NOTICE OF OPEN MEETING OF THE SAN ANTONIO REGIONAL FLOOD PLANNING GROUP

Region 12 San Antonio RFPG

07/14/2022
2:00 PM

TAKE NOTICE that a meeting of the San Antonio Regional Flood Planning Group as established by the Texas Water Development Board, will be held on Thursday, July 14, 2022, at 2:00 PM, in-person at the San Antonio River Authority Board room, located at 201 W. Sheridan St. and virtually on GotoMeeting at https://meet.goto.com/421049989.

Agenda:

1. (2:00 PM) Roll-Call
2. Public Comments – limit 3 minutes per person
3. Approval of the Minutes from the Previous San Antonio Regional Flood Planning Group Meeting (Region 12)
4. Communications from the Texas Water Development Board (TWDB)
5. Chair Report
6. Updates from Region 12 Subcommittees
7. Discussion and Appropriate Action on Chapters 1-4
8. Preview and Discussion Regarding Additional Chapters
9. Discussion Regarding Citizen Submissions
10. Regional Liaison Update
11. Public Comments - limit 3 minutes per person
12. Date and Potential Agenda Items for Next Meeting
13. Adjourn

If you wish to provide written comments prior to or after the meeting, please email your comments to khayes@sariverauthority.org or physically mail them to the attention of Kendall Hayes at San Antonio River Authority, 201 W. Sheridan, San Antonio, TX, 78204 and include“Region 12 San Antonio Flood Planning Group Meeting” in the subject line of the email.

Additional information may be obtained from: Kendall Hayes (210) 302-3641, khayes@sariverauthority.org, San Antonio River Authority, 201 W. Sheridan, San Antonio, TX.

Meeting Minutes
Region 12 San Antonio Regional Flood Planning Group Meeting
Monday, June 27, 2022
1:30 PM
San Antonio River Authority

Roll Call:

Voting Member	Interest Category	Present (x) /Absent ( ) / Alternate Present (*)
Brian Yanta	*Agricultural interests*	X
David Wegmann	*Counties*	X
Derek Boese	*River authorities*	X
Doris Cooksey	*Electric generating utilities*	X
Deborah (Debbie) Reid	*Environmental interests*	*Annalisa Peace
Nefi M. Garza	*Flood districts*	X
Cara C. Tackett	*Industries*	X
Jeffrey Carroll	*Municipalities*	X
John Paul Beasley	*Public*	X
Suzanne B. Scott	*Nonprofit*	X
Steve Gonzales	*Small business*	
David Mauk	*Water districts*	*Hayli Hernandez
Steve Clouse	*Water utilities*	X

Non-voting Member	Agency	Present(x)/Absent( )/ Alternate Present (*)
Marty Kelly	Texas Parks and Wildlife Department	X
James Guin	Texas Division of Emergency Management	
Jami McCool	Texas Department of Agriculture	X
Jarod Bowen	Texas State Soil and Water Conservation Board	X
Kris Robles	General Land Office	X
Anita Machiavello	Texas Water Development Board (TWDB)	X
Susan Roberts	Texas Commission on Environmental Quality	

Quorum:
Quorum: **Yes**
Number of voting members or alternates representing voting members present: **12**
Number required for quorum per current voting positions of 13: 7

All meeting materials are available for the public at: *http://www.region12texas.org.*

AGENDA ITEM NO.1: ROLL CALL
Ms. Kendall Hayes, San Antonio River Authority, called the role and confirmed a quorum.

AGENDA ITEM NO.2: PUBLIC COMMENT – LIMIT 3 MINUTES PER PERSON

No public comments.

AGENDA ITEM NO.3: APPROVAL OF THE MINUTES FROM THE PREVIOUS SAN ANTONIO REGIONAL FLOOD PLANNING GROUP MEETING (REGION 12)

Mr. Boese motioned to approve the minutes. Ms. Tackett seconded the motion, motion passed.

AGENDA ITEM NO.4: COMMUNICATIONS FROM THE TEXAS WATER DEVELOPOMENT BOARD (TWDB)

Ms. Anita Machiavello provided an update from the Texas Water Development Board. She reminded the RFPG to submit the subcontract when it is prepared. She reminded the RFPG that a newsletter was sent out last week from TWDB.

AGENDA ITEM NO.5: CHAIR REPORT

Chair Garza reminded the RFPG that the July meetings are critical to approving the appropriate chapters for the August 1st deliverable. He notified the RFPG that he has left the City of San Antonio and provided an opportunity for the RFPG members to discuss his future on the committee. Discussion ensued. The matter will be further discussed following the submission of the draft RFP.

AGENDA ITEM NO.6: UPDATES FROM REGION 12 SUBCOMITTEES

Ms. Scott provided an update on the Outreach Committee’s last meeting. The committee received a report on the June public meetings. She notified the RFPG that the committee will be organizing outreach meetings in August during the public comment period.

Mr. Boese provided an update on the Technical Committee’s last meeting. The committee reviewed the FMX list and recommends that the RFPG adopt the full list of FMX submittals.

AGENDA ITEM NO.7: PRESENTATION FROM DAVE MAUK REGARDING LOW WATER CROSSINGS

Mr. Mauk was absent and did not give his presentation. He will present at a subsequent meeting.

AGENDA ITEM NO.8: DISCUSSION AND APPROPRIATE ACTION REGARDING TASK 5

Mr. Branyon presented. Discussion ensued regarding the qualifications to be included in the draft submittal, the timeline for adding additional FMX's, and the inclusion of public comments. The presentation and recording of this meeting can be found on the Region 12 website at www.region12texas.org.

Mr. Beasley motioned to approve the FMX list presented today as well as the potential submittals from Kendall County. Mr. Boese seconded the motion, motion passed.

AGENDA ITEM NO.9: DISCUSSION AND APPROPRIATE ACTION REGARDING PROPOSED CHANGES PER TWDB INFORMAL COMMENTS

Mr. Branyon presented the proposed changes to Tasks 4B and 3.

Ms. Scott motioned to amend Task 4B to reflect TWDB's informal comments. Ms. Cooksey seconded the motion, motion passed.

Mr. Wegmann motioned to amend Task 3 to reflect TWDB's informal comments. Mr. Boese seconded the motion, motion passed.

AGENDA ITEM NO.10: DISCUSSION REGARDING ALLOCATION OF ADDITIONAL FUNDING

Mr. Branyon presented on the updated scope of work and the specific allocation of funding. This amendment was approved by the RFPG in November 2021.

AGENDA ITEM NO.11: REGIONAL LIAISON UPDATE

Ms. Cooksey provided an update on Region 11. Region 11 is actively approving their chapters in preparation for the August deliverable.

Ms. Peace provided an update on Region 10. Region 10 is actively approving their FMX list in preparation for the August deliverable. This region reviewed their FMX list as individual items and not as a consent agenda item. Discussion ensued regarding the importance of including submittals for TWDB consideration and prioritization.

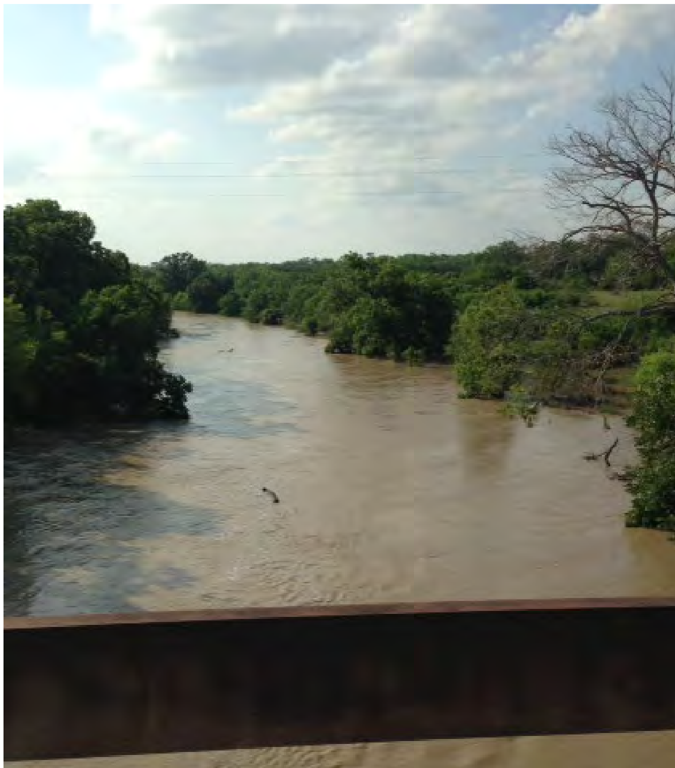
AGENDA ITEM NO.12: PUBLIC COMMENTS

No public comments.

AGENDA ITEM NO.13: DATE AND POTENTIAL AGENDA ITEMS FOR NEXT MEETING

The Planning Group will meet twice in July. Once on July 14^{th} at 2:00 PM and again on July 25^{th} at 1:30 PM.

AGENDA ITEM NO.14: ADJOURN
Mr. Boese motioned to adjourn. Ms. Tackett seconded the motion, motion passed.



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Planning Area Description

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1 Planning Area Description

[31 TAC §361.30-32]

1.1 Background

In 2019, the 86th Texas Legislature passed Senate Bill 8, which established a regional and state flood planning process for 15 identified flood planning regions across the state (31 Texas Administrative Code (TAC) Chapters 361 and 362). Information from each of the fifteen 2023 Regional Flood Plans will be compiled in the 2024 State Flood Plan. The Texas Water Development Board (TWDB) oversees the development of each regional plan and compiles the state flood plan. The TWDB is also charged with providing funding for investments in flood science and mapping efforts to support development of the plans.

The investments and planning efforts represent an important step in Texas flood planning, because:

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

Regional flood plans (RFP) are required to 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 RFPs 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 2024. An updated version of the State Flood Plan (SFP) will be developed 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 which is selected by the RFPG.

The SAFPR sponsor is the San Antonio River Authority (SARA). The Texas Legislature also allocated funding to be distributed by the TWDB for the procurement of technical assistance to develop the regional flood plans. HDR Engineering, Inc. (HDR) was selected through a competitive process to assist the San Antonio RFPG in developing the 2023 San Antonio RFP (the Plan).

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 Plan. The San Antonio 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 a diversity of perspectives are included, members represent a wide variety of stakeholders potentially affected by flooding. Interest categories include:

1. Public
2. Nonprofit (category added by the SARFPG)
3. Counties
4. Municipalities
5. Industries
6. Agriculture
7. Environmental
8. Small Business
9. Electric-generating utilities
10. River Authorities
11. Water Districts
12. Water Utilities
13. Flood Districts

The members of the San Antonio RFPG for the first flood planning cycle are listed in Table 1-1.

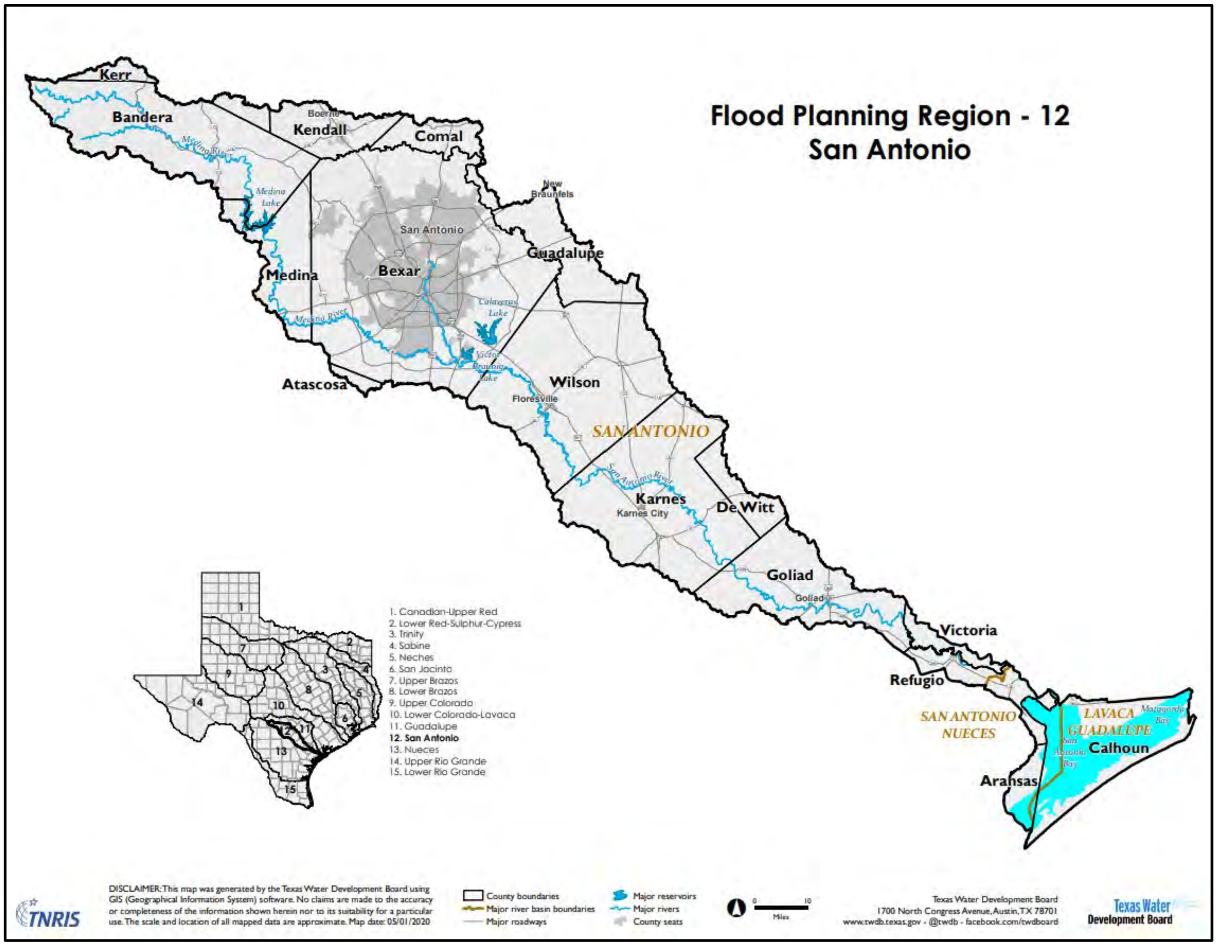
Table 1-1. San Antonio RFPG Members

Voting Members		
Member Name	**Interest Category**	**Organization**
Brian Yanta	Agricultural	Goliad County
David Wegmann	Counties	Bexar County
Doris Cooksey	Electric Generating Utilities	CPS Energy
Debbie Reid	Environmental	Greater Edwards Aquifer Alliance
Nefi Garza	Flood Districts	City of San Antonio
Cara Tackett	Industries	Pape-Dawson Engineers
Jeffrey Carrol	Municipalities	City of Boerne
Suzanne Scott	Nonprofit	Nature Conservancy
John Beasley	Public	U.S. Army Environmental Command
Derek Boese	River Authorities	San Antonio River Authority
Steve Gonzales	Small Business	Civil Tech Engineering, Inc.
David Mauk	Water Districts	Bandera Co River Authority & Groundwater District
Steven Clouse	Water Utilities	San Antonio Water System

Non-Voting Members	
Member Name	**Entity**
Marty Kelly	Texas Parks and Wildlife Department
Natalie Johnson	Texas Division of Emergency Management
Jami McCool	Texas Department of Agriculture
Jarod Bowen	Texas State Soil and Water Conservation Board
Kris Robles	General Land Office
Anita Machiavello	Texas Water Development Board
Joel Anderson	Texas Commission on Environmental Quality

The San Antonio Flood Planning Region (SAFPR), Region 12, consists of parts of Aransas, Atascosa, Bandera, Bexar, Calhoun, Comal, DeWitt, Goliad, Guadalupe, Karnes, Kendall, Kerr, Medina, Refugio, Victoria, and Wilson Counties. The San Antonio River Basin (SARB) encompasses approximately 4,410 square miles (Figure 1-1). The SAFPR is bounded on the west and south by Texas Water Development Board (TWDB) Flood Planning Region 13 (Nueces), on the north by TWDB Flood Planning Region 11 (Guadalupe), and on the east by the Gulf of Mexico. In 2019, this region had a population of approximately 2,225,430.

Figure 1-1. San Antonio (Region 12) Flood Planning Region



1.2 Goal and Purpose of the 2023 San Antonio Regional Flood Plan

All regional flood plans are to be developed according to 39 guiding principles (see 31 TAC 362.3). The 2023 Plan will focus on identifying both existing and future condition flood risks within the San Antonio basin, evaluate flood hazard exposure to life and property, identify and evaluate potentially feasible flood management strategies and flood mitigation projects, and present 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 amongst other information.

1.3 San Antonio Regional Flood Planning

The counties considered in the development of the SAFPR are listed in Table 1-2 below. Small portions of Atascosa (Region 13) County, Aransas (Region 13) County, Kerr (Region 11) County, Medina (Region 13) County, Aransas (Region 13) County, and Refugio (Region 13) County, Medina (Region 13) County, and Atascosa (Region 13) County are also located in the SAFPR, but they were not considered during the development of the San Antonio Regional Flood Plan since the vast majority of each of these counties are in other regions and they are unlikely to enact county-wide actions specific to the SAFPR. The Town of Tivoli is an unincorporated city that was considered but is not included in the 2023 Plan.

Table 1-2. Counties included in the SAFPR

	Aransas County	Calhoun County	Guadalupe County	Medina County
Atascosa County	Comal County	Karnes County	Refugio County	
Bandera County	DeWitt County	Kendall County	Victoria County	
Bexar County	Goliad County	Kerr County	Wilson County	

The municipalities considered in the development of the SARFP are listed in Table 1-3 below.

Table 1-3. Municipalities in the SAFPR

City of Alamo Heights	City of Falls City	City of La Coste	City of Santa Clara
City of Austwell	City of Floresville	City of Leon Valley	City of Schertz
City of Balcones Heights	City of Garden Ridge	City of Live Oak	City of Seadrift
City of Bandera	City of Goliad	City of Marion	City of Selma
City of Boerne	City of Grey Forest	City of New Berlin	City of Shavano Park
City of Bulverde	City of Helotes	City of New Braunfels	City of Somerset
City of Castle Hills	City of Hill Country Village	City of Nordheim	City of St. Hedwig
City of Castroville	City of Hollywood Park	City of Olmos Park	City of Stockdale
City of China Grove	City of Karnes City	City of Poth	City of Terrell Hills
City of Cibolo	City of Kenedy	City of Runge	City of Universal City
City of Converse	City of Kirby	City of	City of Von Ormy
City of Elmendorf	City of La Vernia	City of Sandy Oaks	City of Windcrest
City of Fair Oaks Ranch			

Forty-nine other entities outside of the county and municipality categories were considered in the development of the 2023 Plan,and are listed in Table 1-4.

Table 1-4. Other Flood or Water-Related Entities in the SAFPR

Entity	Type
Bandera County River Authority	River Authority
Guadalupe-Blanco River Authority	River Authority
Nueces River Authority	River Authority
San Antonio River Authority	River Authority
Upper Guadalupe River Authority	River Authority
Alamo Area Council of Governments	Other
Bandera County FWSD 1	Other
Bexar-Medina-Atascosa Counties WCID 1	Other

Entity	Type
Bexar County WCID 10	Other
Canyon Regional Water Authority	Other
Cibolo Canyon Conservation and Improvement District 1	Other
Cibolo Creek Municipal Authority	Other
Coastal Bend Council of Governments	Other
Comal County WCID 6	Other
Crosswinds at South Lake Special Improvement District	Other
East Central SUD	Other
Ecleto Creek Watershed District	Other
Escondido Watershed District	Other
Espada Development District	Other
Falcon Point WCID 1	Other
Flying L PUD	Other
Golden Crescent Regional Planning Commission	Other
Green Valley SUD	Other
Hondo Creek Watershed Improvement District	Other
Johnson Ranch MUD	Other
Kendall County WCID 2	Other
Kendall County WCID 2A	Other
Kendall County WCID 3	Other
Kendall County WCID 4	Other
La Salle WCID 1-A	Other
La Salle WCID 1-B	Other
Lerin Hills MUD	Other
Medina County FWSD 1	Other
Medina County WCID 1	Other
Northeast Medina County WCID 1	Other
Port O'Connor MUD	Other
Refugio County Drainage District 1	Other
Refugio County Navigation District	Other
Refugio County WCID 1	Other
Refugio County WCID 2	Other
San Antonio MUD 1	Other
Victoria County Navigation District	Other
West Side Calhoun County Navigation District	Other

Entity	Type
Westside 211 Special Improvement District	Other
Wilson County FWSD 1 of Wilson County Texas	Other

The SAFPR includes an area that drains to the San Antonio River and associated tributaries. The San Antonio River originates from springs fed by the Edwards Aquifer in central Bexar County. The Medina River starts at the top of the river basin in Bandera County and joins the San Antonio River along with Cibolo, Leon, and Salado Creeks and numerous tributaries. The river confluences with the Guadalupe River before the combined rivers discharge into San Antonio Bay.

There are 14 groundwater conservation districts located within the SAFPR, which regulate and manage the use of groundwater resources potentially impacted by flooding.

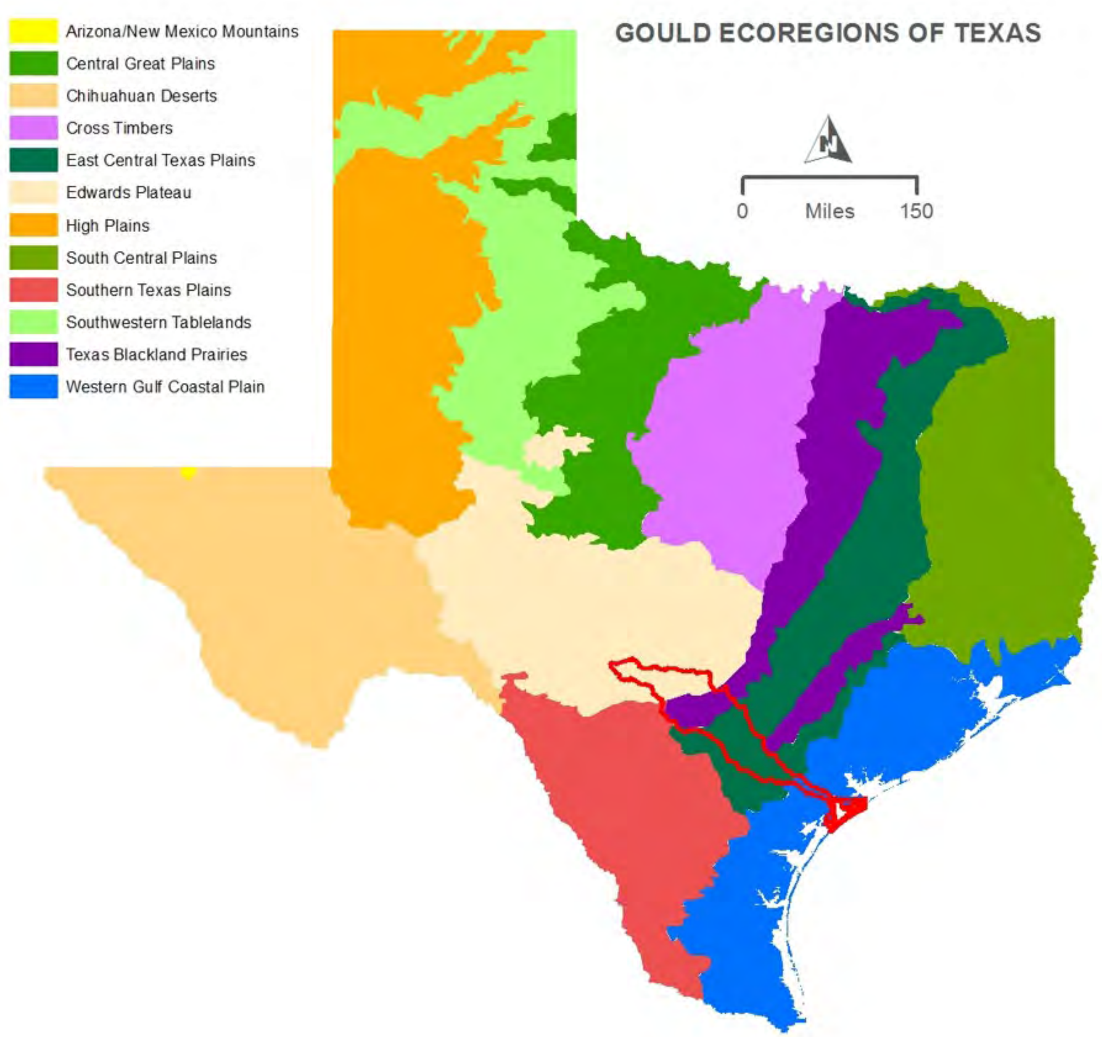
The SAFPR includes five of the 12 ecoregions identified by Texas Parks and Wildlife Department (TPWD), including the Blackland Prairie, Edwards Plateau, Post Oak Savannah, Rolling Plains, and the Western Gulf Coast Prairies and Marshes, as shown in Figure 1-2 1.

The SAFPR is dominated by limestone, rocky clay, and sand-based, sandy-loam, highly alkaline soils, which restrict the species of trees that flourish here.2 The surface of the Blackland Prairie portion of the SAFPR is dominated by limestone and heavy clay soils with an average rainfall of 32 inches. The Edwards Plateau mostly contains clay loam soil which turns into rocky clay or solid limestone beneath the surface with an average rainfall of 23 inches per year. The Post Oak Savannah is primarily clay loam to clay with an average rainfall of 35 inches, leading into the Rolling Plains, which has a high alkalinity soil and an average rainfall of 22 inches. Lastly, the Western Gulf Coastal Plain is the southeast portion of the SAFPR, containing sand-based soil with typically high salt content and an average rainfall of 23 inches per year.

Most precipitation comes from violent spring and early summer thunderstorms. These thunderstorms produce short, intense rainfall over very limited areas. These intermittent storms punctuate periods of drought. Average annual rainfall over the region varies between 22 and 32 inches of rain with rainfall increasing downstream in the lower basin.

1 Service, T. A. (2021). Texas Ecoregions. Retrieved from Trees of Texas: http://texastreeid.tamu.edu/content/texasEcoRegions/
2 Service, T. A. (2021). Texas Ecoregions. Retrieved from Trees of Texas: http://texastreeid.tamu.edu/content/texasEcoRegions/

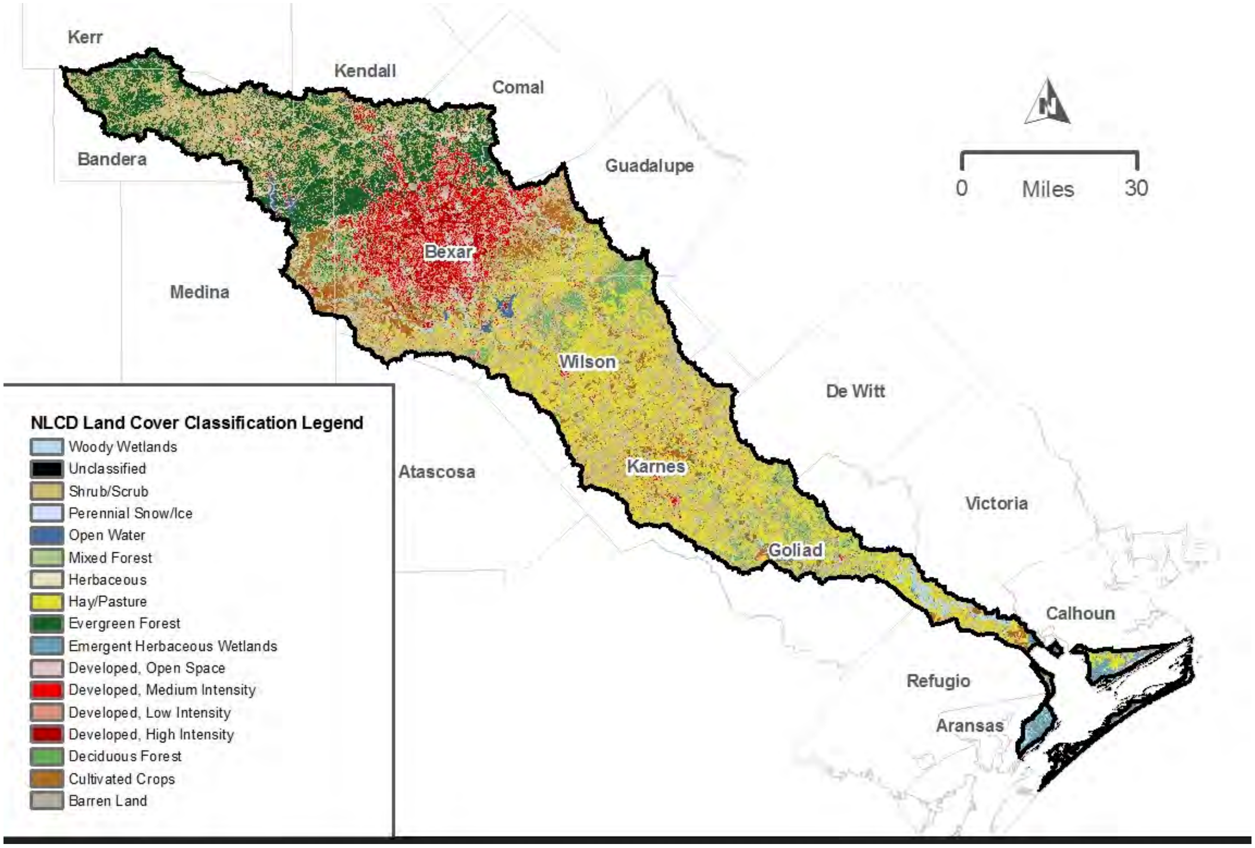
Figure 1-2. Ecoregions in the SAFPR



The SAFPR is a productive agricultural region with most farming and ranching primarily southeast of San Antonio, with some ranching activity northwest of San Antonio. Although fewer individuals are exposed to flood hazards in rural areas, the impact of flooding on agriculture and ranching can be severe. Floods can delay planting and ruin crops, kill livestock, and damage barns or other structures, causing significant economic hardship to the farmers and ranchers.

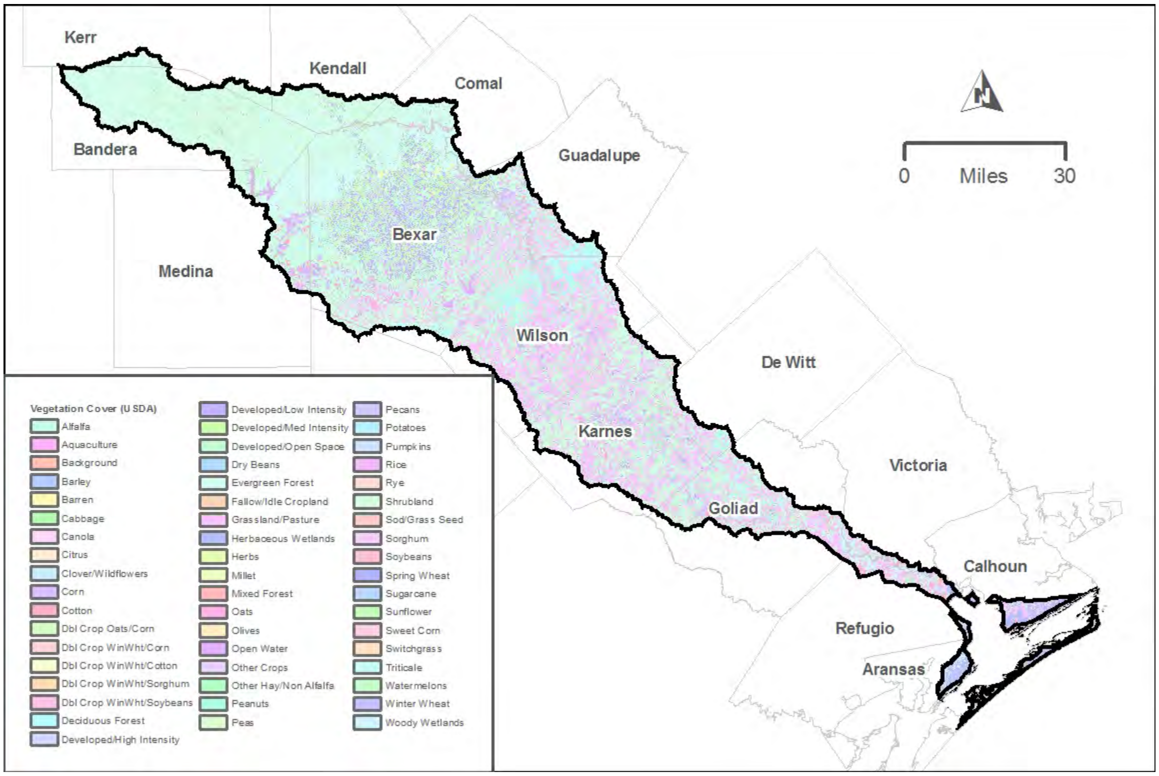
Ranchland and farmland are the predominant use of working lands across the SAFPR, as shown in Figure 1-3. Together ranchland and farmland account for 69.1% of the total land area with ranchland being 60.5% and farmland being 8.6%.

Figure 1-3 SAFPR Land Cover (NLCD)



As shown in Figure 1-4, the predominate vegetative cover types by land area are shrub/scrub (37.1%), hay/pasture (23.4%), cultivated crops (8.6%), evergreen forest, i.e. cedar breaks (7.0%), developed areas of varying development intensities (6.2%), and deciduous forest (4.4%). Emergent herbaceous wetlands, herbaceous, woody wetlands, mixed forest, open water, and barren land make up the remaining 13%.

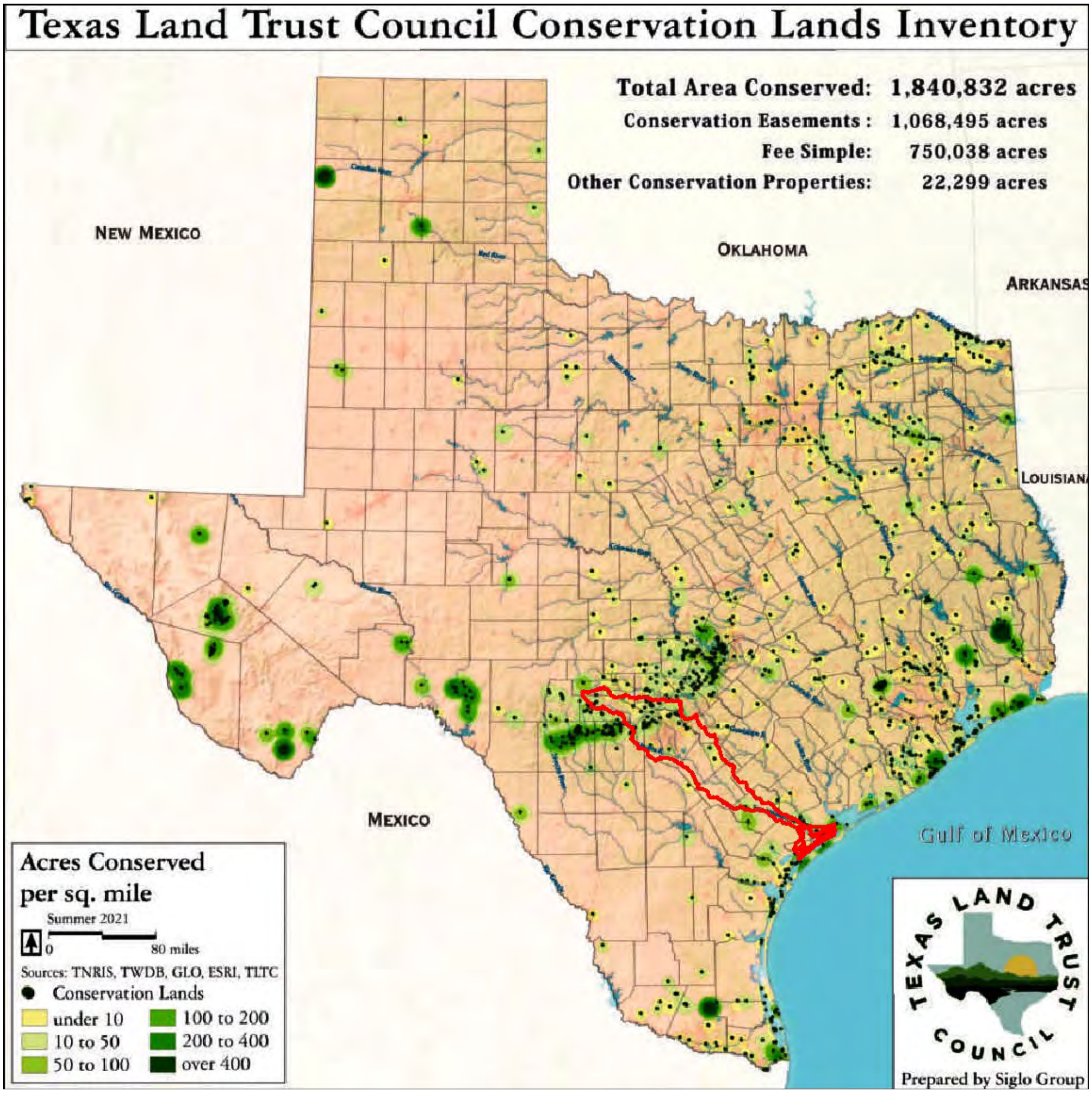
Figure 1-4. SAFPR Vegetation Cover (USDA)



1.4 Conservation Easements

The SAFPR contains Conservation Lands to enable landowners to protect natural resources for future generations while maintaining private ownership. Conservation Lands in the SAFPR are predominately located in the Edwards Plateau region.

Figure 1-5. SAFPR Conservation Easements (TLTC)

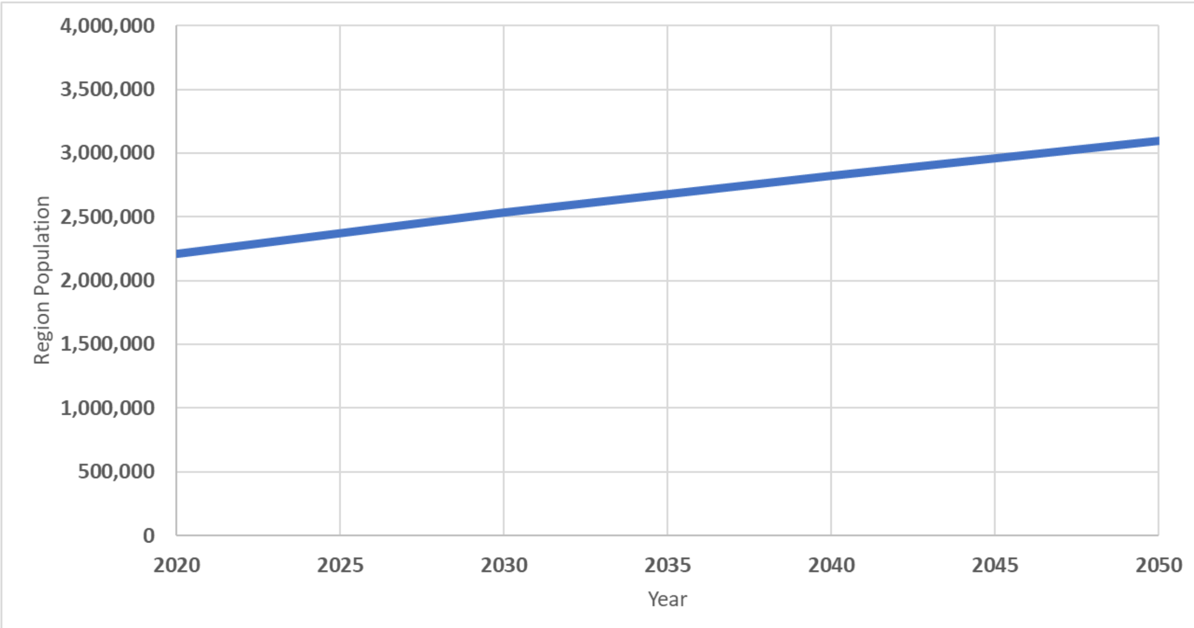


1.5 Socioeconomic Characteristics

Outside of the San Antonio metropolitan area, the SAFPR is largely rural in nature, although significant growth is occurring in the portions of Comal, Guadalupe, Kendall and Wilson counties that lie within the planning region. The population of those four counties and Bexar County contain almost 97% of the total population of the region. The City of San Antonio and its surrounding suburbs contain roughly 81% of the region's population. The next largest group of cities in the region include Boerne, Cibolo, Converse, Schertz and Universal City. Many smaller cities are contained in the rural areas of the planning region.

Overall, the region is expected to grow by 40% between 2020 and 2050 to a population of about 3,095,520 (Figure 1-6). This significant amount of growth will lead to extensive expansion of development adding housing and businesses to support the growing population. As the region experiences population growth, more people will be exposed to flooding, with a greater possibility of being extreme, as permeable land surfaces are replaced with impermeable services associated with development.

Figure 1-6. SAFPR population projection



Nine counties are projected to grow by at least 20% between 2020 and 2050. Kendall County is the fastest growing county in the region with a projected growth of 106% over the next 30 years.

Table 1-5. Counties with highest projected growth, 2020-2050

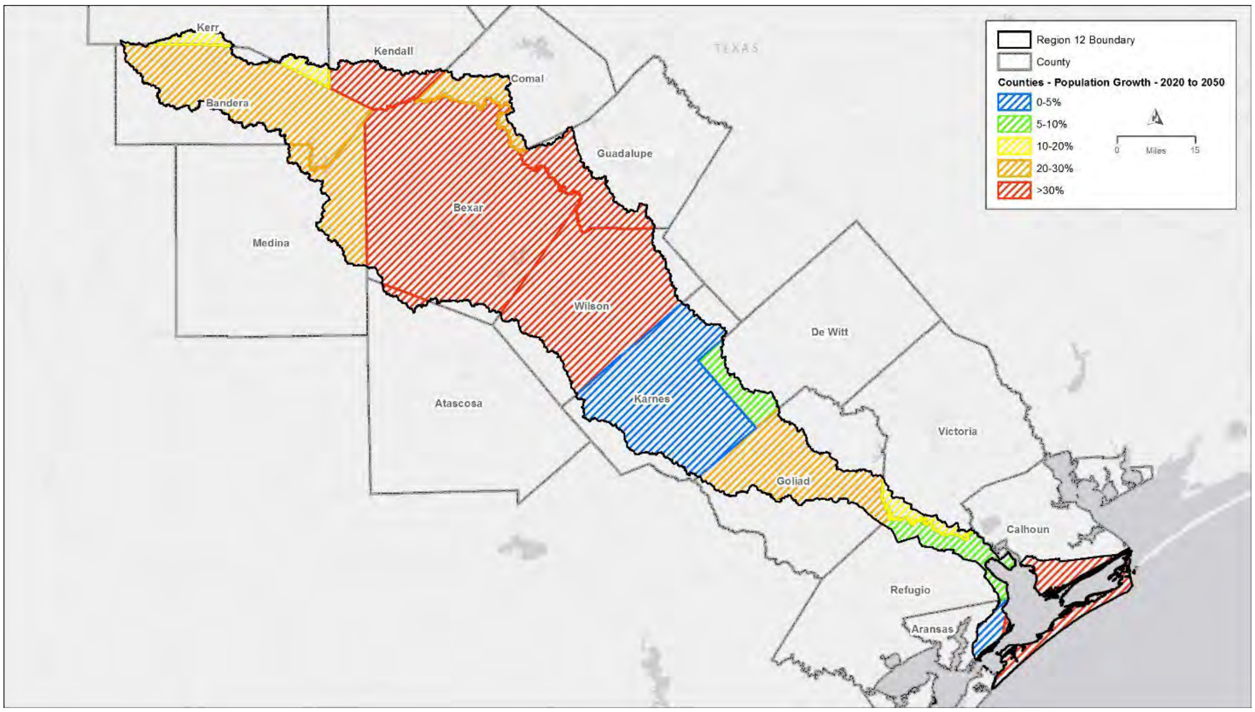
County	2020 Population	2050 Population	% Growth
Kendall	25,519	52,659	106%
Guadalupe	90,434	166,790	84%
Wilson	53,265	88,957	67%
Comal	17,239	27,737	60%
Atascosa	1,593	2,287	44%
Bexar	1,965,639	2,686,036	37%
Medina	12,618	16,232	29%
Bandera	23,755	30,173	27%
Goliad	4,745	5,937	25%

The cities with the highest projected growth as a percentage of 2020 population are Boerne, Elmendorf, Schertz, Cibolo, and Floresville (Table 1-6).

Table 1-6. Cities with highest projected growth, 2020-2050

County	2020 Population	2050 Population	% Growth
Boerne	17,732	28,903	96%
Elmendorf	2,160	4,001	85%
Schertz	39,245	71,017	81%
Cibolo	23,066	38,853	68%
Floresville	8,123	13,476	66%

Figure 1-7: SAFPR Population Growth, 2020-2050



The SAFPR area has an economic base centered on trades and services, manufacturing, mining, agricultural and livestock production. All sectors of the economy have experienced growth in recent years. Table 1-7 provides a county-by-county summary of economic activity in the key sectors most significantly affecting the economy of the SAFPR. A strong trades and services sector, including a thriving tourism industry in San Antonio, accounts for about 46 percent of regional economic activity. Fabricated metal products, industrial machinery, and food processing form the core of the manufacturing sector, which accounts for approximately 30 percent of regional economic activity. Oil and gas production dominate the mining sector of the economy and, together, represent about 22 percent of the reginal economic activity. Beef cattle, corn, and grain sorghum are the dominate agricultural enterprises. The agricultural sector, including both livestock and crops, accounts for about 1 percent of regional economic activity.

Table 1-7. County Economic Activity in the SAFPR

County	Trades & Services Economic Activity (Million Dollars)[1]	Manufacturing Economic Activity (Million Dollars)[1]	Market Value of all Livestock (Million Dollars)[2]	Market Value of All Crops (Million Dollars)[2]	Value of Oil Production (Million Dollars)[3]	Value of Gas Production (Million Dollars)[3]	Total (Million Dollars)
Atascosa	464	0	54	21	1,327	94	1,960
Bexar	18,346	14,766	17	51	5	0	33,185
Comal	2,685	960	9	1	0	0	3,655
DeWitt	205	0	32	7	2,924	975	4,143
Goliad	41	0	13	5	13	30	102
Guadalupe	1,965	2,543	53	21	43	0	4,625
Karnes	151	0	18	11	6,409	1,265	7,854
Kendall	1,149	0	11	1	0	0	1,161
Medina	580	0	48	46	6	0	680
Refugio	80	0	11	25	139	35	290
Victoria	2,216	0	24	34	112	15	2,401
Wilson	250	122	56	13	80	2	523
Total	**28,132**	**18,391**	**346**	**236**	**11,058**	**2,416**	**60,579**

[1] Source: 2017 Economic Census. US Department of Commerce.

[2] Source: 2017 Census of Agriculture, Volume 1 Geographic Area Series. "Table 1. County Summary Highlights: 2017."

[3] Determined by using the number of barrels produced as reported to the Texas Railroad Commission times $61.40/barrel (the average price for 2018).

[4] Determined by using the cubic feet produced as reported to the Texas Railroad Commission times $3.67/cubic feet (the average price for 2018).

Trades and services is the leading economic activity in the region, largely centered around tourism in the San Antonio area. Other counties with large trades and services sectors include Comal, Guadalupe and Victoria Counties.

In 2017, manufacturing facilities contributed over $18 billion in sales in the region. The leading manufacturing counties in the region for which data are available are Bexar, Comal and Guadalupe. Significant economic activity associated with manufacturing also occurs in Atascosa, DeWitt, Goliad, Karnes, Kendall, Medina, and Victoria Counties, although data are withheld to avoid disclosures for individual producers.

This region has many sand and gravel quarries and is also rich in petroleum products, including oil and natural gas. Much of the stone quarried is used in the production of cement. The leading cement producing area in the region is Bexar County. Most of the stone, gravel, and sand mining activities are located in Bexar, Comal, and Victoria Counties. The regional also derives a significant portion of its mining income from oil and gas activities. All but Comal and Kendall have some economic activity derived from oil and gas. The leading oil and gas producing counties in the region are DeWitt, Karnes, and Atascosa.

Much of the cropland in the region is farmed using dryland techniques, with Medina and Atascosa counties being the areas with the most irrigated cropland. The leading agricultural producing counties in the region, by market value of product, are Bexar, Medina, Victoria, and Refugio. The major crops grown in the region include corn and grain sorghum, with wheat soybeans and cotton also being grown.

Major types of livestock produced in the area include cattle and calves, beef cattle, and sheep and lambs. The leading livestock producing counties in the region by market value are Wilson, Atascosa, Guadalupe, and Medina.

The median annual household income in the SAFPR ranges from $84,747 in Kendall County to $50,076 in Refugio County, a difference of $34,671. The average household median income of the region is $64,173, or slightly above the state average of $61,874. Approximately seven counties have a median household income value less than the state average. The region also contains several counties that have relatively high median household incomes with Comal, Guadalupe, Kendall, and Wilson Counties greater than $75,000. These four counties are also projected to have the greatest growth in the SAFPR.

Median household income levels can be affected by many factors, including education levels, opportunity of employment, and location. Overall, the higher median income in the region indicates that the average individual affected by floods may be at a financial advantage compared to their state counterparts; however, it is important to remember that there are several counties with low median income values. Residents in these counties, may have a harder time recovering from a flood event.

1.6 Flood-prone Areas and Major Flood Risks

1.6.1 Flood-prone Areas

The 1.0% and 0.2% annual chance storm event inundation boundaries were compiled for all waterways with contributing drainage areas larger than one-tenth of a square mile (sq. mi.) for the entire region. This complete coverage was due in part to the availability of flood inundation boundaries for the entire basin, provided by Fathom to the TWDB for use in regional flood planning[3]. The most accurate inundation boundaries were applied when multiple inundation data sets were available.

A ‘floodplain quilt’ was obtained from TWDB, consisting of multiple layers of data from various sources available throughout the state that were ‘quilted’ together into a single flood hazard dataset. The ‘floodplain quilt’ does not typically include localized flooding or depict complex urban flooding problems. Additionally, new preliminary inundation boundaries were obtained from SARA, which is currently the only detailed flood data that uses the latest NOAA Atlas 14[4] rainfall. In addition, public identified flood-prone areas identified through public comments will be evaluated as the data becomes available.

The following list summarizes the various flood inundation data sets used in their order of most accurate to least accurate, with data sets including the base level engineering (BLE) data and above considered accurate.

- SARA Preliminary Data (Submitted to the Federal Emergency Management Agency (FEMA) for review)
- National Flood Hazard Layer (NFHL) Preliminary Data
- NFHL Detailed Effective Data
- Base Level Engineering Studies
- NFHL Approximate Effective Data
- Fathom Draft Data – October 29th, 2021
- Public Comments

A portion of the SAFPR contains ‘approximate’ 1.0% annual chance flood inundation boundaries but no 0.2% annual chance storm event inundation boundaries (i.e. NFHL Approximate Study Areas). Thus, for these approximate areas, the Fathom 1.0% and

3 https://www.fathom.global/product/flood-hazard-data-maps/
4 https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

0.2% annual chance data were used to define flood hazard extents. In 2022, additional preliminary data will be provided by SARA and the entire San Antonio River Basin will have complete BLE coverage. Therefore, existing flood hazard mapping will be updated in its entirety to include Preliminary, Detailed Effective or BLE quality data.

Figure 1-8 thru Figure 1-11 below provides a region-wide depiction of the 1.0% annual chance flood event and 0.2% annual chance flood event inundation boundaries, and the source of flooding for each area, for use in the risk analysis. In addition, flood risks are described in further detail in Chapter 2.

1.6.2 Additional Flood-Prone Areas

Additional flood-prone areas were identified based on the location of hydrologic features, historic flooding, and/or local knowledge. Additional flood-prone areas were added for the following:

- Local knowledge (stakeholders / citizens)
- Database identifying ow water crossings (Texas Natural Resource Information System (TNRIS))
- U.S. Geological Survey (USGS) gages
- Historical flood data (National Weather Service (NWS), FEMA, TxDOT, and complaints reported through the City of San Antonio (CoSA) 311 system)

1.6.3 Local Knowledge

The SAFPR is divided into four subregions (Upper Basin, Upper Mid Basin, Lower Mid Basin, and Lower Basin) as shown in the Figure 1-8 thru Figure 1-11 to facilitate stakeholder and citizen engagement. The first round of in-person meetings introduced the regional flood planning process and to gather local knowledge of flood-prone areas, historical flooding, flood mitigation projects and needs. Additionally, an interactive on-line comment map was used to allow stakeholders and citizens the opportunity to identify flood-prone areas for consideration in the Plan. Points that were outside of the 1% and 0.2% chance storm event flood hazard area were delineated as possible flood-prone areas based on the descriptions included in the comments.

Figure 1-8. SAFPR Flood-Prone Areas – Upper Basin

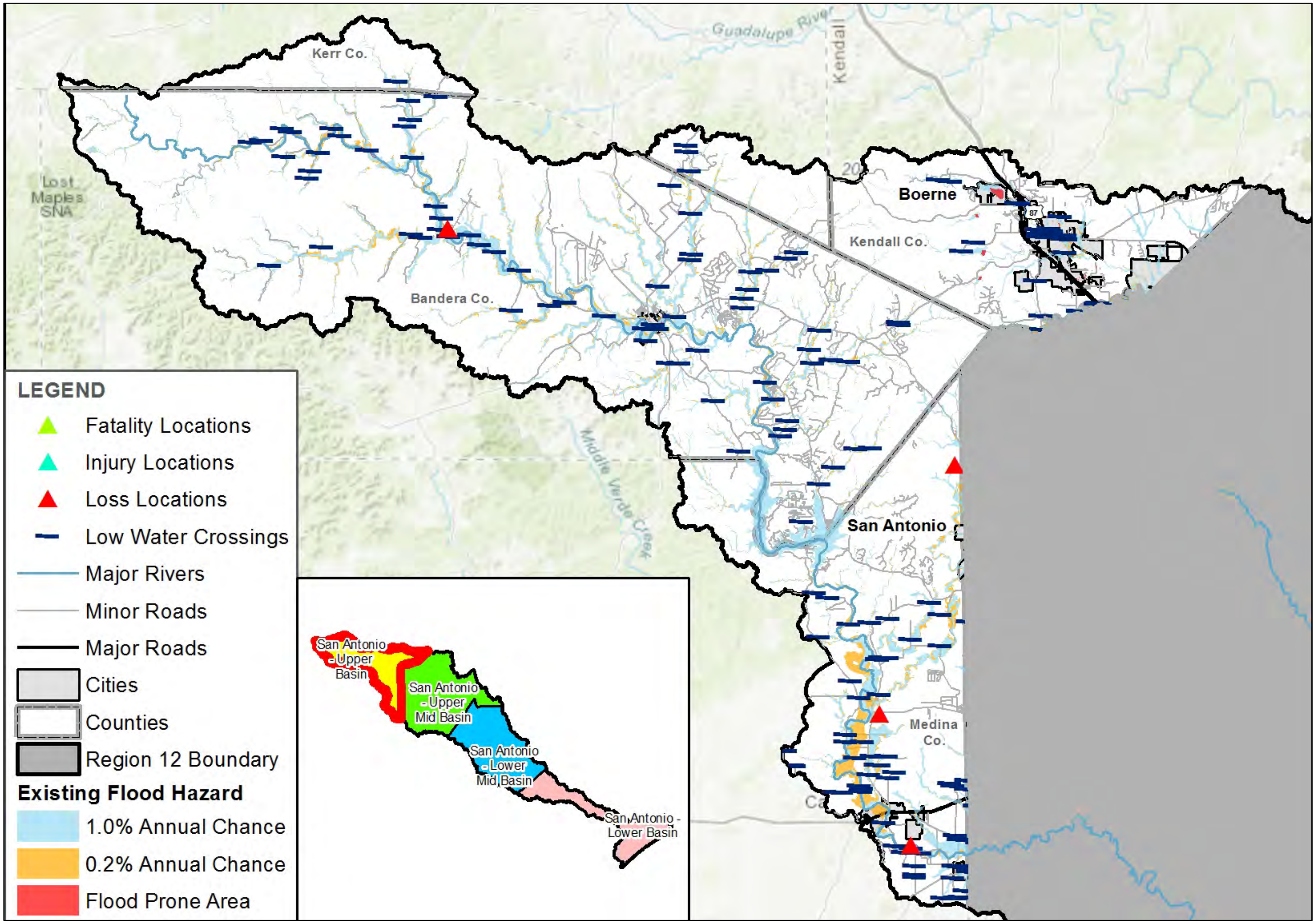


Figure 1-9. SAFPR Flood-Prone Areas – Upper Mid Basin

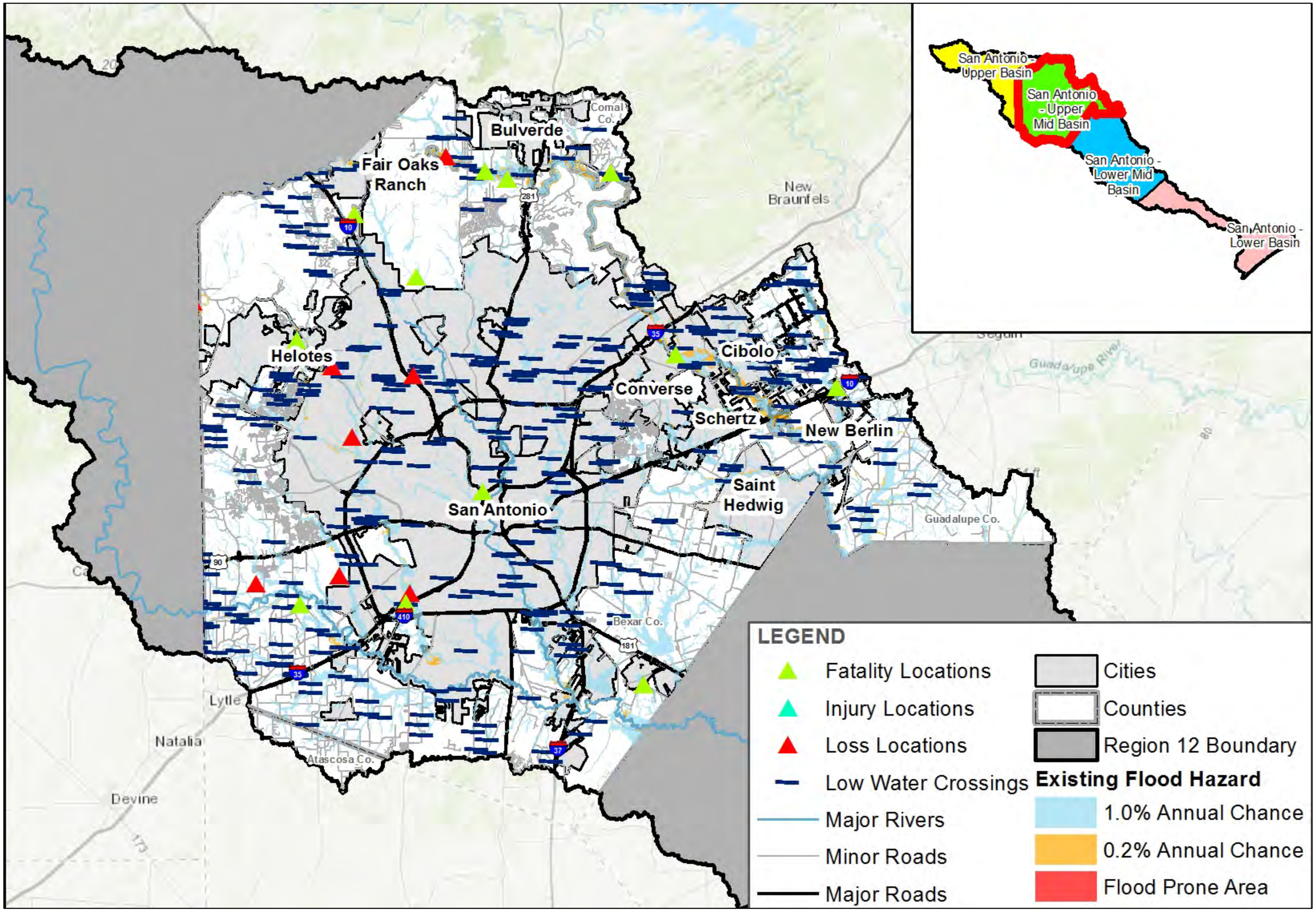


Figure 1-10. SAFPR Flood-Prone Areas – Lower Mid Basin

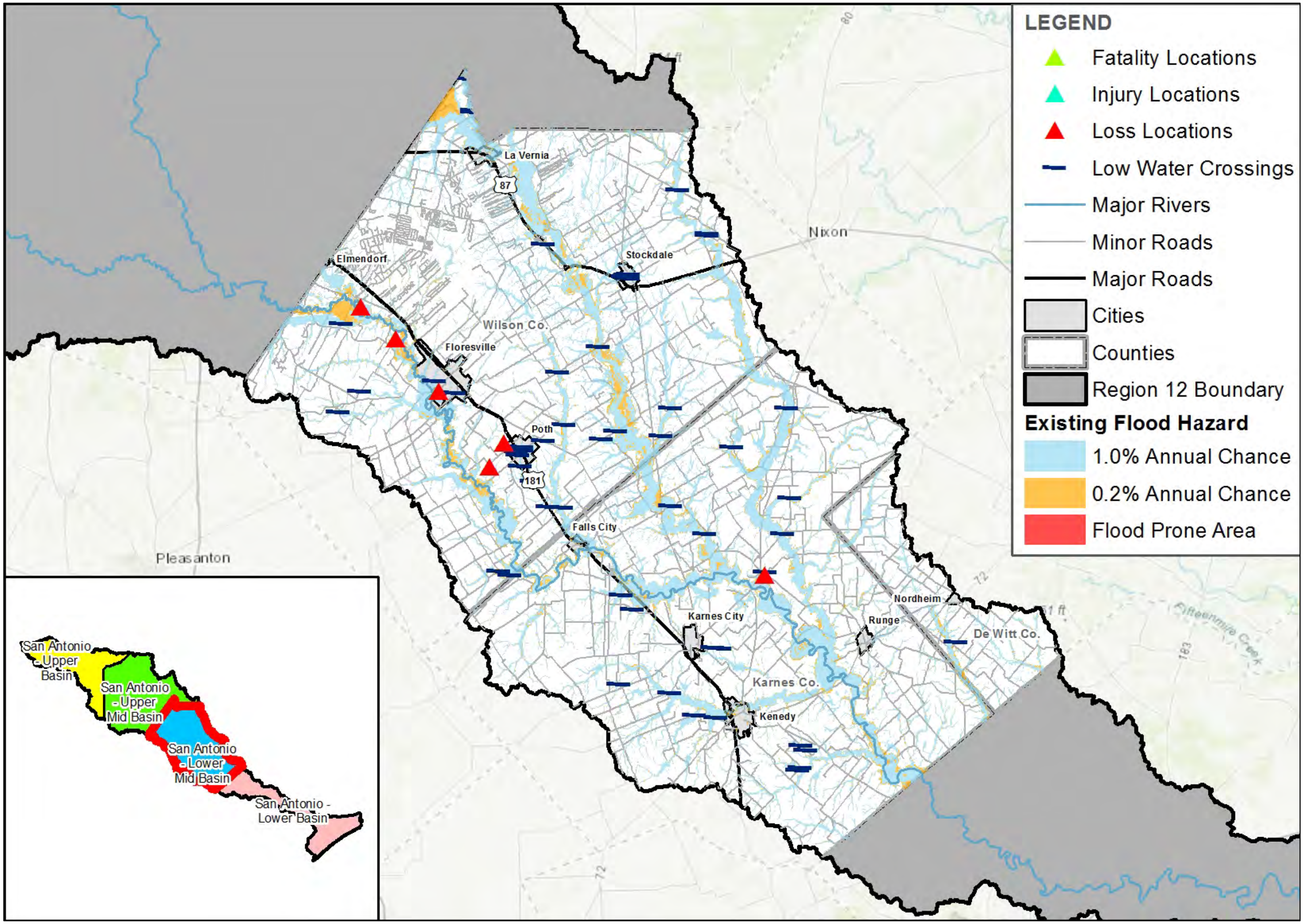
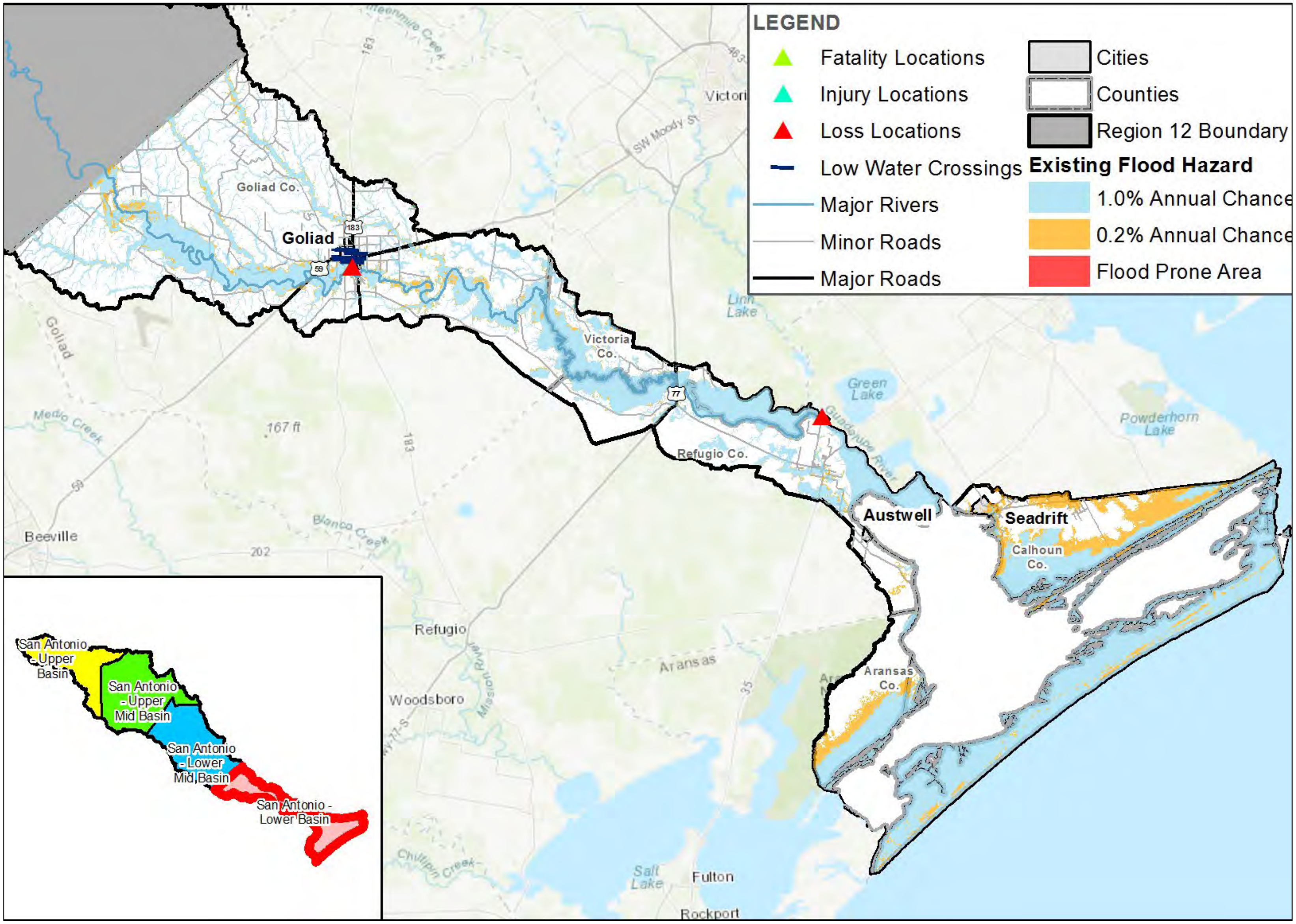


Figure 1-11. SAFPR Flood-Prone Areas – Lower Basin



1.6.4 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.

A total of 498 low-water crossings have been identified in the RFP. These low-water crossings are from TNRIS and were last updated in March 2021. The TNRIS data includes locations monitored by the Bexar Flood Website, Bexar County Highwater Alert Lifesaving Technology (HALT) and San Antonio Flood Emergency (SAFE) Route System Community feedback was used to identify additional problematic low-water crossings not already included in the TNRIS data.

1.6.5 USGS Gage Data

USGS gage information was used to identify flood-prone areas and evaluate historical flood events. A few key locations were identified along the major rivers and tributaries within the basin. The gages in these locations were evaluated for crucial historic flood events which are summarized in **Table 1-8** below.

1.7 Key Historical Flood Events

1.7.1 Historical Flooding

Past flood events provide insight on the location of flood-prone areas within the basin. **Table 1-8** below provides a list and brief description of historical events within the basin.

Table 1-8. List of Historic Floods

Flood Event	Description
2021 Coastal Flash Floods	Early summer 2021, a series of storms hit the Texas Mid Costal Counties causing flash flooding. Victoria and Karnes County USGS gages along the San Antonio River saw record discharge amounts. As a result of this flash flooding, the NWS reports one injury and one death in Victoria.
2017 Hurricane Harvey	Hurricane Harvey is one of the most expensive storms on record, costing an estimated $24 million dollars in damages to Region 12 counties.
2016 Floods	Texas was hit by a series of large storms in 2016. Historic USGS gage discharge rates were recorded in Karnes and Victoria counties along the San Antonio River. NWS reports two flash flood related casualties recorded this year within the region.
2015 Memorial Day Flood	May 2015, a slow-moving storm swept Oklahoma and Texas causing flash flooding throughout the region. Bandera and Victoria County USGS gages along the Medina and San Antonio River recorded historic discharge rates. As a result of this flash flooding, the NWS reports one death in Bexar County and one in Medina County.

2015 October Flood	In October of 2015, a tornado and a large storm ravaged Central Texas. Wilson County USGS gage on the Cibolo Creek saw record discharge amounts. As a result of this flash flooding, the NWS reports one death in Bexar and one in Comal counties.
2013 May Floods	May 2013 brought flash floods that affected the whole region. Historic discharge rates were recorded along the San Antonio River in Bexar and Karnes County. These flash floods resulted in 3 reported casualties by the NWS in Bexar and Guadalupe counties.
2010 June Floods	Flash floods hit Central Texas in June 2010, making it one of the more costly events the region has endured. An estimated $20 million dollars in damages were reported for Bexar, Comal, and Guadalupe counties. As a result, the NWS reports one death in Comal County.
Water Year 2007	A 6-month period where there was nearly continuous flooding in Texas from March to September. In August, Tropical Storm Erin hit the regions coastal counties. 2007 was one of the costliest years ever recorded for flood damage. Just in Region 12, there was $20 million in damages reported by the NWS. June through August NWS reports historic USGS gage discharge rates for the San Antonio River and Cibolo Creeks in Bexar and Wilson County. NWS reports that Region 12 had 10 fatalities within this 6-month span.
2005 Hurricane Rita	Hurricane Rita was the most intense hurricane to pass through the Gulf of Mexico and caused severe coastal flooding and. According to the Alamo Area Council of Governments Regional Mitigation Action Plan, it caused severe coastal flooding and lead to emergency declarations in Atascosa, Bandera, Bexar, Comal, Guadalupe, Karnes, Kerr, Medina, and Wilson counties.
2004 November Flash Flood	November 2004, the region was hit by a costly flash flood that resulted in 2 deaths in Bexar County and set historic peak discharge rates at the USGS gage on Salado Creek in Bexar County.
2002 Flash Floods	July 2002 Flash Floods hit the region. Historic USGS discharge rates were recorded all across the region; Medina River in Bandera County, Salado Creek in Bexar County, and San Antonio River in Karnes and Goliad counties. As a result of these floods the NWS reports 5 deaths from Bexar and Kendall counties. Later that year extreme flash flooding in November resulted in 18 injuries in Bexar County.
2001 Floods	August 2001, Atascosa, Bexar, Comal, Guadalupe, Karnes, Kerr, and Wilson Counties encountered sever flash flooding. Water was reported 6 inches over the 500-year floodplain mark along SH123 in Wilson County. Floods caused an estimated $2,000,000 in damages.

1998 October Flood	South central Texas experienced record-breaking rainfall in October 1998, making it the costliest flood event for the region. NWS reports $446 million in damages across the region. NWS reports 11 casualties in Bexar County and 4,040 injuries total for the region, most of them being in Bexar, Comal, Guadalupe, and De Witt counties. Historic USGS gage discharge rates were recorded throughout the region, from Medina River in Bandera County all the way down to the coast on the San Antonio River in Goliad. Per the San Antonio River Authority, the completion of the San Antonio River Flood Tunnels in January 1998 significantly reduced the impacts of these flash floods in San Antonio.
1997June Flash Flood	Heavy rainfall in June 1997 caused flash flooding in South Central Texas. As a result, the NWS reports 4 casualties and 115 injuries across Bexar, Medina, Bandera, Guadalupe, Comal, and Kendall counties. Historic USGS gage discharge rates were recorded along the Medina River in Bandera and Bexar County. This is one of the more costly events for the region, the NWS reports $29 million in damages resulting this event.
1990 July Flood	July 1990 was known as the "wettest" July in San Antonio. One of the largest USGS gage discharge rates was recorded for San Antonio River in Bexar County.
1987 June Flood	The upper counties were hit by a storm in June 1987, setting historic USGS gage discharge rates for the Medina River in Bandera and Bexar County.
1978 Hurricane Amelia	Hurricane Amelia hit Texas and stalled over the region's upper counties. This storm devastated Bandera County and surrounding areas. Due to this event, the USGS gage on the Media River in Bandera County recorded the highest discharge rate and water level ever recorded for the region, at 281,000 cfs and 50 ft.
1967 Hurricane Beulah	Hurricane Beulah hit Texas in September. The storm caused Goliad County to record the highest flow discharge of 138,000 cfs, the second highest recorded discharge in the FPR.
1946 San Antonio Flood	A September flood hit Bexar and Karnes counties. This event set a historic USGS discharge rate along the San Antonio River in Karnes County. As a result, the San Antonio River Authority reports 4 casualties in San Antonio.
1921 San Antonio Flood	On September 9, 1921, a tropical depression stalled just north of San Antonio and within hours flooded the creek networks in San Antonio. Due to this event, the San Antonio River Authority reports a total of $3.7 million in damages and more than 51 casualties in San Antonio. This flood sparked construction of the Olmos Dam.
1913 October Flood	A record rainfall of over 7 inches in 24-hours caused major flooding along the San Antonio River. The City of San Antonio reports flooding along San Pedro and Alazan creeks. Historic USGS gage levels were recorded in Goliad and Karnes Counties.

1.7.2 National Weather Service Flood Data

The NWS has documented fatalities, injuries, and property damage as the result of past flood events since 1996.

Data summarizing property damage, fatalities, and injuries are shown in Figure 1-11, Figure 1-12, and Figure 1-13.

A summary of flood damage data gathered from the NWS can be seen in Table 1-9 and Table 1-10. Table 1-9 reports flood damage in dollars, injuries, and fatalities by year. Table 1-10 uses the same base data as Table 1-9 but is summarized based on counties. To generate Table 1-9 and Table 1-10, data were collected from the NWS and filtered to highlight damage only generated by rain, storm, and flood.

Figure 1-12. Property Damage from Flooding, Since 1996 (NWS)

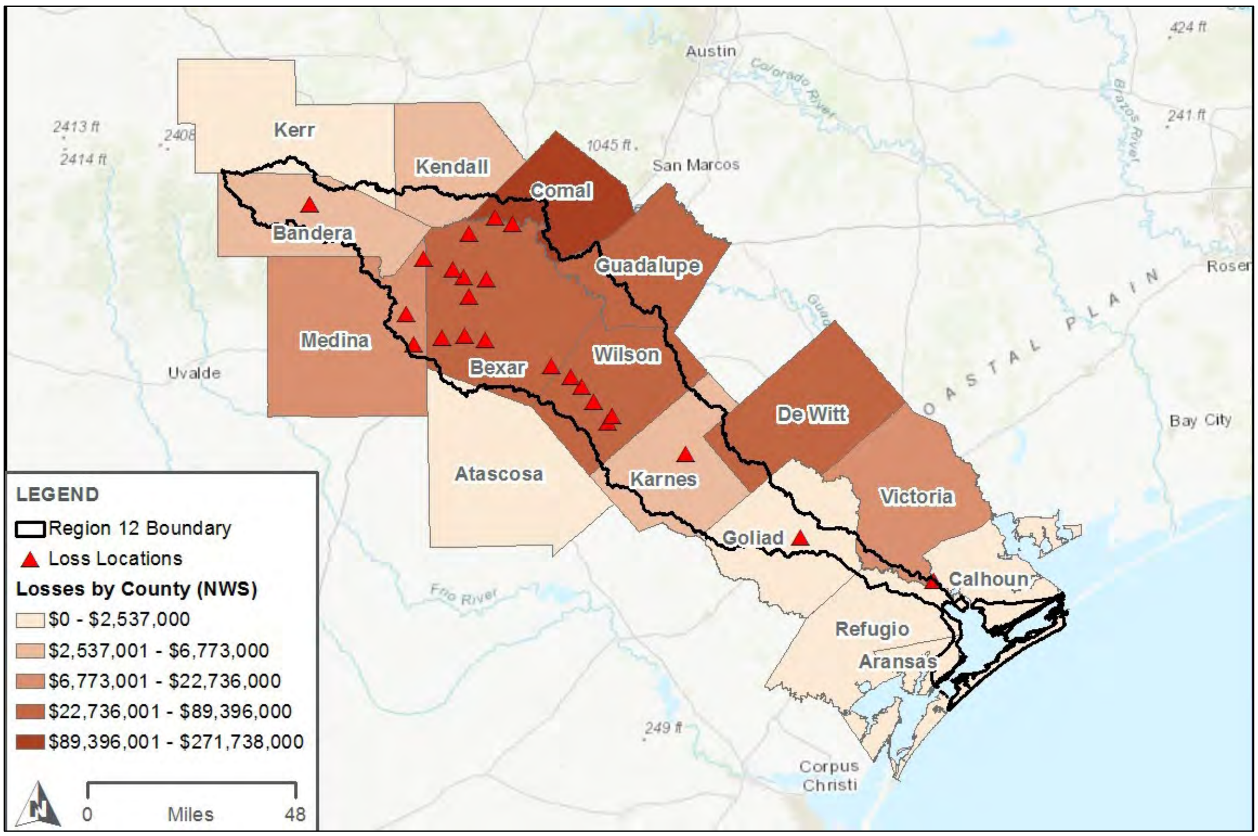


Figure 1-13. Fatalities from Flooding, Since 1996 (NWS)

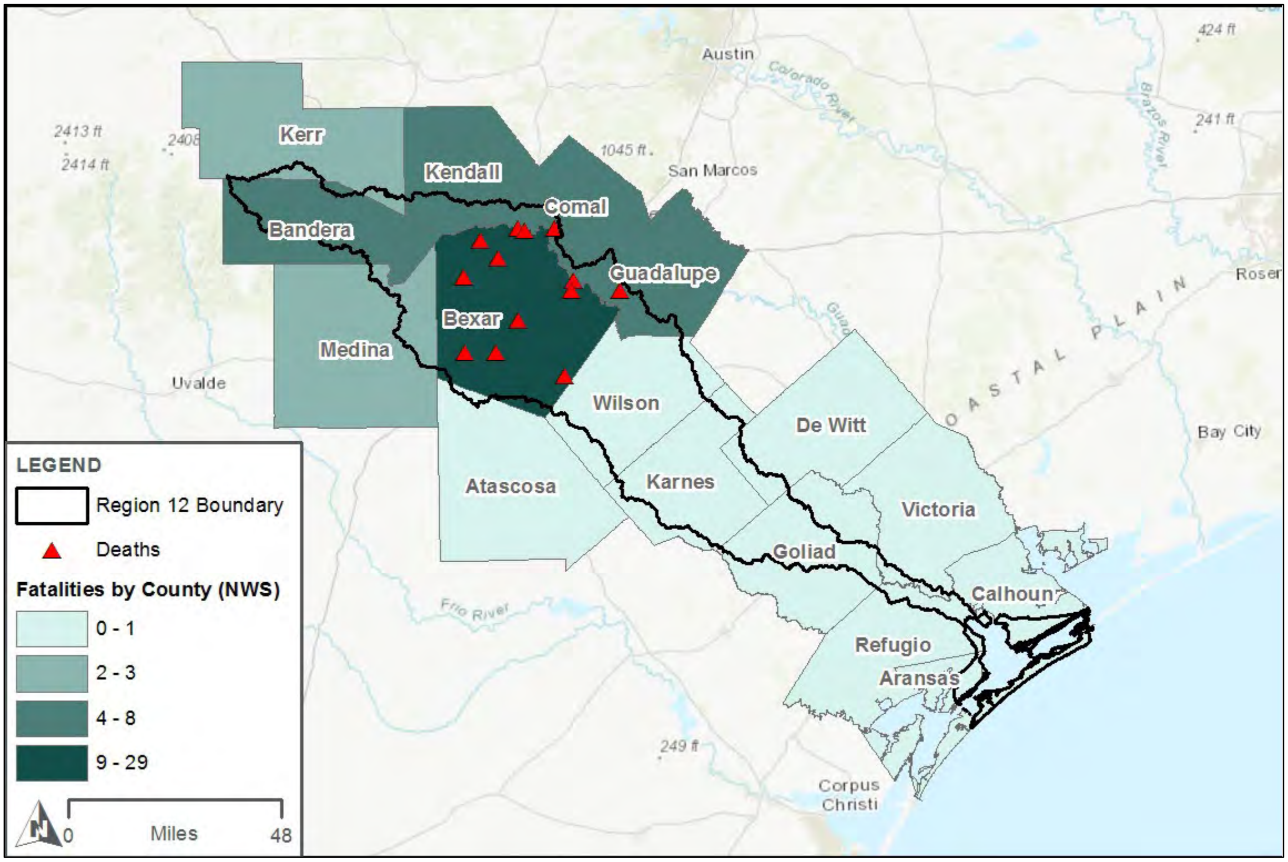


Figure 1-14. Injuries from Flooding, Since 1996 (NWS)

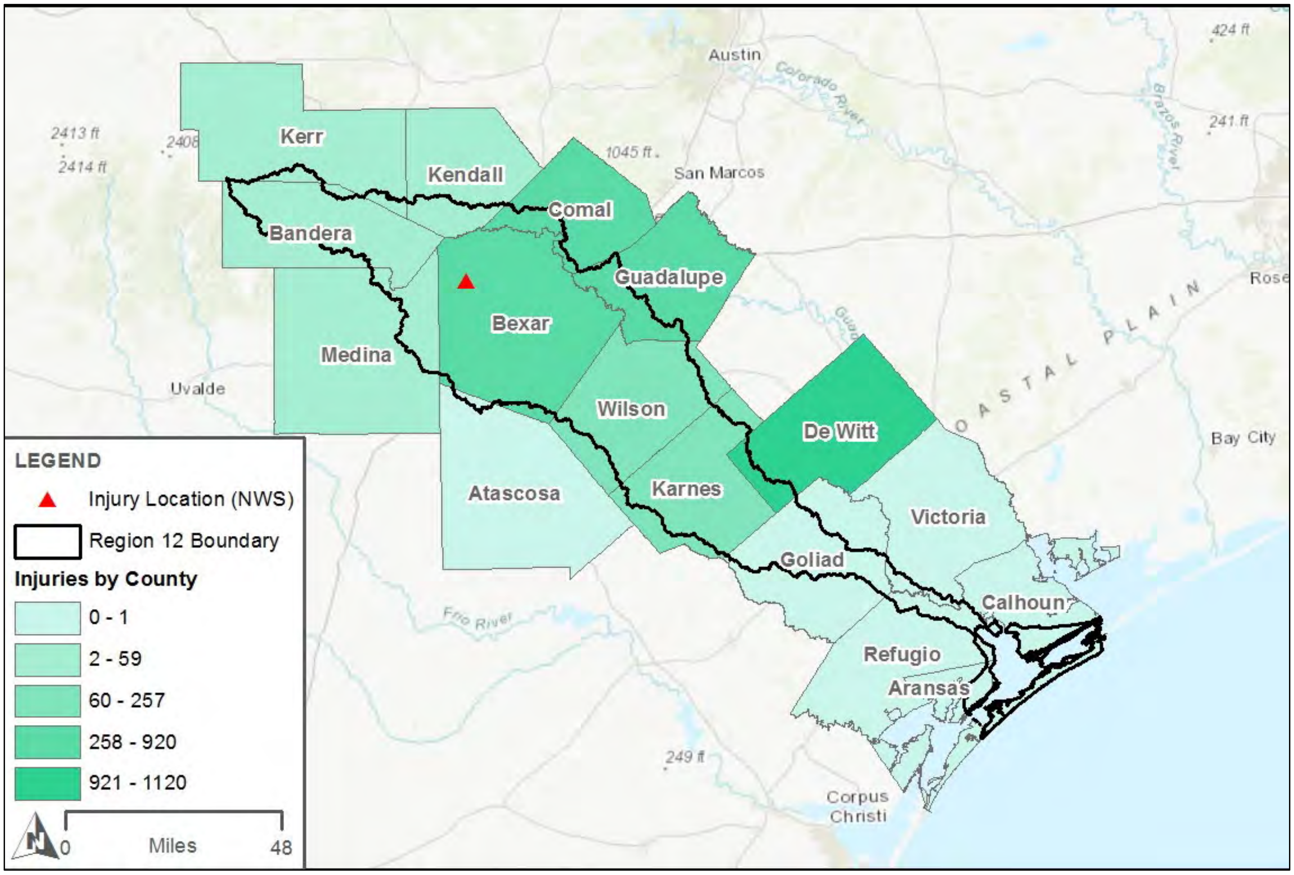


Table 1-9. Losses associated with Flooding in SAFPR by year Since 1996 (National Weather Service)

Flood Year	Damages	Injuries	Fatalities
1996	$76,000	2	1
1997	$32,173,000	115	6
1998	$452,054,000	4,063	17
1999	$446,000	0	0
2000	$1,208,000	8	1
2001	$4,969,000	63	1
2002	$2,300,000	22	5
2003	$528,000	0	0
2004	$1,572,000	1	4
2005	$0	0	0
2006	$2,000,000	0	0
2007	$21,920,000	1	10
2008	$20,000	0	0
2009	$0	0	0
2010	$20,900,000	0	4
2011	$0	0	0
2012	$110,000	0	0
2013	$100,000	0	4
2014	$200,000	0	0
2015	$155,000	0	4
2016	$250,000	0	2
2017	$24,000,000	0	1
2018	$50,000	0	0
2019	$5,000	0	0
2020	$1,455,000	0	0
2021 [1]	$690,000	1	1
Total	***$567,181,000***	***4,276***	***61***
[1] Data as of December 2021.			

Table 1-10. Losses associated with Flooding from 1996-2021 by County (National Weather Service)

Counties	Percentage of County Area in Region 12	Damages	Injuries	Fatalities
Aransas	13%	$2,537,000	0	0
Atascosa	1%	$1,267,000	0	0
Bandera	66%	$7,783,000	26	5
Bexar	97%	$44,390,000	852	29
Calhoun	27%	$1,110,000	0	0
Comal	17%	$272,468,000	920	6
De Witt	9%	$43,265,000	1,120	0
Goliad	39%	$25,000	0	1
Guadalupe	24%	$52,083,000	829	8
Karnes	80%	$4,584,000	170	0
Kendall	19%	$6,846,000	20	6
Kerr	5%	$1,253,000	22	3
Medina	15%	$17,148,000	59	2
Refugio	13%	$0	0	0
Victoria	5%	$22,736,000	1	1
Wilson	82%	$89,686,000	257	0
Total		***$567,181,000***	***4,276***	***61***

1.7.3 FEMA Flood Damage Data

FEMA data on disaster funding for flood damages was obtained from 1996 to June 2021. Data is shown in the following Figure 1-14 below.

Table 1-11 includes flood related damages by county. Unlike the gross damage data in Table 1-9 and Table 1-10, data in Table 1-11 is summarized from various federal programs. FEMA funding of four federal programs is summarized by county: Public Assistance Funded Project Summaries, Individuals and Households Program – Valid Registrations, Individual Assistance Housing Registrants – Large Disasters, and Housing Assistance Program.

Figure 1-15. FEMA Flood Assistance to Owners and Renters for Flood Damages, Since 1996

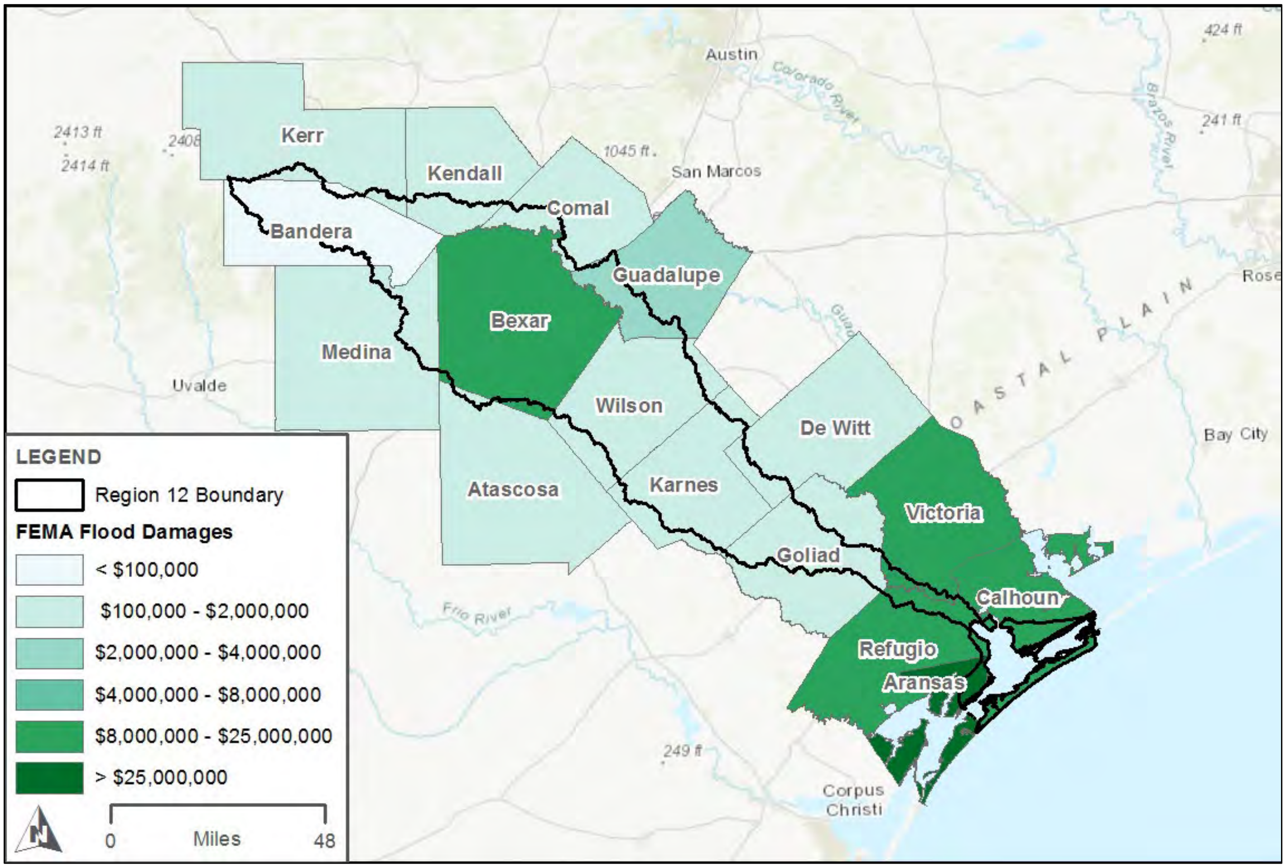


Table 1-11. FEMA Funding for Flood Related Damages by Program (1996 – June 2021)

Counties	Percentage of County Area in SAFPR	Public Assistance Funded Project Summaries	Individuals and Households Program - Valid Registrations		Individual Assistance Housing Registrants - Large Disasters	Housing Assistance Program
		Federal Share Obligated	Flood Damage Amount	Repair Amount	Real Property Damage Amount Observed by FEMA	Owners and Renters Combined Amount
Aransas	13%	$75,463,478	$7,328,541	$12,488,979	$55,009,113	$50,412,810
Atascosa	1%	$1,663,563	$94,935	$280,715	$226,154	$875,027
Bandera	66%	$2,080,777	$0	$0	$79,676	$97,212
Bexar	97%	$50,005,333	$2,045,533	$1,317,967	$4,605,858	$19,501,737
Calhoun	27%	$23,004,779	$588,398	$3,278,010	$3,723,571	$9,217,394
Comal	17%	$6,525,770	$585,521	$172,868	$549,725	$1,539,102
De Witt	9%	$4,320,705	$484,243	$435,925	$1,137,800	$1,499,327
Goliad	39%	$625,031	$22,554	$636,172	$577,051	$1,554,971
Guadalupe	24%	$5,118,692	$741,266	$402,861	$325,694	$2,089,239
Karnes	80%	$754,616	$4,580	$530,048	$372,964	$1,128,253
Kendall	19%	$712,625	$118,970	$29,522	$160,589	$264,451
Kerr	5%	$1,224,307	$0	$0	$140,710	$228,894
Medina	15%	$2,679,089	$1,421,149	$843,199	$208,545	$1,484,783
Refugio	13%	$28,969,743	$195,479	$2,816,461	$6,029,616	$8,192,161
Victoria	5%	$34,618,575	$2,070,202	$6,387,900	$9,538,865	$22,614,208
Wilson	82%	$2,081,921	$0	$18,564	$218,166	$360,002
Totals	**-**	***$239,849,004***	***$15,701,370***	***$29,639,191***	***$82,904,099***	***$121,059,571***

1.8 Political Subdivisions with Flood-Related Authority

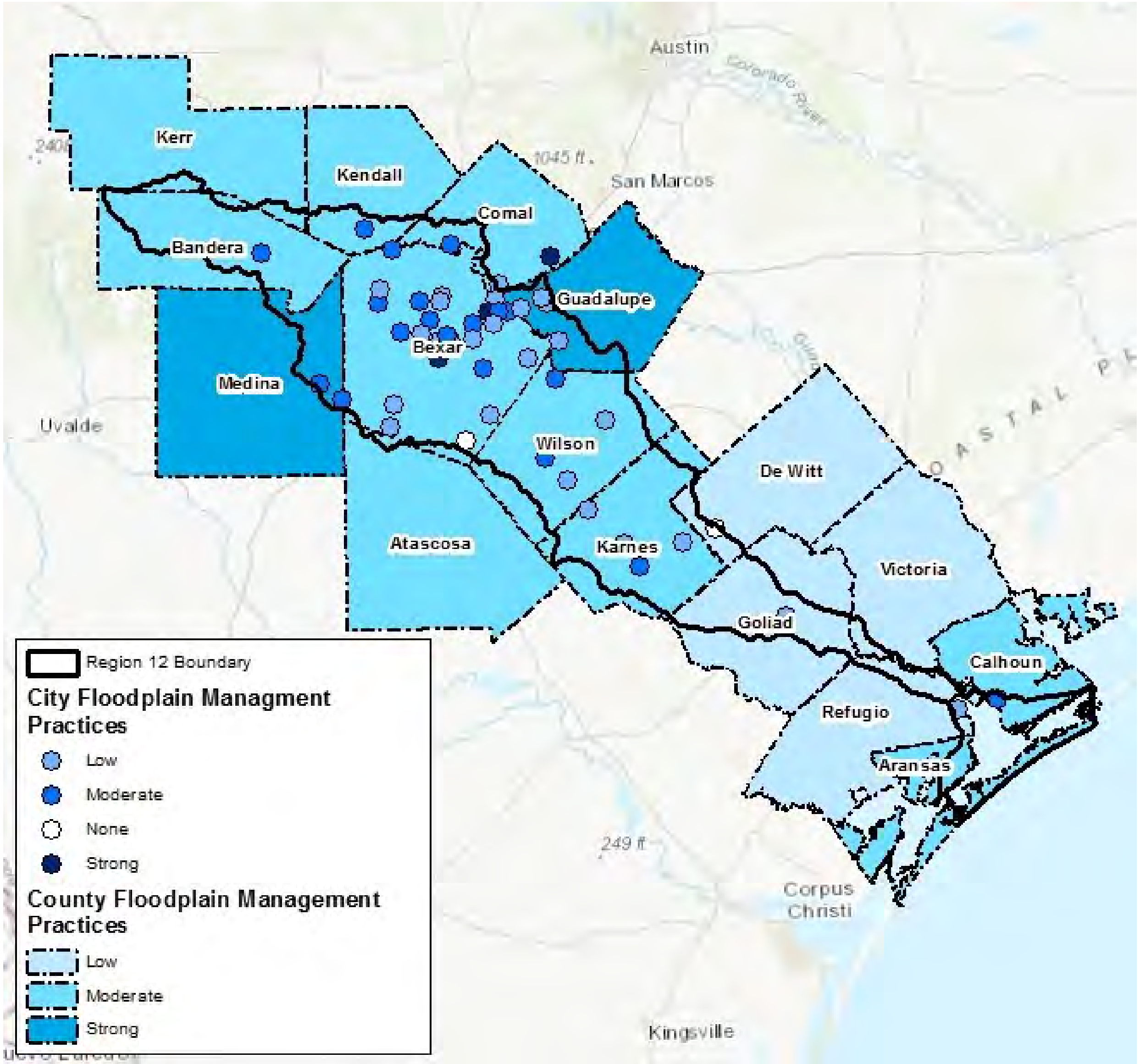
A list of existing political subdivisions within the SAFPR that have flood-related authority is provided in Table 1 in Appendix A. The list contains 110 entities including 49 cities, 16 counties, 4 river authorities, and additional entities with flood-related authority. The TWDB provided a list of the National Flood Insurance Program (NFIP) participants in the region; a total of 63 entities were identified including 16 counties and 47 cities. All entities participating in the NFIP have floodplain management regulations and have adopted minimum regulations pursuant to Texas Water Code requirements. Out of the 63 entities identified, a total of 32 entities have adopted higher standards according to the Texas Floodplain Management Association 2016 Higher Standards Survey.

Utilizing the data described above and combined with entity outreach efforts, a draft level of floodplain management practices was determined. The level of floodplain management practices was identified as ‘strong’, ‘moderate’, ‘low’, or ‘none’ based on the following criteria provided by the TWDB.

- ‘Strong’ Level – Significant regulations that exceed NFIP standard with enforcement, or community belongs to the Community Rating System
- ‘Moderate’ Level – Some higher standards adopted
- ‘Low’ Level – Regulations meet the minimum NFIP standards
- ‘None’– No floodplain management practices in place

Based on the above criteria, out of the 110 entities, 5 entities are classified as having a ‘strong’ level, 28 entities are classified as having a ‘moderate’ level, and 30 entities are classified as having a ‘low’ level of floodplain management practices. However, based on the above criteria, some of the ‘moderate’ level entities could be considered ‘strong’ level, further examination is needed as more data are collected. shows Floodplain management practices of the municipalities and counties in the SAFPR are shown in Figure 1-15.

Figure 1-16. Levels of Floodplain Management Practices in the SAFPR



1.9 Flood Risk 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 elevations, 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:

- **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 requirements 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 (CIP) identify capital project alternatives for an entity, provide economic analysis for alternatives, and often rank alternatives based on feasibility. The City of San Antonio has completed drainage master plans to develop a drainage CIP organizing future projects.

Local regulations and development codes, as well as their prevalence in the SAFPR, are discussed in detail in Chapter 3.

1.10 Agricultural and Natural Resources Impacted by Flooding

1.10.1 Farming

Flooding or excess precipitation can cause delays in, and reduction of, crop harvest and can erode sediment and nutrients resulting in partial or sometimes complete 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 SAFPR have varying resiliency to excess precipitation and prolonged ground inundation. Permanent crops, such as trees, tend to be more resilient to excess precipitation and ground inundation than row crops, such as corn or cotton. In the SAFPR, row crops comprise most of the farming production. Heavy rain before planting can delay planting or prevent planting for the season. In addition, flooding damages can occur after crops such as cotton or hay have been harvested but not bailed or processed.

1.10.2 Ranching

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 goats5. Flood events can cause delays in building back livestock herds. Flood damages to livestock silage can reduce livestock head counts.

1.10.3 Natural Resources

The SAFPR contains numerous natural resources that can be impacted by flood events, such as wildlife. 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.

However, in some ways, flooding can be a benefit for fields, wetlands, and 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 lands.

1.11 Existing Local and Regional Flood Plans

A list of previous flood studies considered by the SARFPG to be relevant to the development of the San Antonio RFP is provided in Table 1-12. 1 Previous Local and Regional Flood Plans

Table 1-12. 1 Previous Local and Regional Flood Plans

Previous and Relevant Flood Study	Description	Jurisdictions Covered	Counties	Year
Base Level Engineering	BLE is an efficient modeling and mapping approach that aims to provide technically credible flood hazard data at various geographic scales such as community, county, watershed, and/or state level. These data are meant to complement the current effective FIRM data, but not replace it.	All jurisdictions within the SAFPR	Bandera, Bexar, Karnes, Kendall, Kerr, Goliad, Refugio, Wilson, Medina, Victoria, DeWitt, Atascosa, Aransas, Guadalupe, Calhoun, Comal	Ongoing

5 https://www.mla.com.au/research-and-development/dealing-with-natural-disasters/flood-recovery/. Accessed on March 18, 2022.

Previous and Relevant Flood Study	Description	Jurisdictions Covered	Counties	Year
City of Boerne Drainage Master Plan	The City of Boerne updated their drainage masterplan and updated development Code Changes.	City of Boerne	Kendall	2021
Upper Cibolo Risk MAP Study	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the SAFPR in the Upper Cibolo watershed. The results are being incorporated into the draft National Flood Hazard Layer (NHFL).	City of Bulverde, City of Boerne, City of Fair Oaks Ranch, City of San Antonio, Bandera County, Bexar County, Comal County, Kendall County	Bandera, Bexar, Comal, Kendall	2021
Lower San Antonio Risk MAP Study	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the SAFPR in the Upper Cibolo watershed. The results are being incorporated into the draft National Flood Hazard Layer (NHFL).	City of Floresville, City of Kenedy, City of Runge, City of Northeim, City of Goliad, City of Falls City, City of Karnes, City of Poth, City of San Antonio, Bexar County, Dewitt County, Wilson County, Karnes County, Goliad County	Bexar, Guadalupe, DeWitt, Wilson, Karnes, Goliad	2021
San Geronimo Risk MAP Study	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the SAFPR in the San Geronimo watershed. The results are being incorporated into the draft National Flood Hazard Layer (NHFL).	City of San Antonio, Bandera County, Bexar County, Medina County	Bandera, Bexar, Medina	2021

Flood Study	Description	Jurisdictions	Counties	Year
Coastal Resiliency Master Plan	Developed by the Texas General Land Office (GLO), the 2019 Texas Coastal Resiliency Master Plan is the second installment of a statewide plan to protect and promote a vibrant and resilient Texas coast that supports and sustains a strong economy and healthy environment for all who live, work, play or otherwise benefit from the natural resources and infrastructure along the Texas coast.	All jurisdictions within the Texas Coastal Counties	Aransas, Refugio,	2020
Aransas County Multi-Jurisdictional Floodplain Management Plan	The focus of the mitigation action plan is to reduce future losses within Aransas County by identifying mitigation strategies based on a detailed hazard risk analysis, including both an assessment of regional hazards and vulnerability. The mitigation strategies seek to identify potential loss-reduction opportunities. The goal of this effort is to work towards more disaster-resistant and resilient communities throughout Aransas County.	Aransas County	Aransas	2020

Flood Study	Description	Jurisdictions	Counties	Year
Calaveras Risk MAP Study	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the San Antonio River Basin in the Calaveras watershed. The results have been incorporated into the preliminary National Flood Hazard Layer (NHFL). FEMA's Flood Datasets are available through the **Map Service Center** **.** Flood risk data can be viewed on the **SARA Risk MAP Viewer** .	City of China Grove, City of Elmendorf, City of San Antonio, Bexar County, Wilson County	Bexar, Wilson	2019
Bandera County River Authority and Groundwater District Flood Plan	The Bandera County River Authority and Groundwater District (BCRAGD) Flood Plan defines lines of communication, personnel assignments, safety, special flood conditions and post-flood operations for Bandera County.	All jurisdictions within the BCRAGD	Bandera	2019

Flood Study	Description	Jurisdictions	Counties	Year
Development of Flood Warning Tool Set for Medina River, Bandera County (TWDB Final Report: Contract No. 1600012035)	The study area encompassed a 23-mile reach of the Medina River from the confluence of Winans Creek to English Crossing Road above Medina Lake. The USGS developed a Hydrologic Engineering Center River Analysis System (HEC-RAS) model, which applied data from existing streamflow-gaging stations and installed two additional 'stage only' streamflow gaging stations along the headwaters of the North and West Prongs of the Medina River. A flood atlas, consisting of a library of flood-inundation maps for a range of streamflow conditions, was developed and included on the **USGS Flood Inundation Mapping Program (FIMP) Website.** . The Flood Inundation Maps (FIMS) depict estimates of the areal extent and depth of flooding corresponding to selected water levels (stages) at the USGS streamflow-gaging station 08178880 Medina River at Bandera, Texas.	All jurisdictions within BCRAGD	Bandera	2019

Flood Study	Description	Jurisdictions	Counties	Year
Aransas County Texas Multi-Jurisdictional Hazard Mitigation Action Plan	Plan covering two counties, 8 cities, and 2 school districts. The purpose of the Plan is to minimize or eliminate long-term risks to human life and property from known hazards and to break the cycle of high cost disaster response and recovery within the planning area.	Aransas County	Aransas	2019
Medina Risk MAP Study	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the San Antonio River Basin in the Medina River watershed. The results have been incorporated into the effective National Flood Hazard Layer (NHFL). FEMA's Flood Datasets are available through the **Map Service Center** . Flood risk data can be viewed on the **SARA Risk MAP Viewer** .	City of Bandera, City of Castroville, Kerr County, Bandera County, Medina County	Bandera, Kendall, Kerr, Medina	2018
Hazard Identification, Risk Assessment and Consequence Analysis	The Hazard Identification Risk Assessment (HIRA) is the first step in evaluating natural and technological hazards that exist. It serves as a basis for the development plans, public education programs, responder training and exercises. It also lays foundation to begin mitigation efforts to minimize these identified potential threats.	Bexar County, City of San Antonio	Bexar	2017

Flood Study	Description	Jurisdictions	Counties	Year
City of San Antonio Local Drainage Master Plan	In 2016, SARA teamed with the CoSA to develop a Drainage Master Plan of previously documented potential projects within the city limits, in order to identify candidates for the 2017 bond program.	City of San Antonio	Bexar	2016
Bexar Risk MAP Study – Ft Sam Trib, Airport Trib, and UNT 1 to Martinez A	Floodplain physical map revisions based on updated hydrologic and hydraulic analysis within the San Antonio River Basin in the Medina River watershed. The results have been incorporated into the effective National Flood Hazard Layer (NHFL). FEMA's Flood Datasets are available through the **Map Service Center.** . Flood risk data can be viewed on the **SARA Risk MAP Viewer.** .	City of San Antonio, City of Terrell Hills, Bexar County	Bexar	2015

Flood Study	Description	Jurisdictions	Counties	Year
Holistic Watershed Masterplans	SARA has worked with partner agencies since 2009 to complete Watershed Master Plans for the Upper San Antonio River, Leon Creek, Salado Creek, Medina River, Lower San Antonio River, and Cibolo Creek watersheds. The Master Plans have two primary objectives: Identify needs and opportunities related to flood risk, water quality issues, low impact development, stream restoration, nature based park planning, mitigation banking, and conservation easements. Develop and assess proposed projects to address the identified needs and preserve identified opportunities. The **Watershed Master Plan Viewer** displays data produced in the various Master Plan reports, as well as other useful reference data. It is intended to be used as a visualization tool to assist the public, stakeholders, and decision-makers in understanding both watershed issues and potential solutions.	All jurisdictions within Bexar, Karnes, Wilson, and Goliad Counties	Bexar, Goliad, Karnes, Wilson	2009-2015

Flood Study	Description	Jurisdictions	Counties	Year
Bexar, Wilson, Karnes, and Goliad County-Wide 2010 FIS Studies	The FEMA NFHL data was digitized and updated with new terrain, survey, hydrologic, and hydraulic data. FEMA's Flood Datasets are available through the **Map Service Center**.	All jurisdictions within Bexar, Wilson, Karnes, and Goliad Counties	Bexar, Wilson, Karnes, Goliad	2010
Alamo Area Council of Governments Regional MutiHazard Mitigation Plan	In 2005, CoSA and Bexar County participated in the development of the Alamo Area Council of Government's (AACOG) Regional Multi-Hazard Mitigation Plan. This plan looked at a range of hazards and provided some basic risk and vulnerability information for those identified.	All jurisdictions within AACOG Area	Bexar, Kerr, Kendall, Comal, Bandera, Guadalupe, Medina, Atascosa, Wilson, Karnes	2005
City Master Plans	City Master Plans for the Cities of Boerne, Fair Oaks, Castroville, LaCoste, La Vernia, Floresville	City of Boerne, Fair Oaks, Castroville, LaCoste, La Vernia	Kendall, Bexar, Medina, Wilson	2020, 2021, 2022

1.12 Assessment of Existing Infrastructure

Background knowledge of the SAFPR's existing natural and structural flood infrastructure provides context in identifying strategies and flood planning recommendations throughout the planning process. This section details the natural flood mitigation features and major flood infrastructure in the SAFPR. Applicable natural features and infrastructure are summarized in Table 1-13.

Table 1-13. 2 Natural Features and Constructed Major Flood Infrastructure

Flood Infrastructure	Source / Description	Non-Functional / Deficient
***Natural Features*[6]**		
Rivers, Tributaries, and functioning floodplains	National Hydrography Dataset (NHD)	Functional

6 31 TAC §361.31 states that regional flood plans include a general description of the location, condition, and functionality of natural features and constructed major infrastructure within the FPR. Several of these do not exist within the SAFPR, including vegetated dunes; sea barriers, walls and revetments; and tidal barriers and gates

Functioning Floodplains	Floodplains from TWDB compiled ‘flood quilt’	Functional
Wetlands	National Wetland Inventory	Functional
Sinkholes	NHD	Unknown
Alluvial Fans	None known	n/a
Playa Lakes	None known	n/a
	Constructed Major Infrastructure	
Levees	USACE	Uncredited
Stormwater Tunnels	City of San Antonio	Functional
Stormwater Canals	None known	n/a
Dams that Provide Flood Protection	TCEQ, NRCS, and SARA	Functional
Detention and Retention Ponds	Numerous sources, including TCEQ and individual municipalities and counties	Unknown
Storm Drain Systems	individual municipalities and counties	Unknown

Existing flood infrastructure in the SAFPR consists of both natural features and constructed features, which are owned and managed by numerous entities, including both governmental entities and individual property owners. Flood infrastructure may include non-structural measures such as natural area preservation, buyout of repetitive flood loss properties, or flood warning systems, and includes major public infrastructure like flood control dams. The TWDB Flood Data Hub7 provides data to assist with identifying flood management infrastructure. The SAFPR’s geodatabase was populated with available information from the TWDB and other state and federal sources. The multiple data sources were reviewed and amended to include one data point per location if duplication occurred across datasets.

1.12.1 Natural Features

Urbanization and overuse of rangeland can reduce the permeability of soil making land less efficient at detaining stormwater and infiltration rainfall into the soil profile. In more urbanized areas, drainage infrastructure is designed to collect and concentrate stormwater, which can increase the velocity and intensity of runoff leading to higher and faster flood flow peaks.

As land fragmentation in some areas of the SAFPR increases due to urbanization, oil and gas development, and other factors, focused land management efforts will be necessary to continue to receive the flood control benefits provided by open land. The U.S. Army Corps of Engineers’ (USACE)program Engineering with Nature8 aims to bring natural and engineered processes together to deliver more efficient and sustainable projects. In the SAFPR, local, state, and federal governments manage local, state, and regional parks and lands, and wildlife management areas that form part of the region’s natural infrastructure.

7 https://www.twdb.texas.gov/flood/planning/data.asp, Accessed March 18, 2022.
8 https://ewn.erdc.dren.mil/, Accessed March 21, 2022.

When left in their natural state, open lands are typically efficient at managing rainfall. Rainfall is slowed by vegetation, which allows rainfall an opportunity to infiltrate into the soil. Rangeland performs this function effectively. However, rainfall on cropland may pool and runoff comparatively more quickly. Well-designed parklands in more urban areas can attain nearly the same rate of capture and detention of stormwater as lands in undeveloped areas. For engineered natural features to achieve flood mitigation effectively, they are often designed to form part of an interconnected network of open space containing predominantly natural areas, which is known as low impact development[9] or green infrastructure. These practices can be defined as replicating natural processes to capture stormwater runoff where even small changes in developed areas can lessen downstream flooding.

Rivers, Tributaries and Functioning Floodplains

Streams and rivers and their associated floodplains have the natural flood storage capacity to contribute significantly to overall flood control and management. The natural hydrologic features operate as a single integrated natural system. When this system is disrupted, effects can cascade through the watershed, increasing flood risk. Floodplain maintenance in an undeveloped state provides rivers and streams the ability to store the maximum volume of floodwater and reduce flood peak volumes. Preservation of a natural integrated system of waterways and floodplains serves a valuable function in urban areas, as well.

With a length of approximately 240 miles, the San Antonio River is a tributary of the Guadalupe River and the main stream within the SAFPR. The San Antonio River's watershed drains an area of about 4,194 square miles. It flows generally southeast through Bexar, Wilson, Karnes, Goliad and Refugio counties before emptying into the Guadalupe River right before the combined rivers discharge into the San Antonio Bay. Other significant rivers and streams within the SAFPR include the Medina River, Cibolo Creek, and Salado Creek.

The SAFPR's lakes, reservoirs, parks, and preserves serve as important components of the ecosystem as they encompass a wide variety of plants, animals and physical features that are imperative for the continued ecological health of the region. These water bodies and natural areas retain water during flood events. These types of natural flood infrastructure are generally located in or close to floodplain areas throughout the basin with higher concentrations of them being located along or close to the major rivers and tributaries.

Karst Features

Recharge-related sinkhole flooding, flow-related flooding, and discharge-related flooding are associated with karst topography. Rapid urban development on karst usually increases the mass on the land surface, which increases the chance of collapse through sinkholes. Even if there are no sinkholes visible in a karst region, continuing karstic development under urban areas can affect building foundations. In addition, impervious paved surfaces in urban areas can block infiltration, altering native groundwater flow paths. In some situations, karst features can rapidly infiltrate surface flood waters and

9 https://lowimpactdevelopment.org/, Accessed March 21, 2022.

provide flood reduction capabilities. Water quality control measures and flood management should occur simultaneously to prevent groundwater contamination.

1.12.2 Constructed Flood Infrastructure

Major constructed flood infrastructure can range from dams and levees to municipal drainage systems, which consist of constructed channels and storm drain systems. Dams, Reservoirs, Levees, and Weirs

Impounded water features such as reservoirs serve many purposes including flood risk reduction, recreation, and water supply for municipal, industrial, irrigation, and fire protection purposes. Three major reservoirs (greater than 5,000 acre-feet storage capacity) are located in the SAFPR, as shown in Table 1-13.

Table 1-14. Major reservoirs in the SAFPR

Reservoir	Location
Calaveras Lake	Bexar County, 20 miles southeast of downtown San Antonio
Medina Lake	Medina and Bandera County, approx. 12 miles southeast of the City of Bandera
Victor Braunig Lake	Bexar County, 17 miles south of downtown San Antonio

Additional dams on smaller tributaries exist across the SAFPR and were identified from several sources, including the Texas State Soil and Water Conservation Board (TWSSWB), the Texas Commission on Environmental Quality (TCEQ), and the USACE. Several dams were designed and constructed by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), and although not available in the readily available documentation, the function of these dams often was for flood control. All identified dams have been included as part of the SAFPR’s infrastructure inventory.

No individual weir structures constructed for flood control purposes were identified in the SAFPR.

Levees are man-made embankments that artificially contain flood flows to a restricted floodplain. More than one million Texans and $127 billion dollars’ worth of property are protected by levees, including 51 USACE levee systems. There are 8 levees located in the SAFPR, three of which are part of the Guadalupe River levee system, four are a part of the Refugio County levee system, and one is located in Victoria and Calhoun Counties.

Stormwater Management Systems

Stormwater management systems serve to manage both the quantity and quality of the water that drains into natural waterways. The TCEQ regulates the discharge of municipal separate storm sewer systems (MS4) through the two sets of permits administered under the Texas Pollutant Discharge Elimination System (TPDES), known as Phase I (large and medium) or Phase II (small) MS4 permits. To be subject to MS4 permit requirements, a municipality must own and operate storm drainage infrastructure. Phase I MS4 requirements apply to incorporated cities that have populations exceeding 100,000 as of the 1990 census. Phase II MS4 requirements apply to all smaller “urbanized” areas as defined by the Bureau of the Census using either the 2000 or 2010 Census as containing 50,000 persons or more. In the SAFPR, San Antonio is under Phase I MS4 permit requirements, while some communities in Karnes and Wilson counties are subject to the Phase II MS4 permit requirements.

1.12.3 Assessment of Condition and Functionality of Existing Infrastructure

The general location, description, level of service, functionality, deficiency, and owning/operating entities for each identified natural flood mitigation features and constructed major flood infrastructure are summarized in Table 2 in Appendix A and the GIS geodatabase attached as Appendix B. Additional information for significant or deficient/non-functioned features or infrastructure are detailed in subsequent sections as necessary.

The TWDB defines infrastructure functionality as follows.

- Functional infrastructure is defined as serving its intended design level of service.
- Non-functional infrastructure is defined as not providing its intended or design level of service.
- Deficient is defined as infrastructure or natural features in poor structural or non-structural condition and needs replacement, restoration, or rehabilitation.

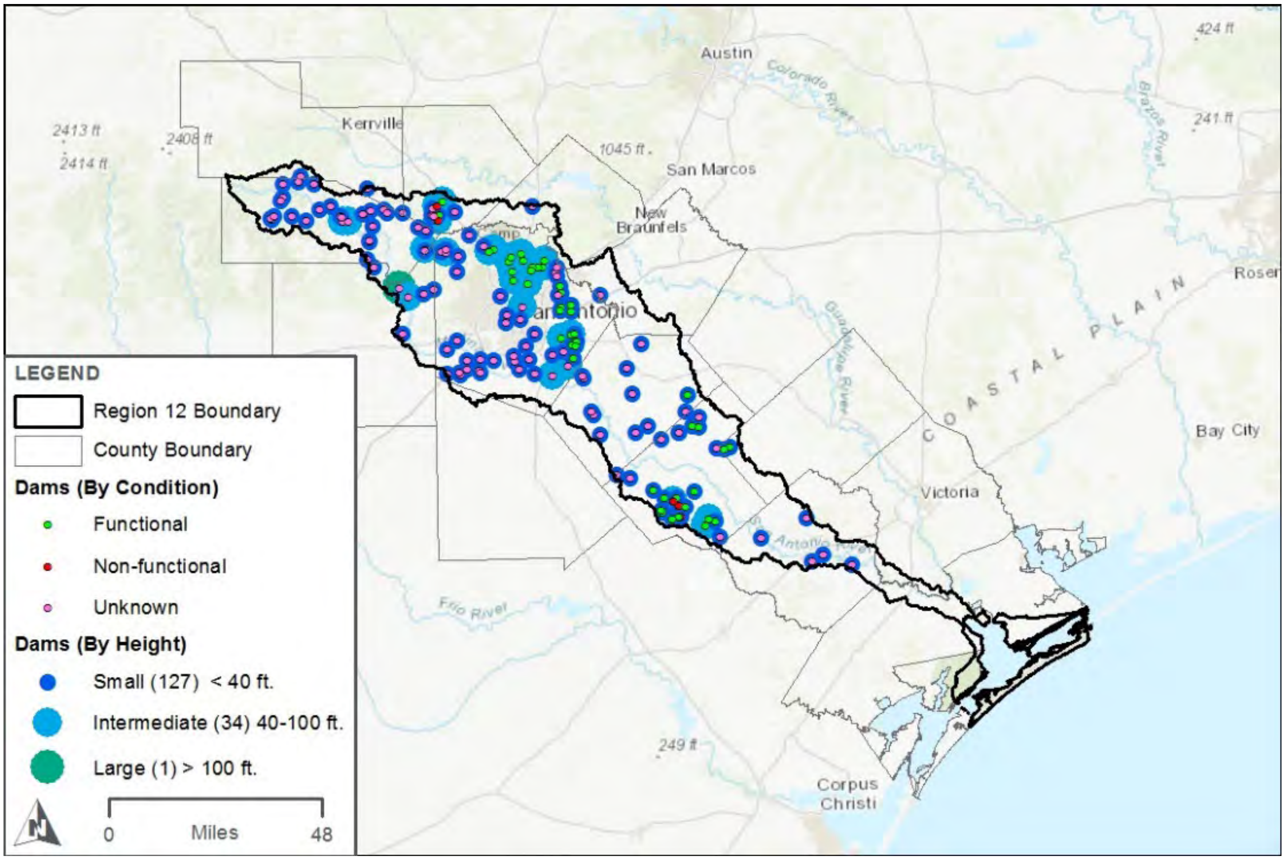
Non-Functional or Deficient

Information compiled and responses provided to stakeholder outreach has been limited to date. Two explanations for non-functional and deficient infrastructure include lack of funding for a stormwater utility and higher design standards adopted since the construction of existing stormwater drainage systems. Many municipalities lack a dedicated funding source for stormwater projects, operations, and maintenance; however, Texas state law provides a mechanism for municipalities to establish a dedicated revenue source for drainage through the implementation of a stormwater utility fee.

Dam Safety Assessment

In 2019, the Association of State Dam Safety Officials (ASDSO) estimated the cost to rehabilitate all non-federal dams in Texas at around $5 billion. The Texas State Soil & Water Conservation Board (TSSWCB) estimates about $2.1 billion is needed to repair or rehabilitate dams included in the Small Watershed Programs. A dam is classified as high hazard if its failure could cause significant loss of life, serious damage to structures, or disruption to important public utilities or transportation facilities. A dam’s hazard classification is not an assessment of condition. The TCEQ maintains condition data for non-federal dams as part of the Texas Dam Safety Program, however, however, information about the condition of many dams is not publicly available. Of the 7,200 non-federal dams in Texas, more than 3,200 are exempt from dam safety requirements, representing almost half of non-federal dams.

Figure 1-17. Dams Located in the SAFPR



1.12.4 Proposed or Ongoing Flood Mitigation Projects

Table 3 in Appendix A and the attached GIS database in Appendix B include a general description of the location, source of funding, and anticipated benefits of proposed or ongoing flood mitigation projects in the SAFPR including:

New structural flood mitigation projects currently under construction,

Non-structural flood mitigation projects currently being implemented, and

Structural and non-structural flood mitigation projects with dedicated funding to construct and the expected year of completion.

The data for this section are derived from two primary sources: the SAFPR's existing Hazard Mitigation Plans and a stakeholder survey. Gaps and limitations exist within the data. Overall, it only represents a small number of the communities within the basin and few data were provided on individual projects. Additional information for proposed or ongoing flood mitigation projects are detailed in subsequent sections as necessary.

Structural Projects under Construction

The cities of San Antonio, Schertz, and Cibolo have developed recent drainage master plans with lists of drainage capital improvement projects, some of which have been constructed and others that are still awaiting funding. Responses from other communities regarding projects under construction were insufficient to provide additional details regarding these projects. Chapter 4 provides a more detailed assessment of current and potential projects.

1.12.5 Implementation of Nonstructural Flood Mitigation Projects

Information obtained from stakeholder outreach has been limited to date. The top goal cited by respondents has been implementation of protective standards and policies, followed by identification and communication of flood risk, restoring failing infrastructure, and implementation of flood warnings and responses. Chapter 3 includes further information regarding the region’s goals and practices, and Chapter 4 describes implementation of nonstructural flood mitigation projects.

2

Flood Risk Analysis

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2 Flood Risk Analysis

The objective of this task was to perform a comprehensive flood risk analysis for the SAFPR. Flood risks were assessed for the 1% annual chance storm events and 0.2% annual chance storm events. The analysis was performed for existing conditions of the region, as well as a future condition scenario that considers changes in flood hazards over the 30-year planning horizon. The overall flood risk analysis is comprised of three separate but related evaluations, including:

1. Flood Hazard Analyses –characterize location, magnitude, and frequency of flooding;
2. Flood Exposure Analyses –identify who and what might be harmed within the region; and
3. Vulnerability Analyses –identify vulnerabilities of communities and critical facilities.

The following sections describe the process undertaken to determine and quantify flood hazards in the region and present the results of the evaluation, including a summary of the types and magnitude of flooding and the communities most susceptible to its harmful effects. TWDB-required Tables 4 and 5 summarize the quantitative results of this analysis by county within the region and are included as Appendix A.

2.1 Existing Condition Flood Risk Analysis

2.1.1 Existing Condition Flood Hazard Analysis

The purpose of the existing condition flood hazard analysis was to identify and compile a comprehensive outlook of existing flood hazards in the region. To date, no full-coverage evaluation of flood risk has ever taken place in the SAFPR or in the State of Texas. It should be noted that extensive mapping has occurred in the region, and only two tributaries around the City of Boerne were identified as having insufficient mapping data.

The output of the flood hazard analysis is a map of flood hazard areas that are subject to several types of flooding during the 1% and 0.2% annual chance storm events. This effort is not regulatory in nature, and the results of this evaluation do not have an impact on NFIP insurance requirements or premiums. Rather, this exercise is intended to gather a single, comprehensive set of best available information on actual flood risk in the region to help communities understand their current risks and better prepare in the event of a flood.

Types of Flood Hazards in the Region

To plan for a flood, it is important to understand the types of flooding an area faces. Each type of flooding is different in how it occurs, how it is forecast, and the damages it can cause. This evaluation considered several different types of flooding in identifying the flood hazard areas.

Riverine Flooding: Riverine flooding is caused by bank overtopping when the flow capacity of rivers is exceeded. Rising water generally originates from high-intensity rainfall creating soil saturation and large volumes of runoff to the receiving waters, either locally and/or in upstream watershed areas.

Pluvial Flooding: Pluvial floods can occur when the inflow of stormwater exceeds the capacity of drainage natural and manmade drainage systems, causing flooding of streets, property, and nearby structures. One of the common misconceptions about flooding is that you must be located near a body of water to be at risk. Yet pluvial, or surface floods are not caused by swelling rivers. Pluvial flooding as defined in this plan normally occurs in urban environments. Pluvial flooding also includes flash floods, where high velocity surface waters sweep through low-lying areas.

Coastal Flooding: Coastal flooding occurs when normally dry, low-lying land is flooded by seawater.

Playa Flooding: Playa flooding occurs when playas overtop and flood surrounding areas.

Possible Flood Prone Areas:

This analysis also considers potentially flood-prone areas that the San Antonio RFPG identifies outside of previously mapped flood hazard areas. They can be identified through the location of hydrologic features, historic flooding, and/or local knowledge. Since the cause and recurrence of flooding in these areas is uncertain, separate flood hazard areas have been developed and are listed with “unknown” flood frequency in this analysis.

The region is subject to the danger of swift-moving flood waters in riverine areas due to the steepness of the land and narrow channels. This causes fast moving deep flood waters that cause costly destruction to communities and infrastructure in low-lying areas. Pluvial flooding, or urban flooding, is also a source of significant flooding exposure, particularly in the cities of San Antonio, Boerne, Bandera, and Karnes City.

Additionally, possible flood prone areas were identified through multiple sources of data. The first was through identification of the region’s low water crossings compared to known flood hazard areas. Those areas which had low-lying roads intersecting waterways would be considered low water crossings. There were 498 low water crossings defined in the SAFPR. Low-water crossing points outside of the 1% and 0.2% annual chance storm event flood hazard area were delineated as possible flood prone areas, since their status as low water crossings indicates that there is likely flood risk at these locations, even if it is not mapped.

The second source of data was comments on an ArcGIS Online web map where the public could report areas of flooding. This web-based map was shared on the San Antonio RFPG website, as well as emailed to community officials in the region. Points that were outside of the 1% and 0.2% annual chance storm event flood hazard area were delineated as possible flood-prone areas based on the description included in the comment.

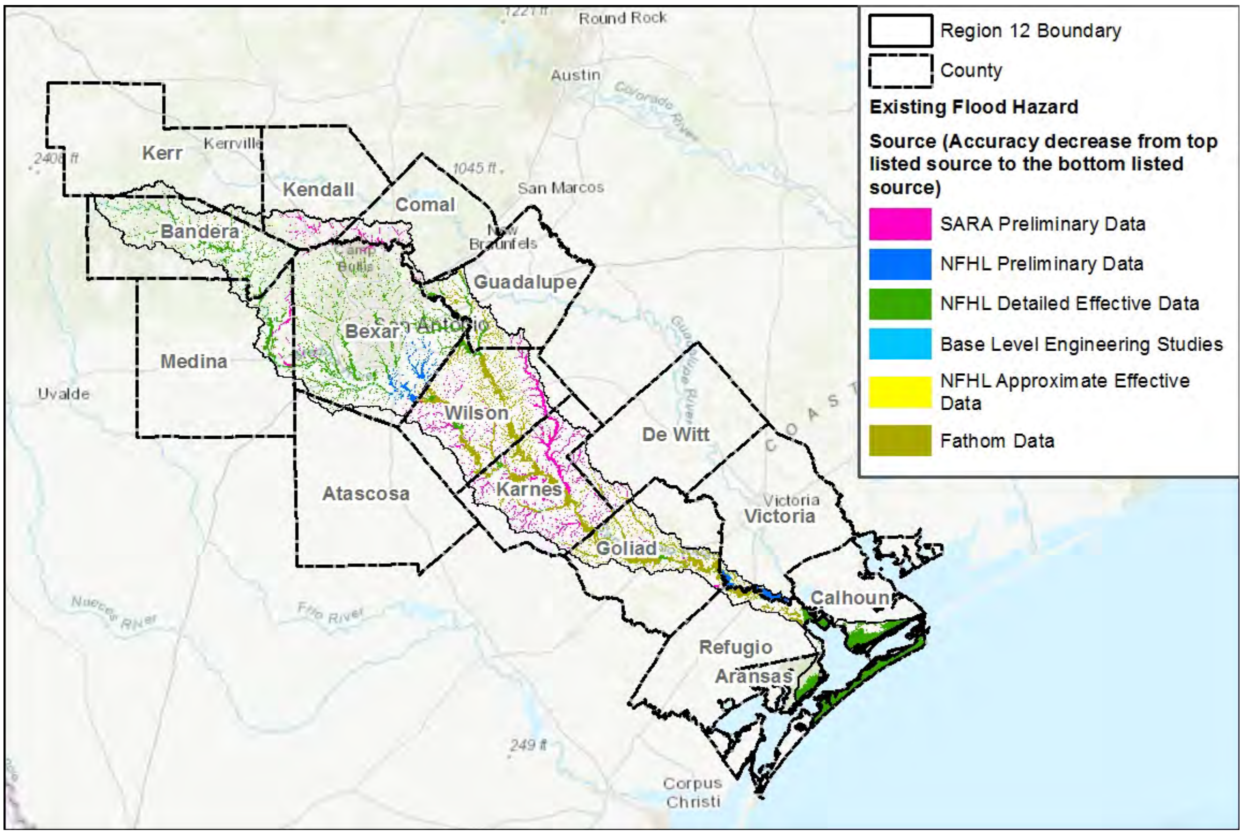
The third source of data was the historical flood data for the SAFPR that was gathered through a variety of local and national entities. United States Geological Survey (USGS) gage information was used to identify flood prone areas and evaluate historical flood events based on flow surges. Other historical flood data was pulled from National

Weather Service, FEMA, TxDOT, publications on historical flood events, and City of San Antonio 311 complaints. These sources provided areas of concern, project areas, and past flood data. This data was used to map out previous and updated flood risk areas, as well as determine the damage cost from major past storm flooding events.

Existing Hydrologic & Hydraulic Model Availability

The development of the flood hazard areas relied on floodplain modeling and mapping information from existing sources from all the counties in the SAFPR, rather than the development of new flood hazard information. Hydrologic and hydraulic models used for the purposes of defining flood risk boundaries are available for the entire region, as summarized in Figure 2-1 below.

Figure 2-1. Existing Flood Model Data



Best Available Data Determination

To assist RFPGs with the flood hazard analysis, the TWDB prepared a statewide, GIS dataset that is comprised of the most recent flood hazard data in Texas, referred to as the "floodplain quilt." The floodplain quilt "quilts" together data from several sources, including First American Flood Data Services (FAFDS) flood zone determinations, FEMA National Flood Hazard Layer (NFHL) information developed from detailed and approximate flood studies, and FEMA Base Level Engineering (BLE) data.

The 1% and 0.2% annual chance storm event flood risk boundaries were defined for all waterways with contributing drainage areas larger than one-tenth square mile for the entire basin. This complete coverage was due in part to the availability of 'Fathom' flood risk boundaries for the entire basin. Where multiple data sets were available, the most accurate risk boundaries were applied. The 'floodplain quilt' was obtained from TWDB. The 'floodplain quilt' does not typically include localized flooding or complex urban flooding problems. Additionally, new preliminary inundation boundaries were obtained from SARA, which is currently the only detailed flood data that uses the latest National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall. In addition, flood prone areas identified through public comments will be evaluated as the data becomes available. As of July 8, 2022 there has been 65 comments received.

The following list summarizes the various flood inundation data sets used in their order of accuracy from most accurate to least accurate, with data sets including the BLE data and above considered accurate.

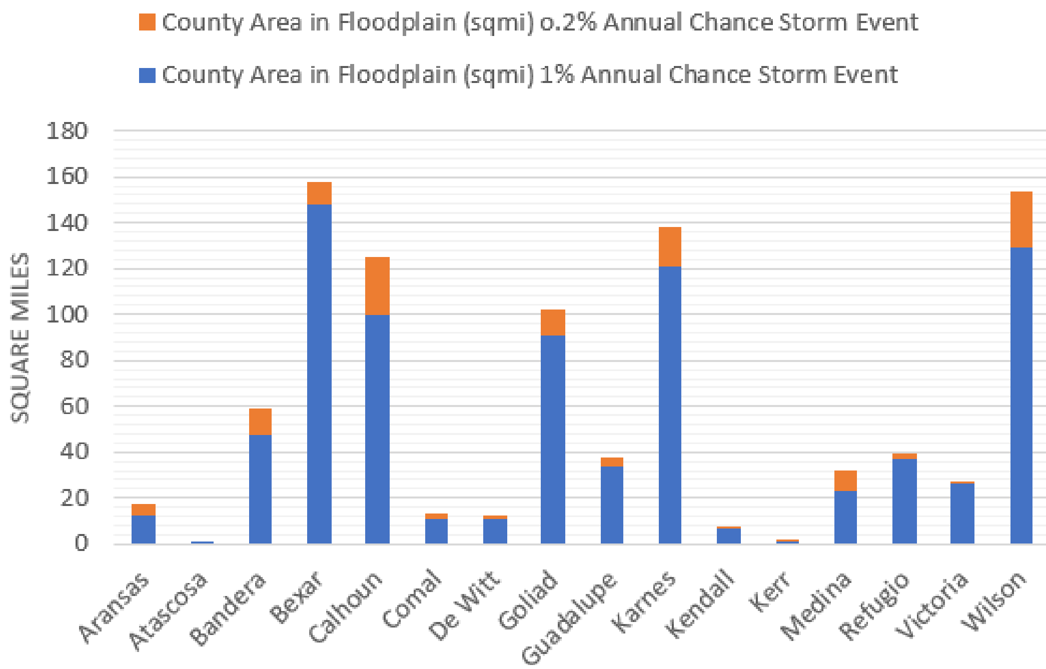
1. SARA Preliminary Data (Submitted to FEMA for review)
2. NFHL Preliminary Data
3. NFHL Detailed Effective Data
4. Base Level Engineering Studies
5. NFHL Approximate Study Areas
6. Fathom Draft Data – October 29th, 2021
7. Public Comments

A portion of the Regional Flood Planning Area contains 'approximate' 1.0% annual chance storm event flood inundation boundaries but no 0.2% annual chance storm event flood inundation boundaries (i.e. NFHL Approximate Study Areas). Thus, for these approximate areas, the Fathom 1.0% and 0.2% annual chance storm event data was used to define flood hazard extents. By the end of 2022, additional preliminary data will be provided by SARA and the entire San Antonio River basin will have complete BLE coverage. Therefore, existing flood hazard mapping will be updated in its entirety to include Preliminary, Detailed Effective or BLE quality data.

Identified Existing Flood Hazard Areas

Figure 2-2 shows the flood hazard area under existing conditions. Refer to Figure 1-8 to 1-11 in Chapter 1 for additional reference. These floodplains cover over 925 square miles, or 18% of the land area of SAFPR. Of the mapped flood hazard area, 800 square miles are inundated during the 1% annual chance storm event, and an additional 125 square miles are inundated during the 0.2% annual chance storm event. Figure 2-2 presents the total flood hazard area by county. Overall, the counties of Bexar, Wilson, and Karnes have the highest total flood hazard area, with over 400 square miles of flood hazard in these counties alone.

Figure 2-2.



2.2 Existing Conditions Data Gaps

As previously described, the majority of SAFPR has extensive mapping coverage. However, there were two identified tributaries around the City of Boerne that are not mapped. Besides those two, no other mapping gaps were present. This information is presented visually in Map 5 in Appendix A.

2.2.1 Existing Condition Flood Exposure Analysis

Once the existing condition flood hazard areas were defined by given model data, the existing condition flood exposure analysis was performed to identify the people and property at risk. This analysis was completed using an automated GIS process that intersected various data sources with the flood hazard area boundaries to create the various flood exposure feature classes for the different feature types. The analysis considered exposure of different types of existing development within the flood hazard area, including:

1. Buildings: including residential and non-residential structures, those structures identified as critical facilities, and the associated population at risk. The population at risk evaluated both the day and night population estimates for each structure, with the higher of the two values being used to estimate the population in the flood hazard area.
2. Roadways: including estimated number of road crossings and total roadway length inundated by flooding. Those road crossings identified as low water crossings were specifically identified, as these crossings are generally overtopped by floodwaters more frequently.

3. Agricultural Areas: including the total area of farming and ranching lands within the flood hazard area.

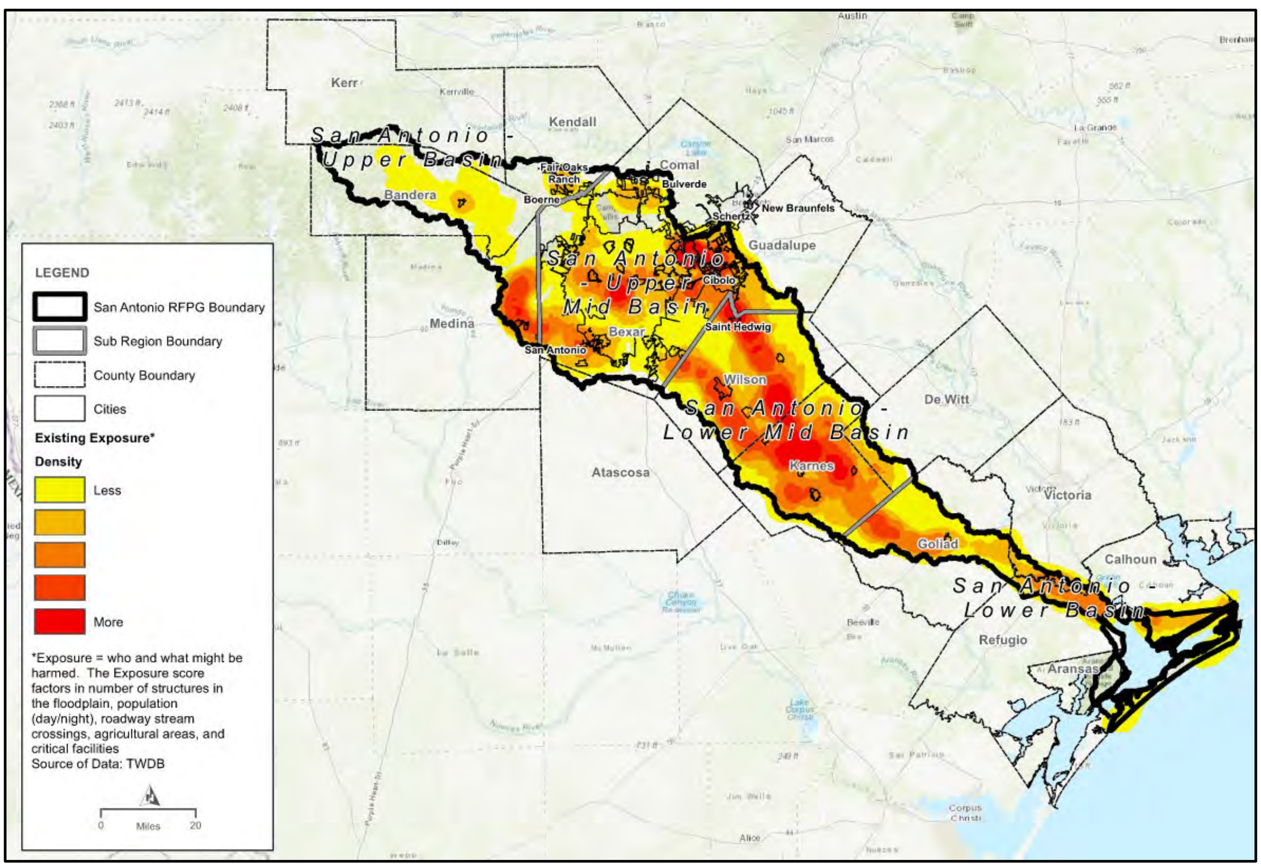
Flood Exposure Due to Existing Levees or Dams

The analysis also required the consideration of population and property located in areas where existing levees or dams do not meet FEMA accreditation as inundated by flooding without those structures in place. Of the four levee systems, three are identified as not meeting FEMA accreditations and one is unknown. However, it is assumed that the current floodplain limits properly reflect the flood protection benefits of these structures.

Existing Flood Exposure Summary

The following sections describe the results of the existing flood exposure analysis with a summary table following. From this analysis several hot spots for flood exposure appear to be (1) the urban areas around the Cibolo and Medina Rivers due to the density of development and total population in those areas and (2) and the confluence of the San Antonio and Cibolo Rivers due to the magnitude of flood volume on each respective creek and similarity in watershed size. Additionally, flooded roadways and agricultural areas are found throughout the region, and the impacts due to the loss of function in these areas should not be understated. A heat map was produced to illustrate the flood exposure in the SAFPR as shown in the Figure 2-3 below.

Figure 2-3. Existing Exposure Heat Map



Residential Properties

The number of residential structures within the floodplain for the SAFPR are relatively higher than surrounding regions due to the SAFPR being highly urbanized with dense residential areas. There are 13,684 residential structures in the 1% annual chance storm event floodplain and an additional 5,519 residential structures contained within the 0.2% annual chance storm event floodplain. This large number can be attributed to the region containing the heavily populated San Antonio area, containing 10,204 residential structures in the 1% and 0.2% annual chance storm event floodplain. The number of residential properties in the existing flood hazard area by county is summarized in Table 2-1.

Non-Residential Properties

Non-residential properties are properties, public and private, that are not used as permanent residential dwellings. Non-residential properties within the flood hazard area follow a similar exposure pattern as residential structures. Out of the 16 counties that have area in the SAFPR, 15 counties have non-residential structures in the floodplain. There are 7,430 total non-residential structures in the floodplain. The number of non-residential structures by county in the existing flood hazard area is summarized in Table 1.

Public Infrastructure

Public infrastructure is a broad term that includes roads; public water collection, treatment, and distribution facilities; gas and electrical facilities; and other public utilities. These facilities often perform essential functions that require enhanced levels of flood protection so that they may continue to function and provide services during and after a flood event. As a result, a concentrated effort to identify “critical facilities” was performed in the flood exposure analyses. Examples of critical facilities include hospitals, fire stations, police stations, power generation facilities, and schools. Table 2-1 below shows critical infrastructure located within the SAFPR in relation to the 1% and 0.2% annual chance flood events.

Roadway impacts are also evaluated through the length of roadway in floodplain and the amount of roadway crossings effected as summarized in Table 2-1. Flooded roadways pose a substantial risk to motorists, as over half of all flood-related drownings occur when vehicles are driven into hazardous flood waters. Functioning roadways serve a critical function during flood events, providing access to first responders and clear routes to safety in the case of an evacuation.

Other impacts to public infrastructure are not specifically quantified in this analysis, due to the lack of publicly available data for most of these infrastructure types. However, some general impacts and expected loss of function for these infrastructure types are outlined in the Expected Loss of Function Section.

MAJOR INDUSTRIAL AND POWER GENERATION FACILITIES

There are 87 buildings in the 1% and 0.2% annual chance existing flood hazard that are marked as industrial facilities, none are classified as critical. Within the flood hazard area, there are 14 facilities associated with power generation. All 14 power generation facilities are marked as critical.

CRITICAL FACILITIES

There are 220 critical facilities total within the existing flood hazard area, 78% of which are in Bexar, Comal and Guadalupe Counties. The two most common types of facilities within the flood hazard area are schools and Department of Defense (DOD) Military Facilities. Total critical facilities by county are summarized Table 2-1.

ROADWAY CROSSINGS

There are large amounts of urbanized areas in the SAFPR leading to 2,903 crossings being in the flood risk area. There is a vast network of rivers and tributaries, meaning several major river crossings are found along these transportation corridors.

ROADWAY SEGMENTS

Bandera, Bexar, Guadalupe, Karnes, and Wilson all have over 60 miles of road segment in the existing flood hazard area. Every county has over 1 mile of road segment that is in the flood hazard area totaling 967 miles in the SAFPR. Most of the roadway segments affected are in Bexar County due to the San Antonio Metropolitan area.

AGRICULTURAL AREAS

The county with the most agricultural areas within the floodplain is Karnes County, with a little over 22 square miles out of the total 98 square miles. Bexar, Goliad, and Wilson Counties have over 10 square miles of agricultural area as well. All the remaining counties have much smaller amounts of agricultural areas within the floodplain (most less than 1 square mile).

To evaluate the value of land exposed, average values for agricultural land in Texas were identified using the from the 2020 United States Department of Agriculture (USDA) Land Values Summary. This summary included an average value of $1,980/ac for non-irrigated cropland and $1,680/ac for pasture. Within the entire region, there are 2,326 square miles of cropland and 6,324 square miles of ranchland. From these values, a weighted average cost for agricultural land was identified as $1,760/ac. Within the entire flood hazard area, there is about 5.5 million acres, or $9.7 billion of crops and pasture exposed.

Table 2-1. Summary of Structures in the Existing Flood Hazard Areas

County	1% Annual Chance Flood Risk									
	Area in Floodplain (sqmi)	Number of Structures in Floodplain	Residential Structures in Floodplain	Population (daytime)	Population (nightime)	Population	Roadway Crossings (#)	Roadways Segments (miles)	Agricultural Areas (sqmi)	Critical Facilities (#)
Aransas	12.217	0	0	0	0	0	0	7.477	0.016	0
Atascosa	0.962	57	51	32	95	95	14	2.205	0.045	0
Bandera	47.944	938	567	788	1027	1463	225	61.398	1.105	1
Bexar	148.206	11261	8309	52003	31084	73524	1261	353.048	10.087	95
Calhoun	99.621	929	688	310	640	728	11	14.475	1.002	2
Comal	10.877	363	269	817	426	1113	63	15.022	0.503	34
De Witt	10.927	22	6	3	8	9	52	6.976	0.483	0
Goliad	91.113	177	62	102	204	216	117	30.113	12.497	0
Guadalupe	33.497	2239	1768	8128	5336	11783	153	65.287	4.876	42
Karnes	120.558	336	161	195	422	524	284	58.800	22.649	0
Kendall	6.970	628	398	1812	1650	2904	56	12.465	0.067	5
Kerr	1.267	20	8	6	17	17	7	1.053	0.034	0
Medina	23.166	478	299	401	550	778	79	20.457	5.024	1
Refugio	37.193	163	67	101	166	184	10	10.128	2.712	1
Victoria	26.582	30	11	9	19	22	9	5.101	1.858	1
Wilson	129.100	1459	1020	1449	1823	2797	392	89.064	16.790	9
TOTAL	800.20	19100	13684	66156	43467	96157	2733	753.07	79.75	191
County	0.2% Annual Chance Flood Risk									
	Area in Floodplain (sqmi)	Number of Structures in Floodplain	Residential Structures in Floodplain	Population (daytime)	Population (nightime)	Population	Roadway Crossings (#)	Roadways Segments (miles)	Agricultural Areas (sqmi)	Critical Facilities (#)
Aransas	5.574	0	0	0	0	0	0	5.592	0.017	0
Atascosa	0.000	0	0	0	0	0	0	0.000	0.000	0
Bandera	10.705	663	290	551	637	967	20	20.348	0.179	4
Bexar	9.328	2347	1895	7839	5583	11781	25	44.710	1.762	8
Calhoun	25.328	604	457	338	316	572	13	18.604	0.785	2
Comal	2.121	286	238	665	323	897	6	4.639	0.097	0
De Witt	1.556	25	8	3	9	9	5	1.412	0.077	0
Goliad	11.125	110	33	56	130	138	5	8.297	1.297	0
Guadalupe	4.080	1570	1355	8080	5882	12298	8	20.323	0.765	3
Karnes	17.822	227	94	123	172	237	50	27.294	3.222	0
Kendall	0.826	333	208	2510	707	2967	0	4.626	0.027	5
Kerr	0.348	14	2	0	6	6	0	0.239	0.006	0
Medina	8.525	751	553	1603	1104	2338	3	20.828	4.217	5
Refugio	1.894	16	2	8	22	23	1	2.096	0.444	0
Victoria	0.998	7	3	1	2	2	0	0.557	0.048	0
Wilson	24.111	580	381	370	799	960	34	34.763	5.197	2
TOTAL	124.34	7533	5519	22147	15692	33195	170	214.33	18.14	29
Combined Flood Risk Total	**924.54**	**26633**	**19203**	**88303**	**59159**	**129352**	**2903**	**967**	**98**	**220**

Expected Loss of Function

The impacts of flooding on lives and livelihoods are often felt not just during a flood event but long afterwards. As communities assess damages after a flood, several different types of impacts must be evaluated. Historical flood impacts, including dollar values of damages and known injuries and losses of life are quantified in Chapter 1. This section presents a qualitative assessment of the types of flood impacts and the expected losses of function in both the public and private sectors.

Inundated Structures

Structural flooding can be devastating to property owners and communities as a whole. Structural flooding can cause water damage to the building as well as the contents inside. Often, this leads to costs due to families being displaced from their homes. Businesses may also lose inventory that is damaged during a flood and may not be able to operate while repairs are being made. In extreme cases, the flood damages can be so severe that the structure and contents constitute a total loss. These impacts are lessened at lower flood elevations, which is why it's important to consider depth when evaluating flood impacts on structures.

Health and Human Services

Health impacts from flooding can be both direct and indirect. The two-thirds of flood-related deaths worldwide are due to drowning, but other impacts can also have negative implications for human health (World Health Organization, 2014). Direct effects of flooding include heart attacks, drowning from travelling through flood waters, injuries from flood conditions, and disease. Indirect impacts include damage to health care infrastructure, water shortages and contamination, disruption of food supplies, population displacement, and disruption of livelihoods (World Health Organization, 2014). Hospital preparedness is important during flooding. Natural disasters can cause both damage to existing infrastructure and increase the number of patients who need assistance (World Health Organization, 2014).

Water Supply and Wastewater Treatment

Water treatment plants can be particularly at-risk during flooding events, as many are located next to rivers or other water sources. Failure of water supply systems results in both direct costs (repairing pipes, contamination of the network) and indirect costs (service disruptions impacting people outside of flood waters) (Arrighi, Tarani, Vicario, & Castelli, 2017). The indirect impacts can reach up to three times as many people as were directly flooded (Arrighi, Tarani, Vicario, & Castelli, 2017).

There are also several impacts from flooding on wastewater systems. For houses using septic tanks, sewage can be carried back into the house through piping in some flood events, which will cause physical damage and could introduce disease-causing bacteria and viruses (Heger & Anderson, 2018). This is particularly a concern in rural areas that often do not have a community wastewater collection system. Flooding can also damage the wastewater system, and if untreated wastewater is released, there can be environmental and water-quality damage (Heger & Anderson, 2018). Wastewater treatment plants can be impacted by flooding through loss of power, damage to the plant, and personnel being unable to safely reach the plant (Nielsen, 2018). If systems are damaged in a flood, people can be left without adequate wastewater management systems until they can be repaired.

(Add local example; Bandera and La Vernia Wastewater Treatment Plant)

Utilities and Energy Generation

Damage to power lines and electricity distribution equipment from floating debris and inundation are some of the direct impacts of flooding on utilities and energy (U.S. Environmental Protection Agency, n.d.). Due to road impacts, maintenance and repair can also be delayed (U.S. Environmental Protection Agency, n.d.). Electricity disruptions have impacts on other aspects of energy production as well, as oil and gas pipeline disruptions are often due to power outages after severe weather events ((U.S. Environmental Protection Agency, n.d.).

Transportation and Emergency Services

Flooding can cause immediate impacts to transportation systems by causing delays or disruptions due to inundated and damaged infrastructure (Rebally, Valeo, He, & Saidi, 2021). On a greater scale, these conditions impact the economics of the region. Due to roads being unsafe for travel, closed, or submerged, connectivity is reduced, deviated, or cancelled for people, goods, and services (Rebally, Valeo, He, & Saidi, 2021). For these reasons, flood impacts on transportation infrastructure have consequences throughout the region, in both flooded and dry areas.

Flooding has a negative impact on emergency services. Due to inaccessible roads and increased traffic congestions, it can take a longer time to get to people in need (Loughborough University, 2020). Within England, researchers found that 84% of the population can be reached with 7-minutes for emergency situations, however, in a 30-year flood scenario, it drops to 70%, and in a 100-year event, it drops even lower to 61% (Loughborough University, 2020).

(add local example; US 281 being closed due to Olmos Dam backing up water during May 2013 event and 98 flood)

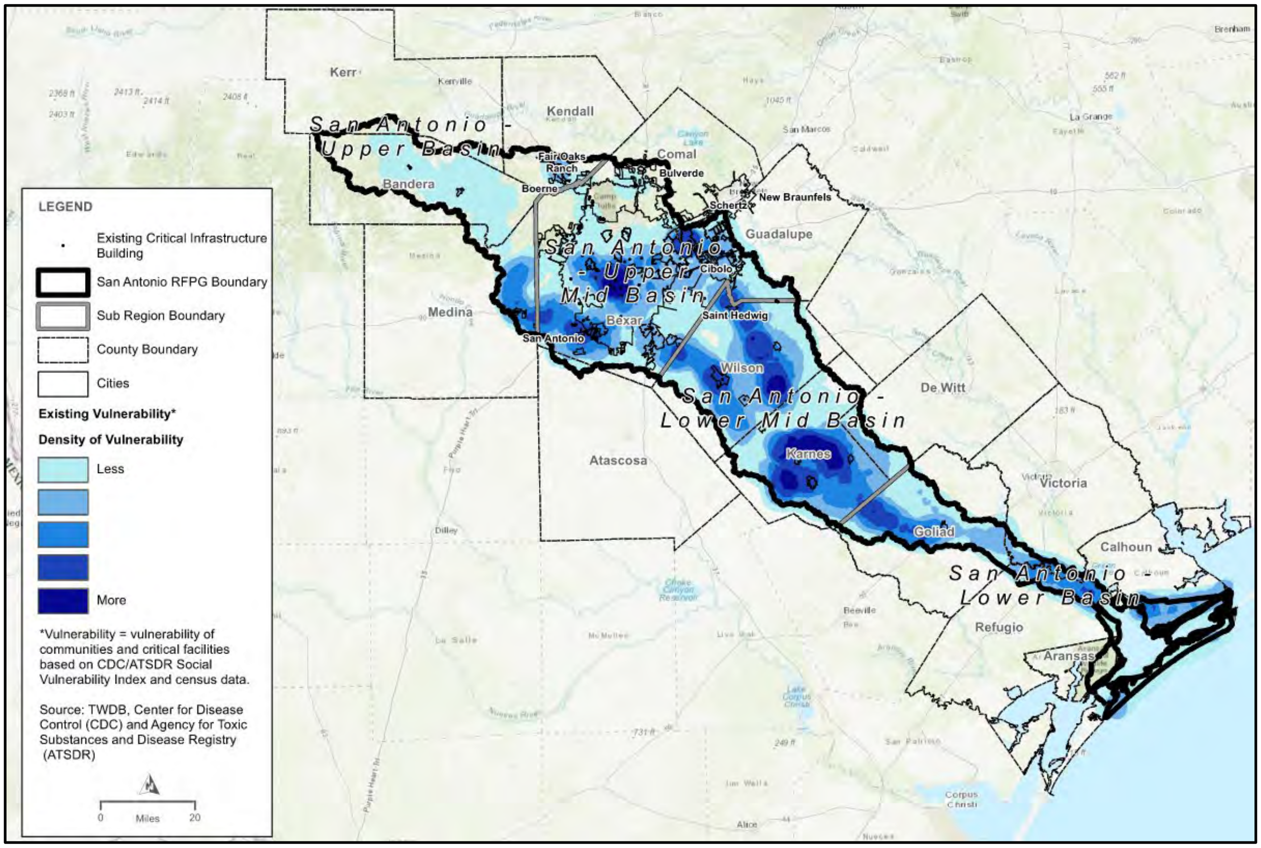
2.2.2 Existing Conditions Vulnerability Analysis

After completing the flood exposure analysis, the populations and structures exposed to flooding within the identified flood hazard area were analyzed to determine their vulnerability to flooding. Vulnerability was assessed using the SVI scale. Several factors are evaluated to determine an area's Social Vulnerability, which measures a person's or group's "capacity to anticipate, cope with, resist and recover from the impacts of a natural hazard," based on their relative vulnerability. The Social Vulnerability Index (SVI) is a standard system developed by the Centers for Disease Control for assigning a Social Vulnerability score at a census-tract basis. SVI is provided as a decimal value from 0.00 to 1.00; the higher the SVI, the more assistance a community is likely to need. Knowledge of a community's SVI allows planners to better prepare for emergency events ranging from disease outbreaks, hurricanes, and exposure to dangerous chemicals. A score of 0.75 or greater indicates that a community is highly vulnerable to impacts from a natural disaster.

TWDB provided a building dataset that included SVI values for each building. SVI was also assigned to the other exposure features (low water crossings, critical infrastructure, etc.) based on the average SVI of the surrounding census tract. Based on the exposure features in the existing condition flood hazard area, an average SVI of the exposed area was computed for each county. Using these results, vulnerable portions of the region were identified.

The results of the analysis are summarized in Figure 2-4. The potential effects from flooding could be higher in areas of high SVI value and critical infrastructure due to damage to the infrastructure and potential lack of services after the flooding event.

Figure 2-4. Existing Vulnerability



2.3 Future Condition Flood Risk Analysis

In addition to quantifying the current flood risk, it is helpful to consider the change in flood risk over the course of the planning horizon to help communities plan ahead for new or increased risks. With this concept in mind, a future condition flood risk analysis was performed for the SAFPR.

The future condition flood risk analysis included two components: projected increases in flood hazard and additional exposure/vulnerability. The first step was to define a future flood hazard area boundary to identify areas of existing development that, while not currently at risk of flooding during the 1% or 0.2% annual chance storm events, may be at risk of flooding during these events in the future. The second step was to identify areas that face an increase in future flood risk due to new development or redevelopment that may occur in these areas. The methods employed to evaluate future risk and the results of the analysis are explored in the following sections.

2.3.1 Future Condition Flood Hazard Analysis

History has demonstrated that flood hazards tend to increase over time in populated areas due to projected increases in impervious cover, anticipated sedimentation in flood control structures, as well as other factors that result in increased or altered flood hazards. As a result, the future condition flood hazard area was defined based on an expected increase in flooding extents and magnitude across the region.

Several methods have been provided by the TWDB to determine the future flood hazard layer. The first step of this task is to identify areas within the region where future condition hydrologic and hydraulic model results and maps already exist. Currently in the San Antonio FPR, there are detailed FEMA studies that include a future 1% annual chance floodplain. However, they were developed using future landuse shapefiles created by Bexar County and the City of San Antonio. This process differs from the method proposed by the TWDB and does not consider climatic changes. Therefore, one of the following four methods must be used to identify the future flood risk across the region:

1. Increase water surface elevation based on projected percent population increase (as a proxy for land development)
2. Utilize the existing 0.2% annual chance floodplain as a proxy for the future 1% annual chance storm event
3. A combination of methods 1 and 2 or a RFPG-proposed method
4. Request TWDB for a Desktop Analysis

Region 12 employed Method 2 and 3, described further in this section.

Future Conditions Based on “No Action” Scenario

It must be noted that these estimated changes in flood hazard extents are meant to represent the “30-year, no action” scenario for the purpose of evaluating the potential magnitude for future flood risk. This information will in no way be used for floodplain mapping for regulatory purposes, such as local (municipal) floodplain management and development regulation, or in any way by Federal Emergency Management Agency (FEMA) or the National Flood Insurance Program (NFIP). This is simply a planning level analysis for the purpose of supporting the regional flood planning process.

Methods for Developing the Future Flood Hazard Layer

Future flood conditions represent projected conditions 30 years into the future or year 2050 and can be influenced by several factors, such as:

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

The existing 0.2% flood risk areas were used as a proxy for the future 1% flood risk areas in areas where future 1% flood risk areas did not exist, per Method 2 in TWDB’s guidance. Method 3, A RFPG method, was used to calculate the 0.2% future storm event risk area given as a buffer value. For the 0.2% annual chance future conditions floodplain, HDR utilized the 2018 *San Antonio River Basin Future Precipitation Study,* developed by SARA, which estimates the 0.2% annual chance storm event rainfall total will increase 3.8 inches in 20 years and 5.1 inches in 40 years. As part of separate effort with SARA, HDR utilized the precipitation study information along with draft hydrology models for the major watersheds currently being developed by SARA as part of a county wide floodplain remapping effort within the SARB to estimate peak discharges. This analysis showed the average increase in the 0.2% annual chance storm event peak flows throughout the basin were between 30% and 40% for the 20- and 40-year future projections, respectively. From this data, HDR estimated a 35% increase in 0.2% annual chance storm event peak flows for a 30-year future event. With this estimated flow increase, HDR evaluated the horizontal increase in 0.2% annual chance floodplain top-widths using selected HEC-RAS models in various locations throughout the watershed. Below is a more detailed explanation of how the future flood hazard conditions were calculated.

Hydraulic Model Updates

All watershed hydraulic models were updated by increasing the 0.2% annual peak flows by 35%, as established above. However, due to variations in model versions, boundary conditions, and types, some specific modifications were made to execute the hydraulic models.

All selected stream effective hydraulic models except Salado Creek and Upper San Antonio River, downloaded from SARA's digital data & modeling repository (D2MR), were provided in their original HEC-RAS format (v3.1.2 and v4.0). At the time of this analysis, SARA provided draft hydraulic models for the Salado Creek and Upper San Antonio River systems developed as part of SARA county wide floodplain remapping effort which were provided in HEC-RAS v5.0.7. For the purpose of this exercise, all models were executed in HEC-RAS v4.1 or later which allow for Defined Results Tables with "Left and Right Station" results, as needed for the top-width assessment. A comparison between the HEC-RAS v3.1.2/v4.0 versus v4.1 existing 0.2% annual chance storm event results showed less than 0.01% difference in peak water surface elevations (WSE); therefore, the version change posed no impact to hydraulic results.

Hydraulic models with boundary conditions defined as known WSE were left unchanged for this analysis based on a sensitivity analysis performed on Ojo De Aqua at the Lower San Antonio River confluence in Karnes County. the Ojo De Aqua hydraulic model was simulated assuming an unchanged known WSE boundary condition and updated boundary condition based on future 0.2% annual chance peak flows along Lower San Antonio River to evaluate potential changes due to boundary condition assumptions. Based on results, there was less than 0.01% change in WSE on the first 2-3 cross sections. Therefore, it was determined leaving the boundary conditions as is had no effect on this comparison objective of this exercise.

Due to the type of available study, some models only had the 1% annual chance rainfall present and not the 0.2% annual chance storm event needed for the assessment. Seguin Branch LOMR was one of the models that didn't have the 0.2% annual chance storm event, so this flow was pulled from the HEC-HMS hydrology model downloaded from SARA D2MR. However, it's presumed that this HEC-HMS model is not the same model that was used to establish the HEC-RAS models 1% annual chance storm event peak flows. The HEC-HMS 1% annual chance storm event peak flows were within 4% of the HEC-RAS peak flows, 8,541 cfs vs 8,860 cfs, so the 0.2% annual chance storm event peak flow data from HEC-HMS was used to determine the top-width difference. Following the completion of this process where 0.2% results were lacking, it was determined a more efficient method would be needed to complete the exercise within the project time constraints. In comparing surrounding hydraulic models with both 1% and 0.2% annual chance storm event peak flows, a conversion multiplier was established to determine the existing 0.2% annual chance peak flow from the 1% annual chance peak flows when not available. A summary of the hydraulic models, 1% to 0.2% annual chance multipliers, and reasoning are included in Table 2-2.

Table 2-2. RAS Models Using Multipliers

RAS Model	0.2% Flows Increase Criteria	Reason
Cibolo Wilson Co	43%	• US : Lower Cibolo RAS average 43% • DS : SAR Lower Karnes average 43% ---> large reaches fall in between, probably stay the same
Cibolo Karnes Co	43%	
Ecleto	66%	• Smaller reaches like Marcelinas and Seguin are higher average than larger reaches; Cibolo and SAR. • Ecleto similar geo-location to Marcelinas, similar. • SAR Lower Goliad higher average than US SAR Lower Karnes. Therefore assume Manahuilla and Cabeza increase from Ecleto to DS.
Manahuilla	67%	
Cabeza	68%	

Hydraulic models were run with the above considerations and modifications and the existing and future 0.2% annual chance storm event peak WSE results were compared.

Hydraulic Model Assessment

As explained above, there were some variations in the hydraulic model updates but the same assessment of the peak WSE was implemented for all modeled streams.

Existing and future 0.2% annual chance storm event results were compared based on top-width and WSE differences. Averages for both were calculated for each modeled stream. To develop a refined average, outlier data was not considered to avoid skewing results. Outlier data consisted of top-width differences greater than 500 ft, WSE differences greater than 5ft, and any result where the WSE was not contained within the cross section.

Each hydraulic model was categorized based on urbanization levels, location within the region, and general land slope to develop geo-spatial watershed relationships. Some of the longer reaches with varying categories were split for this assessment. Urbanization levels were defined as *Urban* if most of the reach passed through cities, or *Rural* if the reach was primarily passing through undeveloped/agriculture land. Location was divided by *Upper* – North of San Antonio and North San Antonio; *Mid* – Mid San Antonio to Edge of Bexar County; *Lower* – Wilson and Karnes Counties; and *Costal*: DeWitt and Goliad Counties. Slopes were generalized into ranges less than 0.1%, 0.1%-0.2%, 0.2%-0.5%, and greater than 0.5%. Averages from each of the categories can be found in Table 2-3 below.

Table 2-3: Assessment Categories and Results for the Existing and Future 0.2% Annual Chance Comparison

Assessment Category	Category Type	Total Top-Width Difference (ft)	One Side Top-Width Difference (ft)	WSE Difference (ft)
Urbanization	Urban	119	59	2
	Rural	152	76	2
Location	Upper	118	59	2
	Mid	156	78	2
	Lower	140	70	2
	Coastal	154	77	2
Slope	x ≥ 0.005	90	45	2
	0.002 ≤ x < 0.005	148	74	2
	0.001 ≤ x < 0.002	147	74	2
	x < 0.001	169	85	3
Medina		67	33	4
Average:		**139**	**70**	**2**

The average increases in top-width would be applied to the existing 0.2% annual chance floodplain as a horizontal buffer to develop the future 0.2% annual chance floodplain.

Results

Using the results developed from the top-width exercise, a buffer criteria was established based on stream spatial location within the region to develop the future 0.2% annual chance floodplain. Final criteria areas were refined to the following boundaries:

- Upper: North of North Loop 1604 from Culebra Road to I35
- Mid: South of North Loop 1604 to south of Karnes County
- Coastal: South Karnes County to the Gulf of Mexico
- Medina: Reaches and tributaries not evaluated in the assessment

Based on initial results of Medina tributaries evaluated in the top-width assessment, result differences were noted to be significantly lower top-width results and higher WSE differences compared to all other reaches. This can be attributed to the steep terrain and channel bank slopes. Therefore, a separate buffer criterion for established for the Medina watershed.

The final criteria set is as follows in Table 2-4. The buffer is the top-width increase that should be applied to each side of the existing 0.2% annual chance storm event floodplain to develop the future 0.2% annual chance storm event floodplain.

Table 2-4: Final Criteria for the 0.2% Future Floodplain Buffer

Criteria	Type	Buffer (ft)
Location	Medina	40
	Upper	60
	Mid	75
	Coastal	80

Population growth projections outside of population centers are generally less than xx people per square mile. Therefore, it was determined no flood risk areas increases due to population growth would occur outside the urban areas. Both the future 1% and 0.2% annual chance storm event flood risk area extents within the county regions, outside of cities or populated areas, are assumed to remain the same as the existing flood risk areas extent. Final future conditions flood risk methods are summarized in Table 2-5.

Table 2-5. Future Conditions Flood Risk Methods

	Best Available		→		→		Most Approximate	
	Local Flood risk areas *(if current)*		Zone AE on NFHL or FAFDS		Zone A on NFHL / FAFDS		No FEMA or Better than Quilt	
	1%	0.2%	1%	0.2%	1%	0.2%	1%	0.2%
Existing	Local Study (if provided)		Existing Quilt 1%	Existing Quilt 0.2%	Fathom 1%	Fathom 0.2%	Fathom 1%	Fathom 0.2%
Future - Urban Downstream of City	Local Ultimate Development Study (if provided)		Existing Quilt 0.2%	Existing 0.2% + Delta* Mapping	Fathom 0.2%	Fathom 0.2% + Delta* Mapping	Fathom 0.2%	Fathom 0.2% + Delta* Mapping
Future Rural	Local Ultimate Development Study (if provided)		Existing Quilt 1%	Existing Quilt 0.2%	Fathom 1%	Fathom 0.2%	Fathom 1%	Fathom 0.2%

Identified Future Flood Hazard Areas

Using the method described earlier, the maps for the future 1% and 0.2% annual chance storm event flood hazard areas were developed in GIS. Table 2-6 summarizes the results of the future flood analysis.

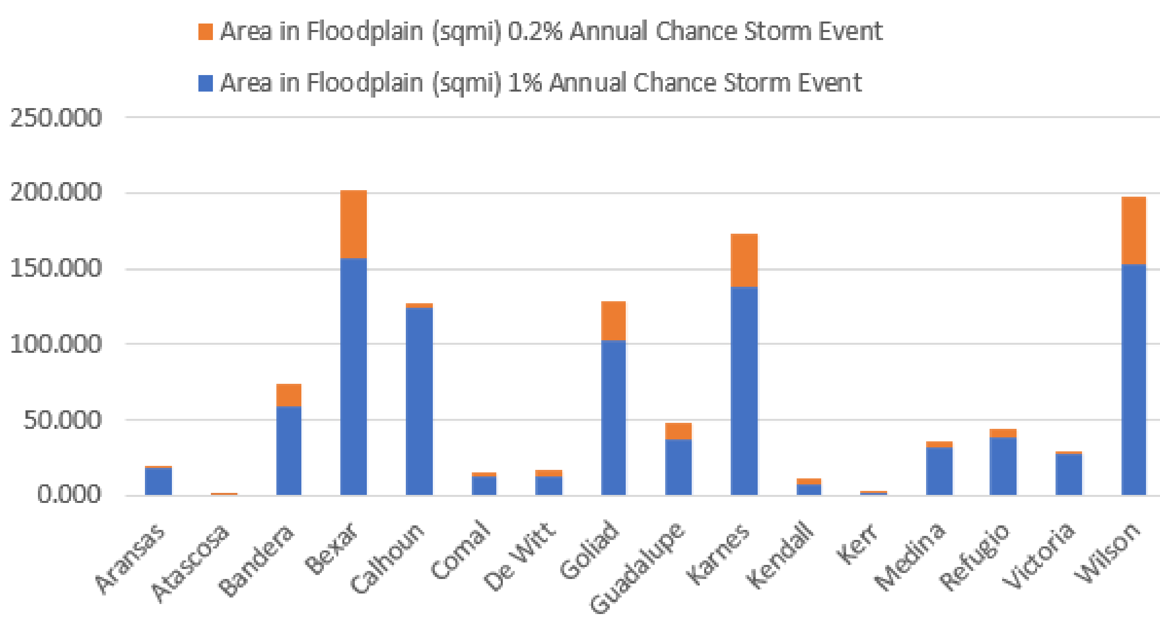
A comparison of the existing and future flood hazard area is presented tabularly in Table 2-6. An additional 200 square miles of flood hazard area is added to the floodplain with estimated future conditions, or an increase of 52%.

Table 2-6

Flood Hazard Area	Total Existing Area (sq. mi.)	Total Future Area (sq. mi.)	Area Change (sq. mi.)	Area Change
1%	800.2	925.57	125.37	14%
0.2%	124.34	199.32	74.98	38%
Total	**925.54**	**1124.89**	**200.35**	**52%**

The total future condition flood hazard area is summarized by county in Figure 2-5. As with existing conditions, Bexar, Calhoun, Goliad, Bandera, Wilson, and Karnes are the counties with significantly high total area in both the 1% and 0.2% annual chance storm events. The future area in square miles inundated under future conditions is represented in Figure 2-5. Due to the methodology selected, most of the increase in floodplain is from more urbanized counties. Of the counties located in SAFPR, the flood hazard area increased the most in Wilson, Bexar, and Karnes Counties.

Figure 2-5



Future Conditions Data Gaps

Region 12 used detailed study floodplains and the buffer to develop the future modeling extents, not all existing detailed mapping in the SARB has detailed future conditions. As a result, large portions of the region are considered to be a data gap under future conditions.

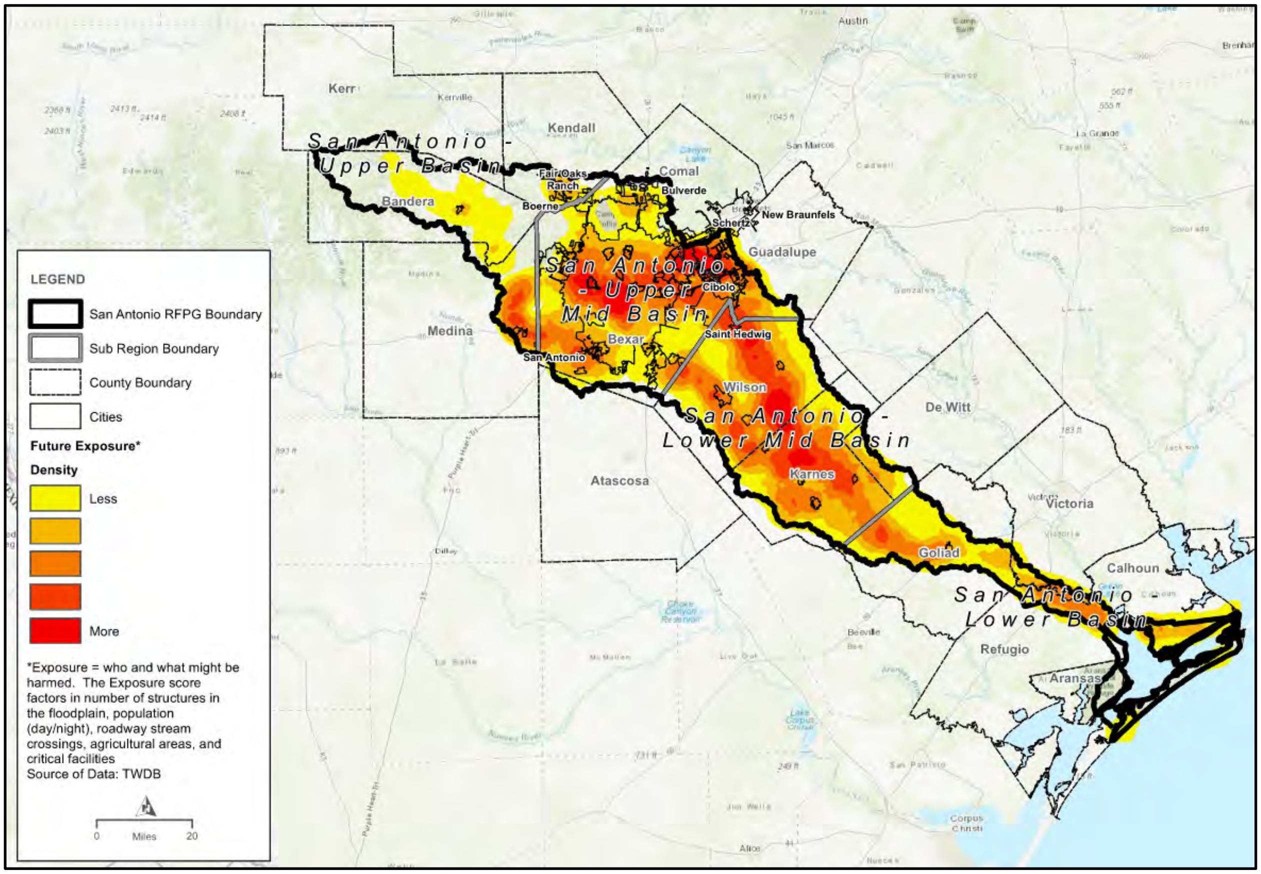
2.3.2 Future Condition Flood Exposure Analysis

The same flood exposure analysis procedure was followed to quantify exposure under future conditions. This exposure was only quantified for existing development as it compared to the future condition flood hazard area. It is difficult to quantify exposure of future development due to the inherent uncertainty in the exact location of development and changes in population. However, an effort was made to evaluate areas of future development and provide qualitative information regarding potential exposure in these areas.

Future Flood Exposure Summary

The following sections describe the results of the future flood exposure analysis through the same series of maps that is presented for existing flood exposure. The Cities of San Antonio, Boerne, Bandera, and Karnes continue to have a high concentration of flood exposure in the region. The urban areas around the San Antonio River, Medina River, and Cibolo Creek have the highest concentration of flood exposure in the region, due to the density of development and total population in these areas. However, other portions of the region see a greater density of flood exposure as compared to existing conditions. A heat map illustrating the future conditions flood exposure in the SAFPR is shown in Figure 2-6 below.

Figure 2-6 Future Exposure Heat Map



Residential Properties

Table 2-7 summarizes residential property exposure by county. Those counties with the largest increase in number of residential structures impacted are the most urbanized counties in the region (Bexar, Wilson, Guadalupe, and Bandera). The total number of residential structures that are exposed to the future floodplains greatly increases from 19,203 structures to close to 42,830 structures.

Non-Residential Properties

Table 2-7 summarizes non-residential property exposure by county. While the total number of non-residential properties contained in the future flood hazard area did not increase as dramatically as residential properties, urbanized counties still saw an increase. Bexar, Wilson, Guadalupe, and Bandera Counties, which saw high residential building increases, are also represented in some of the highest increases of non-residential properties in the same areas. The total increase in non-residential property exposed to future 1% and 0.2% annual chance storm events is 5,224 structures.

Public Infrastructure

There are 872 buildings marked as public infrastructure within the future flood hazard, 348 more than in the existing flood hazard. Within this group, 402 buildings are critical facilities and discussed further below. Most of these buildings are located within municipalities, with a large portion found within San Antonio.

MAJOR INDUSTRIAL AND POWER GENERATION FACILITIES

There are 167 buildings in the future flood hazard that are marked as industrial, 80 more than in the existing mapped flood hazard. Of those marked as Industrial facilities, none are classified as critical facilities. Within the future flood hazard area, there are 35 facilities associated with power generation. Similar to the existing power generation facilities, all 35 are considered critical facilities.

CRITICAL FACILITIES

There are 402 critical facilities total within the future flood hazard area, 182 more than in the existing flood hazard. Table 2-7 shows a count for each type of critical facility, while Figure 2-6shows the location of these facilities. The two most common types of facilities within the flood hazard area are schools and DOD facilities.

ROADWAY CROSSINGS

The number of roadway stream crossings in the future flood hazard area are greatest where there is more urbanization, such as Bexar, Bandera, Wilson, and Karnes counties (Table 2-7). The number of crossings in the future 1% and 0.2% annual chance storm event flood hazard area is 4,004, putting over a thousand more roadway crossings in the future flood zones. As mentioned before, this increase in stream crossings per county is associated with a greater extent of urban area becoming exposed under the future flooding scenario.

ROADWAY SEGMENTS

Similar to the roadway crossings Bexar, Bandera, Wilson, and Karnes counties have the most miles of roadway within the future hazard area. This can be attributed to an increase in urbanized flooding in the future flood scenario. All the counties in SAFPR have roadways that would be inundated in the future 1% and 0.2% annual chance storm event. There is a total of 1,571 miles of roadway exposed to flood risk in the future assessments.

AGRICULTURAL AREAS

Table 2-7 shows represents the relative number of agricultural areas inundated by flooding under future conditions by county. The amount and value of agricultural areas impacted by flooding increased by only 3.8% in the future flood hazard condition to 50 square miles and almost $5.0 billion, respectively. Of the counties located primarily in SAFPR, the counties with the largest increase are Bexar, Wilson, Karnes, and Medina. These areas saw larger increases in overall floodplain size so this increase is expected for the area.

Table 2-7 Summary of Structures in the Future Flood Hazard Areas

County	1% Annual Chance Flood Risk									
	Area in Floodplain (sqmi)	Number of Structures in Floodplain	Residential Structures in Floodplain	Population (daytime)	Population (nightime)	Population	Roadway Crossings (#)	Roadways Segments (miles)	Agricultural Areas (sqmi)	Critical Facilities (#)
Aransas	17.791	0	0	0	0	0	0	13.069	0.033	0
Atascosa	0.962	57	51	32	95	95	14	2.205	0.045	0
Bandera	58.648	1601	857	1339	1664	2430	245	81.746	1.284	5
Bexar	157.539	13608	10204	59842	36667	85305	1286	397.758	11.849	103
Calhoun	124.950	1533	1145	648	956	1300	24	33.078	1.787	4
Comal	13.000	649	507	1482	749	2010	69	19.661	0.600	34
De Witt	12.484	47	14	6	17	18	57	8.388	0.560	0
Goliad	102.239	287	95	158	334	354	122	38.410	13.794	0
Guadalupe	37.577	3809	3123	16208	11218	24081	161	85.629	5.640	45
Karnes	138.381	563	255	318	594	761	334	86.113	25.871	0
Kendall	7.798	961	606	4322	2357	5871	56	17.109	0.093	10
Kerr	1.615	34	10	6	23	23	7	1.292	0.039	0
Medina	31.692	1229	852	2004	1654	3116	82	41.284	9.241	6
Refugio	39.090	179	69	109	188	207	11	12.255	3.156	1
Victoria	27.580	37	14	10	21	24	9	5.658	1.906	1
Wilson	153.218	2039	1401	1819	2622	3757	426	123.846	21.987	11
TOTAL	924.57	26633	19203	88303	59159	129352	2903	967.50	97.89	220
County	**0.2% Annual Chance Flood Risk**									
	Area in Floodplain (sqmi)	Number of Structures in Floodplain	Residential Structures in Floodplain	Population (daytime)	Population (nightime)	Population	Roadway Crossings (#)	Roadways Segments (miles)	Agricultural Areas (sqmi)	Critical Facilities (#)
Aransas	1.059	0	0	0	0	0	0	2.897	0.003	0
Atascosa	0.232	22	19	9	30	30	2	0.472	0.012	0
Bandera	15.181	1095	631	938	1363	1798	57	22.146	0.098	5
Bexar	43.917	22277	19061	94501	74892	146537	346	237.517	2.056	149
Calhoun	2.335	121	104	11	49	49	8	8.941	0.111	0
Comal	2.660	441	382	980	797	1531	22	9.525	0.055	1
De Witt	4.341	44	12	5	18	19	25	9.799	0.242	0
Goliad	25.613	263	114	434	400	649	85	40.699	1.106	3
Guadalupe	10.807	1483	1251	4468	4033	7398	59	37.138	1.644	10
Karnes	34.492	471	204	408	416	710	261	80.011	3.441	0
Kendall	3.025	536	391	1612	1868	2914	16	6.922	0.016	3
Kerr	0.899	47	19	5	19	20	1	0.832	0.008	0
Medina	3.988	285	171	288	413	563	7	7.419	0.522	1
Refugio	4.722	78	27	234	130	279	13	20.397	0.722	3
Victoria	1.968	22	12	6	25	26	4	4.586	0.119	0
Wilson	44.082	1666	1229	1941	2478	3731	195	115.094	2.928	7
TOTAL	199.32	28851	23627	105840	86931	166254	1101	604.40	13.08	182
Combined Flood Risk Total	**####**	**55484.00**	**42830.00**	**194143.00**	**146090.00**	**295606.00**	**4004.00**	**1571.90**	**110.97**	**402.00**

Potential Flood Mitigation Projects

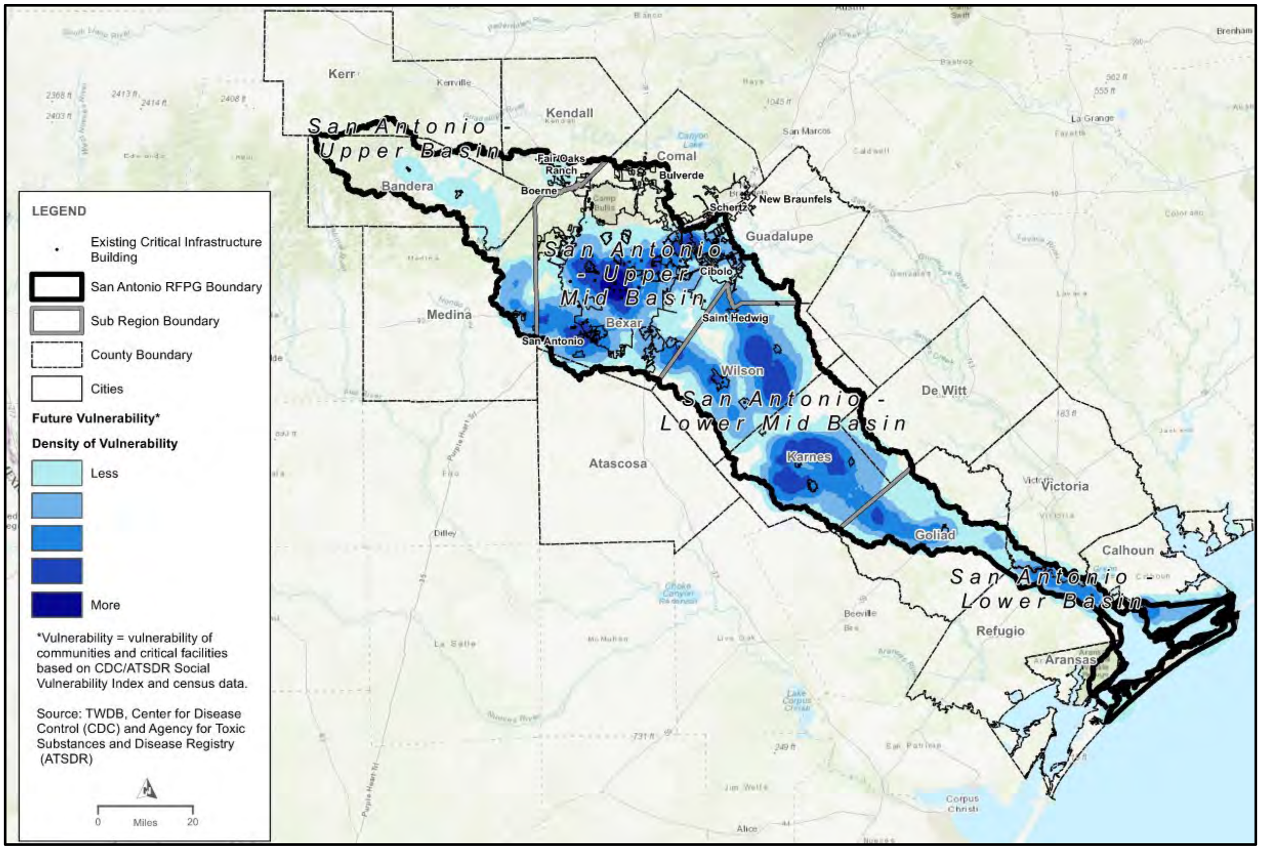
The future condition flood exposure analysis also required the consideration of impacts from flood mitigation projects in progress with dedicated construction funding that are scheduled for completion prior to the adoption of the next SFP. There are 46 proposed and on-going projects have been identified in the SAFPR that meet this criteria.

Major cities within the SAFPR have Capital Improvement Plans (CIPs) and stormwater fees, which may lead to the implementation of additional local stormwater projects. However, these projects do not have specific allocations, so they were not considered in the development of the future flood hazard layer since their construction is not guaranteed. Additionally, these projects will have a small-scale impact on the floodplain and will not result in major impacts on regional flood risk.

2.3.3 Future Conditions Vulnerability Analysis

The vulnerability analysis for future conditions was performed in the same manner as the existing analysis but considering the future condition flood exposure features. The results of the analysis are summarized in Figure 2-7.

Figure 2-7. Future Vulnerability Analysis



3

Floodplain Management Practices and Flood Protection Goals

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3 Floodplain Management Practices and Flood Protection Goals

The San Antonio RFPG was tasked with evaluating current floodplain management practices/recommending future floodplain management practices (Task 3A) and recommending flood mitigation goals (Task 3B). The following chapter details the process and findings of the San Antonio RFPG to accomplish this chapter's tasks.

3.1 Evaluation and Recommendations on Floodplain Management

The initial effort under Task 3A was to collect and perform an assessment of current floodplain management regulations within the San Antonio Flood Planning Region (SAFPR) (i.e., floodplain ordinances, court orders, drainage design standards, and other related policies). The Texas Water Development Board (TWDB) provided floodplain ordinances, as well as a summary of the Texas Floodplain Management Association's (TFMA) Higher Standards Survey results by entities who participated. Floodplain management regulations not provided by TWDB that were readily available on the regulatory entity's websites were also collected. Parallel to this effort, a web-based survey was sent out to each regulatory entity in the SAFPR to gather additional information. All information collected was used to evaluate the current floodplain management and land use practices within the SAFPR.

3.1.1 Extent to which Current Floodplain Management and Land Use Practices Impacts Flood Risks

Policies, regulation, and regional trends are some of the different aspects of floodplain management and land use practices. Implementing these aspects improves protection of life and property. However, different entities can vary greatly from one another on floodplain management and land use practices. The minimum standards for development in and around the floodplain can be found in the Nation Flood Insurance Program (NFIP) which is managed by the Federal Emergency Management Agency (FEMA).

Congress created the NFIP in 1968 through the National Flood Insurance Act of 1968 to provide federally subsidized flood insurance protection. Since its creation, the NFIP has been updated on multiple occasions to strengthen it. Title 44 of the Code of Federal Regulations (44 CFR) includes the rules and regulations of the NFIP. 44 CFR Part 60 establishes the minimum criteria that FEMA requires for NFIP participation, which includes identifying special flood hazard areas within the community. 44 CFR Part 60 establishes the minimum criteria that FEMA requires for NFIP participation and the minimum standards for floodplain development.

Cities and counties work with FEMA to establish Base Flood Elevations (BFEs) and Special Flood Hazard Areas (SFHAs) along rivers, creeks and large tributaries that are shown on Flood Insurance Rate Maps (FIRMs). Communities use the FIRM, BFE, and

SFHA data in their floodplain permitting processes as a requirement for participating in the NFIP. Insurance agents use FIRMs to determine flood risk, which determines the flood insurance rate for individual properties.

The entities of the SAFPR can establish their own policies, standards, and other practices for managing the land use areas of flood risk. Any entities participating in the NFIP have the authority and responsibility to permit or deny the development of special flood hazard areas (SFHA). They can adopt and enforce higher standards than the FEMA NFIP minimum standards to better protect people and property from flooding. FEMA supports entities who choose to establish higher standards to better protect life and property.

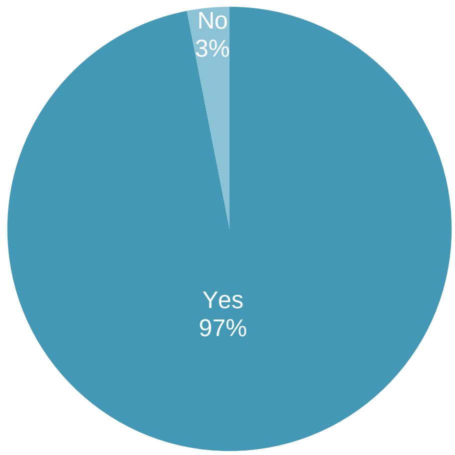
Cities and counties who participate in the NFIP program can purchase NFIP flood insurance to reduce the economic impacts of floods (FEMA Flood Insurance, 2021). Renters also can purchase NFIP “contents only” flood insurance policies to cover the cost of their belongings in the event of flood damage. NFIP participation also makes the community eligible for disaster assistance following a flood event.

Existing Population and Property

Multiple resources were considered in determining the extent to which current floodplain management and land use practices impact flood risk to existing population and property. Cities and communities have the authority to approve floodplain ordinances or court orders, respectively. There are 110 existing political subdivisions within the SAFPR that have flood related authority. They include cities, counties, river authorities, and additional entities with flood-related authority.

Of the 110 existing political subdivisions in the SAFPR, there are 16 counties and 49 cities for a total of 65 eligible NFIP participants. NFIP participating communities are required to have a floodplain ordinance or court order that meet or exceed the minimum standards set out in the NFIP. Of the 65 eligible entities, 63 are NFIP participants. NFIP participants are limited to cities and counties, so the results discussed in the rest of this chapter are limited to those entities. Figure 3.1 shows the percentage of entities within the SAFPR that participate in the NFIP.

Figure 3-1. Percentage of NFIP Participating Entities in the SAFPR



The minimum standards set out in 44 CFR Part 60 state that buildings are required to be constructed at or above the Base Flood Elevation (BFE), provide for floodproofing options for nonresidential buildings, and mandate provisions specific to the elevation and anchoring of manufactured houses. While the minimum standards are in place for flood protection, these standards may be based on maps that were developed with outdated topography, rainfall, and runoff data. Therefore, standards adopted based on these sources could result in limited protection from flood damages.

While adopting only minimum standards has a chance of providing flood damage protection, cities and counties can adopt “higher” standards to improve the extent of flood damage protection. In the TWDB Exhibit C guidance document, the term “higher” standard is defined as freeboard, detention requirements or fill restrictions. FEMA defines freeboard as additional height above the BFE that serves as a factor of safety when determining the elevation of the lowest floor. The BFE is the elevation of surface water resulting from a flood that has a 1 percent chance of occurring in any given year. The BFE is typically based on FEMA FIRMs (maps) and associated Flood Insurance Studies (models). However, the BFE can be based on localized data developed by the community that may not be incorporated into a FEMA mapping product.

The Texas Floodplain Management Association (TFMA) performs a Higher Standards Survey every year of cities and counties to document which entities have adopted higher standards. According to the TFMA Higher Standards Survey in 2016, and additional research performed, 31 entities in the SAFPR are reported as having freeboard requirements of one or more feet above the BFE, two entities with no freeboard requirement, and all other entities required to be elevated to or above the BFE. A breakdown of the freeboard requirements are shown in **Table 3.1** below. Of the cities and counties that have a freeboard requirement, the majority require the BFE plus 1 foot.

Table 3-1. Freeboard Requirements for Cities and Counties in the SAFPR

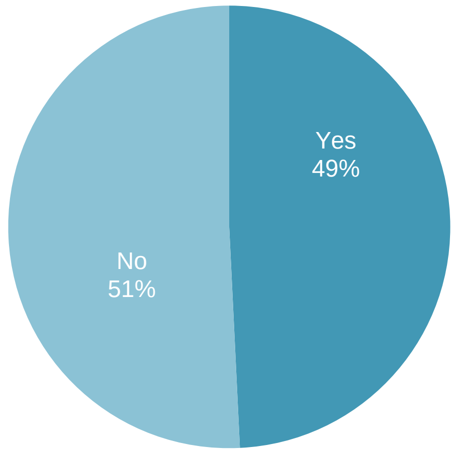
Freeboard Requirements	Number of Entities	Percent
At or above BFE	34	52%
1’ above BFE	20	31%
1.5’ above BFE	2	3%
2’ above BFE	6	9%
3’ above BFE	1	2%
None	2	3%
Total	**65**	**100%**

In addition to freeboard requirements, some cities and counties enforce other higher standards such as:

- Requiring new developments to perform detailed studies to establish BFE data when not available.
- Stormwater detention requirements.
- Limitations to criteria variance within designated floodways.
- Local floodplains to identify risk outside of FEMA flood zones.
- Drainage way protection zones to provide resilience against storms that exceed current design standards.
- Ultimate development design criteria

Of the 63 NFIP participating entities, a total of 32 entities have adopted higher standards. **Figure 3.2** demonstrates that nearly half of the SAFPR’s entities require some form of higher standards.

Figure 3-2 Percentage of Entities that Require Higher Standards



Within the NFIP, FEMA manages the Community Rating System (CRS) program. The CRS program is a voluntary program in which the cities and counties can participate (FEMA CRS,2021), (FEMA CRS Manual, 2021). The more flood risk reduction activities in which an entity participates, the more points it earns. The points translate to a CRS score that ultimately provides residents and businesses within the jurisdiction the opportunity to receive a discount of flood insurance premiums. The flood insurance savings encourages residents and businesses to purchase flood insurance to protect buildings and contents.

As of October 2022, the SAFPR will have four entities participating in the Community Rating System. These communities have a CRS class ranging between 6 and 8 and represent a 5 percent to 20 percent savings on flood insurance premiums. Per TWDB Technical Guidance, these communities qualify as having "Strong" floodplain management standards. The list of CRS participating entities is provided in **Table 3-2**.

Table 3-2. SAFPR Entities Participating in the Community Rating System (CRS) Program

Entity	CRS Class	% Discount for Structures within Special Flood Hazard Area	% Discount for Structures Located Outside the Special Flood Hazard Area
Guadalupe County	8	10	5
Live Oak, City of	7	15	5
New Braunfels, City of	8	10	5
San Antonio, City of	6	20	10

An additional portion of the data collection effort included a question that asked survey participants to select the description that best represented their impression of their enforcement level of their floodplain regulations. The TWDB Exhibit C described enforcement levels as the following:

- high – actively enforces the entire ordinance, performs many inspections throughout construction process, issues fines, violations, and Section 1316s where appropriate, and enforces substantial damage and substantial improvement;
- 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 regulations.

From the survey responses and other data collection efforts, the SAFPR gathered 14 entity enforcement levels. Following the TWDB guidance, the remaining entities were not categorized as their level of enforcement is unknown. **Table 3.3** summarizes the 14 collected responses.

Table 3-3. Level of Enforcement of Floodplain Regulations in the San Antonio SAFPR

Level of Enforcement	Number of Responses	Percent
High	4	29%
Moderate	8	57%
Low	1	7%
None	1	7%
Total	**14**	**100%**

Utilizing the data collected, the level of floodplain management practices were identified as “strong”, “moderate”, “low” or “none” based on the following criteria provided by the TWDB.

- Strong (significant regulation that exceed NFIP standards with enforcement, or community belongs to the Community Rating System)
- Moderate (some higher standards, such as freeboard, detention requirements or fill restrictions)
- Low (regulations meet the minimum NFIP standards)
- None (no floodplain management practices in place)

Of the 65 NFIP eligible entities, 5 entities are classified as ‘strong’, 28 entities are classified as ‘moderate, and 30 entities are classified as having a ‘low’ level of floodplain management practices. The remaining two entities are classified as ’none’. **Table 3.4** and **Figure 3.3** summarize the results of the floodplain management practices. TWDB-Required Table 6 is included in **Appendix A** and provides details considered for each community and county in determining the appropriate description of overall floodplain management practices.

Figure 3-3. Floodplain Management Practices for NFIP Eligible Communities in the SAFPR

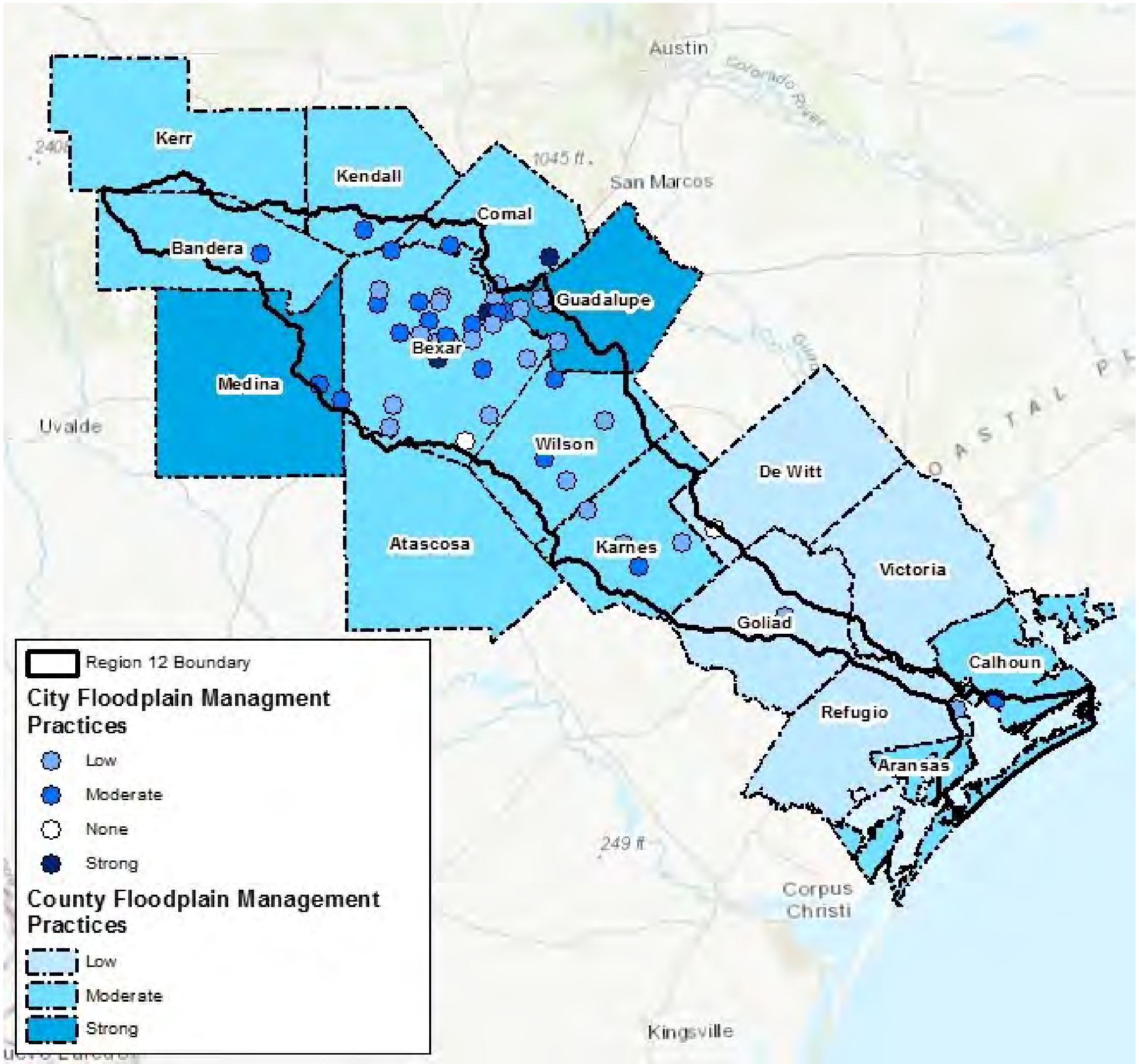


Table 3-4. Floodplain Management Practices for NFIP Eligible Communities in the SAFPR

Description	Number of Communities and Counties	Percent
Strong	5	8%
Moderate	28	43%
Low	30	46%
None	2	3%
Total	**65**	**100%**

Although 97% of the entities in the SAFPR are NFIP participants, there is still a significant gap between key floodplain management practices and certain communities that could enhance their floodplain management policies.

Future Population and Property

Future floodplains are uncertain. However, it is anticipated that the future floodplains will look different from existing floodplains in many areas within the SAFPR. The hydrologic and hydraulic models used to generate floodplain maps are regularly being updated with new topography, survey, precipitation, runoff, and other data as development occurs in and around floodplains. For future population growth and development in and around the floodplain, areas without maps or with outdated floodplain maps and models are at a greater danger of increased flood risk. Incorporating the existing and future floodplains will provide cities and counties with additional direction as to where population and development should be directed to protect people and property.

The existing floodplain ordinances or court orders that include higher standards may continue to protect life and property if they are enforced appropriately. At the same time, future floodplain models and maps will need to be updated with best available data, and advanced modeling techniques, to effectively assess risk. The combination of applying higher standards and best available data should translate into life and property savings in the future.

Correctly designed detention and retention ponds are often required to mitigate the impacts that impervious surfaces and more efficient drainage infrastructure have on the runoff from a developed property. The standard engineering design requirement is to manage runoff so that it discharges from the developed property at the existing rate that it leaves the property in its natural state. Incorporating this requirement may help mitigate increased runoff in the future, which in turn can reduce future flood hazard exposure.

Another way communities can prepare and protect future life and property is to include a future conditions scenario in watershed and stream studies. Typically, the future conditions scenario is based on a defined time in the future, often 30 years, or is based on the area’s fully developed land conditions. In addition, future conditions may include rainfall greater than current design criteria to reflect the increased rainfall depth trends seen in rainfall records and known as non-stationarity. Applying a future conditions scenario to studies essentially adds a factor of safety to the area to help better protect the current areas from future flood risk.

An additional factor of safety that can be implemented to reduce future flood hazard exposure is freeboard. Freeboard is the term used for additional height provided above the base flood elevation discussed in Section 3.A.1.a. Even if the BFE changes in the future, freeboard could allow the structure to remain above the future flood water surface level.

3.1.2 Consideration of Recommendation or Adoption of Minimum Floodplain Management and Land Use Practices

For this task, the San Antonio RFPG is required to consider the possibility of recommending or adopting consistent minimum floodplain management standards and land use practices regionwide. Recommended practices encourage entities with flood control responsibilities to establish minimum floodplain management standards over the next several years, while the adoption of minimum standards requires entities to have adopted the minimum standards before their floodplain management strategies (FMS's), evaluations (FME's), and projects (FMP's) could be considered for potential inclusion in the San Antonio RFP. After considering and analyzing the data collected for Task 3A, the SAFPR decided to recommend floodplain management and land use practices rather than requiring entities to adopt higher standards to submit FMPs or FMEs,

The San Antonio RFPG developed a "Toolbox" of potential higher standards. The intent of the toolbox is to provide specific ordinances and technical statements that could be applied to regulatory language to strengthen the floodplain management and land use practices of Region 12 entities. The toolbox is divided into two main categories, ordinance higher standards and technical higher standards. The sections below provide a detailed explanation about the two categories.

Ordinance Higher Standards

The ordinance higher standards are specific statements that could be added and adopted into community's floodplain ordinances or court orders. For this task, the RFPG reviewed the floodplain ordinances and court orders within the SAFPR, specifically the higher standards the entities have already adopted. The statements and the language they were written in are reflected in the SAFPR's chosen ordinance higher standards. The SAFPR's recommended standards were chosen with the intent that entities could refer to the statements and adopt them into their own floodplain ordinances or court orders. Because they are already written in the language of an ordinance statement, they could be adopted with minimal effort.

The recommended higher standards were further categorized into Regulatory, Technical, or Technical/Regulatory groups. Within the NFIP ordinance, there are seven statements of purpose and five methods of reducing flood loses. Per the NFIP, the statements of purpose promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas. They seven statements are as follows:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Ensure that potential buyers are notified that property is in a flood area.

In order to accomplish the statements of purpose, the five methods of reducing flood losses are as follows:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage;
5. Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands.

When deciding on the recommended ordinance higher standards, the San Antonio RFPG connected each ordinance statement to the NFIP statements of purpose and methods of reducing flood losses they related to. The NFIP connections are a way to show how the recommended ordinance higher standards fulfill the NFIP higher standard requirements. **Table 3.5** lists the ordinance higher standards recommended by the San Antonio RFPG.

Technical Higher Standards

In addition to the ordinance higher standards, the San Antonio RFPG has recommended six technical higher standards. The technical higher standards are based on technical criteria that will strengthen future analyses and studies done by the entities of the SAFPR. The technical higher standards give the entities another tool they can use without having to adopt a development or regulatory specific ordinance. The technical higher standards are tools that can be used to apply an additional factor of safety and enhance future studies and analysis. **Table 3.5** lists the technical higher standards.

Recommendations

Table 3.5 presents the final recommended ordinance and technical higher standards as approved by the San Antonio RFPG for consideration by the entities within the SAFPR. The recommended standards were created in parallel with the flood mitigation and floodplain management goals that were developed for Task 3B. The ordinance and technical higher standards recommended, also reflect the objectives captured in the goals described in Task 3B.

As in other chapters of this report, the TWDB requires a detailed table of existing floodplain management practices with the SAFPR. The TWDB-required Table 6 has been populated for all cities and counties within the SAFPR and is included in Appendix X Table 6.

Table 3-5. Recommendation of Floodplain Management and Land Use Practices

Standard	Quick Summary	Technical or Regulatory	NFIP Connection
Ordinance Higher Standards			
In Progress			
Technical Higher Standards			
In Progress			

3.2 Flood Mitigation and Floodplain Management Goals (361.36)

One of the critical components of the inaugural State Flood Plan process was the development of flood mitigation and floodplain management goals. The objective of Task 3B is to define and select a series of goals that will serve as the drivers of the regional flood planning effort. The San Antonio RFPG put a lot of effort into discussing and selecting a series of goals that they felt were the most beneficial for the SAFPR.

As stated in the Guidance Principles in 31 TAC §362.3, the main goal of the regional floodplain plans must be "to protect against the loss of life and property", which is further defined as:

1. Identify and reduce the risk and impact to life and property that already exists, and
2. Avoid increasing or creating new flood risk by addressing future development within the areas known to have existing or future flood risk.

With the guidance principles in mind, the RFPG must set goals that are achievable by the entities of the SAFPR. Once implemented, the goals must demonstrate progress towards the overarching goal set by the state. This section summarizes the flood mitigation and floodplain management goals determined by the San Antonio RFPG.

3.2.1 Flood Mitigation and Floodplain Management Goal Categories

When determining the flood mitigation and floodplain management goals, the San Antonio RFPG established six overarching goal categories. The categories were established to better define and clarify the individual goals set forth by the San Antonio RFPG. The goals and goal categories build upon TWDB regional flood planning guidance and provide a comprehensive framework for future strategy development focused on reducing flood risk to people and property, while not negatively affecting neighboring areas. The six goal categories include:

1. Education and Outreach
2. Flood Warning and Readiness
3. Flood Studies and Analysis
4. Flood Prevention
5. Non-Structural Flood Infrastructure Projects
6. Structural Flood Infrastructure Projects

3.2.2 Goals

The six goal categories are detailed below. They include specific goal statements that can be achieved and measured in either short (10 years) or long term (30 years). Per Texas Water Development Board (TWDB) requirements and guidelines, the goals selected by the RFPG must include the information listed below:

- Description of the goal
- Term of the goal set at 10 years (short-term) and 30 years (long-term)
- Extent or geographic area to which the goal applies
- Residual risk that remains after the goal is met
- Measurement method that will be used to measure goal attainment
- Association with overarching goal categories

The goals must be specific and achievable flood mitigation and floodplain management goals that when implemented will demonstrate progress towards the overarching goal. The following were considered in the development of the goals:

- Guidance Principles as listed in 31 TAC §362.3
- The existing condition flood risk analyses
- The future condition flood risk analyses
- The consideration of current floodplain management and land use approaches
- Input from the public
- Understanding of the residual risk of each goal (i.e. the remaining risk)

The flood mitigation and floodplain management goals were developed by Region 12 Technical Subcommittee and approved by the San Antonio RFPG at the Planning Group Meeting on November 16, 2021. The adopted goals apply to the entire SAFPR; no sub-regional goals were identified. The information requirements listed above are presented for each goal in **Appendix X Table 11**.

Goal Category 1: Education and Outreach

This category intends to increase the number of flood education and outreach opportunities across the SAFPR. Public education and outreach may incorporate a variety of methods from publishing newsletter articles to hosting booths at in-person events. Communities that participate in FEMA's Community Rating System (CRS) program typically have significant public outreach elements in their stormwater programs as they receive credit for doing so. The CRS program is described in Section 3.1.1.1 of this chapter. Increasing education and outreach opportunities improves flood hazard awareness and the protection of people and property by better preparing the SAFPR entities for future flooding events. **Table 3.6** includes four specific goals for this category.

Table 3-6. Education and Outreach Goals

Goal ID	Goal Statement	Goal Term
12000001	Track existing public outreach and education activities to improve awareness of flood hazards and benefits of flood planning including nature based solutions in the SAFPR and ensure there are at least 6 additional occurrences per year.	Short Term (10 Year)
12000002	Increase to 12 per year or maintain public outreach and education activities to improve awareness of flood hazards and benefits of flood planning including nature based solutions in the SAFPR.	Long Term (30 Year)
12000003	Increase the proficiency of stakeholders and floodplain managers across the SAFPR through training from Region 12 entities, TFMA, ASFPM and FEMA. Improve 50% of FPM knowledge of nature based solutions, floodplain preservation, and cost/benefit of traditional structural solutions including providing certificates.	Short Term (10 year)
12000004	Increase the proficiency of stakeholders and floodplain managers across the SAFPR through training from Region 12 entities, TFMA, ASFPM and FEMA. Improve 100% of FPM knowledge of nature based solutions, floodplain preservation, and cost/benefit of traditional structural solutions including providing certificates.	Long Term (30 year)

Goal Category 2: Flood Warning and Readiness

This category aims to improve the overall flood warning and readiness across the SAFPR by reducing flood deaths and high-water rescues, improving response time of flood warning notifications across the SAFPR. Improving flood warning and readiness involves multiple entities and departments and will provide timely warning of impending flood danger. **Table 3.7** includes six specific goals for this category.

Table 3-7. Flood Warning and Readiness Goals

Goal ID	Goal Statement	Goal Term
12000005	Support the development of a regionally coordinated warning and emergency response program that can detect the flood threat and provide timely warning of impending flood danger to reduce flood deaths and high-water rescues across the SAFPR.	Short Term (10 Year)

12000006	Support the development of a regionally coordinated warning and emergency response program that can detect the flood threat and provide timely warning of impending flood danger to reduce flood deaths and high-water rescues across the SAFPR.	Long Term (30 Year)
12000007	Increase the number of flood gauges (rainfall, stream, reservoir, etc.) in the SAFPR to provide localized information to emergency responders, and storage and accessibility of data to agencies.	Short Term (10 year)
12000008	Increase the number of flood gauges (rainfall, stream, reservoir, etc.) in the SAFPR to provide localized information to emergency responders, and storage and accessibility of data to agencies.	Long Term (30 year)
12000009	Increase the number of entities that communicate real time flood warnings to the public. Leverage mobile phone navigation apps to provide real time rerouting for the public.	Short Term (10 year)
12000010	Increase the number of entities that communicate real time flood warnings to the public. Leverage mobile phone navigation apps to provide real time rerouting for the public.	Long Term (30 year)

Goal Category 3: Flood Studies and Analysis

The intent of goal category 3 is to increase the overall number and extent of flood studies and analyses. Updating floodplain maps and studying or restudying streams with best available data improves flood hazard awareness and the protection of people and property. By better understanding the current and potential future status of flood hazard areas, entities can use flood studies and analyses to better manage their development. It also allows them to use more accurate data to pursue flood hazard mitigation projects and funding for them. **Table 3.8** includes six specific goals for this category.

Table 3-8. Flood Studies and Analysis Goals

Goal ID	Goal Statement	Goal Term
12000011	Establish a baseline and increase the number of entities which utilize Atlas 14 (Volume 11) or best available data from NOAA revised rainfall data as part of revisions to design criteria and flood prevention regulations by 50% percent. (SAFPR specific)	Short Term (10 Year)
12000012	Increase the number of entities which utilize/adopt Atlas 14 (Volume 11) or best available data from NOAA revised rainfall data as part of revisions to design criteria and flood prevention regulations by 100%. (SAFPR specific)	Long Term (30 Year)

12000013	Increase the number of entities that conduct detailed studies to update their local flood risk by 25%.	Short Term (10 Year)
12000014	Increase the number of entities that conduct detailed studies to update their local flood risk by 100%.	Long Term (30 Year)
12000015	Decrease the average age of FEMA Flood Insurance Rate Maps (NFHL/FIRMs/FIS) to less than 10 years.	Short Term (10 Year)
12000017	Establish a baseline number of existing studies and process for analyzing watersheds to identify existing Natural Flood Mitigation Features (NFMF) such as headwaters, buffers, and conservation easements.	Short Term (10 Year)

Goal Category 4: Flood Prevention

The intent of goal category 4 is to increase the overall extent of flood prevention. Entities that make an effort to prevent flooding will reduce the risk of future floods and see less severe damages from flooding events. Preventative flood measures are a way to protect life and property before flooding occurs. Preventative measures also warrant better overall floodplain management effects which can be seen in the five specific goals for this category. **Table 3.9** includes five specific goals for this category.

Table 3-9. Flood Prevention Goals

Goal ID	Goal Statement	Goal Term
12000019	Increase the number of participating Community Rating System (CRS) entities in the FPR by 5.	Short Term (10 Year)
12000020	Increase the rating of participating entities within Community Rating System (CRS) in the FPR by 100%.	Long Term (30 Year)
12000021	Increase the number of entities which regulate to the 1% annual chance future conditions floodplains as part of new development and redevelopment by 10%.	Short Term (10 year)
12000022	Increase the number of entities which regulate to the 1% annual chance future conditions floodplains as part of new development and redevelopment by 50%.	Long Term (30 year)
12000023	Increase the number of entities above the established baseline that have adopted a holistic watershed approach using existing Natural Flood Mitigation Features (NFMF) such as headwaters, buffers, and conservation easements for flood risk reduction as a basis for comprehensive subdivision regulations.	Short Term (10 year)

The Region 12 RFPG committee has identified a gap in flood risk and flood mitigation knowledge related to nature-based infrastructure (NBI) across the SAFPR. The committee recognizes that NBI provides significant, low-cost flood mitigation and many NBI areas also serve as the source of groundwater recharge in the SAFPR sustaining the water supply for many communities. Protecting and enhancing NBI where appropriate, provides benefits for flood peak attenuation, ecosystem services, groundwater recharge, and recreational value typically at a lower cost than constructed solutions. NBI provides both monetary and non-monetary benefits that should be accounted for in flood mitigation planning.

Goal Categories 5 and 6: Flood Infrastructure Projects

Flood infrastructure projects can reduce flood risks and hazards through the maintenance and rehabilitation of existing infrastructure. This can occur for structural infrastructure projects, non-structural projects, and a combination of structural/non-structural projects. Twelve specific goal statements were created for this category. The directly align with TWDB's overarching goal of the protection of life and property. Of the 12 goal statements listed below, goals 12000025, 12000026, 12000027, and 1000028 are non-structural infrastructure goals. Goal statements 12000031, 12000032, 12000033, 12000034, 12000035, and 12000036 are non-structural infrastructure goals. Goal statements 12000029, and 12000030 are structural/non-structural infrastructure goals. **Table 3.10** includes twelve specific goals for this category.

Table 3-10. Flood Infrastructure Project Goals

Goal ID	Goal Statement	Goal Term
12000025	Establish a baseline and increase the number of acres of publicly protected open space by 10 % as part of land conservation and acquisitions to reduce future impacts of flooding.	Short Term (10 Year)
12000026	Increase the number of restored acres of publicly protected open space land in the SAFPR.	Long Term (30 Year)
12000027	Reduce the number of NFIP repetitive-loss properties in the FPR by 25%.	Short Term (10 year)
12000028	Reduce the number of NFIP repetitive-loss properties in the FPR by 75%.	Long Term (30 year)
12000029	Reduce the number of existing (2022) residential properties in the future 1% annual chance floodplain by 10%.	Short Term (10 year)
12000030	Reduce the number of existing (2022) residential properties in the future 1% annual chance floodplain by 50%.	Long Term (30 year)
12000031	Reduce the number of vulnerable critical facilities located within the existing and future 1% annual chance (100-year) floodplain by 50%.	Short Term (10 year)

12000032	Reduce the number of vulnerable critical facilities located within the existing and future 1% annual chance (100-year) floodplain by 100.	Long Term (30 year)
12000033	Identify the eligible top 50 vulnerable roadway segments and low water crossings located within the existing and future 1% annual chance (100-year) floodplain.	Short Term (10 year)
12000034	Eliminate or mitigate the eligible top 50 vulnerable roadway segments and low water crossings located within the existing and future 1% annual chance (100-year) floodplain.	Long Term (30 year)
12000035	Increase the number of structural projects by 10% that include a NBS or Green Infrastructure (GI) component.	Short Term (10 year)
12000036	Increase the number of structural projects by 50% that include a NBS or Green Infrastructure (GI) component.	Long Term (30 year)

Benefits and Residual Risk after Goals are Met

The goals were developed by the San Antonio RFPG to set the stage for actions that can be quantified and measured in the future regional and state flood planning cycles. Future data collection efforts and the implementation of floodplain management projects/evaluations/strategies can be used to establish baseline data for future measurements to determine the progress towards achieving the SAFPR's goals. Once implemented, the specific goals detailed in this section once will fulfill the TWDB's overarching goals of identifying and reducing the risk and impact to life and property, and avoiding increasing or creating new flood risk by addressing future development within the areas known to have existing or future flood risk. Beyond protecting against the loss of life and property, the goals offer several benefits, including protecting infrastructure, water supply, and the environment and sustainability. The types of benefits are presented below in **Table 3.11**.

Table 3-11. Flood Planning Goal Benefits

Types of Benefits	Overarching Goal Categories					
	Goal 1 Flood Education and Outreach	Goal 2 Flood Warning and Readiness	Goal 3 Flood Studies and Analysis	Goal 4 Flood Prevention	Goal 5 Non-Structural Flood Infrastructure Projects	Goal 6 Structural Flood Infrastructure Projects
Protect Life	◑	●	◑	◑	●	●
Protect Infrastructure		◑	◑	●	◑	●
Protect Property		◑	◑	●	●	●
Protect the environment	◑		◑	●	●	●
Protect/enhance water supply				◑	◑	◑
Sustain the economy		◑		◑	●	◑
Realize multiple benefits*				◑	◑	◑
Increase public awareness	●	●	◑	◑	◑	◑
Build community support	●	●	◑	◑		

●-Direct Benefit

◑-Potential Benefit

*Multiple benefits could include improved flood protection while improving water supply, increasing public recreation opportunities

However, it is recognized that it is not possible to protect against all potential flood risks. In selecting the flood risk reduction goals, the RFPG is inherently determining the accepted residual risk for the SAFPR. In general, residual risks for flood risk reduction goals could be characterized as follows:

1. While a new development may be constructed outside the 1% annual chance floodplain, flood events of greater magnitude will inundate areas beyond those preserved as a floodplain.
2. Flood events may exceed the level of service for which infrastructure is designed.
3. Communities depend on future funding and program priorities to maintain, repair, and replace flood protection assets. Routine maintenance of infrastructure is required to maintain its design capacity. Maintenance is sometimes overlooked due to budget, staff, and time constraints.
4. Policies, Regulations, and Standards reduce adverse impacts associated with development activity but does not eliminate it. Limitations placed on local government by the state legislature reduce the ability to adopt locally defined best approaches to protect the community.
5. The lack of local enforcement of floodplain regulations also creates risk.
6. In our representative government, policy changes that adversely impact budgets, prior plans, assets, and standards is always a possibility.
7. Practical (time and money) limits of understanding and precision associated with studies, models, and plans.
8. Human behavior is unpredictable, people may choose to ignore flood warning systems or cross over flooded roadways for a variety of reasons.

As in other chapters of this report, the TWDB requires a detailed table of the recommended flood mitigation and floodplain management goals. The TWDB-required Table 11 has been populated and is included in Appendix X Table 11.

4

Assessment and Identification of Flood Mitigation Needs

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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 TWDB in December 2021 (Section 4.2).

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 San Antonio Flood Planning Region (SAFPR). This information guides the identification of flood mitigation actions.

4.1.1 Greatest Flood Risk Knowledge Gaps

The greatest flood risk knowledge gaps for the SAFPR have been identified as areas in the basin where:

1. Flood inundation boundaries are either not defined or considered inaccurate
2. Flood studies have not occurred in the recent past and are not on-going or proposed
3. Flood management practices do not exist or are not effectively enforced

Flood Inundation Boundary 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. Refer to Chapter 2 – Flood Risk Analysis Figure 2-1 depicts were there are the largest modeling gaps in the SAFPR. The lower half of the SAFPR portion of the basin does not have accurate flood mapping available and relies on approximate and fathom data.

Flood Studies and On-Going Projects Gaps

Flood studies are used to identify existing and future flood risks and often recommend solutions to reduce those risks. Without a flood study it is difficult to implement actionable steps to reduce flood risk. Flood studies help determine what types of flood projects are needed for an area to reduce their flood impacts. Flood mitigation projects are key to reducing risks in an area. For the SAFPR, generally flood studies and projects have occurred or are occurring for counties throughout. The major flood studies and projects include the:

- General Land Office flood study
- San Antonio Drainage Improvements
- Karnes County Wide Flood Planning/Prevention Study

- TxDOT Projects

Refer to Appendix A – Required Maps, Map 2: Proposed or Ongoing Flood Mitigation Projects depicting where these projects are occurring in the SAFPR.

Floodplain Management Practices

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 storm event elevation. Without floodplain management practices, it is difficult to control future flood risks. Refer to Chapter 3 Floodplain Management Practices and Flood Protection Goals Figure 3-4 depicts where floodplain management practices are unknown or considered “low”. This includes more rural areas located near the cost and away from the major population growth center of San Antonio.

4.1.2 Greatest Known Flood Risk and Flood Mitigation Needs

The areas of greatest known flood risk and flood mitigation needs in the SAFPR 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.

Flood Hazard

The flood hazard analysis defined the 1% and 0.2% annual chance storm event boundaries for the entirety of the basin rivers and associated tributaries with contributing drainage areas greater than one square mile. The existing condition flood hazard is depicted on a sub region level in Appendix A – Required Maps, Map 4: Existing Condition Flood Hazard.

Flood Exposure

The flood exposure analysis indicated roughly 26,633 structures at potential risk of flooding from the 1% and 0.2% annual chance flood event. From this analysis several hot spots for flood exposure appear to be (1) the urban areas around the Cibolo and Medina Rivers due to the density of development and total population in those areas and (2) and the confluence of the San Antonio and Cibolo Rivers due to the magnitude of flood volume on each respective creek and similarity in watershed size. Additionally, flooded roadways and agricultural areas are found throughout the region, and the impacts due to the loss of function in these areas should not be understated. A heat map was produced to illustrate the flood exposure in the SAFPR as shown in the Appendix A – Required Maps, Map 6: Existing Condition Flood Exposure.

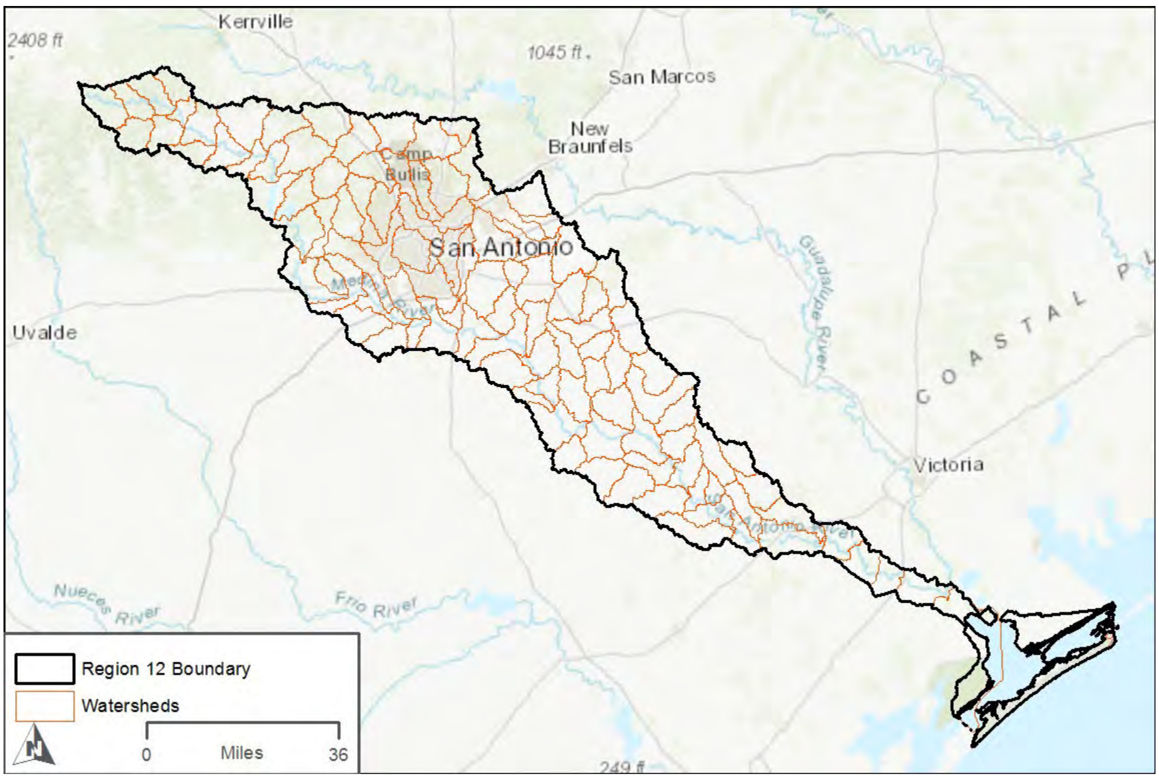
Flood Vulnerability

The flood vulnerability analysis identified roughly 220 critical facilities in the 1% and 0.2% annual chance storm event inundation and in general mirrored the exposure analysis in terms of hot spot areas as shown in Appendix A – Required Maps, Map 7: Existing Condition Flood Vulnerability. The most vulnerable locations are on the outskirts of the City of San Antonio and at confluence of the San Antonio and Cibolo Rivers in Karnes County.

Greatest Known 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 180 HUC-12 watersheds in the SAFPR, as shown in Figure 4-1 below.

Figure 4-1. San Antonio Flood Planning Region HUC 12 Watershed



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 (7.5%) – Property damage data provided by the National Weather Service, FEMA, and local knowledge of flood-prone areas.
- Historical Life Loss (15.7%) – Flood fatality and injury data collected by the National Weather Service since 1996.

- Property Damage – Exposure (14.8%) – Exposure data representing the number of building structures located within the best available 1% and 0.2% annual chance flood inundation boundaries.
- Property Damage – Vulnerability (4.9%) – Vulnerability data representing the number of building structures identified in the 'exposure' layer above within a high vulnerability area (i.e. SVI > 0.75%)
- Property Damage – Critical Facilities (15.7%) - Vulnerability data representing critical facilities such as hospitals, schools, fire and police stations, etc. identified in the 'exposure' layer above.
- Life Loss – Low Water Crossings (9.8%) - Data as provided by TNRIS.
- Life Loss – Dams (10.0%) - Data representing potential hazardous dams that have been identified as either hydraulically inadequate or deficient by the TCEQ.
- Public Comments (7.5%) - Reported flooding problems collected from public comments.
- Roadway Length Divided By Total HUC12 Area (6.0%) - The length of roadway in each HUC12 divided by the total area of the HUC12.
- Agricultural Area Divided By Total HUC12 Area (8.8%) - The area used for agriculture in each HUC12 divided by the total area of the HUC12.

The data points for each category were either counted or weighted average was calculated 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.

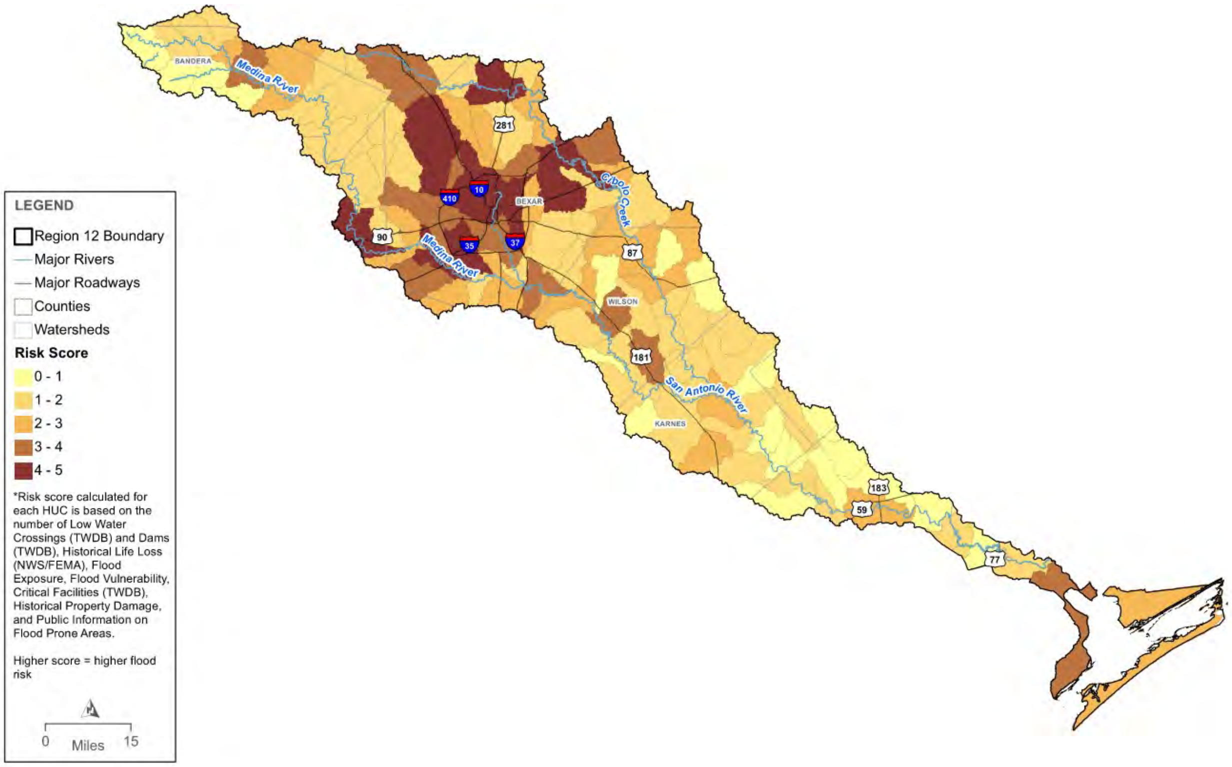
Table 4-1. Flood Risk Score Example Calculation

HUC 12 ID	Historical Property Damage	Historical Life Loss	Property Damage – Exposure (Buildings)	Property Damage – Vulnerability (Buildings)	Property Damage – Critical Facilities	Low Water Crossings	Life Loss (Dams)	Public Comments	Roadway Length	Agricultural Area	Total Score	Scaled Score[1]
1210040505204	0	0	3	0	4	4	0	0	5	1		
Weighted Percentage	7.5%	15.7%	14.8%	4.9%	15.7%	9.8%	10.0%	7.5%	6.0%	8.8%	100%	
Weighted Score	0	0	0.444	0	0.628	0.392	0	0	0.3	0.088	1.852	2.411

1 – Scaled score is equal to the total score multiplied by the scale factor, which is the greatest possible score (5) divided by the greatest score in the dataset (3.841)

See Figure 4-2 below for flood risk scores for each HUC-12 watershed in the San Antonio Basin. No risk is represented by a score of zero and the highest risk is represented by a score of 5.

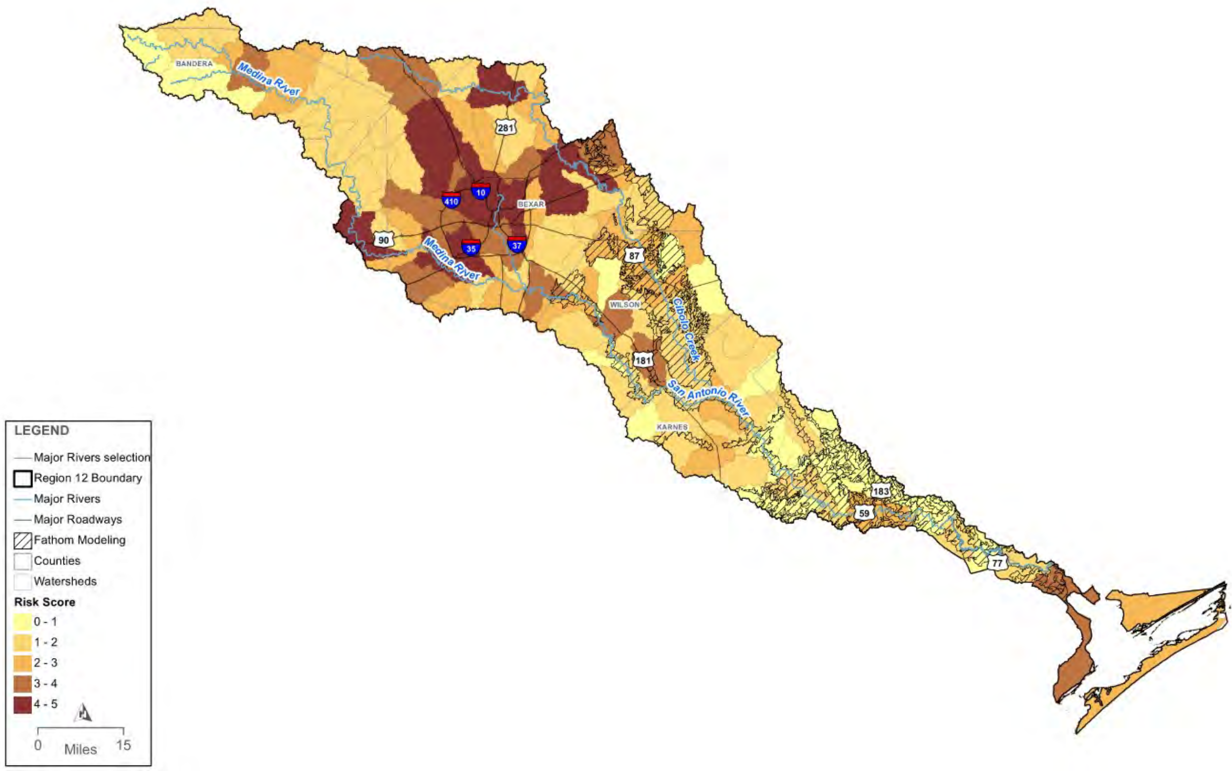
Figure 4-2. Overall Flood Risk per HUC 12 watersheds



Flood Mitigation Needs – Modeling Gaps

Figure 4-3 below overlays the overall flood risk where flood modeling gaps have been identified. Identified high flood risk areas in the mid and upper basin are in areas without detailed hydrologic and hydraulic models and inundation mapping. Prioritizing investment in detailed hydrologic and hydraulic models in the gap areas with the highest overall flood risk is recommended.

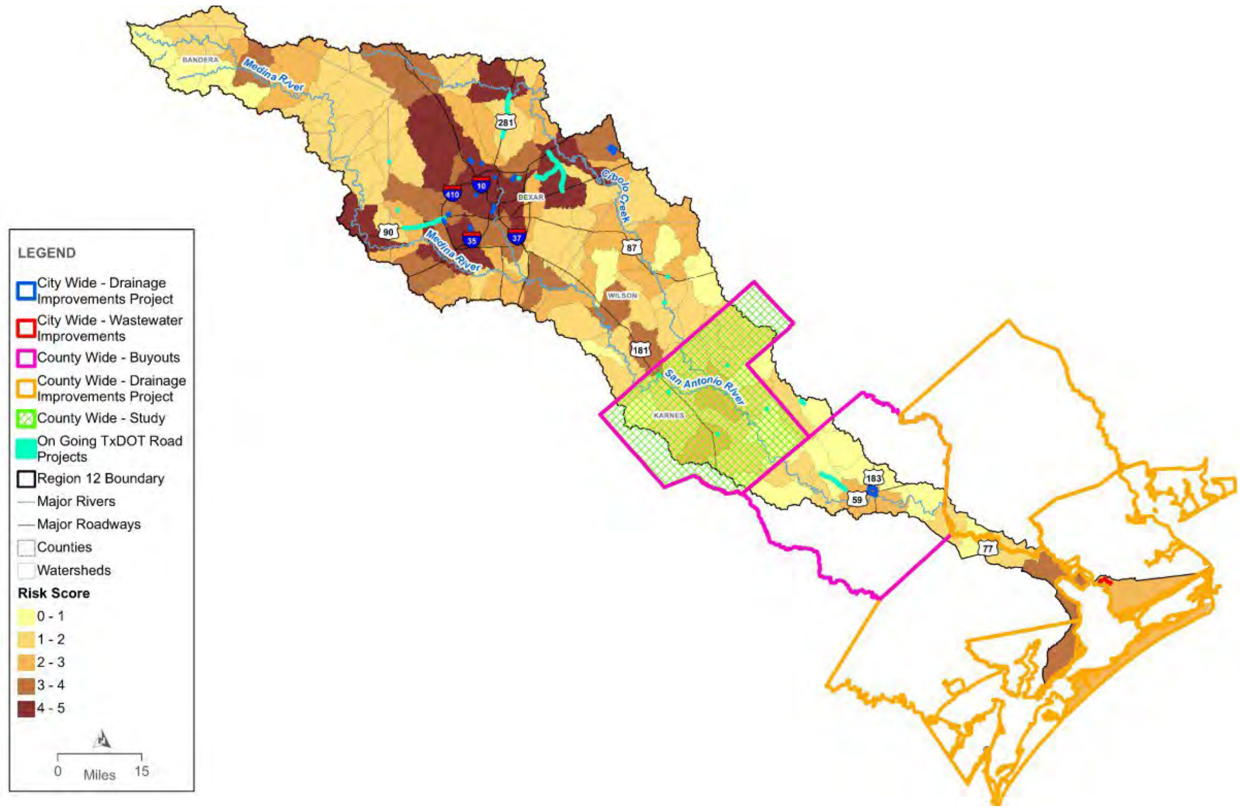
Figure 4-3. Accurate Modeling and Mapping Overly w/ Overall Flood Risk



Flood Mitigation Needs – Flood Study / Project Gaps

Figure 4-4 below overlays the overall flood risk where no on-going or proposed flood studies / projects have been identified. Specifically, the high-risk flood areas in lower basin located in areas without detailed modeling. Investment in flood studies or projects in this and other identified gap areas with high flood risk is recommended.

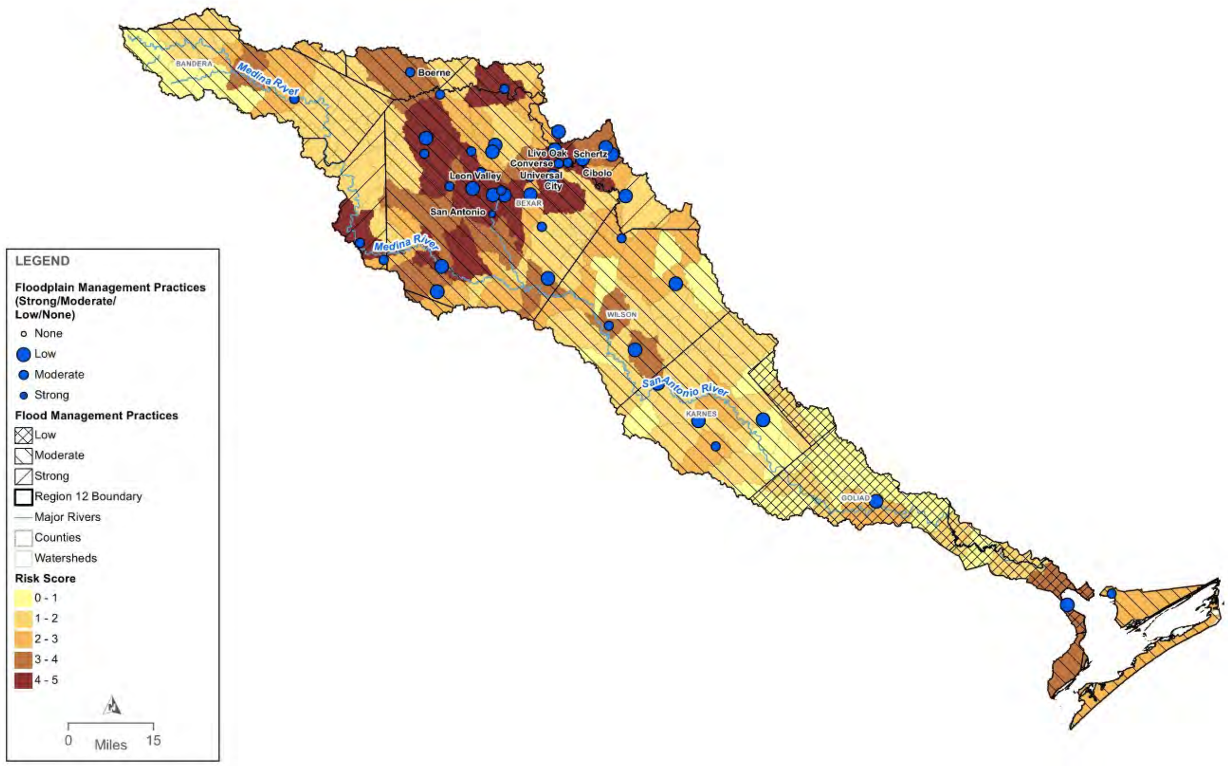
Figure 4-4. Flood Study / Project Gaps and Mapping Overly w/ Overall Flood Risk

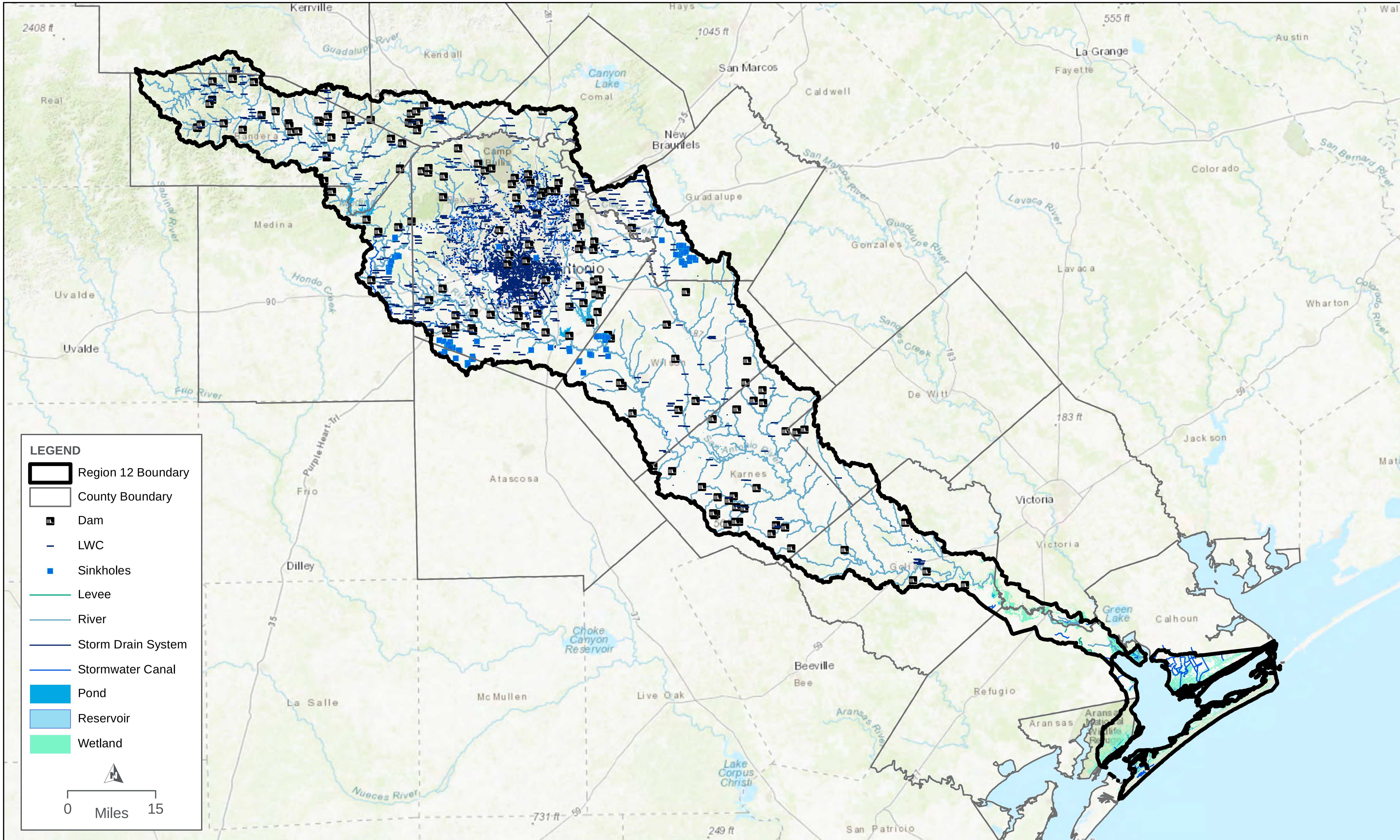


Flood Mitigation Needs– Floodplain Management Gaps

Figure 4-5 below overlays the overall flood risk where flood management practice is none or low in relation to the overall flood risk. Enhancement of flood management practices in areas with a high flood risk and a floodplain management gap is recommended. Examples would be the enhancement of floodplain management in the counties of Goliad, Refugio, Wilson and Karnes.

Figure 4-5. Floodplain Management Overly w/ Overall Flood Risk





REGION 12 - EXISTING FLOOD INFRASTRUCTURE

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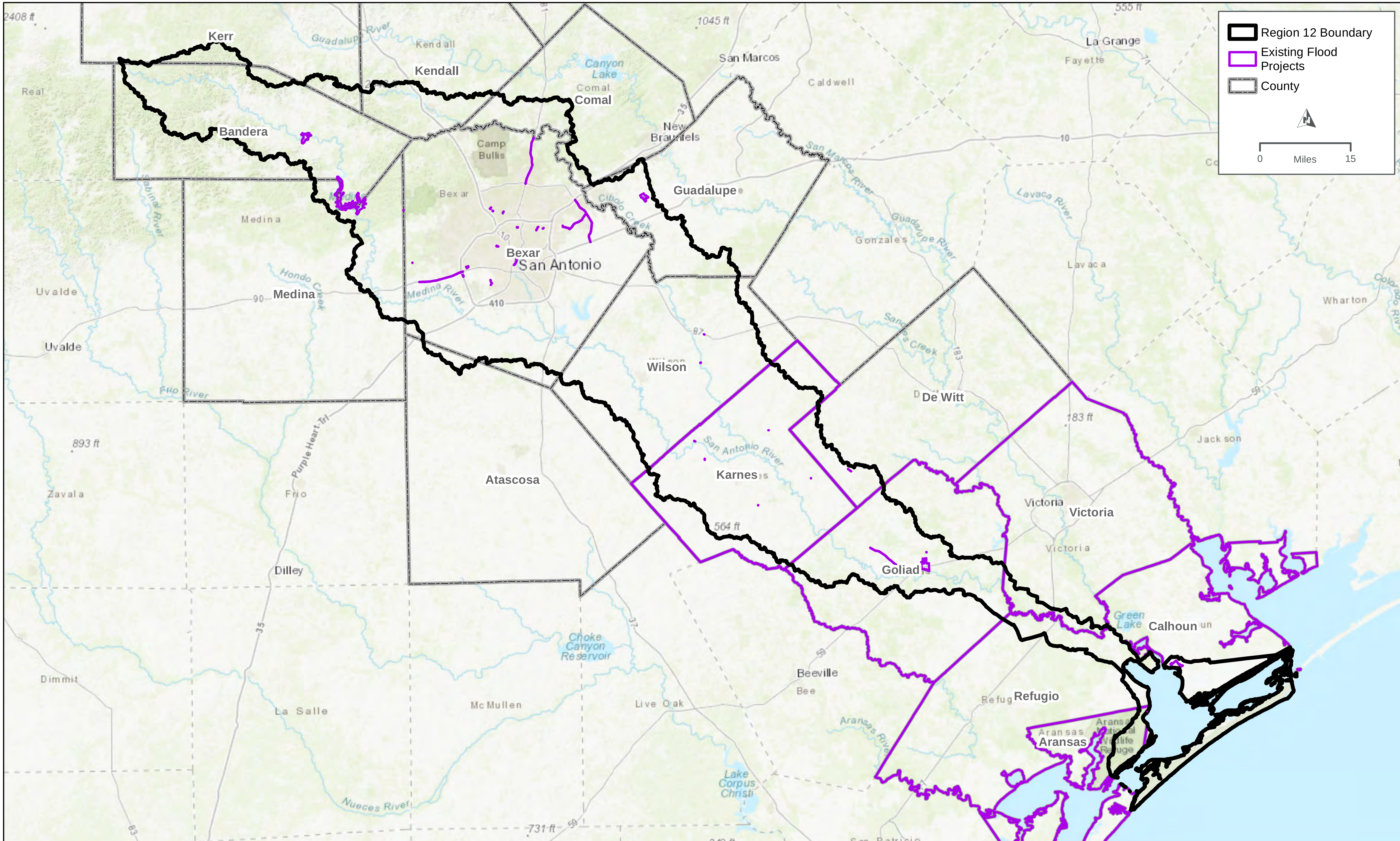

REGION 12 - PROPOSED OR ONGOING FLOOD MITIGATION PROJECTS

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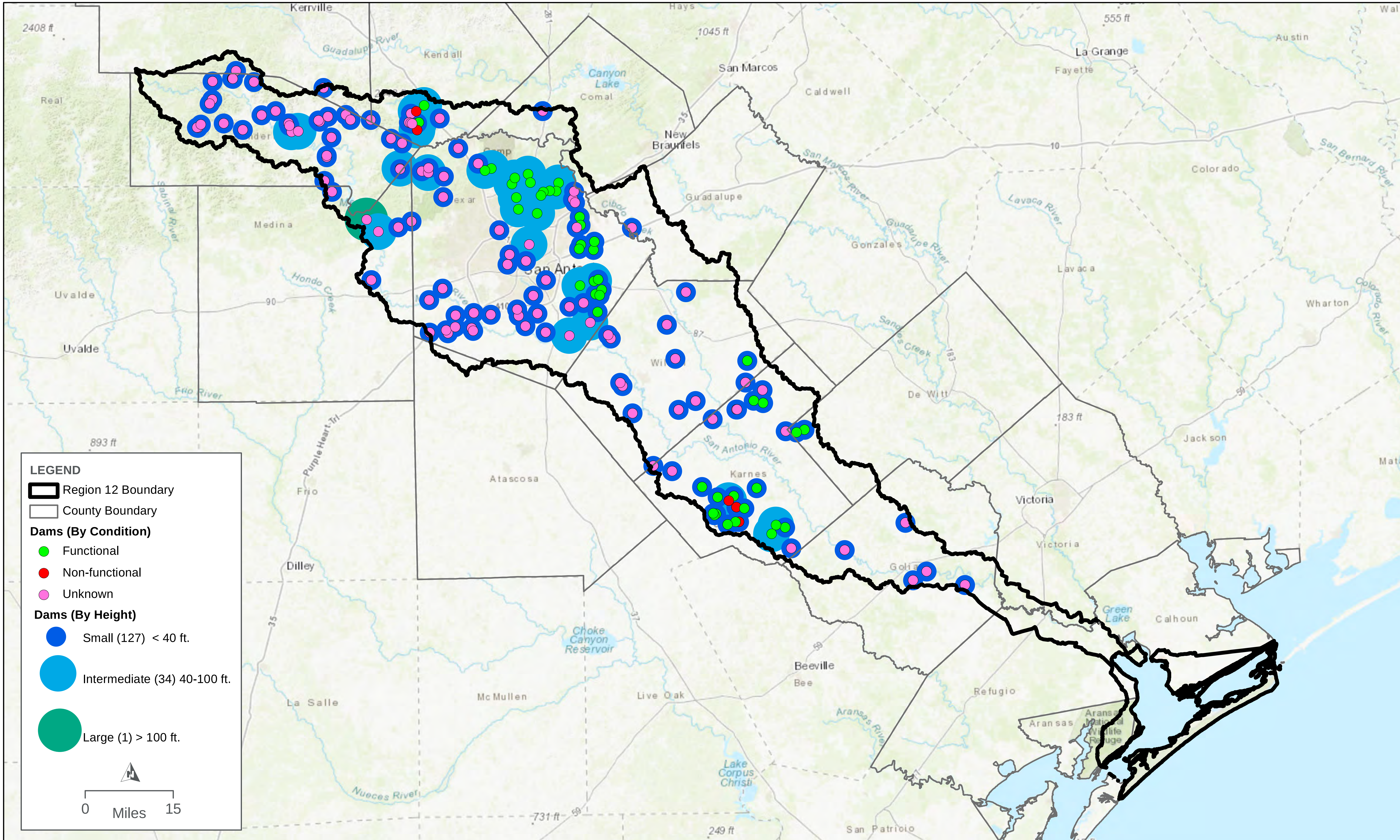

REGION 12 - NON-FUNCTIONAL OR DEFICIENT DAMS

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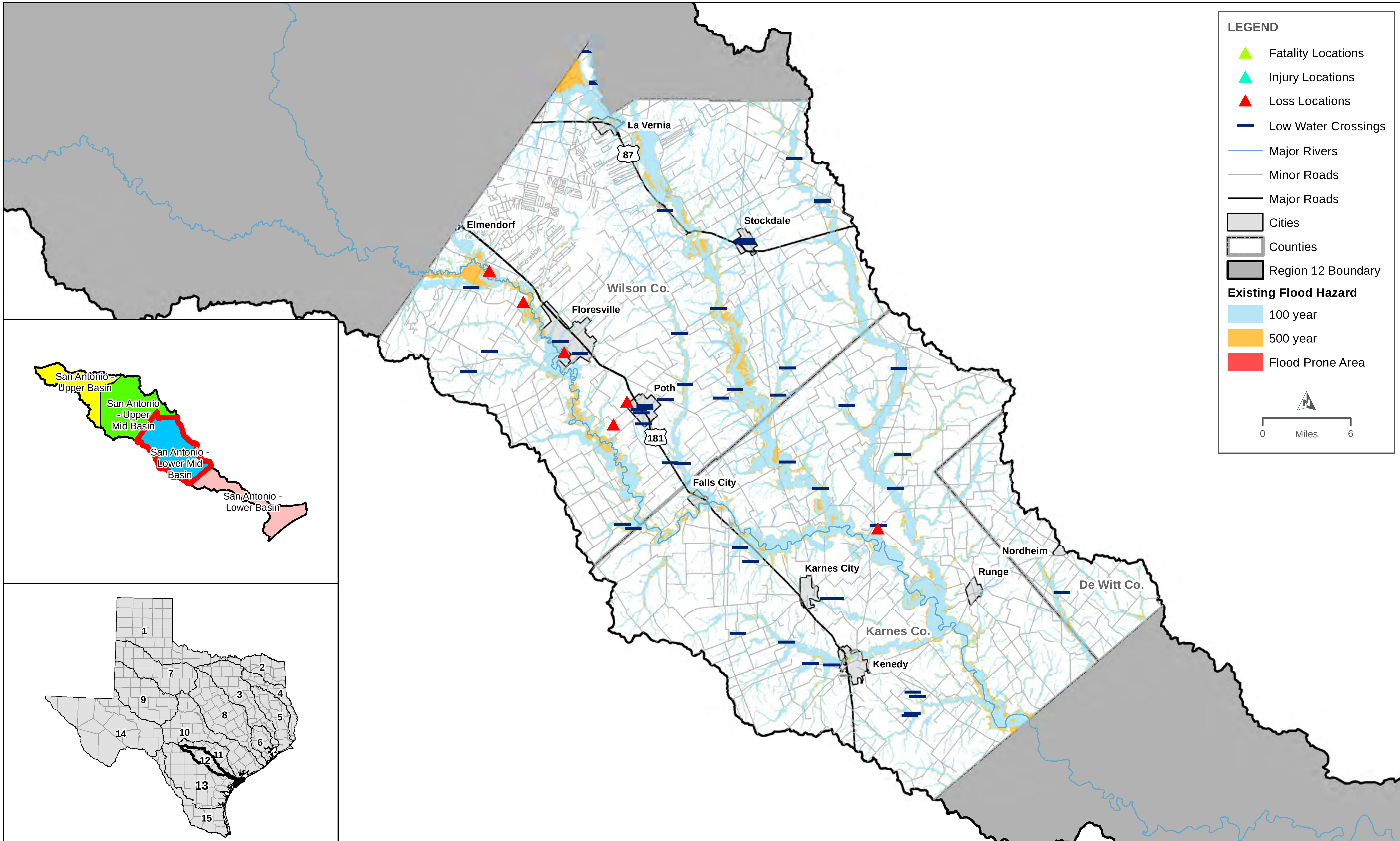

REGION 12 SAN ANTONIO LOWER MID BASIN - EXISTING FLOOD HAZARD

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FIGURE 3

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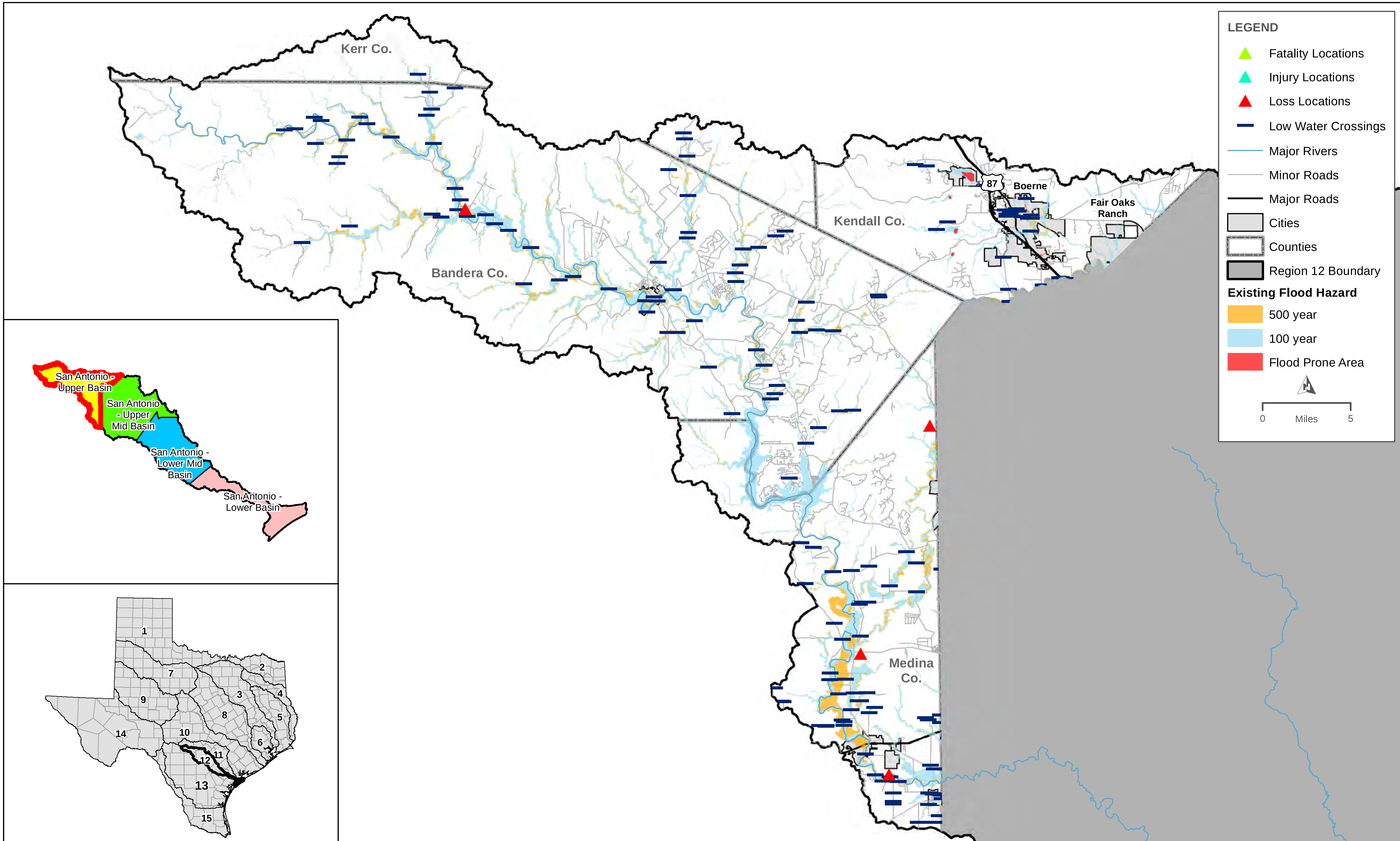

REGION 12 SAN ANTONIO UPPER BASIN - EXISTING FLOOD HAZARD

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FIGURE 1

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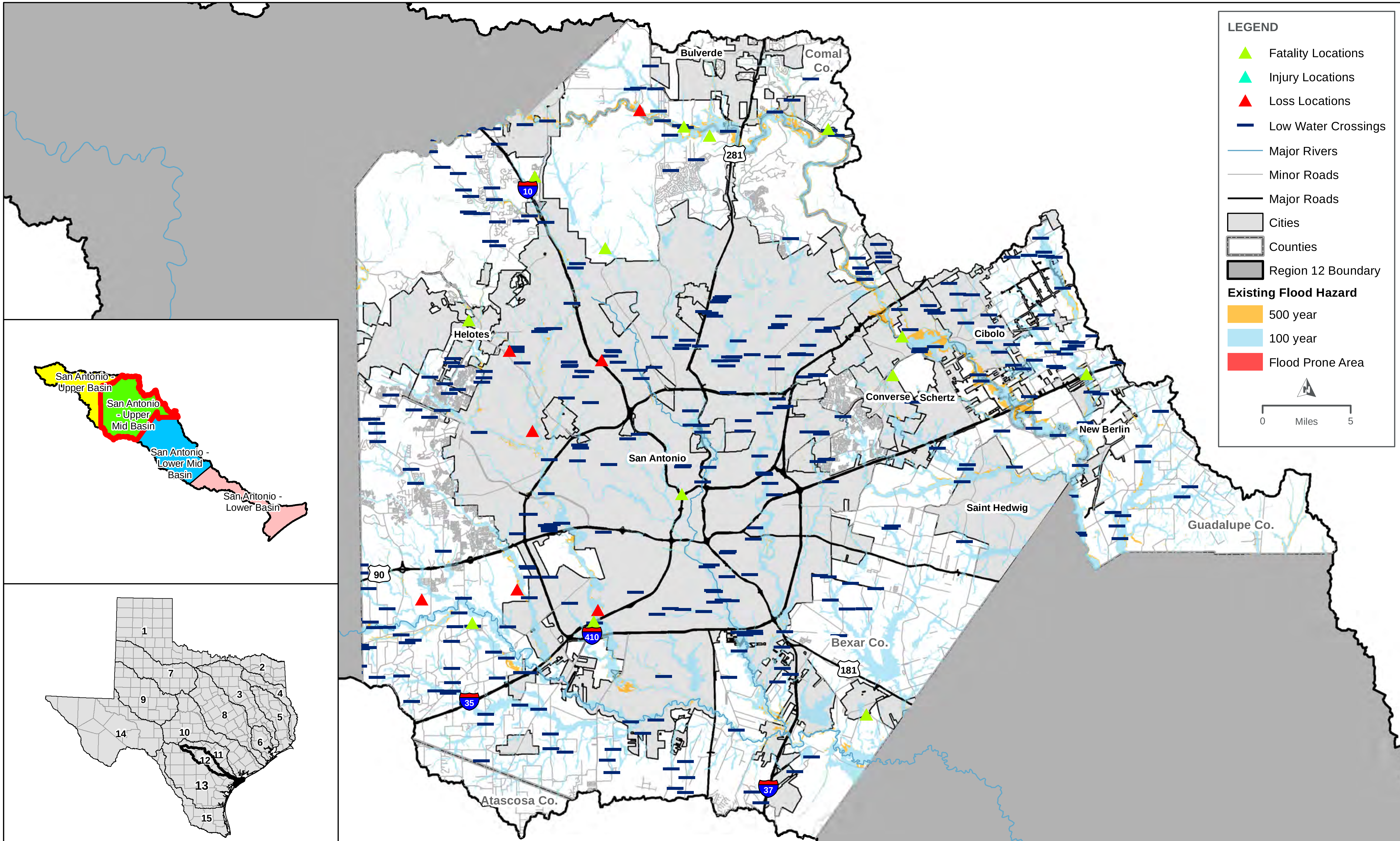

REGION 12 SAN ANTONIO UPPER MID BASIN - EXISTING FLOOD HAZARD

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FIGURE 2

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REGION 12 (NORTH) - EXISTING FLOOD HAZARD
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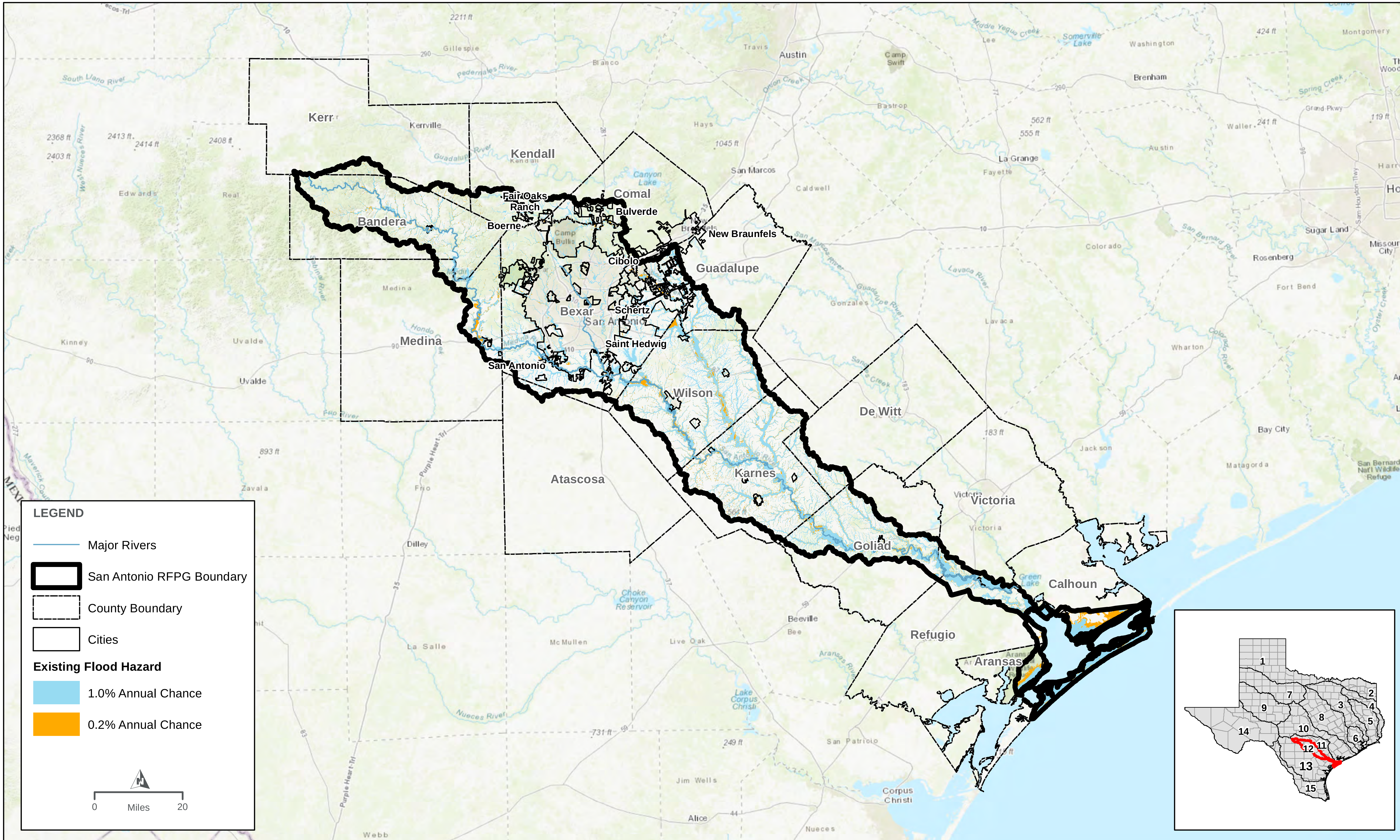

REGION 12 - EXISTING CONDITION FLOOD HAZARD

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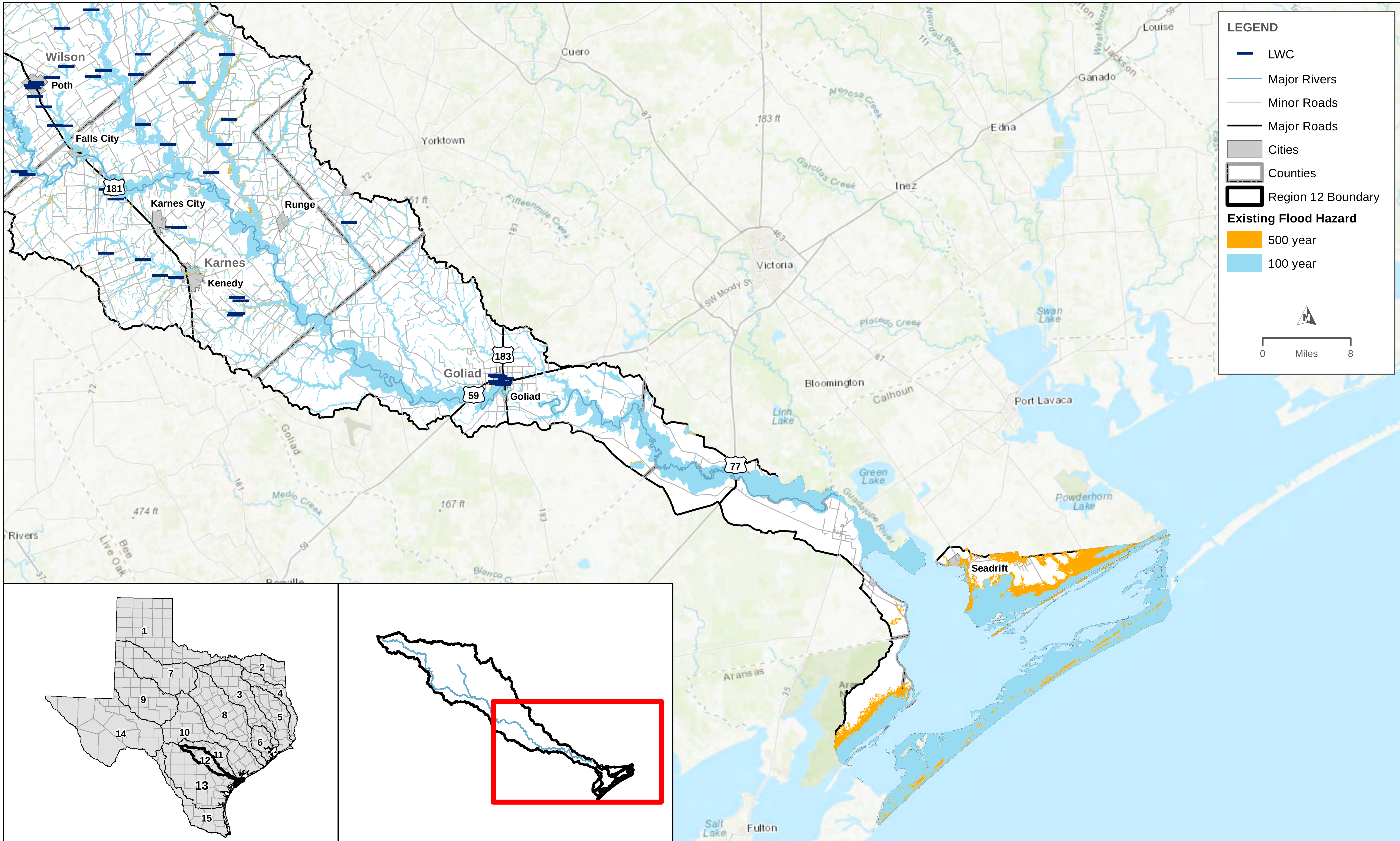

REGION 12 (SOUTH) - EXISTING FLOOD HAZARD

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FIGURE 2

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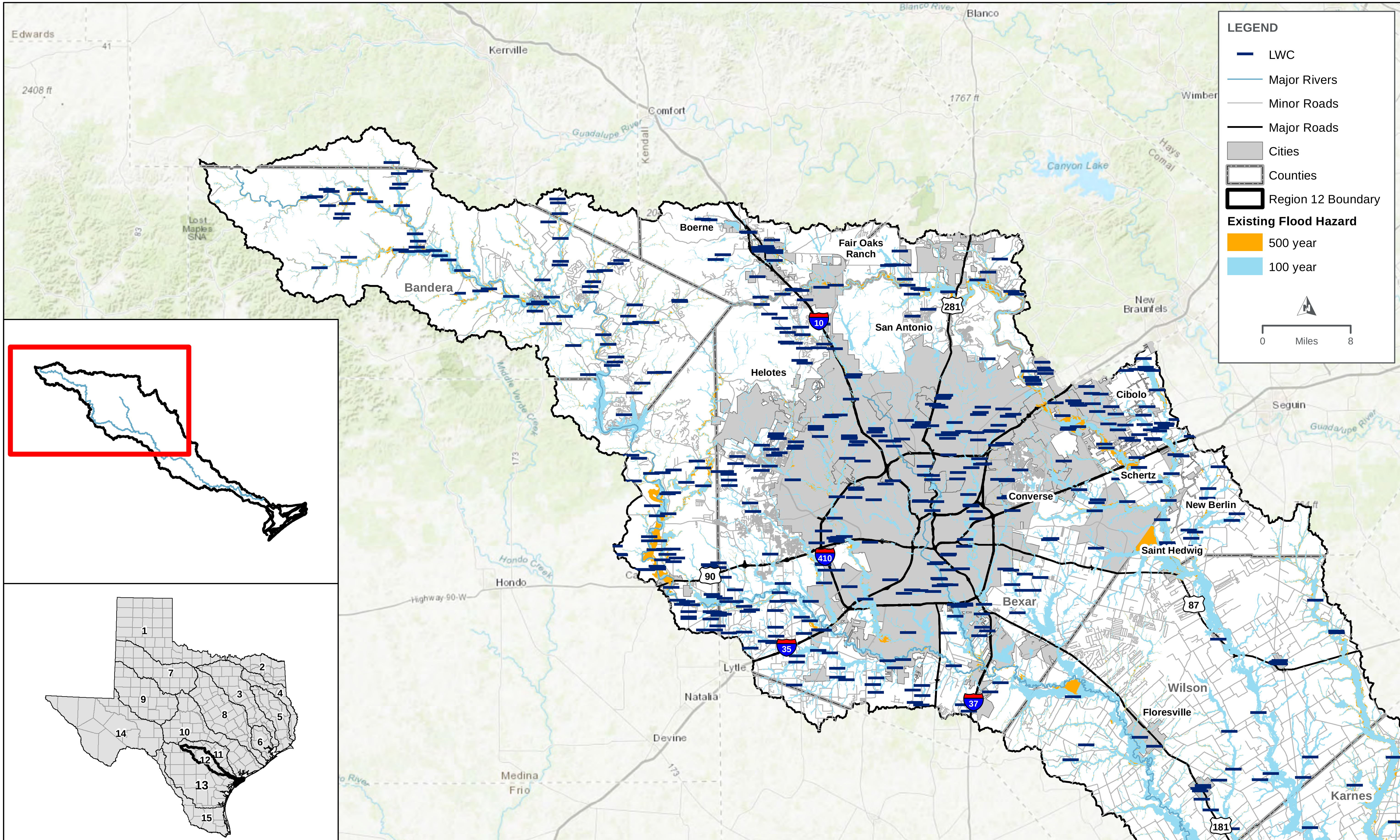

REGION 12 (NORTH) - EXISTING FLOOD HAZARD

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FIGURE 1

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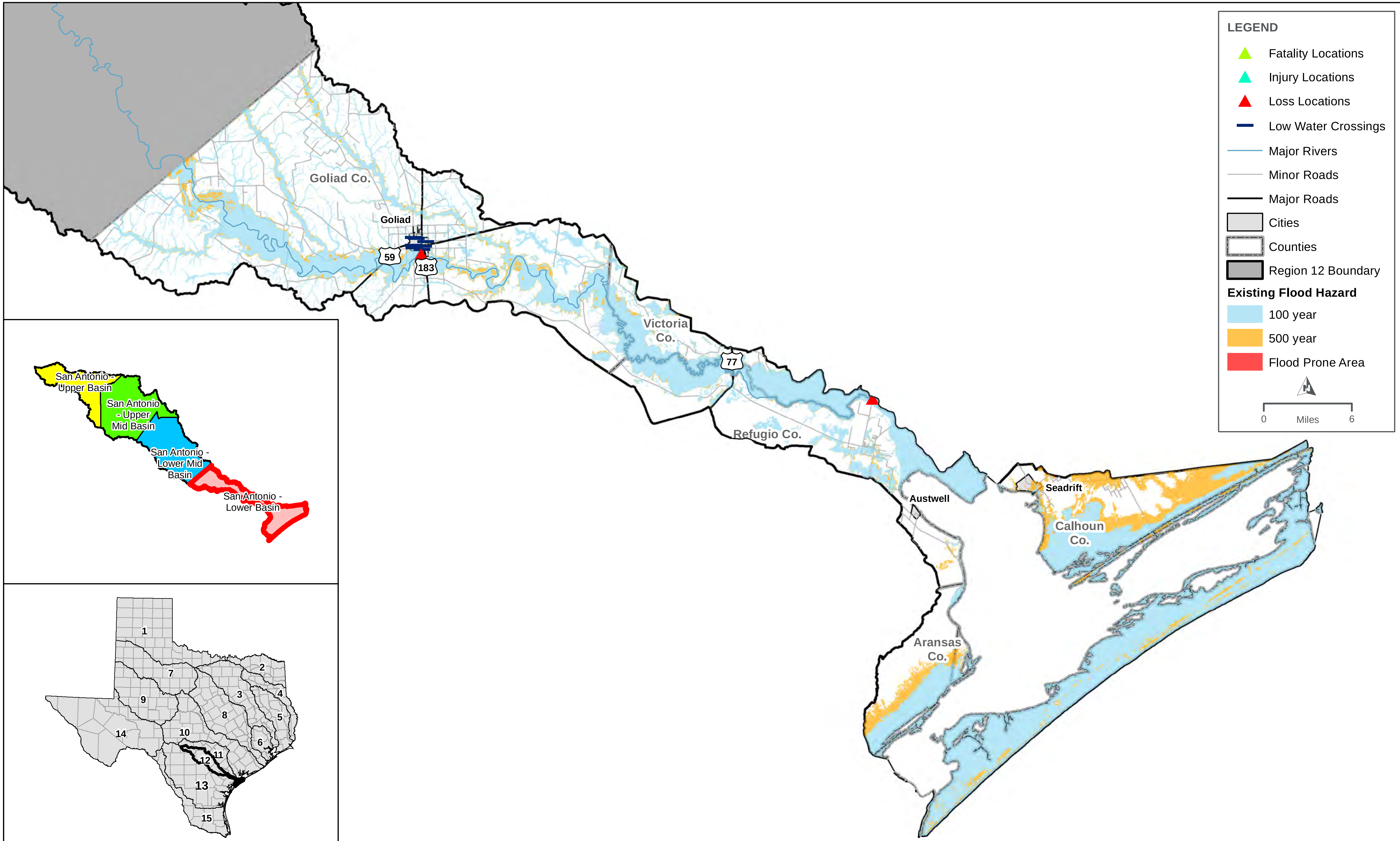
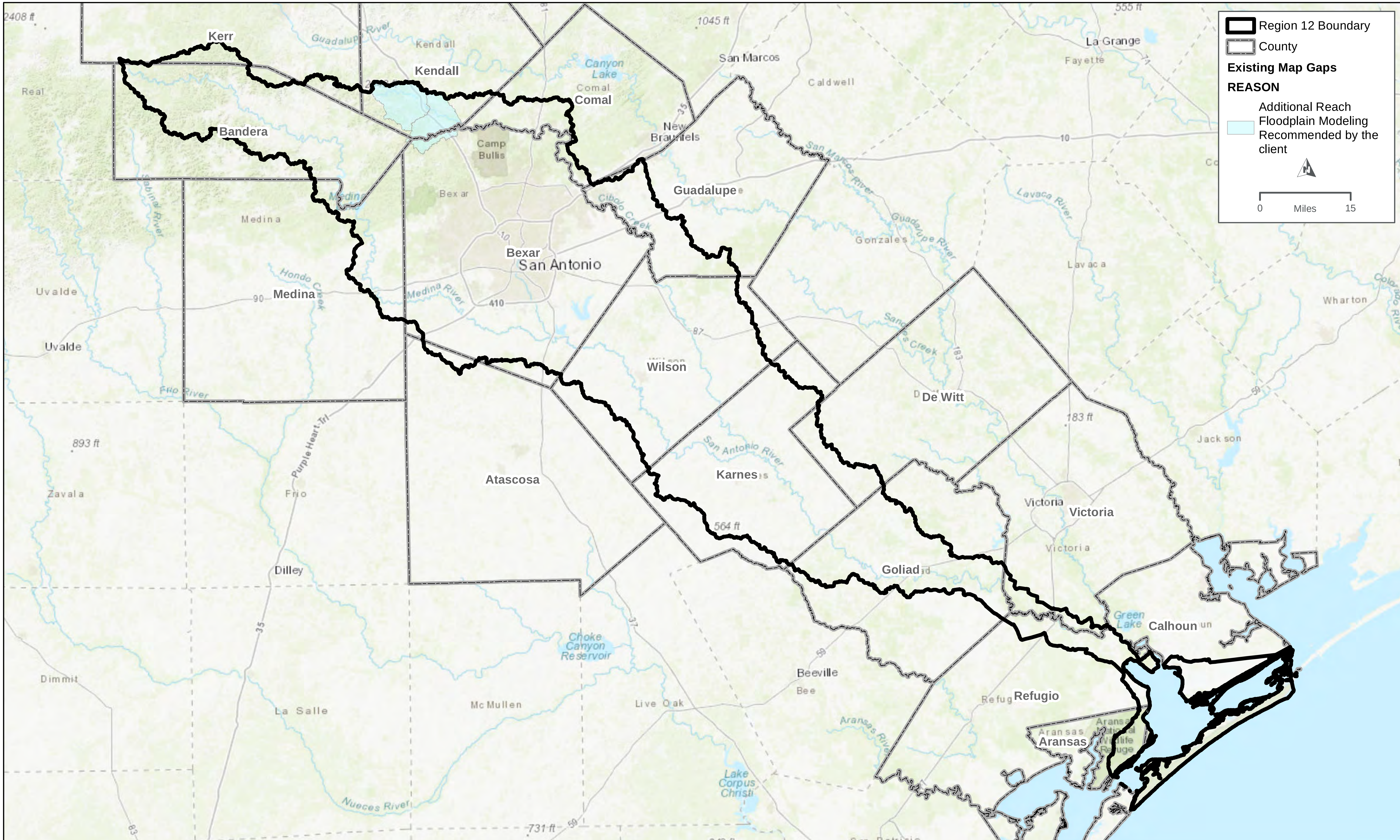


REGION 12 SAN ANTONIO LOWER BASIN - EXISTING FLOOD HAZARD

DRAFT

FIGURE 4

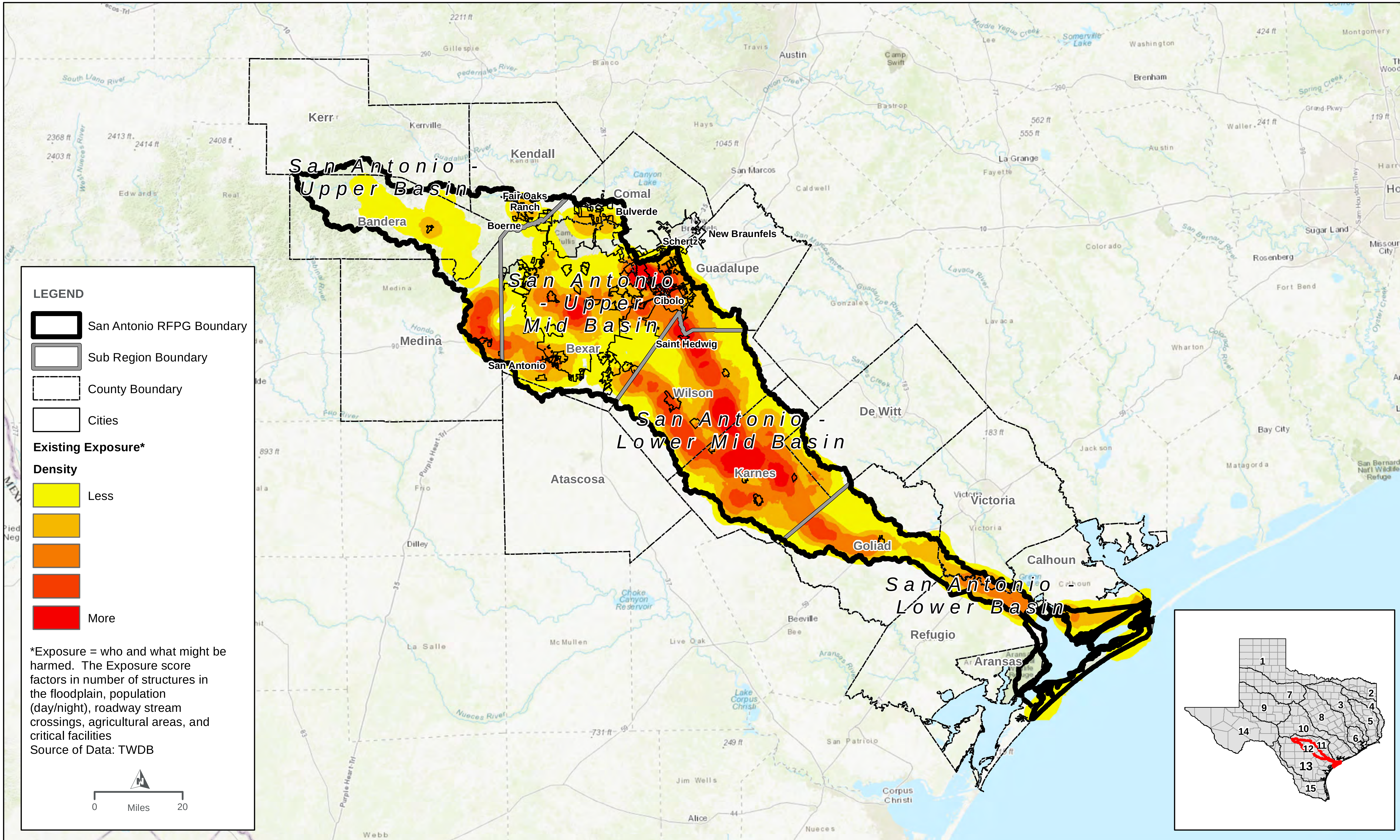
PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\EXISTINGFLDHAZARD_GROUPD_11X17_FIG4.MXD - USER: PDUNNING - DATE: 2/21/2022



REGION 12 - KNOWN DATA GAPS

DRAFT

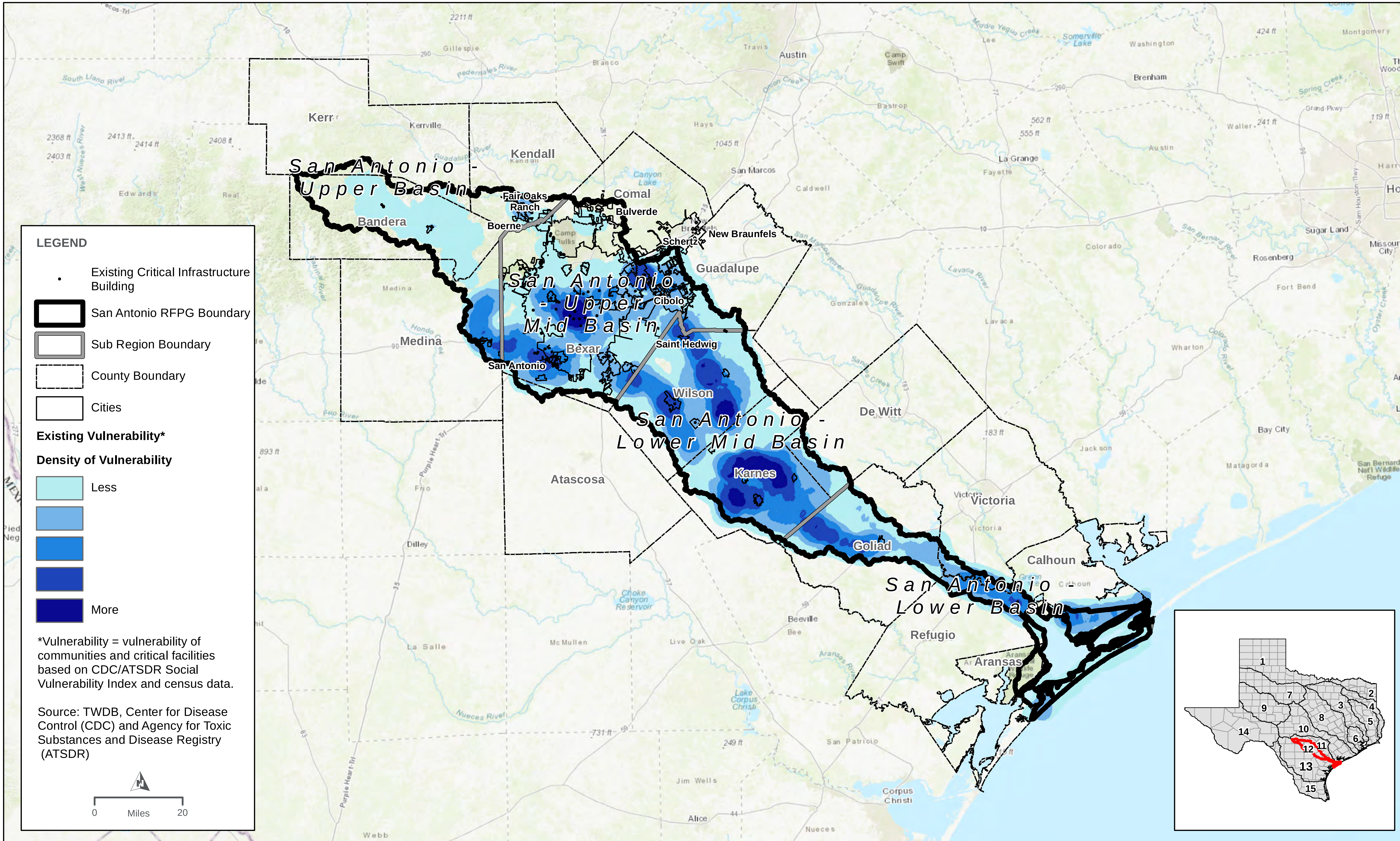
PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\TM_FIGURES\MAP5_GAPMAP_11X17.MXD - USER: CAMARAL - DATE: 7/8/2022



REGION 12 - EXISTING CONDITION EXPOSURE ANALYSIS

DRAFT

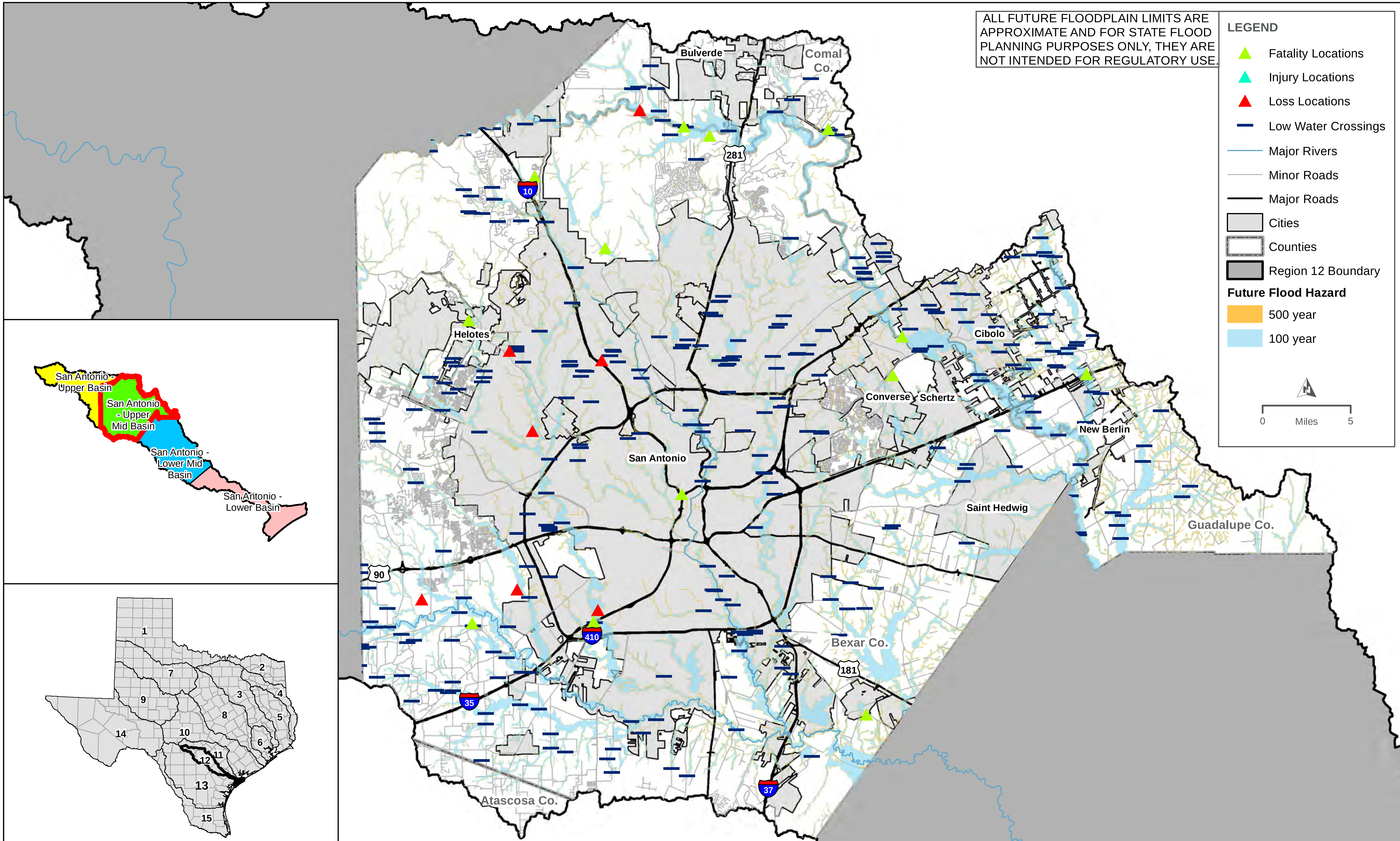
DOCUMENT PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\TECHNICALGUIDELINES\REGIONAL_HEATMAP_EXISTING_EXPOSURE_11X17.MXD



REGION 12 - EXISTING CONDITION VULNERABILITY ANALYSIS

DRAFT

DOCUMENT PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\TECHNICALGUIDELINES\REGIONAL_HEATMAP_EXISTING_VULNERABILITY_11X17.MXD

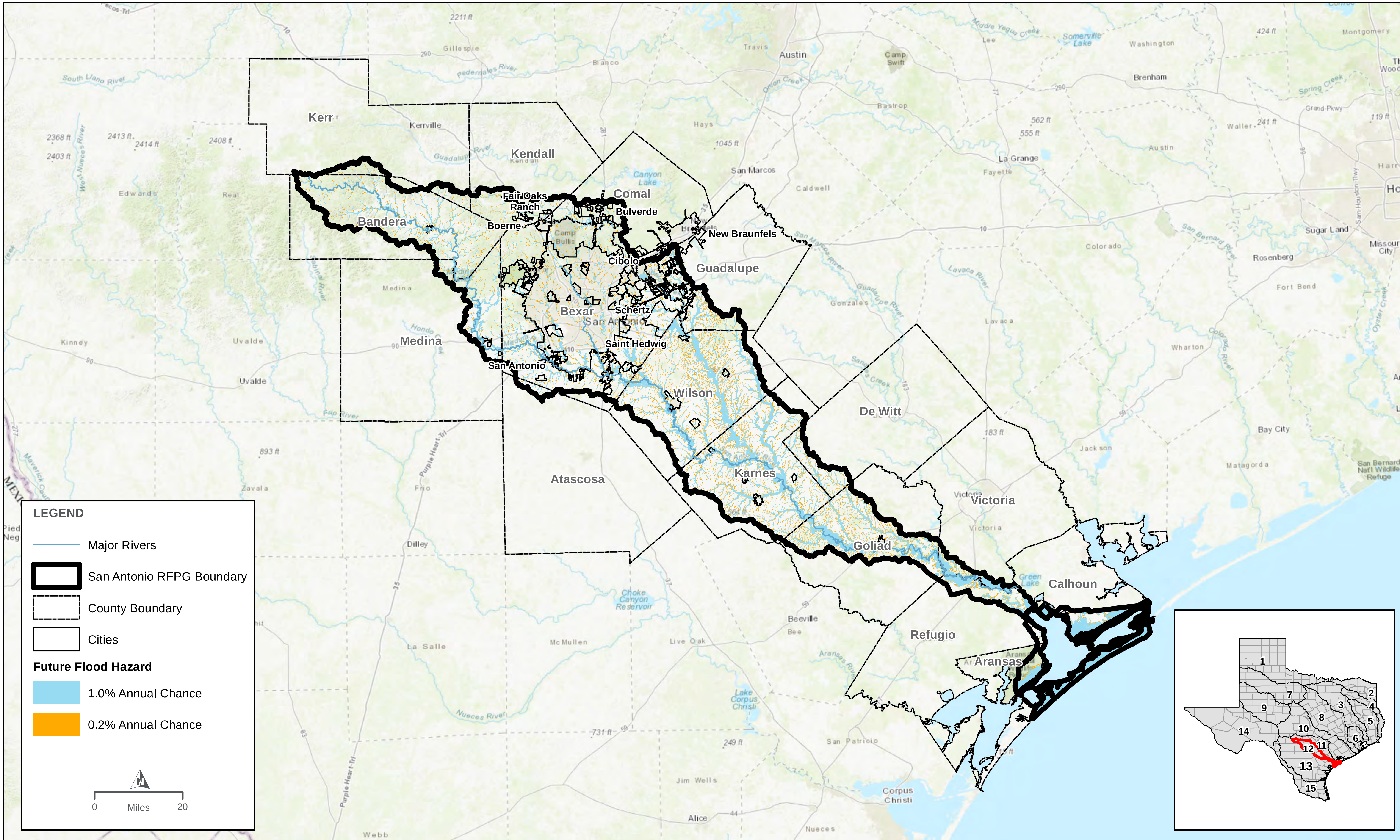


REGION 12 SAN ANTONIO UPPER MID BASIN - FUTURE FLOOD HAZARD

DRAFT

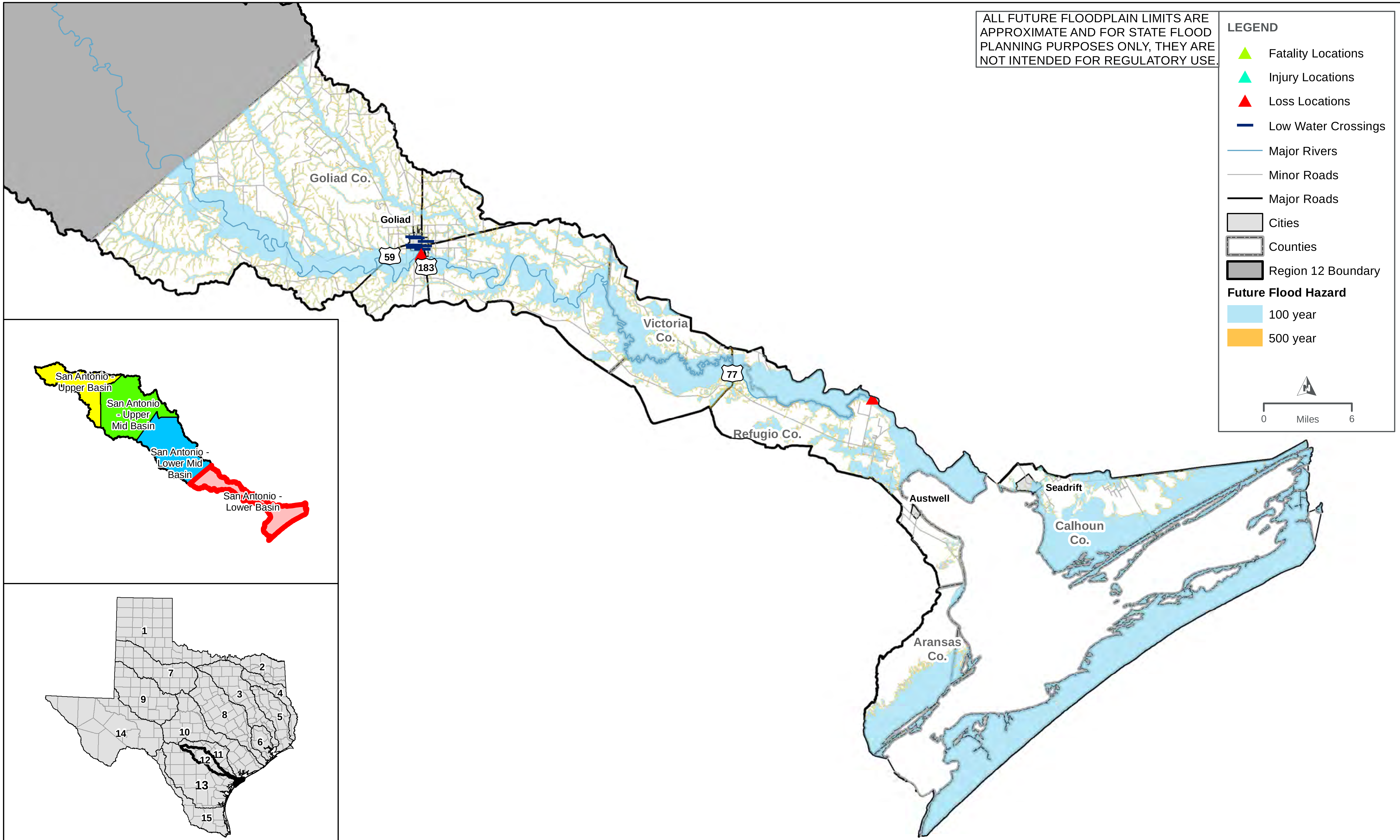
FIGURE 2

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\FUTUREFLDHAZARD_GROUPB_11X17_FIG2.MXD - USER: PDUNNING - DATE: 7/6/2022



REGION 12 - FUTURE CONDITION FLOOD HAZARD

DRAFT

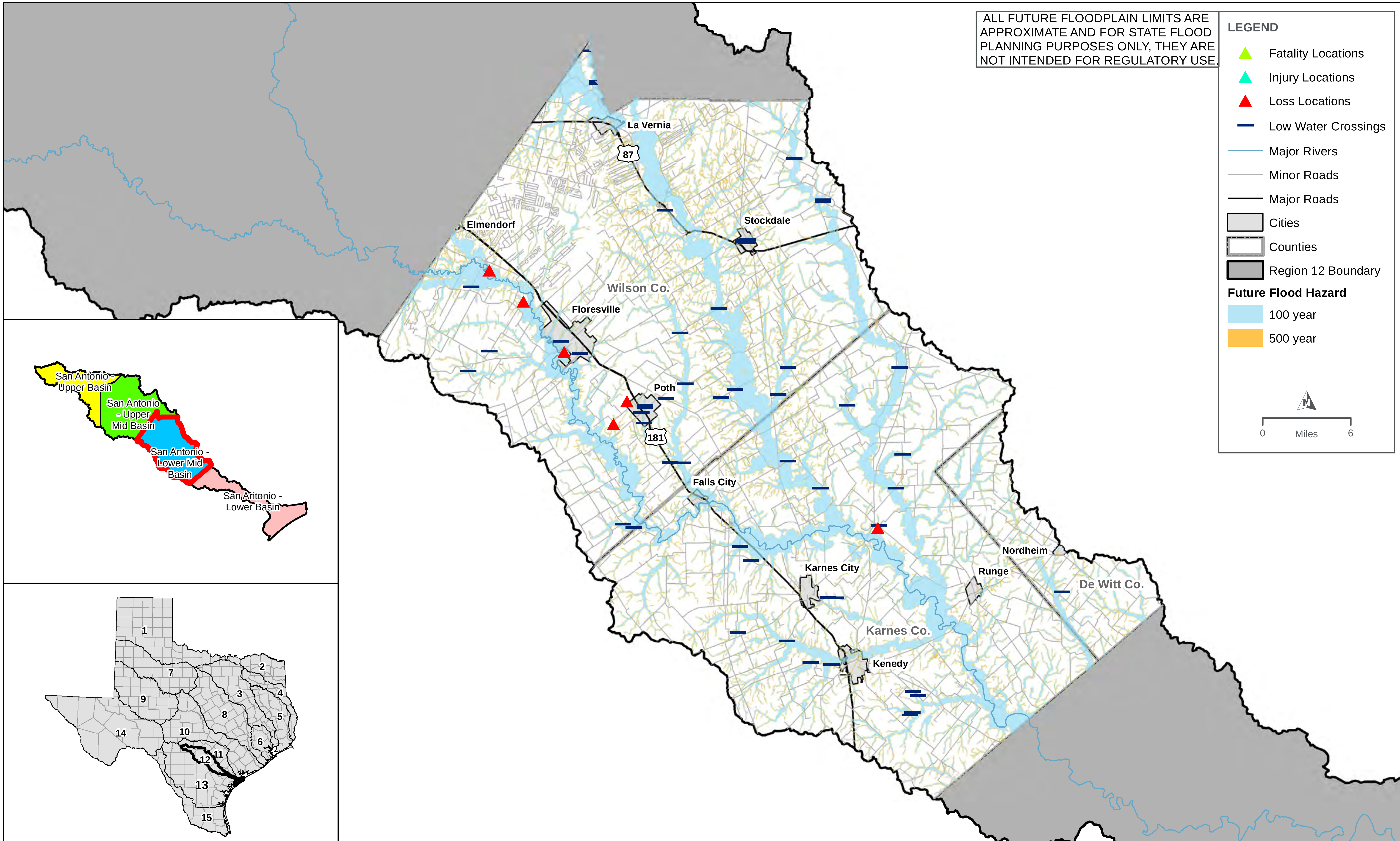


REGION 12 SAN ANTONIO LOWER BASIN - FUTURE FLOOD HAZARD

DRAFT

FIGURE 4

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\FUTUREFLDHAZARD_GROUPD_11X17_FIG4.MXD - USER: PDUNNING - DATE: 7/6/2022

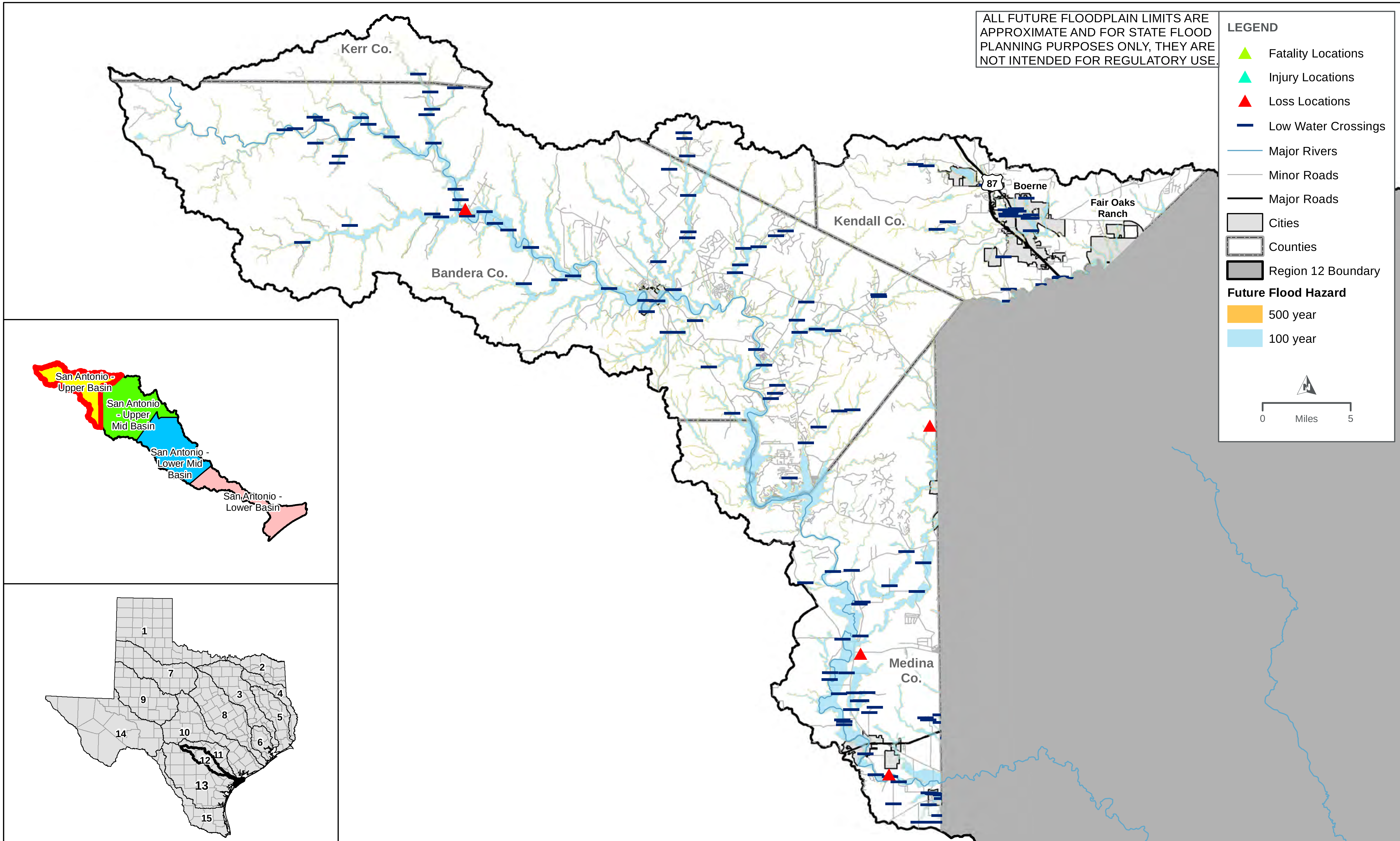


REGION 12 SAN ANTONIO LOWER MID BASIN - FUTURE FLOOD HAZARD

DRAFT

FIGURE 3

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\FUTUREFLDHAZARD_GROUPC_11X17_FIG3.MXD - USER: PDUNNING - DATE: 7/6/2022

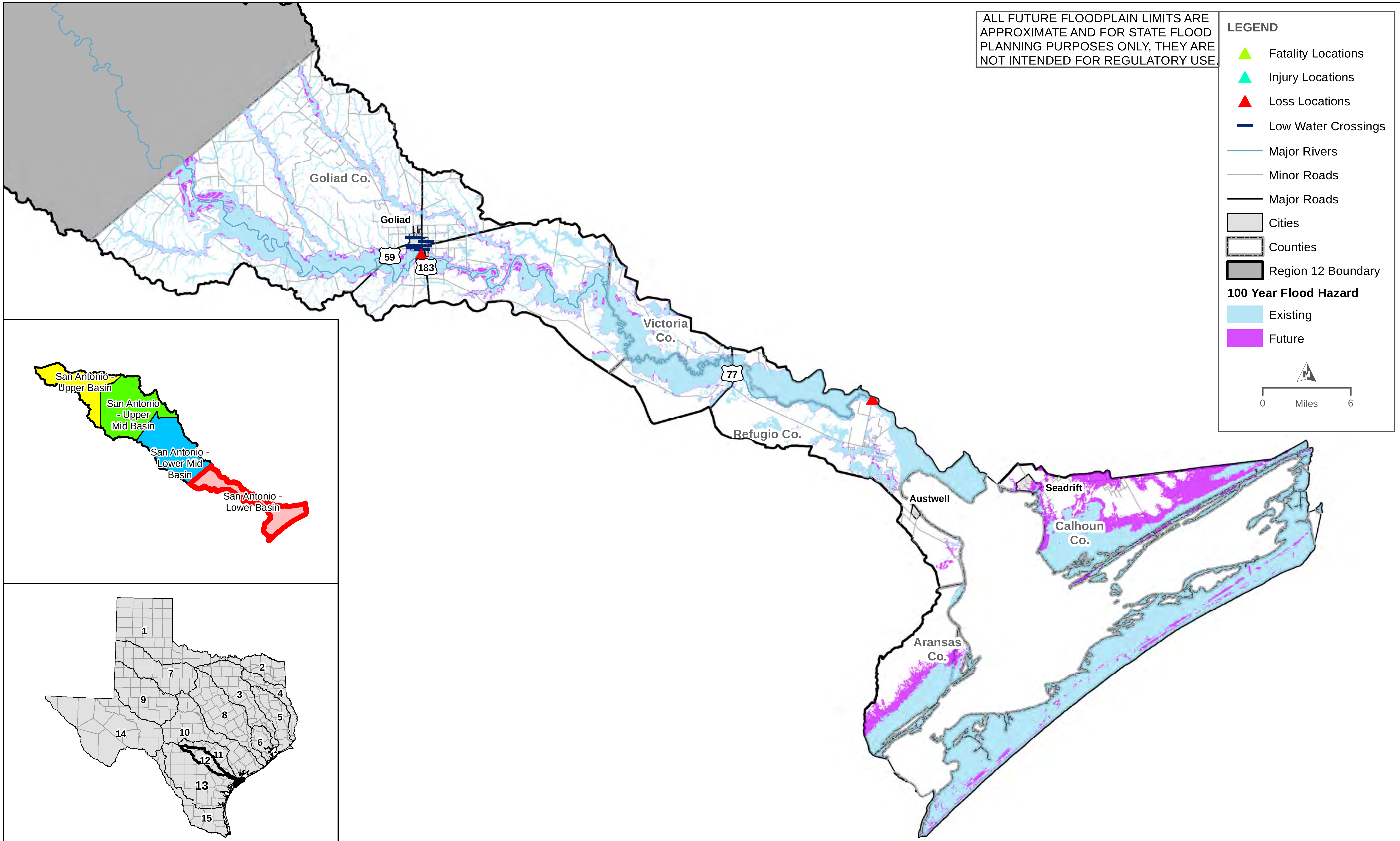


REGION 12 SAN ANTONIO UPPER BASIN - FUTURE FLOOD HAZARD

DRAFT

FIGURE 1

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\FUTUREFLDHAZARD_GROUPA_11X17_FIG1.MXD - USER: PDUNNING - DATE: 7/6/2022

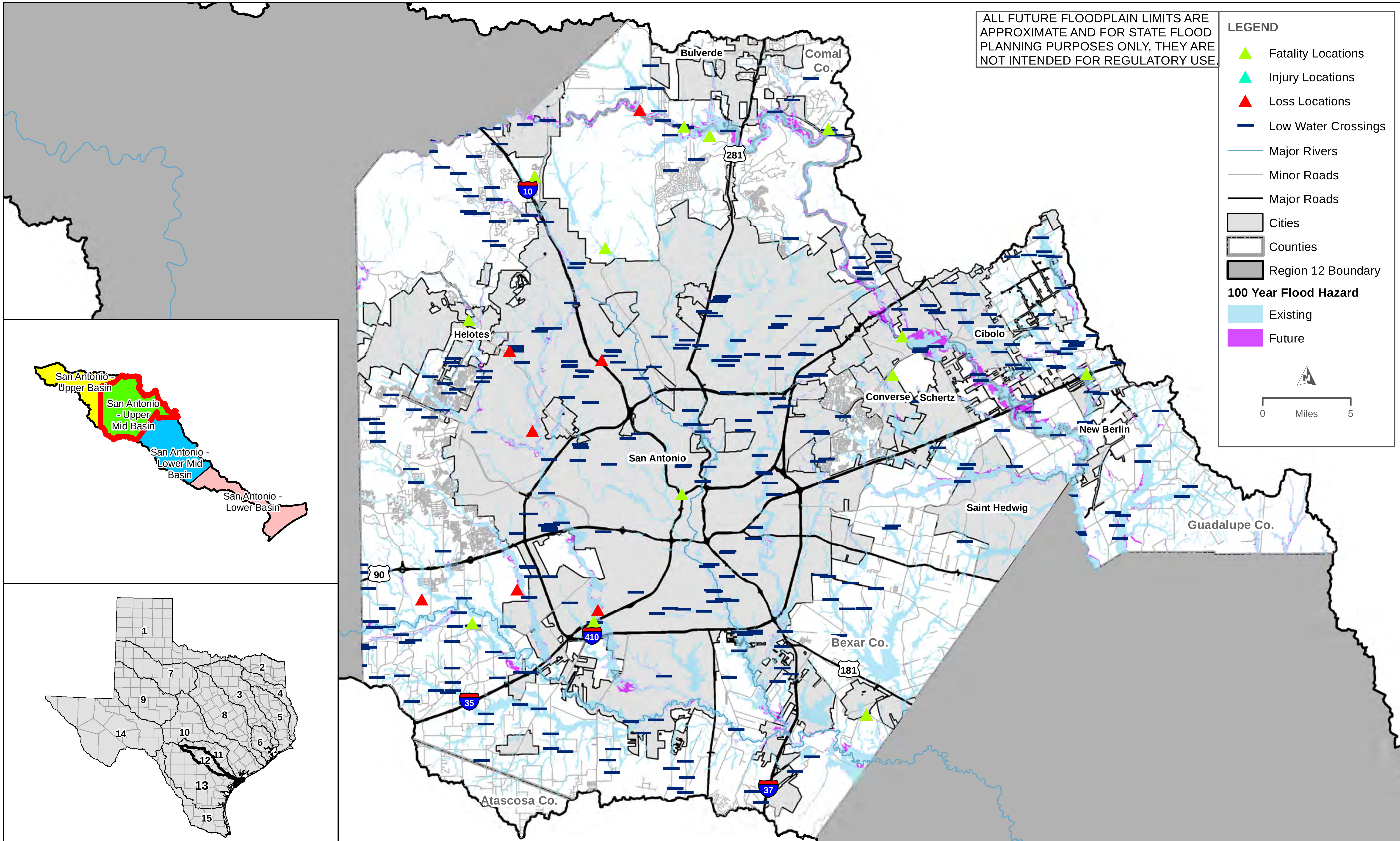


REGION 12 SAN ANTONIO LOWER BASIN - EXISTING & FUTURE FLOOD HAZARD COMPARISON

DRAFT

FIGURE 4

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\HAZARDCOMPARISON_GROUPD_11X17_FIG4.MXD - USER: PDUNNING - DATE: 3/2/2022

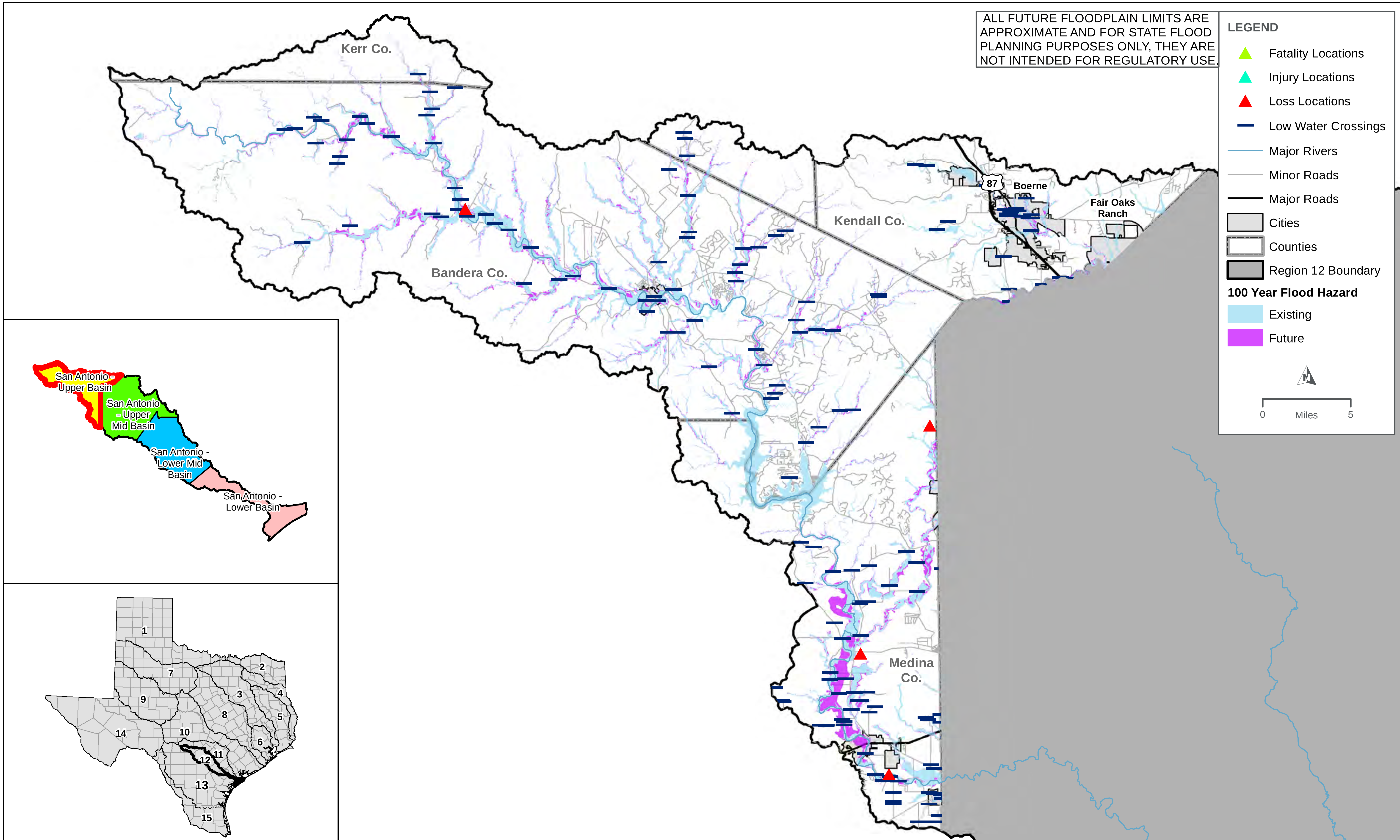


REGION 12 SAN ANTONIO UPPER MID BASIN - EXISTING & FUTURE FLOOD HAZARD COMPARISON

DRAFT

FIGURE 2

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\HAZARDCOMPARISON_GROUPB_11X17_FIG2.MXD - USER: PDUNNING - DATE: 3/2/2022

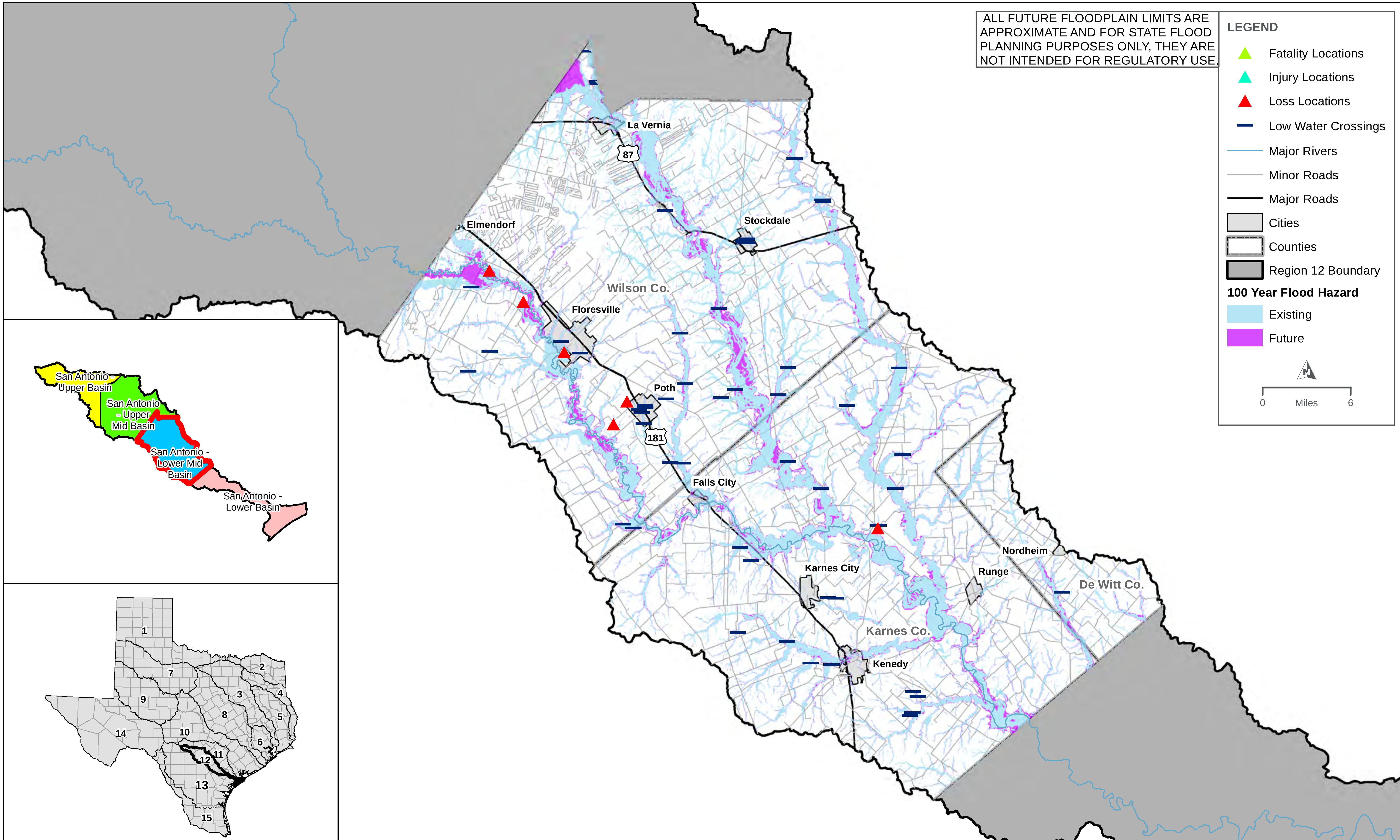


REGION 12 SAN ANTONIO UPPER BASIN - EXISTING & FUTURE FLOOD HAZARD COMPARISON

DRAFT

FIGURE 1

PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\HAZARDCOMPARISON_GROUPA_11X17_FIG1.MXD - USER: PDUNNING - DATE: 3/2/2022

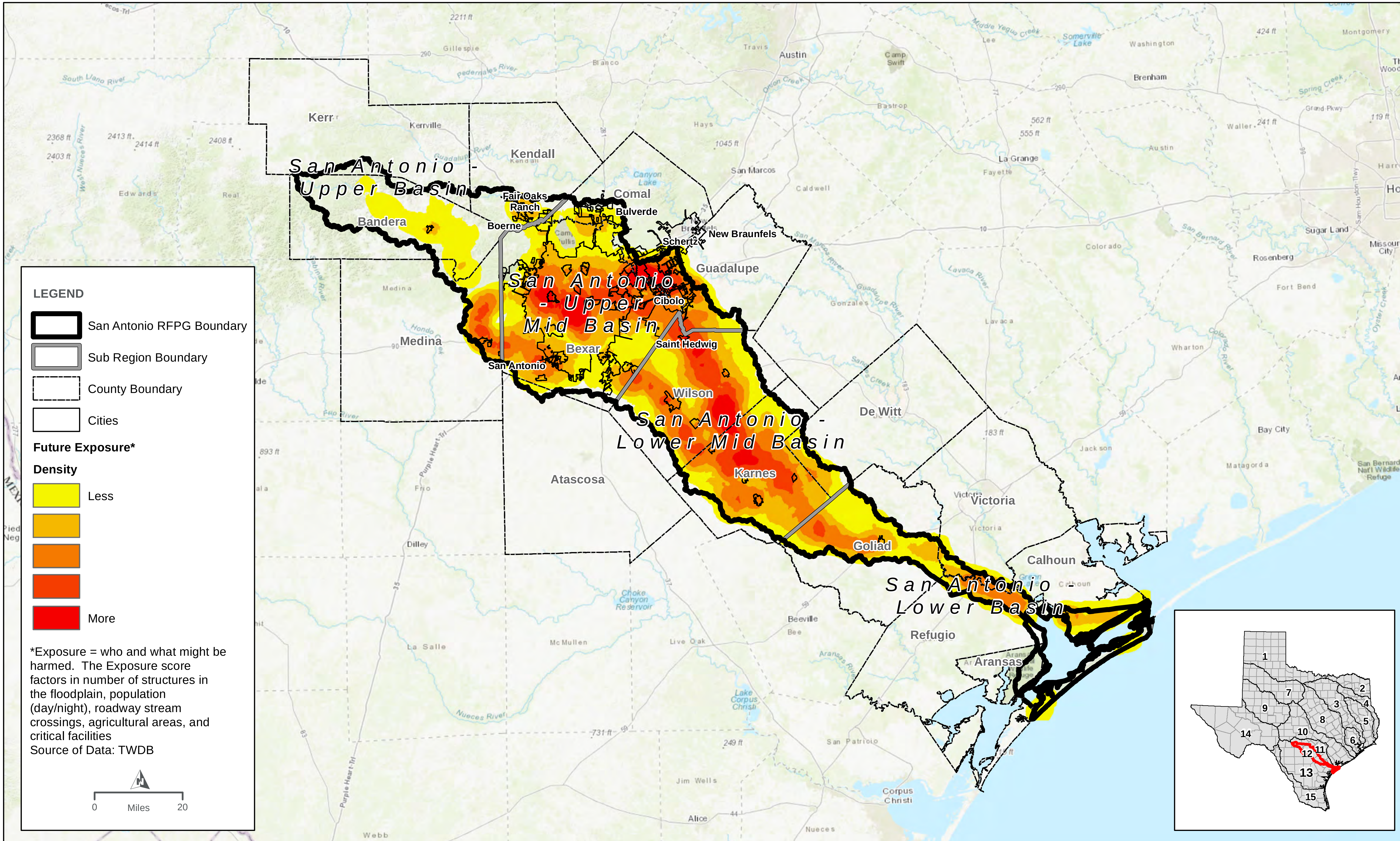


REGION 12 SAN ANTONIO LOWER MID BASIN - EXISTING & FUTURE FLOOD HAZARD COMPARISON

DRAFT

FIGURE 3

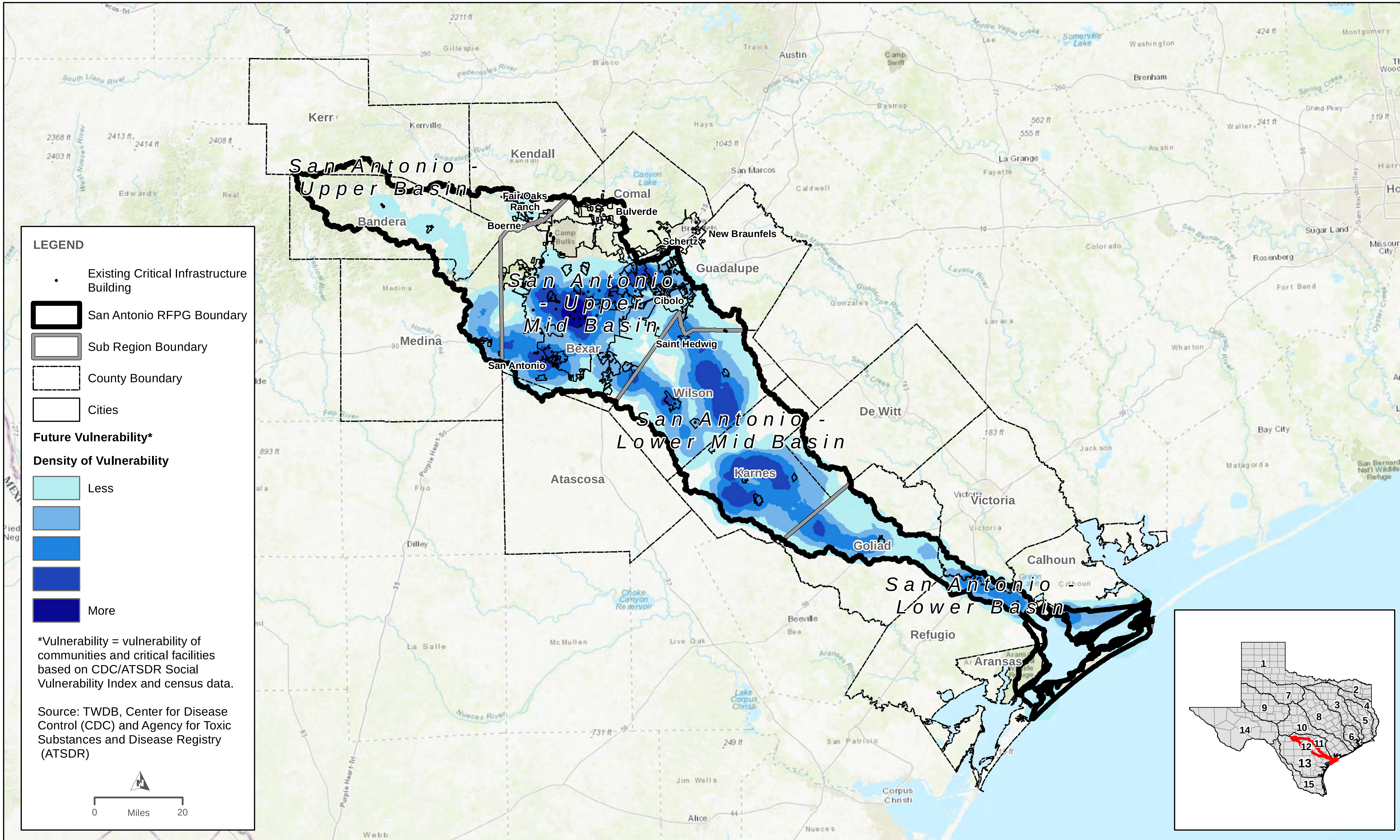
PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\STATIC_MAPS\HAZARDCOMPARISON_GROUPC_11X17_FIG3.MXD - USER: PDUNNING - DATE: 3/2/2022



REGION 12 - FUTURE CONDITION EXPOSURE ANALYSIS

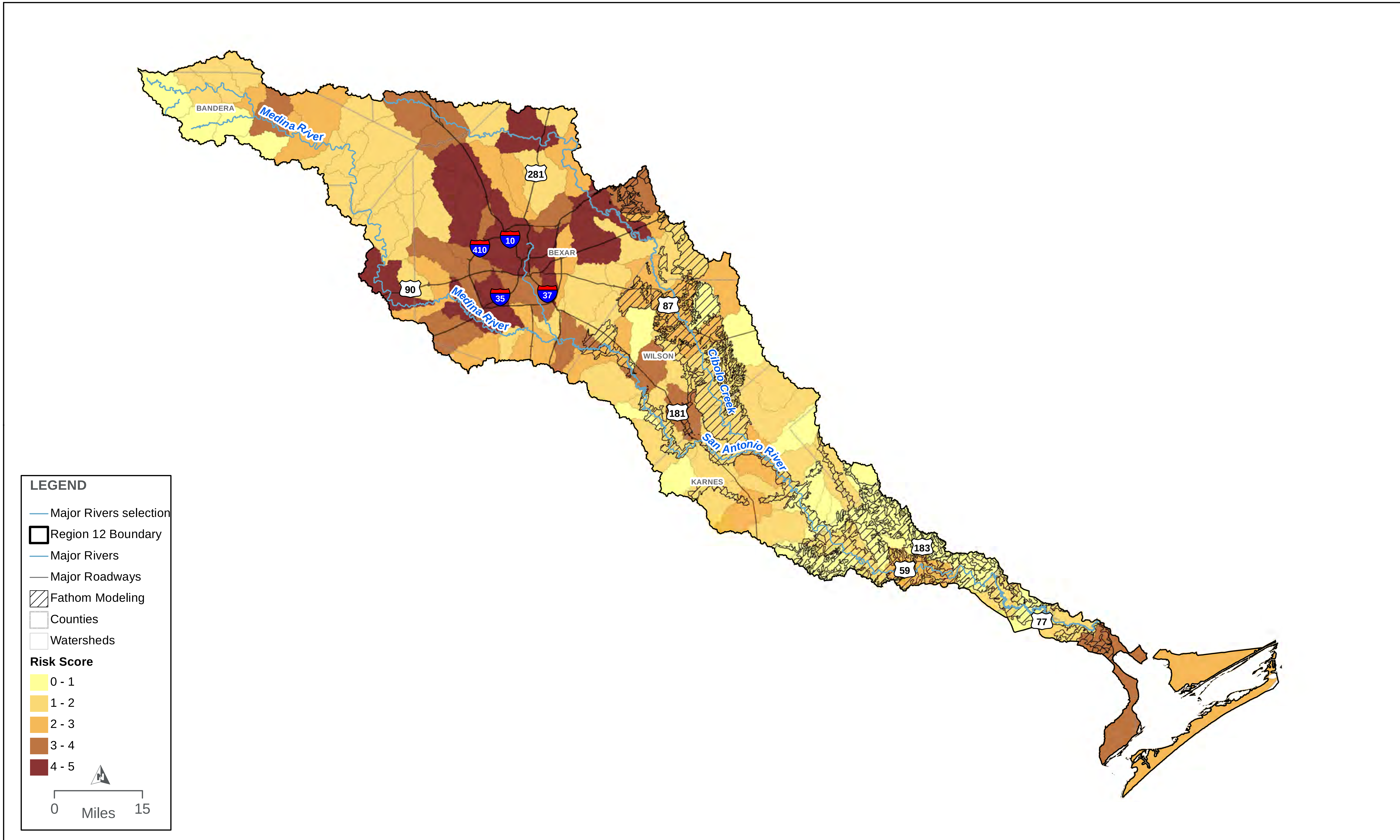
DRAFT

DOCUMENT PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\TECHNICALGUIDELINES\REGIONAL_HEATMAP_FUTURE_EXPOSURE_11X17.MXD



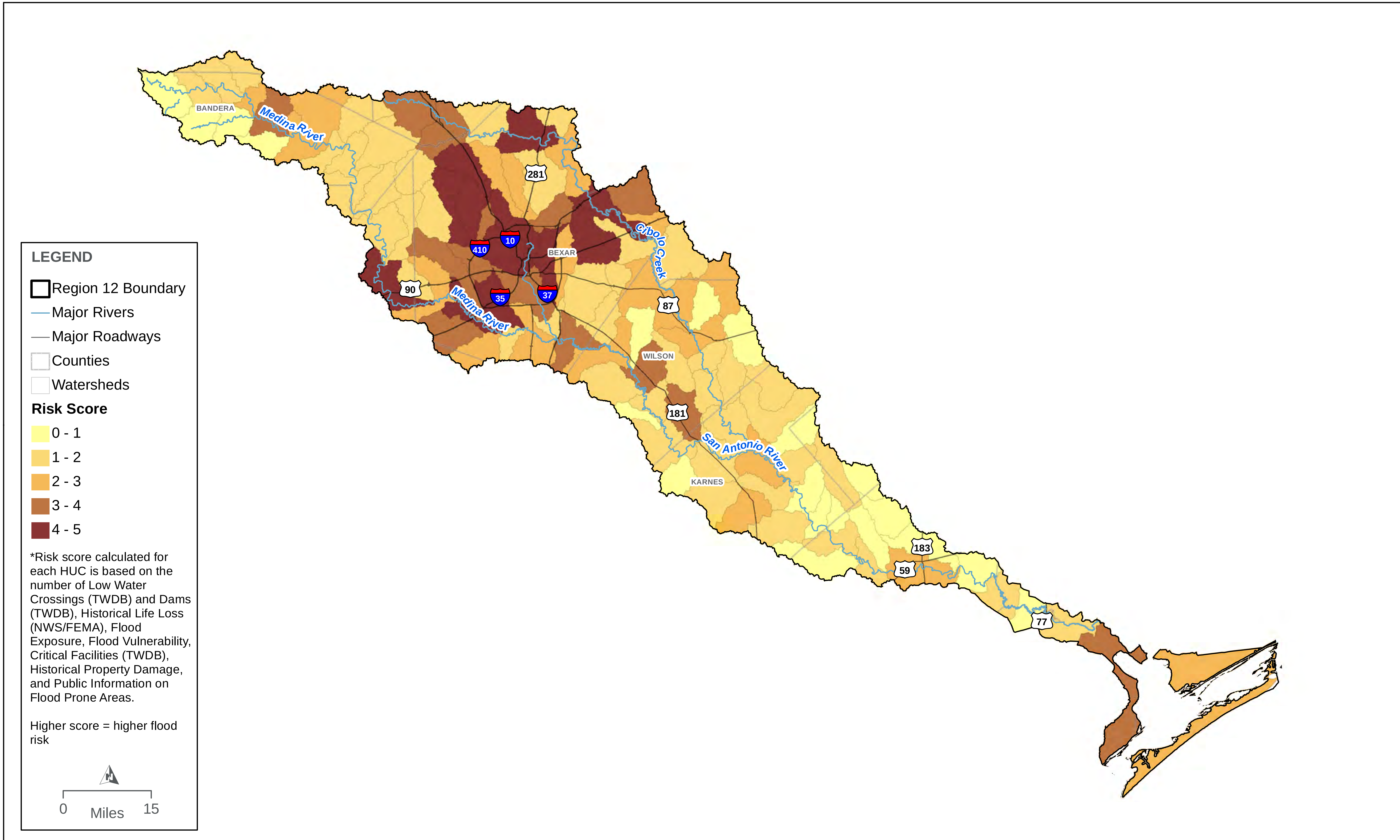
REGION 12 - FUTURE CONDITION VULNERABILITY ANALYSIS

DRAFT



REGION 12 - FATHOM MODELING AND RISK SCORE

DRAFT



REGION 12 - HIGHEST FLOOD RISK

DRAFT

DOCUMENT PATH: Z:\PROJECTS\TWDB\TWDB_RFPG\RFP2023_REGION12_ELECTRONICFILES_HDR_WORKING\MAP_DOCS\EXHIBITS\ADDITIONAL_FIGURES\FLD_RSK_11X17_RSK_SCR.MXD

SARFP: Flood Prone Comments

https://hdr.maps.arcgis.com/apps/CrowdsourceReporter/index.html?appid=3b5355d3c32a4f9a9e3118532b633ebb&utm_source=social

County	City	GlobalID	Flood_Conc	Flood_Freq	When_Did	Descriptio	How_Long	Can_Conta	Name	Phone	Email	Concern being addressed by project? (Y/N)	Action	Notes
Bandera	<Null>	{F25B717D	Road	Few_Occasions	2016, 2015, 2002 - Major flood events	Closes the road down which is the main access for citizens	19	yes	Jerry Russe	8307963636	jerryrusse@gmail.com	N	Following up with the governing body	
Bandera	<Null>	{F43405F1	Road	Few_Occasions	2015, 2016, 2002 - Major Flood Events	Prevents access to citizens from the city	19	yes	Jerry Russe	8307963636	jerryrusse@gmail.com	N	Following up with the governing body	
Bandera	<Null>	{D531C6DI	Road	Few_Occasions	Major storms	This low water crossing can sometimes remain flooded for months	12	yes	Dave Mauk	8303774204	dmauk@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{A62EDCF2	Road	Few_Occasions	1978, 1998, 2002, 2015, and 2016	FM 2107 is the only path for residents to access community lifelines.	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{7F0A3351	Road	Frequently	Minor and major flood events.	Impairs travel for citizens to reach community lifeline services.	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{067D40DC	Road	Frequently	Minor and major flood events	Lower Mason Creek and Bandera Creek contribute to flooding at SH 16.	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	Bandera	{E7C06360	Building	Frequently	Many minor and all major events	Wastewater treatment plant is in 100 yr floodplain	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{141A2979	Building	Few_Occasions	Major flood events (1978)	Electrical sub-station	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{EBE71DF1	Road	Frequently	Rain, minor, and major flood events.	Bridge drainage is clogged.	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{F918FDBC	Channel	Frequently	minor and major events	culverts are clogged at bridge.	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{369CCC42	Road	Frequently	Minor and Major Flood Events	blocks public access to lifelines in Bandera	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Bandera	<Null>	{4F982631	Road	Frequently	Minor and Major Flood Events	Blocks people of Tarpley from EMS and other lifelines in the city of Bandera	40	yes	Luke Whitmire	18307967260	lwhitmire@bcragd.org	N	Following up with the governing body	
Kendall	Boerne	{8917EF88	Road	Frequently	<Null>	Road Overtops frequently in rain events at this low water crossing. In 2002 a fatality occurred at this location when car tried to drive thru the water.	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{A57EE804	Road	Frequently	overtops frequently. loss of life at his location in 2002	<Null>	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{99AA5CAE	Road	Few_Occasions	Memorial Day 2015	major intersection overtopped, limiting emergency response to area. see you tube video https://www.youtube.com/watch?v=qJJ6-2cFlNg	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	<Null>	{87E3E925	Other	Few_Occasions	<Null>	recent SARA studies show this location no longer providers 100-yr protection to City of Boerne.	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	<Null>	{E9162678	Other	Few_Occasions	<Null>	recent SARA studies show this location no longer providers 100-yr protection to City of Boerne.	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	<Null>	{7B40FCF3	Other	<Null>	<Null>	recent SARA studies show this location no longer providers 100-yr protection to City of Boerne.	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{2CFFA605	Other	Few_Occasions	<Null>	recent SARA studies show this location no longer providers 100-yr protection to City of Boerne.	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{9409CE4D	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{91D759ED	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{17003BE7	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{F99DBF43	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{A8F235CE	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{306ABE6C	Road	Few_Occasions	<Null>	TxDOT structure undersized	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{610DFA0E	Road	Few_Occasions	<Null>	TxDOT structure undersized	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{B4A87BB8	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{4E055E05	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{D7AD6EE6	Road	Few_Occasions	<Null>	existing road structure undersized	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{6ECFD4F7	Road	Few_Occasions	Memorial Day 2015	River Road (hwy46) is 6-8 feet underwater during rain event	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	<Null>	{07CA43C8	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{A708D0D5	Road	Frequently	<Null>	road overtops frequently after small rain events	20	yes	Jeffrey Carroll	8302499511	jcarroll@boerne-tx.gov			
Kendall	Boerne	{D3D5311D	Road	Few_Occasions	5 Year + Rain Events at Min	<Null>	8	yes	Ty Wolosin	12549791988	tywolosin@gmail.com			
Kendall	Boerne	{2B08FA18	Road	Few_Occasions	5 Year + Rain Events	In addition to going over the road, it is also flooding several homes near by.	8	yes	Ty Wolosin	12549791988	tywolosin@gmail.com			
Kendall	Boerne	{B221A68A	Road	Frequently	5 Year + Rain Events	Flooding over the road, keeps BPD from being able to get to Boerne at fastest route.	8	yes	Ty Wolosin	12549791988	tywolosin@gmail.com			
Bexar	<Null>	{7C4316A0	Land	Few_Occasions	mid 2021	New development on old golf course causes flooding that affects the adjacent homes that are backing up to the course	17	yes	Vinnie Bilotto	2103633333	vinnie@asprop.com			
Kendall	<Null>	{AA840B66	Road	Frequently	<Null>	Old Fredericksburg Rd crosses Balcones Creek at the Kendall/Bexar County line. This low water crossing is frequently impacted.	14	yes	Mary Ellen Ellen Schulle	8303318252	me.schulle@co.kendall.tx.us			
Bexar	Helotes	{CEA7BAA(	Channel	Frequently	14-Oct-21	Our house and property are located in the southeast corner of Cedar springs neighborhood in Helotes. The tail and of the French Creek drainage project passes along 430 feet of our property line between our house and the ditch is a green belt approximately 60 to 80 ft wide. On October 13 or 14 The ditch overflowed and put about 6 in of water up on our driveway, One about 170 ft from the ditch. Our neighbors on the other side of the ditch the Fores received several feet of water in their house. This is the second or third time their house has flooded because of the ditch. I have submitted comments on January 11th at the region 12 flood planning public meeting held in St Hedwig the.	3	yes	Paul Hardin	801-420-2419	PaulcHardin55@gmail.com			
Bexar	Helotes	{95E20ED7	Building	Frequently	Last date Oct 12.	We built our home in 2000. Since construction development and Frenchcreek flood project it occurred twice last year. When we built home their was only a small part of creek that was in flood zone. Since construction and especially being at the end of the Frenchcreek project the surface water has been directed at our home. The water is rushing and we have no way of escaping. The project did not consider the creek bottles necks below our property making the increase of water to rush at our home placing us in danger. We would appreciate any help you can give us to prevent flooding of our home and neighbors. We did not flood at all until county did land across the creek. Now that we have more water directed at us we fear for our lives. Please see attach pictures of last flood. We are pleading for help.	21 years	yes	Jane and Rodger Fore	2108726125	J44fore@gmail.com			
Bexar	Helotes	{DBA6A5F(	Channel	Few_Occasions	Oct-21	The flooding of Strong Cedar street in Helotes has caused the cul-de-sac street to fill up with water. The water from the French Creek drainage project has risen above the curbs and goes a few feet up past the sidewalks towards our houses. The flooding in the street is so high at points that if our cars were left in the street water would get inside.	20	yes	Alan Johnson	2108272295	ajstoy@gmail.com			
Wilson	<Null>	{BF919694	Road	Frequently	last time was 9/10/2020	The Marcelinas Creek has caused erosion to progress close to the county road right of way threatening the loss of the roadway.	20 yrs	yes	LeANN HOSEK	8303938357	emc@wilsoncountytx.gov	Y	Stakeholder added this point	
Bexar	Von Ormy	{66BFEA06	Road	Frequently	Oct-21	<Null>	35	yes	george	2108618982	cityvonarmy02@icloud.com			
Bexar	<Null>	{FA6BE7E2	Land	Few_Occasions	<Null>	flooding in heavy rain occasion	35	yes	george	2108618982	cityvonarmy02@icloud.com			
Bexar	<Null>	{95B97682	Road	Few_Occasions	<Null>	complete road flooding on heavy rain occasion	35	yes	george	2108618982	cityvonarmy02@icloud.com			
Bexar	<Null>	{5E4FB4CD	Road	Few_Occasions	<Null>	complete road flooding on heavy rain occasion	35	yes	george	2108618982	cityvonarmy02@icloud.com			
Bexar	San Antoni	{F8BCA123	Building	Frequently	2001 - current	Alley runoff floods abutting garage and has crossed street to enter onto other property. Additional 18" of base added to drives to prevent water from entering home.e	27 years	yes	Debbie Reid	2103009681	debbiejreid@hotmail.com			

Medina	<Null>	{692F1CA8	Channel	Frequently	<Null>	Widespread creek flooding.	<Null>	yes	Abe Salinas	210.491.2391	aasalinas@kfriese.com	Y	Stakeholder added this point	
Medina	<Null>	{4E32B8B4	Channel	Frequently	<Null>	Widespread creek flooding.	<Null>	yes	Abe Salinas	210.491.2391	asalinas@kfriese.com	Y	Stakeholder added this point	
Medina	Castroville	{9393D115	Building	Frequently	<Null>	Frequent localized flooding of structures	<Null>	yes	Abe Salinas	210.491.2391	asalinas@kfriese.com	Y	Stakeholder added this point	
Medina	Castroville	{7F5CD981	Building	Frequently	<Null>	Frequent flooding of structures	<Null>	yes	Abe Salinas	210.491.2391	asalinas@kfriese.com	Y	Stakeholder added this point	
Guadalupe	<Null>	{02BBB623	Road	Few_Occasions	After any significant rainfall	Green Valley and Creek roads in northern Guadalupe County flood from Santa Clara Creek during rainfall events	4-5 years	yes	Matt Wagner	9792202863	mkwagner4008@gmail.com			
Bexar	San Antoni	{B2BA231E	Road	Few_Occasions	1998 was most severe	Decades of illegal fill placement in Indian Creek north of 410 south has essentially dammed the stream and high flow times now flood Somerset Road as well as adjacent properties. This has significantly elevated the 100 year flood plane in these areas. IMPORTANTLY, Somerset Road is a major thoroughfare and rectifying this flooding in the future will be extremely expensive. Indian Creek should be rechannelized to its original state.	35 years	yes	Randall Preissig	2104921994	JJJRS5@hotmail.com			
Bexar	San Antoni	{342CE006	Land	Frequently	May-21	51 neighbor's property flood, water in houses and garages, 10 acres	12 years	yes	Thomas Carder	501-258-9172	<Null>			
Guadalupe	<Null>	{5A7FCF21	Road	Frequently	Several times every year when it rains	Green Valley and Creek and parts of Weil roads flood frequently.	5 years	yes	Matt Wagner	19792202863	mkwagner4008@gmail.com			
Bexar	Universal (	{1294DDA1	Land	Unknown	<Null>	The vegetation is overgrown causing it to slow the flow of stormwater.	<Null>	<Null>	<Null>	<Null>	<Null>			
Refugio	<Null>	{58E54C9E	Road	<Null>	<Null>	Culvert improvement on Hatch St in Tivoli. The bridge on Hatch Street in Tivoli was replaced with a culvert which drains slow and causes the water to breach the levee.	<Null>	<Null>	<Null>	<Null>	<Null>			
Refugio	<Null>	{1DF7AE62	Channel	Frequently	<Null>	Culvert Improvement on Highway 239 in Tivoli. Some culverts on Highway 239 in Tivoli are too small causing water to get in houses.	<Null>	<Null>	City of Tivoli	<Null>	<Null>	N	Following up with the governing body	
Refugio	<Null>	{86841432	Channel	Unknown	<Null>	Underground Drain Maintenance in Tivoli. Underground drains in Tivoli on Highway 239, William Street and Wilson Street need cleaning. The blockage causes water to drain slow and creates potential flooding hazards	<Null>	<Null>	city of Tivoli	<Null>	<Null>	N	Following up with the governing body	
Refugio	<Null>	{6B3AB773	Channel	Frequently	<Null>	Ditches and culverts Maintenance in Tivoli. Ditches and culverts in Tivoli need cleaning on Scott Street, Dedear Road, Bissett Road, Oleander Avenue, Garza Street, Villarreal Street, Lee Street, Eugen Lane and Raymond Lane, Layton Lane, and Bickford Road	<Null>	<Null>	City of Tivoli	<Null>	<Null>	N	Following up with the governing body	
Refugio	<Null>	{D236935E	Land	Frequently	<Null>	Miller Creek on the Smoky Creek Ranch Drainage Improvements	<Null>	<Null>	City of Tivoli	<Null>	<Null>	N	Following up with the governing body	
Refugio	<Null>	{436E50F8	Road	Unknown	<Null>	The bridge on J.W. Johnson in Tivoli is in bad shape and needs to be replaced.	<Null>	<Null>	City of Tivoli	<Null>	<Null>	N	Following up with the governing body	
Refugio	<Null>	{91148CEC	Land	Few_Occasions	<Null>	The bridge on J.W. Johnson in Tivoli is in bad shape and needs to be replaced.	<Null>	<Null>	City of Tivoli	<Null>	<Null>	N	Following up with the governing body	Duplicate