WILLIAMSON COUNTY

Interjurisdictional Community Flood Protection Plan

WILLIAMSON COUNTY
1848

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TETRA TECH

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Executive Summary

WHY PLAN FOR FLOODING

Recent floods have shown that Williamson County needs to address the issue of flooding on a countywide basis. flash flooding are three common types of flooding in Williamson County:

- Flash floods can occur at any time during the year, but history has shown that floods in spring and late summer into fall are the most prevalent and destructive. Flash floods are often caused by prolonged or repetitive severe thunderstorms and tropical systems.
- After a significant wildfire, vegetation is lost, and soils can harden to repel rather than absorb water. This can result in mud/silt or debris flows that impact public and private property (county roads, private homes/cabins, etc.) as the result of heavy rains or flash flooding. Mud/silt or debris flows as a result of flash flooding can also impacts flow conveyance, increasing the potential for flood damage. The loss of vegetation can negatively impact cultivated farm lands by potentially increasing run-off and erosion leading to flow conveyance.
- Additionally, there is a direct correlation between continued development and increase in impervious ground cover along with constructed drainage systems that route water into the floodway more efficiently. Impervious surfaces that do not absorb rain or allow it to infiltrate into the ground such as pavement, sidewalks or rooftops, can aggravate erosion and hasten the transport of sediments into drainageways. Per the Environmental Protection Agency (EPA) perhaps the most defining characteristic of urban streams is the increased amount and rapidity of stormwater or surface runoff to those systems. Impervious surfaces associated with urbanization reduce infiltration and increase surface runoff, altering the pathways by which water (and any associated contaminants) reach urban streams. Flooding is often the result.

The Williamson County Office of Emergency Management instituted the formation of a Countywide Flood Protection Steering Committee in 2018 because of historical flooding within the County as well as the potential for future flooding as identified in the Williamson County 2016 Hazard Mitigation Plan.

The intent of this project is to provide a broad comprehensive view of the flood hazards in Williamson County and their impacts. The expected outcome of this project is a resource tool that both county and local municipal officials can use to make informed decisions on where to locate flood mitigation activities to achieve the maximum benefit of their flood mitigation dollars. This tool, the 2018 ***Interjurisdictional Community Flood Protection Plan*** (the Flood Protection Plan) is intended to be a living document that is updated to capture the dynamic nature of flooding and its impacts. The County will use the Plan to direct multi-municipal flood mitigation projects. To be most beneficial, all flood mitigation activities should be prioritized based on the cumulative benefit of the mitigation activity and its ability to mitigate deleterious flooding impacts across municipal boundaries.

The Flood Protection Plan will serve as a guidance document augmenting the 2016 Williamson County Hazard Mitigation Plan. The Flood Protection Plan recommends local and regional policies, programs, and projects to reduce the risk to people and property from flooding in Williamson County. It presents a long-term vision for managing all flood hazards in Williamson County and recommends near-term actions to achieve that vision. The Flood Protection Plan recommends actions Williamson County and cities in the county may take to reduce flood risks and to protect, restore or enhance riparian and aquatic ecosystems.

WHAT IS FLOOD HAZARD MITIGATION? ACCORDING TO THE HAZARDS AND VULNERABILITY RESEARCH

Mitigation is defined as "sustained action taken to reduce or eliminate long-term risk to life and property." It involves strategies such as planning, policy changes, programs, projects, and other activities to address risk from hazards in a planning area. The responsibility for hazard mitigation lies with many, including private property owners, businesses, industry, and local, state and federal government. Recognizing that there is no one solution for mitigating flood hazards, planning provides a mechanism to identify the best alternatives within the capabilities of a jurisdiction. An Interjurisdictional Community Flood Protection Plan (the Protection Plan) is intended to achieve the following to set the course for reducing the risk associated with flooding:

- Ensuring that all possible activities are reviewed and implemented so that local problems are addressed by the most appropriate and efficient solutions.
- Ensuring that activities are coordinated with each other and with other community goals and activities, preventing conflicts and reducing the cost of implementing each individual activity.
- Coordinating local activities with federal, state and regional programs.
- Educating residents on the hazards, loss reduction measures, and natural and beneficial functions of their floodplains.
- Building public and political support for mitigation projects.
- Fulfilling planning requirements for obtaining state or federal assistance.
- Facilitating the implementation of floodplain management and mitigation activities through an action plan that has specific tasks, staff assignments and deadlines. The Williamson County Interjurisdictional Community Flood Protection Plan identifies policies and actions chosen through a facilitated process that focused on meeting these objectives.

MISSION STATEMENT, GOALS AND OBJECTIVES

The goals of the 2018 Williamson County Flood Interjurisdictional Community Flood Protection Plan are:

1. To reduce the risks from flood hazards.
2. To avoid or minimize the environmental impacts of flood hazard management.
3. To reduce the long-term costs of flood hazard management
4. To reduce repetitive loss through construction mitigation or by returning at-risk properties to green space.

Williamson County's objectives are the set of flood hazard management actions that will lead to achieving the identified goals. The objectives are:

1. Evaluate the risks to existing development in flood hazard areas and identify actions to reduce risks to life and property.
2. Manage land uses in hazardous areas in order to prevent creation of new flood risks.
3. Identify and map flood hazard areas and make maps readily available to the public.
4. Maintain a regionally coordinated flood warning and emergency response program in a state of readiness to be activated in the event of a flood.
5. Maintain, repair, or retrofit existing flood protection facilities in a manner that addresses public safety, is cost-effective and makes the facilities less susceptible to future damage.
6. Acquire vulnerable properties, with a special emphasis on those that have been repeatedly damaged by floods, when acquisition opportunities arise.

7. Remove or retrofit existing river facilities or modify maintenance practices to protect, restore or enhance riparian habitat and to support recovery of species listed under the Endangered Species Act.
8. Prioritize flood hazard management project and program recommendations based on level of risk, cost-effectiveness over the long term, and consistency with regional natural resource management protocols.
9. Sponsor and support public outreach and education activities to improve awareness of flood hazards and recommend actions that property owners can take to reduce risks to themselves and to others.
10. Manage activities in rivers and floodplains in a manner compatible with multiple and sometimes competing uses, including existing and proposed urban development within cities, flood risk reduction, agriculture, fish and wildlife habitat improvements, open space, recreation, and water supply.
11. Promote the economic and ecological sustainability of river and creek corridors.
12. Coordinate across Williamson County departments and with other jurisdictions to provide consistency in flood hazard management and disaster response activities.
13. Identify appropriate funding sources for implementing the recommended flood hazard management activities and pursue opportunities to use these funds in a timely and efficient manner.
14. Program in order to take full advantage of scientific and technological advances, and to use the best available floodplain management practices, principles and information.

INTERJURISDICTIONAL COMMUNITY FLOOD PROTECTION OVERVIEW

Williamson County's population has more than tripled in the last several decades, with a corresponding increase in new development occurring in high-risk flood areas. The community has a vested interest in minimizing the hazard of flooding in these areas. The community, through various forums, has expressed a desire to reduce the risk and hazard of flooding.

Given that resources to address this concern are limited, officials from Williamson County, local flood control districts, state and federal agencies, cities, towns and others have joined forces to develop the Williamson County communities' first interjurisdictional community flood protection plan.

Early in the development of this first plan, participating entities agreed that the plan should be generally consistent with the Hazard Mitigation Plans within Williamson County.

This Williamson County Interjurisdictional Community Flood Protection Plan (Flood Protection Plan) was developed in tandem with the Williamson County Interjurisdictional Community Flood Protection Plan Core Committee. The Williamson County IICFPPP sets forth goals and objectives, actions and policies designed to reduce the risk and impact of flooding in the County. Additionally, annexes for each of the participating communities are included with this plan. The goal is for the ICFPP Core Committee, together with the flood protection district staff, to provide an annual review and refine the ICFPP to meet the community's changing needs concerning flood protection. This plan envisions cooperation between various agencies, including the close collaboration between the County, local flood districts, the Texas Water Development Board, the Texas Commission on Environmentally Quality, and the cities and communities.

Primary themes of this Flood Protection Plan are:

- Development of partnerships through robust stakeholder engagement
- Integration with broader water resources objectives
- Identification of policy issues and recommended actions to resolve them

MITIGATION ACTIONS

In addition to collecting information about flood hazards, the Plan participants were asked to identify flood mitigation activities (completed, in process or planned for). Actions identified in applicable mitigation plans were reviewed and status was updated. Knowing the location and the type of historical flood hazards helps corroborate the causes of existing hazards. Participants were asked to identify where the hazard mitigation activity was or had occurred and to identify the type of activity. Several common types of countywide flood hazard mitigation activities are listed below.

Mitigation Actions:

1. Locate frequent flood hazard locations in Williamson County and assist local municipalities and agencies in gaining a better understanding of the nature of the repeated flooding concerns.
2. Create an updatable database that contains pertinent flood hazard characteristics, designed to be updated as mitigation activities are completed, and new flood hazard locations are identified.
3. Use the database to prioritize the County's watersheds based on the level of deleterious impacts caused by the flooding hazards. The prioritization process should reflect the goal that local mitigation activities with broader benefits in the regional watershed have the highest priority.
4. Develop a standardized approach for the identification and design of flood mitigation activities in the County's watersheds.
5. Implement a standardized approach for three of the County's high priority watersheds as identified during the prioritization process.

Chapter 1. Introduction

1.1 WHY PREPARE THIS PLAN?

Flood hazard mitigation is a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from flooding through long- and short-term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of floods. The responsibility for flood hazard mitigation lies with many, including private property owners, business, industry, and local, state and federal government.

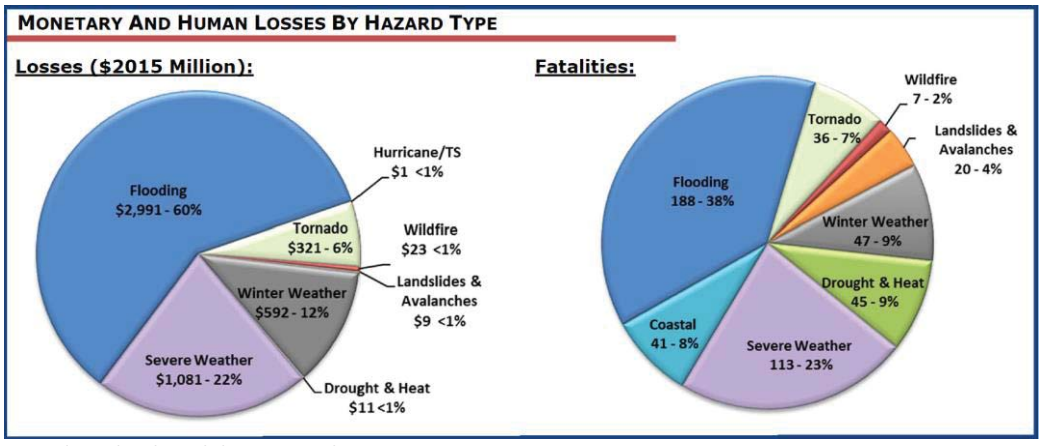
According to the Hazards and Vulnerability Research Institute, the natural hazard resulting in the highest monetary loss in the United State as well as the highest number of fatalities in 2015 (latest year reported) was flooding. Per the Institute, in 2015, the State of Texas was number one in the nation for the following: most hazard events, highest monetary losses, and most fatalities.

A flood protection plan promotes the following to set the course for reducing the risk associated with flooding:

- Ensuring that all possible flood management activities are reviewed and implemented so that local problems are addressed by the most appropriate and efficient solutions.
- Ensuring that flood management activities are coordinated with one another and with other community goals and activities, preventing conflicts and reducing the cost of implementing each individual activity.
- Coordinating local flood management activities with federal, state and regional programs.
- Educating residents on the flooding hazard, loss reduction measures, and the natural and beneficial functions of floodplains.
- Building public and political support for mitigation projects.
- Fulfilling planning requirements for obtaining state or federal assistance.
- Facilitating the implementation of floodplain management and mitigation activities through an action plan that has specific tasks, staff assignments and deadlines.

To break the cycle of repeated flooding, Williamson County recognizes that it must take proactive steps to reduce the loss of life as well as monetary losses from flood events.

Figure 1-1. Monetary and Human Losses by Hazard Type



Source: 2015 Hazards and Vulnerability Research Institute

Numerous state and federal programs and regulations promote comprehensive flood hazard planning. Notable among these is the Federal Emergency Management Agency's (FEMA) Community Rating System (CRS) program. This program that is part of the National Flood Insurance Program (NFIP). It provides benefits in the form of reduced flood insurance costs for communities that meet minimum requirements for flood hazard management.

The National Weather Service's Flood Safety Program lists the following ten flood facts for the State of Texas:

1. Central Texas has been identified as the most flash-flood prone area in the United States by the National Weather Service.
2. Texas holds 6 of 12 world record rainfall rates in 24 hours or less. (Source United States Geological Survey [USGS])
3. Texas leads the nation in flood-related deaths almost every year -- averaging twice the next nearest state (California).
4. Texas leads the nation in flood-related damages nearly every year - sharing this distinction with Florida and Louisiana.
5. Some 20 million of Texas' 171 million acres are flood-prone - more than in any other state. (Source: 2001 Blue Ribbon Committee Study -- Texas Senate Concurrent Resolution 68)
6. Texas has approximately 8 million structures in floodplains, and 3 million of these have no flood insurance. (Source: Blue Ribbon Committee Study)
7. Texas is among the top four states with repeat flood losses to the same properties. (Source: Blue Ribbon Committee Study)
8. From 1986 to 2000, Texas experienced 4,722 flash flood events. (Source: Blue Ribbon Committee Study)
9. Texas has 1.5 full-time employees to administer the NFIP in 1,000 communities (Source: Blue Ribbon Committee Study)
10. "Texas has the fewest numbers of state employees devoted to disaster preparedness of any of the most populous states," according to Tom Millwee, past head of the Texas Department of Public Safety and Chair of Blue Ribbon Committee.

1.1.1 Interjurisdictional Community Flood Protection Plan General Background

The 2016 Williamson County Hazard Mitigation Plan (HMP) was a public planning process that included the ranking and analysis of natural hazards which have historically affected the County as well as hazards projected to affect the County in the future. Flooding was one of the hazards analyzed in that process. Williamson County ranked flooding as high probability and high risk in this process.

The following description of flooding is an excerpt from the *2013 State of Texas Hazard Mitigation Plan*.

> *"Floods are defined as the accumulation of water within a water body and the overflow of excess water into adjacent floodplain lands."*

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from:

- The overflow of stream banks

- The unusual and rapid accumulation of runoff of surface waters from any source
- Mudflows or the sudden collapse of shoreline land

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat-sloped) streams.

The causes of floods relate directly to the accumulation of water from precipitation, or the failure of man-made structures, such as dams or levees. Floods caused by precipitation are further classified as coming from: rain in a general storm system, rain in a localized intense thunderstorm, melting snow and ice, and hurricanes/tropical storms. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure's capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised because of age, poor construction and maintenance, seismic activity, rodent tunneling, or myriad other causes.

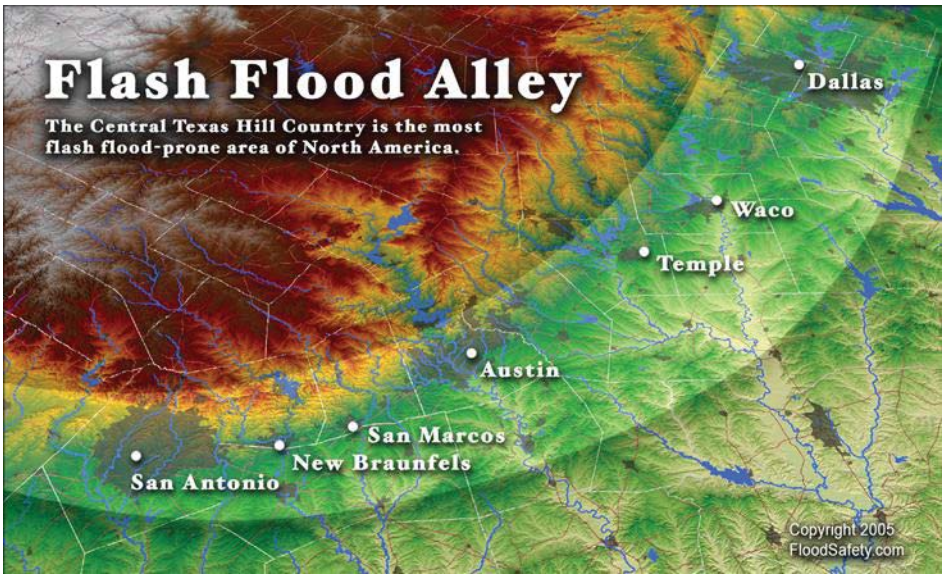
1.1.2 Types of Flooding

1.1.2.1 General Rain Floods

General rain floods can result from moderate to heavy rainfall occurring over a wide geographic area lasting several days. They are characterized by a slow steady rise in stream stage (surface elevation) and a peak flood of long duration. As various minor streams empty into larger and larger channels, the peak discharge on the mainstream channel may progress upstream or downstream (or remain stationary) over a considerable length of river. General rain floods can result in considerably large volumes of water. Because the rate of rise is slow and the time available for warning is great, few lives are usually lost, but millions of dollars in public and private property are at risk.

1.1.2.2 Thunderstorm Floods

Damaging thunderstorm floods are caused by intense rain over basins of relatively small area. They are characterized by a sudden rise in stream level, short duration, and a relatively small volume of runoff. Because there is little or no warning time, the term "flash flood" is often used to describe thunderstorm floods. Texas is known as the "Flash Flood Alley" and the area along the Balcones Escarpment (from Austin south to San Antonio, then west to Del Rio) is one of the nation's three most flash flood-prone regions. Williamson County and participating communities lie in the path of the "Flash Flood Alley."



Flash Floods can occur every month of the year in Texas but are most common in the spring and summer. The mean annual number of thunderstorm flood days varies from 40 in eastern Texas to 60 in western Texas. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms.

Flash floods can occur within a few minutes or after hours of excessive rainfall. Flash floods can roll boulders, tear out trees, destroy buildings and bridges, as well as carve out new channels. Rapidly rising water can reach heights of 30 feet or more. Flash flood-producing rains can also trigger catastrophic mudslides. Often there is no warning that flash floods are coming. Hill Country flash floods devastated the river basin and are a major reason why the U.S. Army Corps of Engineers located new dams at Lake Georgetown, Lake Granger and downstream of Georgetown. Flash flooding poses a deadly danger to residents of the San Gabriel River Basin. Roads running through low-lying areas are prone to sudden and frequent flooding during heavy rains. Motorists often attempt to drive through barricaded or flooded roadways. It takes only 18 to 24 inches of water moving across a roadway to carry away most vehicles. Floating cars easily get swept downstream, making rescues difficult and dangerous.

1.1.2.3 Hurricanes and Tropical Storms

The United States has a significant hurricane problem. More than 60 percent of the nation's population live in coastal states from Maine to Texas, Hawaii, and Puerto Rico. In the United States, the Atlantic and Gulf Coast coastlines are densely populated and many regions lie less than 3 meters (10 feet) above mean sea level.

Williamson County and participating communities, are exposed to flooding from hurricanes, tropical storms, and tropical depressions. Hurricanes, tropical storms, and tropical depressions produce soaking rain, high winds, flying debris, storm surges, tornadoes, and often the deadliest of all, inland flooding. Rain-triggered flooding is not just limited to coastlines as the reach of a large hurricane can cause deadly flooding well inland to communities hundreds of miles from the coast as intense rain falls from these huge tropical air masses. Increased flooding and erosion rates may cause landslides in some areas, especially mountainous regions.

Besides causing extensive damage in coastal areas, hurricanes and tropical storms can often cause extensive damage to communities several hundred miles inland. Just a few inches of water from a flood can cause tens of thousands of dollars in damage. Examples include an unnamed tropical storm of 1921, Tropical Storm Hermine, Hurricane Rita, Hurricane Ike, and Tropical Strom Allison.

1.1.3 Historical Flood Events

Despite the record of recent drought affecting Texas in the past recent years, the potential for flooding that results in personal and economic losses remains an issue Williamson County. Since 1969, official documentation shows that communities in Williamson County have been affected by flood-related events for which federal disaster declarations were issued, and others that caused damage though no federal declarations were made.

Notable incidents in Williamson County are described below:

- **September 7 to 10, 1921** – One the most severe storm events in the County began on Wednesday, September 7, 1921. What was then classified as a "disturbance" was noted by the U. S. Weather Service off the Texas Coast in the Gulf of Mexico. As the storm rolled north and inland it converged with a low-pressure system parked over the Balcones Escarpment and greatly increased in intensity and impact. Heavy rains and flash flooding combined with strong electrical storms blanketed the area. While Austin reported 18.23 inches of rain, the true brunt of the storm's force was felt in Williamson County. When the heaviest rain ended on September 10, 38.21 inches of rain over a 24-hour period had been reported in Thrall. This rainfall record stood unchallenged for 70 years. Taylor reported 23.11 inches of rain from the same storm. The rain, which was described as sounding like a roar, forced Boggy, Brushy, Bull Donahoe, Mustang, Possum, Turkey and Willis Creeks as well as the San Gabriel River out of their banks, flooding the lowlands of eastern Williamson County.

  Telephone, telegraph and electrical poles were snapped cutting communications and isolating communities. The final death toll from the storm event was 92. However, at the time of the storm, there was a significant population of undocumented field workers supporting the harvest of cotton and other crops. In many cases,

no formal records of workers were kept and the number of human lives lost in this storm event is thought to exceed the official count of 92.

Agricultural losses were estimated at $640,000 which is approximately $9,000,000 in 2018 dollars. At the time, officials estimated $400,000 in damage to roads and bridges which would equal approximately $5,600,000 in current dollars. A figure of $200,000 was identified as "other losses" which equals an estimated $2.8 million in current dollars. This one storm event's estimated damage in 2018 dollars totals more than $17 million. An important postscript to the storm is that this event was the impetus for the construction of a dam on the San Gabriel River upstream from Georgetown.

- **May 27, 1957 –** Based on Williamson County Historical Commission information, 1955 and 1956 were severe drought years n Williamson County. In the spring of 1957, the County experienced 8 inches of rain in a relatively brief period immediately following 2 or 3 weeks of ground-saturating rains. Significant agricultural losses were once again experienced in this flood event.
- **December 20, 1991 to January 14, 1992** – Williamson County was included in a Federal Declaration for Individual and Public Assistance (Disaster 930).
- **June 8, 1997** – Rainfall of 2 to 3 inches fell over Williamson County, with isolated totals near 5 inches. Water was reported over an Interstate 35 bridge in Georgetown and numerous rescues were performed throughout the area. The resulting property damage totaled $50,000, but no injuries or fatalities were reported for Williamson County.
- **July 1, 2001** – Thunderstorms moving repeatedly over the eastern part of Williamson County produced a rainfall of 2 to 3 inches, with as much as 5 inches reported near Taylor. Flash flooding closed numerous county roads through the remainder of the morning. No injuries or fatalities were associated with the event, though property damages totaled $50,000.
- **November 11, 2001** – Heavy rains accounted for 4 to 6 inches over the south portion of Williamson County, with a major part of the rainfall occurring over Brushy Creek. Numerous rescues were required with some victims being pulled out of trees. At least three cars were washed off a bridge over Brushy Creek south of Hutto. Several dozen people were evacuated from their homes before the structures were destroyed. Nearly three dozen trailers and recreational vehicles were damaged or destroyed at resorts along State Highway 29 and the San Gabriel River east of Georgetown. Two deaths occurred in the Brushy Creek area. A 27-year old man drowned after his car stalled in a low-water crossing and a 59-year old woman drowned after her car had stalled in a low-water crossing across Brushy Creek. Ten additional injuries were also reported because of the storm. Property damages totaled $500,000.
- **October 10, 2004** – Slow-moving showers and thunderstorms dropped between 2 and 3 inches of rain in southwest Williamson County in the late evening period. Maximum totals were 5 to 6 inches between Leander and Cedar Park, closing most low-water crossings due to flash flooding risk. Several high-water rescues were made between the two cities. Newspapers reported several cars cut off and stranded by water up to 6 feet deep and rising on FM 2243 just northeast of Leander. Related property damages totaled $100,000, but no injuries or fatalities were reported.
- **June 27, 2007** – Two lines of thunderstorms intersected and stalled near Marble Falls, producing 6- to 8-inch rainfall over western Williamson County, with up to 14 inches between Florence and Liberty Hill. Most roads in the western and southern portions of the county were closed through the mid-morning, including highly traveled thoroughfares such as US 183 and State Highway 29. Property damages totaled $500,000, but no injuries or fatalities were associated with the event.
- **June 28, 2007** - Scattered to numerous showers and thunderstorms persisted along the Interstate-35 corridor from Georgetown southward to south of San Antonio, where widespread flash flooding was reported. The highest rainfall total in Williamson County was 8 inches in Cedar Park. Ten evacuations were required along Smith Branch Creek and Brushy Creek because of high water. Most rural roads in southern Williamson County were closed, including FM 260, FM 1431, and State Highway 29 where it intersects with State Highway 95. At

least eight high-water rescues were made in the Liberty Hill area. No related injuries or fatalities were reported. Resulting property damages totaled $150,000.

- **September 2010** - Tropical Storm Hermine brought widespread flooding to Williamson County, dropping nearly 11 inches of rain in 24 hours in areas including Cedar Park. The flooding caused more than 2 feet of water to flow over the auxiliary spillway at Dam No. 7 in Brushy Creek Lake Park in Cedar Park, which was built in 1964. According to the Texas Floodplain Management Association (TFMA), the flood damaged 687 homes in Williamson County. Of those 687, about 150 had major damage from flooding the homes with about 24 to 48 inches of water. The TFMA report shows 32 houses were destroyed after more than 48 inches of water flooded those homes.
- **October 31, 2010** – A series of storms produced heavy rainfall that led to major flooding across the Onion Creek and Blanco/San Marcos River watersheds. Across Round Rock and the northern sections of Williamson County, heavy rain fell much of the night with areas reporting up to 10 inches of rain. The event caused several homes along Brushy Creek to be evacuated. Several houses were damaged over the eastern portions along the Highway 79 corridor including Forest Creek, Hutto, and the County Road 123 area. Voluntary evacuations were called for in eastern Round Rock and Hutto, with 88 homes evacuated in total. Several swift water rescues were performed, including eight vehicle rescues. Overall, 19 homes were affected by flooding rains in Williamson County, with overall property damages totaling $1.1 million in uninsured losses to public infrastructure. No injuries or fatalities were reported.
- **Halloween Floods of 2013** - On Oct. 30 and 31, as much as 8 inches of rain fell in parts in of Williamson County. The Williamson County Office of Emergency Management notified 88 homes to evacuate. The disaster declaration requests assistance with the costs incurred during the response and recovery operations. On Nov. 6, Williamson County Judge Dan A. Gattis signed a disaster declaration for Williamson County after the area experienced heavy flooding in late October.
- **"All Saints Day Flood" – October 2015** - On Oct. 30, 2015, a disaster swept Central Texas in a catastrophic flood within six months of the historical Memorial Day Floods. The official daily rainfall total on Friday October 30, 2015 for Austin Bergstrom International Airport (ABIA) was 14.99 inches, according to the San Antonio National Weather Service office. This shattered the all-time daily rainfall record for the Bergstrom site, including its years as Bergstrom Air Force Base, since it began keeping weather records in 1942. The previous one-day record at Bergstrom was 8.70 inches on Nov. 23, 1974. The National Weather Service reported that October 31, 2015 as the second wettest calendar day on record in Austin, Texas.
  Friday's rainfall was also greater than any previous 15-day period on record for the airport site. Combined with rains from the Oct. 22-25, 2015 storm and additional rainfall Saturday, ABIA picked up 23.82 inches of rain in the last 10 days of October.
- **May 23 to 25, 2015** – An extreme precipitation event occurred throughout the central and south Texas regions over Memorial Day weekend. A large volume of precipitation fell within a relatively short period of time, resulting in damaging floods throughout the region. According to the National Weather Service, observed rainfalls in Comal, Guadalupe, Hays, Comal, Travis, and Kerr Counties exceeded 6 inches within a 48-hour period. Areas within Blanco, Comal, and Kendall Counties received at least 8 inches within 48 hours, and a Blanco County rain gauge managed by the Lower Colorado River Authority recorded 9.41 inches of rain over the same period. Williamson County received an average of 2.61 inches of precipitation throughout the County. On May 25, 2015 Bushy Creek reached a peak flow of approximately 3,000 cubic feet per second and reached an elevation of about 9 feet. Additionally, the floods resulted in major slide damages to Lower Brushy Creek Sites 2 and 7. Repairs were completed in July 2017 and were paid for by USDA Emergency Watershed Protection and TSSWCB Flood Control Program grant funds. There were multiple injuries and one fatality (outside the City of Georgetown) in Williamson County. Estimated damage in Williamson County for this event was $7 million. Unfortunately, two bodies were found in Travis and Williamson County after the flood waters receded.

- **September 22** to **26, 2018** - Thunderstorms hammered central Texas, dropping nearly 10 inches of rain in some spots and causing flash floods, road closures and power outages. Approximately 90 people were forced to evacuate a wedding venue in Liberty Hill as waters rose to dangerous levels. Almost 30 were able to escape the building on their own, but at least 50 people needed to be rescued by local authorities after water trapped them inside. The San Gabriel River overflowed into the streets of Georgetown, cresting at 24.2 feet (compared to 3 feet typically). Limestone blocks of a San Gabriel Park retaining wall were pushed over, and railings and a retaining wall and a power line were damaged at Blue Hole Park. Sections of a pedestrian crossing near the confluence of the North and South Forks of the San Gabriel River were torn apart. Officials said the river rose to moderate flood levels before receding Saturday afternoon as flood warnings were canceled in the area. Officials reported to the Statesman that the storms knocked out power for hundreds of residents in the area. Oncor Electric reported 212 customers without power in Round Rock and other areas in Williamson County on Saturday morning, as a result of the storm.

The Williamson County sheriff's office issued evacuation orders Saturday morning for people living on McShepherd Road along the San Gabriel River near Georgetown, and on County Road 129 and County Road 123 along Brushy Creek. More than 16 trailer homes also were evacuated in the Shady Oaks RV Park off State Highway 29, east of Interstate 35 near Georgetown along the river.

- **October 7 to 16, 2018** - Texas Governor Greg Abbott declared a state of disaster in 18 flood-stricken counties in central and south Texas as a result of a severe weather and prolonged flooding that began October 7 and caused widespread and severe property damage and loss of life. Williamson County is one of 18 counties included in the declaration. Other counties included: Bastrop, Burnet, Colorado, Fayette, Hood, Jim Wells, Kerr, Kimble, La Salle, Live Oak, Llano, Mason, McMullen, Nueces, Real, San Patricio and Travis.

1.1.4 National Flood Insurance Program

Entities within Williamson County have implemented many mitigation and flood control projects and plans, but responsible parties are constantly seeking additional ways to mitigate flood impacts on the community. This expansion of the *2016 Williamson County Hazard Mitigation Plan – Flood Chapter* considers historical events, analyzes

risk on the hydrologic unit level (HUC) as well as the community level, reviews existing programs and mitigation actions and recommends enhancements to them.

The National Flood Insurance Program (NFIP) is a program created by the United States Congress in 1968 through the National Flood Insurance Act of 1968. The program enables property owners in participating communities to purchase insurance protection, administered by the government, against losses from flooding, and requires flood insurance for all loans or lines of credit that are secured by existing buildings, manufactured homes, or buildings under construction, that are located in a community that participates in the NFIP.

This NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. As of August 2017, the program insured about 5 million homes (down from about 5.5 million homes in April 2010), the majority of which are in Texas and Florida.

Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), the federal government will make flood insurance available within the community as a financial protection against flood losses. The SFHAs and other risk premium zones applicable to each participating community are depicted on Flood Insurance Rate Maps (FIRM). The Mitigation Division within the Federal Emergency Management Agency (FEMA) manages the NFIP and oversees the floodplain management and mapping components of the program.

The intent of the NFIP was to reduce future flood damage through community floodplain management ordinances and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

Table 1-1. Community FIRM Data

Community	Initial FHBM* Identified	Initial FIRM** Identified	Current Effective Map Date
Austin	09/13/74	09/02/81	01/06/16
Bartlett	09/12/75	11/02/95	09/26/08
Cedar Park	11/15/77	09/27/91	01/06/16
Coupland	NA	NA	NA
Florence	04/12/74	09/27/91	09/26/08
Georgetown	03/08/74	09/27/91	09/26/08
Granger	02/07/75	09/27/91	09/26/08
Hutto	NA	09/27/91	09/26/08
Jarrell	NA	NA	NA
Leander	06/10/80	09/27/91	09/26/08
Liberty Hill	NA	9/26/08	09/26/08
Round Rock	09/13/77	09/27/91	08/18/14
Taylor	03/29/74	03/01/82	09/26/08
Thrall	NA	09/27/91	09/26/08
Weir	NA	09/26/08	09/26/08
Williamson County	11/01/77	09/27/91	09/26/08

Notes:
**FHBM – Flood Hazard Boundary Map*
*** FIRM – Flood Insurance Rate Map*
NA – Not applicable

The Community Rating System (CRS) is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. The CRS outlines 18 creditable activities that fulfill the program goals of reducing flood losses, facilitating accurate insurance rating and promoting awareness of flood insurance. The activities are in four categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness

Flood insurance premiums in participating communities are discounted (in increments of 5 percent) to reflect the reduced flood risk resulting from community actions to meet the CRS goals. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. Class 10 communities are those that do not participate in the CRS; they receive no discount. CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Williamson County does not currently participate in the CRS program. Within the County, only the City of Austin currently participates in the program.

The County is currently evaluating the opportunities and benefits in participation in this program.

1.1.5 Williamson County's Planning Authority

Floodplain regulations are enforced to protect public safety and health. In addition, they encourage sound engineering practices and efficient floodplain management techniques. All construction in Williamson County must adhere to federal floodplain regulations. Regulations are established by the federal government and implemented by the Federal Emergency Management Agency (FEMA). The County Engineer's Office is responsible for examining construction for compliance with local and federal floodplain regulations.

1.1.6 Guidelines for Flood Planning

The County Engineer's Office is the designated floodplain administrator for Williamson County. Official floodplain maps for the County are available for viewing in the office at 3151 S.E. Inner Loop, Suite B, Georgetown, Texas, 78626. Floodplain permitting within various cities in Williamson County is handled by those cities directly.

Currently, residents come to the County Engineer's Office for consultation to determine whether any specific location is within the floodplain. Alternatively, FEMA maintains a website (http://msc.fema.gov/portal) where residents can view the same maps. Per county ordinance, a Certificate of Compliance is required for all structures or other developments outside of a FEMA-mapped floodplain in unincorporated areas of the county. The Certificate of Compliance verifies that no FEMA-mapped 100-year floodplain exists in the area of proposed development.

1.1.7 How to Use This Plan

This Interjurisdictional Community Flood Protection Plan is organized into the following primary parts, which follow the organization of the CRS steps for comprehensive flood hazard planning:

- Part 1—Planning Process and Project Background (Chapters 1-4)
- Part 2—Risk Assessment (Chapters 5-8)
- Part 3—Mitigation Strategy and Action (Chapters 9 and 10)
- Part 4—Plan Maintenance (Chapter 11)

- Participating Jurisdiction Annexes (Chapter 12)

The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A–Public Outreach Materials
- Appendix B—Example Progress Report
- Appendix C—Flood Mapping by HUC-12 Watersheds
- Appendix D—Supporting Materials

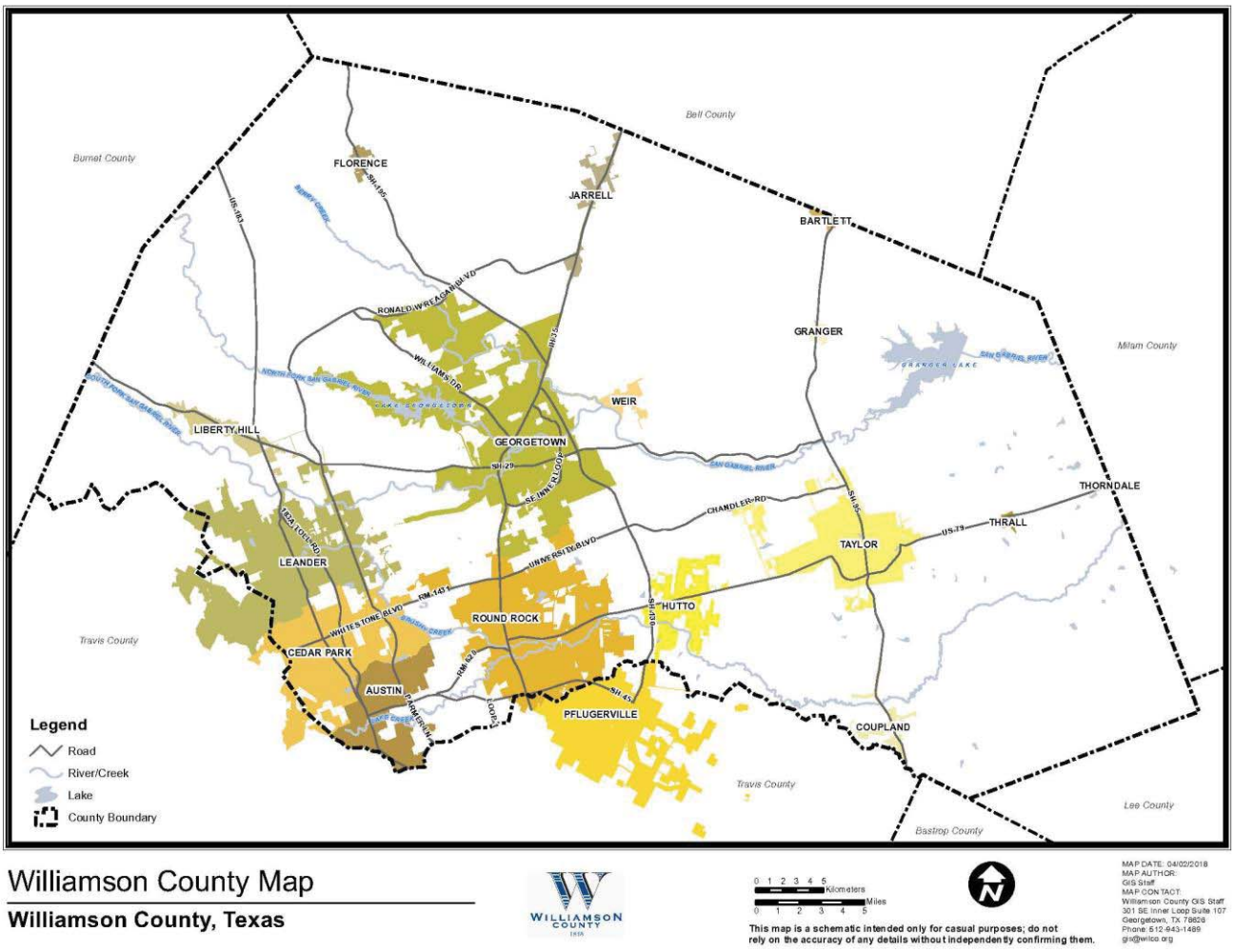
Chapter 2. Plan Development Methodology

2.1 DEFINING THE PLANNING AREA

2.1.1 Planning Area

The Planning area for this document is composed of the whole of Williamson County as identified below in Figure 2-1.

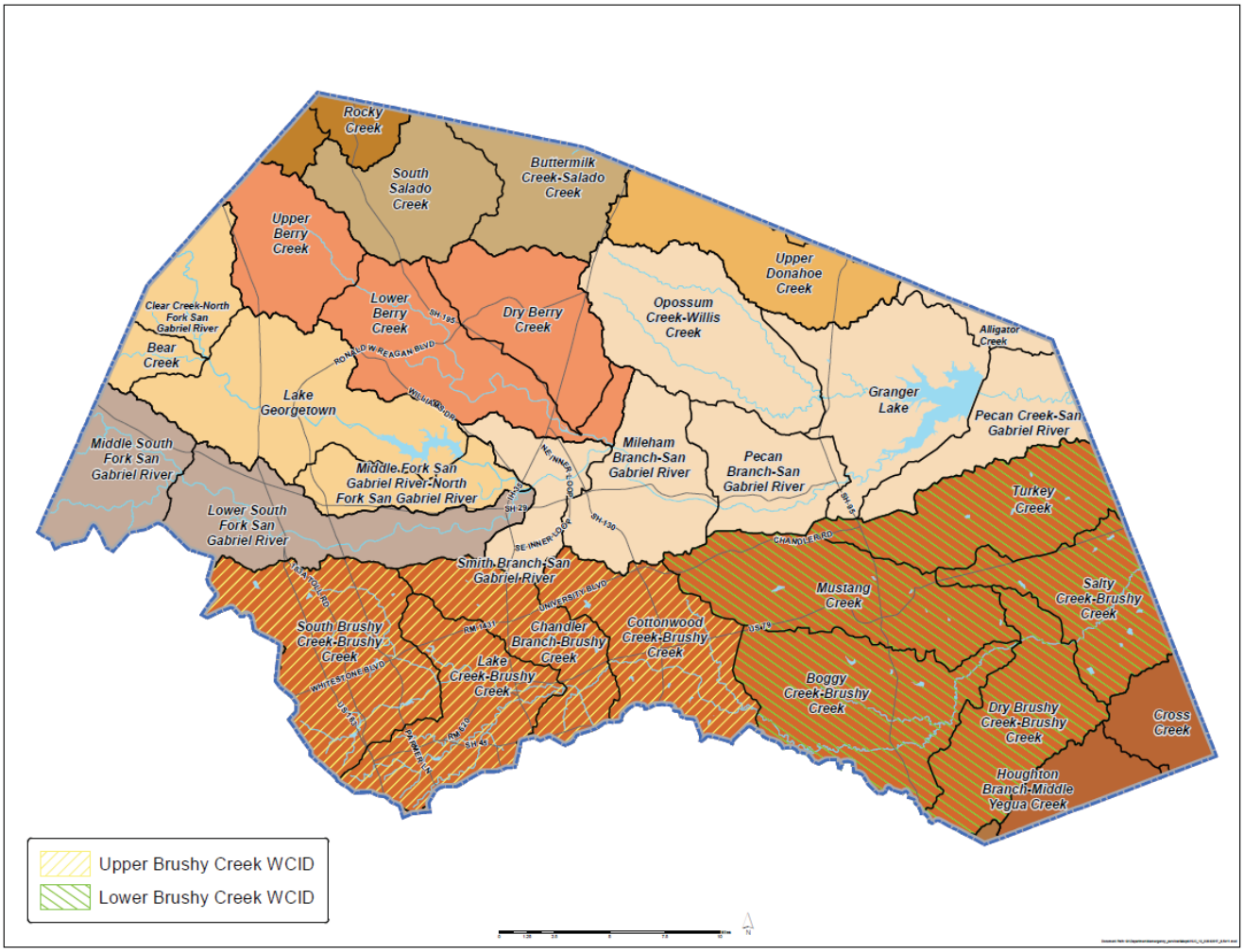
Figure 2-1. Williamson County CFPP Planning Area



The Planning Area consists of 29 separate watersheds (see Figure 2-2 below) based on the hydrologic unit level classification scheme created by USGS. A hydrological code or hydrologic unit code is a sequence of numbers or letters that identify a hydrological feature like a river, river reach, lake, or area such as a watershed or catchment. USGS created this hierarchical system of hydrologic units with subdivisions including regions, sub regions, basins, sub basins, watersheds and sub watersheds. Each unit was assigned a unique Hydrologic Unit Code (HUC). The boundaries of the hydrologic units typically correspond to drainage basins. In general, hydrologic units were delineated where surface drainage within each unit converges at a single outlet point—a type of hydrologic unit

called a "classic hydrological unit." However, it was not always possible to delineated units in this way while adhering to the size and subdivision standards of the system. Williamson County is with-in Region 12, the Texas-Gulf region.

Figure 2-2. Williamson County Hydrologic Unit Level 12



2.2 THE PROCESS

2.2.1 Formation of the Planning Team

This planning project was initiated and overseen by the Williamson County Office of Emergency Management. The County hired Tetra Tech, Inc. to assist with plan development and implementation. A planning team was formed to lead the planning effort, made up of the following members:

- Jarred Thomas, CEM©, TEM®, CHPP, CHS-V, Director/EM Coordinator, Williamson County Office of Emergency Management
- George Strebel, GISP, GIS Manager, Williamson County

- David Zwernemann – Williamson County Floodplain Manager
- Mike Wofford, Williamson County HAZMAT
- Laura D. Johnston, Tetra Tech—Project Manager/Lead Project Planner
- Rob Flaner, Tetra Tech—Flood Subject Matter Expert
- Stephen Veith, Tetra Tech—GIS Analyst

2.3 COORDINATION WITH OTHER AGENCIES

2.3.1 Teams and Work Groups

The development of this plan is a product of the Williamson County Office of Emergency Management, the Community Flood Protection Core and Stakeholder Groups. The list of members for the Community Flood Protection Core Group is in Table 2-1 below. Some Core Group members also participated in the Stakeholder Group.

2.3.2 Core Team

This plan is the product of a collaborative effort represented first and foremost by its Core Group. This plan's Core Group includes representatives from local government, local flood protection districts, and the State of Texas. In addition, a representative from the U.S. Forest Service participated. Individuals serving on the Core Group included:

Table 2-1. Williamson County CFPP Core Committee Members

Community	Committee Member
Cedar Park	John Cummins
Coupland	Kyle McKnight
Florence	Aubury Holmes
Georgetown	Raymond Mejia
Granger	Kyle McKnight
Hutto	Scott Kerwood and Michael Shoe
Jarrell	Ray Cummings
Leander	Bill Gardner
Liberty Hill	Aubury Holmes
Lower Brushy Creek WCID	Jim Clarno
Round Rock	Dorothy Miller
Taylor	Pat Ekiss
Thrall	Kyle McKnight
Upper Brushy Creek WCID	Alysha Girard
Weir	Kyle McKnight
Williamson County	George Strebel
	Jarred Thomas
	David Zernemann

2.4 REVIEW OF EXISTING PROGRAMS

The planning effort included review and incorporation, if appropriate, of existing plans, studies, reports and technical information. Chapter 4 of this plan provides a review of laws and ordinances in effect within the planning area that can affect mitigation actions, including an assessment of all Williamson County regulatory,

technical and financial capabilities to implement flood hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area:

- Williamson County 2016 Hazard Mitigation Plan
- Community Hazard Mitigation Plans
- Community Flood Plans
- Community Storm Water Management Plans
- Community Planning Tools including Comprehensive Plans
- City of Austin Flood Mitigation Task Force
- Local Ordinances

2.5 PUBLIC INVOLVEMENT

Broad public participation in the planning process helped to ensure that diverse points of view about the planning area's needs were considered and addressed.

2.5.1 Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee
- Attempt to reach as many citizens as possible using multiple media
- Use a survey to evaluate public perception of flood risk and support of mitigation actions
- Identify and involve stakeholders
- Conduct public meetings to invite the public's input
- Solicit press coverage

2.5.1.1 Steering Committee Participation

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of this plan. Gaining stakeholder participation on the Steering Committee was a key element in the public participation strategy. Stakeholders targeted for this process included:

- Participating community representatives
- Williamson County departments responsible for activities relevant to flood hazard management
- Representatives of areas having experienced repetitive losses
- State and federal agencies with a role in public lands management within the planning area

2.5.1.2 Public Meetings

The Interjurisdictional Community Flood Protection Plan has been regularly discussed at the Williamson County Fire Chiefs meetings, the Capital Area Council of Governments - Homeland Security Task Force meetings, and the Williamson County Emergency Management meetings. Additionally, the Plan process was recently discussed at the Texas Association of Watershed Sponsors annual meeting. Williamson County Emergency Management is committed to working with, integrating efforts and coordinating flood protection efforts in the area with all communities and stakeholders.

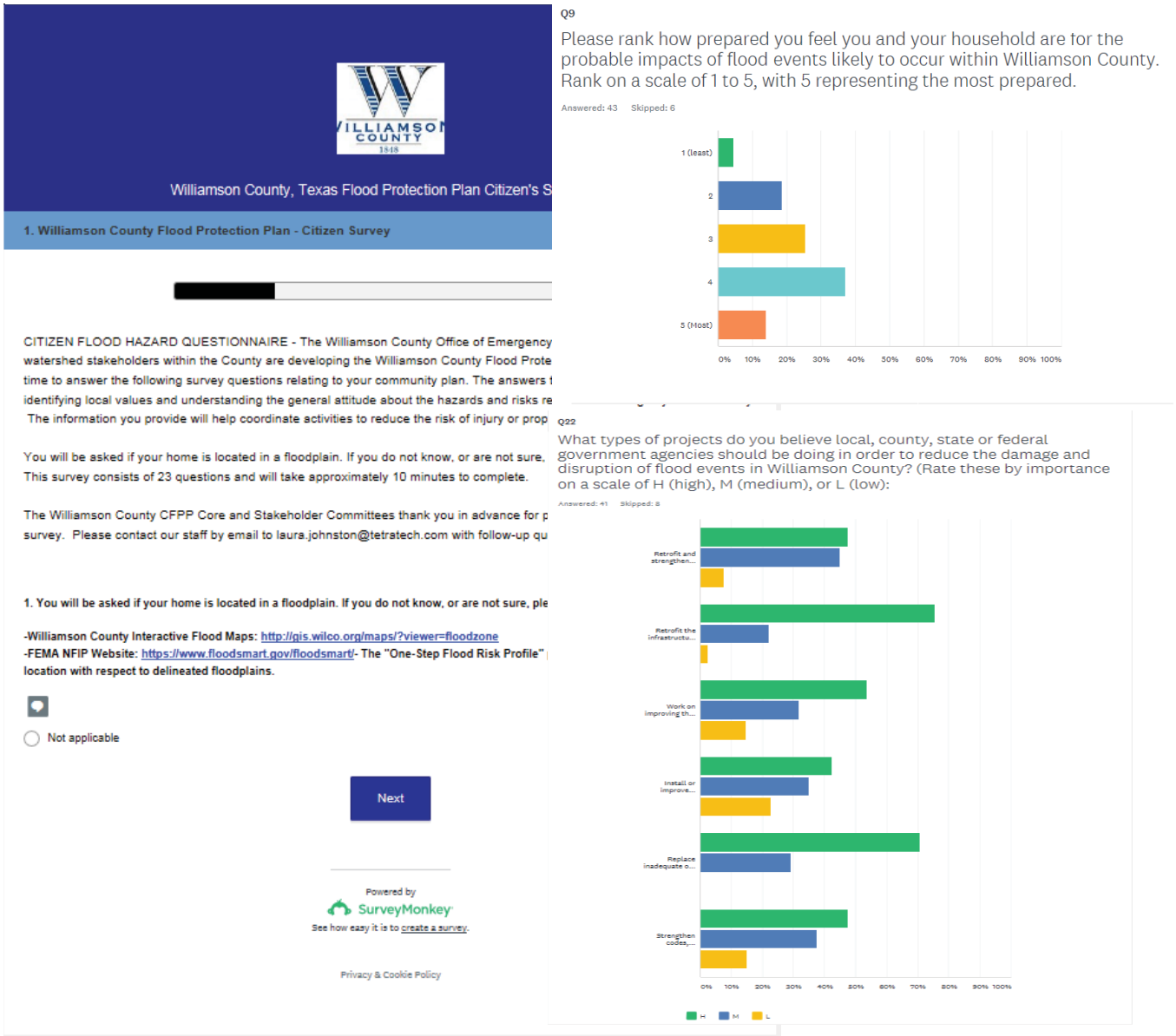
2.5.1.3 Survey

A survey (see Figure 2-3) was developed by the planning team with guidance from the County. The survey was used to gauge household preparedness for the flood hazard and the level of knowledge of tools and techniques that assist in reducing risk and loss from flooding. This survey was designed to help identify areas perceived as vulnerable to floods.

Survey responses helped guide the Steering Committee in selecting goals, objectives and mitigation actions. Hard copies of the surveys were made available at the public open house meetings. A link to the survey was made available on the Williamson County Emergency Management website.

While the survey itself queried respondents on 22 different questions, respondents were also provided the opportunity to submit written comments in two especially beneficial areas. These two areas asked respondents: 1) Please identify any flood areas in your community where private or public infrastructure has been damaged by flooding. And 2) Please identify any mitigation projects that you think are appropriate to address flood hazards in your community. damaged by flooding. The individual responses were provided to the committee for their consideration prior to the development of proposed mitigation actions. Responses are also included in **Appendix D** of this plan.

Figure 2-3. Survey



Chapter 3. Williamson County Profile

3.1 HISTORICAL OVERVIEW

Williamson County was created on March 13, 1848, the 76th county created in the state and one of eleven that the Legislature designated that year, along with Hays, Gillespie and others. The legislative act named John Berry, William Dalrymple, David Cowan, Washington Anderson, J. M. Harrell and J. O. Rice commissioners charged with establishing the county seat and first government. Under a large oak tree just southeast of the present courthouse site, the commissioners met with George Glasscock, Sr., who donated 173 acres he owned along the San Gabriel River to be the county seat, which was named Georgetown in his honor. A small settlement along the river was already established, with a post office named Brushy whose name was changed for the new town.

3.2 PHYSICAL SETTING

3.2.1 Location and Geography

This section provides an overview of the location and geography of Williamson County. Table 3-1 provides a description of the location, boundaries and significant features.

3.2.1.1 Geography

Table 3-1. Williamson County Geography

Williamson County	
Latitude/longitude	30.7592° N, 97.6982° W
Plan area and unit boundaries	Williamson County covers 1,134 square miles. It is located in central Texas (see Figure 3-1. Location of the Williamson County Planning Area within the State of Texas) and it is a part of the Austin-Round Rock Metropolitan Area. The City of Round Rock is the largest city and the City of Georgetown is the county seat for Williamson County. The plan area covers the entire county.
Frontage and perimeter road(s), and railroads	U.S. Highway 183, Interstate Highway 35, and State Highway 95 are the major north-south roads. U.S. Highway 79 and State Highway 29 cross the county east and west. The county is also crossed by four railroads, the Southern Pacific, the Missouri-Kansas-Texas, the Missouri Pacific, and the Georgetown.
Rivers and creeks	The San Gabriel River and Brushy, Berry, Opossum and Salado Creeks flow through the county in a west-east direction.

3.2.1.2 Location

Figure 3-1. Location of the Williamson County Planning Area within the State of Texas

3.2.1.3 Land Type and Open Space

The County is a combination of urban and non-agricultural development, crops, pastures, and native grasses. The Balcones Canyonlands National Wildlife Refuge is in the western part of Williamson County and conserves habitat for wildlife in the Texas Hill Country. Blackland coastal prairie begins east of Interstate Highway 35 and serves primarily as crop production and livestock grazing.

According to the Texas A&M Institute of Renewable Natural Resources survey on land trends, Texas has been losing open space lands since 1997 and Williamson County has lost more than 8.5 percent of open space land to the growing Austin-Round Rock Metropolitan Area.

3.3 GEOGRAPHY

Texas is broadly divided into four regions by physical geography features such as landforms, climate, and vegetation. Williamson County lies in two major land resource areas, the High Plains of the Great Plains Natural Region and the Gulf Coastal Plain of the Coastal Plains Natural Region.

The county occupies 1,134 square miles and is divided into two regions by the Balcones Escarpment, which runs through the center from north to south along a line from Jarrell to Georgetown to Round Rock. The western half of the county is an extension of the Great Plains and is hilly brush land with little topsoil and an average elevation of 850 feet, while the eastern region is part of the Coastal Plains and is flat to gently rolling with an average elevation of 600 feet. Williamson County is drained in the center and south by the San Gabriel River, which is the only river in the county, and in the north by creeks that run into the Lampasas and Little Rivers north of the county line. Soils in the eastern part of the county are mostly dark loamy to clayey "blackland" soils. These soils are considered prime farmland while those west of the Balcones Escarpment are light to dark and loamy with limey subsoils. The southeast corner of the county has light-colored soils with sandy surfaces and clayey subsoils. Vegetation west of the escarpment is characterized by tall and mid-height grasses, post and live oak, mesquite, and junipers. The eastern

part of the county, which has been extensively used for agricultural purposes, is still wooded along its streams with mesquite, oak, pecan, and elm trees.

3.4 CLIMATE

Williamson County is hot and humid in the summer and cool in winter when an occasional surge of cold air causes a sharp drop in otherwise mild temperatures. Average temperatures range from 95 degrees Fahrenheit (°F) in the summer to 38°F in the winter. Table 3-2 contains temperature summaries for the station.

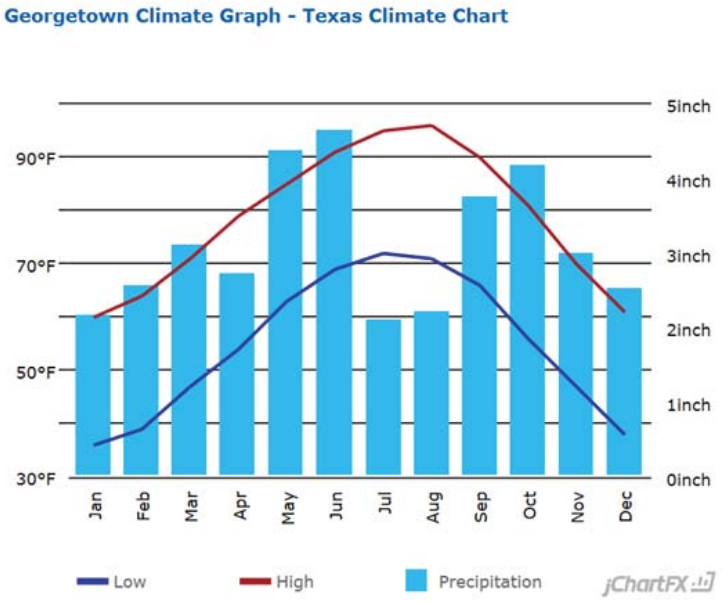
Table 3-2. Average Weather Georgetown, TX - 78628 - 1981-2010 Averages

Climate Measure Period of Record 1929-2001	Temperature
Annual average high temperature	78.6°F
Annual average low temperature	54.8°F
Average temperature	66.7°F
Average annual precipitation - rainfall	37.29 inches

Notes:
°F Degrees Fahrenheit
Source: US Climate Data, Georgetown Weather Station

Rainfall in Williamson County is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfalls are infrequent. Precipitation is highest in May with the average annual precipitation is 37.29 inches. Severe thunderstorms occur mostly in the spring. Figure 3-2 shows the average monthly precipitation in Williamson County.

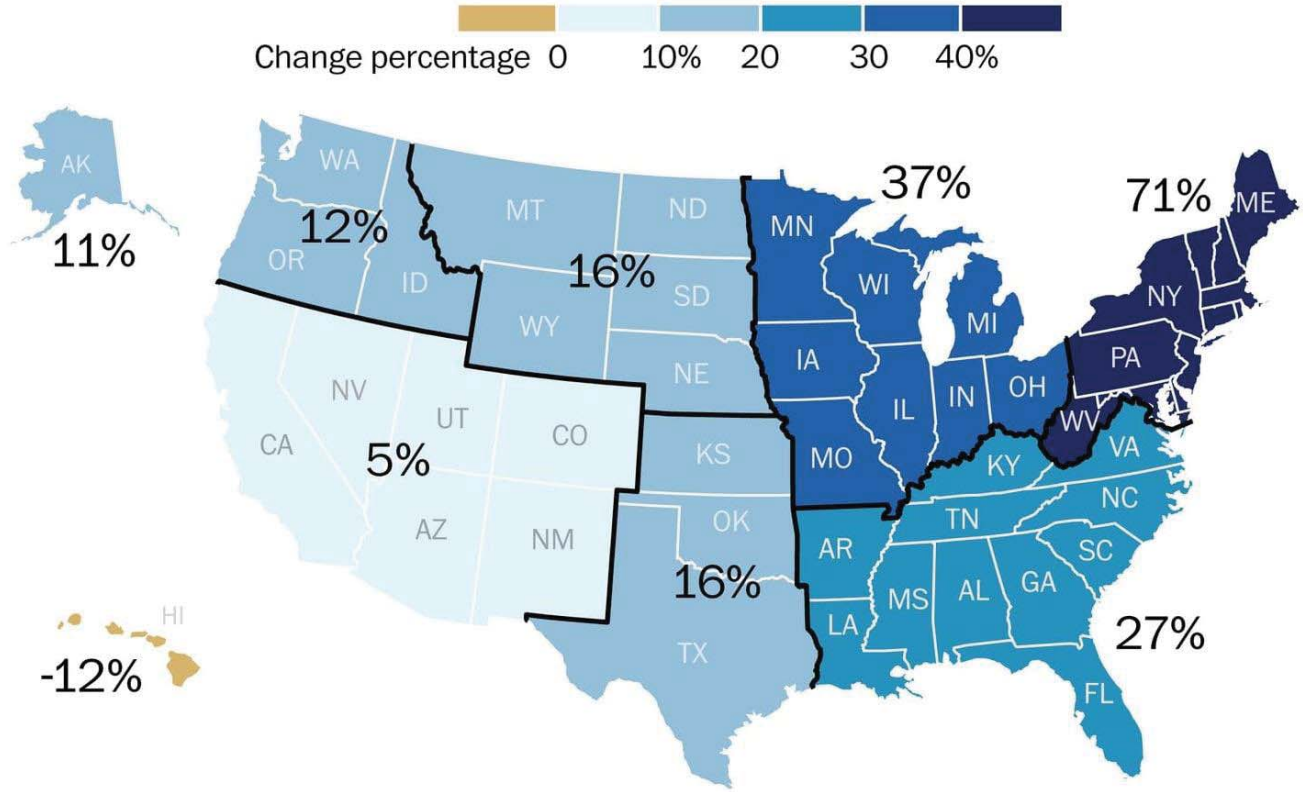
Figure 3-2. Average Monthly Temperature and Precipitation



Source: U.S. Climate Data, https://www.usclimatedata.com/climate/georgetown/texas/united-states/ustx0512

The map below (Figure 3-3) shows percent increases in the amount of precipitation falling in very heavy events from 1958 to 2012 across the U.S. The south-central U.S., including Texas, has seen a 16 percent increase in very heavy precipitation events over this period. Heavy events in this case are defined as the heaviest 1 percent of all daily events.

Figure 3-3. Observed Change in Heavy Precipitation



Source: GlobalChange.gov and the Washington Post

Additionally, a recent National Oceanic and Atmospheric Administration (NOAA) analysis released in September 2018 found significantly higher rainfall frequency values in parts of Texas, redefining the amount of rainfall it takes to qualify as a 100-year or 1,000-year event.

The study, published as NOAA Atlas 14, Volume 11 Precipitation-Frequency Atlas of the United States, Texas, found increased values in parts of Texas, including larger cities such as Austin and Houston, that will result in changes to the rainfall amounts that define 100-year events, which are those that on average occur every 100 years or have a 1 percent chance of happening in any given year. In Austin, for example, 100-year rainfall amounts for 24 hours increased as much as 3 inches up to 13 inches. The 100-year estimates around Houston increased from 13 inches to 18 inches and values previously classified as 100-year events are now much more frequent 25-year events.

NOAA further concluded that current standards used for infrastructure design and floodplain regulations will likely be revised based on the new values. Officials in locations that have seen significant increases are already assessing the potential impacts of adopting the new estimates based on NOAA's preliminary data shared over the past year.

3.5 DEVELOPMENT FEATURES

3.5.1 Land Use

Individual land-use practices are as diverse as the landscape itself. The way land is managed, communities and homes are built, and food is produced all have an impact on flooding. As the state continues to experience exponential population growth, the potential for flood losses will be affected by how and where homes are built.

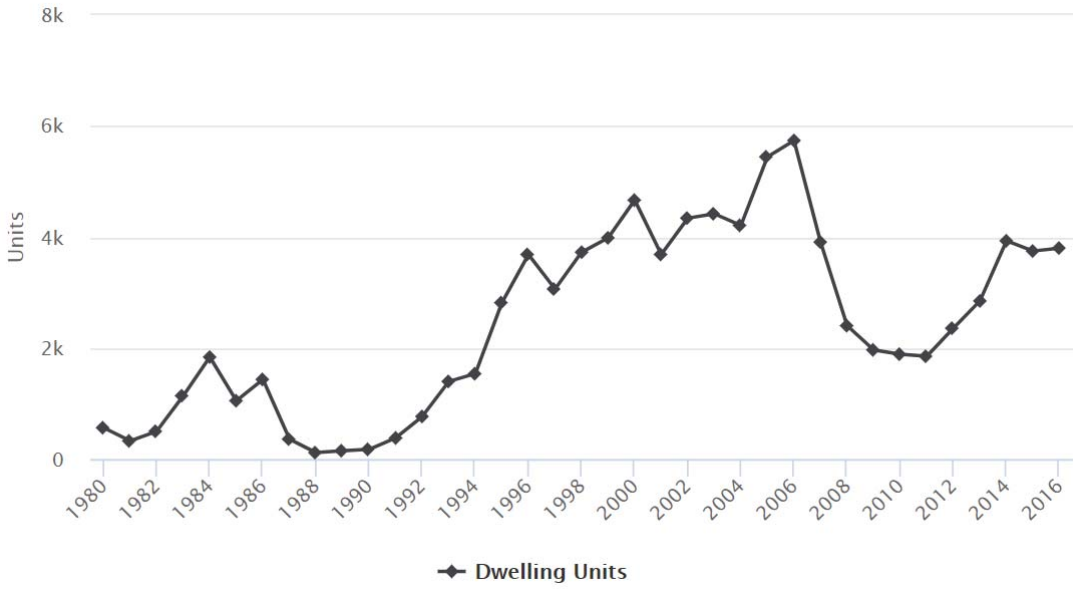
The primary land-use changes listed below impact flood occurrence and intensity:

- Changes in grazing practices
- Changes in commercial crop production
- Fragmentation of land ownership
- Increased development and density of development in previously rural areas
- Increases in impervious surfaces thus increasing drainage volume and speed into the stream beds

3.5.2 Building Permit Growth

Housing units in Williamson County are mainly single-family detached homes; however, there are approximately 4,575 mobile homes in the county. According to the U.S. Census Bureau, the number of residential building permits reported in Williamson County decreased from 2006 to 2011, dropping from 5,738 in 2006 to 1,851 in 2011. In 2012 to 2014, residential building permits increased. Permits have leveled off somewhat since 2014. As residential building permits continue to be issued, unincorporated areas of Williamson County will be impacted by an increase in vulnerability. Figure 3-4 shows the reported residential building permits in Williamson County. Structures, aboveground infrastructure, critical facilities, agricultural areas (crops and structures), and natural environments are all vulnerable to flooding.

Figure 3-4. Residential Building Permits in Williamson County from 1980 to 2016



3.5.3 Urban Encroachment

Much of Texas' recent population boom has taken place in unincorporated areas outside of city limits. According to the 2010 U.S. Census, Texas added 4,293,741 residents between 2000 and 2010. The state added almost the entire population of Kentucky to its population in the last decade. The Austin-Round Rock-San Marcos area was the eighth fastest growing metropolitan area in the country. Williamson County is one of Texas' 10 fastest growing counties and contains large unincorporated areas next to a major city—Austin. Central Texas towns like Georgetown, Cedar Park, and Round Rock were among the nation's 25 fastest-growing cities in 2016 with populations of 50,000 or more. The growth has occurred outward rather than upward, commonly referred to as sprawl. This sprawl growth results in increasing impacts on the floodway and floodplain zone as previously discussed.

3.5.4 General Plans

3.5.4.1 Long-Range Transportation Plan

The Williamson County Long-Range Transportation Plan focuses on what road and transit improvements should be built or improved over the next 25 years to help address expected growth in the County. The County has worked in close collaboration with its member cities to develop the plan, which analyzes current population and employment data to make projections about how and where the County will grow in the future. It also contemplates land-use patterns and the role of transit moving forward.

3.5.4.2 Subdivision Ordinance

On August 20, 2013, the Williamson County Commissioner's Court approved a revision to Williamson County's Subdivision Regulations, including a new fee structure. These revised regulations were made effective immediately for all new applications received on or after August 20, 2013.

Generally, Texas counties, including Williamson, have no zoning authority and have limited authority to regulate land use, primarily through approval of plats. Many cities use zoning ordinances to plan growth by regulating the types of

activities or development that may take place in a given area. City zoning districts include uniform regulations on permissible land uses, building height and lot-size requirements, or other development restrictions.

Approval of plats is the primary tool by which a Texas county regulates subdivision development in unincorporated areas. A plat is a legal document that includes a map of the subdivided property and public improvements, such as streets or drainage infrastructure. A plat must be approved by the county commissioner's court and filed with the county clerk as a permanent real property record. The plat may be used for land title research, land sales, or property tax purposes. Local Government Code, Section 232.003 specifies the steps a commissioner's court may order before approving a plat, such as requiring rights-of-way on subdivision roads, adopting reasonable specifications on street and road construction and drainage infrastructure, and requiring purchase contracts to specify the availability of water. Williamson County Subdivision Regulations require that a floodplain study and delineation be conducted for any point on a watercourse within the plat that includes a watershed greater than 64 acres. This requirement is above and beyond the Floodplain Regulations (Section 5.21 of the Williamson County Subdivision Regulations).

3.6 DEMOGRAPHICS

3.6.1 Growth

As of July 1, 2017, the United States Census Bureau estimates that Williamson County has a population of 547,545. Table 3-3. shows planning area population data from 1990 through 2016. The Williamson County population has had a dramatic increase of 79 percent from 1990 (139,551) to 2000 (249,967) and more than doubled in population from 2000 to 2017. Williamson County has been one of the fastest growing counties in Texas and the nation since 1990.

Table 3-3. Recent Population Data

	Population			
	1990	2000	2010	2016
City of Bartlett (pt.)[a]	N/A	857	2,688	2,752
City of Cedar Park (pt.)	5,161	25,508	52,387	68,918
City of Coupland	N/A	N/A	279	302
City of Florence	867	1,054	1,144	1,249
City of Georgetown	16,233	28,339	48,004	67,140
City of Granger	1,121	1,299	1,424	1,514
City of Hutto	630	1,250	16,720	23,832
City of Jarrell	N/A	N/A	1,000	1,346
City of Leander (pt.)	N/A	7,596	26,868	42,761
City of Liberty Hill	N/A	1,409	932	1,612
City of Pflugerville (pt.)	N/A	N/A	48,366	59,245
City of Round Rock (pt.)	N/A	60,060	100,774	120,892
City of Taylor	11,524	13,575	15,385	16,857
City of Thorndale (pt.)	N/A	N/A	1,291	1,293
City of Thrall	554	710	843	928
City of Weir	220	591	456	500
Balance of County	**N/A**	**N/A**	**103,975**	**117,577**
Total	**139,551**	**249,967**	**422,536**	**528,718**
State of Texas	**16,986,510**	**20,851,820**	**25,145,561**	**28,304,596**

Notes:

a. pt. - part of the city population within Williamson County.

b. City incorporated in 2001.

N/A Not available
Source: 2010 and 2016 Factfinder, USCensus.gov

Table 3-3. shows population changes in Williamson County from 1990 to 2016. Between 1990 and 2016, the State of Texas' population grew by 66 percent (about 1.8 percent per year) while Williamson County's population increased by 378 percent (14.5 percent per year).

3.6.2 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters based on isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the national population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

Based on U.S. Census data estimates, 11.3 percent of the planning area's population is 65 or older. U.S. Census data do not provide information regarding disabilities in the planning area's over-65 population. U.S. Census estimates for 2015 indicate that 6.6 percent of Williamson County families have children under 18 and are below the poverty line.

3.6.3 Disabled Populations

The 2010 U.S. Census estimated that 57 million non-institutionalized Americans with disabilities live in the U.S. This equates to about one in five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. According to the 2016 U.S. Census, 6.7 percent of the population under the age of 65 in Williamson County lives with some form of disability.

3.6.4 Ethnic Populations

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be less effective for ethnic populations and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the 2016 U.S. Census estimates, the ethnic composition of Williamson County is predominantly white, at about 82.6 percent. The largest minority ethnic population is Hispanic or Latino at 24.1 percent.

Williamson County has an 11.5 percent foreign-born population. Other than English, the most commonly spoken language in Williamson County is Spanish. The U.S. Census estimates 6.8 percent of the residents speak English "less than very well."

3.7 ECONOMY

The National Data reporting center Home Facts reports the unemployment rate in Williamson County, Texas, is 3.00 percent, with job growth of 3.05 percent. Future job growth over the next 10 years is predicted to be 42.70 percent.

The economy of Williamson County employs 256,940 people. The economy is specialized in mining, quarrying, professional, scientific, technical services, and real estate (rental and leasing). The largest industries in Williamson County are retail trade (12.12 percent), health care and social assistance (11.61 percent), manufacturing (10.84 percent), and professional, scientific, technical services (9.8 percent). The U.S. Census Bureau reports the 2016 median household income in Williamson County is $75,935.

3.8 WATERSHEDS

A watershed is an area draining into a river, lake, or other water body. According to the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), the Flood Control Act of 1936 (Public Law 74-738) authorized providing watershed protection and flood prevention as a complement to the downstream flood control program of the Corps of Engineers. Since the Law's inception in 1954, Texas has had 145 watershed plans approved and 2,041 flood control structures (earthen dams) have been constructed. There are 45 completed dams in the Upper and Lower Brushy Creek Watersheds of Williamson County. Detailed survey reports were prepared recommending the installation of watershed improvement programs in 25 watersheds from this list. The Flood Control Act of 1944 (Public Law 78-534) authorized the installation of improvements contained in 11 of the detailed survey reports. Two of the 11 authorized watersheds are located entirely in Texas: The Middle Colorado River and the Trinity River. A portion of a third authorized watershed, the Washita River, is in Texas and Oklahoma.

In 1953, the House and Senate Agricultural Appropriations Committees obtained an appropriation of $5 million for a "pilot" watershed program. The Secretary of Agriculture by Memorandum 1325, dated April 1, 1953 established the "Pilot Watersheds Program" and assigned responsibility to the Soil Conservation Service which approved 62 watersheds in 33 states. Four of the pilot watersheds were in Texas: Cow Bayou, Green Creek, Calaveras Creek, and Escondido Creek. All 62 of the planned flood water retarding structures in these four watersheds were installed and are now in the operation and maintenance phase.

The Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) authorized a permanent nationwide program to provide technical and financial assistance to local watershed groups willing to assume responsibility for initiating, carrying out, and sharing in costs of upstream watershed conservation and flood control. Since the law's inception in 1954, Texas has had 99 PL 83-566 watershed plans approved, of which nine have been deauthorized.

Texas NRCS is coordinating efforts with other resource agencies to achieve maximum conservation accomplishments. NRCS employees regularly attend Texas Association of Watershed Sponsors and National Watershed Coalition meetings to coordinate watershed program activities with organization goals. NRCS works closely with the Texas Commission on Environmental Quality - Dam Safety Program on hazard classification reviews of all dams and formal inspections of high hazard dams. According to the U.S. GS, six watersheds cross Williamson County.

Chapter 4. Relevant Programs and Regulations

4.1 FEDERAL

4.1.1 Disaster Mitigation Act of 2000

The Federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local and Indian tribal governments as a condition of mitigation grant assistance. The DMA amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by replacing previous mitigation planning provisions with new requirements that emphasize the need for planning entities to coordinate mitigation planning and implementation efforts. The law added incentives for increased coordination and integration of mitigation activities at the state level by establishing two levels of state plans. The DMA also established a new requirement for local mitigation plans and authorized up to 7 percent of Hazard Mitigation Grant Program funds to be available for development of state, local, and Indian tribal mitigation plans.

4.1.2 National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities that enact flood hazard management regulations. For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood (100-year flood) and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRM), which are the principal tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their flood hazard management program.

NFIP participants must, at a minimum, regulate development in floodplains in accordance with NFIP criteria.

Before issuing a permit to build in a mapped flood area, participants must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Williamson County participates in the NFIP, as do the cities of Austin, Bartlett, Cedar Park, Florence, Georgetown, Granger, Hutto, Jarrell, Leander, Liberty Hill, Pflugerville, Round Rock, Taylor, Thrall, and Weir. All have adopted regulations that meet the NFIP requirements. Table 4-1 summarizes participation dates for these communities.

Table 4-1. NFIP Participation by Williamson County and Municipalities

ID	Community Name	Initial Flood Hazard Boundary Map	Initial Flood Insurance Rate Map	Current Effective Map Date
480624	City of Austin	9/13/74	9/2/81	1/6/16
480707	City of Bartlett	9/12/75	11/2/95	9/26/08
481282	City of Cedar Park	11/15/77	9/27/91	1/6/16
480669	City of Florence	4/12/74	9/27/91	9/26/08

ID	Community Name	Initial Flood Hazard Boundary Map	Initial Flood Insurance Rate Map	Current Effective Map Date
480668	City of Georgetown	3/8/74	9/27/91	9/26/08
481046	City of Granger	2/7/75	9/27/91	9/26/08
481047	City of Hutto	NA	9/27/91	9/26/08
481536	City of Leander	6/10/80	9/27/91	9/26/08
480073	City of Liberty Hill	NA	9/26/08	9/26/08
481028	City of Pflugerville	05/02/75	05/01/78	08/18/14
481048	City of Round Rock	9/13/77	9/27/91	8/18/14
480670	City of Taylor	3/29/74	3/1/82	9/26/08
481632	City of Thrall	NA	9/27/91	9/26/08
481674	City of Weir	NA	9/26/08	9/26/08
481079	Williamson County	11/1/77	9/27/91	9/26/08

Notes:
NA Not applicable
Source: Federal Emergency Management Agency Community Status Book Report, 9/7/2018

Structures permitted or built in participating communities before the first FIRM was adopted are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." The insurance rate is different for the two types of structures. The effective date for the current FIRM for Williamson County is September 26, 2008. At the time of this planning process, FEMA was in the process of updating Williamson County's maps under its RiskMAP initiative. Williamson County is currently in good standing with the provisions of the NFIP.

4.1.3 Community Rating System

The CRS is a voluntary program within the NFIP that encourages flood hazard management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted in participating communities to reflect the reduced flood risk resulting from community actions to meet the CRS goals to reduce and avoid flood damage to insurable property, strengthen and support the insurance aspects of the NFIP and foster comprehensive floodplain management.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 19 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 67 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including riverine, shallow and flash flood risks.

As of October 2016, out of 1,391 communities in the U.S. participating in the CRS program, only 116 were rated Class 5 and only 11 were rated higher. Williamson County and its incorporated cities are currently reviewing the benefits of participation in the CRS program. The City of Austin is the only City in the County that currently participates.

4.1.4 Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take**—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

4.1.5 The Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues is addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

4.1.6 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. NEPA established the Council on Environmental Quality, whose regulations (40 CFR Parts 1500-1508) set the standard for NEPA compliance. Consideration of environmental impacts and decision-making process is documented in an environmental impact statement or environmental assessment. Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and the unbiased presentation of direct, indirect, and cumulative environmental impacts.

4.1.7 National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving floods and other hazards. NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency-responder disciplines. These cases necessitate coordination across this spectrum of organizations. Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, terrorist activities, and other human-caused disasters) regardless of size or complexity.

4.1.8 Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency, officials must use a combination of warning methods to ensure that all residents have any necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or visual alerts. Two technical documents issued for shelter operators address physical accessibility needs of people with disabilities as well as medical needs and service animals.

The ADA intersects with disaster preparedness programs in regard to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (for example, vehicles with wheelchair lifts or paratransit buses). Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance.

4.1.9 Rural Development Program

The mission of the U.S. Department of Agriculture (USDA) Rural Development Program is to help improve the economy and quality of life in rural America. The program provides project financing and technical assistance to help rural communities provide the infrastructure needed by rural businesses, community facilities, and households. The program addresses rural America's need for basic services, such as clean running water, sewage and waste disposal, electricity, and modern telecommunications and broadband. Loans and competitive grants are offered for various community and economic development projects and programs, such as the development of essential community facilities including fire stations.

4.1.10 Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover because of limited resources. CDBG-DR grants often supplement disaster programs of the Federal Emergency Management Agency, the Small Business Administration, and the U.S. Army Corps of Engineers. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a federally declared county
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger.

4.1.11 Emergency Watershed Program

The USDA Natural Resources Conservation Service (NRCS) administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. Financial and technical assistance are available for the following activities:

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded banks
- Correct damaged drainage facilities
- Establish cover on critically eroding lands
- Repair levees and structures
- Revise conservation practices (National Resources Conservation Service, 2016)

4.1.12 Emergency Relief for Federally Owned Roads Program

The U.S. Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs (Office of Federal Lands Highway, 2016).

4.1.13 U.S. Army Corps of Engineers Programs

The U.S. Army Corps of Engineers has several civil works authorities and programs related to flood risk and flood hazard management:

- Floodplain Management Services are 100-percent federally funded technical services such as development and interpretation of site-specific data related to the extent, duration and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.
- For more extensive studies, the Corps of Engineers offers a cost-shared program called Planning Assistance to states and tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50 percent of the cost.
- The Corps of Engineers has several cost-shared programs (typically 65 percent federal and 35 percent non-federal) aimed at developing, evaluating and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed:
    - The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.
    - Larger-scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65 percent federal and 35 percent nonfederal.
    - Watershed Management planning studies can be specifically authorized and are cost-shared at 50 percent federal and 50 percent nonfederal.
- The Corps of Engineers provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fighting activities and cost sharing in the repair of flood protective structures. Assistance afforded under PL 84-99 is broken down in to the following three categories:
    - **Preparedness—** The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; and for rehabilitation of flood control and hurricane protection structures. Funding for Corps of Engineers emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state and federal agencies.
    - **Response Activities—**PL 84-99 allows the Corps of Engineers to supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fighting efforts require a Project Cooperation Agreement signed by the public sponsor and a requirement for the sponsor to remove all flood fighting material after the flood has receded. PL 84-99 also authorizes emergency water support and

drought assistance in certain situations and allows for "advance measures" assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.

- **Rehabilitation—**Under PL 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20 percent cost to the eligible nonfederal system owner. All systems considered eligible for PL 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program (RIP) prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged.

4.2 STATE

4.2.1 House Bill 1018

State of Texas House Bill 1018 requires cities and counties to join the NFIP. The 77th Legislature of the State of Texas amended Subchapter 1, Chapter 16 in the Water Code by adding Section 16.3145 to read as follows: "The governing body of each city and county shall adopt ordinances or orders, as appropriate, necessary for the city or county to be eligible to participate in the National Flood Insurance Program, not later than January 1, 2001." This bill was prompted after three Presidential Disaster declarations.

4.2.2 Senate Bill 936

State of Texas Senate Bill 936 enacted in the 77th legislative session allows counties and general law cities to regulate on the same level as cities. Adoption of more comprehensive floodplain management regulations is now possible, thanks to this bill. The bill also allows counties to collect reasonable fees to cover administrative costs incurred by the administration of a local floodplain management program. It also provides for criminal and civil penalties and injunctive relief.

4.2.3 House Bill 1445

State of Texas House Bill 1445 passed during the 79th legislative session addresses the *Barricade Law* that makes it a criminal offense to cross a barricade at a flooded area.

4.2.4 Senate Bill 1601

State of Texas Senate Bill 1601 enacted in the 75th legislative session addresses the issue that utility hookups only be approved after all necessary permits have been completed with the jurisdiction.

4.2.5 Texas State Building Code

In 2001, then Governor Rick Perry signed a bill to adopt the International Residential Code as the municipal residential building code for the State of Texas. The bill went into effect on September 1, 2001 and gave cities until January 1, 2002 to transition and begin enforcing the new code. The code provided municipalities with the authority to adopt local amendments to the code, establish procedures for the administration and enforcement of the code, and review and consider amendments and new editions of the code, which covers one- and two-family dwellings. This was the first statewide residential building code in Texas. Texas is currently operating under the 2006 International Building Code.

4.2.6 Texas Division of Emergency Management

TDEM is a division within the Texas Department of Public Safety and has its roots in the civil defense programs established during World War II. It became a separate organization through the Texas Civil Protection Act of 1951, which established the Division of Defense and Disaster Relief in the Governor's Office to handle civil defense and disaster response programs. The division was collocated with the Department of Public Safety (DPS) in 1963. The division was renamed the Division of Disaster Emergency Services in 1973. After several more name changes, it was designated an operating division of the Texas Department of Public Safety in 2005. Legislation passed during the 81st session of the Texas Legislature in 2009 formally changed the name to TDEM. TDEM operates according to the Texas Disaster Act of 1975 (Chapter 418 of the Texas Government Code).

TDEM is "charged with carrying out a comprehensive all-hazard emergency management program for the state and for assisting cities, counties, and state agencies in planning and implementing their emergency management programs. A comprehensive emergency management program includes pre- and post-disaster mitigation of known hazards to reduce their impact; preparedness activities, such as emergency planning, training, and exercises; provisions for effective response to emergency situations; and recovery programs for major disasters."

4.2.7 Texas Water Development Board

The Texas Water Development Board (TWDB) was created in 1957 but its history dates back to a 1904 constitutional amendment authorizing the first public development of water resources. The TWDB mission is "to provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas." TWDB provides water planning, data collection and dissemination, financial assistance, and technical assistance services.

The TWDB is the State National Flood Insurance Program (NFIP) Coordinating Agency. The TWDB partners with FEMA and the Community Assistance Program. TWDB provides technical assistance, training, ordinance/court order assistance, and public outreach. Part of the agency entails the Texas Natural Resources Information System (TNRIS) which is the state mapping and geographic information data repository. The State Map Modernization Coordinator manages the Flood Mitigation Assistance Grant Program, Flood Protection Planning Grant fund, and the Severe Repetitive Loss Grant fund.

TWDB financial assistance programs are funded through state-backed bonds, a combination of state bond proceeds and federal grant funds or limited appropriated funds. Since 1957, the Texas State Legislature and voters approved constitutional amendments authorizing TWDB to issue up to $10.93 billion in Texas Water Development Bonds. To date, TWDB has sold nearly $3.95 billion of these bonds to finance the construction of water- and wastewater-related projects. In 1987, TWDB added the Clean Water State Revolving Fund (CWSRF) to its portfolio of financial assistance programs. Low-interest loans from the CWSRF finance costs associated with the planning, design, construction, expansion, or improvement of wastewater treatment facilities, wastewater recycling and reuse facilities, collection systems, stormwater pollution control projects, and nonpoint source pollution control projects. Funded in part by federal grant money, CWSRF provides loans at interest rates lower than the market can offer to any eligible applicant. CWSRF offers 20-year loans using either a traditional long-term, fixed-rate or a short-term, variable-rate construction period loan that converts to a long-term, fixed-rate loan on project completion.

4.2.8 Texas Soil and Water Conservation Board

The Texas State Soil and Water Conservation Board (TSSWCB) is the state agency that administers Texas' soil and water conservation law and coordinates conservation and nonpoint source water pollution abatement programs. The TSSWCB was created in 1939 by the Texas Legislature to organize the state into 216 soil and water conservation districts (SWCD) and to serve as a centralized agency for communicating with the Texas Legislature as well as other

state and federal entities. The TSSWCB is the lead state agency for the planning, management, and abatement of agricultural and silvicultural (forestry) nonpoint source water pollution and administers the Water Supply Enhancement Program. Each SWCD is an independent political subdivision of state government. Local SWCDs are actively involved throughout the state in soil and water conservation activities such as operation and maintenance of flood control structures.

4.2.9 Texas Watershed Management

All watersheds in Texas are threatened by nonpoint sources of pollution which are detrimental to the valuable water resources of the state. To help combat this threat, federal and state water resource management agencies have adopted a watershed-scale approach for managing water quality. One vital component of this approach involves engaging local stakeholders to become actively involved in planning and implementing water resource management and protection programs in their watershed.

To support this need for stakeholder involvement, the Texas Watershed Steward (TWS) program was initiated to provide science-based, watershed education to help citizens identify and take action to address local water quality impairments. Texas Watershed Stewards learn about the nature and function of watersheds, potential impairments, and strategies for watershed protection. The program is open to all watershed residents including homeowners, business owners, agricultural producers, decision-makers, community leaders, and other citizens.

4.2.10 Texas Disaster Act of 1975

The Texas Disaster Act of 1975 was enacted to:

1. Reduce vulnerability of people and communities of the state to damage, injury, and loss of life and property resulting from natural or man-made catastrophes, riots, or hostile military or paramilitary action;
2. Prepare for prompt and efficient rescue, care, and treatment of persons victimized or threatened by disaster;
3. Provide a setting conducive to the rapid and orderly restoration and rehabilitation of persons and property affected by disasters;
4. Clarify and strengthen the roles of the governor, state agencies, the judicial branch of state government, and local governments in prevention of, preparation for, response to, and recovery from disasters;
5. Authorize and provide for cooperation in disaster mitigation, preparedness, response, and recovery;
6. Authorize and provide for coordination of activities relating to disaster mitigation, preparedness, response, and recovery by agencies and officers of the state, and similar state-local, interstate, federal-state, and foreign activities in which the state and its political subdivisions may participate; and
7. Provide an emergency management system embodying all aspects of pre-disaster preparedness and post-disaster response.

4.2.11 Flood Control and Insurance Act

The Texas Flood Control and Insurance Act was enacted in 1969. The Act states the need to participate in the 1968 National Flood Insurance Program: “The purpose of this Act is to evidence a positive interest in securing flood insurance coverage under this Federal program, and to so procure for those citizens of Texas desiring to participate; and the promoting of public interest by providing appropriate protection against the perils of flood losses and encouraging sound land use by minimizing exposure of property to flood losses.”

4.2.12 Texas Department of Insurance

The Texas Department of Insurance has been identified as the co-coordinator for the NFIP in Texas (TWDB is the other state agency). The role of the Department of insurance is to provide aid and advice and to cooperate with all participating political subdivisions. The Department administers the Windstorm Inspection Program in the first tier of Texas counties fronting the Gulf of Mexico. The Department also facilitates the availability of wind insurance.

4.2.13 Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) oversees State Dam Safety Program which monitors and regulated both private and public dams in Texas.

4.2.14 Texas Office of Rural Community Affairs

The Texas Office of Rural Community Affairs manages community development grants including the Community Development Block Grant and the Disaster Relief and Urgent Need fund for communities after a disaster.

4.2.15 Texas Department of Housing and Community Affairs

The Texas Department of Housing and Community Affairs (TDHCA) implements anchoring regulations in place for manufactured homes and provides other important information regarding installation of manufactured homes.

4.2.16 Texas Department of Health

The Texas Department of Health processes and manages individual grants for families after a disaster.

4.2.17 Texas Parks and Wildlife

Texas Parks and Wildlife processes and manages permits for sand and gravel operations and addresses environmental concerns.

4.3 LOCAL

4.3.1 Flood Insurance Rate Maps

The Federal Emergency Management Agency (FEMA) is currently revising floodplain boundaries for portions of Williamson County. FEMA has issued a preliminary Flood Insurance Study (FIS) report for the entire county and incorporated areas and has also issued preliminary Flood Insurance Rate Map (FIRM) panels for the applicable areas included in recent studies.

This update of special flood hazard information includes a comprehensive flood study conducted by the Texas Water Development Board and the Upper Brushy Creek Water Control and Improvement District (WCID) for the Brushy Creek watershed downstream to near Coupland. The update also includes floodplains immediately north and east of this watershed boundary because the existing floodplains are within a FIRM panel already being revised with the watershed study. Existing floodplains outside of this area are not being revised at this time with the exception of the San Gabriel Watershed where FEMA is currently revising floodplain boundaries (March 16, 2018 FEMA PMR [preliminary map release).

The new maps show the proposed increases and decreases in the 1-percent annual chance (100-year) storm floodplain boundaries. The 1-percent annual chance flood results in the commonly used phrase “100-year floodplain,”

which is regulated by FEMA and the county through the National Flood Insurance Program (NFIP). The Base Flood Elevation (BFE) is the elevation of the 1-percent annual chance flood. FEMA studies also establish the 0.2-percent annual chance flood and resulting floodplain, which is commonly referred to as the "500-year floodplain."

4.4 CAPABILITY ASSESSMENT

The planning team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs and policies, and evaluates its capacity to carry them out summarizes the legal and regulatory capability of Williamson County. These programs are directly relevant to the County's capabilities to implement flood hazard reduction programs.

Table 4-2. Williamson County and Municipalities Legal and Regulatory Capability

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	See right	While the County does not have a general plan, multiple communities within the County have general plans.
Zoning ordinance	See right	Zoning is under the governance of local communities and not at the County level.
Subdivision ordinance	Yes	Williamson County Master Subdivision Policy, 2013 (as amended).
Growth management	No	
Floodplain ordinance	Yes	Flood Damage Prevention Order signed August 8, 2008.
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	Community Development Partnership Program (CDPP) under development. Community Development Floodplain Program (CDFP) under development.
Building code	No	
Current Hazard Mitigation Plan	Yes	Approved by FEMA in 2016. Additionally, the County adopted the Williamson County Interjurisdictional Community Wildfire Protection Plan in 2018.
Erosion or sediment control program	No	Upper Brushy Creek Water Control & Improvement District is starting to develop a strategy to manage stormwater.
Stormwater management	No	Upper Brushy Creek Water Control & Improvement District is starting to develop a strategy to manage stormwater.
Site plan review requirements	No	Not currently conducted, but the County intends to hire a Fire Marshal in 2016.
Capital improvement plan	Yes	5-Year Capital Improvement Plan (Certificates of Obligation or Bonds).
Economic development plan	No	
Local emergency operations plan	Yes	Williamson County Basic Emergency Operations Plan covers the County and Cities of Coupland, Florence, Granger, Hutto, Liberty Hill, Thrall, and Weir.
Other special plans	No	Regional Debris Management Plan under development.
Flood insurance study or other engineering study for streams	Yes	The County Engineer's Office is the local repository for the FEMA FIRM for unincorporated areas of the county and makes the maps available for public review. The office maintains flood insurance rate maps in conjunction with the NFIP. The current maps are dated 9/26/08.
Elevation certificates	Yes	The Williamson County Engineer keeps a copy of the flood elevation certificates on file in its office.

Notes:
CDFP Community Development Floodplain Program
CDPP Community Development Partnership Program
FEMA Federal Emergency Management Agency
FIRM Flood Insurance Rate Map
NFIP National Flood Insurance Program

Chapter 5. Risk Assessment Overview

5.1 PURPOSE OF RISK ASSESSMENT

This part of the Flood Protection Plan evaluates the risk of the flood hazard in the planning area. Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards such as flooding. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- **Exposure identification**—Evaluate the extent of people, property, environment and economy exposed to the effects of the natural hazard.
- **Vulnerability evaluation**—Estimate potential damage from the natural hazard and associated costs.

The risk assessment describes the flooding hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk:

- Identify and profile the flooding hazard; the following information is considered:
  - Principal sources of flooding in the planning area
  - Major past flood events
  - Geographic areas most affected by floods
  - Estimated flood event frequency
  - Estimates of flood severity
  - Warning time likely to be available for response
  - Existing flood protection programs and projects
  - Secondary hazards associated with the flood hazard
  - Potential impacts of climate change on flooding
  - Expected future trends that could affect the flood hazard
  - Scenario of potential worst-case flood event
  - Key issues related to flood hazard management in the planning area
- Determine exposure to the flood hazard—Exposure was evaluated by overlaying flood maps with an inventory of structures, facilities, and systems to identify which of them would be exposed to flood events.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each flood event and assessing structures, facilities, and systems that are exposed. In addition, the repetitive loss areas in the County were reviewed, mapped and evaluated.

5.2 METHODOLOGY

5.2.1 Existing Data Collection and Data Gap Analysis

1. Review existing county and local flood hazard/mitigation plans.
2. Interview municipal representatives as necessary.
3. Establish a Steering Committee to provide information, data and feedback. The Williamson County Interjurisdictional Community Flood Protection Plan Steering Committee was established as a group of local officials and community representatives committed to undertaking a cooperative approach in addressing flooding issues. A list of the Flood Steering Committee representatives can be found in on page 2-3.

5.2.2 Flood Hazard Characterization

1. Define common floods hazard types and establish consensus among members of the Steering Committee and incorporate their comments.
2. Define common flood hazard impacts and develop a prioritization system based on their deleterious impacts to adjoining community, infrastructure, etc. Establish consensus from the Steering Committee and incorporate their comments.

5.2.3 Flood Hazard Data Collection

1. Develop forms and tables to capture standardized flood hazard information (location, cause of flooding, frequency) and proposed mitigation information (location, which hazard it mitigates, level of completion, etc.)
2. Send forms and tables to representatives of the Steering Committee and participating communities group for review. Incorporate feedback.
3. Distribute the forms and tables to the entire Steering Committee (city officials/representatives, staff and flood management agencies) and to other relevant agencies (example: Williamson County Road and Bridge).
4. Conduct one-on-one meetings with entities when necessary to ensure completeness and accuracy of data.
5. Create GIS shapefiles from the collected flood hazard and flood hazard impact data and include attributes to record all collected data.
6. Integrate the data from these shapefiles into a spreadsheet-based database.

5.2.4 Database Creation

1. Create GIS shapefiles from the collected flood hazard and flood hazard impact data and include attributes to record all collected data.
2. Integrate the data from these shapefiles into an excel database.

5.2.5 Prioritization of Watersheds

1. Identify the HUC-12 watersheds to be used.
2. Prioritize watersheds based on cumulative flood hazard impacts using a prioritization model established by the consultant and approved by the Steering Committee.
3. Select the highest priority watersheds, as determined by the prioritization model, for potential further analysis. Present to the Steering Committee and incorporate any comments or adjustments
4. Finalize the three highest priority sites.

5.2.6 Flood Depth Grid Generation

An important input to for modeling flood damage is a flood depth grid, which defines the depth of flood water at points covering the flooded area for any given flood event. For this Flood Protection Plan, depth grids were prepared for the 500-year flood event where mapping and detailed flood studies were available. The following methods were used to create the flood depth grid, depending on the mapping data available:

- **Water Surface Elevation Reconstruction**—This technique used datasets that include base (500-year) flood water surface elevations for a floodway or floodplain. These datasets were primarily gathered from the FEMA detailed study flood zones along the San Gabriel River and parts of Brushy Creek. GIS tools were used to create a water surface based on the water surface value given for the base flood. Water surface elevations for the 500-year flood were derived from cross sectional values in the most recent FEMA *Flood Insurance Studies* (numbers 48491CV001A, September 2008, 48491CV001B, September 2017, and 48491CV001C, March 2018) (The water surface elevation grids were intersected with the existing ground surface to create flood depth grids.
- **Flood Zone Direct Calculation**—This technique was used for flood zone datasets that provided only a water depth or water surface elevation. This includes zones AO, AH, and similar FEMA zones. If a depth was given for one of these zones, a depth grid was created directly out of that zone boundary. If a static water surface elevation was given, a water surface grid was created out of that zone and intersected with the ground surface to create flood depth grids.
- **Flood Zone Interpolation**—This technique was used for designated approximate A zones. The floodplain boundaries were intersected with the ground surface, with the assumption that the elevation along that boundary marked the water surface elevation edge. The boundary was interpolated to three dimensions and converted to a water surface grid. This grid was then intersected with the ground surface within the boundary to create flood depth grids.

5.2.7 Flood Inundation Mapping Science

The United States Geologic Survey (USGS) considers three key questions when planning for a flood: What areas will be flooded? How deep will the flood waters get? When will the flood arrive? Information from historical flooding can help a community anticipate how much impact similar flood events could have, but there are other methods and tools that can provide more accurate and nuanced estimations of a wide variety of flood conditions.

The USGS Flood Inundation Mapping (FIM) program focuses on a flood inundation map library which helps communities' pair that data with USGS real-time stream data and National Weather Service flood forecasts to form a two-dimensional flood warning system. Together, these products can help communities estimate the extent of the flood and identify at-risk areas and resources in advance of the flood waters arriving, providing a powerful advantage in the effort to keep people and property safe from rising waters.

5.2.7.1 What Areas Will Be Flooded?

A flood inundation map library is a set of maps that show the spatial extent and depth of flooding at specific water-level (stream stage) intervals along an individual stream section. For example, one inundation map might be produced at every foot of stream stage along a typical flood hydrograph. These maps are created using hydraulic and topographic modeling, not historical flood observations, and can more accurately visualize a wider range of flooding scenarios than relying on past experiences alone.

5.2.7.2 How Deep Will the Flood Waters Get?

USGS operates a network of stream gauges that provide real-time information about water levels throughout the U.S. - they measure how high the water is right now. By combining USGS real-time data with flood inundation map libraries, communities can better envision what changing water levels will mean. For example, a statement like "flood stage of 12 feet" can be converted into a meaningful map that shows the community where flooding is likely to occur.

5.2.7.3 How are Flood Inundation Maps Created for the County?

Step 1 - Stream selection

The first step is to identify the location where the flood modeling will be performed. All watersheds as defined at the HUC 12 designation level were analyzed for the Williamson County Interjurisdictional Community Flood Protection Plan.

Step 2 - Modeling flood heights

Once a stream section is identified, a carefully calibrated hydraulic model is developed. Given a specific stream stage (height), the model estimates the height of a flood along the reach. The model is run multiple times at incremental stream stages over the range of flooding conditions from near-bankfull to record flooding levels, producing a series of water-surface profiles that define flood heights throughout the reach.

Step 3 - Delineating the extent of flood inundation

After the hydraulic model identifies the incremental flooding heights, those data are combined with a detailed ground-surface elevation model (a lidar-based Digital Elevation Model). This process creates a spatial grid showing where flooding would occur. These grids define the probable areas of flood water inundation and are the first pieces of a flood inundation map.

Step 4 - Computing depths of flood inundation

The next step is to model how deep the flooding would be for each grid cell in the inundation area. Once the depth grids have been determined, surface and inundation extents are calculated for all flood levels along the reach. Each extent represents a single flood inundation map and provides a full picture of the flooding scenario - both how far and how deep the flood waters could reach. Each library's modeling and development process is documented and reviewed by other flood scientists to ensure the modeling was done correctly and produced valid results.

Step 5 - Geospatial processing

The last step is to overlay the probable areas of flood water inundation onto individual community as well as individual watershed maps, which helps communities visualize, plan, and respond to floods. A flood inundation map library is the full set of maps showing flood inundation from near-bankfull river levels to record flooding levels.

Error! Reference source not found. and **Error! Reference source not found.** summarize the number of structures within the four set flood depth categories by municipality. The analysis estimated 2,472 structures or 43 percent of the structures within the County are located within the "Less than 1 foot" category, an estimated 1,662 structures or 29 percent of the structures are located within the 1-3 foot category, an estimated 914 structures or 16 percent of the structures are located within the 3-6 foot category, and an estimated 694 structures or 12 percent of the structures are located in areas with an estimated flood depth greater than 6 feet. There is a total of 5,742 structures included in this analysis.

Table 5-1. Number of Structures by Flood Depth by Municipality

	Total Number of Structures by Flood Depth				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Austin	80	20	0	0	100
Cedar Park	184	190	62	15	451
Coupland	0	0	0	0	0
Florence	31	47	10	0	88
Georgetown	309	83	62	162	616
Granger	66	42	0	0	108
Hutto	127	82	16	1	226
Jarrell	0	0	0	0	0

	Total Number of Structures by Flood Depth				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Leander	169	29	5	3	206
Liberty Hill	0	0	0	0	0
Round Rock	283	193	127	57	660
Taylor	58	63	8	4	133
Thrall	3	81	12	0	96
Weir	3	6	1	0	10
Unincorporated County	1,159	826	611	452	3,048
Total	2,472	1,662	914	694	5,742

Table 5-2. Number of Structures by Flood Depth by Watershed

	Total Number of Structures by Flood Depth				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Bear Creek	16	14	14	12	56
Boggy Creek-Brushy Creek	4	22	55	30	111
Buttermilk Creek-Salado Creek	27	7	0	1	35
Chandler Branch-Brushy Creek	116	56	8	7	187
Clear Creek-North Fork San Gabriel River	16	13	8	4	41
Cottonwood Creek-Brushy Creek	314	231	108	57	710
Cross Creek	2	4	1	2	9
Dry Berry Creek	18	17	2	0	37
Dry Brushy Creek-Brushy Creek	18	6	6	0	30
Granger Lake	142	53	16	76	287
Houghton Branch-Middle Yegua Creek	17	4	0	0	21
Lake Creek-Brushy Creek	301	187	125	55	668
Lake Georgetown	84	61	65	143	353
Lower Berry Creek	214	43	9	2	268
Lower South Fork San Gabriel River	114	117	80	51	362
Middle Fork San Gabriel River-North Fork San Gabriel River	59	13	8	6	86
Middle South Fork San Gabriel River	39	10	9	15	73
Mileham Branch-San Gabriel River	125	137	121	116	499
Mustang Creek	58	69	11	9	147
Opossum Creek-Willis Creek	8	32	15	1	56
Pecan Branch-San Gabriel River	94	19	34	52	199
Pecan Creek-San Gabriel River	7	9	3	0	19
Salty Creek-Brushy Creek	2	11	15	6	34
Smith Branch-San Gabriel River	157	120	83	25	385
South Brushy Creek-Brushy Creek	394	238	81	22	735
South Salado Creek	77	60	13	0	150
Turkey Creek	4	88	14	1	107
Upper Berry Creek	28	11	0	0	39
Upper Donahoe Creek	17	10	10	1	38
Total	2,472	1,662	914	694	5,742

Error! Reference source not found. And 5-4 below summarize the improved market value of the structures within the four set flood depth categories by municipality and HUC 12 watershed. The analysis found the estimated improved market value of the 337 structures located within the City of Round Rock with an estimated flood depth of 1 foot or greater there is an estimated improvement market value more than just under $50,000,000. Further, the analysis found the estimated improvement market value of the 307 structures located within Georgetown designated with a projected 1 foot or greater of water impacting the structures is approximately $12,200,000. There are 5,742 structures included in this analysis.

Since flood depth was determined to be the best method to document and analyze valuation of areas and potential future losses Tables 5-3 and 5-4 further document improvement market value (in 2018 dollars) by municipality and by watershed by flood depth.

Table 5-3. Improvement Market Value by Municipality

(As of Wilco Parcel Layer, June 2018, values in US dollars)

	Total Number of Structures by Flood Depth				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Austin	$7,673,871	$2,069,415			100
Cedar Park	$25,728,810	$8,121,116	$5,241,941	$313,632	451
Coupland					0
Florence	$1,063,940	$1,801,392	$289,509		88
Georgetown	$53,616,588	$8,608,949	$2,284,716	$1,309,018	616
Granger	$1,208,816	$1,140,921			108
Hutto	$19,164,966	$10,321,077	$289,390		226
Jarrell					0
Leander	$29,209,092	$3,096,957	$49,863	$19,945	206
Liberty Hill					0
Round Rock	$47,377,024	$27,665,998	$14,759,246	$7,082,015	660
Taylor	$3,453,529	$2,354,904	$168,995		133
Thrall		$1,210,002	$223,083		96
Weir		$638,028			10
Unincorporated County	$111,778,476	$57,276,824	$32,041,797	$21,077,958	3,048
Total	$ 300,275,016	$ 124,305,590	$ 55,348,543	$ 29,802,570	**5,742**

(As of WilCo Parcel Layer, June 2018, values in US Dollars)

Table 5-4. Improvement Market Value by HUC 12 Watershed

	(As of WilCo Parcel Layer, June 2018, values in US Dollars)				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Bear Creek	$ 1,516,470	$ 454,559	$ 262,480	$ 591,464	56
Boggy Creek-Brushy Creek	$ 376,383	$ 972,186	$ 1,955,846	$ 1,025,514	111

	(As of WilCo Parcel Layer, June 2018, values in US Dollars)				
	Less Than 1 Foot	1-3 Feet	3-6 Feet	Greater than 6 Feet	Total Structures
Buttermilk Creek-Salado Creek	$ 1,512,113	$ 669,450	$ -	$ -	35
Chandler Branch-Brushy Creek	$ 18,819,028	$ 7,073,122	$ -	$ -	187
Clear Creek-North Fork San Gabriel River	$ 356,117	$ 918,283	$ 891,753	$ 223,249	41
Cottonwood Creek-Brushy Creek	$ 45,730,180	$ 31,472,785	$ 8,770,397	$ 3,633,525	710
Cross Creek	$ 27,358	$ 54,716	$ -	$ -	9
Dry Berry Creek	$ 599,433	$ 273,077	$ 169,190	$ -	37
Dry Brushy Creek-Brushy Creek	$ 333,333	$ 314,947	$ 180,799	$ -	30
Granger Lake	$ 2,785,105	$ 1,140,921	$ -	$ -	287
Houghton Branch-Middle Yegua Creek	$ 395,902	$ 46,921	$ -	$ -	21
Lake Creek-Brushy Creek	$ 41,195,068	$ 23,071,683	$ 14,955,392	$ 7,153,664	668
Lake Georgetown	$ 4,366,267	$ 1,744,740	$ 1,272,967	$ 495,241	353
Lower Berry Creek	$ 51,176,710	$ 8,411,610	$ 330,685	$ 160,241	268
Lower South Fork San Gabriel River	$ 8,071,407	$ 5,716,241	$ 4,999,779	$ 4,503,297	362
Middle Fork San Gabriel River-North Fork San Gabriel River	$ 22,606,875	$ 1,708,913	$ 450,610	$ 222,749	86
Middle South Fork San Gabriel River	$ 3,746,123	$ 926,519	$ 568,672	$ 1,856,301	73
Mileham Branch-San Gabriel River	$ 6,596,498	$ 5,095,648	$ 3,803,906	$ 5,614,087	499
Mustang Creek	$ 3,453,429	$ 2,737,565	$ 709,548	$ 40,736	147
Opossum Creek-Willis Creek	$ 926,713	$ 618,661	$ 592,482	$ -	56
Pecan Branch-San Gabriel River	$ 4,181,988	$ 1,674,204	$ 3,518,526	$ 1,958,661	199
Pecan Creek-San Gabriel River	$ 875,053	$ 121,520	$ 79,291	$ -	19
Salty Creek-Brushy Creek	$ 189,520	$ 519,609	$ 232,098	$ 567,974	34
Smith Branch-San Gabriel River	$ 13,665,307	$ 9,701,281	$ 3,301,358	$ 699,063	385
South Brushy Creek-Brushy Creek	$ 62,830,916	$ 14,453,157	$ 7,421,583	$ 1,029,355	735
South Salado Creek	$ 2,966,587	$ 2,379,913	$ 603,900	$ -	150
Turkey Creek	$ -	$ 1,668,082	$ 223,083	$ 27,449	107
Upper Berry Creek	$ 764,953	$ 248,867	$ -	$ -	39
Upper Donahoe Creek	$ 210,180	$ 116,410	$ 54,198	$ -	38
Total	**$ 300,275,016**	**$ 124,305,590**	**$ 55,348,543**	**$ 29,802,570**	**5,742**

Note: Blank cells indicate there are no improved properties in that category

5.2.8 Repetitive Damage

Flooding is the most common natural hazard in Williamson County. Sometimes floodplain management regulations mitigate repetitive flood losses when a building is substantially damaged. A structure where the cost to repair is equal to or exceeds 50 percent of the building's value is considered substantially damaged. A substantially damaged building must be brought up to the same flood protection level as a new building under a community's floodplain management ordinance. Repetitive loss buildings are not always located in a regulated floodplain or they do not get substantially damaged and remain at risk to future damage. Many owners of properties that experience repetitive flooding are not aware of the magnitude of damage they are exposed to because they either purchased the property after the last flood or the seller or lender did not disclose the flood hazard. Repetitive Loss (RL) and Severe Repetitive Loss (SRL) data is available through FEMA and is based on flood insurance damage claims both by property and by community. This information will not always be indicative of the total damage associated with any particular event, but it may demonstrate the relative risk by depicting a concentration of data in particular geographic locations.

One of the Goals of the current Texas State Hazard Mitigation Plan (#8) is "to reduce the number of Repetitive Loss and Severe Repetitive Loss properties through acquisition of real property from property owners, and demolition or relocation of buildings to convert the property to open space."

There are two categories used when discussing properties which flood repetitively. Per the current State of Texas Hazard Mitigation Plan, A Repetitive Loss property is a structure covered by a contract for flood insurance made available under the NFIP that:

a. Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and
b. At the time of the second incidence of flood-related damage, the contract for flood insurance contained increased cost-of-compliance coverage.

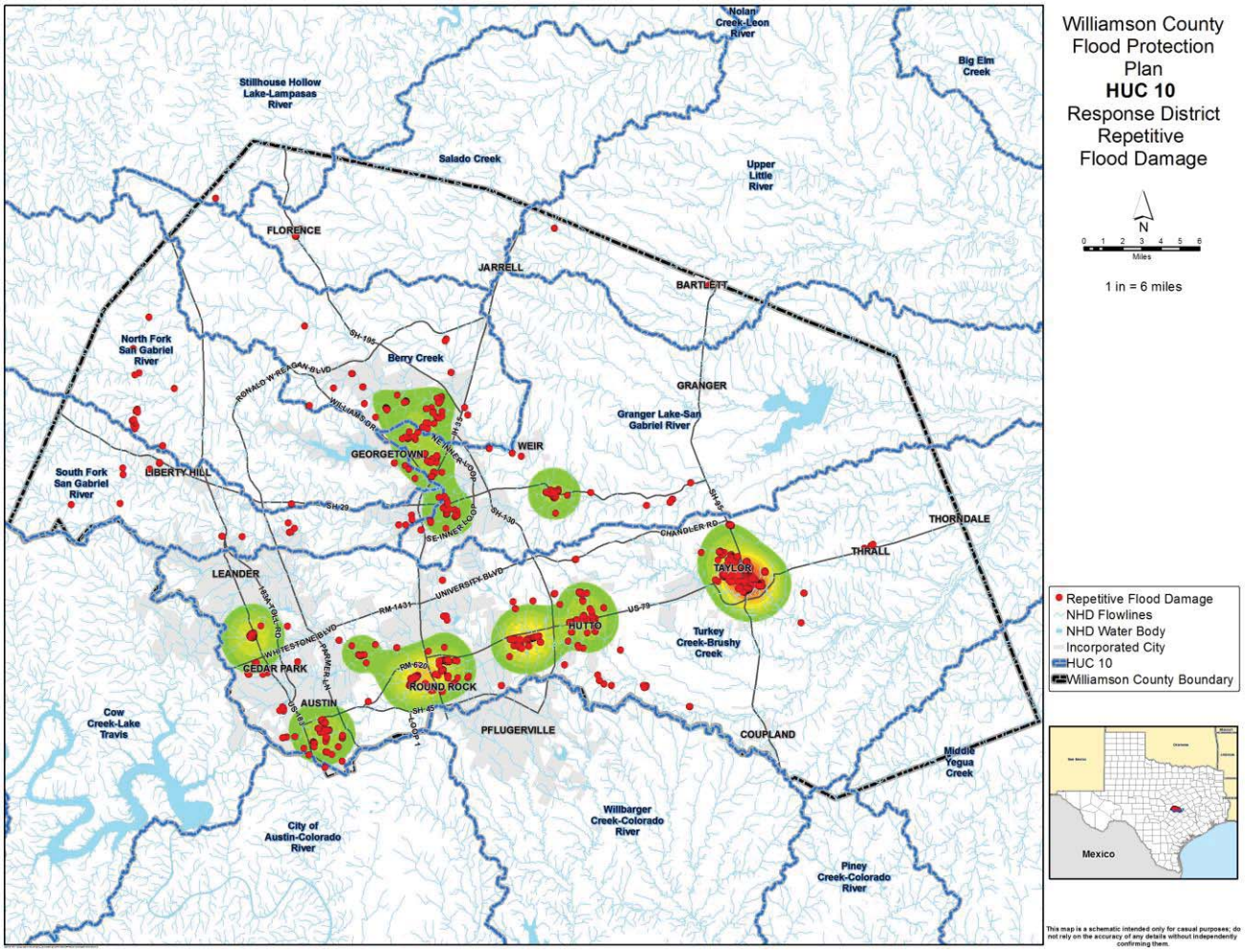
A Severe Repetitive Loss property is a structure that:

a. Is covered under a contract for flood insurance made available under the NFIP;
b. Has incurred flood related damage – (i) For which four or more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or (ii) For which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

As part of the mitigation strategy, the Interjurisdictional Community Flood Protection Plan should identify any of the current funding sources, including any potential funding sources that will be pursued in order to fund proposed mitigation actions for repetitive loss properties.

Figure 5-1 below maps concentrations of repetitive flood damage properties across the County (within HUC 10 District boundaries). While there are properties across a good portion of the County there are concentrations can be found along Brushy Creek as well as in Georgetown along the San Gabriel and Berry Creek. Repetitive and severe repetitive loss properties are reviewed as an element of this study as part of the assessment of the County to better understand which problem areas can be addressed through mitigation actions to reduce or potentially eliminate the impacts of flooding to property and people.

Figure 5-1. Williamson County Repetitive Flood Damage (HUC 10)



5.2.9 Limitations

Loss estimates, exposure assessments and vulnerability evaluations rely on the best available data and methodologies. However, results are subject to uncertainties associated with the following factors:

- Incomplete scientific knowledge about flood hazards and their effects on the built environment
- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of the flood hazard
- Mitigation actions already employed
- The amount of notice residents must prepare for a flood event

FEMA adheres to a protocol for map revision. Understanding that flood hazard areas are dynamic and constantly changing, FEMA attempts to keep its maps current by adhering to this protocol. At any point in time a current map may not reflect current conditions.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk.

Based on the fact the results are particularly imprecise for modeling that uses the flood zone interpolation technique, it was determined that loss estimates would be of limited value at the time of the writing of this plan. Therefore, Williamson County made the decision to analyze the potential for future damage based on flood depth modeling at both the HUC 12 Watershed Level as well as at the individual community level within the County.

Chapter 6. Risk Assessment Implementation

6.1 GENERAL CONCEPTS

A floodplain is the area adjacent to a flood source such as a river, creek, alluvial fan or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When flood waters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be altered or significantly reduced.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the overland flow of water from any source.

Floodplain—The land area along the sides of a body of water that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood event that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

6.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level. Water-surface elevation is one of the most important factors used in estimating flood damage.

6.1.2 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those

left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive, and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage of new food sources. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be tolerant of root disturbance and quick-growing compared to non-riparian trees.

6.1.3 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for several reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain if steps are taken to mitigate the activities' adverse impacts on floodplain functions.

6.2 DEFINING FLOOD HAZARDS

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat-sloped) streams.

6.2.1 Types of Flood Events

Analysis of existing plans (for example, County and Participating Communities Freestanding Hazard Mitigation Plans) showed a lack of a specific and consistent definition of flood hazards to be able to understand the cause, frequency, and expected damage of the flood hazard. Therefore, definitions were developed for several types of hazards created by flooding. Another reason to create specific definitions for flood hazards is to assist in identifying an appropriate mitigation strategy since similar flood hazards often have similar mitigation activities. The specific flood hazard definitions were developed by the County and approved by the Stakeholder group as identified below:

- **Riverine Flood Hazard:** A location where overflow from a river, stream or creek channel damages assets and often results in a federal disaster declaration. This type of flooding generally occurs more than 6 hours after peak rainfall.
- **Flash Flood Hazard:** A location where a rapid and extreme flow of high water overflows from a river, stream or creek channel into a normally dry area beginning within 6 hours of an intense rainfall event. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. For example, a minor flooding event rapidly becomes a larger flooding event after another burst of intense rain.
- **Stormwater Flood Hazard**: A location where damage to an asset occurs resulting from insufficient capacity of private or municipal stormwater drainage infrastructure. This includes ditches, catch basins and piping systems.
- **Debris Jam Flood Hazard:** A location where damage to assets occurs resulting from flooding or erosion that is caused by debris reducing the capacity of water corridors, bridges, culverts or stormwater drainage

infrastructure. Debris can be wood, bedload (stones moved by water in streams) or manmade (sofas, car parts, propane tanks, etc.).

- **Erosion Hazard:** Eroding banks that threaten public or private infrastructure. Threatened infrastructure is near an actively eroding bank (notable movement of bank over the last 5 years) and the rate of erosion could threaten infrastructure within the next 5 years.
- **High Groundwater Level Flood Hazard:** An area where damage occurs in areas not connected to recognizable drainage channels. Through a combination of infiltration and surface runoff (sheet flow) water may accumulate and cause flooding problems, generally in concave basins.
- **Unknown Flooding Hazard:** The cause of flooding is not known.

6.3 MAJOR FLOOD EVENTS

6.3.1 Historical Flooding Events

Location	Date	Estimated Property Damage	Lost Crops	Injuries	Deaths
Countywide	08/31/1996	$5,000	$0	0	0
Countywide	09/18/1996	$3,000	$0	0	0
Countywide	09/19/1996	$3,000	$0	0	0
Countywide	04/04/1997	$10,000	$0	0	0
Countywide	04/25/1997	$5,000	$0	0	0
Countywide	06/08/1997	$50,000	$0	0	0
Countywide	06/22/1997	$500,000	$50,000	0	0
Countywide	07/04/1998	$5,000	$0	0	0
Countywide	10/17/1998	$50,000	$10,000	0	0
Williamson (Zone)	10/17/1998	$30,000	$10,000	0	0
Countywide	05/10/1999	$15,000	$0	0	0
East Portion	05/11/1999	$10,000	$0	0	0
Georgetown	06/13/1999	$3,000	$0	0	0
Countywide	06/21/1999	$8,000	$0	0	0
Countywide	07/10/1999	$20,000	$0	0	0
Countywide	07/12/1999	$5,000	$0	0	0
Countywide	05/01/2000	$40,000	$0	0	0
South Portion	11/23/2000	$15,000	$0	0	0
East Portion	05/06/2001	$15,000	$0	0	0
East Portion	07/01/2001	$50,000	$0	0	0
South Portion	08/26/2001	$10,000	$0	0	0
Countywide	11/15/2001	$500,000	$0	10	2
Countywide	02/20/2003	$10,000	$0	0	0
Cedar Park	05/12/2003	$10,000	$0	0	0
West Portion	01/16/2004	$5,000	$0	0	0
Liberty Hill	10/26/2004	$100,000	$0	0	0
Round Rock	06/03/2007	$10,000	$0	0	0
Florence	06/26/2007	$500,000	$0	0	0
Andice	06/28/2007	$150,000	$0	0	0
Round Rock	10/30/2013	$1,100,000	$0	0	0
Jollyville	05/05/2015	$20,000	$0	0	0

Location	Date	Estimated Property Damage	Lost Crops	Injuries	Deaths
Beyersville	05/06/2015	$20,000	$0	0	0
Hutto	05/25/2015	$7,000,000	$0	0	1

Notes: Incidents where there are no documented dollar losses have been eliminated from this table.
Source: NOAO National Center for Environmental Information 2018

6.3.2 Historical Dam Breaks/Levee Failure

The dam commonly known as Dam #22 on Upper Brushy Creek Dam was near failure in May 2015 during flooding over Memorial Day weekend.

Chapter 7. Flood Hazard Exposure

Hazus is the Federal Emergency Management Agency's (FEMA) methodology for estimating potential losses from hazards. Hazus was developed by FEMA in cooperation with the National Institute of Building Sciences and uses Geographic Information Systems (GIS) to estimate physical, economic, and social impacts from certain types of disasters. This allows users to graphically illustrate hazard and risk information. State and local officials can use Hazus to define risk, focus mitigation, and inform policy. Hazus provides three levels of analysis which can be employed depending on user expertise and available datasets. The Level 2 analysis Provides more accurate loss estimates and requires that some national inventory data be replaced with local information The Level 2 (user-defined) Hazus protocol was used to assess exposure to flooding in the planning area. The model used census data at the block level, FEMA floodplain data and hydrology and hydraulics data developed for this assessment, which has a level of accuracy acceptable for planning purposes. The 100-year and 500-year floodplain areas discussed in the exposure and vulnerability sections of this plan have been combined to include both FEMA mapped floodplains. Note, the 100-year floodplain in a subset and included within the 500-year floodplain. The Hazus default data were enhanced using local GIS data from local, state and federal sources.

7.1 LAND USE IN THE FLOODPLAIN

Some land uses are more vulnerable to flooding, such as single-family homes, while others are less vulnerable, such as agricultural land or parks. **Error! Reference source not found.** shows the existing land use of all parcels in the 500-year floodplains, including vacant parcels and parcels in public/open space uses. Approximately 90 percent of the parcels in the 500-year floodplain are classified as either farm and ranch, agricultural, or uncategorized. Uncategorized categories are predominantly composed of state or federally owned land within the planning area.

Table 7-1. Land Use in the Floodplain

Land Use Category	500-year Floodplain	
	Area (acres)	% of total
Agriculture	5,449.62	1.45%
Commercial	7,777.62	2.08%
Farm and Ranch	150,149.00	40.07%
Industrial	8,683.29	2.32%
Residential – Single Family	8,941.69	2.39%
Residential – Multiple Family	913.9	0.24%
Residential – Mobile Home	339.91	0.09%
Tax Exempt	11,207.19	2.99%
Utility	9.11	0.00%
Uncategorized	181,201.1	48.36%
Total	**374,672.43**	**100%**

Note:
Land use designations were derived from Williamson County records and using general classification codes adapted with State Codes

7.2 CRITICAL FACILITIES AND INFRASTRUCTURE

Property damage from flood events can be severe and can significantly alter entire communities. Table 7-2 displays the general locations and the number of schools, tier II facilities, hospitals, railroads, dams, airports, fire stations, EMS stations, and law enforcement stations (critical facilities as provided by Williamson County GIS Department) in the

various flood hazard zones within Williamson County. Efforts should be taken in the future to harden and protect critical infrastructure from flood events as well as to ensure that the siting of future critical infrastructure be outside of high flood hazard risk areas.

Table 7-2 summarize the planning area critical facilities and infrastructure in the 500-year floodplain. Additional details are provided in the following sections.

Table 7-2. Critical Facilities and Infrastructure in the 500-year Floodplain

	Total Number of Critical Facilities in the Floodplain								
	Schools	Tier II Facilities	Fire Stations	EMS Stations	Law Enforcement Stations	Hospitals	Railroad Lines	Dams	Airports
Austin	14	7	2	0	0	1	0	0	0
Bartlett	0	2	0	0	0	0	1	0	0
Cedar Park	22	14	5	4	2	2	4	5	0
Coupland	1	0	1	0	0	0	1	0	0
Florence	4	1	1	1	1	0	0	0	0
Georgetown	31	32	5	9	4	3	2	2	2
Granger	2	1	1	0	1	0	0	1	0
Hutto	9	9	1	1	1	0	1	1	0
Jarrell	2	5	1	0	1	0	0	0	0
Leander	18	11	5	1	1	0	2	2	2
Liberty Hill	4	16	1	1	1	0	1	0	0
Pflugerville	0	1	0	0	0	0	0	0	0
Round Rock	33	34	9	6	2	3	10	6	0
Taylor	12	22	3	2	2	1	7	1	1
Thrall	4	2	1	0	1	0	1	0	0
Weir	0	0	1	1	0	0	0	0	0
Total	**156**	**157**	**37**	**26**	**17**	**10**	**30**	**18**	**5**

7.2.1 Hazardous Materials Facilities

Hazardous material facilities are those that use or store materials that can harm the environment if damaged by a flood. For this assessment, such facilities were identified using the EPA Toxic Release Inventory (TRI) database plus other facilities identified by the planning team. Five businesses in the 500-year floodplain have been identified as TRI reporting facilities or other known hazardous material-containing facilities. During a flood event, containers holding these materials can rupture and leak into the surrounding area, having a potentially disastrous effect on the environment as well as residents.

7.2.2 Utilities and Infrastructure

It is important to identify who may be at risk if infrastructure is damaged by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the planning area. Preserving access is particularly important for emergency service providers needing to reach vulnerable populations or to make repairs.

Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. The following sections provide more information on specific types of critical infrastructure.

7.2.3 Roads/Low Water Crossings

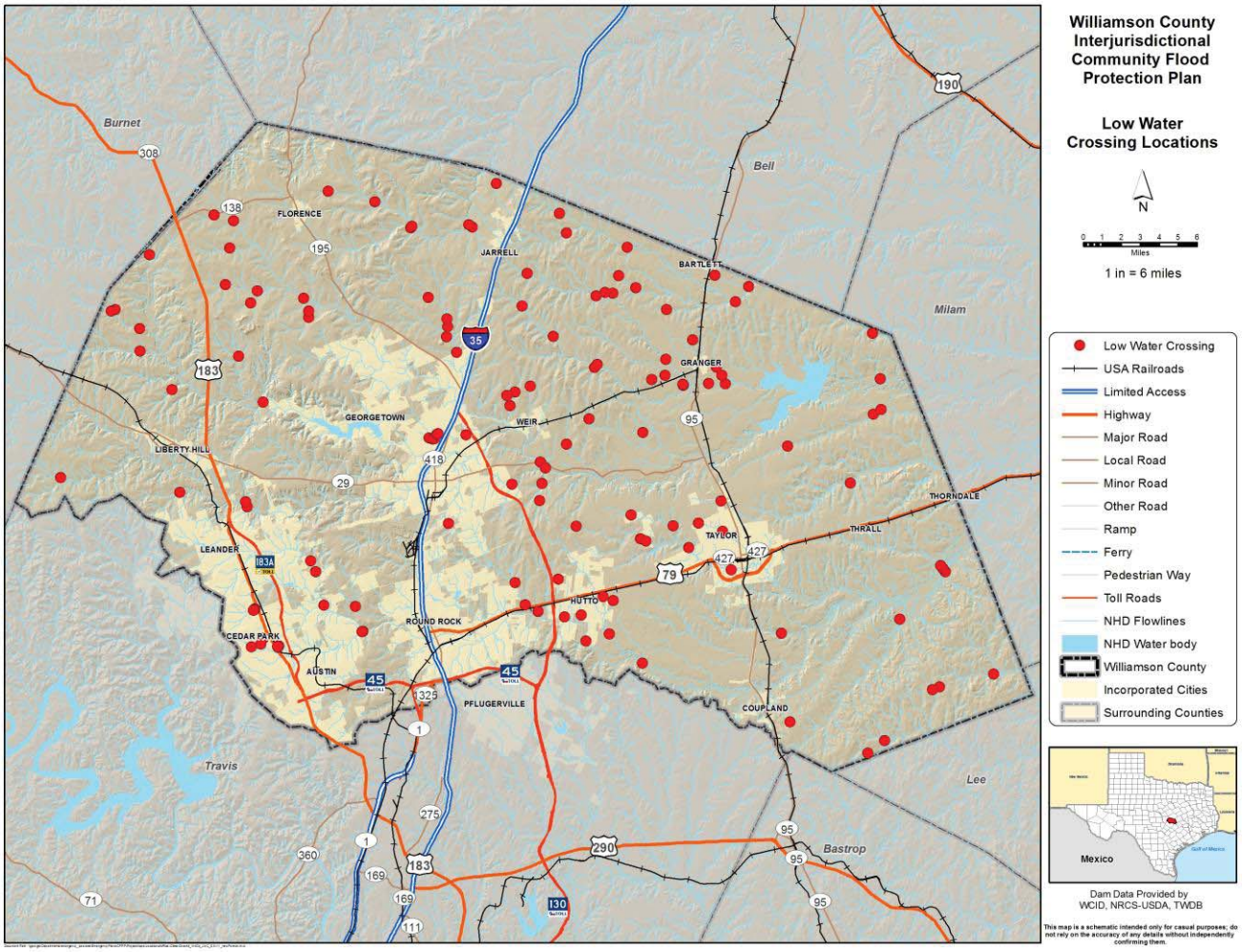
The following major roads in the planning area pass through the 500-year floodplain and thus are exposed to flooding. Some of these roads are built above the flood level, and others function to prevent flooding. Still, in severe flood events these roads can be blocked or damaged, preventing access to some areas:

- Baron Lane
- Brushy Creek Road
- Cedar Park Drive
- County Road 101
- County Road 177
- County Road 179
- County Road 365
- County Road 366
- County Road 369
- Cypress Lane
- Farm Market 685
- Mallard Lane
- Patriot Lane
- Peach Tree Lane
- South Kings Canyon Drive
- South Rainbow Bridge
- South Rio Grande
- Sumac Lane

Roads within the unincorporated areas:

- Brushy Bend Road (1)
- Coyote Trail (1)
- CR 100 (2)
- CR 106 (1)
- CR 108 (1)
- CR 110 (1)
- CR 121 (1)
- CR 123 (1)
- CR 124 (2)
- CR 129 (1)
- CR 130 (1)
- CR 132 (1)
- CR 137 (1)
- CR 140 (1)
- CR (1)
- CR 149 (2)
- CR 152 (1)
- CR 166 (1)
- CR 199 (1)
- CR 200 (2)
- CR 208 (1)
- CR 215 (1)
- CR 220 (1)
- CR 221 (1)
- CR 223 (1)
- CR 229 (1)
- CR 232 (3)
- CR 234 (2)
- CR 236 (2)
- CR 239 (1)
- CR 245 (2)
- CR 246 (1)
- CR 250 (1)
- CR 251 (1)
- CR 255 (1)
- CR 258 (1)
- CR 266 (1)
- CR 267 (1)
- CR 272 (1)
- CR 279 (2)
- CR 284 (1)
- CR 301 (1)
- CR 303 (2)
- CR 305 (2)
- CR 307 (1)
- CR 315 (1)
- CR 321 (2)
- CR 325 (1)
- CR 326 (1)
- CR 328 (2)
- CR 329 (1)
- CR 335 (1)
- CR 336 (2)
- CR 343 (1)
- CR 347 (2)
- CR 348 (1)
- CR 350 (1)
- CR 351 (2)
- CR 361 (1)
- CR 363 (1)
- CR 369 (1)
- CR 380 (1)
- CR 382 (1)
- CR 384 (2)
- CR 388 (1)
- CR 398 (1)
- CR 416 (1)
- CR 424 (1)
- CR 428 (1)
- CR 434 (3)
- CR 460 (1)
- CR 471 (1)
- CR 476 (2)
- CR 482 (1)
- CR 483 (1)
- CR 484 (1)
- CR 491 (1)
- FM 1331 (1)
- FM 1660 (1)
- Gold Oaks Road (2)
- Live Oak Trails (1)
- North CR 122 (1)
- Sam Bass Road (1)
- San Gabriel Ranch Road (1)
- Shady Hollow Drive (3)

Figure 7-1. Williamson Low Water Crossings



7.2.4 Bridges

Flooding events can significantly impact bridges, which provide the only ingress and egress to some neighborhoods. There are 108 bridges that are in or cross over the 500-year floodplain, 16 of which are in the incorporated communities and 92 are in the unincorporated portion of the county.

7.2.5 Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Flood waters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Flood waters can contaminate drinking water supplies. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

7.2.6 Dams

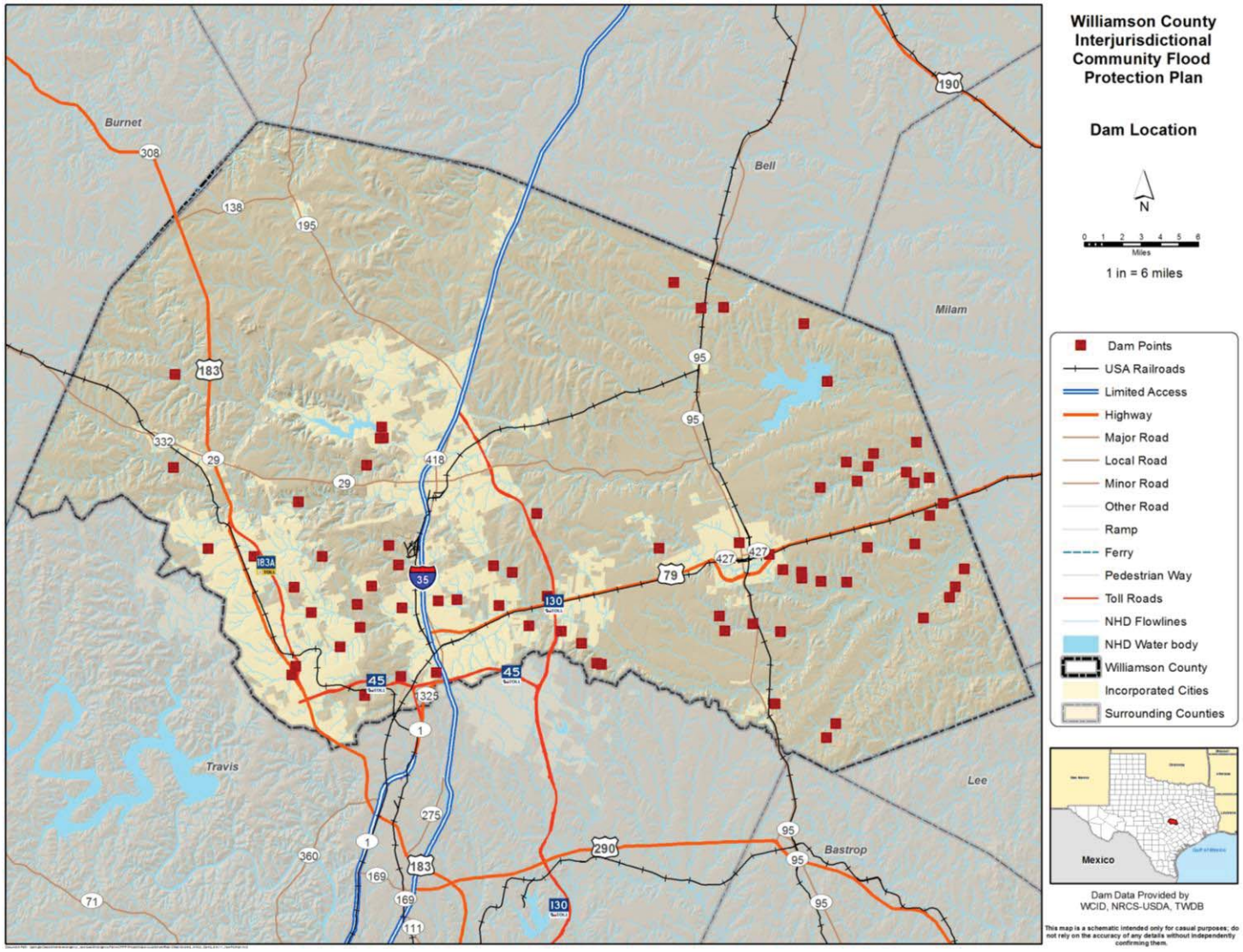
Water is an essential natural resource and one of the most efficient ways to manage and control water resources is through dam construction. A dam is defined in the Texas Water Code as a barrier, including one for flood detention, designed to impound liquid volumes and which has a height of dam greater than 6 feet" (Texas Administrative Code, Chapter 299, 1986).

The Texas Commission on Environmental Quality (TCEQ) has jurisdiction over rule changes to dams and 99 percent of dams are under state regulatory authority. Those regulations are implemented by the TCEQ Dam Safety Program, which monitors and regulates both private and public dams in Texas. The program periodically inspects dams that pose a high or significant hazard and makes recommendations and reports to dam owners to help them maintain safe facilities. The primary goal of the state's Dam Safety Program is to reduce the risk to lives and property from the consequences of dam failure.

In 2008, TCEQ proposed several rule changes including the definition of dams and dam classifications. These changes were approved. According to the new definition, a dam in Texas is a barrier with a "height greater than or equal to 25 feet and a maximum storage (top of dam) capacity of 15 acre-feet; a height greater than 6 feet and a maximum storage capacity greater than or equal to 50 acre-feet; or one that poses a threat to human life or property in the event of failure, regardless of height or maximum storage capacity."

The majority of dams and lakes in Texas are used for water supply. Dams also provide benefits such as irrigation for agriculture, hydropower, flood control, maintenance of lake levels, and recreation. Despite the benefits and importance of dams to our public works infrastructure, many safety issues exist for dams as with any complex infrastructure; the most serious threat is dam failure. Approximately 75 percent of the dams in Williamson County are owned by either the local government or a local government agency. The remaining 25 percent are privately owned. for locations of dams within Williamson County.

Figure 7-2. Williamson County Dam Locations



7.2.7 Regulatory Oversight

The potential for catastrophic flooding based on dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure to protect the lives and property of the public.

7.2.7.1 Texas Rules and Regulations for Dam Safety and Dam Construction

Effective September 1, 2013, dams are exempt from safety requirements if they are located on private property, have a maximum impoundment capacity of less than 500 acre-feet, are classified as low or significant hazard, are located in a county with a population of less than 350,000 (as per 2010 U.S. Census), and are not located within the corporate limits of a municipality. Note that these exemptions; however, do not apply as the population of Williamson County is greater than the 350,000 threshold. Dam owners will still have to comply with maintenance and operation requirements.

Table 7-3. Dam Counts and Exemptions

Jurisdiction	Dam Count
City of Cedar Park	6
City of Georgetown	2
City of Granger	1
City of Hutto	1
City of Leander	2
City of Round Rock	6
City of Taylor	1
Unincorporated Areas	*57
Total	**76**

Note:
**Dams data provided by Texas Water Development Board (TWDB) in 2015.*

Chapter 8. Flood Hazard Vulnerability

Many areas exposed to flooding may not experience serious flooding or flood damage. Vulnerability can be defined as the extent of harm, which can be expected under certain conditions of exposure, susceptibility and resilience (UNESCO-IHE, 2016). Defining vulnerability can help flood hazard managers understand the best ways to reduce it. The main objective in assessing vulnerability is to inform decision-makers or specific stakeholders about options for adapting to the impact of flooding hazards. This section describes vulnerabilities in population.

8.1 VULNERABLE POPULATIONS

An analysis using Hazus model demographic data (based on 2015/2017 estimated U.S. Census data) identified populations vulnerable to the flood hazard as follows:

- **Economically Disadvantaged Populations**—An estimated 5.8 percent of people within the County are living in poverty.
- **Population over 65 Years of Age**—An estimated 11.3 percent of the population in the County are over 65 years of age.
- **Population under 16 Years of Age**—An estimated 26.0 percent of the population within the County are under 18 years of age.

In addition, persons with disabilities or others with access and functional needs are more likely to have difficulty responding to a flood or other hazard event than the general population. Local government is the first level of response to assist these individuals. Coordination of efforts to meet their access and functional needs is paramount to life safety efforts. Knowing the percentage of population with a disability allows emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. According to the U.S. Census Bureau 2015 American Community Survey estimates, 6.7 percent of individuals under age 65 in Williamson County have some form of disability.

8.2 IMPACTS ON PROPERTY

A depth-damage function is a mathematical relationship between the depth of flood water above or below the first floor of a building and the amount of damage that can be attributed to that water. Depth-damage relationships are based on the premise that water height, and its relationship to structure height (elevation), is the most important variable in determining the expected value of damage to buildings." Proper planning and evaluation of flood damage reduction projects require knowledge of actual damage caused to various types of properties. The United States Army Corps of Engineers (USACE), Flood Damage Data Collection Program was developed to provide support for this concept by providing Corps district offices with standardized relationships for estimating flood damage and other costs of flooding, based on actual losses from flood events. Under this program, data have been collected from major flooding that occurred in various parts of the United States. Damage data collected are based on comprehensive accounting of losses from flood victims' records. The results from the analysis of this acquired data are generic damage curves that can be used for loss estimation. In tables illustrating damage as a function of water depth, the first-floor elevation is equivalent to 0 water height; negative numbers indicate heights below the first-floor threshold. Depth-damage relationships are computed separately for structure and contents.

Many factors affect the amount of damages arising from a flood. The variable aspects of floods that impact on the damages include depth of flooding, time of year of flooding, velocity of flood water, duration of flooding, sediment load, and warning time. Although all these factors may be relevant to the flood damages incurred, most historical assessment procedures have focused on only one explanatory variable, depth of flooding. Because the depth-damage function is the primary relationship used in flood damage estimation work, various depth-damage curves have been

developed. These can be specific to certain structures, such as an individual home, or averaged for several similar buildings, such as one-story residential dwellings with basements.

To help illustrate the damage potential to the structures exposed to flood inundation identified in of the Appendices and Annexes of this Plan this plan, the USACE Generic Damage functions are shown in Tables 8-1 and 8-2 below.

Table 8-1. USACE Generic Damage Functions, Structure

Generic Depth-Damage Relationships-Structure, No-Basement						
	1 Story		2 or more Stories		Split-Level	
Depth	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard Deviation of Damage
-2	0%	0.0%	0%	0.0%	0%	0.0%
-1	2.5%	2.7%	3.0%	4.1%	6.4%	2.9%
0	13.4%	2.0%	9.3%	3.4%	7.2%	2.1%
1	23.3%	1.6%	15.2%	3.0%	9.4%	1.9%
2	32.1%	1.6%	20.9%	2.8%	12.9%	1.9%
3	40.1%	1.8%	26.3%	2.9%	17.4%	2.0%
4	47.1%	1.9%	31.4%	3.2%	22.8%	2.2%
5	53.2%	2.0%	36.2%	3.4%	28.9%	2.4%
6	58.6%	2.1%	40.7%	3.7%	35.5%	2.7%
7	63.2%	2.2%	44.9%	3.9%	42.3%	3.2%
8	67.2%	2.3%	48.8%	4.0%	49.2%	3.8%
9	70.5%	2.4%	52.4%	4.1%	56.1%	4.5%
10	73.2%	2.7%	55.7%	4.2%	62.6%	5.3%
11	75.4%	3.0%	58.7%	4.2%	68.6%	6.0%
12	77.2%	3.3%	61.4%	4.2%	73.9%	6.7%
13	78.5%	3.7%	63.8%	4.2%	78.4%	7.4%
14	79.5%	4.1%	65.9%	4.3%	81.7%	7.9%
15	80.2%	4.5%	67.7%	4.6%	83.8%	8.3%
16	80.7%	4.9%	69.2%	5.0%	84.4%	8.7%

Source: USACE, Economic Guidance Memorandum (EGM) 01-03

Table 8-2. USACE Generic Damage Functions, Contents

Generic Depth-Damage Relationships-Contents, No-Basement						
	1 Story		2 or more Stories		Split-Level	
Depth	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard derivation of Damage
-2	0%	0.0%	0%	0.0%	0%	0.0%
-1	2.4%	2.1%	1.0%	35%	2.2%	2.2%
0	8.1%	1.5%	5.0%	2.9%	2.9%	1.5%
1	13.3%	1.2%	8.7%	2.6%	4.7%	1.2%
2	17.9%	1.2%	12.2%	2.5%	7.5%	1.3%
3	22.0%	1.4%	15.5%	2.5%	11.1%	1.4%
4	25.7%	1.5%	18.5%	2.7%	15.3%	1.5%
5	28.8%	1.6%	21.3%	3.0%	20.1%	1.6%

Generic Depth-Damage Relationships-Contents, No-Basement						
	1 Story		2 or more Stories		Split-Level	
Depth	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard Deviation of Damage	Mean of Damage	Standard derivation of Damage
6	31.5%	1.6%	23.9%	3.2%	25.2%	1.8%
7	33.8%	1.7%	26.3%	3.3%	30.5%	2.1%
8	35.7%	1.8%	28.4%	3.4%	35.7%	2.5%
9	37.2%	1.9%	30.3%	3.5%	40.9%	3.0%
10	38.4%	2.1%	32.0%	3.5%	45.8%	3.5%
11	39.2%	2.3%	33.4%	3.5%	50.2%	4.1%
12	39.7%	2.6%	34.7%	3.5%	54.1%	4.6%
13	40.0%	2.9%	35.6%	3.5%	57.2%	5.0%
14	40.0%	3.2%	36.4%	3.6%	59.4%	5.4%
15	40.0%	3.5%	36.9%	3.8%	60.5%	5.7%
16	40.0%	3.8%	37.2%	4.2%	60.5%	6.0%

Source: USACE, Economic Guidance Memorandum (EGM) 01-03

When interpreting the data shown in Tables 8-1 and 8-2, it is important to note that "structure" and "contents" have been defined as follows:

- Structure: a permanent building that consists as four walls and a roof and everything that is permanently attached to it.
- Contents: contents are usually defined as everything within the house, not permanently installed, such as rugs, portable dishwashers, and freestanding bookshelves. Valuation of contents is usually estimated by content-to-structure value ratios identified to be appropriate by the risk assessment analyst.

8.2.1 Watershed Prioritization Exercise

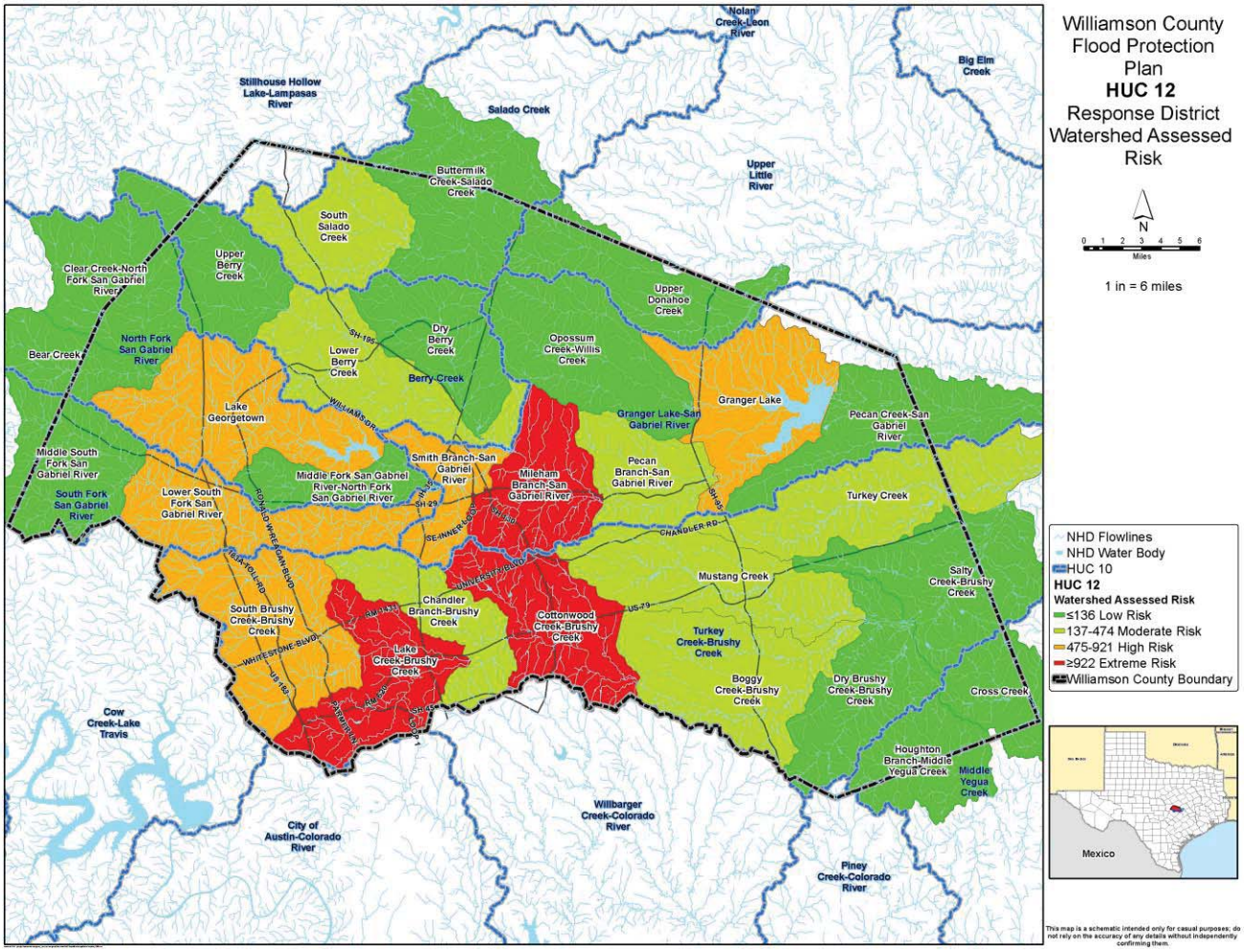
As flooding events increase across the State of Texas and the Nation as a whole, securing funding to mitigate flooding has become more competitive. Therefor it is important to prioritize watersheds in order to invest limited funds in the highest priority watersheds ensuring the "best bang of the buck". One element of this Plan was to rank risk for each of the 29 HUC-12 watersheds on the basis of the historic number of structures impacted by flood depths as well as damage claims submitted. The total number of structures in each of flood depth category was multiplied by a weighted value. The number of historic damage claims was also added into the analysis. Finally, each watershed was then assigned a risk value: low, moderate, high and extreme risk.

Table 8-3 below represents the prioritization exercise that the steering committee undertook. Of special note are the three watersheds that were identified as Extreme Risk. The Extreme Risk watersheds include: Cottonwood Creek/Brushy Creek Watershed, the Lake Creek/Brushy Creek Watershed and the Mileham Branch of the San Gabriel River Watershed.

Table 8-3. Watershed Prioritization Exercise

Watershed Prioritization Exercise Total Number of Structures by Flood Depth X Weighted Values												
	Less Than 1 Foot	X 1	1-3 Feet	X 2	3-6 Feet	X 3	Greater than 6 Feet	X 4	Total Structures	At Risk Composite Values	Damage Claims	Watershed Assessed Risk
Bear Creek	16	16	14	28	14	42	12	48	56	134	2	136
Boggy Creek-Brushy Creek	4	16	22	44	55	165	30	120	111	345	18	363
Buttermilk Creek-Salado Creek	27	16	7	14	0	0	1	4	35	34	0	34
Chandler Branch-Brushy Creek	116	16	56	112	8	24	7	28	187	180	18	198
Clear Creek-North Fork San Gabriel River	16	16	13	26	8	24	4	16	41	82	2	84
Cottonwood Creek-Brushy Creek	314	16	231	462	108	324	57	228	710	1030	175	1205
Cross Creek	2	16	4	8	1	3	2	8	9	35	0	35
Dry Berry Creek	18	16	17	34	2	6	0	0	37	56	6	62
Dry Brushy Creek-Brushy Creek	18	16	6	12	6	18	0	0	30	46	0	46
Granger Lake	142	16	53	106	16	48	76	304	287	474	0	474
Houghton Branch-Middle Yegua Creek	17	16	4	8	0	0	0	0	21	24	0	24
Lake Creek-Brushy Creek	301	16	187	374	125	375	55	220	668	985	206	1191
Lake Georgetown	84	16	61	122	65	195	143	572	353	905	16	921
Lower Berry Creek	214	16	43	86	9	27	2	8	268	137	64	201
Lower South Fork San Gabriel River	114	16	117	234	80	240	51	204	362	694	16	710
Middle Fork San Gabriel River-North Fork San Gabriel River	59	16	13	26	8	24	6	24	86	90	6	96
Middle South Fork San Gabriel River	39	16	10	20	9	27	15	60	73	123	4	127
Mileham Branch-San Gabriel River	125	16	137	274	121	363	116	464	499	1117	41	1158
Mustang Creek	58	16	69	138	11	33	9	36	147	223	211	434
Opossum Creek-Willis Creek	8	16	32	64	15	45	1	4	56	129	0	129
Pecan Branch-San Gabriel River	94	16	19	38	34	102	52	208	199	364	8	372
Pecan Creek-San Gabriel River	7	16	9	18	3	9	0	0	19	43	0	43
Salty Creek-Brushy Creek	2	16	11	22	15	45	6	24	34	107	0	107
Smith Branch-San Gabriel River	157	16	120	240	83	249	25	100	385	605	88	693
South Brushy Creek-Brushy Creek	394	16	238	476	81	243	22	88	735	823	98	921
South Salado Creek	77	16	60	120	13	39	0	0	150	175	13	188
Turkey Creek	4	16	88	176	14	42	1	4	107	238	11	249
Upper Berry Creek	28	16	11	22	0	0	0	0	39	38	0	38
f	17	16	10	20	10	30	1	4	38	70	3	73
Total	**2472**		**1662**		**914**		**694**		**5742**		1006	
Legend												
≤136 Low Risk												
137-474 Moderate Risk												
475-921 High Risk												
≥922 Extreme Risk												

Figure 8-1. Williamson County Watershed Assessed Risk (HUC 12)



8.2.2 Issues

The purpose of this plan is to consider flood issues and challenges across the County in realization that water does not stay within community boundaries or even drainage boundaries. Streams are fed by runoff from rainfall and snowmelt moving as overland or subsurface flow. Floods occur when large volumes of runoff flow quickly into streams and rivers. The peak discharge of a flood is influenced by many factors, including the intensity and duration of storms and snowmelt, the topography and geology of stream basins, vegetation, and the hydrologic conditions preceding storm events. Some of the issues facing Williamson County and the communities within include:

- Land use and other human activities also influence the peak discharge of floods by modifying how rainfall is stored on and runs off the land surface into streams.
- Urban areas, where much of the land surface is covered by roads and buildings, have less capacity to store rainfall. Construction of roads and buildings often involves removing vegetation, soil, and depressions from the land surface. The permeable soil is replaced by impermeable surfaces such as roads, roofs, parking lots, and sidewalks that store little water, reduce infiltration of water into the ground, and accelerate runoff to ditches and streams.

- In suburban areas, where lawns and other permeable landscaping may be common, rainfall and snowmelt can saturate thin soils and produce overland flow, which runs off quickly.
- Dense networks of ditches and culverts in cities reduce the distance that runoff must travel overland or through subsurface flow paths to reach streams and rivers. Once water enters a drainage network, it flows faster than either overland or subsurface flow.
- As growth continues to increase in and around the County, the amount of pervious surface is reduced, reducing the amount of water that is able to be absorbed into the ground and increasing runoff.
- Development along stream channels and floodplains can alter the capacity of a channel to convey water and can increase the height of the water surface (also known as stage) corresponding to a given discharge. In particular, structures that encroach on the floodplain, such as bridges, can increase upstream flooding by narrowing the width of the channel and increasing the channel's resistance to flow.
- Sediment and debris carried by flood waters can further constrict a channel and increase flooding. This hazard is greatest upstream of culverts, bridges, or other places where debris collects.
- Storm events have increased in frequency and intensity resulting in greater number of at-risk days for floods.
- Researchers say such flood episodes are likely to worsen as efforts to protect vulnerable communities are outpaced by factors that increase the risk of flooding, including the ongoing practice of building on river floodplains.
- Experts say the immense rains — some spawned by tropical ocean waters, others by once-routine thunderstorms — are the product of long-rising air temperatures and an increase in the sheer size of the storms. Because warmer air can hold more water, large storms are dropping far more rain at a faster rate. According to Andreas Prein, an atmospheric scientist at the National Center for Atmospheric Research in Boulder, Colorado "Things are definitely getting more extreme. You just have to look at the records. All areas of the continental U.S. have seen increases in peak rainfall rates in the past 50 years. And there is a chance that we are underestimating the risk, actually."
- Many scientists agree that climate adaptation is likely to increase the occurrence and severity of storms as well as droughts, and thus increase the likelihood of flooding. The cumulative effects of decades of land-use choices have gradually increased the likelihood of flooding.
- Standards used for infrastructure design and floodplain regulations will likely be revised based on the new storm values established by NOAA for Texas.

As development with the County and the cities continues, combined with increased frequency and intensity of storm events, greater impacts will be felt unless comprehensive and strategic mitigation actions are taken now.

Chapter 9. Mitigation Strategy

9.1 MISSION STATEMENT, GOALS AND OBJECTIVES

This Flood Protection Plan is an expansion of the Flood Chapter and actions documented in the recently adopted 2016 Williamson County Hazard Mitigation Plan. The main goals of the Plan are to enhance life-safety for residents and responders and to mitigate undesirable flood outcomes to property, infrastructure, the environment and quality of life. This Plan addresses these goals and guides the Williamson County community in implementation.

Williamson County has flood issues including riverine flooding and flash flooding. The purpose of the plan is to provide a comprehensive overview of the flood issues within the 10-distinct watershed and associated sub-watershed areas and to develop a catalog of recommended flood mitigation alternatives to support the reduction of flood impacts in the County. This plan is intended to support community and flood district flood mitigation strategies to build safer communities and to support the wise implementation of regional flood mitigation initiatives into other planning documents.

The goals of this plan are to:

1. Protect the life, safety, and health of the public and first responders.
2. Protect property and promote community sustainability.
3. Build local support, commitment, and capacity to develop projects to reduce the impact of flooding on residents and communities.

The objectives of this plan are to:

1. Identify flood-prone areas in each district.
2. Identify infrastructure that needs to be improved in each district.
3. Identify priority areas for residential flood mitigation.
4. Develop a mitigation catalog of activities to address flood issues including structural projects and non-structural actions including hydraulic studies; improved mapping; updated codes, ordinances and

9.2 CATALOG OF MITIGATION ALTERNATIVES

A catalog of possible mitigation actions was distributed to the Steering Committee for their review and consideration in the development of community- and county-specific mitigation actions for near, mid and long-term implementation. In addition, the committee was also provided the FEMA Mitigation Ideas Handbook for further consideration. The catalog can be found in **Appendix E** of this Plan.

Chapter 10. Action Plan Development

10.1 BUILDING A MITIGATION STRATEGY

As the costs of flood disasters continue to rise, local governments and citizens must find ways to reduce risks from flood hazards to our communities and ourselves. Efforts for reducing risks to hazards are easily made compatible with other community goals; safer communities are more attractive to employers as well as residents.

As communities' plan for new development and improvements to existing infrastructure, mitigation can and should be an important component of the planning effort. Mitigation means taking sustained action to reduce or eliminate long-term risk from hazards and their effects.

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. In order for mitigation to be effective, communities and the County need to take action now—before the next disaster—to reduce human and financial consequences later (analyzing risk, reducing risk, and insuring against risk). A mitigation action is a specific action, project, activity, or process taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan's mission and goals. The actions to reduce vulnerability to threats and hazards form the core of the plan and are a key outcome of the planning process. General categories of flood mitigation activities/actions include:

- *Property Protection (PP)* - Actions that reduce potential damage to buildings by acquisition, elevation, relocation and structural retrofits.
- *Flood Damage Prevention (FD)* - Actions that lower flood water elevations or prevent future losses (such as channel and floodplain modifications, or floodplain reclamation)
- *Natural Resource Protection (NR)* - Actions that minimize hazard loss and preserve or restore the function of natural systems using soil stabilization measures such as bank protection and stabilization, wetland restoration, attenuation of peak flows through detention facilities and debris management.
- *Structural Projects (SP)* - Actions that use or modify structures to mitigate a hazard such as replacement or retrofit of bridges and culverts, and protection of critical utilities, levees, floodwalls and dams.
- *Emergency Services (ES)* - Actions that protect people and property, during and immediately following a disaster or hazard event including protection of essential facilities or critical transportation routes.
- *Public Education (PE)* - The project can serve as an educational tool for the community to protect themselves and the overall community from flood disasters and associated losses.

The Federal Emergency Management Agency (FEMA) considers the primary types of flood mitigation actions to reduce near and long-term vulnerability to include: local plans and regulations; structural projects; natural systems protection; education programs; and, preparedness and response actions.

10.1.1 Local Plans and Regulations

Local land use or comprehensive plans embody the goals, values and aspirations of the community, as expressed through a process of community engagement. The plan should identify current development patterns and trends as well as areas where future development should and should not occur. The plan should include This Plan addresses and ordinances that steer development away from hazard-prone areas, such as floodplains, to avoid putting people and property at risk. In some cases, local plans can work at cross-purposes. For example, a capital improvement plan may call for extending water and sewer lines to an area that is vulnerable to natural hazards. Williamson County emergency managers, planners and others in a community should coordinate in preparing plans to ensure consistency across plans; that is, consistent goals, policies, and strategies.

Local ordinances and review processes influence the way land and buildings are developed and built. Examples include:

- Comprehensive plans
- Land use ordinances
- Subdivision regulations
- Development reviews
- Building codes and enforcement
- NFIP Community Rating System reviews
- Capital improvement programs
- Open space preservation
- Stormwater management regulations and master plans

Plans, ordinances, policies and regulations should be mutually reinforcing. All should lead to the development of a more sustainable, resilient community.

10.1.2 Structure and Infrastructure Projects

These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Examples include:

- Acquisition and elevation of structures in flood prone areas
- Structural retrofits
- Floodwalls and retaining walls
- Detention and retention structures
- Culverts

10.1.3 Natural Systems Protection

These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. Examples include:

- Sediment and erosion control
- Stream corridor restoration
- Conservation easements
- Wetland restoration and preservation

10.1.4 Education and Awareness Programs

These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions. Examples include:

- Radio or television spots
- Websites with maps and information
- Real estate disclosures

- Presentations to school groups or neighborhood organizations
- Mailings to residents in hazard-prone areas.
- StormReady

10.1.5 Preparedness and Response Actions

Mitigation actions reduce or eliminate long-term risk and are different from actions taken to prepare for or respond to hazard events. Mitigation activities lessen or eliminate the need for preparedness or response resources in the future. When analyzing risks and identifying mitigation actions, the planning team may also identify emergency response or operational preparedness actions. Examples include:

- Creating mutual aid agreements with neighboring communities to meet emergency response needs
- Purchasing radio communications equipment for the Fire Department
- Developing procedures for notifying citizens of available shelter locations during and following an event

For some hazards, including preparedness actions in the mitigation plan may be necessary and practical. The mitigation plan may be the best place for Williamson County to capture and justify the need for these actions.

10.2 IDENTIFYING PROJECTS TO REDUCE RISK

Williamson County and many of the communities have been proactive in reducing the risk and exposure to natural hazards. One of the methods to identify and reduce the impacts to hazards is via hazard mitigation planning.

The following flood mitigation actions were included in the current 2016 Williamson County Hazard Mitigation Plan (approved in 2017). The cities of Cedar Park, Florence and Hutto participated in this plan and adopted the Plan by formal resolution. The 2016 Williamson County Hazard Mitigation Plan identified 11 mitigation projects that address either directly or indirectly flood hazards in the unincorporated areas of Williamson County. Additionally, the plan identified five flood-related projects in Cedar Park, seven in Florence and nine flood-related projects in the City of Hutto. The table below summarizes those projects.

Additionally, the following communities within Williamson County have adopted free-standing hazard mitigation plans: Georgetown, Leander, Round Rock, Taylor, Thrall and Upper Brushy Creek Water Control and Improvement District (WCID). Mitigation actions included in their plans which address flood hazard have been included in their community annexes within this plan.

Table 10-1. Williamson County Hazard Mitigation Plan Flood Mitigation Actions

Action No.	Action Title	Description	Mitigation Action Ranking (H, M, or L)	Project Status
Williamson County				
1	Purchase NOAA All Hazard Radios	Purchase radios and disperse to residents to use for hazard events in the area.	H	
2	Educate homeowners on hazards	Educate homeowners on how to mitigate their homes from flood hazards on county website and public forums.	H	
4	Stream flow and flood monitoring	Install a network of streamflow gauges and cameras throughout Williamson County. The data can then either be used in a real-time mapping solution or in a direct feed into the emergency	M	

Action No.	Action Title	Description	Mitigation Action Ranking (H, M, or L)	Project Status
		operations centers. This project is scalable to the available funding.		
5	Critical infrastructure Threat and Hazard Identification and Risk Assessment (THIRA)	As a part of the County Continuity of Operations Plan () planning process, audit and map each facility relating to the potential risk to natural hazards. Develop a prioritization list and strategies for mitigating potential risks and hazards.	M	
6	Repetitive flood loss properties	Collaborate with floodplain professionals, building contractors, and homeowners to identify repetitive flood loss properties/structures. Determine the most cost-effective measures to implement to mitigate against continued flood losses including residential property buyouts.	L	
7	Comprehensive evacuation planning	Collaborate with public safety professionals, traffic engineers, public information professionals and homeowner's associations to develop comprehensive plans and messaging. Develop area-specific plans based upon local THIRA.	M	
8	Develop and establish a comprehensive volunteer program	Establish and train a core group of Community Emergency Response Teams (CERT) instructors. Develop and implement a comprehensive CERT program to include training, continuing education, exercise program, and activation procedures.	H	
9	Road and bridge drainage infrastructure projects	Analyze past and potential future flood-related damages to road infrastructure. Develop a priority list based upon past damages, road/structure out of service time caused by flooding, and potential or past history of flooding. Create and implement plans to mitigate identified structures.	H	
12	All-hazards mapping	Collaborate with public safety professionals, GIS, hazard-specific subject matter experts, private partners, and CIKR owner/operators to obtain data and create a comprehensive all-hazards mapping solution. Additional GIS tools may be required to facilitate use of the data.	L	

Action No.	Action Title	Description	Mitigation Action Ranking (H, M, or L)	Project Status
13	Community Flood Protection Plan	Collaborate with public safety professionals, building associations, homeowner's associations, floodplain professionals and public information professionals to develop a comprehensive CFPP to include public education, infrastructure improvement/protection, residential mitigation, and response recommendations.	L	
14	Flood barrier and signage	Install permanent structures with built manual barriers to facilitate a more rapid closing of the road/structure. This shall include additional signage warning motorists of the flood potential prior to the barrier and attached to the barrier: "Turn Around Don't Drown."	M	

Chapter 11. Plan Maintenance

This chapter presents a plan maintenance process that includes the following:

- A section describing the method and schedule of monitoring, evaluating, and updating the Interjurisdictional Community Flood Protection Plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the Flood Protection Plan maintenance process.

The plan maintenance strategy is the formal process that will ensure that the Interjurisdictional Community Flood Protection Plan remains an active and relevant document. It includes a schedule for monitoring and evaluating the Plan annually and producing updated plan every five years. The strategy also describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategy outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

11.1 PLAN IMPLEMENTATION

The effectiveness of the Interjurisdictional Community Flood Protection Plan depends on its implementation and incorporation of its action items into existing local plans, policies and programs. Together, the action items in the Plan provide a framework for activities that Williamson County and the participating communities can implement over the next 5 years. The Steering Committee has established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs. Williamson County's Office of Emergency Management in cooperation with the participating communities will have lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

11.2 STEERING COMMITTEE

The Steering Committee is a stakeholder body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the Steering Committee's position that a working committee with representation similar to that of the Steering Committee should have an active role in the plan maintenance strategy. Therefore, it is recommended that a committee remain a viable body involved in key elements of the plan maintenance strategy. The new committee should include representation from all participating communities in the county. The principal role of a steering committee in this plan maintenance strategy will be to review the annual progress report and to provide input to Williamson County's Emergency Management Department on possible enhancements to be considered at the next update. Future updates will have participation by a steering committee like the one that participated in this plan development process, so keeping an interim steering committee intact could provide a head start on future updates. It will be the steering committee's role to review the progress report to identify issues needing to be addressed by future updates.

11.3 ANNUAL PROGRESS REPORT

The minimum task of the ongoing annual steering committee meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any flood hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to evaluate whether the timeline for identified projects needs to be amended (such as changing a project from long-term to short-term because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs that involve hazard mitigation

The planning team has created a template for preparing a progress report (see Appendix B). The plan maintenance committee and identified lead agencies will provide feedback to the planning team on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Williamson County Emergency Management program website page dedicated to the Interjurisdictional Community Flood Protection Plan
- Provided to the local media through a press release
- Presented to the Williamson County Commissioners Court to inform them of the progress of mitigation actions implemented during the reporting period

11.4 PLAN UPDATE

Williamson County intends to update the Interjurisdictional Community Flood Protection Plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A flood hazard event that causes loss of life
- An update of Williamson County emergency management plans.

It will not be the intent of future updates to develop a completely new Interjurisdictional Community Flood Protection Plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The public will be given an opportunity to comment on the update prior to adoption.
- The Williamson County Commissioners Court will adopt the updated plan.

It is Williamson County's intention to fully integrate this Interjurisdictional Community Flood Protection Plan into the Williamson County Hazard Mitigation Plan in the future. This will allow for a uniform update cycle for both plans and eliminate redundant planning.

11.5 CONTINUING PUBLIC INVOLVEMENT

The public will continue to be apprised of the plan's progress through the Williamson County Office of Emergency Management's website and by making copies of annual progress reports available to the media. The website will not only house the final plan, it will become the one-stop shop for information regarding the Plan and plan implementation. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from the steering committee. This strategy will be based on the needs and capabilities of Williamson County at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area, as appropriate.

11.6 INCORPORATION INTO OTHER PLANNING MECHANISMS

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The various participating communities' comprehensive plans are an integral part of this plan. The Plan development process provided the opportunity to review and expand on policies in these planning mechanisms. Williamson County's Hazard Mitigation Plan and the Interjurisdictional Community Flood Protection Plan are complementary documents that work together to achieve the goal of reducing flood-risk exposure.

Other planning processes and programs to be coordinated with the recommendations of the Interjurisdictional Community Flood Protection Plan include:

- Williamson County Hazard Mitigation Plan
- Emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Stormwater management programs
- Water system vulnerability assessments

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

The following flood mitigation actions were included in the current 2016 Williamson County Hazard Mitigation Plan. The cities of Cedar Park, Florence and Hutto participated in this plan and adopted the Plan by formal resolution. The 2016 Williamson County Hazard Mitigation Plan identified 11 mitigation projects that address, either directly or indirectly, flood hazards in the unincorporated areas of Williamson County. Additionally, the plan identified five flood-related projects in Cedar Park, seven in Florence and nine flood-related projects in the City of Hutto. A table, summarizing those projects is below. Additionally, the following communities within Williamson County have adopted free-standing hazard mitigation plans. These actions can be found summarized in the Mitigation Action Tables in each of the freestanding annexes. These communities include: Georgetown, Leander, Round Rock, Taylor-Thrall-Lower Brushy Creek WCID (pending approval) and the Upper Brushy Creek WCID. Mitigation actions included in their plans which address flood hazard have been included in their community annexes within this plan.

Chapter 12. Glossary of Terms

12.1 ACRONYMS

ADA—Americans with Disabilities Act

ASHRAE—American Society of Heating, Refrigerating and Air-Conditioning Engineers

BATool™—Baseline Assessment Tool

CAO—Critical Areas Ordinance

CDBG-DR—Community Development Block Grants, Disaster Recovery

CFR—Code of Federal Regulations

CIP—Capital Improvement Plan

CRS—Community Rating System

CWA—Clean Water Act

DMA —Disaster Mitigation Act

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FCAAP—Flood Control Assistance Account Program

FCZD—Flood Control Zone District

FEMA—Federal Emergency Management Agency

FF—Funding and Financing

FIRM—Flood Insurance Rate Map

FRR—Flood Risk Reduction

GIS—Geographic Information System

GMA—Growth Management Act

H&H—Hydrology and Hydraulics

Hazus-MH—Hazards, United States-Multi Hazard (Hazus)

HMGP—Hazard Mitigation Grant Program

IPCC—Intergovernmental Panel on Climate Change

ISO—Insurance Services Office

LIDAR—Light Detection and Ranging

NASA—National Aeronautics and Space Administration

NEPA—National Environmental Policy Act

NFIP—National Flood Insurance Program

NIMS—National Incident Management System

NOAA—National Oceanic and Atmospheric Administration

NRCS—National Resources Conservation Service

NSFHA—Non-Special Flood Hazard Area

NWS—National Weather Service

ppb—Parts Per Billion

ppm—Part Per Million

RIP—Rehabilitation and Inspection Program

SEPA—State Environmental Policy Act

SFHA—Special Flood Hazard Area

TRI—Toxic Release Inventory

USDA—U.S. Department of Agriculture

USFS—U.S. Forest Service

USGS—U.S. Geological Survey

WRIA—Water Resource Inventory Area

12.2 DEFINITIONS

100-Year Flood: The 100-year flood is the flood that has a 1 percent chance of being equaled or exceeded in any given year. The 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1 percent chance of being equaled or exceeded in any given year, also known as the "100-year" or "1 percent chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation actions, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally above ground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with flooding. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: A critical facility is one that is deemed vital to the planning area's ability to provide essential services while protecting life and property. A critical facility may be a system or an asset, either physical or virtual, the loss of

which would have a profound impact on the security, economy, public health or safety, environment, or any combination of thereof, across the planning area.

Drainage Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the special flood hazard area.

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance Rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the special flood hazard area.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of flood waters.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of an Interjurisdictional Community Flood Protection Plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property caused by disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Hazards U.S. Multi-Hazard (Hazus-MH or Hazus) Loss Estimation Program: Hazus-MH is a GIS-based program used to support the development of risk assessments as required under the Disaster Mitigation Act. The Hazus-MH software program assesses risk in a quantitative manner to estimate damage and losses associated with natural hazards.

Hazus-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. Hazus-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region compose an inventory. Inventories include assets that could be lost when a disaster occurs, and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under state law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Action: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1,000.00; or
- Two paid flood losses in excess of $1,000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold because of occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk Assessment: Risk assessment is the process of estimating potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as Zone A in riverine situations and Zone V in coastal situations. The SFHA may or may not encompass all a community's flood problem areas.

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation and damage to adjacent land uses, control unwanted meander, and improve habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25 percent. For this study, steep slope is defined as slopes greater than 33 percent.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damage, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains down gradient from areas of higher land to areas of lower land to the lowest point also called a common drainage basin.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

Annexes (Participating Communities)

ANNEX 8. Hutto

Overview

The City of Hutto is a home-rule municipality operating under a Council-Manager form of government in Central Texas. As of August 2018, 30,448 people call the growing community home, making Hutto one of the fastest-growing cities in the nation.

Development Features

The City of Hutto's website states that the 10-year Growth Guidance Plan (GGP) provides a strategic approach for the physical build out of the City to identified growth boundaries through 2015. The intent of this planning effort is to achieve the orderly growth and development of the City to promote beneficial and appropriate land uses and supporting infrastructure.

The City's Growth Guidance Plan is to provide information, policy guidance and action strategies for effectively managing future development, protecting neighborhoods, conserving valuable natural resources, enhancing the community's appearance, providing for adequate municipal facilities and services, making fiscally responsible decisions regarding future capital investments, and preserving a special quality of life for our citizens and a positive experience for visitors to Hutto.

Land Use

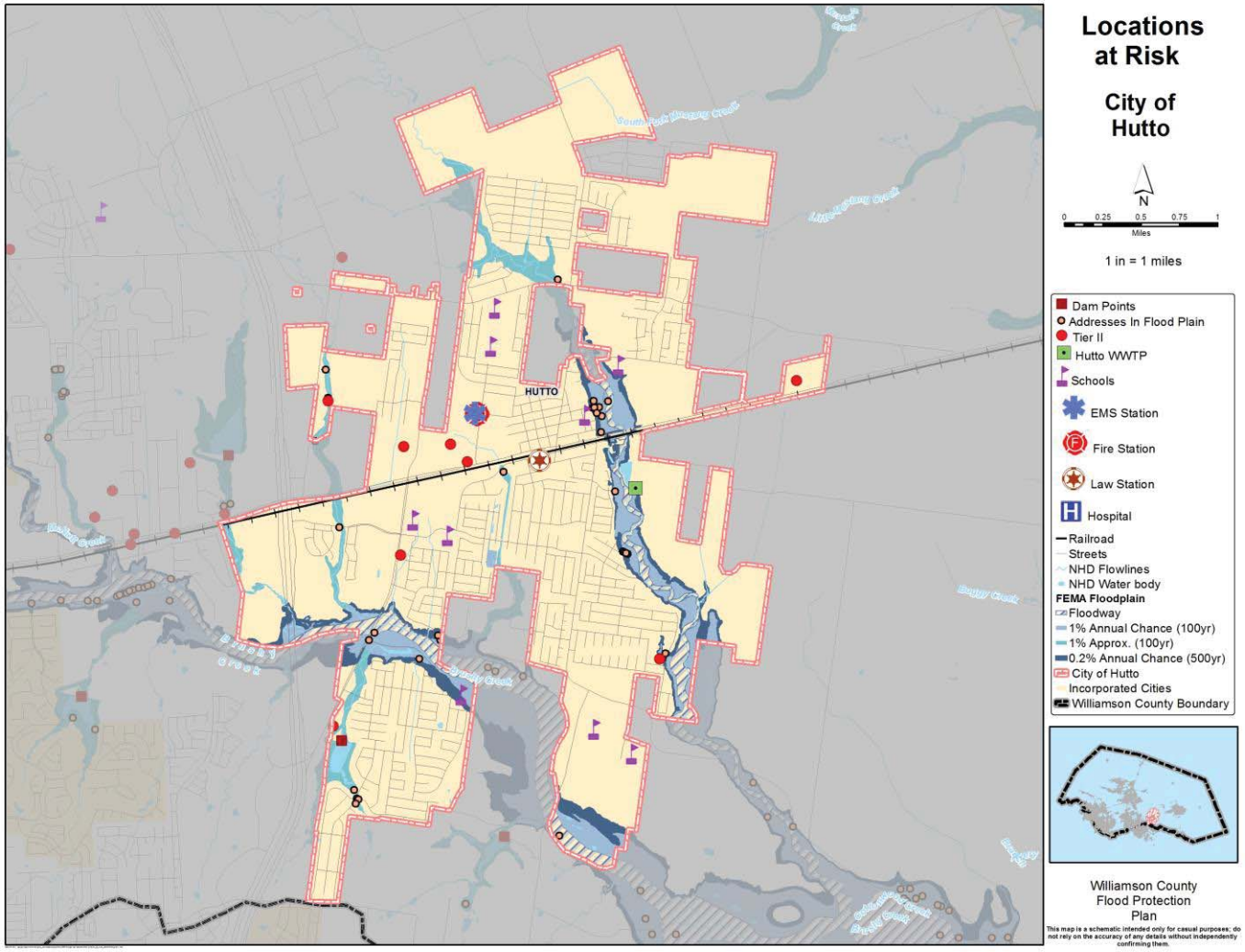
The City of Hutto's website further states that The Growth Guidance Plan represents consensus among citizens and community leaders on Hutto's future and approved by the Comprehensive Plan Steering Committee. Mayor and City Council, Planning and Zoning Commission, Parks Advisory Board, Economic Development Corporation, Historic Preservation Commission, the development community, and citizens provided direction and advice in forming the Growth Guidance Plan. Adopting the Growth Guidance Plan ratifies the document to perform multiple functions necessary for planning and growth management policies as well as satisfying the need for plan documents identified in existing City codes and ordinances. These functions and roles include the following:

- Official baseline population projection (2000-2030)
- General Land Use Plan for annexation, future zoning and rezoning, extra-territorial jurisdiction (ETJ), and land use assumptions
- Establishment of six geographic growth areas for planning purposes
- Authorized land use categories for designating preferred development within growth areas
- Water infrastructure improvements plan
- Wastewater improvements plan
- Roadway improvements plan
- Basis for additional planning processes and documents to include the Capital Improvements Program and area improvement efforts such as a Downtown Plan

The Growth Guidance Plan also performs the role of any of the following plan descriptions: "Comprehensive Plan", "Future Land Use Plan", "Comprehensive Master Plan", "Roadway Plan", and the like in official city documents such as the Charter and Code of Ordinances.

Critical Facilities and Infrastructure

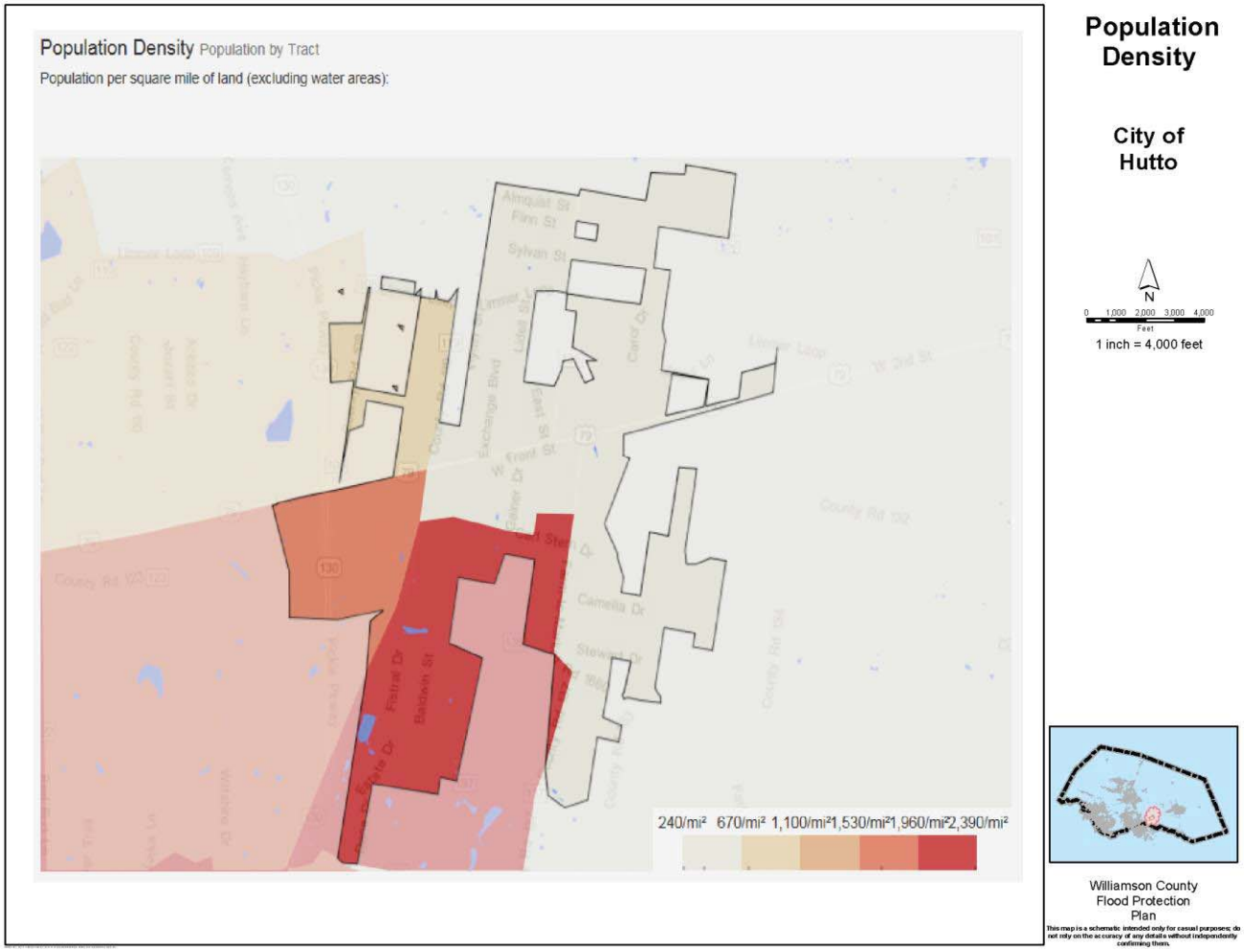
Annex Figure 8-1 City of Hutto Locations at Risk



Population Distribution

Hutto, Texas's estimated population is 25,367 according to the most recent United States census estimates. Hutto, Texas is the 113th largest city in Texas based on official 2017 estimates from the US Census Bureau. The population density is 3074.40 people/mi² (1187.03 people/km²), with a household density of 303.74 people/km² (786.69 people/mi²).

Annex Figure 8-2. City of Hutto Population Density



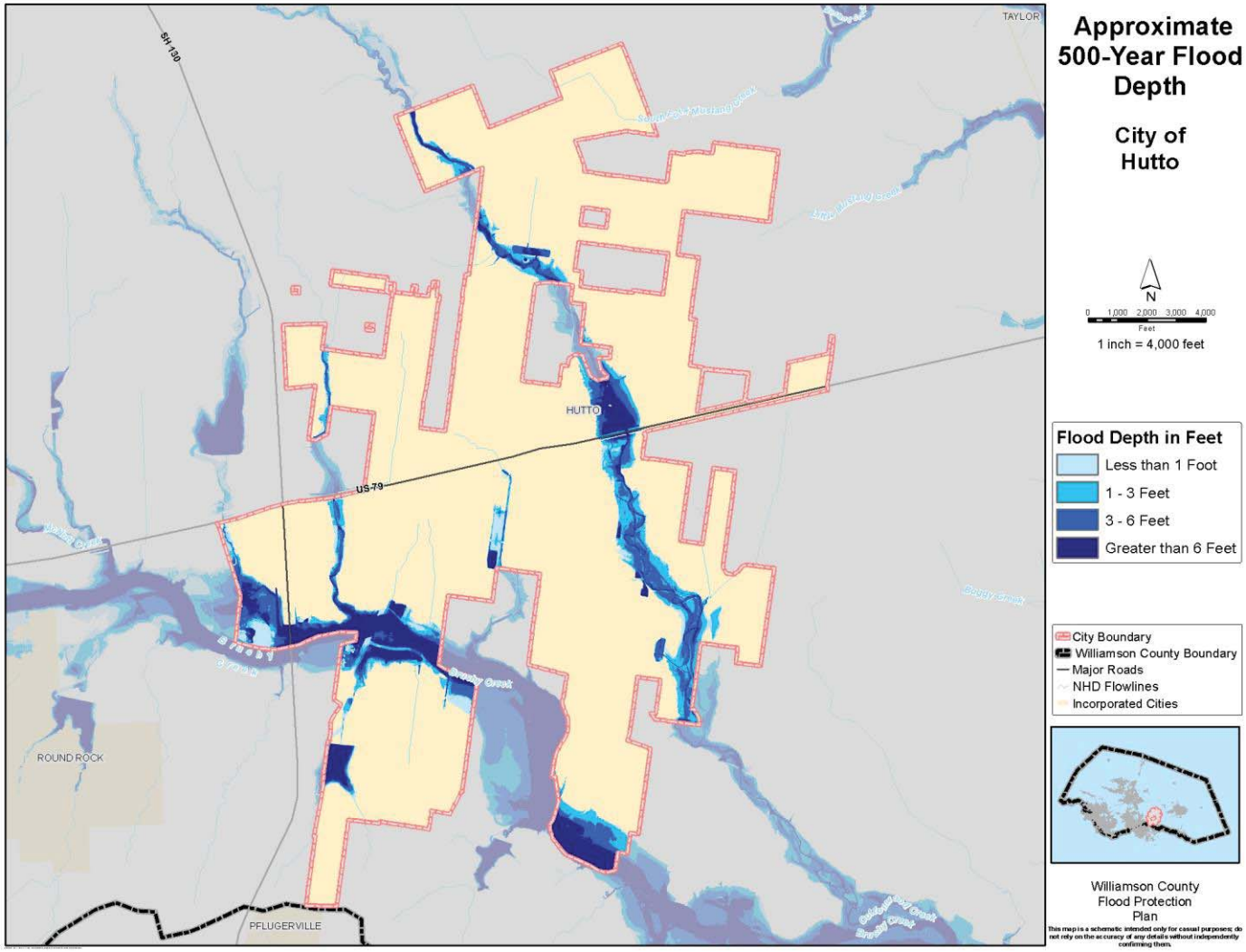
Capabilities

Annex Table 8-1. Hutto Regulatory Mitigation Capabilities Matrix

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	Yes	Hutto 2040 Comprehensive Plan
Zoning ordinance	Yes	Smart Code 2012
Subdivision ordinance	Yes	Smart Code 2012
Growth management	Yes	Strategic Guide 2035
Floodplain ordinance	Yes	Chapter 7, Stormwater and Drainage Standards
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	
Building code	Yes	Managed by Development Services
Current Hazard Mitigation Plan		
Erosion or sediment control program	Yes	Erosion and sediment control is managed by Development Services.
Stormwater management	Yes	Stormwater management is managed by Development Services.
Site plan review requirements	Yes	Managed by Development Services
Capital improvement plan	Yes	Hutto Five-Year Capital Improvement Plan, 2015-2019
Economic development plan	Yes	Key policies and actions to guide economic development are managed by the Hutto Economic Development Corporation.
Local emergency operations plan	No	The City of Hutto is a subscriber to the Williamson County Emergency Management Program.
Other special plans		
Flood insurance study or other engineering study for streams	Yes	Development Services maintains flood insurance rate maps in conjunction with the NFIP. FEMA floodplain maps indicate flood insurance is necessary along Brushy Creek.
Elevation certificates	No	The Commissioners' Court of Williamson County keeps records of flood elevation certificates on file in its office.

Vulnerability Assessment

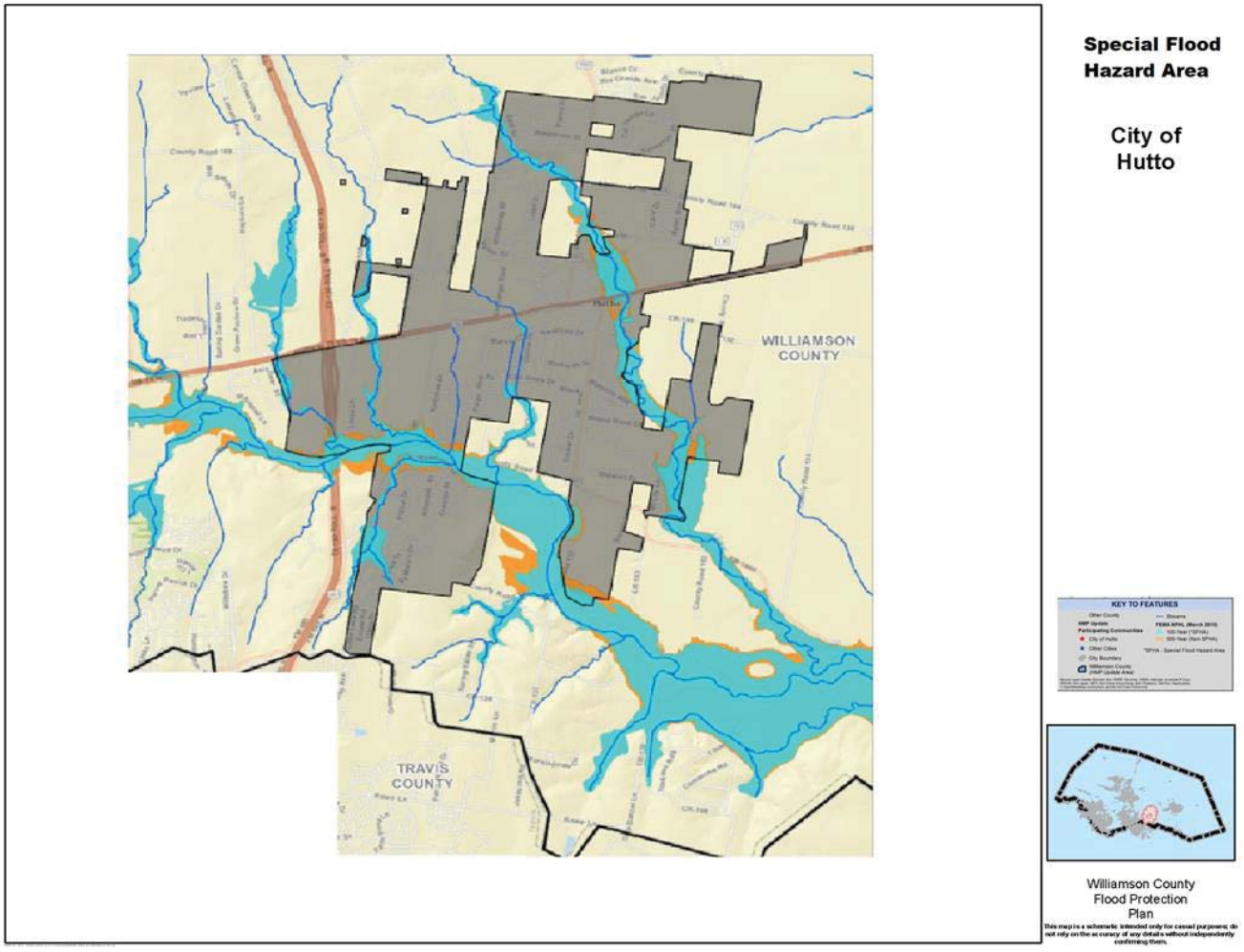
Annex Figure 8-3 City of Hutto Approximate 500-Year Flood Depth



Flood Mapping

FEMA defines the land area covered by the flood waters of the base flood is the Special Flood Hazard Area (SFHA) on NFIP maps. The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The figure below identifies those areas in Hutto identified as SFHA.

Annex Figure 8-4 City of Hutto Special Flood Hazard Area



Building a Mitigation Strategy

Hutto participated in the 2016 Williamson County Hazard Mitigation Plan. The strategy developed in for the County Plan covers Hutto.

Hazard Mitigation Goals

Hutto participated in the 2016 Williamson County Hazard Mitigation Plan. The overarching goals and strategies identified in the County Plan stand for the City of Hutto.

Goal 1: Protect the life, safety, and health of the public and first responders.

- Objective 1.1: To inform the public and first responders about natural hazards and actions required to reduce risks to life and health, property, and the environment.
- Objective 1.2: To maximize the latest in technology to reduce the risk to the public and first responders through advanced mapping, warning, and emergency communications.
- Objective 1.3: To reduce the risk to the public and first responders through enhanced protective measures to areas known to be of high hazard.
- Objective 1.4: To identify and employ enhanced protective measures to critical infrastructure and key resources to safeguard against natural hazards.

Goal 2: To increase public education and awareness of local hazard mitigation programs.

- Objective 2.1: Increase public awareness of the natural hazards associated with Williamson County and their immediate surroundings.
- Objective 2.2: Educate the public on personal mitigation actions to prevent or reduce the risk to life and health, property, and environment.

Goal 3: Build local support, commitment, and capacity to develop community sustainability.

- Objective 3.1: Develop strong public-private partnerships to reduce community vulnerability from natural hazards.
- Objective 3.2: Develop a strong volunteer base to safeguard the community both pre and post disaster.
- Objective 3.3: Include hazard mitigation concerns or priorities into the planning and budgeting processes.

Goal 4: Protect property and promote community sustainability.

- Objective 4.1: Incorporate hazard mitigation into long-range planning and development activities.
- Objective 4.2: Promote alternative uses to areas prone to natural hazards to include the expansion of open spaces and recreational opportunities.
- Objective 4.3: To limit the development of at risk properties that would increase risk through the enforcement of applicable regulatory measures.
- Objective 4.4: To reduce the repetitive losses reported to the National Flood Insurance Program.
- Objective 4.5: To identify and employee cost-effective measures to protect existing structures, emphasizing those categorized as critical infrastructure and key resources.

Goal 5: Maximize investment resources related to hazard mitigation.

- Objective 5.1: Seek outside funding opportunities for hazard mitigation projects.
- Objective 5.2: Increase the involvement and participation of property owners in the protection of their properties.
- Objective 5.3: Increase the insurance coverage of at risk properties, both public and private.
- Objective 5.4: Prioritize hazard mitigation projects through a cost benefit analysis with the emphasis based upon the risk to life and health, property, and the environment.

Projects Identified to Reduce Risk

Annex Table 8-2. City of Hutto Hazard Mitigation Plan Flood Mitigation Actions

Action No.	Action Title	Description	Mitigation Action Ranking (H, M, or L)	Project Status
City of Hutto				
1	Establish and implement an agricultural zoning district to preserve areas of land in high-hazard areas	Purchase NOAA All Hazard Radios to be used in city offices and residents	H	
2	Purchase NOAA All Hazard Radios	Join the CRS of the NFIP, to incentivize new development to maintain existing 1 percent chance floodplain areas and to reward citizens who obtain flood insurance through the NFIP with lower premiums.	H	
3	Join the CRS of the NFIP	A link to the FIRM map will be uploaded to the city's website, as well as instructions on how to order.	M	
4	Provide public access to the local FIRMs and map ordering information through the City of Hutto website	Create new Code Red Emergency Notification System. Gather data and enter local Hutto residences and business phone numbers.	M	
5	Code Red Emergency Notification System	Develop construction plans, obtain drainage easements, bid project and construct.	L	
6	Cottonwood Channel improvement	Construction plans are complete. Need to bid project and construct.	H	
7	Town West Outlet structure repair	Educate homeowners of how to mitigation their homes from these hazards on city website and public forums.	L	
8	Educate homeowners on all hazards	Safe routes will be identified for various emergency scenarios, and the designated emergency coordinator will publish these to the appropriate entities.	M	
9	Create an evacuation plan, with multiple routes for varying scenarios	Purchase NOAA All Hazard Radios to be used in city offices and residents	L	