefit comes from the implementation of the recommended floodplain management standards, which puts measures in place to avoid incurring the placement of future property and life at risk of flooding. By implementing the RFP, the existing floodplain management standards identified in Chapter 3 will be leveraged and will have basis to bolster and expand local regulations to protect future life and structures from high flood risk events.

Contributions to and Impacts on Water Supply Development and the State Water Plan

Flood mitigation actions were reviewed to determine whether impacts to water supply/availability exists. A coordinated effort with representatives from multiple regional water planning groups occurred to identify water management strategies that could be impacted. Those regional water planning groups include Region N (Coastal Bend), Region L (South Central Texas), and Region M (Rio Grande). The NRFPG identified four flood mitigation actions on June 27, 2022, that have benefits related to water supply development. These include a two-way pipeline between Choke Canyon Reservoir and Lake Corpus Christi, a Nueces off-channel reservoir with or without ASR configuration, sediment removal at Lake Corpus Christi, and a Nueces River Diversion from the Nueces River to Choke Canyon Reservoir. There are no anticipated negative impacts from these four recommended FMSs on water supply, water availability, or projects in the state water plan.

ES.7 Flood Response Information and Activities

Flood response information was gathered through stakeholder outreach to flood-related authorities in the Nueces Basin. Flood response activities, preparedness, response, and recovery measures are summarized for the various entities in the basin. The plan also summarizes state and federal agency roles in flood response support and provides a description of various means by which data is collected and disseminated in a flood event. This information is provided to help others in the basin develop flood response and recovery programs. Note the NRFP only summarizes the nature and types of flood response preparations in the basin, including recovery, but does not perform analyses or other activities related to planning for disaster response or recovery.

ES.8 Administrative, Regulatory, and Legislative Recommendations

The NRFP provides administrative, regulatory, or other recommendations for inclusion in the 2023 NRFP. These recommendations were developed by a subcommittee and presented and adopted by the NRFPG on May 16, 2022. Overall, 19 recommendations were provided within the categories of administration, regulatory/policy, and legislation. The recommendations are provided in detail in Chapter 8 – Administrative, Regulatory, and Legislative Recommendations. Recommendations generally addressed a variety of needs and issues, including facilitating public outreach; improving coordination; addresses funding deficiencies for a variety of needs such as road and bridge improvements, maintenance, nature-based incentive programs, public information campaigns; improving flood mitigation practices to consider nature-based solutions; adopting higher standard regulations for buildings; addressing socioeconomic disadvantaged communities; empowering county governments over land development activities; enabling regional authorities; and addressing removal of debris/sediment deposited after storm events.

ES.9 Flood Infrastructure Financing Analysis

The NRFP describes common sources of local, state, and federal flood funding.

Local Funding

Local funding mechanisms identified include use of a general fund, bond program, permitting fees, dedicated stormwater or drainage fees, and special districts. The plan identifies two entities with dedicated drainage fees, which includes Corpus Christi and the City of Portland. The plan identified four special districts focused on drainage, which includes Nueces County Bishop Driscoll Drainage District 3, Nueces County Drainage and Conservation District 2, Refugio County Drainage District 1, and San Patricio County Drainage District.

State Funding

State funding for flood projects is primarily through TWDB and Texas State Soil and Water Conservation Board (TSSWCB). In the Nueces Basin, several counties and cities have received support from the TWDB Flood Infrastructure Fund (FIF) and many coastal communities have applied for FEMA grants. After the first SFP is adopted, only projects included in the most recently adopted state plan will be eligible for funding from the FIF.

Federal Funding

There are multiple avenues to receive federal funding through the various federal agencies, including FEMA, U.S. Department of Housing and Urban Development (HUD), USACE, U.S. Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), and special appropriations. Recent special appropriations of note include the 2021 American Rescue Plan Act (ARPA) and the 2021 Infrastructure Investment and Jobs Act (IIJA), also called the Bipartisan Infrastructure Law (BIL). ARPA delivered $350 billion directly to local, state, and tribal governments through the Coronavirus State and Local Fiscal Recovery Funds (SLFRF). And BIL authorized over $1 trillion for infrastructure spending across the U.S. and provides a significant infusion of resources over the next several years into existing federal financial assistance programs. Note, the recent federal special provision ARPA and BIL funding has not yet been allocated and made available for flood mitigation studies and projects that would be eligible under the state flood plan.

Overall Need for Funding

Overall, a total of $1.510 billion is needed to implement the recommended FMEs, FMPs, and FMSs identified in this Amended 2023 NRFP. From the total cost, it is projected that $1.435 billion in state and federal funding is needed.

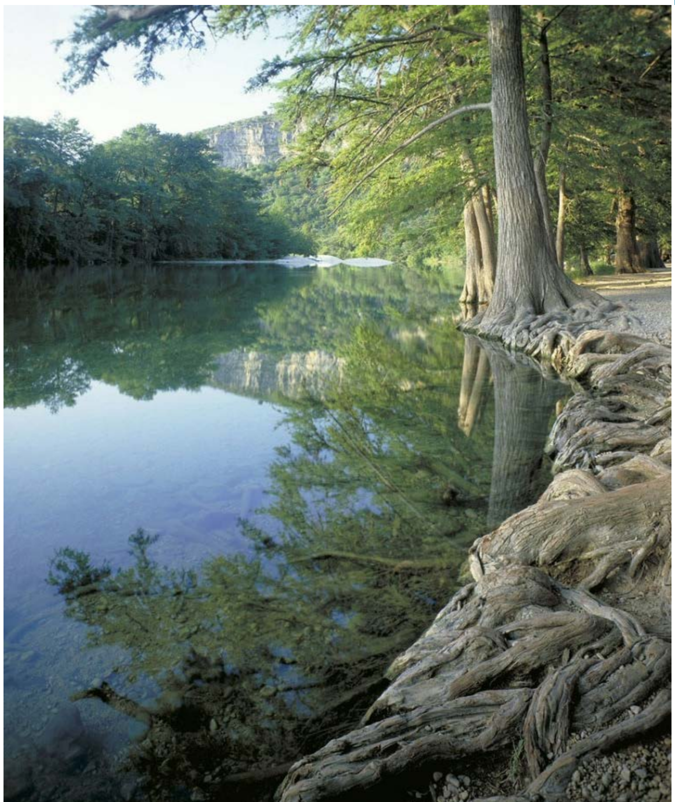
ES.10 Adoption of Plan and Public Participation

The NRFPG met all requirements under the Texas Open Meetings Act and Public Information Act during development of the NRFP. The NRFP incorporated public participation from the onset. This included opportunities at all regional flood planning group meetings for the public to comment on any aspect of the plan or planning process, press releases and notices of public meetings, and a dedicated website for NRFPG information.

The NRFPG submitted an approved, draft RFP to the TWDB on August 1, 2022. A public in-person hearing for the draft plan was held on September 26, 2022, at 11:00 a.m. at the McMullen County Emergency Management Office and a public virtual hearing for the draft plan was held on September 26, 2022, at 6:30 p.m. via a zoom meeting. Comments received on the draft plan and responses to comments were approved by the NRFPG on December 12, 2022, and are included in Appendix D.

The NRFPG approved the 2023 NRFP on December 12, 2022, for submittal to the TWDB. Comments on the 2023 NRFP were provided by the TWDB on March 13, 2023 and discussed by the NRFPG on March 27, 2023. The TWDB comments and responses to comments are included in Appendix D.

The Amended 2023 NRFP was adopted by the NRFPG on TBD for submittal to the TWDB.



Chapter 1 – Planning Area Description

31 TAC § 361.30, 361.31, and 361.32

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1 Planning Area Description

The 31-county Nueces Region (Region 13) has an area of 24,094 square miles (15,420,000 acres), approximately 9.0% of the state's land area (Figure 1-1). The region is bound to the north by the Texas Water Development Board (TWDB) Flood Planning Region 12 (San Antonio), and to the south by TWDB Flood Planning Region 15 (Lower Rio Grande). In 2020, this region had a population of approximately 1,140,000.

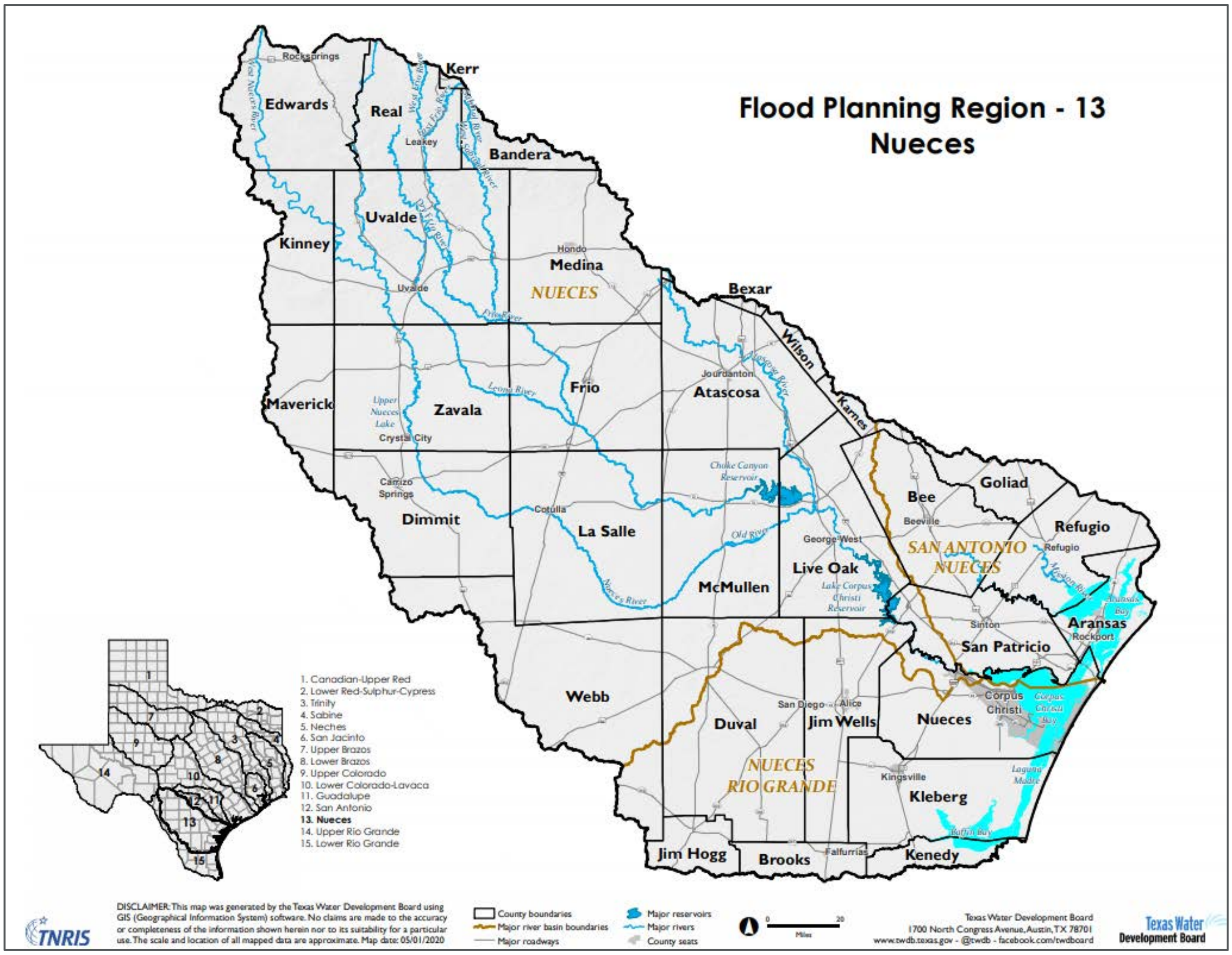

Figure 1-1. Nueces (Region 13) Flood Planning Region

1.1 Background

In 2019, the Texas Legislature and Governor Abbott adopted changes to Texas Water Code §16.061 that established a regional and state flood planning process and identified 15 flood planning regions across the state to coincide with major river basins. Information from each of the 15 regional flood plans (RFPs) will be compiled in the *2023 State Flood Plan*. The TWDB was charged with overseeing the development of each regional plan and compiling the state flood plan. The TWDB was also charged with providing funding for investments in flood science and mapping efforts to support plan development.

This investment and planning efforts represent an important step in flood planning in Texas, because

- flood risks, impacts, and mitigation costs have never been assessed at a statewide level for Texas;
- flood risks pose a serious threat to lives and livelihoods across the state; and
- much of the flood risk in Texas is unmapped or based on out-of-date maps.

RFPs must be based on the best available science, data, models, and flood risk mapping. When complete, the plans will focus both on reducing existing risk to life and property and on enhancing floodplain management to avoid increasing flood risk in the future. The first RFP must be submitted to the TWDB by January 10, 2023. The TWDB will then compile these regional plans into a single statewide flood plan and will present it to the Legislature in 2023. An updated version of the state flood plan will be due every five years thereafter.

The TWDB has appointed a regional flood planning group (RFPG) for each region and has provided them with funding to prepare their plans. The TWDB administers the regional flood planning process through a contract with the planning group's sponsor selected by the RFPG. The Nueces Flood Planning Region (NFPR) sponsor is the Nueces River Authority. The Texas Legislature also allocated funding to be distributed by the TWDB for procuring technical assistance to develop the RFPs. HDR Engineering (HDR) was selected through a competitive process to serve as the technical consultant for the NFPR flood planning effort.

Stakeholders residing in and representing various interest categories were appointed for each region to provide representation and lead a bottom-up approach to developing the 2023 RFP. The RFPG's responsibilities include directing the work of the technical consultant; soliciting and considering public input; identifying specific flood risks; and identifying and recommending flood management evaluations, strategies, and projects to reduce risk in their regions. To ensure diverse perspectives are included, members represent a wide variety of stakeholders potentially affected by flooding. The following interest categories are included.

1. Public
2. Counties
3. Municipalities
4. Industries
5. Agriculture
6. Environment
7. Small Business

8. Electric-generating utilities
9. River authorities
10. Water districts
11. Water utilities
12. Flood districts

The members of the Nueces RFPG (NRFPG) for the first flood planning cycle are listed in Table 1-1 and Table 1-2.

Table 1-1. NRFPG Voting Membership

Member Name	Interest Category	Organization
Barbara Canales (Chairman)	Industries	N/A
Andrew Rooke (Vice-Chairman)	Small Business	F.B Rooke & Sons
Robert Williams (Secretary)	Public	Mayor, Jourdanton
Larry Dovalina	Water Utilities	City of Cotulla
Shanna Owens	Counties	San Patricio County DEMS
Julie Lewey	River Authorities	Nueces River Authority
Debra Barrett	Agricultural	Barrett Ag
Lauren Williams	Environmental	The Nature Conservancy
JR Ramirez	Water Utilities	Wintergarden GCD
Larry Thomas	Flood Districts	Bandera County River Authority
David Baker (resigned)	Electric Generating Utilities	City of Hondo
LJ Francis (resigned)	Municipalities	Consultant

Table 1-2. NRFPG Non-Voting Membership

Member Name	Agency
Tressa Olsen	Texas Water Development Board
Jim Tolan	Texas Parks and Wildlife Department
Brian Hurtuk	Texas Division of Emergency Management
Kara Smith and Jami McCool	Texas Department of Agriculture
Kendria Ray	Texas State Soil and Water Conservation Board
Simone Sanders	General Land Office
Joel Anderson	Texas Commission on Environmental Quality

Member Name	Agency
Open	Liaison to San Antonio RFPG and Rio Grande RFPG
Dave Mauk	Liaison from the San Antonio RFPG

1.2 Goal and Purpose of the 2023 Nueces (Region 13) Regional Flood Plan

All regional flood plans are to be developed according to 39 guiding principles (see 31 Texas Administrative Code [TAC] 362.3). The 2023 Nueces (Region 13) RFP focuses on identifying both existing and future condition flood risks within the Nueces basin; evaluating flood hazard exposure to life and property; identifying and evaluating potentially feasible flood management strategies and flood mitigation projects; presents recommended strategies and projects that minimize residual flood risk; and provides effective and economical management of flood risk to people, properties, and communities, and associated environmental benefits amongst other information.

1.3 Nueces Flood Planning Region Overview

1.3.1 Government Entities within Nueces Flood Planning Region

The following 31 counties were considered in the development of the Nueces RFP.

- Aransas County
- Atascosa County
- Bandera County
- Bee County
- Bexar County
- Brooks County
- Dimmit County
- Duval County
- Edwards County
- Frio County
- Goliad County
- Jim Hogg County
- Jim Wells County
- Karnes County
- Kenedy County
- Kerr County
- Kinney County
- Kleberg County
- La Salle County
- Live Oak County
- Maverick County
- McMullen County
- Medina County
- Nueces County
- Real County
- Refugio County
- San Patricio County
- Uvalde County
- Webb County
- Wilson County
- Zavala County

The following 57 municipalities were considered in the development of the Nueces RFP.

- Agua Dulce
- Alice
- Aransas Pass
- Asherton
- Bayside
- Beeville
- Benavides
- Big Wells
- Bishop
- Crystal City
- Devine
- Dilley
- Driscoll
- Encinal
- Falfurrias
- Freer
- Fulton
- George West
- Lake City
- Lakeside
- Leakey
- Lytle
- Mathis
- Natalia
- Odem
- Orange Grove
- Pearsall
- Refugio
- Robstown
- Rockport
- Rocksprings
- Sabinal
- San Diego
- San Patricio
- Sinton
- Taft

- Camp Wood
- Carrizo Springs
- Charlotte
- Christine
- Corpus Christi
- Cotulla
- Gregory
- Hondo
- Ingleside
- Ingleside on the Bay
- Jourdanton
- Kingsville
- Petronila
- Pleasanton
- Port Aransas
- Portland
- Poteet
- Premont
- Three Rivers
- Uvalde
- Woodsboro

The following 50 other government entities were considered by the Nueces RFPG in the development of the Nueces RFP.

- Guadalupe-Blanco River Authority
- Lower Colorado River Authority
- Nueces River Authority
- San Antonio River Authority
- Upper Guadalupe River Authority
- Bexar-Medina-Atascosa Counties Water Control and Improvement District (WCID) 1
- Alamo Area Council of Governments
- Alice Water Authority
- Aransas County Municipal Utility District (MUD 1)
- Aransas County Navigation District
- Aransas County WCID 1
- Bandera County River Authority
- Beeville Water Supply District
- Canyon Regional Water Authority
- Coastal Bend Council of Governments
- Corpus Christi Downtown Management District
- Duval County Conservation & Reclamation District
- Escondido Watershed District
- Freer WCID
- Golden Crescent Regional Planning Commission
- Hondo Creek Watershed Improvement District
- Medina County WCID 2
- Middle Rio Grande Development Council
- Nueces County Bishop Driscoll Drainage District 3
- Nueces County Drainage & Conservation District 2
- Nueces County WCID 3
- Nueces County WCID 4
- Nueces County WCID 5
- Padre Island Gateway Municipal Management District
- Pettus MUD
- Port of Corpus Christi Authority
- Refugio County Drainage District 1
- Refugio County Navigation District
- Refugio County WCID 2
- Rio Grande Regional Water Authority
- Riviera WCID
- San Diego MUD 1
- San Patricio County Drainage District
- San Patricio County MUD 1
- San Patricio County Navigation District 1
- San Patricio MWD
- South Texas Development Council

- Jim Hogg County WCID 2
- Jim Wells County Fresh Water Supply District (FWSD) 1
- Lamar Improvement District
- Maverick County WCID 1
- McMullen County WCID 1
- South Texas Water Authority
- Three Rivers Water District
- Zavala County WCID 1

1.3.2 Nueces Flood Planning Region Subregions

The NFPR is sub-divided into four subregions, as shown in Figure 1-2, to facilitate stakeholder engagement amongst the basin's varying geographic areas.

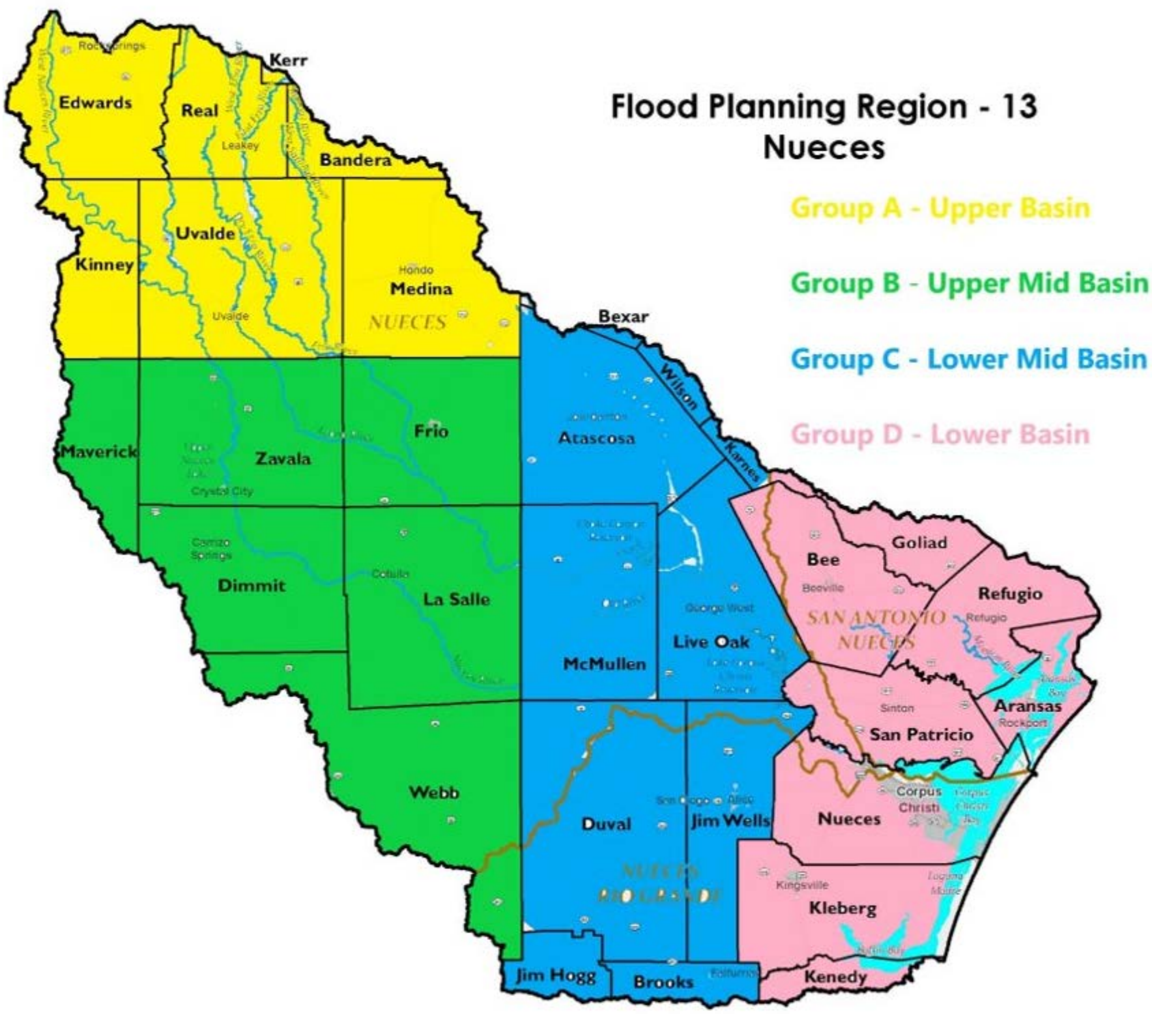

Figure 1-2. Nueces Flood Planning Area and Sub-Regions

1.3.3 Major Water Bodies

The NFPR includes an area that drains to Nueces River and associated tributaries. Nueces River rises in two forks in Edwards and Real counties and flows 315 miles to Nueces Bay on the Gulf near Corpus Christi. Principal tributaries of the Nueces are the

Frio and Atascosa rivers. Nueces River feeds the Nueces Estuary, which includes Corpus Christi Bay and its western and southern extensions in Nueces Bay and Oso Bay. The Nueces Estuary spans 106,990 acres and is separated from the Gulf of Mexico by Mustang Island. The Nueces Estuary also receives freshwater from Oso Creek via Oso Bay.

The NFPR also includes coastal areas north and south of the Nueces River basin. This includes the area that drains to the Mission River, which is formed by the confluence of Blanco and Medio creeks and runs southeast for 24 miles to its mouth at Mission Bay, an inlet of Copano Bay and subsequently Aransas Bay. And the NFPR includes the area that drains to the upper Laguna Madre Estuary. San Fernando Creek provides freshwater inflow into this estuary through Baffin Bay.

The NFPR contains the following major reservoirs.

- **Choke Canyon Reservoir** – This reservoir is located along Frio River four miles west of Three Rivers in Live Oak County. The Bureau of Reclamation built the reservoir in 1982 and the City of Corpus Christi and the Nueces River Authority own and operate it for municipal water supply and recreational purposes. According to a TWDB 2012 survey, Choke Canyon has a storage capacity of 662,821 acre-feet with a drainage area above the dam of 4,667 square miles. (TWDB, 2022)
- **Lake Corpus Christi (Live Oak)** – This reservoir is located along Nueces River four miles west of Mathis at the intersection of Live Oak, San Patricio, and Jim Wells County lines. The reservoir was originally built in 1929 and reconstructed in 1955. The City of Corpus Christi owns and operates the dam for municipal water supply and recreational purposes. According to a TWDB 2012 survey the reservoir has a capacity of 254,732 acre-feet with a drainage area above the dam of 16,656 square miles. (TWDB, 2022)
- **Upper Nueces Lake** – This reservoir is also known as the Upper Dam and is located along Nueces River six miles north of Crystal City in Zavala County. The reservoir was originally built in 1926 and was reconstructed in 1948. Zavala and Dimmit counties' Water Improvement District No.1 own and operate the dam for irrigational, recreational, and water supply purposes. The current storage capacity is estimated at 5,200 acre-feet with a drainage area above the dam of 2,160 square miles. (TWDB, 2022)

1.3.4 Major Ecosystems

The NFPR includes five of the 10 ecosystems identified by Texas Parks and Wildlife Department (TPWD) (Figure 1-3). NFPR ecoregions primarily consist of the Gulf Prairies and Marshes, South Texas Plains, and Edwards Plateau with slivers of the Post Oak Savanah and Blackland Prairie.

1.3.4.1 Gulf Coast Prairie

The Gulf Coast Prairies and Marshes region is a near-level, slowly drained plain less than 150 feet in elevation, dissected by streams and rivers flowing into the Gulf of Mexico. The region includes barrier islands along the coast, salt grass marshes surrounding bays and estuaries, remnant tallgrass prairies, oak parklands and oak mottes scattered along the coast, and tall woodlands in the river bottomlands. Average annual rainfall varies from 30 to 50 inches per year distributed fairly uniformly throughout the year. The growing season is usually more than 300 days, with high humidity and warm temperatures. Soils are acidic sands and sandy loams, with clays occurring primarily in the river bottoms. Native vegetation consists of tallgrass prairies and live oak woodlands. Brush species such as mesquite and acacias are more common now than in the past. Although much of the native habitat has been lost to agriculture and urbanization, the region still provides important habitat for migratory birds and spawning areas for fish and shrimp. (TPWD, 2022)

1.3.4.2 South Texas Plains

The South Texas Brush Country is characterized by plains of thorny shrubs and trees and scattered patches of palms and subtropical woodlands in the Rio Grande Valley. The plains were once covered with open grasslands and a scattering of trees, and the valley woodlands were once more extensive. Today, the primary vegetation consists of thorny brush such as mesquite, acacia, and prickly pear mixed with areas of grassland. The average annual rainfall of 20 to 32 inches increases from west to east. Average monthly rainfall is lowest during winter, and highest during spring (May or June) and fall (September). Summer temperatures are high, with very high evaporation rates. Soils of the region are alkaline to slightly acidic clays and clay loams. The deeper soils support taller brush, such as mesquite and spiny hackberry, whereas short, dense brush characterizes the shallow caliche soils. Although many land changes have occurred in this region, the brush country remains rich in wildlife and a haven for many rare species of plants and animals. It is home for semi-tropical species that occur in Mexico, grassland species that range northward, and desert species commonly found in the Trans-Pecos. Livestock grazing and crop production are the principal agricultural land uses. (TWDB, 2022)

1.3.4.3 Edwards Plateau

The Edwards Plateau region comprises an area of central Texas commonly known as the Texas Hill Country. It is a land of many springs, stony hills, and steep canyons. The region is home to a whole host of rare plants and animals found nowhere else on earth. Average annual rainfall ranges from 15 to 34 inches. Rainfall is highest in May or June and September. Soils of the Edwards Plateau are usually shallow with a variety of surface textures. They are underlain by limestone. Elevations range from slightly less than 100 feet to over 3,000 feet above sea level. Several river systems dissect the surface, creating a rough and well-drained landscape. The limestone of the Edward's Plateau is honeycombed with thousands of caves. Beneath the eastern edge of the Plateau lies a hidden world of underground lakes known as the Edwards Aquifer. This precious water resource also is home to a number of curious creatures, such as the blind salamander. Today, the Edwards Plateau is characterized by grasslands, juniper/oak woodlands, and plateau live oak or mesquite savannah. Open grasslands and savannahs were more common in pre-settlement times than they are today. Ranching is the primary agricultural industry in the region. (TPWD, 2022)

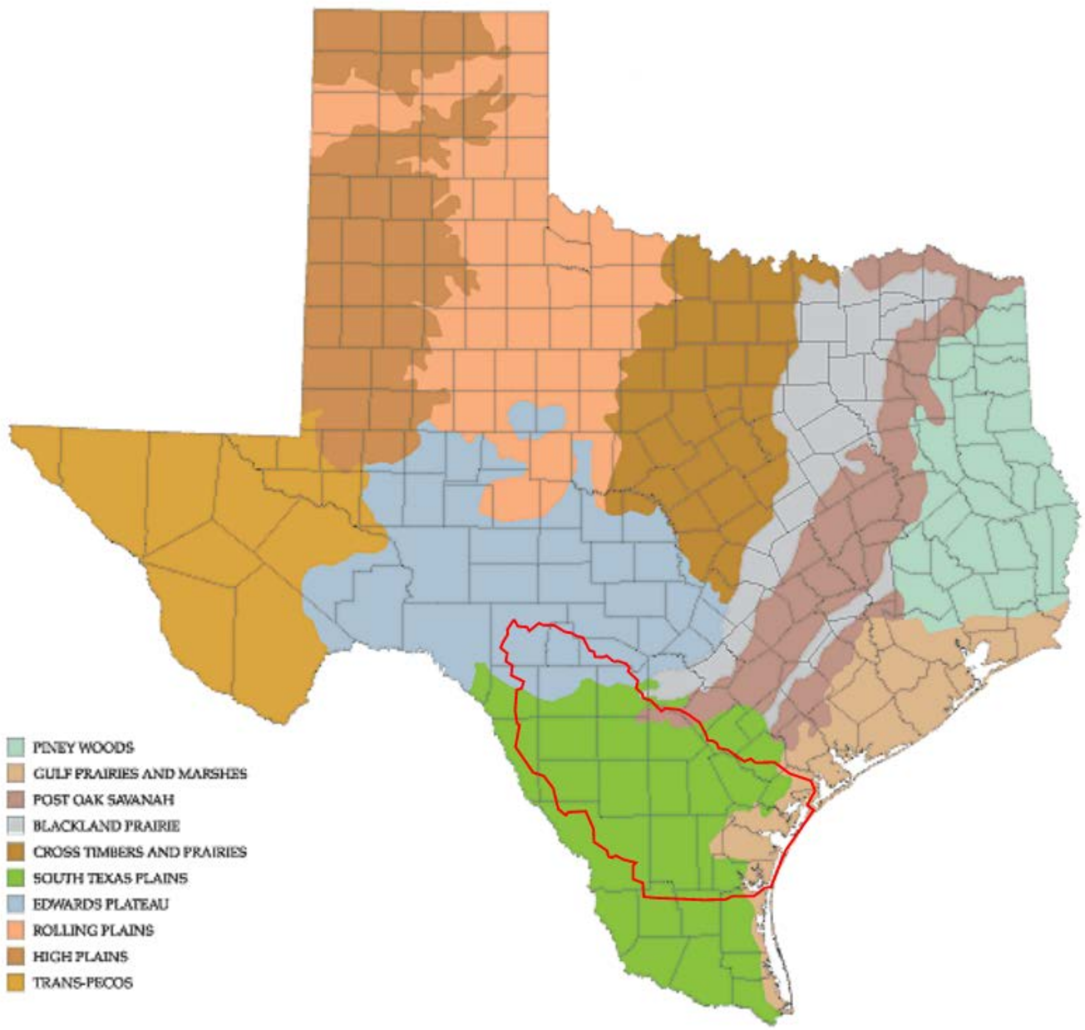

Figure 1-3. Region 13 Ecoregions (Source: Gould)

1.3.5 Land Use and Vegetative Cover

The NFPR is predominately rural with large areas of low to medium development intensity limited to the Corpus Christi metropolitan area. Pastures and cultivated crops are the predominant use of working lands across the NFPR. The land and vegetative cover align closely with the various ecoregions within the NFPR as shown in Figure 1-4 and Figure 1-5.

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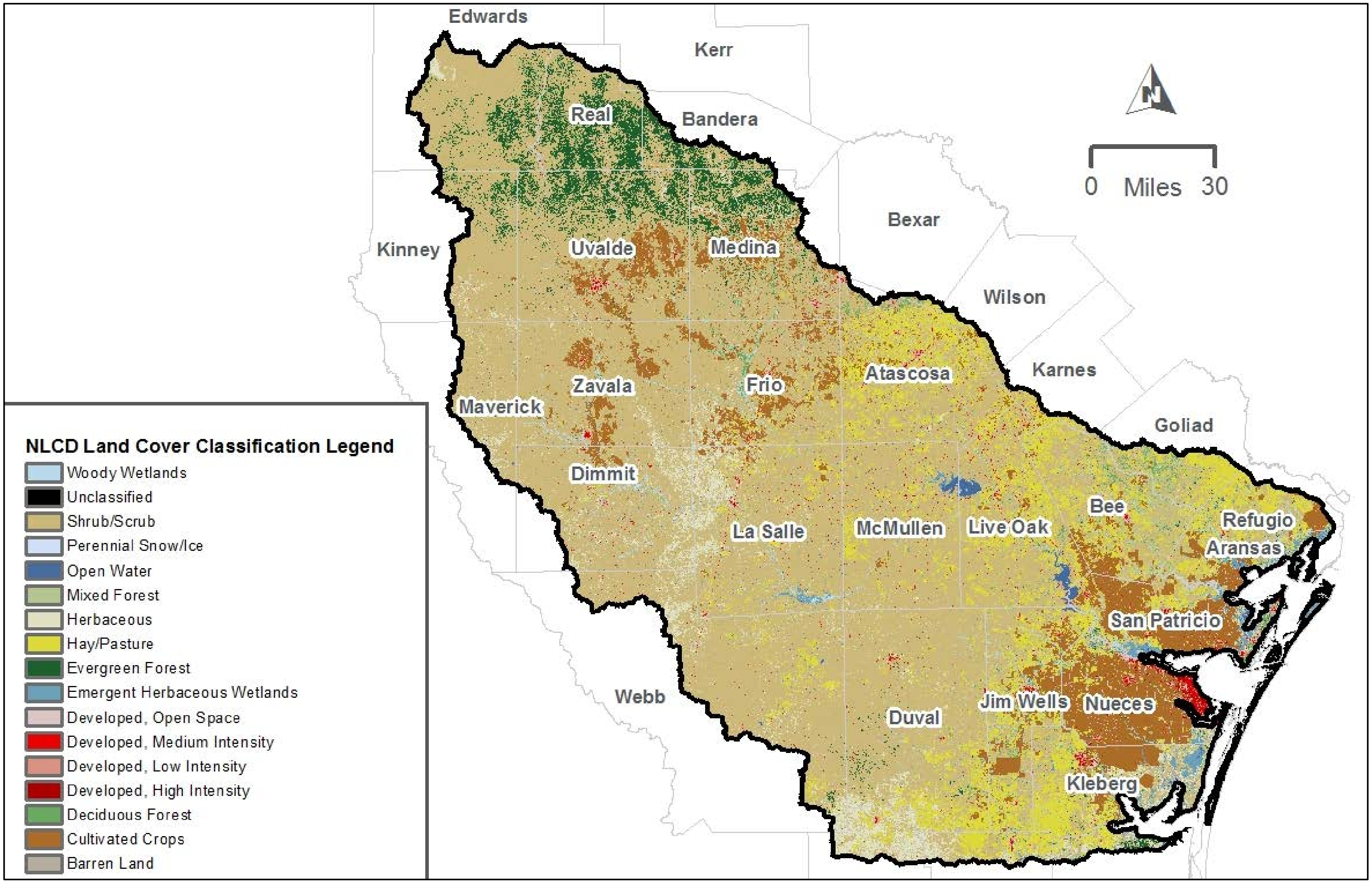

Figure 1-4. Land Cover (NLCD)

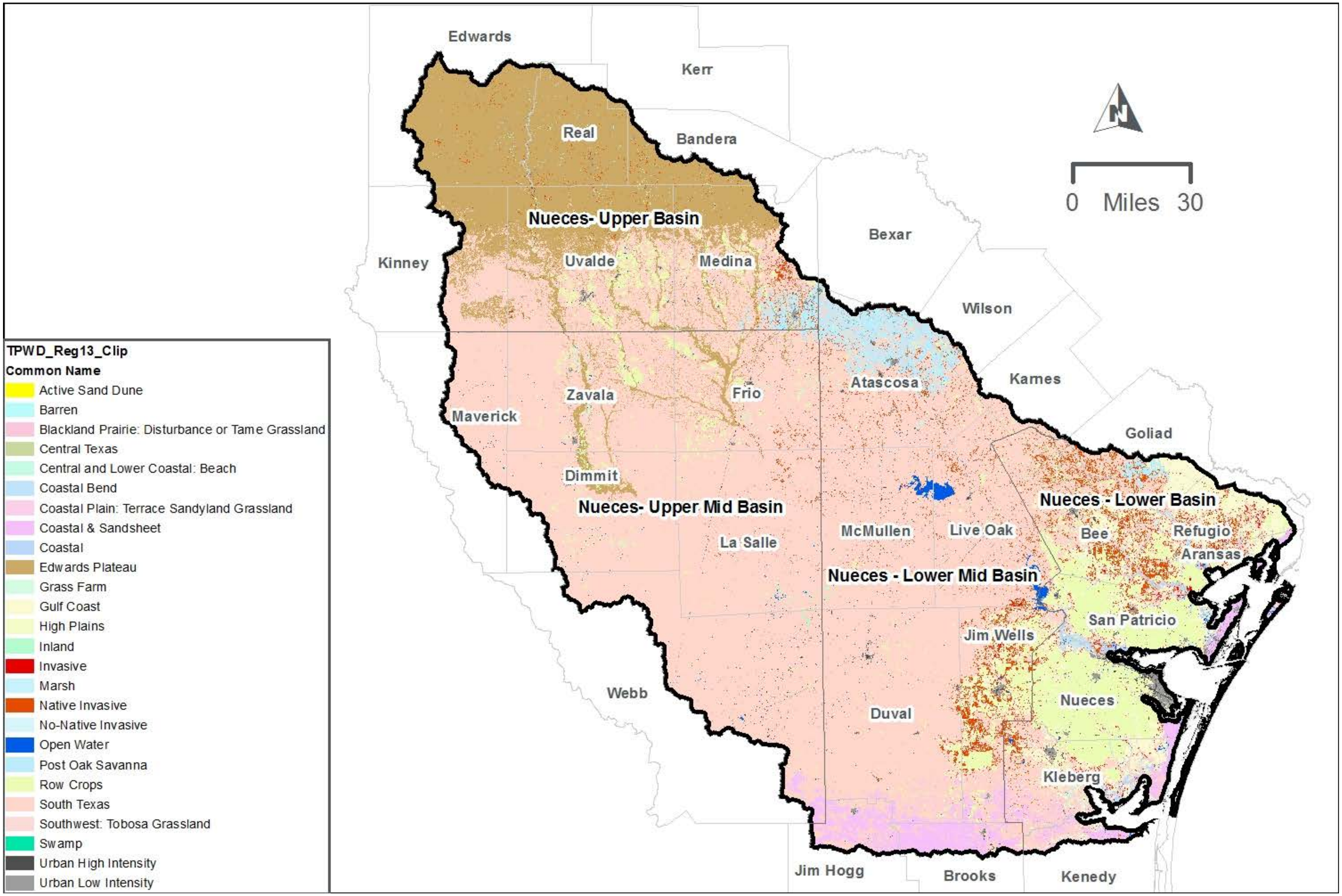

Figure 1-5. Vegetation Cover (TPWD)

1.3.6 Conservation Lands

The NFPR contains Conservation Lands to enable landowners to protect natural resources for future generations while maintaining private ownership. Conservation Lands in the NFPR are predominately located in the Edwards Plateau region as shown in Figure 1-6.

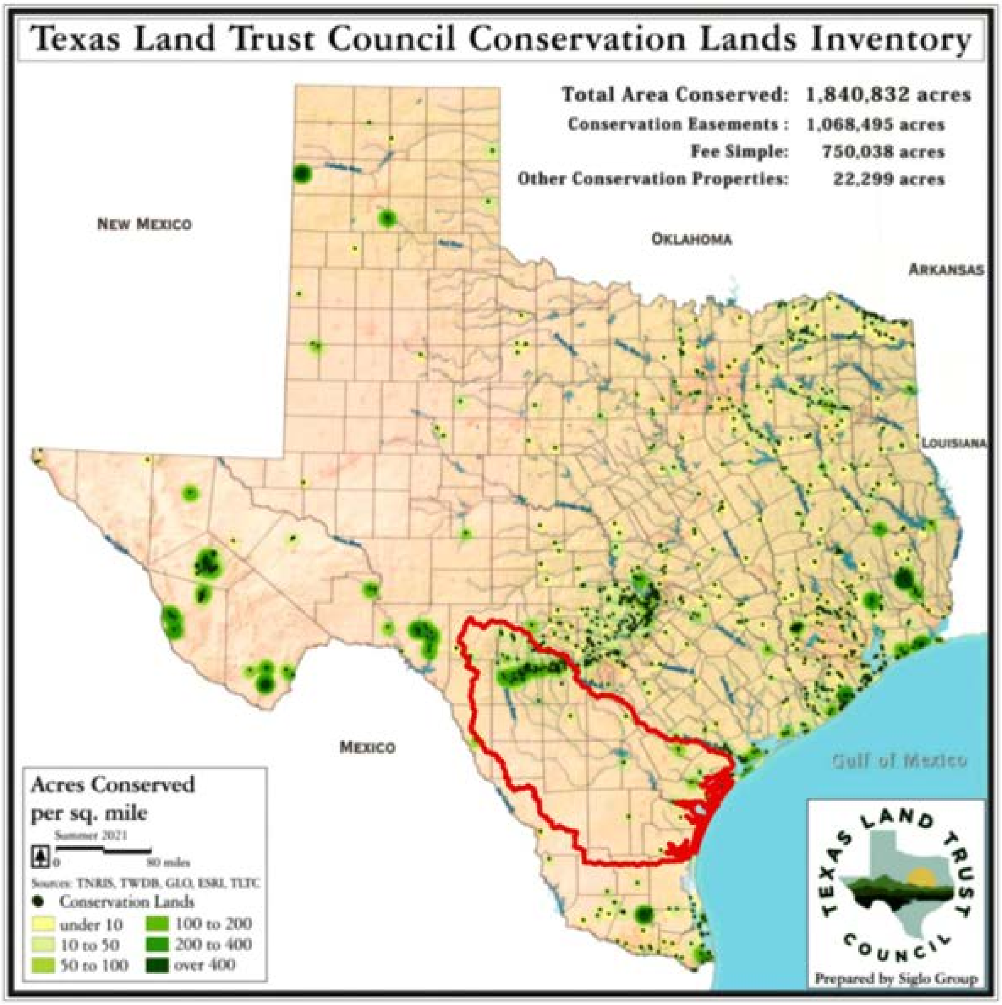

Figure 1-6. Conservation Lands Inventory (Texas Land Trust Council, 2021)

1.4 Social and Economic Character

1.4.1 Population Most at Risk of Flood Impacts

Population data for 2020 and 2050 was obtained from a query of the 2021 Regional Water Plan Data. The population in the NRPR was estimated at 1,140,000 in 2020. The basin is largely rural in nature with the City of Corpus Christi being the only major population center within the basin. The City of Corpus Christi had a population of roughly 325,000 in 2020 or roughly 30% of the total basin population. Most of the population resides in the lower basin as shown in Table 1-3. Other highly populated areas of the basin are near the population centers of Laredo (Webb County) and San

Antonio (Medina, Atascosa, Wilson, and Bexar counties) which are included in the Lower Rio Grande (Region 15) and San Antonio (Region 12) regions respectively. Future growth near these major cities will impact the population in the basin.

Overall, the region is expected to grow by 33% between 2020 and 2050 to a population of about 1,516,000. Most of this growth is expected to occur within areas of redevelopment or new development in or near cities (Figure 1-7).

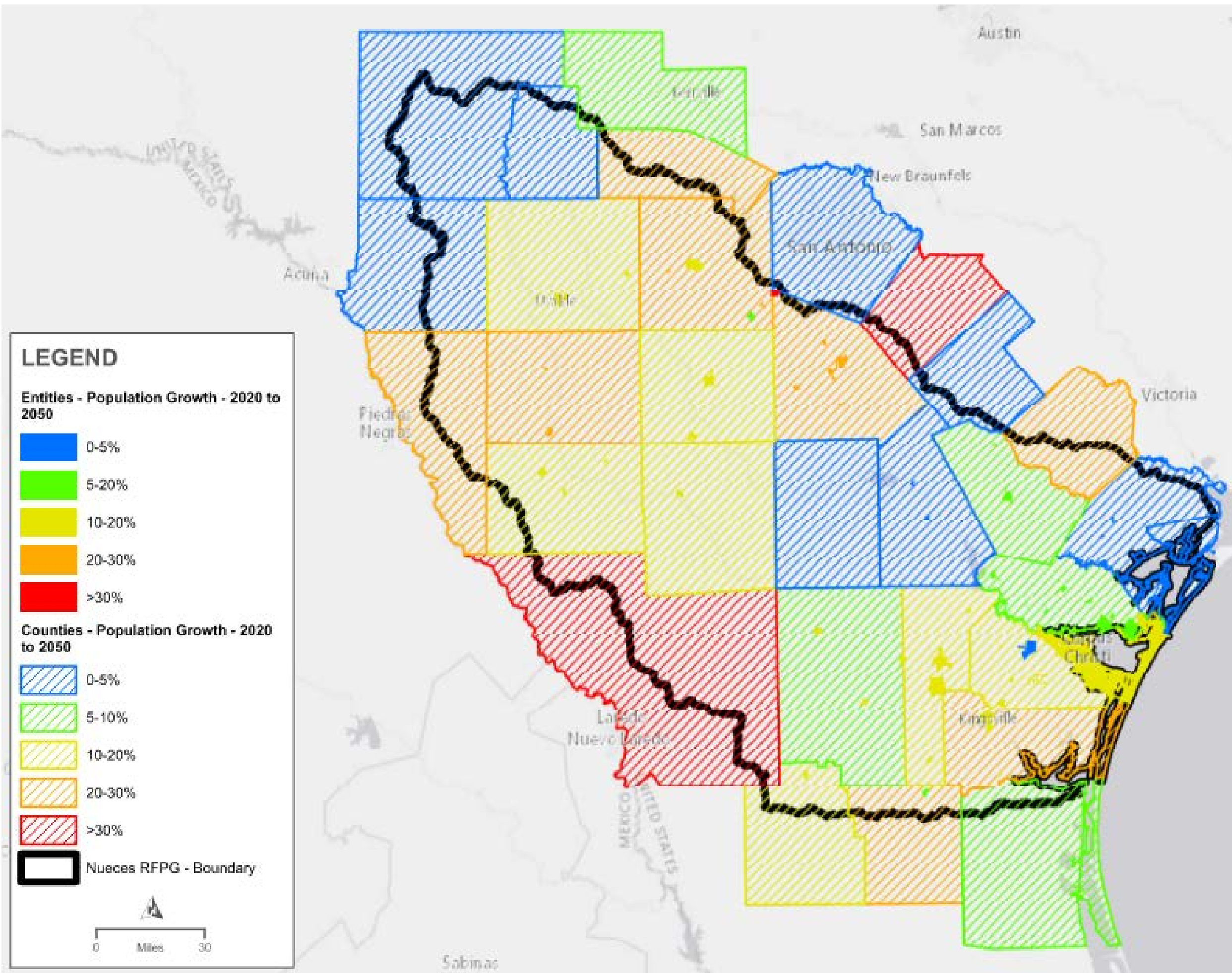

Figure 1-7. Projected Population Growth (2020 to 2050)

There are five cities projected to grow by at least 20% between 2020 and 2050 (See Table 1-3).

Table 1-3. Cities with highest projected growth rate, 2020-2050

Cities	2020	2050	% Growth
Lytle	4,150	5,532	33%
Jourdanton	4,829	6,626	37%
Poteet	3,871	5,022	30%
Pleasanton	11,142	14,454	30%
Crystal City	8,063	9,880	23%

There are three counties projected to grow by at least 30% between 2020 and 2050 (See Table 1-4).

Table 1-4. Counties with highest projected growth rate, 2020-2050

Counties	2020	2050	% Growth
Webb	318,028	464,960	46%
Wilson	54,266	79,044	46%
Atascosa	52,574	68,210	30%

The upper mid-basin represents the youngest population with the lowest median household income, lowest percent of higher education, and highest percent of population living below the poverty line (See Table 1-5).

Table 1-5. Demographics of the Various Nueces Sub-Regions

Demographic Category	Upper Basin	Upper Mid Basin	Lower Mid Basin	Lower Basin
Population (percent of entire basin)	9%	7%	17%	67%
Median Age	39	33	38	37
Median Household Income	$51,000	$36,000	$48,000	$53,000
Education – Bachelors+	17%	11%	14%	21%
Lives Below Poverty Line	15%	27%	20%	18%

The greatest risk of flood impacts is for areas experiencing population growth and for areas with limited resiliency due to limited resources. Without proper flood ordinances, population growth and associated developments are more likely to increase flood risks to life and property.

1.4.2 Economic Activity and Sectors Most at Risk of Flood Impacts

Economic activity and sectors most at risk of flooding include the following.

- **Real Estate** – Buildings located in areas susceptible to flood inundation are at risk of flood damage. The Nueces basin has roughly 61,000 buildings located within the existing 1% annual chance (100-year) floodplain.
- **Transportation** – Floods can cause roadways and bridges to be temporarily impassible for extended periods and can potentially cause long-term closures from wash outs and structural failures. The Nueces basin has roughly 3,200 miles of roadway segments and 5,400 roadway crossings located in the existing 1% annual chance floodplain.
- **Tourism** – The coastal waters and pristine waters of the upper basin support a robust tourism industry. Storm surges along the coast or flash flooding in the upper basin have caused the loss of housing and businesses that support the tourism industry.
- **Agriculture** – Agriculture by its nature is often located near waterways and thus susceptible to flood impacts. Agriculture development in proximity to deep, fast moving, and/or long-standing flood inundation areas are highly susceptible to flood impacts. The Nueces basin has roughly 390 square miles of agriculture areas within the existing 1% annual chance floodplain.

1.4.3 Development Most at Risk of Flood Impacts

Development most at risk of flood impacts include the following.

- **Development in low-lying gulf prairie and marsh lands located along the coast.** These areas are very flat and are inundated for long periods of time during and after flood events. Large portions of Nueces and San Patricio counties, as well as other areas along the coastline are within high growth areas and within these gulf prairie and marsh lands.
- **Unregulated development can potentially put existing and new buildings in harm's way.** Several high growth areas within the basin lack floodplain management practices and enforcement of regulations to mitigate future flooding events.
- **Roadway crossings of waterways are susceptible to damage from stormwater debris, erosion, and hydraulic forces.** There are roughly 5,400 roadway crossings of floodplains in the Nueces basin. Of these, 576 roadway crossings are considered low water crossings. Most of the low water crossings and many more other crossings are at high risk of flood impacts. Refer to Section 2.1.1.1 for further information on low water crossings.

1.5 Flood Prone Areas and Types of Major Flood Risks

Flood prone areas in the region generally include the following types of major flood risks.

- **Riverine Flooding** – Areas at risk of flooding when rivers and creeks come out of their banks. These areas are often included in 1% and 0.2% annual chance floodplains. Of particular high risk are existing and future development and populations located along the major rivers such as the Nueces, Frio, and Atascosa.
- **Coastal Flooding** – Areas at risk of flooding when sea water surges inland from tropical storm events. These areas are often included in 1% and 0.2% annual chance floodplains along coastlines. Of particular high risk are existing and future developments located within the low-lying areas of the gulf prairies and marshes.
- **Pluvial Flooding** – Areas at risk of flooding when extreme rainfall creates a flood independent of an overflowing water body. Pluvial flooding is caused when the ground is over saturated and/or drainage systems are overflowed and the excess water (surface water) cannot be absorbed or drained away.
  - **Urban Flooding** – A form of pluvial flooding that includes areas where local storm drain infrastructure is inadequate and flooding frequently occurs. These areas are often identified by residents as known frequent flood problem areas. Of particular high risk are existing and future developments planned and built without proper consideration of local drainage patterns.
- **Flash Flooding** – A form of riverine or pluvial flooding is particularly dangerous in the upper basin where flash flooding of low water crossings and low-lying areas can occur with little warning. Of particular high risk are campgrounds located in low-lying, frequently-flooded areas, and frequently traveled low water crossings.

Flood-prone areas in the region are identified in the flood plan by the following.

- **Areas within the 1% and 0.2% annual chance flood inundation boundaries.** These boundaries were defined for all waterways for both existing and future conditions with contributing drainage areas larger than one square mile for the entire basin.
- **Known low water crossings.** Low water crossings are considered potential flood-prone areas due to their inherent life-loss risk during flood conditions. Low water crossings are defined where a creek crosses a road that is low enough to be subject to frequent flooding during storm events or during a 50% annual chance (2-year) storm event.

- **Areas where residents and officials have reported past flooding.** Subregional meetings, interviews with officials, and an on-line public comment map were used to obtain information on known flood prone areas.
- **Areas where past flood damages, injuries, and deaths were recorded.** Historical flood data information was obtained and reviewed from the National Weather Service (NWS), the Federal Emergency Management Agency (FEMA), and the U.S. Geological Survey (USGS).

The flood prone areas are best identified by referring to the flood hazard, exposure, and vulnerability maps. These maps are fully described in Chapter 2 of the flood plan.

1.6 Key Historical Flood Events

Historical flood data is compiled from news reports of historical flood events, USGS gage records, NWS flood data, and FEMA flood damages. Table 1-6 summarizes the major historical flood events in the NFPR. A detailed summary of all key historical flood events and data obtained is included in Appendix C1 – Historic Flood Event Data.

Table 1-6. Major Historical Flood Events

Flood Event	Short Description
2017 Hurricane Harvey	64 injuries and 2 fatalities, $4.28 billion in damages in the Nueces Basin
2003 Flash Floods	Flash floods in northwestern counties of the Nueces Basin
2002 Frio River Flood	Record stages for middle basin parts near Tilden
1998 Flash Flood Real County	2 fatalities in Real County
1997 Flash Flood in Medina, Bandera, and Goliad Counties	4 fatalities across Medina, Bandera, and Goliad Counties.
1996 Nueces Flood	Record peak stage of the Nueces River near Uvalde
1971 Hurricane Edith and Fern	Historic flooding in the lower counties of the Nueces Basin
1967 Hurricane Beulah	41 fatalities, $1 billion of damage, and thousands of people lost their homes
1935 Nueces and West Nueces Flood	The earliest documented major flood in the Nueces River Basin
1932 Frio and Nueces Flood	The highest peak stage in the Frio River at Concan and the second highest recorded peak stage in the Nueces River near Uvalde.

1.7 Engagement of Political Subdivisions with Flood-Related Authority

The NRFPG compiled a list of existing political subdivisions within the NFPR that have flood-related authorities or responsibilities and identified a point of contact for each entity based on the FEMA Community Contact Report (dated February 12, 2021), and additional information provided by the Nueces River Authority. HDR developed a floodplain management survey about existing practices and sent it to the identified contacts. Survey results and follow-up correspondence confirmed that 13 of 31 counties and 12 of 57 cities with flood-related authority have floodplain management regulations. Of these, 11 counties and 11 cities have moderate/strong floodplain management practices and moderate/high levels of enforcement on these regulations. Additionally, eight counties and nine cities have been identified to have adopted higher floodplain management standards. These actively engaged counties and cities tend to be located near the high population and growth centers of Corpus Christi, San Antonio, and Laredo. For detailed information refer to Chapter 3, which fully describes floodplain management practices for the basin.

1.8 Extent of Local Regulation and Development Codes

Using policies and regulations to reduce the exposure of people and properties to flood risk are forms of non-structural flood control. By encouraging or requiring communities to avoid developing in flood-prone areas altogether, or to take precautions such as increasing building elevation, preserving overflow areas through buffering, and avoiding sensitive natural areas such as wetlands, communities can reduce the likelihood and extent of damages to existing and new development. Local regulations and development codes pertaining to flooding include the following.

- **Floodplain Ordinances** – Floodplain ordinances regulate development and the impact new development has on a community's floodplain. Community regulations are typically based on FEMA-provided flood hazard information but can be based on other local sources of data as well. Participation in the NFIP requires a community to have adopted a floodplain ordinance with minimum requirements established by FEMA.
- **Building Standards** – Building standards may include considerations for structures located within a floodplain, including minimum finish floor elevations and flood proofing requirements. NFIP requirements also set standards for property owners seeking to renovate structures in a floodplain, including those that experience repetitive or severe flood losses.
- **Drainage Design Standards** – Adopted drainage design standards set the minimum standards for stormwater management that must be met prior to the

approval of construction plans. Drainage criteria in the region are typically adopted by municipalities but are also used by counties.

- **Zoning and Land Use Policies** – Planning and zoning ordinances regulate acceptable types of land uses within a community to promote appropriate development, safety, and general welfare. Some communities use zoning and land use ordinances to establish open space requirements, conservation easements, and minimum setbacks from creeks and wetlands to preserve floodplain function and promote sustainable and resilient development.
- **Local and Regional Flood Plans** – Local and regional flood plans analyze a community's flood risk and present how that entity will improve its resiliency. Drainage master plans describe a community's physical and institutional planning environment and establish interjurisdictional roles and responsibilities when many drainage entities are present. Capital improvement plans (CIPs) identify capital project alternatives for an entity, provide economic analysis for alternatives, and often rank alternatives based on feasibility.
- **NFIP's Community Rating System (CRS)** – Credits community efforts beyond meeting minimum NFIP standards. The CRS provides 19 public information and floodplain management activities. Of which, a community must conduct elevation certificates and conduct floodplain management planning if in a designated repetitive loss community. All other activities are optional for participation in CRS. However, the program awards points and assigns a rating class on a scale of 1 to 10 based on participation in the various activities. Then the CRS assigns the percent discount for a community based on the determined rate class (i.e., a rate class of 7 correlates with a discount of 15% for property owners in a Special Flood Hazard Area).

As described in Section 1.7, local regulations related to flood management are strongest near major population centers and generally lacking for the remainder of the basin, which is rural in nature. The exposure analysis performed in this regional plan indicates that approximately 61,000 and 78,000 structures are in the existing and future 1% annual chance floodplains, respectively. However, this does not include the possibility of additional structures being built in the floodplain over the next 30 years. Thus, improving floodplain mapping and strengthening local regulations and development codes is key to reducing the future flood risk. One of the most effective regulations to reduce flood risk is to enact freeboard requirements on new structures. The NRFPG is strongly encouraging cities and counties in the Nueces Basin to actively consider requiring minimum finished floor elevations be set 2 feet above base flood elevations or above local ordinances, whichever is higher, in the basin. Extent of local regulations and development codes are presented in further detail in Chapter 3.

1.9 Agricultural and Natural Resources Impacted by Flooding

In the Nueces basin, cultivated crops are widespread within the coastal prairie and marsh area and pasture/hay land use is also widespread in the lower basin and in Atascosa County (see Figure 1-4 and Figure 1-5).

Flooding or excess precipitation can delay and reduce crop harvest, and erosion of sediment and nutrients downstream result in complete or partial crop loss. The impact that flooding has on farming depends on factors, including crop type, stage of the growing or harvesting season when the flood event occurs, and the magnitude of flooding. The numerous crop types grown in the Nueces basin region have varying degrees of resiliency to excess precipitation and prolonged standing water. Permanent crops, such as trees, tend to be more resilient to excess precipitation and standing water than row crops, such as corn or cotton. Heavy rain before planting can delay planting or prevent planting for the season. In addition, flooding damages can occur after a crop, like cotton or hay, has been harvested but not bailed or processed. But floods can also have a positive impact on farming as floods contribute to the fertility of agricultural lands.

Ranching activities in the region are also impacted by flooding. Livestock can be swept away, drowned, or injured by flash floods. After a flood, livestock can be particularly susceptible to certain types of parasites and diseases. Excessive rain may cause an increase in vectors, including flies and mosquitos, and cases of foot rot, which is a foot disease of cattle, sheep, and goats. Flood events can cause delays in building back livestock herds. Flood damages to livestock silage can reduce livestock head counts.

The Nueces region contains numerous natural resources that can be impacted by flood events. As with livestock, wildlife can be injured or killed by flash floods. Severe flood conditions can degrade stream health and impact ecosystems in the region.

In some ways, flooding can be a benefit for fields, wetlands, riparian areas if limited in depth, duration, and velocity. However, typically, in this region where flash floods are common, flooding causes erosion of sediment and nutrients, which can cause nutrient overgrowth and algal blooms in water bodies and nutrient deficiencies in agricultural producing lands.

1.10 Existing Local and Regional Flood Plans

A list of previous flood studies considered by the NRFPG to be relevant to the development of the RFP are fully described in Appendix C2 – List of Previous Flood Studies. Table 1-7 lists the names and publication years of these plans.

Table 1-7. List of Previous and Relevant Studies

Previous and Relevant Studies	Year
Coastal Texas Protection and Restoration Feasibility Study	2021
Lower Nueces River Watershed Protection Plan	2020
Atascosa-McMullen Multi-Jurisdictional Hazard Mitigation Action Plan	2020
Coastal Resiliency Master Plan	2019
Bandera County River Authority and Groundwater District Flood Plan	2019
The City of Alice & Jim Wells County Multi-Hazard Mitigation Plan	2018
San Patricio County Hazard Mitigation Action Plan	2018
Aransas County Multi-Jurisdictional Floodplain Management Plan	2017
Aransas County Texas Multi-Jurisdictional Hazard Mitigation Action Plan	2017
Nueces County Multi-Jurisdictional Hazard Mitigation Action Plan	2017
Hazard Identification, Risk Assessment (HIRA) and Consequence Analysis	2014
A Joint Erosion Response Plan for Nueces County and the City of Corpus Christi	2012
Coastal Bend Mitigation Action Plan	2012
Potential for Bed-Material Entrainment in selected Streams of the Edwards Plateau	2008

1.11 Existing Infrastructure

Background knowledge of the NFPR's existing natural and structural flood infrastructure provides context in identifying strategies and flood planning recommendations throughout the planning process. This section details the major natural flood mitigation features and constructed flood infrastructure in the NRFP area.

The general location, description, level of service (LOS), functionality, deficiency, and owning/operating entities for each identified natural flood mitigation features and constructed major flood infrastructure are summarized at length in Appendix A1 – TWDB Table 1 – Existing Flood Infrastructure Table and the GIS geodatabase and are shown at a basin-wide scale in Appendix B1 – TWDB Map 1 - Existing Flood Infrastructure Regional Map. Features and infrastructure included, as applicable, are summarized in Table 1-8.

Additional information about significant or deficient/non-functioned features or infrastructure are detailed in subsequent sections as necessary.

- **Functional** infrastructure is defined as serving its intended design LOS.

- **Non-functional** infrastructure is defined as not providing its intended or design LOS.
- **Deficient** infrastructure is defined as constructed or natural features in poor structural or non-structural condition in need of replacement, restoration, or rehabilitation.

Non-functional and deficient flood infrastructure is shown at a basin-wide scale in Appendix B3 – TWDB Map 3 - Non-Functional or Deficient Flood Mitigation Features or Infrastructure Regional Map.

Table 1-8. List of Natural Features and Constructed Major Infrastructure

Flood Infrastructure	Definition	Description	Non-Functional / Deficient
Natural Features			
Rivers, Tributaries	Rivers are large natural waterways that carry water to an ocean or inland sea. Tributaries are natural waterways that flow into larger rivers or other bodies of water.	Added from National Hydrography Dataset (NHD)	Functional
Functioning Floodplains	A functioning floodplain are areas adjacent to rivers, ponds, lakes, and oceans that are periodically flooded at different points in time.	Added floodplains from the Texas Water Development Board (TWDB) compiled ‘flood quilt’, and other detailed studies.	Functional
Wetlands	A wetland is an area of land that is either covered by water or saturated with water.	Added from National Wetland Inventory	Functional
Sinkholes	A sinkhole is a cavity in the ground, especially in limestone bedrock, caused by water erosion and providing a route for surface water to disappear underground.	Added 23 from NHD and HDR Engineering, Inc. (HDR), many others not defined	Functional
Alluvial Fans	An alluvial fan is a fan-shaped mass of alluvium deposited as the slope of a stream decreases and the flow decreases in velocity.	None identified.	Not applicable

Flood Infrastructure	Definition	Description	Non-Functional / Deficient
Playa Lakes	Playa lakes are often round hollows in the ground that only contains water occasionally.	None identified.	Not applicable
Vegetated Dunes	Vegetated dunes are sand dunes that are somewhat stabilized by plants roots.	Undefined – Geospatial dataset unavailable for dunes in Texas	Not applicable
Constructed Major Infrastructure			
Levees	A levee is an embankment built to contain, control, or divert the flow of water to provide protection from temporary flooding.	Added 8 levees from the National Levee Database. The following major levees are included: City of Three Rivers Levee; City of San Diego Levee; City of Alice Levee; City of Corpus Christi Levee – located west of Port of Corpus Christi Southside; City of Bishop Levee; Levee northwest of Aransas Pass, and south of State Highway 188; City of Aransas Pass Levee – Located on both sides of Port Aransas Causeway, along Redfish Bay; and Aransas National Wildlife Refuge Levee – Located on east side of St. Charles Bay.	Unknown
Sea Barriers, Walls, and Revetments	Sea barriers, walls, and revetments provide an erected structure to prevent the sea from encroaching on or eroding an area of land.	City of Corpus Christi has 2 noted sea walls – one protecting downtown, and another on Padre Island south of Packery Channel.	Functional

Flood Infrastructure	Definition	Description	Non-Functional / Deficient
Tidal Barrier and Gates	A tidal barrier typically spans an estuary, bay, river, or other sea inlet and contains gates that can open and close.	City of Corpus Christi and City of Aransas Pass have tidal barriers or gates that are put in place when tidal surges are expected due to tropical storms.	Functional
Stormwater Tunnels	A stormwater tunnel is a long pipe or box culvert that is typically installed deep underground.	None known	Unknown
Stormwater Canals	A stormwater canal is an artificial constructed above ground waterway used to convey water for irrigation.	A total of 362 miles of stormwater canals were identified within the Nueces Flood Planning Region (NFPR) according to the National Hydrography Dataset (NHD) by USGS.	Unknown
Dams that provide Flood Protection	A flood protection dam is defined as any barrier designed to runoff which has a height greater than six feet. This does not include railroad or roadway embankments.	A total of 501 dams were identified within the Nueces Flood Planning Region (NFPR) according to the National Inventory of Dams. Of this total, 23 flood control dams were constructed and are operated by the Natural Resources Conservation Service (NRCS), and 116 dams are regulated by the Texas Commission on Environmental Quality's (TCEQ) Dam Safety Program.	Of the TCEQ regulated dams, 14 are hydraulically inadequate or non-functional and 22 are in poor condition or deficient. Data from TCEQ and NRCS

Flood Infrastructure	Definition	Description	Non-Functional / Deficient
Detention and Retention Ponds	A detention pond is a man-made basin which holds runoff temporarily to attenuate peak flood flows. A retention pond serves a similar function but typically holds water all year round.	City of Ingleside has a regional detention pond (Whitney Lake Marsh Wildlife Refuge)	Functional
Storm Drain Systems	A storm drain system is a collection of inlets and pipes or box culverts that collect and convey runoff to a nearby waterway. Only major storm drain systems are to be identified in plan, not individual storm drains and inlets.	Major systems included for the City of Corpus Christi and the City of Ingleside	Unknown
Weirs	A weir is a control structure set to raise the level of water upstream or to regulate its flow.	None known	Unknown
Low water Crossings	Low water crossings (LWCs) are defined where a creek crosses a road that is low enough to be subject to frequent flooding during storm events or during a 50% annual chance (2-year) storm event.	548 LWCs were identified from TWDB HUB low water crossing data dated May 2021 22 LWCs were identified from available TxDOT data to be subject to frequent flooding. 6 LWCs were identified from the City of Beeville to be subject to frequent flooding. No other LWCs were identified during this first planning cycle.	Unknown

Flood Infrastructure	Definition	Description	Non-Functional / Deficient
Bridges	A bridge is a roadway structure that spans a waterway and includes all bridges and culverts spanning over 20'.	Added 2,706 bridges and culverts over 20' wide on public roads from National Bridge Inventory databased maintained by the Federal Highway Administration (FHWA).	Unknown
Stormwater Pump Stations	A stormwater pump station provides pump(s) to lift collected stormwater runoff from a sump to a higher discharge point.	City of Corpus Christi has 2 pump stations in the downtown area, and the City of Aransas Pass noted 1 pump station.	Corpus Christi – Functional; Aransas Pass – Non-Functional due to inability to handle flood flows and prevent flooding

1.12 Proposed or Ongoing Flood Mitigation Projects

See Appendix A2 – TWDB Table 2 – Summary of Proposed or Ongoing Flood Mitigation Projects. This list includes 93 projects currently under construction, being implemented, or with dedicated funding to construction, the source of funding, and expected year of completion. The list includes numerous drainage improvement studies and projects for various cities and counties and includes multiple Texas Department of Transportation (TxDOT) bridge replacement and drainage projects, as identified from TxDOT's [Project Tracker (txdot.gov)](). Figure 1-8 below depicts major proposed or ongoing flood mitigation projects.

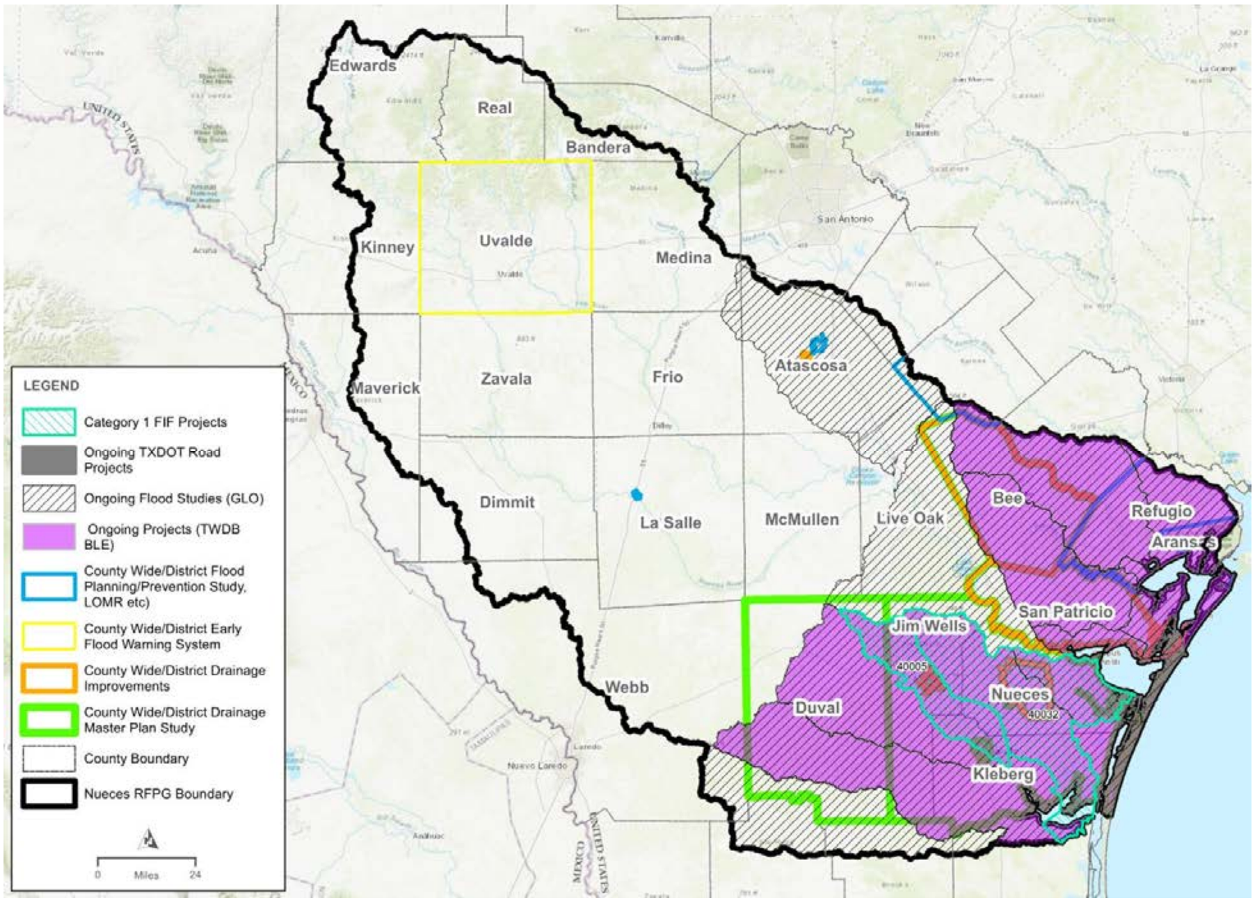

Figure 1-8. Major Flood Studies and On-Going Flood Studies/Projects (Map 2)

Major flood studies and on-going projects relevant to the NFPR include the following:

- General Land Office Regional Flood Study for the Nueces-San Antonio-Guadalupe-Lavaca-Colorado Study Basin
- Various County Drainage Master Plans, County-wide Drainage Improvement Projects, Early Flood Warning Systems, and Flood Prevention Studies (Duval, San Patricio, Nueces, Jim Wells, Kleberg, and Bee Counties)
- TWDB Base Level Engineering (BLE) Projects

- TWDB FIF funded on-going projects, as listed in Table 1-9. The various FIF categories represent the following:
  - o Category 1 – flood protection planning grants for watersheds no smaller than HUC-10
  - o Category 2 – planning, acquisition, design, construction, and rehabilitation type projects
  - o Category 3 – federal award matching funds
  - o Category 4 – measures immediately effective in protecting life and property

Potential TWDB FIF funded projects, as listed in

- Table 1-10.

Table 1-9. TWDB FIF Funded On-Going Projects

TWDB Project #/ Category	Authority	Project Name	Project Description
40005 Cat-1	Alice	Master Drainage Study	H&H Modeling, conceptual engineering design, cost/benefit analysis, and plan for flood early warning system
40011 Cat-1	Karnes County	Flood Protection Planning Study	Study to update floodplain models and maps for high priority streams, flood problem areas, and to develop mitigation alternatives.
40030 Cat-2	Jourdanton	Main Street Drainage Project	Proposed improvements to improve roadside ditches and construct new channels in City's downtown area
40032 Cat-1	Nueces County	Regional Drainage Master Plan Study	Prepare basin-wide hydrologic models and limited-detailed hydraulic models in the Baffin Bay and South Corpus Christi watersheds, develop flood mitigation solutions for drainage problem areas, and conduct benefit/cost analysis.
40052 Cat-2	Nueces County DCD#2	Casa Blanca Drainage Improvements	Project includes drainage improvements to the existing Ruben Chavez S. Ditch and other downstream ditch improvements to mitigate potential flooding along the ditch and in the Casa Blanca subdivision.
40064 Cat-4	Uvalde County	Self-Supporting Tower for Early Warning System	The installation of the tower will provide sustainability to the Uvalde County Flood Early Warning System

TWDB Project #/ Category	Authority	Project Name	Project Description
40071 Cat-4	Nueces County DCD#2	Flood Early Warning System (FEWS)	Install 12-15 FEWS Stations in locations known to have repeated flooding.
40084 Cat-2	Cotulla	Flood Planning Study for LOMR	Defined AE flood hazard zone and floodway for the City of Cotulla.
40092 Cat-2	Nueces County DCD#2	Bosquez Rd. / Avenue J Drainage Improvements	Drainage improvements to improve drainage conditions at Robstown High School, Bluebonnet Subdivision, Hwy 44, and further downstream.
40093 Cat-2	Nueces County DCD#2	Ditch “A” and Bluebonnet Drainage Improvements	Drainage improvements at Ditch “A” and the Bluebonnet subdivision.
40117 Cat-2	Nueces River Authority	Green Lake Outfall System and Gregory Diversion Ditch	Project to address flooding issues in the Green Lake Drainage Basin and includes Green Lake dam and channel improvements, Gregory flood relief channel improvements, and Portland drainage improvements.
40135 Cat-2	Kingsville	Drainage Master Plan – Location 7 Improvements	Drainage improvements in the Location 7 drainage basin to relieve flooding along Pasadena Drive and in the Glover Park Subdivision in the southwest side of the City.
40142 Cat-2	Kingsville	Drainage Master Plan – Location 1	Drainage improvements in the Location 1 drainage basin to relieve flooding in Fairview Heights and San Jose Estates subdivisions in the northeast side of the city.

TWDB Project #/ Category	Authority	Project Name	Project Description
40143 Cat-2	Kingsville	Drainage Master Plan – Location 3	Drainage improvements in the Location 3 drainage basin to relieve flooding in Forest Park 2 subdivision on the east side of the city.
40144 Cat-2	Kingsville	Drainage Master Plan – Location 4	Drainage improvements in the Location 4 drainage basin to relieve flooding in Sarita Park 4/5, and Southmore Acres subdivision on the south-central side of the city.
40192 Cat-2	Kingsville	Drainage Master Plan – Location 8	Drainage improvements on Paulson Falls Drive to improve surface water drainage.

Table 1-10. TWDB FIF Proposed Projects

Abridged App #	Entity Name	Project Name
13606	Bee County	Medio Creek Flood Control Improvements
13605	Bee County	Master Drainage Planning Study
13819	Nueces County DCD#2	Flood Early Warning System
13818	Nueces County DCD#2	Master Drainage Planning Study
13558	Pleasanton	Atascosa Flood Prevention Project
13533	Kingsville	Location 2
13536	Kingsville	Location 5
13537	Kingsville	Location 6
13540	Kingsville	Location 9
13639	Aransas Pass	Stormwater Pump Station #3 (Euclid)
13627	Alice	Pintas Creek at Sunset Dr. & Virginia St. Drainage Improvements
13653	Alice	Master Drainage Planning Study
13608	Driscoll	Master Drainage Planning Study

Chapter 2 – Flood Risk Analysis

31 TAC § 361.33 and 361.34

Frio River flood in Tilden, July 2002

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2 Flood Risk Analyses

The objective of this chapter is to describe the existing and future condition flood risks. The overall flood risk is determined by defining the flood hazard, exposure, and vulnerability risk as follows and shown in Figure 2-1 below:

- **Hazard** – Determine the location, magnitude, and frequency of flooding;
- **Exposure** – Identify who and what might be harmed within the region; and
- **Vulnerability** – Identify vulnerabilities of communities and critical facilities.

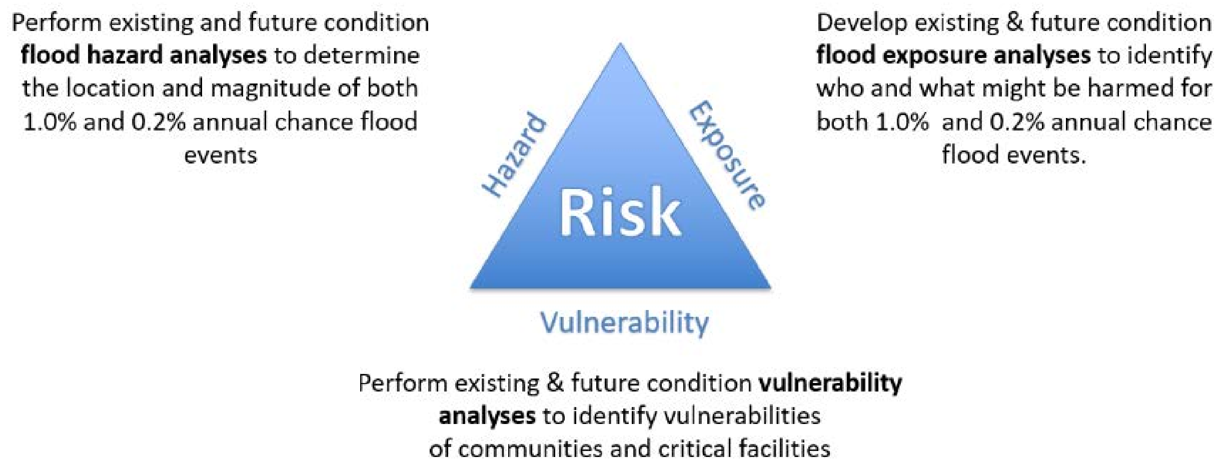

Figure 2-1. Flood Risk Analysis (Source: TWDB Exhibit C Technical Guidelines)

The above information forms the basis for establishing priorities in subsequent planning tasks, to identify areas that need flood management evaluations (FMEs), and to efficiently deploy resources.

2.1 Existing Condition Flood Risk Analyses

2.1.1 Existing Condition Flood Hazard Analysis

The objective of this section is to identify and compile a comprehensive outlook of existing condition flood hazards in the region, including riverine flooding, urban flooding, coastal flooding, and possible flood-prone areas of risks. This effort and the resulting maps are not regulatory in nature but are, instead, intended to gather and present a single, coherent, continuous set of best available information on actual flood risk throughout the region.

To achieve the above objective an existing condition flood hazard analysis was performed to determine the location and magnitude of both 1% annual chance and 0.2% annual chance flood events for the entire region using best available data, including detailed and approximate modeling and mapping data. The process of defining the existing condition flood hazard is as follows:

- **Data Collection** – Collect data and conduct analyses sufficient to characterize the existing conditions for the planning area
- **Availability of Detailed Model Results** – Identify areas where hydrologic and hydraulic model results are already available and summarize the information including the age of the map and modeling information for each area
- **Best Available Data** – Use best available data, hydrologic and hydraulic models for each area
- **Flood Hazard Maps** – Prepare a map showing areas having an annual likelihood of inundation of more than 1% and 0.2%, the areal extent of this information, and sources of flooding for each area
- **Gap Analysis** – Prepare a map showing gaps in inundation boundary mapping and identify known flood-prone areas based on location of hydrologic features, historic flooding and/ or local knowledge

2.1.1.1 Data Collection

Data was collected to obtain best available flood inundation boundaries and to obtain information on additional known flood prone areas. This information is used to determine the existing flood hazard.

Flood Inundation Boundaries

The Texas Water Development Board (TWDB) provided the floodplain quilt, which consists of multiple layers of data from various sources available throughout the state to "quilt" together a single flood hazard dataset. The floodplain quilt does not typically include localized flooding or complex urban flooding problems. Additionally, the Nueces Regional Water Planning Group (NRFPG) obtained inundation boundaries from various entities in the basin and identified known flood-prone areas from stakeholder and public comments.

Additional Known Flood-Prone Areas

Additional known flood-prone areas were determined from historical flood data, local knowledge, and from low water crossing data.

Historical Flood Data

The NRFPG compiled historical flood data from United Stated Geologic Survey (USGS) gage records, National Weather Service (NWS) flood data, publications on historical flood events, and Federal Emergency Management Agency (FEMA) flood damages. This data includes information on past property damage, fatalities, and injuries because of flooding. This information is presented in Appendix C1 – Historic Flood Event Data.

Local Knowledge

Four subregional meetings (one for each subregion) were held May 17 through May 20, 2021, to introduce the regional flood planning process and gather local knowledge of flood-prone areas, flood mitigation projects, and needs. The NRFPG received information on 44 flood-prone areas from these initial meetings. Additionally, an interactive on-line public comment map was posted on the Nueces River Authority's Region 13 website (Home – Nueces Regional Flood Planning Group (Region 13) (https:/www.nueces-rfpg.org)) to allow stakeholders and citizens the opportunity to identify flood-prone areas for consideration in the regional flood plan (RFP).

The NRFPG presented available flood hazard data from the "floodplain quilt", local knowledge, and historical flood data to the public at the June 28, 2021 RFPG meeting. The purpose of this public meeting was to identify additional flood hazards that may have not been identified in the initial maps. Additional flood prone areas were received via the interactive geographic information systems (GIS) map and added to the flood hazard data. The interactive map comment period was open from April through September 2021 and gathered an additional 143 comments on flood-prone areas, which when combined with the initial May 2021 roadshows increased the known flood-prone area total to 187.

Additional outreach was performed in February, March, and April of 2022. Three subregional meetings were held: Mid-basin meeting on March 8 in Cotulla, upper basin on March 21 in Leakey, and Lower basin on March 22 in Sinton. Overall, nine counties, eight cities, one drainage district, the National Weather Service, USGS, and Texas A&M University attended. At the regional meetings, the NRFPG presented the latest updates of the development of the RFP and recorded stakeholders' highest flood-related needs. The NRFPG also sent out an interview request to all entities with flood-related authority in February of 2022 to gain further information on highest flood-related needs, high flood risk areas, and ongoing and potential flood-related projects and studies. Through this effort, 20 interviews with various communities were conducted. Stakeholders' input at the regional meetings and interviews were recorded in detail, discussed afterwards, and incorporated into the RFP. As a result of the additional outreach, the total number of obtained flood-prone points grew by 87 to total 274. The flood-prone points are shown for the entire basin in Figure 2-2 and can be seen in detail on a county level in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions County Maps.

Low Water Crossings

Low water crossings (LWCs) are considered potential flood-prone areas due to their inherent life-loss risk during flood conditions. A total of 576 LWCs were identified within the basin (See Section 1.11 for more information on how LWCs were defined and identified). Note this is not an exhaustive list of all known LWCs. For this first planning cycle, the community feedback on flood-prone points is used to identify any additional flood-prone and hazardous LWCs. LWC locations are shown later in the Flood Hazard Map section (Section 2.1.2.4) and associated Figure 2-9 through Figure 2-12. These are also viewable in the county flood hazard maps in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions.

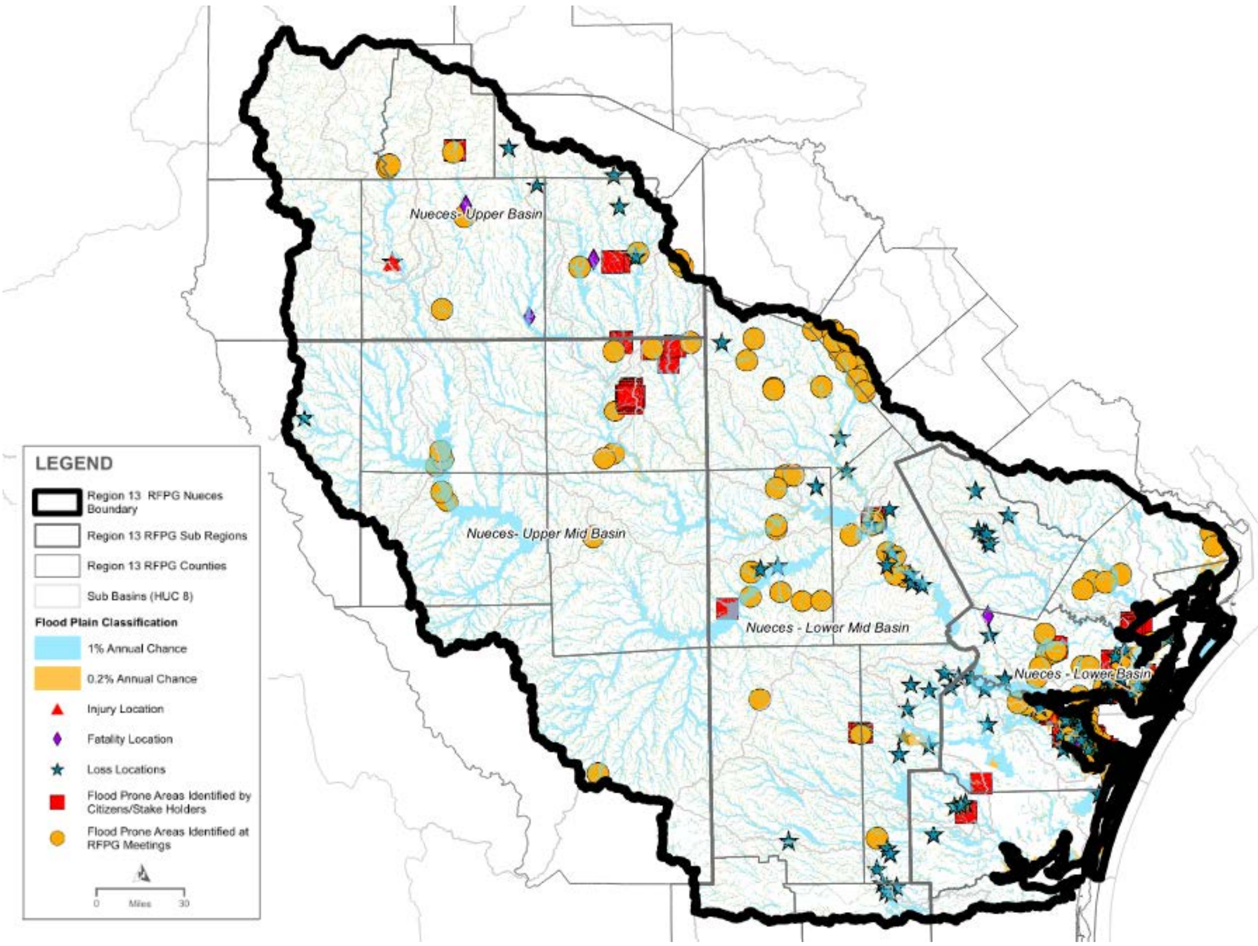

Figure 2-2. Additional Known Flood-Prone Areas

2.1.1.2 Availability of Detailed Model Results

The location of existing available hydrologic and hydraulic model results for mapping are shown for the Nueces Basin in Figure 2-3. Only the National Flood Hazard Layer (NFHL) preliminary and effective data are considered flood mapping data available on a regional scale and based on detailed hydrologic and hydraulic models. The availability of detailed hydrologic and hydraulic models is depicted in Figure 2-4. The remainder of the basin, minus several localized detailed models, are considered approximate model results, which means the models were developed using efficient means for large areas and lack detailed information and development. For example, approximate models may not consider features like roadways that alter flow patterns and may not fully represent natural features like small tributaries and water bodies. Approximate model results include Base Level Engineering (BLE), First American Flood Data Services (FAFDS), Cursory Floodplain Data, and NFHL approximate sources. Most of the basin is based on approximate data. BLE modeling and mapping is projected to be completed for all watersheds in the Nueces basin by the end of Fiscal Year 2023 per TWDB's BLE status viewer.

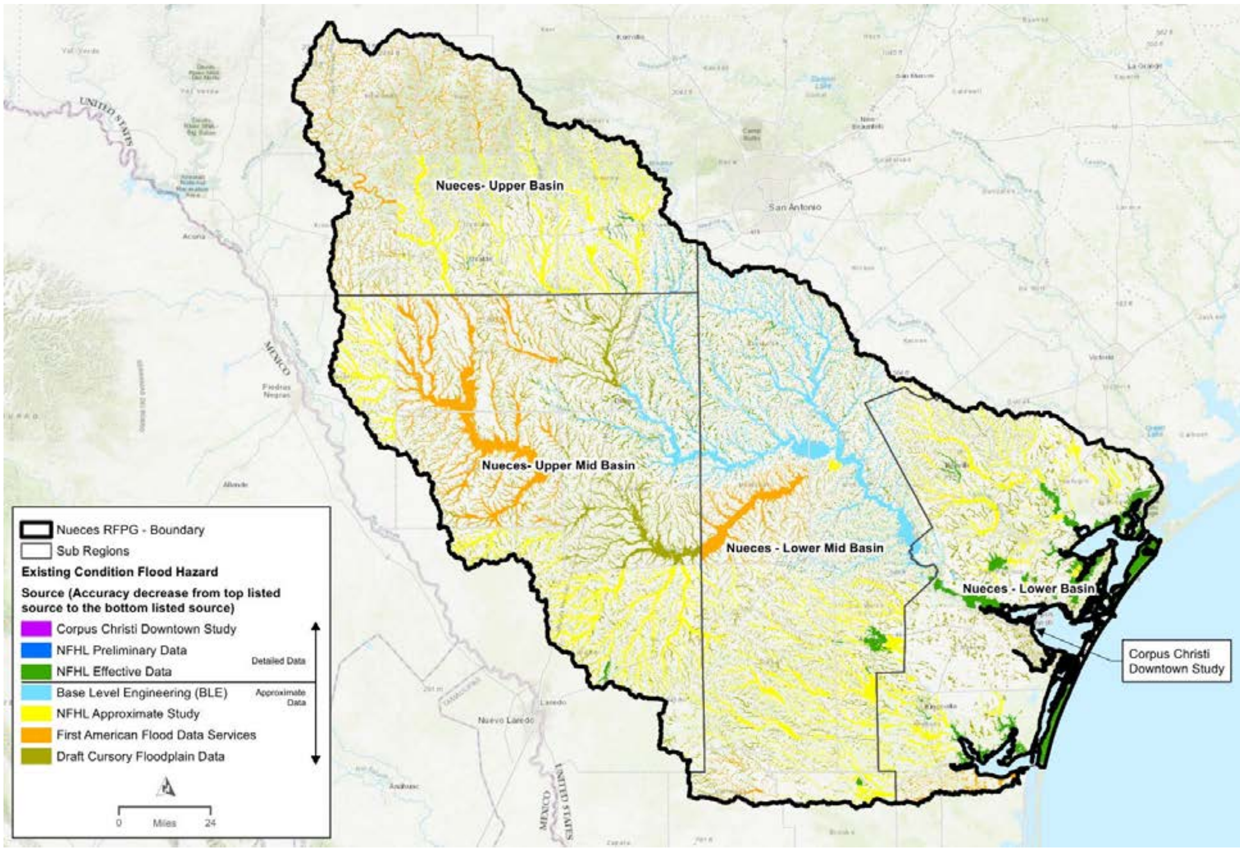

Figure 2-3. Source of Flood Modeling and Mapping Data (Map 5A)

List of Detailed Models

The list of detailed models with brief descriptions are provided below:

NFHL Pending – This data is comprised of the most recent detailed and approximate studies and are pending release as an Effective FIRM.

NFHL Preliminary – This data maps the 1% and 0.2% annual chance storm events and has been issued for public review and awareness of proposed change. Preliminary models available for Nueces County.

NFHL Effective Models (Detailed Study Areas only) – This data has flood hazard information that includes detailed studies (Flood Zones AE, AO, AH, and VE) and is the current effective FIRM. This data includes Letter of Map Revision (LOMR) information that was effective when obtained.

Corpus Christi Downtown Detailed Study Model – Two-dimensional (2D) hydraulic model of the seclusion area performed by HDR in 2016 for the salt flats levee system in downtown Corpus Christi.

Cotulla LOMR Model – Provides a detailed Hydrologic Engineering Center-River Analysis System (HEC-RAS) model used for a 2022 LOMR for the City of Cotulla.

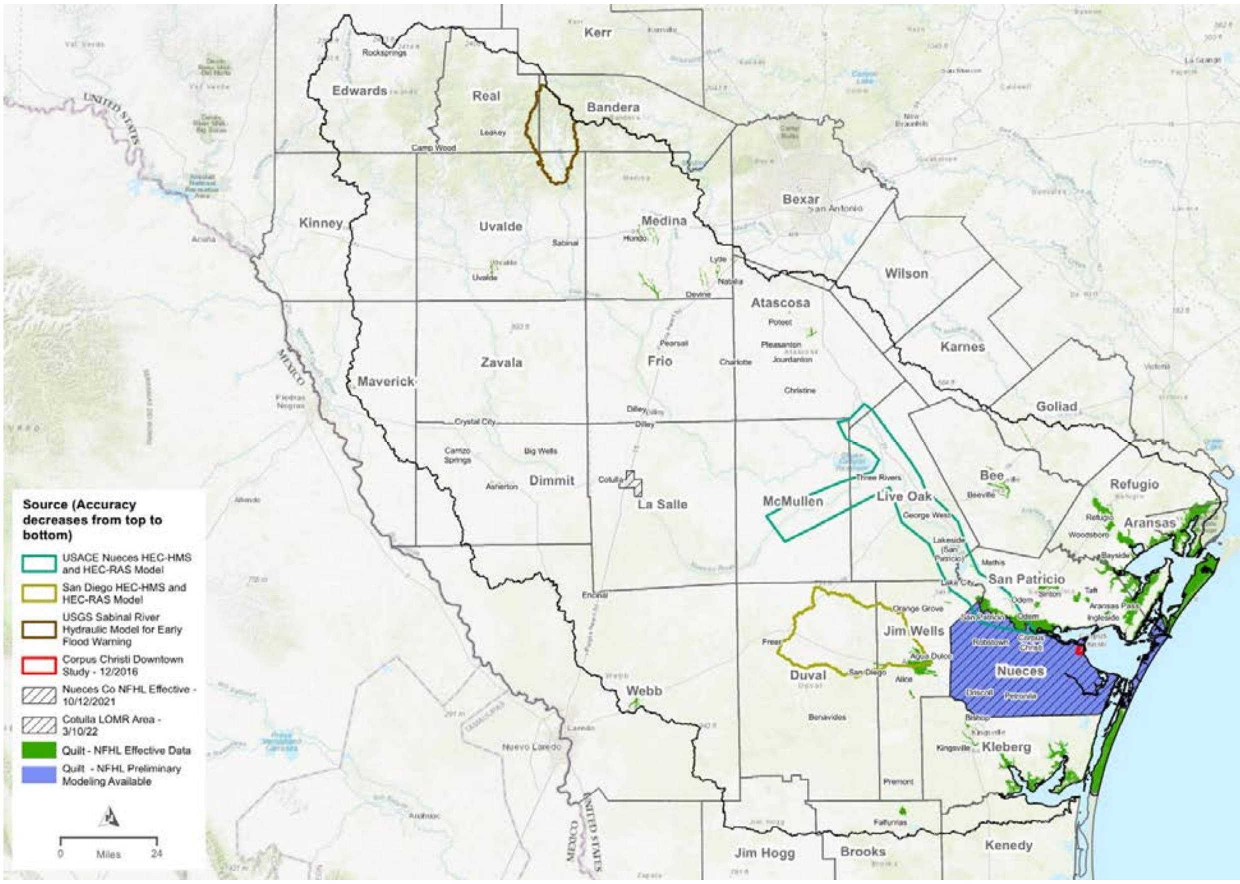

Figure 2-4. Detailed Hydrologic and Hydraulic Model Availability (Map 22)

List of Approximate Models

Base Level Engineering (BLE) – BLE is an efficient modeling and mapping approach that is considered an approximate study and meant to compliment the current effective Flood Insurance Rate Map (FIRM) where applicable. BLE results were provided in the TWDB floodplain quilt as shown in Figure 2-3. Recently, 2021 BLE model results were received for the Laguna Madre area with all watersheds in the Nueces basin scheduled for completion by the end of Fiscal Year 2023 per TWDB's BLE status viewer.

NFHL Effective Data (Approximate Study Areas only) – This data has flood hazard information that includes approximate studies (i.e. Flood Zone A) on the effective FIRM map.

FAFDS – This data contains digitized flood hazard information from previously published FIRMs and FISs and is not available on the NFHL. Available for portions of McMullen, Dimmit, Zavala, and Frio counties.

Draft Cursory Floodplain Data – Draft Cursory Floodplain Data was provided in July of 2021 for the 1% annual chance flood event. The Draft Cursory Floodplain Data was based on a 30-meter digital elevation model (DEM). This data was used for areas with no other floodplain information.

Cursory Floodplain Data – The Cursory Floodplain Data was provided in December of 2021 and provides 1% and 0.2% annual chance flood inundation boundaries. This model is based on Atlas 14 rainfall data and available laser altimeter datasets (Lidar) to produce a 3-meter ground surface grid for final mapping. Due to large processing requirements and timing of the draft 2023 RFP schedule, the Cursory Floodplain Data was not incorporated into the 2023 Region 13- Nueces RFP. Cursory Floodplain Data is intended for use for areas with no available flood mapping data until the BLE data becomes available.

Other Available Detailed Hydrologic and Hydraulic Models in the Nueces not used for Mapping

U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) 4.2 model – This hydrologic model encompasses the entire Nueces basin and is part of the Corps Water Management System (CWMS) and is used to develop a real-time simulation (HEC-RTS [Hydrologic Engineering Center-Real Time Simulation]) for watershed stakeholders. The model includes 102 sub-basins, 84 stream routings, 84 junctions, 36 calibration gages and two reservoirs (Choke Canyon and Lake Corpus Christi). Calibration/validation events include July 2002 and June/July 2007 and October 2018. This model, the extent of which is shown in Figure 2-5, is currently under development.

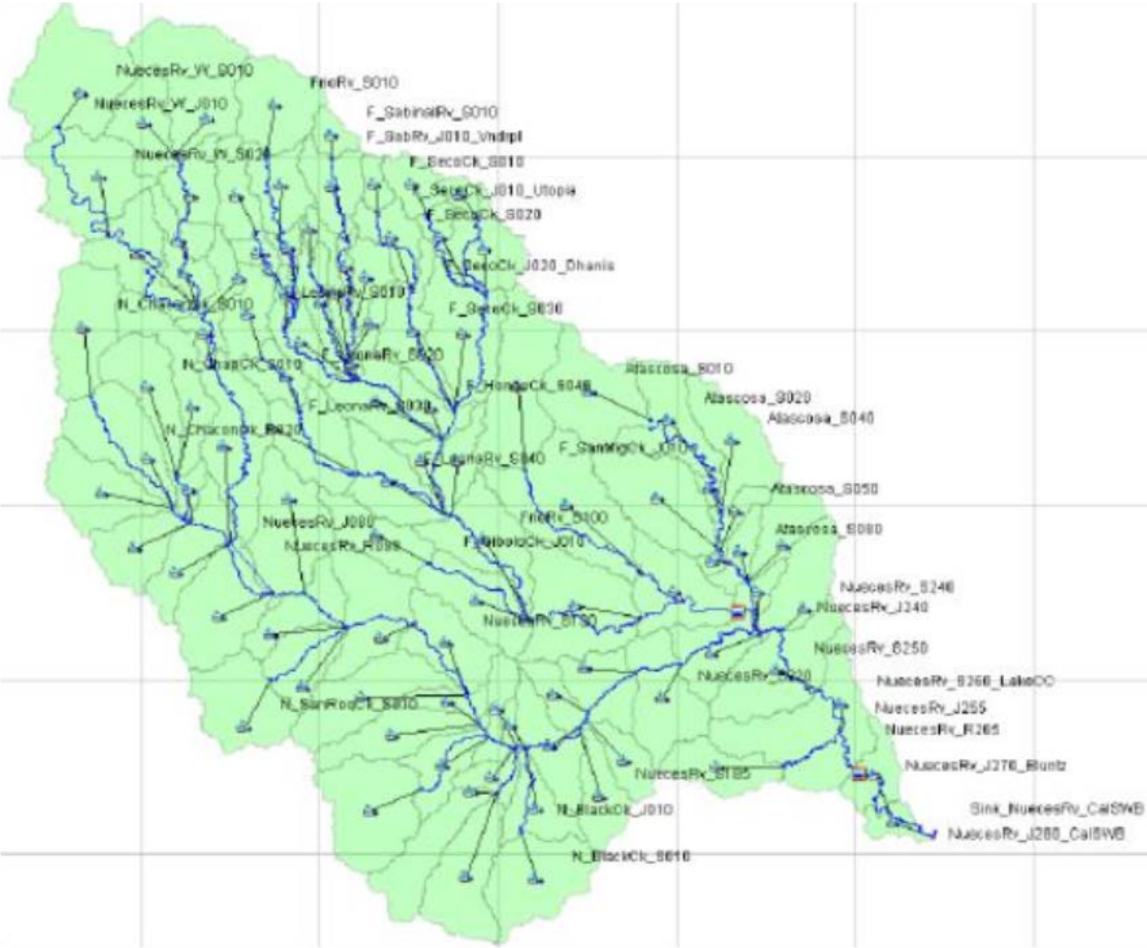

Figure 2-5. USACE HEC-HMS Model Extents (Source: USACE, 2021)

USACE's Nueces River HEC-RAS 5.0.6 Model – This model is also a part of the USACE CWMS for Nueces River and consists of a 1D steady/unsteady model, which includes portions of Atascosa River, Frio River downstream of Choke Canyon, and Nueces River from Tilden down to Odem (between Lake Corpus Christi and Corpus Christi Bay). This model was not used to map the 1% or 0.2% annual chance flood inundation boundaries. This model, the extent of which is shown in Figure 2-4 and Figure 2-6, is currently under development.

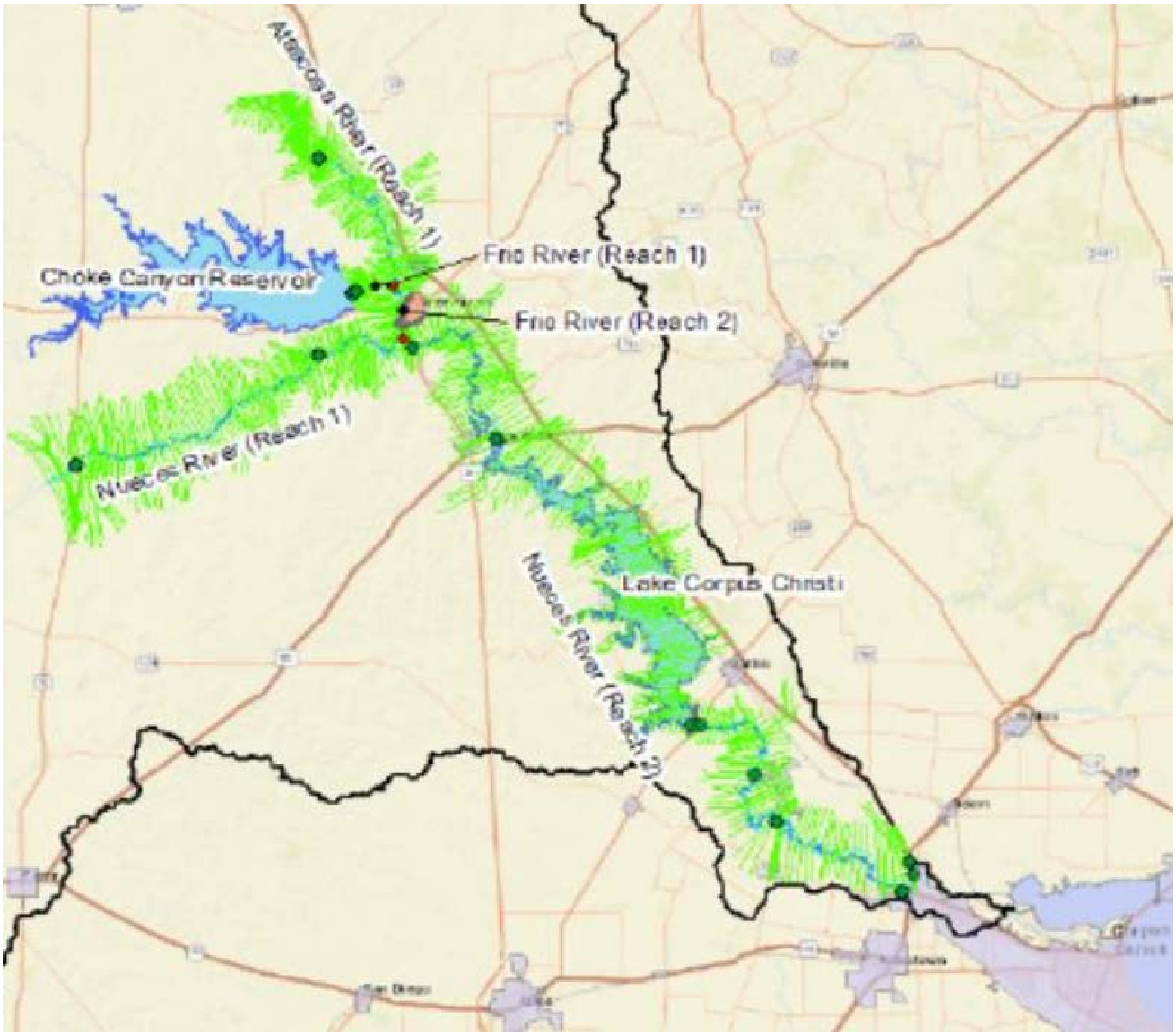

Figure 2-6. USACE Nueces HEC-RAS Model Extents (Source: USACE, 2021)

USACE San Diego HEC-HMS and HEC-RAS models – These models include the main stem of San Diego Creek, in Duval and Jim Wells Counties near Alice, San Diego, and Freer. San Diego Creek, Amargosa Creek, Chiltipin Creek, Muerto Creek, Res de Enmedio, Rosita Creek, San Fernando Creek, Toro Creek, and Lake Alice are modeled. This model was not used to map the 1% or 0.2% annual chance flood inundation boundaries. This model, the extent of which is shown in Figure 2-4 and Figure 2-7, is currently under development.

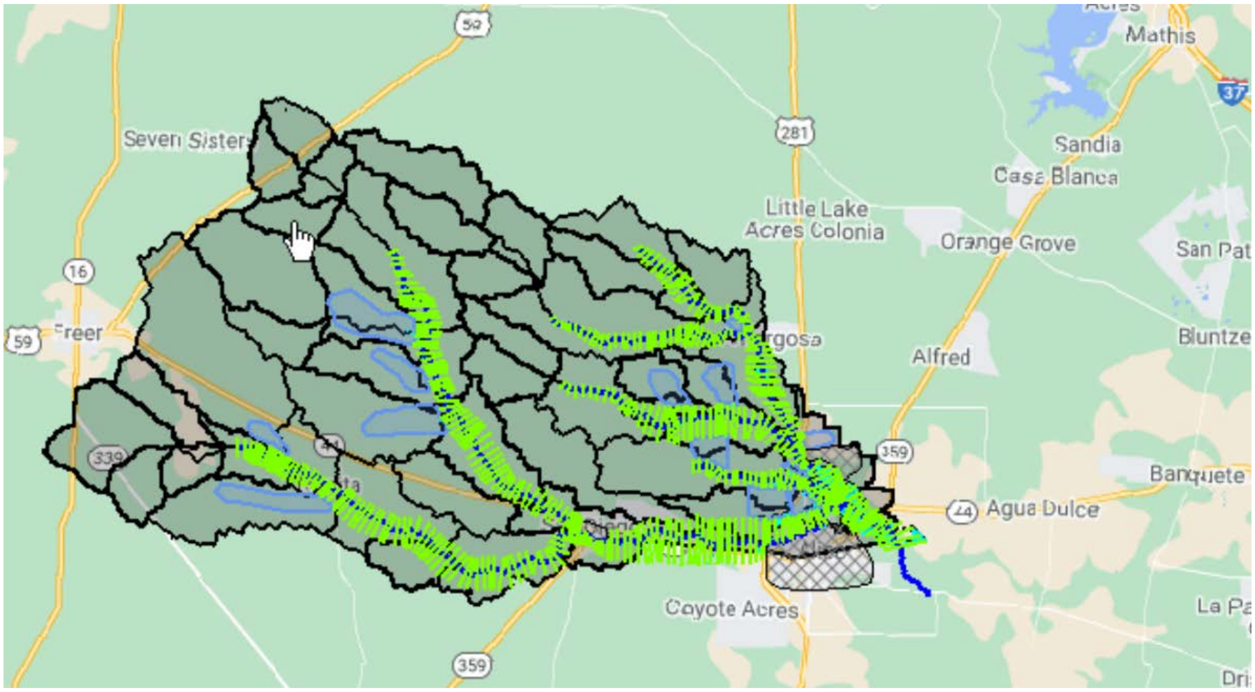

Figure 2-7. USACE San Diego Model Extents (Source USACE, 2021)

USGS Sabinal Flood Warning Model – This model is being developed for the purposes of flood warning and was not used to map the 1% and 0.2% flood inundation boundary. This model, the extent of which is shown in Figure 2-4 and Figure 2-8, is currently under development.

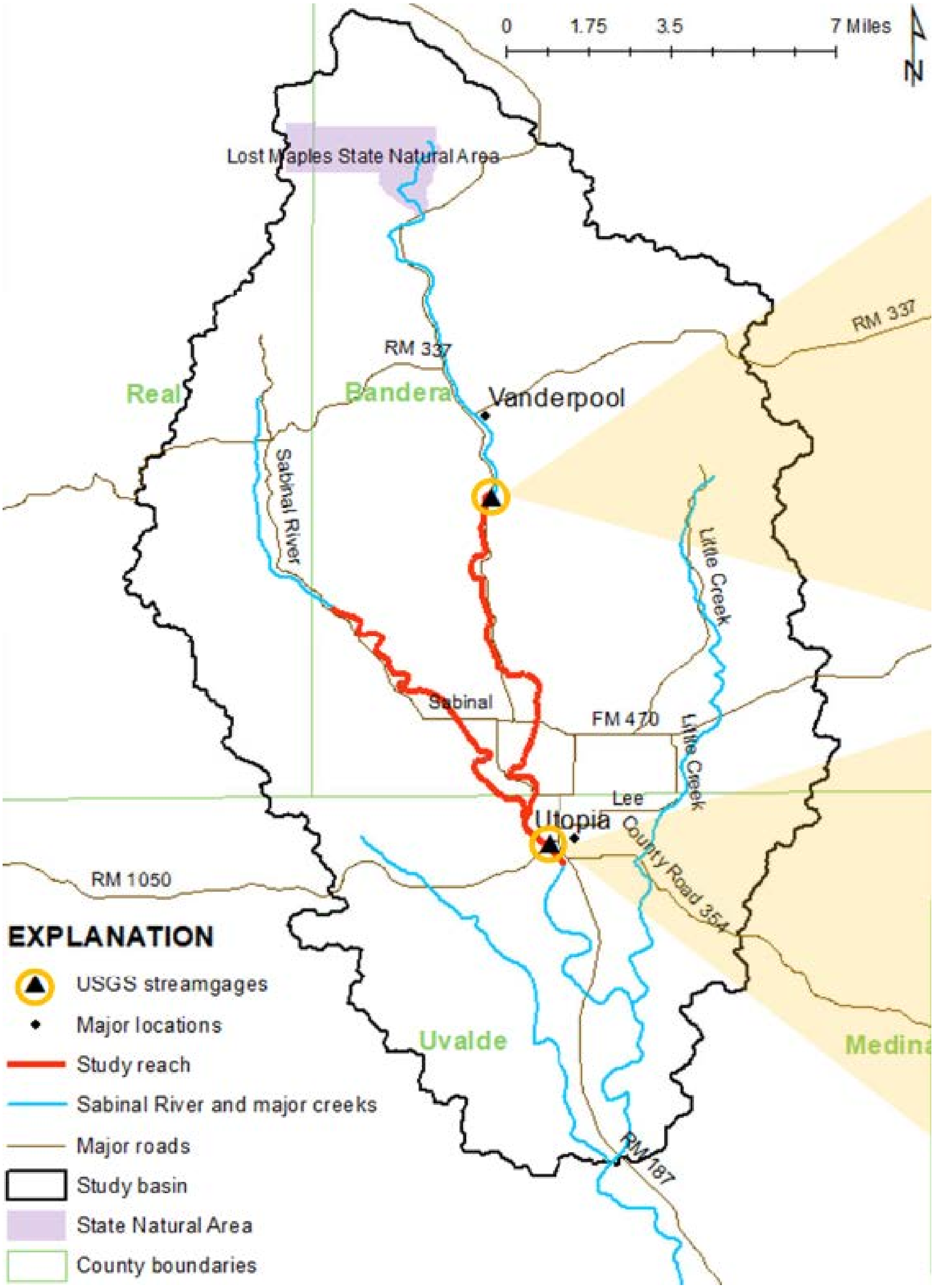

Figure 2-8. Sabinal Model Extents (Source USGS)

2.1.1.3 Best Available Data

The quality of available modeling and mapping data was assessed based on its date and level of detail in development. More detailed floodplain coverages supersede less detailed floodplain coverages for the same location. The best available information was used in the plan to define the extents of the 1% and 0.2% annual chance flood event boundaries. The following list shows the various flood inundation data sets used in order of highest to lowest accuracy.

Detailed Data Sets

1. Inundation boundaries produced by governmental entities through detailed modeling
    a. Corpus Christi Downtown Study
    b. Cotulla LOMR (to be added in the Revised 2023 Region 13- Nueces RFP)
2. NFHL Effective and Preliminary Data

Approximate Data Sets

3. BLE
4. NFHL Approximate Study Areas
5. FAFDS
6. Cursory Floodplain Data
7. Draft Cursory Floodplain Data
8. Additional Known Flood Prone Areas

More recent and accurate Cursory Floodplain Data has been received but not implemented into the inundation boundaries at this time due to their large data processing requirements and the timing of this initial plan. The new Cursory Floodplain Data has 30-meter modeling and 3-meter mapping accuracy and uses Atlas 14 rainfall data. Complete BLE coverage of the basin is anticipated by the end of 2023, which will provide higher accuracy floodplain coverage than other available approximate data sets.

2.1.1.4 Flood Hazard Maps

Areal Extent of 1% and 0.2% Annual Likelihood of Inundation

The 1% and 0.2% annual chance flood inundation boundaries were defined for all waterways with contributing drainage areas larger than 1 square mile for the entire basin. This complete coverage was due in part to the availability of Draft Cursory Floodplain Data flood inundation boundaries for the entire basin. The most accurate inundation boundaries were applied when multiple inundation data sets were available.

A large portion of the regional flood planning area contains approximately 1% annual chance flood inundation boundaries but no 0.2% annual chance flood inundation boundaries (i.e., NFHL approximate study areas or lower accuracy data). Thus, for these areas, the 0.2% annual chance flood inundation boundary had to be estimated for approximate areas by buffering the 1% annual chance inundation boundary by 100 feet to each side. This 100-foot buffer was approximated by evaluating portions of the region that had available detailed studies that defined both the 1% and 0.2% annual chance flood inundation boundary using a similar offset between the 1% and 0.2% annual chance flood inundation boundary.

The existing condition 1% and 0.2% annual chance flood inundation boundaries are provided in the geodatabase (i.e., ExFldHazard) and shown in Figure 2-9 through Figure 2-12 and on a county level basis in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions County Maps.

Source of Flooding

The source or type of flooding can be riverine; pluvial, including urban flooding; or coastal flooding. The various sources of flooding are further defined below. Riverine and pluvial flooding are the primary sources of the 1% and 0.2% inundation boundaries shown in the flood hazard maps, except for flood hazard areas located along the coastline subject to storm surge inundation. Flood hazard areas identified as flood prone were identified from local knowledge of flood prone areas and typically are representative of pluvial or urban flooding. The type of flooding for the 1% annual chance floodplain are shown in xx for the various subregions.

- Riverine Flooding – This type of flooding is caused by bank overtopping when the flow capacity of rivers and streams is exceeded locally. The rising water levels generally originate from high-intensity rainfall creating soil saturation and large volumes of runoff either locally and/or in upstream watershed areas.
- Pluvial Flooding including Urban Flooding – Pluvial flooding occurs when heavy rainfall collects on the landscape. Urban flooding is caused when the inflow of stormwater in urban areas exceeds the capacity of drainage systems to infiltrate stormwater into the soil or to carry it away.
- Coastal Flooding – This type of flooding occurs when normally dry, low-lying land is flooded by seawater.

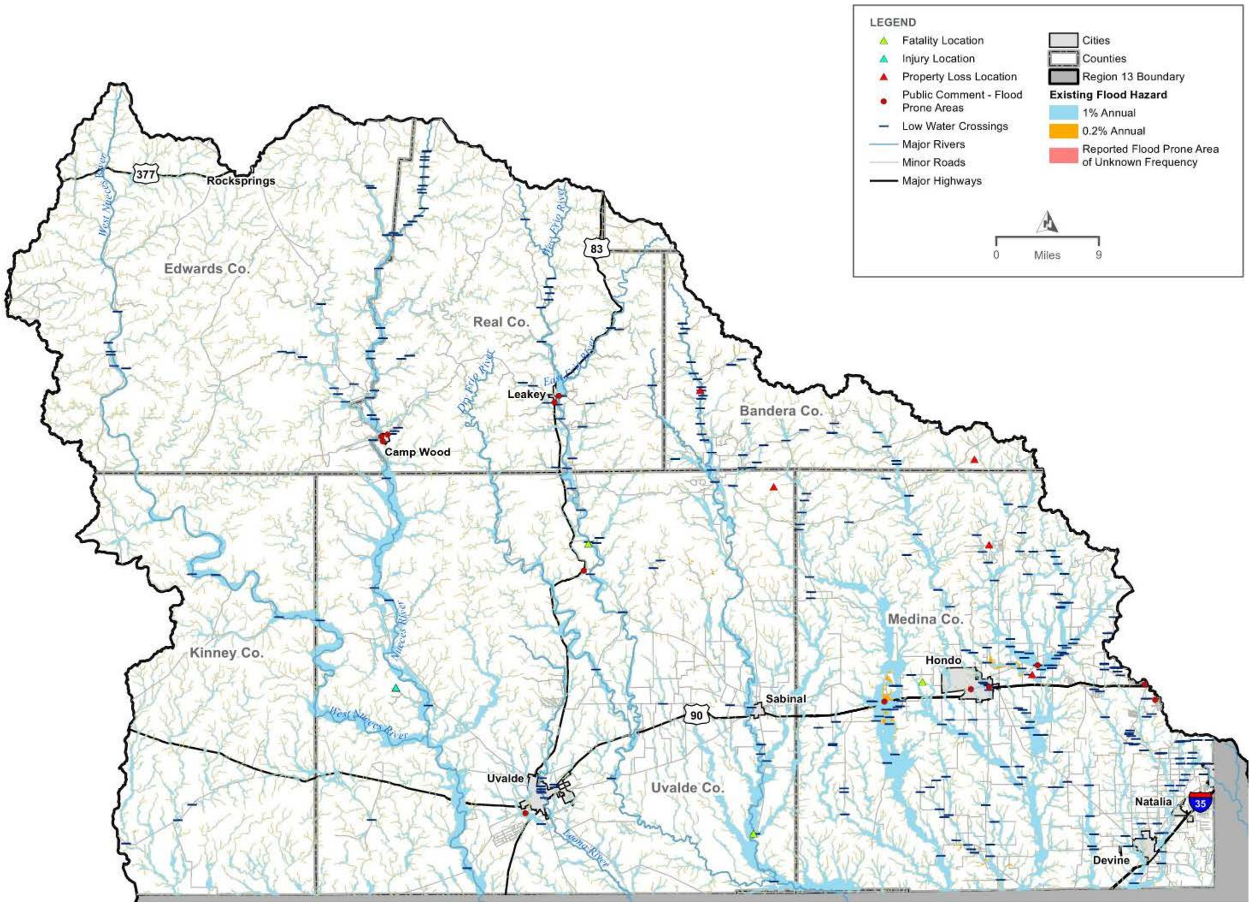

Figure 2-9. Flood Hazard Areas and Source of Flooding in the Upper Nueces Basin (Map 4A)

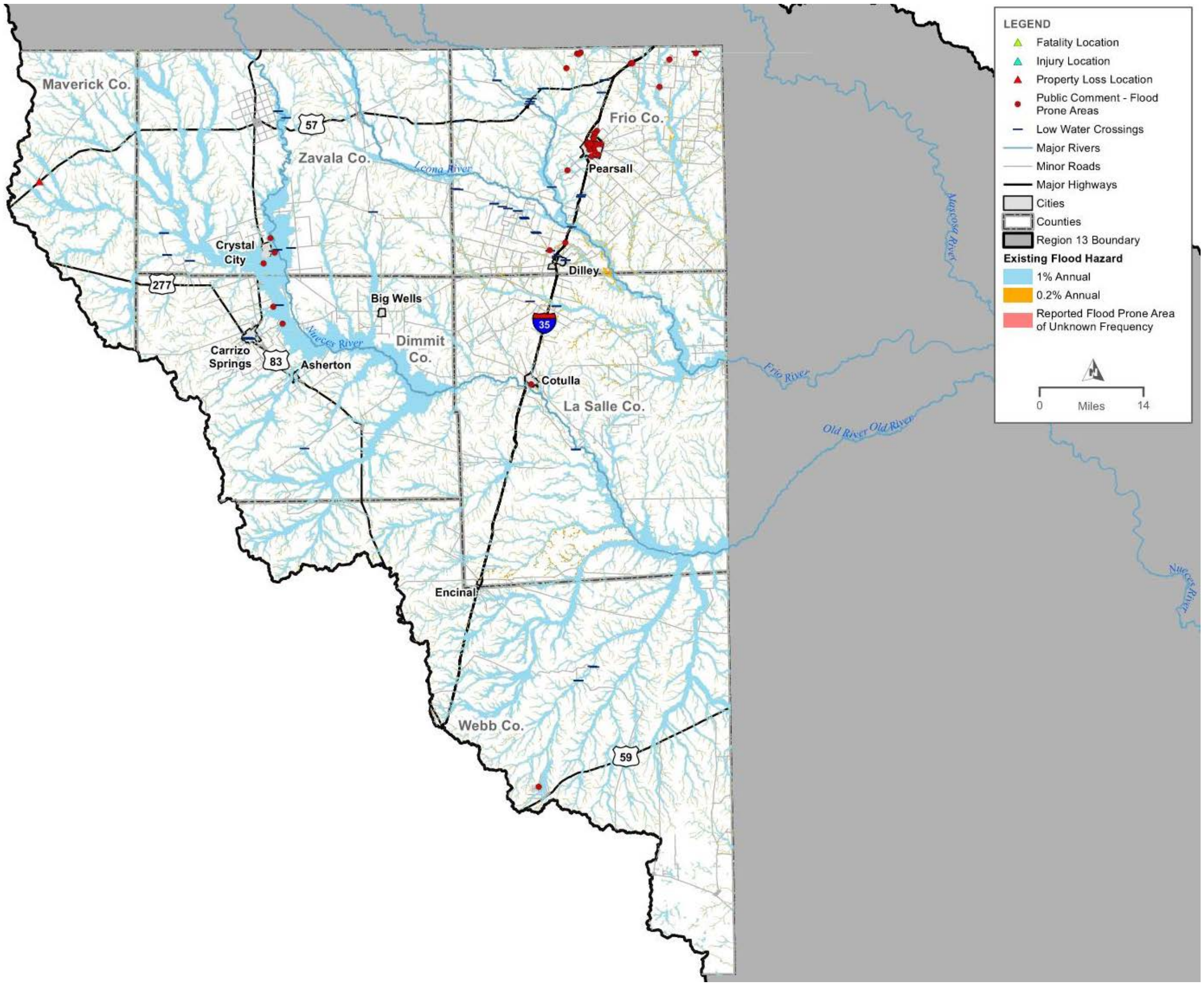

Figure 2-10. Flood-Hazard Areas and Source of Flooding in the Upper Mid-Nueces Basin (Map 4B)

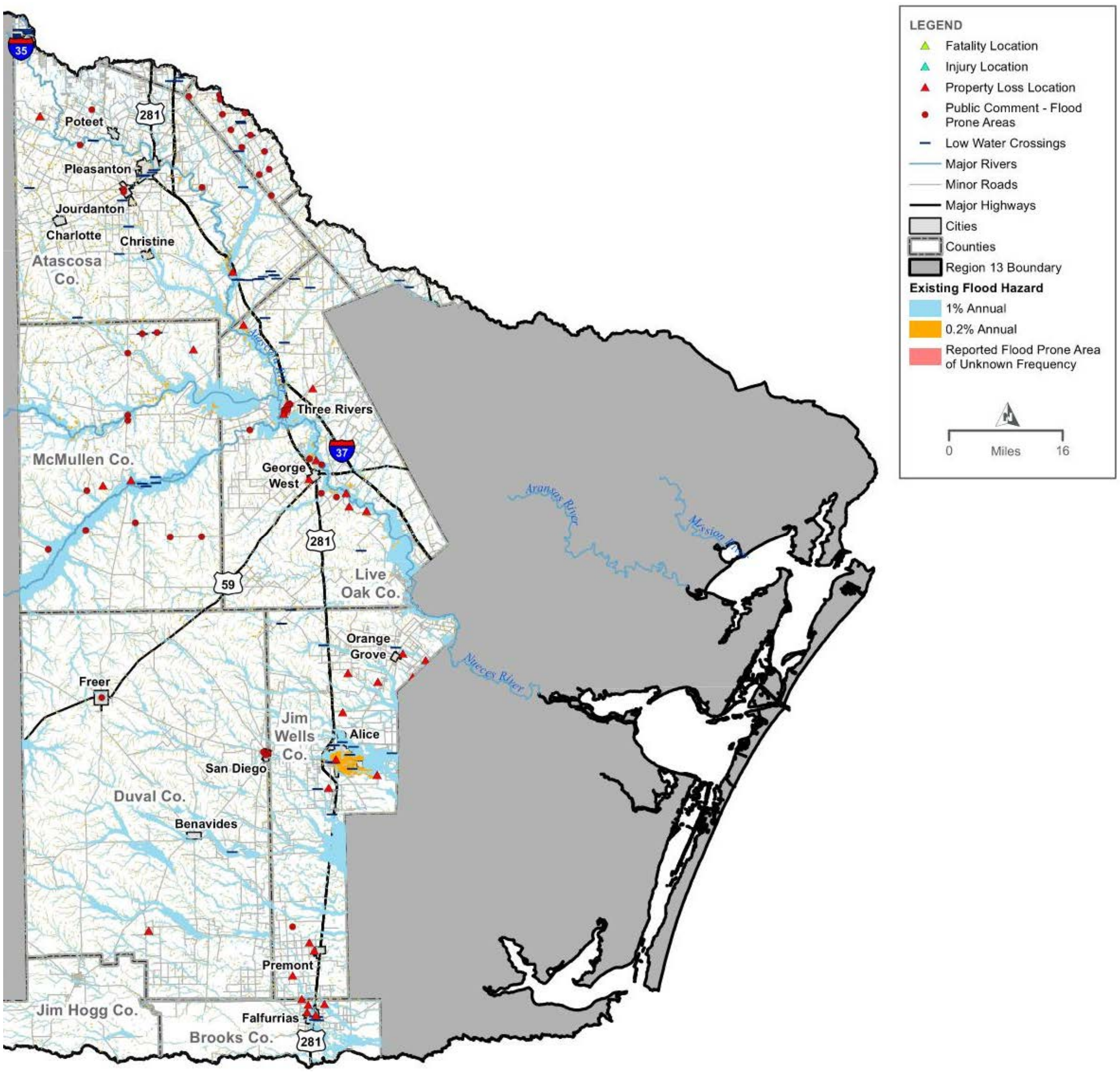

Figure 2-11. Flood Hazard Areas and Source of Flooding in the Lower Mid-Nueces Basin (Map 4C)

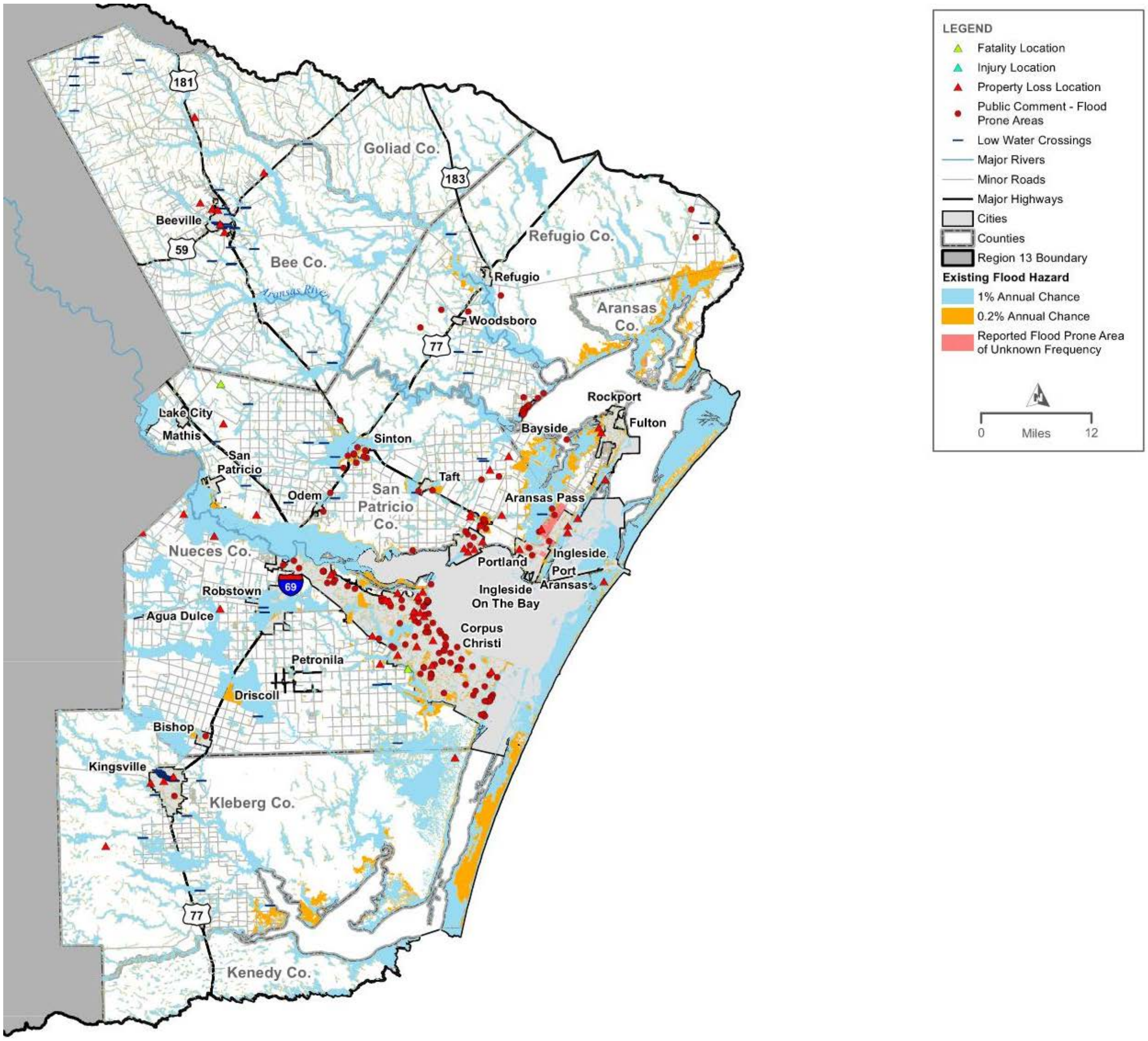

Figure 2-12. Flood Hazard Areas and Source of Flooding in the Lower Nueces Basin (Map 4D)

2.1.1.5 Gap Analysis

The map in Figure 2-13 shows remaining gaps in flood risk inundation boundary mapping relative to identified known flood-prone areas based on the location of hydrologic features, historic flooding, and/or local knowledge for areas that lack modeling and mapping. The map identifies areas with clearly outdated modeling and/or mapping, the absence of modeling and/or mapping, and areas with modeling and/or mapping that require updates. Areas that require updates include areas with significant rainfall frequency data changes. The gap analysis reviews conflicting or overlapping datasets to determine which is considered “best available” for each area within the region. The gaps can be used to recommend potential FMEs.

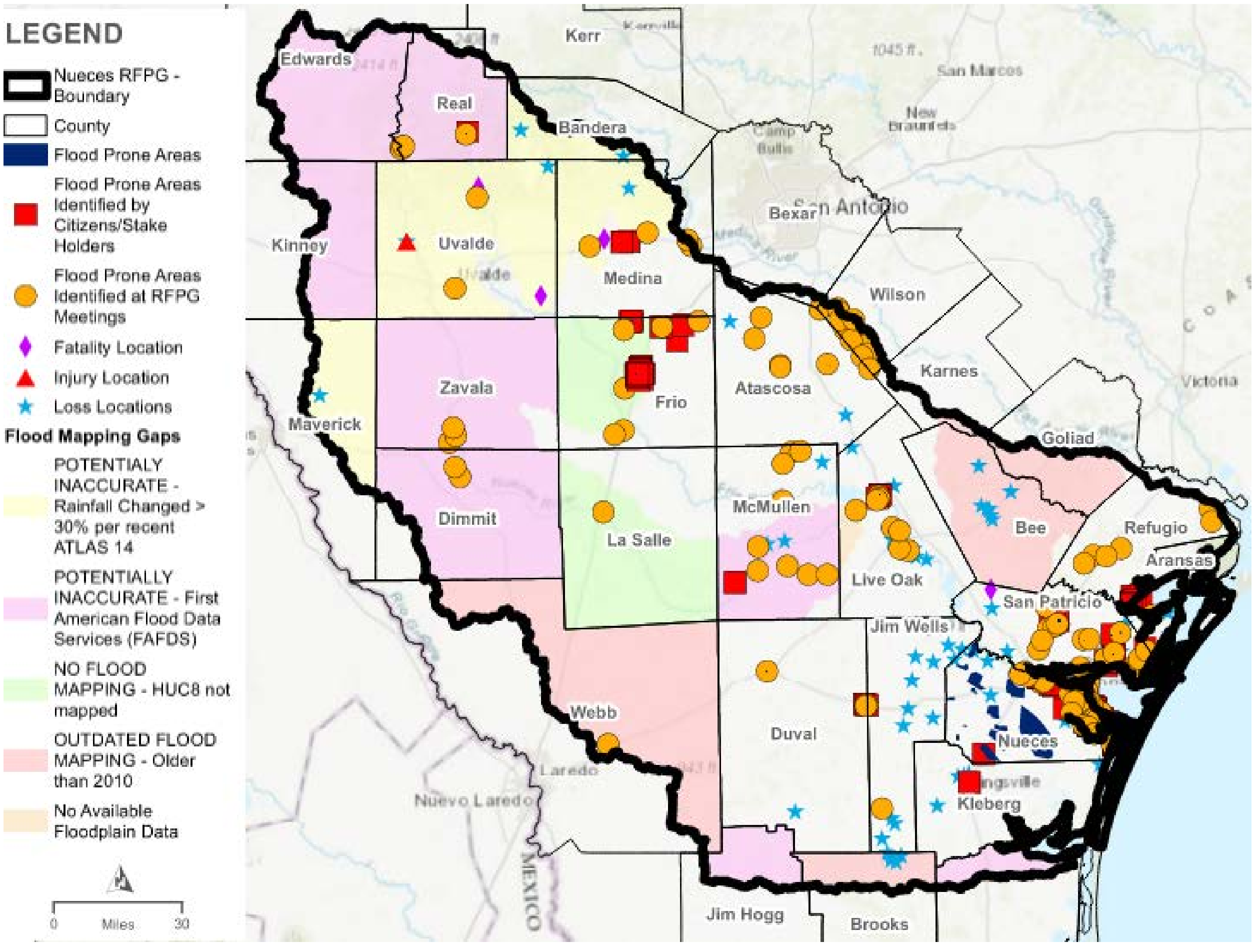

Figure 2-13. Inundation Boundary Gaps and Known Flood Prone Areas (Map 5C)

The following counties, as shown in Figure 2-13, have been identified as having no flood inundation maps available for at least a portion of the counties:

- La Salle
- Frio

The following counties, as shown in Figure 2-13, have been identified as having potentially inaccurate maps due to outdated mapping (includes FAFDS mapping):

- Mapping occurring prior to the year 2000.
  - Edwards
  - Real
  - Kinney
  - Zavala
  - Dimmit
  - McMullen
  - Jim Hogg
  - Kenedy
- Mapping occurring prior to the year 2010.

- Webb
- Brook
- Bee

The following counties, as shown in Figure 2-13 and Figure 2-14, have been identified as having potentially inaccurate maps due to new rainfall data published in 2018, which increased rainfall by more than 30%.

- Maverick
- Kinney
- Edwards
- Real
- Uvalde
- Bandera
- Medina

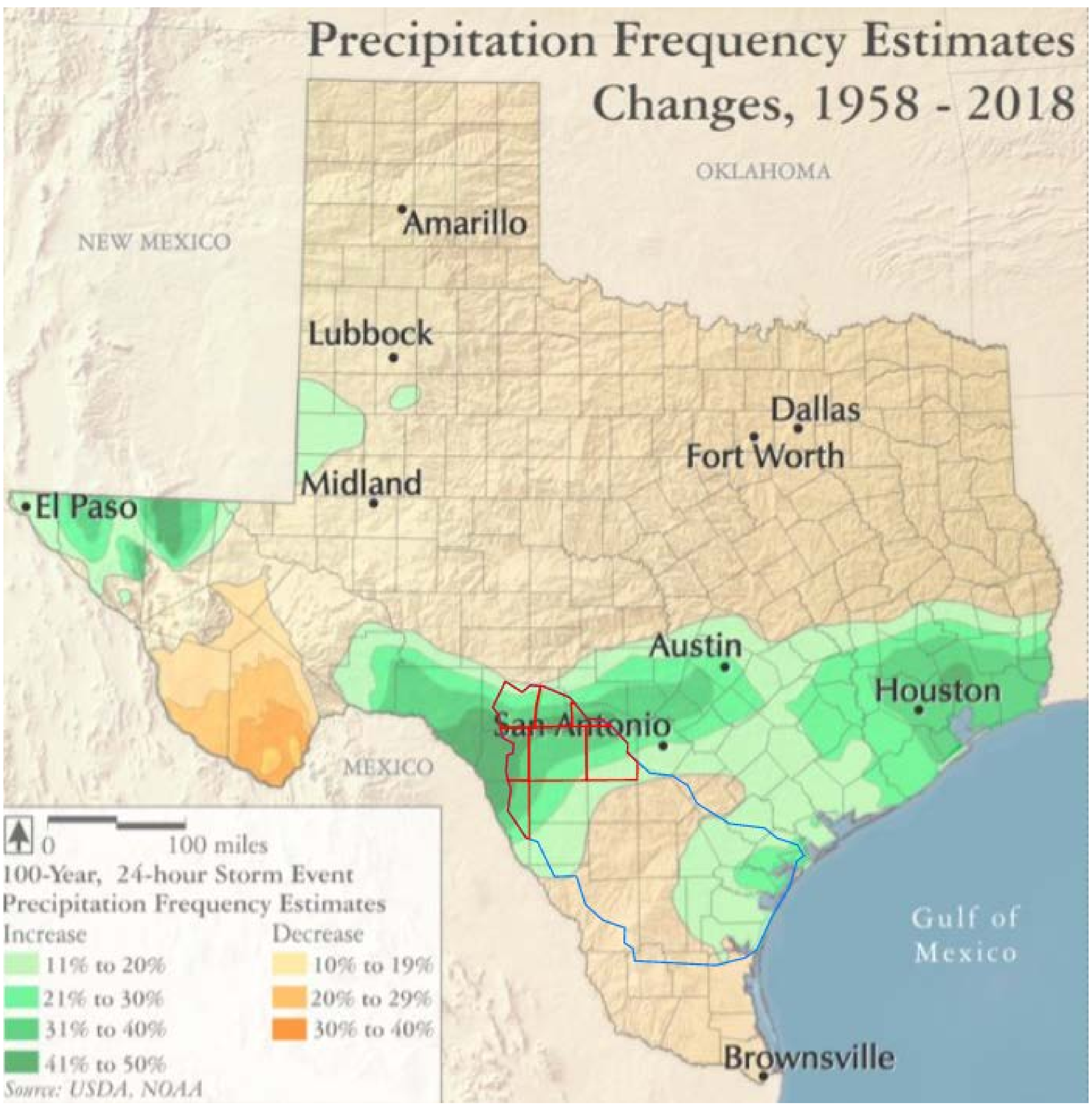

Figure 2-14. Percent Change of Precipitation Frequency Estimates (USDA, NOAA)

2.1.1.6 Existing Condition – Total Land Area at Flood Risk

This flood hazard analysis summarizes total area and agricultural area within the 1% and 0.2% annual chance flood risk, which is summarized by county in Appendix A3 – TWDB Table 3 – Existing Condition Flood Risk Summary Table. Total land area within the Nueces Flood Planning region at risk of 1% annual chance flood inundation is summarized by county and flood risk type (riverine, pluvial, and coastal) in Figure 2-15. In total, 4,578 square miles of land (19.0% of all land in the basin) is at risk of 1% annual chance flood inundation, with 71% of the inundation occurring as the result of riverine flooding. An additional 1,287 square miles is at risk of 0.2% annual chance flood inundation. The total land at risk of 1% or 0.2% annual chance flood inundation is 5,865 square miles (24.3% of all land in the basin).

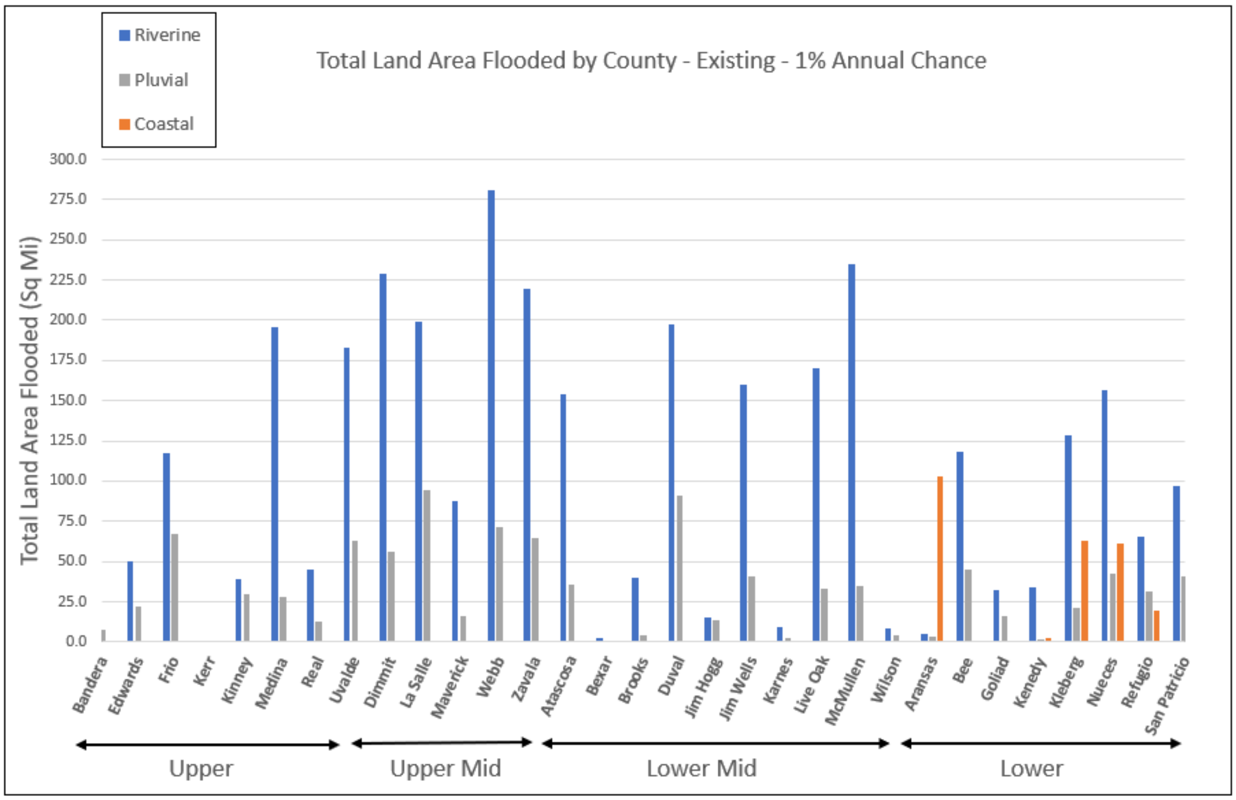

Figure 2-15. Total Land Area at Flood Risk of 1% annual chance storm by Type, County – Existing Condition

2.1.2 Existing Flood Exposure Analyses

2.1.2.1 Analysis of Existing Development within Existing Flood Hazard

The existing flood exposure analyses is a high-level, region-wide, GIS-based analyses to identify who and what might be harmed by flooding. This includes identifying all structures located within both the 1% and 0.2% annual chance flood event and possible flood prone area boundaries, as defined in the existing flood hazard analysis in Section 2.1.1.

The existing condition flood exposure analysis indicated roughly 61,000 structures and a population of 137,000 at potential risk of flooding from the 1% annual chance flood event. This grows to 98,000 structures and a population of 223,000 at potential risk of flooding from the 0.2% annual chance flood event. A heat map was produced to illustrate where these structures are generally clustered in the Nueces Flood Planning Region, as shown in Figure 2-16. From this analysis, several hot spots for flood exposure appear to be:

(1) the City of Corpus Christi area, including Robstown

(2) the Rockport, Ingleside, and Port Aransas areas

(3) cities in the lower basin including Alice, Sinton, Kingsville, Falfurrias, and Beeville

(4) areas along the Nueces River from the City of Three Rivers to Corpus Christi

(5) cities in the upper basin, including Crystal City, Knippa, D’Hanis, Uvalde, Hondo, Pearsall, Devine, Sabinal, and Dilley

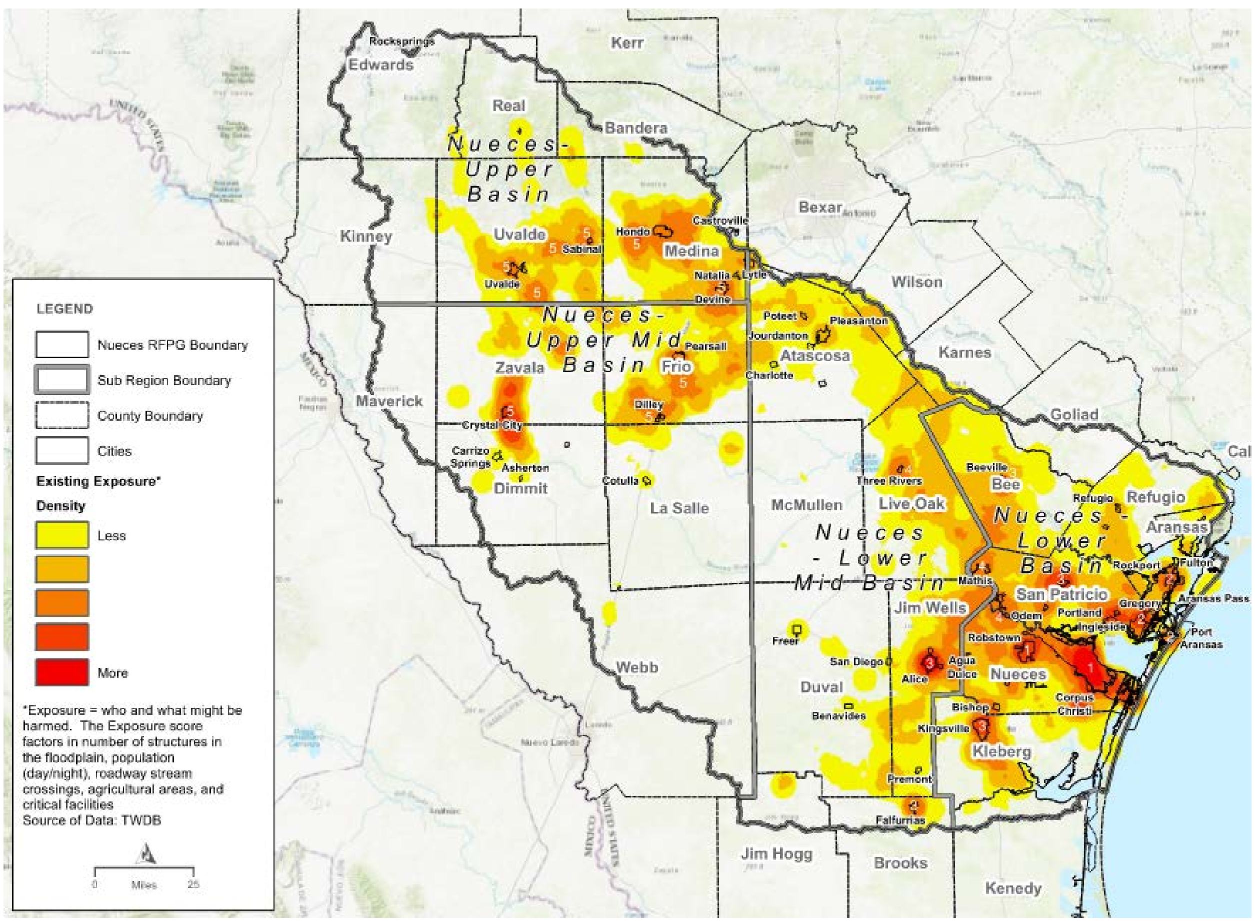

Figure 2-16. Existing Condition Exposure Analysis (Map 6)

2.1.2.2 Proposed Flood Mitigation Projects

This existing flood exposure analysis did not include any flood mitigation projects with dedicated construction funding and scheduled for completion prior to adoption of the next state flood plan.

2.1.2.3 Non-accredited Levees and Dams

This existing flood exposure analysis assumes existing levees or dams are in place and providing flood protection as shown in the best available flood hazard maps. This assumption was made due to data limitations associated with this being the first flood plan. Future flood plan updates should further consider non-accredited levees and dams in the exposure analysis.

2.1.2.4 Flood Exposure to Property, Population, and Infrastructure

See Appendix A3 – TWDB Table 3 – Existing Condition Flood Risk Summary Table, which provides on a county basis the number of structures, population, roadway stream crossings, roadway segments, agricultural areas, and critical facilities located in the 1%and 0.2% annual chance flood risk, and in the possible flood prone areas. The flood exposure analysis includes a determination of day and night population estimates that are located within the flood hazard areas with the higher of the day or night estimate used in estimating the population in the floodplain or flood-prone area.

2.1.2.5 Expected Loss of Function

The exposure analysis indicates that approximately 61,000 structures are at potential risk of flooding from a 1% annual chance storm event. Flooding of structures can cause temporary and/or permanent loss of use and can damage the structural elements through hydrostatic and hydrodynamic loads pushing against the building and its foundation. At a minimum flooded structures incur damage to building materials.

The exposure analysis indicates that approximately 3,200 miles of roadway and 5,400 roadway crossings are at risk of flooding from the 1% annual chance storm event. These roadways have the potential to be impassible for an extended period depending on the depth of flooding. Flooding of roadways can potentially leave populations stranded and inaccessible to emergency services during a time of distress.

2.1.3 Existing Vulnerability Analysis

The objective of this analysis is to identify critical infrastructure amongst the items identified in the existing condition flood exposure analysis and to compute Social Vulnerability Index (SVI) values for each structure identified during the flood exposure analysis. The SVI values were obtained from the U.S. Centers for Disease Control and Prevention (CDC), which calculates SVI using 15 U.S. census variables as shown in

Figure 2-17 to help local officials identify communities that may need support before, during, or after disasters (https://www.atsdr.cdc.gov/placeandhealth/svi/index.html).

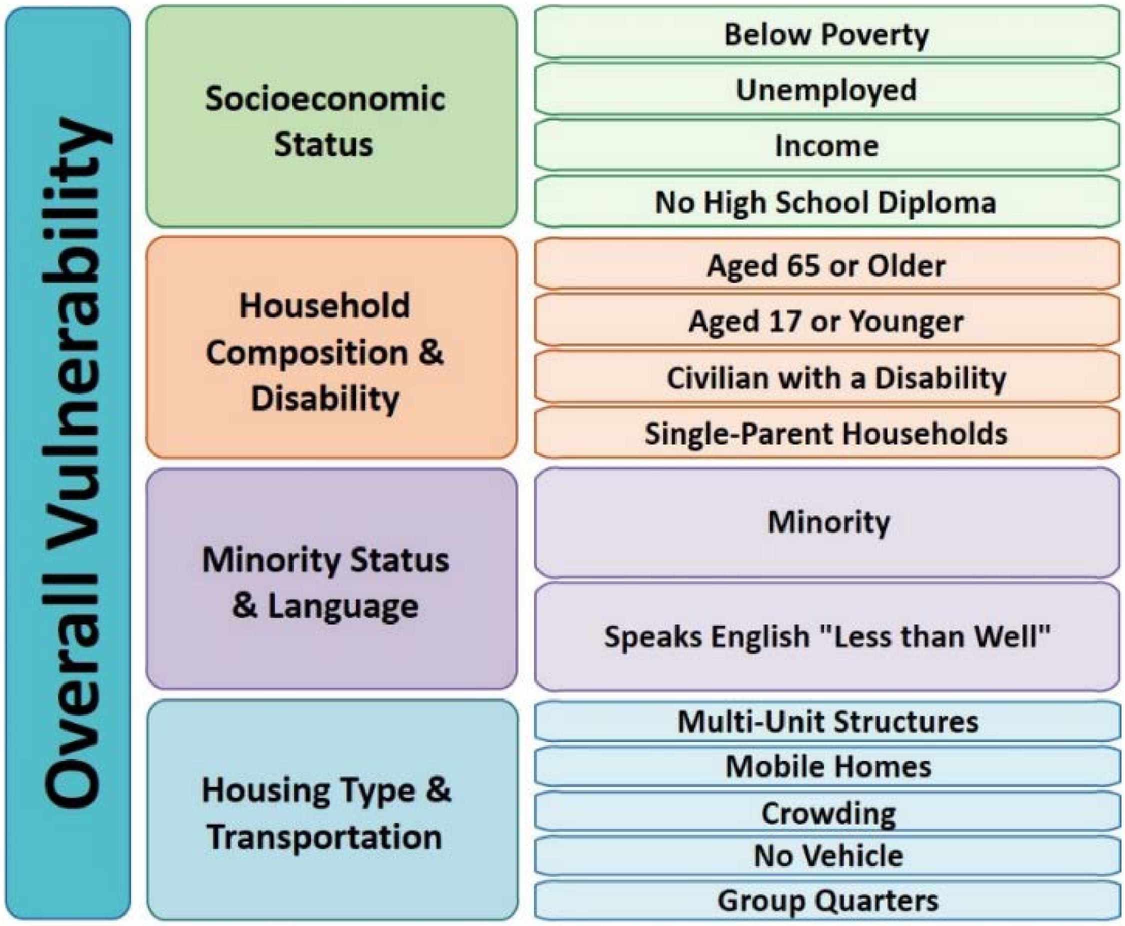

Figure 2-17. SVI Variables (CDC SVI 2018)

SVI is intended as the proxy for resilience for this planning cycle. The higher the SVI, the higher the vulnerability. The TWDB provided building data with SVI values for use in this analysis. An assigned SVI value over 0.75 for any given structure is consider vulnerable in this analysis.

2.1.3.1 Vulnerability of Critical Facilities

Critical infrastructure includes any schools (K-12), hospitals, police stations, and fire stations in the region. The flood vulnerability analysis identified approximately 445 critical facilities in the 1% annual chance flood inundation. Figure 2-18 shows the location of critical infrastructure in the region most vulnerable to flooding. Appendix A3 – TWDB Table 3 – Existing Condition Flood Risk Summary Table provides the number of critical facilities identified on a per county basis.

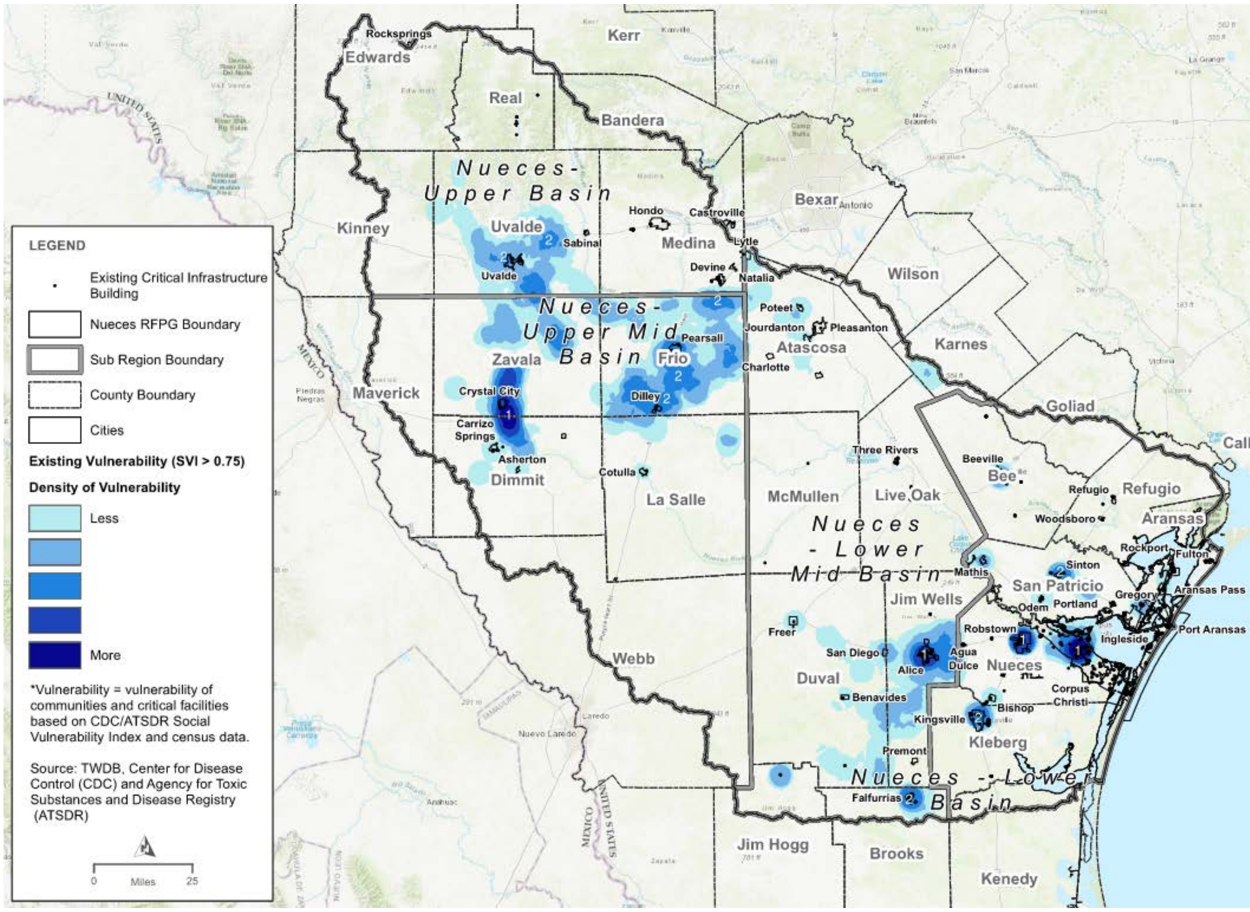

Figure 2-18. Existing Condition Vulnerability Heat Map and Location of Critical Infrastructure

2.1.3.2 Resilience of Communities Located in Flood-prone Areas

The average SVI of features in floodplain or flood-prone areas per county is provided in Appendix A3 – TWDB Table 3 – Existing Condition Flood Risk Summary Table**.**

Locations of high SVI areas located in floodplains or flood-prone areas are shown in

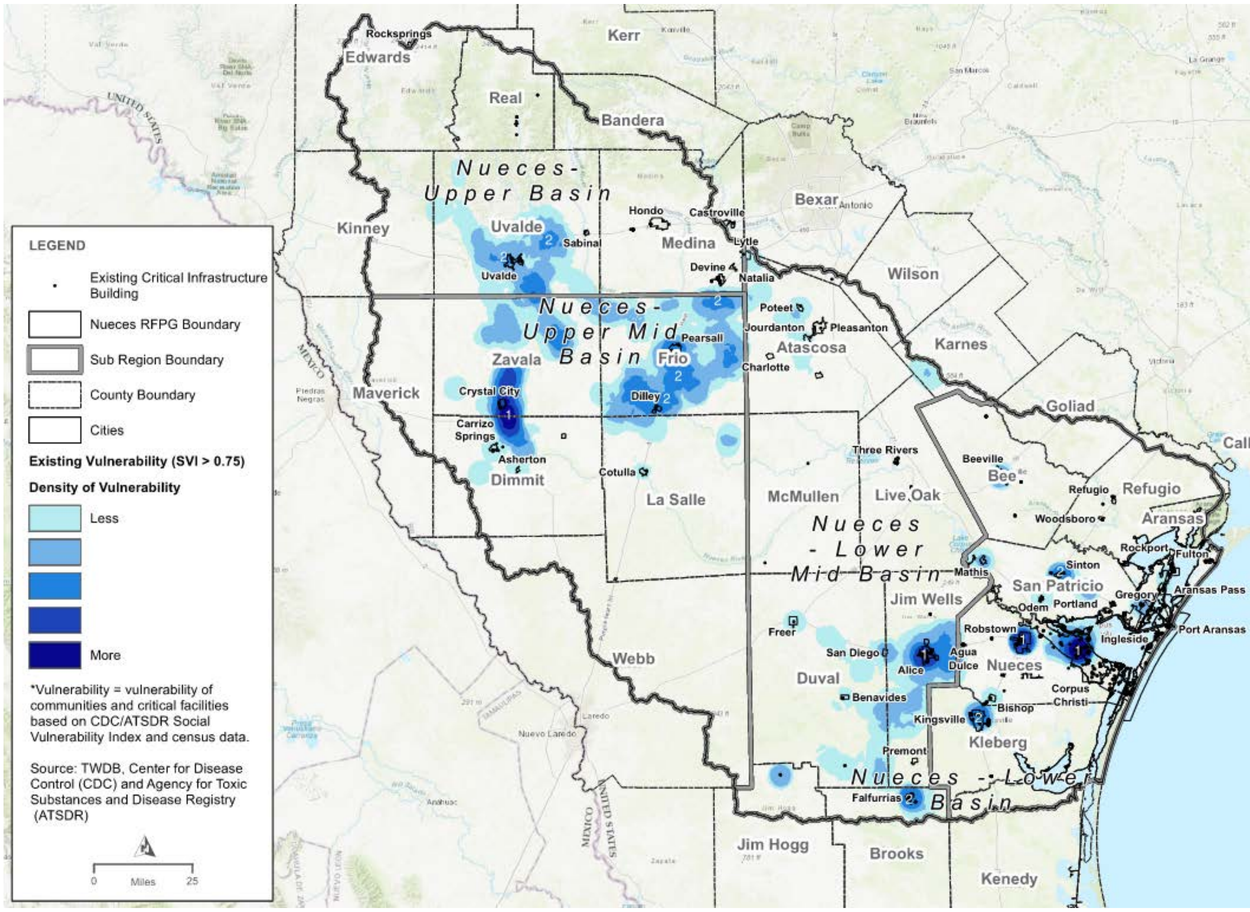

Figure 2-18.

(1) Most vulnerable areas – Corpus Christi and Robstown area, City Alice, and Crystal City

(2) Other vulnerable areas – Kingsville, Sinton, Falfurrias, Dilley, Pearsall, Devine, Uvalde, and Knippa.

2.2 Future Condition Flood Risk Analysis

A future condition flood risk analysis was performed to approximate the flood hazard extents projected in 30 years' time or the year 2050. The future condition analysis also defines the additional flood exposure and vulnerability risk.

2.2.1 Future Condition Flood Hazard Analysis

2.2.1.1 Projected Population and Development Trends and Practices

Chapter 1 discusses projected population and development trends and practices. The population of the Nueces basin is expected to grow from 1.14 million in 2020 to 1.52 million in 2050. New land development and population increases are projected to be the largest near the major population centers of the Cities of Corpus Christi, San Antonio, and Laredo. Other high growth areas by percent growth include the cities of Jourdanton, Lytle, Poteet, Pleasanton, and Crystal City, and the counties of Webb, Wilson, and Atascosa.

Population growth generally correlates to an increase in urbanization. This, in turn, leads to an increase in impervious ground cover as land use changes. Unmitigated, urbanized areas will increase watershed rainfall runoff leading to higher water surface elevations in the region's rivers, creeks, and channels during extreme rainfall events. New land development could potentially place new structures in the floodplain or flood-prone areas, especially in areas with limited flood plain regulations and enforcement.

Population growth over the next 30 years is considered a significant factor in the future conditions flood risk for the Nueces Region's riverine systems. However, for the coastal regions, population growth and the associated additional impervious cover is not considered to influence the future inundation conditions. The relative sea level rise (RSLR), which considers multiple factors such as climate change, land subsidence, and glacial melting, was the primary factor in the coastal areas.

2.2.1.2 Identification of Future Condition Flood Risk

When developing a predicative assessment for future conditions flood risk, the TWDB contract scope requires that each region consider two major factors: unmitigated population increase and climate change. The following is a list of potential factors that can influence future flood conditions:

- Precipitation increases due to climate change
- Rising sea levels
- Land subsidence
- Population growth and associated development increases (impervious cover)
- Natural stream migration changes to existing waterways
- Implementation of constructed drainage infrastructure

The Nueces Region includes a significant coastal area, that has different flood patterns and drainage challenges as compared to inland, riverine areas. Thus, the future condition flood risk is determined using separate approaches for inland riverine areas and for coastal areas. The following sections describe the approaches used for each.

2.2.1.3 Inland Riverine Future Conditions

For the 2020 to 2023 planning cycle, the development of the future flood hazard for riverine systems (inland areas) is dependent on population growth and a corresponding horizontal floodplain buffer applied. This inland approach was established due to the lack of available detailed floodplain data and hydrologic/hydraulic models.

The horizontal floodplain buffers, summarized in Table 2-1, were developed to approximate the increase in the 1% and 0.2% annual chance flood inundation boundaries, based on population increases projected from 2020 to 2050 from TWDB 2021 Regional Water Plan data. Population increases are applied, as appropriate, to the existing 1% and 0.2% annual chance boundaries to obtain the future condition boundaries surrounding cities and concentrated populated areas.

Table 2-1. Future Condition Buffers based on Estimated Population Increase

Estimated Population Increase	Estimated, corresponding buffer in floodplain width (ft)	
	1% Annual Chance Event	0.2% Annual Chance Event
0%	0	0
1%	5	5
5%	20	15
10%	40	30
15%	60	45
25%	100	75
50%	200	150

Horizontal buffers were established by estimating the anticipated water surface increase due to increased development and determining the corresponding horizonal floodplain increase based on available LiDAR terrain for several areas throughout the watershed, including the upper hill county, minor/major tributaries and rivers through the watershed, and conveyance systems near cities.

Population growth projections outside of concentrated areas within the remaining county regions were determined using the same 2021 Regional Water Plan population information. These populations are the remaining counts beyond the cities and districts within each respective county. Based on projected population density increases within the county regions, it was determined that maximum increases were less than 20 people per square mile. Based on these assessments, it is estimated that no floodplain increases attributed to population growth will occur outside the city areas; therefore, they show no change. Future 1% and 0.2% annual chance floodplain areas within the county regions, outside of cities or populated areas, are assumed to match the existing floodplain limits.

2.2.1.4 Coastal Future Conditions

Relative sea level change is estimated on best available existing data. The following data sources are currently available and reviewed for this task.

- *National Research Council (NRC) (1987) Responding to Changes in Sea Level: Engineering Implications* – The NRC study developed sea level rise (SLR) /

change (SLC) scenarios. This study was leveraged by USACE and National Oceanic and Atmospheric Administration (NOAA) and is the main resource for all present-day estimates

- National Oceanic and Atmospheric Administration (*NOAA) 2017 – Global & Regional Sea Level Rise Scenarios for the United States (TR NOS CO-OPS 083)* – NOAA has developed a tool to calculate the approximate SLR computed from the most recent Intergovernmental Panel on Climate Change (IPCC) and modified NRC projections. NOAA computed five scenarios including "high," "intermediate-high," "intermediate," "intermediate-low," and "low." These SLR scenarios are presented in Figure 2-19. This data can be extrapolated from graphs and applied to a digital terrain model.
- *NOAA 2022 – Sea Level Rise Technical Report – Update to 2017 report and data.*
- *U.S. Army Corp of Engineers (USACE) 2013 – Incorporating Sea Level Change in Civil Works Programs (ER 1100-2-8162)* – This source provides design guidelines for incorporating the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects.
- *USACE Sea-Level Change Curve Calculator (Version 2021.12)* – The USACE developed a tool to calculate the approximate SLR for three scenarios including "high", "intermediate", and "low".
- *General Land Office (GLO) Coastal Texas Protection and Restoration Feasibility Study Final Report (2021) (Coastal Texas Study)* – Uses the NOAA 2017 data and prepared inundation mapping for entire coast of Texas. The inundation mapping is based on various scenarios, including: 1% and 0.2% annual chance storm events modeled and future conditions with no mitigation (i.e., a "no action") scenarios available for years 2035 and 2085.
- *NOAA Continuously Updated Digital Elevation Model (CUDEM) (2020-2021)* – This dataset was used to identify coastal flood areas based on elevation for mapping future sea level rise.

Both NOAA and USACE SLR estimates are computed from the same sources resulting in similar scenarios. For reference, a comparison of SLR categories is shown in Table 2-2 with brief descriptions of background assumptions.

Table 2-2. Comparison of NOAA and USACE Sea Level Rise Scenarios

NOAA Scenarios	USACE Scenarios	Description
Low	Low	Linear historic sea level rise.

Intermediate-Low	Intermediate	NRC Curve I – Moderate Greenhouse Gas Emission
Intermediate	-	NRC Curve I – High Greenhouse Gas Emission
Intermediate-High	High	NRC Curve III – Moderate Glacier Melt
High	-	NRC Curve III – High Glacier Melt

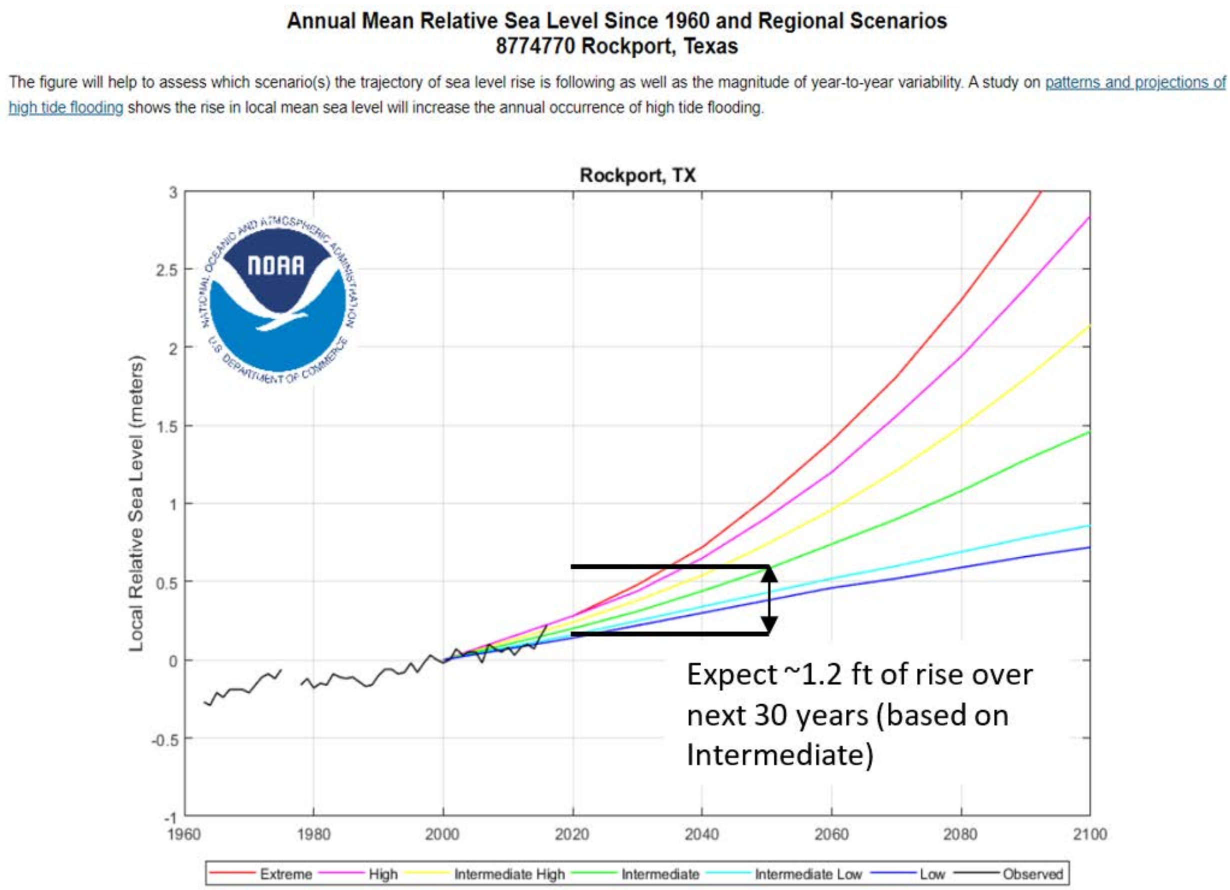

Figure 2-19. NOAA 2017 – Annual Mean Relative Sea Level Scenarios – Rockport, TX

NOAA's *Global & Regional Sea Level Rise Scenarios for the United States* (2017 with 2022 update) provides the most relevant technical data related to SLR. When considering the various scenarios of SLR, the "Intermediate-Low" scenario has a high likelihood of occurrence based on predicted outcomes and includes scientifically reasonable considerations for increased greenhouse gas emissions, ocean thermal expansion, and land-based subsidence/uplift. However, the "Intermediate" scenario is the most typical scenario selected for design. It includes considerations for past observed sea level trends and global effects due to moderate increases in greenhouse gas emissions. Table 2-3 compares the NOAA and USACE data to understand what the expected SLR is for the Nueces Region at the 30-year projected time frame.

Table 2-3. Water Surface Elevation Increase (ft) projected from 2020 to 2050

NOAA Scenarios	USACE Scenarios	USACE 2013[1]	NOAA 2017[2]	NOAA 2022[2]	Description
Intermediate-Low	Intermediate	0.7	0.9	1.0	NRC Curve I
Intermediate	-	-	1.2	1.1	
Intermediate-High	High	1.5	1.6	1.3	NRC Curve II

1. https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html
2. https://coast.noaa.gov/slr/

GLO's 2021 *Coastal Texas Protection and Restoration Feasibility Study Final Report* (Coastal Texas Study) used the NOAA 2017 data to prepare inundation mapping for the entire coast of Texas for several different scenarios and various projections into the future (see Figure 2-20). None of the modeled scenarios precisely match the 30-year projection required by the RFP. However, the Year 2035 "High" and Year 2085 "Low" scenarios result in similar SLR values as was predicted by the NOAA 2022 intermediate and intermediate-low scenarios.

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	Pier 21 (Region 1)			Rockport (Regions 2 and 3)			Port Isabel (Region 4)		
Year	Low	Intermediate	High	Low	Intermediate	High	Low	Intermediate	High
2017	0	0	0	0	0	0	0	0	0
2035	0.4	0.5	0.8	0.3	0.4	0.8	0.2	0.3	0.7
2085	1.4	2.1	4.4	1.2	1.9	4.1	0.8	1.5	3.8
2135	2.5	4.2	9.8	2.0	3.8	9.4	1.4	3.2	8.8

***Table 1.1:** Relative Sea Level Change Projections (feet)*

Figure 2-20. Coastal Texas Study Relative Sea Level Change Projections

The future coastal conditions flood hazard methodologies were discussed at the March 28, 2022 NRFPG meeting. Advantages and disadvantages of each methodology were presented for consideration, including NOAA and Coastal Texas data sources. The NRFPG approved use of the Year 2085 "Low" model data for Rockport, Texas, from the Coastal Texas Study to use for development of the 2023 Nueces RFP. This model data assumes a 1.2-foot SLR. This is similar to the NOAA 2022 intermediate sea level rise of 1.1 foot. However, the Coastal Texas Year 2085 "Low" model projection data was later found not to be available for use in the 2023 Nueces RFP. In lieu of using the Coastal Texas data, **the NRFPG proposes using the NOAA 2022 intermediate SLR of 1.1**

foot and applying an appropriate offset to the existing 1% and 0.2% annual chance coastal flood inundation boundaries for future planning efforts.

To determine and apply an appropriate offset, the Nueces Region Coastal Zone is divided into five coastal zones as listed below and shown in Figure 2-21.

- Baffin Bay
- Baffin Bay – Bluff
- Corpus Christi
- Copano
- Barrier Island – Back Bay

The regions are divided by their primary river systems and then further divided based on observed topography. For instance, a sharp increase in elevation near the waterline was noted in the Baffin Bay – Bluff cross-sections.

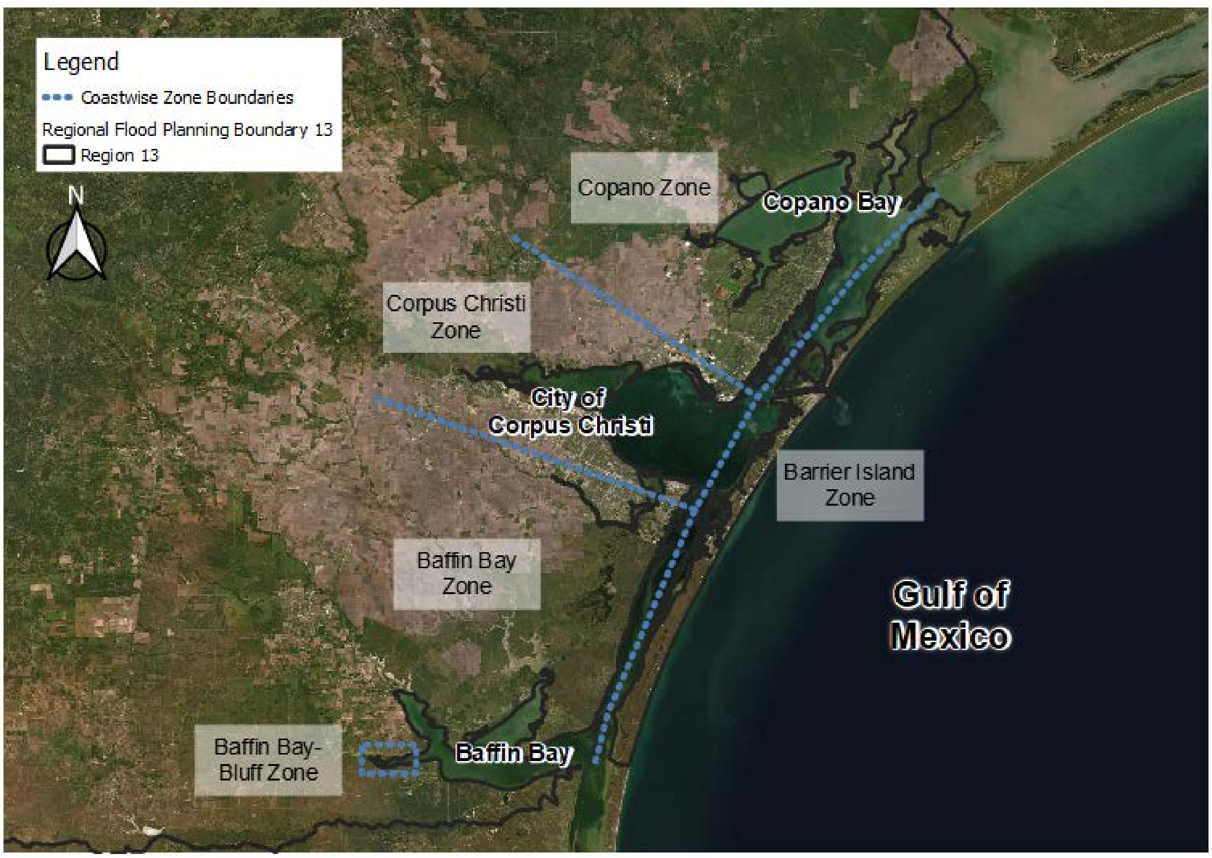

Figure 2-21. Coastal Zones used for applied Future Sea-Rise Buffer

Using the NOAA 2022 “Intermediate” SLR estimate, a horizontal buffer was computed using the best available terrain data from transects of the coast to determine the average overland slope in each Coastal Zone (see Table 2-4). The average overland slope for SLR was limited specifically to the coastal areas and does not include overland slopes further inland. All slopes were calculated from the waters line heading inland. The Barrier Island Zone slope was measured for the back bay, extending from the bay towards the Gulf of Mexico. This adjustment was made because the coastal dune system on the Gulf of Mexico side is considered bluffs for this analysis and the horizontal buffer is negligible. Based on the 1.1-foot vertical SLR and the average overland slope in each Coastal Zone, a horizontal buffer was calculated as shown in Table 2-4.

This horizontal buffer is applied to the future conditions 1% and 0.2% flood hazard layer within each Coastal Zone to estimate future conditions flood impacts due to sea level rise. Results of the future SLR mapping analysis are summarized in Section 2.2.2.1; however, due to time constraints, the SLR buffers are not incorporated into the future condition flood hazard layer in this first regional flood plan.

Table 2-4. Sea Level Rise Buffer Estimate

Buffer	Baffin Bay Zone	Baffin Bay – Bluff Zone	Corpus Christi Zone	Copano Zone	Barrier Island – Back Bay Zone
Average Overland Slope (%)	0.34%	2.40%	1.92%	0.16%	0.27%
Estimated Zonal Sea Level Rise Buffer (feet)	324	46	57	688	407

To perform the future SLR mapping, coastal flood areas were identified based on highest elevations from the future conditions 1% and 0.2% flood hazard layers. The NOAA CUDEM dataset was used to define the highest elevation for each flood event frequency. The average highest elevation for the future condition 1% flood event was approximately +1.27 meters (NAVD88), and the average highest elevation for the future condition 0.2% flood event was approximately +2.73 meters (NAVD88). Based on these elevations and using engineering judgment, a generalized coastal polygon was developed to select and identify coastal flood areas from the future condition 1% flood hazard layer.

Sea level rise buffers were then applied to the future condition coastal flood hazard areas to estimate future sea level rise extents. Buffer lengths varied by coastal zone as shown previously in Table 2-4. A map showing the extent of the 1.1-foot vertical SLR buffer area relative to the future conditions flood hazard layer is provided in

Appendix C13 – FMP No Negative Impact Determination Documentation. Due to the relatively small buffer length in the “Baffin Bay – Bluff Zone” and “Corpus Christi Zone”, SLR impacts may not appear at the provided map scale for Nueces and San Patricio Counties. Changes to Existing Floodplain Functionality

Floodplains function in natural and beneficial ways by (1) providing storage and conveyance of stormwater, and (2) reducing flood velocities and flood peaks, wind and wave impacts, and soil erosion and sedimentation. Due to the lack of data, no anticipated changes to the existing floodplain functionality are included in this draft 2023 Nueces RFP.

2.2.1.5 Sedimentation in Flood Control Structures and Major Geomorphic Changes

Sedimentation in flood control structures results in the loss of floodplain storage and associated attenuation of flood flows. To understand the impacts on the future flood hazard from sedimentation detailed hydraulic modeling is required. Due to the lack of detailed modeling available in this first flood plan the impacts of sedimentation are not considered in the development of the future flood hazard.

River channels and their adjacent floodplains are dynamic systems that are in a constant state of flux and adjustment to changing patterns of streamflow, sediment loads, and riparian and aquatic ecosystems. Major geomorphic changes can include the migration of river meanders, or the widening or deepening of a river segment. Due to the lack of data, no geomorphic changes in riverine or coastal systems are assumed in the development of the future flood hazard.

2.2.1.6 Completion of Flood Mitigation Projects

The completion of flood mitigation projects has the potential to reduce the future flood hazard. However, the future condition does not include the completion of any flood mitigation projects currently under construction or that already have dedicated construction funding. This is due to the lack of information for flood mitigation projects currently underway in the basin.

2.2.1.7 Future Condition Hydrologic and Hydraulic Model Results

No future condition hydrologic and hydraulic model results have been identified during this draft 2023 Nueces RFP.

2.2.1.8 Future Flood Hazard Mapping

The future condition 1% and 0.2% annual chance flood inundation boundaries are provided in the geodatabase (i.e., FutFldHazard) and depicted on a subregion level in Appendix B8 – TWDB Map 8 - Future Condition Flood Hazard.

2.2.1.9 Future Flood Mapping Gap Analysis

BLE inundation boundary mapping is estimated to be completed for the entire Nueces basin in 2023 according to TWDB's BLE status update viewer. BLE mapping is considered approximate; however, based on the schedule for completion, it is unavailable for 2023 Nueces RFP consideration. No additional detailed modeling and mapping projects can be confirmed for inclusion in the future flood hazard risk layers.

Thus, the future flood condition gap boundaries are assumed to be the same as the existing condition gap boundaries (refer to Figure 2-13).

2.2.1.10 Future Condition – Total Land Area at Flood Risk

This flood hazard analysis summarizes total area and agricultural area within the 1% and 0.2% annual chance flood risk under future conditions, which is summarized by county in Appendix A4 – TWDB Table 5 – Future Condition Flood Risk Summary Table. Total land area within the Nueces Flood Planning region at risk of 1% annual chance flood inundation under future conditions is summarized by county and flood risk type (riverine, fluvial, and coastal) in Figure 2-22. In total, 4,629 square miles of land (19.2% of all land in basin) is at risk of 1% annual chance flood inundation under future conditions, an increase of 51 square miles from existing conditions. An additional 1,283 square miles is at risk of 0.2% annual chance flood inundation. The total land at risk of 1% or 0.2% annual chance flood inundation is 5,912 square miles of land (24.5% of all land in basin).

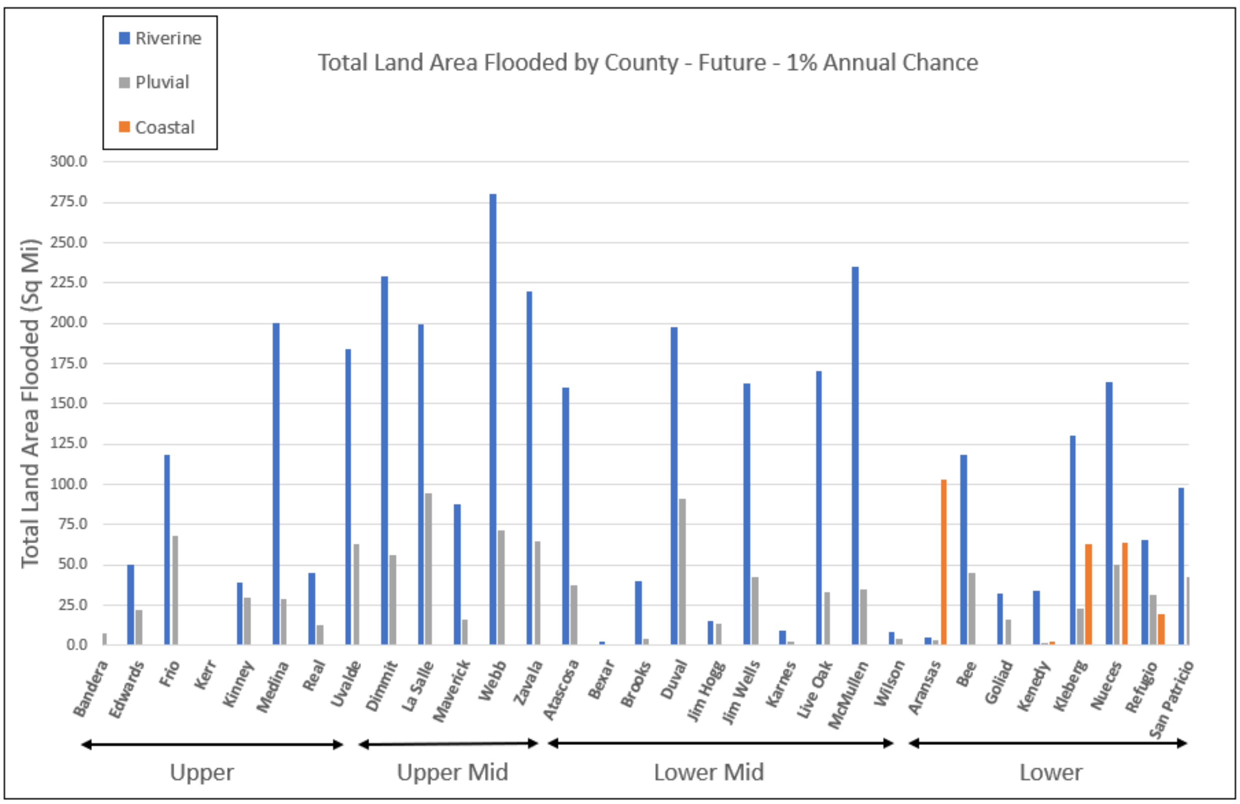

Figure 2-22. Total Land Area at Flood Risk of 1% annual chance storm by Type, County – Future Condition

2.2.2 Future Flood Exposure Analyses

The future flood exposure analysis is a high-level, region-wide, GIS-based analysis to identify who and what might be harmed by flooding. This includes identifying all structures located within both the 1% and 0.2% annual chance flood event and possible flood-prone area boundaries, as defined in the future flood hazard analysis. For additional details, see Appendix A4 – TWDB Table 5 – Future Condition Flood Risk Summary Table, which includes a summary of the land area, number of structures, population, roadway segments and crossings, agriculture area, and critical facilities that are exposed to the future condition 1% and 0.2% annual chance flood risk and possible flood-prone areas.

The future flood exposure analysis indicated approximately 78,000 structures and a population of 191,000 at potential risk of flooding from the 1% annual chance flood event, which is 17,000 more structures than in the existing condition. This grows to 112,000 structures and a population of 283,000 at potential risk of flooding from the 0.2% annual chance flood event.

The existing condition flood exposure analysis indicated roughly 61,000 structures and a population of 137,000 at potential risk of flooding from the 1% annual chance flood event. This grows to 98,000 structures and a population of 283,000 at potential risk of flooding from the 0.2% annual chance flood event.

However, this does not include the potential construction of new structures built in the floodplain. A heat map illustrates where these structures are generally clustered in the Nueces Flood Planning Region (NFPR), as shown in Figure 2-23. The location of hot spots for flood exposure are similar to those identified in existing conditions.

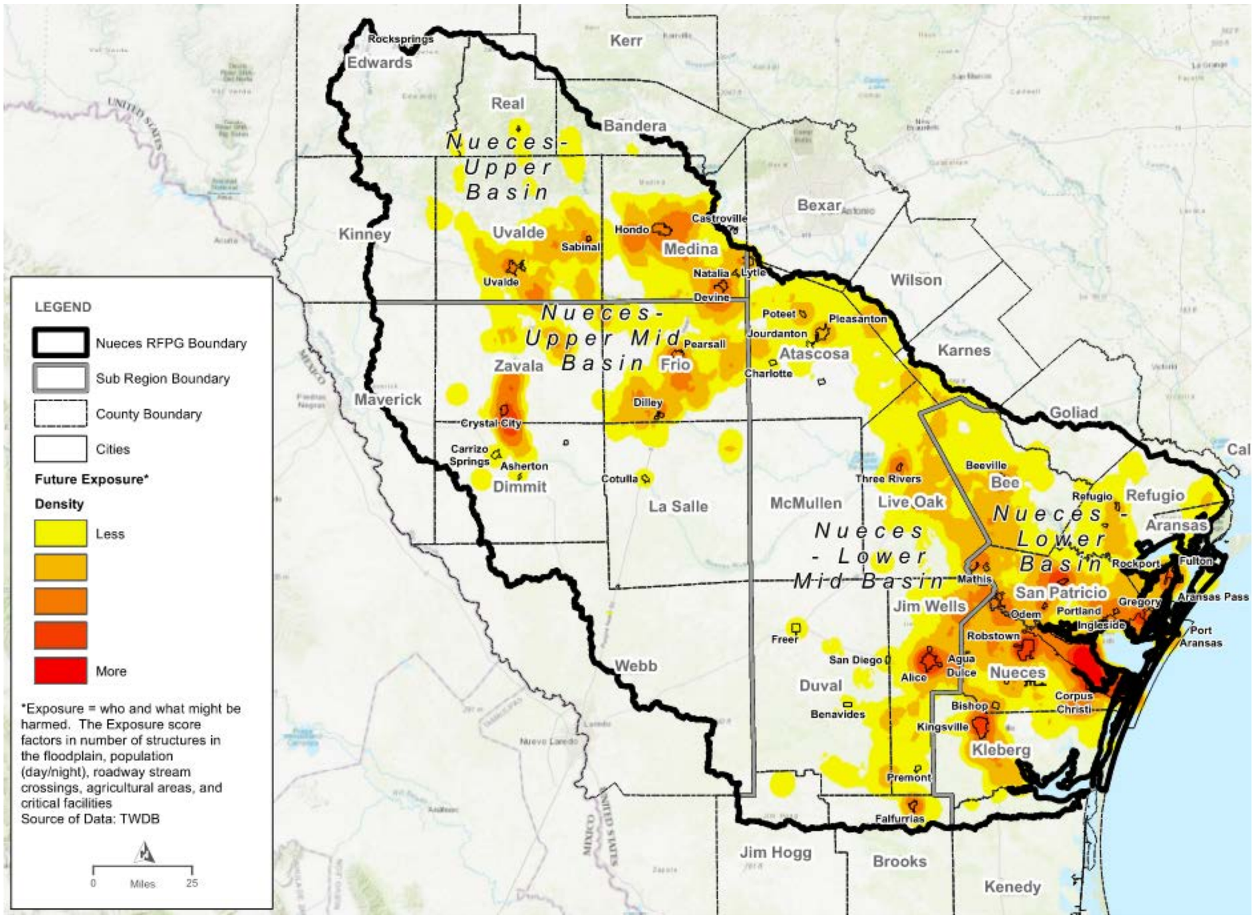

Figure 2-23. Future Condition Exposure Analysis (Map 11)

2.2.2.1 Future Sea Level Rise Analysis

Based on the future sea level rise analysis discussed in Section 2.2.1.4, a sea level rise exposure analysis was performed to identify additional land area, buildings, or critical facilities within the future condition 1% flood hazard sea level rise buffer area. Results from this analysis are summarized in Table 2-5 and show that a majority of estimated sea level rise impacts are located in Aransas, Kleberg, and Refugio Counties due to the relatively flat coastal terrain in these areas.

Table 2-5. Sea Level Rise Exposure Results by County

County[1]	Future Condition 1% Flood Hazard Sea Level Rise Exposure[1]		
	Area in Floodplain (sq. mi.)	Structures in Floodplain (#)	Critical Facilities (#)
Aransas	39.6	2,886	15

County[1]	Future Condition 1% Flood Hazard Sea Level Rise Exposure[1]		
	Area in Floodplain (sq. mi.)	Structures in Floodplain (#)	Critical Facilities (#)
Kenedy	8.9	12	-
Kleberg	27.7	149	-
Nueces	2.6	82	-
Refugio	14.5	324	1
San Patricio	7.1	164	-

1. Results shown in this table represent estimated flood exposure within the sea level rise buffer area (outside the future condition 1% flood hazard area). These impacts are counted in addition to the 1% flood hazard area exposure impacts detailed in Appendix A4 – TWDB Table 5 – Future Condition Flood Risk Summary Table.

2.2.3 Future Vulnerability Analysis

The objective of this analysis is to identify critical infrastructure amongst the items identified in the future flood exposure analysis and to compute SVI for each structure identified during the flood exposure analysis.

2.2.3.1 Vulnerabilities of Critical Facilities

The future flood vulnerability analysis identified approximately 642 critical facilities in the 1% annual chance flood inundation. This is an increase of approximately 197 critical facilities when compared to existing conditions. This analysis does not include the potential construction of new critical facilities built in the floodplain. A heat map illustrates where these structures are generally clustered in the NFPR (Figure 2-24).

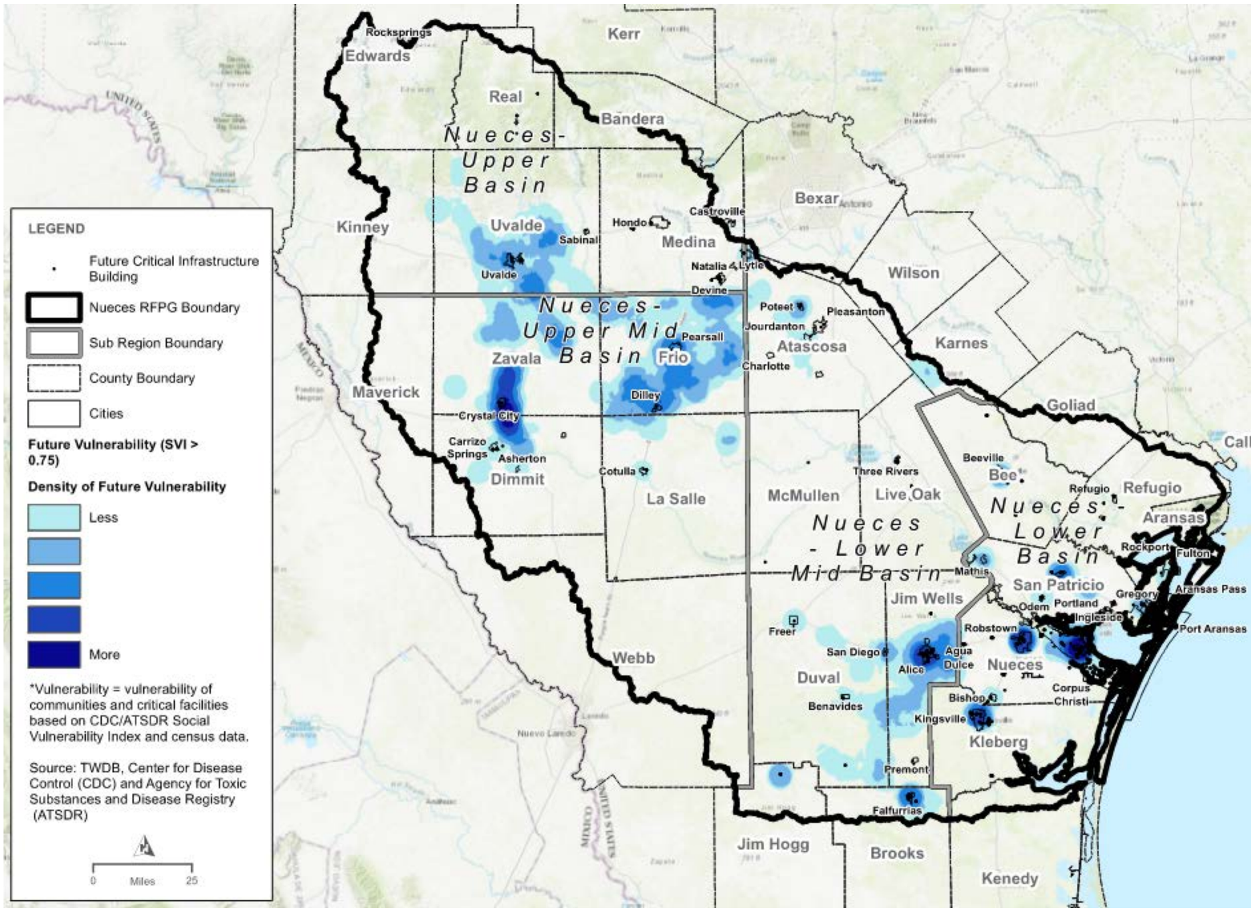

Figure 2-24. Future Condition Vulnerability Heat Map (Map 12)

2.2.3.2 Resilience of Communities in Flood-Prone Areas

Natural disasters, such as flooding, can pose a threat to the community's health and wellbeing. A number of factors, including socioeconomic, access to hospital systems, and crowded housing among others affects a community's resilience and ability to recover. The SVI developed by the CDC and Agency for Toxic Substances and Disease Registry (ATSDR) is a tool that uses U.S. census data to determine the social vulnerability by census tract. This information is then compiled into a database to help emergency response planners and public officials identify and map areas that are most likely to need support before, during, and following a flood event or natural disaster. The average SVI for the future condition floodplain or flood-prone areas per county is provided in Appendix A4 – TWDB Table 5 – Future Condition Flood Risk Summary Table. Locations of high SVI areas located in floodplains or flood prone areas are shown in Figure 2-24. The most vulnerable areas to flood risk are similar to those identified in the existing condition.

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Chapter 3 – Floodplain Management Practices and Flood Protection Goals

31 TAC § 361.35, 361.36

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3 Floodplain Management Practices and Flood Protection Goals

The goal of this task is for regional flood planning groups (RFPGs) to

- evaluate and make recommendations on forward-looking floodplain management, land use, and economic practices, and
- define overarching flood mitigation and floodplain management goals to protect against the loss of life and property, including specific and achievable short-term (10-year) and long-term (30-year) goals.

These two goals are addressed in the following sections on Floodplain Management Practices and Goals.

3.1 Evaluation and Recommendations on Floodplain Management Practices

Floodplain management, land use, infrastructure design, and other practices play a key role in identifying and reducing risk and impact that flooding causes to life and property, specifically in preventing the creation of additional flood risk in the future. This section considers current floodplain management practices, evaluates how best to address future development and population growth, and provides recommendations regarding forward-looking floodplain management strategies for inclusion in the Regional Flood Plan.

3.1.1 Current Floodplain Management Practices

3.1.1.1 Entities with Flood-Related Authority

Entities identified as having flood-related authority in the region are listed in Appendix A5 – TWDB Table 6 – Existing Floodplain Management Practices. The list includes 31 counties, 57 cities, and 46 districts with flood-related authority.

3.1.1.2 Outreach to Entities with Flood Authority

A Current Floodplain Management Practices and Goal survey was sent to floodplain stakeholders and administrators representing Nueces Region entities with flood-related authority on June 17, 2021. As of June 14, 2022, 32 of 134 entities had completed the survey on existing floodplain practices. Specifically, 15 counties of 31, 12 municipalities of 57, and 5 of 46 other government entities responded to the survey. The survey results are summarized in Appendix C3 – Floodplain Management Practices and Goal Survey Results. Entities that responded to the survey include the following.

- Aransas County
- Bandera County
- Bexar County
- City of Beeville
- City of Bishop
- City of Corpus Christi
- City of Cotulla La Salle County
- City of Gregory
- City of Hondo
- City of Ingleside
- City of Ingleside on the Bay
- City of Leakey
- City of Port Aransas
- City of Portland
- City of Sinton
- City of Uvalde
- Dimmit County
- Duval County
- Duval County Conservation / Reclamation District
- Frio County
- Karnes County
- Kerr County
- McMullen County Water Control and Improvement District (WCID) #1
- Medina County
- Real County
- Refugio County
- San Patricio County
- San Patricio County Drainage District
- Uvalde County Underground Water Conservation District (UWCD)
- Webb County
- Wilson County
- Zavala County

The survey gathered information on the use of various floodplain practices typically employed by entities in the Nueces Basin with flood authority. This information is summarized for each entity listed in the Existing Floodplain Management Practices Summary Table. Floodplain management regulations are common with 25 of the 32 cities and counties that responded to the flood practice survey. Descriptions and details of floodplain management practices in the Nueces Basin are described in further detail in the sections below.

3.1.1.3 Minimum Floodplain Management Regulations

Minimum floodplain management regulations include compliance with Texas Water Code Section 16.3145 and FEMA's National Flood Insurance Program (NFIP) participation.

- Texas Water Code Section 16.3145 requires a city or county to adopt the necessary ordinances or orders for the city or county to be eligible to participate in the NFIP. This practice is common with 23 of the 28 reporting cities and counties complying with this requirement.
- NFIP participation is voluntary and is based at a minimum on a community's agreement to adopt and enforce the Federal standards for building within a Special Flood Hazard Area (SFHA). In exchange the FEMA makes flood

insurance available. NFIP participation is a wide-spread practice in the Nueces Basin with 85 of 86 reporting cities and counties participating.

3.1.1.4 Higher Floodplain Management Standards

Higher floodplain management standards can include an assortment of practices to further reduce flood risk above and beyond minimal standards. The Texas Floodplain Management Association (TFMA) produced a guide for higher standards in 2018 that describes 32 higher standard practices that if implemented would reduce flood risks (https://www.tfma.org/page/documents-reports).

Of these practices, the implementation of freeboard requirements was listed as the single most effective means for reducing flood risks. Freeboard is the standard for placing the first floor of a structure above the elevation of the calculated 1% annual chance flood level to allow for nature's uncertainty and future changes in the watershed that will increase flood levels.

TFMA's 2018 Higher Standards Survey identified 368 entities across Texas and 19 entities in the Nueces Basin that have adopted higher standards. These include 10 counties: Aransas, Bandera, Bexar, Kerr, Live Oak, Medina, Nueces, Refugio, San Patricio, and Webb. The remaining nine are municipalities: Alice, Aransas Pass, Charlotte, Corpus Christi, Ingleside, Kingsville, Port Aransas, Rockport, and Uvalde. In general, many entities in the lower basin and those near San Antonio and Laredo have adopted higher standards.

Most of the entities in the Nueces Basin identified in the TFMA survey results have adopted freeboard requirements of greater than 1 foot above the existing base flood elevation (BFE), with Rockport and Aransas County adopting 1.5 feet above the existing BFE, with Uvalde and San Patricio County adopting 2.0 feet above the existing BFE, and Bandera County adopting 3 feet above the existing BFE. Multiple entities (5) have 1 foot above fully developed BFE requirements. For further information see Appendix C4 – TFMA Higher Standard Survey Results for the Nueces Basin.

NFIP's Community Rating System (CRS) credits community efforts beyond meeting minimum NFIP standards. For the Nueces Basin only, Corpus Christi has been identified as a CRS community with a rate class of 7. For more information on CRS see Section 1.8.

3.1.1.5 Degree of Floodplain Management Practices

Existing floodplain management practices are generally described as none, low, moderate, and strong, as defined below and displayed in Table 3-1 and Figure 3-1.

- None – no floodplain management practices in place
- Low – regulations meet the minimum NFIP standards

- Moderate – Some higher standards, such as freeboard, detention requirements, or fill restrictions
- Strong – Significant regulations that exceed NFIP standard with enforcement, or community belongs to the Community Rating System.

Table 3-1. Level of Floodplain Management Standards

Floodplain Management Practice	Entity Response	Counties (31 total)	Municipalities (57 total)	Other (46 total)
Floodplain Management Practices (Strong/Moderate/Low/None)	Strong	3	5	2
	Moderate	8	6	0
	Low	3	2	1
	None	1	0	1
	Unknown	16	44	42

Entities with strong flood management practices are generally concentrated near the large population growth urban areas of Corpus Christi, San Antonio, and Laredo. The locations that lack floodplain management practices generally consist of more rural counties in historically low population growth areas.

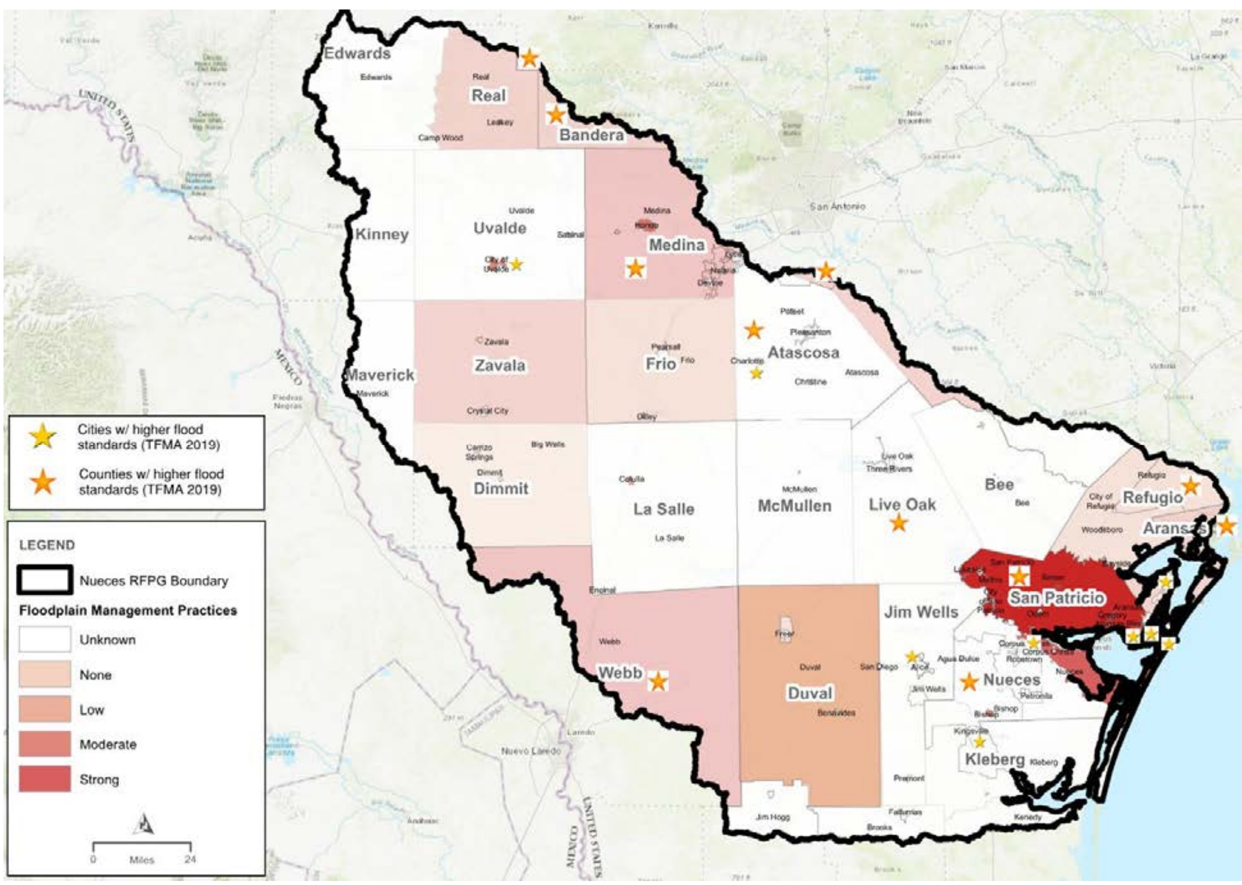

Figure 3-1. Level of Floodplain Management Standards

3.1.1.6 Level of Enforcement of Floodplain Management Practices

- The level of enforcement varies among entities from none to high, as defined below and displayed in Table 3-2

Table 3-2 and Figure 3-2.

- High – actively enforces the entire ordinance, performs many inspections throughout building construction process, issues fines, violations, and Section 1316s where appropriate, and enforces substantial damage and substantial improvement. Note: Section 1316 of the National Flood Insurance Act of 1968 provides for the denial of flood insurance coverage for any property determined to be in violation of State or local floodplain management regulations.
- Moderate – enforces much of the ordinance, performs limited inspections and is limited in issuance of fines and violations.
- Low – provides permitting of development in the floodplain, may not perform inspections, may not issue fines or violations.
- None – does not enforce floodplain management practices

Table 3-2. Level of Enforcement Practices

Floodplain Management	Entity	Counties	Municipalities	Other
Level of Enforcement of Practices (High/Moderate/Low/None)	High	3	5	2
	Moderate	8	6	0
	Low	3	2	1
	None	1	0	1
	Unknown	16	44	42

Similar to the strength of flood plain practices, levels of enforcement (shown in Figure 3-2), are strongest near the high growth urban areas of Corpus Christi, San Antonio, and Laredo.

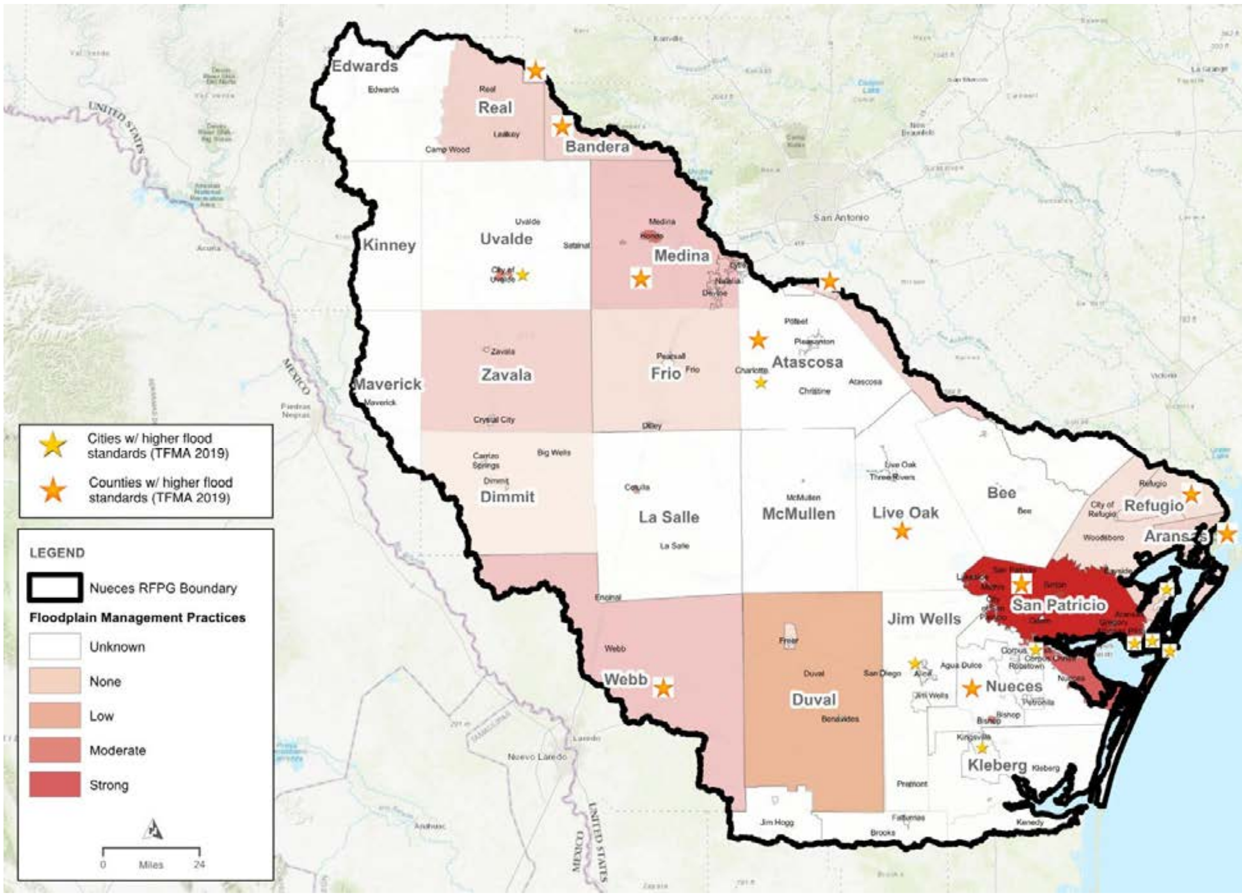

Figure 3-2. Level of Enforcement in Areas with Established Floodplain Management Practices

3.1.1.7 Stormwater or Drainage Fee

The existence of a stormwater or drainage fee is uncommon. Only the City of Portland reported to have this type of fee. The city issues a $3 drainage utility fee on each monthly utility bill for city services. The fee was established in 2004 and is intended to finance needed drainage system improvements such as curb, gutter, and associated storm inlet reconstruction as part of major street maintenance and improvement programs throughout the City.

3.1.2 How to Address Future Development and Population Growth

The future exposure analysis, summarized in Chapter 2, identified approximately 73,000 structures at potential risk of flooding from the 1% annual chance floodplain. This analysis did not include the potential for new structures to be added to the floodplain as development occurs. New development is anticipated in the Nueces Basin, especially for areas located near the large urban areas of San Antonio, Laredo, and Corpus Christi.

The best approach to address future development and population growth is to limit exposure of new development to the existing and future flood hazard. This can be accomplished by pro-actively

(1) defining accurate floodplain limits through the development of detailed hydrologic and hydraulic models and mapping in areas of anticipated high development and population growth, and

(2) adopting freeboard requirements in these high growth areas to require finished floor elevations of structures to be located safely above the 1% annual chance floodplain elevations.

Implementing higher standards beyond freeboard requirements should also be considered to further reduce the future flood risk to life and property. Some of the more effective higher standards for consideration include:

- No Adverse Impact – Requires new development to mitigate adverse impacts to other properties throughout the watershed.
- Floodplain Fill/Use Standards – Provide standards and restrictions for the placement of fill or development activity in a floodplain.
- Setbacks – provides a limited use/development area along waterways.

Land development in upstream areas is apt to increase runoff in downstream areas by encroaching on riparian areas that diminishes the capacity of streams to store flood waters during storm events. The NRFPG recommends that cities and counties consider ordinances for land developers to consider flood mitigation measures to reduce future flood risk.

3.1.3 Recommended Strategy for Floodplain Management

The NRFPG does not have the authority to enact or enforce floodplain management, land use, or other infrastructure design standards. Thus, the NRFPG aims to encourage implementation of recommended floodplain practices by local entities in the region with flood-related authority.

The NRFPG has recommended the following floodplain management standard for the region for consideration by Nueces basin counties, cities, and others with flood administrating authority:

Finished floor of structures should be a minimum of 1 foot above base flood elevations (BFE) (i.e. 1% annual chance or 100-year) or based on local ordinances, whichever is higher. The NRFPG strongly encourages cities and counties in the Nueces Basin to actively consider a minimum 2 feet above base flood elevations, consistent with upcoming 2025 FEMA ordinances. Such higher standards build more resilience and reduces future flood risk for homeowners. The standards are based on available data, to be updated based on Atlas 14 data when available.

Implementation of this recommendation along with defining accurate floodplain limits through the development of detailed hydrologic and hydraulic models and mapping in areas of anticipated high development and population growth is the best approach to address future development and population growth and to limit exposure of new development to the existing and future flood hazard. BLE mapping is in progress and will become available for the entire Nueces Basin in 2023. Although not regulatory in nature, the BLE will provide comprehensive and updated floodplain mapping information. The NRFPG encourages cities and counties in the Nueces Basin to consider adoption of flood ordinances that regulate to the best available data, such as BLE and FEMA floodplains.

Other high-standard practices that should be considered include participation in the NFIP's CRS, requiring new development to mitigate adverse impacts to other properties throughout the watershed, providing standards and restrictions for the placement of fill or development activity in a floodplain, and the use of setbacks, which limit use/development areas along waterways.

Floodplain mitigation studies in the Nueces Basin are encouraged to consider natural systems and beneficial functions of floodplains, including flood peak attenuation and ecosystem services when identifying projects to reduce flood risk. Flood mitigation design approaches that work together with natural floodplain patterns is advised. Most natural flood mitigation features, including floodplains, are in need of maintenance and can be improved with land use management.

Flood management agencies should carefully consider protecting existing streams, riparian areas, and floodplains when considering channelization projects. If channelization is necessary, a two-stage channel with a low-flow channel and a floodplain allows for the continued transport of sediment, habitat for aquatic wildlife, and can reduce maintenance (Rosgen 1996).

As basic flood delineation models become available, building more sophisticated hydrologic and hydraulic models that include soil absorption, geologic porosity, plant interception, and other variables that slow flows or convey surface water below ground can help to provide a deeper understanding of water quality improvements and ground water recharge potential to assess benefits of nature-based solutions.

The NRFPG did <u>not</u> choose to adopt region-specific, minimum floodplain management, land use, or other standards that impact flood-risk, that each entity in the flood planning region must adopt prior to inclusion of any of their Flood Mitigation Evaluations, Strategies, or Projects in the Regional Flood Plan.

3.2 Floodplain Mitigation and Floodplain Management Goals

This section defines specific and achievable flood mitigation and management short- and long-term goals. These goals were developed with the objective "to protect against the loss of life and property", as set forth in the Guidance Principles in 31 Texas Administrative Code (TAC) §362.3. The short- and long-term goals identify specific and achievable flood mitigation and floodplain management goals that, when implemented, will demonstrate progress towards this overarching objective.

A subcommittee formed by NRFPG members[1] met on August 25 and September 8, 2021, to discuss floodplain priorities and prepare proposed short-term (10-year) and long-term (30-year) goals for RFPG consideration. During the September 27, 2021 RFPG meeting, comments were received and addressed on floodplain management standard and goals and the comment period remained open for 30 days after the meeting. On November 3, 2021, RFPG members, Sky Lewey and Lauren Hutch Williams, participated in a call with HDR Engineering, Inc. (HDR) to provide additional comments on nature-based goals.

The NRFPG defined 10 overarching flood mitigation and floodplain management goals as summarized in Table 3-3**.** Each goal includes both specific and achievable short-term and long-term goals. Short-term goals were set for a duration of 10-years with a target year of 2033 and long-term goals were set for a duration of 30-years with a target year of 2053. The 10 goals were developed to prepare the Nueces Basin for flooding for the following four categories and 10 sub-categories:

- Protect against loss of life caused by flooding
    - Improve safety at low water crossings
    - Reduce risks at high-hazard dams
    - Implement flood warning systems and improve regional data collection
- Protect against property damage caused by flooding
    - Perform flood mapping evaluations and update floodplain maps
    - Reduce the number of structures within the 1% annual chance floodplain
- Floodplain management
    - Prepare minimum flood management standards
    - Nature-based practices through land conservation and restoration programs
    - Develop public information campaign
- Funding
    - Increase funding for maintenance of drainage systems
    - Identify funding for community outreach and for permit support

A more detailed table of the goals is provided in Appendix A6 – TWDB Table 11 – Flood Mitigation and Floodplain Management Goals. This table includes additional columns to

[1] The Region 13 floodplain management practices and goals subcommittee consisted of Larry Dovalina, Andy Rooke, Larry Thomas, and Jim Tolan.

describe the residual risk of each goal and to describe how each goal will be measured. The residual risk represents the amount of remaining risk that would be expected if the floodplain mitigation and management goals are fully achieved. Any flood risk not avoided or reduced through meeting a goal will remain as a residual risk. Note it is not possible to protect against all potential flood risks.

Table 3-3. Nueces Region Floodplain Goals

Region 13 Draft Floodplain Goals		10 Year	30 Year
Protect against loss of life caused by flooding			
1	Improve Safety at **Low Water Crossings** through Structural Improvements or Warning Systems	Conduct an inventory of low water crossings (LWCs), characterize risk, and rank LWCs to prioritize those with high risk. Prepare a large-scale public outreach campaign to include “Turn Around Don’t Drown" signage at LWCs or roadways aimed at reducing loss of life. Address top 30% of high-risk, LWCs through mitigation or warning systems.	Address 80% of high-risk LWC identified in the study.
2	Rehabilitate, Remove, or Replace Deficient **High Hazard Dams** as Identified by the Texas Commission on Environmental Quality (TCEQ) Dam Safety Regulation Program	Conduct a comprehensive study to identify all deficient high-hazard dams in the 31-county region. Remove or rehabilitate the top 30% high-hazard dams.	Remove or rehabilitate 100% deficient high-hazard dams.
3	Improve regional coordination, data collection/sharing of flood events and impacts, and **implement flood warning systems**	Develop (or expand) a successful flood management program on a regional-scale to cover 20% of the data gap area(s) identified in the 2023 plan. Prepare large-scale public outreach to include "Turn Around Don't Drown" campaigns aimed at reducing loss of life.	Develop (or expand) a successful flood management program on a regional-scale to cover 80% of the data gap area(s) identified in the 2023 plan.

Region 13 Draft Floodplain Goals		10 Year	30 Year
Protect against property damage caused by flooding			
4	Perform **flood mapping evaluations and update floodplain maps** and flood hazard data.	Develop maps to Base Level Engineering (BLE) or National Flood Hazard Layer (NFHL)-level accuracy for 60% of the basin that does not currently have accurate mapping. Identify structures and buildings in the NFHL-Detailed Study Areas with elevations less than 1 foot above base flood elevation (BFE).	Develop accurate maps to NFHL-level accuracy for 100% of the basin. Identify structures and buildings in the NFHL-Detailed Study Areas with elevations less than 1 foot above BFE.
5	**Reduce the number of structures within NFHL-Detailed Study Area** and Existing Floodplain with 1% annual chance flood risk.	Identify structures within existing floodplain with 1% annual chance flood risk for 60% of the basin. Prepare a list of high-hazard buildings based on function, critical function, repetitive loss, or other community-related importance, summarize, and distribute results to affected floodplain management entities. Reduce the number of high hazard structures within the 1% existing floodplain by 10% for existing structures and identify new structures for targeting with 30-year goal.	Identify structures within existing floodplain with 1% annual chance flood risk for 100% of the basin, including areas that have been updated with more accurate mapping. Prepare a list of high-hazard buildings based on function, critical function, repetitive loss, or other community-related importance, summarize, and distribute results to affected floodplain management entities. Reduce the number of high-hazard structures within the 1% existing floodplain by 50%.

Region 13 Draft Floodplain Goals		10 Year	30 Year
Floodplain management			
6	Prepare **minimum flood management standards**, including identifying operations and maintenance best practices to maintain drainage structures including remove gravel and sediment deposition to mitigate future flooding impacts.	Provide minimum flood standard recommendation(s) adopted by the NRFPG to floodplain administrators and community leaders, to include: Finished floor of structures are to be constructed a minimum of 1 foot above BFE 100-year or based on local ordinances, whichever is more stringent. The NRFPG strongly encourages cities and counties in the Nueces Basin to actively consider minimum 2 foot above base flood elevations, consistent with upcoming 2025 FEMA ordinances. The standards are based on available data, to be updated with Atlas 14 and/or TWDB BLE data when available. Achieve 30% voluntary adoption of the RFPG minimum standards by counties/cities. Define and recommend additional minimum flood standards for regional support towards implementation, as study results become available. Increase the number of communities adopting higher standards beyond NFIP requirements to 50% of counties and 30% of communities (current is 26% counties and 17% communities). Provide advocacy on the regional and state level to ensure that all communities across the region share a base-level of floodplain management support by 2030.	Achieve 100% voluntary adoption of RFPG minimum standards by counties/cities, including additional minimum flood standards defined during studies conducted through 2033 (10 year). Increase the number of communities adopting higher standards beyond NFIP requirements to 100% of counties and 100% of communities.

Region 13 Draft Floodplain Goals		10 Year	30 Year
7	Increase **nature-based practices through land conservation and restoration programs** and participation in landowner incentive programs to encourage voluntary land stewardship practices to manage floodwaters, slow runoff and dissipate flood energy to include riparian, wetland, forest, upland, and other habitat protection programs.	Identify existing areas noted for conservation, restoration, and/or habitat protection, and develop a strategy for expanding these programs and/or identifying high success areas for riparian/wetland/forest conservation, restoration, and upland protection programs to enhance flood mitigation benefits. Identify preferred areas in Nueces Basin to expand federal and state land protection programs, and other programs that provide incentives for voluntary land conservation and restoration. Preserve 35% of undeveloped riparian corridor mileage and protect 25% of acreage within the 100-year floodplain through voluntary, local, state, or federal land conservation programs.	Work with local leadership to implement nature-based riparian, wetland, and upland conservation and/or restoration programs for 40% of the high success areas identified. Preserve 80% of undeveloped riparian corridor mileage and protect 50% of acreage within the 100-year floodplain through voluntary, local, state, or federal land conservation programs.
8	Develop **public information campaign** to increase community knowledge of rules and regulations, flood-prone areas, and importance of protecting floodplains from encroachment	Identify local, subregional workgroups aligned with flooding issues. Develop public information campaign templates with relevant flood-related communications for 20% of the Nueces Region.	Develop public information plan campaigns with relevant flood-related communications for 80% of the Nueces Region area.
Funding			
9	Increase dedicated **funding sources to provide maintenance** of drainage and culvert systems (both structural and non-structural solutions) to divert flood flows and identify structural improvements causing flooding issues to remove/rectify.	Increase dedicated funding sources, including state-funding opportunities to support operations and maintenance (O&M) for 20% of the communities and 30% counties in the Nueces Region.	Develop dedicated funding sources, including state-funding opportunities, to support O&M for 80% of the communities and 90% counties in the Nueces Region.

Region 13 Draft Floodplain Goals		10 Year	30 Year
10	Identify **funding, resources, and technical training** for floodplain districts, managers, administrators or designees to enhance technical capacity for identifying floodplain projects, community outreach, and permitting support to verify new projects meet floodplain development requirements.	Identify dedicated funding sources, including state-funding opportunities for 20% of the communities and 30% counties in the Nueces Region. Develop a strategy for public engagement on flood-related issues, including a list of flood mitigation funding programs and potential opportunities for communities to participate in programs to support flood risk reduction (such as the Federal Emergency Management Agency's (FEMA) Community Rating System) to serve as a template for rural and underserved communities by 2030.	Develop dedicated funding sources, including state-funding opportunities for 80% of the communities and 90% counties in the Nueces Region.

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Chapter 4 – Assessment and Identification of Flood Mitigation Needs

31 TAC § 361.37

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4 Assessment and Identification of Flood Mitigation Needs

This chapter identifies 1) the greatest flood risk knowledge gaps and known flood risks (Section 4.1), and 2) presents the technical memorandum submitted to the Texas Water Development Board (TWDB) in December 2021 (Section 4.2). The identification and evaluation of potential flood management evaluations (FMEs), potentially feasible flood management strategies (FMSs), and flood mitigation projects (FMPs) are described in Chapter 5. Collectively, FMEs, FMSs, and FMPs are referred to in the regional flood plan (RFP) as flood mitigation actions.

4.1 Flood Mitigation Needs Analysis

The flood mitigation needs analysis identifies where the greatest flood risk knowledge gaps exist and where known flood risk and flood mitigation needs are located within the Nueces Flood Planning Region (NFPR). This information guides the identification of flood mitigation actions.

4.1.1 Greatest Known Flood Risk and Flood Mitigation Needs

The areas of greatest known flood risk and flood mitigation needs in the NFPR are defined as areas with elevated levels of risk to property and life. The level of risk is defined by looking at the location and magnitude of flooding from the 1% and 0.2% annual chance flood event (flood hazard), who and what may be harmed (flood exposure), and what communities and critical facilities may be vulnerable (flood vulnerability). The details of the flood hazard, exposure, and vulnerability analyses are fully described in Chapter 2 – Flood Risk Analysis.

An analysis of known flood risk data was performed based on watershed boundaries. For the purposes of this analysis, a hydrologic unit code (HUC)-12 sized watershed was chosen. There are 627 HUC-12 watersheds in the NFPR, as shown in Figure 4-1.

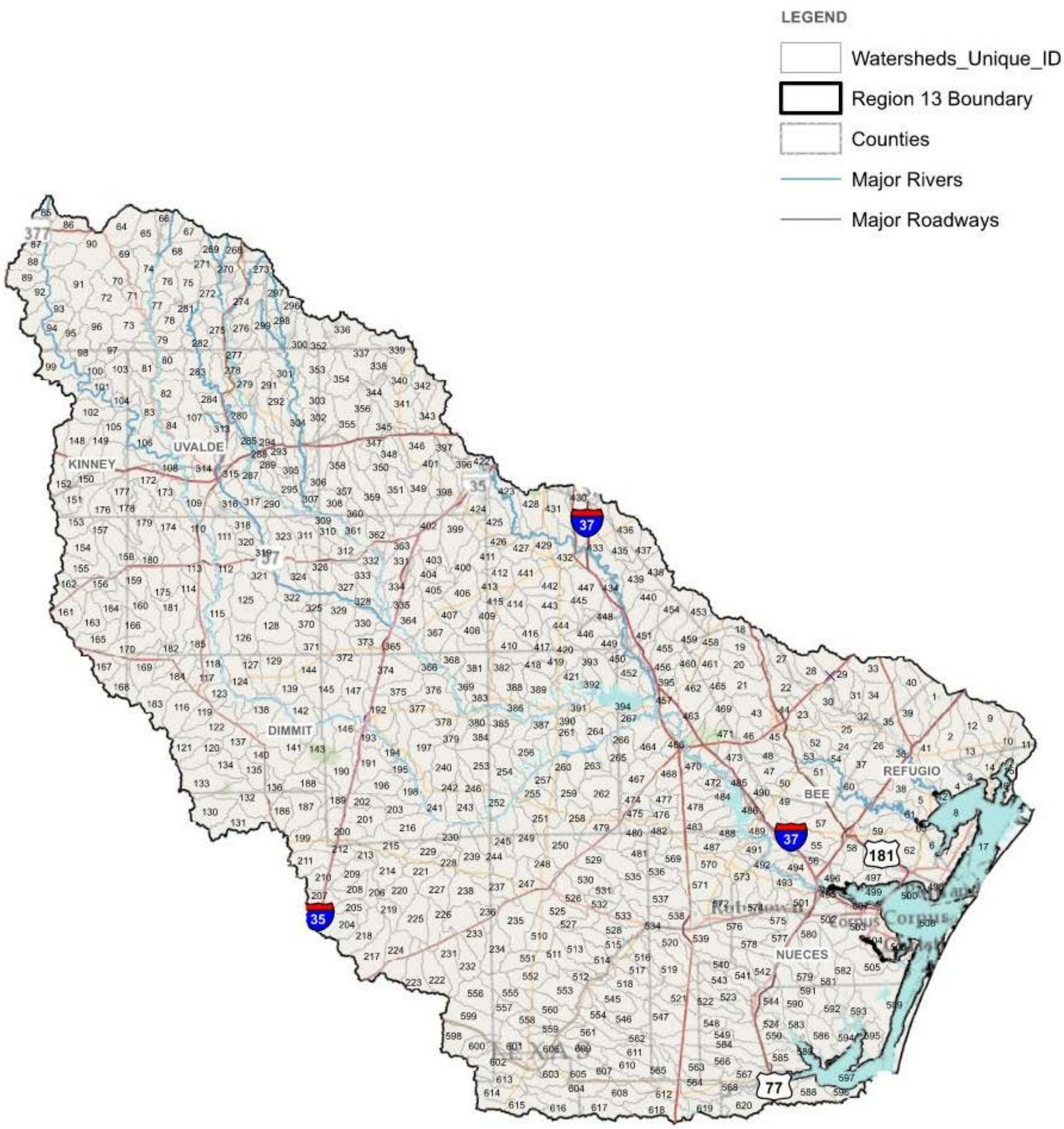

Figure 4-1. Nueces Flood Planning Area HUC 12 Watersheds

The flood risk data related to property damage and life loss risk was evaluated for each HUC-12 watershed in the basin. The various flood risk data categories are listed below with descriptions and assigned weighting percentage applied for each category provided.

- Historical Property Damage (15%) – Property damage data provided by the National Weather Service (NWS), the Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), and local knowledge of flood-prone areas.

- Historical Life Loss (15%) – Flood fatality and injury data collected by the NWS since 1996.
- Property Damage – Exposure (15%) – Exposure data representing the number of residential and commercial building structures located within the best available 1% and 0.2% annual chance flood inundation boundaries.
- Property Damage – Vulnerability (15%) – Vulnerability data representing the number of residential and commercial building structures identified in the "exposure" layer above within a high vulnerability area (i.e., Social Vulnerability Index (SVI) > 0.75%)
- Property Damage – Critical Facilities (15%) - Vulnerability data representing critical facilities, which includes: shelters, airports, Department of Defense military facilities, hospitals, schools (K-12), fire stations, and police stations identified in the 'exposure' layer above.
- Life Loss – Low Water Crossings (15%) - Data as provided by Texas Natural Resources Information System (TNRIS).
- Life Loss – Dams (10%) - Data representing potential hazardous dams that have been identified as either hydraulically inadequate or deficient by the Texas Commission on Environmental Quality (TCEQ).

The data points for each category were counted for each HUC-12 watershed and a score of 1 to 5 assigned based on the statistical relationship to all other HUC-12 watersheds. Then, each category was weighted in terms of property damage and life loss risk to obtain an overall score. Total scores were then adjusted by a scale factor so that the highest score is 5 on the 1 to 5 scale. See an example of this calculation in Table 4-1.*This page is intentionally blank.*

Table 4-1. Flood Risk Score Example Calculation (HUC12 121101060901, ID313)

Item	Historical Property Damage (Flood Prone Areas)	Historical Property Damage (Agency Data)	Historical Life Loss	Property Damage – Exposure (Buildings)	Property Damage – Vulnerability (Buildings)	Property Damage – Vulnerability (Critical Buildings)	Low Water Crossings	Life Loss (Dams)	Total Score	Scaled Score[1]
Count	0	0	0	174	84	4	6	0		
Percentile Rank	0	0	0	90%	93%	93%	96%	0%		
Unweighted Score (1-5)	0	0	0	5	5	5	5	0		
Weighted Percentage	7.5%	7.5%	15 %	15%	15%	15%	15%	10%	100%	
Weighted Score	0	0	0	0.75	0.75	0.75	0.75	0	3.00	4.29
1 – Scale score is equal to total score multiplied by the scale factor, which is the highest possible score (5) divided by the maximum score (3.5) (i.e. 3.00 x 5 / 3.5 = 4.29)										

See Figure 4-2 for flood risk scores for each HUC-12 watershed in the Nueces Basin. No risk is represented by a score of zero and the highest risk is represented by a score of 5. The flood risk category data point scores and total score for each HUC-12 watershed are presented in Appendix C6 – HUC-12 Flood Risk Data Score Table and on a county basin in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions.

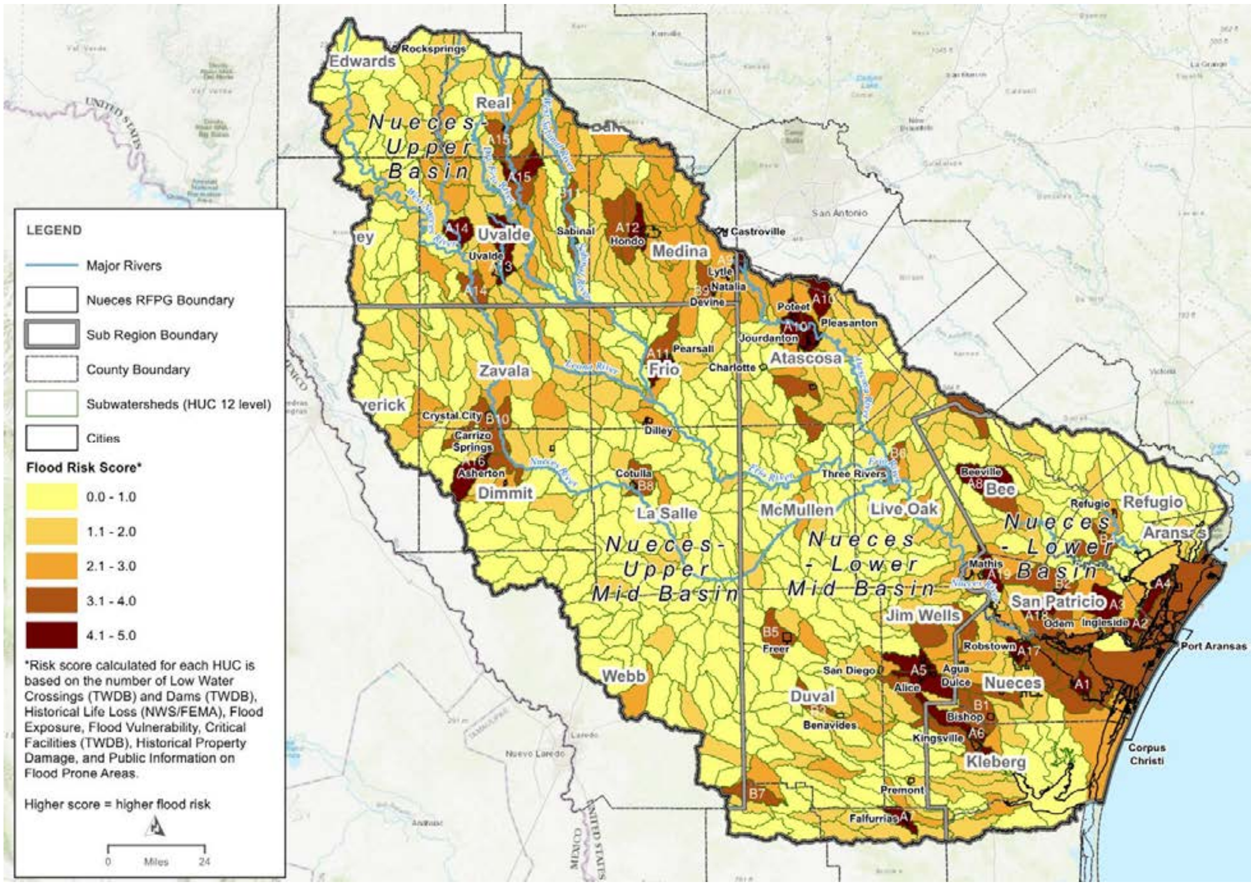

Figure 4-2. Overall Flood Risk per HUC-12 watersheds (Map 15)

Table 4-2 provides a listing of the greatest flood risk areas in relation to municipalities and counties and indicates if the greatest flood risk area is also located in exposure and vulnerability hot spots.

4.1.2 Greatest Flood Risk Knowledge Gaps

The greatest flood risk knowledge gaps for the NFPR are areas in the basin where the following conditions exist:

- Flood inundation boundaries are either not defined or considered inaccurate due to a lack of detailed modeling and mapping
- Flood studies and projects have not occurred in the recent past and are not on-going or proposed through funded projects

- Flood management practices do not exist or are not effectively enforced

4.1.2.1 Detailed Modeling and Mapping Gaps

Flood inundation boundaries are used to define the location and magnitude of flooding. Without accurate flood inundation boundaries, the existing flood risk is not well understood; therefore, controlling future risk through floodplain management regulations is difficult. Flood inundation boundaries based on recent detailed hydrologic and hydraulic models are considered accurate. These areas are shown in Figure 4-3.

Most of the basin does not have accurate flood mapping available and relies on approximate data. See Table 4-2 for a list of high-risk flood areas that are also located in the detailed flood modeling and mapping gap. Prioritizing investment in detailed hydrologic and hydraulic models in the gap areas with the highest overall flood risk is recommended.

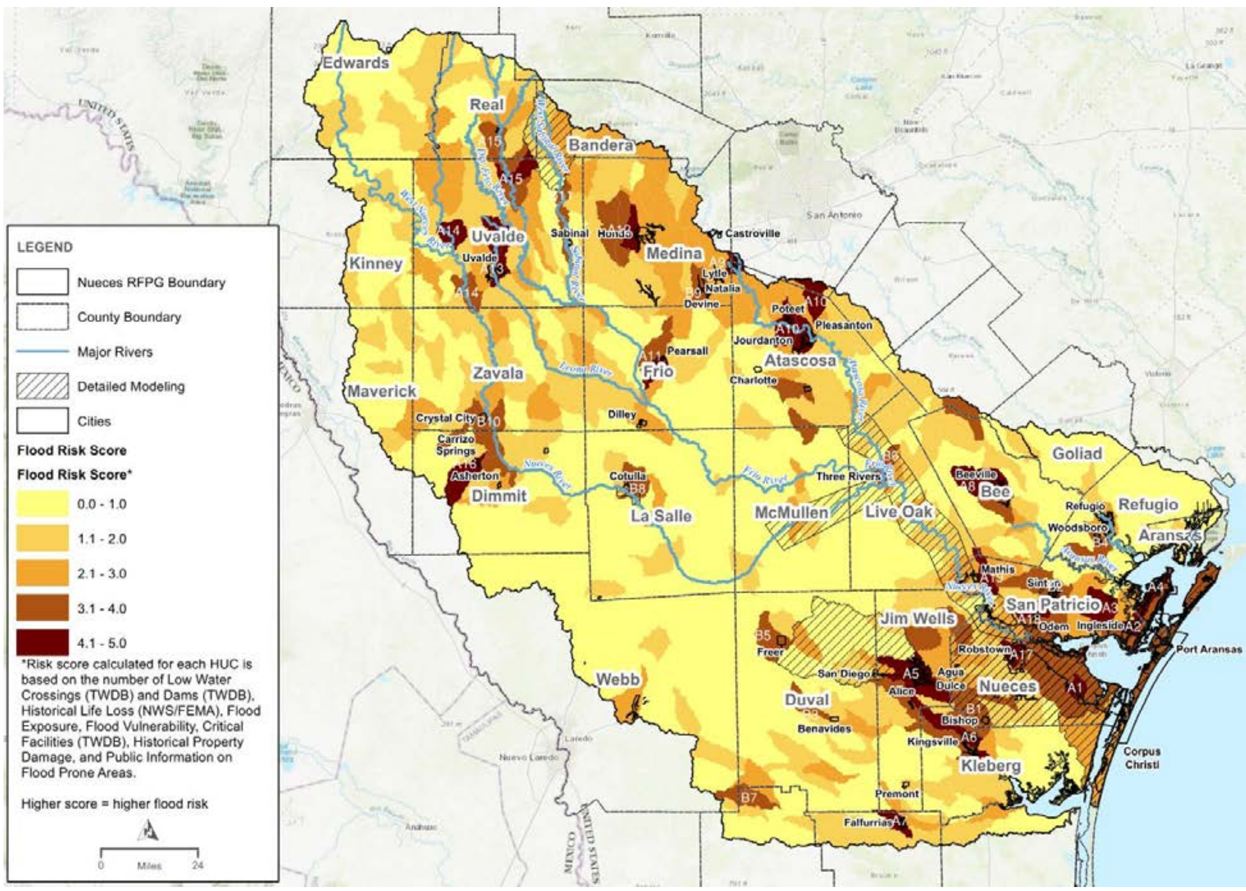

Figure 4-3. Accurate Modeling and Mapping Overlay with Overall Flood Risk (Map 14A)

4.1.2.2 Flood Studies and Projects Gaps

Flood studies are used to identify existing and future flood risks and often recommend mitigation or corrective solutions to reduce those risks. Without a flood study, it is difficult to implement actionable steps to reduce flood risk. For the NFPR, generally, flood studies have occurred or are occurring for counties near the coast. Figure 4-4 overlays the overall flood risk map with locations where on-going or proposed flood studies / projects have been identified. High flood risk areas located in flood study / project gap areas have been identified in Table 4-2.

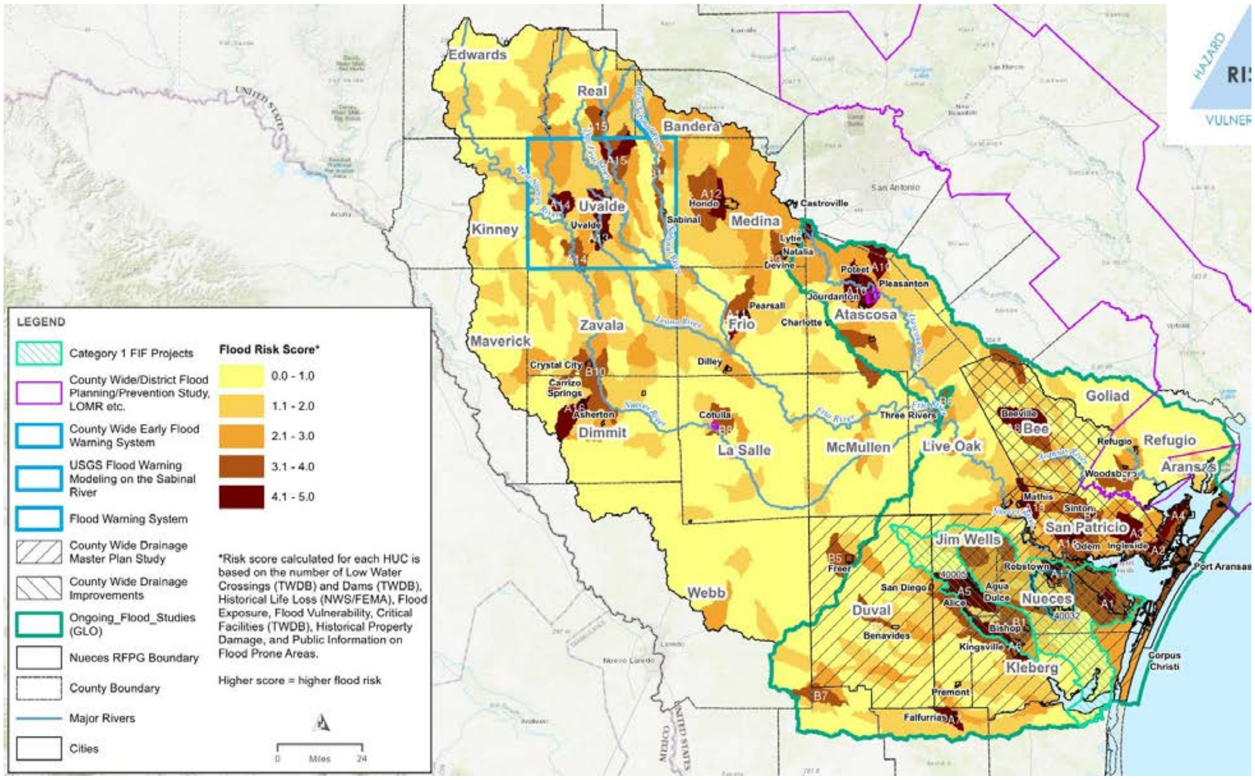

Figure 4-4. Flood Study / Project Overlay with Overall Flood Risk (Map 14B)

4.1.2.3 Floodplain Management Practice Gaps

Enacting floodplain management practices is effective in preventing activities that will result in increased flood risk in the future. Examples include requiring a floodplain permit for development activity in the floodplain and/or requiring building finished floor elevations to be one foot above the 1% annual chance flood elevation. Without floodplain management practices, it is difficult to control future flood risks. Figure 4-5 depicts the level of floodplain management practices and where higher floodplain standards are practiced in relation to the high flood risk areas. Areas of high flood risk in floodplain management gap areas are identified in Table 4-2 and generally include areas located away from the major population growth centers of Corpus Christi, San Antonio, and Laredo. Enhancement of flood management practices in areas with a high flood risk and a floodplain management gap (enforcement is low or none) is recommended.

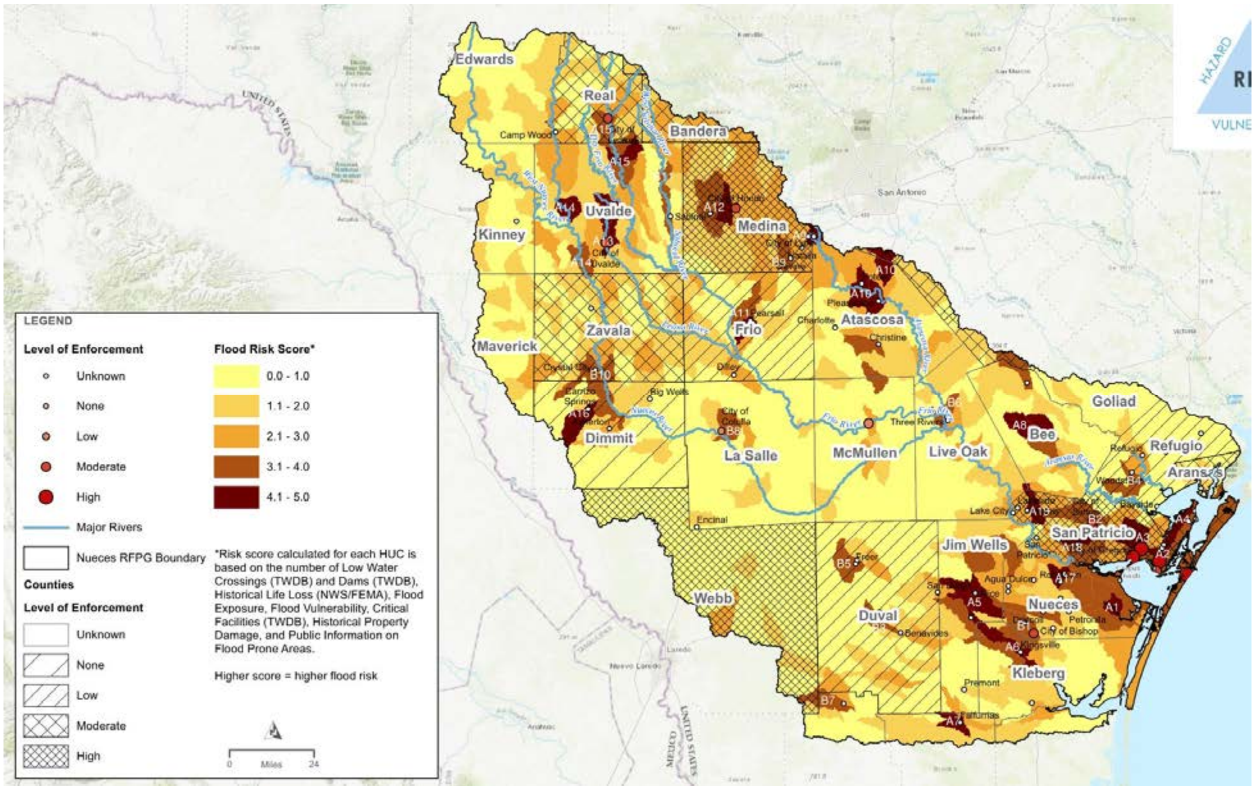

Figure 4-5. Floodplain Management Overlay with Overall Flood Risk (Map 14C)

4.1.2.4 Flood Mitigation Need Summary

The watershed areas with the highest flood risk scores are generally associated with populations located in or near cities or other unincorporated areas. Thus, areas with high flood risks were associated with these population centers in Table 4-2. Flood risk areas that have a flood score risk between 4 to 5 were grouped together to form a list of the highest risk areas. Similarly, flood risk areas that have a flood risk score between 3 to 4 were grouped together and considered high risk flood areas. Then, each flood risk area was evaluated to determine if the risk area is in a hot spot for exposure or vulnerability, as defined in Chapter 2. Further, each flood risk area was evaluated to determine if the risk area is in a knowledge gap area for detailed modeling and mapping, flood studies and projects, or floodplain management practices. The resulting table provides a list that represents the flood mitigation needs in the basin.

Table 4-2. Greatest Known Flood Risk Areas in Relation to Exposure/Vulnerability Hot Spots and Knowledge Gaps

Area ID	Area Description	Vulnerability Hot Spot	Exposure Hot Spot	Detailed Modeling Gap	Flood Study/Project Gap	Flood Management Gap
Highest Risk Areas (Score 4-5)						
A1	City of Corpus Christi, Nueces County	Y	Y	N	N	N
A2	Cities of Ingleside and Aransas Pass, San Patricio County	N	Y	N	N	N
A3	City of Gregory, San Patricio County	N	Y	N	N	N
A4	City of Rockport and Fulton, Aransas County	N	Y	N	N	N
A5	City of Alice, Jim Wells County	Y	Y	N	N	N
A6	City of Kingsville, Kleberg County	Y	Y	N	N	N
A7	City of Falfurrias, Brooks County	Y	Y	Y	N[1]	Y
A8	City of Beeville, Bee County	N	Y	N	N	Y
A9	City of Lytle, Medina County	N	Y	Y	Y	N
A10	Pleasanton, Jourdanton, and Poteet area in Atascosa County	N	N	Y	Y[1]	N
A11	City of Pearsall, Frio County	Y	Y	Y	Y	Y
A12	Hondo area, Medina County	N	Y	N	Y	N
A13	City of Uvalde, Uvalde County	Y	Y	N	N[2]	N

Area ID	Area Description	Vulnerability Hot Spot	Exposure Hot Spot	Detailed Modeling Gap	Flood Study/Project Gap	Flood Management Gap
A14	Area along Nueces River in western Uvalde County	N	N	Y	Y[2]	Y
A15	Cities of Vanderpool and Utopia area along Frio River in Real and Uvalde Counties	N	N	Y	Y[2]	Y[3]
A16	City of Carrizo Springs, Dimmit County	N	N	Y	Y	Y
A17	City of Robstown, Nueces County	Y	Y	N	N	N
A18	City of Odem, San Patricio County	N	Y	N	N	N
A19	City of Mathis, San Patricio County	N	Y	N	N	N
High Risk Areas (Score 3-4)						
B1	Cities of Bishop and Driscoll, Nueces County	N	Y	N	N	N
B2	City of Sinton, San Patricio County	Y	Y	N	N	N
B3	City of Benavides, Duval County	N	N	Y	N	Y
B4	City of Woodsboro, Refugio County	N	N	N	N	N
B5	City of Freer, Duval County	N	N	Y	N	Y
B6	City of Three Rivers, Live Oak County	N	Y	N	Y[1]	N
B7	City of Hebbronville, Jim Hogg County	N	N	Y	Y[1]	Y

Area ID	Area Description	Vulnerability Hot Spot	Exposure Hot Spot	Detailed Modeling Gap	Flood Study/Project Gap	Flood Management Gap
B8	City of Cotulla, LaSalle County	N	N	N	Y	Y
B9	City of Devine, Medina County	Y	Y	Y	Y	N
B10	Crystal City, Zavala County	Y	Y	Y	Y	N
B11	Sabinal River area in northeast Uvalde County and southwest Bandera County	N	N	N	Y	N

1. Located within GLO study area
2. Located within Uvalde Flood Warning System
3. Portion in Uvalde County potentially in a flood management gap area

4.2 Mid-Point Technical Memorandum

As an interim deliverable during development of the Nueces regional flood plan (NRFP), a technical memorandum was submitted to the TWDB on December 22, 2021, along with a geodatabase submittal. This technical memorandum provided a mid-point update on the following regional draft plan elements:

- Political Subdivisions with Flood-Related Authority
- Previous Relevant Flood Studies
- Inundation Boundaries for the existing and future flood hazard
- Additional flood-prone areas
- Availability of existing hydrologic and hydraulic models
- List of available flood-related models of most value
- Adopted flood mitigation and floodplain management goals
- Documented process to identify feasible projects and strategies
- Potential flood evaluations and potential feasible flood projects and strategies
- Identified flood projects and strategies determined infeasible

The NRFPG approved the technical memorandum for submittal to the TWDB on December 6, 2021. The technical memorandum is included in Appendix C5 – Mid-Point Technical Memorandum.

TWDB split out the geodatabase deliverable into two packages, due January 7, and March 7, 2022, respectively. The NRFPG submitted a single geodatabase along with the technical memorandum as part of the January 2022 deliverable and subsequent checklist acknowledging the March 2022 geodatabase deliverable for completion.

Frio River at Kenneth Arthur Crossing (Upper Nueces Basin)

Chapter 5 – Identification, Evaluation, and Recommendation of Flood Management Evaluations, Flood Management Strategies, and Associated Flood Mitigation Projects

31 TAC § 361.38 and § 361.39

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5 Identification, Evaluation, and Recommendation of Flood Mitigation Actions

The objective of Chapter 5 is for regional flood planning groups (RFPGs) to evaluate and recommend identified flood mitigation actions, including flood management evaluations (FME), flood management strategies (FMS), and flood mitigation projects (FMP) for inclusion in the regional flood plan (RFP). This section builds on previous chapters with the ultimate objective of recommending flood mitigation actions that

- reduce the risk identified in the existing and future condition flood risk analyses,
- address flood mitigation and floodplain management goals, and
- address the greatest flood risk and flood mitigation needs.

This chapter summarizes and documents:

1. Categorization of the various flood mitigation actions,
2. Describes the process used to identify, evaluate, and recommend flood mitigation actions,
3. Summarizes the recommendation of flood mitigation actions in 2023 RFP,
4. Describes additional evaluations performed to identify potential additional FMEs and FMPs, and
5. Summarizes the recommendation of flood mitigation actions in the 2023 amended RFP.

5.1 Categorization of Flood Mitigation Actions

5.1.1 Flood Management Evaluation

An FME, by Texas Water Development Board (TWDB) definition, is “a proposed flood study of a specific, flood-prone area that is needed in order to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs.” There are three general categories of FMEs as described below. An FME may include any or all these study elements or phases:

- Flood hazard modeling and mapping / risk identification studies
- Flood mitigation alternatives analysis / feasibility studies
- Preliminary Engineering studies

5.1.2 Flood Mitigation Project

An FMP, by TWDB definition, is "a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring costs and when implemented will reduce flood risk, mitigate flood hazards to life or property."

One of the primary objectives of the regional flood plan (RFP) is to identify and recommend FMPs for implementation, making them eligible for FIF funding; therefore, identifying FMPs that meet state flood plan criteria and requirements for inclusion into the state flood plan (SFP) is a high priority. Per the TWDB rules, of the four common phases of emergency management shown in Figure 5-1, the regional flood planning process focuses primarily on mitigation projects but may also include preparedness projects. Flood preparedness, response, and recovery activities are discussed in Chapter 7.

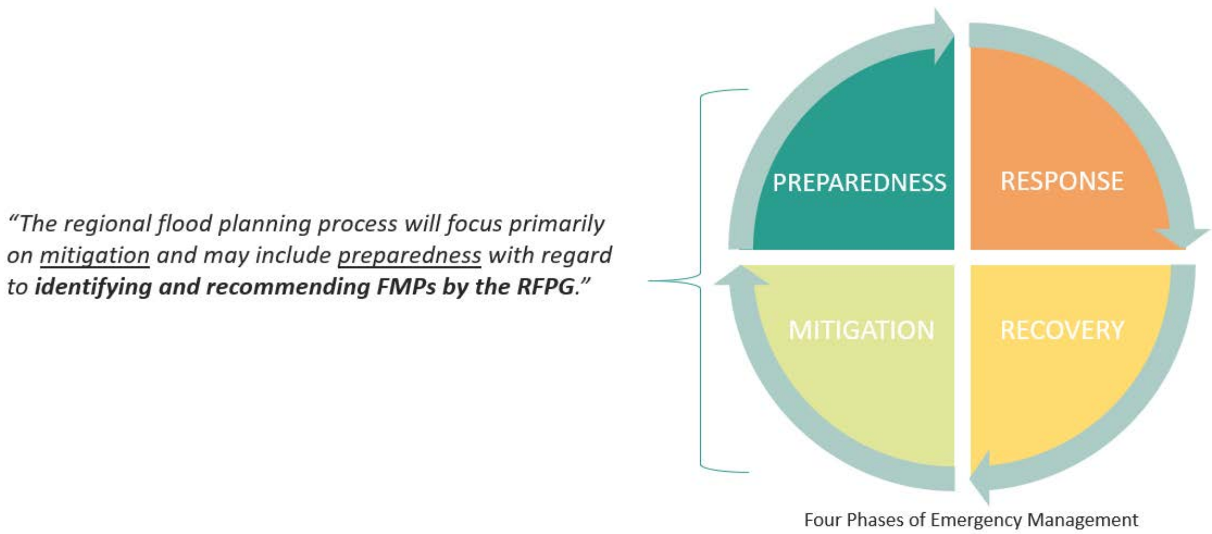

Figure 5-1. Four Phases of Emergency Management

FMPs are further categorized as either structural or non-structural.

Structural FMPs are defined as building or modifying infrastructure to change flood characteristics to reduce flood risk. They are infrastructure projects with advanced analysis and 30% to 100% design development, including construction plans, specifications, and cost estimates. Structure FMPs include one or a combination of the following project types:

- Low water Crossings (LWCs) or Culvert/Bridge Improvements
- Channel Improvements
- Flood Detention
- Flood Walls/Levees
- Flood Diversion – Examples include diversion channels or diversion tunnels

- Storm Drain Improvements
- Dam Improvements
- Coastal Protections – Examples include coastal levees, dikes, and seawalls and often include beach erosion countermeasures such as riprap revetments. Coastal protections can also include green or hybrid solutions such as living shorelines and breakwaters.
- Nature-based Features – Examples include stream and coastal restorations, wetlands, natural channel design, other green infrastructure elements, and land preservation. TWDB strongly encourages the RFPG to consider nature-based flood risk reduction solutions in their overall approach.

Non-structural FMPs change the way people interact with flood risk and move people out of harm's way. These types of projects do not involve modifications to the watershed or flood infrastructure; therefore, they do not have negative impacts to adjacent areas or environmental impacts. Non-structural FMPs include one or a combination of the following project types:

- Flood Readiness and Resilience – Examples include flood response plans, evacuation plans, and emergency action plans
- Floodplain Evacuation – Examples include property acquisition / buyouts
- Flood Early Warning Systems – Examples include stream gauges and warning signals to more complex early flood warning systems that can forecast floods and warn large populations to evacuate
- Floodproofing – Examples include making structures watertight and elevation of individual structures
- Regulatory Requirements for Reduction of Flood Risk – Examples include floodplain development ordinances and drainage design criteria related to planning, zoning, land development, and building codes

5.1.3 Flood Mitigation Strategy

An FMS, by TWDB definition, is "a proposed plan to reduce flood risk or mitigate flood hazards to life or property". The RFPG should include as FMSs any proposed action that the group would like to identify, evaluate, and recommend that does not quality as either a FME or FMP. FMSs generally fall into the following categories:

- Flood mitigation education and outreach
- Buyout programs
- Flood management regulations

5.2 Description of Process to Identify, Evaluate, and Recommend Flood Mitigation Actions

The following steps were used to identify, evaluate, and recommend flood mitigation actions:

1. Define draft process for identifying and evaluating flood mitigation actions.
2. Extract potential flood mitigation actions from review of relevant flood studies.
3. Conducted initial stakeholder outreach to obtain information on flood mitigation actions.
4. Identify additional flood mitigation actions to address unmet greatest known flood needs and goals.
5. Perform initial screening and evaluation of flood mitigation actions to determine if actions meet minimum TWDB requirements.
6. Recommend flood mitigation actions.
7. Perform, within the RFPG's resources and the time available, a portion of identified FMEs to identify additional recommended FMEs and FMPs for inclusion in the Amended 2023 Regional Flood Plan.

Steps 1-6 above were performed as part of the 2023 NRFP. Step 7 is a new step that forms the basis of the Amended 2023 RFP, based on additional resources provided by TWDB to RFPGs (Tasks 11-13). The above steps are further described in the following sections.

5.2.1 Draft Process

TWDB requirements state that each RFPG is to develop and receive public comment on a "…proposed process to be used by the RFPG to identify and select flood management evaluations, flood mitigation strategies, and flood mitigation projects. This process is to be documented and such documentation is to be included in the draft and final adopted Regional Flood Plan."

At the NRFPG meeting on July 26, 2021, a Region 13 subcommittee was formed to develop a draft process. The Region 13 subcommittee included Debra Barrett, Lj Francis, Kendria Ray, and Lauren Hutch Williams, who met on August 23, 2021, to prepare recommendations for the NRFPG. The resulting recommendations of a draft process to be used by the RFPG to identify potentially feasible FMEs, FMSs and FMPs for the Nueces regional flood plan (NRFP) was approved at the September 27, 2021, regional flood planning meeting. The approved draft process is provided in Figure 5-2 and Figure 5-3.

Agenda Item #10. Proposed Process for Identifying Potential Flood Management Evaluations, Strategies, and Projects for the 2023 Nueces Regional Flood Plan

The process outlined below for identifying and selecting FMEs, FMSs, and FMPs was developed by the Region 13 subcommittee (consisting of Debra Barrett, Lj Francis, Kendria Ray, and Lauren Williams) on August 23rd for Nueces RFPG consideration at its Sept 27th meeting with public input.

1) The Nueces RFPG solicited public and stakeholder comments related to identifying potential FMEs, FMS, and FMPs, as follows:
    - Deploying a public comment map on the Region 13 website Home - Nueces Regional Flood Planning Group (Region 13) (nueces-rfpg.org), requesting feedback on flood-prone areas in the Nueces Basin. The comment map was open from April through August 2021. As of July 23rd, 185 comments on flood-prone areas were received.
    - A survey requesting information on proposed/ongoing flood projects was sent on June 18, 2021 to over 400 floodplain administrators and stakeholders in the Nueces Basin.
    - Direct outreach included four sub-regional meetings held May 17-20th, personal emails to floodplain administrators, and follow-up phone calls to selected municipalities to gather information on local and regional flood plans in the Nueces Basin and flood planning needs. As of August 17th, 32 entities had completed a survey on existing floodplain practices.
2) A subcommittee formed during the July 26th Nueces RFPG meeting consisted of voting and non-voting NRFPG members met on August 23rd to develop a draft process for identifying projects.
3) The Nueces RFPG will receive public comment at the September 27th meeting on the proposed process to be used to identify and select FMEs, FMSs, and FMPs.
4) Ongoing/proposed projects and flood-prone areas will be reviewed to identify project needs and data gaps.
5) Considering information provided by stakeholders, an initial screening of studies, projects and strategies will be performed based on the following metrics:
    - Addresses flood mitigation/ floodplain management goals adopted by the NRFPG
    - Prioritize emergency needs
    - Consider prevention projects to mitigate future flooding
    - Consider identified projects within a lens of potential impact to Agreed Order provisions
    - Indication regarding potential use of federal funds, TWDB, or other sources of funding and include a table of potential funding sources in the draft and final plan
    - Reduces flooding risk (benefits life and property) for drainage areas of 1 sq mile or more
    - Assess potential for including nature-based solutions and applicability
    - Unlikely to negatively affect a neighboring area (FMS or FMP only)
    - Reduces flood risk for 100-year storm event (1% annual chance of flood)(FMS or FMP only)
6) Using TWDB guidance (next page), a draft list of FMEs, FMSs, and FMPs will be compiled for consideration by the Nueces RFPG at its meeting in Oct/Nov 2021. Infeasible FMSs and FMPs will be identified, including primary reason for deeming infeasible.
7) A list of potential FMEs and potentially feasible FMS and FMPs identified by the NRFPG and infeasible FMSs and FMPs will be included in the Technical Memorandum due to TWDB in Jan 2022.
8) The Nueces RWPG will consider and submit a scope of work to the TWDB of FMEs, FMSs, and FMPs to be evaluated in the 2023 Nueces Regional Flood Plan.

Flood Management Evaluation (FME)- flood study of a specific flood prone area needed to assess risk
Flood Mitigation Project (FMP)- structural or non-structural project that when implemented will reduce flood risk, mitigate hazards to life or property. Includes nature-based solutions. 'No negative impact'
Flood Management Strategy (FMS)- proposed plan to reduce flood risk or mitigate flood hazards. Any action that a RFPG would like to evaluate and recommend that does not qualify as FME or FMP.

Figure 5-2. Process for Identifying Potential Flood Mitigation Actions for the 2023 Nueces RFP

9) The process by which potentially feasible FMS are selected for evaluation in the 2023 Nueces Regional Flood Plan will be revisited and updated (if necessary) after submittal of the technical memorandum. A description of process will be included in draft and final plans.

TWDB guidance for designating FMEs/FMPs (from TWDB)

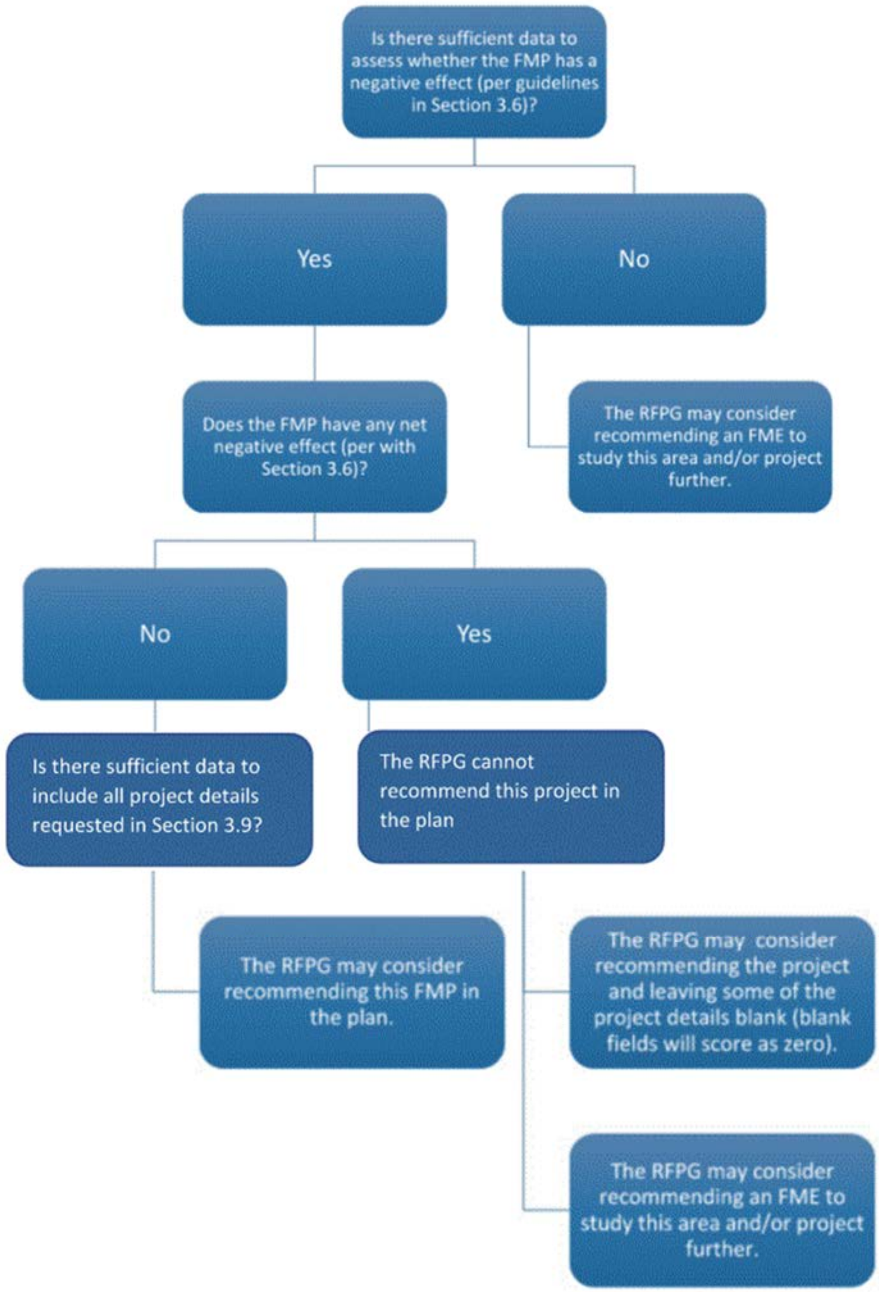

Figure 5-3: Process for Identifying Potential Flood Mitigation Actions for the 2023 Nueces RFP (Continued)

5.2.2 Review of Relevant Flood Studies

A list of potential flood mitigation actions, derived from the review of previous relevant flood studies, are listed in Appendix C2 – List of Previous Flood Studies. These include multiple hazard mitigation plans, regional floodplain management plans, and other flood risk reduction type plans. All recommended FMEs were screened to ensure that they would not exactly duplicate the work of an ongoing TWDB Flood Infrastructure Fund (FIF) category 1 study. Although some recommended FMEs overlap with ongoing FIF category 1 studies, all recommended FMEs studies have different aims from the ongoing FIF category 1 studies. While some duplication of effort is inevitable between funded FMEs and the FIF category 1 studies, care should be taken to communicate with the sponsoring entity to minimize any duplication of work.

5.2.3 Stakeholder Outreach

Effective outreach to individuals with knowledge of known flood-prone areas and potential flood mitigation evaluations and projects was a key to developing the list of flood mitigation actions. Continuous efforts have been made since the start of the flood planning process to identify and engage those with flood-related authority in the basin. Four subregional meetings were held in May 2021 to introduce the regional flood planning process and to gather local knowledge of flood-prone areas, flood mitigation projects, and needs based on the pre-established subregional designed county groupings, shown previously in Figure 1-2.

In February 2022, the NRFPG reached out to county judges to further refine the stakeholder list of those with flood-related authority and knowledge, to identify flood plain contacts for county and city representation, and garner interest in upcoming stakeholder outreach. Stakeholders were contacted and 20 individual interviewers and three subregional meetings were held from February through April 2022. The list of flood mitigation actions previously identified were reviewed during the additional outreach to determine if any were under consideration or no longer needed, if the list was complete, and to obtain additional information.

Initial efforts to contact potential sponsors consisted of sending surveys to communities. These surveys contained projects associated with each community identified, giving the community an opportunity to communicate any projects that are no longer relevant or any projects that they are actively pursuing. These surveys were followed by calls to those same community contacts to inform communities of the survey and its purpose. To supplement this initial outreach effort, relationships previously developed with Nueces Region communities were leveraged to inform them of the NRFPG and its purpose and inform them of the previously sent survey to gather additional input. As in-person community outreach meetings took place, additional discussions and meetings occurred that further garnered community input regarding potential mitigation actions.

While these actions furthered the goal of receiving community feedback on what projects they wanted to pursue, not all communities were reached, and accordingly, the NRFPG decided that an affirmative willingness to sponsor a given action would not be a prerequisite for inclusion in the plan. As a result, all potential actions were considered for inclusion unless an entity had specifically declined to be listed as a sponsor and no other appropriate potential sponsor was identified. This approach was adopted for the following reasons.

1. It provides a conservative estimate of the flood mitigation need in the region.
2. It does not oblige an entity to sponsorship; it simply allows an entity to be eligible for funding if interest in and capacity to sponsor a project become evident within this planning cycle.

All sponsors associated with recommended actions were subsequently sent a survey to identify potential funding needs and sources for the actions listed in the plan. This effort is detailed in Chapter 9.

From September 2022 to May 2023, the NRFPG reached out to potential project sponsors by email, phone call, and in-person meetings to gather information for further evaluation of additional recommended FMEs and FMPs for the Amended 2023 NRFP.

5.2.4 Identified Additional Flood Mitigation Actions to meet unmet Needs and Goals

A flood risk gap evaluation was performed in Chapter 4 to determine how the list of flood mitigation actions relate to the greatest known flood risk and mitigation needs and the regional goals. Areas identified as high risk but lacking flood studies or projects to address the flood mitigation need include:

- City of Falfurrias in Brooks County
- City Lytle in Medina County
- City of Three Rivers in Live Oak County
- Pleasanton, Jourdanton, and Poteet area in Atascosa County
- City of Pearsall in Frio County
- Devine area in Medina County
- Hondo area in Medina County
- City of Uvalde in Uvalde County
- Crystal City in Zavala County
- City of Carrizo Springs in Dimmit County
- Cities of Vanderpool and Utopia area along Frio River in Real and Uvalde County
- Area along Nueces River in western Uvalde County
- City of Cotulla in LaSalle County
- City of Woodsboro in Refugio County

- City of Hebbronville in Jim Hogg County
- Sabinal River are in northeast Uvalde County and southwest Bandera County

Potential flood mitigation evaluations were identified to provide flood studies for the list of high-risk areas above.

A gap evaluation was also performed in Chapter 4 to determine how the list of flood mitigation actions relate to the floodplain mitigation and floodplain management goals presented in Chapter 3. The list of flood mitigation actions was found insufficient to achieve several of the Nueces Basin goals. Thus, additional studies were recommended as listed in Table 5-1 to help achieve Nueces basin goals while addressing areas of flood risk.

Table 5-1. Recommended Flood Studies to address Goals

Goal #	Name of Study	Potential Sponsor
1 – Low Water Crossings	Nueces Basin low water crossing study and upgrade prioritization	Nueces River Authority
2 – High Hazard Dams	Nueces Basin High Hazard Dam identification and risk assessment	Texas State Soil Conservation and Water Conservation Board (TSSWCB)
3 – Regional Coordination / Flood Warning Systems	Nueces Basin early flood warning system	Nueces River Authority
4 – Flood Map Updates	Nueces Basin Floodplain Map Updates	Nueces River Authority
6 – Minimum Flood Standards	Nueces Basin Minimum Flood Management Standards	Nueces River Authority
7 – Nature Based Practices	Nueces Basin Assessment of Flood Mitigation and Performance of Nature-based Solutions (NBS)	The Nature Conservancy

Goal #	Name of Study	Potential Sponsor
7 – Nature Based Practices	Scaling Up Nature Based Solutions (NBS) in the Nueces Flood Planning Region to support community resilience and enhance flood and hazard mitigation planning	The Nature Conservancy
8 – Flood Public Information Campaign	Nueces Basin flood public information campaign	Nueces River Authority

5.2.5 NRFPG Evaluation Process

The NRFPG considered recommendations on flood mitigation actions through a multi-step process. As documented in 5.2.3, the NRFPG created a Technical Subcommittee tasked with establishing a selection methodology, implementing the evaluation and selection process, and reporting their findings and recommendations back to the NRFPG for formal approval. The methodology included a screening of all potential flood mitigation actions considering TWDB requirements for inclusion in the RFP and any other additional considerations established by the Technical Subcommittee. The reasons for not recommending a particular flood mitigation action were reviewed by the NRFPG as part of the evaluation and recommendation process with reasons documented in the potential flood mitigation action tables attached to this plan (see Appendix A7 through A9).

The screening process for evaluating and recommending flood mitigation actions is summarized in Figure 5-4 for FMEs and in Figure 5-5 for FMPs and FMSs. These processes were primarily developed following the TWDB rules and requirements for inclusion in the plan. However, the TWDB left some evaluation criteria at the discretion of the RFPG and additional guidance was necessary prior to implementing the screening process. The main discretionary evaluation criteria are the LOS to be provided by an FMP and the benefit-cost ratio (BCR) for the project. The TWDB recommends FMPs should minimally mitigate flood events associated with the 1% annual chance flood (100-year LOS). However, if a 100-year LOS is not feasible, the RFPG can document the reasons for its infeasibility and still recommend an FMP with a lower LOS. Similarly, the TWDB recommends that proposed actions have a BCR greater than one, but the RFPG may recommend FMPs with a BCR lower than one with proper justification.

1. Goals	•Remove FMEs that do not support a specific RFPG goal
2. Contact Sponsors	•Verify if study has been completed •Verify interest in potential FME •Request additional data to refine FME areas •Remove FMEs that are complete or if Sponsor is not interested
3. Analysis	•Refine FME areas as needed •Populate Flood Risk Indicators •Calculate cost for FME (See section below for further information)
4. Re-Classify	•Evaluate quantifiable results and identify FMEs that could result in the greatest benefits •Identify FMEs that have real potential to develop into FMPs for the next cycle •Identify FMEs that could be re-classified to FMP •Identify FMEs located in areas of greatest need (use Task 4A results)
5. Goals	•Review selected FMEs to verify if they cover all short-term goals •Develop additional FMEs as needed to cover missing short-term goals •Identify Sponsors for additional FMEs and obtain their commitment
6. Recommend	•Final FME Recommendations (see Section 5.1.3.1 - Summary of Approach in Recommending FMEs)

Figure 5-4: FME Screening, Evaluation, and Recommendation Process

1. Goals
- Remove FMPs / FMSs that do not support an RFPG goal

2. Remove
- Focuses on addressing response and recovery rather than mitigation.
- Does not provide flood mitigation for the 100-yr flood event (may still be recommended if RFPG desires)
- Is not a discrete project

3. Contact Sponsors
- Verify if project is complete / already funded
- Verify interest in potential FMP/FMS and request additional data
- Remove FMPs/FMSs that are complete or if Sponsor is not interested

4. Initial Analysis
- Populate Flood Risk Indicators
- Calculate Reduction in Flood Risk
- Calculate Costs (See section below for further information)

5. Full Analysis
- Negative Impacts Determination (See section below for further information)
- Benefit-Cost Analysis (See section below for further information)

6. Remove
- Causes adverse impacts
- No quantifiable flood reduction benefits
- Duplicate Benefits

7. Re-Classify
- Determine if there are any FMPs that need to be re-classified to FME

8. Evaluate
- Quantifiable results to ID FMPs / FMSs with the most complete information and / or result in the greatest benefits
- Identify FMPs / FMSs located in areas of greatest need (use Task 4A results)

9. Recommend
- Final FMP / FMS Recommendations

Figure 5-5: FMP and FMS Screening, Evaluation, and Recommendation Process

5.2.5.1 Flood Mitigation Action Costing Assumptions

To quantify the flood mitigation need within the Nueces Region, each flood mitigation action was assigned a cost. This was completed by leveraging the data available for each project and following a set of guidelines that promoted consistency while determining costs across multiple projects. Project cost estimates developed after September 2020 had the potential to be used directly, as it was assumed that these remained an accurate representation of the projects' cost. For those projects that had cost estimates developed prior to September 2020, the project cost was escalated to an equivalent September 2020 dollar amount using Consumer Cost Index (CCI) values. To accommodate instances where flood mitigation action did not have project cost estimates available, a set of costing tables were developed based on action type and prevalent subcategories among the actions under review. The cost tables for FMEs and FMSs can be found in Appendix C8 – Supporting Costing Material for Flood Mitigation Actions. A table was not developed for FMPs as FMP costing was reliant upon escalating cost estimates provided by sponsors. Costing supporting materials such as factors used to derive September 2020 dollars from available cost estimates and calculators used to develop costs for Flood Mapping Updates and Dam Failure Analysis projects are also included in attached supporting costing material.

5.2.5.2 No Negative Impacts Determination

Each identified FMP must demonstrate that there would be no negative impacts on a neighboring area due to its implementation. No negative impact means that a project will not increase flood risk of surrounding properties. Using best available data, the increase in flood risk must be measured by the 1% annual chance event water surface elevation and peak discharge.

For the purposes of flood planning effort, the following requirements, per TWDB Technical Guidelines, should be met to establish no negative impact, as applicable:

1. Stormwater does not increase inundation in areas beyond the public right-of-way, project property, or easement
2. Stormwater does not increase inundation of storm drainage networks, channels, and roadways beyond design capacity
3. Maximum increase of 1D Water Surface Elevation must round to 0.0 feet (<0.05 ft) measured along the hydraulic cross-section
4. Maximum increase of 2D Water Surface Elevations must round to 0.3 feet (<0.35 ft) measured at each computation cell
5. Maximum increase in hydrologic peak discharge must be < 0.5% measured at computation nodes (sub-basins, junctions, reaches, reservoirs, etc.). This discharge restriction does not apply to a 2D overland analysis.

If negative impacts are identified, mitigation measures may be used to alleviate such impacts. Projects with design level mitigation measures already identified may be included in the regional flood plan and could be finalized at a later stage to conform to the "No Negative Impact" requirements prior to funding or execution of a project.

Furthermore, the RFPG has flexibility to consider and accept additional "negative impact" for requirements 1 through 5 based on engineer's professional judgment and analysis given any affected stakeholders are informed and accept the impacts. This should be well-documented and consistent across the entire region. However, flexibility regarding negative impact remains subject to TWDB review.

The typical process for this determination is to perform a comparative assessment of pre- and post-project conditions for the 1% annual chance event (100-year flood) for each potentially feasible FMP based on their associated hydrologic and hydraulic models. The floodplain boundary extents, resulting water surface elevations, and peak discharge values would be compared at pertinent locations to determine if the FMP conforms to the no negative impacts requirements. This comparative assessment would be performed for the entire zone of influence of the FMP.

5.2.5.3 Benefit-Cost Analysis

Benefit-cost analysis (BCA) is the method by which the future benefits of a hazard mitigation project are determined and compared to its costs. The end result is a benefit-cost ratio (BCR), which is calculated by dividing the project's total benefits, quantified as a dollar amount, by its total costs. Updated construction cost estimates and estimates of project benefits must also be available to define a BCR for each recommended FMP. The BCR is a numerical expression of the relative "cost-effectiveness" of a project. A project is generally considered to be cost effective when the BCR is 1.0 or greater, indicating the benefits of a prospective hazard mitigation project are sufficient to justify the costs (FEMA, 2009). However, a BCR greater than 1.0 is not a requirement for inclusion in the RFP. The RFPG can decide to recommend a project with a lower BCR with appropriate justification.

The NRFPG considered all potentially feasible FMPs within the context of necessary data and detailed hydrologic and hydraulic modeling results available in accordance with TWDB technical requirements.

5.2.6 Summary of Approach of Recommending Flood Mitigation Actions

While there is an abundant need across the Nueces Region and the State of Texas for data collection, strategy implementation, and project construction to reduce or remove risk of flooding, not every flood mitigation action can be recommended in the RFP or included in the state flood plan (SFP) due to insufficient available information. The NRFPG evaluated the identified flood mitigation actions, and based on the significant needs in the region, recommended all those that met the TWDB requirements and offered the greatest potential of reducing flood risks within the region, understanding that as additional information is developed through ongoing or future studies that they can be recategorized as needed in future planning cycles. All recommended projects considered alignment with NRFPG-adopted flood mitigation and floodplain management goals (Chapter 4).

5.2.6.1 Summary of Approach of Recommending FMEs

In considering potential FMEs for recommendation, the NRFPG sought to determine which FMEs would be most likely to result in identification of potentially feasible FMSs and FMPs in future planning cycles. Recommended FMEs were also required to demonstrate alignment with at least one regional floodplain management and flood mitigation goal developed under Task 3. Finally, each recommended FME should identify and investigate at least one solution to mitigate the 1% annual chance flood. It is the intent that all FMEs with a hydrologic and hydraulic modeling component will evaluate multiple storm events, including the 1% annual chance flood. The exact solutions identified through performing these FMEs cannot be defined at this time. However, it is anticipated that an impact analysis will be performed for all alternatives and project benefits will be tabulated for the 1% annual chance flood to help inform any recommended alternatives and to define potentially feasible FMPs under this planning framework. Based on these TWDB requirements, the NRFPG identified two main reasons for recommending FMEs.

The first subset of recommended FMEs would result in increased flood risk modeling and mapping coverage across the region as they are implemented. These types of FMEs have two major implications for identifying potentially feasible FMSs and FMPs.

First, a current and comprehensive understanding of flood risk across the basin is necessary to identify high-risk areas for evaluation and development of flood risk reduction alternatives. Secondly, FMPs, and in some cases, FMSs, require a demonstrated potential reduction in flood risk to be recommended in the regional flood plan. For this metric to be assessed, hydrologic and hydraulic modeling must be available to compare existing and post-project floodplain boundaries to determine the flood risk reduction potential of a given project.

The second subset of recommended FMEs are project planning type FMEs. These FMEs are generally studies or preliminary designs to address a specific, known flood need. However, these flood mitigation actions currently lack some or all the detailed technical data necessary for evaluation and recommendation as an FMP such as demonstrating no adverse impacts, having a BCR greater than 1.0, or confirmation that the project provides mitigation for the 1% annual chance flood event. An example would be an existing study that identifies a potential drainage construction project but does not provide a no adverse impact analysis or statement. Completing these components as part of an FME will result in a potentially feasible FMP for consideration during future flood planning efforts. Sponsor input was a major driver for choosing not to recommend FMEs. FMEs that were indicated by the sponsor as being in progress, completed, or lacking interest to pursue were not recommended. Additionally, FMEs in close proximity to one another were combined into a single FME for recommendation due to overlapping goals or benefits.

5.2.6.2 Summary of Approach of Recommending FMPs

For consideration as an FMP, a project must be defined in a sufficient level of detail to meet the technical requirements of the flood planning project Scope of Work and the associated Technical Guidelines developed by the TWDB. In summary, the RFPG must be able to demonstrate that each recommended FMP meets the following TWDB requirements:

1. The primary purpose is mitigation (response and recovery projects are not eligible for inclusion in the regional flood plan).
2. Supports at least one regional floodplain management and flood mitigation goal. The goals associated with each FMP are included in Appendix A6 – TWDB Table 11 – Flood Mitigation and Floodplain Management Goals.
3. The FMP is a discrete project (not an entire capital program or drainage master plan).
4. Implementation of the FMP results in:
    a. Quantifiable flood risk reduction benefits (for further information see Benefit-Cost Analysis section below)
    b. No negative impacts to adjacent or downstream properties (for further information see No Negative Impacts Determination section below)
    c. No negative impacts to an entity’s water supply
    d. No overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan (TWDB, 2022 State Water Plan, Appendix B).

In addition, the TWDB recommends that, minimally, FMPs should mitigate flood events associated with the 1% annual chance flood (100-year LOS). However, if a 100-year LOS is not feasible, the RFPG can document the reasons for its infeasibility and still recommend an FMP with a lower LOS.

The TWDB recommends that proposed projects have a BCR greater than one, but the RFPG may recommend FMPs with a BCR lower than one with proper justification.

5.2.6.3 Summary of Approach in Recommending FMSs

The approach for recommending FMSs adheres to similar requirements as the FMP process. However, due to the flexibility and varying nature of RFPG's potential use of FMSs, some of these requirements may not be applicable to certain types of FMSs. In general, the RFPG must be able to demonstrate that each recommended FMS meets the following TWDB requirements as applicable:

1. The primary purpose is mitigation (response and recovery projects are not eligible for inclusion in the regional flood plan).
2. Supports at least one regional floodplain management and flood mitigation goal.
3. Implementation of the FMS results in:
    a. Quantifiable flood risk reduction benefits
    b. No negative impacts to adjacent or downstream properties (a No Negative Impact certification is required)
    c. No negative impacts to an entities water supply
    d. No overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan.

In addition, the TWDB recommends that, at a minimum, FMSs should mitigate flood events associated with the 1% annual chance flood (100-year LOS). However, if a 100-year LOS is not feasible, the RFPG can document the reasons for its infeasibility and still recommend an FMS with a lower LOS.

Although each potentially feasible FMS must demonstrate that there would be no negative flood impacts on a neighboring area due to its implementation, there was no modeling available for the FMSs identified within this region, and therefore it could not be determined that there would be any reduction in flood risk or negative impacts to adjacent or downstream properties.

Multiple communities communicated an interest to pursue FMSs associated with Flood Management Standards and a Flood Public Information Campaign. Due to the number of communities expressing interest in these activities and the benefits associated with their uniform implementation across the region, it was determined that these FMSs would be more effectively executed at the regional level by the Nueces River Authority. Accordingly, community FMSs that fell under these two categories were not recommended, and instead the regional implementation of these FMSs was instead recommended.

5.2.7 Recommendation of Flood Mitigation Actions

On May 6, 2022, the NRFPG voted to recommend FMEs, FMPs, and FMSs for inclusion into the 2023 RFP. This meeting was held in accordance with the requirements of the RFPG bylaws, the Texas Open Meetings Act, and the general requirements of the Texas Water Code and the flood planning process.

5.2.7.1 Identified and Recommended FMEs in the 2023 NRFP

The NRFPG identified and evaluated a total of 179 potential FMEs in the 2023 Final Plan. Of these projects, 163 were recommended, representing a combined total of $282,331,000 of flood management evaluation need across the region. Note, the 2023 Final Plan FME recommendations have been amended as described in Sections 5.3.

5.2.7.2 Identified and Recommended FMPs in the 2023 NRFP

The NRFPG identified and evaluated a total of four potential FMPs in the 2023 Final Plan. Of these projects, zero were recommended due to insufficient levels of detail to meet the technical requirements for an FMP. After the 2023 Final Plan was delivered in January 2023, additional work was completed that resulted in recommendations of 31 FMPs in the Amended 2023 NRFP as described in Sections 5.3.

5.2.7.3 Identified and Recommended FMSs in the 2023 NRFP

A variety of FMS types were identified for the Nueces Region. Generally, these FMSs recommend broad regional strategies and initiatives. Some strategies encourage and support communities and municipalities to actively participate within the National Flood Insurance Program (NFIP). Other FMSs recommend the establishment and implementation of public awareness and educational programs to better inform communities of the risks associated with flood waters. Additional FMSs promote preventive maintenance programs to optimize the efficiency of existing stormwater management infrastructure, recommend the development of a stormwater management manual to encourage best management practices (BMPs), or promote the establishment of community-wide flood warning systems. These FMSs support several of the regional floodplain management and flood mitigation goals established in Chapter 3.

The NRFPG identified and evaluated a total of 60 potential FMSs. Of these projects, 40 were recommended, representing a combined total cost of $20,286,000.

Note, the 2023 Final Plan FMS recommendations did not change in the Amended 2023 NRFP.

5.3 Additional Evaluations Performed for the Amended 2023 NRFP

Multiple FMEs from the 2023 NRFP were selected by the NRFPG to be further evaluated to identify additional FMPs and advance FMEs for inclusion in the Amended 2023 NRFP. The selection of the FMEs for further evaluation was to achieve the following objectives:

- Evaluate flood risks in areas with currently limited flood risk data
- Evaluate flood risk reduction solutions, including feasibility studies
- Perform preliminary engineering needed to identify, evaluate, and recommend potential feasible FMPs for future planning cycles.

5.3.1 Identification of FMEs for Further Evaluation

The RFPG was required to approve the list of FMEs for additional evaluation. The process used to identify which FMEs to perform additional evaluation was as follows:

- Identify FMEs in the highest flood risk areas as identified in Map 15 – Region 13 Highest Flood Risk. The NRFPG must consider the needs in the region, flood risk to life and property, potential flood risk reduction, critical infrastructure, and other relevant factors.
- Identity FMEs in areas where there are no on-going flood studies as identified in Map 14B – Region 13 Proposed/On-going projects and Risk Score.
- Identify FMEs in areas where FMEs are close to being FMPs.

Thus, to identify FMEs to perform, the highest flood risk areas as defined in the flood mitigation needs analysis performed in Chapter 4, were listed along with associated on-going flood studies, potential new FMPs and FMEs, and a budget allocation assigned for the additional evaluation efforts. On September 26, 2022, the NRFPG voted to approve the list of additional evaluations and their respective allocation of the overall additional evaluation effort, as shown in Table 5-2. These additional evaluations are to be performed to identify additional potential FMEs and FMPs for inclusion in the Amended 2023 NRFP. Additionally, the NRFPG identified the Nueces County Regional Drainage Master Plan Study (Tri-County Study), Duval County Master Plan, San Patricio County Flood and Drainage Study, and the City of Corpus Christi Drainage Study as local projects to track which were anticipated to increase the total amount of additional FMEs and FMPs in the Amended 2023 NRFP.

Table 5-2. Additional Evaluations for the Amended 2023 RFP

Flood Area ID (Map 15)	Flood Area General Description	Prop/ On-going Flood Study	Potential New FMPs	Potential New FMEs	Additional Study Allocation of Overall Effort
Highest Risk Flood Areas (Score 4-5)					
A1	City of Corpus Christi, Nueces County	Yes	3	-	3%
A2	Cities of Ingleside and Aransas Pass, San Patricio County	Yes	1	-	1%
A3	City of Gregory, San Patricio County	Yes	1	-	1%
A4	Cities of Rockport and Fulton, Aransas County	Yes	3	-	3%
A5	City of Alice, Jim Wells County	Yes	1	-	1%
A6	City of Kingsville, Kleberg County	Yes	1	-	1%
A7	City of Falfurrias, Brooks County	Yes	-	-	0%
A8	City of Beeville, Bee County	Yes	-	-	0%
A9	City of Lytle, Medina County	-	-	1	1%
A10	Pleasanton, Jourdanton, and Poteet, area in Atascosa County	-	2	-	18%
A11	City of Pearsall, Frio County	-	4	-	18%
A12	Hondo Area, Medina County	-	1	-	9%

Flood Area ID (Map 15)	Flood Area General Description	Prop/ On-going Flood Study	Potential New FMPs	Potential New FMEs	Additional Study Allocation of Overall Effort
A13	City of Uvalde, Uvalde County	-	-	-	0%
A14	Area along Nueces River in western Uvalde County	-	2	-	9%
A15	Cities of Vanderpool and Utopia area along Frio River in Real and Uvalde Counties	-	3	-	9%
A16	City of Carrizo Springs, Dimmit County	-	-	1	2%
A17	City of Robstown, Nueces County	Yes	-	-	0%
A18	City of Odem, San Patricio County	Yes	-	-	0%
A19	City of Mathis, San Patricio County	Yes	-	1	0.5%
High Risk Flood Areas (Score 4-5)					
B1	Cities of Bishop and Driscoll, Nueces County	Yes	-	-	0%
B2	City of Sinton, San Patricio County	Yes	1	-	0.5%
B3	City of Benavides, Duval County	Yes	2	-	1%
B4	City of Woodsboro in Refugio County	Yes	-	-	0%
B5	City of Freer, Duval County	Yes	1	-	0.5%
B6	City of Three Rivers, Live Oak County	Yes	-	-	0%

Flood Area ID (Map 15)	Flood Area General Description	Prop/ On-going Flood Study	Potential New FMPs	Potential New FMEs	Additional Study Allocation of Overall Effort
B7	City of Hebbronville, Jim Hogg County	Yes	-	-	0%
B8	City of Cotulla, LaSalle County	-	-	-	0%
B9	City of Devine, Medina County	-	1	-	9%
B10	Crystal City, Zavala County	-	1	-	7%
B11	Sabinal River area in northeast Uvalde County and southwest Bandera County	-	-	-	0%
High Risk Flood Areas (Score 3-4)					
	City of San Diego, Duval County	Yes	4	-	1%
	Development of Overall Task 12 Strategy				2%
	Misc. for undesignated FMXs or additional costs				2%
		TOTALS	**32**	**3**	**100%**

5.3.2 Summary of Additional Evaluations

The additional evaluations listed in Table 5-4 were performed over a time span of eight months from October of 2022 through May of 2023. As part of this process, additional outreach to identified potential sponsors occurred, which resulted in additional refinement and advancement of new potential flood mitigation actions. In total, additional evaluations were performed for 36 sponsor flood authority entities located across the basin. These additional evaluations resulted in the identification of 54 new FMEs, 31 new FMPs, and the removal of 19 FMEs, which are described below on a county-by-county basis. See the county maps (Map23A through Map23W in Appendix B) for depictions of the amended flood mitigation actions followed by a county specific listing of recommended flood mitigation actions. The sections below provide a high-level summary of amendment actions taken as a result of the additional evaluations performed.

All recommended FMPs required documentation of 'no negative impact' prior to inclusion in the Amended 2023 NRFP. Refer to

Appendix C13 – FMP No Negative Impact Determination Documentation. For further detail on the additional evaluations performed, see associated Appendix C9 – Additional Evaluation 1-Page FME Summaries, Appendix C10 – Additional Evaluation 1-Page FMP Summaries, and Appendix C11 – Additional Evaluation Technical Memorandums.

5.3.2.1 Aransas County (See Map 23-A)

City of Fulton (Flood Area ID A4)

Additional coordination with the City of Fulton occurred but the following FMEs were determined not to be developed enough to elevate to FMPs, as no detailed hydrologic and hydraulic models or reports were available.

- Existing FME to Remain – FME 131000145 – Fulton West Drainage Improvements
- Existing FME to Remain – FME 131000146 – Fulton East Drainage Improvements
- Existing FME to Remain – FME 131000147 – Palmetto Outfall Improvements

Aransas County (Flood Area ID A4)

Additional coordination with Aransas County resulted in the following:

- Added New FME - FME 131000182 – Aransas County Drainage Study - The need for a new county-wide flood study was identified by Aransas County to develop detailed solutions for their flooding problems, including some of their coast issues.

5.3.2.2 Atascosa-Bexar-Karnes-Wilson Counties (See Map 23-B)

City of Jourdanton (Flood Area ID A10)

Additional coordination with the City of Jourdanton resulted in the following:

- Added New FMP - FMP 133000005 – Jourdanton Drainage and Regional Detention Improvements, from SH-16 to Marion Road

- Removed Existing FME - FME 131000052 – Jourdanton Drainage Improvements and Detention/Retention Ponds – This FME was advanced through additional evaluations, including BCA and 'no adverse impact' analysis, to create FMP 133000005 and thus is no longer necessary.

City of Poteet (Flood Area ID A10)

Additional coordination with the City of Poteet resulted in the following:

- Added New FMP - FMP 133000006 – Rutledge Hollow Creek Tributary Regional Detention Pond Improvements

- Removed Existing FME - FME 131000031 – Atascosa McMullen Hazard Mitigation Plan – City of Poteet Action #7, was advanced through additional evaluations, including pre- and post-project hydrologic and hydraulic modeling, BCA, and 'no adverse impact' analysis, to create FMP 133000006 and thus is no longer necessary.

Bexar County

Additional coordination with Region 12 – San Antonio, resulted in identifying an FMP for Bexar County that is located within Region 13.

- Added New FMP – FMP 133000038 – Old Frio City Road at North Prong Creek Bridge

5.3.2.3 Bandera County (See Map23-C)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Bandera County.

5.3.2.4 Bee-Goliad Counties (See Map23-D)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Bee and Goliad counties.

5.3.2.5 Dimmit County (See Map 23-E)

Carrizo Springs (Flood Area ID A16)

Additional outreach to the City of Carrizo Springs was performed but identification and advancement of an FME did not result.

5.3.2.6 Duval County (See Map 23-F)

Additional coordination with the Duval County Master Plan resulted in the advancement of several FMEs and the development of two new FMPs. Several FMEs for the Cities of

Freer and San Diego were further evaluated under the Duval County Master Plan but remain as FMEs as the ‘no adverse impact’ requirement was not resolved.

City of Benavides (Flood Area ID B3)

- Added New FMP - FMP 133000007 – City of Benavides Las Animas Conveyance Infrastructure
- Removed Existing FME - FME 131000053 – Las Animas Conveyance Infrastructure, was advanced to create FMP 13300007 and thus is no longer necessary.
- Added New FMP - FMP 133000008 - City of Benavides Main City Network Storm Drain Improvements
- Removed Existing FME - FME 131000054 – Benavides Main City Network, was advanced to create FMP 13300008 and thus is no longer necessary.

City of Freer (Flood Area ID B5)

- Existing FME Advanced but to Remain as FME - FME 131000055 – Upsize Burch Street Crossing – This FME was further evaluated but remains as an FME as the ‘no adverse impact’ requirement was not resolved.

City of San Diego

- Existing FME Advanced but to Remain as FME - FME 131000056 – Northern San Diego Street Conveyance Improvements
- Existing FME Advanced but to Remain as FME - FME 131000057 – Northern San Diego Street Conveyance Improvements
- Existing FME Advanced but to Remain as FME - FME 131000060 – Improvements to Drainage Connectivity along Railroad
- Existing FME Advanced but to Remain as FME - FME 131000061 – Improvements to San Diego Levee Outfall System
- Existing FME Advanced but to Remain as FME - FME 131000062 – Southern Dan Diego Levee Outfall System

5.3.2.7 Edwards County (See Map 23-G)

Additional investigation determined that the following project should have been listed as a recommended FME in the 2023 NRFP.

- Added FME – FME 131000167 – Bed-Material Entrainment in selected Streams of the Edwards Plateau – Edwards, Kimble, and Real Counties

5.3.2.8 Frio County (See Map 23-H)

City of Pearsall (Flood Area ID A11)

Multiple FMEs within the City of Pearsall were further advanced through additional pre- and post-project hydrologic and hydraulic modeling, BCA, and 'no adverse impact' analysis, resulting in the following:

- Added New FMP - FMP 133000010 – Davila Street Tributary Regional Detention Pond
- Removed Existing FMEs – FME 131000044 – Colorado Street Drainage Improvements (FH#1) and FME 131000049 – West Apartment Detention Pond Underground Drainage (FH#6) - These two FMEs were combined and advanced to create FMP 13300010 and thus are no longer necessary.
- Added New FMP - 133000011 – Trinity Street Tributary Storm Sewer Bypass Improvements, from Trinity Street to Radio Road
- Removed Existing FME - FME 131000045 – Trinity Street & North Cherry Street Drainage Improvements (FH#2) - This FME was advanced to create FMP 133000011 and thus is no longer necessary.
- Added New FMP - FMP 133000012 – Pearsall High School Regional Detention Pond
- Added New FMP - FMP 133000013 – FM 1581 Channel Lining and Conveyance Improvements
- Removed Existing FMEs – FME 131000032 – Gilliam Road Drainage Improvements (FH#9) and FME 131000046 – West Comal Street & FM 1581 Drainage Channel (FH#3) - These two FMEs were combined and advanced to create FMP 133000013 and thus are no longer necessary.

Frio County (Flood Area ID A11)

Additional coordination with Frio County resulted in the county identifying multiple drainage improvement projects, which resulted in the addition of one FMP and several FMEs as follows:

- Added New FMP - FMP 133000009 – CR 1520 / Tehuacana Road Drainage Improvements (Frio County Project #8)
- Added New FME – FME 131000183 – North Pearsall Drainage Improvements (Frio County Project #5)
- Added New FME - FME 131000184 – CR 3000 / Keystone Road Drainage Improvements (Frio County Project #10)

- Added New FME - FME 131000185 – CR 4757 / Leona River Road Bridge Replacement (Frio County Project #11)
- Added New FME - FME 131000186 – Countywide Bridge Repairs (Frio County Project #12)
- Added New FME - FME 131000187 – CR 3300 / South Goldfinch Road Roadway Reconstruction and Drainage Improvements (Frio County Project #13)
- Added New FME - FME 131000230 – CR 4656 / Vine Loop Drainage Improvements (Frio County Project #9)

5.3.2.9 Jim Hogg – Brooks County (See Map23-I)

5.3.2.10 Jim Wells County (See Map 23-J)

City of Alice (Flood Area ID A5)

Additional coordination with City of Alice staff confirmed the FME below is not developed enough to elevate to an FMP as no detailed pre- and post- project hydrologic and hydraulic models nor reports are available.

- Existing FME to Remain – FME 131000063 – Lattas Creek Improvements

5.3.2.11 Kinney County (See Map 23-K)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Kinney County.

5.3.2.12 Kleberg County (See Map 23-L)

City of Kingsville (Flood Area ID A6)

Additional coordination with the City of Kingsville resulted in the following:

- Added New FME 131000188 – 19th Street from East Lott Avenue to Maple Street Drainage Improvements (Kingsville Project Location 2)
- Added New FME 131000189 – Caesar Place Subdivision Drainage Improvements (Kingsville Project Location 5)
- Added New FME 131000190 – North 17th Street and Corral Avenue Intersection Drainage Improvements (Kingsville Project Location 9)
- Added New FME 131000191 – Carriage Park 2 Subdivision Drainage Improvements
- Existing FME to Remain – FME 131000111 – FM1356 Channel Improvements - City staff confirmed this project is not developed enough to elevate to an FMP as

no detailed pre- and post-project hydrologic and hydraulic models nor reports are available.

5.3.2.13 LaSalle County (See Map 23-M)

Additional evaluations did not result in changes to the recommended flood mitigation actions in LaSalle County.

5.3.2.14 Live Oak County (See Map 23-N)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Live Oak County.

5.3.2.15 Maverick-Zavala Counties (See Map 23-O)

Crystal City (Flood Area ID B10)

Additional coordination with the Crystal City resulted in the following:

- Added New FMP 133000014 – Downtown Crystal City Regional Detention Pond Improvements
- Existing FME to Remain - FME 131000016 – Crystal City City-wide Drainage Study, was advanced with the city further identifying their greatest flood problem areas and additional hydrologic and hydraulic analysis performed to identify potential flood risk areas and solutions. These additional evaluations resulted in the development of FMP 133000014. However, FME 131000016 to remain as further evaluation across the city is still required.

5.3.2.16 McMullen County (See Map 23-P)

Additional evaluations did not result in changes to the recommended flood mitigation actions in McMullen County.

5.3.2.17 Medina County (See Map 23-Q)

City of Devine, Medina County (Flood Area ID B9)

Additional coordination with the City of Devine resulted in the following:

- Added New FMP – FMP 133000015 – Burnt Boot Creek Drainage Improvements from Route 132 to Colonial Parkway
- Removed Existing FME – FME 131000064 – Burnt Boot Creek Drainage Improvement Project – this FME was further evaluated resulting in the development of the following FMP and thus is no longer necessary.

City of Lytle (Flood Area ID A9)

Additional coordination with the City of Lytle resulted in the following:

- Added New FME - FME 131000192 – Lake Shore Estates Master Drainage Plan

City of Hondo, Medina County (Flood Area ID A12)

Additional coordination with the City of Hondo did not result in the advancement of an existing FME nor the development of a new FMP. Before undertaking new structural type projects, the city desires to perform additional study of the land with new and future conditions, to improve local codes and standards, and to perform outreach to the community on the topic of flooding.

5.3.2.18 Nueces County (See Map 23-R)

City of Corpus Christi (Flood Area ID A1)

Additional coordination with the City of Corpus Christi and the Nueces County Regional Drainage Master Plan (i.e. Tri-County study) resulted in the following:

- Removed Existing FME – FME 131000088 – Greenwood WWTP Flood Mitigation – City of Corpus Christi conveyed they have already found funding for this project. Thus, this FME is removed from the amended RFP and has been added to the ‘proposed and ongoing flood mitigation project’ list.
- Added New FMP – FMP 133000016 – Kinney Street Pump Station Inlet Modification
- Removed Existing FME – FME 131000148 – Kinney Street Pump Station Inlet Modification – this FME was advanced to create FMP 133000016 and thus is no longer necessary.
- Added New FMP – FMP 133000017 – Power Street Pump Station Improvements
- Removed Existing FME – FME 131000149 – Power Street Pump Station Improvements – this FME was advanced to create a new FMP and thus no longer necessary.
- Added New FMP – FMP 133000021 – Balchuck Lane & Digger Lane Improvements (Tri-County Study Risk Area 26)
- Added New FMP - FMP 133000022 – Nottingham Acres (Tri-County Study Risk Area 27)
- Added New FMP - FMP 133000023 – South Prairie Estates (Tri-County Risk Area 28)

- Added New FME - FME 131000193 – Santa Maria (Tri-County Study Risk Area 31)
- Added New FME – FME 131000194 – Corpus Christi International Airport
- Added New FME - FME 131000195 – Tierra Grande & Crossroads Estates (Tri-County Risk Area 23)
- Added New FME - FME 131000196 – US Naval Base (Tri-County Risk Area 29)

City of Aqua Dulce, Nueces County

Additional coordination with the Nueces County Regional Drainage Master Plan resulted in the following:

- Added New FMP - FMP 133000018 – Aqua Dulce (Tri-County Risk Area 06)

City of Banquete, Nueces County

Additional coordination with the Nueces County Regional Drainage Master Plan resulted in the following:

- Added New FMP - FMP 133000019 – Banquete (Tri-County Study Risk Area 05)

Nueces County

Additional coordination with the Nueces County Regional Drainage Master Plan resulted in the following:

- Added New FME – FME 131000211 – Petronila Creek Environmental Study (Tri-County Risk Area 30)

City of Robstown, Nueces County (Flood Area ID A17)

Additional coordination with the Nueces County Regional Drainage Master Plan resulted in the following:

- Added New FMP - FMP 133000025 – Callicoate Farms (Tri-County Risk Area 11)
- Added New FMP – FMP 133000026 – Fiesta Ranch (Tri-County Risk Area 20)
- Added New FME – FME 131000197 – FM 1694 & TX 44 North (Tri-County Risk Area 12)
- Added New FME – FME 131000198 – FM 665 & CR 69 Area (Tri-County Risk Area 21)
- Added New FME – FMP 131000199 – IH 69E Crossing (Tri-County Risk Area 09)

- Added New FMP – FMP 133000027 – Indian Trails (Tri-County Risk Area 03)
- Added New FME – FME 131000200 – North Robstown (Tri-County Risk Area 08)
- Added New FMP - FMP 133000028 – Ranch and Cyndie Park (Tri-County Risk Area 01)
- Added New FMP – FMP 133000029 – Rancho Banquete (Tri-County Risk Area 04)
- Added New FME – FME 131000201 – Robstown Drains (Tri-County Risk Area 10)
- Added New FME – FME 131000202 – County Road 61 & TX 44 (Tri-County Risk Area 14)
- Added New FME – FME 131000203 – FM 1694 & TX 44 South (Tri-County Risk Area 13)
- Added New FME – FME 131000204 – FM 892 (Tri-County Risk Area 18)
- Added New FME – FME 131000205 – Lost Creek & Nye & Peterson Farm (Tri-County Risk Area 17)
- Added New FME – FME 131000206 – Petronila Acres (Tri-County Risk Area 22)
- Added New FME – FME 131000207 – San Petronila Estates (Tri-County Risk Area 24)
- Added New FME – FME 131000208 – Spring Gardens & Primavera Estates (Tri-County Risk Area 15)
- Added New FME – FME 131000209 – Tierra Verde (Tri-County Risk Area 16)
- Added New FME – FME 131000210 – Westwood Estates (Tri-County Risk Area 02)

Nueces County Drainage District No.2 (Flood Area ID A17)

Additional coordination with the Nueces County Drainage District No.2 resulted in the development of the following:

- Added New FMP – FMP 133000030 – Robstown Various Drainage Improvements (FH#8,10, 12)

City of Bishop, Nueces County (Flood Area ID B1)

Additional coordination with the Nueces County Regional Drainage Master Plan resulted in the following:

- Added New FMP - FMP 133000020 – City of Bishop La Paloma Ranch (Tri-County Study Risk Area 07)

City of Driscoll, Nueces County (Flood Area ID B1)

- Added New FMP - FMP 133000024 – Driscoll (Tri-County Risk Area 19)

5.3.2.19 Real-Kerr Counties (See Map 23-S)

Real County (Flood Area ID A15)

Additional coordination with Real County resulted in the county identifying several new FMEs and recommending further evaluation of flood risks within the City of Camp Wood.

- Added New FME – FME 131000212 – McDonald Crossing of Plumin Creek and Crossing of Nueces River
- Added New FME – FME 131000213 – Bajo Camino Low Water Crossing

City of Camp Wood

- Existing FME Advanced but to Remain as FME - FME 131000006 – City of Camp Wood Downtown Drainage Improvements – this FME was further advanced through the development of pre- and post-project hydrologic and hydraulic models, but further coordination and analysis is needed to define potential FMPs.

5.3.2.20 Refugio County (See Map 23-T)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Refugio County.

5.3.2.21 San Patricio County (See Map 23-U)

City of Ingleside, San Patricio County (Flood Area ID A2)

Additional coordination with the City of Ingleside was performed resulting in additional information on the FMEs below being obtained, but the information was determined insufficient to advance the FMEs to FMPs.

- Existing FME to Remain - FME 131000140 – Morgan Avenue & Mooney Avenue Drainage Improvements
- Existing FME to Remain - FME 131000139 – Drainage Improvements – FM 1069 to McCampbell Slough

City of Gregory, San Patricio County (Flood Area ID A3)

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FMP – FMP 133000031 – City of Gregory Citywide Stormwater Drainage Improvements
- Removed Existing FME – FME 131000128 – Citywide Stormwater Drainage Improvements – this FME was advanced to create FMP 13300031 and thus is no longer necessary.

City of Taft, San Patricio County (Flood Area ID A3)

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FMP – FMP 133000037 – City of Taft Citywide Stormwater Drainage Improvements
- Removed Existing FME – FME 131000131 – Citywide Stormwater Drainage Improvements. This FME was advanced to create FMP 133000037.

Lake City, San Patricio County

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FME – FME 131000216 – Park Road 25 Improvements (San Patricio County Drainage Master Plan Area Lc-A)

City of Odem, San Patricio County (Flood Area ID A18)

Additional coordination with the San Patricio County Drainage Master Plan resulted in the development of the following:

- Added New FMP – FMP 133000033 – City of Odem Citywide Stormwater Drainage Improvements
- Removed Existing FMEs – FME 131000155 – Cityside Stormwater Drainage Improvements and FME 131000156 – Expanding Drainage System to Odem High School Area – These FMEs were combined and advanced to create FMP 133000033.

City of Mathis, San Patricio County (Flood Area ID A19)

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FME – FME 131000231 – East Jackson Street South Ditch Development (San Patricio County Drainage Master Plan Area Ma-A)
- Added New FME – FME 131000232 – Replace Existign Culvert at Six Mile Creek Crossing of CR 359 (San Patricio County Drainage Master Plan Area Ma-B)

- Added New FME – FME 131000233 – New Culvert Near Front Street and CR 359 (San Patricio County Drainage Master Plan Area Ma-C)
- Added New FME – FME 131000234 – New Pipe at Huerta Street (San Patricio County Drainage Master Plan Area Ma-D)

City of Sinton, San Patricio County (Flood Area ID B2)

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FMP – FMP 133000035 – City of Sinton Citywide Stormwater Drainage Improvements
- Removed Existing FMEs – FME 131000159 – Citywide Stormwater Drainage Improvements and FME 131000161 – San Patricio County Hazard Mitigation Action Plan (City of Sinton, Action #15). These two FMEs were combined and advanced to create FMP 133000035.
- Existing FME to Remain – FME 131000158 – Channel Outfall Drainage Improvements

San Patricio County

Additional coordination with the San Patricio County Drainage Master Plan resulted in the following:

- Added New FME – FME 131000221 – Gregory Outfall Development (San Patricio County Drainage Master Plan Area Co-F)
- Added New FME – FME 131000222 – West Ingleside Outfall (San Patricio County Drainage Master Plan Area Co-G)
- Added New FME – FME 131000223 – Taft Southwest Outfall (San Patricio County Drainage Master Plan Area Co-H)
- Added New FME – FME 131000219 – South Sinton Levee (San Patricio County Drainage Master Plan Area Co-C)
- Added New FME – FME 131000220 – South Sinton Drainage Improvements (San Patricio County Drainage Master Plan Area Co-E)
- Added New FME – FME 131000214 – Glen Erin Estates Improvements (San Patricio County Drainage Master Plan Area Sp-A)
- Added New FME – FME 131000215 – Nopal Street Improvements (San Patricio County Drainage Master Plan Area Sp-B)
- Added New FME – FME 131000217 – The Colony Subdivision (San Patricio County Drainage Master Plan Area Co-A)

- Added New FME – FME 131000218 – County Road 1136 Improvements (San Patricio County Drainage Master Plan Area Co-B)

5.3.2.22 Uvalde County (See Map 23-V)

Uvalde County (Flood Area ID A14)

Additional coordination with Uvalde County resulted in the following:

- Added New FME - FME 131000224 – Various Flood Warning Gages
- Added New FME – FME 131000225 – Seven Bluff Low Water Crossing on Frio River
- Added New FME - FME 131000226 - County Road 348 on Bear Creek
- Added New FME - FME 131000227 - Kenneth Arthur Low Water Crossing on Frio River
- Added New FME - FME 131000228 - Avant Low Water Crossing - Tributary to Frio River
- Added New FME – FME 131000229 - Indian Creek Low Water Crossing

Webb County (See Map 23-W)

Additional evaluations did not result in changes to the recommended flood mitigation actions in Webb County.

5.3.3 Identified and Recommended Flood Mitigation Actions in the Amended 2023 NRFP

On May 15, 2023, the NRFPG voted to amend the 2023 NRFP recommended FMEs, FMPs, and FMSs to represent additional refinement and recommended flood mitigation actions, as described above in 5.3. This meeting was held in accordance with the requirements of the RFPG bylaws, the Texas Open Meeting Act, and the general requirements of the Texas Water Code and the flood planning process.

Additional stakeholder outreach and advancements of flood mitigation actions as part of the Amended 2023 RFP efforts resulted in the identification of a total of 269 recommended flood mitigation actions that were determined to meet TWDB requirements, of which 31 are FMPs, 198 are FMEs, and 40 are FMSs. This is an increase of 31 FMPs and 35 FMEs when compared to the 2023 RFP. The list of recommended 2023 RFP FMSs was not changed with the Amended 2023 RFP.

County-based tables and maps of flood mitigation actions are presented in Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions.

A complete list of identified possible flood mitigation actions can be found in Appendix A7 – TWDB Table 12 – Potential Flood Management Evaluations Identified by RFPG, Appendix A8 – TWDB Table 13 – Potential Feasible Flood Mitigation Projects Identified By RFPG, and Appendix A9 – TWDB Table 14 – Potentially Feasible Flood Management Strategies Identified by RFPG.

A complete list of recommended flood mitigation actions can be found in Appendix A10 – TWDB Table 15 – Flood Management Evaluations Recommended by RFPG, Appendix A11 – TWDB Table 16 – Flood Mitigation Projects Recommended by RFPG, and Appendix A12 – TWDB Table 17 – Flood Management Strategies Recommended by RFPG.

5.3.3.1 Identified and Recommended FMEs in the Amended 2023 NRFP

The NRFPG identified and evaluated a total of 213 potential FMEs in the Amended 2023 NRFP. Of these projects, 198 were recommended, representing a combined total of $284,500,000 needed across the region. This is an increase of 35 recommended FMEs, and $2,170,000 in additional evaluations, when compared to the 2023 NRFP. The number, types, and costs of FME projects recommended by the NRFPG are summarized in Table 5-3.

Table 5-3: Summary of Recommended FMEs in the Amended 2023 NRFP

FME Types	FME Descriptions	# of FMEs Identified	# of FMEs Recommended	Cost of Recommended FMEs
Preparedness	Gauges, Barriers, Debris/ Vegetation Removal, and Channelization	5	3	$800,000
Project Planning	Previously Identified Drainage Projects and Flood Studies	172	165	$222,530,000
Watershed Planning	FIS Studies, Watershed Studies	25	21	$58,570,000
Other	Property Acquisition and Buyout Programs	11	9	$3,930,000
	Total	**213**	**198**	**$284,500,000**

5.3.3.2 Identified and Recommended FMPs in the Amended 2023 NRFP

The NRFPG identified and evaluated 31 potential FMPs in the Amended 2023 NRFP and all 31 are recommended, representing a combined total of $1,205,100,000 of Flood

Mitigation Project needs across the region. The number, types, and costs of identified and recommended FMPs by the NRFPG are summarized in Table 5-4.

Table 5-4: Summary of Recommended FMPs in the Amended 2023 NRFP

FMP Types	# of FMPs Identified	# of FMPs Recommended	Total Cost of Recommended FMPs
Channel	3	3	$17,100,000
Detention	4	4	$7,400,000
Infrastructure	19	19	$1,154,100,000
Low Water Crossing	3	3	$9,200,000
Storm Drain	2	2	$17,300,000
Total	**31**	**31**	**$1,205,100,000**

5.3.3.3 Identified and Recommended FMSs in the Amended 2023 NRFP

No changes were made to the list of identified and recommended FMSs in the 2023 NRFP. The NRFPG identified and evaluated a total of 60 potential FMSs. Of these projects, 40 were recommended, representing a combined cost of $20,286,000. The number and types of FMSs recommended by the NRFPG are summarized in Table 5-5.

Table 5-5: Summary of Recommended FMPs in the Amended 2023 NRFP

FMS Project Types	# of FMPs Identified	# of FMPs Recommended	Total Cost of Recommended FMPs
Education and Outreach	17	9	$757,000
Flood Measurement and Warning	10	4	$1,050,000
Infrastructure Projects	8	2	$100,000
Property Acquisition and Structural Evaluation	3	3	$10,700,000
Regulatory and Guidance	17	17	$7,161,000
Other	5	5	$518,000
Total	**60**	**40**	**$20,286,000**

Flood gates at Lake Corpus Christi, May 2019

Chapter 6 – Impacts of Regional Flood Plan and Contributions to Water Supply Development and State Water Plan

31 TAC § 361.40 and 361.41

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6 Impacts of Regional Flood Plan and Contributions to Water Supply Development and State Water Plan

The objective of this chapter is to summarize the impacts and contributions of implementing the regional flood plan (RFP) would have on reducing flood risks and provide a region-wide summary and description of the contribution that the RFP would have on water supply development. In previous chapters, existing and future flood risks were determined based on 1% and 0.2% annual chance flood events within the Nueces Flood Planning Region (NFPR). In addition, an inventory and assessment of existing infrastructure, including major constructed infrastructure and natural features were compiled for use as a baseline. Flood mitigation needs were identified leading to recommendations of flood management evaluations and strategies, and flood mitigation projects. This chapter summarizes the positive benefits and negative effects of implementing the RFP and identifies impacts the RFP could have on water supply development and the State Water Plan.

6.1 Impacts of Regional Flood Plan

Impacts are determined before-and-after RFP implementation of recommended flood management evaluations (FME), flood management strategies (FMS), and flood mitigation projects (FMPs) relative to existing and future flood risk. These two comparisons may, for example, also indicate a percent change in flood risk, including flood exposure to vulnerable communities and critical infrastructure. The comparison before-and-after RFP implementation estimates both how much the region's existing flood risk will be reduced through implementation of the plan as well as how much additional, future flood risk (that might otherwise arise if no changes were made to floodplain policies etc.) will be avoided through flood management or mitigation activities. This in turn, will help guide the NFPR towards measuring the impacts of floodplain management goals described in Chapter 3 and additional changes/improvements to the region's floodplain management policies that might be necessary in the future.

This effort included:

- a region-wide summary of the relative reduction in flood risk that implementation of the RFP would achieve within the region including with regard to life, injuries, and property.

- a general description of the types of potential positive and negative socioeconomic or recreational impacts of the recommended FMSs and FMPs within the NFPR.
- a general description of the overall impacts of the recommended FMPs and FMSs in the Regional Flood Plan on the environment, agriculture, recreational resources, water quality, erosion, sedimentation, and navigation.

6.1.1 Region-Wide Summary of Flood Risk Reduction of Implementing the Regional Flood Plan

The existing flood risk is anticipated to increase due to population growth and associated development within the basin. The two primary strategies to reduce the existing and future flood risks in the basin are the implementation of floodplain management regulations and the implementation of flood mitigation actions.

The recommended strategy for floodplain management for consideration by Nueces basin counties, cities, and others with flood administrating authority is described fully in Chapter 3 and includes accurately defining the floodplain through the development of detailed hydrologic and hydraulic models in areas with anticipated high development and population growth and requiring the finish floor of structures to be a minimum of one foot above base flood elevations (i.e. 1% annual chance or 100-year). It is assumed in this analysis that full implementation of the recommended floodplain management regulations is a part of implementing the NFPR. If this strategy is fully implemented across the basin, then the future flood risk would not be realized.

A total of 31 FMPs, 198 FMEs, and 40 FMS were recommended for inclusion in the NFPR. These flood mitigation actions were recommended to reduce the risk identified in the existing and future condition flood risk analyses, to address flood mitigation and floodplain management goals, and to address the greatest flood risk and flood mitigation needs. The reduction in flood risks has been quantified for several flood exposure elements for the 1% annual chance storm event for the various FMPs in Appendix A11 – TWDB Table 16 – Flood Mitigation Projects Recommended by RFPG. These flood exposure elements include area in the floodplain and structures, population, critical facilities, and roadway segments at flood risk. It is assumed in this analysis that the implementation of the various FMPs would result in full realization of the reported flood risk reduction benefits reported for the various flood exposure elements.

Flood risk reduction benefits were not quantified for the recommended FMEs and FMSs and thus not accounted for in this analysis. But it is acknowledged that implementation of the recommended FMEs and FMEs would result in some additional reduction in the future flood risk. The impact of implementing the recommended FMEs and FMSs is discussed is Sections 6.1.2 and 6.1.3 below.

Table 6-1 and Table 6-2 below summarize the existing and future flood risk for the various flood exposure elements listed, and then quantifies the reduction in the flood risk and the residual risk if the RFP is fully implemented.

Table 6-1. Regional Flood Plan Implementation Impacts (1% Annual Chance)

Flood Exposure Element	Existing Flood Risk (no RFP)	Future Flood Risk (no RFP)	Reduction in Flood Risk (FMPs)	Reduction in Flood Risk (Floodplain Management)	Future Flood Risk (RFP)
Area in Floodplain (sq mi)	4,578	4,630	Unknown	-52	4,578 (-1%)
Estimated Number of Structures at Risk	60,967	77,878	-1,155	-16,911	59,812 (-23%)
Estimated Population at Flood Risk	144,053	198,915	-4,044	-54,862	140,009 (-30%)
Critical Facilities at Risk	11,356	11,474	-18	-118	11,338 (-1%)
Miles of Roadway Segments at Risk	3,215	3,537	-29	-322	3,186 (-10%)

Table 6-2. Regional Flood Plan Implementation Impacts (0.2% Annual Chance)

Flood Exposure Element	Existing Flood Risk (no RFP)	Future Flood Risk (no RFP)	Reductio n in Flood Risk (FMPs)	Reduction in Flood Risk (Floodplain Management)	Future Flood Risk (RFP)
Area in Floodplain (sq mi)	5,865	5,913	Unknown	-48	5,865 (-1%)
Estimated Number of Structures at Risk	98,164	112,489	Unknown	-14,325	98,164 (-13%)
Estimated Population at Flood Risk	234,826	279,603	Unknown	-44,777	234,826 (-16%)
Critical Facilities at Risk	19,510	19,211	Unknown	-0	19,510 (+2%)
Miles of Roadway Segments at Risk	4,794	5,097	Unknown	-303	4,794 (-6%)

As shown in the above tables, the implementation of the FMPs would have beneficial flood risk reduction, but their impacts are limited when a comparison is made to the overall basin-wide flood risk. However, the implementation of the FMPs is expected to have more significant benefit on the localized flood risk that they are intended to address. The results also show the importance of enacting the recommended floodplain management strategy to avoid additional future flood damages.

Each individual flood mitigation action was reviewed to determine if 'no negative impact' to neighboring areas was documented (See

Appendix C13 – FMP No Negative Impact Determination Documentation). No flood mitigation action was recommended if potential negative impacts were identified. Thus, the implementations of the NRFP will not negatively affect neighboring areas located within or outside of the region.

6.1.2 FMS Impacts

A total of 40 FMSs were recommended in the NFPR. FMSs are defined by the Texas Administrative Code (TAC) as "a proposed plan to reduce flood risk or mitigate flood hazards to life or property." The types of FMSs recommended by the Nueces Regional Flood Planning Group (NRFPG) include updating flood ordinances, adding flood gages for monitoring, property buy-outs, implementing flood early warning systems, and other programs for which benefits are difficult to quantify with certainty.

For this evaluation, the impacts of implementing recommended FMSs were estimated in the form of flood protection for areas within the watershed that might benefit through implementation of the FMS. However, due to the nature of the FMSs, this may or may not correlate to a direct reduction in loss of life, injuries, and property according to the values indicated. To study the impact of the FMSs on the Region, the area in floodplain, structures, population, critical facilities, and miles of roadway segments, exposed to the 1% annual chance event were summed for the area encompassed by recommended FMSs. Presumably, the exposed elements within the FMS polygons will benefit from the FMS, however it's impossible to know exactly what will benefit from an FMS unless a detailed impact analysis is performed. Therefore, the analysis in this section was meant to give an indication of the overall coverage and potential benefit of implementing the FMSs.

Table 6-3. Existing Flood Risk vs FMS Coverage (1% Annual Chance)

Flood Exposure Element	Basin-wide Existing Flood Risk	Risk Covered within an FMS	Residual Risk
Area in Floodplain (sq mi)	4,578	1,174	3.404
Estimated Number of Structures at Risk	60,967	34,827	26,140
Estimated Population at Risk	144,053	5,613	138,440
Critical Facilities at Risk	11,356	4,292	7,064
Miles of Roadway Segments at Risk	3,215	1,290	1,925

6.1.3 FME Impacts

A total of 198 FMEs were recommended in the NFPR. While compiling data during the baseline development of the RFP, the NRFPG identified many data gaps within the NFPR pertaining to areas of high flood risks that lacked floodplain management practices, flood management enforcement, detailed hydrologic and hydraulic models, and inundation mapping as described in Chapter 4. The lack of data leads people and structures to being potentially exposed to unnecessary flood hazards. FMEs were developed to address that exposure. In general, the FMEs include flood hazard modeling and mapping to identify flood risk, flood mitigation alternatives analysis and feasibility studies, and preliminary engineering studies among others.

Similar to FMSs, to study the impact of the FMEs on the Region, various flood exposure elements, exposed to the 1% annual chance event were summed for the area encompassed by recommended FMEs, as shown in Table 6-4. Presumably, the exposed elements within the FME polygons will benefit from the FME, however it's impossible to know exactly what will benefit from an FME unless a detailed impact analysis is performed.

Table 6-4. Existing Flood Risk vs FME Coverage (1% Annual Chance)

Flood Exposure Element	Basin-Wide Existing Flood Risk	Risk Covered within an FME	Residual Risk
Area in Floodplain (sq mi)	4,578	1,811	2,767
Estimated Number of Structures at Risk	60,967	28,401	32,566
Estimated Population at Risk	144,053	6,420	137,633
Critical Facilities at Risk	11,356	5,001	6,355
Miles of Roadway Segments at Risk	3,215	1,611	1,604

6.1.4 Low Water Crossings

Implementing flood mitigation actions across the NRFP will reduce the impact of existing low water crossings (LWCs). As projects are implemented over time, the number of LWCs will be reduced saving life and property. A total of 548 LWCs have been identified in the NRFP as described in Table 1-8. If the recommended FMPs are implemented, then 13 of the 548 LWCs would be removed. Further, FME 131000175 – Nueces Basin Low Water Crossing Study and Upgrade Prioritization states a goal of addressing 30% of the highest prioritized LWCs. If this study is completed and the resulting FMPs are implemented, then another 160 LWCs would benefit. Thus, a total of 173 of the identified 548 LWCs would benefit through the implementation of the NRFP.

6.1.5 Socioeconomic and Recreational Impacts

6.1.5.1 Socioeconomic

Socioeconomic impacts were taken into consideration while developing the NRFP to verify that flood reduction benefits were evenly distributed among all groups and balanced across the region. The NFPR has a diverse population with wide ranging economic levels. Disadvantaged socioeconomic populations have limited access to resources hindering response and recovery from flood events. As discussed in Chapter 1, the NFPR was divided into four subregions based on differences in socioeconomic, land characteristics, and types of flooding. Most of the population, over 82%, is in the lower half of the NFPR. Three of the basins are similar regarding median household income, households below the poverty line, and diversity, as shown in Table 6-5. The upper mid basin is the outlier with lower diversity, lower household income and a higher percentage of households below the poverty line. Zavala County, located in the upper mid basin, is also identified as the seventh poorest county in the country based on median household income.

Table 6-5. NFPR Socioeconomic Information

Basin	Population	Median Household Income	Households below Poverty Line	Diversity Index	Households
Upper	72,672	$50,821	15%	48%	24,807
Upper Mid	52,882	$36,235	27%	23%	16,407
Lower Mid	136,020	$48,122	20%	43%	46,382
Lower	535,465	$53,435	18%	51%	192,680

In developing the appropriate FMSs, FMPs, and FMEs, the NRFPG included goals to reduce impacts due to flood events and improve the lives of all socioeconomic groups, ensuring the most disadvantaged were well represented. Flood exposure and vulnerability analyses completed for the NFPR and described in Chapter 2 used socioeconomic indicators to identify vulnerabilities of communities and critical facilities that are most susceptible to high flood risk.

6.1.5.2 Recreation Impacts

Many parks located along water fronts are designed to be flooded periodically with minimal impact to infrastructure. Floodplains and wetlands can support recreation and tourism. Flood control basins often include reservoirs, which are recreational and wildlife attractions. Choke Canyon Reservoir is a good example of this. Although not specifically identified in the NRFP, as FMSs and FMPs are implemented and structures in floodplains are removed, new opportunities become available for local sponsors to re-develop these lands for public benefit. These areas can be used for county parks and hiking and biking trails. The NRFPG encourages local flood administrative agencies to seek secondary benefits such as recreational opportunities in flood-prone areas and to support public education campaigns and clear signage indicating flood potential. While the NRFPG supports such repurposing of floodplain areas for recreation, no negative impacts to existing recreation activities in the Nueces Basin should be caused by these activities.

6.1.5.3 Floodplain Management Practices Impacts

By implementing the RFP, the existing floodplain management standards identified in Chapter 3 will be leveraged and have basis to bolster and expand local regulations to protect future life and structures from high flood risk events. Currently, there are sparse moderate to strong regulations and the additional future flood risks identified in Chapter 2 necessitate stronger floodplain management practices to reduce impacts to life, injury, or properties. The NRFPG has identified a minimum floodplain management standard throughout the region, as discussed in Chapter 3, and implementation of the RFP will provide more accurate flood inundation mapping to support communities as they align future floodplain management standards and ordinances to mitigate future risk exposure.

6.1.6 Overall Impacts of Recommended FMSs and FMPs on Environment, Agriculture, Water Quality, Erosion, Sedimentation, and Navigation

Flood risk management concepts to consider when evaluating FMSs and FMPs include the following[2]:

- Flood is a natural process that has many benefits to human and natural systems.
- Promoting some flooding as desirable and making room for water promotes native species, maintains vital ecosystem services, and reduces the chance of flooding elsewhere.
- Natural landscapes and watersheds provide flood mitigation functions that should be promoted, protected, enhanced, and restored.
- Prioritize risk reduction over flood control by focusing first on reducing loss of life and injury.
- Utilize limited resources fairly.
- Address flood risk using a portfolio approach to first implement non-structural (policy, land management, emergency management) followed by structural (grey and natural and nature-based) strategies.
- Criteria for assessing projects strategies should include a comprehensive suite of measures spanning economical, operational, societal, and environmental advantages and disadvantages. Assessments focusing on economics alone (number of buildings, acres) should be avoided.

[2] From Texas Parks and Wildlife, October 26, 2022.

Implementing the RFP provides numerous benefits associated to the primary purposes of FMSs, FMPs, and FMEs. The FMS benefits although not readily quantifiable, will protect the health and safety of the region by reducing flood risk through advanced flood warning systems, removing roads and structures from flooding, and providing officials the tools to properly manage flood prone areas.

The recommended FMSs in the NRFP are anticipated to have a beneficial impact on environment, agriculture, water quality, and erosion by providing additional data and understanding of flood events that will lead to implementation of flood mitigation projects that divert or address flood flows to reduce their impact. Several recommended FMSs are specifically identified to reduce erosion and sedimentation impacts. Flood projects should consider stream crossing designs that allow for sediment transport and passage of aquatic organisms and do not impound water.

The FMSs recommended in the NRFP are not anticipated to impact navigation.

No long-term impairment to designated water quality in the State Water Quality Management Plan is anticipated as a result of recommended FMS or FMPs.

The plan, when implemented, will not negatively affect neighboring areas located within or outside the flood planning region.

Several FMSs were identified to have a positive impact on water supply. They are described in the following section on water supply.

6.2 Contributions to and Impacts on Water Supply Development and the State Water Plan

According to TWDB guidance, RFPGs must include a regionwide summary of the contribution that the RFP would have to water supply. As part of this analysis, FMSs and FMPs were reviewed to determine whether impacts to water supply/availability exists. Impacts include contributions as well as reductions in water supply and availability. These impacts as determined are sorted according to the following categories:

1. Involves directly impacting water supply volume available during drought of record which requires both availability and directly connecting supply to specific water user group(s)
2. Directly benefits water availability
3. Indirectly benefits water availability
4. Or has no anticipated impact on water supply

A coordinated effort with representatives from multiple regional water planning groups occurred to identify water management strategies that could be impacted. Those regional water planning groups include, Region N (Coastal Bend), Region L (South Central Texas), and Region M (Rio Grande). There are four FMS that were identified by the NRFPG on June 27, 2022, that have benefits related to water supply development. These strategies, with exception of a direct Nueces River diversion to Choke Canyon Reservoir (CCR) have been evaluated and included in Coastal Bend (Region N) Regional Water Plans. In order for the Nueces River diversion to CCR project to be included as a recommended FMS in the RFP, it must have an estimated annual water supply. This project, therefore, was not eligible for recommendation. The three FMS with water supply benefits that were recommended by the NRFPG are shown in Table 6-6. A map showing the location of these recommended FMSs in relation to the 1% annual chance flood inundation area is shown in

Figure 6-1.

Table 6-6. FMS/FMP Contributions to Water Supply

Name	FMS/ FMP	Volume (AF/YR)	Impacts Water Supply Volume	Directly Benefits Water Availability	Indirectly Benefits Water Availability	No Impacts on Water Supply
Two-way pipeline (LCC-CCR)	FMS	Approx. 22,000 – 40,000	X			
Nueces Off Channel Reservoir	FMS	Approx. 30,000 – 48,000	X			
LCC Sediment Removal	FMS	Approx. 9,000	X			

AF-YR=acre-feet per year

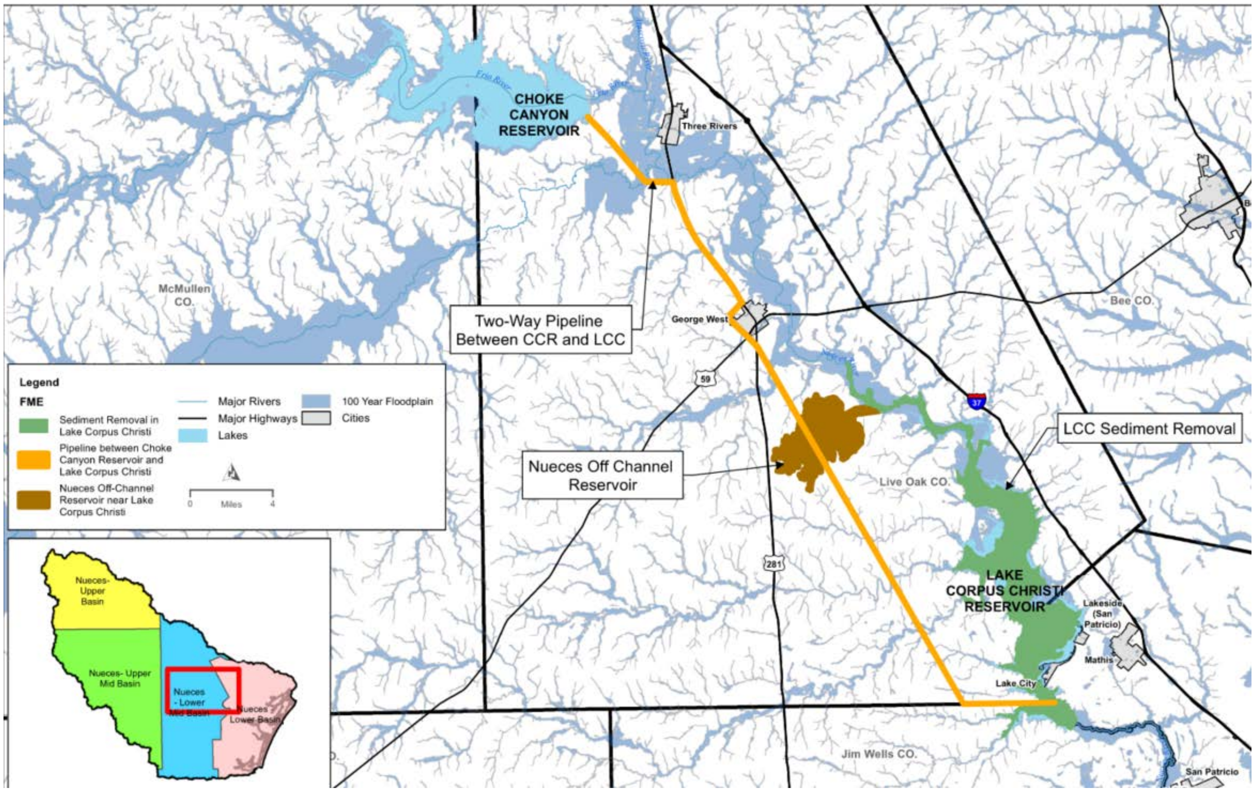

Figure 6-1 FMS Related to Water Supply

Two-way pipeline between Choke Canyon Reservoir (CCR) and **Lake Corpus Christi (LCC)** - The two-way pipeline has been recommended as a water management strategy in previous Coastal Bend (Region N) Regional Water Plans and State Water Plans. The groundwater – surface water interactions in the alluvial soils of the Gulf Coast aquifer between CCR to LCC are complex. The channel losses along this stretch of the river are considerable with amounts varying based on seasonal conditions. Losses are more pronounced during prolonged drought events. A two-way pipeline between CCR and LCC would mitigate the losses in the natural stream between the two reservoirs. The two-way pipeline provides operators the ability to balance water volumes in the two lakes to better make use of the extra capacity to store water in CCR while freeing up capacity in LCC to capture additional flood flows from the Atascosa and Nueces Rivers that converge at the City of Three Rivers. In extended drought periods, water can be moved from CCR to LCC minimizing losses while maximizing water supply for contracted users. Simulations for the historical period 1934-2003 concluded that this pipeline operation could provide a firm yield of approximately 22,000 – 40,000 acre-feet per year. This strategy was not recommended in the 2022 State Water Plan.

Nueces off-channel reservoir - The Nueces off-channel reservoir (OCR) has been recommended as a water management strategy in previous Coastal Bend (Region N) Regional Water Plans and State Water Plans. The OCR can serve to enhance the system yield of CCR and LCC while capturing water that would otherwise spill into LCC.

The OCR would be operated in conjunction with water levels at LCC to maximize the total volume of water stored. The capture of additional flood flow provides added protection against prolonged droughts ensuring water supply availability for contracted users. In addition to water supply, the OCR can simultaneously maintain the instream flows to the Nueces Bay and Estuary (B&E). Past studies show that, for a 280,000 acre-feet reservoir, the firm yield ranges from approximately 30,000 – 48,000 acre-feet per year. This strategy was not recommended in the 2022 State Water Plan.

Although it has not been studied previously, there may be additional benefits achieved through operation of the Nueces off-channel reservoir in conjunction with Aquifer Storage and Recovery (ASR). Such an ASR concept might include treating water from the Nueces off-channel reservoir and recharging aquifers in favorable hydrogeologic areas near treatment facilities for later recovery and use by local or regional water providers during drought or high seasonal water demand periods. In 2019, the Corpus Christi Aquifer Storage and Recovery Conservation District and the City of Corpus Christi conducted an ASR exploratory program in Nueces County using reclaimed water for industrial purposes and the results appear favorable up to yields of 18 MGD. Although this specific project would not be a candidate to use in conjunction with the Nueces off-channel reservoir, it was a recommended water management strategy in the 2021 Coastal Bend Regional Water Plan and 2022 State Water Plan. Additional studies would be needed to evaluate aquifers in proximity to the Nueces OCR and local water treatment plants, to further evaluate conjunctive use opportunities with the OCR and ASR.

Sedimentation Removal at LCC - Sediment accumulation in LCC has been discussed for decades. To address this issue, dredging of LCC was considered. This project was evaluated in the 2001 Coastal Bend (Region N) Regional Water Plan, but has not been re-evaluated or considered as a water management strategy in the most recent four planning cycles. In the 2001 Coastal Bend Regional Water Plan, it was estimated that approximately 163 million cubic yards (in situ volume) of sediment needs to be dredged to restore the storage capacity of LCC to 1959 conditions. The removal of sedimentation would free up capacity to store additional water and/or allow for more flood water capture. For water supply, the dredging program could provide a long-term yield (30-year) of approximately 9,000 acre-feet per year. This strategy was costly and presented disposal challenges.

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Chapter 7– Flood Response Information and Activities

31 TAC §361.42

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7 Flood Response Information and Activities

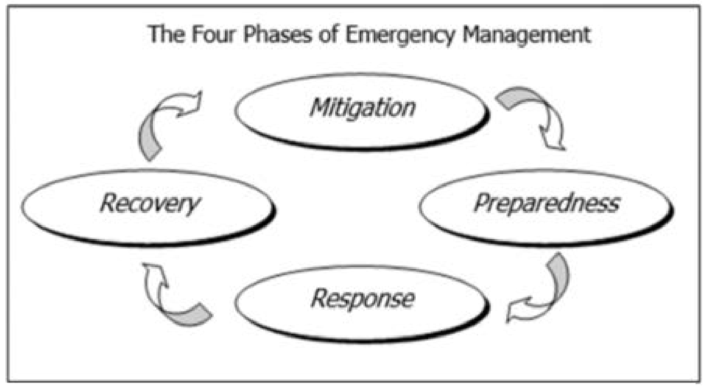
Texas Water Development Board (TWDB) guidance states that regional flood planning groups (RFPGs) are to summarize the nature and types of flood response preparations in the basin including recovery. It specifies, however, that RFPGs "shall not perform analyses or other activities related to planning for disaster response or recovery activities." The focus of this chapter is to present flood response information gathered through stakeholder outreach to flood-related authorities in the Nueces basin and provide general recommendations on flood response activities as a tool for others in the basin to use to develop flood response and recovery programs.

7.1 Types of Flooding in the Nueces Region

As discussed previously in Chapter 2 (Section 2.1.1.4), the three primary types of flooding in the Nueces Basin include riverine; pluvial, including urban flooding; and coastal flooding. In the 24,094-square-mile (15,420,000 acre) basin included in the Nueces Flood Planning Region (NFPR), the land surface elevation ranges from 2,400 feet mean sea level (msl) near Rocksprings in Edwards County to near sea-level (0 feet msl) in the coastal area near Corpus Christi. These elevation differences across the region and different soil types cause different types of flood risk. The NFPR was sub-divided into four subregions with this in mind, as shown in Figure 1-2. The upper basin is more prone to riverine flash floods; the upper and lower mid-basins are prone to riverine floods but are not flashy in nature like the upper basin; and the lower basin is more susceptible to coastal floods. Cities located in all subregions are prone to pluvial and urban flooding where inadequate local drainage is exceeded. This causes overtopping of drainage systems and flood flows to pool in the streets. Flash floods are caused by heavy rainfall over a relatively short period of time, resulting in flood water accumulating quickly that is powerful, extremely dangerous, and hampers mobility and emergency access for flood response. **Stormwater in the upper and lower mid-basin of the Nueces Region is typically conveyed through streets and engineered drainage features that were not effectively designed or maintained for effective flood control. Furthermore, many of these areas in the mid-basin have had inaccurate or no flood modeling or mapping to serve as a basis for flood mitigation. When such flood events occur, it is imperative that plans are in place to combat the effects of the flooding.**

7.2 The Nature and Types of Flood Response Preparations

There are four phases to emergency management:



Source: Federal Emergency Management Agency, 1998. IS-010 Emergency Management Institute: Animals in Disaster, Module A: Awareness and Preparedness

- **Flood Mitigation:** The implementation of actions, including structural and non-structural solutions, to reduce flood risk to protect against the loss of life and property.
- **Flood Preparedness:** Actions, aside from mitigation, that are taken before flood events to prepare for flood response activities.
- **Flood Response:** Actions taken during and in the immediate aftermath of a flood event.
- **Flood Recovery:** Actions taken after a flood event involving repairs or other actions necessary to return to pre-event conditions.

For example, when a severe rain event is projected to occur, steps are taken for **preparedness**: disaster preparedness plans are in place, drills and exercises are performed, an essential supply list is created, and potential vulnerabilities are assessed. During the **response** phase, disaster plans are implemented, search and rescue may occur, and low water crossing (LWC) barricades may be erected. In the **recovery** phase, evaluation of flood damage, rebuilding damaged structures, and removing debris occurs.

Mitigation is an important step of the four phases of emergency management. Hazard mitigation is defined as any sustained action taken to reduce or eliminate the continued risk to life and property from hazard events. It is an on-going process that seeks to break the cycle of damage and restoration in hazardous areas.

Flood mitigation is the primary focus of the regional flood planning process through the RFPG efforts to identify and recommend flood management evaluations (FMEs), flood management strategies (FMSs), and flood management projects (FMPs). The plan may also include FMEs, FMSs, and FMPs that focus on flood preparedness.

Examples of mitigation actions include regulatory requirements for reduction of flood risk, watershed planning, flood mapping updates, drainage infrastructure improvements, property acquisition and relocation, or public outreach projects. Examples of preparedness actions include installing disaster warning systems, purchasing radio communications equipment, or conducting emergency response training.

7.3 Flood Response Activities for Local Entities in the Nueces Region

The Nueces Region’s ability to prepare, respond, recover, and mitigate disaster events is determined by several factors. With a clear understanding of a community’s capabilities, a recognition of the entities with whom coordination is key, and knowledge of the actions sustained to promote resiliency, the region can be better equipped to implement sound measures for flood mitigation and preparedness.

The purpose of flood risk management is to help prevent or reduce flood risk through either structural or non-structural means or a combination of the two. The responsibility for flood risk management is shared amongst federal, state, and local government agencies; private-sector stakeholders; and the general public.

The major responsibilities of the county governments in the 31 counties located within the NFPR include providing public safety, holding elections at every level of government, maintaining Texans’ most important records; building and maintaining roads, bridges, and in some cases, county airports; providing emergency management services; providing health and safety services; collecting property taxes for the county and sometimes for other taxing entities; issuing vehicle registration and transfers; and registering voters.

Cities, or municipalities, generally take responsibility for parks and recreation services, police and fire departments, housing services, emergency medical services, municipal courts, transportation services (including public transportation), and public works (streets, sewers, signage, and so forth). There are 57 municipalities within the NFPR.

There are 50 “other” governmental entities within the NFPR that have various levels of flood management authority. These include associations that represent river authorities, water control improvement districts, drainage districts, member local governments, mainly cities and counties, that seek to provide cooperative planning, coordination, and technical assistance on issues of mutual concern that cross jurisdictional lines. River authorities or districts in Texas are public agencies established by the state legislature and given authority to develop and manage the waters of the state. The Nueces Region has five river authorities within its region that each have the power to conserve, store, control, preserve, use, and distribute the waters of a designated geographic region for the benefit of the public. A drainage district is a special purpose district created by the Texas Legislature and governed by County Commissioners Courts. It is a government agency established to reduce the effects of flooding through improvement of drainage features. There are four drainage control districts in the NFPR.

These 138 total entities and/or political subdivisions in the NFPR described above and listed in Chapter 1 (Section 1.3.1) were considered during development of the 2023 Nueces Regional Flood Plan (NRFP). During plan development, it was determined that many of the “other” governmental entities do not actively engage in flood response activities, and instead support local county and municipalities in administering flood mitigation and response programs.

To examine the state of its flood preparedness, the Nueces Regional Flood Planning Group (NRFPG) obtained emergency management plans, hazard mitigation plans, and other regional and local flood planning studies from county and local jurisdictions. An emergency management plan is a course of action developed to mitigate the damage of potential events that could endanger an organization's ability to function. Such a plan should include measures that provide for the safety of personnel and, if possible, property and facilities.

Hazard mitigation planning reduces loss of life and property by minimizing the impact of disasters. It begins with state, regional, and local governments identifying natural disaster risks and vulnerabilities that are common in their area. After identifying these risks, they develop long-term strategies for protecting people and property from similar events. Mitigation plans are key to breaking the cycle of disaster damage and reconstruction. Having an up-to-date hazard mitigation action plan (HMAP) is key in assessing risk and in developing mitigation actions.

The NRFPG collected hazard mitigation plans, emergency management plans, and ordinances for local entities in the Nueces Region that covered 21 counties and 30 municipalities in the Nueces Basin, as shown in Table 7-1.

Table 7-1. Summary of Nueces Basin entities with flood hazard mitigation plans, flood management plans, and ordinances

Entity Name	Type of Entity	Level of Engagement (none, low, medium, high)	Ordinance Adopted	Ordinance date	Flood hazard, mitigation action, or emergency management plan	Flood hazard, mitigation action or emergency management plan	Floodplain management plan	Floodplain management plan date
Aransas County	County	Medium	X	2019	X	2017	X	2017
Atascosa County	County	--	X	2013	X	2020	--	--
Bandera County	County	Medium	X	2020	X	2014	--	--
Bee County	County	--	X	2010	X	2012	--	--
Bexar County	County	Medium	X	2007	X	2014	--	--
Duval County	County	Low	--	--	X	2020	--	--
Frio County	County	Low	X	2016	X	2018	--	--
Jim Wells County	County	--	--	--	X	2012	--	--
Karnes County	County	Medium	X	2010	--	--	--	--
Kerr County	County	Medium	X	2020	--	--	--	--
Kleberg County	County	--	--	--	X	2012	--	--
La Salle County	County	--	X	2008	--	--	--	--
Live Oak County	County	--	--	--	X	2012	--	--
Mcmullen County	County	--	X	2013	X	2020	--	--
Medina County	County	High	X	--	--	--	--	--
Nueces County	County	High	X	--	X	2017	--	--
Real County	County	Medium	X	--	--	--	--	--
Refugio County	County	Low	X	2014	X	2021	--	--
San Patricio County	County	High	X	2019	X	2012	--	--
Webb County	County	High	X	2019	X	--	--	--
Wilson County	County	Medium	X	2010	--	--	--	--
Agua Dulce	Municipality	--	--	--	X	2017	--	--
Alice	Municipality	--	X	2017	--	--	--	--
Aransas Pass	Municipality	--	X	--	X	2017	X	2017
Beeville	Municipality	Low	--	--	X	--	--	--
Bishop	Municipality	Medium	X	2001	X	2017	--	--
Charlotte	Municipality	--	X	2009	X	2020	--	--
Christine	Municipality	--	X	--	X	2020	--	--
Corpus Christi	Municipality	High	X	--	X	2017	--	--
Cotulla	Municipality	Low	X	--	--	--	--	--
Driscoll	Municipality	--	--	--	X	2017	--	--
Fulton	Municipality	--	X	--	X	2017	X	2017

Entity Name	Type of Entity	Level of Engagement (none, low, medium, high)	Ordinance Adopted	Ordinance date	Flood hazard, mitigation action, or emergency management plan	Flood hazard, mitigation action or emergency management plan	Floodplain management plan	Floodplain management plan date
Gregory	Municipality	High	X	2019	X	2018	--	--
Hondo	Municipality	Medium	X	--	--	--	--	--
Ingleside	Municipality	High	X	--	X	2018	--	--
Ingleside on the Bay	Municipality	Medium	X	--	X	2018	--	--
Jourdanton	Municipality	--	X	--	X	2020	--	--
Lytle	Municipality	--	X	--	X	2020	--	--
Mathis	Municipality	--	--	--	X	2018	--	--
Odem	Municipality	--	--	--	X	2018	--	--
Pearsall	Municipality	--	X	--	X	--	--	--
Petronila	Municipality	--	--	--	X	2017	--	--
Pleasanton	Municipality	--	X	--	X	2020	--	--
Port Aransas	Municipality	High	X	--	X	2017	--	--
Portland	Municipality	High	X	--	X	2018	--	--
Poteet	Municipality	--	--	--	X	2020	--	--
Robstown	Municipality	--	X	--	X	2017	--	--
Rockport	Municipality	--	X	2015	X	2017	X	2017
San Patricio	Municipality	--	--	--	X	2018	--	--
Sinton	Municipality	Medium	--	--	X	2018	--	--
Taft	Municipality	--	--	--	X	2018	--	--

7.4 Flood Preparedness Measures in the Nueces Flood Planning Region

Flood preparedness is the first line of action that an entity can take prior to the occurrence of a flood events to prepare for flood response. In the NFPR, flood preparedness measures were identified for 23 counties and 41 cities based on information gathered from local stakeholders with flood-related authority, internet queries, and previous local and regional flood plans. Table 7-2 lists the names of entities and their flood preparedness measures.

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Table 7-2. Flood Preparedness Measures for Entities in the Nueces Flood Planning Region

Entity Name	Type of Entity	*Flood Preparedness Measures*																			
		Develop management plan with regular updates	Public Information Plan/Officer	Prepare staging areas	Build flood early warning systems	Protect buildings against flood damage at initial construction	Master plan of all flood-related projects	Land use practices and policies to reduce future flooding	Have Floodplain Administrator	Have Emergency Management Coordinator	Develop evacuation plan	Storm/Stormwater management plan	Consider higher standards list	Subdivision regulations	Floodplain regulations	National Flood Insurance Program (NFIP) minimum requirements	Local Floodplain ordinance with higher standards (greater than NFIP)	Drainage Master Plan	Developed Flood Plan	Erosion Response Plan	Emergency Operations Plan
Aransas County	County	X	X	--	--	X	X	X	X	X	--	X	X	X	X	X	X	X	X	--	X
Atascosa County	County	--	--	--	--	--	--	--	X	X	--	--	X	X	--	--	--	--	--	--	X
Bandera County	County	--	--	--	X	--	--	--	X	--	--	--	--	X	X	X	--	--	X	--	--
Bee County	County	--	--	--	--	X	--	--	X	X	--	--	--	X	--	--	--	--	--	--	--
Bexar County	County	X	X	--	--	--	--	--	X	--	--	--	--	X	X	--	X	--	--	--	--
Duval County	County	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	X
Frio County	County	--	--	--	--	--	--	--	X	--	--	--	--	X	X	X	--	--	--	--	X
Jim Wells County	County	--	--	--	--	--	--	--	--	X	--	--	--	X	--	--	--	--	--	--	--
Karnes County	County	--	--	--	--	X	--	--	X	X	--	--	--	X	X	--	X	--	--	--	X
Kerr County	County	--	--	--	--	X	--	--	X	--	--	--	X	X	X	X	--	--	--	--	--
Kleberg County	County	--	--	--	--	--	--	--	--	X	--	X	--	--	--	--	--	--	--	--	--
La Salle County	County	--	--	--	--	X	--	--	X	--	--	--	--	X	--	--	--	--	--	--	--
Live Oak County	County	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
McMullen County	County	--	X	--	--	--	--	--	X	X	--	X	--	X	--	--	--	--	--	--	--
Medina County	County	--	--	--	--	X	--	--	X	--	--	--	X	X	X	X	X	--	--	--	--
Nueces County	County	--	--	--	--	--	--	X	X	X	--	X	--	--	--	--	--	X	X	X	X
Real County	County	--	--	--	X	--	--	--	X	--	--	--	--	X	X	X	--	--	--	--	--
Refugio County	County	--	--	--	--	X	--	--	X	X	--	--	--	X	X	--	--	--	--	--	X
San Patricio County	County	X	--	--	--	X	--	--	X	X	--	--	--	X	X	--	X	--	X	--	--
Uvalde County	County	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Webb County	County	--	--	--	--	X	--	--	X	--	--	--	--	X	X	--	X	--	--	--	--
Wilson County	County	--	--	--	--	--	--	--	X	X	--	--	--	X	X	--	X	--	--	--	X
Zavala County	County	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	X	--	--	--	--
Agua Dulce	Municipality	--	--	--	--	--	--	X	--	X	--	--	--	--	--	--	--	--	--	--	X
Alice	Municipality	--	--	--	--	--	--	--	X	X	--	--	X	--	--	--	--	--	--	--	--
Aransas Pass	Municipality	X	X	--	--	--	--	--	X	X	--	X	--	X	X	--	--	--	X	--	X
Bayside	Municipality	X	--	--	--	X	--	--	X	X	--	--	--	X	X	--	--	--	--	--	X

Entity Name	Type of Entity	Flood Preparedness Measures																			
		Develop management plan with regular updates	Public Information Plan/Officer	Prepare staging areas	Build flood early warning systems	Protect buildings against flood damage at initial construction	Master plan of all flood-related projects	Land use practices and policies to reduce future flooding	Have Floodplain Administrator	Have Emergency Management Coordinator	Develop evacuation plan	Storm/Stormwater management plan	Consider higher standards list	Subdivision regulations	Floodplain regulations	National Flood Insurance Program (NFIP) minimum requirements	Local Floodplain ordinance with higher standards (greater than NFIP)	Drainage Master Plan	Developed Flood Plan	Erosion Response Plan	Emergency Operations Plan
Beeville	Municipality	--	--	--	--	--	--	X	--	--	--	--	--	--	--	X	--	--	--	--	--
Benavides	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	X
Bishop	Municipality	--	--	--	--	X	--	X	X	X	--	X	--	X	X	X	--	--	X	--	X
Charlotte	Municipality	--	--	--	--	--	--	--	X	--	--	--	X	--	--	--	--	--	--	--	--
Christine	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--
Corpus Christi	Municipality	--	--	--	--	--	--	X	X	X	--	X	--	X	X	--	X	--	--	X	X
Cotulla	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	X	X	X	--	--	--	--	--
Driscoll	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--
Freer	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	X
Fulton	Municipality	--	--	--	--	--	--	--	X	X	--	--	--	X	X	--	--	--	X	--	X
Gregory	Municipality	--	--	--	--	X	--	--	X	X	--	--	--	X	X	X	X	--	--	--	--
Hondo	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	X	X	X	--	--	--	--	--
Ingleside	Municipality	--	--	--	--	--	--	--	X	X	--	--	X	X	X	--	X	--	--	--	--
Ingleside on the Bay	Municipality	--	--	--	--	--	--	--	X	X	--	--	--	--	--	X	--	--	--	--	--
Jourdanton	Municipality	--	X	--	--	--	--	--	X	X	--	--	--	X	--	--	--	--	--	--	--
Kingsville	Municipality	--	--	--	--	--	--	--	X	X	--	--	X	--	--	--	--	--	--	--	--
Lake City	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Lakeside	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Leakey	Municipality	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	--	--	--	--	--
Lytle	Municipality	--	--	--	--	--	--	--	X	X	--	--	--	X	--	--	--	--	--	--	--
Mathis	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Odem	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Petronila	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	X
Pleasanton	Municipality	--	X	--	--	--	--	--	X	X	--	--	--	X	--	--	--	--	--	--	X
Port Aransas	Municipality	--	--	--	--	--	--	--	X	X	--	--	--	X	X	X	X	--	--	--	--
Portland	Municipality	--	--	--	--	--	--	--	X	X	--	--	--	X	X	--	X	--	--	--	--
Poteet	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	X	--	--	--	--	--	--	--
Refugio	Municipality	X	--	--	--	X	--	--	X	X	--	--	--	X	X	--	--	--	--	--	X
Robstown	Municipality	--	--	--	--	--	--	X	X	X	--	--	--	--	--	--	--	--	--	--	X

Entity Name	Type of Entity	Flood Preparedness Measures																			
		Develop management plan with regular updates	Public Information Plan/Officer	Prepare staging areas	Build flood early warning systems	Protect buildings against flood damage at initial construction	Master plan of all flood-related projects	Land use practices and policies to reduce future flooding	Have Floodplain Administrator	Have Emergency Management Coordinator	Develop evacuation plan	Storm/Stormwater management plan	Consider higher standards list	Subdivision regulations	Floodplain regulations	National Flood Insurance Program (NFIP) minimum requirements	Local Floodplain ordinance with higher standards (greater than NFIP)	Drainage Master Plan	Developed Flood Plan	Erosion Response Plan	Emergency Operations Plan
Rockport	Municipality	X	X	--	--	X	X	X	X	X	--	X	X	X	X	X	X	X	X	--	X
Rocksprings	Municipality	X	X	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
San Diego	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	X
San Patricio	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Sinton	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	X	X	X	--	--	--	--	--
Taft	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Uvalde	Municipality	--	--	--	--	--	--	--	X	--	--	--	--	X	X	--	X	--	--	--	--
Woodsboro	Municipality	X	--	--	--	X	--	--	X	X	--	--	--	X	X	--	--	--	--	--	X

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7.5 Flood Response and Recovery Measures in the Nueces Flood Planning Region

Flood response actions are actions taken during and in the immediate aftermath of a flood event. Flood recovery involves repair or other actions after a flood event to restore to pre-flood conditions. Table 7-3 lists the names of entities and their flood response and recovery measures.

Table 7-3. Flood Response and Recovery Measures for Entities in the Nueces Region

Entity Name	Type of Entity	*Flood Response and Recovery Measures*														
		High Water Marks	Contact Residents	Conducts evacuations (with Safety Precautions for Flood Responders)	Provides shelters during flood response	Closes flooded roads	Operates flood warning systems	Assess road and property damage	List and schedule repairs and replacements	Fire or police department responds	Pump out flooded areas	Emergency Operations Center (EOC) is activated	EOC to deploy necessary supplies	Field operation plan during flood event	Stream gage monitoring	Use Traffic Control Plan
Aransas County	County	X	X	--	--	--	X	X	--	--	--	--	X	--	--	--
Atascosa County	County	--	--	--	--	--		X	--	X	--	--	--	--	--	--
Bandera County	County	--	--	X	--	--	X	--	--	--	--	--	--	X	X	X
Frio County	County	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--
Nueces County	County	--	--	--	--	--	X	X	X	--	--	--	--	--	--	--
Uvalde County	County	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--
Agua Dulce	Municipality	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
Aransas Pass	Municipality	--	--	--	--	X	X	X	--	--	X	X	--	--	--	--
Beeville	Municipality	--	--	--	--	--	--	--	--	X	--	X	--	--	--	--
Bishop	Municipality	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
Corpus Christi	Municipality	--	--	--	--	X	X	X	X	--	X	X	--	--	--	--
Fulton	Municipality	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
Ingleside	Municipality	--	--	--	--	X	--	X	--	X	X	--	--	--	--	--
Pearsall	Municipality	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--

Entity Name	Type of Entity	*Flood Response and Recovery Measures*														
		High Water Marks	Contact Residents	Conducts evacuations (with Safety Precautions for Flood Responders)	Provides shelters during flood response	Closes flooded roads	Operates flood warning systems	Assess road and property damage	List and schedule repairs and replacements	Fire or police department responds	Pump out flooded areas	Emergency Operations Center (EOC) is activated	EOC to deploy necessary supplies	Field operation plan during flood event	Stream gage monitoring	Use Traffic Control Plan
Petronila	Municipality	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
Robstown	Municipality	--	--	X	--	--	X	--	--	--	--	--	--	--	--	--
Rockport	Municipality	--	--	--	--	X	X	X	X	X	X	--	--	--	--	--

7.6 State Agencies that Provide Flood Response Support

State agencies play an important role in flood response and can help provide support and resources for flood preparation activities.

The state hazard mitigation plan is an effective instrument to reduce losses by reducing the impact of disasters upon people and property. Although mitigation efforts cannot eliminate impacts of disastrous events, the plan endeavors to reduce the impacts of hazardous events to the greatest extent possible. The plan evaluates, profiles, and ranks natural and human-caused hazards affecting Texas as determined by frequency of event, economic impact, deaths, and injuries. The plan

- assesses hazard risk,
- reviews current state and local hazard mitigation and climate adaption capabilities, and
- develops strategies and identifies state agency (and other entities) potential actions to address needs.

Table 7-4 summarizes various state contributing entities and partners with a description of their role related to flood response. Specific activities related to the NFPG (Region 13) are also noted.

Table 7-4. State Agency Roles in Flood Response Activities

Agency	State or Federal	Role	Region 13 specific notes	Actions within Region 13
Texas General Land Office (GLO)	State	Restoring critical infrastructure and mitigating future damage through resilient community planning. More than $14 billion have been allocated for recovery and mitigation.	GLO Region 3 serves Aransas, Kenedy, Kleberg, Nueces, Refugio, and San Patricio Counties	Fulton Beach Road Projection (Aransas), Shell Point Ranch Wetlands Protection (Aransas), Lamar Beach Road Protection (Aransas), Flour Bluff Living Shoreline (Aransas), Newcomb's Point Shoreline Stabilization (Aransas), Little Bay Restoration Initiative (Aransas), Baffin Bay Watershed Monitoring and Management Plan (Kenedy, Kleberg), Tern Island and Triangle Tree Island Rookery Habitat Protection (Kleberg), Coastal Ben Gulf Barrier Island Conservation (Kleberg), Aransas National Wildlife Refuge Dagger Point Shoreline Preservation (Nueces), Portland Living Shoreline (Nueces), Nueces River Delta Shoreline Stabilization (Nueces, San Patricio), Guadalupe Delta Estuary Restoration (Refugio), Guadalupe River and Delta Wildlife Management Area Acquisition (Refugio), Indian Point Marsh Area Living Shoreline (San Patricio), Corus Christi Bay Wastewater, Stormwater Quality and Pollution Management Improvements (San Patricio)

Agency	State or Federal	Role	Region 13 specific notes	Actions within Region 13
Texas Water Development Board (TWDB)	State	Designated as the State National Flood Insurance Program (NFIP) Coordinating Agency for Texas. TWDB administers the state and regional flood planning process with the flood planning regions.	Not applicable	Not applicable
Texas Park and Wildlife Department (TPWD)	State	Texas Parks and Wildlife Game Wardens are often first on the scene to assist local law enforcement to search for and rescue victims of disasters - especially flood victims.	Not applicable	Not applicable
Texas Division of Emergency Management (TDEM)	State	Ensure the state and its local governments respond to and recover from emergencies and disasters and implement plans and programs to help prevent or lessen the impact of emergencies and disasters	Region 3 serves Aransas, Bee, Brooks, Dimmit, Duval, Edwards, Jim Hogg, Jim wells, Kenedy, Kinney, Kleberg, LaSalle, Live Oak, Maverick, Nueces Real, Refugio, San Patricio, Uvalde, Webb, and Zavala. Region 6 serves Atascosa, Bandera, Bexar, Frio, Goliad, Karnes, Kerr, McMullen, Medina, Wilson	Not applicable

Agency	State or Federal	Role	Region 13 specific notes	Actions within Region 13
Texas State Soil and Water Conservation Board (TSSWCB)	State	Works to ensure that the State's network of over 2,000 flood control dams are protecting lives and property by providing operation, maintenance, and structural repair grants to local government sponsors.	Flood control dams within Region 13 counties are eligible	Not applicable
Texas Department of Transportation (TxDOT)	State	TxDOT has been working with state and federal emergency planners to refine the evacuation process for emergencies such as hurricanes and flash floods	Evacuation routes have been refined for Corpus Christi, including Aransas Pass and Port Aransas	Evacuation routes include counties in Region 13
Texas Engineering Extension Service (TEEX)	State	Established to enhance the capabilities of emergency responders and local officials to prepare for, respond to, and recover from catastrophic events resulting from natural events, etc. TEEX is the sponsoring agency for Texas Task Force 1, which includes one of the country's most extensive water rescue program.	Not applicable	Not applicable

Dams and levees are owned and operated by individuals, private and public organizations, and the government. The responsibility for maintaining a safe dam resides with the owner. A dam failure resulting in an uncontrolled release of the reservoir can have a devastating effect on persons and property downstream. It is critical that dam owners are part of the flood planning process to ensure collaborative and cohesive flood planning.

There are 506 dams in the NFPR, and 116 of these dams are regulated by the Texas Commission on Environmental Quality (TCEQ's) Dam Safety Program. As part of the Dam Safety Program, owners of significant and high hazard dams are required to submit an Emergency Action Plan (EAP) to the TCEQ. Dam EAPs document responsibilities during flood response and identify the flood inundation area. Of the 116 TCEQ regulated dams, 28 have an EAP on file with TCEQ.

The NFPR also includes 23 flood control dams constructed and operated by the Natural Resources Conservation Service (NRCS). The NRCS dams are in Duval, Jim Wells, Uvalde, Atascosa, and Live Oak Counties. A preliminary evaluation was performed to categorize dam hazard using the following classification:

- High Hazard- There are structures in the downstream floodplain. A high hazard classification indicates that if the dam were to fail, there would be large consequences (such as loss of life), not that the dam is in a condition that is more likely to fail.

- Significant Hazard- There are no structures in the downstream floodplain, but there are up to two structures near the downstream floodplain.

- Low Hazard- There are no structures in or near the downstream floodplain.

Table 7-5 summarizes the NRCS flood control dams in the NFPR.

Table 7-5 NRCS Dams in the Nueces Basin - 2021

Hazard Potential	No of State Regulated Dams
High Hazard Potential	15
Significant Hazard Potential	2
Low Hazard Potential	4
Unknown*	2

*Dams not analyzed due to lack of readily available information. At this time, only 21 out of 23 NRCS regulated dams were evaluated.

7.7 Federal Agencies Flood Response Support

There are several federal agencies that provide support and resources for flood preparation activities.

The **Federal Emergency Management Agency (FEMA)** is an agency of the U.S. Department of Homeland Security (DHS). While on-the-ground support of disaster recovery efforts is a major part of FEMA's charter, the agency provides state and local governments with experts in specialized fields and funding for rebuilding efforts and relief funds for infrastructure by directing individuals to access low-interest loans, in conjunction with the Small Business Administration. FEMA also provides funds for training of response personnel throughout the United States and its territories as part of the agency's preparedness effort.

The **National Weather Service (NWS)** mission is to provide weather, water and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy. NWS provides flash flood indicators through watches, warnings, and emergency notices.

- Flash Flood WATCH is issued when conditions look favorable for flash flooding. A watch usually encompasses several counties. This is the time the public should start thinking about their plan of action and where they would go if water begins to rise.
- Flash Flood WARNING is issued when dangerous flash flooding is happening or will happen soon. A warning is usually a smaller, more specific area. This can be issued due to excessive heavy rain or a dam/levee failure. This is when the public must act quickly as flash floods are an imminent threat to them and their family. They may only have seconds to move to higher ground.
- Flash Flood EMERGENCY is issued for the exceedingly rare situations when extremely heavy rain is leading to a severe threat to human life and catastrophic damage from a flash flood is happening or will happen soon. Typically, emergency officials are reporting life threatening water rises resulting in water rescues/evacuations.

The NWS has developed a simplified, quick loading radar website called Local Standard Radar https://www.weather.gov/radar_lite to help emergency managers with flood preparations and notifications to residents.

The United States Geological Survey (USGS) obtains and monitors rainfall, water surface stage, and peak river flows; measures high water marks; and maintains stream gage stations that are vital in capturing flood data for future flood preparedness and flood mitigation programs. Using rainfall totals, intensity, and river stage response, the

USGS is able to estimate flow travel times for early flood warning. The USGS provided partnership cooperative funding with the Bandera County River Authority Groundwater District (BCRAGD) and TWDB to construct the Bandera County Texas Flood Early Warning System for Medina and Sabinal Rivers. This program aides in protection of human life, livestock, reduction of property damage, and overall public safety.

The **National Oceanic and Atmospheric Administration (NOAA)** is a scientific and regulatory agency within the U.S. Department of Commerce that forecasts weather, monitors oceanic and atmospheric conditions, charts the seas, conducts deep sea exploration, and manages fishing and protection of marine mammals and endangered species in the U.S. exclusive economic zone. NOAA provides historical data that can help communities determine their future probability of flood events and is key in the planning and mitigation process.

The **U.S. Corps of Engineers (USACE)** is responsible for a wide range of efforts in the United States, including addressing safety issues related to waterways, dams, and canals but also environmental protection, emergency relief, hydroelectric power, and much more. USACE composed of several districts and the NFPR includes both the Fort Worth District and Galveston District. The USACE Flood Risk Management Program (FRMP) works across the agency to focus the policies, programs and expertise of USACE toward reducing overall flood risk. This includes the appropriate use and resiliency of structures such as levees and floodwalls, as well as promoting alternatives when other approaches (e.g., land acquisition, flood proofing, etc.) reduce the risk of loss of life, reduce long-term economic damages to the public and private sector, and improve the natural environment. USACE is currently conducting flood and drainage studies within the NFPR, which are described in greater detail in Chapter 2.

Daily river forecasts are issued by **River Forecast Centers (RFCs)** using hydrologic models based on rainfall, soil characteristics, precipitation forecasts, and several other variables. Some RFCs also provide peak flow forecasts. A wide variety of users rely on these forecasts, including those in agriculture, hydroelectric dam operation, and water supply resources. The forecasts can provide essential information on the river levels and conditions.

7.8 Emergency Information

There are various means by which data can be collected and disseminated in a flood event. These include gauges to measure the current flood risk and communication systems to alert the public.

Two types of gauges used are rain gauges and stream gauges. A rain gauge is a meteorological instrument that measures precipitation in a given amount of time per unit area. It collects water falling on it and records the change over time in the rainfall depth.

Stream gauging is a technique used to measure the discharge, or the volume of water moving through a channel per unit time, of a stream. The height of water in the stream channel, known as a stage or gauge height, can be used to determine the discharge in a stream. Within the NFPG, there are 50 U.S. Geological Survey (USGS) stream gages.

In addition to the NWS, local news stations or radio stations are vital components in relaying real time information to local residents of inclement weather and flooding. They can also alert residents to low water crossing closings, dam or levee breaches, and other potential dangers. They can also issue flood watches, warnings, and emergency notifications.

An Emergency Alert System (EAS) is software that provides alert messages during an emergency. Messages can interrupt radio and television to broadcast emergency alert information. Messages cover a large geographic footprint. Emergency message audio/text may be repeated twice, but EAS activation interrupts programming only once, then regular programming continues.

A reverse 911 system allows an agency to pull up a map on a computer, define an area and send off a recorded phone message to each business or residence in that area. It can provide data to residents of flood dangers in their area.

School emergency alert systems are tools that allows schools to communicate quickly to staff, students, first responders, and others so that they can take appropriate action in the event of an emergency. Various versions of this tool are used in schools through the region from daycares to K-12 grade, as well as universities.

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Chapter 8 – Administrative, Regulatory, and Legislative Recommendations

31 TAC § 361.43

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8 Administrative, Regulatory, and Legislative Recommendations

Texas Water Development Board (TWDB) guidelines state that regional flood planning groups (RFPGs) are to develop administrative, regulatory, or other recommendations for inclusion in the 2023 Regional Flood Plan (RFP). The Nueces Regional Flood Planning Group (NRFPG) formed a subcommittee at an open meeting on March 28, 2022, to consider legislative and regional policy recommendations. The subcommittee met on May 3 to discuss and develop recommendations, which were adopted by the NRFPG on May 16, 2022. The following are the Nueces Region's recommendations regarding these matters.

8.1 Administrative Recommendations

I. The NRFPG should play a role in facilitating public information/public education activities in the Nueces Basin and providing support to local public agencies to promote a wider understanding of state and regional flood issues and the importance of flood preparedness and long-range regional flood planning and mitigation.

II. The TWDB is encouraged to identify and eliminate barriers that prevent multi-jurisdictional, multi-county, or council of government-level areas from working together to provide regional flood mitigation solutions. For example, if a primary sponsor meets all administrative requirements but additional participating jurisdictions do not, allow the regional solution to remain in consideration for state funding.

III. The TWDB is encouraged to prepare a brief report that summarizes enforcement levels of floodplain ordinances for all cities and counties (where applicable) and includes guidance on tools and resources that are available to help communities improve the enforcement of floodplain standards.

IV. The NRFPG encourages counties and cities to consider drainage districts as a mechanism to manage flooding.

V. The TWDB should provide a funding mechanism for smaller communities to receive dedicated funding for studies / planning efforts to identify flood management strategies (FMSs), flood management evaluations (FMEs), and flood mitigation plans (FMPs), including both traditional, engineered flood mitigation projects and nature-based solutions. Most smaller communities do not have the resources to hire an engineer to complete these studies.

VI. The TWDB should use the project list in the adopted RFP and state flood plan (SFP) to help connect local communities to grant programs administered by federal or other state agencies (e.g., General Land Office, Federal Emergency Management Agency [FEMA], U.S. Army Corps of Engineers [USACE], U.S. Geological Survey [USGS], U.S. Department of Housing and Urban Development [HUD] Community Block Grant Programs, and others).

VII. The TWDB is encouraged to develop a roadmap on how state and federal agencies work together on flood preparedness, mitigation, response, and recovery activities to support counties, cities, and local floodplain administrators. In addition to the linkages between agencies, the roadmap should distinguish the roles of each agency, schedule of ongoing studies relevant to regional flood planning, how efforts are being coordinated, and other topics.

VIII. The TWDB is encouraged to consider use of hybrid approaches that blend structural engineered projects and nature-based solutions for flood mitigation:

a. Incentivize voluntary buy out programs, turning previously flooded properties/neighborhoods into stormwater parks as an alternative to large-scale construction projects.

b. Provide training to state agencies, local governments, engineers, planners in the use of natural floodplain preservation/conservation.

IX. The TWDB is encouraged to develop a compendium of resources identifying nature-based solutions for communities to use for flood mitigation purposes.

X. Public entities in the Nueces Flood Planning Region {NFPG; Region 13) are strongly encouraged to provide their share of continued funding for administrative support activities that facilitate NRFPG (Region 13) activities.

8.2 Regulatory/ Policy Recommendations

I. The Texas Legislature is urged to support adoption of 2015 or 2018 versions of the International Building Code and the International Residential Code as State Building Standards. This would improve Texas' eligibility for funding under the Building Resilient Infrastructure and Communities (BRIC) program. The FEMA 2015 International Building Code document[3] provides an excerpt of flood related provisions which ensures proper floodplain management practices are integrated with the building permit process. A key measure of the 2015

[3] https://www.fema.gov/sites/default/files/2020-07/2015_icodes_flood_provision.pdf

International Building Code is the requirement of one foot of freeboard for new buildings.

II. The Texas Legislature is urged to develop a program through the TWDB to provide support services to rural and socioeconomic disadvantaged communities to develop and maintain flood management activities. The TWDB could develop and provide a toolkit with guidance and templates on floodplain ordinances, minimum building standards, flood response plans, and other materials to support those with limited experience and flood management resources.

III. The NRFPG (Region 13) urges the legislature to provide implementation guidance to empower county governments to have greater regulatory control over land development activities, including land use plans, adoption of waterway set-backs to protect natural features that mitigate flooding, and/or levying stormwater drainage impact fees to maintain flood infrastructure if desired. Additionally, to provide funding support to local floodplain administrators to develop accurate inundation mapping, which is current absent in over 70% of the 31-county area in Region 13.

IV. The legislature is urged to encourage coordinated efforts between TWDB and FEMA on use of best data, rather than outdated FEMA maps, and;

V. Incorporate USGS flood inundation mapping (FIM) projects co-funded by the state with cost share from local communities.

8.3 Legislative Recommendations

I. The Texas Legislature is urged to continue funding the TWDB to provide support for state-mandated RFPG activities.

II. The Texas Legislature should consider enabling legislation to allow creation of a regional flood authority or funding to river authorities to administer a program to provide support to local floodplain administrators, counties and cities in the region, if needed on a voluntary basis.

III. The NRFPG (Region 13) urges the legislature to support policies to address Texas' flood risk needs and prepare for and respond to current and future flood conditions, including coordination of federal and state-level agency floodplain initiatives, including Texas Division of Emergency Management (TDEM), FEMA, and the Texas General Land Office (GLO) on a 5-year cycle for consideration by RFPGs.

IV. The NRFPG (Region 13) urges the legislature to support legislation to empower counties or Groundwater Conservation Districts with authority to protect natural

Aquifer Storage and Recovery features, like karst recharge and fracture zones, and sink holes that help mitigate flood intensity while transferring potential flood water into aquifers.

V. The Texas Legislature should continue to provide funding to state agencies for flood planning initiatives, including providing technical support and assistance to county and city floodplain administrators or designees to support development of building standards, permitting support to verify new projects meet floodplain development requirements, and training. These initiatives should prioritize solutions that do not rely on channel maintenance programs to reduce flood risk.

VI. The Texas Legislature is urged to make funds available through RFPGs to facilitate public information campaigns through local floodplain administrators and public entities to increase community knowledge of rules and regulations, flood-prone areas, and importance of protecting floodplains from encroachment.

VII. The Texas Legislature is urged to direct the Texas Commission on Environmental Quality (TCEQ) to work with Texas Parks and Wildlife, the Texas Department of Transportation (TXDOT), local road and bridge departments, and other state agencies to support removal of debris and/or sediment deposited from major flooding events to avoid creating new flood risk hazards.

VIII. The Texas Legislature is urged to make funds available through the TWDB to establish a dedicated program to provide low-interest loans or grants to implement projects identified through local and TxDOT road and bridge assessment and remediation plans.

IX. The Texas Legislature is urged to support forward-thinking measures for our transportation system by requiring TxDOT to build to 1% annual chance (100-year) standards using the best available and most current flood maps and that such infrastructure will not increase downstream flooding nor damage riparian streamsides.

X. The Texas Legislature is urged to provide biennial appropriations to maintain the Flood Infrastructure Fund. Biennial appropriations to FIF will ensure that the state can continue to invest in FMPs included in the regional flood plans.

XI. The Texas Legislature is urged to make funds available through the TWDB to establish a dedicated program to provide funding for maintenance or engineering controls of drainage and culvert systems (both structural and non-structural nature-based solutions) to divert flood flows and identify and resolve structural improvements causing flooding issues.

XII. The Texas Legislature is urged to make funds available to support nature-based practices through land conservation, restoration programs, and participation in landowner incentive programs to encourage voluntary land stewardship practices to manage floodwaters by slowing runoff and dissipating flood energy to include riparian, wetland, forest, upland, and other habitat protection programs. Promote land coverage studies to effectively identify riparian corridors to protect for floodplain mitigation and erosion reduction. Additional low interest programs to support voluntary city and county buy-back of lands for county parks and flood mitigation should also be included.

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Chapter 9 – Flood Infrastructure Financing Analysis

31 TAC § 361.44

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9 Flood Infrastructure Financing Analysis

The Texas Water Development Board (TWDB) requires that each regional flood planning group (RFPG) assess and report on how sponsors propose to finance recommended flood management evaluations (FME), flood management strategies (FMS), and flood mitigation projects (FMP). A primary aim of this survey effort is to understand the funding needs of local sponsors and propose what role the state should have in financing the recommended FMEs, FMSs, and FMPs.

Section 9.1 presents an overview of common sources of funding for flood mitigation planning, projects, and other flood management efforts. The methodology and results of the financing survey are presented in Section 9.2.

9.1 Sources of Funding for Flood Management Activities

Communities across the state use a variety of funding sources for their flood management efforts, including local, state, and federal sources. This section discusses some of the most common avenues of generating local funding and various state and federal financial assistance programs available to communities. Table 9-1. on the following page summarizes the local, state, and federal sources discussed in this chapter, and characterizes each by the following three key parameters: first, which state and federal agencies are involved, if applicable; second, whether they offer grants, loans, or both; and third, whether they are classified as regularly occurring opportunities or are only available after a disaster.

A combination of increased local capabilities and increased funding amounts and opportunities from the state and federal government will be required to meet the flood risk study and mitigation needs identified through this planning process. State funding will be particularly needed to provide access to funding for small, rural communities, incentivizing high-priority projects and project types, and improving access to and leveraging federal funding sources. Chapter 8 includes the Nueces Regional Flood Planning Group (NRFPG) recommendations for increasing local, regional, and state funding programs.

9.1.1 Local Funding

Overall, larger urban communities typically bear a greater percentage of the burden for funding flood- and stormwater-related activities in their jurisdictions than the smaller, more resource-limited communities, who are often are unable to generate a significant amount of funding for these activities.

This section primarily focuses on the funding mechanisms available to municipalities and counties, as a large majority of the FME, FMS, and FMP sponsors are these types of entities. Special purpose districts are briefly discussed as there may be opportunities to create more of these types of districts in the region.

A community's general fund revenue (for cities or counties) stems from sales, property, and other taxes, and is typically the primary fund used by a government entity to support most departments and services such as police, fire, parks, trash collection, and local government administration. Due to the high demands on this fund for many local needs, there is often not a significant amount available for funding flood projects out of the general fund.

Table 9-1. Common Sources of Flood Funding in Texas

Source	Federal Agency	State Agency	Program Name	Grant (G)	Loan (L)	Post-Disaster (D)
Federal	EPA	TWDB	Clean Water State Revolving Fund (CWSRF)	G**	L	-
	FEMA	TWDB	Flood Mitigation Assistance (FMA)	G	-	-
	FEMA	TDEM	Building Resilient Infrastructure and Communities (BRIC)	G	-	-
	FEMA	TCEQ	Rehabilitation of High Hazard Potential Dam Grant Program (HHPD)	G	-	-
	FEMA	*TBD*	Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM)	-	L	-
	FEMA	TDEM	Hazard Mitigation Grant Program (HMGP)	G	-	D
	FEMA	TDEM	Public Assistance (PA)	G	-	D
	HUD	GLO	Community Development Block Grant – Mitigation (CDBG-MIT)	G	-	D
	HUD	GLO	Community Development Block Grant Disaster Recovery Funds (CDBG-DR)	G	-	D
	HUD	TDA	Community Development Block Grant (TxCDBG) Program for Rural Texas	G	-	-
	NOAA	-	National Coastal Zone Management Program	-	-	-
	NFWF	-	National Coastal Resilience Fund	G	-	-

	USACE	-	Partnerships with USACE, funded through Continuing Authorities Program (CAP), Water Resources Development Acts (WRDA), or other legislative vehicles*	-	-	-
	USDA	-	Watershed Protection and Flood Prevention Program	-	-	-
State	-	TWDB	Flood Infrastructure Fund (FIF)	G	L	-
	-	TWDB	Texas Water Development Fund (Dfund)	-	L	-
	-	TSSWCB	Structural Dam Repair Grant Program	G	-	-
	-	TSSWCB	Operation and Maintenance (O&M) Grant Program	G	-	-
	-	TSSWCB	Flood Control Dam Infrastructure Projects - Supplemental Funding	G	-	-
Local	-	-	General fund	-	-	-
	-	-	Bonds	-	-	-
	-	-	Stormwater or drainage utility fee	-	-	-
	-	-	Special-purpose district taxes and fees	-	-	-

*Opportunities to partner with USACE are not considered grant or loan opportunities, but shared participation projects where USACE performs planning work and shares in the cost of construction.
**The CWSRF program offers principal forgiveness, which is similar to grant funding.

Dedicated fees such as stormwater or drainage fees are an increasingly popular tool for local flood-related funding, primarily in more urban areas. Municipalities can establish a stormwater utility (sometimes called a drainage utility), which is a legal mechanism used to generate revenue to finance a city’s cost to provide and manage stormwater services. To provide these services, municipalities assess fees from users of the stormwater utility system. Impact fees, which are collected from development to cover a portion of the expense to expand stormwater systems necessitated by the new development, can also be used as a source of local funding for flood-related efforts. Of the 32 county and city entities in the Nueces Basin that responded to a survey sent out by the NRFPG, the City of Corpus Christi reported that it has a stormwater fund and the City of Portland has a stormwater utility fee to help fund projects.

Another source for local funding to support flood management efforts includes special districts. A special district is a political subdivision established to provide a single public service (such as water supply, drainage, or sanitation) within a specific geographic area.

Examples of these special districts include water control and improvement districts (WCID), municipal utility districts (MUD), drainage districts (DD), and flood control districts (FCD). Each of the different types of districts are governed by different state laws, which specify the authorities and process for creation of a district. Districts can be created by various entities, from the Texas Legislature or the Texas Commission on Environmental Quality (TCEQ) to county commissioners' courts or city councils. Depending on the type of district, the districts may have the ability to raise revenue through taxes, fees, or issuing bonds to fund flood and drainage-related improvements within a district's area. There are four DDs in the Nueces Flood Planning Region (NFPR): Nueces County Bishop Driscoll Drainage District 3, Nueces County Drainage and Conservation District 2, Refugio County Drainage District 1, and San Patricio County Drainage District.

Lastly, municipalities and counties have the option to issue debt through general obligation bonds, revenue bonds, or certificates of obligation, which are typically paid back using any of the previously mentioned local revenue raising mechanisms. Overall, local governments have various options for raising revenue to support local flood-related efforts; however, each avenue presents its own unique challenges and considerations. It is important to note that municipalities have more authority to establish various revenue raising options in comparison to counties. Of the communities that do have access to local funding, the amount available is generally much lower than the total need, leading local communities to seek out state and federal financial assistance programs.

9.1.2 State Funding

Today, communities have a broader range of state and federal funding sources and programs available due to new grant and loan programs that didn't exist even five years ago. There are two primary state agencies currently involved in providing state funding for flood projects: the TWDB and the Texas State Soil and Water Conservation Board (TSSWCB). State and federal financial assistance programs discussed here are not directly available to homeowners and the general public. Local governments apply on behalf of their communities to receive and implement funding for flood projects in their jurisdiction. In the Nueces Basin, several counties and cities have received support from the TWDB Flood Infrastructure Fund (FIF) program and many coastal communities have applied for Federal Emergency Management Agency (FEMA) grants.

The TWDB's FIF[4] is a new funding program passed by the Texas Legislature and approved by Texas voters through a constitutional amendment in 2019. The program provides financial assistance in the form of low or no interest loans and grants (cost match varies) to eligible political subdivisions for flood control, flood mitigation, and drainage projects. FIF rules allow for a wide range of flood projects, including structural

[4] http://www.twdb.texas.gov/financial/programs/FIF/index.asp

and nonstructural projects, planning studies, and preparedness efforts such as flood early warning systems. After the first state flood plan (SFP) is adopted, only projects included in the most recently adopted state plan will be eligible for funding from the FIF. FMEs, FMSs, and FMPs recommended in this regional flood plan (RFP) will be included in the overall SFP and will be eligible for this funding source.

The TWDB also manages the Texas Water Development Fund (Dfund)[5] program, which is a state-funded streamlined loan program that provides financing for several types of infrastructure projects to eligible political subdivisions. This program enables the TWDB to fund projects with multiple eligible components (water supply, wastewater, or flood control) in one loan at low market rates. Financial assistance for flood control may include structural and nonstructural projects, planning efforts, and flood warning systems.

The TSSWCB[6] has three state-funded programs specifically for flood control dams: the Operation and Maintenance (O&M) Grant Program; the Flood Control Dam Infrastructure Projects - Supplemental Funding Program; and the Structural Repair Grant Program. The O&M Grant Program is a grant program for local soil and water conservation districts (SWCD) and certain co-sponsors of flood control dams. This program reimburses SWCDs 90% of the cost of an eligible operation and maintenance activity as defined by the program rules; the remaining 10% must be paid with non-state funding. The Flood Control Dam Infrastructure Projects - Supplemental Funding Program was newly created and funded in 2019 by the Texas Legislature. Grants are provided to local sponsors of flood control dams, including SWCDs, to fund the repair and rehabilitation of the flood control structures, to ensure dams meet safety criteria to adequately protect lives downstream. The Structural Repair Grant Program provides state grant funds to provide 95% of the cost of allowable repair activities on dams constructed by the United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS), including match funding for federal projects through the Dam Rehabilitation Program and the Emergency Watershed Protection (EWP) Program of the Texas NRCS.

9.1.3 Federal Funding

The federal governments play an important, sometimes critical role, particularly in the financing of large-scale flood mitigation projects and studies that would otherwise be beyond the capabilities of the state and local governments. Commonly used funding programs administered by seven different federal agencies are discussed in this section. The funding for these programs originates from the federal government but for many of the programs, a state agency partner plays a key role in the management of

[5] http://www.twdb.texas.gov/financial/programs/TWDF/index.asp

[6] https://www.tsswcb.texas.gov/index.php/programs/flood-control-program

the program. Each funding program has its own unique eligible applicants, eligible project types, requirements, and application and award timelines. A few examples of eligibility requirements for some of the federal grant programs are: requiring recipients of funding to participate in the National Flood Insurance Program (NFIP), requiring recipients to have an approved hazard mitigation plan, or requiring a project to have a benefit cost ratio (BCR) of 1.0 or greater. More information regarding each program and their unique eligibility requirements and award processes can be found at the links in this section.

9.1.3.1 Federal Emergency Management Agency

Common FEMA-administered federal flood-related funding programs include Flood Mitigation Assistance (FMA), Building Resilient Infrastructure and Communities (BRIC), Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM), Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program, Hazard Mitigation Grant Program (HMGP), the Public Assistance (PA) program, and the Cooperating Technical Partners (CTP) Program.

FMA[7] is a nationally competitive annual grant program that provides funding to states, local communities, federally recognized tribes, and territories. The TWDB administers[8] FMA in Texas. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP. Funding is typically a 75% federal grant with a 25% local match. Projects mitigating repetitive loss and severe repetitive loss properties may be funded through a 90% federal grant and 100% federal grant, respectively. FEMA's FMA program now includes a disaster initiative called Swift Current. The program was released as a pilot initiative in 2022 and explored ways to make flood mitigation assistance more readily available during disaster recovery. Similar to traditional FMA, the program mitigates repetitive losses and substantially damaged buildings insured under the NFIP.

The BRIC[9] is a new nationally competitive non-disaster annual grant program implemented in 2020. The program supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The Texas Division of Emergency Management (TDEM) administers[10] BRIC in Texas. Funding is typically a 75% federal grant with a 25% local match. Small, impoverished communities may be funded through a 90% federal grant and 100% federal grant, respectively.

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[7] https://www.fema.gov/grants/mitigation/floods

[8] https://www.twdb.texas.gov/flood/grant/fma.asp

[9] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

[10] https://www.tdem.texas.gov/bric

STORM[11] is a new revolving loan program enacted through federal legislation in 2021 to provide needed and sustainable funding for hazard mitigation projects. The program is designed to provide capitalization grants to states to establish revolving loan funds for projects to reduce risks from disaster, natural hazards, and other related environmental harm. At the time of the publication of this plan, the program does not yet appear to be operational and has not yet been implemented in Texas.

FEMA's HHPD[12], administered in Texas by TCEQ, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. The cost share requirement is typically no less than 35% state or local share.

Under the HMGP[13], FEMA provides funding to state, local, tribal, and territorial governments so they can rebuild from a recent disaster in a way that reduces, or mitigates, future disaster losses in their communities. TDEM administers[14] the program in Texas. Funding is typically a 75% federal grant with a 25% local match. While the program is associated with Presidential Disaster Declarations, the HMGP is not a disaster relief program for individual disaster victims or a recovery program that funds repairs to public property damaged during a disaster. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster.

FEMA's PA[15] program provides supplemental grants to state, tribal, territorial, and local governments, and certain types of private non-profits following a declared disaster so communities can quickly respond to and recover from major disasters or emergencies through actions such as debris removal, life-saving emergency protective measures, and restoring public infrastructure. Funding cost share levels are determined for each disaster and are typically not less than 75% federal grant (25% local match) and typically not more than 90% federal grant (10% local match). In Texas, TDEM administers FEMA PA. In some situations, FEMA may fund mitigation measures as part of the repair of damaged infrastructure. Generally, mitigation measures are eligible if they directly reduce future hazard impacts on damaged infrastructure and are cost-effective. Funding is limited to eligible damaged facilities located within PA-declared counties.

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[11] https://www.congress.gov/bill/116th-congress/senate-bill/3418/all-info

[12] https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams

[13] https://www.fema.gov/grants/mitigation/hazard-mitigation

[14] https://www.tdem.texas.gov/mitigation

[15] https://www.fema.gov/assistance/public

The CTP[16] program is an effort launched by FEMA in 1999 to increase local involvement in developing and updating Flood Insurance Rate Maps (FIRMs), Flood Insurance Study (FIS) reports, and associated geospatial data in support of FEMA's Risk Mapping, Assessment and Planning (Risk MAP) Program. To participate in the program, interested NFIP-participating communities, state or regional agencies, universities, territories, tribes, or nonprofits must complete training and execute a partnership agreement. Working with the FEMA regions, a program participant can develop business plans and apply for grants to perform eligible activities.

9.1.3.2 Housing and Urban Development

The U.S. Department of Housing and Urban Development (HUD) administers the following three federal funding programs: Community Development Block Grant – Disaster Recovery (CDBG-DR), Community Development Block Grant – Mitigation (CDBG-MIT), and Community Development Block Grant (TxCDBG) for Rural Texas.

Following a major disaster, Congress may appropriate funds to HUD under the CDBG-DR[17] program when there are significant unmet needs for long-term recovery. Appropriations for CDBG-DR are frequently very large, and the program provides 100% grants in most cases. The Texas General Land Office (GLO) administers[18] the CDBG-DR program in Texas. The special appropriation provides funds to the most impacted and distressed areas for disaster relief, long term-recovery, restoration of infrastructure, housing, and economic revitalization.

The GLO also administers[19] the CDBG-MIT program[20] in Texas. Eligible grantees can CDBG-MIT assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks with typically 100% grants. The primary feature differentiating CDBG-MIT from CDBG-DR is that unlike CDBG-DR, which funds recovery from a recent disaster to retore damaged services, systems, and infrastructure, CDBG-MIT funds are intended to support mitigation efforts to rebuild in a way which will lessen the impact of future disasters.

The TxCDBG[21] program provides annual grants on a formula basis to small, rural cities and to counties to develop viable communities by providing decent housing and suitable living environments, and expanding economic opportunities principally for persons of low- to moderate-income. Funds can be used for public facilities such as water and

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[16] https://www.fema.gov/flood-maps/cooperating-technical-partners

[17] https://www.hudexchange.info/programs/cdbg-dr/

[18] https://recovery.texas.gov/disasters/index.html

[19] https://recovery.texas.gov/mitigation/

[20] https://www.hudexchange.info/programs/cdbg-mit/overview/

[21] https://www.hud.gov/program_offices/comm_planning/cdbg

wastewater infrastructure, street and drainage improvements, and housing. In Texas, the Texas Department of Agriculture (TDA) administers[22] the TxCDBG program.

9.1.3.3 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE)[23] works with non-federal partners (states, tribes, counties, or local governments) throughout the country to investigate water resources and related land problems and opportunities and, if warranted, develop civil works projects that would otherwise be beyond the sole capability of the non-federal partner(s). Partnerships are typically initiated or requested by the local community to their local USACE district office. Before any project or study can begin, USACE determines whether there is an existing authority under which the project could be considered, such as the Continuing Authorities Program (CAP)[24], or whether Congress must establish study or project authority and appropriate specific funding for the activity. New study or project authorizations are typically provided through periodic Water Resource Development Acts (WRDA) or via another legislative vehicle. Congress will not provide project authority until a completed study results in a recommendation to Congress of a water resources project, conveyed via a Report of the Chief of Engineers (Chief's Report) or Report of the Director of Civil Works (Director's Report). Opportunities to partner with USACE are not considered grant or loan opportunities, but shared participation projects where USACE performs planning work and shares in the cost of construction. USACE also has technical assistance opportunities, including Floodplain Management Services and the Planning Assistance to States program, available to local communities.

9.1.3.4 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency's (EPA) Clean Water State Revolving Fund (CWSRF)[25] provides financial assistance in the form of loans with subsidized interest rates and opportunities for partial principal forgiveness for planning, acquisition, design, and construction of wastewater, reuse, and stormwater mitigation infrastructure projects. Projects can be structural or non-structural. Low Impact Development (LID) projects are also eligible. The TWDB administers the CWSRF in Texas.

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[22] https://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant(CDBG)/About.aspx

[23] https://planning.erdc.dren.mil/toolbox/library/IWRServer/2019-R-02.pdf

[24] https://www.swd.usace.army.mil/About/Directorates-Offices/Programs-Directorate/Planning-Division/CAP/

[25] http://www.twdb.texas.gov/financial/programs/CWSRF/index.asp

9.1.3.5 U.S. Department of Agriculture

The USDA's NRCS provides technical and financial assistance to local government agencies through the following programs: EWP Program, Watershed Protection and Flood Prevention Program, Watershed Surveys and Planning, and Watershed Rehabilitation. The EWP[26] program, a federal emergency recovery program, helps local communities recover after a natural disaster by offering technical and financial assistance to relieve imminent threats to life and property caused by floods and other natural disasters that impair a watershed. The Watershed Protection and Flood Prevention Program helps units of federal, state, local and tribal government protect and restore watersheds; to prevent erosion, floodwater, and sediment damage; to further the conservation development, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds. The focus of Watershed Surveys and Planning program is funding watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance aimed at identifying solutions that use land treatment and nonstructural measures to solve resource problems. Lastly, the Watershed Rehabilitation Program helps project sponsors rehabilitate aging dams that are reaching the end of their design lives. This rehabilitation addresses critical public health and safety concerns. The USDA also offers various Water and Environmental grant and loan funding programs[27], which can be used for water and waste facilities, including stormwater facilities, in rural communities.

9.1.3.6 Special Appropriations

On occasion and when the need is large enough, Congress may appropriate funds for special circumstances such natural disasters or pandemics (COVID-19). A few examples of recent special appropriations from the federal government that can be used to fund flood-related activities are discussed in this section.

In 2021, the American Rescue Plan Act (ARPA) provided for a substantial infusion of resources to eligible state, local, territorial, and tribal governments to support their response to and recovery from the COVID-19 pandemic. Coronavirus State and Local Fiscal Recovery Funds (SLFRF), a part of ARPA, delivers $350 billion directly to state, local, and tribal governments across the country. Communities have significant flexibility to meet local needs within the eligible use categories, one of which includes improving stormwater facilities and infrastructure as an authorized use. Eligible entities may request their allocation of Coronavirus State and Local Fiscal Recovery Funds directly from the U.S. Department of Treasury.

Although not a direct appropriation to local governments like ARPA, the 2021 Infrastructure Investment and Jobs Act (IIJA), also called the Bipartisan Infrastructure

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[26] https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/

[27] https://www.rd.usda.gov/programs-services/water-environmental-programs

Law (BIL), authorizes over $1 trillion for infrastructure spending across the U.S. and provides for a significant infusion of resources over the next several years into existing federal financial assistance programs, including several of the flood funding programs discussed in this Chapter, as well as creating new programs.

Note, the recent federal special provision ARPA and BIL funding has not yet been allocated and made available for flood mitigation studies and projects that would be eligible under the state flood plan.

9.1.4 Barriers to Funding

Local communities encounter barriers to accessing or seeking funding sources for flood management activities, including lack of knowledge of funding sources, lack of expertise and staff time to apply for funding, and no local funds available for local match requirements. As opposed to some other types of infrastructure, flood projects do not typically generate revenue and many communities do not have steady revenue streams to fund flood projects, as discussed in Section 9.1.1. Consequently, communities struggle to generate funds for local match requirements or loan repayment. Complex or burdensome application or program requirements as well as prolonged timelines also act as barriers to accessing state and federal financial assistance programs. Of those communities able to overcome these barriers, apply for funding, and generate local resources for match requirements, the high demand for state and federal funding, particularly for grant opportunities, means that need outstrips supply, leaving many local communities without the resources they need to address flood risks.

9.2 Flood Infrastructure Financing Survey

This task required surveying local city and county officials to obtain information on how flood infrastructure projects were financed. The primary aim of this survey effort was to understand the funding needs of local sponsors and then propose what role the state should have in financing recommended FMEs, FMSs, and FMPs. For the NFPR, an initial survey was sent out by email in May 2021 to city/county representatives requesting information on their floodplain management and financing programs. Only four responses were received on the initial email outreach. This was due in part to outdated mailing lists due to staff changes and limited capacity of city/county personnel who often fill multiple organizational roles for the rural communities in the region. After emailing the initial survey, the consultant followed up from June 16 to August 10, 2021 with two rounds of targeted outreach via in-person meetings, phone calls and emails to sponsors to gather preliminary information on local funding mechanisms to support flood mitigation and management programs.

A total of 67 entities were contacted and 32 responses were received. This represents a response rate of about 50%, which is considered a high response rate given the conditions described previously. The most effective method of gathering information from sponsor's on their flood financing plans was to contact them directly to set up a phone interview. Table 9-2 summarizes the 32 responses received by local sponsors on their funding mechanisms that could be used, at least partially, to finance recommended FMEs, FMSs, and FMPs. A recurring theme from the sponsor's is that limiting funding was available to conduct drainage studies, which is considered a precursor to identifying specific projects. Several communities in the Nueces Basin, however, have been successful at receiving TWDB Flood Infrastructure Financing grants or Texas Division of Emergency Management funding that have provided much needed support in characterizing flood prone areas so that meaningful projects can be identified to ameliorate flooding issues.

To assess the funding need for recommended FMEs, FMSs, and FMPs, estimated percentages of local investment and state or federal need were applied. For basin-wide programs sponsored by the Nueces River Authority or other non-county or city entities, 100% of the total project costs were estimated as being needed from state or federal sources. For municipalities with a population less than 2,000 and counties with a population of less than 2,500 or those that indicated in the survey that no funding was available for flood activities, 100% of the total project costs were estimated as being needed from state or federal sources. For the municipalities with a population more than 2,000 and counties with a population more than 2,500, it was estimated that 90% of total project costs are required from state and federal sources and 10% projected local investment unless survey responses received indicated that these entities had no funding. A high percentage of outside need is supported by discussions with stakeholders during outreach efforts for this plan, which confirmed that many communities, particularly smaller and more rural communities, do not have any local funding available for flood management activities and larger communities that did report having local funding indicated relatively little local funding available in relation to overall need.

Overall, a total of $1.510 billion is needed to implement the recommended FMEs, FMPs, and FMSs in the NRFP. From the total cost, it is projected that $1.435 billion in state and federal funding are needed. Note the above costs are based on 2020 dollars and subject to change as new information is obtained and implementation timeframes are adjusted. Since most federal funding programs are dependent on availability or on project selection in a nationally competitive grant program, it is difficult to estimate how much federal funding may be available to implement these studies, strategies, and projects. It is conservatively estimated that as much as the full amount may be needed from state sources. This number does not represent the amount of funding needed to mitigate all risks in the region and solve flooding problems in their totality. This number simply represents the funding needs for the specific, identified studies, strategies, and projects in this cycle of regional flood planning. Future cycles of regional flood planning will continue to identify more projects and studies needed to further flood mitigation efforts in the NFPR.

Table 9-2. Funding Sources for Flood Mitigation Projects

Entity Name	Type (County, Municipality, Other)	Funding Sources for Flood Mitigation Projects									
		Bond Program	Special Tax Districts	Permitting Fees	General Fund	Storm Water Fund	Storm Water Utility Fee	Ad Valorem Tax	Other	None	Unknown
Aransas County	County	X	X	X	-	-	-	-	-	-	-
Bandera County	County	-	-	X	-	-	-	-	-	-	-
Bexar County	County	-	-	X	X	-	-	-	-	-	-
City of Beeville	Municipality	-	-	-	X	-	-	-	-	-	-
City of Bishop	Municipality	-	-	-	-	-	-	-	-	X	-
City of Corpus Christi	Municipality	-	-	-	-	X	-	-	-	-	-
City of Cotulla La Salle County	Municipality	-	-	-	X	-	-	-	-	-	-
City of Gregory	Municipality	-	-	X	X	-	-	X	-	-	-
City of Hondo	Municipality	-	-	-	X	-	-	-	X	-	-
City of Ingleside	Municipality	X	-	-	X	-	-	-	-	-	-
City of Leakey	Municipality	-	-	-	X	-	-	-	-	-	-
City of Port Aransas	Municipality	-	-	-	X	-	-	-	-	-	-
City of Sinton	Municipality	-	-	-	X	-	-	-	-	-	-
City of Uvalde	Municipality	-	-	-	X	-	-	-	-	-	X
Dimmit County	County	-	-	-	-	-	-	-	-	-	X
Duval County	County	-	-	-	X	-	-	-	-	-	-
Duval County Conservation & Reclamation District	Other	-	-	-	-	-	-	-	-	X	-
Frio County	County	-	-	-	-	-	-	-	-	X	-
Karnes County	County	-	-	X	-	-	-	-	-	-	-
Kerr County	County	-	-	-	X	-	-	-	-	-	-
McMullen County WCID #1	Other	-	-	-	-	-	-	-	-	X	-
Medina County	County	-	-	X	-	-	-	-	-	-	-
City of Portland, Texas	Municipality	-	-	-	X	-	X	-	-	-	-
Real County	County	-	-	-	X	-	-	-	-	-	-
Refugio County	County	-	-	-	-	-	-	-	-	X	-
San Patricio County	County	-	-	-	X	-	-	-	-	-	-
San Patricio County Drainage District	Other	-	-	-	-	-	-	X	-	-	-
City of Ingleside on the Bay	Municipality	-	-	-	-	-	-	-	-	X	-
Uvalde County UWCD	Other	-	-	-	-	-	-	X	-	-	-

Entity Name	Type (County, Municipality, Other)	Funding Sources for Flood Mitigation Projects									
		Bond Program	Special Tax Districts	Permitting Fees	General Fund	Storm Water Fund	Storm Water Utility Fee	Ad Valorem Tax	Other	None	Unknown
Webb County	County	-	-	-	X	-	-	-	-	-	-
Wilson County	County	-	-	X	-	-	-	-	-	-	-
Zavala County	County	-	-	-	-	-	-	-	-	-	X

Chapter 10 - Public Participation and Plan Adoption

31 TAC § 361.21, 361.12(a)(4)

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10 Public Participation, Adoption, Submittal, and Approval of Regional Plan

10.1 Introduction

The objective of this chapter is to address public participation, public meetings, administrative and technical support activities necessary to complete and submit the draft and final regional flood plan (RFP) and to obtain Texas Water Development Board (TWDB) approval.

The Nueces Regional Flood Plan (NRFP) was adopted in accordance with Texas Administrative Code provisions related to regional flood planning and the guidance principles adopted in Title 31 Texas Administrative Code (TAC) §362.3.

The NRFP conforms with the 39 flood planning guidance principles delineated in 31 TAC §361.20 (31 TAC §362.3), including that the plan will not negatively affect a neighboring area. The guidance principles and the means by which these requirements are met are listed in Table 10-1, along with references to the RFP chapters, which are listed in Table 10-2. Furthermore, the NRFP was developed based on Texas Water Development Board (TWDB) guidance and adequately provides for the preservation of life and property and the development of water supply sources, where applicable. Appendix A includes full data tables requested by TWDB in Exhibit C in the digital submission.

Table 10-1. Title 31 TAC §362.3 Guidance Principles and the Means by which Requirements are Met in NRFP

Guidance Principle	Means by which Requirement is Met in RFP
(1) shall be a guide to state, regional, and local flood risk management policy;	The RFP is a guide with management goals in Chapter 3, management strategies in Chapter 5, and management and policy recommendations in Chapter 8.
(2) shall be based on the best available science, data, models, and flood risk mapping;	Best available information from a quality, coverage, and contemporary perspective were used in NRFP, for example in Chapter 2 analyses.

Guidance Principle	Means by which Requirement is Met in RFP
(3) shall focus on identifying both current and future flood risks, including hazard, exposure, vulnerability and residual risks; selecting achievable flood mitigation goals, as determined by each RFPG for their region; and incorporating strategies and projects to reduce the identified risks accordingly;	The NRFP examines current and future flood risk in Chapter 2, flood mitigation goals in Chapter 3, and strategies in Chapter 5. Maps show the areas of flood risks.
(4) shall, at a minimum, evaluate flood hazard exposure to life and property associated with 0.2% annual chance flood event (the 500-year flood) and, in these efforts, shall not be limited to consideration of historic flood events;	Flood hazard exposure is evaluated and presented in Chapter 2. Maps show the areas of flood risks associated with different percent annual chance flood event.
(5) shall, when possible and at a minimum, evaluate flood risk to life and property associated with 1% annual chance flood event (the 100-year flood) and address, through recommended strategies and projects, the flood mitigation goals of the RFPG (per item 2 above) to address flood events associated with a 1% annual chance flood event (the 100-year flood); and, in these efforts, shall not be limited to consideration of historic flood events;	Flood risks are evaluated and presented in Chapter 2, with recommended strategies and projects provided in Chapter 7 and Chapter 8.
(6) shall consider the extent to which current floodplain management, land use regulations, and economic development practices increase future flood risks to life and property and consider recommending adoption of floodplain management, land use regulations, and economic development practices to reduce future flood risk;	Floodplain management practices throughout the Nueces Region are mostly low as described in Chapter 3 (illustrated in Figure 3-1). Increased recognition of floodplains and accurate floodplain mapping is needed for most of the region to update flood risks.
(7) shall consider future development within the planning region and its potential to impact the benefits of flood management strategies (and associated projects) recommended in the plan;	Future development is considered in Chapter 2 and Chapter 3. The area in and near the City of Corpus Christi vicinity has the greatest potential for developmental pressures in flood prone areas needing management strategies.

Guidance Principle	Means by which Requirement is Met in RFP
(8) shall consider various types of flooding risks that pose a threat to life and property, including, but not limited to, riverine flooding, urban flooding, engineered structure failures, slow rise flooding, ponding, flash flooding, and coastal flooding, including relative sea level change and storm surge;	Various types of flooding risks that pose a threat to life and property, including, but not limited to, riverine flooding, urban flooding, engineered structure failures, slow rise flooding, ponding, playa flooding, and flash flooding, are considered in Chapter 2. Coastal flooding is not applicable in the Upper Colorado Region.
(9) shall focus primarily on flood management strategies and projects with a contributing drainage area greater than or equal to one square miles except in instances of flooding of critical facilities or transportation routes or for other reasons, including levels of risk or project size, determined by the RFPG;	Chapter 4 and Chapter 5 focus on flood management strategies and projects.
(10) shall consider the potential upstream and downstream effects, including environmental, of potential flood management strategies (and associated projects) on neighboring areas. In recommending strategies, RFPGs shall ensure that no neighboring area is negatively affected by the regional flood plan;	Consideration of neighboring area is described in Chapter 4 and Chapter 5. Strategies and projects are assessed to confirm negative impacts to surrounding areas would not occur.
(11) shall include an assessment of existing, major flood mitigation infrastructure and will recommend both new strategies and projects that will further reduce risk, beyond what existing flood strategies and projects were designed to provide, and make recommendations regarding required expenditures to address deferred maintenance on or repairs to existing flood infrastructure;	Infrastructure is evaluated in Chapter 4 and Chapter 5. The strategies and projects include many related to infrastructure. In fact, there may be too much focus on classical infrastructure controls and a need for more deliberation on alternative solutions. Chapter 9 examines the financing aspects.

Guidance Principle	Means by which Requirement is Met in RFP
(12) shall include the estimate of costs and benefits at a level of detail sufficient for RFPGs and sponsors of flood mitigation projects to understand project benefits and, when applicable, compare the relative benefits and costs, including environmental and social benefits and costs, between feasible options;	Costs drive most decision making and are discussed in most chapters, although Chapter 4, Chapter 5, and Chapter 9 present the most information on costs. For the most part, costs are likely underestimated for a variety of reasons, including lack of problem and solution definition, extent of flood damage, and inflation.
(13) shall provide for the orderly preparation for and response to flood conditions to protect against the loss of life and property and reduce injuries and other flood-related human suffering;	Preparation and response is described in Chapter 7.
(14) shall provide for an achievable reduction in flood risk at a reasonable cost to protect against the loss of life and property from flooding;	Like costs and benefits in Chapter 4 and Chapter 5, reasonable costs to achievable reduction in flood risk is considered.
(15) shall be supported by state agencies, including the TWDB, General Land Office, Texas Commission on Environmental Quality, Texas State Soil and Water Conservation Board, Texas Parks and Wildlife Department, and the Texas Department of Agriculture, working cooperatively to avoid duplication of effort and to make the best and most efficient use of state and federal resources;	Agency representation is addressed in Chapter 10, Public Participation.
(16) shall include recommended strategies and projects that minimize residual flood risk and provide effective and economical management of flood risk to people, properties, and communities, and associated environmental benefits;	Chapter 5 includes recommended strategies and projects.

Guidance Principle	Means by which Requirement is Met in RFP
(17) shall include strategies and projects that provide for a balance of structural and nonstructural flood mitigation measures, including projects that use nature-based features, that lead to long-term mitigation of flood risk;	Chapter 2 includes nature-based goals. Chapter 4 and Chapter 5 include strategies and projects that are labeled as other, which includes nature-based solutions. A variety of strategies and projects are included but balance could be improved in future planning.
(18) shall contribute to water supply development where possible;	Contributions and impacts to water supply development are assessed in Chapter 6. Due to the hydrology and landscape of the region, there is little potential to contribute or impact water supply development.
(19) shall also follow all regional and state water planning guidance principles (31 TAC 358.3) in instances where recommended flood projects also include a water supply component;	Contributions and impacts to water supply development are assessed in Chapter 6. Due to the hydrology and landscape of the region, there is little potential to contribute or impact water supply development.
(20) shall be based on decision-making that is open to, understandable for, and accountable to the public with full dissemination of planning results except for those matters made confidential by law;	The NRFP is based on the requirements of the TAC and the associated TWDB technical guidance documents.
(21) shall be based on established terms of participation that shall be equitable and shall not unduly hinder participation;	The RFP is based on the requirements of the TAC and the associated TWDB technical guidance documents. Chapter 10 directly addressed public participation.
(22) shall include flood management strategies and projects recommended by the RFPGs that are based upon identification, analysis, and comparison of all flood management strategies the RFPGs determine to be potentially feasible to meet flood mitigation and floodplain management goals;	The NRFPG worked directly with the technical consultant in the development of the NRFP as described in Chapter 1.
(23) shall consider land-use and floodplain management policies and approaches that support short- and long-term flood mitigation and floodplain management goals;	Land-use and floodplain management policies and approaches that support short- and long-term flood mitigation and floodplain management goals are addressed in Chapter 3

Guidance Principle	Means by which Requirement is Met in RFP
(24) shall consider natural systems and beneficial functions of floodplains, including flood peak attenuation and ecosystem services;	Chapter 3 includes natured-based goals like attenuation and ecosystem services within the category of environmental stewardship.
(25) shall be consistent with the National Flood Insurance Program (NFIP) and shall not undermine participation in nor the incentives or benefits associated with the NFIP;	This is a primary aspect of the goals and purpose of the RFP as stated in Chapter 1. The RFP is consistent with the NFIP.
(26) shall emphasize the fundamental importance of floodplain management policies that reduce flood risk;	Policies that reduce flood risk are a fundamental importance of the RFP and is specifically emphasize in Chapter 2.
(27) shall encourage flood mitigation design approaches that work with, rather than against, natural patterns and conditions of floodplains;	Chapter 3 includes natured-based goals to work with natural patterns and conditions within the category of environmental stewardship.
(28) shall not cause long-term impairment to the designated water quality as shown in the state water quality management plan as a result of a recommended flood management strategy or project;	Chapter 6 states there are no anticipated impacts to the State Water Quality Management Plan.
(29) shall be based on identifying common needs, issues, and challenges; achieving efficiencies; fostering cooperative planning with local, state, and federal partners; and resolving conflicts in a fair, equitable, and efficient manner;	These are part of the process for identifying the FME, FMS, and FMP lists as described in Chapter 5.
(30) shall include recommended strategies and projects that are described in sufficient detail to allow a state agency making a financial or regulatory decision to determine if a proposed action before the state agency is consistent with an approved regional flood plan;	Chapter 5 includes recommended strategies and projects.

Guidance Principle	Means by which Requirement is Met in RFP
(31) shall include ongoing flood projects that are in the planning stage, have been permitted, or are under construction;	Chapter 1 includes discussion about proposed and ongoing flood mitigation projects.
(32) shall include legislative recommendations that are considered necessary and desirable to facilitate flood management planning and implementation to protect life and property;	Legislative recommendations along with rationale are provided in Chapter 8.
(33) shall be based on coordination of flood management planning, strategies, and mitigation projects with local, regional, state, and federal agencies projects and goals;	These are part of the process for identifying the FME, FMS, and FMP lists with the NRFPG providing the coordination as described in Chapter 5.
(34) shall be in accordance with all existing water rights laws, including but not limited to, Texas statutes and rules, federal statutes and rules, interstate compacts, and international treaties;	The conclusion of Chapter 6 states there are no anticipated impacts to water rights.
(35) shall consider protection of vulnerable populations;	Flood risks to vulnerable populations are evaluated in Chapter 2 using the social vulnerability index. Vulnerability was then carried forward to the process for identifying FME, FMS, and FMP lists in Chapter 5.
(36) shall consider benefits of flood management strategies to water quality, fish and wildlife, ecosystem function, and recreation, as appropriate;	Chapter 4 recognizes the consideration of these additional benefits alongside the needs analysis results for developing strategies and projects.
(37) shall minimize adverse environmental impacts and be in accordance with adopted environmental flow standards;	Chapter 6 addresses minimizing adverse environmental impacts and meeting adopted environmental flow standards in the recommendations.
(38) shall consider how long-term maintenance and operation of flood strategies will be conducted and funded; and	Chapter 9 includes the consideration of conducting and funding O&M.

Guidance Principle	Means by which Requirement is Met in RFP
(39) shall consider multi-use opportunities such as green space, parks, water quality, or recreation, portions of which could be funded, constructed, and or maintained by additional, third-party project participants.	Chapter 4 recognizes the consideration of these additional opportunities alongside the needs analysis results for developing strategies and projects.

Table 10-2. NRFP Chapter by which Title 31 TAC §362.3 Provisions are Achieved

Regional Flood Plan (RFP) Chapter	General Content
1	Planning Area Description
2	Existing Condition Flood Risk Analyses Future Condition Flood Risk Analyses
3	Evaluation and Recommendations on Floodplain Management Practices Flood Mitigation and Floodplain Management Goals
4	Flood Mitigation Needs Analysis
5	Identification of Potential Flood Management Evaluations and Potentially Feasible Flood Management Strategies and Flood Mitigation Projects Evaluation and Recommendation of Flood Management Evaluations and Flood Management Strategies and Associated Flood Mitigation Projects
6	Impacts of Regional Flood Plan Contributions to and Impacts on Water Supply Development and the State Water Plan
7	Flood Response Information and Activities
8	Administrative, Regulatory, and Legislative Recommendations
9	Flood Infrastructure Financing Analysis
10	Public Participation and Plan Adoption

10.2 Public Involvement Program

The NRFPG met all requirements under the Texas Open Meetings Act and Public Information Act during development of the NRFP. The public involvement program was incorporated at the onset of the Nueces Regional Flood Planning Group (NRFPG) flood planning process in order to maximize the opportunity for public review and input into the process of developing the flood plan as well as providing comments on the draft regional flood plan (RFP).

The public involvement program included:

- An opportunity at all regional flood planning group (RFPG) meetings for the public to comment on any aspect of the plan or planning process
- Press releases and notices of public meetings
- Dedicated website for NRFPG information (Home – Nueces Regional Flood Planning Group (Region 13) (https://nueces-rfpg.org))
- Public *In-Person* Hearing for draft RFP was held:

  Monday, September 26, 2022, 11 AM
  McMullen County Emergency Management Office
  306 Live Oak Street
  Tilden, Texas 78072

- Public *Virtual* Hearing for draft RFP was held:

  Monday, September 26, 2022, 6:30 – 7:30 PM
  Zoom Meeting: https://us02web.zoom.us/j/82662268207
  Dial by phone: 877 853 5257 US Toll-free
  Meeting ID: 826 6226 8207

The NRFPG conducted all business in meetings that were posted according to Texas Open Meetings Act and Public Information Act provisions. The plan was developed in accordance with Texas Administrative Code (TAC) public participation requirements specified in 31 TAC §357.12, §357.21, and §357.50(f).

Comments received on the draft and final RFP and responses to comments are included in Appendix D.

10.3 Coordination with Stakeholders

Information was provided by entities with floodplain management responsibilities located in the Nueces Flood Planning Region (NFPR) throughout development of the RFP. Three surveys were sent out to stakeholders during a period from March through December 2021 to gather input on local flood plans, ongoing flood projects, flood mitigation needs, and other information. An on-line interactive map was made available from May through December 2021 on the Region 13 website (Home – Nueces Regional Flood Planning Group (Region 13) (https://nueces-rfpg.org)) to gather public and stakeholder input on flood-prone areas. Individual interviews were set up with entities that we were able to successfully contact to discuss specific flooding concerns.

Representatives of flood planning entities within the NRFPG were also regularly notified of NRFPG meetings and subregional public informational meetings.

10.4 Nueces Regional Flood Planning Group Meetings

The NRFPG regularly met in accordance with the approved bylaws. The NRPWG met on a more frequent basis as needed in order to facilitate and direct the flood planning of the region. The following is a summary of the NRFPG meeting dates:

Nueces - Region 13 RFPG Meetings

November 4, 2020	January 31, 2022
November 30, 2020	March 28, 2022
January 25, 2021	May 16, 2022
March 29, 2021	June 27, 2022
April 26, 2021	July 18, 2022
May 24, 2021	September 26, 2022
June 28, 2021	December 12, 2022
July 26, 2021	March 27, 2023
September 27, 2021	May 15, 2023
October 25, 2021	June 26, 2023
December 6, 2021	

The NRFPG requested that the Texas Water Development Board (TWDB) execute the initial contract to develop the 2023 Nueces Regional Flood Plan (NRFP) on November 30, 2020. The NRFPG authorized the Nueces River Authority to publish a request for qualifications at its regular meeting on January 25, 2021.

The executive team met on February 8, 2021, and March 16, 2021, to discuss subgroups and technical consultant selection approach. Both of these meetings were open to the public.

The NRFPG selected HDR Engineering, Inc. (HDR) as the technical consultant for development for the NRFP on March 29, 2021.

On June 28, 2021, the NRFPG accepted public and stakeholder suggestions and recommendations on issues, provisions, projects, and strategies to consider during the 2023 flood planning cycle and development of the RFP.

On May 15, 2022, the NRFPG adopted the final list of FMEs, FMPs, and FMSs to include in the amended NRFP.

The Amended 2023 NRFP was adopted by the NRFPG on TBD for submittal to the TWDB.

The NRFPG also designated three subcommittees to expedite more specific work efforts and further increase the effectiveness and timeliness of the planning process. The following summarizes these subcommittee and respective meetings.

10.4.1 Floodplain Management Standards and Goals Subcommittee

- Subcommittee Members: Andrew Rooke, Larry Dovalina, Jim Tolan, and Larry Thomas
- Designated by NRFPG: July 26, 2021
- Subcommittee meetings: August 25, 2021, September 8, 2021, December 8, 2022

10.4.2 Process to Identify Potentially Feasible Flood Management Strategies and Flood Mitigation Projects

- Subcommittee Members: Debra Barrett, Lauren Williams, LJ Francis, and Kendria Ray
- Designated by NRFPG: July 26, 2021
- Subcommittee meeting: August 23, 2021

10.4.3 Legislative, Administrative and Policy Subcommittee

- Subcommittee Members: Britni Van Curan, Larry Dovalina, Laura Williams, Andy Rooke, and Lj Francis
- Designated by NRFPG: March 28, 2022
- Subcommittee meeting: May 3, 2022, with support by Larry Thomas and Luke Whitmire. Also, December 6, 2022.

The NRFPG approved the final RFP on December 12, 2022 for submittal to the TWDB.

10.5 Nueces- Region 13 Local Stakeholder Meetings

As described in previous chapters, four subregions were developed within the NFPR to distribute information and gather input on regional flood planning activities. There were two primary stakeholder outreach periods during development of the 2023 draft RFP to introduce the flood planning process, share flood information gathered, and seek local input for purposes of identifying flood mitigation projects to include in the NRFP. Local meetings were held at a location in close proximity to the sub-regions shown in Figure 10-1.

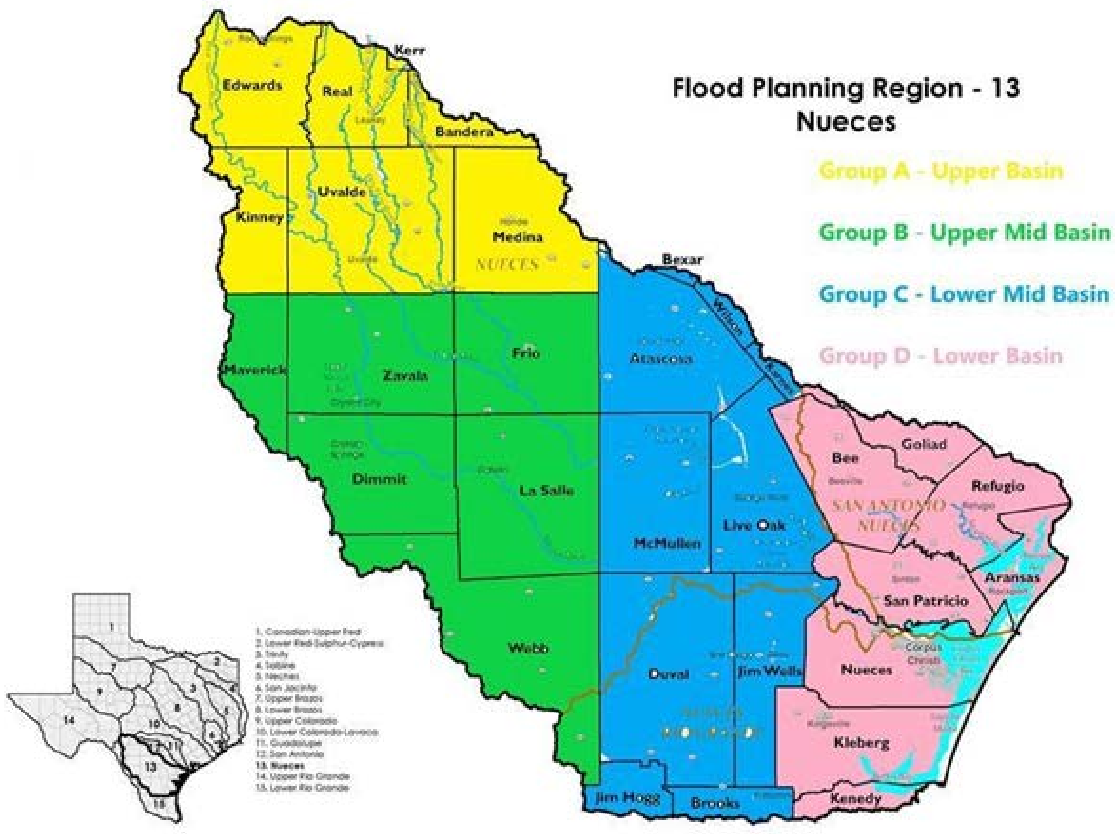


Figure 10-1. Four Subregions in the Nueces Region 13 Flood Planning Group Area

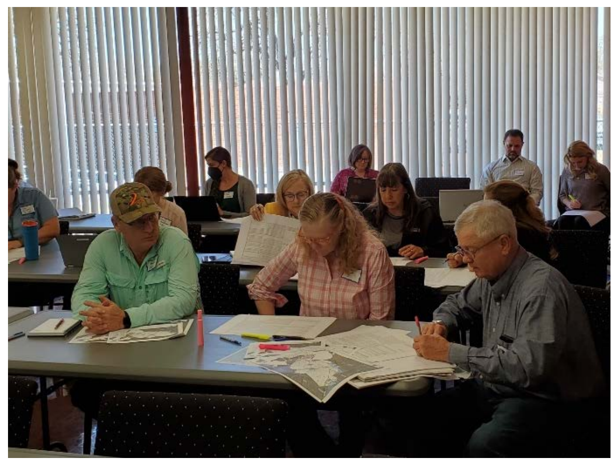
10.5.1 First Series of Sub-Regional Stakeholder Meeting to Introduce Planning Process and Gather Input on Flood-Prone Areas (from May 17- 20, 2021)

- Upper Basin (Group A)
  - Date: May 17, 2021
  - Location: Real County Courthouse
    146 US-83, Leakey
- Upper Mid Basin (Group B)
  - Date: May 19, 2021
  - Location: City of Cotulla Cotulla Convention Center, Cotulla
- Lower Mid Basin (Group C)
  - Date: May 18, 2021

  - Location: McMullen County
    306 Live Oak St, Tilden

- Lower Basin (Group D)
  - Date: May 20, 2021
  - Location: San Patricio County Courthouse
    400 W. Sinton St., Sinton

10.5.2 Second Series of Sub-Regional Stakeholder Meeting to Share Interim Flood Data Collected and Identify Flood Mitigation Projects (from March 8-22, 2022)



- Upper Basin (Group A)
  - Date: March 21, 2022
  - Location: Real County Courthouse
    146 US 83, Leakey TX
  - Attended by Edwards, Kinney, Real, and Medina counties, and cities of Rockspings, Hondo, and Leakey
- Upper Mid Basin (Group B) and Lower Mid Basin (Group C)
  - Date: March 8, 2022
  - Location: City of Cotulla
    Cotulla Convention Center
  - Attended by Zavala, Frio, McMullen, and Wilson counties, and cities of Pearsall, Cotulla, and Jourdanton
- Lower Basin (Group D)
  - Date: March 22, 2022
  - Location: San Patricio County Courthouse
    400 W. Sinton St., Sinton
  - Attended by San Patricio County, San Patricio Drainage District, cities of Beeville and Ingleside, the National Weather Service, USGS, and Texas A&M University

10.5.3 Outreach to Project Sponsors to Identify, Evaluate, and Recommend Additional Flood Mitigation Projects

The NRFPG approved on September 26, 2022, the approach for identifying and evaluating additional flood management evaluations and flood mitigation projects and a detailed list of projects that would be evaluated as part of the Amended 2023 NRFP (Task 12).

Following the meeting and through May 2023, the HDR team contacted Nueces Basin entities to discuss the list of identified projects by sponsor and learn more about each potential sponsor's greatest flood needs. Interviews and in-person meetings were conducted in 2022 and 2023 as summarized in Table 10-3.

Table 10-3. Task 12 Interviews and In-Person Meetings

Date	Entity	Notes
2022-10-03	Nueces County	Virtual meeting w/ county and Tri-County study consultant (Halff)
2022-10-07	Duval County	Virtual meeting w/ Drainage Master Plan consultant (CDM Smith)
2022-10-18	City of Pearsall	In-person meeting w/ city in Pearsall
2022-10-18	City of Dilley	In-person meeting w/ city in Dilley
2022-10-18	City of Hondo	In-person meeting w/ city in Hondo
2022-10-19	City of Devine	Virtual meeting w/ city and technical consultant (Garcia & Wright Consulting Engineers, Inc.)
2022-10-19	City of Lytle	Virtual meeting w/ city
2022-10-21	City of Jourdanton	Virtual meeting w/ city and consultant (6S Engineering)
2022-11-03	Crystal City	Virtual meeting w/ city
2022-11-18	City of Poteet	Virtual meeting w/ city
2022-11-21	Real County	In-person meeting w/ county and city of Camp Wood in Leakey
2022-12-02	Frio County	Virtual meeting w/ the county and consultant Poznecki-Camarillo, Inc.
2022-12-07	Uvalde County	In-person meeting w/ county
2023-03-30	City of Kingsville	Virtual meeting w/ city
2023-03-23	City of Corpus Christi	Virtual meeting w/ city

2023-04-13	City of Alice	Email correspondence w/ city
2023-04-18	San Patricio County	Virtual meeting w/ San Patricio County Drainage Master Plan consultant (CDM Smith)

10.6 Regional Flood Planning Group Chairs Conference Calls and Meetings

The TWDB held conference call meetings with RFPG chairs to provide guidance and respond to issues regarding the planning process as described below:

- March 3, 2021 (10:30am – 12:00pm)
    - 1st Cycle Initial Grant Contracts
    - Working Conceptual Timeline
    - Regional Flood Planning Housekeeping and Reminders
    - Flood Data Update

- June 23, 2021 (2:30pm – 4:00pm)
    - 1st Planning Cycle Documents (2020-2023) webpage
    - Regional Flood Planning Group (RFPG) webpages
    - Chairs' feedback on webpages
    - Technical and Data Submittal Guidelines
    - Chairs' feedback on guidelines
    - Regional Flood Planning Grant Contracts and Subcontracts
    - Chairs' feedback on contracting and subcontracting process

- September 15, 2021 (1:30pm – 3:00pm)
    - Extension of Time to Complete Portions of Technical Memorandum
    - Additional Funding to Enhance First Regional Flood Plans

- December 8, 2021 (2:30pm – 4:00pm)
    - Summary from Technical Consultants' Conference Call
        - Emergency Need
        - Flood Management Strategies (FMS)

- March 2, 2022 (1:00pm – 2:30pm)
    - Future condition analysis - planning level analysis, not regulatory
    - Classification of FMEs/FMSs/FMPs in the Regional Flood Plan
    - FMP project details

- May 26, 2022 (2:00pm – 3:30pm)
    - Recap on Technical Consultants Conference Call

- Public Notice Posting Requirements for Draft Regional Flood Plan
- Amendment Process

10.7 Coordination with Other Regions

At each regional flood planning group meeting there was an agenda item for Patrick McGinn (Region 13 interregional liaison) to present updates from the San Antonio (Region 12) and Rio Grande (Region 15).

Several coordination calls between the NRFPG technical consultant and San Antonio (Region 12) RFPG and the Rio Grande (Region 15) RFPG consultants occurred during development of the draft RFP. Additional coordination was conducted with Region 12 for stakeholder outreach and sharing of information for Bandera, Medina, Bexar, Wilson, Karnes, and Goliad counties located in both regions.

10.8 Coordination with Other Entities

Frequent coordination calls occurred between the technical consultant and local county and city flood management officials to confirm flood concerns and plans.

Emails were sent to stakeholders in May 2021, August 2021, and January 2022 with follow-up phone calls to gather information on flood-prone areas, existing floodplain management practices, and community flood needs and projects. Three surveys were deployed to gather input, which were discussed at sub-regional meetings described above in Section 10.4 and NRFPG meetings.

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Appendix A1 – TWDB Table 1 – Existing Flood Infrastructure Table

This appendix is available for viewing on the Region 13 Nueces website (https://www.nueces-rfpg.org).

Appendix A2 – TWDB Table 2 – Summary of Proposed or Ongoing Flood Mitigation Projects

Appendix A3 – TWDB Table 3 – Existing Condition Flood Risk Summary Table

Appendix A4 – TWDB Table 5 – Future Condition Flood Risk Summary Table

Appendix A5 – TWDB Table 6 – Existing Floodplain Management Practices

Appendix A6 – TWDB Table 11 – Flood Mitigation and Floodplain Management Goals

Appendix A7 – TWDB Table 12 – Potential Flood Management Evaluations Identified by RFPG

Appendix A8 – TWDB Table 13 – Potential Feasible Flood Mitigation Projects Identified By RFPG

Appendix A9 – TWDB Table 14 – Potentially Feasible Flood Management Strategies Identified by RFPG

Appendix A10 – TWDB Table 15 – Flood Management Evaluations Recommended by RFPG

Appendix A11 – TWDB Table 16 – Flood Mitigation Projects Recommended by RFPG

(Not provided at this time as no projects recommended)

Appendix A12 – TWDB Table 17 – Flood Management Strategies Recommended by RFPG

Appendix A13 – TWDB Table 19 – Funding Survey

Appendix B1 – TWDB Map 1 - Existing Flood Infrastructure Regional Map

Appendix B2 – TWDB Map 2 - Proposed or Ongoing Flood Mitigation Projects Regional Map

Appendix B3 – TWDB Map 3 - Non-Functional or Deficient Flood Mitigation Features or Infrastructure Regional Map

Appendix B4 – TWDB Map 4 - Existing Condition Flood Hazard Subregion Maps

Map 4A - Existing Condition Flood Hazard - Subregion A – Upper Basin

Map 4B - Existing Condition Flood Hazard – Subregion B – Upper Mid-Basin

Map 4C - Existing Condition Flood Hazard – Subregion C – Lower Mid-Basin

Map 4D - Existing Condition Flood Hazard – Subregion D – Lower Basin

Map 4E – Type of Existing Flood Hazard – Subregion A – Upper Basin

Map 4F – Type of Existing Flood Hazard – Subregion B – Upper Mid-Basin

Map 4G – Type of Existing Flood Hazard – Subregion C – Lower Mid-Basin

Map 4H - Type of Existing Flood Hazard – Subregion D – Lower Basin

Appendix B5 – TWDB Map 5 - Existing Condition Flood Hazard Gaps Regional Maps

Map 5A – Source of Flood Modeling and Mapping Data

Map 5B – Modeling Map

Map 5C – Known Data Gaps

Appendix B6 – TWDB Map 6 - Existing Condition Flood Exposure Regional Map

Appendix B7 – TWDB Map 7 - Existing Condition Vulnerability and Critical Infrastructure Regional Map

Appendix B8 – TWDB Map 8 - Future Condition Flood Hazard Subregion Maps

Map 8A - Future Condition Flood Hazard – Subregion A – Upper Basin

Map 8B - Future Condition Flood Hazard – Subregion B – Upper Mid-Basin

Map 8C - Future Condition Flood Hazard – Subregion C – Lower Mid-Basin

Map 8D - Future Condition Flood Hazard – Subregion D – Lower Basin

Map 8E – Type of Future Condition Flood Hazard – Subregion A – Upper Basin

Map 8F – Type of Future Condition Flood Hazard – Subregion B – Upper Mid-Basin

Map 8G – Type of Future Condition Flood Hazard – Subregion C – Lower Mid-Basin

Map 8H - Type of Future Condition Flood Hazard – Subregion D – Lower Basin

Appendix B9 – TWDB Map 9 - Future Condition Flood Hazard - Gaps in Inundation Boundary Mapping and Identify Known Flood-Prone Areas Regional Map

(not provided, same as existing, see Map 5)

Appendix B10 – TWDB Map 10 - Extent of Increase of Flood Hazard Compared to Existing Condition Regional Map

Map 10 – Extent of Increase of Flood Hazard Compared to Existing Condition

Map 10A – Extent of Future Flood Hazard Compared to Existing Condition – 1% Annual Chance – Upper Basin

Map 10B – Extent of Future Flood Hazard Compared to Existing Condition – 1% Annual Chance – Upper Mid Basin

Map 10C – Extent of Future Flood Hazard Compared to Existing Condition – 1% Annual Chance – Lower Mid Basin

Map 10D – Extent of Future Flood Hazard Compared to Existing Condition – 1% Annual Chance – Lower Basin

Map 10E – Extent of Future Flood Hazard Compared to Existing Condition – 0.2% Annual Chance – Upper Basin

Map 10F – Extent of Future Flood Hazard Compared to Existing Condition – 0.2% Annual Chance – Upper Mid Basin

Map 10G – Extent of Future Flood Hazard Compared to Existing Condition – 0.2% Annual Chance – Lower Mid Basin

Map 10H – Extent of Future Flood Hazard Compared to Existing Condition – 0.2% Annual Chance – Lower Basin

Appendix B11 – TWDB Map 11 - Future Condition Flood Exposure Regional Map

Appendix B12 – TWDB Map 12 - Future Condition Vulnerability and Critical Infrastructure Regional Map

Appendix B13 – TWDB Map 13 - Floodplain Management Practices Regional Map

Appendix B14 – TWDB Map 14 - Greatest Gaps in Flood Risk Information Regional Maps

Map 14A – Detailed Modeling and Risk Score

Map 14B – Proposed/Ongoing Projects and Risk Score

Map 14C – Level of Enforcement and Risk Score

Appendix B15 – TWDB Map 15 - Greatest Flood Risk Regional Map

(Reference Appendix B23 for county based greatest flood risk maps)

Appendix B16 – TWDB Map 16 - Potential Flood Management Evaluations in relation to other Studies/Mapping Regional Maps

Map 16A – Potential Flood Management Evaluations and Ongoing Projects

Map 16B – Potential Flood Management Evaluations and Detailed Modeling

Appendix B17 – TWDB Map 17 - Potential Flood Mitigation Projects Regional Map

Appendix B18 – TWDB Map 18 - Potential Flood Management Strategies Regional Map

Appendix B19 – TWDB Map 19 - Recommended Flood Management Evaluations Regional Map

(Refer to Appendix B23 for county based recommended Flood Management Evaluations)

Appendix B20 – TWDB Map 20 - Recommended Flood Mitigation Projects Regional Map

(Not provided at this time as no projects recommended)

Appendix B21 – TWDB Map 21 - Recommended Flood Management Strategies Regional Map

(Refer to Appendix B23 for county based recommended Flood Management Strategies)

Appendix B22 – TWDB Map 22 - Modeling Availability Regional Map

Appendix B23 – Flood Hazard Risk, Flood Risk Score, and Recommended Flood Mitigation Actions County Maps

See specific county map sorted alphabetically.

Map 23A – Aransas County

Map 23B – Atascosa-Bexar-Karnes-Wilson Counties

Map 23C – Bandera County

Map 23D – Bee-Goliad Counties

Map 23E – Dimmit County

Map 23F – Duval County

Map 23G – Edwards County

Map 23H – Frio County

Map 23I – Jim Hogg-Brooks County

Map 23J – Jim Wells County

Map 23K – Kinney County

Map 23L – Kleberg-Kenedy County

Map 23M – LaSalle County

Map 23N – LiveOak County

Map 23O – Maverick-Zavala County

Map 23P – McMullen County

Map 23Q – Medina County

Map 23R – Nueces County

Map 23S –Real-Kerr County

Map 23T – Refugio County

Map 23U – San Patricio County

Map 23V – Uvalde County

Map 23W – Webb County

Appendix C1 – Historic Flood Event Data

Appendix C2 – List of Previous Flood Studies

This appendix is included in the digital version and is available for viewing on the Region 13 Nueces website (https://www.nueces-rfpg.org).

Appendix C3 – Floodplain Management Practices and Goal Survey Results

Appendix C4 – TFMA Higher Standard Survey Results for the Nueces Basin

Appendix C5 – Mid-Point Technical Memorandum

Appendix C6 – HUC-12 Flood Risk Data Score Table

Appendix C7 – List of Removed Flood Mitigation Actions

Appendix C8 – Supporting Costing Material for Flood Mitigation Actions

Appendix C9 – Additional Evaluation 1-Page FME Summaries

Appendix C10 – Additional Evaluation 1-Page FMP Summaries

Appendix C11 – Additional Evaluation Technical Memorandums

See specific Technical Memorandum sorted alphabetically.

C11-1 – City Camp Wood FME Evaluation Technical Memorandum

C11-2 – City of Jourdanton FMP Technical Memorandum

C11-3 – City of Poteet FMP Technical Memorandum

C11-4 – City of Benavides FMP Evaluation Technical Memorandum

C11-5 – Frio County FMP Technical Memorandum

C11-6 – City of Pearsall FMP Technical Memorandum

C11-7 – Crystal City FMP Technical Memorandum

C11-8 – City of Devine FMP Technical Memorandum

C11-9 – City of Corpus Christi FMP Technical Memorandum

C11-10 – Tri-County Drainage Master Plan FMP Technical Memorandum

C11-11 – San Patricio Drainage Master Plan FMP Technical Memorandum

C11-12 – Bexar County FMP Technical Memorandum

Appendix C12 – Future Sea Level Rise Analysis Map Exhibit

Appendix C13 – FMP No Negative Impact Determination Documentation

Appendix D1 – Comments Received on the Draft 2023 Plan and Responses

Appendix D2 – Comments Received on the Final 2023 Plan and Responses