# 3

# Existing infrastructure and key ongoing projects



## QUICK **FACTS**

- The statewide regional flood planning process is Texas' first attempt to generate a statewide inventory and assessment of major flood infrastructure. The information that planning groups collected during the first cycle of regional flood planning is invaluable; however, it is not a complete assessment of all major flood infrastructure in Texas.
- The expectation is that the inventory and assessment of existing major flood infrastructure will improve during each cyclical iteration of the regional and state flood planning process.
- More than 1.3 million existing flood infrastructure features, including natural and man-made, were identified by the regional flood planning groups. About 3.5 percent of these were identified as functional and less than 1 percent as non-functional. The functionality and condition information on most of the flood infrastructure identified was not available and reported as unknown.
- The regional flood planning groups identified 11,395 low water crossings. Approximately 2 percent (259) of these were identified as functional, and the functionality of the remaining 98 percent (11,116) was identified as unknown. The condition of almost 99 percent (11,234) was identified as unknown.
- The regional flood planning groups identified 6,731 flood control dams. Of these, 21 percent (1,411) were reported as functional and 4 percent (294) as non-functional. The functionality of the remaining 75 percent (5,026) was identified as unknown. Ten percent (651) of dams were identified as non-deficient and 1 percent (98) as deficient. The condition of the remaining 89 percent (5,982) was identified as unknown.
- Approximately 1,884 linear miles of 515 levees were identified. Of these, approximately 10 percent (188 miles) were identified as functional, 8 percent (147 miles) as non-functional, and almost 82 percent (1,548 miles) as unknown. Approximately 3 percent (60 miles) were identified as deficient, 4 percent (66 miles) as non-deficient, and 93 percent (1,758 miles) as unknown.
- Regional flood planning groups identified 2,798 proposed and ongoing flood mitigation projects currently under construction, being implemented, or with dedicated funding to construct them. Together, the projects have an overall cost of $8 billion dollars.

Texas is one of the fastest growing states in the nation, with a projected population of over 30.1 million people in 2024 (Texas Demographic Center, 2022). Such tremendous growth and development necessitate reliable and functional flood infrastructure to protect residents and property from extreme weather and flooding.

The 2019 Texas Legislature passed Senate Bill 8, which requires that "the state flood plan must include: an evaluation of the condition and adequacy of flood control infrastructure on a regional basis." As part of the planning process, each regional flood planning group was required to inventory the existing natural features and major constructed infrastructure, including but not limited to the following:

- Rivers and tributaries
- Wetlands
- Playa lakes
- Levees
- Sea barriers, walls, and revetments
- Dams that provide flood protection
- Storm drain systems

This requirement helped the planning groups make informed decisions on where investment may be needed to address existing deficiencies, enhance functionality, and ensure that Texas' prior investments in infrastructure perform as designed to protect against the risk and impact of flooding.

The Texas Water Development Board (TWDB) provided the following definitions for the planning groups to categorize the functionality and condition of major flood infrastructure in each region:

Functionality:
- **Functional**: The infrastructure is serving its intended design level of service.
- **Non-functional**: The infrastructure is not providing its intended or design level of service.

Condition:
- **Deficient**: The infrastructure or natural feature is in poor structural or non-structural condition and needs replacement, restoration, or rehabilitation.
- **Non-deficient**: The infrastructure or natural feature is in good structural or non-structural condition.

Compiling this information for the first time was a challenging task for the flood planning groups. To assist them, the TWDB provided several datasets via the Flood Planning Data Hub,[16] which included low water crossings, **major reservoirs**, state regulated dams, and the National Levee Database. Because the regional flood planning groups were unable to physically assess existing infrastructure themselves, they requested, collected, and compiled information on the condition and functionality of existing flood infrastructure from communities within their respective regions. The information that planning groups collected during the first cycle of regional flood planning is invaluable; however, it is not a complete inventory or assessment of all major flood infrastructure in Texas. Indeed, much of the condition and functionality of existing infrastructure is currently unknown.

The expectation is that the inventory and assessment of existing major flood infrastructure will improve during each cyclical iteration of the regional and state flood planning process. To that end, the TWDB funded a study that will produce an infrastructure assessment tool to assist the planning groups and communities with improving future assessments of major flood infrastructure. This study is currently scheduled for completion in 2024.

As part of the regional flood planning process, the 15 planning groups were also required to compile a list of proposed or ongoing flood mitigation projects that are currently under construction, being implemented, or with dedicated funding for construction. This information, combined with the data they collected regarding previously constructed major flood infrastructure, helped inform and guide the planning groups in their subsequent effort to identify and recommend flood risk solutions for their regions.

## 3.1 Inventory and assessment of existing statewide major flood infrastructure

The regional flood planning groups were required to include an assessment of existing infrastructure in their plans, which included a general

[16] twdb-flood-planning-resources-twdb.hub.arcgis.com/

description of the location, condition, and functionality of natural features and constructed major infrastructure within the flood planning region. The planning groups were required to identify and assess existing major flood infrastructure, and in doing so were given discretion in determining the scale of what constitutes “major” infrastructure.

The flood planning groups identified 1,361,643 major flood infrastructure features across all 15 flood planning regions. Across all flood infrastructure types identified, about 96 percent (1,313,651) of these have an unknown functionality, less than 1 percent (433) were identified as non-functional, and about 3.5 percent (47,559) were found to be functional. Similarly, the condition of about 98 percent (1,339,999) was reported by the planning groups as unknown. Less than 1 percent (6,943) were categorized as deficient, while the remaining 1 percent (14,701) were identified as non-deficient. Flood infrastructure refers to natural or constructed systems and structures that manage flooding. Natural flood infrastructure refers to the ecological features and functions that naturally exist and mitigate flood risks. Constructed major flood infrastructure refers to human-built mechanisms that manage flooding, including such structural elements as dams, levees, and drainage systems.

Constructed and natural infrastructure give a river basin its hydraulic and hydrologic characteristics, which are the primary functions and indicators of how floodwater moves and behaves as it travels. The types of existing flood infrastructure vary across the state depending on regional geographic features. For example, Texas coastal regions require coastal barriers and levees to manage flood risk, while areas in West Texas rely on natural playa lakes supplemented with constructed storm drain systems.

The regional flood planning groups reported on existing infrastructure in their regions using a two-step process: first inventorying both natural and constructed major flood infrastructure and, secondly, assessing the condition and functionality of that infrastructure.

The following summarizes the natural features and major constructed infrastructure identified by the regional flood planning groups that contribute to flood risk reduction:

Natural features:
- Rivers, tributaries, and functioning floodplains
- Wetlands and marshes
- Playa lakes
- Ponds
- Sinkholes
- Coastal features
- Parks and preserves
- Other natural features

Constructed:
- Reservoirs, dams, and weirs
- Levees and revetments
- Low water crossings, roadway stream crossings, and bridges
- Detention and retention ponds
- Stormwater management systems and components
- Constructed coastal infrastructure
- Other constructed infrastructure

The regional flood planning groups were also required to assess the functionality and effectiveness of major flood infrastructure.

Since this was the first attempt to create a statewide inventory, there was very limited information available regarding the condition of existing major flood infrastructure, which required the planning groups to obtain this information from communities through outreach. Outreach efforts varied by region, resulting in a range of both volume and quality of information, including an absence of information for some infrastructure. In these cases, regional flood planning groups used other available data, such as age, to estimate the expected condition and functionality of

*Table 3-1. Natural features identified by the regional flood planning groups**

| Region | Rivers/ tributaries (mile) | Wetland (acre) | Playa (acre) | Playa (count) | Sinkhole | Open space (acre)[a] | Coastal[b] | Other[c] |
|---|---|---|---|---|---|---|---|---|
| 1 | 13,152 | 193,012 | 204,563 | 9,302 | | | | |
| 2 | 7,233 | 432,919 | | | | 180,055 | | |
| 3 | 0.3 | 447,706 | | | 16 | 317,932 | | |
| 4 | 6,267 | 333,034 | | | | | | |
| 5 | 8,872 | 237,147 | | | | | | |
| 6 | 2,505 | 188,756 | | | | | | |
| 7 | 6,854 | 36,896 | 147,260 | 10,109 | | | | |
| 8 | | 246,462 | | | 3 | 106,861 | 63 | |
| 9 | 19,898 | 132 | 38 | 3 | | | | 26 |
| 10 | 6 | 275,570 | | | 7 | 131,981 | 42 | |
| 11 | 4,214 | 46,405 | | | | | | |
| 12 | 8,246 | 58,081 | | | 78 | | | |
| 13 | 29,050 | 182,377 | | | 29 | | | |
| 14 | 83,579 | 346,202 | | | | | | |
| 15 | | 355,455 | | | 5 | 44,208 | 27 | |
| **Total** | **189,875** | **3,380,155** | **351,861** | **19,414** | **138** | **781,037** | **132** | **26** |

*Note: Blank cells in this table do not always signify the absence of natural flood features; they indicate that such assets were not identified or reported by the regional flood planning groups.*

** All figures are presented as counts unless otherwise labeled.*

[a] *Open space includes features categorized as parks and preserves.*

[b] *Ten of the 15 flood planning regions include coastal areas with varying geographical features such as beaches, estuaries, bays, and barrier islands.*

[c] *These features were reported as "Other" with no additional description or identification.*

the natural flood features and major flood infrastructure. The majority of information concerning the condition and functionality of major flood infrastructure in Texas currently does not exist. All data reported by the regional flood planning groups, including location, description, level of service, functionality, ownership, and operating details for major flood infrastructure, is accessible via the Interactive State Flood Plan Viewer.[17]

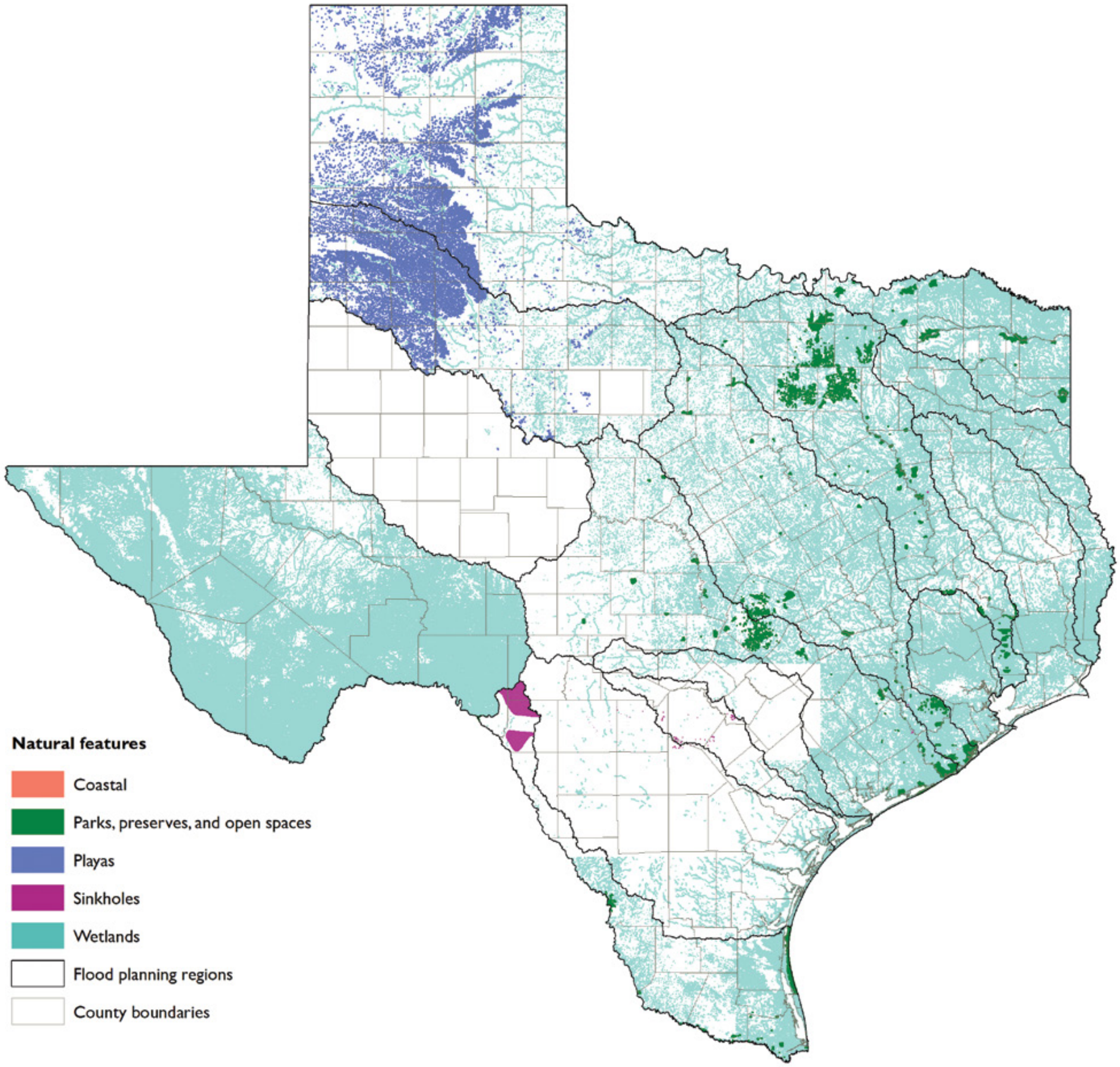
## 3.1.1 Natural features

Of the 1,361,643 statewide flood infrastructure features identified by the flood planning groups, 54 percent (741,773) were natural features (Table 3-1). The functionality was unknown for almost 95 percent (701,960) of the natural features identified, and the condition for approximately 97 percent (721,191) was unknown.

**Natural features** refer to the ecological characteristics and functions of the physical landscape that mitigate flood risk. A lake or wetland, whether man-made or naturally occurring, can mitigate the effects of flooding through water **storage**; the conveyance of stormwater runoff to creeks, streams, and rivers; or through natural infiltration of water into the ground. The efficiency of natural systems varies by soil type, bedrock type, and the amount of vegetation. When allowed to effectively infiltrate the ground, water from rain events is less likely to overwhelm tributaries and stormwater systems. Rivers, streams, and flood-

[17] texasstatefloodplan.org

*Figure 3-1. Major natural flood mitigation infrastructure in Texas*



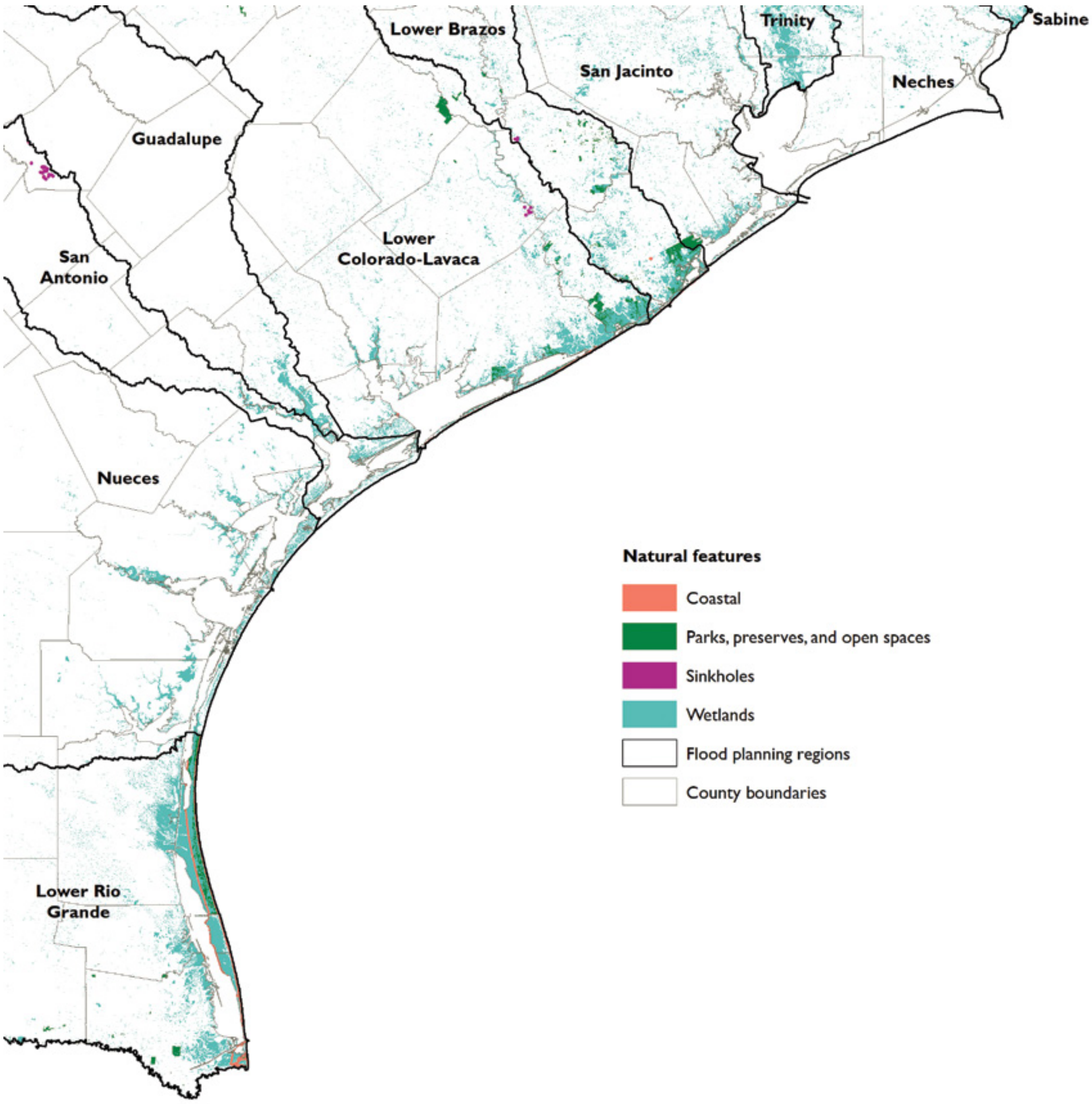

plains are important parts of our natural features and systems. Flooding, to an extent, is a normal part of the hydrology of a river system and is necessary to maintain healthy **fluvial geomorphology** and for the lifecycle of some fish and other aquatic organisms.

As the Texas population grows, cities and towns expand and natural areas are developed, altering how floodwater interacts with the land surface. Road construction and housing developments generally create more impervious cover, which does not allow water to easily soak into the ground, resulting in increased stormwater runoff that can overwhelm tributaries and drainage systems. Figure 3-1 and Figure 3-2 show the geographic locations of the major natural flood mitigation infrastructure identified by the 15 flood planning regions.

## Rivers, tributaries, and floodplains

The regional flood planning groups identified approximately 189,875 miles of combined rivers and tributaries; however there were several regional flood planning groups that did not report any rivers or tributaries or reported very few

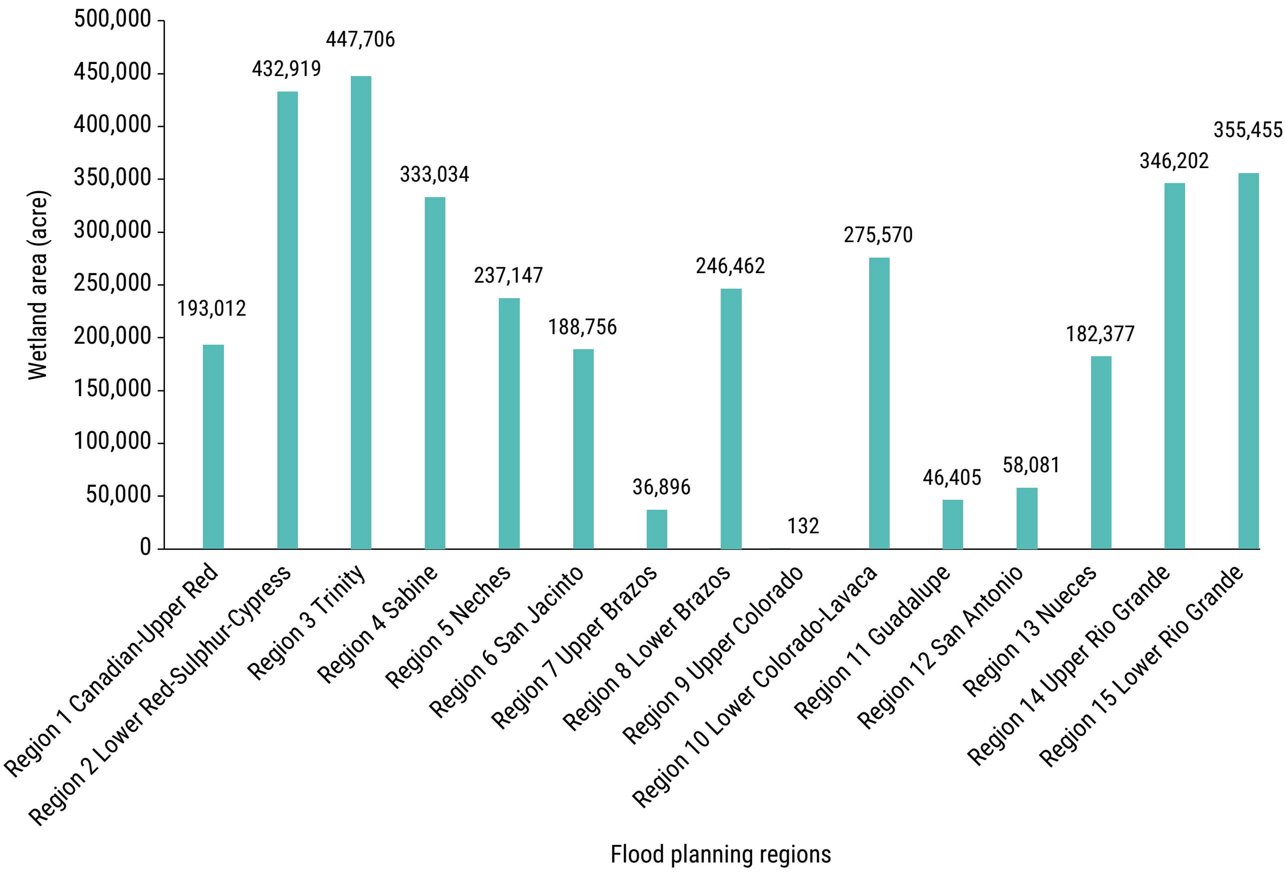
*Figure 3-2. Coastal inset of major natural flood infrastructure in Texas*




(Table 3-1). Of the rivers and tributaries identified, about 4 percent (7,233 miles) were identified as functional, while the functionality of almost 94 percent (182,642) miles) was unknown. Similarly, about 4 percent (7,233 miles) were identified as non-deficient, while the condition of almost 94 percent (182,642 miles) was identified as unknown.

Each river, including its major and minor tributaries, comprises a complex network of functioning floodplains. A floodplain refers to the flat areas adjacent to rivers and streams that can absorb, store, and convey floodwater during periods of high flow. Floodplains are also subject to inundation during a flood. The size and shape of a floodplain influences the characteristics and severity of a flood event. The boundaries of a **natural floodplain** can change with each flood event as sediments are scoured and deposited within the river channel and upon adjacent lands. Similarly, the coastal shoreline changes frequently (FEMA, 2022a). A **regulatory floodplain** is determined by FEMA through modeling a specific storm event and depicting the boundaries of inundation resulting from that storm on a map. As a result, a regulatory floodplain only changes when a new study or mapping effort is conducted (TWDB, 2019).

*Figure 3-3. Area of identified wetlands by flood planning region*




Tributaries and their floodplains are vital components of an integrated system contributing to flood control and management. Land preservation and leaving space for floodwater to flow allow floodplains to carry out their natural flood management role, reducing the intensity of floodwater and lowering the risk of flooding. A discussion of the importance of floodplain management and recommendations is included in Chapter 5.

In addition to flood management, functioning floodplains provide other important benefits, such as erosion control, groundwater **recharge**, and recreational opportunity (FEMA, 2022b).

## Wetlands and marshes

Wetlands and marshes are natural systems found near lakes, rivers, and oceans that are often inundated by water, either permanently or seasonally during rainy seasons. The natural hydraulics of wetlands and marshes provide significant flood control benefits through temporary water storage during extreme weather events.

Wetlands and marshes also provide important ecosystem benefits for people in coastal communities and the environment through water filtration and purification, biodiversity, climate regulation, and carbon sequestration. As floodwaters withdraw, the water retained by wetlands is slowly released from the soil, reducing the amount of flooding downstream (VDEC, n.d.). When left undisturbed, wetlands and marshes act as natural barriers that shield the coast from the force of wave action and storm surges.

The planning groups identified 3,380,155 acres of freshwater and coastal wetlands, making wetlands one of the most prominent natural features in the state (Figure 3-3). Of these wetlands, almost 13 percent (432,919 acres) were identified as functional, with the functionality of the remaining 87 percent (2,947,236 acres) identified as unknown. The condition of all 3,380,155 acres was identified as unknown.

### Playa lakes

Despite only covering approximately 2 percent of the state's landscape, playa lakes are notably one of the most significant natural features of the High Plains region in the northwestern and central-western portions of the state, which are characterized by little variation in elevation. Playa lakes are shallow, clay-lined depressions in the otherwise flat landscape that act as natural water detention areas of rainfall and irrigation runoff. Unlike many wetlands, playas are ephemeral, going through unpredictable periods of wet and dry cycles depending on the region's precipitation patterns (TPWD, n.d.).

Playa lakes are categorized as overflow or non-overflow playas depending on their hydrologic characteristics. Non-overflow playas have enough storage capacity to completely contain all the combined runoff in the area during a 1 percent (100-year) annual chance storm event, also known as the 100-year storm event. Overflow playas typically lack the storage capacity to completely contain the area's combined runoff water from a 1 percent annual chance storm event, which ultimately contributes, as the name states, to overflow. When one playa is filled with water, excess water flows to the next playa lake, creating an efficient method for controlling runoff. Playa lakes may become deficient if they are mismanaged. For example, when playas are "pitted" or dug out to create ponds for livestock, they drain too quickly and aquifers are not recharged (PLJV, 2012).

The flood planning groups identified approximately 351,861 acres of playa lakes, all located in the Texas High Plains and all with unknown functionality (Table 3-1). About 14 percent (47,889 acres) were identified as non-deficient, while almost 28 percent (99,370 acres) were identified as deficient. The condition of approximately 58 percent (204,601 acres) was identified as unknown.

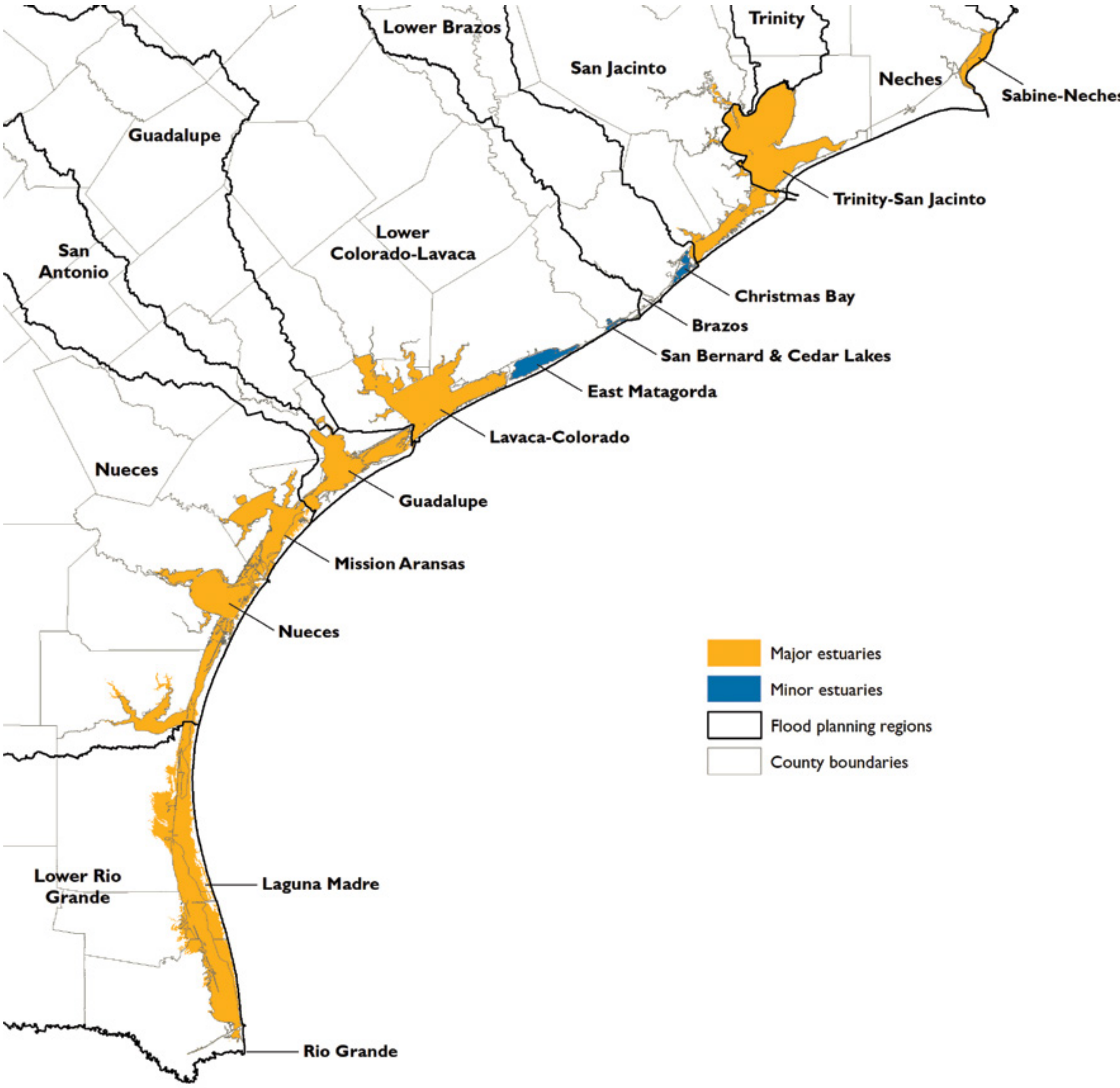
### Ponds

While there are few naturally occurring ponds and only one naturally occurring lake in Texas (Caddo Lake), man-made ponds and lakes are often thought of as natural flood infrastructure because they mimic the flood mitigation qualities of natural features, like water storage and natural infiltration of water into the ground. Ponds can be a useful tool for mitigating localized flood risk, particularly in urban or suburban areas where space is limited. Ponds capture and store excess water during periods of heavy precipitation. Once full, they release water in a controlled manner to mitigate the effects of downstream flooding. While ponds are important components of local flood infrastructure, they are unlikely to provide benefits at the regional or statewide scale. For the purposes of this plan, combined reported data on both ponds and reservoirs is included in Section 3.1.2.

### Sinkholes

Sinkholes are geological formations characterized by the collapse or subsidence of the Earth's surface, often caused by the dissolution of soluble rocks, such as limestone. In some circumstances, sinkholes can have limited benefits for flood protection, including temporary storage capacity for water, providing natural drainage points allowing water to infiltrate the ground, and groundwater recharge. However, sinkholes in Texas pose unique challenges for flood infrastructure due to their potential to impact the stability and functionality of flood control systems. In Texas, where limestone formations are prevalent, sinkholes present risks to flood infrastructure, including levees, canals, and drainage systems, by compromising their structural integrity (USGS, 2018). The regional flood planning groups identified 138 sinkholes throughout the state, the functionality and condition of which are all unknown.

*Figure 3-4. Major and minor estuaries along the Texas coast*




## Coastal areas

Texas has 367 miles of coastline between Orange County to the north and Cameron County to the south. Of the 15 flood planning regions, 10 include coastal areas with varying geographical features such as beaches, estuaries, bays, and barrier islands. The planning groups identified 132 natural coastal features, of which all were identified as unknown functionality. Natural coastal features like alluvial fans, beaches, and coastal dunes help protect the coast against waves and tidal action that can cause erosion and worsen inland flooding. They provide flood protection by acting as a natural buffer against storm surges and tidal action, reducing the potential impact on coastal communities.

Many of the coastal regional flood planning groups' plans referenced the beneficial role of estuaries in flood protection. Estuaries are characterized by shallow, sheltered waterways that are home to a unique range of plant and animal species. During storm events, estuaries act as natural buffers, sequestering excess water and slowing its flow into coastal land areas. **Estuary** vegetation also helps trap sediments, which stabilizes the shoreline and reduces erosion, further protecting the coastline from storm surges and wave action. There are 10 major river basins that terminate at the Texas coast, creating seven major and five minor estuaries by mixing freshwater runoff with the saltwater of the Gulf of Mexico (Figure 3-4).

A variety of studies and projects are underway to protect and revitalize the Texas coast, such as wetland restoration, beach nourishment, and the construction of new seawalls. These initiatives include the Texas Water Development Board's Coastal Science Program,[18] the National Coastal Zone Management Program[19] managed by the National Oceanic and Atmospheric Administration, and the 2019 Coastal Resiliency Master Plan[20] managed by the Texas General Land Office. Also notable is the National Estuaries Program,[21] which includes the Galveston Bay Estuary Program and Coastal Bend and Bays Estuary Program managed in Texas by the Texas Commission on Environmental Quality.

### Parks, preserves, and open spaces

While over 96 percent of Texas land is privately owned, its public lands are some of the most diverse in the country with 88 state parks, 14 national park units, and numerous other city, county, and community green spaces across the state (ASCE, 2021). Parks and preserves are broadly recognized for their recreational and aesthetic benefits, but they also serve crucial components of any major flood infrastructure assessment. They are often located within floodplains, near rivers and creeks, and help retain excess water runoff that may otherwise overwhelm channels and drainage systems during rainfall. Parks, preserves, and open spaces may become deficient when they are developed or interfered with, making their floodplains less effective at handling floodwaters.

The types of areas identified range from wildlife management areas and national and state parks to golf courses and school sports fields. The regional flood planning groups identified approximately 781,037 acres of parks, preserves, and open spaces (Table 3-1). Nearly 6 percent (46,177 acres) of parks, preserves, and open spaces were identified as functional and non-deficient, while the functionality and condition of the remaining 94 percent were identified as unknown.

### Other natural features

The regional flood planning groups identified 26 natural features that did not fall into any of the categories discussed in preceding sections. All 26 were identified by the Region 9 Upper Colorado Regional Flood Planning Group and called "unnamed other." The functionality and condition of all 26 were identified as unknown.

## 3.1.2 Constructed major flood infrastructure

The planning groups were required to identify and assess existing major flood infrastructure, and in doing so were given discretion in determining the scale of what constitutes "major" infrastructure. Of the 1,361,643 statewide flood infrastructure features identified by the flood planning groups, about 46 percent (619,870) were constructed major flood infrastructure (Table 3-2).

The number of identified major constructed flood infrastructure varied by flood planning region (Figure 3-5). Texas communities deploy a variety of constructed or non-natural measures to protect themselves from flood risk. Across the state, dams and levees are considered constructed major flood infrastructure for mitigating future flood risk. More localized features are also common, including man-made channels and ditches, stormwater management systems, and detention and retention ponds. All these constructed elements are crucial for protecting Texas communities from flood risk. Figure 3-6 and Figure 3-7 provide maps of the major constructed flood infrastructure identified by the planning groups.

It is important to understand that much of the minor, localized municipal stormwater drainage infrastructure throughout cities consists of smaller drains and culverts and is, for practical

[18] www.twdb.texas.gov/surfacewater/bays/index.asp

[19] www.coast.noaa.gov/czm/

[20] www.glo.texas.gov/coast/coastal-management/coastal-resiliency/index.html

[21] www.epa.gov/nep

*Table 3-2. Summary of major constructed flood infrastructure types by flood planning region**

| Region | Reservoirs | Dams | Levees (mile) | Low water crossings | Ponds | Storm drain systems (mile)[a] | Coastal | Gages[b] | Other[c] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | 624 | 14 | 1,249 | 25,132 | 329 | | | 5 |
| 2 | 29 | 487 | 100 | 133 | 115 | | | 35 | 1 |
| 3 | | 1,845 | 402 | 2,298 | 531 | 3,599 | | 1,545 | 115,443 |
| 4 | 15 | 341 | 64 | 132 | 58,591 | 235 | | | 0 |
| 5 | 1,159 | 338 | 205 | 186 | 57,780 | 79 | 160 | | 20 |
| 6 | 17 | 180 | 152 | 239 | 22,738 | 178 | 59 | 312 | 0 |
| 7 | 12 | 240 | 0 | 300 | 37,617 | 184 | | | 0 |
| 8 | 67 | 485 | 255 | 1,168 | 281 | | 40 | 1,942 | 53 |
| 9 | 76 | 120 | 5 | 538 | 27,968 | | | | 0 |
| 10 | 2 | 700 | 110 | 1,354 | 2,030 | | 454 | 157 | 4 |
| 11 | 6 | 221 | 28 | 815 | 30,502 | 517 | | | 0 |
| 12 | 28 | 162 | 13 | 496 | 424 | 806 | | 49 | 2,714 |
| 13 | 10 | 501 | 25 | 576 | 1,483 | 1,102 | 6 | 65 | 2,707 |
| 14 | | 218 | 249 | 1,782 | 674 | 774 | | | 4,197 |
| 15 | | 269 | 261 | 129 | 199 | 128 | 217 | | 5 |
| **Total** | **1,443** | **6,731** | **1,884** | **11,395** | **266,065** | **7,931** | **936** | **4,105** | **5,876** |

*Note: Blank cells in this table do not necessarily signify the absence of flood infrastructure; they indicate that such assets were not identified or reported by the regional flood planning groups.*

** All figures are presented as counts unless otherwise labeled.*

*[a] Storm drain systems include features classified as canals.*

*[b] Gages include features classified as high-water marks.*

*[c] Other category includes storm drain system components, revetments, bridges, and weirs.*

*Figure 3-5. Number of identified major constructed flood infrastructure by flood planning region*

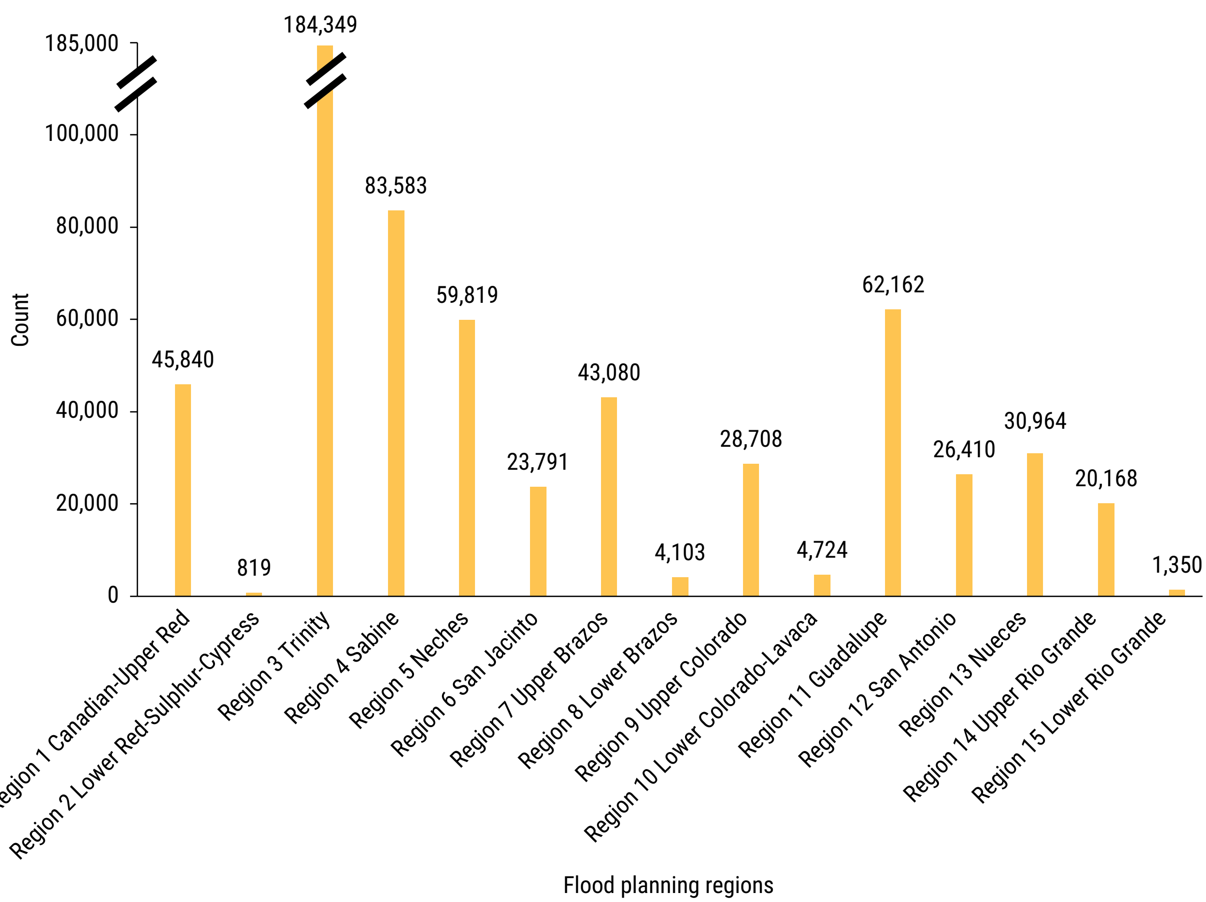
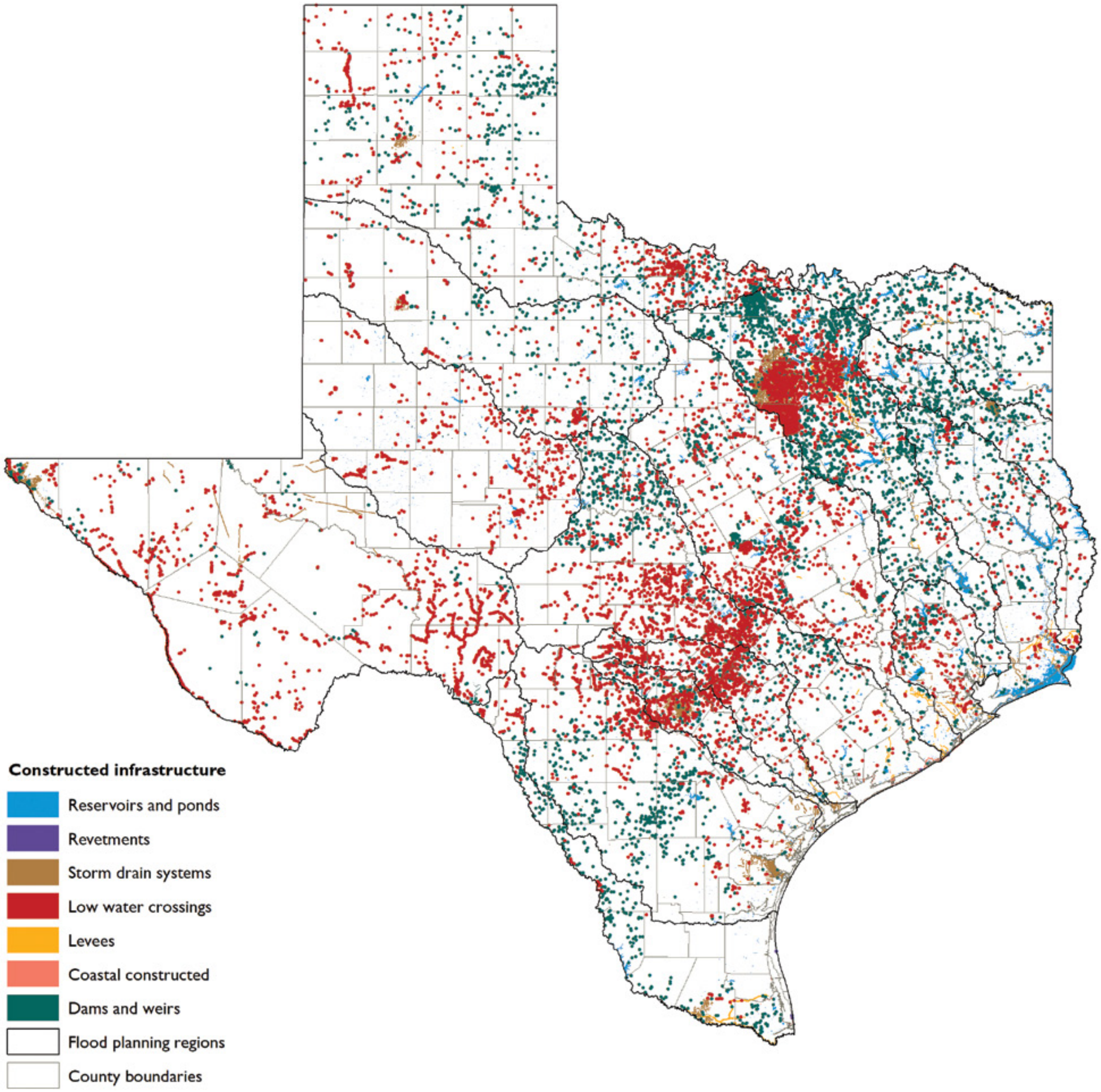


*Figure 3-6. Locations of constructed major flood mitigation infrastructure*

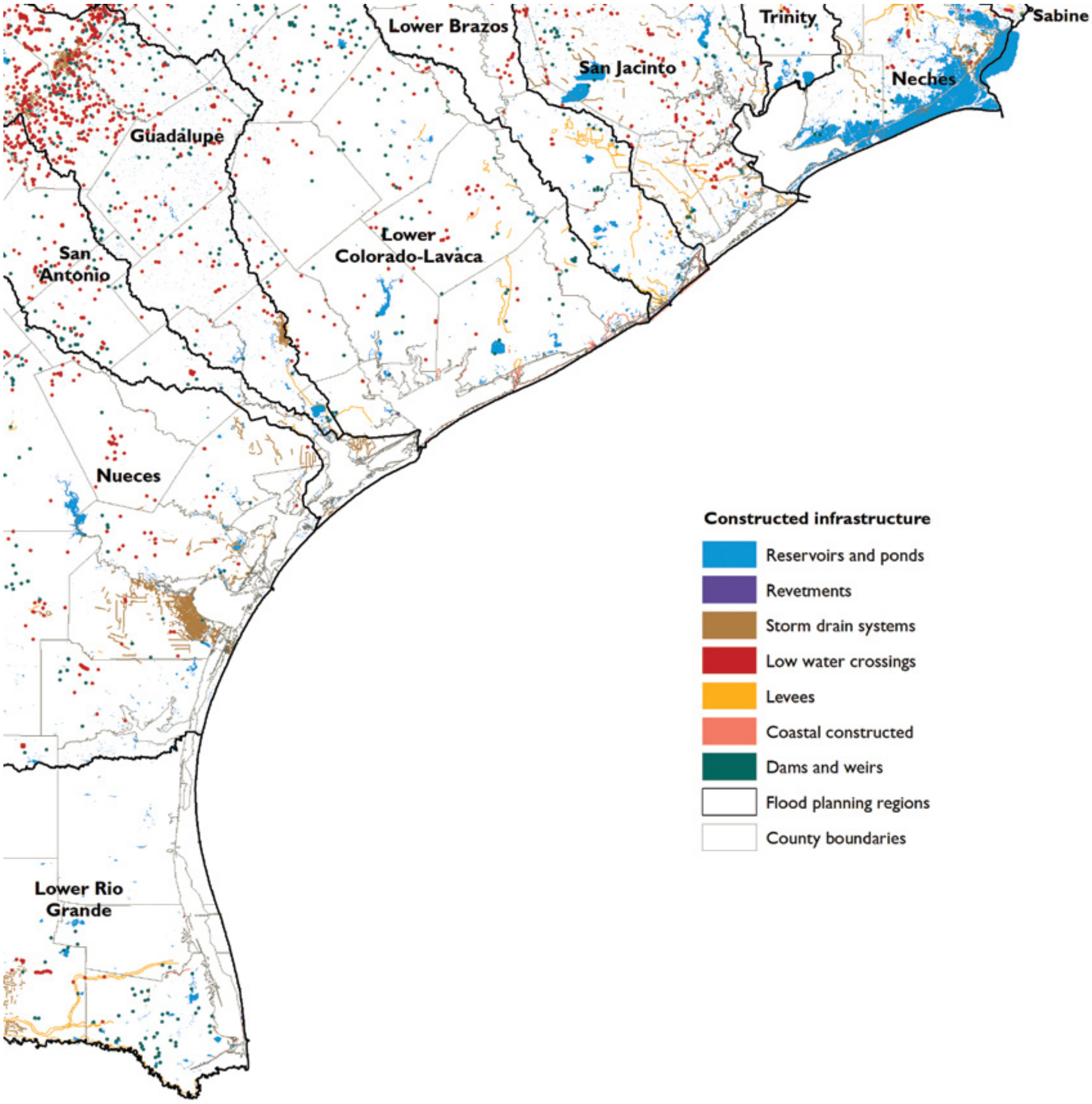



and cost purposes, generally designed to handle smaller, more frequent rainfall events (e.g., 10-year event). It is therefore expected for the stormwater municipal drainage infrastructure to be overwhelmed by larger, more severe, infrequent storm events. In contrast, the major flood infrastructure addressed in the regional and state flood planning process, such as major drainage channels within urban areas, is generally designed to mitigate flood risk associated with larger storm events.

Although not included as major flood infrastructure in the regional flood plans, many roadways are designed to handle stormwater and often serve as part of the drainage system to carry stormwater during a larger storm event.

The condition and functionality of much of the constructed major flood infrastructure were largely unknown to the flood planning groups. The functionality of two types of constructed major flood infrastructure, dams and levees, is

*Figure 3-7. Coastal inset of major constructed infrastructure in Texas*




described in greater detail in later sections of this chapter.

The following are key types of constructed major flood infrastructure identified by the regional flood planning groups:

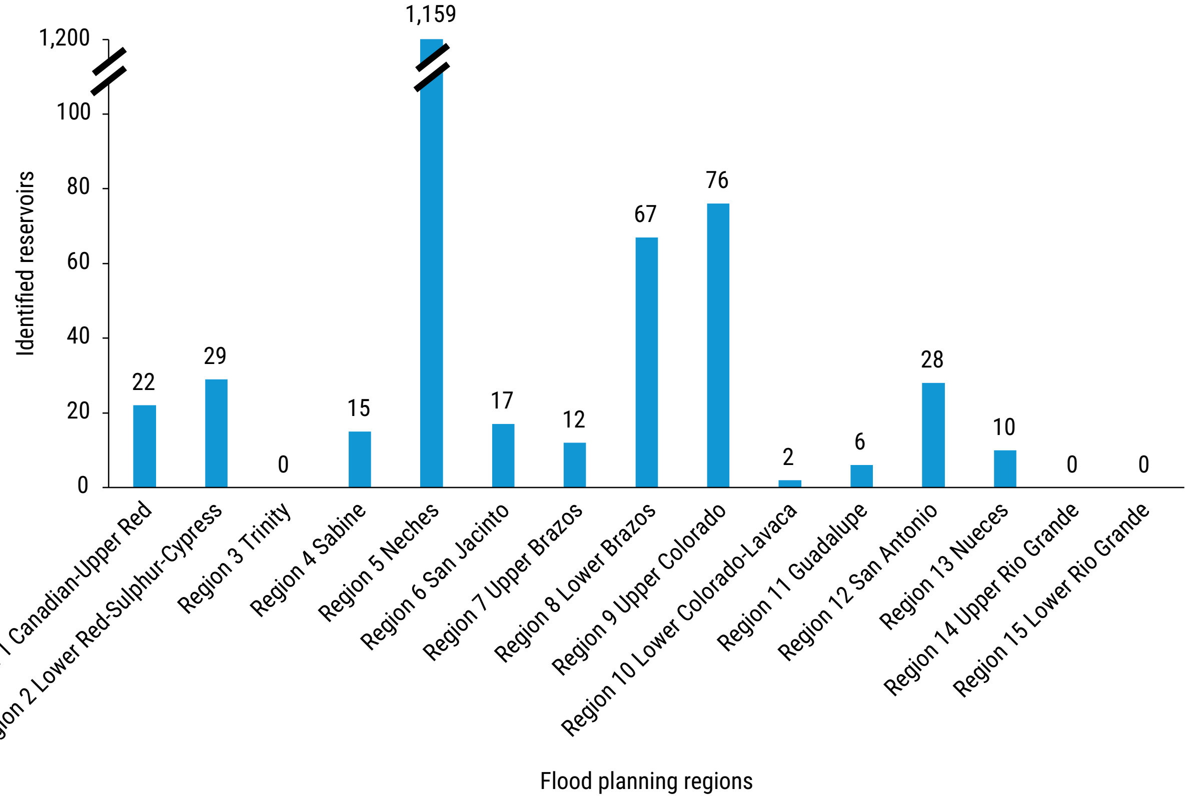
- Reservoirs, dams, and weirs
- Levees and revetments
- Low water crossings, roadway stream crossings, and bridges
- Detention and retention ponds
- Stormwater management systems and components
- Constructed coastal infrastructure
- Other constructed infrastructure

## Reservoirs, dams, and weirs

***Reservoirs***

Man-made lakes, also called reservoirs, are often created by installing dams across rivers or tributaries to capture and store water for a variety of purposes, including water supply. Flood control reservoirs mitigate risk by impounding excess water that would otherwise overwhelm downstream areas during extreme weather events. The planning groups identified a total of 1,443 reservoirs across the state that have some measure of

*Figure 3-8. Number of identified reservoirs with some measure of flood control by flood planning region*




*Note: Data reflects existing infrastructure as identified and reported by the regional flood planning groups.*

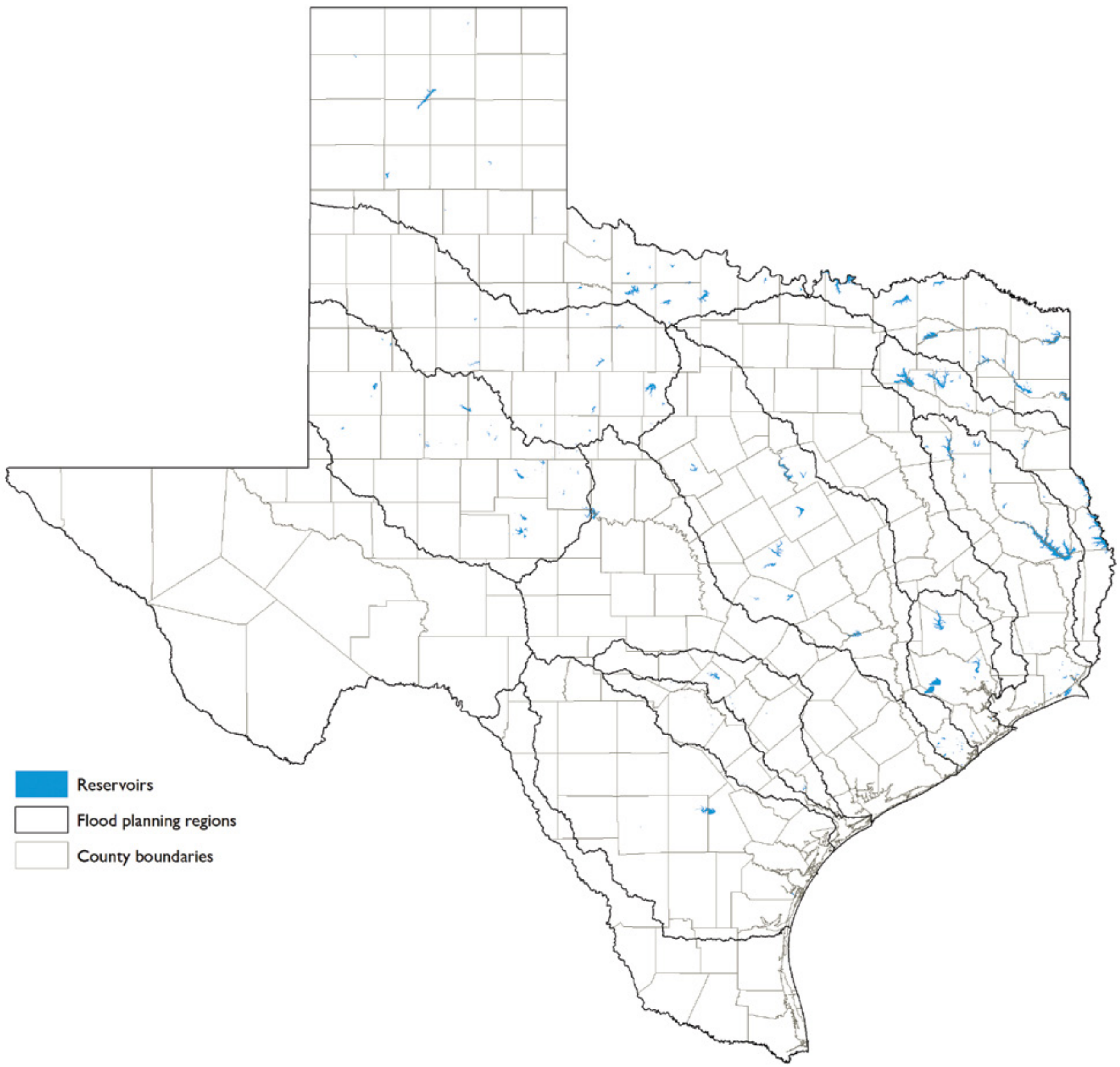
flood control (Figure 3-8 and Figure 3-9). Of the 1,443, Region 5 Neches accounted for almost 80 percent (1,159). Of all reservoirs identified as having some measure of flood control, the functionality of more than 98 percent (1,414) is unknown and the condition of all 1,443 is unknown.

Most reservoirs in Texas generally serve one of two primary functions: water supply, which is used for irrigation and human consumption, or flood control. Some reservoirs serve both purposes either through separate, designated storage volumes or by carefully managing a common storage volume using sophisticated techniques (e.g., Forecast Informed Reservoir Operations). Major water supply reservoirs are defined as those having at least 5,000 acre-feet of storage capacity and often serve additional purposes beyond water supply, including recreation and fire protection. Of the 1,443 reservoirs identified by the regional flood planning groups as providing some measure of flood control, at least 177 of those are also considered major water supply reservoirs.

***Dams***

The planning groups were given latitude to identify dams that have some flood mitigation functionality to include in the regional flood plans. The dams with only water supply functionality were not included for this exercise. The groups identified a total of 6,731 dams as having some measure of flood risk reduction (Figure 3-10). Of these, 27 percent (1,845) are within Region 3 Trinity and, overall, identified dams are highly concentrated around the Dallas-Fort Worth area. The dam evaluation identified 21 percent (1,411) as functional and 4 percent (294) as non-functional. The functionality of the remaining 75 percent (5,026) was identified as unknown. The condition

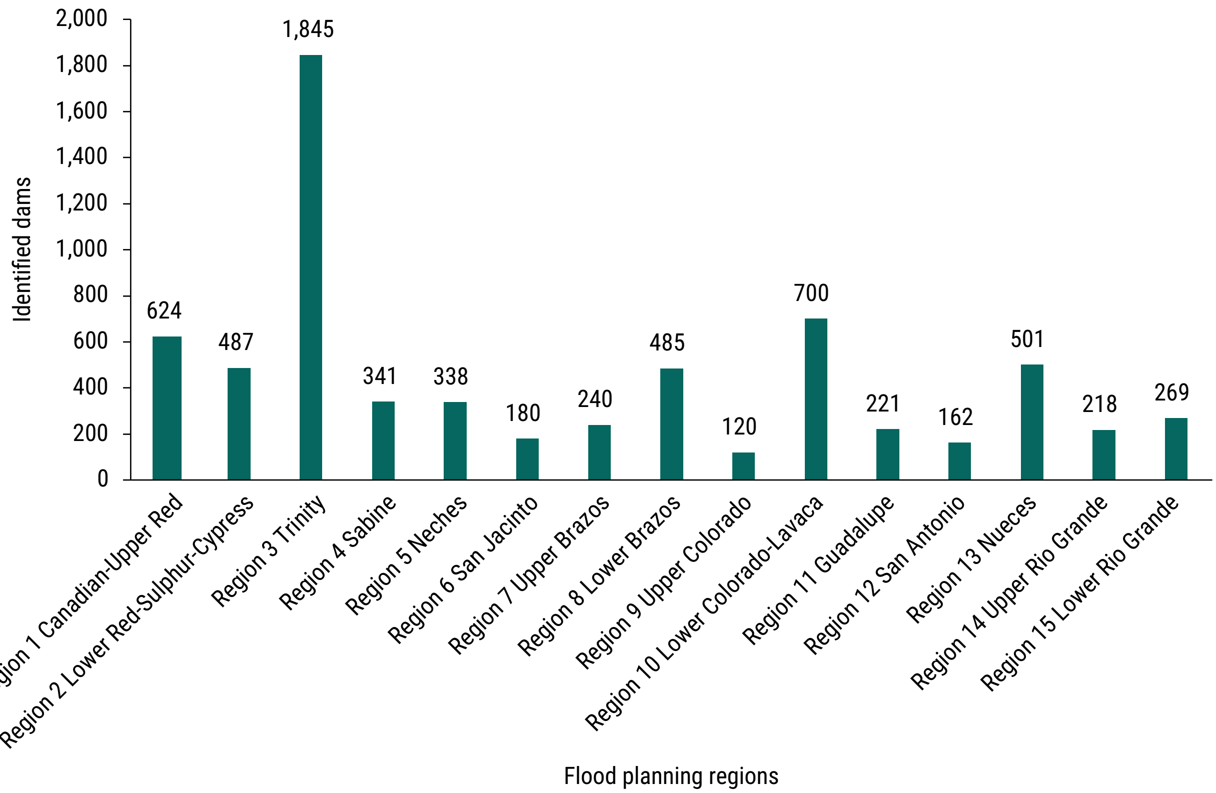
*Figure 3-9. Locations of identified reservoirs with some measure of flood control*




of 10 percent (651) of dams was identified as non-deficient, 1 percent (98) of dams were identified as deficient, and the remaining 89 percent (5,982) were identified as unknown.

Dams can be owned and operated by state and local governments, public and private agencies, and private citizens, making data collection challenging. As such, much information on dams, including ownership information and the dams' original purpose, is generally unavailable. The 15 regional flood planning groups obtained dam and reservoir information for their regions through various sources, including the Texas State Soil and Water Conservation Board, the Texas Commission on Environmental Quality, and the United States Army Corps of Engineers. Figure 3-11 shows the location of dams with flood control functionality across the state as identified by the planning groups.

*Figure 3-10. Number of identified dams with some measure of flood control by flood planning region*



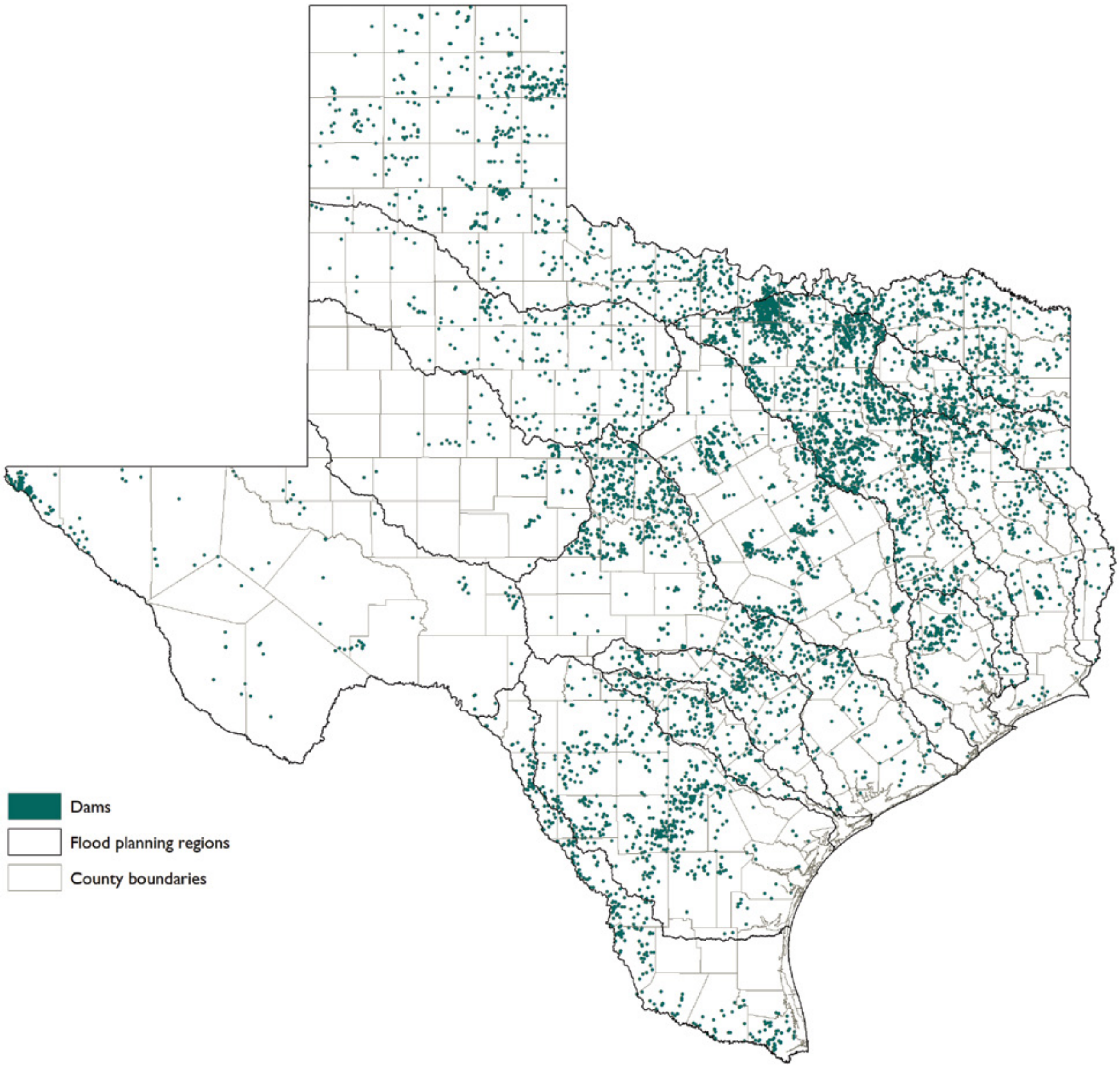

*Note: Data reflects infrastructure as identified and reported by the regional flood planning groups.*

The Texas State Soil and Water Conservation Board is responsible for developing and implementing a *Ten-Year Dam Repair, Rehabilitation, and Maintenance Plan*, in which it identifies and prioritizes high-risk Natural Resources Conservation Service dams that require attention. The agency also coordinates with local sponsors to develop cost-effective solutions to ensure that repairs and upgrades meet regulatory safety standards. A discussion of the *Ten-Year Dam Repair, Rehabilitation, and Maintenance Plan* is provided under Section 3.1.4.

The U.S. Army Corps of Engineers maintains the National Inventory of Dams based on information provided by dam owners, federal agencies, and state dam safety agencies (USACE, 2020). The inventory is a collaborative effort involving various entities that contribute data and updates on dams throughout the United States.

The Natural Resources Conservation Service within the United States Department of Agriculture plays a role in providing technical assistance and expertise related to the construction and inventorying of dams in Texas. The Natural Resources Conservation Service collaborates with landowners, communities, and other stakeholders to develop and implement conservation practices for various purposes, such as water resource management, erosion control, flood mitigation, and wildlife habitat enhancement. It may collect and maintain data on dams implemented through its programs or projects. However, it's important to note that the primary responsibility for dam inventorying and regulation in Texas lies with the Texas Commission on Environmental Quality. Over the past 70 plus years, the Natural Resources Conservation Service has assisted local sponsors in constructing 2,041 flood control dams in Texas (TSSWCB, 2020).

*Figure 3-11. Locations of identified dams with some measure of flood control*




The Texas Commission on Environmental Quality Dam Safety Program is authorized under Texas Water Code § 12.052 and regulates dams based on 30 Texas Administrative Code § 299. The primary objective of the Dam Safety Program is to ensure that dams are constructed, operated, and maintained in a manner that minimizes risks to public safety and the environment. The Texas Commission on Environmental Quality also maintains a comprehensive database of state-regulated dams in Texas. This inventory includes dams that meet specific criteria, such as size, hazard classification, and location. The agency classifies dams based on size using the maximum capacity and height of the dam to determine if it is a small, intermediate, or large dam. Dams are also classified by their downstream hazards and can be classified as low, significant, or high hazard depending on what or who is located downstream that could potentially be impacted by a dam breach. The Texas Commission on Environmental Quality collects and updates data on these dams, which helps in monitoring their condition, identifying potential risks, and facilitating effective regulatory oversight. It also reviews construction plans and specifications for new dams and for modifications to existing dams, hydrologic and hydraulic studies, breach studies, emergency action plans, water right permit applications, and water district creations for dam safety issues and attends emergency action plan tabletop exercises. The agency does not regulate any federal dams; they are maintained and operated at the federal level (TCEQ, 2023).

Texas began constructing dams and reservoirs in the 1930s and 1940s to combat the devastating effects of fluvial flooding that damaged livestock supply and property (Brazos River Authority, n.d.). From the 1950s through the 1970s, most of Texas' dams were constructed primarily for water supply purposes during drought conditions. Per the American Society of Civil Engineers – Texas Section, dams have a typical lifespan of about 50 years, which suggests that about 73 percent (4,907) of the state's dams are either reaching or have exceeded their lifespan (ASCE, 2021). However, timely rehabilitation of aging dams could extend their life spans well beyond 50 years.

Of the 6,731 flood protection dams identified by the flood planning groups, construction completion dates were available for approximately 83 percent (5,603). While approximately 58 percent of those with known dates were constructed prior to 1969, the 1960s were the most prolific period of dam construction in the state. Nearly 2,000 of the dams identified by the planning groups were constructed between 1960 and 1969. The average age of all dams as identified and reported by the flood planning groups was 67 years old.

As of May 2023, there are a total of 7,367 dams regulated by the Dam Safety Program, regardless of their primary function. Of these, 1,541 dams are classified as having a high hazard potential, meaning those where failure or mis-operation will likely cause loss of life. A total of 544 dams were classified as having significant hazard potential, and 5,254 were classified as having low hazard potential (TCEQ, 2023; Trina Lancaster, Texas Commission on Environmental Quality, written comm., 2023).

The consequences of dam failure can be severe and depend on several factors, including the volume of water that would be released due to sudden failure and the size and distance of communities located downstream from the dam. Consequences of dam failure include loss of life, extensive damage to private property and critical infrastructure, and the loss of agricultural lands and the disruption to local economies (TCEQ, 2023).

There are several sources of dam failure. For example, poorly constructed dams or those built before the establishment of improved building standards may be particularly prone to failure. Dams require regular maintenance and inspections to ensure they function properly, especially to be able to withstand intense rain events. Dams that go without proper maintenance will deteriorate much more quickly than they would otherwise. All dams have a design lifespan when built and, over time, the materials used to construct the dam can deteriorate, leading to failure if left unchecked. Dams designed for a limited storage capacity, or those that have lost storage capacity over time through **sedimentation**, may become overwhelmed during severe rain events, resulting in what is called overtopping. This can lead to failure (TCEQ, 2023).

Aging dams combined with increasing populations and urbanization results in a growing need for dam maintenance, repair, and rehabilitation in Texas. The 2021 American Society of Civil Engineers Infrastructure Report Card[22] gave Texas a D+ for dams, meaning that the majority of those surveyed were in poor condition or at risk of failure. The Association of State Dam Safety Officials estimated the cost for rehabilitating all nonfederal dams in Texas at around $5 billion in

[22] www.infrastructurereportcard.org/wp-content/uploads/2021/07/TxIRC_2021_Brief.pdf

2019, and the Texas State Soil and Water Conservation Board estimates that approximately $2.1 billion is needed to repair or rehabilitate dams included in the Small Watersheds Program (ASCE, 2021). Several of the planning groups recommended legislative funding initiatives to support the maintenance of private dams in the regional flood plans. These and all other planning group legislative recommendations are discussed in Chapter 2 of this plan. Some of the planning groups also recommended dam-related flood management projects. For example, Region 3 Trinity recommended a project focused on upgrading the Holland Lake Spillway so it can meet Texas Commission on Environmental Quality dam safety requirements.

***Weirs***

Weirs are typically small, wall-like dams built across waterways that allow water to flow over the top and are used to control the water level upstream. Weirs are used at stream gages and on canals to determine the volume of flow. Occasionally, these may serve as flood management infrastructure by capturing floodwaters before overtopping. The regional flood planning groups identified a total of 189 weirs across the state, of which nearly 100 percent were identified as having unknown functionality and condition.

## Levees and revetments

***Levees***

Levees are man-made structures composed of long mounds of earth, concrete, and other materials built up along the banks of rivers to contain flood flows within a restricted floodplain. They prevent overflow from reaching nearby communities and infrastructure and are typically built in low-lying areas that are naturally prone to flooding during heavy rain events. As such, levees are critical for protecting communities from flooding, and safety assessments are vital to ensuring performance at their designed standards.

The flood planning regions identified approximately 1,884 miles of levee systems across the state (Figure 3-12). Region 3 Trinity identified the most mileage of levees by length, with a total of approximately 402 miles. Figure 3-13 shows the locations of the identified levees across the state.

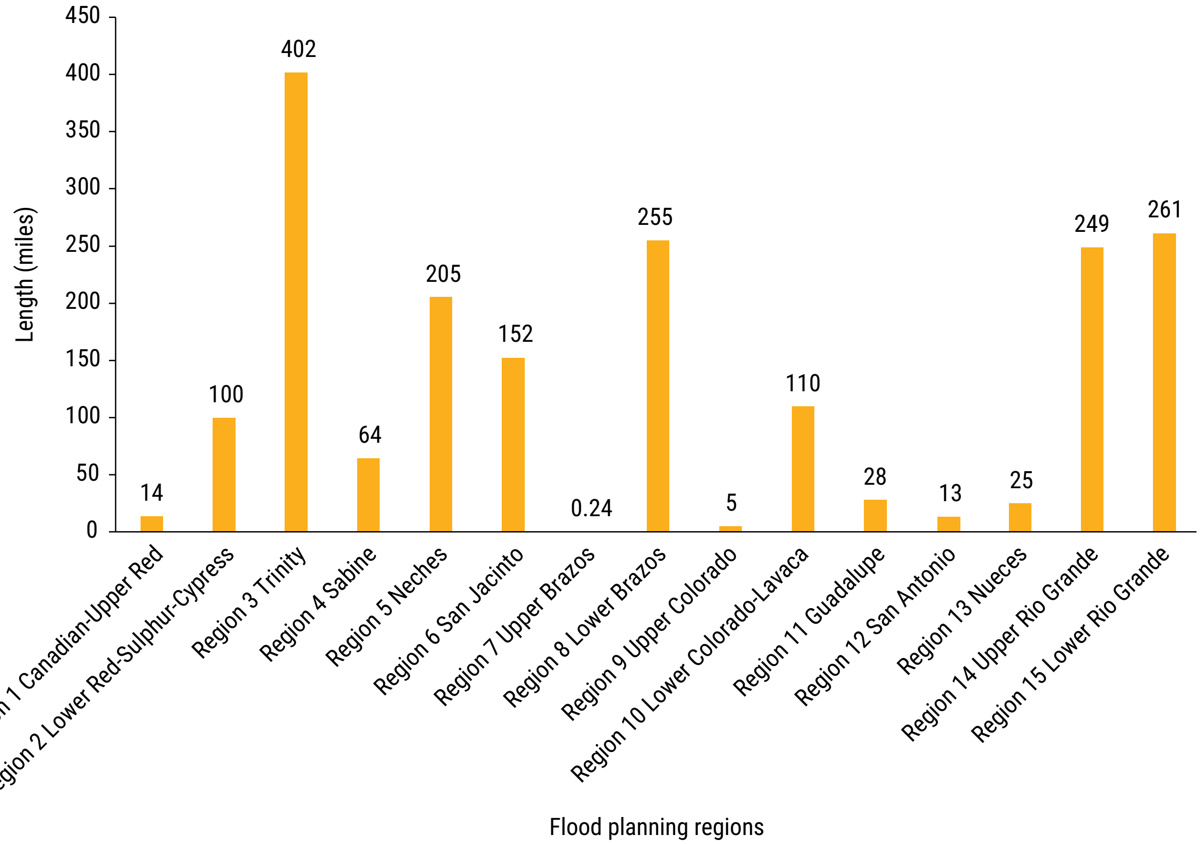
Of the levees identified, the functionality of 82 percent (1,548 miles) was identified as unknown, while about 10 percent (188 miles) were identified as functional and 8 percent (147 miles) as non-functional. Similarly, the condition of approximately 93 percent (1,758 miles) was identified as unknown, while 3 percent (60 miles) was identified as deficient, and 4 percent (66 miles) was non-deficient. For future planning cycles, coordination with communities, special districts, and the public will likely lead to the collection of more detailed information that can be incorporated into future regional flood plans.

According to the 2021 Texas Infrastructure Report Card, almost 90 percent of Texas levees are constructed, inspected, and maintained by local agencies that often lack the resources necessary for regular evaluations, making functionality and condition-related information more difficult to collect (ASCE, 2021).

Under Texas Water Code § 16.236,[23] the Texas Commission for Environmental Quality is granted the authority to regulate the construction, maintenance, repair, and removal of levees. All new levee construction and improvements are required to undergo a review and approval process with the agency. All applications must include the location and extent of the proposed structure and be accompanied by preliminary engineering plans that demonstrate the effects the project will have on neighboring areas. Additionally, per 30 Texas Administrative Code § 301.34, levees constructed in urbanized areas should be designed to manage the 1 percent (100-year) annual chance storm event and 3 to 4 feet of freeboard, or the safety

[23] https://statutes.capitol.texas.gov/Docs/WA/htm/WA.16.htm

***Figure 3-12. Length of Texas levees by regional flood planning area***




*Note: Statewide total length of levees, as reported by the regional flood planning groups, is approximately 1,884 miles.*

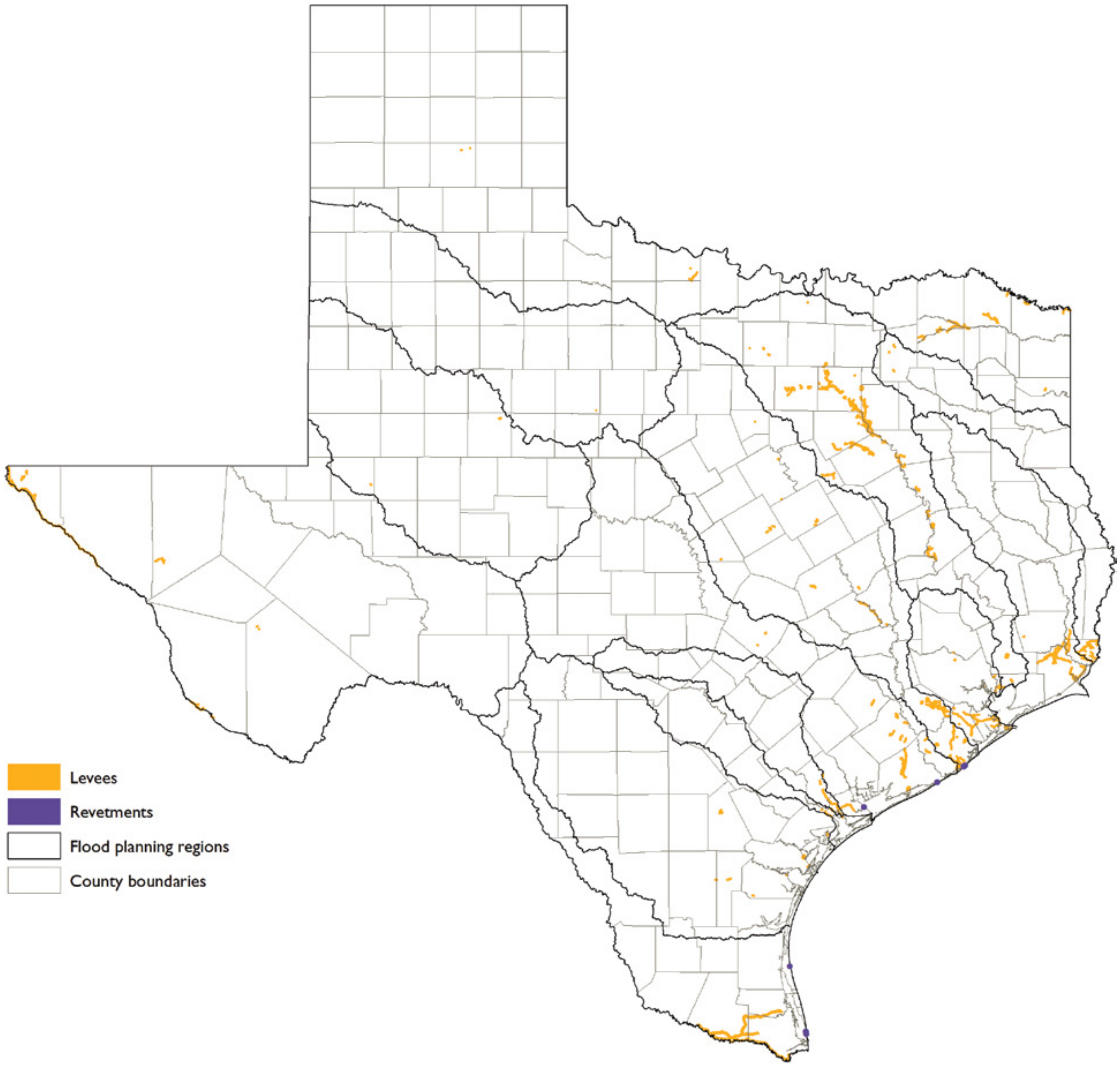
margin built into a levee or flood protection structure. The state's existing levee systems protect more than 1 million Texans and approximately $127 billion of property (ASCE, 2021).

The U.S. Army Corps of Engineers maintains and publishes a congressionally authorized database of levees in the United States known as the National Levee Database.[24] The database contains information on the condition and risk for approximately 2,000 levee systems nationwide, most of which are affiliated with U.S. Army Corps of Engineers programs. The National Levee Database reports a total of 255 Texas levee systems stretching more than 1,400 miles. Fifteen percent (51) of the U.S. Army Corps of Engineers-affiliated Texas levee systems are owned, inspected, and maintained by the U.S. Army Corps of Engineers, while the remaining 85 percent (276) are constructed and under the purview of local governing bodies, many of which often lack the resources necessary to perform routine inspections and maintenance (ASCE, 2021).

One of the tools commonly used to classify levee systems by their condition and current and future maintenance is the U.S Army Corps of Engineers Levee Safety Action Classification, in which risk categories range from one (very high) to five (very low). Of the 41 Texas levee systems assessed to date, five are classified as high to very high risk. More than 75 percent of Texas levee systems remain unscreened for classification. While levee failures have been rare in Texas, increasingly

[24] www.levees.sec.usace.army.mil/#/

*Figure 3-13. Locations of identified levees and revetments in Texas*




intense and frequent storm events are testing the capacity of Texas levee systems (ASCE, 2021).

Finally, the U.S. Army Corps of Engineers and Federal Emergency Management Agency (FEMA) established the National Levee Safety Program,[25] authorized by the National Levee Safety Act (2007) to improve public safety by reducing the risk of failure of levee systems in the United States. The program works to promote and standardize levee safety practices, provide technical assistance and resources to levee owners and operators, and develop and maintain a national levee inventory and assessment database. The program also conducts outreach and education to increase public awareness of the potential risks associated with levees and encourage community participation in levee safety efforts (USACE, 2018).

[25] www.leveesafety.org/pages/about-the-program

***Revetments***

Revetments are components of flood protection infrastructure in Texas that are strategically incorporated along riverbanks and coastal areas prone to flooding. These structures are designed to reduce flood risk by preventing erosion and stabilizing the water's edge. Made of durable materials, such as concrete, riprap, or geotextile fabrics, revetments effectively dissipate the energy of flowing water and waves, safeguarding adjacent properties and critical infrastructure from damage. By providing a protective barrier, revetments help maintain the integrity of riverbanks, channels, and shorelines, minimizing erosion and the potential for flood-related devastation. Only three flood planning groups identified revetments within their regions. Of the revetments identified, the functionality and condition of all were identified as unknown.

## Roadway stream crossings, low water crossings, and bridges

***Roadway stream crossings***

In Texas, most flood-related fatalities occur when a vehicle is washed off an inundated roadway during storm events. A roadway stream crossing refers to a location where a road or highway intersects with a stream or watercourse that may be susceptible to floodwater during periods of heavy rain or other flood events. These crossings are designed to accommodate the flow of water over or under the road, allowing for the safe passage of vehicles and minimizing the impact of flooding on the transportation system (RIDOT, 2021). Not all roadway stream crossings are low water crossings; however, all low water crossings are roadway stream crossings.

***Low water crossings***

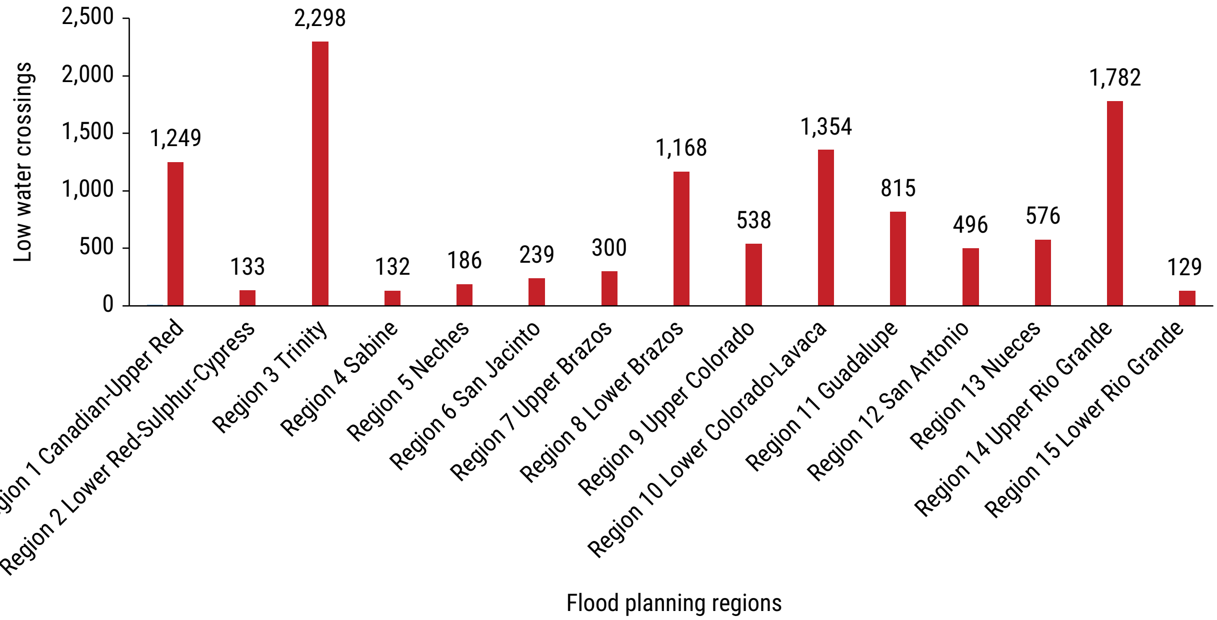
Low water crossings are roadway creek crossings that are subject to frequent inundation during storm events during a 50 percent (2-year) annual chance storm event. They are designed to allow vehicles and pedestrians to cross creek beds during periods of low water flow. As such, low water crossings and other at-risk roadways pose significant flood risk during periods of intense rainfall and flash flooding. Loss of life may occur when drivers attempt to cross low water crossings during a flood event. Even a little water flowing through a creek bed may be powerful enough to disrupt a vehicle's contact with the roadway, sweeping the vehicle off the road. Chapter 4 includes additional discussion of the risk associated with low water crossings in the existing conditions of flood hazard areas.

During the first planning cycle, the planning groups were given flexibility to utilize a community's discretion to identify roadway creek crossings as low water crossings in their regions. As such, the planning groups identified 11,395 low water crossings across Texas (Figure 3-14). While low water crossings span the entirety of the state, they are highly concentrated in the north central area of the state (Region 3 Trinity) and in Central Texas (Region 10 Lower Colorado-Lavaca, Region 11 Guadalupe, and Region 12 San Antonio). Of the low water crossings identified, the functionality of 98 percent and the condition of 99 percent were reported as unknown. Figure 3-15 shows the locations of identified low water crossings across Texas.

***Bridges***

Bridges in Texas serve a critical role as major flood infrastructure by providing essential lifelines during severe weather events. These structures are designed to withstand the forces of floodwater, allowing for safe passage of vehicles and pedestrians when other routes may be impassable. Bridges act as vital connections, enabling transportation and emergency services to reach affected areas and ensuring the movement of essential goods and services. During floods, when roads and low-lying areas become submerged, bridges remain elevated, allowing for continued access and evacuation routes (ASCE, 2021).

*Figure 3-14. Number of identified low water crossings by flood planning region*




While not a requirement, several planning groups identified a total of 5,478 bridges as constructed major infrastructure (Table 3-2). The functionality and condition of these bridges were identified as unknown by the regional flood planning groups.

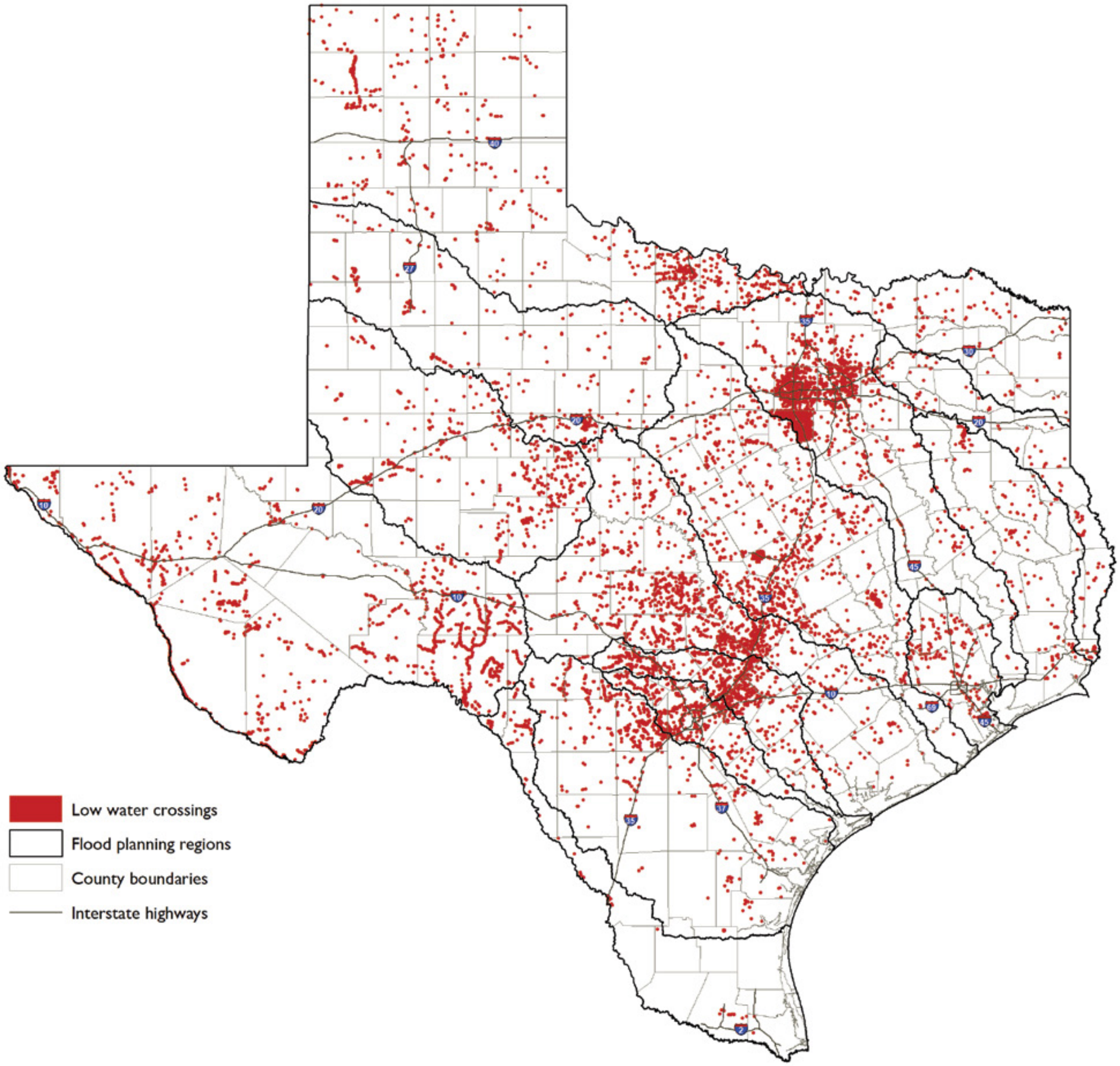
Engineers consider such factors as water flow velocity, debris impact, and scour potential when designing bridges in flood prone areas. However, bridges are still vulnerable to floods, and regular maintenance and monitoring are essential to mitigate potential risks. In 2019 the U.S. Department of Transportation published state bridge inventories, finding that out of 55,000 bridges in Texas, only 1.4 percent (787) are identified as being in "poor condition"—much lower than the national average (TxDOT, 2020). To maintain the functionality and safety of these bridges as flood infrastructure, the Texas Department of Transportation implements a comprehensive maintenance program throughout the state.[26]

[26] www.txdot.gov/business/grants-and-funding/highway-bridge-program-hbp-federal-aid.html

### Detention and retention ponds

Detention and retention ponds are large, excavated areas installed on, or adjacent to, tributaries of rivers, streams, lakes, or bays and in urban areas to protect against flooding and, in some cases, downstream erosion by storing water for a limited period. Detention ponds are designed to temporarily store stormwater until it can be released at a controlled rate into local channels, whereas retention basins are designed to hold water permanently, allowing it to be treated over time. Detention/retention ponds are considered stormwater management best practices that provide general flood protection and can also control extreme floods, such as a 1 percent (100-year) annual chance storm event. Detention ponds are typically required for floodplain management by local land development codes during the construction of new land development projects, including residential subdivisions or shopping centers. The ponds help manage the excess urban runoff generated by newly constructed impervious surfaces, such as roads, parking lots, and rooftops.

*Figure 3-15. Locations of identified low water crossings across Texas*

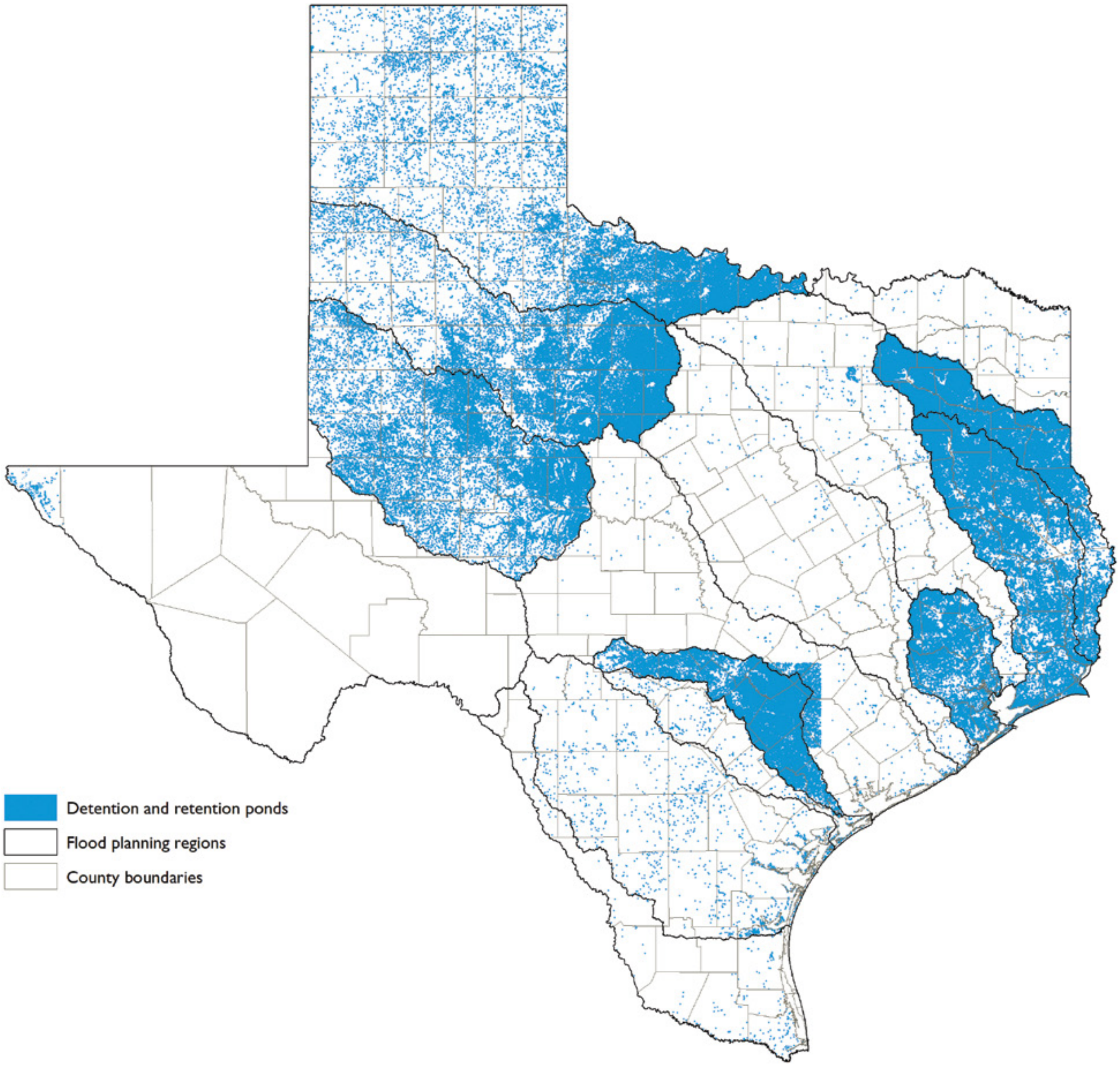



The regional flood planning groups had discretion in determining the scale of what constitutes "major" infrastructure to be included in the regional flood plans. For example, the inventory is not expected to include every small detention pond in a region—rather, only major regional detention ponds. As such, the regional flood planning groups identified 266,065 retention and detention ponds (Table 3-2) covering a combined area of about 1,394,232 acres across Texas (Figure 3-16). Of these, 100 percent were identified as having unknown functionality and condition.

## Stormwater management systems and components

Stormwater management systems are designed to manage the excess water generated during

*Figure 3-16. Locations of identified detention and retention ponds**

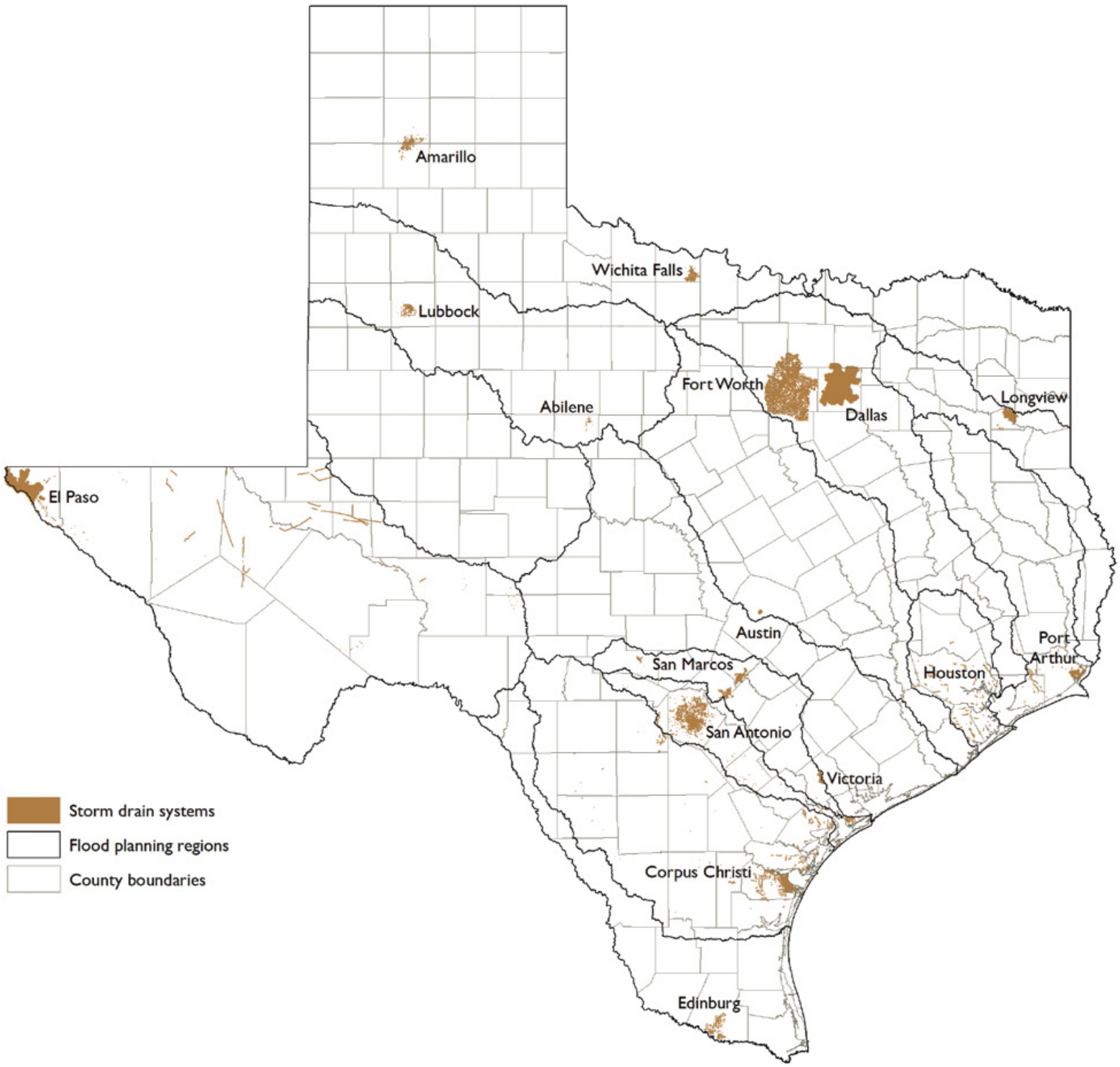



** Data density on this map demonstrates the variability of how flood infrastructure was identified by the regional flood planning groups. While some planning groups chose to include small, unnamed ponds others included only large ponds designed for flood control.*

rainfall events to prevent flooding, erosion, and water pollution. In urban areas, storm drains are a common type of flood infrastructure that collects and conveys stormwater away from populated areas through underground pipes to inlets and outflows.

While the availability of data and information for identified storm drain systems varied from region to region, the regional flood planning groups identified a combined total of approximately 7,931 miles of stormwater management systems, storm drain components—which may include pipes, flumes, bends, culverts, etc.—and stormwater canals. The planning groups identified the highest concentrations of these systems around urban centers, including Dallas-Fort Worth, San Antonio, and El Paso (Figure 3-17). The condition for nearly 100 percent of storm water management systems, components, and canals identified was

*Figure 3-17. Locations of stormwater management systems as reported by the regional flood planning groups**




** Map reflects stormwater management systems as reported by the regional flood planning groups. This information is displayed with the acknowledgment that much of the state's stormwater infrastructure may not have been identified by the regional flood planning groups due to constraints in the availability of infrastructure data across the state. The TWDB is currently funding and guiding a research project to develop infrastructure assessment guidance and a toolkit to help local communities identify and determine functionality of their existing stormwater infrastructure.*

unknown. Fifty-five were identified as non-functional, with the remaining identified as functionality unknown.

These systems are typically managed by the same entity responsible for their construction. Management responsibilities include routine maintenance, like cleaning debris from catchment areas, repairing infrastructure, and generally ensuring that all pieces are functioning properly during rainfall events. In some cases, particularly in larger cities or regions with relatively extensive storm drain systems, specialized stormwater management districts or utilities are created to manage these systems. Examples include the Harris County Flood Control District and the Lower Colorado River Authority. These entities play a critical role in managing stormwater and protecting the environment and public health in their respective communities.

Until now, Texas has not had a statewide inventory of built drainage systems, and the TWDB and regional flood planning groups were not tasked or resourced to create an inventory of all drainage systems. This is a large and complex endeavor that would cost millions of dollars to eventually generate. Instead, local entities are charged with keeping a comprehensive inventory of their own drainage systems. However, Senate Bill 8 (2019) directed the TWDB and regional flood planning groups to include an assessment of existing infrastructure, including a general description of the location, condition, and functionality of natural features and constructed major infrastructure in the regional and state flood plans. To their credit, the groups accomplished a great deal during the compressed first planning cycle as they were able to identify a great number of drainage systems in the state. As the regional and state flood planning program continues, each iteration of the plans will improve upon the inventory of major storm drain infrastructure but will not produce a comprehensive inventory of all drainage systems. That type of inventory effort will continue to be the responsibility of communities to generate and maintain. The current effort to inventory major flood infrastructure does not specifically identify which drainage systems lack topographic relief and slope, specific challenges with those areas, or potential solutions associated with them.

### Constructed coastal infrastructure

Coastal infrastructure plays a vital role in minimizing the potential damage caused by flooding events along the Texas coastline. By providing a first line of defense against the encroaching waters, these structures aim to protect critical assets, infrastructure, and human lives in vulnerable coastal areas. Each infrastructure type exhibits different designs, materials, and capacities tailored to suit specific coastal conditions and local needs. The flood planning groups identified a total of 936 constructed coastal infrastructure, including sea walls, tidal barriers, and tidal gates (Table 3-2). The functionality and condition for almost 100 percent of these were unknown.

### Other constructed infrastructure

The regional flood planning groups identified 191 discrete constructed infrastructure that did not fit within the above categories. The names and descriptions of these ‘other’ features varied but included utilities, roadway stream crossings, schools, and water supply. The functionality and condition for these constructed features were identified as unknown.

## 3.1.3 Summary of functionality and condition of existing flood infrastructure

As previously mentioned, the regional flood planning groups were required to assess the condition and functionality of major flood infrastructure (Table 3-3 and Table 3-4).

Functionality

- Functional: The infrastructure is serving its intended design level of service.
- Non-functional: The infrastructure is not providing its intended or design level of service

Condition

- Deficient: The infrastructure or natural feature is in poor structural or non-structural condition and needs replacement, restoration, or rehabilitation.
- Non-deficient: The infrastructure or natural feature is in good structural or non-structural condition and does not require replacement, restoration, or rehabilitation.

When assessing the condition of existing major flood infrastructure, many engineers use the term “intended design level of service.” Intended

*Table 3-3. Summary of the functionality of identified major flood infrastructure*

| Region | Total infrastructure | Functional | Non-functional | Functionality unknown |
|---|---|---|---|---|
| 1 | 66,637 | | | 66,637 |
| 2 | 40,656 | 40,572 | 20 | 64 |
| 3 | 237,849 | 708 | 76 | 237,065 |
| 4 | 102,649 | 32 | 31 | 102,586 |
| 5 | 108,066 | 31 | 26 | 108,009 |
| 6 | 73,934 | | | 73,934 |
| 7 | 69,365 | | | 69,365 |
| 8 | 52,272 | 100 | 115 | 52,057 |
| 9 | 62,434 | 69 | 1 | 62,364 |
| 10 | 54,296 | | | 54,296 |
| 11 | 74,446 | | | 74,446 |
| 12 | 52,034 | 2,745 | 13 | 49,276 |
| 13 | 98,801 | 2,867 | 15 | 95,919 |
| 14 | 235,891 | 435 | 136 | 235,320 |
| 15 | 32,313 | | | 32,313 |
| **Total** | **1,361,643** | **47,559** | **433** | **1,313,651** |

*Note: Blank cells signify that the functionality of identified major flood infrastructure is not categorized and should not be interpreted as definitive statements of operational status; they merely reflect that the regional flood planning group(s) did not supply information regarding functionality.*

design level of service refers to specific performance and safety requirements that various infrastructure is designed to meet. For dams and levees, level of service is determined by considering such factors as the potential consequences of dam failure, the size of the reservoir that the dam/levee is intended to create, and the expected frequency and magnitude of expected flood events. The intended design level of service is based on a combination of engineering analysis, scientific data, and risk assessments.

Determining the level of service is required to ensure that the dam can safely perform its intended functions, whether that be flood control, water storage, generating hydroelectric power, or creating a recreational reservoir. The intended design level of service is also intended to reduce the risk of dam failure and its potential consequences, including loss of life, property damage, and environmental impacts.

Dams, for example, are typically designed to meet a specific level of service at the time of their construction. However, over time, the performance and safety requirements of dams must evolve due to population growth, changes in climate patterns, or changes in land use. As a result, dams must be periodically re-evaluated and, if necessary, upgraded to ensure that they continue to meet their intended level of service.

### 3.1.4 Dam repair maintenance plan

In addition to creating the regional and state flood planning process, Senate Bill 8 (2019) amended Subchapter B, Chapter 201, of the Agriculture Code to include Section 201.0227. This requires the Texas State Soil and Water Conservation Board to develop a 10-year plan for the repair and maintenance of dams identified as requiring rehabilitation. The *Ten-Year Dam Repair, Rehabilitation, and Maintenance Plan*[27] (2020) addresses the

[27] www.twdb.texas.gov/flood/planning/resources/doc/2020_05_TSSWCB%2010-Year%20Dam%20Repair,%20Rehabilitation,%20and%20Maintenance%20Plan.pdf

*Table 3-4. Summary of the condition of identified major flood infrastructure*

| Region | Total infrastructure | Deficient | Non-deficient | Condition unknown |
|---|---|---|---|---|
| 1 | 66,637 | | | 66,637 |
| 2 | 40,656 | 20 | 10,472 | 30,164 |
| 3 | 237,849 | | 8 | 237,841 |
| 4 | 102,649 | 15 | 81 | 102,553 |
| 5 | 108,066 | 16 | 88 | 107,962 |
| 6 | 73,934 | | | 73,934 |
| 7 | 69,365 | 6,774 | 3,394 | 59,197 |
| 8 | 52,272 | 24 | 248 | 52,000 |
| 9 | 62,434 | | | 62,434 |
| 10 | 54,296 | | | 54,296 |
| 11 | 74,446 | | | 74,446 |
| 12 | 52,034 | 8 | 52 | 51,974 |
| 13 | 98,801 | 28 | 166 | 98,607 |
| 14 | 235,891 | 58 | 192 | 235,641 |
| 15 | 32,313 | | | 32,313 |
| **Total** | **1,361,643** | **6,943** | **14,701** | **1,339,999** |

*Note: Blank cells signify that the condition of identified major flood infrastructure has not been specified and should not be construed as an assessment of its state; they merely reflect that the regional flood planning group(s) did not supply information regarding condition.*

increasing number of deteriorating dams across the state.

The plan involves identifying and prioritizing high-risk dams for repair, rehabilitation, or maintenance based on their potential hazard to life and property downstream. In the plan, the Texas State Soil and Water Conservation Board reported that only 123 of the 639 dams classified as high hazard currently meet the high hazard criteria, indicating that 516 dams require rehabilitation or upgrade to meet safety standards and adequately protect lives downstream. The agency has begun work to implement projects focused on operation, maintenance, repair, and rehabilitation/upgrading of these dams, with an average annual general revenue appropriation of approximately $6.8 million since 2010. Additionally, a supplemental appropriation of $150 million from the Economic Stabilization Fund was provided in 2019, and annual general revenue appropriations for 2020 and 2021 amount to $8,832,484 (TSSWCB, 2020b).

The Texas State Soil and Water Conservation Board works with dam owners to develop and implement cost-effective solutions that meet regulatory standards and protect the environment. The plan also includes a public education and outreach program to raise awareness of the importance of dam safety and encourage proactive maintenance by dam owners. While the agency aims to complete implementation of the plan by 2030, the current Flood Control Program needs include $14 million for maintenance of 2,041 dams, $136 million for repair of 188 dams, and $2 billion construction cost for rehabilitation and upgrade of 516 high hazard dams (TSSWCB, 2020a).

It also offers an Operation and Maintenance Grant Program to support the ongoing maintenance and upkeep of conservation practices implemented through the agency's programs. The program provides financial assistance to eligible landowners for the operation and maintenance of conservation practices, including terraces, grassed water-

*Storm surge along the Galveston seawall during Hurricane Ike in 2008; photo courtesy of the City of Galveston*

ways, diversions, and other practices designed to reduce erosion and improve water quality. The Texas State Soil and Water Conservation Board Flood Control Program's 2020 *Ten-Year Dam Repair, Rehabilitation, and Maintenance Plan* identified 2,041 flood control dams eligible for the Operation and Maintenance Grant Program.

The Texas State Soil and Water Conservation Board must also provide yearly reports to the TWDB on the progress of dam repairs and maintenance from the *Ten-Year Dam Repair, Rehabilitation, and Maintenance Plan*.

## 3.2 Proposed or ongoing flood mitigation projects

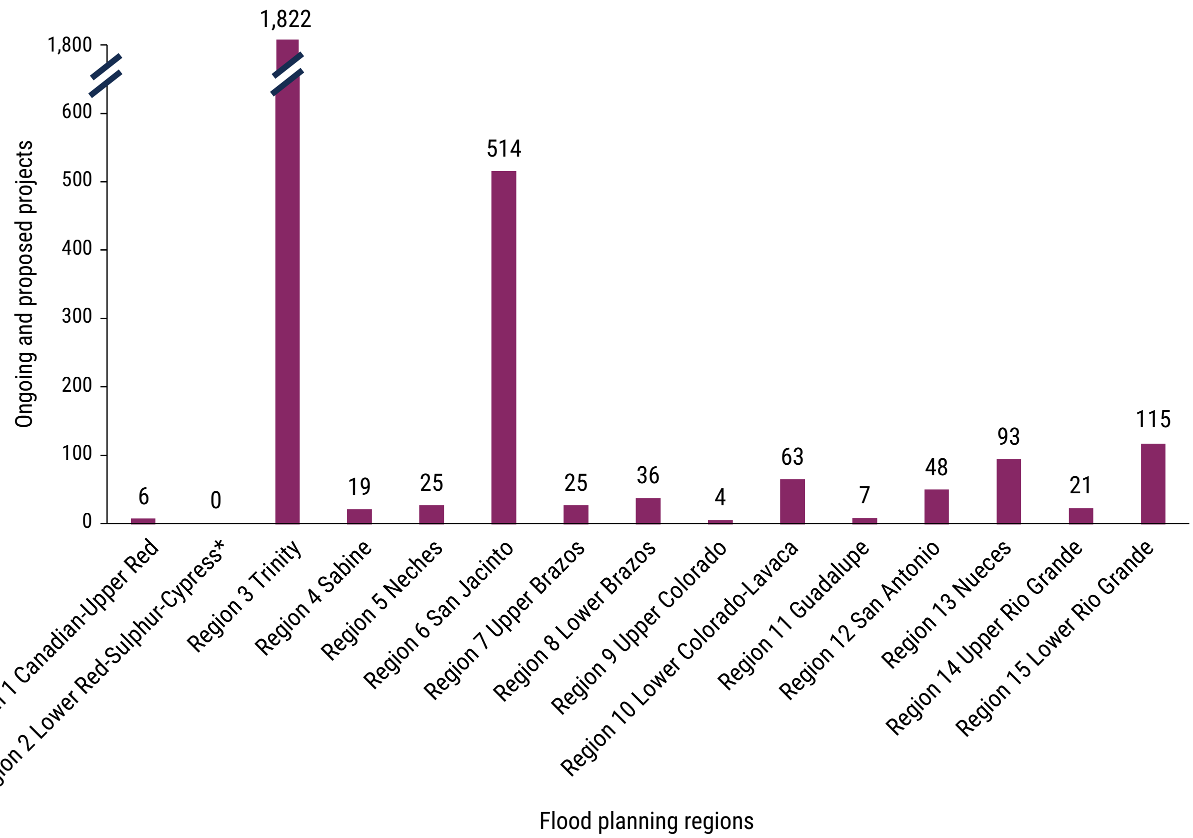
Each regional flood planning group was required to include a general description of the location, source of funding, and anticipated benefits of proposed or ongoing flood mitigation projects in the flood planning regions, including

- 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.

Like the inventory of existing major flood infrastructure, this effort was intended to help inform planning groups as part of their overall flood mitigation needs analyses and to inform their recommendations for flood risk solutions and actions to meet their regions' needs. The information helped to avoid duplication of efforts and potential conflicts between ongoing and newly proposed flood projects.

Data collection methods varied across regional flood planning groups but included outreach to local communities through surveys, one-on-one interviews, and reviewing existing disaster mitigation and comprehensive plans. The planning

*Figure 3-18. Number of identified proposed and ongoing projects per flood planning region*




** Region 2 Lower Red-Sulphur-Cypress did not identify any proposed ongoing projects in its 2023 amended regional flood plan.*

groups identified and compiled a total of 2,798 ongoing or planned projects and studies across the state (Figure 3-18), which included structural and non-structural measures with dedicated funding sources, like repetitive loss land acquisition and buyouts, coastal protection measures, regional detention and conveyance improvements, and public education campaigns. However, many groups had less success acquiring additional information about each project, including expected completion date and cost. While the cost for only about 20 percent (558) of the proposed and ongoing projects was known, that total cost exceeded $8 billion.

Planning groups also inventoried ongoing flood-related studies in their regions. Flood studies are important tools to identify a community's flood risk by utilizing up-to-date data on rainfall trends, topography, land use, and existing infrastructure. Ongoing flood studies can be used in future flood planning efforts to enhance a community's understanding of existing and future flood risk. The evaluations identified by the regional flood planning groups include base level engineering studies, local and county-wide drainage studies, dam inundation studies, and vulnerability assessments. Many of the identified studies include those funded through programs administered by the TWDB, FEMA, and the Texas General Land Office. These key programs are discussed in Chapter 10 Section 10.2.

The success of outreach measures also varied by region. However, the expectation is that participation by local communities will increase as general awareness of Texas' regional flood planning program spreads, ideally facilitating more robust and extensive data collection. A complete list of proposed and ongoing projects and studies, as acquired by the flood planning groups, is included in the Interactive State Flood Plan Viewer.

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*Stormwater flowing through and over culverts in Lebow Channel in Fort Worth, Texas, during Tropical Storm Hermine in 2010; photo courtesy of the City of Fort Worth Stormwater Management Division*

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