

# Flood Risk Report

## Denton Watershed

HUC8 12030104

*October 2017*



# FEMA

## Flood Risk Report History

Version Number	Version Date	Summary
v1.0	10/31/2017	Discovery, Base Level Engineering (BLE), and Flood Risk Report



## Preface

The Department of Homeland Security, Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states and local communities with flood risk information, datasets, risk assessments, and tools that they can use to increase their resilience to flooding and better protect their residents. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP transforms the traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

The Flood Risk Report (FRR) is one of the tools created through the Risk MAP program. A FRR provides non-regulatory information to help local officials, floodplain managers, planners, emergency managers, and others. Local along with Federal and state officials can use the information in the FRR to establish a better understanding of their flood risk, take steps to mitigate those risks, and communicate those risks to residents and local businesses.

The FRR serves as a guide when communities update local hazard mitigation plans, community comprehensive plans, and emergency operations and response plans. It is meant to communicate risk to officials and inform them of the modification of development standards, as well as assist in identifying necessary or potential mitigation projects. The FRR extends beyond community limits to provide flood risk data for the Denton Watershed.

Flood risk is always changing, and studies, reports, or other sources may be available that provide more comprehensive information. This report is not intended to be the regulatory nor the final authoritative source of all flood risk data in the watershed. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

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## Executive Summary

The Flood Risk Report has two goals: (1) **to inform communities of their risks** related to certain natural hazards, and (2) **to enable communities to act to reduce their risk**. The information within this Risk Report is intended to assist Federal, state, and local officials with the following goals:

- **Communicate risk** – Local officials can use the information in this report to communicate with property owners, business owners, and other residents about risks and areas of mitigation interest.
- **Update local hazard mitigation plans and community comprehensive plans** – Planners can use risk information to develop and/or update hazard mitigation plans, comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes can be changed to provide for more appropriate land uses in high-hazard areas.
- **Update emergency operations and response plans** – Emergency managers can identify high-risk areas for potential evacuation and low-risk areas for sheltering. Risk assessment information may show vulnerable areas, facilities, and infrastructure for which continuity of operations plans, continuity of government plans, and emergency operations plans would be essential.
- **Inform the modification of development standards** – Planners and public works officials can use information in this report to support the adjustment of development standards for certain locations.
- **Identify mitigation projects** – Planners and emergency managers can use this risk assessment to determine specific mitigation projects of interest. For example, a floodplain manager may identify critical facilities that need to be elevated or removed from the floodplain.

The North Central Texas Council of Governments (NCTCOG), Texas, became a FEMA Cooperating Technical Partner (CTP) in Fiscal Year 2004 (FY2004) and in FY2015 contracted with FEMA to provide Risk MAP Discovery and Base Level Engineering (BLE) products for the Denton Creek Watershed, Texas. The project area covers the counties bounded by the Denton Creek HUC-8 watershed: Cooke, Dallas, Denton, Montague, Tarrant, and Wise. Maps covering the study area can be found in Appendix III of this report.

This Risk Report focuses on the FY2015 Risk MAP Discovery and BLE project. It showcases risk assessments, which analyze how a hazard affects the built environment, population, and local economy to identify mitigation actions and develop mitigation strategies.

This Risk Report showcases risk assessments, which analyze how a hazard affects the built environment, population, and local economy to identify mitigation actions and develop mitigation strategies.

The information in this Risk Report should be used to identify areas in need of mitigation projects and to support additional efforts to educate residents on the hazards that may affect them. The areas of greatest hazard impact are identified in the Areas of Mitigation Interest section of this report, which can serve as a starting point for identifying and prioritizing actions a community can take to reduce its risks.



## About the FEMA Risk Mapping, Assessment, and Planning (Risk MAP) Program

Flood risk is continually changing over time due to factors such as new building and development and weather patterns. The goal of the Federal Emergency Management Agency's (FEMA) Risk MAP program is to work with Federal, state, tribal, and local partners to identify and reduce flood risk across communities. These projects are conducted using watershed boundaries, and bring together multiple communities to identify broader mitigation actions and create consistency across the watershed. The program provides resources and support that are tailored to each community to help mitigate their risk and work towards a reduction in risk and future loss.

Through coordination and data sharing, the communities in the watershed work as partners in the mapping process. In addition to providing data, the communities can also provide insight into flooding issues and flood prevention within their areas. To prepare for a future study and assist in mitigation, FEMA provides a number of data sources, including information from the community, such as the following:

- Areas of repeated flooding and insurance claims
- Future development plans
- Areas of low water crossings
- High water marks from recent flooding events
- Areas of evacuation during high water
- Master drainage plans, flood risk reduction projects, and large areas of fill placement
- Local flood studies
- Other flood risk information

For more information about ways communities can take action or take advantage of available resources, please review the attached appendices.

FEMA provides communities with Base Level Engineering (BLE) data for select watersheds during the Risk MAP process. BLE is a form of hydrologic and hydraulic modeling which, when completed, can provide modeled flood hazard data in existing Zone As or where no effective flood hazard zone has been designated. Knowing the extent of flooding during the 1-percent-annual-chance flooding event supports risk reduction efforts and supports more resilient community planning. Completed BLE data is provided to watershed communities for planning, risk communication, floodplain management, and permitting activities, and to inform future flood study needs.

For information on BLE in the Denton Watershed, see the Phase Zero: Investment section of this report or Appendix II: Base Level Engineering Report.

## About the Denton Watershed

The first FEMA flood hazard mapping within the Denton watershed was released in the 1970s. As of 2017, all participating communities in the Denton watershed Discovery and BLE Risk MAP Project have modernized countywide Digital Flood Insurance Rate Maps (DFIRMs) and Flood Insurance Study (FIS) Reports. Over the years, the area has experienced rapidly increasing development and recurring severe floods. A record flood event occurred in Denton County in 2015.

After investigation, little data was found on historical flooding in the Denton watershed. With no known stream gauges in Montague County and Wise County there is not a discernable way to accurately measure flood levels. Recorded floods in Cooke and Dallas County indicate that the floods in those counties only occur in the other watersheds, rather than in the Denton watershed. Due to the rural lands surrounding Denton Creek, flood damage in Denton County is minimal within the Denton watershed, except for a flood in 1981. In Tarrant County, Denton Creek flooding occurred in 1942 in the present day Grapevine Lake, which was constructed a decade later. As recently as 2015, however, Grapevine Lake flooded parts of Denton County and the City of Flower Mound.

In 2009, NCTCOG and the Texas Water Development Board (TWDB) created a Mapping Needs Assessment (MNA) study for the Upper Trinity River Basin, which included parts of the Denton Creek watershed. The MNA project identified and prioritized the floodplain management needs of over 2,300 stream miles. In order to prioritize the floodplain management needs, NCTCOG and TWDB created a database of all the engineering flood studies in the Basin. In 2016 FEMA authorized NCTCOG to continue the work of the Mapping Needs Assessment by perform a Discovery and BLE Risk MAP Project Effort in the Denton Creek watershed to gather local information, readily available data to determine project viability, and create Risk MAP products to assist in the movement of communities towards resilience.

## Introduction

### Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over a normally dry area. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the accumulation of unwanted debris. Severe flood losses can destroy buildings and crops and cause severe injuries or death.

#### Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Even if people know where a flood might occur, they may not know the level of flood risk in that area. The most common method for determining flood risk, also referred to as vulnerability, is to identify both the probability and the consequences of flooding:

**Flood Risk** (or Vulnerability) = **Probability x Consequences**; where

**Probability** = the likelihood of occurrence

**Consequences** = the **estimated** impacts associated with the occurrence on life, property, and infrastructure

The probability of a flood is the likelihood that it will occur. The probability of flooding can change based on physical, environmental, and/or engineering factors. These factors will also have an effect on the area that is impacted by the flood, increasing or decreasing the size of the affected area. The ability to assess the probability of a flood, and the level of accuracy for that assessment, are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

The consequences of a flood are the estimated effects associated with its occurrence. Consequences relate to human activities within an area and how a flood affects the natural and built environment. It is important that individuals and communities have an accurate and current understanding of their risk because anyone can be vulnerable to flooding. Individuals that are located outside of the high-risk Special Flood Hazard Area (SFHA) file more than 20% of insurance claims and receive one-third of disaster assistance for flooding. Having an awareness of risk can allow communities and their residents to address the potential consequences. Understanding risk can also allow for long-term development planning, opportunities for revitalization efforts, and modifications in how interaction occurs with the existing risk.

## Watershed Basics

### *Background*

The Denton watershed is located in North Texas and covers portions of Cooke, Dallas, Denton, Montague, Tarrant, and Wise Counties. See Figure 1 for a location map of the Denton watershed. The watershed encompasses 30 communities covering approximately 1,885 square miles.



Within the Denton watershed, grasslands are dominated by either native prairie grasses such as Indian grass, little blue stem, and big blue stem, or pasture grasses such as Bermuda and Johnson grass. Post oak woodlands grow on sandy soils throughout the watershed.

The Denton Creek watershed has over 100 dams which are primarily use for water supply. These dams provide other benefits such as irrigation for agriculture, recreation, and flood control purposes. These are owned either by the local government or local government agency. Others are privately owned dams. Most of the dams in the Denton watershed are low hazard dams. The largest dam in on Denton Creek, the Grapevine Lake dam, which was completed in 1952 and used mainly for water supply and flood control. There is one certified levee in the Denton Watershed, which is maintained by Denton County Levee Improvement District No. 1. Other small private levees may exist within the watershed.

Intense, localized thunderstorms and frontal-type storms in spring and early summer cause most of the flooding events in Denton Watershed. Within Tarrant County, Denton Creek in the current-day Grapevine Lake flooded in 1908 and 1942, and in 1952 the Grapevine Dam was constructed to regulate the discharge to prevent floods. In Denton County, most of the area within the Denton watershed is rural, which minimize structural damage during flood events. Though most floods are not measured by stream gages in Denton County, there was a flood event surrounding the Denton Creek in 1981. Only in 2015 did a flooding event of Grapevine Lake damage private and commercial properties.

After investigation, little data was found on historical flooding in the Denton watershed, as historical flood data is unavailable due to a lack of stream gauges in Montague and Wise Counties. Both Montague and Wise Counties has several Soil Conservation Service (SCS) flood-retarding structures throughout the county to control any flooding. None of the reported floods in Cooke County or Dallas County occurred within the Denton watershed.

Denton Creek is the primary drainage source, flowing centrally from the northwest beginning in Montague County, and then flowing to the southeast through Wise County, Denton County, and finally Dallas County to the confluence with the Elm Fork Trinity River. Denton Creek is fed by several tributaries, including Morris Branch, Oliver Creek, Elizabeth Creek, Buffalo Creek, and Cottonwood Branch.

Figure 1 provides an overview of the Denton watershed and its geographic location within the state.

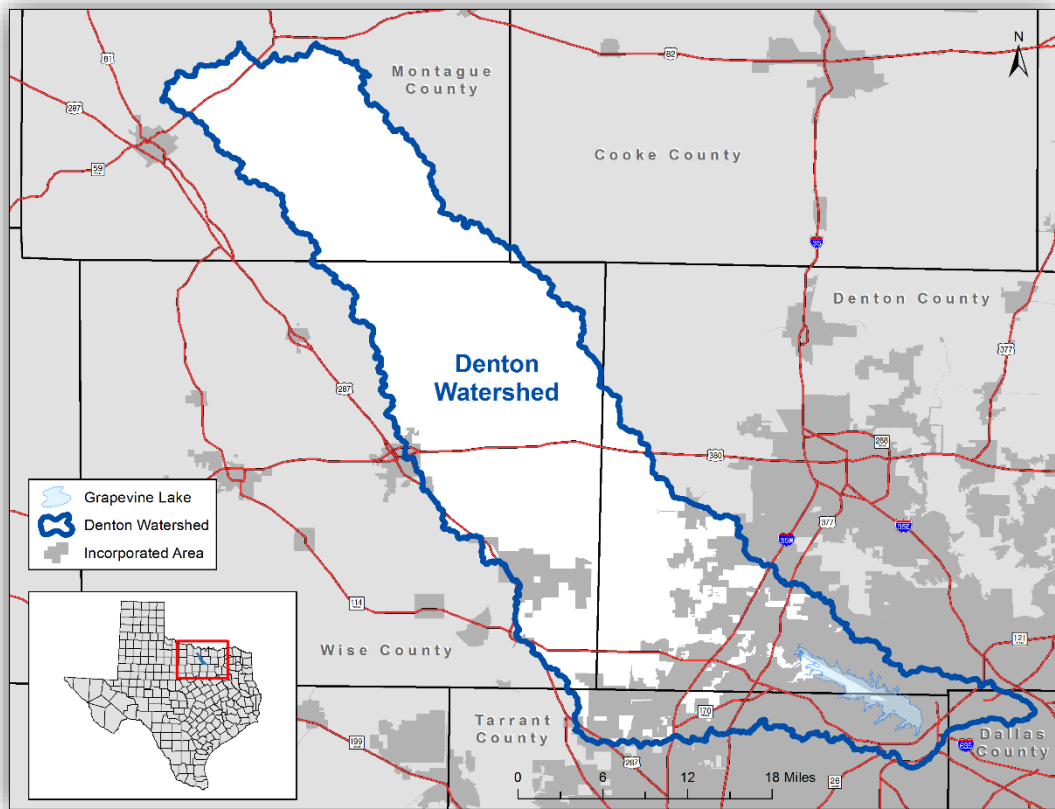


Figure 1: Overview map for the Denton Watershed

### Population

A review of land cover changes and population growth patterns in the watershed revealed that significant development occurred from 2000 to 2010 in the cities of Westlake, Roanoke, Ponder, and Rhome, each increasing in population over 100%. Since 2000, most communities within the Denton watershed have experienced population growth. However, Corral City declined in population since 2000, serving approximately 70% fewer people. The City of Dish was incorporated in 2000 and has seen little change in population since.

Excluding the combined areas of previously developed land and open water, roughly 600 mi<sup>2</sup> of the watershed still has the potential for new construction. Using the average annual growth rate for the cities and unincorporated county areas in the project area, the total population within the watersheds has the potential to rise to over 1.7% by 2021. Therefore, the probability is high that populated areas will expand and rural land will be developed.

To help mitigate the risk to areas where increased population and development are expected, communities can adopt (or exceed) the minimum standards of the National Flood Insurance Program (NFIP). This is recommended as a proactive strategy to manage construction within the floodplain and avoid negative impacts to existing and future development.

### Watershed Land Use

A large portion of Denton watershed is rural, with population density highest in the southern areas of the watershed and the northwest region of the watershed yielding to more rural development. Denton County boasts a large horse industry as well as thriving lake tourism to Grapevine Lake in the southeast portion of the watershed. Dallas County within the Denton watershed is urbanized with large residential and commercial areas. Montague and Wise counties are the most rural areas in the watershed with Montague County being the most rural. Both counties support widespread cattle farming, crop growth, and hunting tourism.

Table 1: Population and Area Characteristics <sup>1</sup>

Risk MAP Project	Total Population in Study Area	Average % Population Growth/Yr (2010-2040)	Predicted Population (by 2021)	Land Area (mi <sup>2</sup> )	Developed Area (mi <sup>2</sup> )	Open Water (mi <sup>2</sup> )
Denton HUC-8 Watershed (12030104)	252,261	55.2%	391,509	1,885.5	103.1	14.9

#### National Flood Insurance Program Status and Regulation

In order to be a participant in the National Flood Insurance Program (NFIP), all interested communities must adopt and submit floodplain management ordinances that meet or exceed the minimum NFIP regulations. These regulations can be found in the Code of Federal Regulations and most of the community ordinance requirements are in Parts 59 and 60. The level of regulation depends on the level of information available and the flood hazards in the area. The levels are as follows:

- A: The Federal Emergency Management Agency (FEMA) has not provided any maps or data – 60.3(a)
- B: Community has maps with approximate A zones – 60.3(b)
- C: Community has a Flood Insurance Rate Map (FIRM) with Base Flood Elevations (BFE) – 60.3(c)
- D: Community has a FIRM with BFEs and floodways – 60.3(d)
- E: Community has a FIRM that shows coastal high hazard areas (V zones) – 60.3(e)

To help mitigate the risk to areas where increased population and development are expected, communities can adopt (or exceed) the minimum standards of the National Flood Insurance Program (NFIP). This is recommended as a proactive strategy to manage construction within the floodplain and avoid negative impacts to existing and future development.

To increase mitigation efforts and community flood awareness through potentially discounted premium rates, an NFIP community that has adopted more stringent ordinances or is actively completing mitigation and outreach activities is encouraged to consider joining the Community Rating System (CRS). The CRS is a voluntary incentive-based program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions.

<sup>1</sup> Data obtained from the U.S. Census Bureau; ESRI Demographic 5-year Projections; and National Land Cover Database



All communities within the project area, except for the Corral City, have a level of regulation suitable for managing floodplains with mapped regulatory floodways and Base (1-percent-annual-chance) Flood Elevations (44 CFR 60.3(d)). Corral City does not participate in the NFIP and, therefore, do not have any regulation for managing floodplains with mapped regulatory floodways and Base (1-percent-annual-chance) Flood Elevations (44 CFR 60.3(d)).

Communities can review their current ordinances and reflect potential flood hazard changes by adopting updated ordinances early. This action can reduce future flood losses by affecting how substantial improvements or new construction are regulated.

#### *Hazard Mitigation Plan*

State, tribal, and local governments must develop and adopt hazard mitigation plans in order to be eligible for certain types of funding. To remain eligible, communities need to update and resubmit their plans every 5 years for FEMA approval. Hazard mitigation plans are created to increase education and awareness, identify strategies for risk reduction, and identify other ways to develop long-term strategies to reduce risk and protect people and property. Seventeen communities in the watershed have hazard mitigation plans. The Cooke County Hazard Mitigation Plan expired on 2/14/2016, and no data was located to determine if a new plan was currently in development. The towns of Bartonville, Corral City, Dish, and the cities of Bartonville, Corral City, Justin, and Rhome have not adopted hazard mitigation plans. The plans effectively allow for FEMA to assess hazards identified through local, state, and federal partnerships and mitigation action items that communities have identified. These hazard mitigation plans were used in the compilation and preparation of this report.

#### *Community Rating System*

The Community Rating System (CRS) is a voluntary incentive-based program that recognizes and encourages community floodplain management activities that communities undertake in addition to the minimum requirements they must meet when joining the NFIP. Individuals that carry flood insurance in a community that participates in the CRS program can receive a discount on their flood insurance premium. Discounts can range from 5 to 45%. Out of the 31 watershed communities participating in the NFIP, six are participating in the CRS program. The cities of Carrollton and Denton have a class of 6, which means structures located in the SFHA are eligible for a 20% premium discount, and structures located in the Non-SFHA are eligible for a 10% discount. The City of Lewisville has a current class of 7, which means that structures located inside SFHA are eligible for a 15% premium discount and structures located in the Non-SFHA are eligible for a discount of 5%. The cities of Fort Worth and Coppell have a class of 8. In this class, structures located inside the SFHA are eligible for a 10% premium discount and structures located in Non-SFHA are eligible for a discount of 5%. Denton County has a class rating of 10. Structures located inside and outside of the SFHA are not eligible for a premium discount. Table 2 depicts NFIP and CRS participation status and provides an overview of the effective flood data availability.

Table 2: NFIP and CRS Participation <sup>2</sup>

Risk MAP Project	Participating NFIP Communities/ Total Communities	Number of CRS Communities	CRS Rating Class Range	Average Years since FIRM Update	Level of Regulations (44 CFR 60.3)
Denton HUC-8 Watershed (12030104)	29/30	6	6-10	6	60.3(d)

Dams

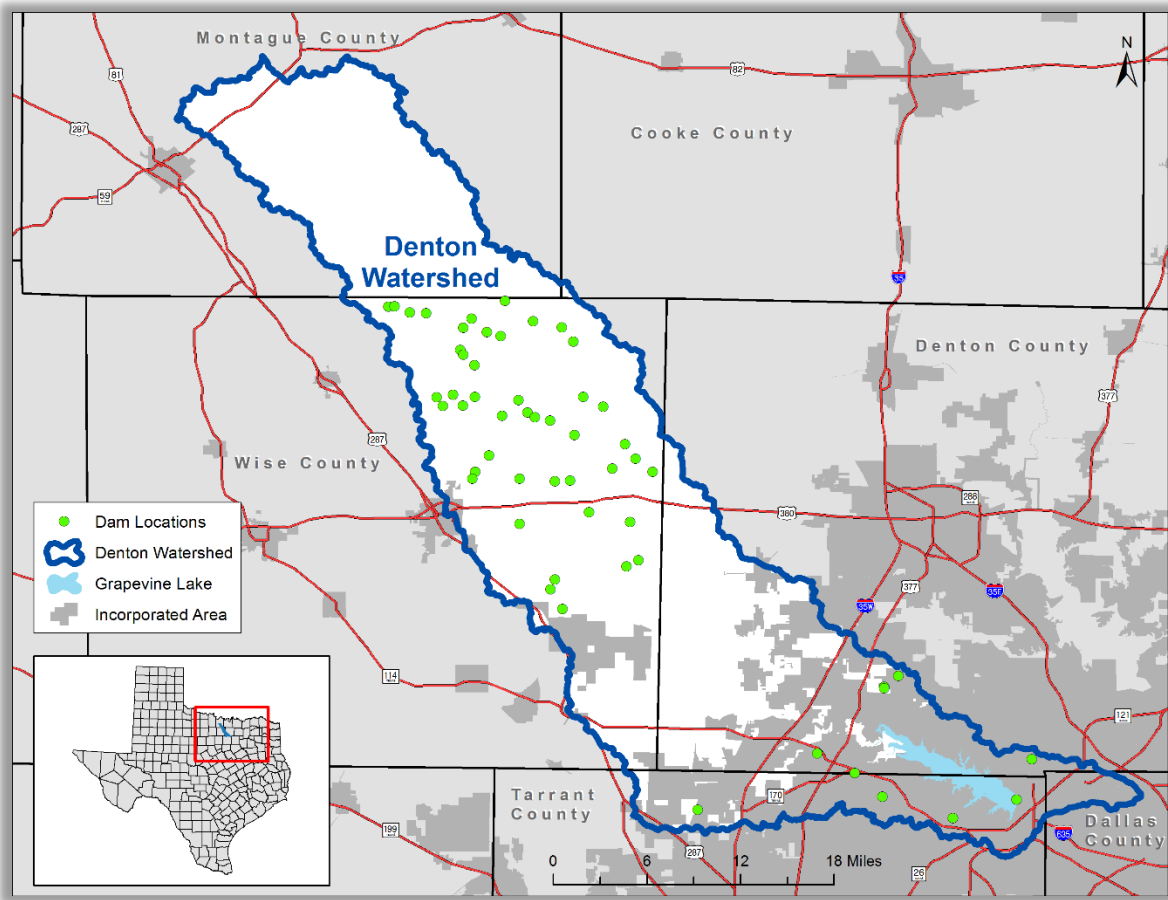


Figure 2: Dam Location Map for Denton Watershed

The Denton Creek watershed has abundant water resources. Several dams along the numerous streams in the watershed are used to maintain water storage and to control or divert flow.

As recorded by the U.S. Army Corps of Engineers (USACE) National Inventory of Dams (NID), there are about 173 dams within the watershed, and 52 dams are considered high hazard. The owners and operators of these dams are required to develop and maintain Emergency Action Plans to reduce the

<sup>2</sup> Data obtained from FEMA Community Information Systems.

risk of loss of life and property if the dam fails. Table 3 provides the characteristics of the dams identified in the project area. Figure 3 shows the locations for the dams in the watershed.

Table 3 provides the characteristics of the dams identified in the project area. Grapevine Lake Dam on Grapevine Lake is the largest dam in the watershed.

*Table 3: Risk MAP Project Dam Characteristics<sup>3</sup>*

Risk MAP Project	Total Number of Identified Dams	Number of Dams Requiring EAP	Percentage of Dams without EAP	Average Years since Inspection	Average Storage (acre-feet)
Denton HUC-8 Watershed (12030104)	173	32	81.5%	11	1,113

*Flood Insurance Rate Maps (FIRMs)*

The average age of the effective FIRMs within the Denton Watershed is 6 years. The oldest effective maps are for Cooke County, which are 9 years old and have an effective date of January 16, 2008. The newest FIRMs are dated July 7, 2014 and are for the communities of Carrollton, Coppell, and Grapevine. All communities in the watershed have FIRMs in effective as of June 2017.

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<sup>3</sup> Data obtained from USACE National Inventory of Dams



## Project Phases and Map Maintenance

### Background

FEMA manages several risk analysis programs, including Flood Hazard Mapping, National Dam Safety, the Earthquake Safety Program, Multi-Hazard Mitigation Planning, and the Risk Assessment Program, all of which assess the impact of natural hazards and lead to effective strategies for reducing risk. These programs support the Department of Homeland Security's objective to "strengthen nationwide preparedness and mitigation against natural disasters."

FEMA manages the NFIP, which is the cornerstone of the national strategy for preparing American communities for flood hazards. In the nation's comprehensive emergency management framework, the analysis and awareness of natural hazard risk remains challenging. A consistent risk-based assessment approach and a robust communication system are critical tools to ensure a community's ability to make informed risk management decisions and take mitigation actions. Flood hazard mapping is a basic and vital component for a prepared and resilient nation.

In Fiscal Year 2009, FEMA's Risk MAP program began to synergize the efforts of Federal, state, and local partners to create timely, viable, and credible information identifying natural hazard risks. The intent of the Risk MAP program is to share resources to identify the natural hazard risks a community faces and ascertain possible approaches to minimizing them. Risk MAP aims to provide technically sound flood hazard information to be used in the following ways:

- To update the regulatory flood hazard inventory depicted on FIRMs and the National Flood Hazard Layer
- To provide broad releases of data to expand the identification of flood risk (flood depth grids, water-surface elevation grids, etc.)
- To support sound local floodplain management decisions
- To identify opportunities to mitigate long-term risk across the nation's watersheds

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*Flood-related damage between 1980 and 2013 totaled \$260 billion, but the total impact to our Nation was far greater—more people lose their lives annually from flooding than any other natural hazard.*

*FEMA, "Federal Flood Risk Management Standard (FFRMS)" (2015)*

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## How are FEMA's Flood Hazard Maps Maintained?

FEMA's flood hazard inventory is updated through several types of revisions.

**Community-submitted Letters of Map Change.** First and foremost, FEMA relies heavily on the local communities that participate in the NFIP to carry out the program's minimum requirements. These requirements include the obligation for communities to notify FEMA of changing flood hazard information and to submit the technical supporting data needed to update the FIRMs.

Although revisions may be requested at any time to change information on a FIRM, FEMA generally will not revise an effective map unless the changes involve modifications to SFHAs. Be aware that the best floodplain management practices and proper assessments of risk result when the flood hazard maps present information that accurately reflects current conditions.

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*Under the current minimum NFIP regulations, a participating community commits to notifying FEMA if changes take place that will affect an effective FIRM no later than 6 months after project completion.*

*Section 65.3, Code of Federal Regulations*

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**Letters of Map Amendment (LOMAs).** The scale of an effective FIRM does not always provide the information required for a site-specific analysis of a property's flood risk. FEMA's LOMA process provides homeowners with an official determination on the relation of their lot or structure to the SFHA. Requesting a LOMA may require a homeowner to work with a surveyor or engineering professional to collect site-specific information related to the structure's elevation; it may also require the determination of a site-specific BFE. Fees are associated with collecting the survey data and developing a site-specific BFE. Local surveying and engineering professionals usually provide an Elevation Certificate to the homeowner, who can use it to request a LOMA. A successful LOMA may remove the Federal mandatory purchase requirement for flood insurance, but lending companies may still require flood insurance if they believe the structure is at risk.

**FEMA-Initiated Flood Risk Project.** Each year, FEMA initiates a number of Flood Risk Projects to create or revise flood hazard maps. Because of funding constraints, FEMA can study or restudy only a limited number of communities, counties, or watersheds each year. As a result, FEMA prioritizes study needs based on a cost-benefit approach whereby the highest priority is given to studies of areas where development has increased and the existing flood hazard data has been superseded by information based on newer technology or changes to the flooding extent. FEMA understands communities require products that reflect current flood hazard conditions to best communicate risk and implement effective floodplain management.

Flood Risk Projects may be delivered by FEMA or one of its Cooperating Technical Partners (CTPs). The CTP initiative is an innovative program created to foster partnerships between FEMA and participating NFIP communities, as well as regional and state agencies. Qualified partners collaborate in maintaining up-to-date flood maps. In FEMA Region 6, which includes the State of Louisiana, CTPs are generally statewide agencies that house the State Floodplain Administrator. However, some Region 6 CTPs are also large River Authorities or Flood Control Districts. They provide enhanced coordination with local, state, and Federal entities, engage community officials and technical staff, and provide updated technical information that informs the national flood hazard inventory.

Risk MAP has modified FEMA's project investment strategy from a single investment by fiscal year to a multi-year phased investment, which allows the FEMA to be more flexible and responsive to the findings of the project as it moves through the project lifecycle. Flood Risk Projects are funded and completed in phases.

## General Flood Risk Project Phases

Each phase of the Flood Risk Project provides both FEMA and its partner communities with an opportunity to discuss the data that has been collected and to determine a path forward. Local engagement throughout each phase enhances the opportunities for partnership, furthers the discussion on current and future risk, and helps identify local projects and activities to reduce long-term natural hazard risk.

Flood Risk Projects may be funded for one or more of the following phases:

- Phase Zero – Investment
- Phase One – Discovery
- Phase Two – Risk Identification and Assessment
- Phase Three – Regulatory Product Update

Local input is critical throughout each phase of a Flood Risk Project. More details about the tasks and objectives of each phase are included below.

### Phase Zero: Investment

Phase Zero of a Flood Risk Project initiates FEMA's review and assessment of the inventories of flood hazards and other natural hazards within a watershed area. During the Investment Phase, FEMA reviews the availability of information to assess the current floodplain inventory. FEMA maintains several data systems to perform watershed assessments and selects watersheds for a deeper review of available data and potential investment tasks based on the following factors:

**Availability of High-Quality Ground Elevation Data.** FEMA reviews readily available and recently acquired ground elevation data. This information helps identify development and earth-moving activities near streams and rivers. Where necessary, FEMA may partner with local, state, and other federal entities to collect necessary ground elevation information within a watershed.



*If [high-quality ground elevation data](#) is both available for a watershed area and compliant with FEMA's quality requirements, FEMA and its mapping partners may prepare engineering data to assess, revise, replace, or add to the current flood hazard inventory.*

**Mile Validation Status within Coordinated Needs Management Strategy (CNMS).** FEMA uses the CNMS database to track the validity of the flood hazard information prepared for the NFIP. The CNMS database reviews 17 criteria to determine whether the flood hazard information shown on the current FIRM is still valid.



*Communities may also inform and request a review or update of the inventory through the CNMS website at <https://msc.fema.gov/cnms/>. The [CNMS Tool Tutorial](#) provides an overview of the online tool and explains how to submit requests.*

**Local Hazard Mitigation Plans.** Reviewing current and historic hazard mitigation plans provides an understanding of a community's comprehension of its flood risk and other natural hazard risks. The mitigation strategies within a local hazard mitigation plan provide a lens to local opportunities and underscore a potential for local adoption of higher standards related to development or other actions to reduce long-term risk.

**Cooperating Technical Partner State Business Plans.** In some states, a CTP generates an annual state business plan that identifies future Flood Risk Project areas that are of interest to the state. The Texas Water Development Board and the Texas Natural Resources Information System work to develop user-friendly data. In this project area, FEMA has worked closely with both entities to develop the project scope and determine the necessary project tasks.



*Communities that have identified local issues are encouraged to indicate their data needs and revision requests to the State CTP so that they can be prioritized and included in the State Business Plans.*

**Possible Investment Tasks.** After a review of the data available within a watershed, FEMA may choose to (1) purchase ground elevation data and/or (2) create some initial engineering modeling against which to compare the current inventory, also known as BLE modeling.

## Phase One: Discovery

Phase One, the Discovery Phase, provides opportunities both internally (between the state and FEMA) and externally (with communities and other partners interested in flood potential) to discuss local issues with flooding and examine possibilities for mitigation action. This effort is made to determine where communities currently are with their examination of natural hazard risk throughout their community and to identify how state and Federal support can assist communities in achieving their goals.



*The Discovery process includes an opportunity for local communities to provide information about their concerns related to natural hazard risks. Communities may continue to inform the project identification effort by providing previously prepared survey data, as-built stream crossing information, and engineering information.*

For a holistic community approach to risk identification and mapping, FEMA relies heavily on the information and data provided at the local level. Flood Risk Projects are focused on identifying (1) areas where the current flood hazard inventory does not provide adequate detail to support local floodplain management activities, (2) areas of mitigation interest that may require more detailed engineering information than is currently available, and (3) community intent to reduce the risk throughout the watershed to assist FEMA's future investment in these project areas. Watersheds are selected for Discovery based on these evaluations of flood risk, data needs, availability of elevation data, Regional knowledge of technical issues, identification of a community-supported mitigation project, and input from Federal, state, and local partners.

**Possible Discovery Tasks.** Discovery may include a mix of interactive webinar sessions, conference calls, informational tutorials, and in-person meetings to reach out to and engage with communities for input. Data collection, interviews, and interaction with community staff and data-mining activities provide the basis for watershed-, community-, and stream-level reviews to determine potential projects that may benefit the communities. A range of analysis approaches are available to determine the extent of flood

risk along streams of concern. FEMA and its mapping partners will work closely with communities to determine the appropriate analysis approach, based on the data needs throughout the community. These potential projects may include local training sessions, data development activities, outreach support to local communities wanting to step up their efforts, or the development of flood risk datasets within areas of concern to allow a more in-depth discussion of risk.

## Phase Two: Risk Identification and Assessment

Phase Two (Risk Identification and Assessment) continues the risk awareness discussion with communities through watershed analysis and assessment. Analyses are prepared to review the effects of physical and meteorological changes within the project watershed. The new or updated analysis provides an opportunity to identify how development has affected the amount of stormwater generated during a range of storm probabilities and shows how effectively stormwater is transported through communities in the watershed.



*Coordination with a community's technical staff during engineering and model development allows FEMA and its mapping partners to include local knowledge, based on actual on-the-ground experience, when selecting modeling parameters.*

The information prepared and released during Phase Two is intended to promote better local understanding of the existing flood risk by allowing community officials to review the variability of the risk throughout their community. As FEMA strives to support community-identified mitigation actions, it also looks to increase the effectiveness of community floodplain management and planning practices, including local hazard mitigation planning, participation in the NFIP, use of actions identified in the CRS Manual, risk reduction strategies for repetitive loss and severe repetitive loss properties, and the adoption of stricter standards and building codes.



*FEMA is eager to work closely with communities and technical staff to determine the current flood risk in the watershed. During the Risk Identification and Assessment phase, FEMA would like to be alerted to any community concerns related to the floodplain mapping and analysis approaches being taken. During this phase, FEMA can engage with communities and review the analysis and results in depth.*

**Possible Risk Identification and Assessment Tasks.** Phase Two may include a mixture of interactive webinars, conference calls, informational tutorials, and in-person meetings to reach out to and engage with communities for input. Flood Risk Project tasks may include hydrologic or hydraulic engineering analysis and modeling, floodplain mapping, risk assessments using Hazus-Multi Hazard software, and preparation of flood risk datasets (water-surface elevation, flood depth, or other analysis grids). Additionally, projects may include local training sessions, data development activities, outreach support to local communities that want to step up their efforts, or the development of flood risk datasets within areas of concern to allow a more in-depth discussion of risk.

## Phase Three: Regulatory Products Update

If the analysis prepared in the previous Flood Risk Project phases indicates that physical or meteorological changes in the watershed have significantly changed the flood risk since the last FIRM was printed, FEMA will initiate the update of the regulatory products that communities use for local floodplain management and NFIP activities.

Delivery of the preliminary FIRM and Flood Insurance Study (FIS) report begins another period of coordination between community officials and FEMA to discuss the required statutory and regulatory steps both parties will perform before the preliminary FIRM and FIS report can become effective. As in the previous phases, FEMA and its mapping partners will engage with communities through a variety of conference calls, webinars, and in-person meetings.



*Once the preliminary FIRMs are prepared and released to communities, FEMA will initiate the statutory portions of the regulatory product update. FEMA will coordinate a Consultation Coordination Officer meeting and initiate a 90-day comment and appeal period. During this appeal period, local developers and residents may coordinate the submittal of their comments and appeals through their community officials to FEMA for review and consideration.*

FEMA welcomes this information because additional proven scientific and technical information increases the accuracy of the mapping products and better reflects the community's flood hazards identified on the FIRMs.



*Communities may host or hold Open House meetings for the public. The Open House layout allows attendees to move at their own pace through several stations, collecting information in their own time. This format allows residents to receive one-on-one assistance and ask questions pertinent to their situations or their interests in risk or flood insurance information.*

All appeals and comments received during the statutory 90-day appeal period, including the community's written opinion, will be reviewed by FEMA to determine the validity of the appeal. Once FEMA issues the appeal resolution, the associated community and all appellants will receive an appeal resolution letter and FEMA will revise the preliminary FIRM, if warranted. A 30-day period is provided for review and comment on successful appeals. Once all appeals and comments are resolved, the flood map is ready to be finalized.



*After the appeal period, FEMA will send community leaders a Letter of Final Determination stating that the preliminary FIRM will become effective in 6 months. The letter also discusses the actions each affected community participating in the NFIP must take to remain in good standing in the NFIP.*

After the preceding steps are complete and the 6-month compliance period ends, the FIRMs are considered effective maps and new building and flood insurance requirements become effective.

That is a brief general overview of a Flood Risk Project. The Flood Risk Report, which is described in the next section, will provide details on the efforts in the Denton Watershed.



## Phase Zero: Investment – 2017 Denton Creek Watershed Risk MAP Project

The Denton Creek watershed represents one of the dominant flooding sources in North Texas and lies in the “flash-flood alley” of Texas. Figure 3 shows the number of flash floods per county in Texas. The watershed impacts over 30 communities which includes approximately 1.4 million people. The subject communities cover more than 4,600 square miles with over 85 square miles mapped of floodplain. Figure 3 shows an overview of the communities in the Denton watershed and their flash flood risk. A vast majority of the floodplain in the Denton watershed is in the unincorporated areas of Wise and Denton counties. See Appendix III for figures showing floodplain mapping in the Denton Creek watershed.

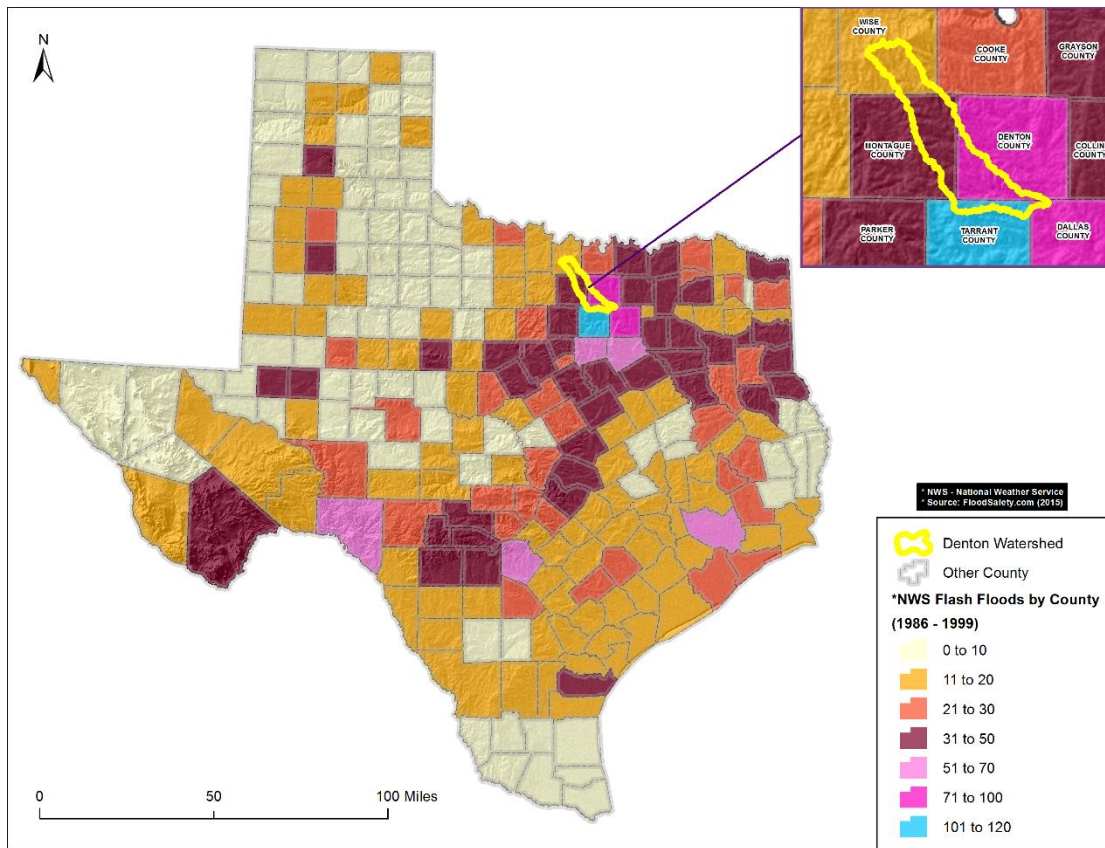


Figure 3: Flash Flood Incidents

All streams in the watershed are either direct or indirect tributaries to Denton Creek. These streams drain 18 HUC-12 watersheds comprising 700 square miles of land. Flooding is highly dependent on rainfall and often follows tropical thunderstorm events hitting the watershed.

Throughout the watershed, annual rainfall totals exceed the Texas average annual precipitation rate of 34 inches. There is an increase in rainfall from the western counties to the eastern counties, with an average rainfall of 37.8 inches in Denton County to 33.7 inches in Montague County. Both the main stem of Denton Creek and its many tributaries have several dams along their lengths, including the Grapevine Lake Dam in Tarrant County, and the Denton Creek WS SCS Site 18D Dam in Denton County.

All FEMA Risk MAP project lifecycles being with Phase Zero/Phase 1 (Investment/Discovery), and the 2017 Denton Creek watershed Project paves the way for local communities to move towards resilience. FEMA selected and prioritized the watershed for BLE Investment and Discovery with the overall goal of assisting local governments in identifying flood risks and strengthening their ability to make informed decisions about reducing these risks. Figure 4 shows communities within the Denton Creek watershed.

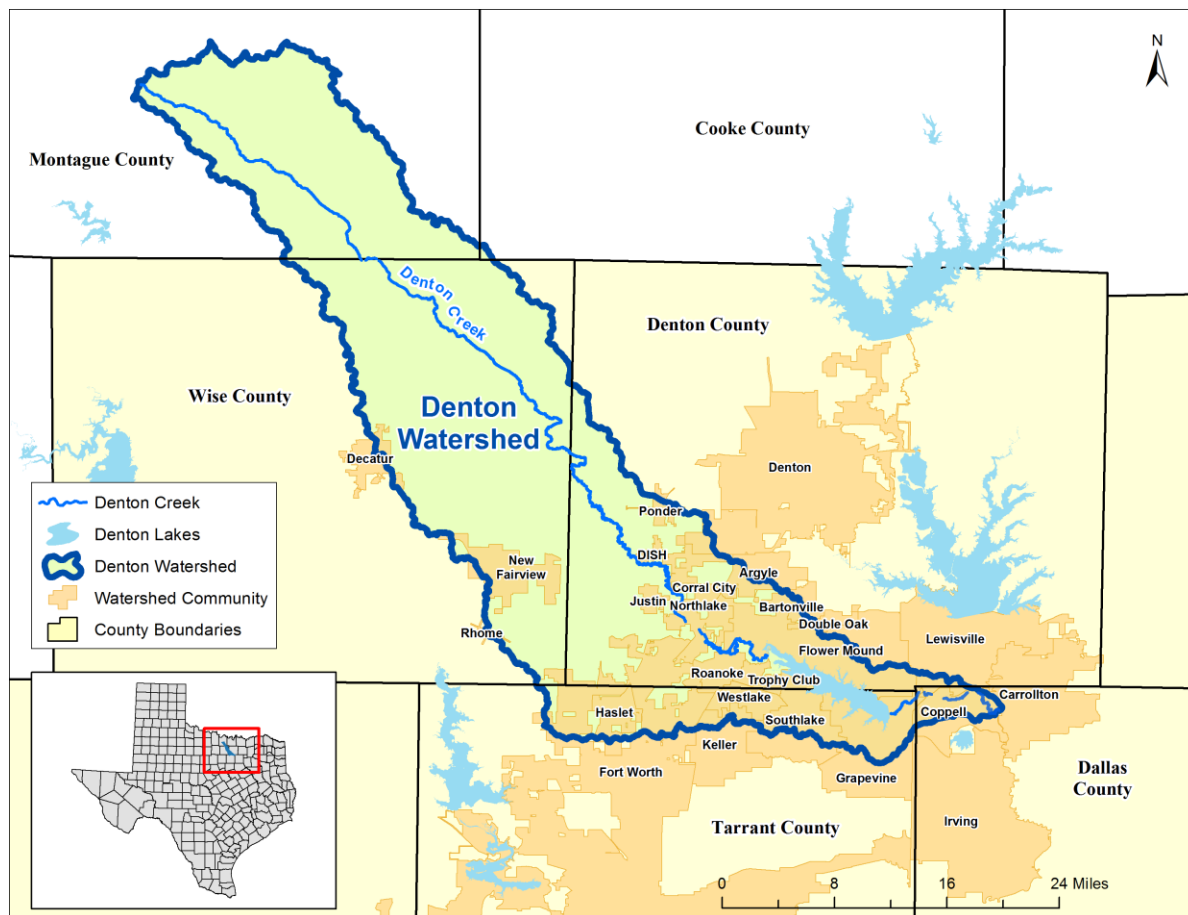


Figure 4: Overview of communities located within the Denton Watershed.

### Watershed Selection Factors

Many factors and criteria are reviewed for watershed selection: flood risk, the age of the current flood hazard data, population growth trends and potential for growth, recent flood claims, and disaster declaration history. The availability of local data and high-quality ground elevation data is reviewed for use in preparing flood hazard data. The CNMS database is reviewed to identify large areas of unknown or unverified data for streams. FEMA consults the State of Louisiana CTP, the State NFIP Coordinator, and the State Hazard Mitigation Officer when watersheds are identified for study.

One of the inhibitors of previous mitigation efforts has been the relative age of the effective FIRMs as well as mapped floodplain area. The average age of maps in the watershed is a comparably young (8 years old.) While a large portion of the watershed has received flood studies, Montague County only has 28 miles of mapped floodplain (Zone A) out of 446 stream miles with 69% of the total number of panels printed for the August 6, 2011 countywide DFIRM.

**Flood Risk.** Recent flooding events have proven that the Denton Watershed poses a significant flood risk for the communities it impacts. The most recent flooding event took place in 2015 in the Flower Mound/Lewisville Lake/Grapevine portion of the watershed when over 20 inches of rain fell during April and May. Flooding conditions were further exacerbated with extended release periods from Lewisville Lake. Many additional flood-related damages have been recorded in the various communities within the watershed. These flood events always cause extensive damage to local infrastructure and illustrate the ongoing threat to the Denton watershed.

**Growth Potential.** The area directly surrounding the Denton Watershed has experienced notable growth since 2000 and is projected to continue this trend. The greatest area of growth occurred in the southwest portion of the watershed in the cities of Fort Worth, Haslet, and unincorporated areas of Tarrant County.

These increasing development pressures in the Denton Creek watershed will result in increased runoff and will require improved drainage system and mitigation activities.

**Age of Current Flood Information.** Throughout the Denton Watershed, existing and effective FEMA products are on average 14 years old. Montague County has particularly old FEMA flood maps with some dating from 1985.

In 2009, NCTCOG and TWDB created a Mapping Needs Assessment for the Upper Trinity River Basin, which identified and prioritized the floodplain management needs of over 2,300 stream miles. In order to prioritize the floodplain management needs, NCTCOG and TWDB created a database of all the engineering flood studies in the Basin. As a part of the Upper Trinity River Basin, Denton was included in this study, and in 2015 FEMA authorized NCTCOG to continue the work of the Mapping Needs Assessment by performing Discovery efforts in the Denton watershed.

**Availability of High-Quality Ground Elevation Data.** FEMA's data availability review indicated that high-quality ground elevation data was available for the majority of the basin. This data provides a great basis for preparing hydrologic and hydraulic modeling and helps identify development and earth-moving activities in the vicinity of streams and creeks. The source and date of the Light Detection and Ranging (LiDAR) topographic data as of July 2017 in the Denton Creek watershed coverage is shown in Figure 5. The available LiDAR data was collected by TWDB and NCTCOG between 2009 and 2011.

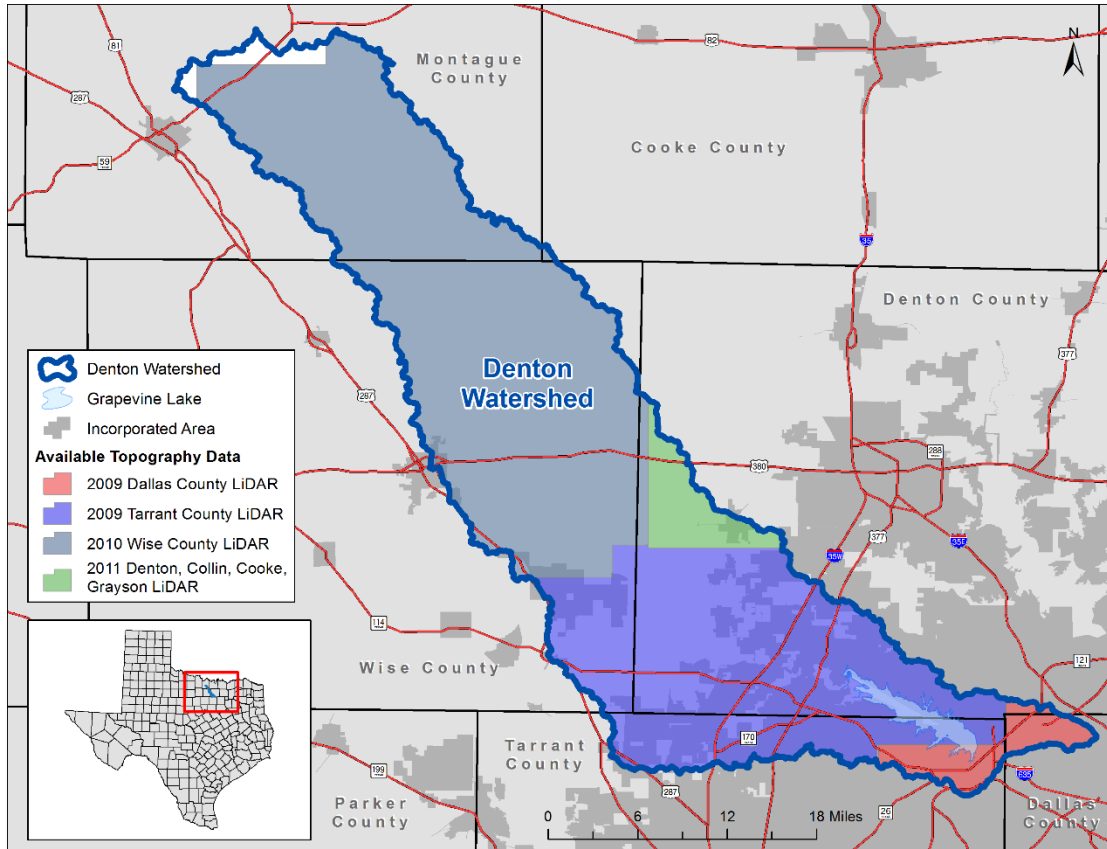


Figure 5: Availability of LiDAR Data.

**Coordinated Needs Management Strategy Database Review.** The CNMS database indicates the validity of FEMA’s flood hazard inventory. CNMS reviews 17 criteria to determine whether flood hazard information shown on the current FIRMs is still valid. Streams that are indicated as **Unverified** or **Unknown** in the database indicate that the information used to map the floodplains currently shown on the FIRM is inaccessible or that a complete evaluation of the critical and secondary CNMS elements could not be performed.

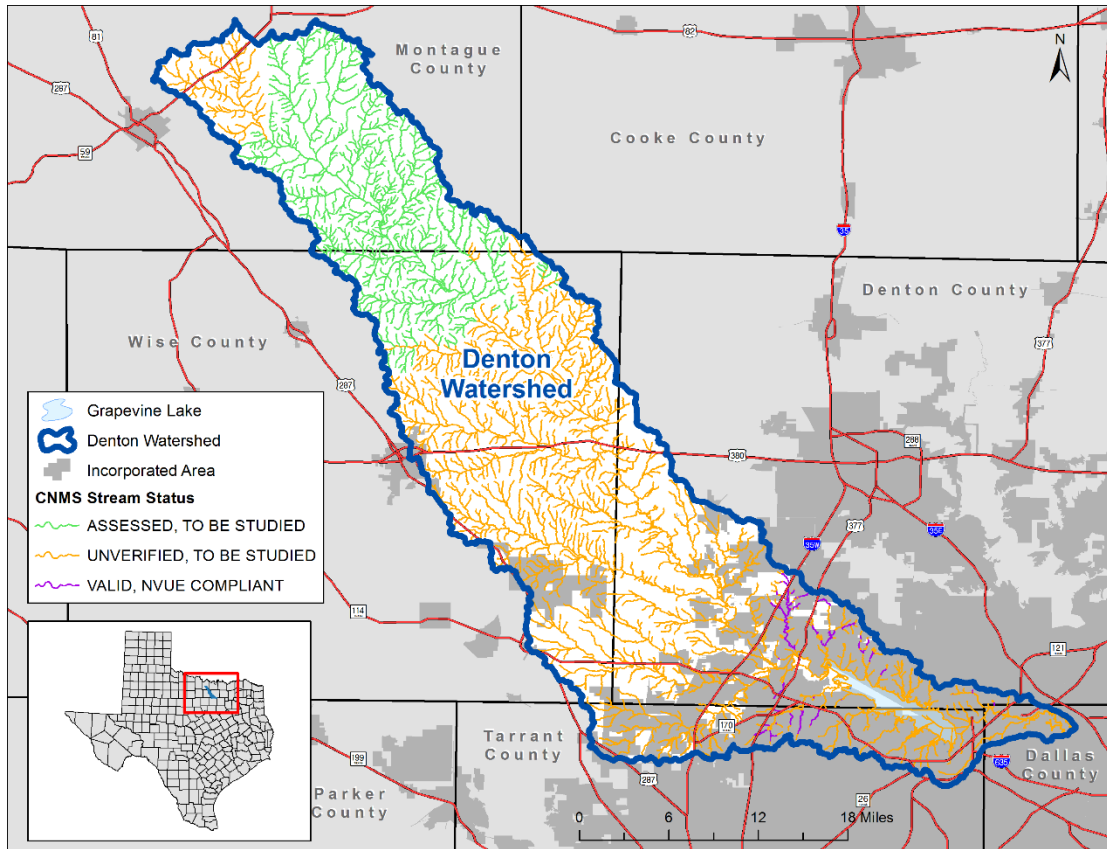


Figure 6: Overview of CNMS streams.

**Unmapped Stream Coverage.** FEMA also reviewed the current stream coverage and reviewed the areas against the [National Hydrography Dataset \(NHD\)](#). The NHD medium-resolution data inventoried by the U.S. Geological Survey (USGS) maps created at a 1:100,000 scale was used to review the watercourses within the Denton HUC-8 watershed. Population centers of 1,000 or more were reviewed for additional mileage against the high-resolution data inventoried by the USGS Quadrangle maps created at a 1:24,000 scale. The intent of this review was to identify streams and watercourses and create a complete stream network for preparing Base-Level Engineering data.

### Base-Level Engineering

In 2017, FEMA, through NCTCOG, invested in BLE for the Denton Creek watershed in Texas. Figure 7 shows the network of streams analyzed using the BLE approach.

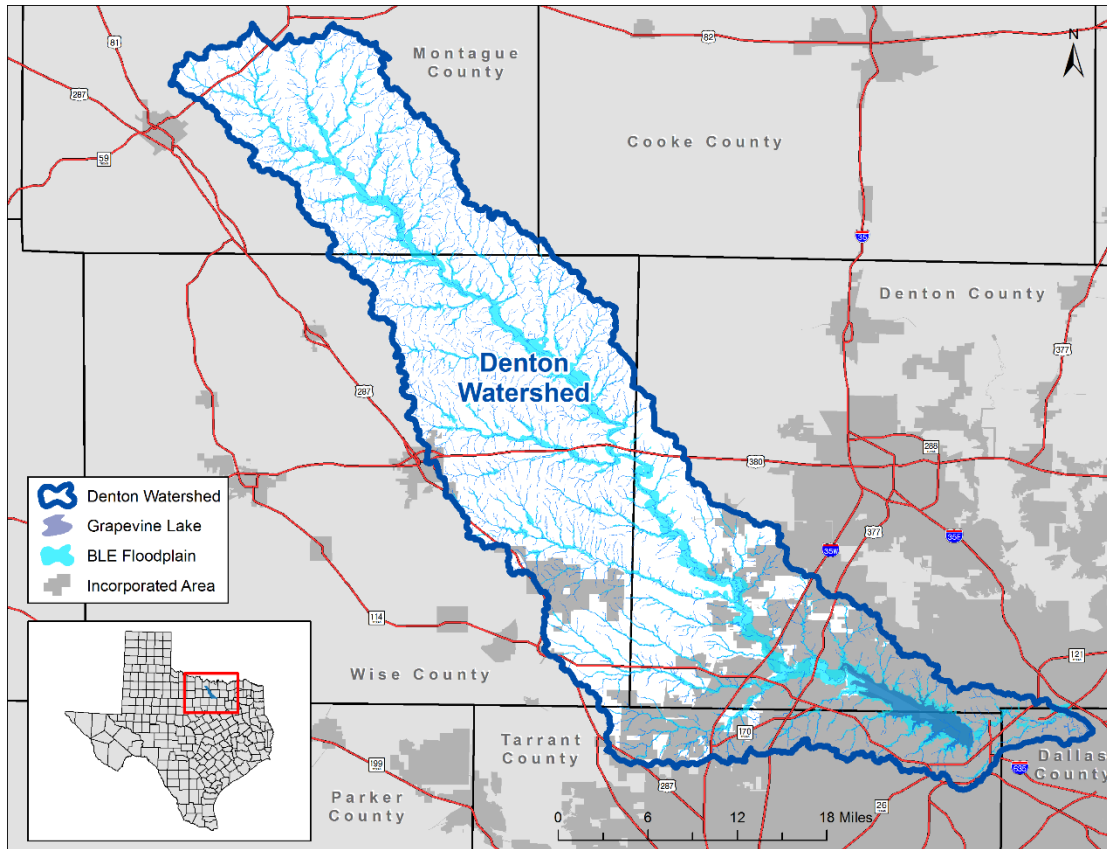


Figure 7: Overview BLE streams.

This approach prepares multi-profile hydrologic (how much water) and hydraulic (how is water conveyed in existing drainage) data for a large stream network or river basin to generate floodplain and other flood risk information for the basin area.

Base-Level Engineering provides an opportunity for FEMA to produce and provide non-regulatory flood risk information for a large watershed area in a much shorter period of time. The data prepared through Base-Level Engineering provides planning-level data that is prepared to meet FEMA's Standards for Floodplain Mapping.

**FEMA Investment (2017).** The Base-Level Engineering will provide the following items for use in the Denton Watershed

- Hydrology modeling (regression) flow values for the 10-, 4-, 2-, 1- and 0.2-percent-annual-chance storm events
- Hydraulic (HEC-RAS) modeling for all study streams (for the same frequencies listed above)
- 1-, and 0.2-percent-annual-chance floodplain boundaries
- 1- and 0.2-percent-annual-chance Water Surface Elevation Grids
- 1- and 0.2-percent-annual-chance Flood Depth Grids
- HAZUS flood analysis for the watershed



- Point file indicating the location of culverts and inline structures that may be informed by local as-built information
- Flood Risk Map (See Appendix III)

The BLE approach will prepare flood hazard information for approximately 660 miles of streams, thus adding over 200 miles of supplementary flood hazard information for communities throughout the watershed. Upon completion, the Base Level Engineering information was published on FEMA's Estimated BFE Viewer (<http://apps.femadata.com/estbfe/>) to allow communities to use for planning, risk communication, floodplain management, and permitting activities.

**CNMS Validation and Assessment.** The Base-Level Engineering results were compared to the current flood hazard inventory identified in the CNMS database. This assessment will allow FEMA and NCTCOG to compare this updated flood hazard information to the current effective floodplain mapping throughout the watershed. A key feature of this assessment also included the collection of Areas of Mitigation Interest layers containing suggested structure inventory for the Discovery collection efforts and flood hazard inventory assessments.

**Community Coordination.** FEMA will share the Base-Level Engineering results (once complete) with communities throughout the project area. Communities will be provided the information, workshops, and training to support the use of Base-Level Engineering for planning, floodplain management, permitting, and risk communication activities. FEMA will work with communities to review, interpret and incorporate the Base-Level Engineering information into their daily and future community management and planning activities.

**Post-Discovery Webinar and Community Coordination.** FEMA and NCTCOG rolled out the BLE mapping and datasets to the communities in the Fall of 2017. The meetings were 1 hour webinars held on 21 September, 2017 and 26<sup>th</sup> September 2017. Communities were provided information and training to support the use of Base-Level Engineering for planning, floodplain management, permitting, and risk communication activities. FEMA will work with communities to review, interpret and incorporate the Base-Level Engineering information into their daily and future community management and planning activities.

**Follow-On Phase Project Decisions.** The Base-Level Engineering results and the current inventory was compared to identify any areas of significant change. If the results show large areas of change (expansions and contractions of the floodplain, increases and decreases of the computed BFEs, and increases in expected flow values) FEMA will continue to coordinate with the communities to identify the streams that should be considered if the FIRMs are updated.

To identify other streams for future refinement, community growth patterns and potential growth corridors should be discussed with FEMA. These areas of expected community growth and development may benefit from updated flood hazard information. Base-Level Engineering can be further refined to provide detailed study information for a FIRM update.

Areas of communities that were developed prior to 1970 (pre-FIRM areas) may include repetitive and severe repetitive loss properties. They may also be areas where re-development is likely to occur.



Having updated flood hazard information before re-development and reconstruction activities take place may benefit communities by providing guidance to mitigate future risk.



*FEMA will work with communities following the delivery of Base-Level Engineering to identify a subset of stream studies to be updated and included on the FIRMs. Communities may wish to review these possible areas and provide feedback once the Base-Level Engineering data has been received. Local communities can also refine Base-Level Engineering information and submit it through the Letter of Map Revision (LOMR) process to revise the existing flood hazard information and maintain the FIRMs throughout their community.*

## Phase One – Discovery: Denton Creek Watershed (2017)

The 2017 NCTCOG Discovery project was about the "Discovery" of flood hazards and risks throughout the Denton Creek watershed. Through the Discovery process, FEMA can determine which areas of the watershed may/will be funded for further flood risk identification and assessment in a collaborative manner while taking into consideration the information collected from local communities. Discovery initiates open lines of communication and relies on local involvement for productive discussions about flood risk. The process provides a forum for a watershed-wide effort to understand the interrelationships between upstream and downstream community flood risk throughout the watershed.

The Denton Creek watershed 2017 Discovery project was completed through the following activities:

- Discovery Engagement Effort
- Data Gathering
- Discovery Meetings
- Watershed Findings and Prioritizations

All possible efforts were made to ensure that stakeholders understood Discovery and the Risk MAP process through emails, phone calls, newsletters, and a developed website created for this Discovery project.

**Discovery Engagement Effort.** NCTCOG held two (2) informational webinars on April 19 and April 24, 2017 for stakeholders in the watershed. A copy of the presentation is available in Appendix III.

The Pre-Discovery informational webinars were held to increase awareness of the Discovery process prior to the Discovery meetings so the stakeholders would be prepared to fully participate in the Discovery process. Six (6) stakeholders participated in the webinars. The goals of the Pre-Discovery webinars were to:

- Explain the Discovery process
- Explain why the NCTCOG was conducting Discovery in the Denton watershed
- Explain FEMA's Risk MAP program and benefits
- To obtain information for Discovery in the watershed

In an effort to gain public awareness of the Denton Discovery process, a Discovery newsletter was developed and distributed to all stakeholders. The newsletter contained information about FEMA's Risk MAP program, the Discovery process, details of the upcoming in-person Discovery meeting, the data collection process, and the Risk MAP process beyond Discovery.

The Discovery engagement process also included the development of a website for data collection. The website allowed participating stakeholders to view and update flood-related information about their community. It also allowed stakeholders to input mitigation concerns, mapping needs and requests on a web map.

**Data Gathering.** Most of the data collected from stakeholders through the website and at the Discovery meetings included information about local flood risk, flood hazards, mitigation plans, mitigation activities, flooding history, development plans, and floodplain management activities. Data was also collected from State and Federal organizations. Table 4 below summarizes the geospatial data collected.

Table 4: Geospatial Data Collection

Data Type	Data Source	Data Description
HUC Watershed Boundaries	USGS	HUC boundaries clipped to the Denton HUC-8. Also includes HUC-10 and HUC-12.
Roadways and Railroads	TNRIS Stratmap	Transportation Lines
Jurisdictional Boundaries	TNRIS	Data includes City and County Boundaries
Current Effective Floodplain Information	FEMA DFIRMs	Data includes Floodplains, BFEs, and Cross Sections
Stream Lines	FEMA DFIRMs	Stream Centerlines from DFIRM
Locations of Letters of Map Revision (LOMRs)	FEMA	LOMRs incorporated into Effective DFIRM databases and LOMRs filed after Effective DFIRM dates for watershed counties
Coordinated Needs Management Strategy	FEMA	CNMS database dated June 30, 2017
Topography	TNRIS	List of the most current ground surface topography
HAZUS-based Average Annualized Loss Estimates	FEMA	2015 HAZUS AAL per Census Tract
Coverage of Known Risk Assessment Data	Texas Hazard Mitigation Package	Based on 2000 Census: Population Vulnerability to 1% Flood and Property Value Vulnerability to 1% Flood
Location of Dams	National Inventory of Dams	Dam locations with Emergency Action Plan (EAP) status
Stream Gauges	USGS	Stream Gauge locations
Flood Claims	NFIP	Total claims per jurisdiction
Repetitive Loss or Severe Repetitive Loss Locations	FEMA	RL/SRL locations from 1979 to 2015
Land Use	National Land Cover Database 2006 from TNRIS	Land Use data as of 2006, developed by USGS
Urban Cover	National Land Cover Database 2006 from TNRIS	Urban Cover is a field located in the Land Use
Census Tract Population Data	US Census Bureau	
Population Density	US Census Bureau	Population density based on 2010 Census
Congressional Areas	US Census Bureau	Congressional District Boundaries
High Water Marks	TNRIS	Historical high water marks obtained by TNRIS from USACE, FEMA Mitigation Team, USGS, and TxDOT
Low Water Crossings	TNRIS	Identified low water crossings in Texas with flooding source and road name

**Discovery Meetings.** Two in-person Discovery meetings were held in the watershed in a come-and-go format. The first Discovery meeting occurred on June 13, 2017 at 9 am at the Town of Flower Mound Service Center in Flower Mound, Texas. The second Discovery meeting occurred on June 21, 2017 at the

City of Decatur City Hall in Decatur, Texas. Hosts of these meetings included FEMA, TWDB, NCTCOG, and Halff.

The main goals of the Discovery meetings were to gather flood risk data; discuss the community's flooding history, development plans, flood mapping needs, and flood risk concerns; discuss the vision for the watershed's future, and the importance of mitigation planning and community outreach.

The Discovery Meetings were held over a four (4) hour period. Community stakeholders were able to participate in the meetings when most convenient to them. Ambassadors assisted stakeholder attendees through various stations in an "open house" format. The stations included:

- *Texas Water Development Board (TWDB)* – information about available Federal and State Grant programs, Hazard Mitigation Planning, Emergency Action plans, as well as implementation of projects
- *Upper Trinity Regional Water District (UTRWD)* – discussion of current UTRWD projects in the region
- *United States Army Corps of Engineers (USACE)* – discussion of current USACE projects in the region
- *NCTCOG Programs* – information on NCTCOG programs available to stakeholders as well as answering NCTCOG questions from attendees
- *Laptops* – stakeholders were able to review, edit, or add information entered on the Discovery website.
- *Discovery Maps* – data collection process to capture information on identifying flood risk locations and problems, areas of growth or planned development, answering floodplain questions, and identifying map need locations.

The 2017 Denton Creek Discovery project gathered 16 new mapping requests across 612 miles of streams.

**Watershed Findings/Prioritizations.** Following the Discovery meetings, the gathered mapping needs were prioritized similar to the 2009 Upper Trinity Basin MNA prioritization. The ranking is a combination of CNMS criteria and guidance from the TWDB. A score was calculated for each map need based on the criteria presented in Table 5.

**Prioritization Rankings.** Map needs with the Denton watershed were documented from stakeholder comments and are listed in Table 7 under the category "Mapping Need". These needs may come from outdated stream studies, large-scale development along a stream, or alterations to a stream itself to reduce flooding risk. Approximately 113 miles of mapping needs were captured during the 2017 Denton Discovery process. Pursuing studies along the entirety of requested miles would be cost prohibitive, so it was necessary for NCTCOG to reduce the list of potential stream projects. Table 6 lists the prioritization rankings for the Denton Watershed based on the State of Texas' prioritization criteria.

Table 5: Prioritization Criteria

Criteria No.	Description	Weight
1	Population density	10
2	Population change	10
3	Population growth (2000-2010)	10
4	History of flood claims	10
5	Number of Letters of Map Change (LOMR/LOMA)	5
6	Available current topography	10
7	Age of technical data – hydrology	5
8	Age of technical data – hydraulics	5
9	Ability to leverage current studies	5
10	Potential for local funding	5
11	Potential for local “work in kind”	3
12	Previous contribution to a FEMA study	2
13	Previous flood events	10
14	Stakeholder mapping request	10

Table 6: Denton Watershed Risk Classifications (HUC-12 Watersheds)

HUC-8 Watershed	HUC-12 Watershed Group	Risk Classification
Denton	Black Creek – Denton Creek	Moderate
	Braden Branch – Denton Creek	Moderate
	Catlett Creek – Sweetwater Creek	Moderate
	Cottonwood Branch – Denton Creek	High
	Denton Creek – Grapevine Lake	Elevated
	Dove Creek – Grapevine Lake	High
	Dry Valley Creek	Moderate
	Elizabeth Creek – Denton Creek	Elevated
	Harts Creek – Denton Creek	Moderate
	Headwaters Elizabeth Creek	High
	Henrietta Creek	High
	Hog Branch – Denton Creek	High
	Marshall Branch – Grapevine Lake	High

HUC-8 Watershed	HUC-12 Watershed Group	Risk Classification
	Morris Branch – Denton Creek	Elevated
	North Pecan Creek – Denton Creek	Moderate
	Oliver Creek	Elevated
	Panther Creek – Denton Creek	Moderate
	Wells Branch – Denton Creek	Moderate

The prioritization rankings listed in Table 6 will be used by FEMA to determine targeted action items, potential projects, and multi-year flood risk project plans within the Denton watershed. Other figures displaying the watershed-based prioritization and potential study streams are located in Appendix III.

**Discovery Findings.** The Discovery meetings held in June 2017 catalogued information about community concerns, known flooding locations, and areas of mitigation interest. The stakeholder comment distribution is shown in the tables and figures below.

Table 7: Denton Comment Distribution by HUC-12 Watershed

HUC-12 Watershed	Comment Types						
	Flooding Risk	Flooding Risk/Mitigation Action	Mapping Concerns	Mapping Needs	Mitigation Actions - Identified	Mitigation Actions - Completed	Regulations
Black Creek - Denton Creek	No comments received						
Braden Branch - Denton Creek	No comments received						
Catlett Creek - Sweetwater Creek	No comments received						
Cottonwood Branch - Denton Creek	0	0	0	0	1	0	0
Denton Creek - Grapevine Lake	No comments received						
Dove Creek - Grapevine Lake	0	0	1	3	1	0	0
Dry Valley Creek	No comments received						
Elizabeth Creek - Denton Creek	No comments received						

HUC-12 Watershed	Comment Types						
	Flooding Risk	Flooding Risk/Mitigation Action	Mapping Concerns	Mapping Needs	Mitigation Actions - Identified	Mitigation Actions - Completed	Regulations
Harts Creek - Denton Creek	No comments received						
Headwaters Elizabeth Creek	0	0	0	1	0	0	0
Henrietta Creek	0	0	1	0	1	0	0
Hog Branch - Denton Creek	0	0	0	4	0	0	0
Marshall Branch - Grapevine Lake	0	0	1	2	0	0	0
Morris Branch – Denton Creek	0	0	0	1	0	0	0
North Pecan Creek - Denton Creek	No comments received						
Oliver Creek	0	0	0	0	1	0	0
Panther Creek - Denton Creek	No comments received						
Wells Branch - Denton Creek	No comments received						

Table 8: Stream Study Requests

Community	Stream
Town of Flower Mound	Bakers Branch
Denton County	Denton Creek Tributary 14 (2 requests)
Tarrant County	Kirkwood Branch
Town of Flower Mound	Stream SB-1
Town of Flower Mound	Stream WC-1
City of Haslet	Unnamed Stream
Town of Flower Mound	Unnamed Stream (3 requests on 3 unnamed streams)
Town of Flower Mound	Wichita Chase Tributary



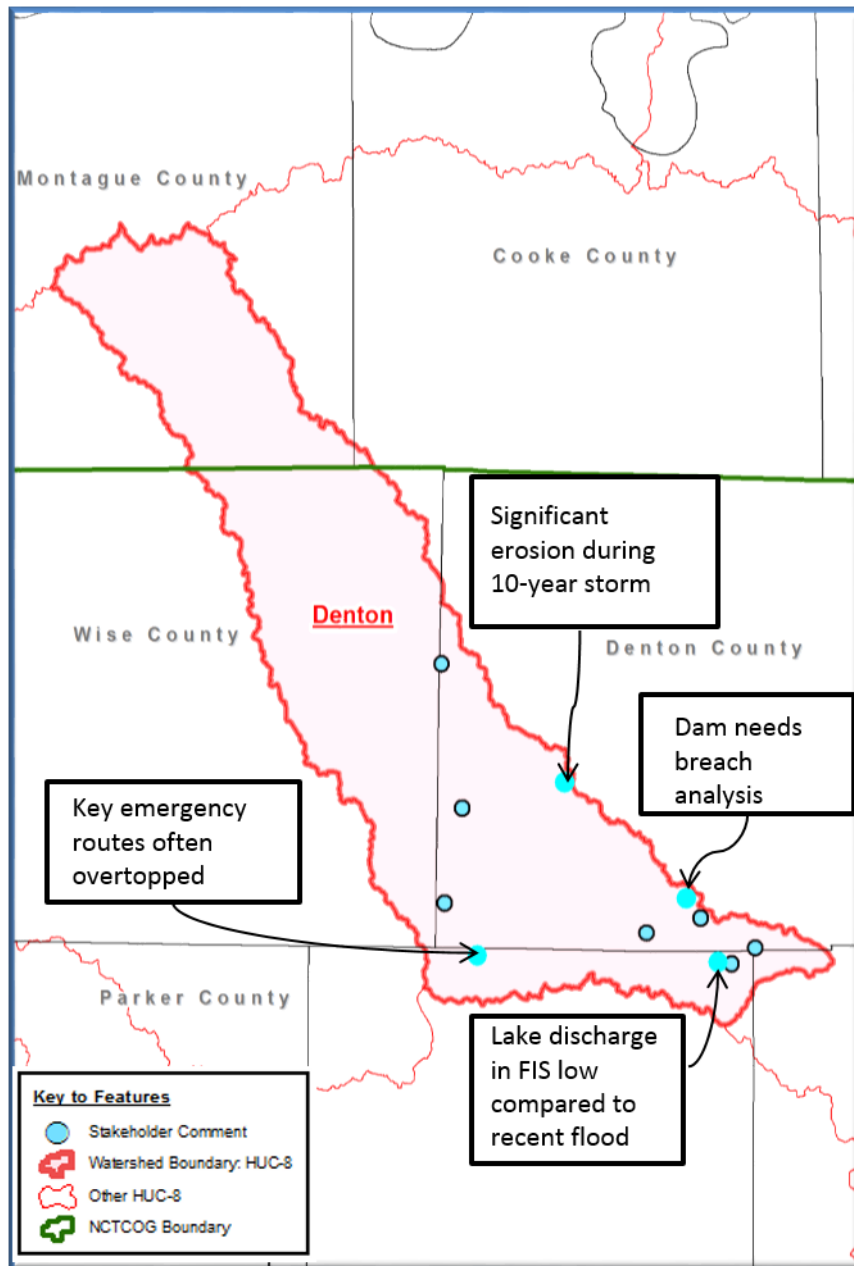


Figure 8: Stakeholder Comments.

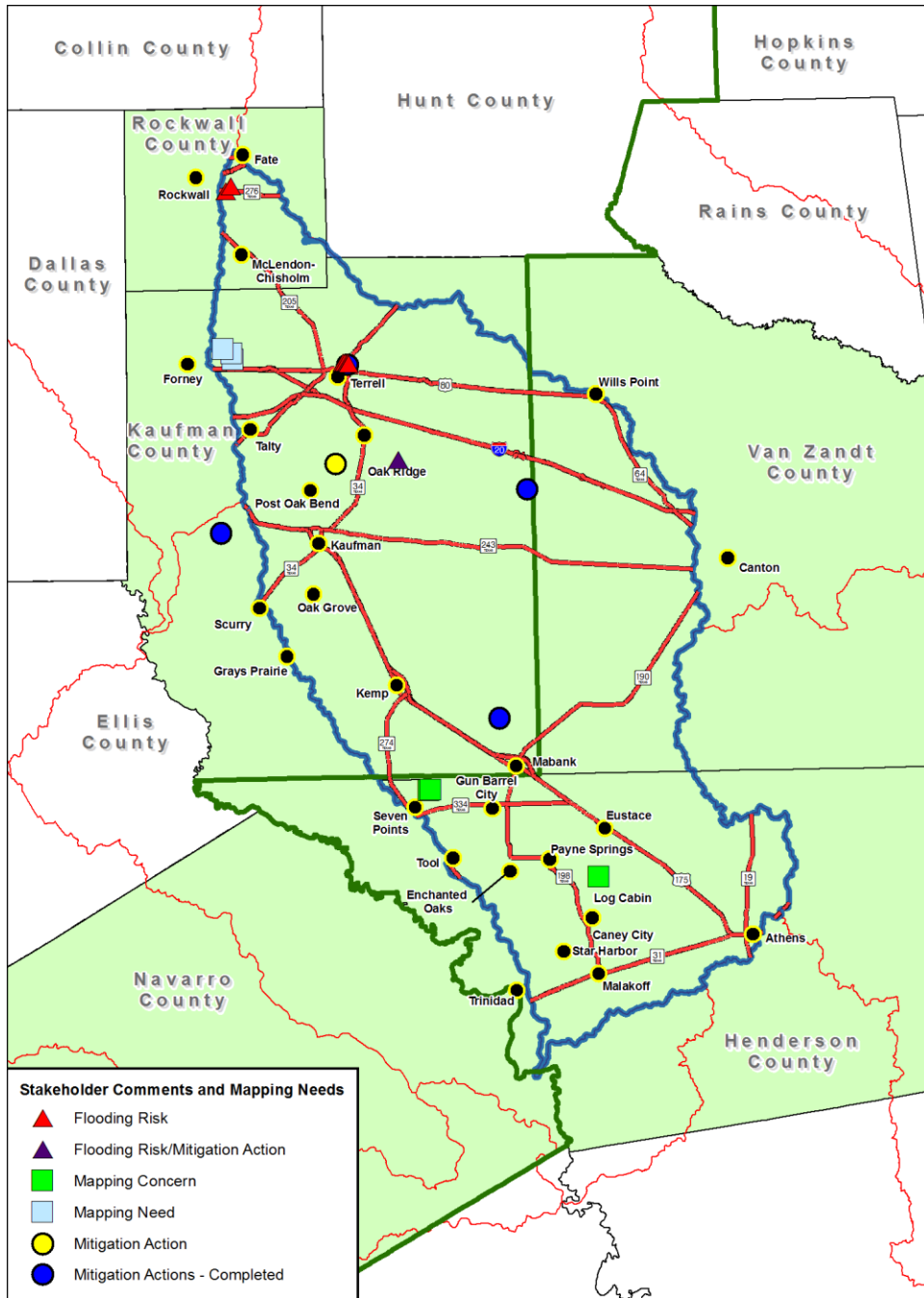


Figure 9: Stakeholder Comment Distribution.

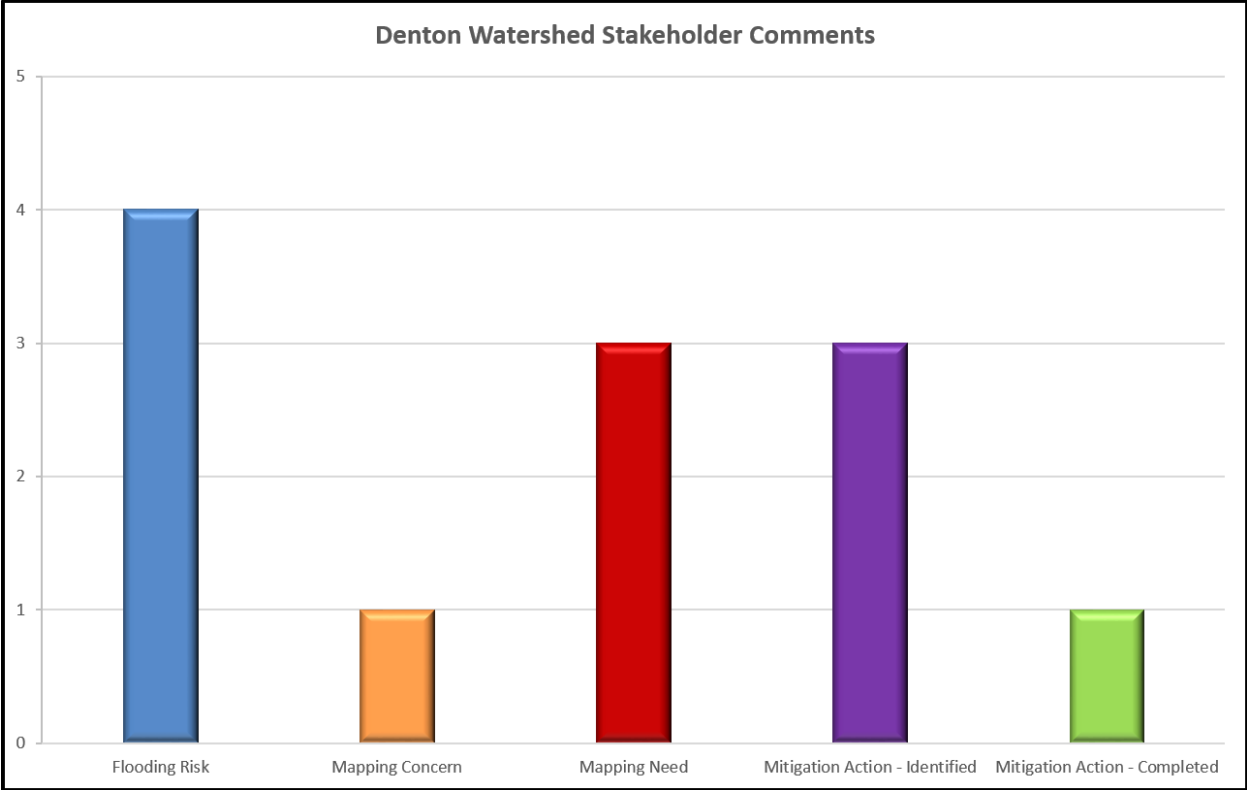


Figure 10: Stakeholder Comment Totals.

## Appendix I: Community-Specific Reports

Denton Watershed Community Overview Table

CID	Community	Total Community Population <sup>1</sup>	Percent of Population in Study Watershed	Total Community Land Area (sq. mi)	Percent of Land Area in Study Watershed	NFIP Participant
480130	COOKE COUNTY	18,622	0.1%	860	0.1%	Yes
480165	DALLAS COUNTY	7,175	0.0%	66.8	15.5%	Yes
480167	CITY OF CARROLTON	119,097	2%	37.5	2%	Yes
480170	CITY OF COPPELL	38,659	54%	14.9	54%	Yes
480598	CITY OF GRAPEVINE	46,334	55%	35.8	55%	Yes
480774	DENTON COUNTY	67,066	16%	535.2	20%	Yes
480775	TOWN OF ARGYLE	3,282	36%	11.5	36%	Yes
481501	TOWN OF BARTONVILLE	1,469	55%	6.8	54%	Yes
480224	TOWN OF CORRAL CITY	27	100%	0.2	100%	No
480194	CITY OF DENTON	113,383	3%	100.8	3%	Yes
480229	TOWN OF DISH	201	100 %	1.5	100%	Yes
481516	TOWN OF DOUBLE OAK	2,867	1%	2.4	0%	Yes
480777	TOWN OF FLOWER MOUND	64,669	70.9%	45	70.9%	Yes
480596	CITY OF FORT WORTH	741,206	2.0%	349.2	9.8%	Yes
480600	CITY OF HASLET	1,517	83.6%	8.2	84.1%	Yes
480939	MONTAGUE COUNTY	10,425	16.8%	938.3	16.7%	Yes
480582	TARRANT COUNTY	21,393	1.5%	173.1	4.1%	Yes
480602	CITY OF KELLER	39,627	18.8%	18.5	18.9%	Yes
480614	CITY OF WESTLAKE	992	100%	7.1	100%	Yes
480778	CITY OF JUSTIN	3,246	100%	2.2	100%	Yes
480195	CITY OF LEWISVILLE	95,290	7.1%	46.5	7.1%	Yes
480782	TOWN OF NORTHLAKE	1,724	99.7%	16.7	100 %	Yes
480784	TOWN OF PONDER	1,395	80%	3	80%	Yes
480785	CITY OF ROANOKE	6,040	100%	5.9	100%	Yes
480612	CITY OF SOUTHLAKE	26,575	60%	22.8	59%	Yes
481606	CITY OF TROPHY CLUB	8,024	100%	4.1	100%	Yes
480614	CITY OF WESTLAKE	992	100%	7.1	100%	Yes
481051	WISE COUNTY	36,494	29%	879.7	29.6%	Yes
480678	CITY OF DECATUR	6,042	29.7%	8.2	29.3%	Yes
481629	CITY OF NEW FAIRVIEW	1,258	91.2%	15.9	91.2%	Yes
481064	CITY OF RHOME	1,522	43.7%	1.3	46.2%	Yes

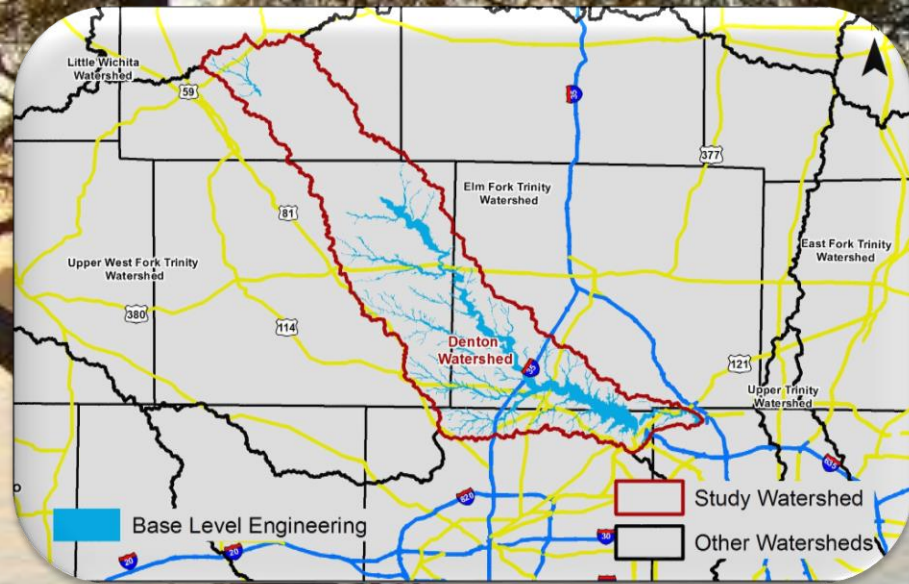
<sup>1</sup>US Census (2010)

# Community-specific Flood Reports



# DENTON WATERSHED

## KNOW YOUR RISK



**1885.5**  
sq. miles

in Risk MAP  
project extent

**183,290**  
Population based  
on 2010 census

1.7% avg. expected  
population growth  
from 2010-2021

**13**  
claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$7.2M**  
in severe repetitive  
loss in the  
watershed

**6**  
Average years  
since last  
effective FIRM

29 communities  
participating in the  
National Flood  
Insurance Program

CNMS Stream  
Miles

**1885.1**

Stream Miles  
Detailed Study

**11.3%**

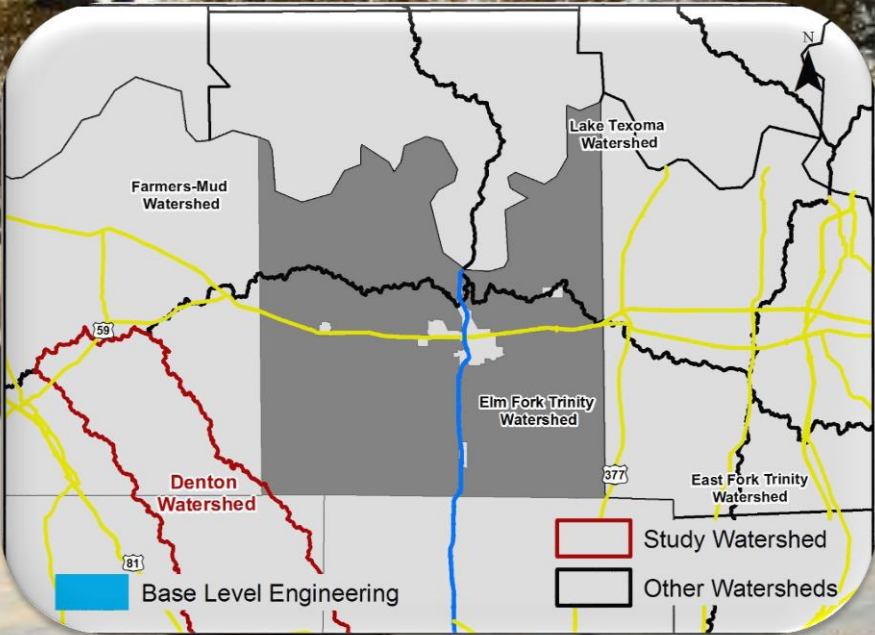
**32** dams require  
Emergency Action  
Plans





# COOKE COUNTY

## KNOW YOUR RISK



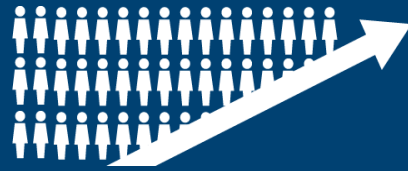
0.6  
Sq. Miles

of the community is  
in the watershed



26

Population based  
on 2010 census in  
the watershed



0.8% expected  
population growth  
from 2010-2021 in  
the watershed



116

policies totaling  
approximately  
\$29,340,000 in  
coverage

0

claims for structures  
repeatedly damaged  
by flood in the  
watershed

0.0%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



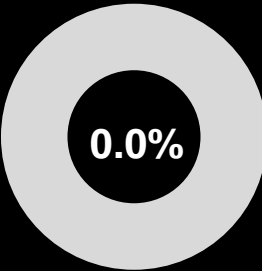
Participating in  
the National  
Flood Insurance  
Program.



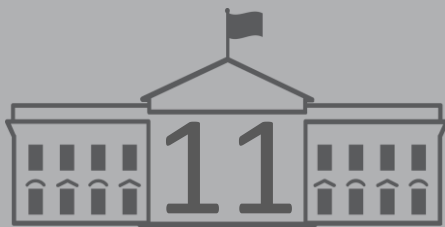
CNMS Stream  
Miles in the  
watershed

1.6

Stream Miles  
Detailed Study in  
the watershed



0.0%



Flood-related  
presidential disaster  
declarations in your  
county

\$0

in severe repetitive  
loss in the watershed



# COOKE COUNTY

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **February 14, 2017**.

The hazard mitigation goals identified projects for:

- Maintain Community Emergency Response Team (CERT) program
- Public awareness programs.
- Apply for funding to support more expansive warning system, generators, updated floodplain mapping, and dam studies
- Achieve “Stormready” Community certification
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA’s Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB’s Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Reduction Projects including Flood Insurance Rate Mapping. HMGP and PDM allow for the funding of generators at critical facilities. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA’s HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety’s Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board’s](#)<sup>3</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for dam studies and engineering plans. Both CWSRF and DFund are long term-fixed interest loans which can be used for building water quality and green infrastructure. CWSRF and DFund, offers grant money for flood reduction projects including FIS updates.

Community Emergency Response Team (CERT) programs are volunteer-based and do not have funding options from FEMA or TWDB. However, CERTs can be registered as non-profit organizations or incorporated in community budgets. Further information is located on the [CERT website](#)<sup>4</sup>. “Stormready” Certification is available through the National Weather Service and facilitates warning the public of impending storms and developing a formal hazardous weather plan.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter orders, such as regulating construction or elevational changes in the floodplain.

<sup>1</sup> <https://www.fema.gov/hazard-mitigation-assistance>.

<sup>2</sup> <http://gohsep.la.gov/GRANTS/RECOVERY-GRANTS/Hazard-Mitigation-Assistance/Hazard-Mitigation-Overview>.

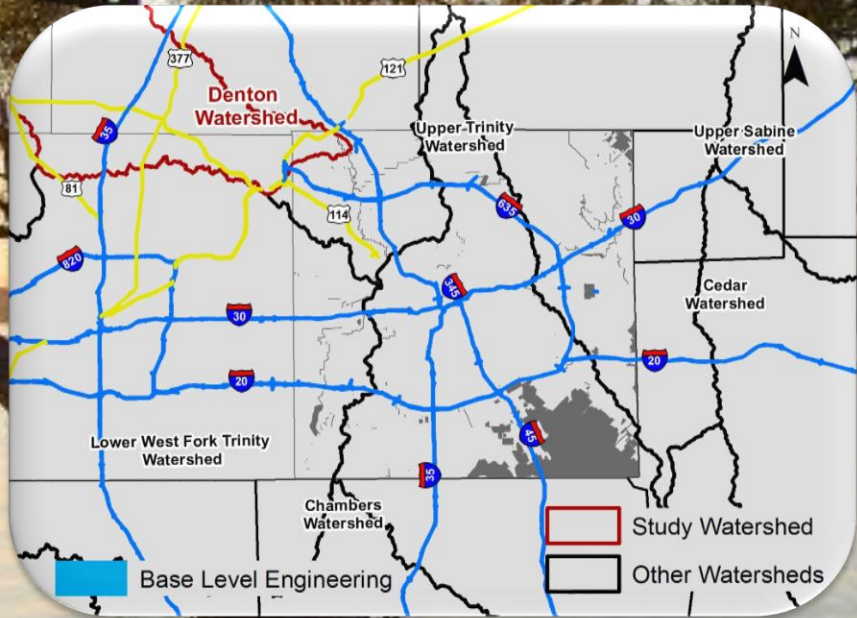
<sup>3</sup> <https://www.epa.gov/green-infrastructure>.

<sup>4</sup> <https://www.nationalservice.gov/resources/disaster-services/starting-cert-program-your-community>.



# DALLAS COUNTY

## KNOW YOUR RISK



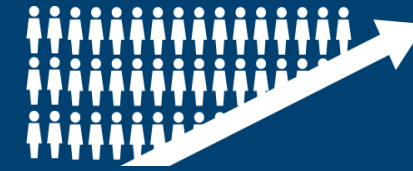
**10.4**  
Sq. Miles

of the community is  
in the watershed\*



**0**

Population based  
on 2010 census in  
the watershed



0.0% expected  
population growth  
from 2010-2021 in  
the watershed



**32**

policies totaling  
approximately  
\$7,226,500 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$0**

in severe repetitive  
loss in the watershed

**0.0%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**28.3**

Stream Miles  
Detailed Study in  
the watershed

**83.0%**



Flood-related  
presidential disaster  
declarations in your  
county

\*Dallas County has no unincorporated land in the watershed, so these values represent the total of the communities within the part of Dallas County in the watershed.



# DALLAS COUNTY

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **February 22, 2021**.

The hazard mitigation goals identified projects for:

- Acquisition of flood prone structures

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, and building water quality and green infrastructure. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of severe repetitive loss residential structures.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

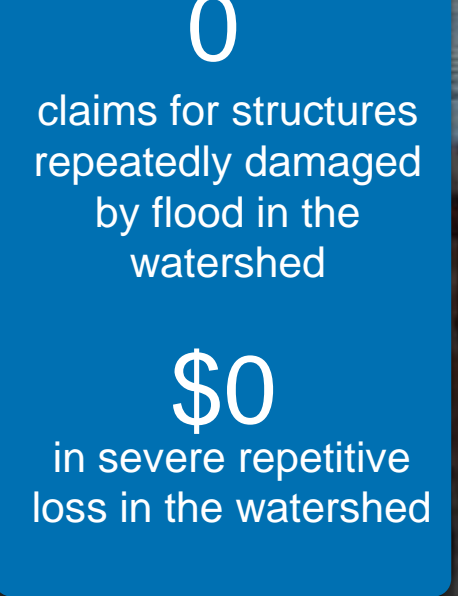
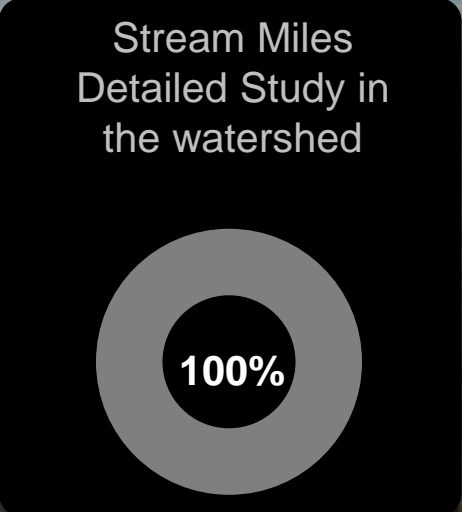
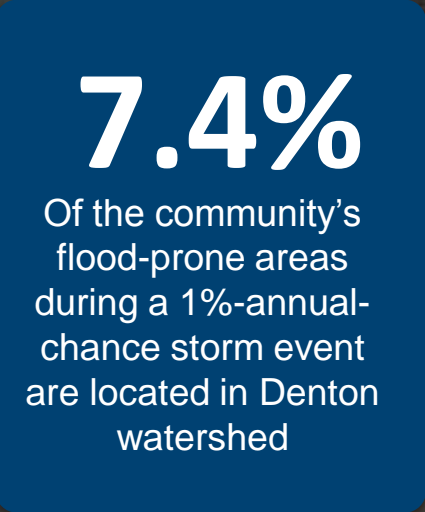
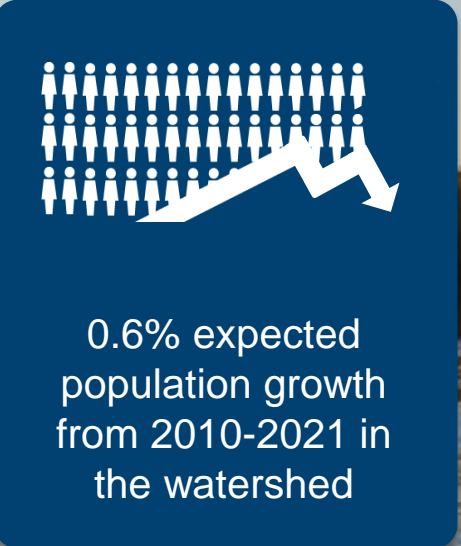
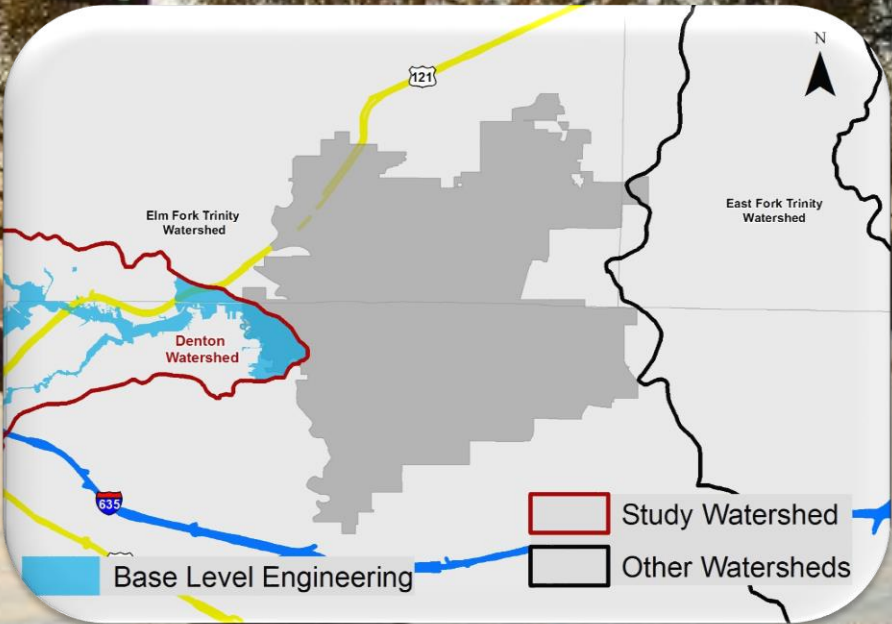
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF CARROLLTON

## KNOW YOUR RISK





# CITY OF CARROLLTON

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **February 22, 2021**.

The hazard mitigation goals identified projects for:

- Acquisition of flood prone structures
- Maintain Emergency Action Plans for high hazard dams

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for dam studies or plans. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of severe repetitive loss residential structures.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

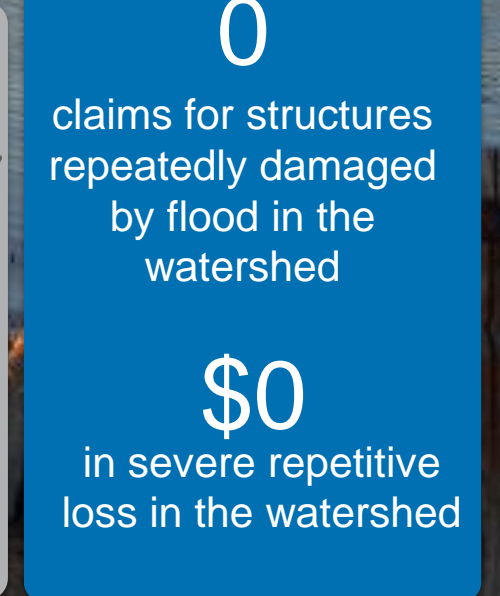
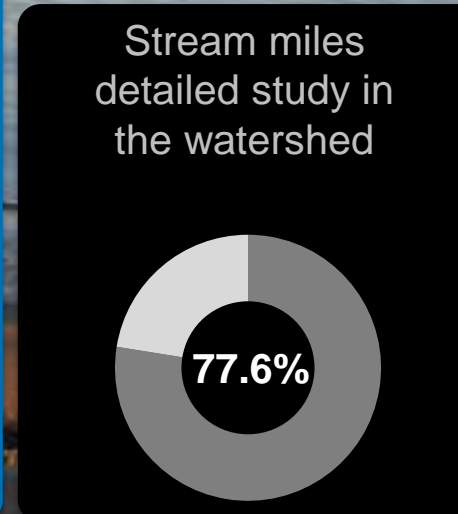
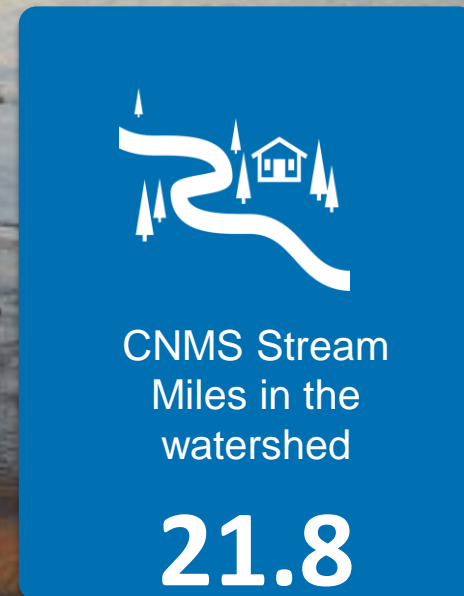
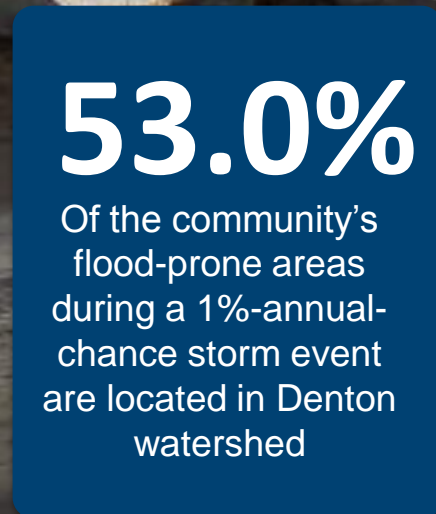
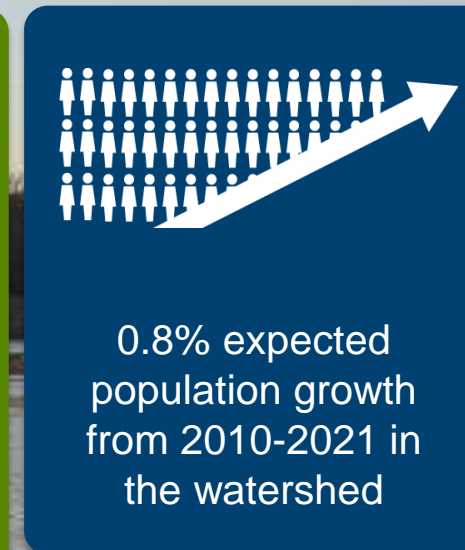
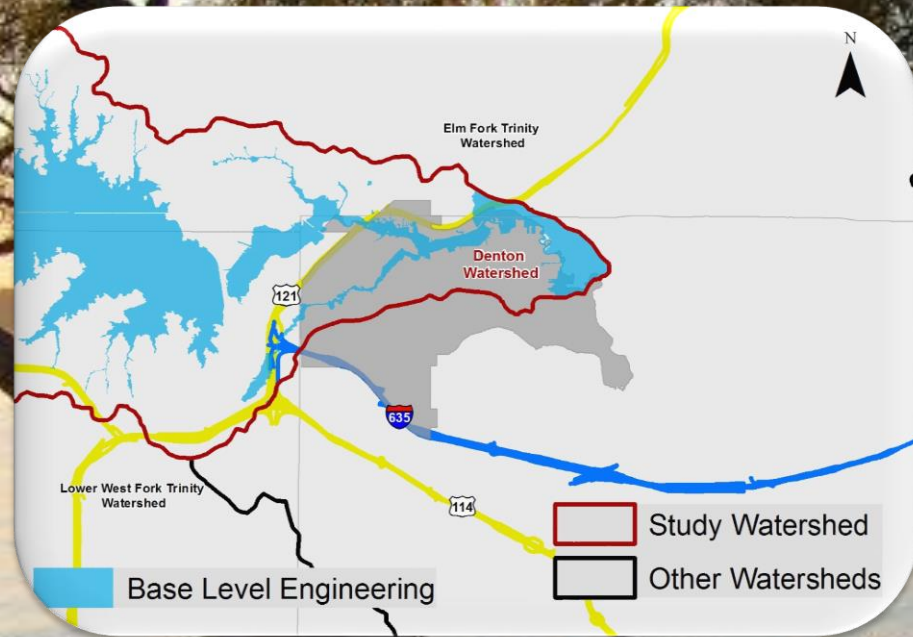
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF COPPELL

## KNOW YOUR RISK





# CITY OF COPPELL

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **February 22, 2021**.

The hazard mitigation goals identified projects for:

- Prohibit further development in open space flood-prone areas
- Public awareness programs
- Acquisition of flood prone structures

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of sever repetitive loss residential structures.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

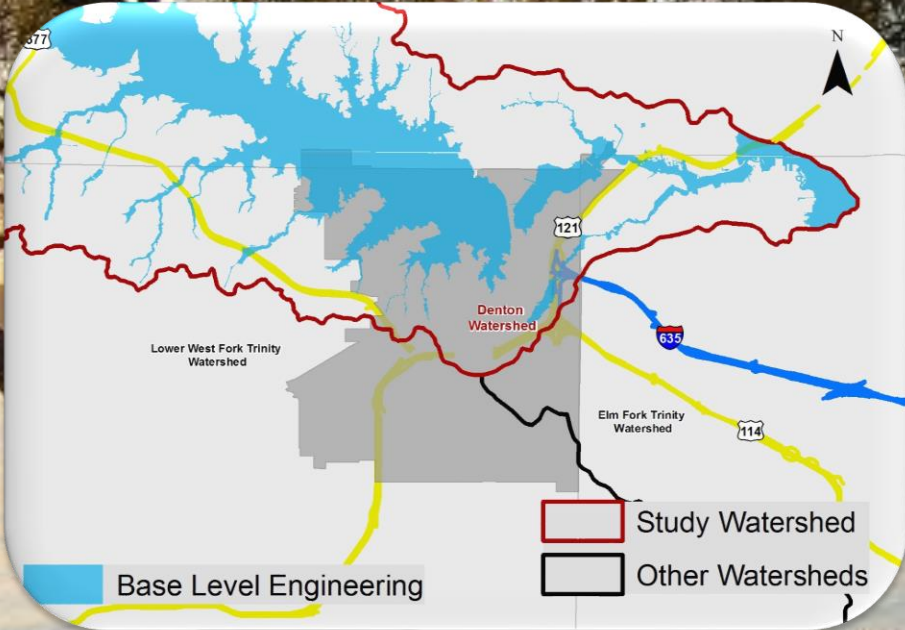
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF GRAPEVINE

## KNOW YOUR RISK



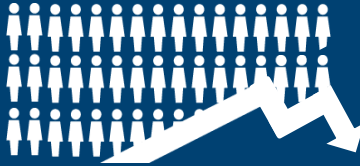
**19.5**  
Sq. Miles

of the community is  
in the watershed



**25,256**

Population based  
on 2010 census in  
the watershed



0.7% expected  
population growth  
from 2010-2021 in  
the watershed



**136**

policies totaling  
approximately  
\$42,244,600 in  
coverage

**3**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**87.5%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



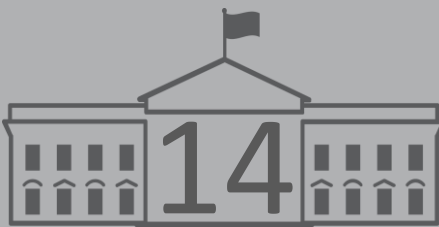
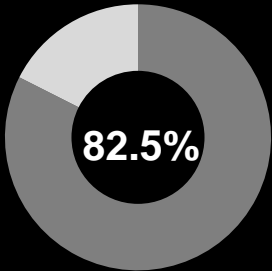
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**53.0**

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

**14**

**\$1M**

in severe repetitive  
loss in the  
watershed



# CITY OF GRAPEVINE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020.**

The hazard mitigation goals identified projects for:

- Public facilities improvement
- Enhance current warning system
- Install generators at critical facilities

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure, including public facilities. HMGP and PDM allow for the funding of generators at critical facilities. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, and building water quality and green infrastructure.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

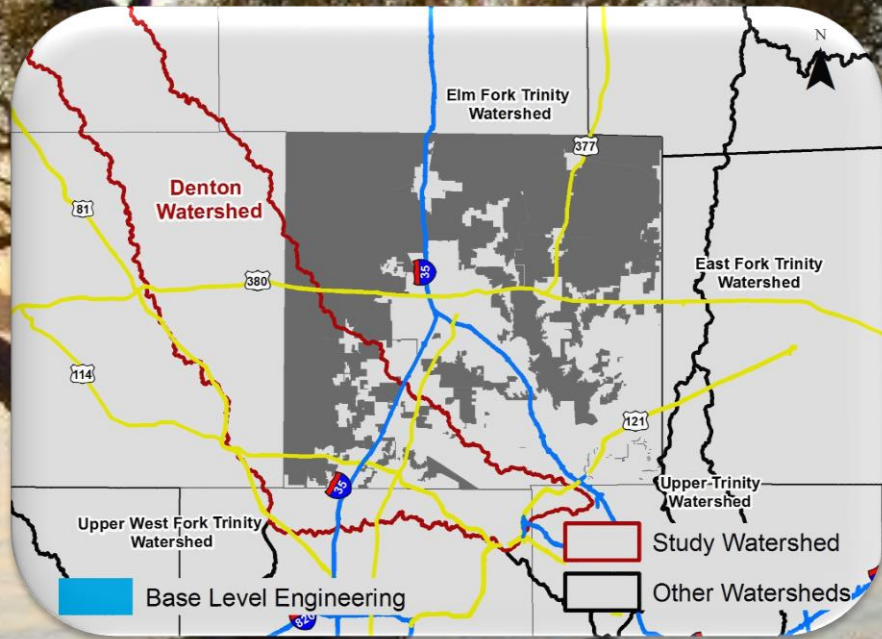
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# DENTON COUNTY

## KNOW YOUR RISK



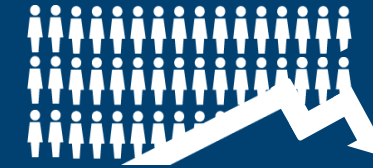
**104.6**  
Sq. Miles

of the community is  
in the watershed



**1,1430**

Population based  
on 2010 census in  
the watershed



3.2% expected  
population growth  
from 2010-2021 in  
the watershed



**424**

policies totaling  
approximately  
\$120,417,600 in  
coverage

**2**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$131K**

in severe repetitive  
loss in the  
watershed

**14.5%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



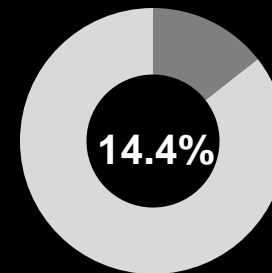
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**273.6**

Stream Miles  
Detailed Study in  
the watershed



**14.4%**



Flood-related  
presidential disaster  
declarations in your  
county

**12**



# DENTON COUNTY

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

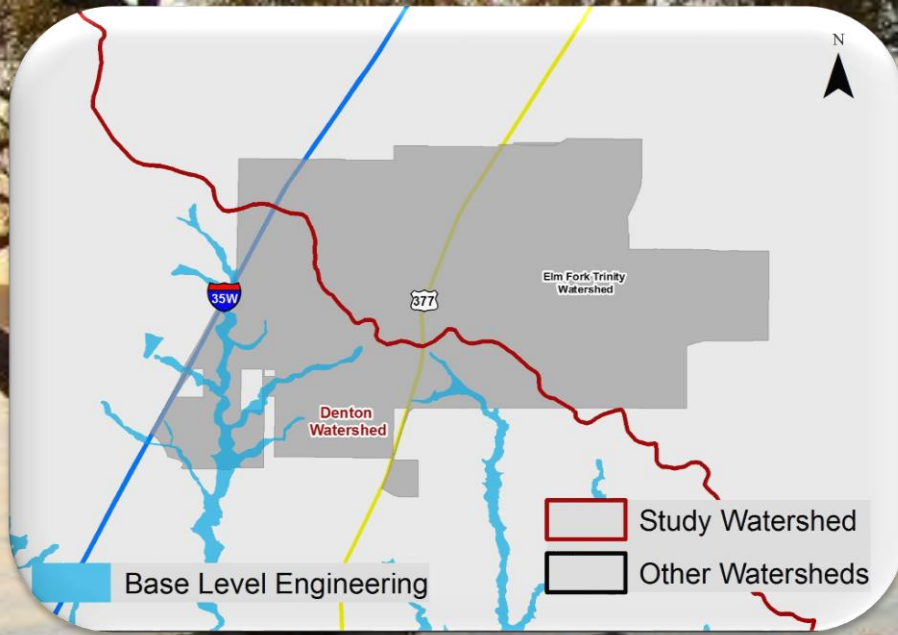
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF ARGYLE

## KNOW YOUR RISK

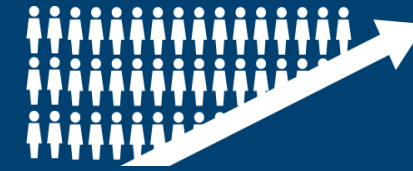


of the community is  
in the watershed



34

Population based  
on 2010 census in  
the watershed



2.1% expected  
population growth  
from 2010-2021 in  
the watershed



34

policies totaling  
approximately  
\$10,538,400 in  
coverage

0

claims for structures  
repeatedly damaged  
by flood in the  
watershed

\$0

in severe repetitive  
loss in the  
watershed

34.1%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



Participating in  
the National  
Flood Insurance  
Program.

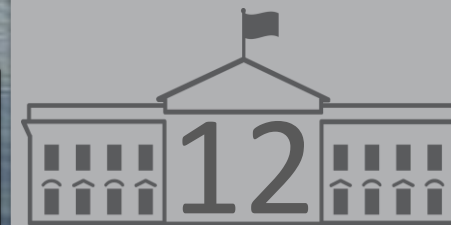


CNMS Stream  
Miles in the  
watershed

8.7

Stream Miles  
Detailed Study in  
the watershed

0.0%



12  
Flood-related  
presidential disaster  
declarations in your  
county

\$0

in severe repetitive  
loss in the  
watershed



# TOWN OF ARGYLE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

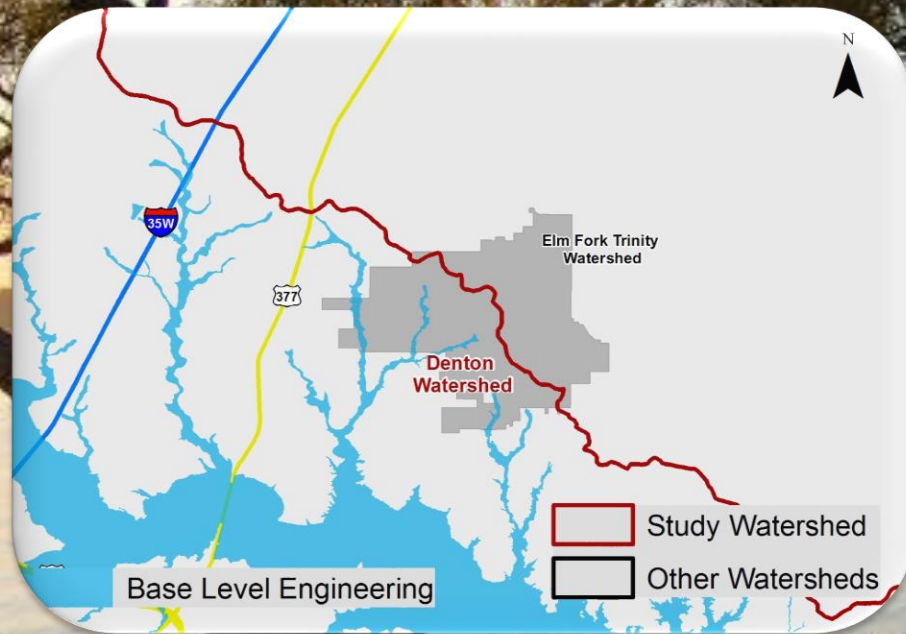
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF BARTONVILLE

## KNOW YOUR RISK

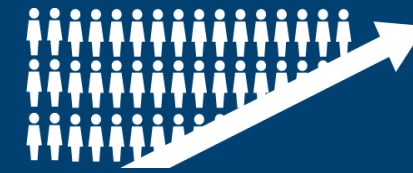


of the community is in the watershed



802

Population based on 2010 census in the watershed



1.6% expected population growth from 2010-2021 in the watershed



12

policies totaling approximately \$3,628,900 in coverage

0

claims for structures repeatedly damaged by flood in the watershed

\$0

in severe repetitive loss in the watershed

57.9%

Of the community's flood-prone areas during a 1%-annual-chance storm event are located in Denton watershed



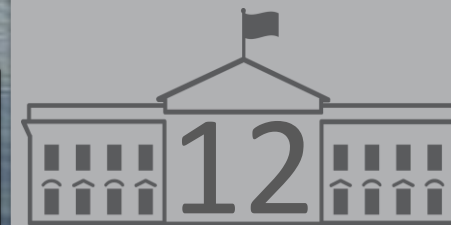
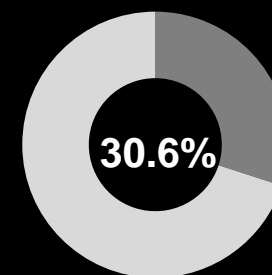
Participating in the National Flood Insurance Program.



CNMS Stream Miles in the watershed

7.0

Stream Miles Detailed Study in the watershed



12  
Flood-related presidential disaster declarations in your county





# TOWN OF BARTONVILLE

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The county also creates a county-wide Hazard Mitigation Plan that the community may choose to adopt. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

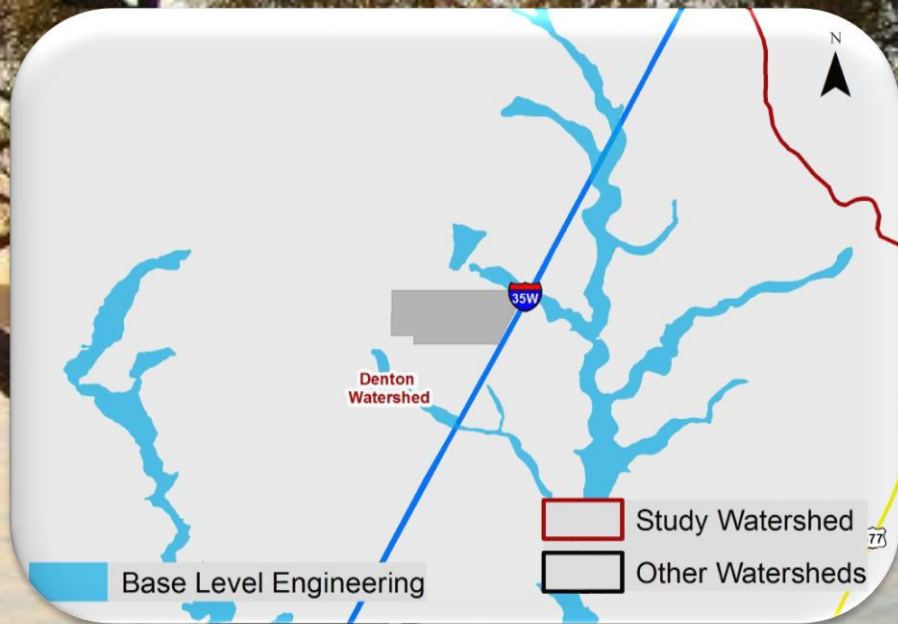
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF CORRAL CITY

## KNOW YOUR RISK



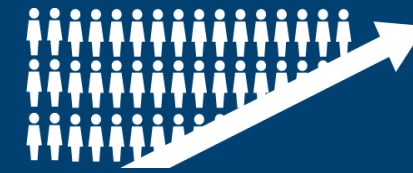
0.2  
Sq. Miles

of the community is  
in the watershed



27

Population based  
on 2010 census in  
the watershed



1.5% expected  
population growth  
from 2010-2021 in  
the watershed



0

policies totaling  
approximately \$0 in  
coverage

0

claims for structures  
repeatedly damaged  
by flood in the  
watershed

\$0

in severe repetitive  
loss in the  
watershed

100%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



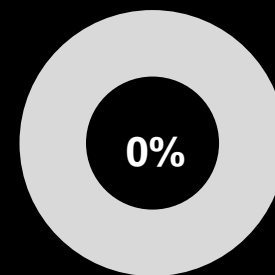
Not participating  
in the National  
Flood Insurance  
Program.



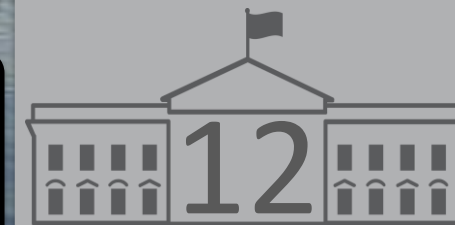
CNMS Stream  
Miles in the  
watershed

0.1

Stream Miles  
Detailed Study in  
the watershed



0%



Flood-related  
presidential disaster  
declarations in your  
county

12



# TOWN OF CORRAL CITY

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Join the National Flood Insurance Program (NFIP)
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. The National Flood Insurance Program (NFIP) insures structures within the Special Flood Hazard Area, provides post-disaster assistance, and encourages local community regulation. More information about [FEMA's HMA grants](#)<sup>1</sup> and about [joining the NFIP](#)<sup>2</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>3</sup> website. The county also creates a county-wide Hazard Mitigation Plan that the community may choose to adopt. Participation in FEMA's [Community Rating System](#)<sup>4</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>5</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

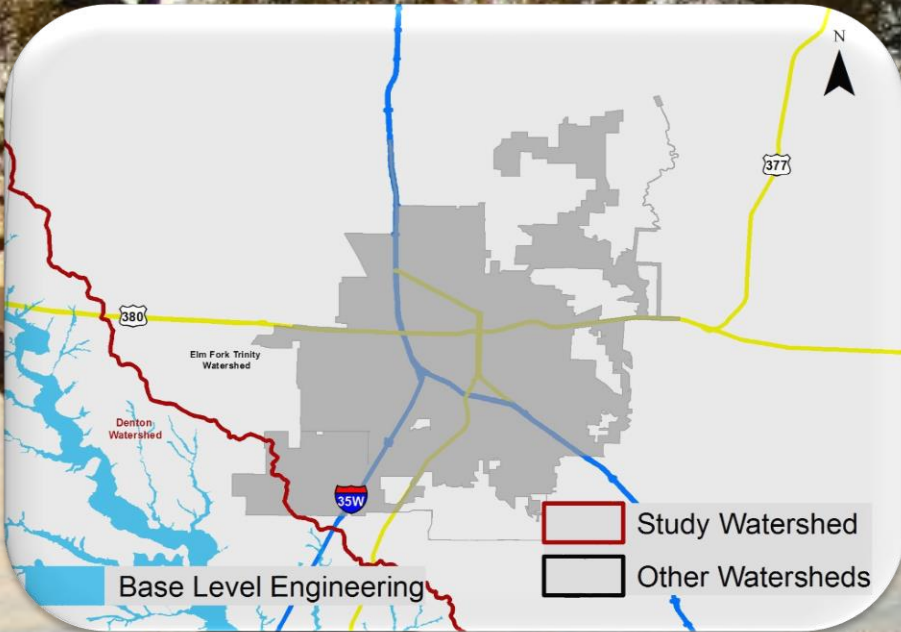
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.fema.gov/media-library/assets/documents/13610>.  
3. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

4. <https://www.fema.gov/community-rating-system>.  
5. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF DENTON

## KNOW YOUR RISK



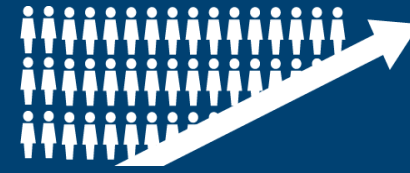
**2.6**  
Sq. Miles

of the community is  
in the watershed



**2,913**

Population based  
on 2010 census in  
the watershed



3.4% expected  
population growth  
from 2010-2021 in  
the watershed



**461**

policies totaling  
approximately  
\$110,251,200 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$0**

in severe repetitive  
loss in the  
watershed

**0.0%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



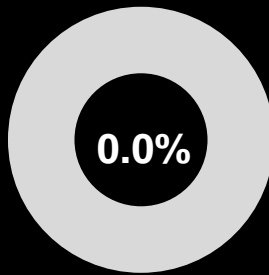
Participating in  
the National  
Flood Insurance  
Program.



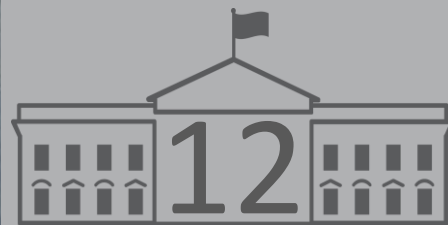
CNMS Stream  
Miles in the  
watershed

**7.2**

Stream Miles  
Detailed Study in  
the watershed



**0.0%**



Flood-related  
presidential disaster  
declarations in your  
county

**12**



# CITY OF DENTON

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

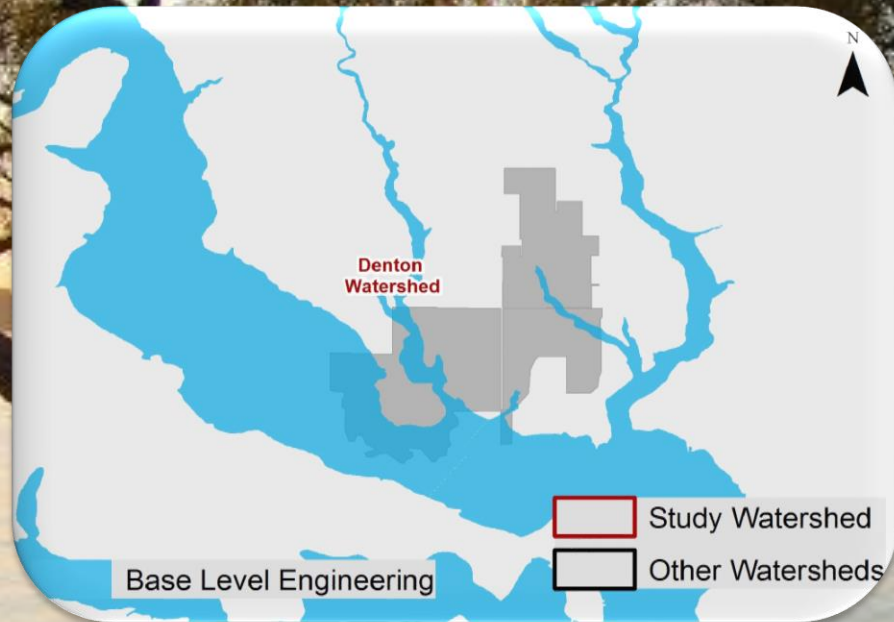
The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.  
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF DISH

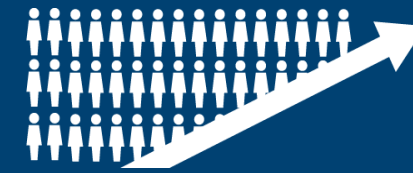
## KNOW YOUR RISK



of the community is in the watershed



Population based on 2010 census in the watershed



policy totaling approximately \$350,000 in coverage



claims for structures repeatedly damaged by flood in the watershed



in severe repetitive loss in the watershed



Of the community's flood-prone areas during a 1%-annual-chance storm event are located in Denton watershed



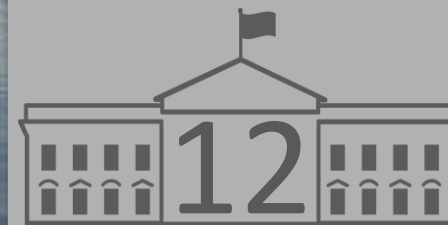
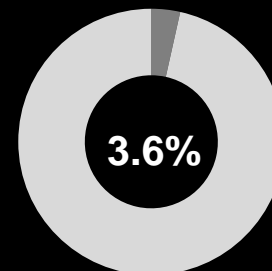
Participating in the National Flood Insurance Program.



CNMS Stream Miles in the watershed



Stream Miles Detailed Study in the watershed



Flood-related presidential disaster declarations in your county



# TOWN OF DISH

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The county also creates a county-wide Hazard Mitigation Plan that the community may choose to adopt. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

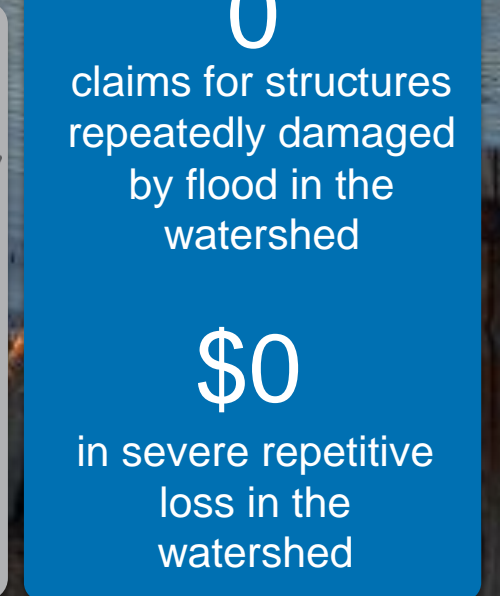
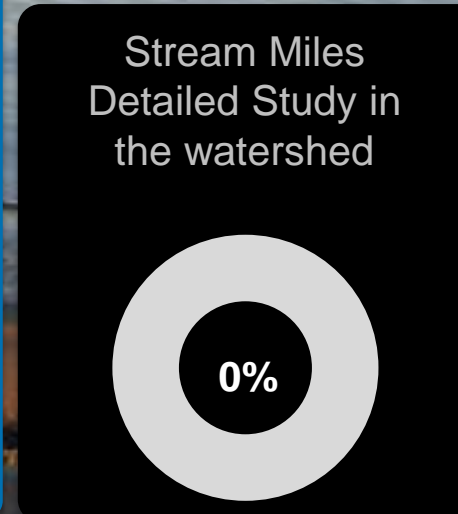
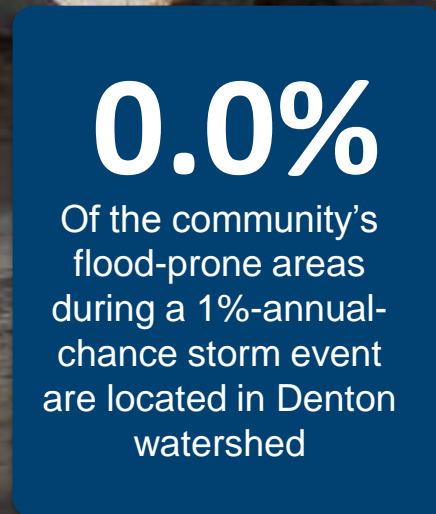
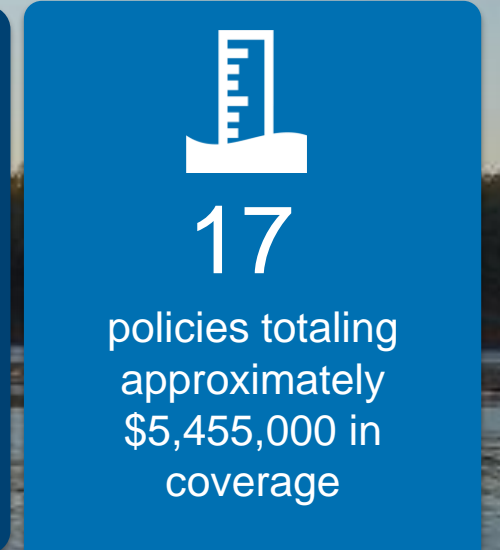
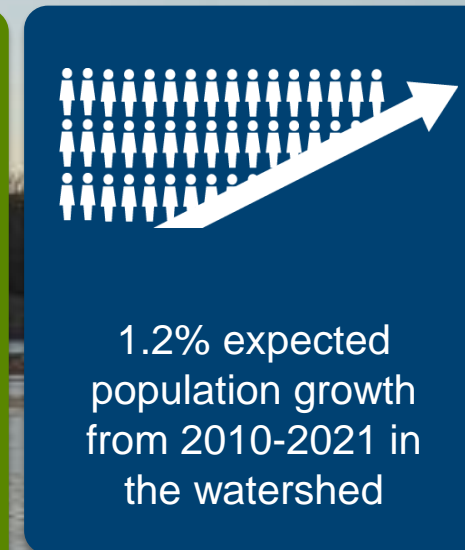
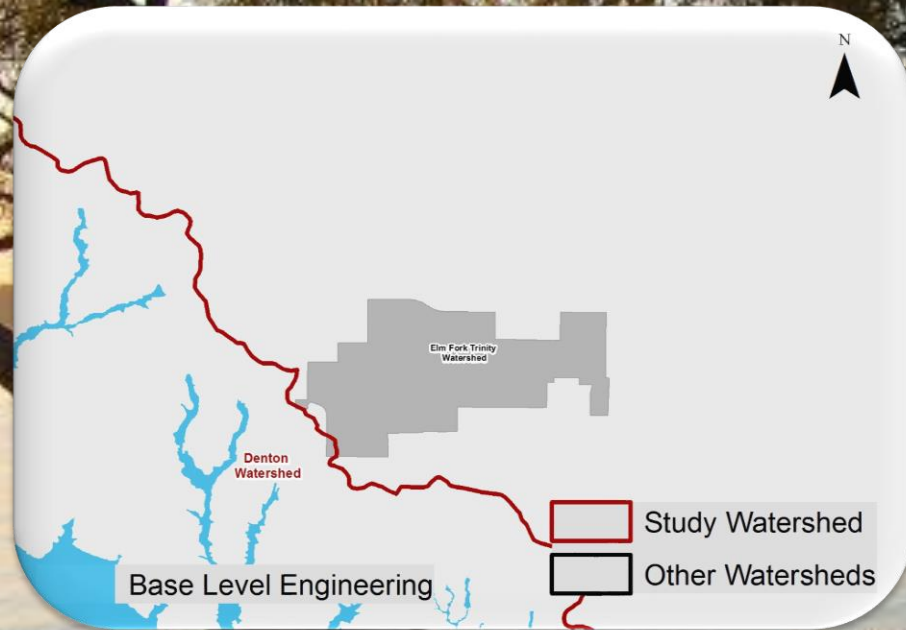
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF DOUBLE OAK

## KNOW YOUR RISK





# TOWN OF DOUBLE OAK

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

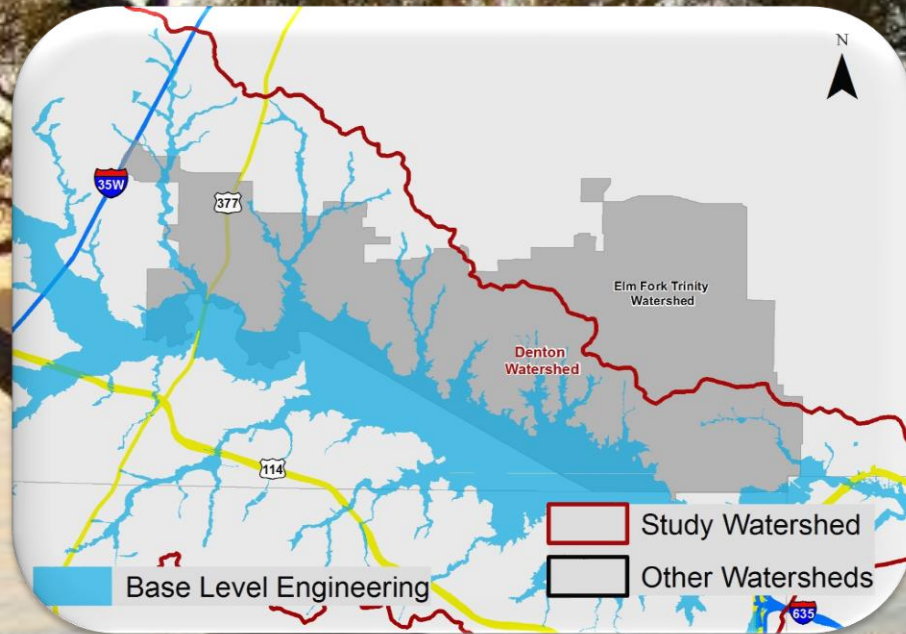
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF FLOWER MOUND

## KNOW YOUR RISK



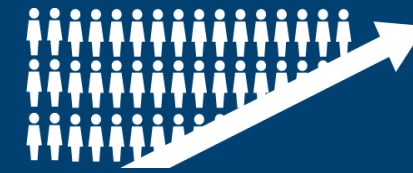
**31.9**  
Sq. Miles

of the community is  
in the watershed



**45,867**

Population based  
on 2010 census in  
the watershed



1.9% expected  
population growth  
from 2010-2021 in  
the watershed



**276**

policies totaling  
approximately  
\$76,248,200 in  
coverage

**2**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**90.1%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



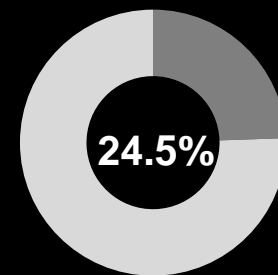
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**91.9**

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

**\$6.5K**

in severe repetitive  
loss in the  
watershed



# CITY OF FLOWER MOUND

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

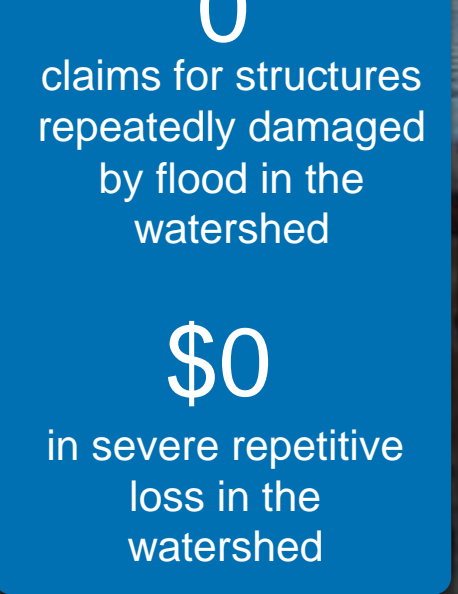
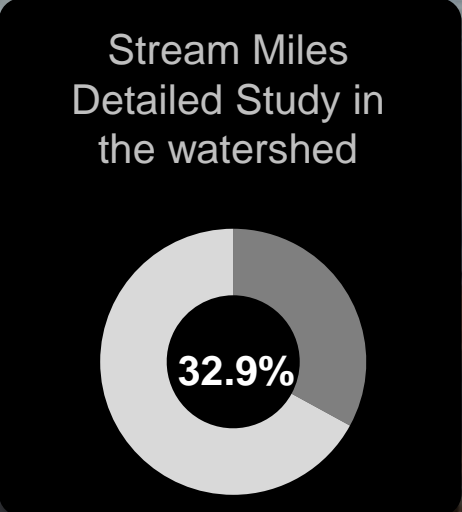
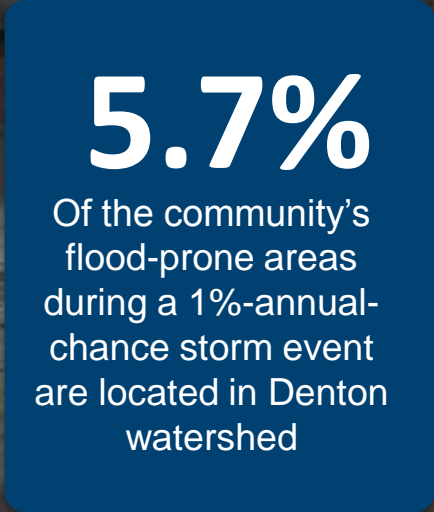
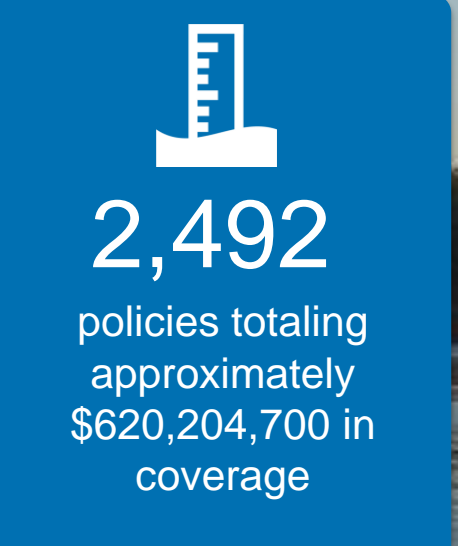
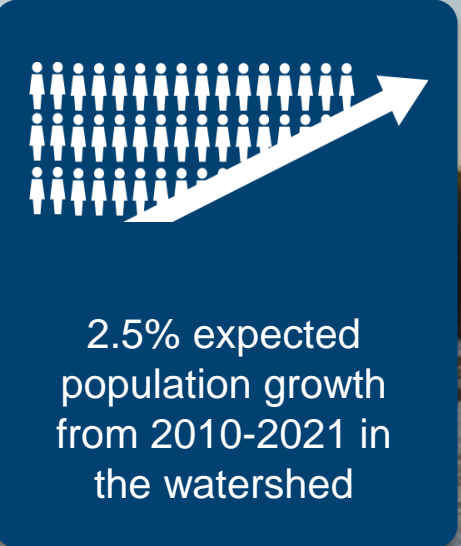
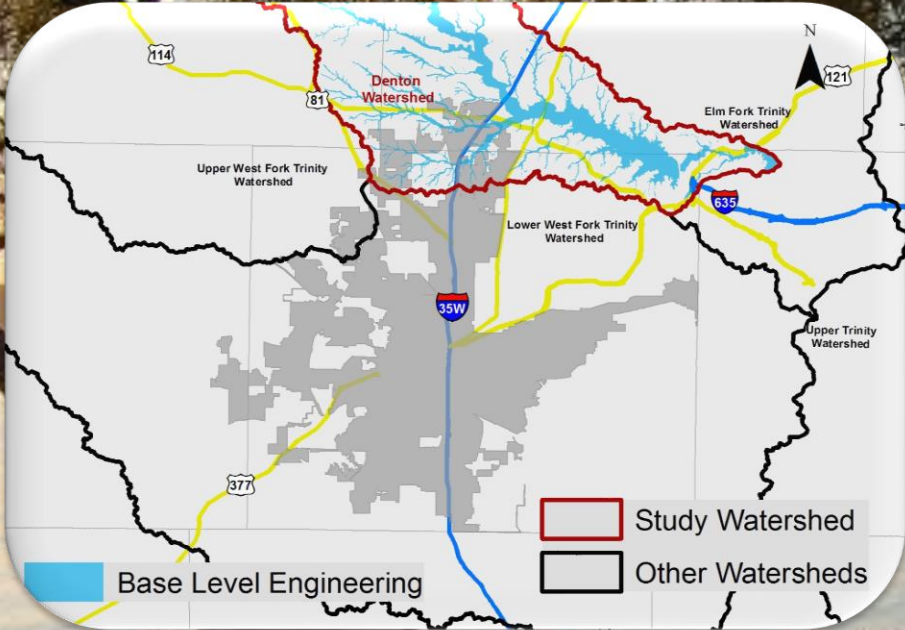
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF FORT WORTH

## KNOW YOUR RISK





# CITY OF FORT WORTH

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020**.

The hazard mitigation goals identified projects for:

- Enhance current warning system
- Public awareness programs
- Study and improve drainage utility infrastructure to minimize or reduce the impact of stormwater on roadways
- Perform breach analysis for high hazard dams and levees

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](https://www.fema.gov/hazard-mitigation-assistance)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

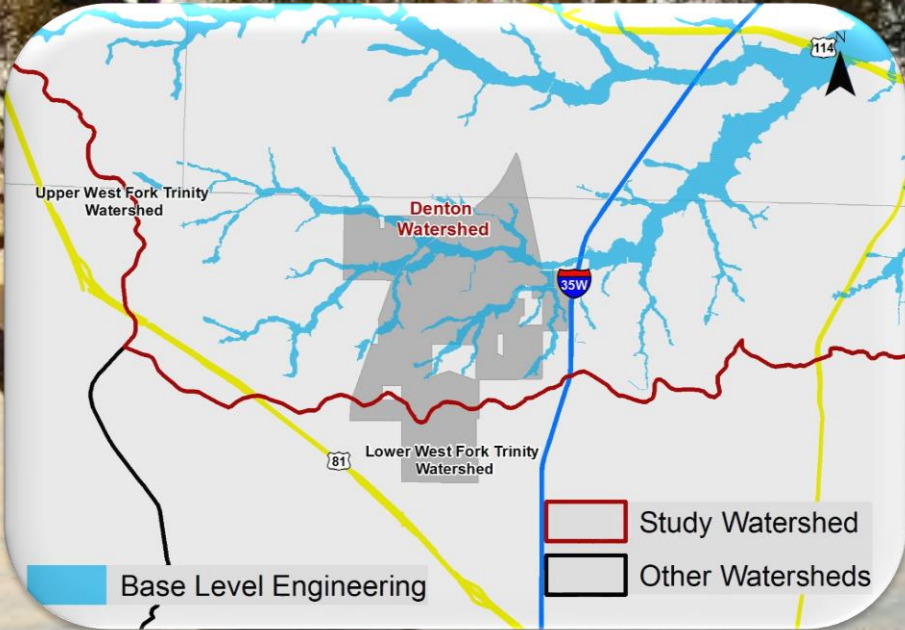
[Texas Water Development Board's](https://www.twdb.texas.gov/financial/programs/)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans that provide additional funding or loans for dam studies and engineering plans, as well as flood reduction projects to improve drainage of flood waters.

1 <https://www.fema.gov/hazard-mitigation-assistance>.  
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF HASLET

## KNOW YOUR RISK

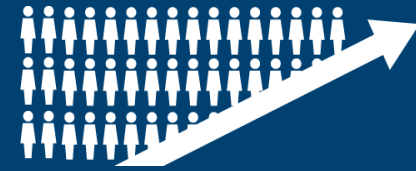


of the community is in the watershed



1,268

Population based on 2010 census in the watershed



1.8% expected population growth from 2010-2021 in the watershed



13

policies totaling approximately \$4,095,600 in coverage

0

claims for structures repeatedly damaged by flood in the watershed

\$0

in severe repetitive loss in the watershed

100%

Of the community's flood-prone areas during a 1%-annual-chance storm event are located in Denton watershed



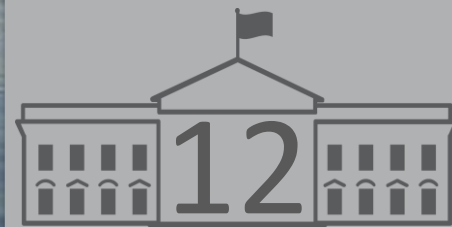
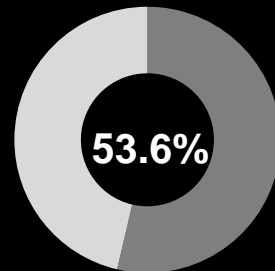
Participating in the National Flood Insurance Program.



CNMS Stream Miles in the watershed

20.0

Stream Miles Detailed Study in the watershed



Flood-related presidential disaster declarations in your county

12



# CITY OF HASLET

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020**.

The hazard mitigation goals identified projects for:

- Public facilities improvement
- Enhance current warning system
- Maintain Community Emergency Response Team (CERT) program
- Join Community Rating System (CRS)
- Acquisition of flood prone structures

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure, including public facilities. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The county also creates a county-wide Hazard Mitigation Plan that the community may choose to adopt. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for acquisition or flood-proofing insured, and building water quality and green infrastructure. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of sever repetitive loss residential structures.

Community Emergency Response Team (CERT) programs are volunteer-based and do not have funding options from FEMA or TWDB. However, CERTs can be registered as non-profit organizations or incorporated in community budgets. Further information is located on the [CERT website](#)<sup>5</sup>.

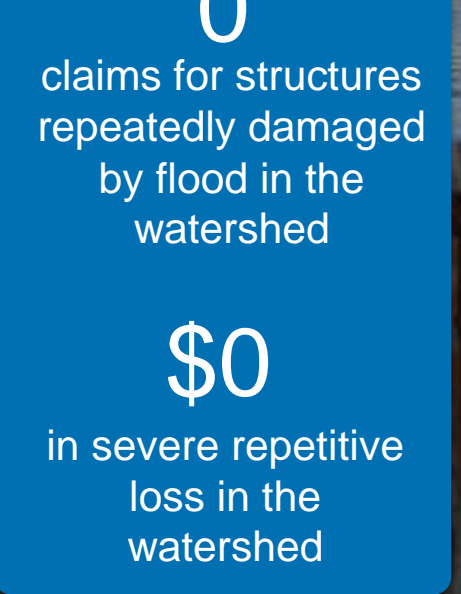
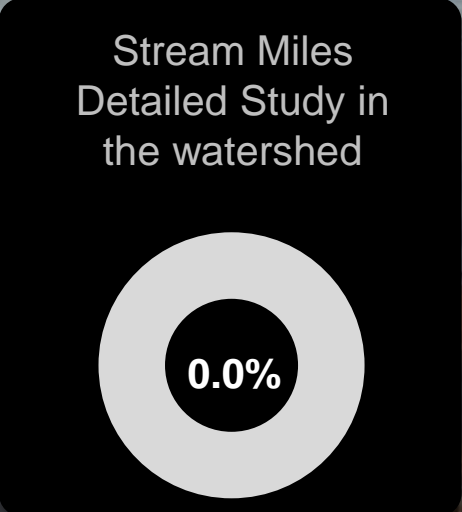
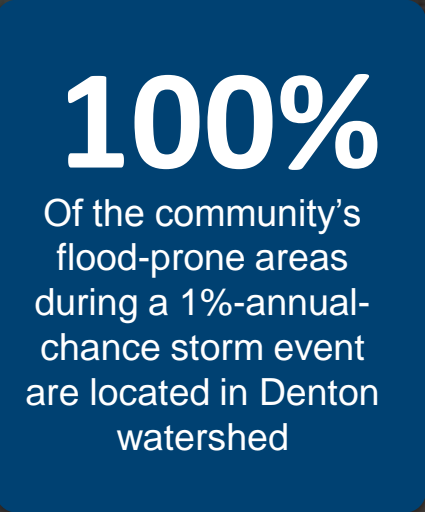
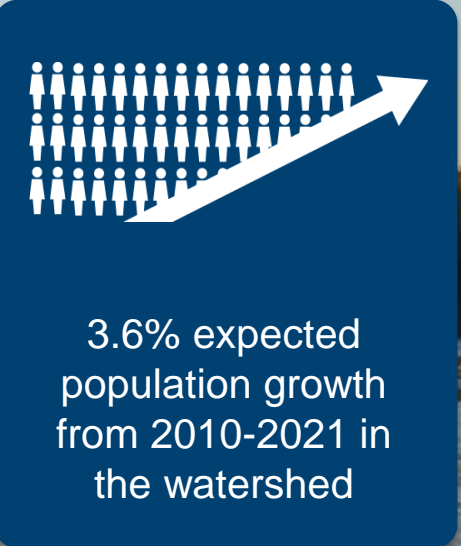
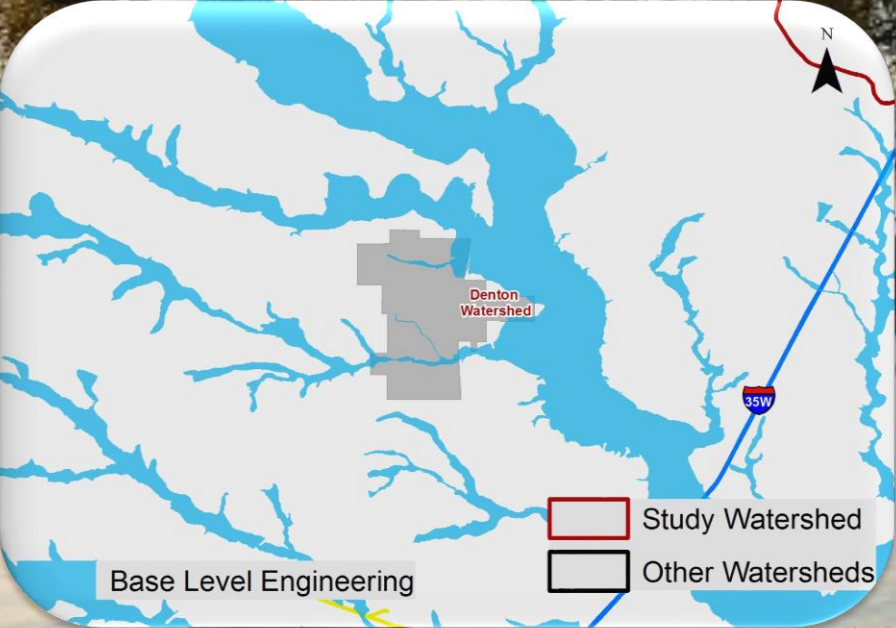
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.  
5. <https://www.nationalservice.gov/resources/disaster-services/starting-cert-program-your-community>.



# CITY OF JUSTIN

## KNOW YOUR RISK





# CITY OF JUSTIN

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

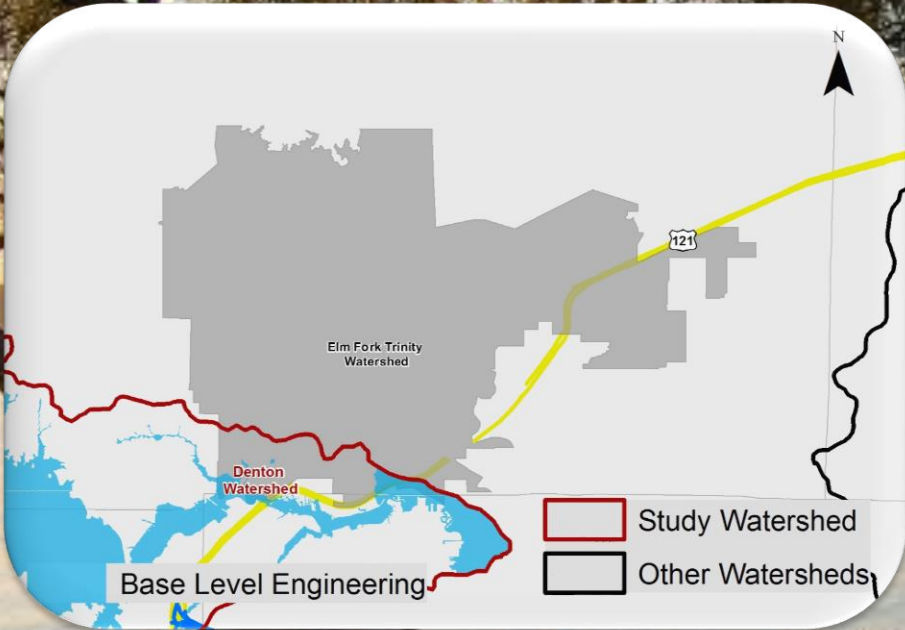
The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.  
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF LEWISVILLE

## KNOW YOUR RISK

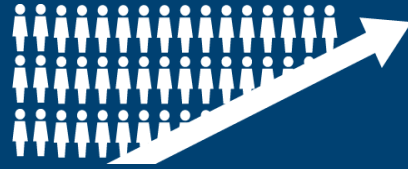


of the community is  
in the watershed



6,775

Population based  
on 2010 census in  
the watershed



0.5% expected  
population growth  
from 2010-2021 in  
the watershed



182

policies totaling  
approximately  
\$55,334,800 in  
coverage

0

claims for structures  
repeatedly damaged  
by flood in the  
watershed

\$0

in severe repetitive  
loss in the  
watershed

3.0%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



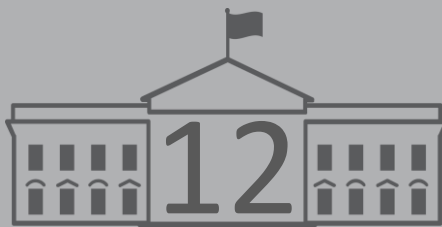
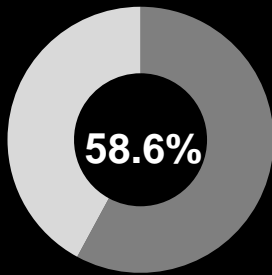
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

3.7

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

12



# CITY OF LEWISVILLE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

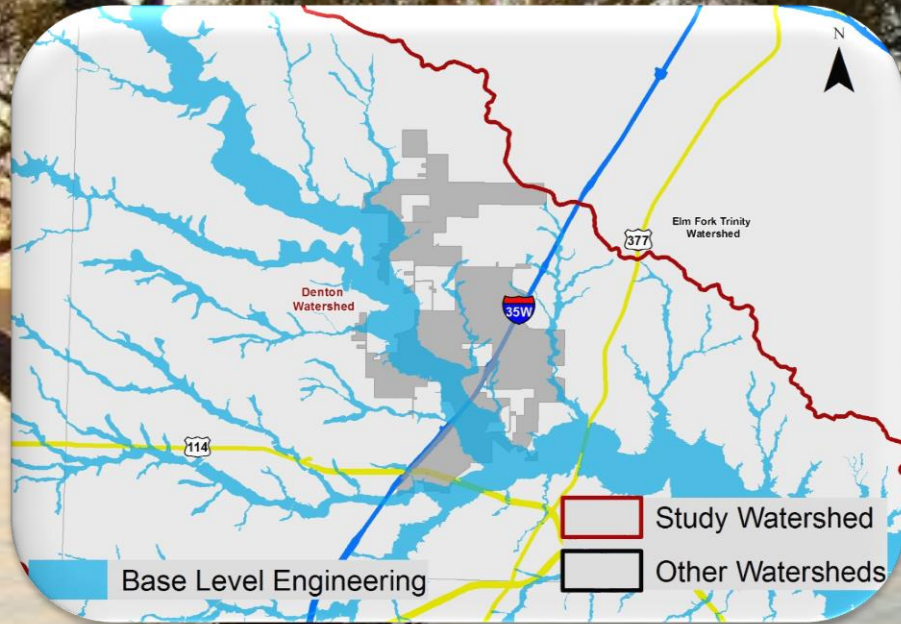
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF NORTHLAKE

## KNOW YOUR RISK



**16.7**  
Sq. Miles

of the community is  
in the watershed



**1,719**

Population based  
on 2010 census in  
the watershed



3.0% expected  
population growth  
from 2010-2021 in  
the watershed



**3**

policies totaling  
approximately  
\$1,125,000 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$0**

in severe repetitive  
loss in the  
watershed

**100%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



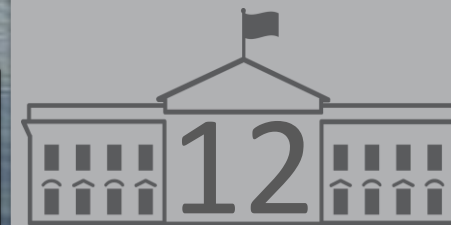
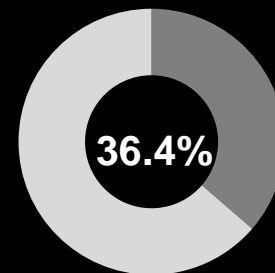
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**42.1**

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

**12**



# TOWN OF NORTHLAKE

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The county also creates a county-wide Hazard Mitigation Plan that the community may choose to adopt. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

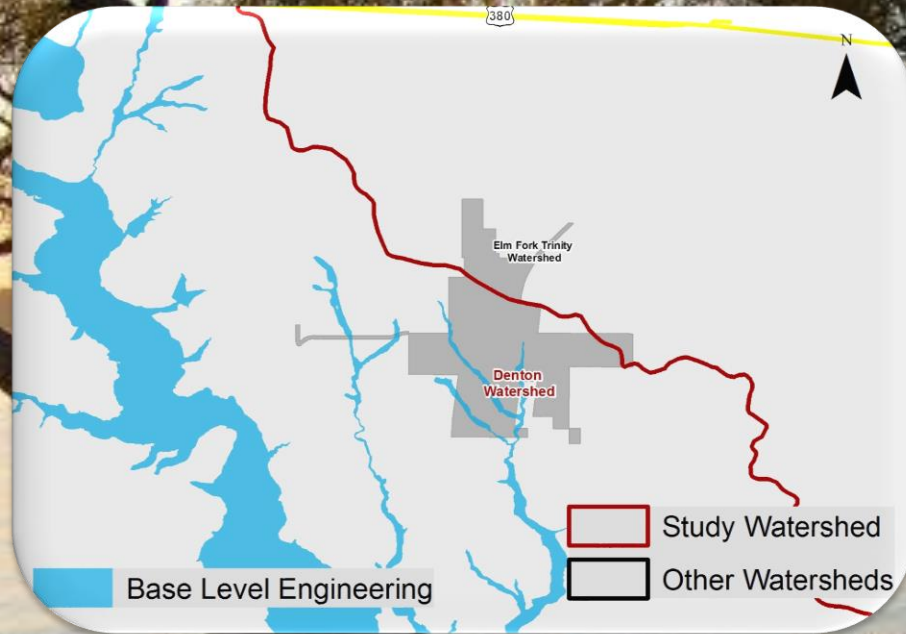
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# TOWN OF PONDER

## KNOW YOUR RISK

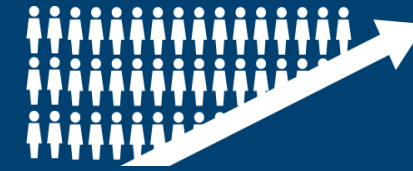


of the community is in the watershed



1,116

Population based on 2010 census in the watershed



3.1% expected population growth from 2010-2021 in the watershed



2

policies totaling approximately \$411,800 in coverage

0

claims for structures repeatedly damaged by flood in the watershed

\$0

in severe repetitive loss in the watershed

100%

Of the community's flood-prone areas during a 1%-annual-chance storm event are located in Denton watershed



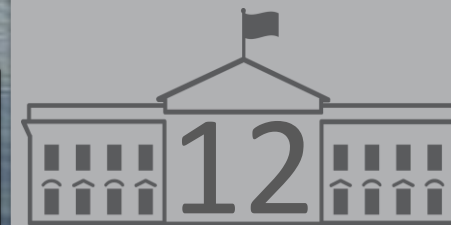
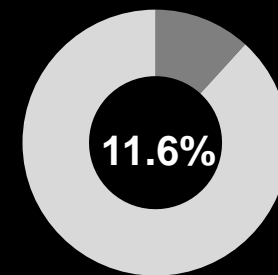
Participating in the National Flood Insurance Program.



CNMS Stream Miles in the watershed

3.4

Stream Miles Detailed Study in the PMR study area



Flood-related presidential disaster declarations in your county

12



# TOWN OF PONDER

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

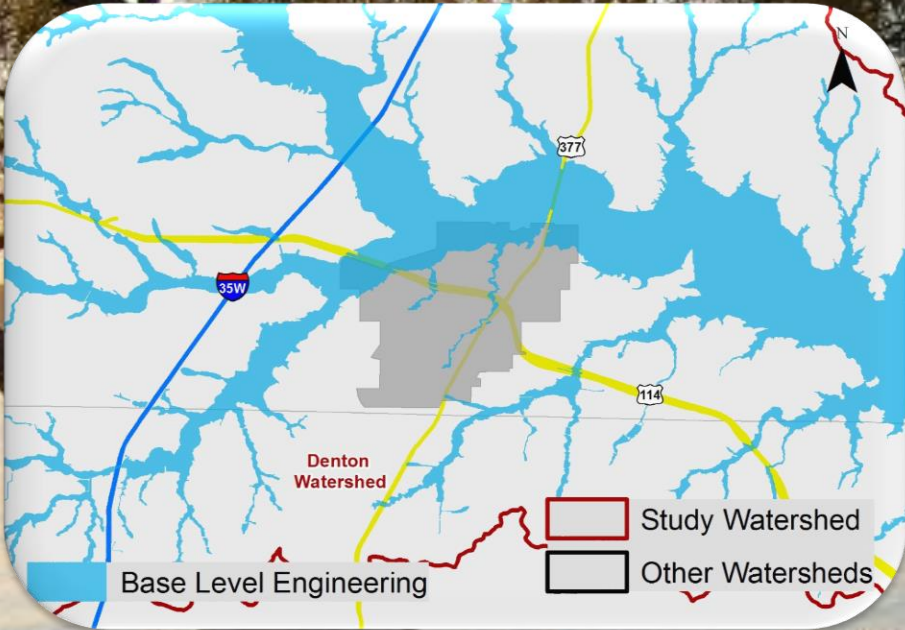
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF ROANOKE

## KNOW YOUR RISK

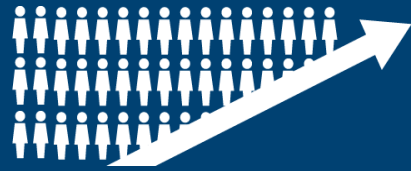


of the community is in the watershed



6,040

Population based on 2010 census in the watershed



4.8% expected population growth from 2010-2021 in the watershed



5

policies totaling approximately \$1,760,000 in coverage

0

claims for structures repeatedly damaged by flood in the watershed

\$0

in severe repetitive loss in the watershed

100%

Of the community's flood-prone areas during a 1%-annual-chance storm event are located in Denton watershed



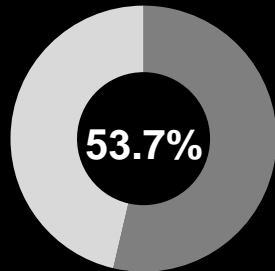
Participating in the National Flood Insurance Program.



CNMS Stream Miles in the watershed

8.2

Stream Miles Detailed Study in the watershed



Flood-related presidential disaster declarations in your county

12



# CITY OF ROANOKE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **March 10, 2021**.

The hazard mitigation goals identified projects for:

- Regulate construction which alters floodplains, channels, and protective barriers
- Prohibit grading changes and other developments which increase flood damage
- Implement voluntary building codes to mitigate flood damage in flood prone structures

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of drainage channels to limit the impact of floodwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which can be used for flood reduction projects such as mapping floodplain updates.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

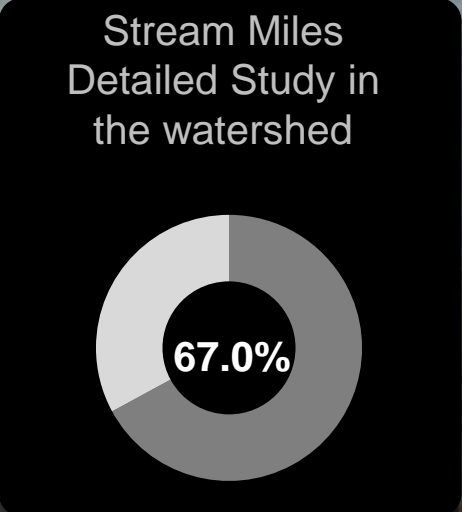
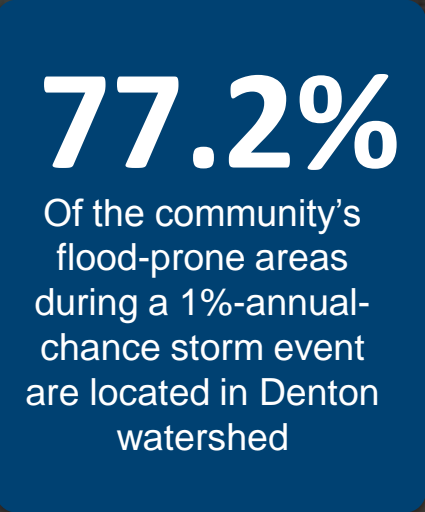
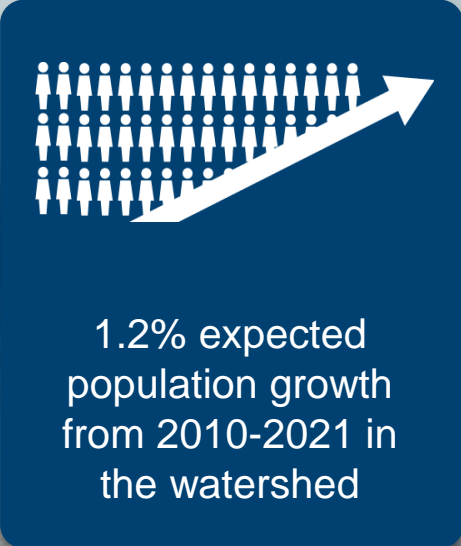
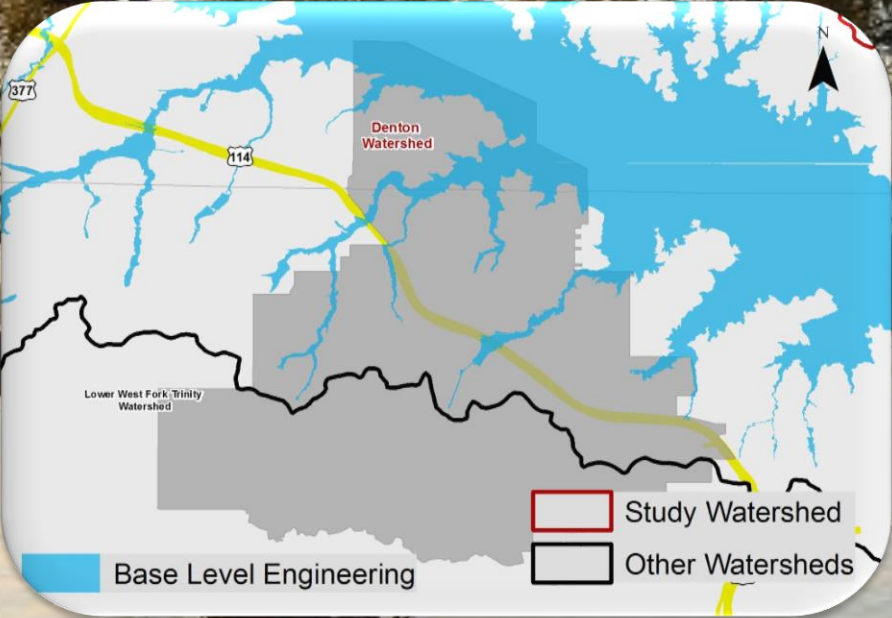
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF SOUTHLAKE

## KNOW YOUR RISK





# CITY OF SOUTHLAKE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020**.

The hazard mitigation goals identified projects for:

- Maintain current warning system
- Improve Community Emergency Response Team (CERT) program
- Design, engineering, and installation of improved drainage utility infrastructure to minimize or reduce the impact of stormwater
- Create multijurisdictional Automatic Vehicle Location (AVL) system for first responders

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for flood reduction projects to improve drainage of flood waters.

Community Emergency Response Team (CERT) programs are volunteer-based and do not have funding options from FEMA or TWDB. However, CERTs can be registered as non-profit organizations or incorporated in community budgets. Further information is located on the [CERT website](#)<sup>4</sup>. Multijurisdictional Automatic Vehicle Location (AVL) will unify the emergency response systems for Northeast Tarrant Communications Center (NETCOM) including the communities Colleyville, Keller, Southlake, and Westlake.

<sup>1</sup> <https://www.fema.gov/hazard-mitigation-assistance>.

<sup>2</sup> <http://gohsep.la.gov/GRANTS/RECOVERY-GRANTS/Hazard-Mitigation-Assistance/Hazard-Mitigation-Overview>.

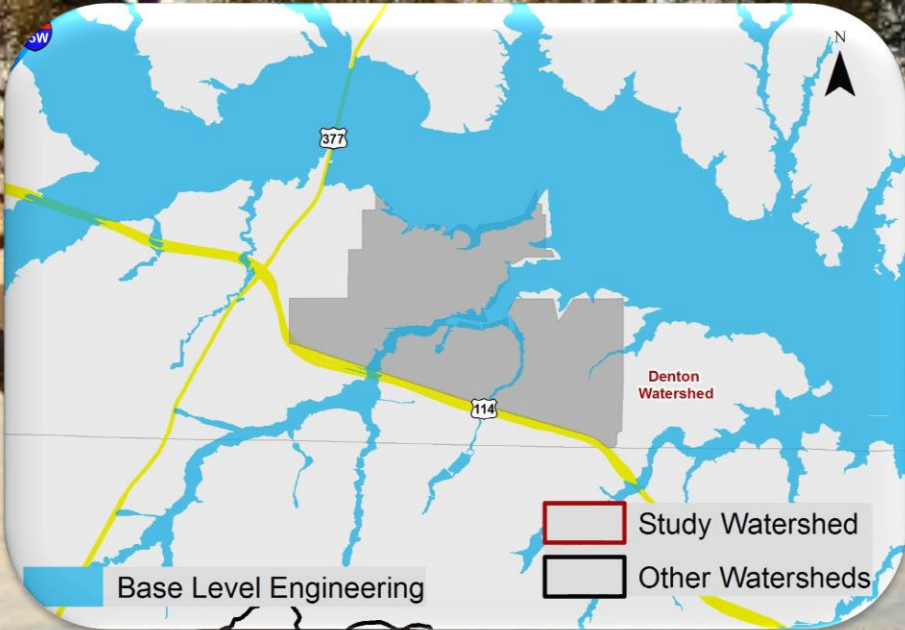
<sup>3</sup> <https://www.epa.gov/green-infrastructure>.

<sup>4</sup> <https://www.nationalservice.gov/resources/disaster-services/starting-cert-program-your-community>.



# CITY OF TROPHY CLUB

## KNOW YOUR RISK

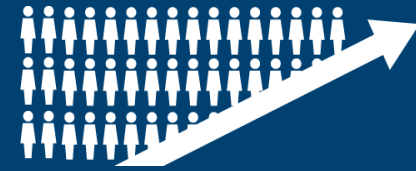


of the community is  
in the watershed



8,024

Population based  
on 2010 census in  
the watershed



1.8% expected  
population growth  
from 2010-2021 in  
the watershed



74

policies totaling  
approximately  
\$22,161,800 in  
coverage

0

claims for structures  
repeatedly damaged  
by flood in the  
watershed

\$0

in severe repetitive  
loss in the  
watershed

100%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



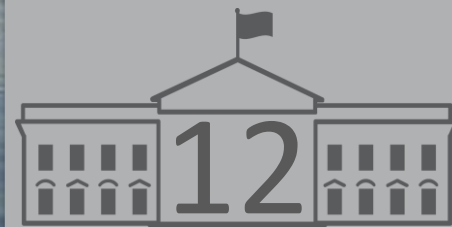
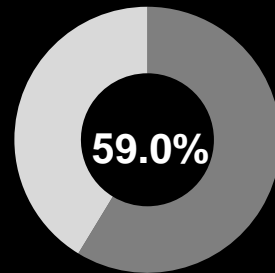
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

4.5

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

12



# CITY OF TROPHY CLUB

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **November 25, 2020**.

The hazard mitigation goals identified projects for:

- Public awareness programs
- Participate in Community Rating System (CRS)
- Complete Storm Water Master plan to improve drainage utility infrastructure to minimize or reduce the impact of stormwater

FEMA's Hazard Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for flood reduction projects to improve drainage of flood waters.

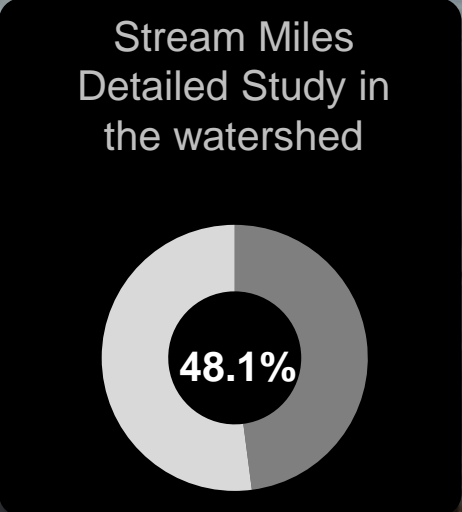
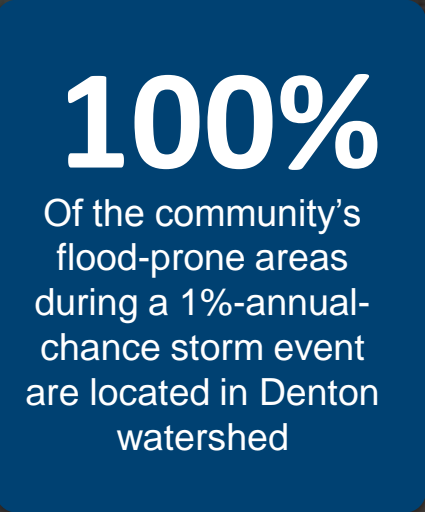
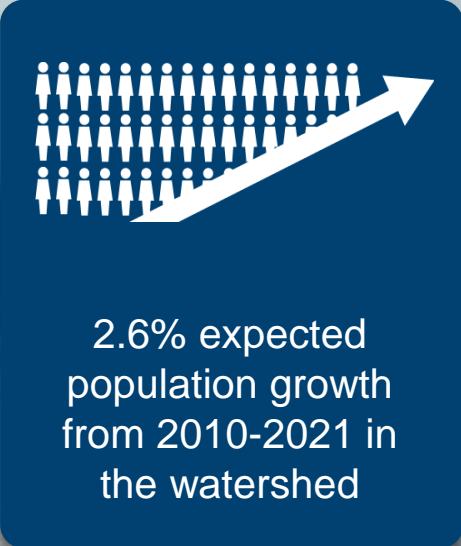
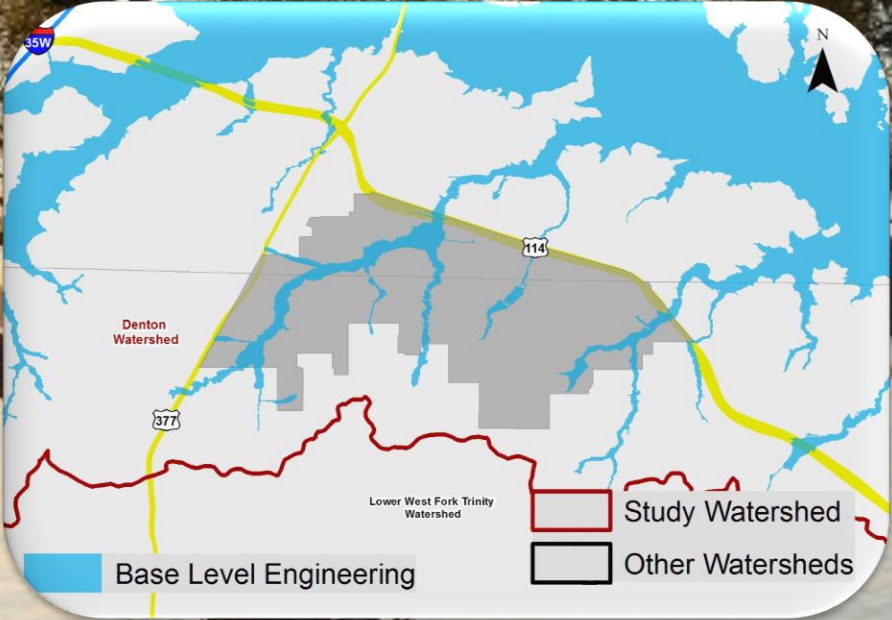
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF WESTLAKE

## KNOW YOUR RISK





# CITY OF WESTLAKE

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020.**

The hazard mitigation goals identified projects for:

- Maintain current warning system
- Create multijurisdictional Automatic Vehicle Location (AVL) system for first responders
- Mitigate damage from dam failure

FEMA's Hazard Mitigation Grant Program (HMGP) includes a 5% Initiative in the HMGP used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. HMGP also provides for post-disaster code enforcement, including damages incurred by dam failure. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for dam studies and engineering plans.

Multijurisdictional Automatic Vehicle Location (AVL) will unify the emergency response systems for Northeast Tarrant Communications Center (NETCOM) including the communities Colleyville, Keller, Southlake, and Westlake.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

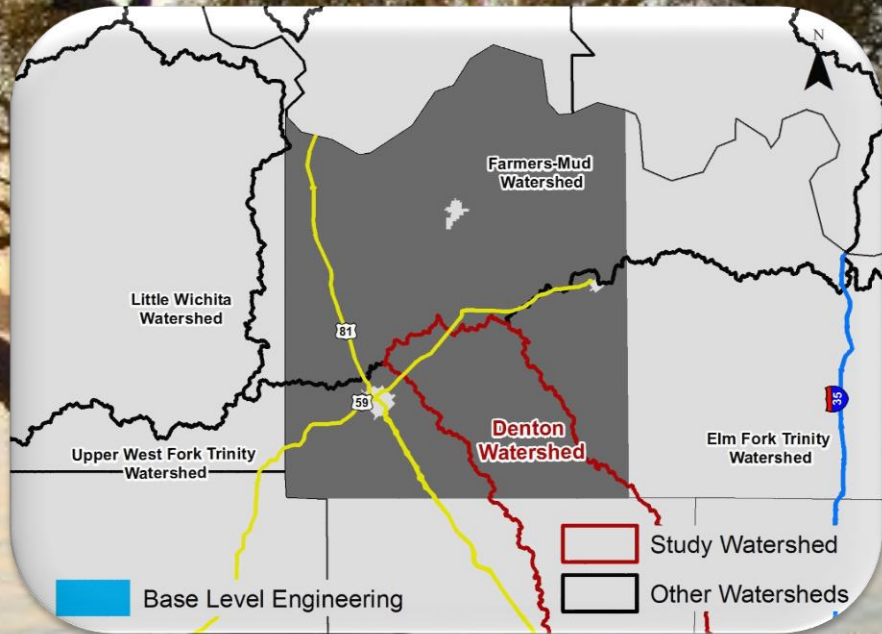
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# MONTAGUE COUNTY

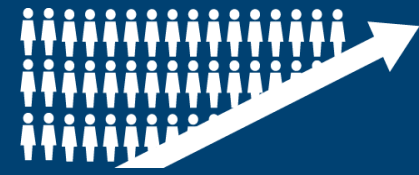
## KNOW YOUR RISK



157  
Sq. Miles  
of the community is  
in the watershed



1,750  
Population based  
on 2010 census in  
the watershed



0.0% expected  
population growth  
from 2010-2021 in  
the watershed



72  
policies totaling  
approximately  
\$14,284,200 in  
coverage



0  
claims for structures  
repeatedly damaged  
by flood in the  
watershed

4.6%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



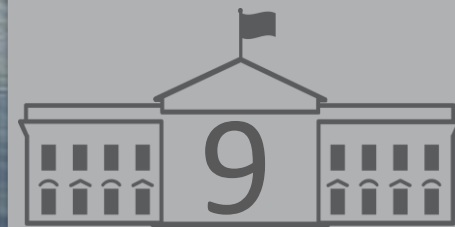
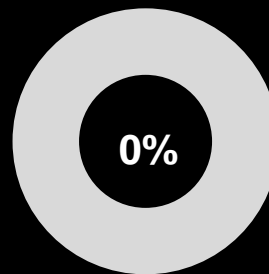
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

446.8

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
parish

\$0

in severe repetitive  
loss in the  
watershed



# MONTAGUE COUNTY

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

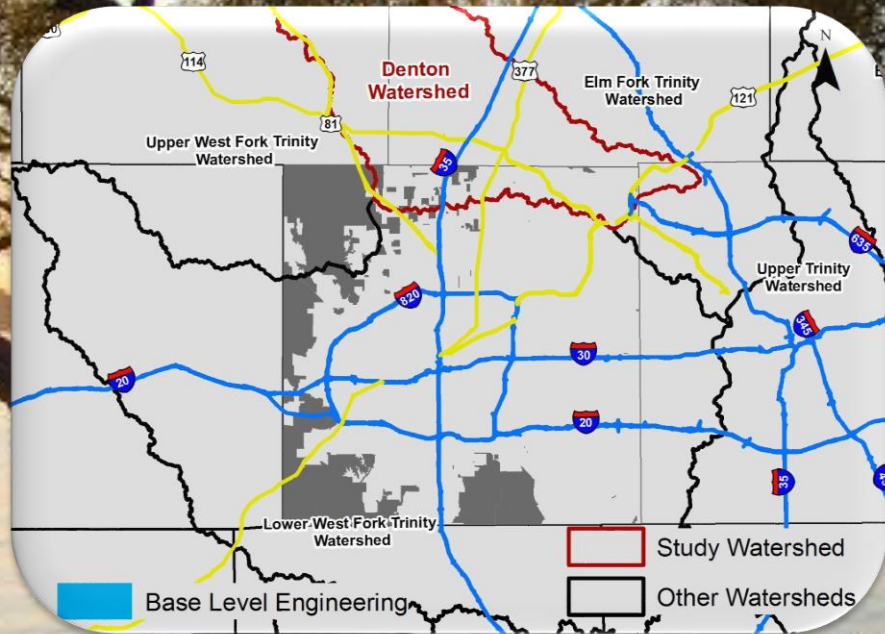
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# TARRANT COUNTY

## KNOW YOUR RISK



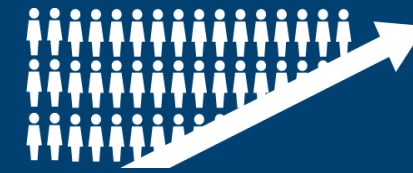
7.1  
Sq. Miles

of the community is  
in the watershed



242

Population based  
on 2010 census in  
the watershed



1.4% expected  
population growth  
from 2010-2021 in  
the watershed



469

policies totaling  
approximately  
\$121,350,300 in  
coverage

2

claims for structures  
repeatedly damaged  
by flood in the  
watershed

\$4M

in severe repetitive  
loss in the  
watershed

0.8%

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



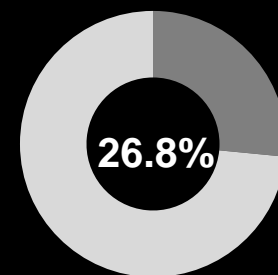
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

14.7

Stream Miles  
Detailed Study in  
the watershed



14

Flood-related  
presidential disaster  
declarations in your  
county



# TARRANT COUNTY

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020**.

The hazard mitigation goals identified projects for:

- Enhance current warning system
- Participate in Community Rating System (CRS)
- Acquisition of flood prone structures
- Public awareness programs
- Inspect dam structural stability and create Emergency Action Plans for high hazard dams
- Study and improve drainage utility infrastructure to minimize or reduce the impact of stormwater on roadways

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure. Additionally, these programs fund localized Flood Risk Reduction Projects including reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for dam studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, and for flood reduction projects to improve drainage of flood waters. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of severe repetitive loss residential structures.

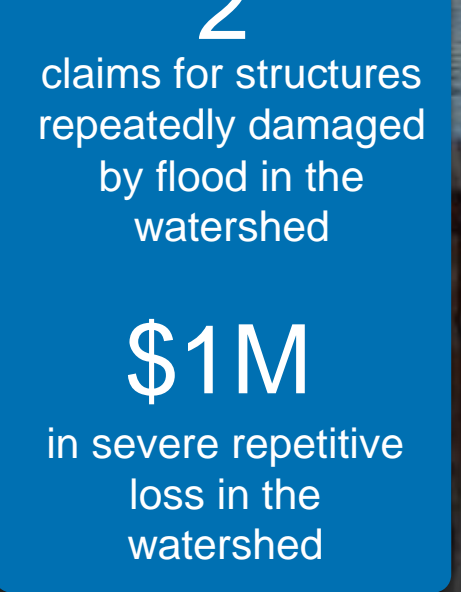
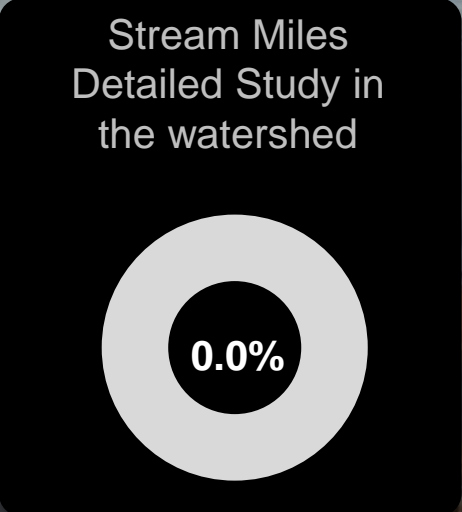
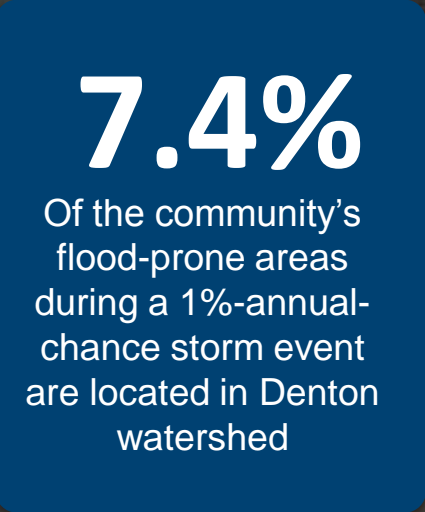
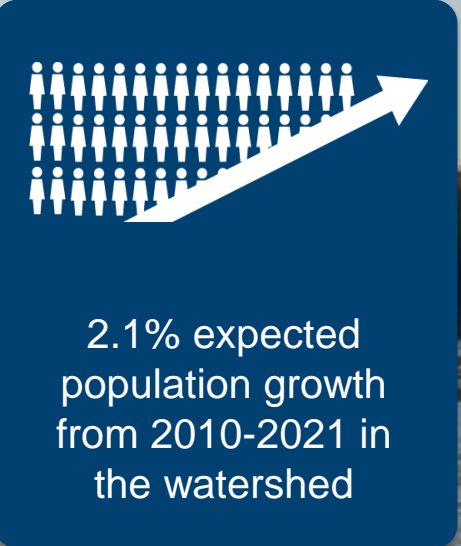
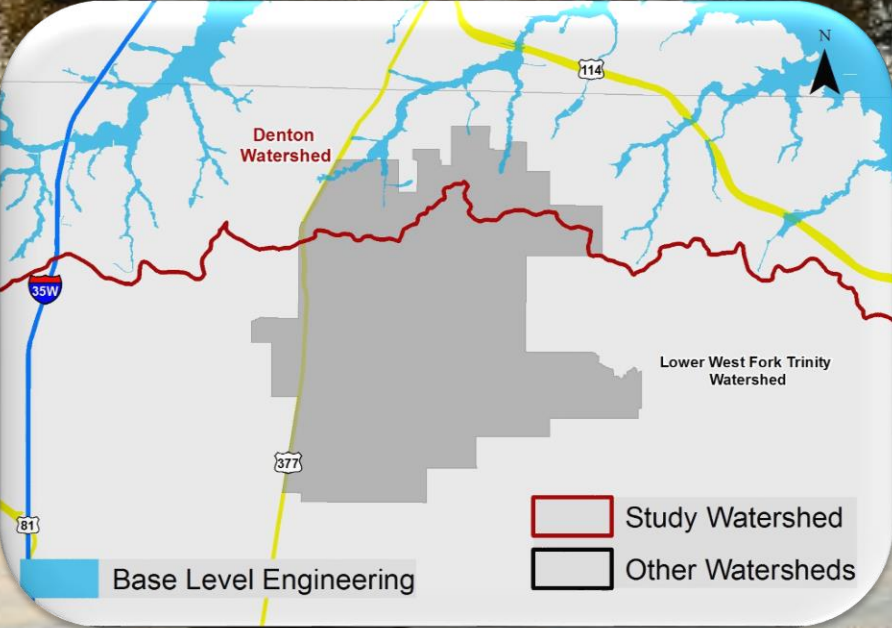
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF KELLER

## KNOW YOUR RISK





# CITY OF KELLER

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 5, 2020.**

The hazard mitigation goals identified projects for:

- Enhance current warning system
- Public awareness programs
- Design, engineering, and installation of improved drainage utility infrastructure to minimize or reduce the impact of stormwater
- Create multijurisdictional Automatic Vehicle Location (AVL) system for first responders

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund localized Flood Risk Reduction Projects including reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for flood reduction projects to improve drainage of flood waters.

Multijurisdictional Automatic Vehicle Location (AVL) will unify the emergency response systems for Northeast Tarrant Communications Center (NETCOM) including the communities Colleyville, Keller, Southlake, and Westlake.

<sup>1</sup> <https://www.fema.gov/hazard-mitigation-assistance>.

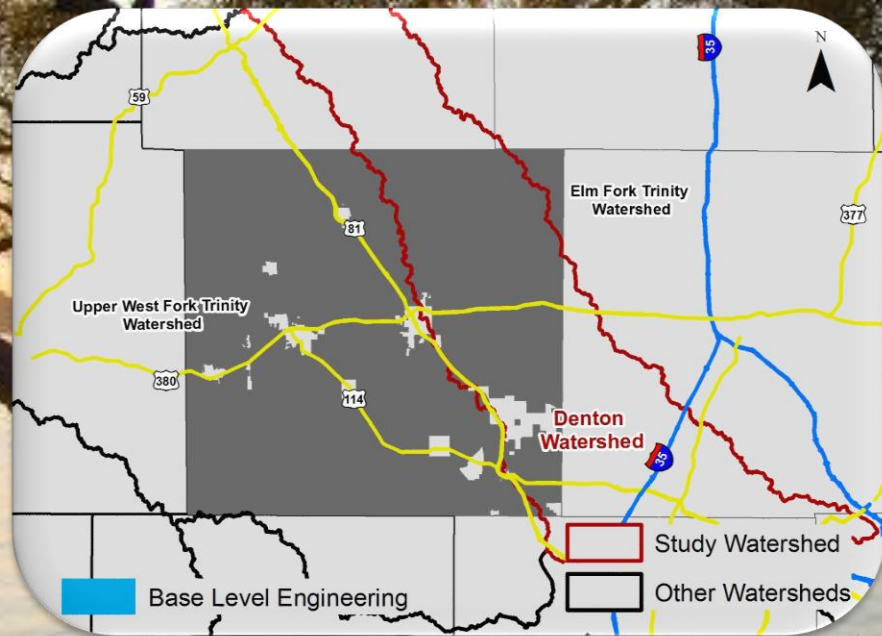
<sup>2</sup> <http://gohsep.la.gov/GRANTS/RECOVERY-GRANTS/Hazard-Mitigation-Assistance/Hazard-Mitigation-Overview>.

<sup>3</sup> <https://www.epa.gov/green-infrastructure>.



# WISE COUNTY

## KNOW YOUR RISK



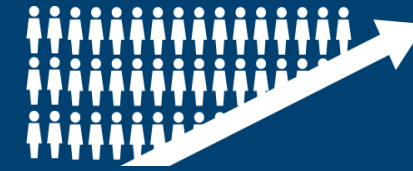
**260.2**  
Sq. Miles

of the community is  
in the watershed



**10,170**

Population based  
on 2010 census in  
the watershed



0.1% expected  
population growth  
from 2010-2021 in  
the watershed



**140**

policies totaling  
approximately  
\$18,881,700 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**20.6%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



Participating in  
the National  
Flood Insurance  
Program.

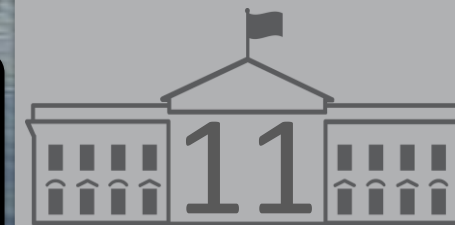


CNMS Stream  
Miles in the  
watershed

**720.2**

Stream Miles  
Detailed Study in  
the watershed

**0.0%**



Flood-related  
presidential disaster  
declarations in your  
parish

**\$0**

in severe repetitive  
loss in the  
watershed



# WISE COUNTY

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **November 30, 2020.**

The hazard mitigation goals identified projects for:

- Acquisition of flood prone structures
- Public awareness programs
- Design, engineering, and installation of drainage utility infrastructure to minimize or reduce the low water crossings

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all allow for acquisition, demolition, relocation, or retrofits to existing structures and infrastructure. These grants also provide for the reconstruction of culverts and drainage channels to limit the impact of stormwater on existing infrastructure. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans can be used for acquisition or flood-proofing insured structures, as well as for flood reduction projects to improve drainage of flood waters. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist acquisition or flood-proofing of severe repetitive loss residential structures.

1 <https://www.fema.gov/hazard-mitigation-assistance>.

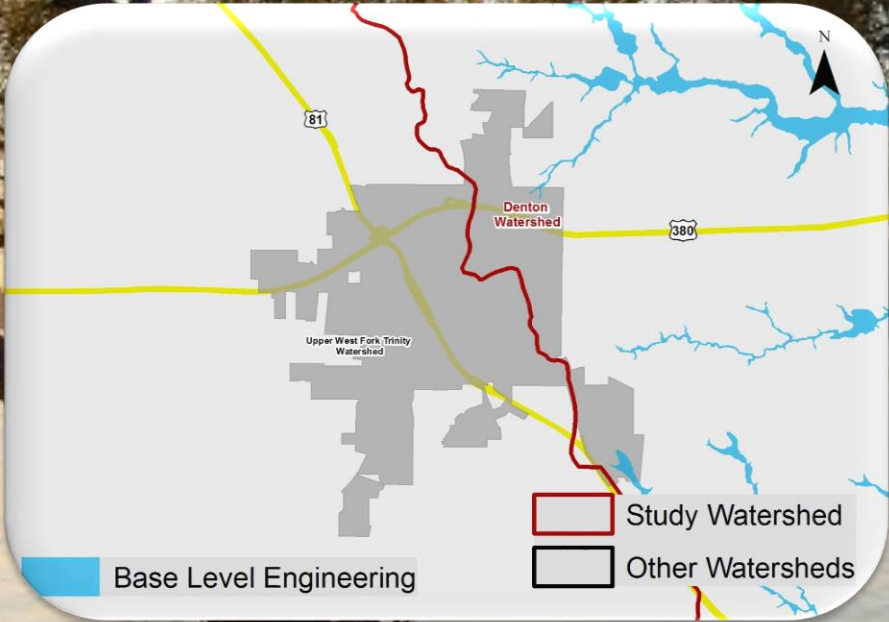
2 <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.

3. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF DECATUR

## KNOW YOUR RISK



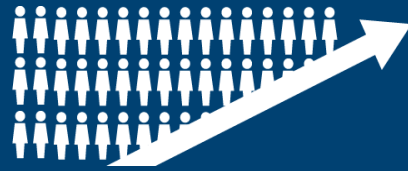
**2.4**  
Sq. Miles

of the community is  
in the watershed



**1,798**

Population based  
on 2010 census in  
the watershed



0.5% expected  
population growth  
from 2010-2021 in  
the watershed



**12**

policies totaling  
approximately  
\$3,697,000 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**\$0**

in severe repetitive  
loss in the  
watershed

**20.7%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



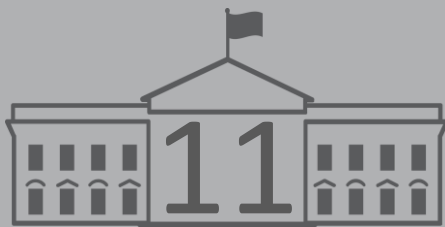
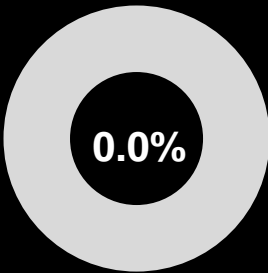
Participating in  
the National  
Flood Insurance  
Program.



CNMS Stream  
Miles in the  
watershed

**3.4**

Stream Miles  
Detailed Study in  
the watershed



Flood-related  
presidential disaster  
declarations in your  
county

**11**



# CITY OF DECATUR

## TAKE ACTION: Potential Next Step



Your Hazard Mitigation Plan is set to expire **August 8, 2021**.

The hazard mitigation goals identified projects for:

- Create Community Emergency Response Team (CERT) program
- Public awareness programs
- Implement voluntary building codes to mitigate flood damage in flood prone structures
- Update floodplain mapping and Flood Insurance Study (FIS)
- Enforce floodplain management standards in new construction

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all provide funding for voluntary retrofits to existing structures and infrastructure for flood-proofing insured structures. There may be eligibility, benefit cost analysis, and cost-share requirements. The 5% Initiative in the HMGP is used for projects for which it may be difficult to conduct a standard BCA to prove cost-effectiveness, such as emergency notification, public awareness, or sirens. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. County emergency managers or the State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>3</sup> Clean and Drinking Water State Revolving Fund (CWSRF) and Texas Water Development Fund (DFund) are long term-fixed interest loans which offer grant money for flood reduction projects including FIS updates. TWDB also funds the Severe Repetitive Loss (SRL) Grant, which can assist communities in engineering designs, acquisition or water-proofing of severe repetitive loss residential structures.

The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in the floodplain.

Community Emergency Response Team (CERT) programs are volunteer-based and do not have funding options from FEMA or TWDB. However, CERTs can be registered as non-profit organizations or incorporated in community budgets. Further information is located on the [CERT website](#)<sup>4</sup>.

<sup>1</sup> <https://www.fema.gov/hazard-mitigation-assistance>.

<sup>2</sup> <http://gohsep.la.gov/GRANTS/RECOVERY-GRANTS/Hazard-Mitigation-Assistance/Hazard-Mitigation-Overview>.

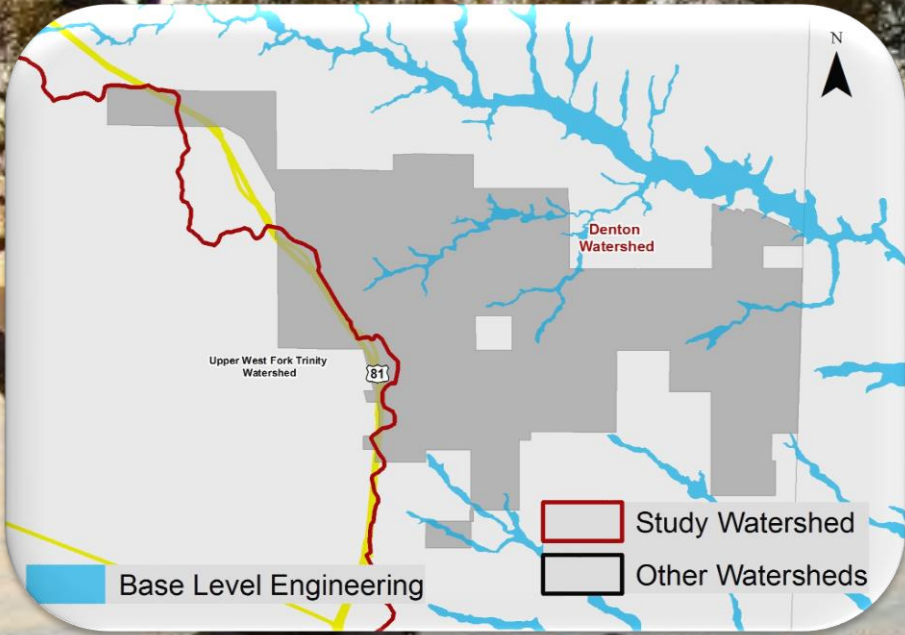
<sup>3</sup> <https://www.epa.gov/green-infrastructure>.

<sup>4</sup> <https://www.nationalservice.gov/resources/disaster-services/starting-cert-program-your-community>.



# CITY OF NEW FAIRVIEW

## KNOW YOUR RISK



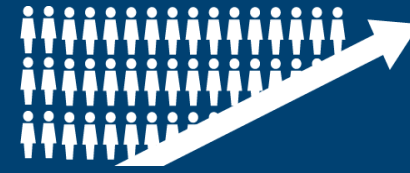
**14.5**  
Sq. Miles

of the community is  
in the watershed



**1,147**

Population based  
on 2010 census in  
the watershed



0.2% expected  
population growth  
from 2010-2021 in  
the watershed



**3**

policies totaling  
approximately  
\$640,000 in  
coverage

**0**

claims for structures  
repeatedly damaged  
by flood in the  
watershed

**97.9%**

Of the community's  
flood-prone areas  
during a 1%-annual-  
chance storm event  
are located in Denton  
watershed



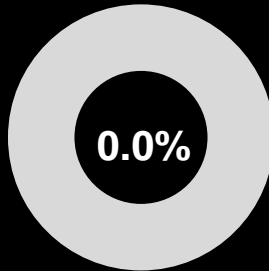
Participating in  
the National  
Flood Insurance  
Program.



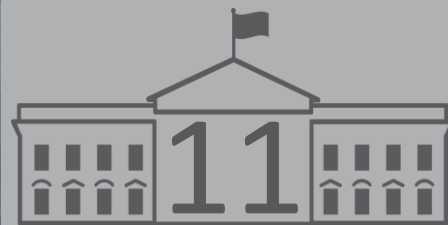
CNMS Stream  
Miles in the  
watershed

**33.2**

Stream Miles  
Detailed Study in  
the watershed



**0.0%**



Flood-related  
presidential disaster  
declarations in your  
parish

**11**

**\$0**

in severe repetitive  
loss in the  
watershed



# CITY OF NEW FAIRVIEW

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

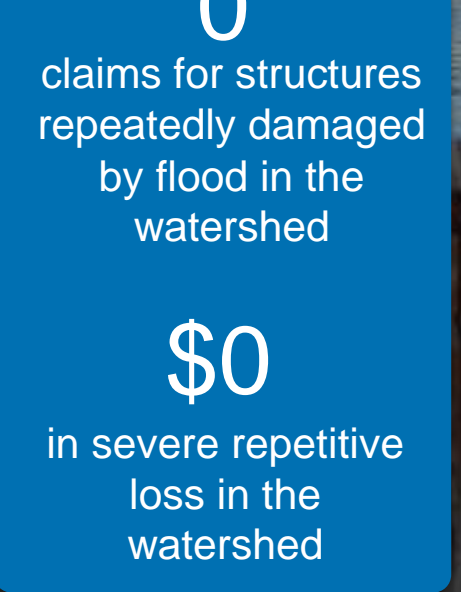
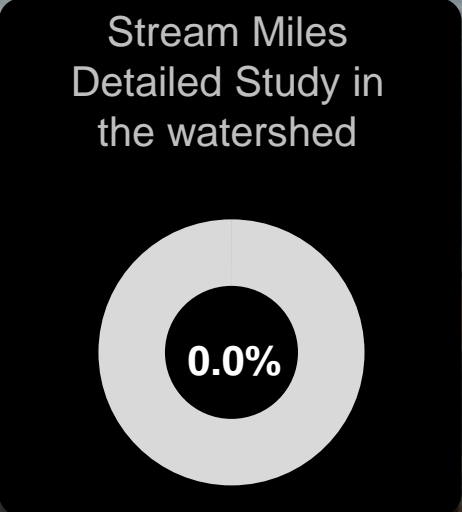
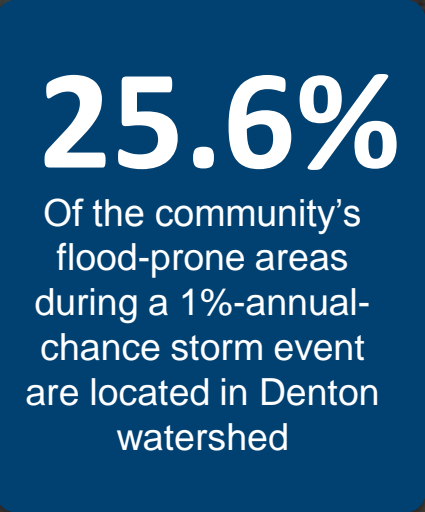
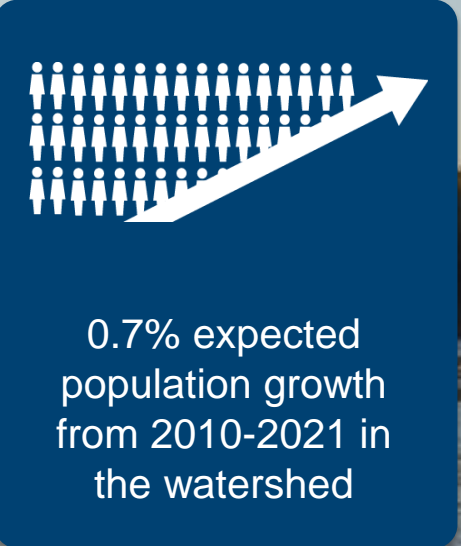
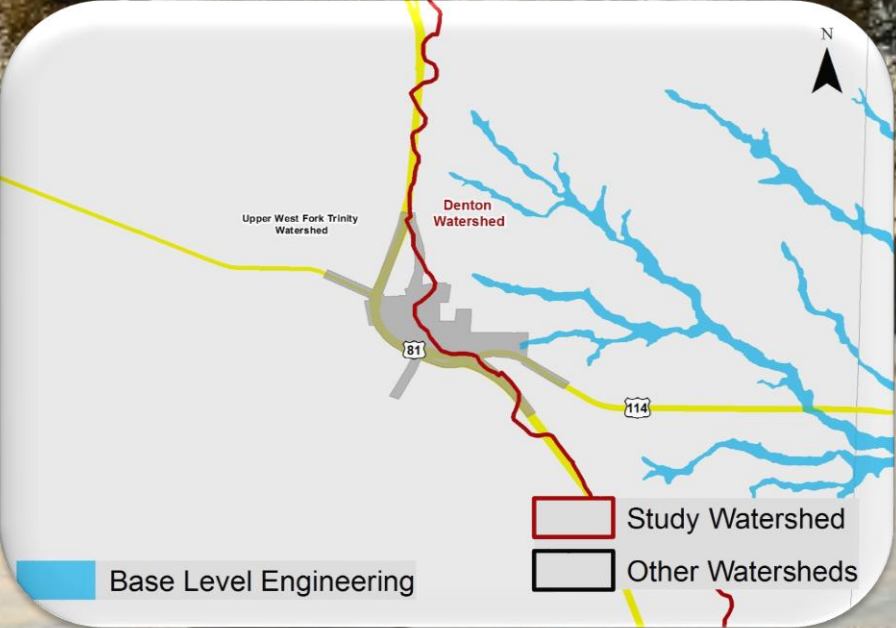
1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



# CITY OF RHOME

## KNOW YOUR RISK





# CITY OF RHOME

## TAKE ACTION: Potential Next Step



You do not have an approved Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and implement community-wide hazard mitigation plan
- Participate in Community Rating System (CRS)

FEMA's Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant (PDM), and TWDB's Flood Mitigation Assistance (FMA) Grant Program all fund programs to create a Hazard Mitigation Plan. Information about [FEMA's HMA grants](#)<sup>1</sup> can be found on our website, as well as on the [Texas Department of Public Safety's Emergency Management Forms and Publications](#)<sup>2</sup> website. Participation in FEMA's [Community Rating System](#)<sup>3</sup> (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs or regulations designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

[Texas Water Development Board's](#)<sup>4</sup> Flood Protection (FP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for creation and adoption of a Hazard Mitigation Plan, and other planning studies.

1. <https://www.fema.gov/hazard-mitigation-assistance>.  
2. <https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants>.  
3. <https://www.fema.gov/community-rating-system>.

4. <https://www.twdb.texas.gov/financial/programs/>.



## Appendix II: Base Level Engineering Report





# Denton Watershed, TX Base Level Engineering (BLE) Results

September 2017

**Prepared for:**

North Central Texas Council of Governments  
616 Six Flags Drive  
Arlington, TX 76005-5888

**Submitted by:**

AECOM  
9400 Amberglen Boulevard  
Building E  
Austin, TX 78729





AECOM  
9400 Amberglen Blvd, Bldg E  
Austin, TX 78729  
T: 512.454.4797; F: 512.454.8807

## DOCUMENT HISTORY

### DENTON WATERSHED

#### REVISION HISTORY

Version Number	Version Date	Summary Changes	Team/Author
1.0	September 2017	Initial Base Level Engineering	AECOM

#### APPROVALS

This document requires the approval of the following persons:

Role	Name	Phone Extension	Title	Review Date	Approved Date
Project Manager	April Smith	512.457.7818	Project Manager	September 24, 2017	September 24, 2017

#### CLIENT DISTRIBUTION

Name	Title/Organization	Location
Halff Associates	Prime Consultant	Via FTP



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## Executive Summary

North Central Texas Council of Government (NCTCOG) contracted AECOM, through Halff Associates' prime contract, to complete a Base Level Engineering (BLE) analysis for the Denton HUC-8 watershed in North Central Texas, to support FEMA's Discovery process and validation of effective Zone A Special Flood Hazard Areas (SFHAs). The BLE process involves using best available data and incorporating automated techniques with traditional model development procedures to produce regulatory quality flood hazard boundaries for the 1-percent annual chance event as well as estimates of flood hazard boundaries for multiple recurrence intervals.

The source digital terrain data used for surface model development in support of hydrologic and hydraulic analysis as well as mapping activities were leveraged from various local, State and Federal partners. Details regarding the different datasets used are provided below in Section 1.1.

Flood discharges for this study were calculated using both United States Geological Survey (USGS) regression equations and gage analyses, where stream gages with sufficient records exist. Regression equations obtained from the USGS Scientific Investigations Report (SIR) 2009-5087, Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach (2009) were used. PeakFQ version 7.1 was used to perform Flood Frequency Analysis (FFA) for the three gages along Denton Creek.

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) program version 4.1 was used to compute water surface elevations on a stream by stream basis. All hydraulic models were computed using 1-D steady state analysis.

The stream mile network that was validated for these watersheds was compiled using FEMA's Community Needs Management Strategy (CNMS) inventory. CNMS is an inventory of flood hazard studies and flood hazard mapping needs for areas where a study is needed. This data is helpful for community officials in analyzing and depicting flood hazards to enhance the understanding of flood risks. Communities may use this information to make informed decisions on their planning and flood mitigation efforts. Table ES - 1 lists the stream miles associated with this validation analysis.

**Table ES - 1: Summary of Stream Miles**

Source	Denton Stream Miles
CNMS	660.10
<b>Total</b>	<b>660.10</b>

The full inventory of Zone A studies in Denton Watershed was classified in CNMS. Total miles validated in CNMS are summarized in Table ES - 2 and illustrated in Figure ES - 1 below.

**Table ES - 2: Zone A Validation Results**

Validation Status	Status Type	Denton (miles)
VALID	NVUE COMPLIANT	27.2
UNVERIFIED	TO BE STUDIED	469.4



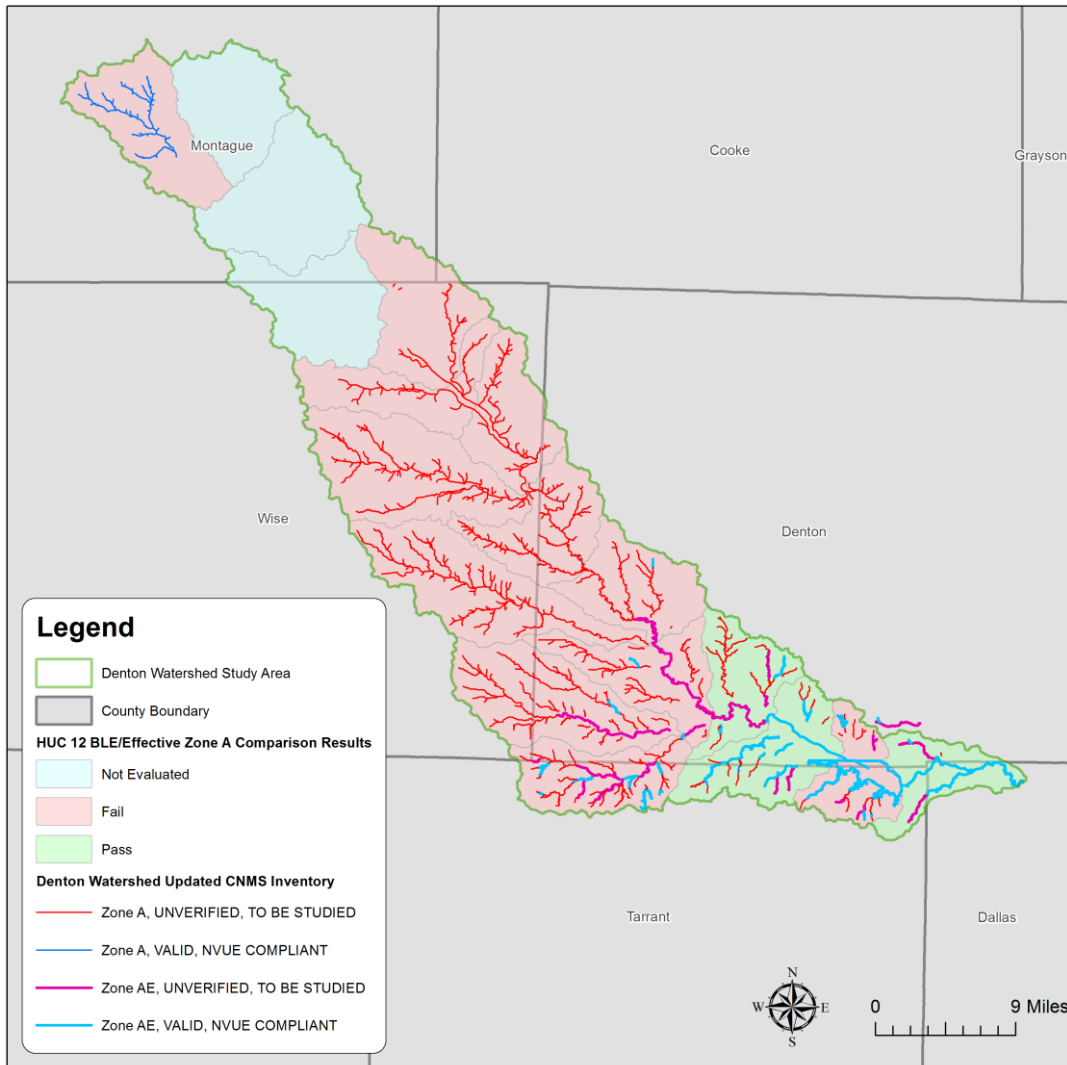


Figure ES - 1: Denton Watershed CNMS Validation Results

An overall risk for each HUC-12 watershed was calculated using the National Flood Risk Percentages Dataset and its proportional area. The weighted risk was multiplied by the percentage of points in the watershed that failed the CNMS comparison to effective to determine the priority score. Figure ES - 2, below shows the range of the Denton HUC-8 priority scores which can be used to initiate discussions during the Discovery phase.



Dove Creek – Grapevine Lake HUC-12 was determined to have the highest priority score and the most need while Marshall Branch – Grapevine Lake HUC-12 has the lowest score.

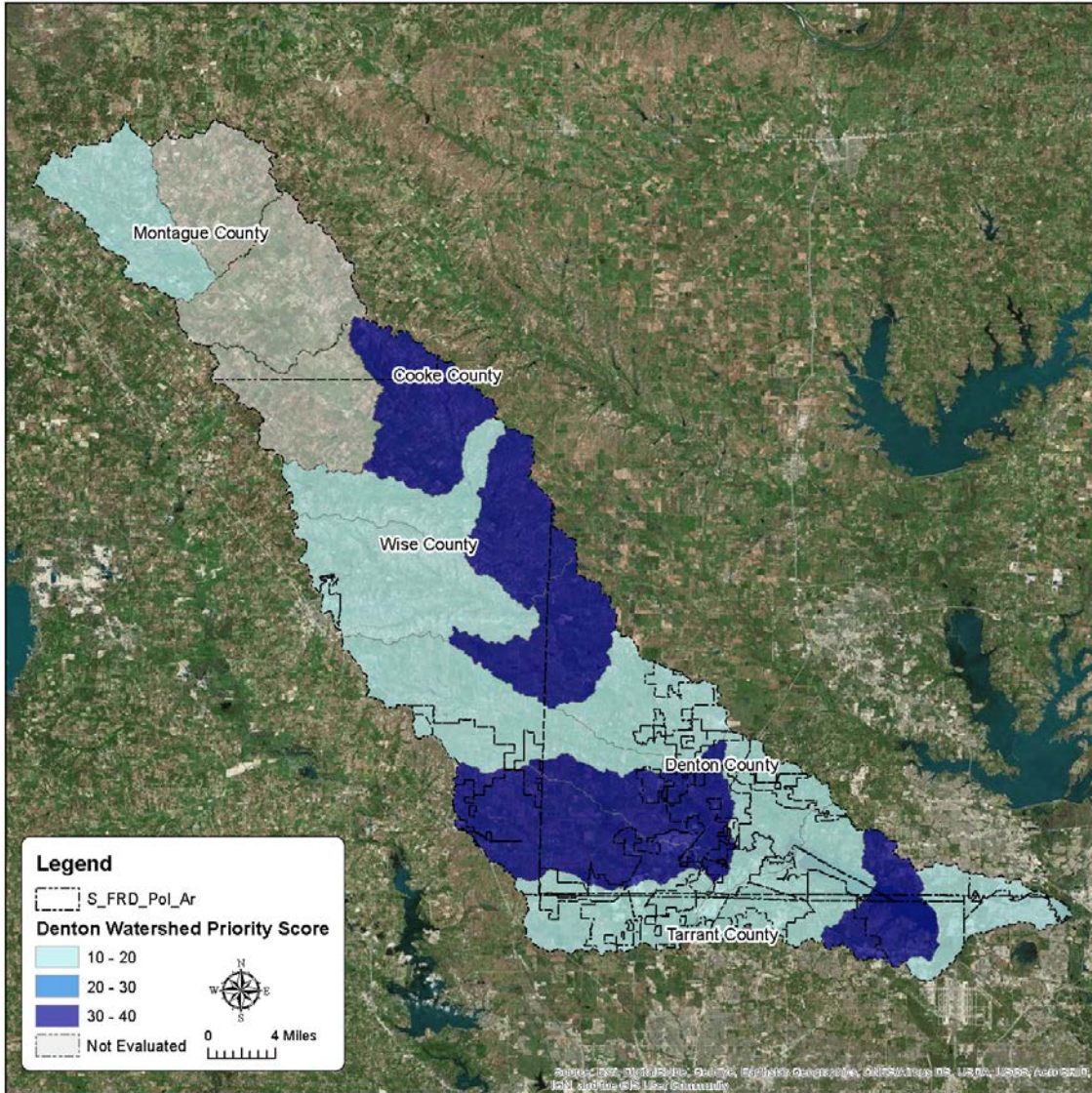


Figure ES - 2: Ranking of Denton Watershed HUC-12s



## Base Level Engineering (BLE) Methodology

Recent innovations and efficiencies in floodplain mapping have allowed the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) to develop a process called Base Level Engineering (BLE), which can be used to address current program challenges, including the validation of Zone A studies and the availability of flood risk data in the early stages of a Flood Risk Project. The BLE process involves using best available data and incorporating automated techniques with traditional model development procedures to produce regulatory quality flood hazard boundaries for the 1-percent annual chance event as well as estimates of flood hazard boundaries for multiple recurrence intervals. The cost for developing the data and estimates resulting from the BLE process are lower than standard flood production costs. The BLE results may be used for eventual production of regulatory and non-regulatory products.

As described in Title 42 of the Code of Federal Regulations, Chapter III, Section 4101(e), once every five years, FEMA must evaluate whether the information on Flood Insurance Rate Maps (FIRMs) reflects the current risks in floodprone areas. FEMA makes this determination of flood hazard data validity by examining flood study attributes and change characteristics, as specified in the Validation Checklist of the Coordinated Needs Management Strategy (CNMS) Technical Reference. The CNMS Validation Checklist provides a series of critical and secondary checks to determine the validity of flood hazard areas studied by detailed methods (e.g., Zone AE, AH, or AO). While the critical and secondary elements in CNMS provide a comprehensive method of evaluating the validity of Zone AE studies, a cost-effective approach for evaluating Zone A studies has been lacking.

In addition to the need for Zone A validation guidance, FEMA standards require flood risk data to be provided in the early stages of a Flood Risk Project. FEMA Program Standard SID #29 requires that during Discovery, data must be identified that illustrates potential changes in flood elevation and mapping that may result from the proposed project scope. If available data does not clearly illustrate the likely changes, an analysis is required that estimates the likely changes. This data and any associated analyses should be shared and results should be discussed with stakeholders.

An important goal of the BLE process is the scalability of the results. Scalability means that the results of a BLE analysis can not only be used for CNMS evaluations of Zone A studies, but can also be leveraged throughout the Risk MAP program. The data resulting from a BLE analysis can be updated as needed and used for the eventual production of regulatory and non-regulatory products, outreach and risk communication, and MT-1 processing. Leveraging this data outside the Risk MAP program may also be valuable to external stakeholders.

North Central Texas Council of Governments (NCTCOG) contracted AECOM, through Halff Associates' prime contract, to complete a Base Level Engineering (BLE) analysis for the Denton HUC-8 watershed in North Central Texas, to support FEMA's Discovery process and validation of effective Zone A Special Flood Hazard Areas (SFHAs).



Study extents for Denton Watershed include portions of Cooke County, Denton County, Montague County, Tarrant County, Wise County and include the following communities: Cities of Carrollton, Coppell, Decatur, Denton, Fort Worth, Grapevine, Haslet, Justin, Keller, Lewisville, New Fairview, Rhome, Roanoke, and Southlake; the Towns of Argyle, Bartonville, Corral City, Dish, Double Oak, Flower Mound, Northlake, Ponder, Trophy Club and Westlake. The study area consisted of three HUC-10 basins: Upper Denton Creek, Middle Denton Creek and Lower Denton Creek. Figure 1 shows the orientation of the Denton HUC-10 basins with respect to the counties.



Figure 1: Denton Watershed HUC-10 Basins



AECOM studied approximately 1,749 miles of stream reaches within the Denton Watershed with a minimum drainage area tolerance of one square mile outside of population centers and one half square mile inside of population centers. Population centers were identified as having a population of greater than 1,000 people. The selection and extent of stream reaches studied was based upon the number of stream miles with minimum drainage area of one square mile (or one half square mile) and not the number of effective Zone A stream miles. Study reaches were extended above this threshold as appropriate to ensure all effective Zone A floodplain received an updated analysis. Topographic data used was from multiple sources was used to determine the hydrologic and hydraulic characteristics of the watershed. Topographic data used was obtained from the North Texas Council of Governments (NCTCOG), Texas Natural Resources Information System (TNRIS), and the United States Geological Survey (USGS). The following sections will summarize the BLE process and will discuss the results along with their recommended use.

## 1.1 Topographic Data

Documentation regarding leverage data and process including coverage, accuracy, acquisition dates, and source contact/agency are presented in the figures, tables and text within this section. All vertical accuracy specifications were obtained from the metadata or survey reports provided with the leverage datasets.

All available metadata, survey reports, and other leverage documentation are available with the source dataset. Figure 2 shows the extents of the Digital Terrain Model (DTM) data used for the HUC-8 watershed studied.

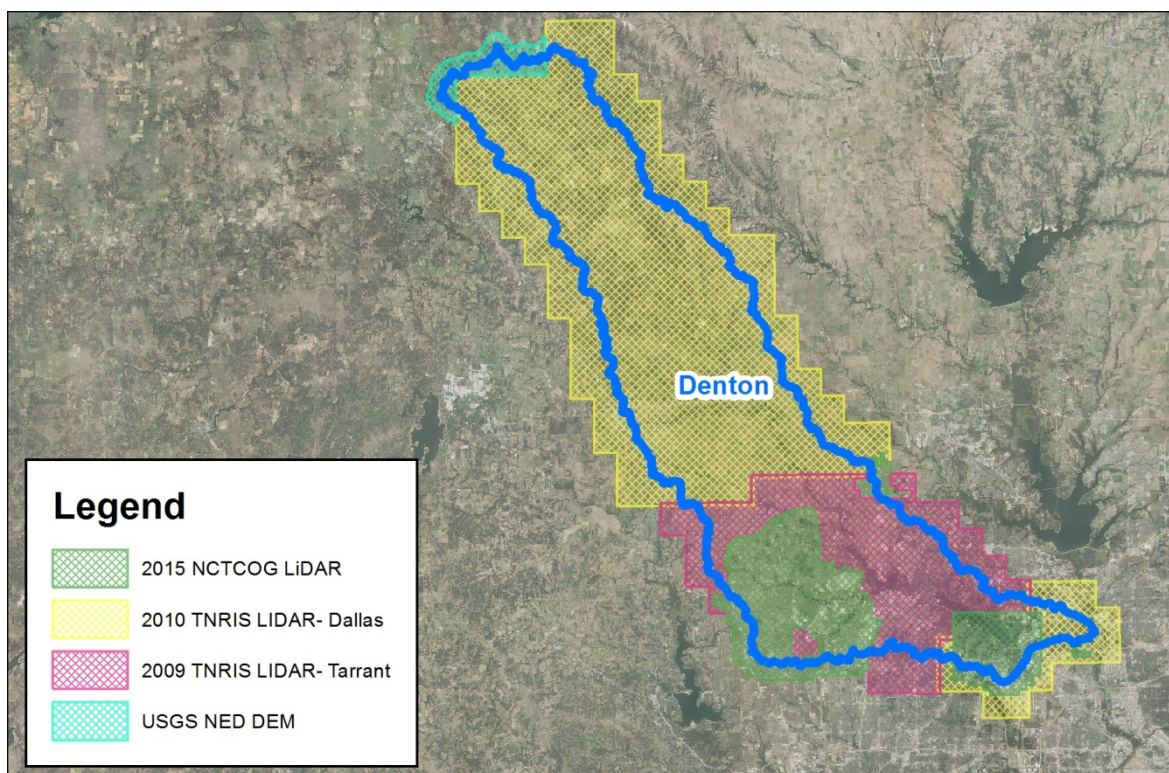


Figure 2: Extent of LiDAR Data for Denton Watershed



## 1.1.1 Source Terrain Data

### 1.1.1.1 Denton Watershed

#### 1.1.1.1.1 2015 NCTCOG LiDAR

The NCTCOG Light Detection and Ranging (LiDAR) was acquired in 2015 by Woolpert Inc. The data density is 1 point per square meter (PPSM) with a 0.5 meter nominal point spacing (NPS). The data was compiled to meet 0.07 meters vertical accuracy at 95 percent confidence level which meets project accuracy specifications of the National Standard for Spatial Data Accuracy (NSSDA). This data was available as LiDAR point clouds in the American Society of Photogrammetry and Remote Sensing (ASPRS) common LiDAR Data Exchange Format (LAS 1.2).

#### 1.1.1.1.2 2010 TNRIS LiDAR (Dallas County)

The TNRIS LiDAR data for Dallas County was acquired in 2010 by Sanborn Map Company. The data density is 1 PPSM with a 1 meter NPS. The data was compiled to meet 0.07 meters vertical accuracy at 95 percent confidence level which meets project accuracy specifications of the NSSDA. This data was available as LiDAR point clouds in the ASPRS common LiDAR Data Exchange Format (LAS 1.2).

#### 1.1.1.1.3 2009 TNRIS LiDAR (Tarrant County)

The TNRIS LiDAR data for Tarrant County was acquired in 2009 by Fugro EarthData Inc. The data density is 4 PPSM with a NPS of 0.5 meter. The data was compiled to meet 0.08 meters vertical accuracy at 95 percent confidence level which meets project accuracy specifications of the NSSDA. This data was available as LiDAR point clouds in the ASPRS common LiDAR Data Exchange Format (LAS 1.1).

#### 1.1.1.1.4 USGS NED DEM

The National Elevation Dataset (NED), a product of the USGS, is a seamless gridded dataset representing the best available raster elevation data available to the USGS for the conterminous United States, Alaska, Hawaii, and territorial islands. The NED is derived from diverse source data that are processed to a common coordinate system and unit of vertical measure. The NED serves the Denton Watershed topographic data development by filling in as best available data where there are gaps in the data sets listed above. This data was used to keep the project on schedule and was only used for a very small area in comparison to the overall HUC-8 watershed.

### 1.1.1.2 Terrain Data Processing

The Watershed Information System (WISE) software platform was utilized in order to create a digital surface model for each watershed's project area. This module allows source data from a variety of sources to be prioritized based on level of accuracy or preference of the user.

For the Denton Watershed, the 2015 NCTCOG LiDAR LiDAR was highest priority with the 2010 TNRIS LiDAR for Dallas County prioritized second, and the 2009 TNRIS LiDAR for Tarrant County the third highest priority dataset. Lastly the USGS NED DEM data was used as the fourth data source for areas where LiDAR did not exist.

The DEMs created from the LiDAR datasets mentioned above were compiled in order of vertical accuracy into a mosaic dataset using ArcMap. From this mosaic, a tile index was created for the



project area and the mosaic was clipped into 50,000-foot tiles, converted to asciis and imported into WISE Terrain Analyst (WTA). Visual inspection of the 10-foot DEMs was performed to ensure no voids and/or artifacts were present in the DEM. The DEM surface model was affirmed to be suitable for hydraulic takeoffs and supporting other hydraulic analyses.

Stream centerlines were manually digitized using the 10-foot DEMs as a source for horizontal alignment and vertical elevation. These stream centerlines are created for use in the hydraulic analysis, hydro-enforcement of the 50-foot DEMs, and visual reference on the FIRM products. Several routines were then used to take localized elevations from the source topographic data and apply them to the streams. This gave the stream vertices elevation information along the Z axis. The resulting elevations ensure that the streams are lower in elevation than any overbank sumps. A separate routine was then used to ensure that the elevations of these vertices descend in height down to an outfall. The final streams file is then “burned” into the 50-foot DEMs to force flow through structures while preventing it from jumping out of the channel banks.

After the DEM was imported, an additional 50-foot DEM was created from the same mosaic and tile index used for the 10-foot DEM. This 50-foot DEM was used for hydro enforcement of the project areas. Proprietary software was used to identify natural sinks, peaks and flat areas in the 50-foot DEM surface. Elevations of the cells in the DEM were algorithmically calculated and the best path to route flow was determined without filling sinks in the DEM. Once all calculations were completed, the flow was checked confirming that all drainage flows downstream correctly and is routed to outside of the HUC-8 basin.

In addition to the quantitative assessment of the source digital terrain, a qualitative visual inspection of the composite DEM was performed using a hillshade derived from the 10-foot DEM. The visual inspection indicated no unusual or non-terrestrial features were observed in the composite DEM assuring the surface files used for hydrologic and hydraulic analyses and floodplain mapping activities are sufficient for BLE analysis.

## 1.2 Hydrology

Flood discharges for this study were calculated using USGS regression equations and gage analysis, where stream gages with sufficient records exist. Scientific Investigations Report (SIR) 2009-5087, Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach (2009) contains the most recent regression equations for Texas and was used as the basis for regression discharge calculations.

Table 1 shows the published equations used for this study. In these equations,  $Q_i$  represents peak streamflow for  $i$ -recurrence interval (annual chance exceedance (a.c.e.)) in cubic feet per second,  $P$  represents mean annual precipitation in inches,  $S$  represents dimensionless main-channel slope,  $\Omega$  represents the OmegaEM parameter, and  $A$  is cumulative drainage area in square miles.

**Table 1: Summary of Regression Equations (SIR 2009-5087)**

Recurrence Interval	Equation <sup>1</sup>
$Q_{10\%}$	$P^{1.203} S^{0.403} \times 10^{[0.918 \Omega + 13.62 - 11.97A^{(-0.0289)]}$
$Q_{4\%}$	$P^{1.140} S^{0.446} \times 10^{[0.945 \Omega + 11.79 - 9.819A^{(-0.0374)]}$



Recurrence Interval	Equation <sup>1</sup>
Q <sub>2%</sub>	$P^{1.105} S^{0.476} \times 10^{[0.961 \Omega + 11.17 - 8.997A^{(-0.0424)}]}$
Q <sub>1%</sub>	$P^{1.071} S^{0.507} \times 10^{[0.969 \Omega + 10.82 - 8.448A^{(-0.0467)}]}$
Q <sub>0.2%</sub>	$P^{0.988} S^{0.569} \times 10^{[0.976 \Omega + 10.40 - 7.605A^{(-0.0554)}]}$
<sup>1</sup> Variables: Q <sub>i</sub> peak flow for i recurrence interval (a.c.e.), in cubic feet per second; P, Mean Annual Precipitation in Inches; S, Main-channel slope (dimensionless); Ω, OmegaEM parameter; A, Cumulative Drainage Area in square miles	

Discharges for the 1-percent plus and 1-percent minus a.c.e. were calculated as well. These values were computed by multiplying the Q<sub>1%</sub> discharges by 0.30\*log10, which is the mean residual standard error for the Q<sub>1%</sub> equation.

The WISE computer program was used to delineate drainage basins in shapefile format using the 50-foot resolution DEM. Basin break points were set by the user with a sub-basin target area of one square mile in size. This criterion was adjusted for streams with larger drainage areas in order to avoid excessive and unnecessary discharge breaks. Break points were also set just upstream of stream confluences. Cumulative drainage area was determined based on these automated delineations performed by WISE in combination with a stream connectivity routine that defined the stream reach segments with upstream and downstream neighbors.

WISE was used to calculate the main-channel slope for each basin. An automated routine was used to determine the longest flowpath from the headwaters of a watershed to the outlet of the point of interest based on flowpaths developed from the 50-foot DEM. Using the longest flowpath, elevations for the endpoints were determined based on the 50-foot DEM. The slope was calculated by dividing the difference in elevation with the flowpath length. The result was expressed in unit less form.

In order determine mean annual precipitation and OmegaEM values for each sub-basin, a Python script was created and run in ESRI's ArcCatalog. The script batch processed the geoprocessing needed to assign mean annual precipitation values in inches and OmegaEM values to each sub-basin.

The mean annual precipitation values were determined based on a shapefile coverage obtained from the Texas Water Development Board and available for download from the following location: [http://www.twdb.texas.gov/mapping/gisdata/doc/Precipitation\\_Shapefile.zip](http://www.twdb.texas.gov/mapping/gisdata/doc/Precipitation_Shapefile.zip)

The annual precipitation values reflect data for the climatological period 1981-2010 as recorded by the Natural Resources Conservation Service (NRCS).

From USGS SIR 2009-5087, the OmegaEM parameter is a generalized terrain and climate index that expresses relative differences in peak-streamflow potential. A shapefile was developed and populated with OmegaEM values based on Figure 2 in SIR 2009-5087. This shapefile was used to determine OmegaEM values on a sub-basin basis. For streams that crossed multiple OmegaEM values, a weighted OmegaEM parameter was calculated and then applied on a sub-basin basis.

Additionally, the Python script used all inputs from each sub-basin and calculated the appropriate discharge values using the regression equations. The resulting discharge values were appended to the sub-basin shapefile attribute table.

Flood Frequency Analyses (FFA) were performed following Bulletin 17B guidelines, using PeakFQ version 7.1, for three gages on Denton Creek. All gages evaluated are listed in Table 2.

Table 2: USGS Stream Gages Used in Analyses

Gage ID	Flooding Source and Location	Computed Drainage Area (mi <sup>2</sup> )	Published Drainage Area (mi <sup>2</sup> )	Period of Record
08053500	Denton Creek near Justin, TX	396.2	400.0	1950-2015
08054000	Denton Creek near Roanoke, TX	615.3	621.0	1923-1955
08055000	Denton Creek near Grapevine, TX	704.1	705.0	1948-2015

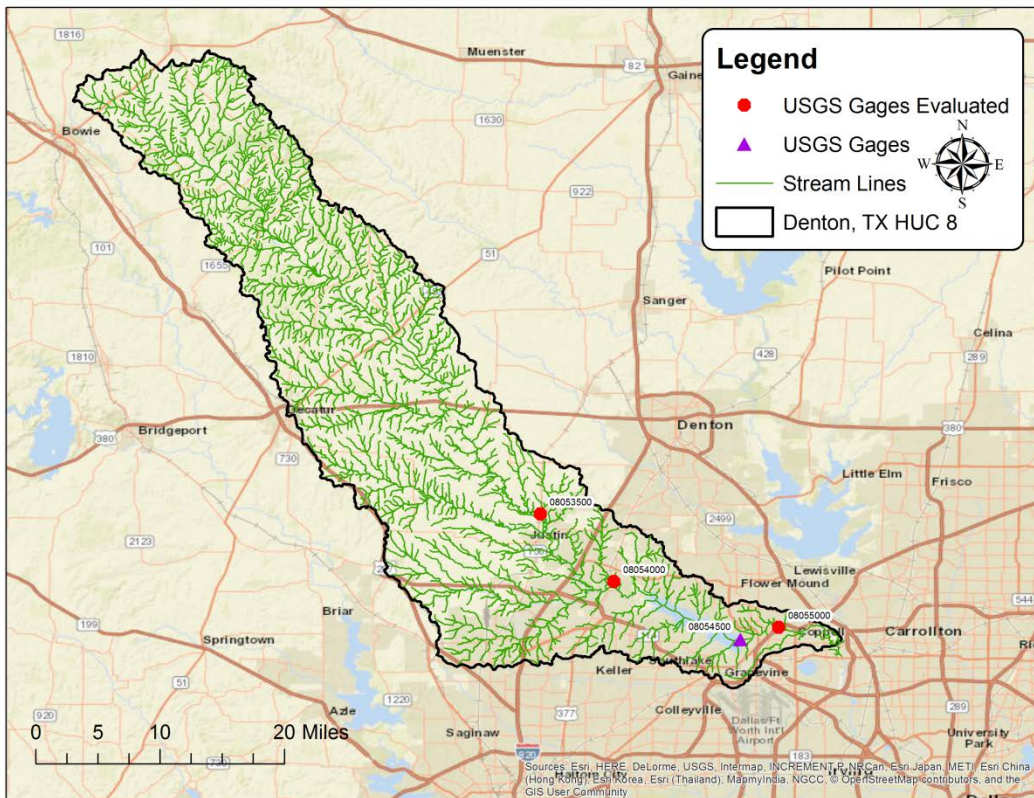


Figure 3: USGS Gage Stations within Denton Watershed



No gage analysis was performed for Gage ID 08054500 (Grapevine Lake near Grapevine, TX) since this gage does not record peak streamflow.

### 1.3 Hydraulics

The hydraulic approach used for this BLE analysis for the Denton Watershed consisted of using the terrain model described in Section 1.1 in combination with hydrology input computed as described in Section 1.2 to establish water surface elevations using 1-D steady state analysis. The Hydrologic Engineering Center's River Analysis System (HEC-RAS) program version 4.1 was chosen as the computer model to compute water surface elevations on a stream by stream basis. The WISE computer program was used to establish model stream orientation, initial hydraulic cross section layout and stationing, assign n-values to cross sections, and to develop all input files for the HEC-RAS program. ESRI's ArcMap program was used to review and refine cross section layout orientation.

First pass cross section layout was performed using an automated routine in WISE based on the drainage area at the cross section location. A first draft model was created based on this initial cross section layout and draft boundaries were developed. At this stage, a second pass inspection for cross section placement occurred. Significant refinement occurred during this step. To improve the hydraulic models, additional cross sections were added as needed to better define the BLE floodplain boundary. Cross sections were extended in locations where overtopping occurred. Orientation of cross sections was refined to improve on the perpendicular orientation to flow. Additional cross sections were added at floodplain constrictions and at downstream portions of tributaries to ensure a proper tie-in with receiving streams. Cross sections were adjusted to remove sections that intersected hydraulic crossings in the floodplain. For some of the largest studied streams, cross sections were laid out manually in order to have more reasonable spacing and better capture the constrictions in the floodplain.

Cross sections were not drawn on top of roadways or railroads but were placed at the upstream and downstream face of major roads and railroads. Ineffective flow stations were placed in the hydraulic models as appropriate to account for flow constrictions as well as at locations deemed by the engineer to be ineffective at conveying flow downstream.

Cross sections were drawn on dam tops for flood control identified dams in order to better represent ponded water upstream of the structures. It was assumed in doing this that the vast majority of the flow during a flood event would pass the spillway and that the hydraulic model would reasonably estimate flow across the spillway as represented in the hydraulic cross section. The elevations used in the modeling were checked against known elevations from past flooding events and effective Zone A boundaries and the results were determined reasonable.

Significant effort was made to start all tributaries below the receiving water surface elevations but this was not always achieved, particularly in wide, flat floodplains where small tributaries ran parallel to large streams or where road crossings or dams interfered with cross section alignments.

The relationship between drainage area and assigned channel geometry is shown in Table 3. These default values for dimensions and spacing are subject to change based on the details noted above as well as the judgment of the responsible engineer.

Table 3: Cross Section Default Parameters

Drainage area (upper limit)	XS Spacing	Channel Top Width	Channel Bottom Width	Channel Depth
1.0	500	4	3.5	0.5
2.0	500	6	4	0.5
4.0	500	11	8	0.5
8.0	500	14	10	0.5
10.0	500	17	13	0.5
15.0	600	20	16	0.5
20.0	600	25	20	0.5
25.0	600	25	20	0.5
30.0	600	25	20	0.5
40.0	600	31	25	0.5
50.0	600	31	25	1
75.0	750	40	30	1
100.0	750	50	42	1
150.0	1000	50	42	1
250.0	1000	50	42	2
500.0	1500	120	100	2
1000.0	2500	351	346	3
2000.0	4000	657	652	3
5000.0	4000	1575	1565	3

Manning's roughness coefficients (n-values) were determined using the 2011 National Land Cover Data (NLCD) dataset in combination with n-values from Chow (1959) and Calenda, et al. (2005). The association between the n-values and the NLCD Classification is shown in Table 4. Manning's n-value takeoffs were performed by WISE and the n-values were adjusted in some locations based on engineering judgment. N-values within channel banks were limited by the automated routine to a range of 0.030 to 0.070.

Table 4: Manning's "n" Roughness Based on 2011 NLCD Classification (Moore, 2011)

NLCD Classification	Minimum	Normal	Maximum	Source
Open Water	0.025	0.03	0.033	Chow 1959
Developed, Open Space	0.01	0.013	0.016	Calenda, et al. 2005
Developed, Low Intensity	0.038	0.05	0.063	Calenda, et al. 2005
Developed, Medium Intensity	0.056	0.075	0.094	Calenda, et al. 2005
Developed, High Intensity	0.075	0.1	0.125	Calenda, et al. 2005
Barren Land	0.025	0.03	0.035	Chow 1959
Deciduous Forest	0.1	0.12	0.16	Chow 1959
Evergreen Forest	0.1	0.12	0.16	Chow 1959
Mixed Forest	0.1	0.12	0.16	Chow 1959
Scrub/Shrub	0.035	0.05	0.07	Chow 1959
Grassland/Herbaceous	0.025	0.03	0.035	Chow 1959
Pasture/Hay	0.03	0.04	0.05	Chow 1959
Cultivated Crops	0.025	0.035	0.045	Chow 1959
Woody Wetlands	0.08	0.1	0.12	Chow 1959
Emergent Herbaceous Wetland	0.075	0.1	0.15	Chow 1959



The boundary condition used for the majority of the study streams was normal depth with a default value of 0.005 ft/ft. For streams with names in the National Flood Hazard Layer (NFHL) and streams with large drainage areas (generally greater than 8 square miles), the normal depth slope was calculated based on the HEC-RAS profile invert.

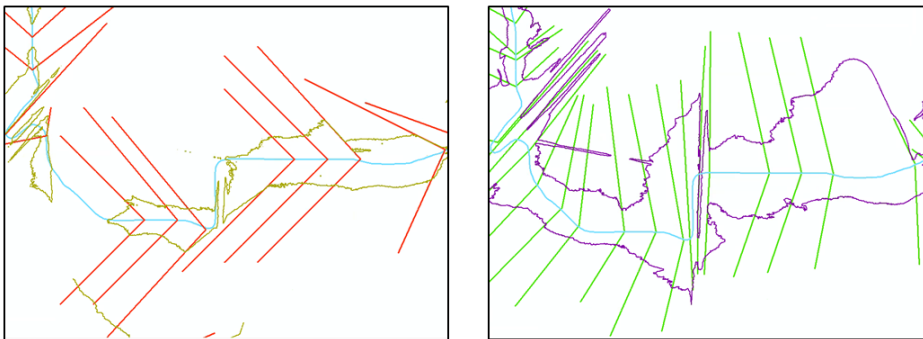
## 1.4 Quality Control

Following the initial BLE analysis in each watershed, the flood hazard area delineations created by the BLE process were reviewed for areas where the results were not ideal.

QC results indicated that some of the models should be extended to cover the scope of effective flood hazard data. Those streams were extended farther upstream to match the extents of the SFHA data.

Typical manual editing resulting from reasonability checks included adding cross-sections, adjusting orientation of cross sections, trimming cross sections and reduction of the default “V” angle of cross sections. Examples of default “V” angled cross sections are shown in Figure 4. It is estimated that 50 percent of cross-sections were adjusted in some work areas while other areas did not require as much editing. Other examples of manual editing included adding cross-sections at confluence areas (see Figure 5 below), modification to improve perpendicular orientation at the channel, adjustment of discharge breaks to better represent flow addition points, revisions to dam spillways and dam tops, and revisions to n-values.

A major component of the QC process was an automated check that identified locations where the 1-percent a.c.e profile was crossed by another frequency or by the 1-percent plus or 1-percent minus profile. Significant effort was made to reasonably resolve all of these instances. Another automated check identified locations where there was a drawdown of greater than 0.5 foot on the 1-percent a.c.e. water surface profile. This check is particularly useful for identifying errors in the model such as a channel that is too wide, a poorly placed cross section, or a need for additional cross sections. Again, significant effort was made to reasonably resolve these drawdown situations.



**Figure 4: Default “V” angle cross-sections automated by WISE (left). Manually edited cross-sections to more accurately capture terrain (right). Resulting flood boundaries shown in gold (left) or purple (right) for clarity.**

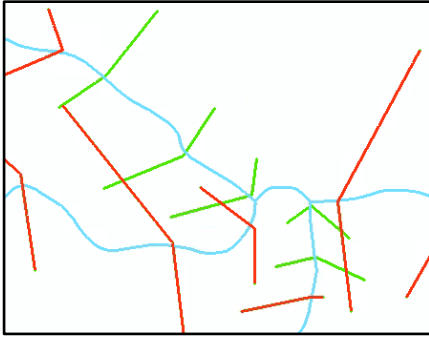


Figure 5: Manually added cross-sections (green) to improve accuracy of tie-ins at confluences.

## 1.5 One-percent Special Flood Hazard Area Delineation

The 1-percent and 0.2-percent boundaries were mapped using a routine that develops water surface elevation grids based on the 10-foot cell size DEM developed from the LiDAR dataset used for this project (See Section 1.1). This product was converted to a polygon for cleaning. The cleaning routine involved manual inspection of the polygons to identify and remove areas of disconnected flooding. In general, areas with a size of less than 5,000 square feet were removed and all others were investigated to determine whether they should be considered as potentially part of the SFHA. This investigation was aided by the ground DEM and aerial imagery. Manual adjustments to the polygons were made to account for spillways on dams which could not be accurately modeled using HEC-RAS as well as disconnected areas along the flooding source that should reasonably be connected.

Following the removal of disconnected flooding areas and other boundary adjustments, the small islands in the floodplain were filled. Islands with a size between roughly 5,000 and 30,000 square feet were inspected and, in general, islands that were less than 10,000 square feet were filled.

Once the island filling process was complete, the water surface raster mapping routine was run and set to conform to the polygon boundary. This ensures that the water surface raster and the floodplain boundary are consistent with each other. The depth raster product was created at the end of the process by performing a raster subtraction with the water surface elevation raster and the ground DEM.

## Challenges

Challenges encountered during BLE analyses will vary based on available data on which to run the analysis. The watershed analyses presented challenges as summarized in the following paragraphs.

As noted in Section 1.2 above, there are a significant number of dams on tributaries to Denton Creek. Hydrologic results from regression calculations were not adjusted to take into account the impact of these structures. Further investigation should be conducted when upgrading these models.

As noted in Section 1.3 above, significant effort was made to start all tributaries below the receiving water surface elevations but this was not always achieved, particularly in wide, flat floodplains where small tributaries ran parallel to large streams or where road crossings or dams interfered with cross section alignments.



Parallel streams with shared floodplains were modeled by moving the combined discharge upstream to the cross section that begins the shared floodplain.

## Results and Recommendations

The BLE results for this study produced a SFHA that compares reasonably well with the effective SFHA in some cases and narrower in other cases. These boundaries provide an additional estimated SFHA in areas that do not currently have an SFHA mapped. These results provide context for flood risk communication as part of the Discovery process, and should be verified through community work map meetings before being applied to a regulatory product.

Maps showing the BLE results are included as Appendix A.

### 3.1 CNMS Validation of Effective Zone A SFHA

The inventory of Zone A studies (496.6 miles) in the Denton watershed were classified in CNMS with validation status of "UNVERIFIED" and status type of "TO BE STUDIED". The following is a summary of the results of the CNMS validation assessment for the effective Zone A studies in the study area. Initial Assessment checks A1-A3 were evaluated for the CNMS inventory of Zone A studies.

#### INITIAL ASSESSMENT A1 – SIGNIFICANT TOPOGRAPHY UPDATE CHECK

This check involves determining whether a topographic data source is available that is significantly better than what was used for the effective Zone A modeling and mapping. For the study area in Denton Watershed TX, the effective Zone A topographic data leveraged a variety of sources, but primarily based upon USGS 24K map products. The topography listed in Section 1.1 above represents a significant improvement from the effective Zone A topographic source.

#### INITIAL ASSESSMENT A2 – CHECK FOR SIGNIFICANT HYDROLOGY CHANGES

This check involves first determining whether new regression equations have become available from the USGS since the date of the effective Zone A study. If newer regression equations exist for the area of interest, then an engineer must determine whether these regression equations would significantly affect the 1-percent-annual-chance flow.

The source for the effective Zone A study areas located in Denton, Montague, Tarrant, and Wise Counties in TX is unknown due to the lack of effective data. It is known that the study analyses for these counties were performed prior to the most recent publication SIR 2009-5087, *Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach* (2009)

Several LOMRs located in Tarrant County are based off hydrologic methods other than regression equations.

Due to the lack of study data, the significant impact that the updated regression equations would have on the 1-percent-annual-chance flow in Denton Watershed TX is unknown.

#### INITIAL ASSESSMENT A3 – CHECK FOR SIGNIFICANT DEVELOPMENT

This check involves using the National Urban Change Indicator (NUCI) dataset to assess increased urbanization in the watershed of the Zone A study. If the percentage of urban area within the HUC-12 watershed containing the effective Zone A study is 15% or more, and has increased by 50% or more since the effective analysis, the study would fail this check. Although the NUCI data



provide year-to-year changes in urbanization, the NLCD also is needed to establish a baseline of urban land cover for this analysis. The check for significant development in this watershed was completed by evaluating percentage of urban change at the HUC-12 level. Of the 18 HUC-12 polygons within the study area, 3 show a percentage of 15% or more urban area and fail A3 validation due to their significant development.

Table 5: Zone A Initial Assessment Results

Assessment Check	Pass / Fail	Notes
A1 – Topography	Fail	Topographic described in Section 1.1 is significantly better than effective topographic source.
A2 – Hydrology	Pass	Newer Regression Equations published in 2009 are available for studies located in Denton, Montague, Tarrant, and Wise Counties, TX. The significant impact the newer regression equations would have on the 1-percent-annual-chance flow is unknown.
A3- Development	Pass	3 of the 18 HUC-12s fail.

#### VALIDATION CHECK A4 – CHECK OF STUDIES BACKED BY TECHNICAL DATA

Zone A studies that pass all initial assessment checks described above may be categorized as “Valid” in the CNMS Inventory only if the effective Zone A study is supported by modeling or sound engineering judgment and all regulatory products are in agreement. If the effective Zone A study passes all initial assessment checks, but is not supported by modeling, or if the original engineering method used is unsupported or undocumented, a comparison of the BLE results and effective Zone A’s is performed. Streams located in Denton, Montague, Tarrant, and Wise Counties have been marked as fail in the A4 check due to lack of evidence in the FIS report and on FEMA’s Mapping Information Platform (MIP) detailing study methods. A few streams within Tarrant County which are effective, or incorporated LOMRs do have technical data support documentation.

#### VALIDATION CHECK A5 – COMPARISON OF BLE AND EFFECTIVE ZONE A

The BLE /effective Zone A comparison method leverages the existing Floodplain Boundary Standard (FBS) certification procedures described in FEMA SID 113, but with a slight modification. This modified FBS comparison approach uses the 1-percent plus and 1-percent minus flood profiles and horizontal and vertical tolerances described in FEMA’s Automated Engineering guidance document dated May 2016. For the comparison of BLE and effective Zone A in the Texas study area, the following vertical and horizontal tolerances were used to conduct the modified FBS procedure. One point was placed every 200 feet along the floodplain boundaries for comparison.

Vertical Tolerance: +/- 10 feet (one-half contour interval of assumed effective topographic source).

Horizontal Tolerance: +/- 75 feet (standard horizontal tolerance for BLE comparison testing).

Of the 404 modeled BLE streams in the study area, 400 were found to correspond (within the tolerance limits) with effective Zone A flood zones. Comparison results are summarized to the individual reach level. Streams where the percentage of passing FBS sample points is greater than or equal to 85% are marked as “Pass”, otherwise marked as “Fail”.

## VALIDATION RESULTS

Based on the validation assessments and BLE comparison results described above, the CNMS inventory of Zone A studies in the Denton Watershed study area has been updated, with 469.4 miles categorized as UNVERIFIED – TO BE STUDIED, and 27.2 miles categorized as VALID – NVUE COMPLIANT. Total miles in each of these categories are summarized in Table 6 and illustrated in Figure 6 below. It should be noted that due to the lack of effective digital data in this watershed approximately 17% of the HUC-12s have no data to evaluate.

Table 6: Zone A Validation Results

Validation Status	Status Type	Denton (miles)
VALID	NVUE COMPLIANT	27.2
UNVERIFIED	TO BE STUDIED	469.4
Total Miles		496.6

Table 7: BLE Comparison Results

HUC-12 Watershed		Total FBS points	Fail	Pass	%Pass	BLE Comparison Pass? (>85%)	Priority Score	
Watershed Name	Watershed Number							
Denton	All Streams	23,998	5,284	18,714	78%	Fail		
Black Creek - Denton Creek	120301040201	1,189	263	926	78%	Fail	14.1	
Braden Branch – Denton Creek	120301040103	Not Evaluated						
Catlett Creek - Sweetwater Creek	120301040203	2,676	558	2,118	79%	Fail	16.5	
Cottonwood Branch - Denton Creek	120301040307	39	5	34	87%	Pass	11.5	
Denton Creek - Grapevine Lake	120301040304	1,114	160	954	86%	Pass	13.1	
Dove Creek - Grapevine Lake	120301040304	455	169	286	63%	Fail	35.5	
Dry Valley Creek	120301040102	Not Evaluated						
Elizabeth Creek - Denton Creek	120301040303	1,606	371	1,235	77%	Fail	21.0	
Harts Creek-Denton Creek	120301040105	1,049	326	723	69%	Fail	24.9	
Headwaters Elizabeth Creek	120301040301	2,455	651	1,804	73%	Fail	22.9	
Henrietta Creek	120301040302	1,978	393	1,585	80%	Fail	18.8	
Hog Branch-Denton Creek	120301040205	1,257	269	988	79%	Fail	19.3	
Marshall Branch-Grapevine Lake	120301040305	695	80	615	88%	Pass	10.5	
Morris Branch-Denton Creek	120301040204	2,158	497	1,661	77%	Fail	20.7	
North Pecan Creek-Denton Creek	120301040202	1,374	382	992	72%	Fail	22.6	
Oliver Creek	120301040206	3,357	550	2,807	84%	Fail	14.2	



HUC-12 Watershed		Total FBS points	Fail	Pass	%Pass	BLE Comparison Pass? (>85%)	Priority Score
Watershed Name	Watershed Number						
Panther Creek – Denton Creek	120301040104	Not Evaluated					
Wells Branch-Denton Creek	120301040101	2,596	610	1,986	77%	Fail	13.4

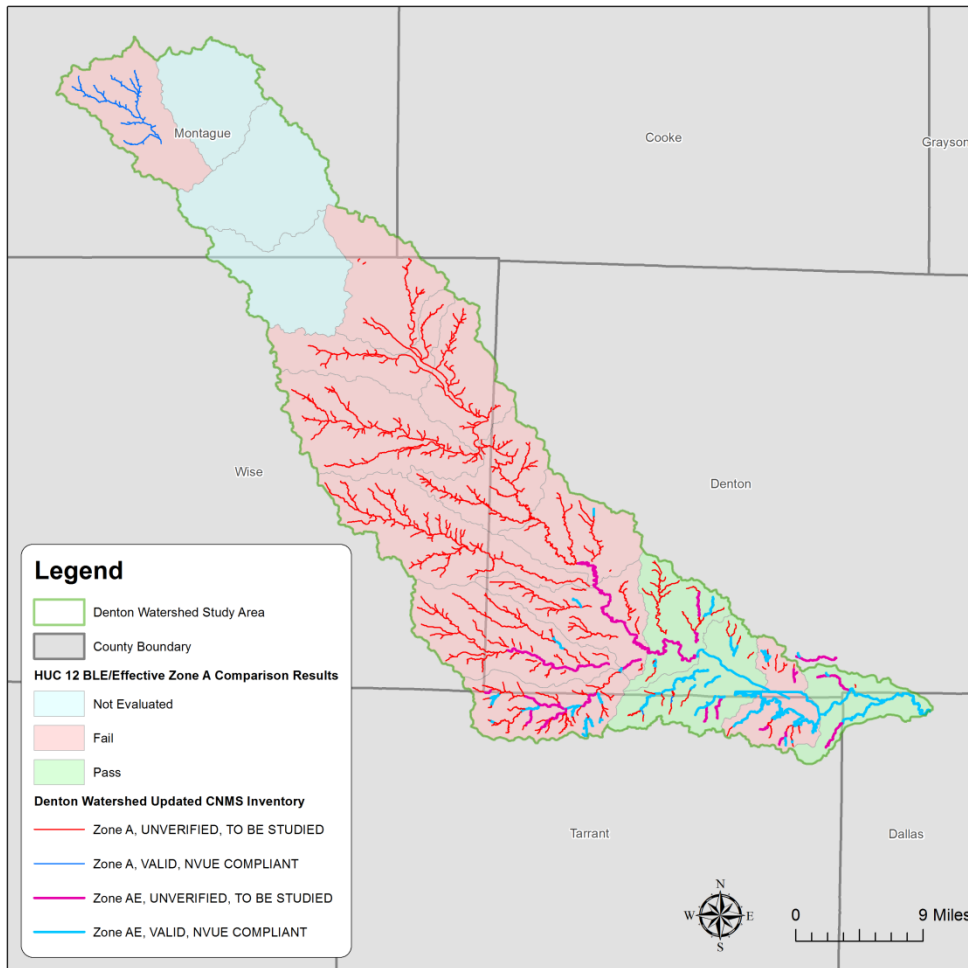


Figure 6: Denton Watershed CNMS Validation Results

An overall risk for each HUC-12 watershed was calculated using the National Flood Risk Percentages Dataset and its proportional area. The weighted risk was multiplied by the percentage of points in the watershed that failed the CNMS comparison to effective to determine the priority score. Figure 7 below shows the range of the Denton HUC-8 priority scores which can be used to initiate discussions during the Discovery phase.

For Denton Watershed, Dove Creek – Grapevine Lake HUC-12 was determined to have the highest priority score and the most need while Marshall Branch – Grapevine Lake HUC-12 has the lowest score.

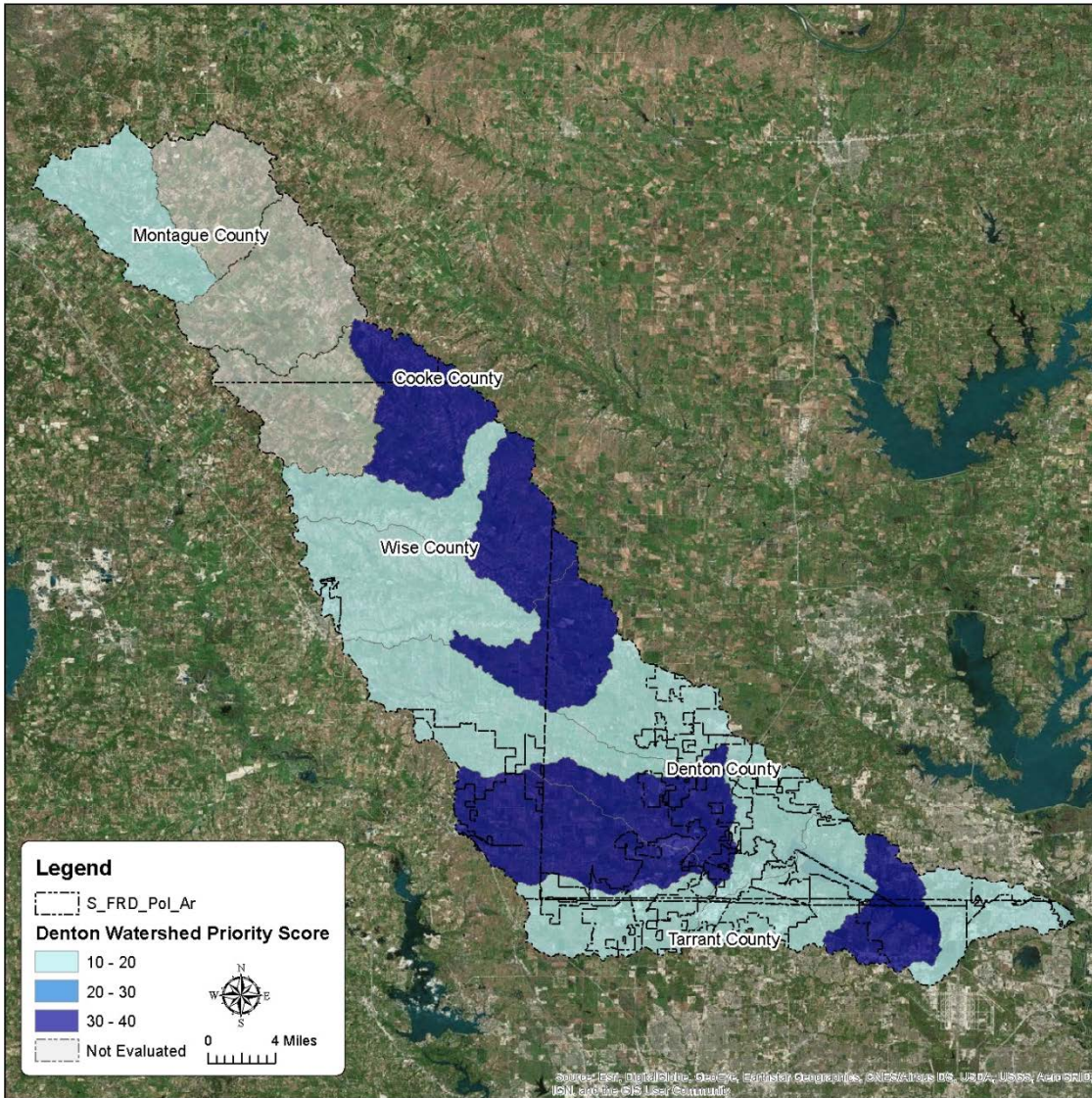


Figure 7: Ranking of Denton Watershed HUC-12s



## 3.2 Flood Risk Analysis

An advanced flood risk analysis was performed using the updated 1-percent-annual-chance grid (known as 'refined' grid) created for this project. The loss analysis uses 2010 census data and the subsequent results are stored in the L\_RA\_Results table.

Hazus version 4.0 was used for the loss analysis.

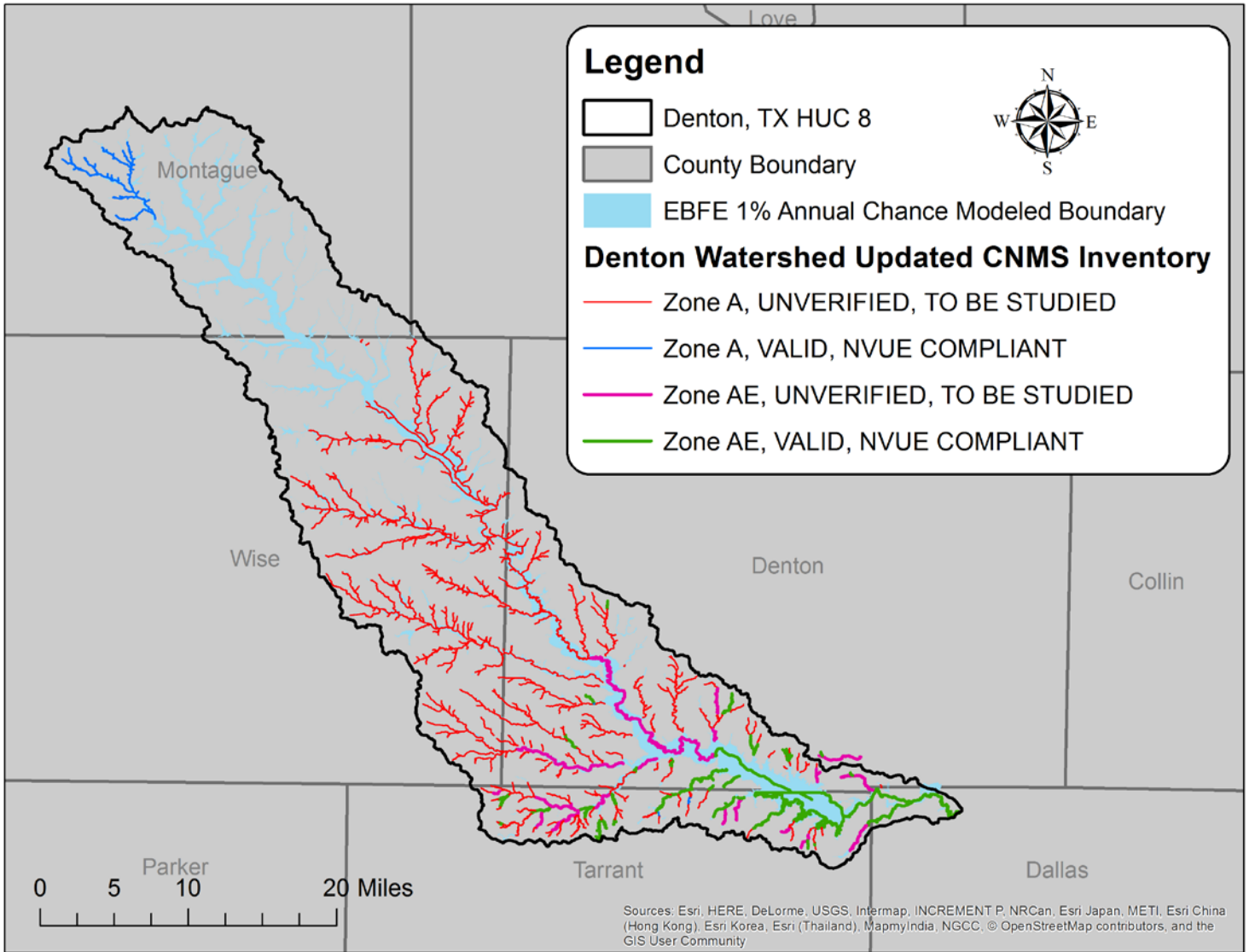
The losses are reported via census blocks. It is important to note that Hazus version 4.0 uses dasymetric census blocks. Dasymetric mapping removes undeveloped areas (such as areas covered by other bodies of water, wetlands, or forests) from the Census blocks, changing their shape and reducing their size in these areas. For more information on dasymetric data visit FEMA's [Media Library](#) for the [Hazus-MH Data Inventories: Dasymetric vs. Homogenous](#), or [Hazus 3.0 Dasymetric Data Overview](#).

## References

1. Watershed Concepts, a Division of Hayes, Seay, Mattern & Mattern. *Watershed Information System (WISE)*, Version 4.1.0. 2008
2. Asquith, William H. and Roussel, Meghan C., 2009, Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach: U.S. Geological Survey Scientific Investigations Report 2009–5087.
3. USGS, “Estimating Magnitude and Frequency of Floods Using PeakFQ Program: USGS Fact Sheet”, 2006.
4. USGS. Multi-Resolution Land Characteristics Consortium. *National Land Cover Database 2011*. (<http://www.mrlc.gov/nlcd2011.php>).
5. Chow, Ven T. "Development of Uniform Flow and It Formulas." *Open Channel Hydraulics*. Caldwell, NJ: Blackburn, 1959. 109-113. Print.
6. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (January 2010). HEC-RAS River Analysis System, Version 4.1.0. Davis, California.
7. FEMA, “Guidance for Flood Risk Analysis and Mapping – Automated Engineering”, May 2016. ([https://www.fema.gov/media-library-data/1469144112748-f3c4ecd90cb927cd200b6a3e9da80d8a/Automated\\_Engineering\\_Guidance\\_May\\_2016.pdf](https://www.fema.gov/media-library-data/1469144112748-f3c4ecd90cb927cd200b6a3e9da80d8a/Automated_Engineering_Guidance_May_2016.pdf)).
8. Texas Precipitation – Average monthly and annual precipitation for the climatological period 1981-2010. Data from NRCS. Retrieved October 2015 from (<http://www.twdb.texas.gov/mapping/gisdata.asp>).



# Appendix A BLE Maps







# Appendix III: Additional Data

# Discovery Figures

Figure 01: HUC Locator Map

Figure 02: Federal House Congressional Districts

Figure 03: State House Congressional Districts

Figure 04: State Senate Congressional Districts

Figure 05: Population Density

Figure 06: Land Use

Figure 07: Urban Cover

Figure 08: Population Change

Figure 09: Flood Hazard Map

Figure 10: Topographic Data

Figure 11: High Water Marks and Low Water Crossings

Figure 12: Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Claims

Figure 13: Flood Risk – Potential Losses

Figure 14: Population Vulnerability

Figure 15: HUC-12 Watershed Prioritizations

Figure 16: Community Rating System (CRS) Eligible Communities Map

Figure 17: Stream Study Request

Pre-Discovery Map

Discovery Map

Post-Discovery Map

HUC-12 Watershed Prioritizations and Potential Projects



Figure 01:

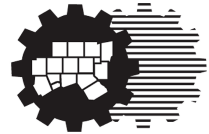
### HUC Locator Map

DENTON WATERSHED

October 31, 2017

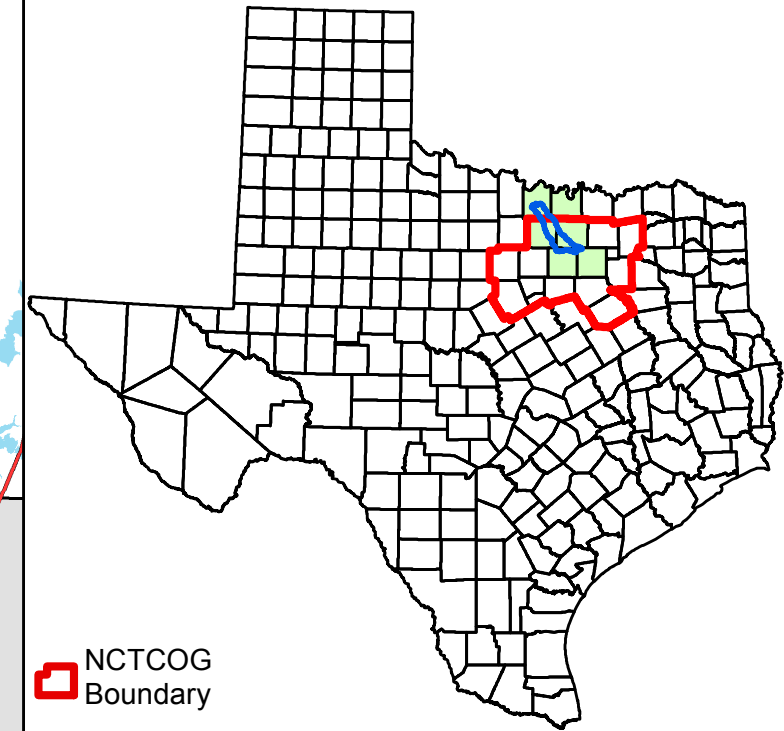


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Council of Governments

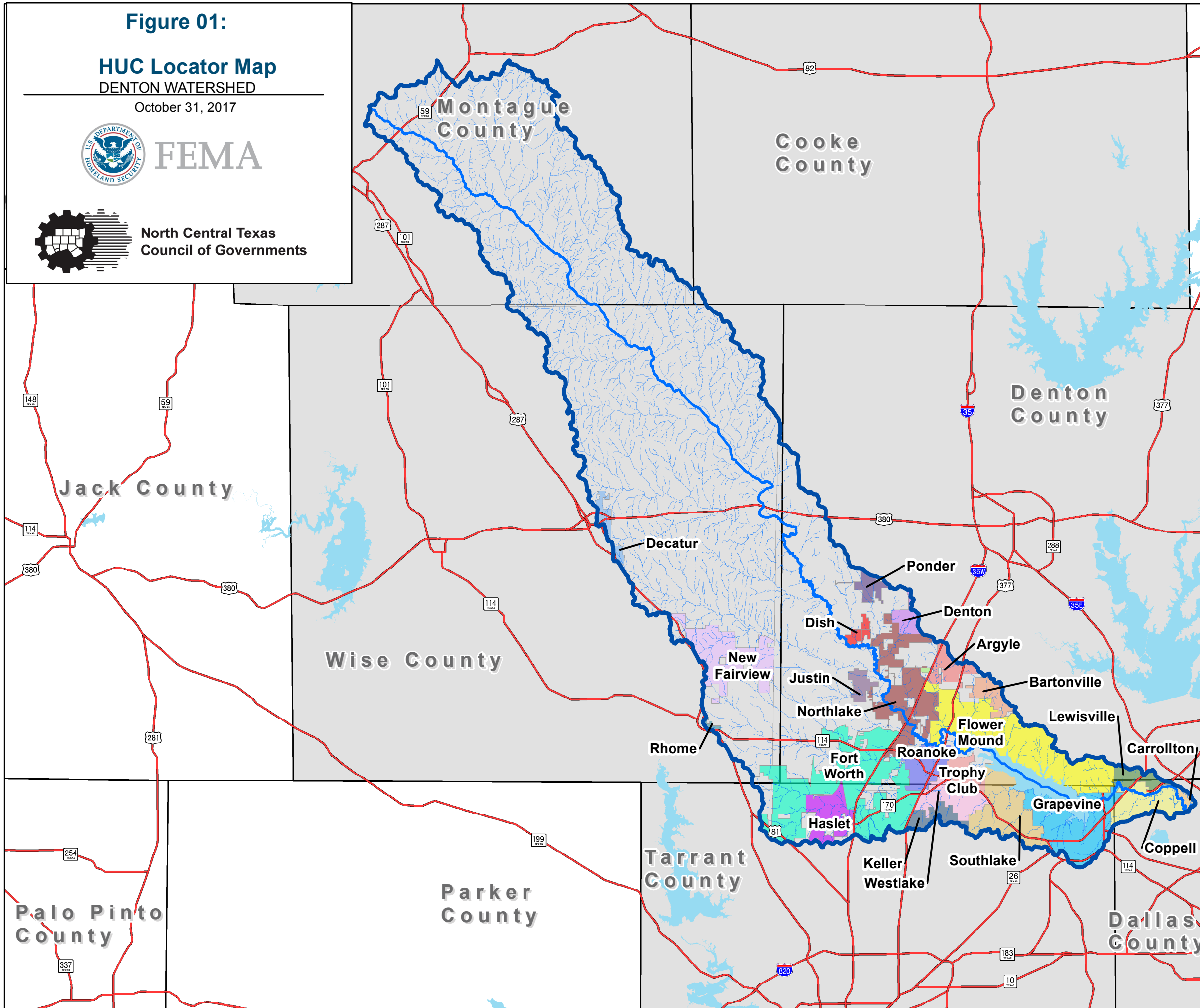
### WATERSHED LOCATOR STATE OF TEXAS



NCTCOG  
Boundary

### Map Symbology

- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries



**Figure 02:  
Federal House  
Congressional Districts**

DENTON WATERSHED

October 31, 2017

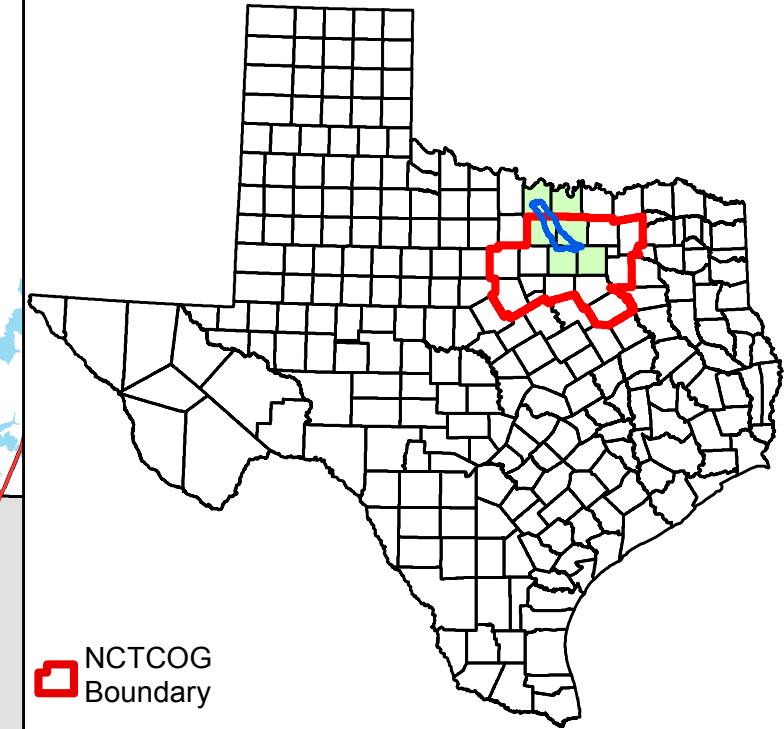


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Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

**Map Symbology**

- County Seat
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Lakes
- ⊕ Denton Watershed Discovery County
- ⊕ County Boundaries

**Federal House Districts (2017)**

- District 12
- District 13
- District 24
- District 26

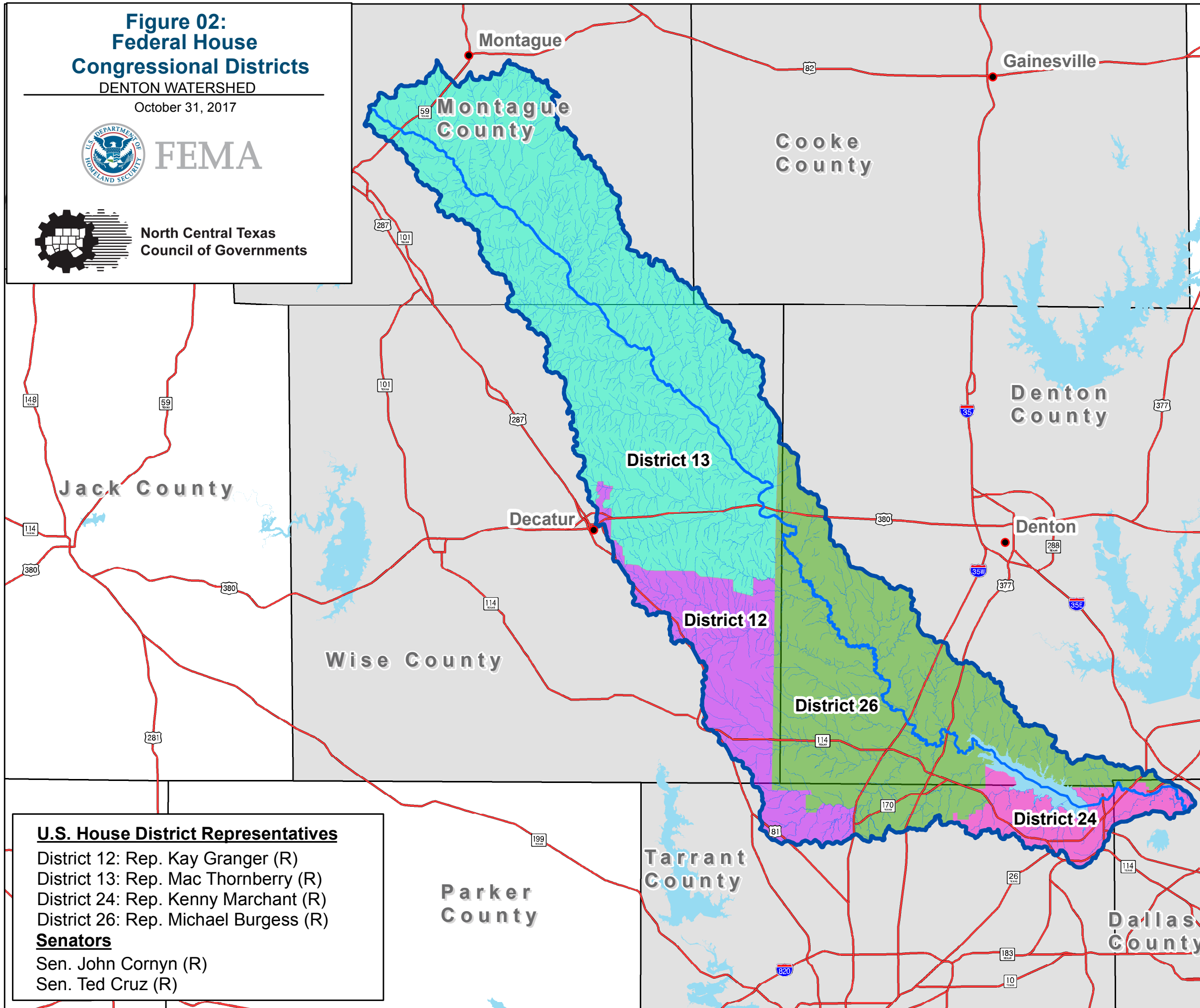
**U.S. House District Representatives**

- District 12: Rep. Kay Granger (R)
- District 13: Rep. Mac Thornberry (R)
- District 24: Rep. Kenny Marchant (R)
- District 26: Rep. Michael Burgess (R)

**Senators**

- Sen. John Cornyn (R)
- Sen. Ted Cruz (R)

0 6 12 Miles





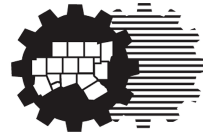
**Figure 03:  
State House  
Congressional Districts**

DENTON WATERSHED

October 31, 2017

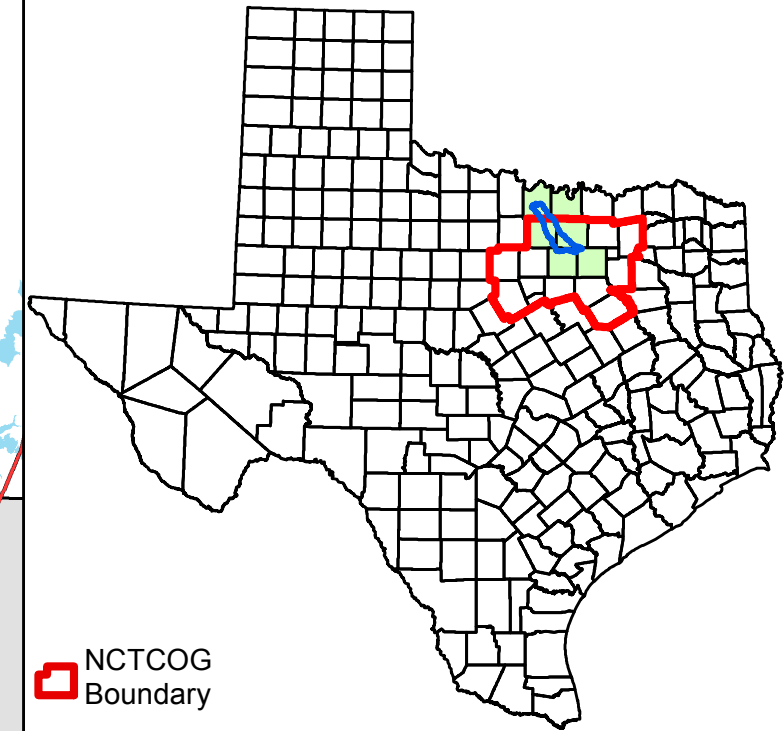


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Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

**Map Symbology**

- County Seat
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Lakes
- Denton Watershed Discovery County
- County Boundaries

**State House Districts (2017)**

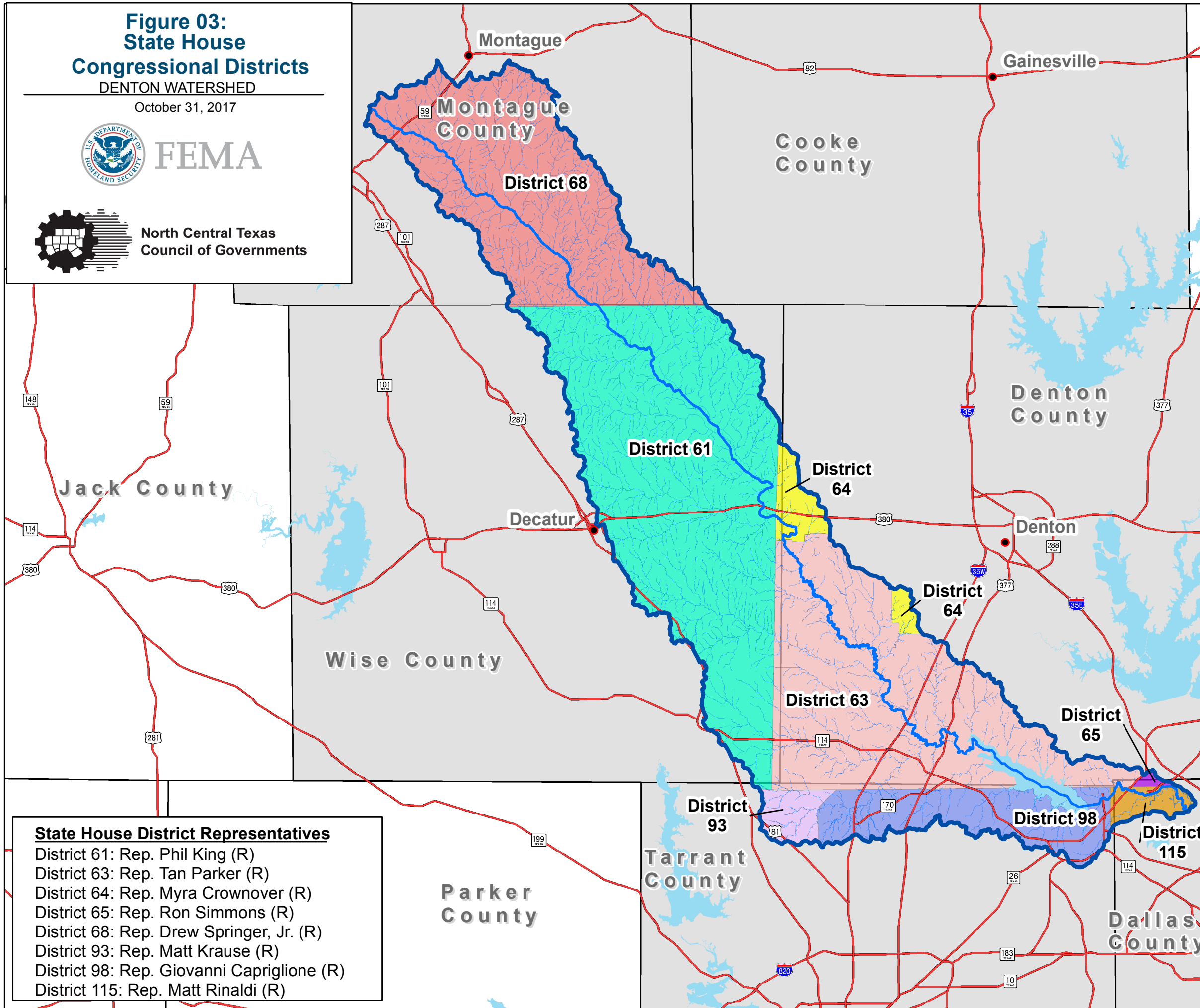
- District 61
- District 63
- District 64
- District 65
- District 68
- District 93
- District 98
- District 115

0 6 12 Miles



**State House District Representatives**

- District 61: Rep. Phil King (R)
- District 63: Rep. Tan Parker (R)
- District 64: Rep. Myra Crownover (R)
- District 65: Rep. Ron Simmons (R)
- District 68: Rep. Drew Springer, Jr. (R)
- District 93: Rep. Matt Krause (R)
- District 98: Rep. Giovanni Capriglione (R)
- District 115: Rep. Matt Rinaldi (R)



**Figure 04:  
State Senate  
Congressional Districts**

DENTON WATERSHED

October 31, 2017

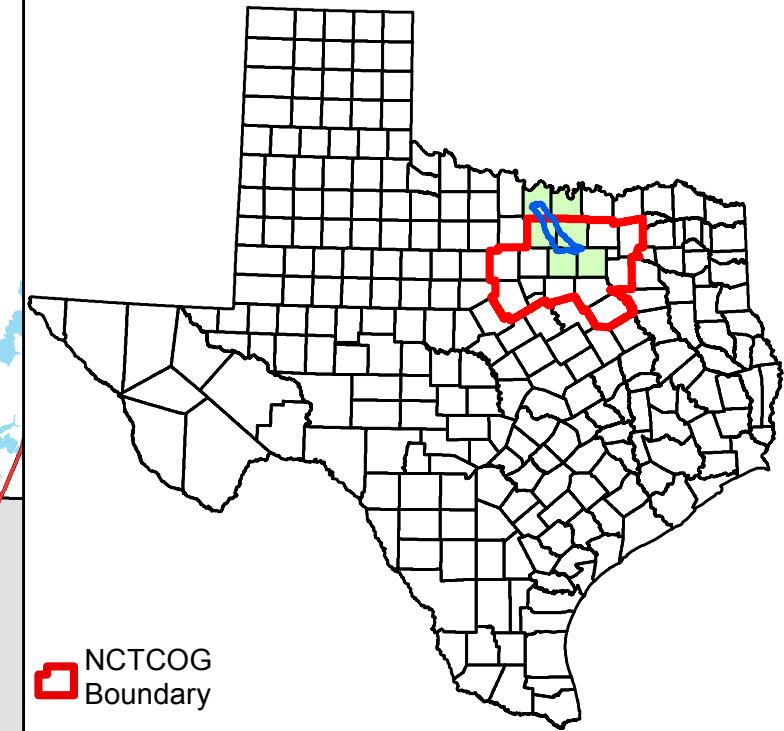


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Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

**Map Symbology**

- County Seat
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Lakes
- ⊕ Denton Watershed Discovery County
- ⊕ County Boundaries

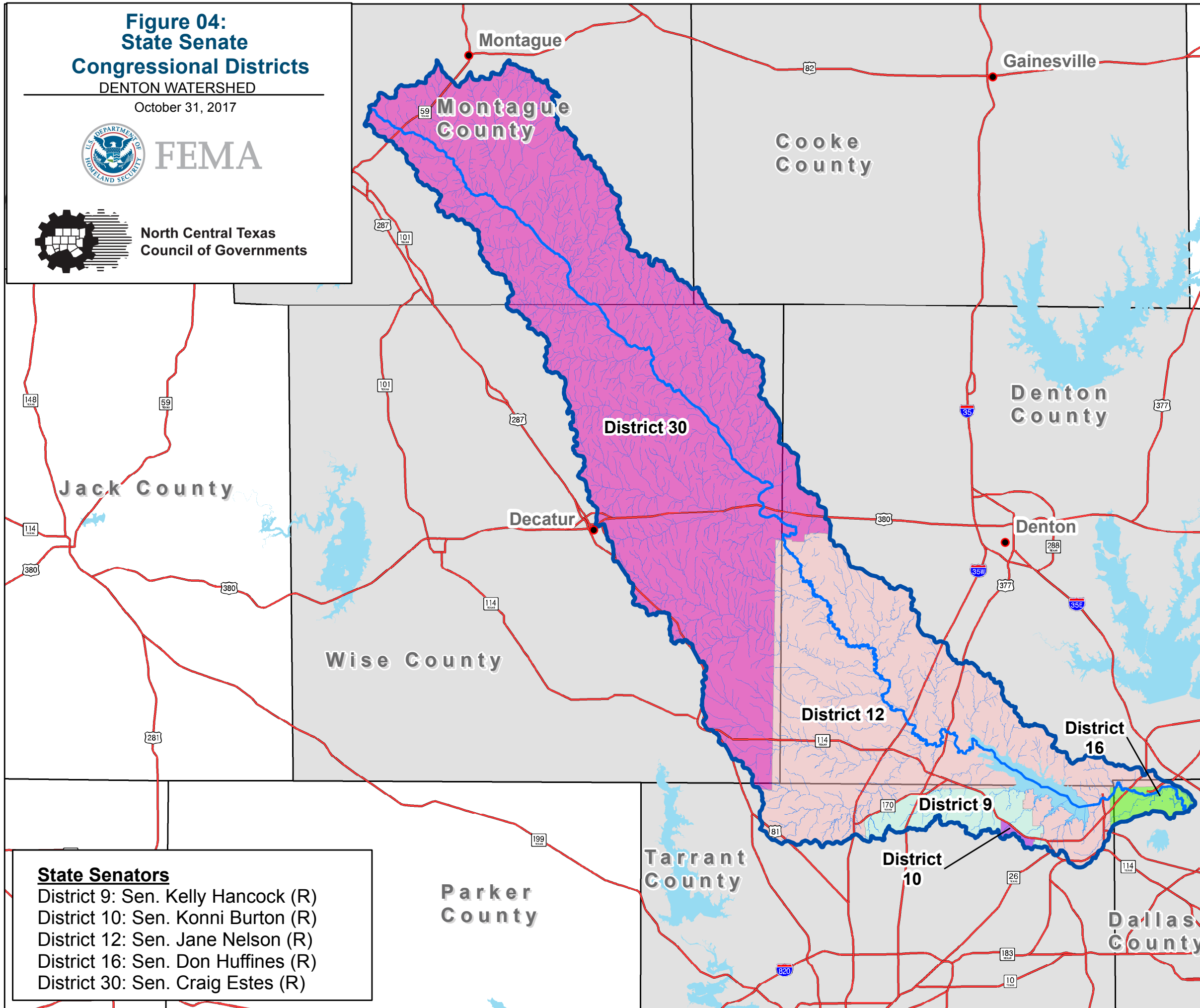
**State Senate Districts (2017)**

- District 9
- District 10
- District 12
- District 16
- District 30

**State Senators**

- District 9: Sen. Kelly Hancock (R)
- District 10: Sen. Konni Burton (R)
- District 12: Sen. Jane Nelson (R)
- District 16: Sen. Don Huffines (R)
- District 30: Sen. Craig Estes (R)

0 6 12 Miles





**Figure 05:**

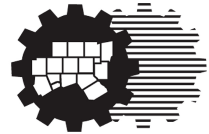
**Population Density**

DENTON WATERSHED

October 31, 2017

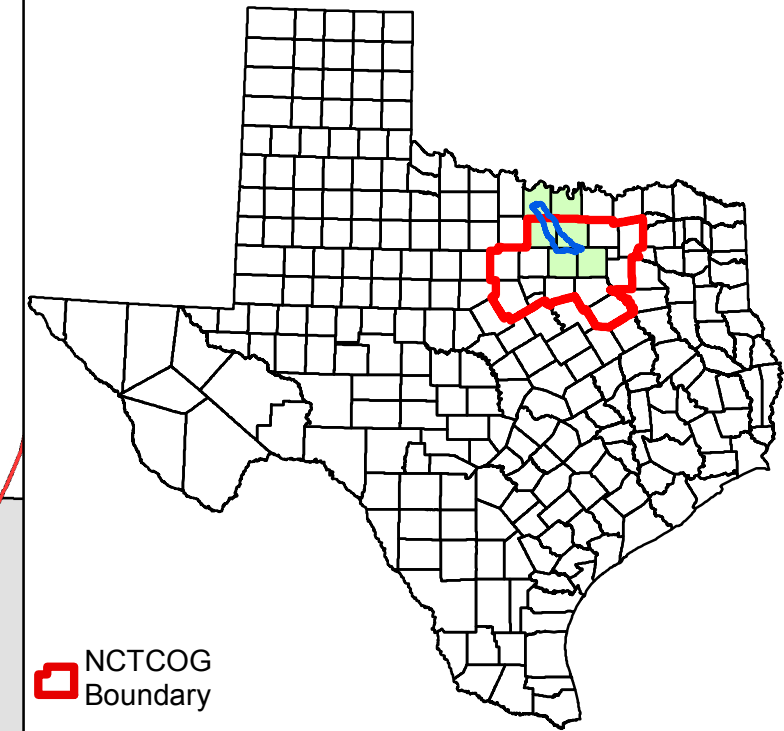


FEMA

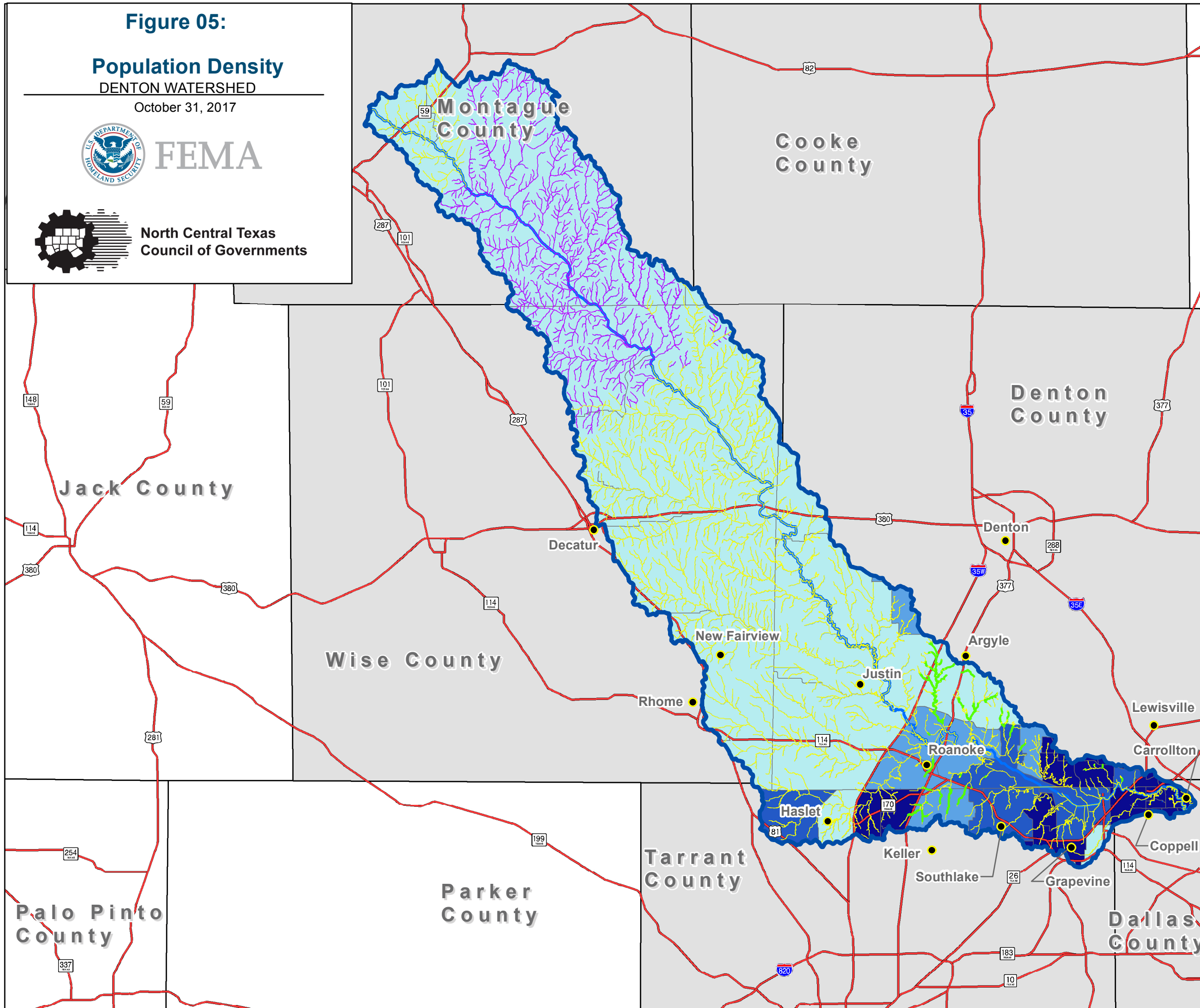


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Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary



**Map Symbology**

- Cities
- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries

**Population Density (2010)**

- Very Low
- Low
- Medium
- High

**CNMS Stream Status\***

- Assessed, To Be Studied
- Unverified, To Be Studied
- Valid, NVUE Compliant

\*Data as of May 2017

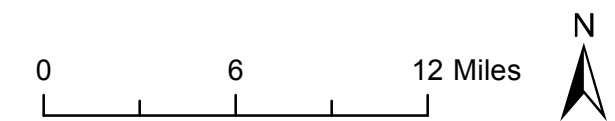


Figure 06:

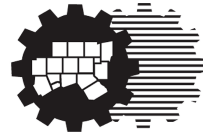
Land Use

DENTON WATERSHED

October 31, 2017

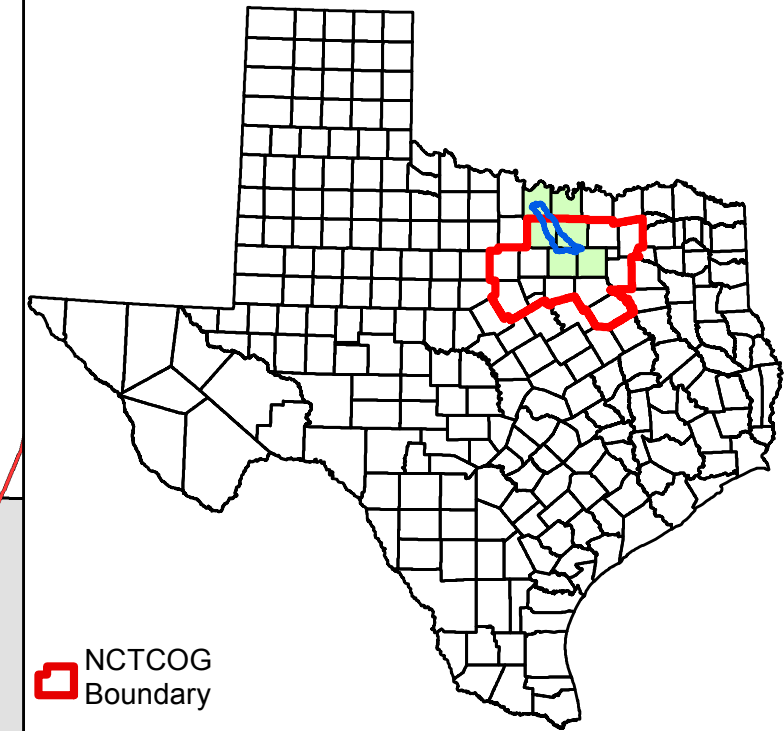


FEMA

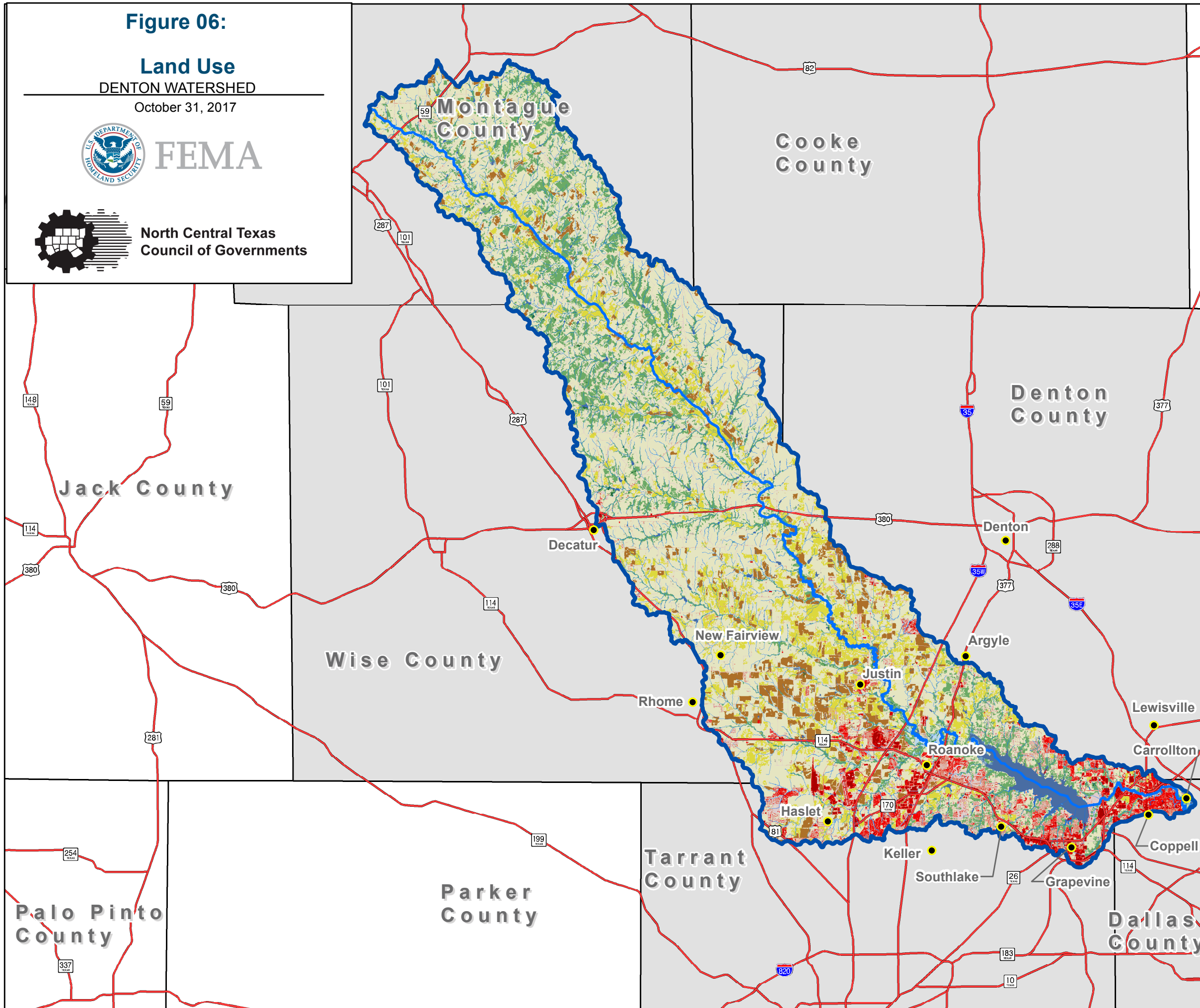


North Central Texas Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG Boundary



Map Symbology

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⬮ Watershed Boundary: HUC-8
- ⬮ Denton Watershed Discovery County
- ⬮ County Boundaries
- Land Use (2011 NLCD)\***
- Open Water
- Developed Open Space
- Developed Low Intensity
- Developed Medium Intensity
- Developed High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Shrubs
- Grassland
- Pasture
- Cultivated Crops
- Woody Wetlands
- Herbaceous Wetlands

\*NLCD is National Land Cover Dataset, created by the U.S. Geological Survey.

0 6 12 Miles





**Figure 07:**

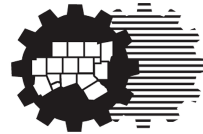
**Urban Cover**

DENTON WATERSHED

October 31, 2017

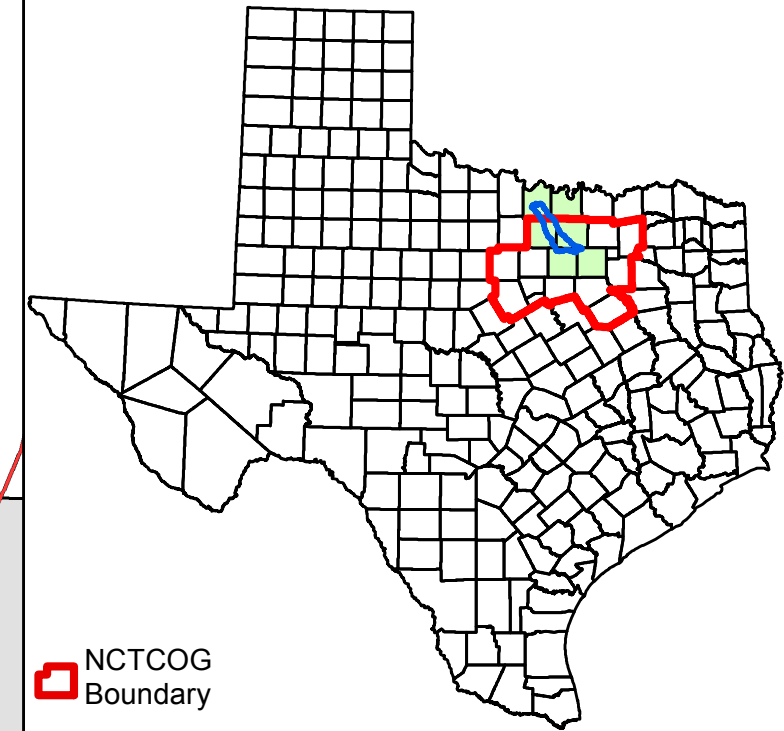


FEMA

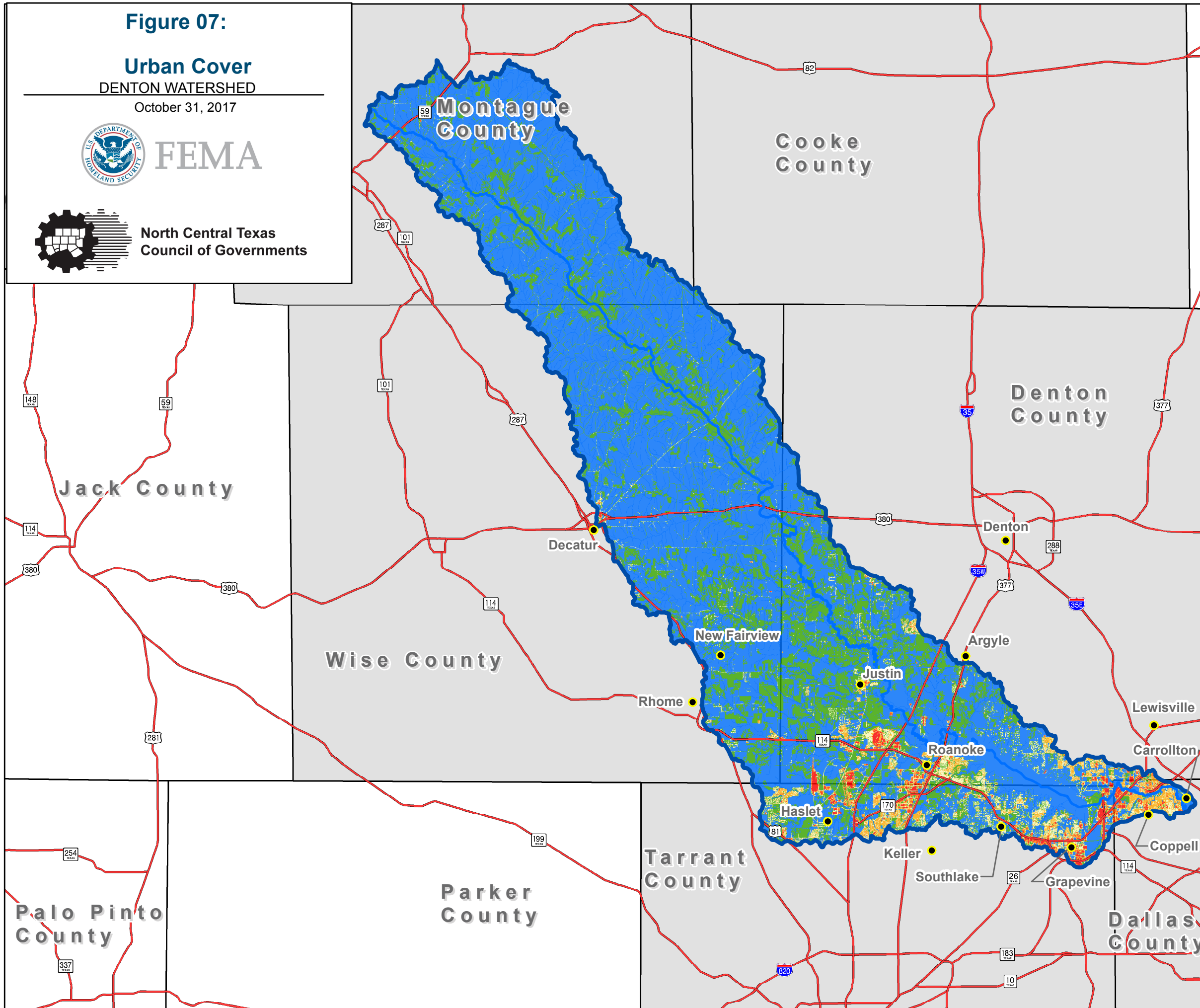


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WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary



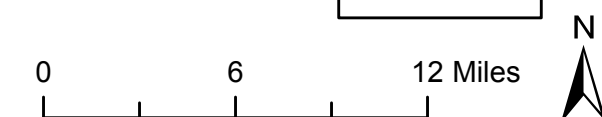
**Map Symbology**

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Denton Watershed Discovery County
- ⊕ County Boundaries

**Urban Cover (2011 NLCD)\***

- 1 - Undeveloped
- 2 - Farmland
- 3 - Developed, Low Intensity
- 4 - Developed, Medium Intensity
- 5 - Developed, High Intensity

\*NLCD is National Land Cover Dataset, created by the U.S. Geological Survey.



**Figure 08:**

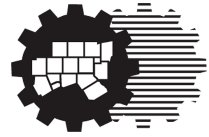
**Population Change**

DENTON WATERSHED

October 31, 2017

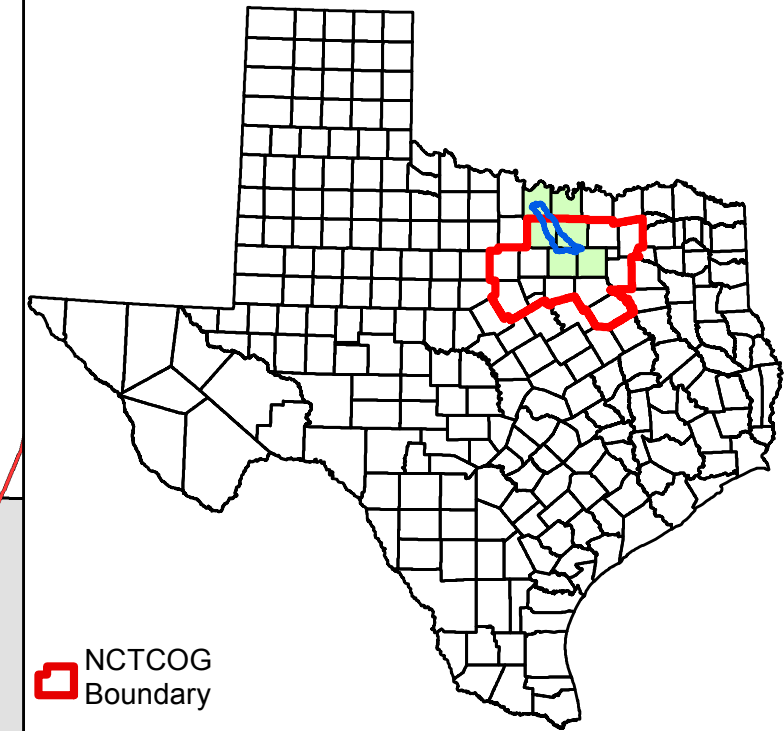


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North Central Texas  
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WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

**Map Symbology**

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊞ Watershed Boundary: HUC-8
- ⊞ Denton Watershed Discovery County
- ⊞ County Boundaries

**Percent Population Change (2000 - 2010)\***

- 0 - 25%
- 25 - 50%
- 50 - 75%
- 75 - 100%
- More than 100%

\*Source: 2006, 2010 U.S. Census

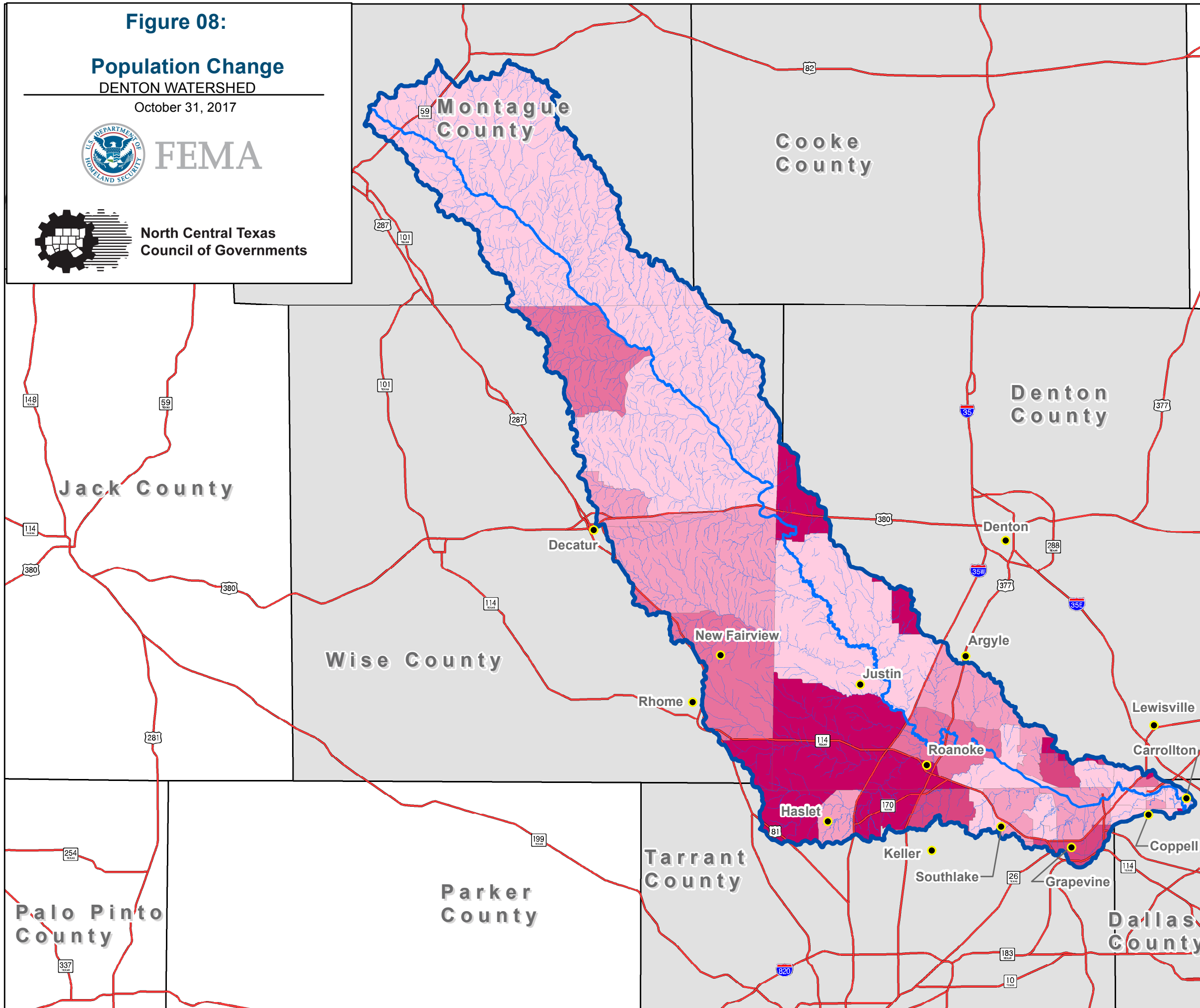
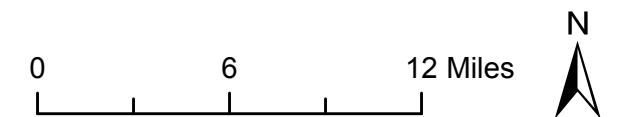




Figure 09:

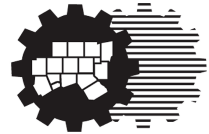
# Flood Hazard Map

DENTON WATERSHED

October 31, 2017

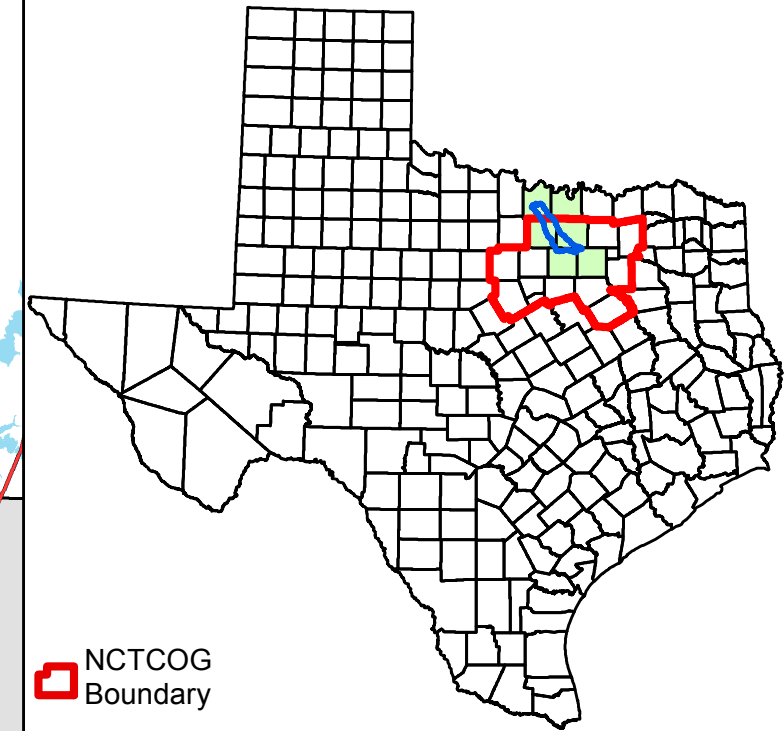


FEMA

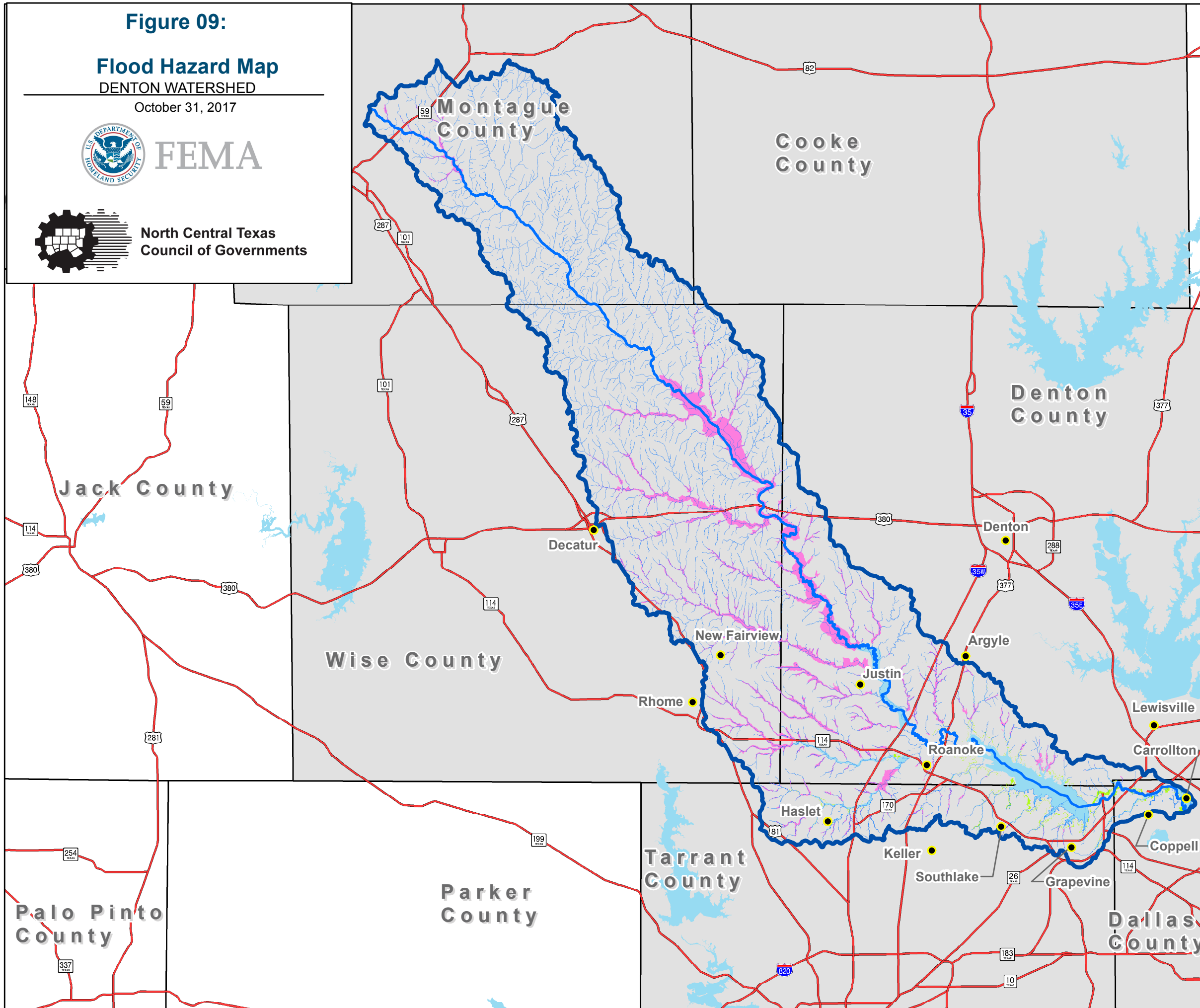


North Central Texas  
Council of Governments

## WATERSHED LOCATOR STATE OF TEXAS



NCTCOG  
Boundary



### Map Symbology

- Cities
- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries
- Effective FEMA Floodplains (2017)**
- Zone A (100-Yr, Approximate)
- Zone AE (100-Yr, Detailed)
- Zone X (500-Yr, Detailed)



**Figure 10:**

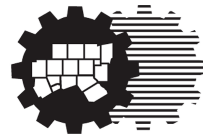
**Topographic Data**

DENTON WATERSHED

October 31, 2017

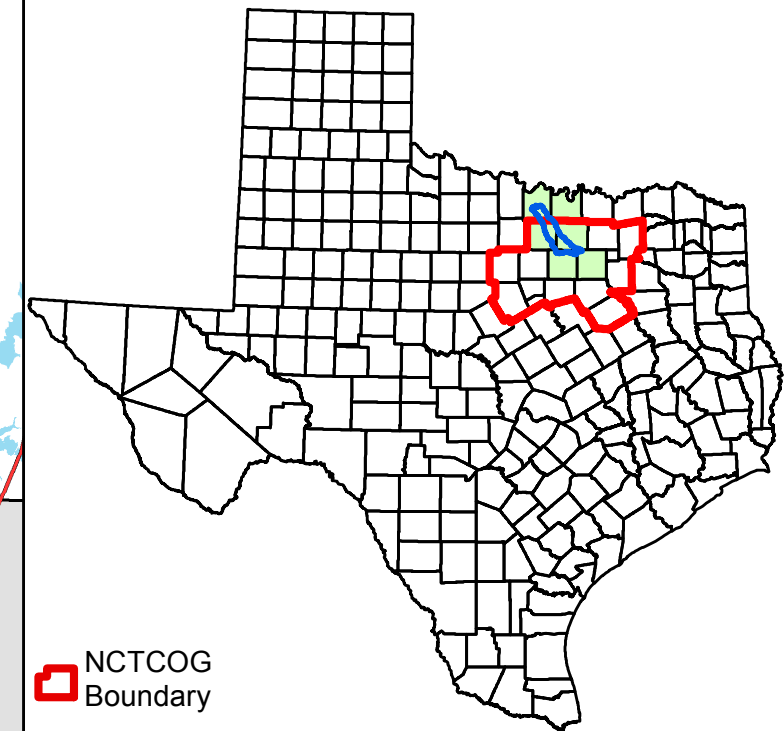


FEMA

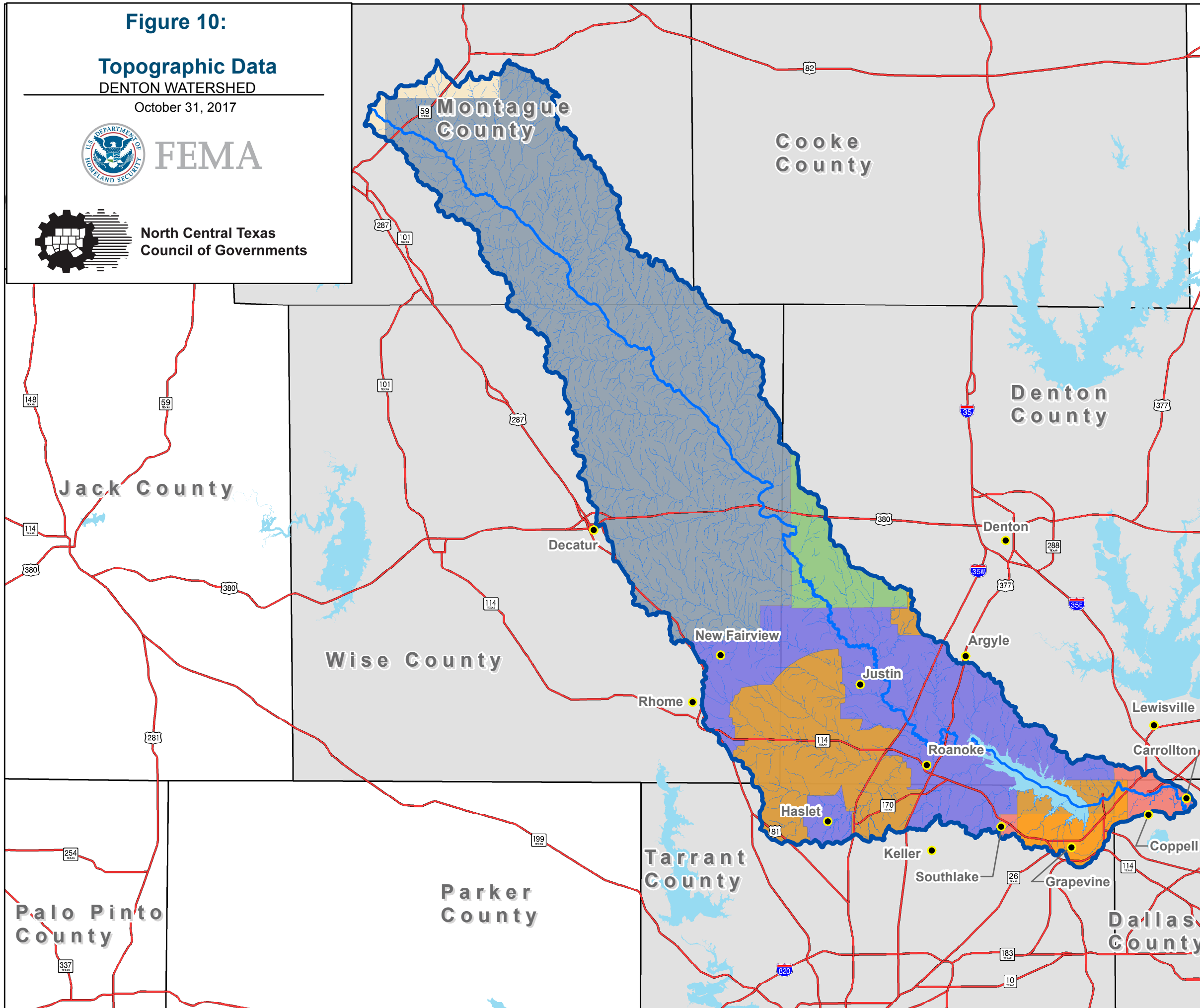


North Central Texas  
Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary



**Map Symbology**

- Cities
- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries

**Available Topography Data**

- 2009 - Dallas County LiDAR\*
- 2009 - Tarrant County LiDAR\*
- 2010 - Wise County LiDAR\*
- 2011 - Denton, Collin, Cooke, Grayson LiDAR\*
- 2015 - NCTCOG LiDAR\*
- USGS 30m DEM

\*Data is from Texas Natural Resources  
Information System (TNRIS)





# Figure 11 : High Water Marks and Low Water Crossings

DENTON WATERSHED

October 31, 2017

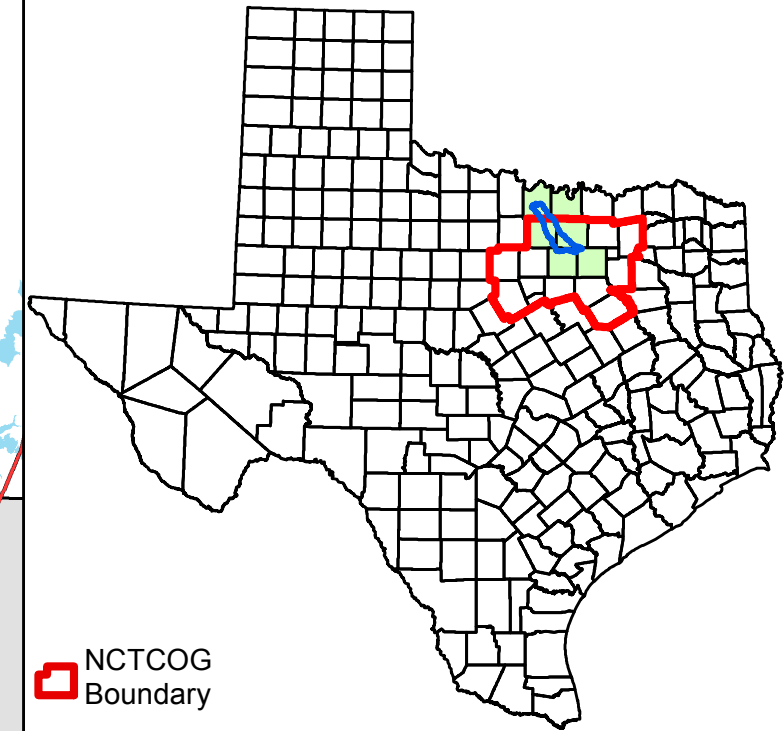


FEMA



North Central Texas  
Council of Governments

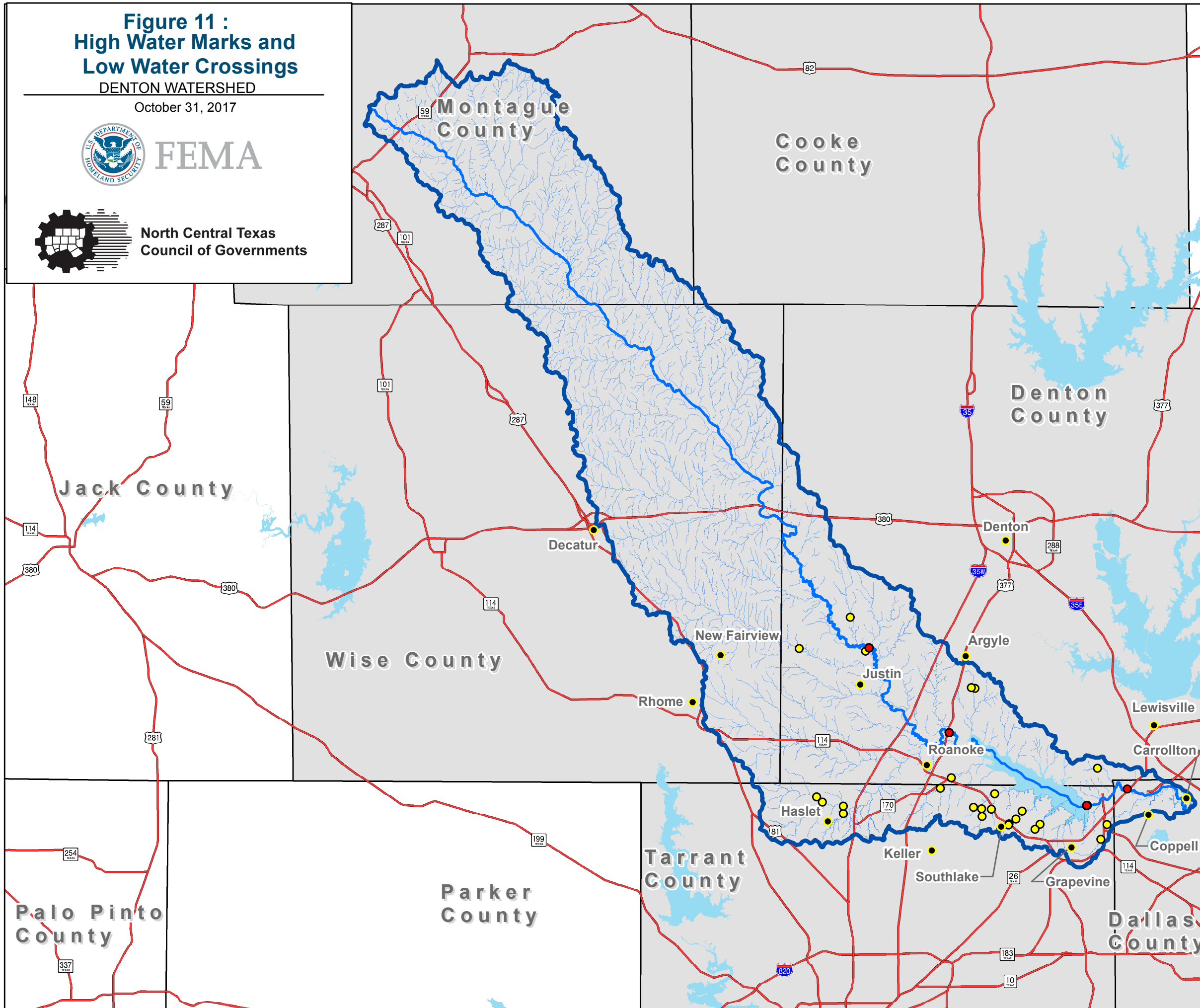
## WATERSHED LOCATOR STATE OF TEXAS



NCTCOG  
Boundary

### Map Symbology

- Cities
- High Water Mark
- Low Water Crossing
- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries



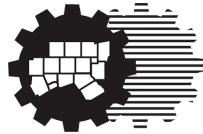
**Figure 12:  
Repetitive Loss (RL) and Severe  
Repetitive Loss (SRL) Claims**

DENTON WATERSHED

October 31, 2017

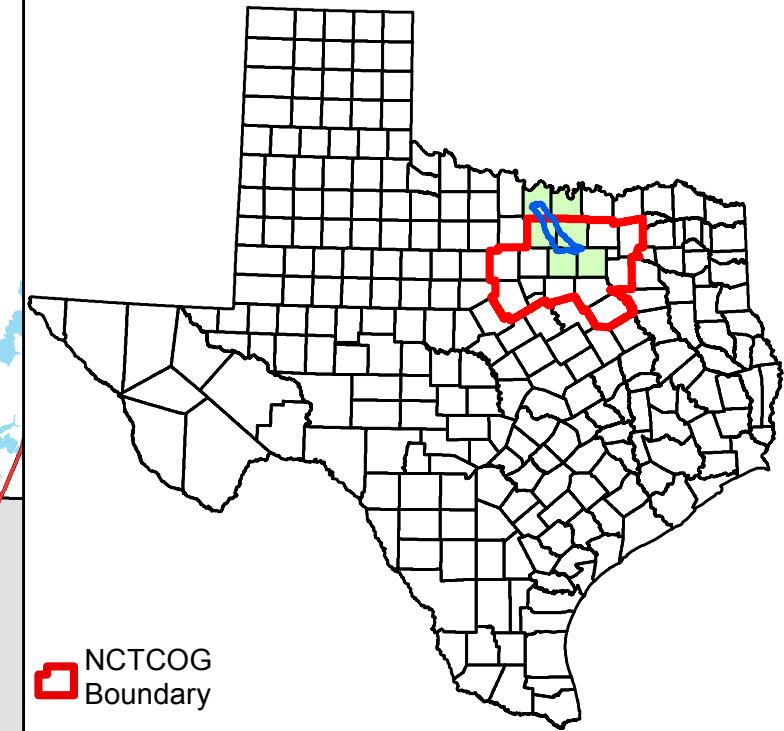


FEMA



North Central Texas  
Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

**Map Symbology**

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Lakes
- ⊕ Denton Watershed Discovery County
- ⊕ County Boundaries

**Total RL/SRL Claims (2015 FEMA)**

- 0
- 2
- 3

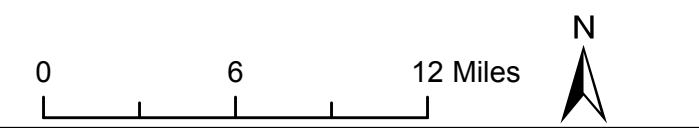
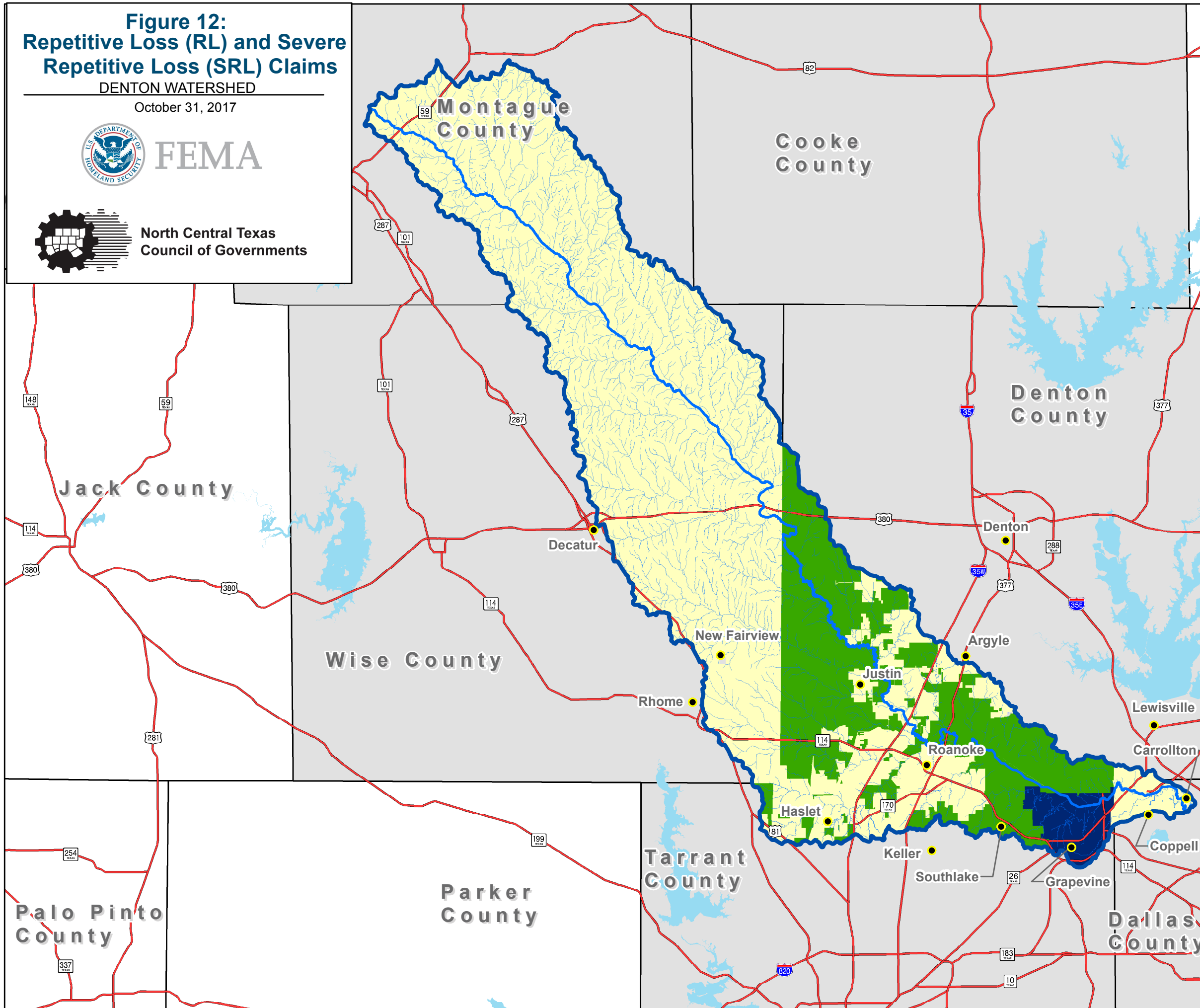




Figure 13:

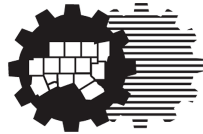
Flood Risk - Potential Losses

DENTON WATERSHED

October 31, 2017

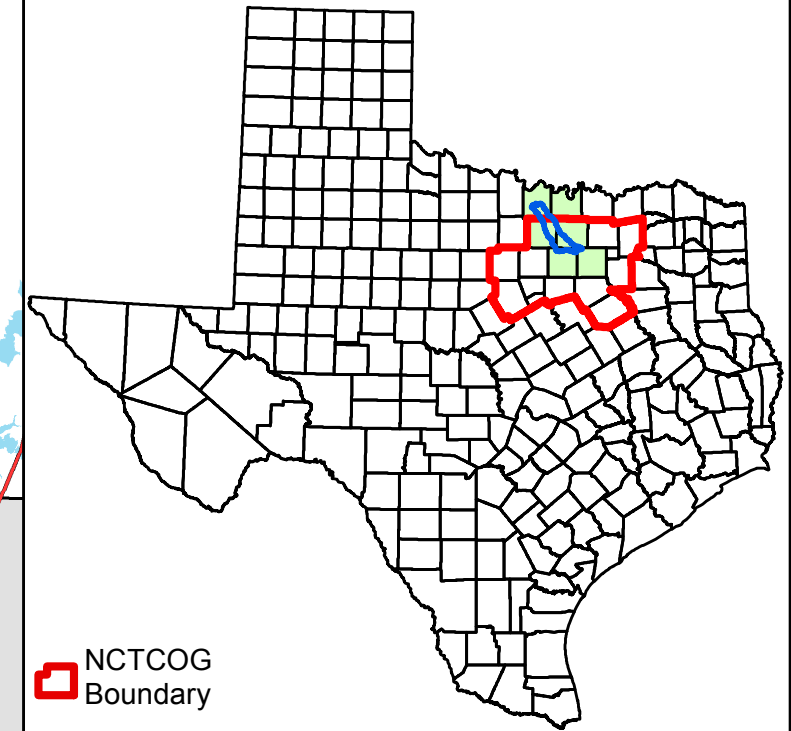


FEMA

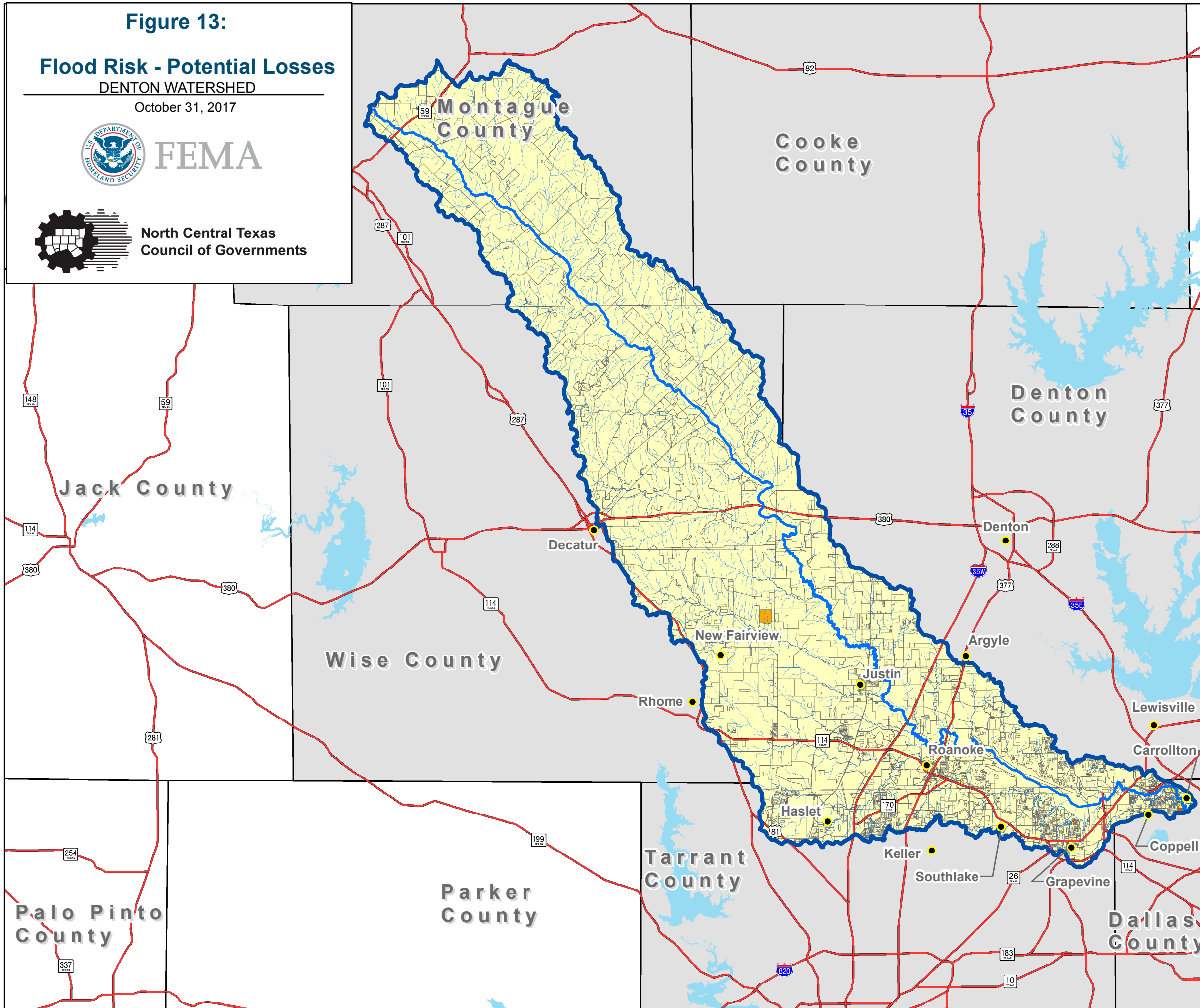


North Central Texas Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG Boundary



Map Symbology

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊞ Watershed Boundary: HUC-8
- ~ Lakes
- ⊞ Denton Watershed Discovery County
- ⊞ County Boundaries

Flood Risk\*

- Very Low
- Low
- Medium
- High
- Very High

\*Note: Flood Risk data source is FEMA 2010 HAZUS Average Annualized Loss (AAL) Study

0 6 12 Miles



**Figure 14:**

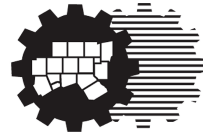
**Population Vulnerability**

DENTON WATERSHED

October 31, 2017

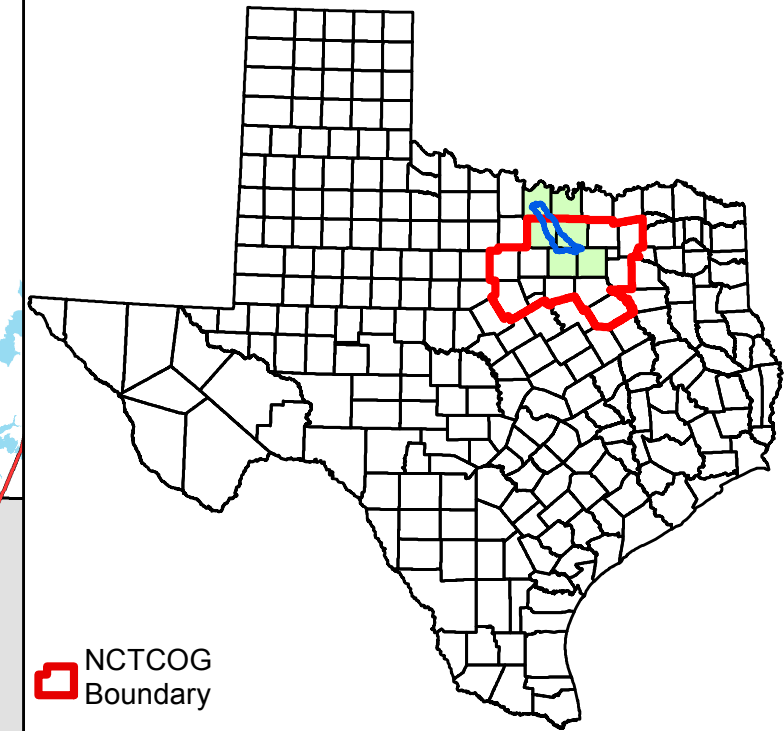


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North Central Texas  
Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



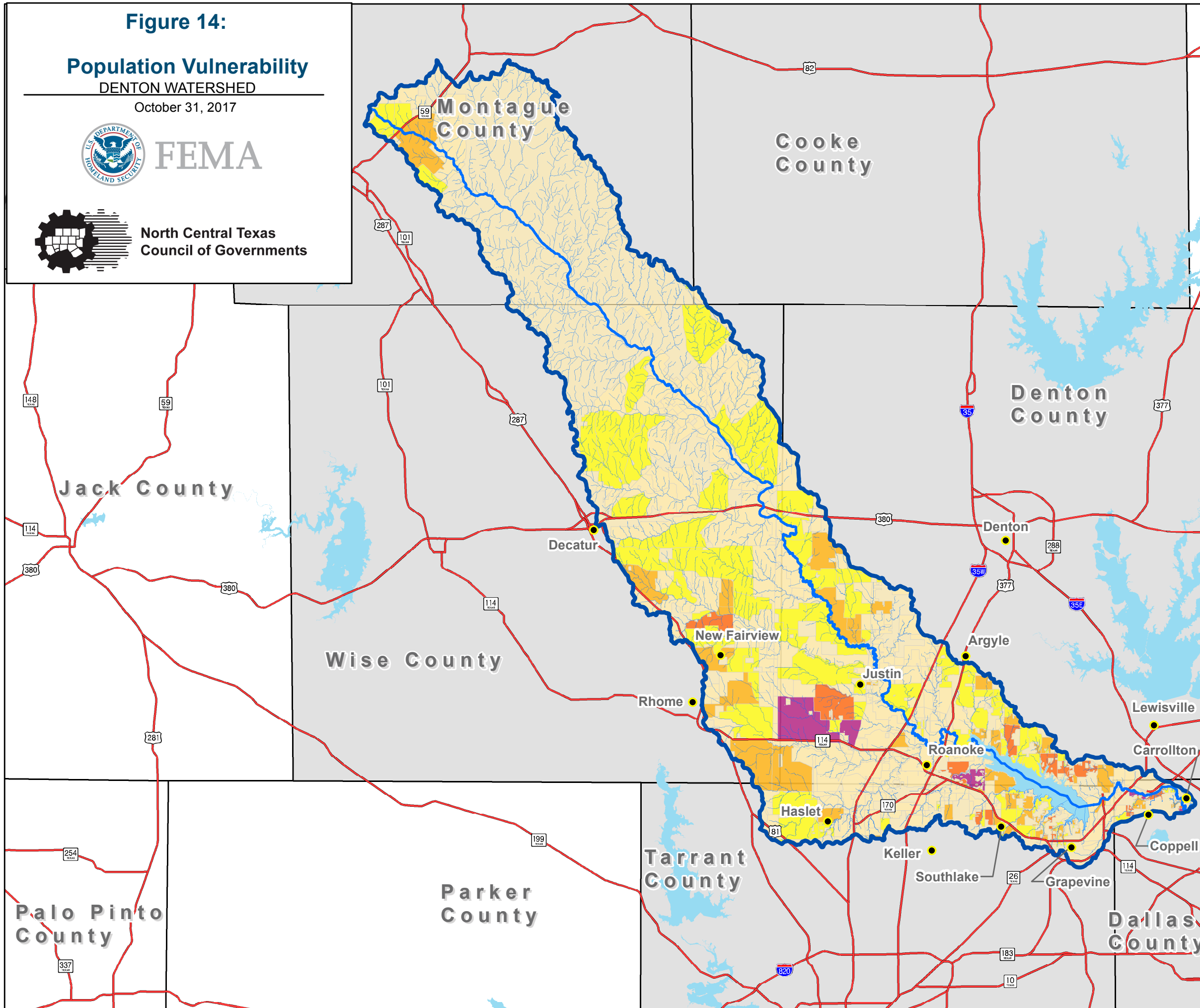
NCTCOG  
Boundary

**Map Symbology**

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊞ Watershed Boundary: HUC-8
- ~ Lakes
- ⊞ Denton Watershed Discovery County
- ⊞ County Boundaries

**Population Vulnerability to 1% Flood  
(2012 Texas Hazard Mitigation Package)**

- Very Low
- Low
- Medium
- High
- Very High





**Figure 15:  
HUC - 12 Watershed  
Prioritizations**

DENTON WATERSHED

October 31, 2017

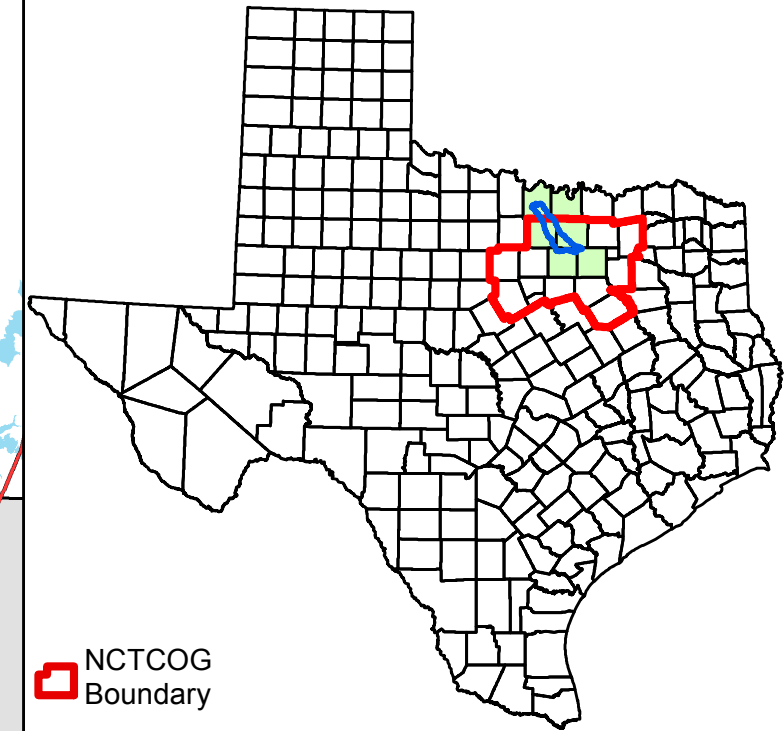


FEMA



North Central Texas  
Council of Governments

WATERSHED LOCATOR  
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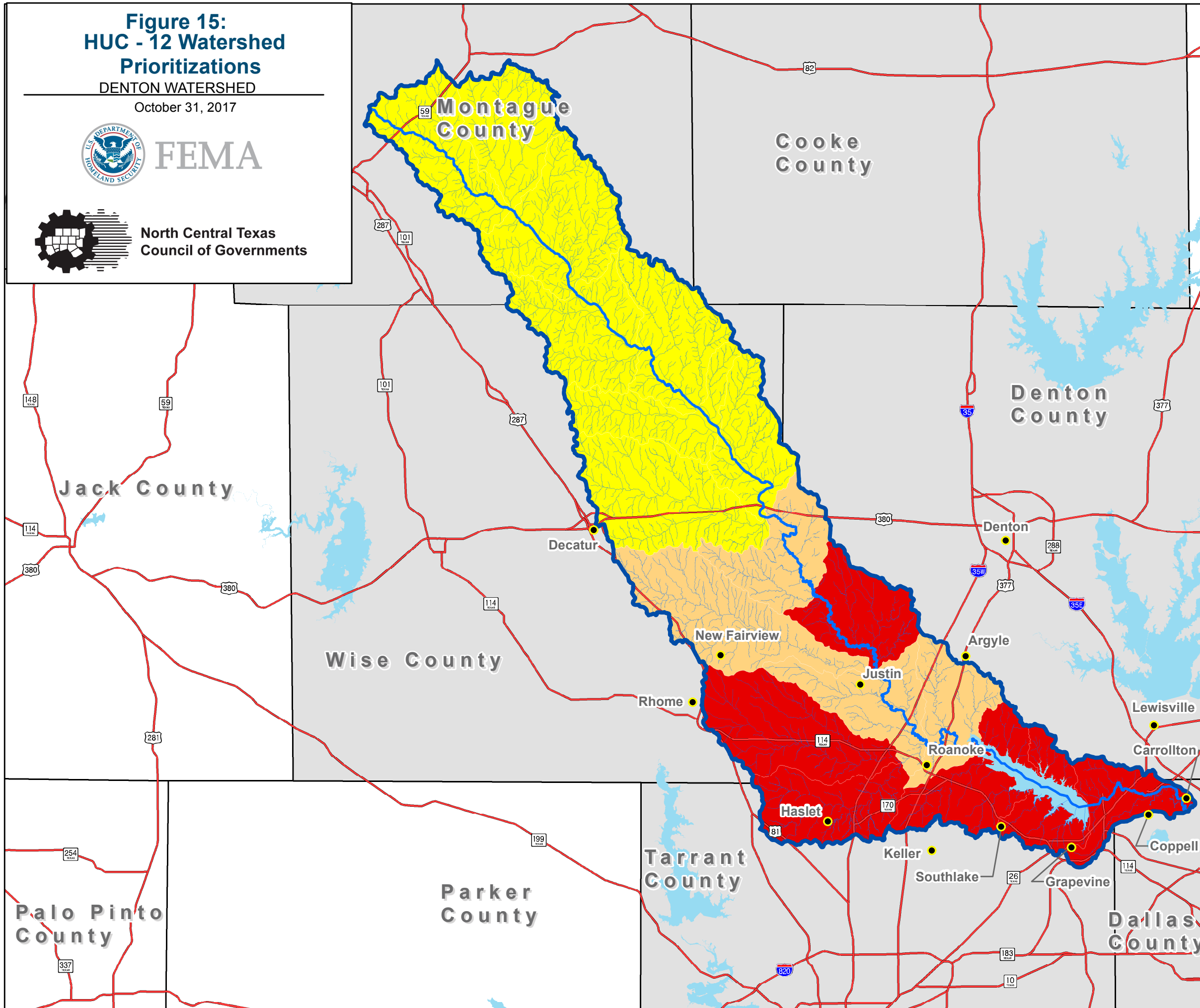
NCTCOG  
Boundary

**Map Symbology**

- Cities
- ~ Denton Creek
- ~ Other Streams
- Major Highways
- ⊕ Watershed Boundary: HUC-8
- ⊕ Lakes
- ⊕ Denton Watershed Discovery County
- ⊕ County Boundaries

**HUC-12 Watershed Prioritizations**

- Moderate
- Elevated
- High



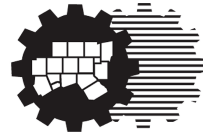
**Figure 16:  
Community Rating System (CRS)  
Eligible Communities Map**

DENTON WATERSHED

October 31, 2017

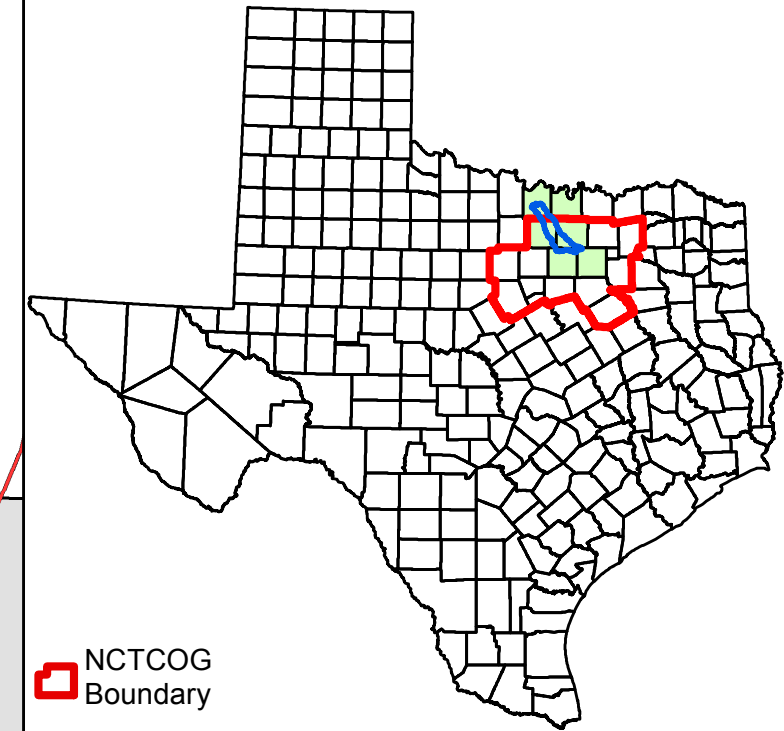


FEMA



North Central Texas  
Council of Governments

WATERSHED LOCATOR  
STATE OF TEXAS



NCTCOG  
Boundary

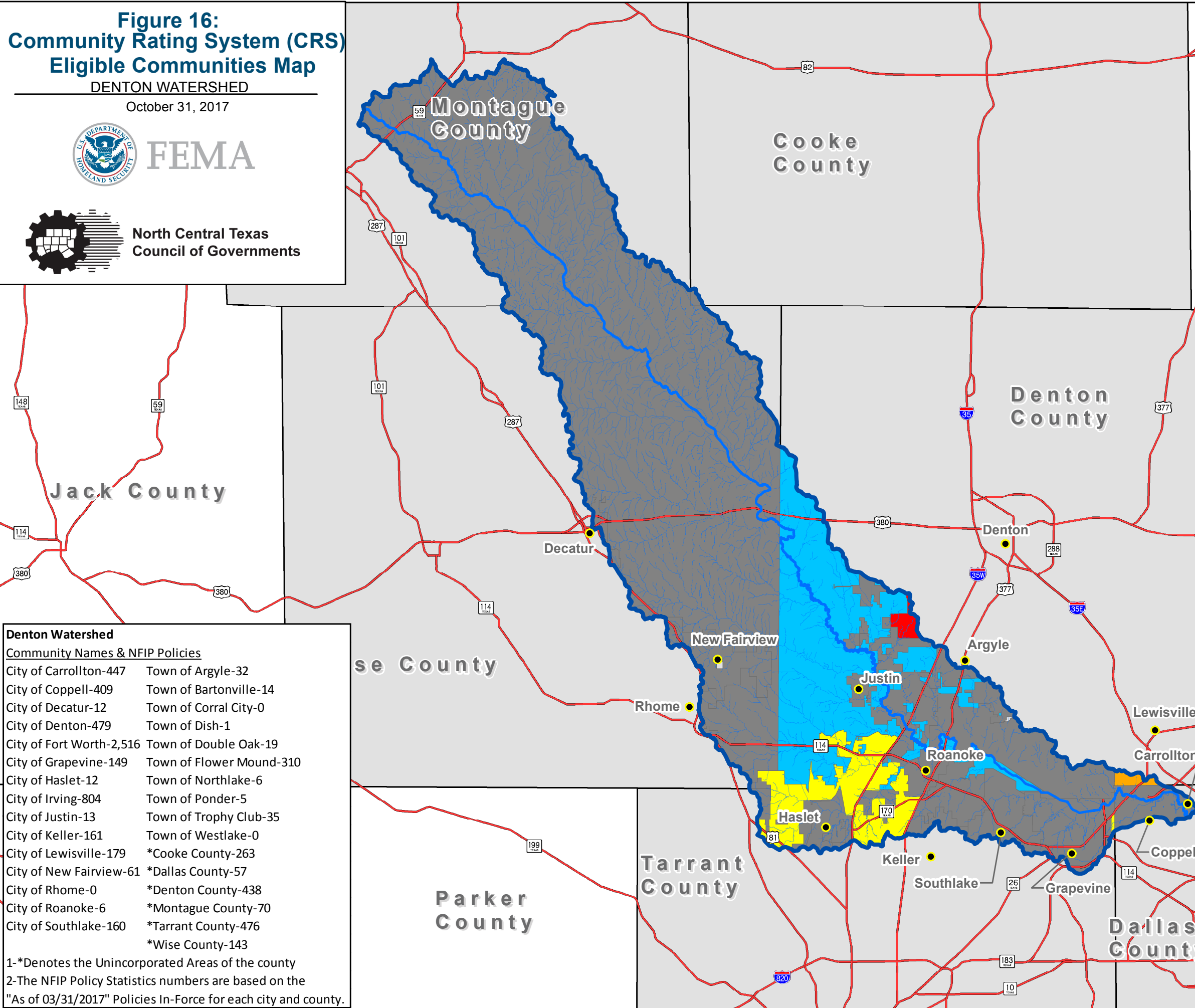
**Map Symbology**

- Cities
  - ~ Denton Creek
  - ~ Other Streams
  - Major Highways
  - ⊞ Watershed Boundary: HUC-8
  - ⊞ Lakes
  - ⊞ Denton Watershed Discovery County
  - ⊞ County Boundaries
- CRS Class (Data as of 10/01/2016)**
- ⊞ Communities Not Participating
  - ⊞ 6
  - ⊞ 7
  - ⊞ 8
  - ⊞ 10

**Denton Watershed**  
Community Names & NFIP Policies

City of Carrollton-447	Town of Argyle-32
City of Coppell-409	Town of Bartonville-14
City of Decatur-12	Town of Corral City-0
City of Denton-479	Town of Dish-1
City of Fort Worth-2,516	Town of Double Oak-19
City of Grapevine-149	Town of Flower Mound-310
City of Haslet-12	Town of Northlake-6
City of Irving-804	Town of Ponder-5
City of Justin-13	Town of Trophy Club-35
City of Keller-161	Town of Westlake-0
City of Lewisville-179	*Cooke County-263
City of New Fairview-61	*Dallas County-57
City of Rhome-0	*Denton County-438
City of Roanoke-6	*Montague County-70
City of Southlake-160	*Tarrant County-476
	*Wise County-143

1- \*Denotes the Unincorporated Areas of the county  
2- The NFIP Policy Statistics numbers are based on the "As of 03/31/2017" Policies In-Force for each city and county.





**Figure 17:**

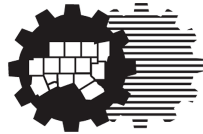
**Stream Study Request**

DENTON WATERSHED

October 31, 2017

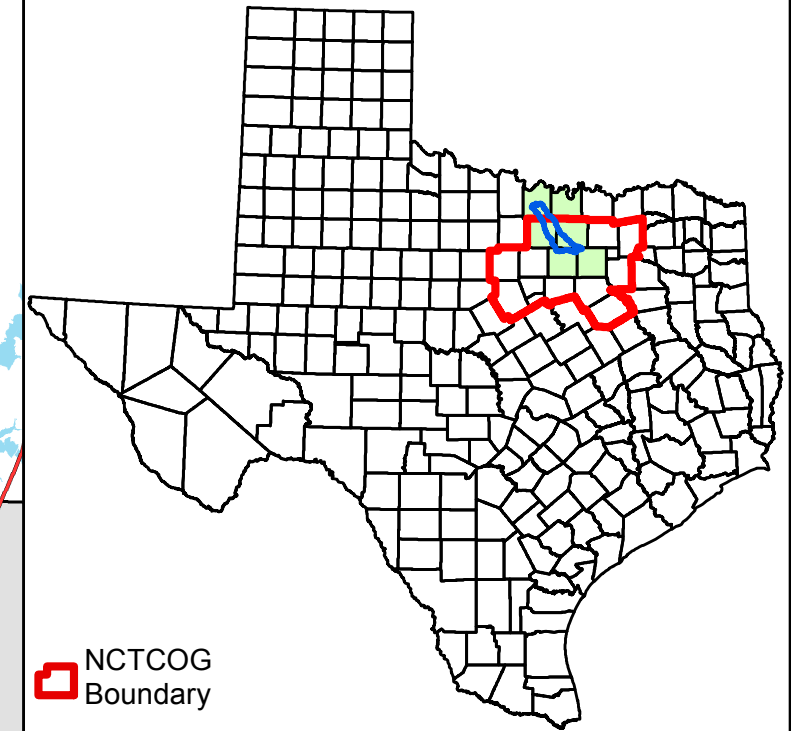


FEMA



North Central Texas  
Council of Governments

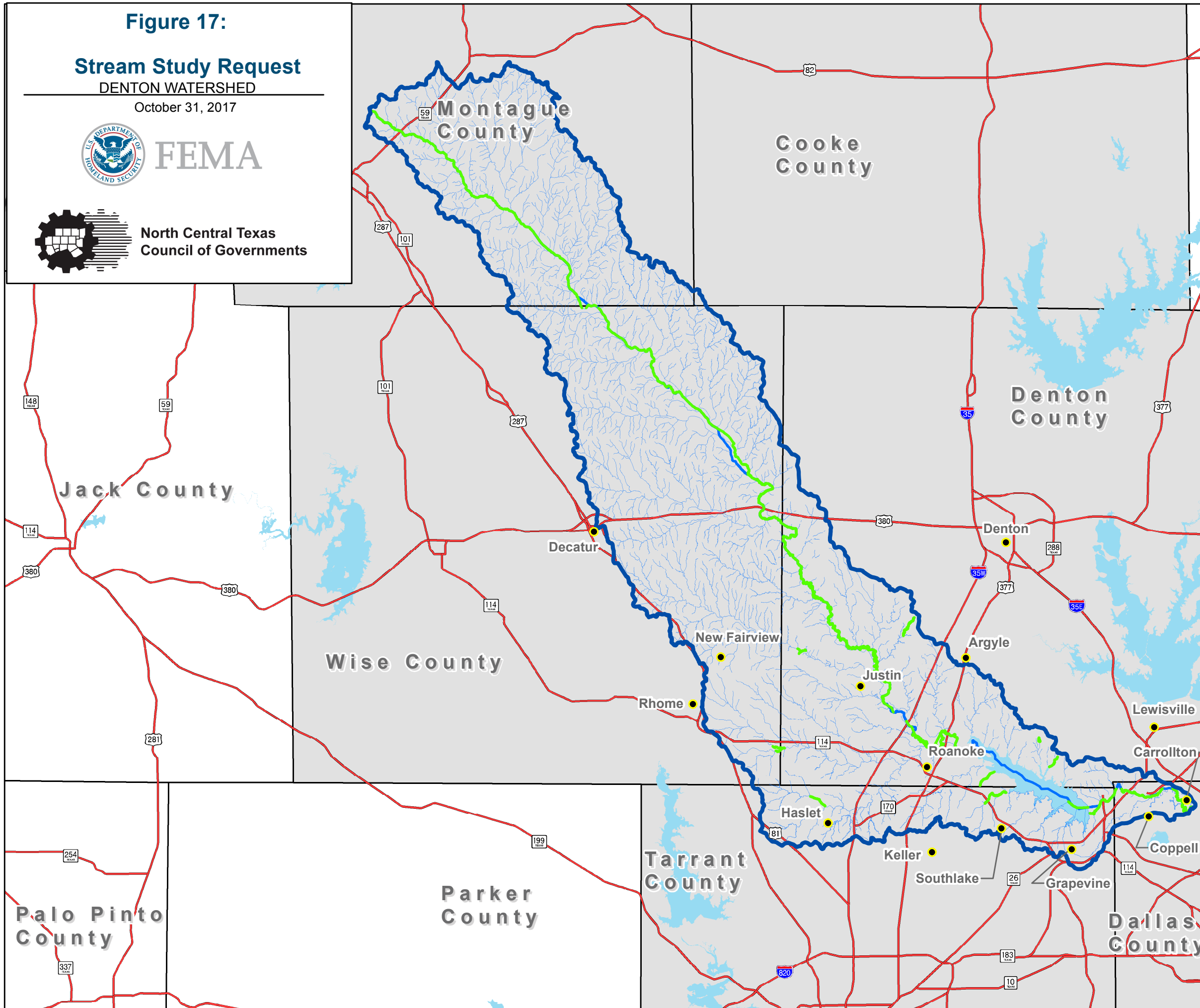
WATERSHED LOCATOR  
STATE OF TEXAS



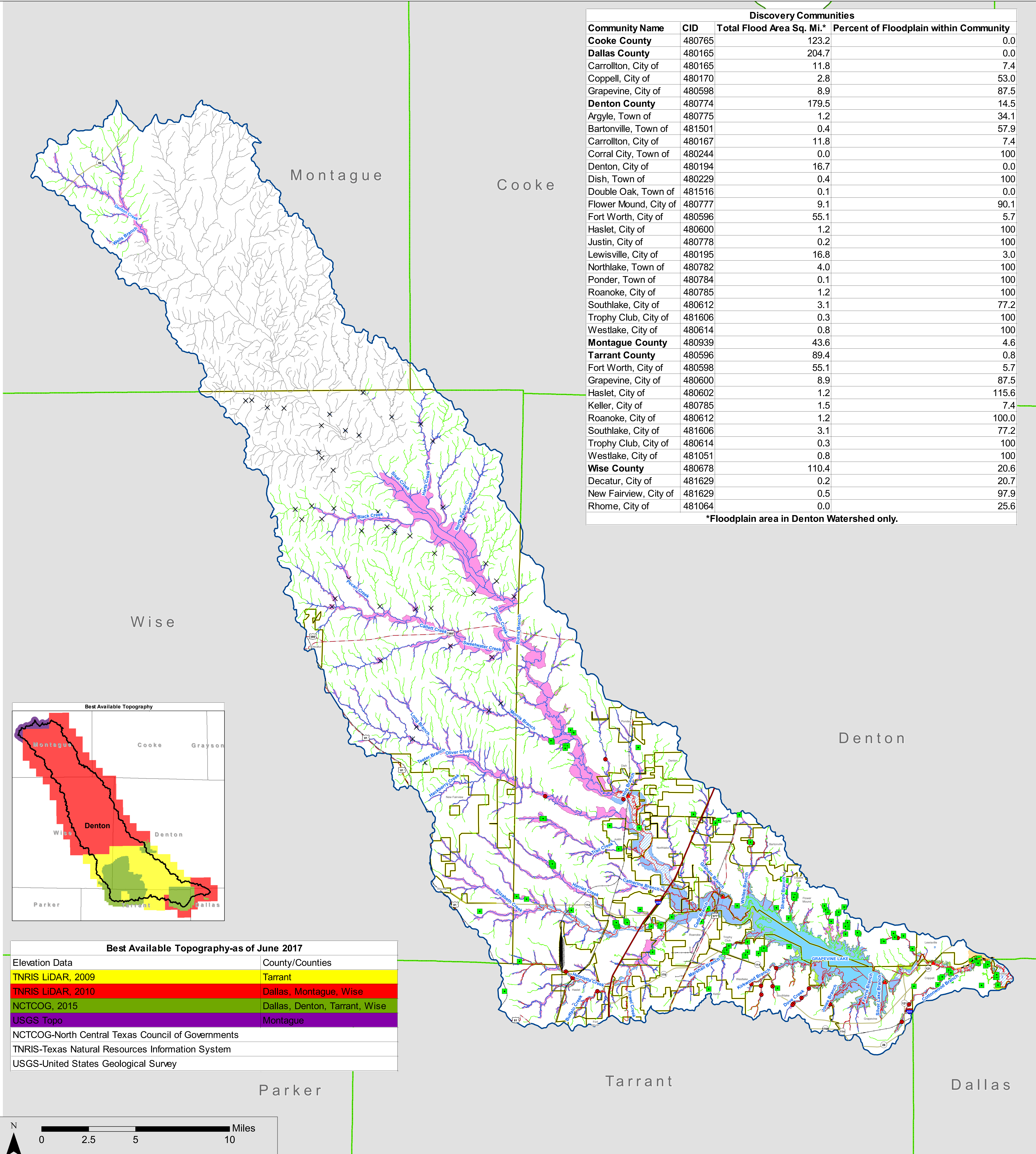
NCTCOG  
Boundary

**Map Symbology**

- Cities
- Stream Study Requests
- Denton Creek
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lakes
- Denton Watershed Discovery County
- County Boundaries

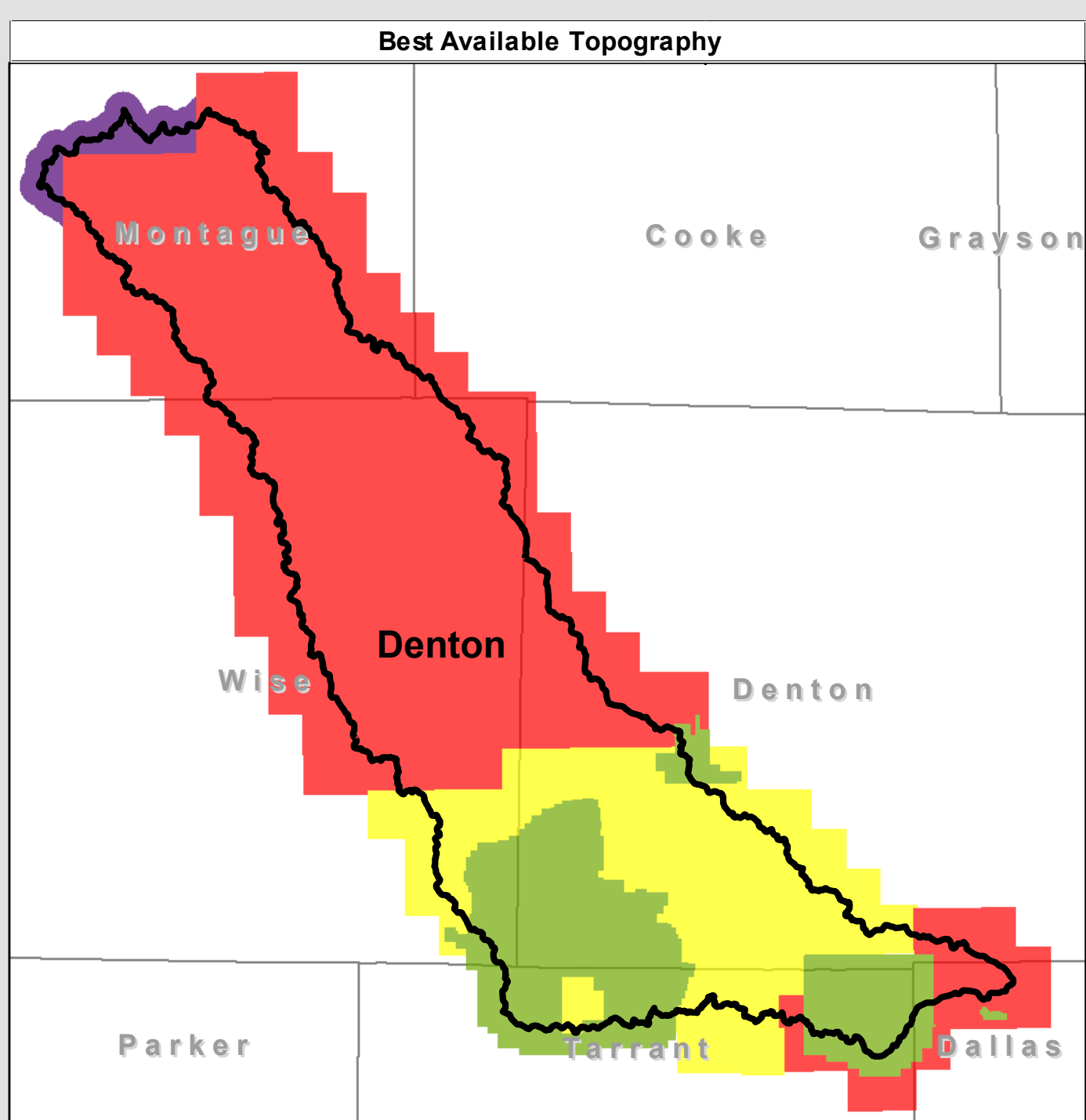






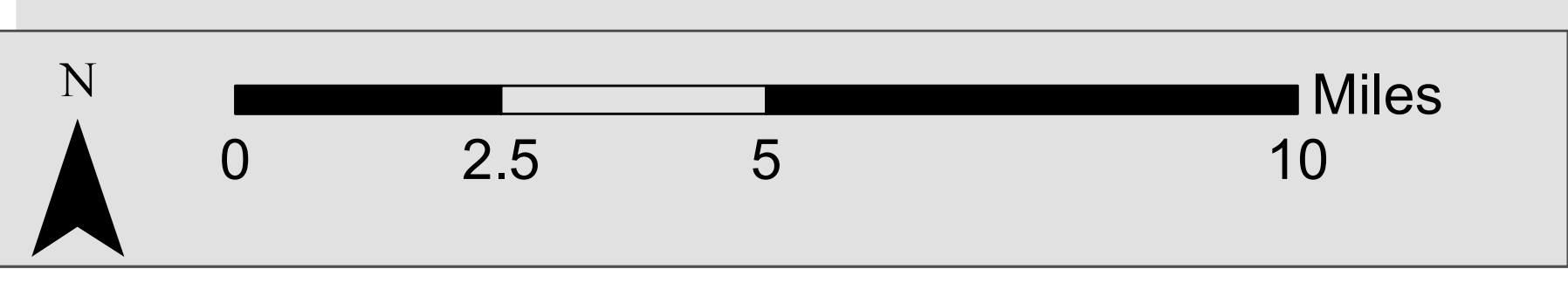
Discovery Communities			
Community Name	CID	Total Flood Area Sq. Mi.*	Percent of Floodplain within Community
<b>Cooke County</b>	480765	123.2	0.0
<b>Dallas County</b>	480165	204.7	0.0
Carrollton, City of	480165	11.8	7.4
Coppell, City of	480170	2.8	53.0
Grapevine, City of	480598	8.9	87.5
<b>Denton County</b>	480774	179.5	14.5
Argyle, Town of	480775	1.2	34.1
Bartonville, Town of	481501	0.4	57.9
Carrollton, City of	480167	11.8	7.4
Corral City, Town of	480244	0.0	100
Denton, City of	480194	16.7	0.0
Dish, Town of	480229	0.4	100
Double Oak, Town of	481516	0.1	0.0
Flower Mound, City of	480777	9.1	90.1
Fort Worth, City of	480596	55.1	5.7
Haslet, City of	480600	1.2	100
Justin, City of	480778	0.2	100
Lewisville, City of	480195	16.8	3.0
Northlake, Town of	480782	4.0	100
Ponder, Town of	480784	0.1	100
Roanoke, City of	480785	1.2	100
Southlake, City of	480612	3.1	77.2
Trophy Club, City of	481606	0.3	100
Westlake, City of	480614	0.8	100
<b>Montague County</b>	480939	43.6	4.6
<b>Tarrant County</b>	480596	89.4	0.8
Fort Worth, City of	480598	55.1	5.7
Grapevine, City of	480600	8.9	87.5
Haslet, City of	480602	1.2	115.6
Keller, City of	480785	1.5	7.4
Roanoke, City of	480612	1.2	100.0
Southlake, City of	481606	3.1	77.2
Trophy Club, City of	480614	0.3	100
Westlake, City of	481051	0.8	100
<b>Wise County</b>	480678	110.4	20.6
Decatur, City of	481629	0.2	20.7
New Fairview, City of	481629	0.5	97.9
Rhame, City of	481064	0.0	25.6

\*Floodplain area in Denton Watershed only.



Best Available Topography-as of June 2017	
Elevation Data	County/Countries
TNRIS LiDAR, 2009	Tarrant
TNRIS LiDAR, 2010	Dallas, Montague, Wise
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USGS Topo	Montague

NCTCOG-North Central Texas Council of Governments  
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**MAP SYMBOLOLOGY**

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  - Low Water Marks
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  - Levee
  - Lakes
  - City Boundaries
  - County Boundaries
  - Watershed Boundary
  - Transportation**
  - Interstate Highway
  - US Highway
  - State Highway
  - Railroads
- Effective Stream Study Type\***
- Zone AE (New/Revised Detailed, SFHA w/ High Risk)
  - Zone A (Approximate, SFHA w/ Low Risk)
  - Zone X (Unshaded, X-Zones, Areas of Minimal Risk)
  - Unmapped Streams
- Effective FEMA Floodplains\***
- Floodway
  - Zone AE (100-Year, Detailed)
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  - Zone X500 (500-Year, Detailed)
  - Zone X Protected by Levee

**WATERSHED LOCATOR**



**NATIONAL FLOOD INSURANCE PROGRAM**  
**Discovery Map**  
**DENTON WATERSHED, TEXAS**

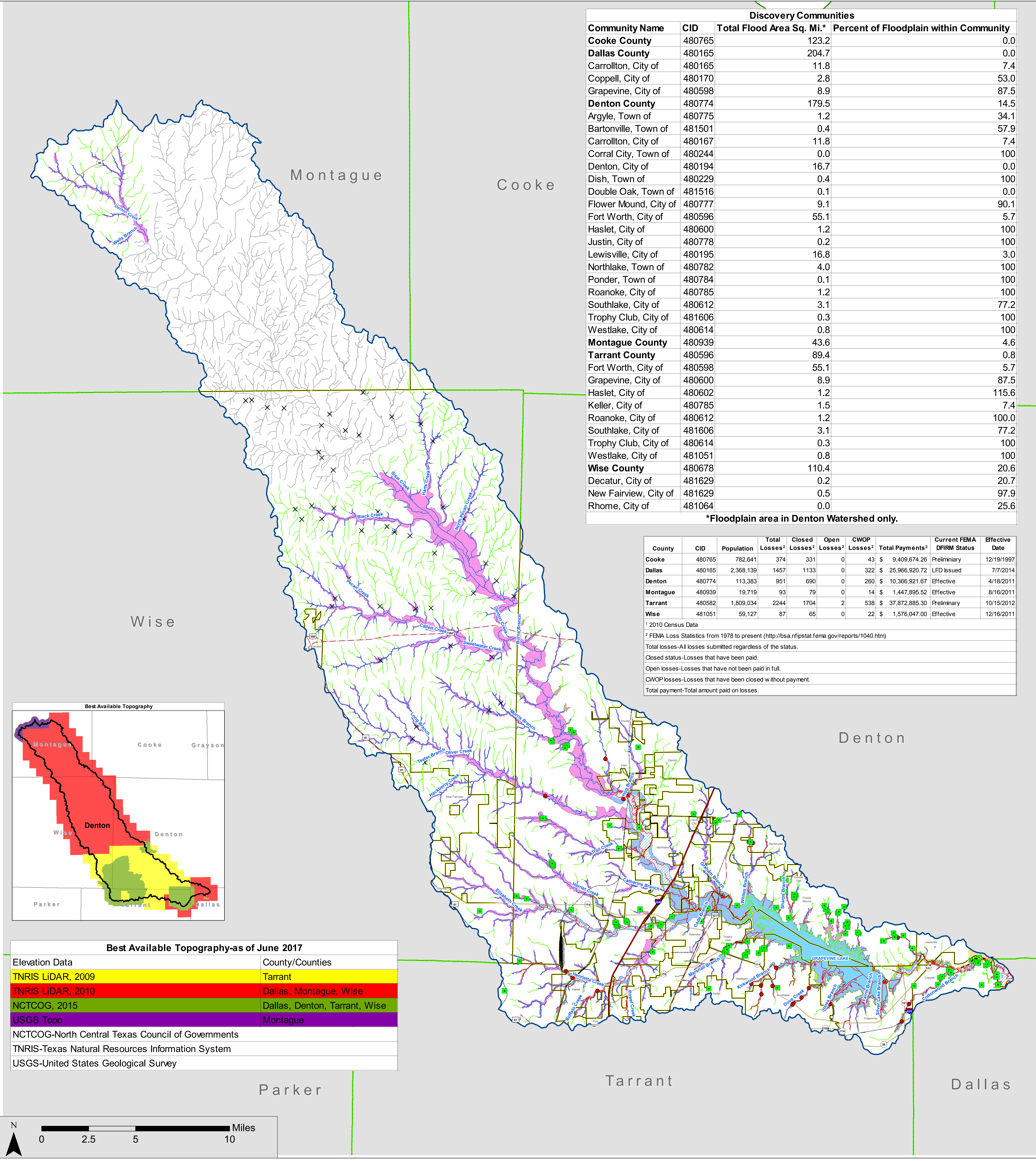
Stream Miles:	1,885.48
Zone AE Miles:	213.37
Zone A Miles:	532.73
Zone X Miles:	1,139.38
Population:	252,261

HUC-8 Code  
**12030104**  
 Release Date  
**06/13/2017**



\*Data as of May 2017



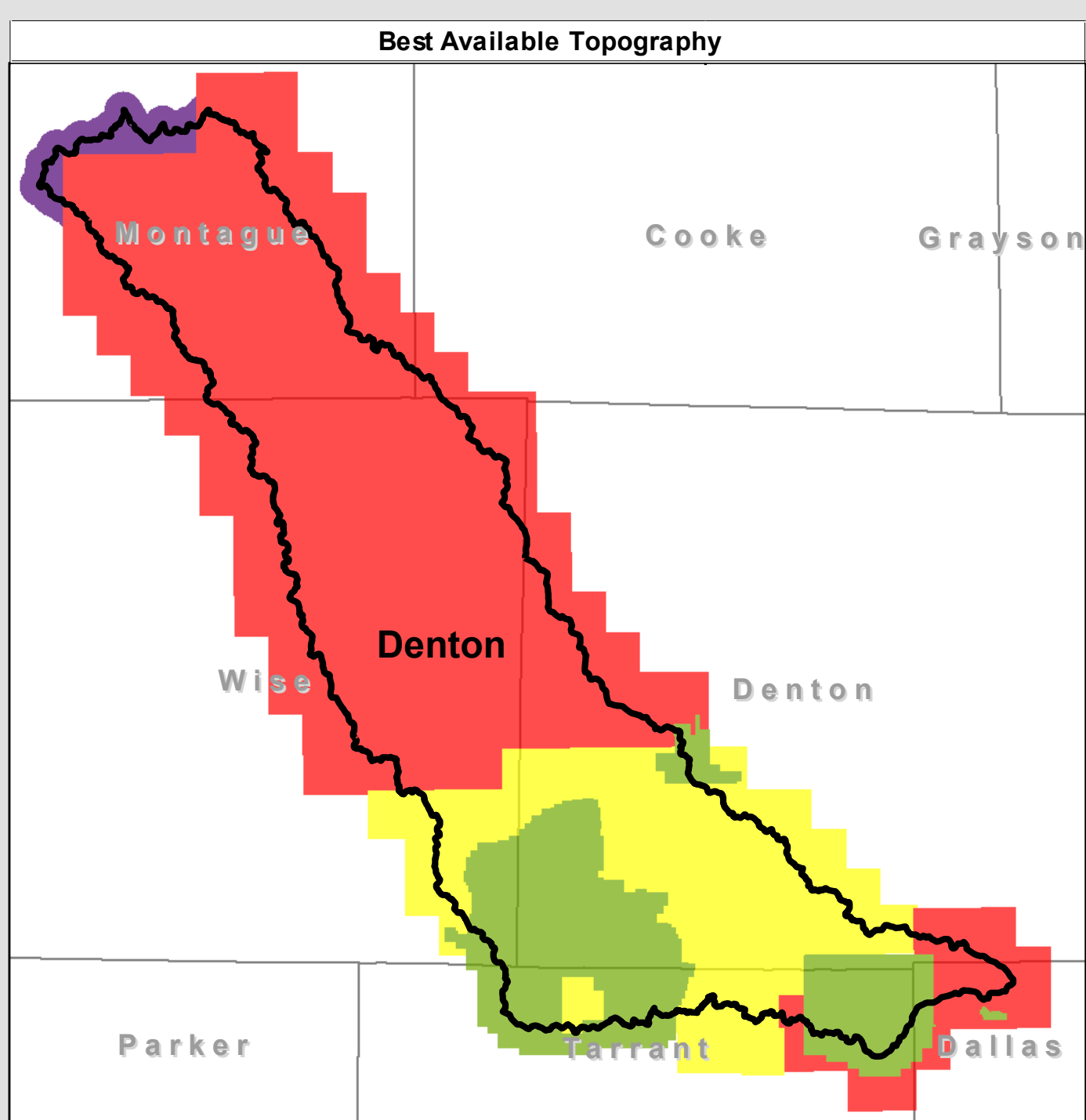


Discovery Communities			
Community Name	CID	Total Flood Area Sq. Mi.*	Percent of Floodplain within Community
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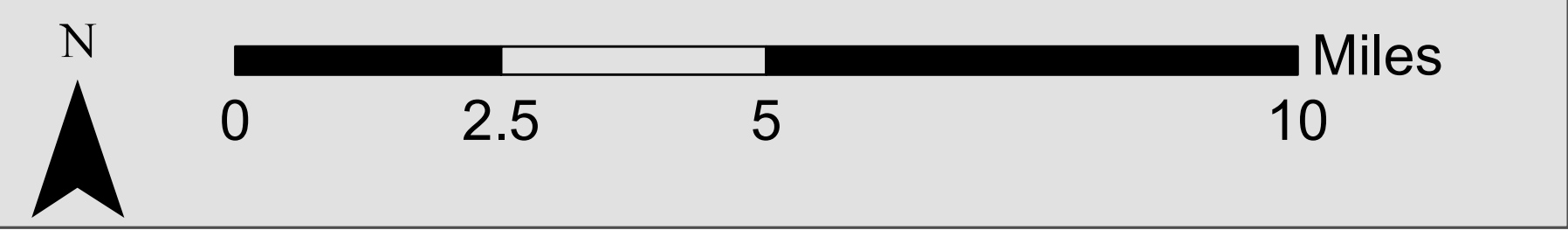
County	CID	Population	Total Losses <sup>2</sup>	Closed Losses <sup>2</sup>	Open Losses <sup>2</sup>	CWOP Losses <sup>2</sup>	Total Payments <sup>2</sup>	Current FEMA DFIRM Status	Effective Date
Cooke	480765	782,641	374	331	0	43	\$ 9,409,674.26	Preliminary	12/19/1997
Dallas	480165	2,368,139	1457	1133	0	322	\$ 25,966,920.72	LFD Issued	7/7/2014
Denton	480774	113,383	951	690	0	260	\$ 10,366,921.67	Effective	4/18/2011
Montague	480939	19,719	93	79	0	14	\$ 1,447,895.52	Effective	8/16/2011
Tarrant	480582	1,809,034	2244	1704	2	538	\$ 37,872,885.30	Preliminary	10/15/2012
Wise	481051	59,127	87	65	0	22	\$ 1,576,047.00	Effective	12/16/2011

<sup>1</sup> 2010 Census Data  
<sup>2</sup> FEMA Loss Statistics from 1978 to present (<http://bsa.nripstat.fema.gov/reports/1040.htm>)  
 Total losses-All losses submitted regardless of the status.  
 Closed status-Losses that have been paid.  
 Open losses-Losses that have not been paid in full.  
 CWOP losses-Losses that have been closed without payment.  
 Total payment-Total amount paid on losses.



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**Discovery Map**  
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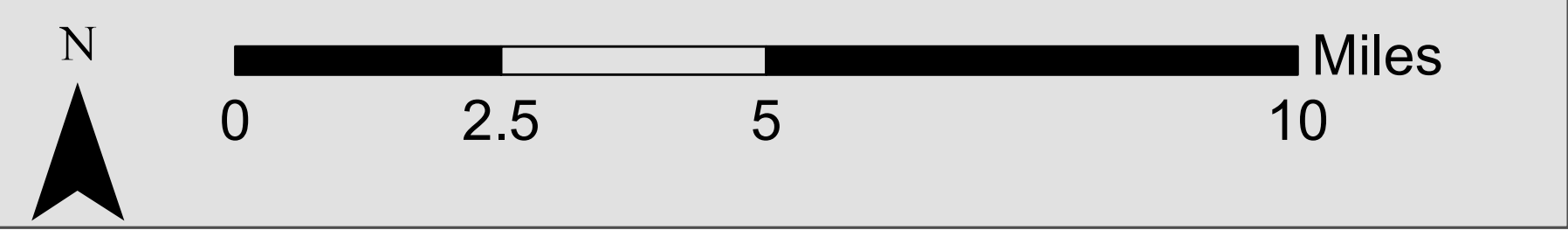
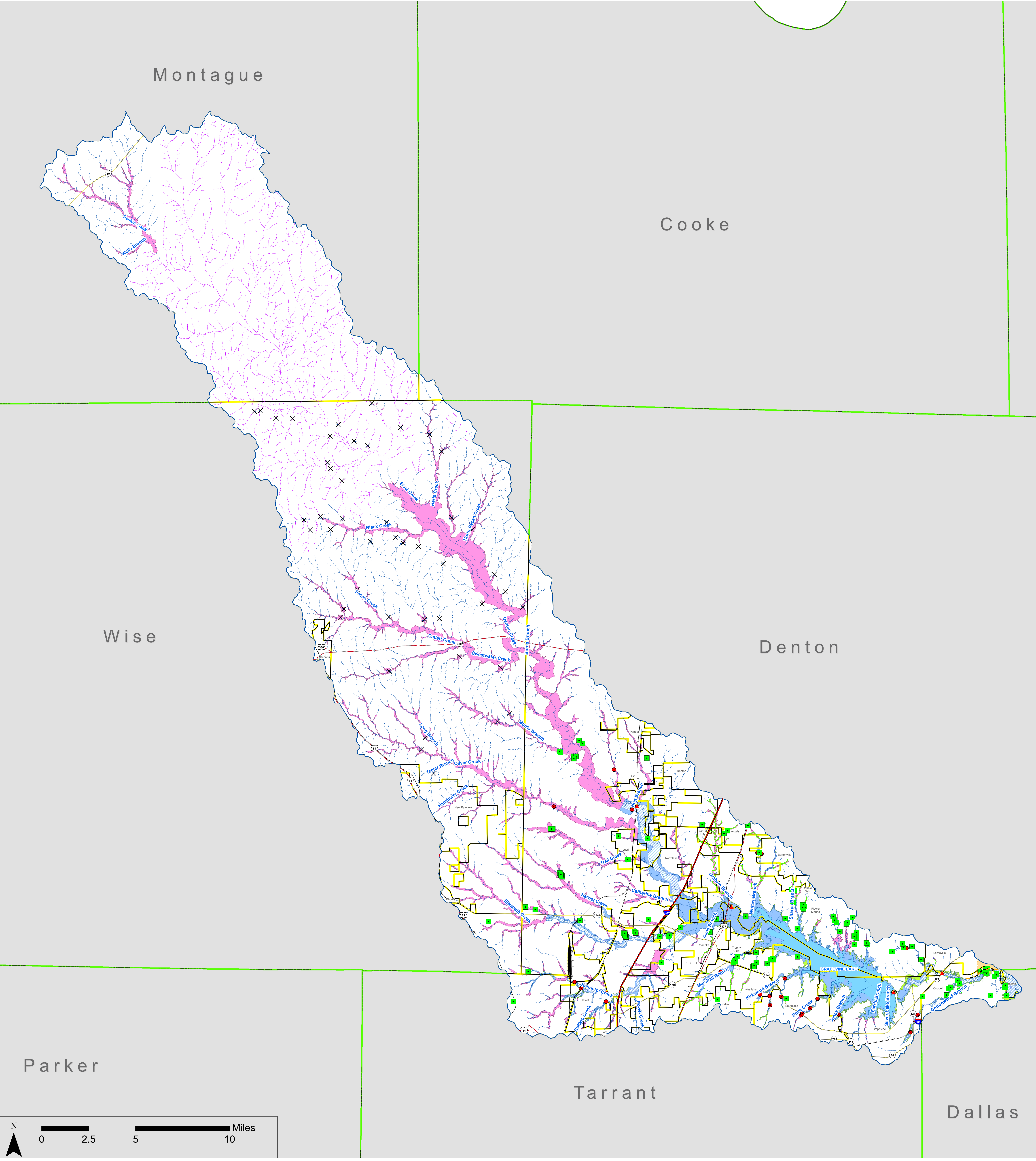
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\*Data as of May 2017





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- ☁ Floodway
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  - Zone A (100-Year, Approximate)
  - Zone X500 (500-Year, Detailed)
  - Zone X Protected by Levee
- CNMS Stream Status\***
- Assessed, To Be Studied
  - Unverified, To Be Studied
  - Valid, NVUE Compliant
- | CNMS Validation Status Definitions |  |
|------------------------------------|--|
| <b>Assessed</b>                    | Unmapped Streams or streams not part of FEMA's SFHA inventory that have been investigated and considered for study in current and/or future Fiscal Years (FYs).  |
| <b>Unverified</b>                  | Stream has not passed the Critical and Secondary Element checks (At least one critical or four or more secondary change conditions flagged) and may either be assigned resources for restudy in current and/or future FYs. |
| <b>Valid</b>                       | Streams considered New, Validated, or Updated Engineering (NVUE) compliant (zero critical and fewer than four secondary elements flagged).   |
| <b>To Be Studied</b>               | Mapped streams that need to be studied and are planned for a future FY or unmapped streams prioritized to be mapped with an SFHA.  |
- \*Data as of May 2017

**WATERSHED LOCATOR**



**NATIONAL FLOOD INSURANCE PROGRAM**  
**Discovery Map**  
**DENTON WATERSHED, TEXAS**

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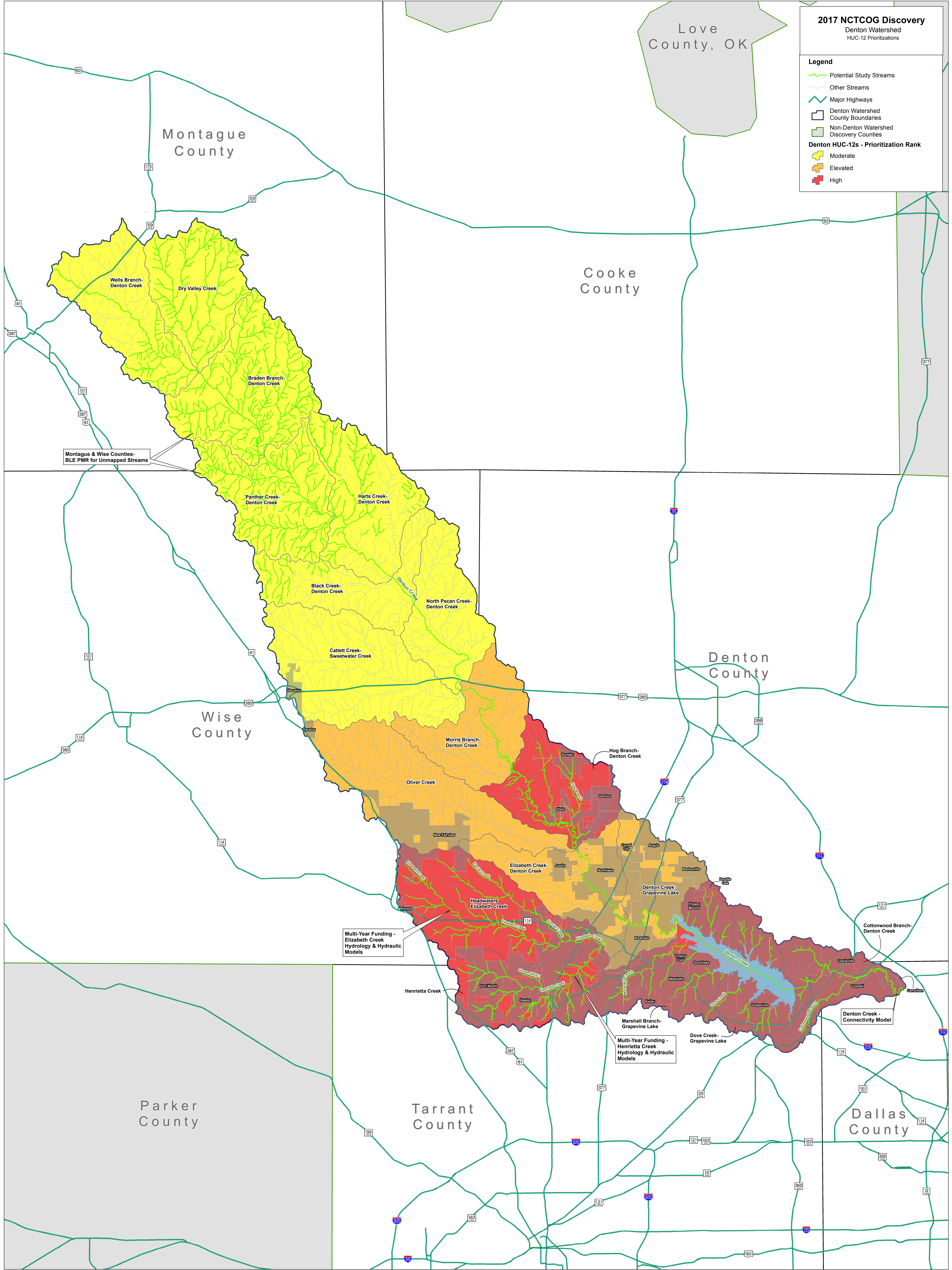
**HUC-8 Code**  
**12030104**  
**Release Date**  
**06/13/2017**





**2017 NCTCOG Discovery**  
Denton Watershed  
HUC-12 Prioritizations

- Legend**
- Potential Study Streams
  - Other Streams
  - Major Highways
  - Denton Watershed County Boundaries
  - Non-Denton Watershed Discovery Counties
- Denton HUC-12s - Prioritization Rank**
- Moderate
  - Elevated
  - High



Montague & Wise Counties-  
BLE PMR for Unmapped Streams

Multi-Year Funding -  
Elizabeth Creek  
Hydrology & Hydraulic  
Models

Multi-Year Funding -  
Henrietta Creek  
Hydrology & Hydraulic  
Models

Denton Creek -  
Connectivity Model



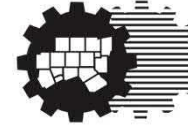
## Pre-Discovery Webinar Slides





FEMA

**RiskMAP**  
Increasing Resilience Together



North Central Texas  
Council of Governments

# North Texas Discovery

“Capturing a More Complete Picture of Your Watershed”

Pre-Discovery Webinars

April 19, 2017

April 24, 2017



# Introduction

- NCTCOG:
  - Edith Marvin – [EMarvin@nctcog.org](mailto:EMarvin@nctcog.org)
  - Mia Brown – [MBBrown@nctcog.org](mailto:MBBrown@nctcog.org)
  - Kori Mullen - [KMullen@nctcog.org](mailto:KMullen@nctcog.org)
- Halff Associates:
  - Jessica Baker – [JBaker@halff.com](mailto:JBaker@halff.com)
  - Jack Young – [JYoung@halff.com](mailto:JYoung@halff.com)
  - Samuel Amoako-Atta – [SAmoako-Atta@halff.com](mailto:SAmoako-Atta@halff.com)
- FEMA:
  - Alan Johnson – [Alan.Johnson@fema.dhs.gov](mailto:Alan.Johnson@fema.dhs.gov)
- TWDB / TNRIS:
  - Manuel Razo – [Manuel.Razo@twdb.texas.gov](mailto:Manuel.Razo@twdb.texas.gov)
  - Michael Segner – [Michael.Segner@twdb.texas.gov](mailto:Michael.Segner@twdb.texas.gov)



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**HALFF**



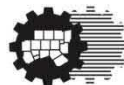
# AGENDA

- Overview of Risk MAP
- NCTCOG Discovery Activities
- Discovery Overview
- 2017 NCTCOG Discovery Watersheds
  - Cedar and Denton Watersheds
  - Pre-Discovery Activities
  - Discovery Activities
  - Post-Discovery Activities
- Data Gathering Website and Walk-through



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 **HALFF**<sup>®</sup>

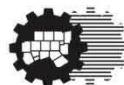
# FEMA's Risk MAP Program

- Risk Mapping, Assessment, and Planning
  - Provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens.
  - Risk MAP Vision
    - **ACTION-driven**, not **MAP-driven** through local understanding and ownership of risk



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Increasing Resilience Together



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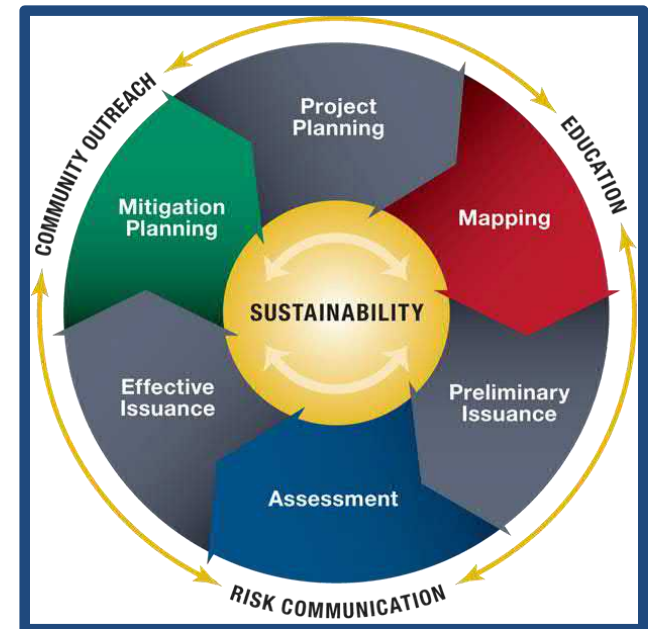


**HALFF**



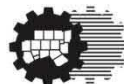
# FEMA's Risk MAP Program

- Risk MAP offers opportunities to change the way FEMA and Local communities interact
- Empowering communities
  - Reduce Future Losses
    - Implementing Mitigation Actions
  - Reduce Your Risks
    - All Hazard Mitigation Planning
    - Look for Grant Opportunities
  - Insure Your Risks
    - The National Flood Insurance Program (NFIP)
  - Communicate Effectively about Risk



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**RiskMAP**  
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# Discovery

## Overview

- *Capture a more complete picture of your watershed by working closely with local communities...*

### Watershed Selected for Discovery

- **Selection Criteria:**
  - Risk
  - Need
  - Elevation data availability
  - Regional knowledge
  - CTP/State input

### Community Engagement / Data Collection

- **Develop watershed partnerships**
- **Discovery Newsletter**
- **Pre-Discovery community visits**
- **Gather all available data**
  - Data needs
  - Issues / Concerns
  - Areas of Mitigation

### Discovery Meeting

- **Review / validate watershed for project areas**
- **Provide information**
  - Mapping
  - Mitigation Planning
  - Grants
  - NFIP Compliance
- **Comprehensive understanding of risk in the watershed**

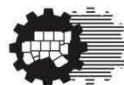
### Post-Meeting Coordination / Scope Refinement

- **Once data is collected**
  - FEMA will coordinate with State/NCTCOG on proposed scope refinement
  - Selected Projects – move toward Kick off meeting
  - Non-Selected Projects – engaged for potential mitigation actions, mitigation plan updates, and/or mitigation technical assistance



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# Discovery Community Engagement

## Overview

What information are we interested in?

### FEMA ENGAGEMENT WITH STAKEHOLDERS AND DATA COLLECTION

Review of all available data begins the process...

#### Risk Identification and Communication

- Low water crossings?
- Large areas of fill placement?
- Future development areas?
- Capital improvement projects?
- Channelization projects?
- Large reservoirs? O&M plan?
- Flood risk reduction projects?
- Digital stream inventory?
- Digital building stock?
- High water marks from recent flooding event?
- Elevation data? LiDAR?
- Local flood studies?



#### Engage:

- U.S. Geological Service
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- State NFIP coordinator
- State Hazard Mitigation Officer
- State floodplain management associations
- State emergency management associations
- Local elected officials
- Regional authorities
- Local floodplain administrators
- Local emergency management officials
- Local levee districts
- Watershed groups
- Special interest groups
- Local business and commerce entities
- CTPs



#### NFIP Community Actions

- Participating in the NFIP?
- Community assistance meetings?
- Community Rating System (CRS)?
- Repetitive loss properties?
- Areas of insurance claims?
- Community assistance visits?
- Community assistance calls?
- Active Letters of Map Change (LOMCs)?
- Recent disaster? Declared?
- Data from PDAs?



#### Mitigation Planning and Mitigation Actions

- Approved hazard mitigation plan?
- Local evacuation plans?
- Current land use plan?
- Future land use plan?
- Drainage master plan(s)?
- Flood reduction projects?
- Culvert enlargement projects?
- Areas of evacuation during high water?
- Local HAZUS runs?
- Digital parcel boundaries?



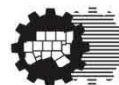
#### Community Benefits and Grant Opportunities

- Grant administration plan?
- Ongoing grant projects?
- Hard projects? (infrastructure)
- Soft projects? (outreach/education)
- Targeted buy-out areas?
- Elevation projects planned?
- Pre-Disaster Mitigation (PDM) grants?
- Severe Repetitive Loss (SRL) grants?
- Grants in need of engineering info?
- Post-disaster 404 projects?
- Post-disaster 406 projects?



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# Discovery Steps

## Overview

FEMA Selects  
Watershed for  
Discovery

Watershed  
Stakeholder  
Coordination

Data Gathering  
and Analysis.  
BLE data  
development

Discovery  
Meeting

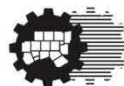
Post Meeting  
Coordination

Risk MAP Project  
Recommendations  
to FEMA



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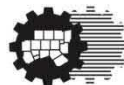
# Base Level Engineering(BLE)

Overview



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# Base Level Engineering(BLE)




## Overview

### Large Scale Automated Engineering (LSAE) Process

- BLE is best used at a larger scale (HUC8)
- LiDAR must be Available
- Model Review and Adjustments
- Gage Review included in hydrology



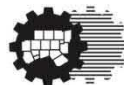
**Key Features**

-  Regulated Stream(s)
-  BLE Streams
-  Lakes and Reservoirs



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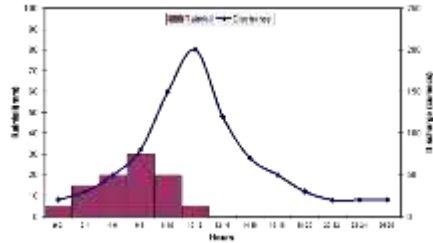


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# Base Level Engineering(BLE)

MODELING

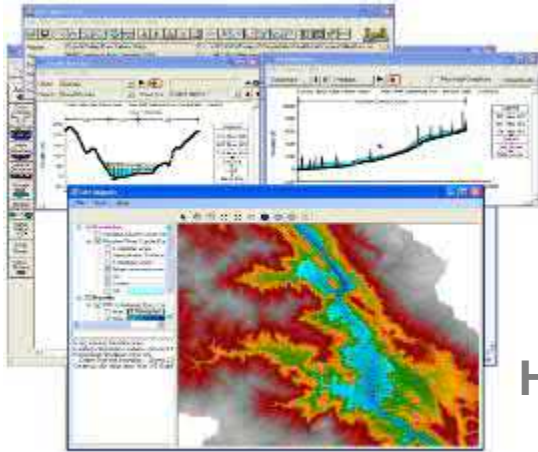


Hydrology

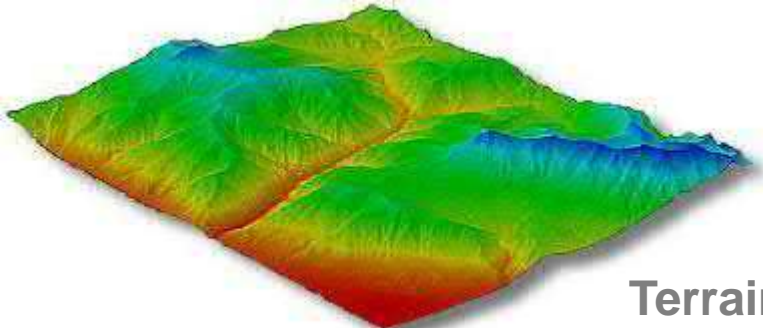
Overview



Mapping



Hydraulics



Terrain

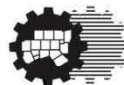
## OUTPUTS

- Hydrology modeling (Regression) flows w/gage analysis
- Hydraulic modeling (HEC-RAS) for 10%, 4%, 2%, 1% and 0.2% storm events
- 10%, 1% and 0.2% floodplain boundaries
- Areas of Expanded Flood Risk
- Depth and Analysis Grids
- Flood Risk Assessment



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# Base Level Engineering(BLE)

## Overview

- Building Block for Future Model Refinement



- Creates a data-based starting point for conversations about existing flood risk



CHEAPER



DATA FOR REVIEW



COLLABORATIVE



FASTER



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# NCTCOG Discovery Activities

2004-2008  
FEMA Map  
Modernization

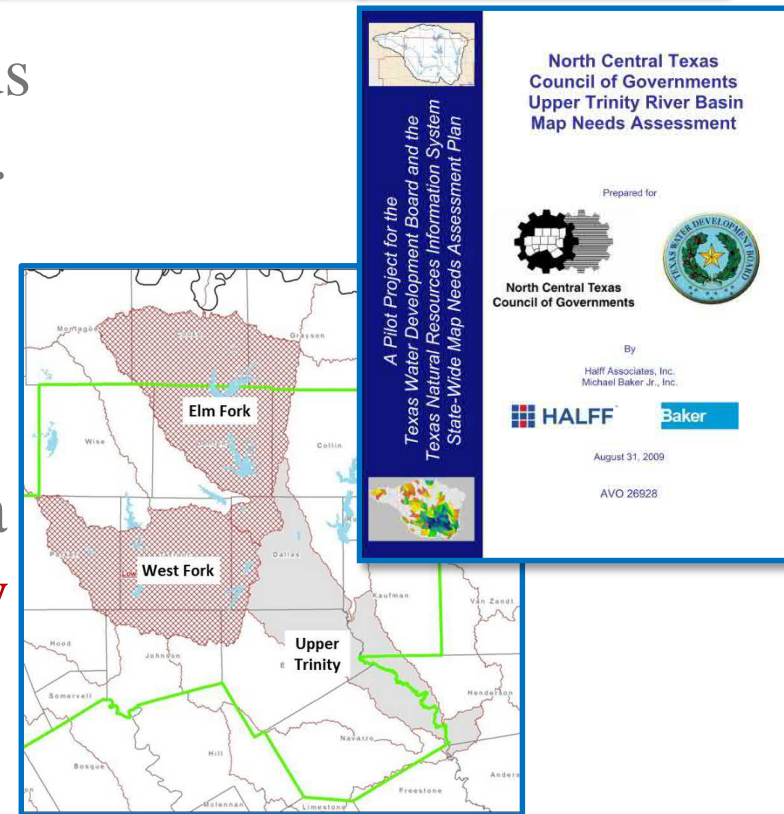
2009  
Map Needs  
Assessment

2012  
Partnered with  
FEMA for CTP  
Grant

2013  
Discovery

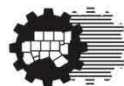
2017  
Discovery

- 2009 TWDB/NCTCOG Map Needs Assessment (MNA) documented...
  - 1,291 new mapping needs
  - 2,370 miles of stream
  - \$44 Million in Flood Mapping Needs
- 2013 Discovery utilized MNA data and update results. **2017 Discovery** will do the same.



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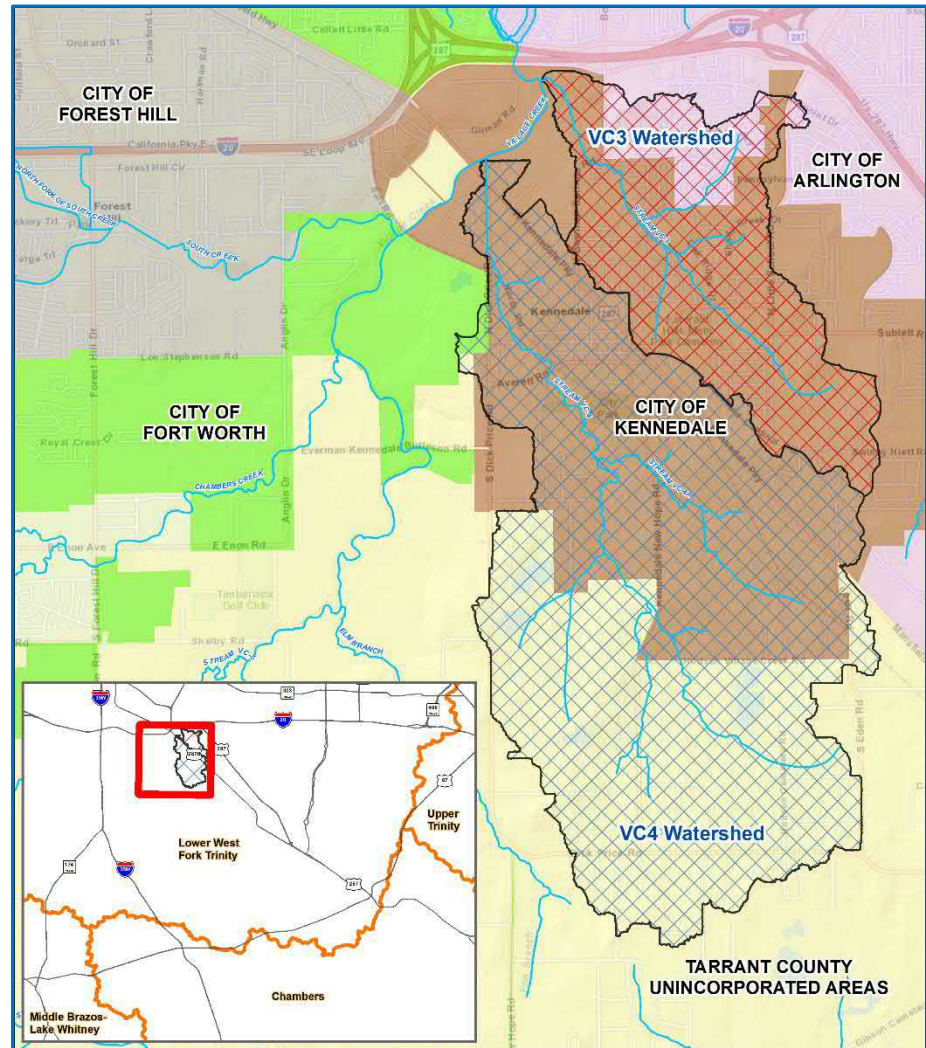
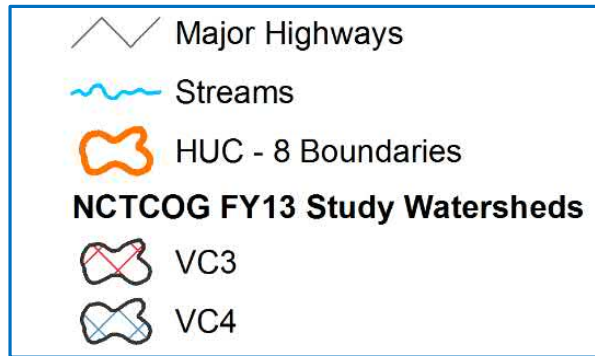
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# Example Post-Discovery Projects

2013

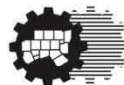
## 2013 Village Creek Study – Kennedale

- New H&H and Mapping for 13 streams
- Flood Risk Products including Flood Risk Assessment



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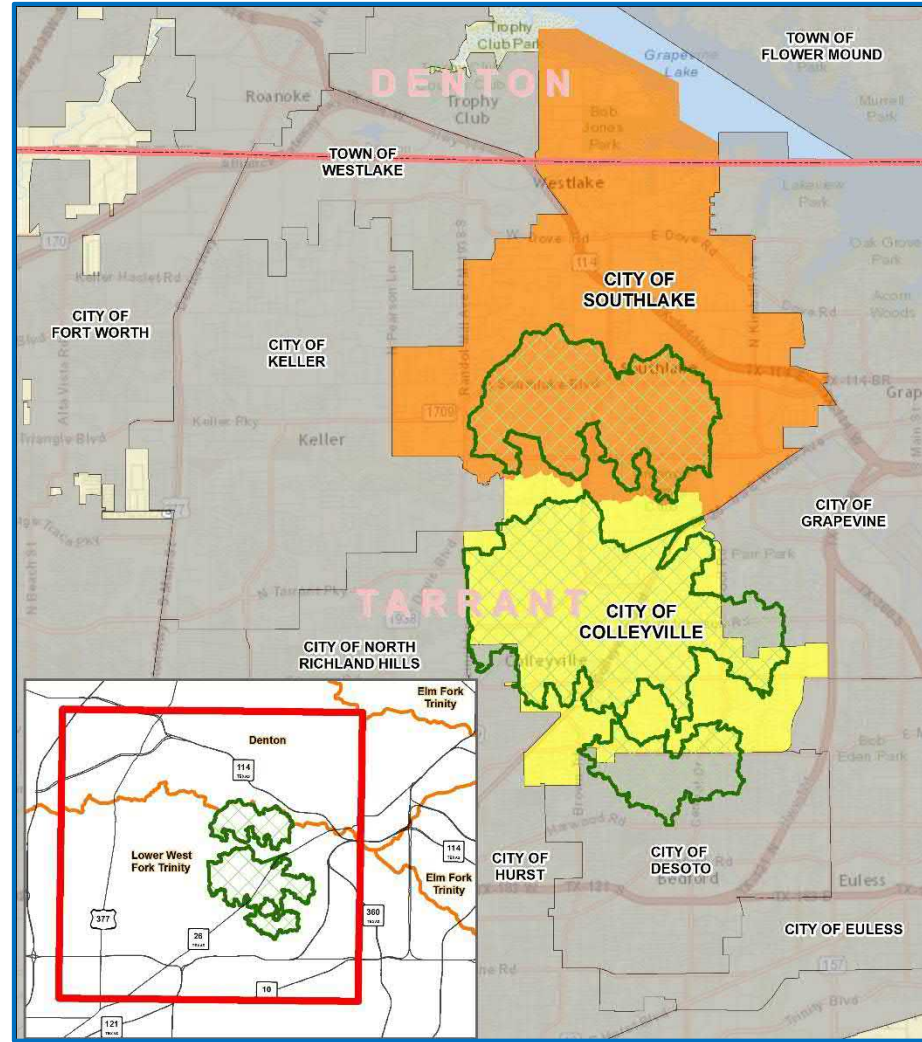


# Example Post-Discovery Projects

2014

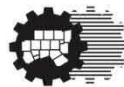
## 2014 Bear Creek Study – Southlake and Colleyville

- New H&H and Mapping for 19 streams (Colleyville) and 8 streams (Southlake)
- Flood Risk Products including Flood Risk Assessment



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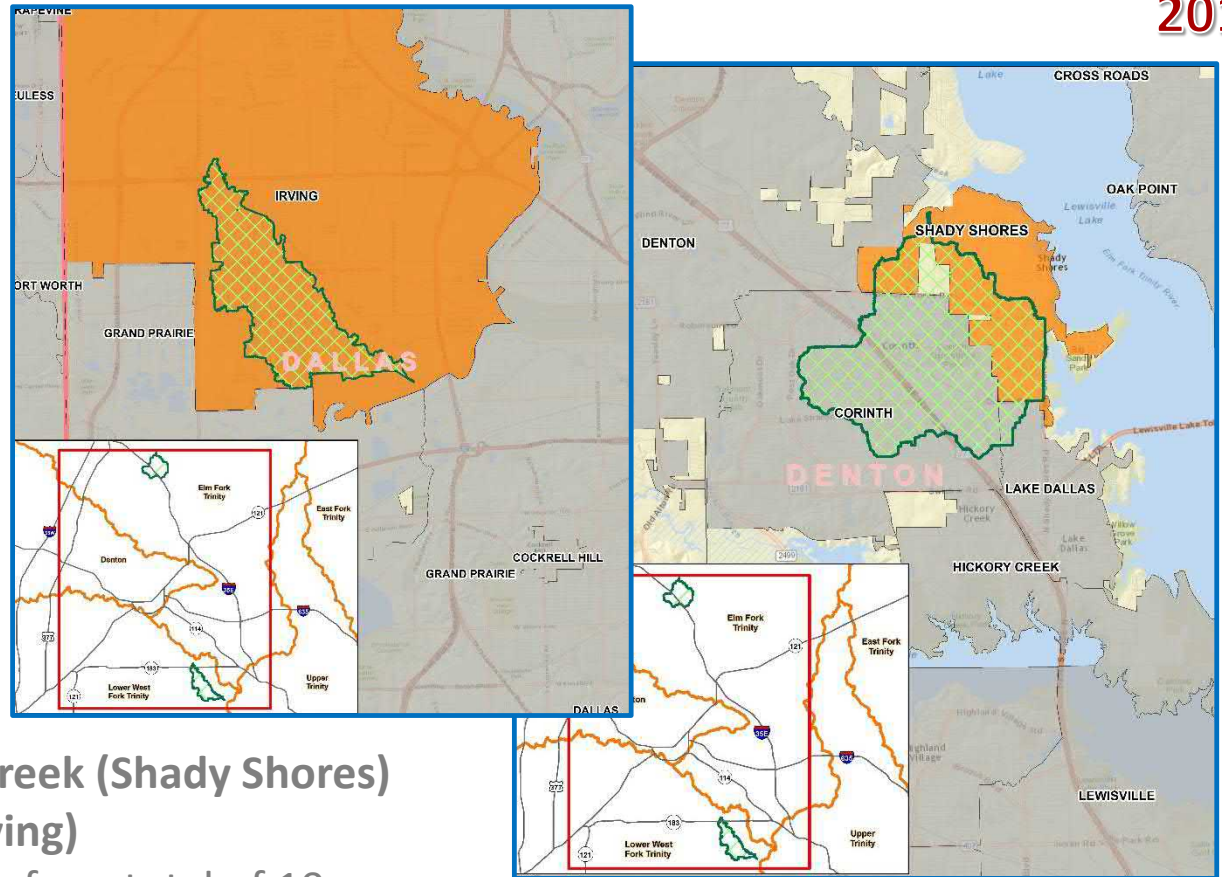
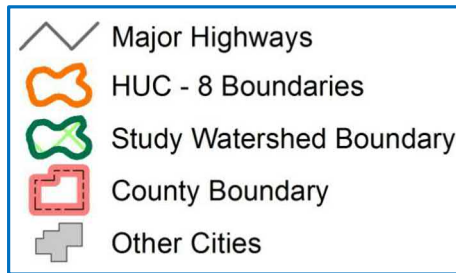
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# Example Post-Discovery Projects

2015



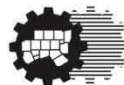
## 2015 Study – Lynchburg Creek (Shady Shores) and West Irving Creek (Irving)

- New H&H and Mapping for a total of 10 streams
- Flood Risk Products including Flood Risk Assessment



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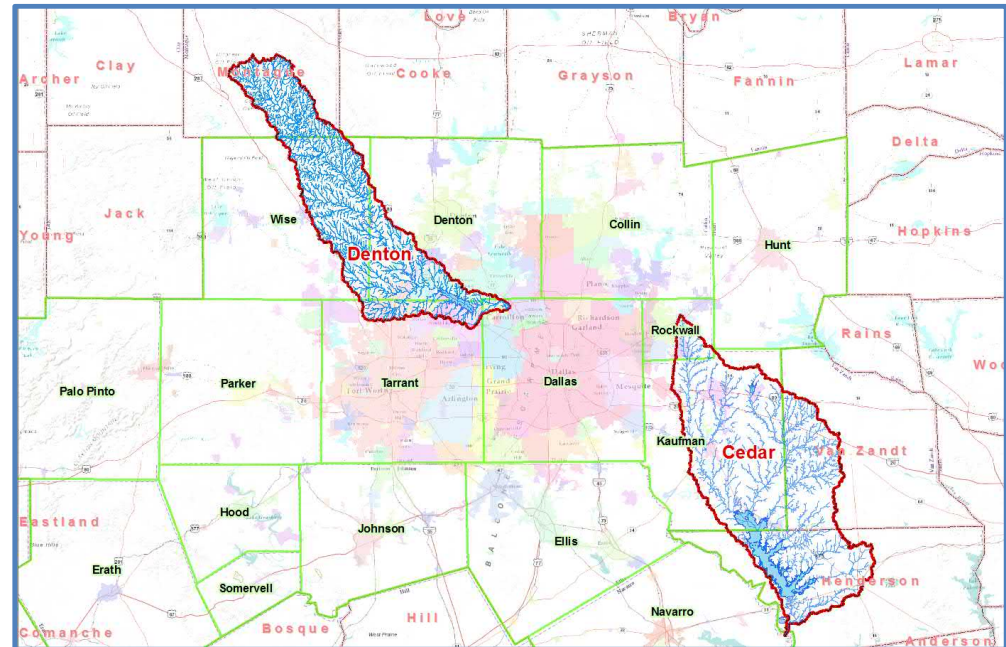


# North Central Texas Council of Governments

2017 North Texas Discovery

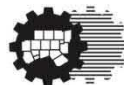
## NCTCOG Leading Cedar and Denton Watersheds

- Goals:
  - Provide information
    - Mitigation planning and actions
    - Risk Communication
  - Gather information
    - Local flood risks and hazards
    - Current mitigation



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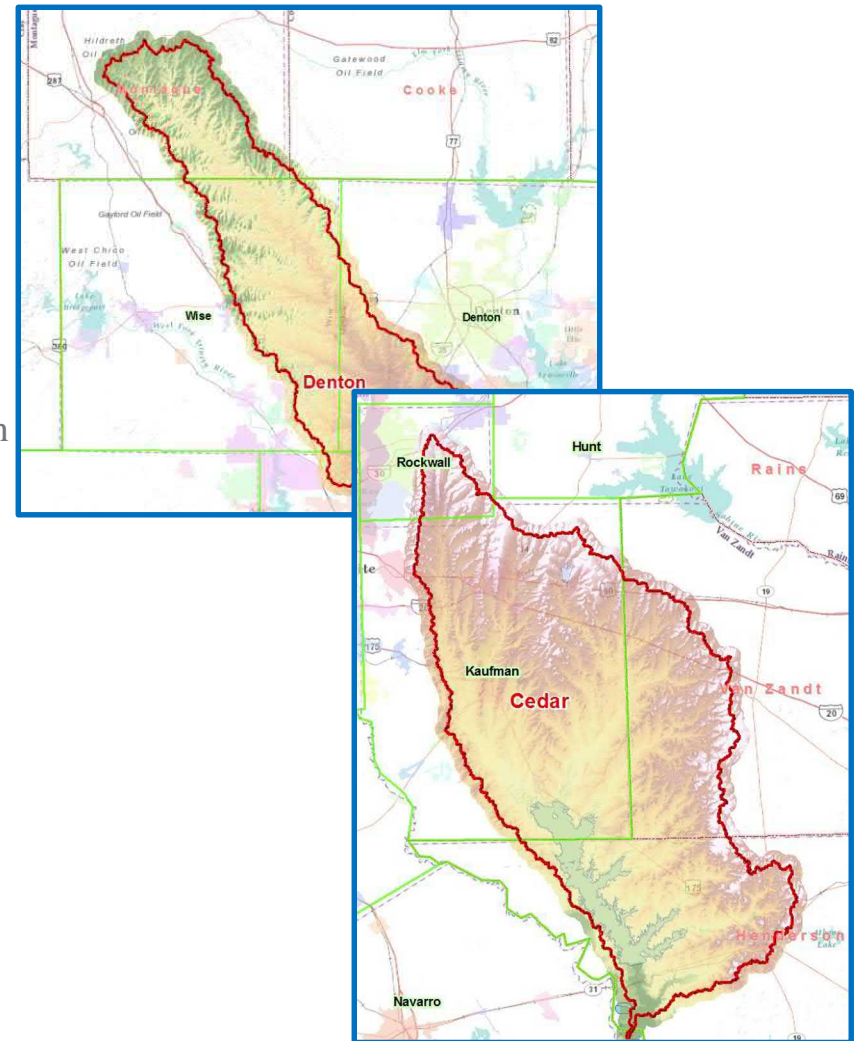
# Discover the Data

## Pre-Discovery Activities

- Watershed
- Communities
- Geospatial Data

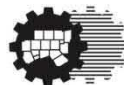
### Examples of data to collect:

- Base map: Boundaries, Hydrography, Transportation
- Flood study needs, risk, elevation data
- Flooding issues, historical flooding, disasters
- Mitigation activities, grant projects, plans
- CRS, CAVs
- Local development, floodplain management plans
- Regional watershed plans
- Infrastructure: culverts, dams, bridges, levees
- Building footprints or parcel data



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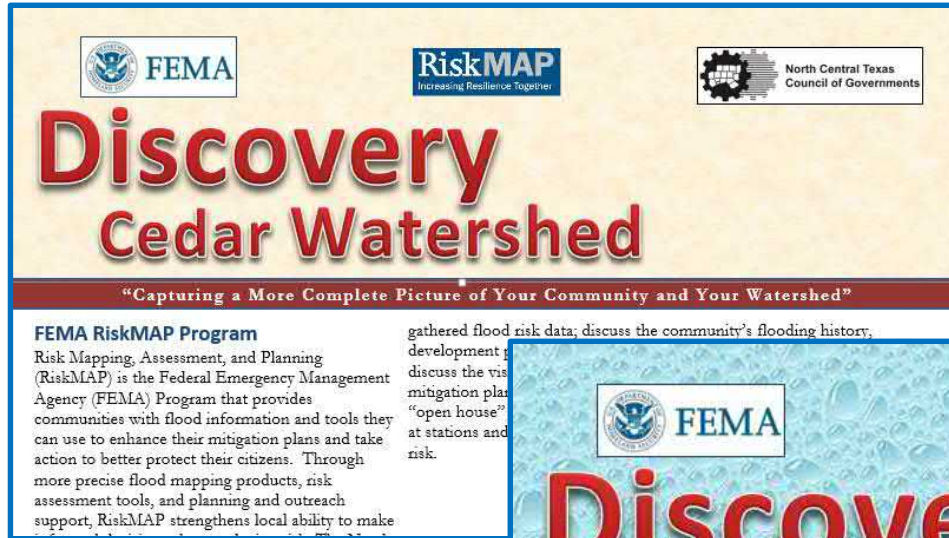





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# Discovery Newsletter Coming ...

Pre-Discovery Activities



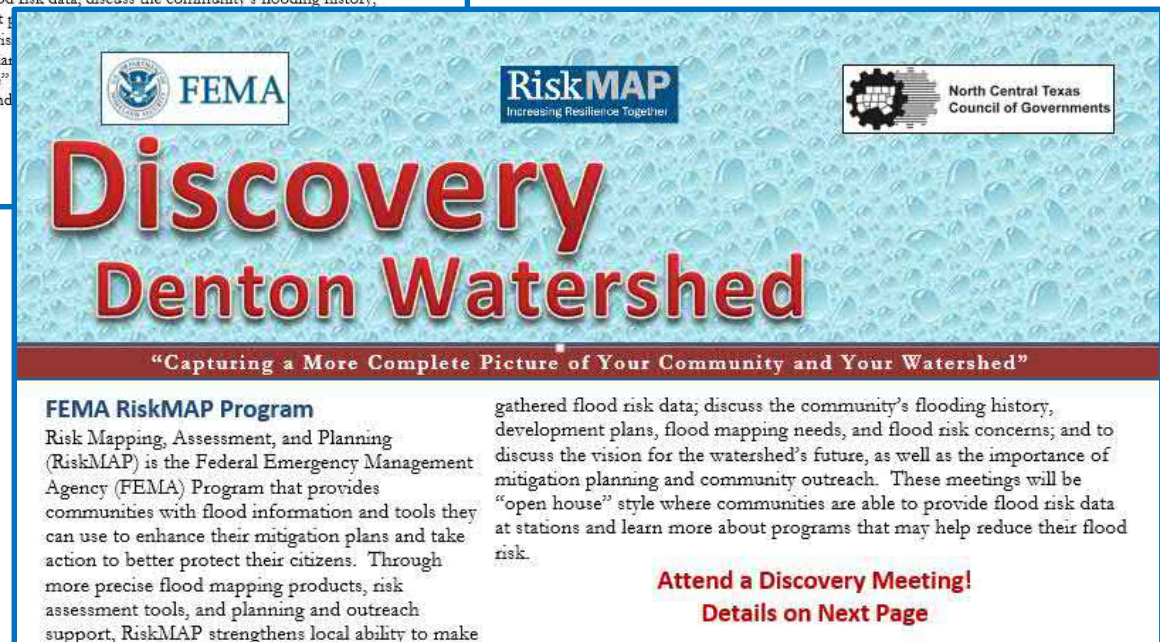
  




## Discovery Cedar Watershed

**“Capturing a More Complete Picture of Your Community and Your Watershed”**

**FEMA RiskMAP Program**  
Risk Mapping, Assessment, and Planning (RiskMAP) is the Federal Emergency Management Agency (FEMA) Program that provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens. Through more precise flood mapping products, risk assessment tools, and planning and outreach support, RiskMAP strengthens local ability to make

gathered flood risk data; discuss the community’s flooding history, development plans, flood mapping needs, and flood risk concerns; and discuss the vision for the watershed’s future, as well as the importance of mitigation planning and community outreach. These meetings will be “open house” style where communities are able to provide flood risk data at stations and learn more about programs that may help reduce their flood risk.



## Discovery Denton Watershed

**“Capturing a More Complete Picture of Your Community and Your Watershed”**

**FEMA RiskMAP Program**  
Risk Mapping, Assessment, and Planning (RiskMAP) is the Federal Emergency Management Agency (FEMA) Program that provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens. Through more precise flood mapping products, risk assessment tools, and planning and outreach support, RiskMAP strengthens local ability to make

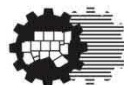
gathered flood risk data; discuss the community’s flooding history, development plans, flood mapping needs, and flood risk concerns; and discuss the vision for the watershed’s future, as well as the importance of mitigation planning and community outreach. These meetings will be “open house” style where communities are able to provide flood risk data at stations and learn more about programs that may help reduce their flood risk.

**Attend a Discovery Meeting!**  
**Details on Next Page**



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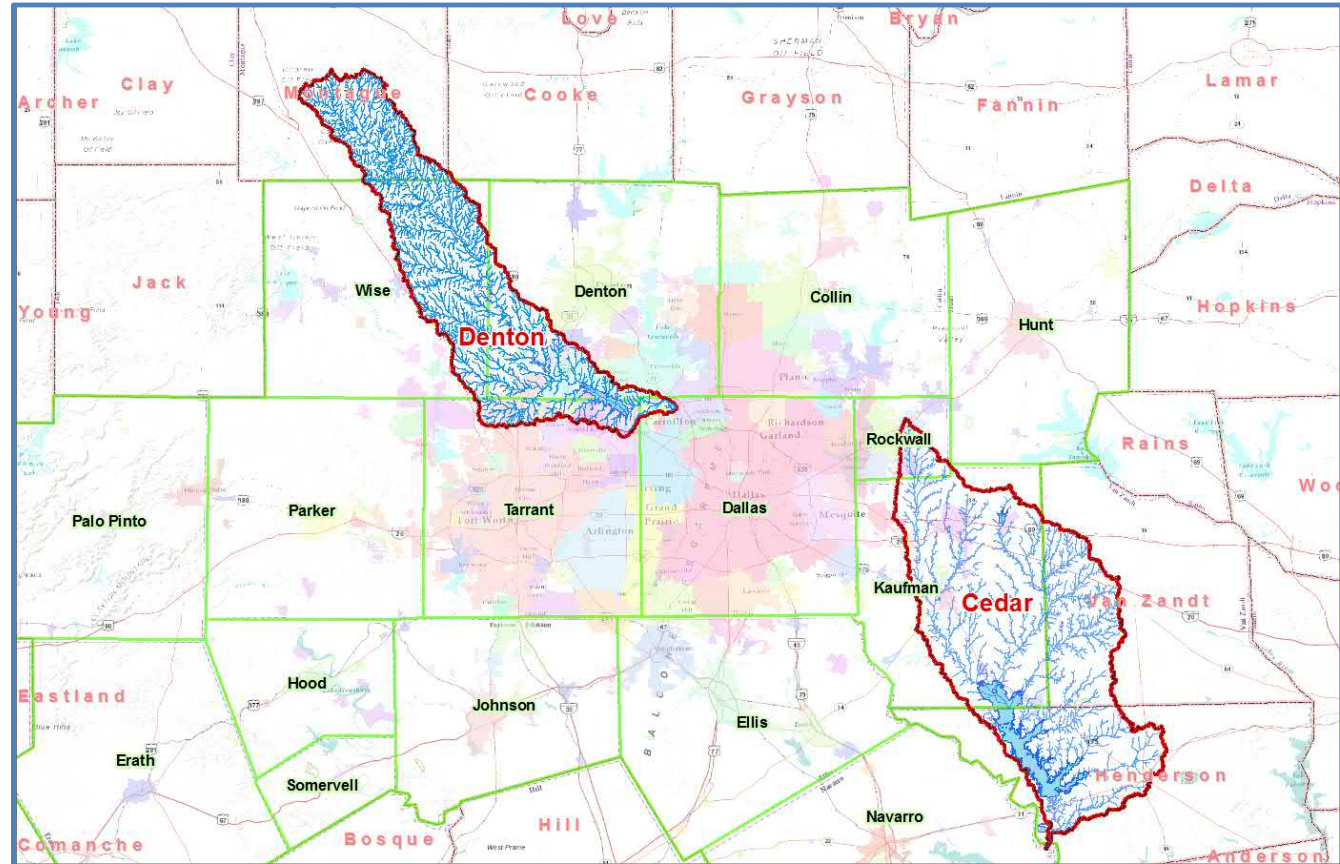


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# Discovery Meetings Coming ...

## Pre-Discovery Activities

- Discovery Meetings in Mid to Late June
- All community stakeholders are encouraged to attend

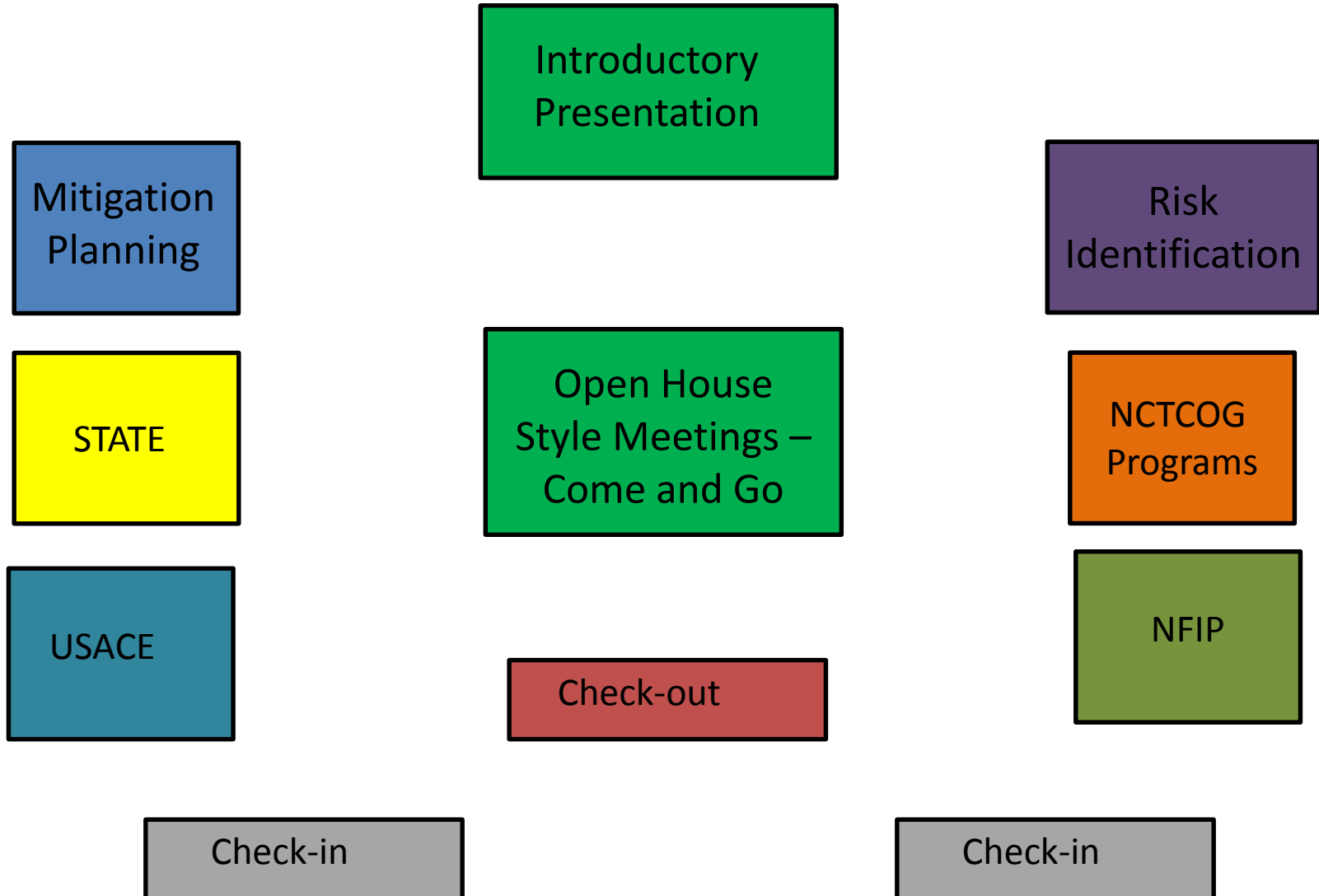




# Discovery Meetings - Layout & Format

---

## Discovery Activities



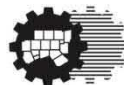
# Discovery Meetings – What to Expect

## Discovery Activities



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# Who Should Come?

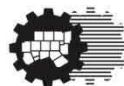
## Discovery Activities

- Community Officials Including:
  - Leaders, Floodplain Administrators, City Engineers, Watershed Organizations, Planners, Emergency Managers, and GIS specialists
- Federal, State, and Regional Agencies
- Other locally identified stakeholders concerned with flood risks or hazard mitigation



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# What Do I Bring?

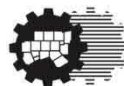
## Discovery Activities

- Knowledge of Flood Risks and Past Flooding in your Community
- Hazard Mitigation Projects – Identified, In Progress, or Complete?
- Master Drainage Plan(s), floodplain studies – completed or identified as needs
- Questions or Concerns regarding your current Digital Flood Insurance Rate Maps – Flood Study Needs
- Current Flood Risk Communication Process
- Dams and Levees – Questions or Concerns
- GIS data



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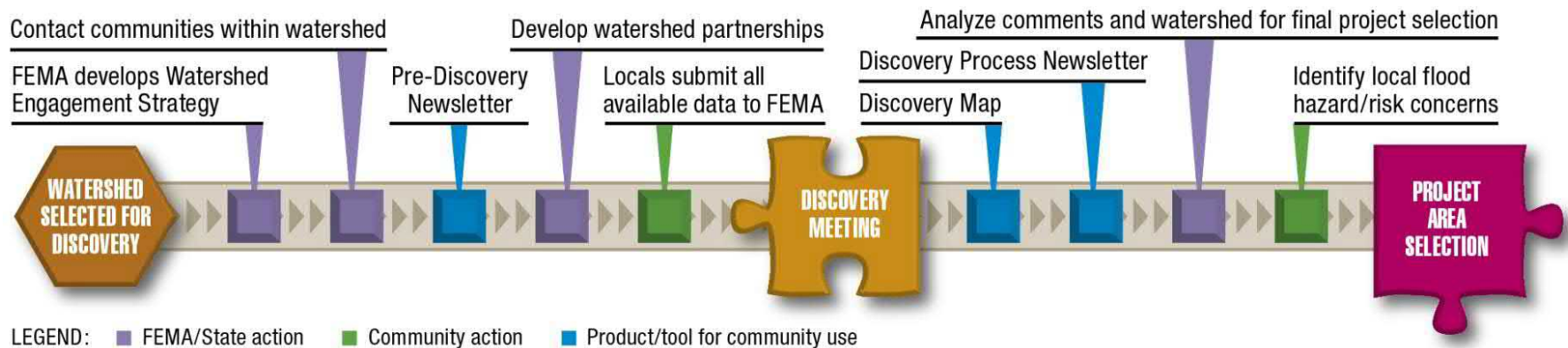


# Post-Discovery Actions

## Post-Discovery Activities

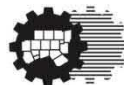
- Post-Discovery Actions

- Analyze data collected
- Review findings with NCTCOG
- Preliminary project selections provided to communities
- Evaluate community input
- Discovery Report



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# Webinar Info

## DISCOVERY WEBINARS

Cedar Creek and Denton Creek Watersheds



You have been identified as an important stakeholder with significant interests within the Cedar Creek or Denton Creek Watersheds. As a stakeholder, you are invited to take part in an informative webinar on the North Central Texas Council of Governments (NCTCOG) and the Federal Emergency Management Agency (FEMA) Risk MAP Discovery efforts in the Cedar and Denton Watersheds.

April 2017

19/24

Both webinars will cover both watersheds.

[Register for April 19 Webinar](#)

[Register for April 24 Webinar](#)

WebEx

Event Information: CTP Discovery Webinar April 19

Registration is required to join this event. If you have not registered, please do so now.

Event status: Not started ([Register](#))

Date and time: Wednesday, April 19, 2017 10:00 am  
Central Daylight Time (Chicago, GMT-05:00)  
[Change time zone](#)

Duration: 1 hour

Description: During this webinar you will hear about the Risk MAP Discovery process currently underway for the Cedar and Denton Watersheds. The goal of Discovery is to work closely with communities and other stakeholders to better understand local flood risks, mitigation efforts, and other topics in order to spark watershed-wide discussions about increasing resilience to flooding.

Event Password is "Discovery"

By joining this event, you are accepting the Cisco WebEx [Terms of Service](#) and [Privacy Statement](#).

[Register](#)

Join Event Now

You cannot join the event now because it has not started.

First name:

Last name:

Email address:

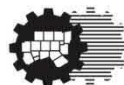
Event password:

[Join Now](#)



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# Pre-Discovery Data Gathering

<https://nctcogdiscovery.halff.com>

Login: EMAIL ADDRESS

Password: NCTCOG\_2017!

## NCTCOG Discovery

Overall Progress

0%



Welcome



Your Info



Backgrounder



Questions



Maps



Meeting Info

Use the buttons above to navigate

## NCTCOG Discovery

Overall Progress

100% THANK YOU!



Welcome ✓



Your Info ✓



Backgrounder ✓



Questions ✓



Maps ✓



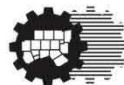
Meeting Info

Use the buttons above to navigate



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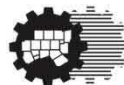
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# Questions



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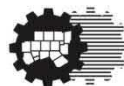
# Contact Information

- NCTCOG:
  - Edith Marvin – [EMarvin@nctcog.org](mailto:EMarvin@nctcog.org)
  - Mia Brown – [MBBrown@nctcog.org](mailto:MBBrown@nctcog.org)
  - Kori Mullen - [KMullen@nctcog.org](mailto:KMullen@nctcog.org)
- Halff Associates:
  - Jessica Baker – [JBaker@halff.com](mailto:JBaker@halff.com)
  - Jack Young – [JYoung@halff.com](mailto:JYoung@halff.com)
  - Samuel Amoako-Atta – [SAmoako-Atta@halff.com](mailto:SAmoako-Atta@halff.com)
- FEMA:
  - Alan Johnson – [Alan.Johnson@fema.dhs.gov](mailto:Alan.Johnson@fema.dhs.gov)
- TWDB / TNRIS:
  - Manuel Razo – [Manuel.Razo@twdb.texas.gov](mailto:Manuel.Razo@twdb.texas.gov)
  - Michael Segner – [Michael.Segner@twdb.texas.gov](mailto:Michael.Segner@twdb.texas.gov)



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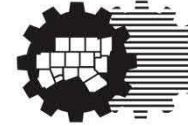
# Discovery Findings Webinar Slides





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# North Texas Discovery Findings

## Cedar and Denton Watersheds

“Capturing a More Complete Picture of Your Watershed”

September 21, 2017

September 26, 2017

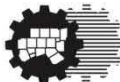
# Introduction

- NCTCOG:
  - Edith Marvin – [EMarvin@nctcog.org](mailto:EMarvin@nctcog.org)
  - Mia Brown – [MBBrown@nctcog.org](mailto:MBBrown@nctcog.org)
  - Kori Mullen - [KMullen@nctcog.org](mailto:KMullen@nctcog.org)
- Halff Associates:
  - Jessica Baker – [JBaker@halff.com](mailto:JBaker@halff.com)
  - Jack Young – [JYoung@halff.com](mailto:JYoung@halff.com)
  - Jarred Overbey – [JOverbey@halff.com](mailto:JOverbey@halff.com)
  - Samuel Amoako-Atta – [SAmoako-Atta@halff.com](mailto:SAmoako-Atta@halff.com)
- FEMA:
  - Alan Johnson – [Alan.Johnson@fema.dhs.gov](mailto:Alan.Johnson@fema.dhs.gov)
- TWDB / TNRIS:
  - Manuel Razo – [Manuel.Razo@twdb.texas.gov](mailto:Manuel.Razo@twdb.texas.gov)
  - Michael Segner – [Michael.Segner@twdb.texas.gov](mailto:Michael.Segner@twdb.texas.gov)



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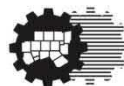
# AGENDA

- Overview of Risk MAP
- NCTCOG Discovery Activities
- Discovery Overview
- 2017 NCTCOG Discovery Watersheds
  - Discovery Activities
  - Discovery Findings
- Base Level Engineering
- Next Steps



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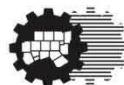
# FEMA's Risk MAP Program

- Risk Mapping, Assessment, and Planning
  - Provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens.
  - Risk MAP Vision
    - **ACTION-driven**, not **MAP-driven** through local understanding and ownership of risk



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# Discovery

## Overview

- *Capture a more complete picture of your watershed by working closely with local communities...*

### Watershed Selected for Discovery

- **Selection Criteria:**
  - Risk
  - Need
  - Elevation data availability
  - Regional knowledge
  - CTP/State input

### Community Engagement / Data Collection

- **Develop watershed partnerships**
- **Discovery Newsletter**
- **Pre-Discovery community visits**
- **Gather all available data**
  - Data needs
  - Issues / Concerns
  - Areas of Mitigation

### Discovery Meeting

- **Review / validate watershed for project areas**
- **Provide information**
  - Mapping
  - Mitigation Planning
  - Grants
  - NFIP Compliance
- **Comprehensive understanding of risk in the watershed**

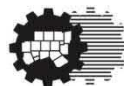
### Post-Meeting Coordination / Scope Refinement

- **Once data is collected**
  - FEMA will coordinate with State/NCTCOG on proposed scope refinement
  - Selected Projects – move toward Kick off meeting
  - Non-Selected Projects – engaged for potential mitigation actions, mitigation plan updates, and/or mitigation technical assistance



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# NCTCOG Discovery Activities

2004-2008  
FEMA Map  
Modernization

2009  
Map Needs  
Assessment

2012  
Partnered with  
FEMA for CTP  
Grant

2013  
Discovery

2017  
Discovery

- 2009 TWDB/NCTCOG Map Needs Assessment (MNA) documented...
  - 1,291 new mapping needs
  - 2,370 miles of stream
  - \$44 Million in Flood Mapping Needs
- 2013 Discovery utilized MNA data and updated results. **2017 Discovery** will do the same.

A Pilot Project for the  
Texas Water Development Board and the  
Texas Natural Resources Information System  
State-Wide Map Needs Assessment Plan

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Map Needs Assessment

Prepared for

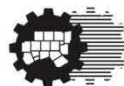
By  
Halff Associates, Inc.  
Michael Baker Jr., Inc.

August 31, 2009  
AVO 26928



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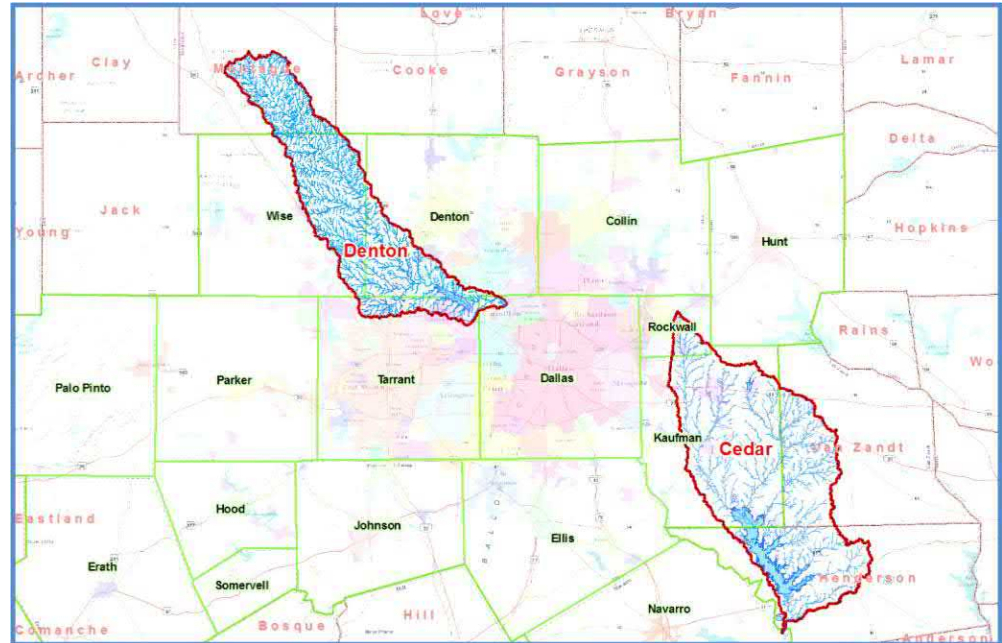


# North Central Texas Council of Governments

2017 North Texas Discovery

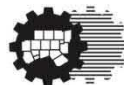
## NCTCOG Leading Cedar and Denton Watersheds

- Goals:
  - Provide information
    - Mitigation planning and actions
    - Risk Communication
  - Gather information
    - Local flood risks and hazards
    - Current mitigation



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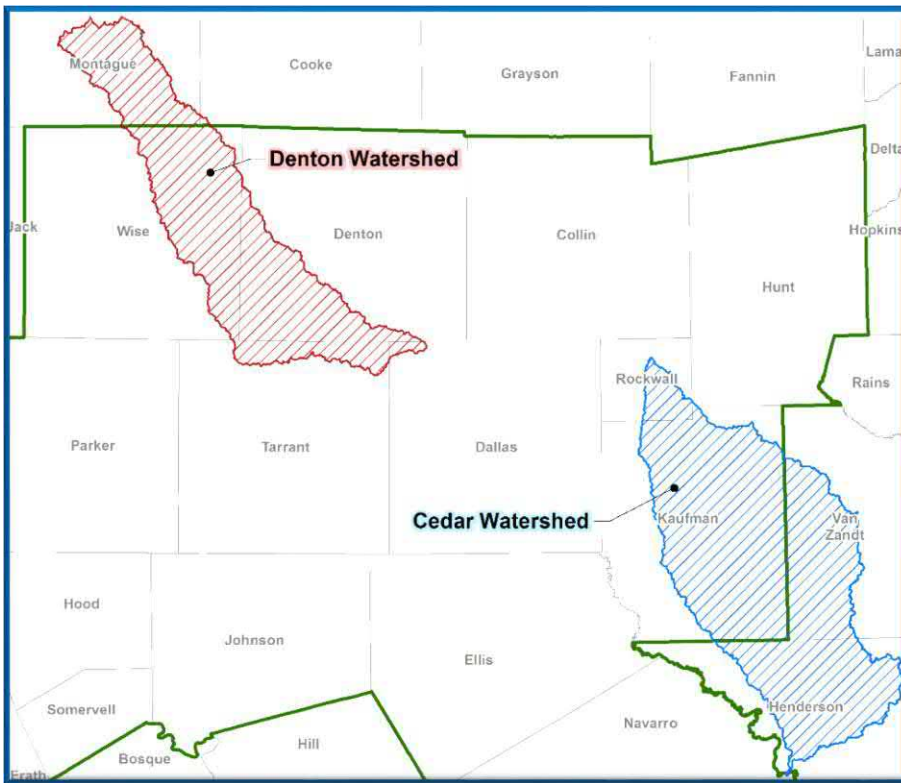
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# Discovery Findings

## Cedar and Denton Watersheds



Contact communities within watershed

FEMA develops Watershed Engagement Strategy

Develop watershed partnerships

Pre-Discovery Newsletter

Locals submit all available data to FEMA

Analyze comments and watershed for final project selection

Discovery Process Newsletter

Discovery Map

Identify local flood hazard/risk concerns

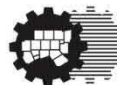


LEGEND: ■ FEMA/State action ■ Community action ■ Product/tool for community use



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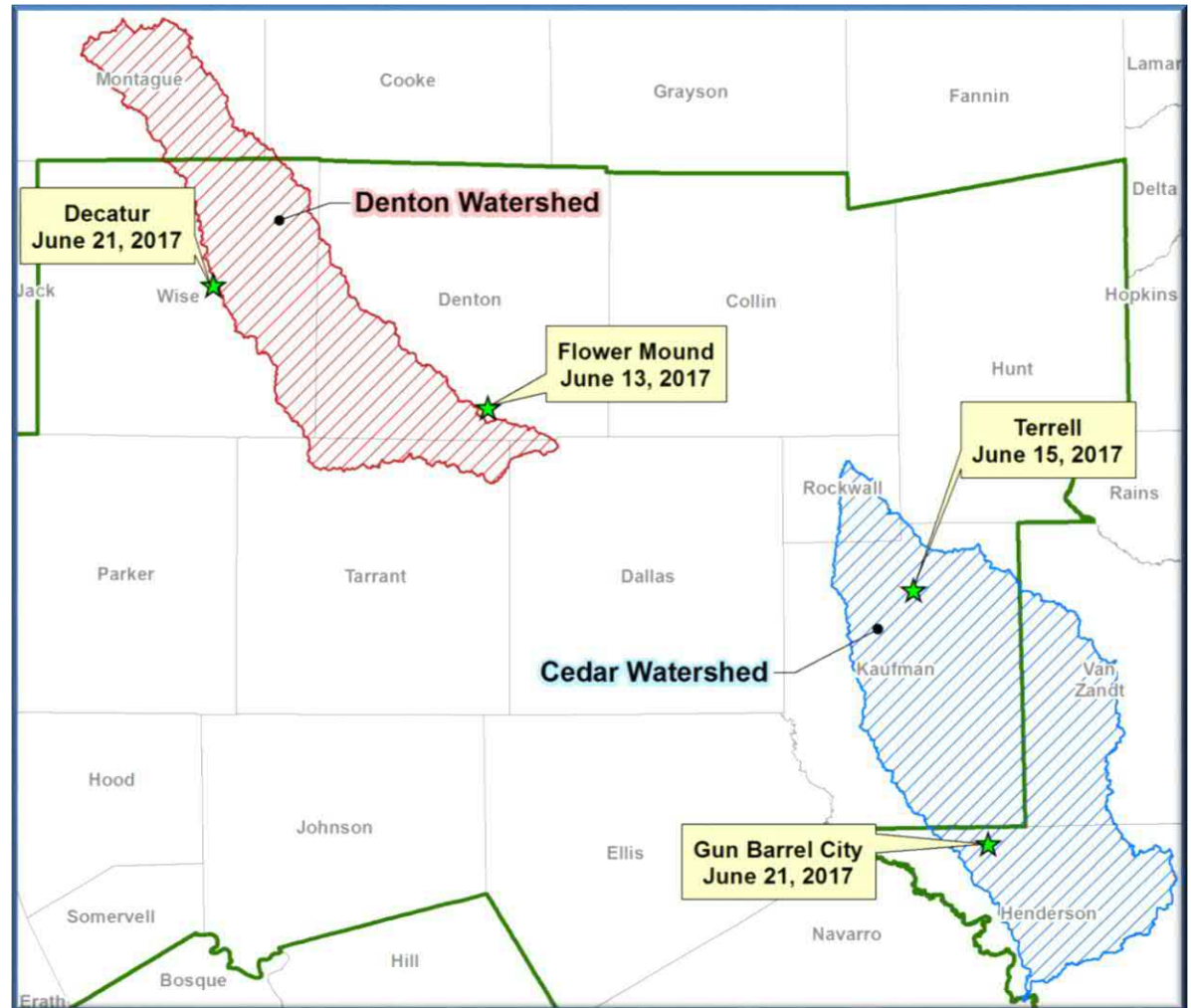
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# 2017 Discovery Meetings

Cedar and Denton Watersheds

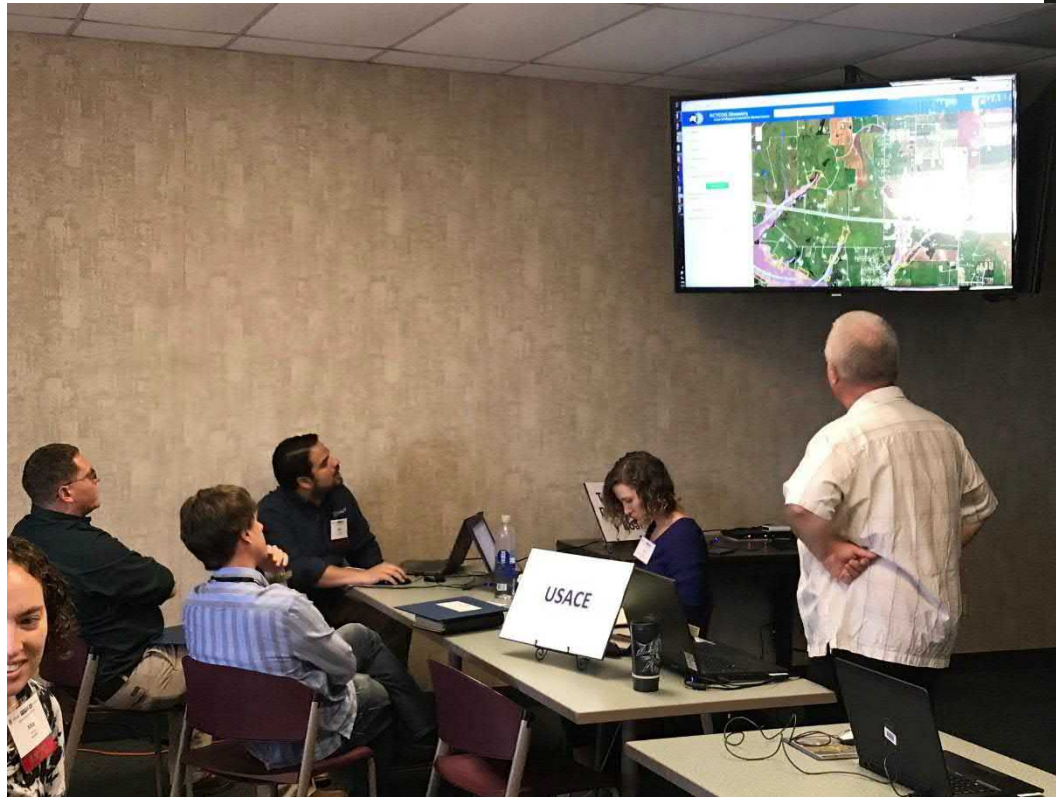
4 Discovery Meetings in June 2017



# 2017 Discovery Meetings

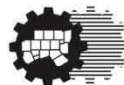
Cedar and Denton Watersheds

Come-and-Go  
Open House  
Meetings



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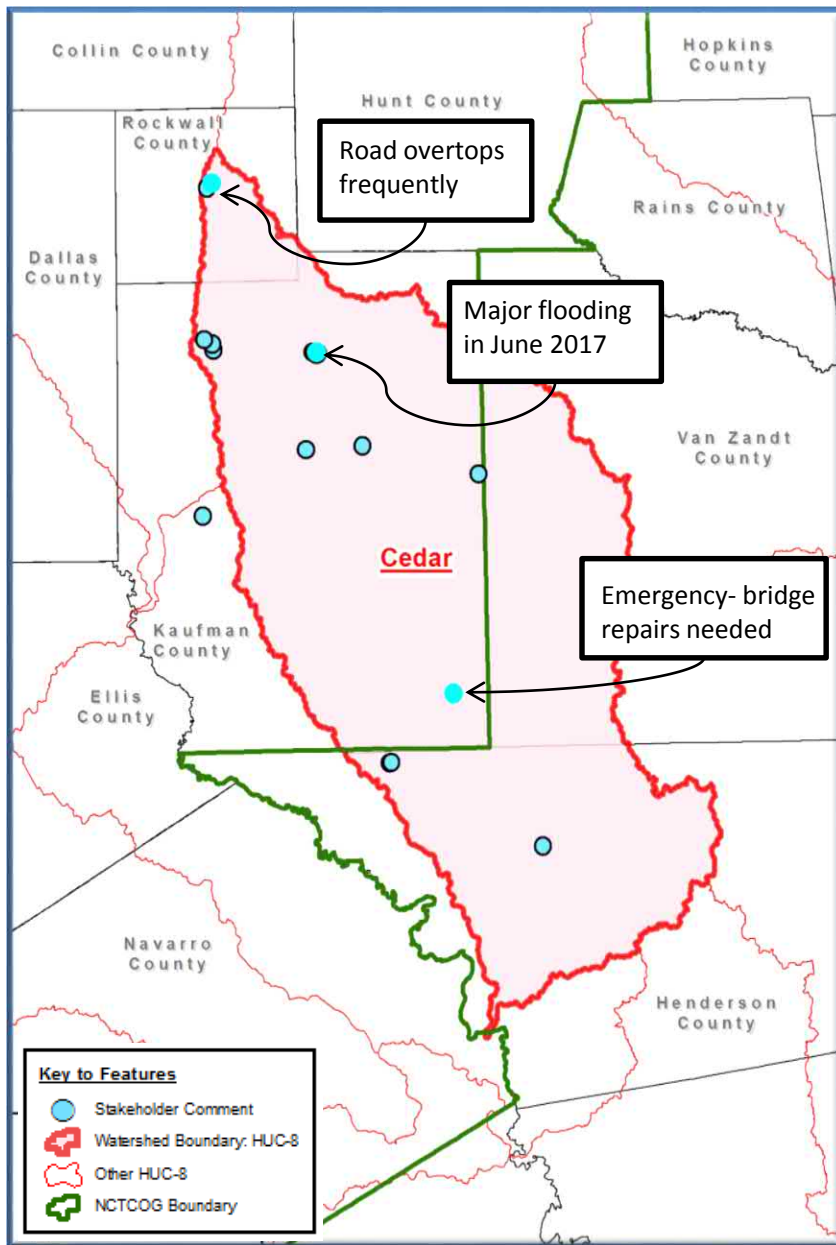


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# Discovery Findings

## Meeting Results: Cedar

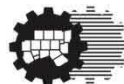


- Community concerns
- Known Flooding locations
- Areas of Mitigation Interest



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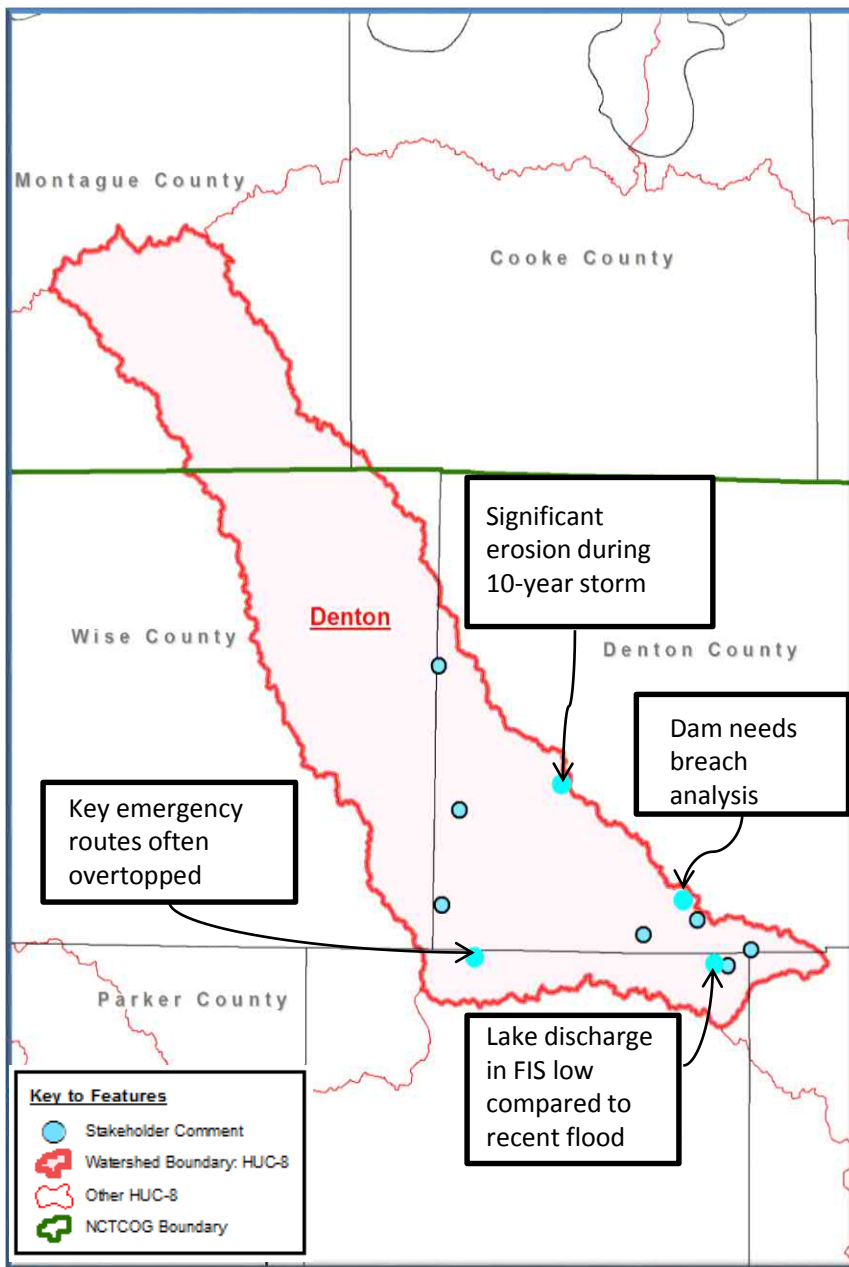


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# Discovery Findings

## Meeting Results: Denton

- Community concerns
- Known Flooding locations
- Areas of Mitigation Interest



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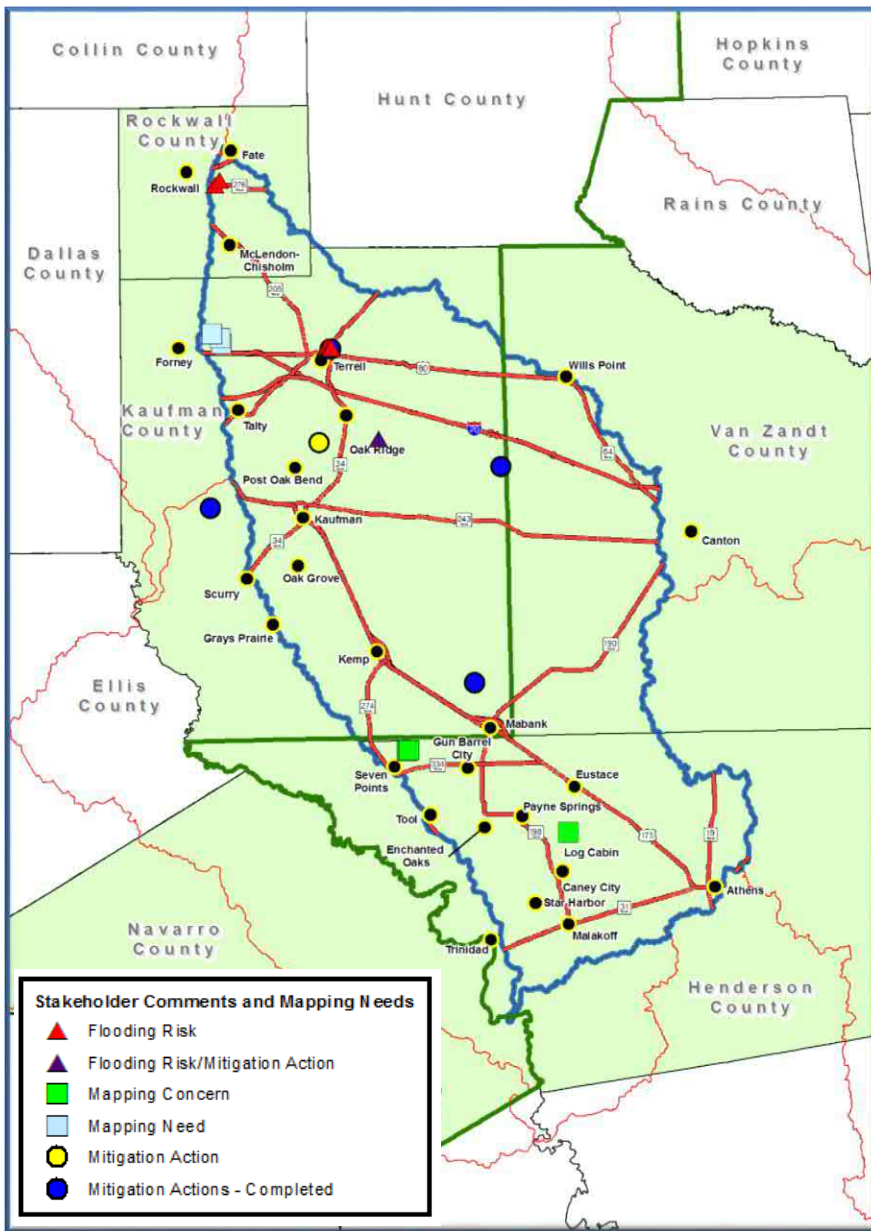
**HALFF**



# Discovery Findings

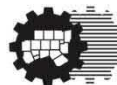
## Meeting Results: Cedar

### Stakeholder Comment Distribution



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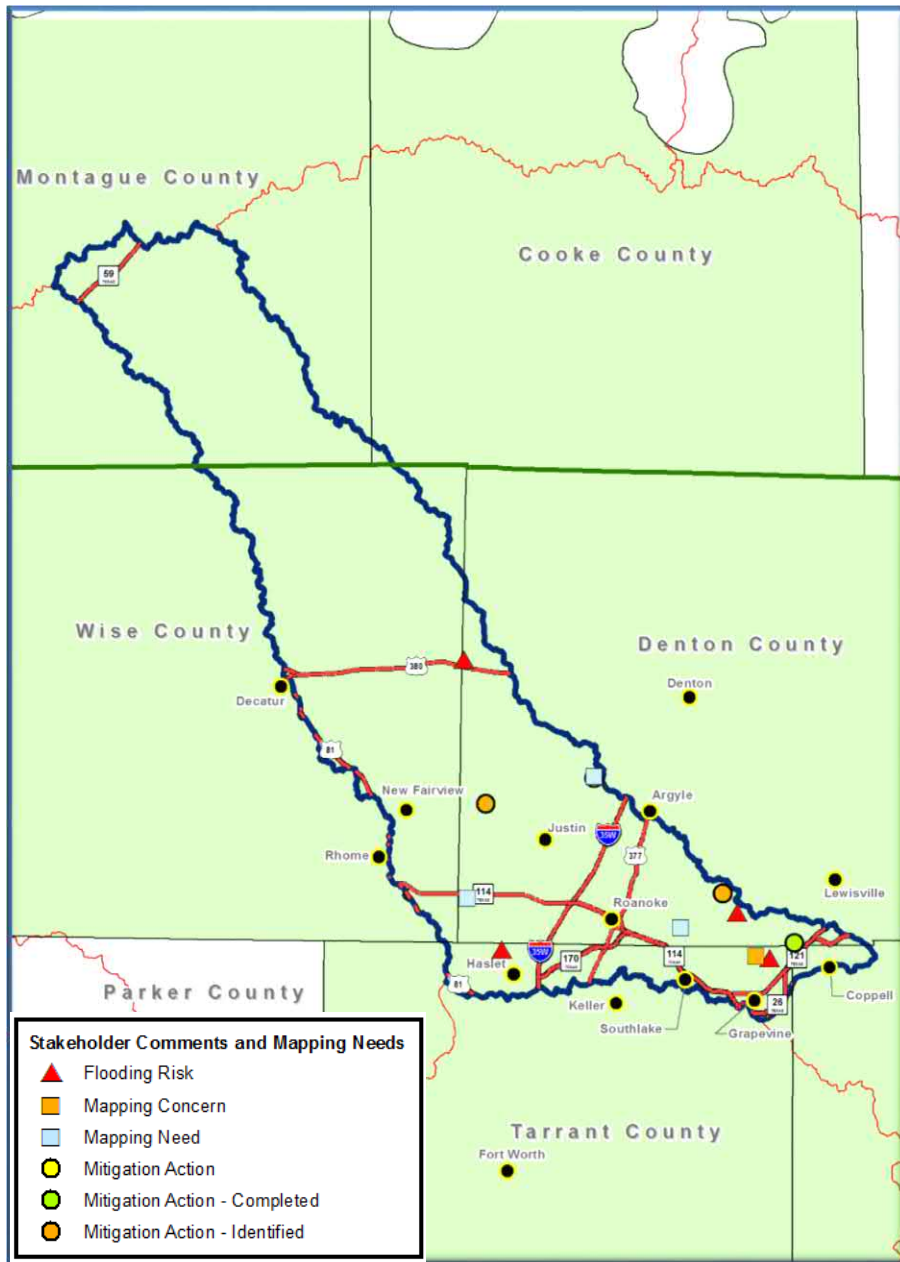


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# Discovery Findings

Meeting Results: Denton

## Stakeholder Comment Distribution



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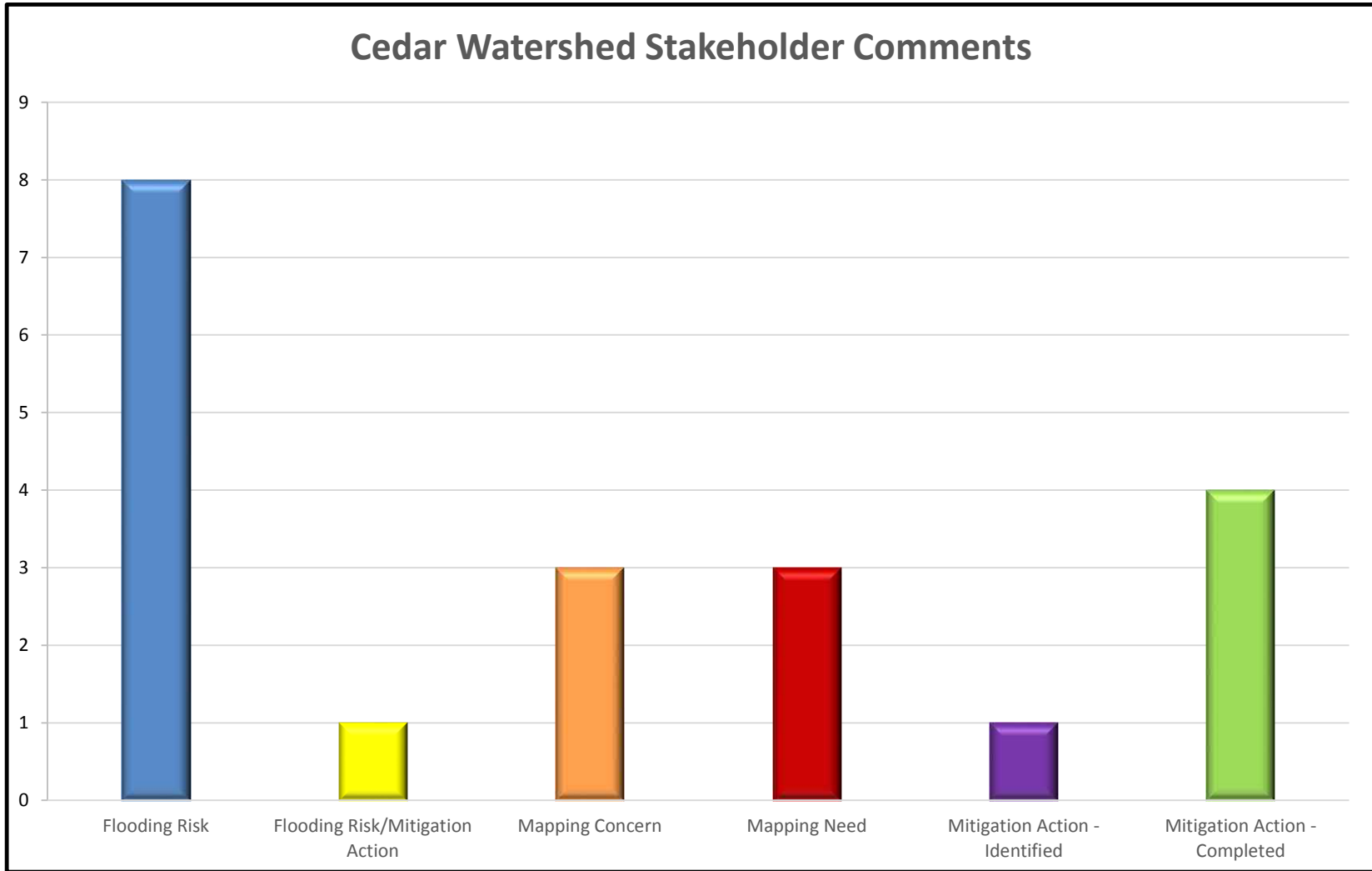


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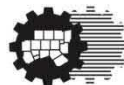
# Discovery Findings

## Meeting Results: Cedar



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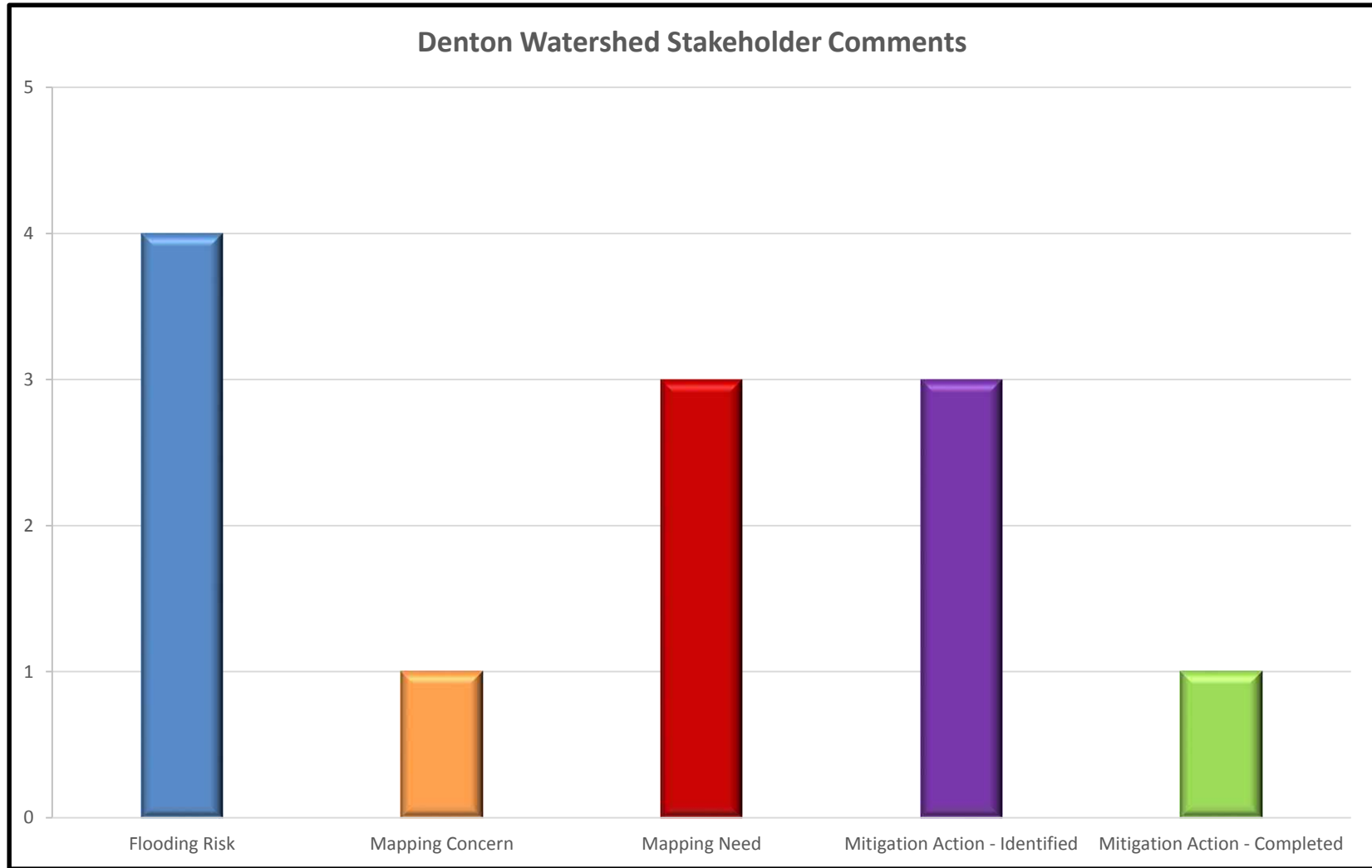
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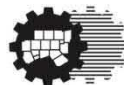
# Discovery Findings

## Meeting Results: Denton



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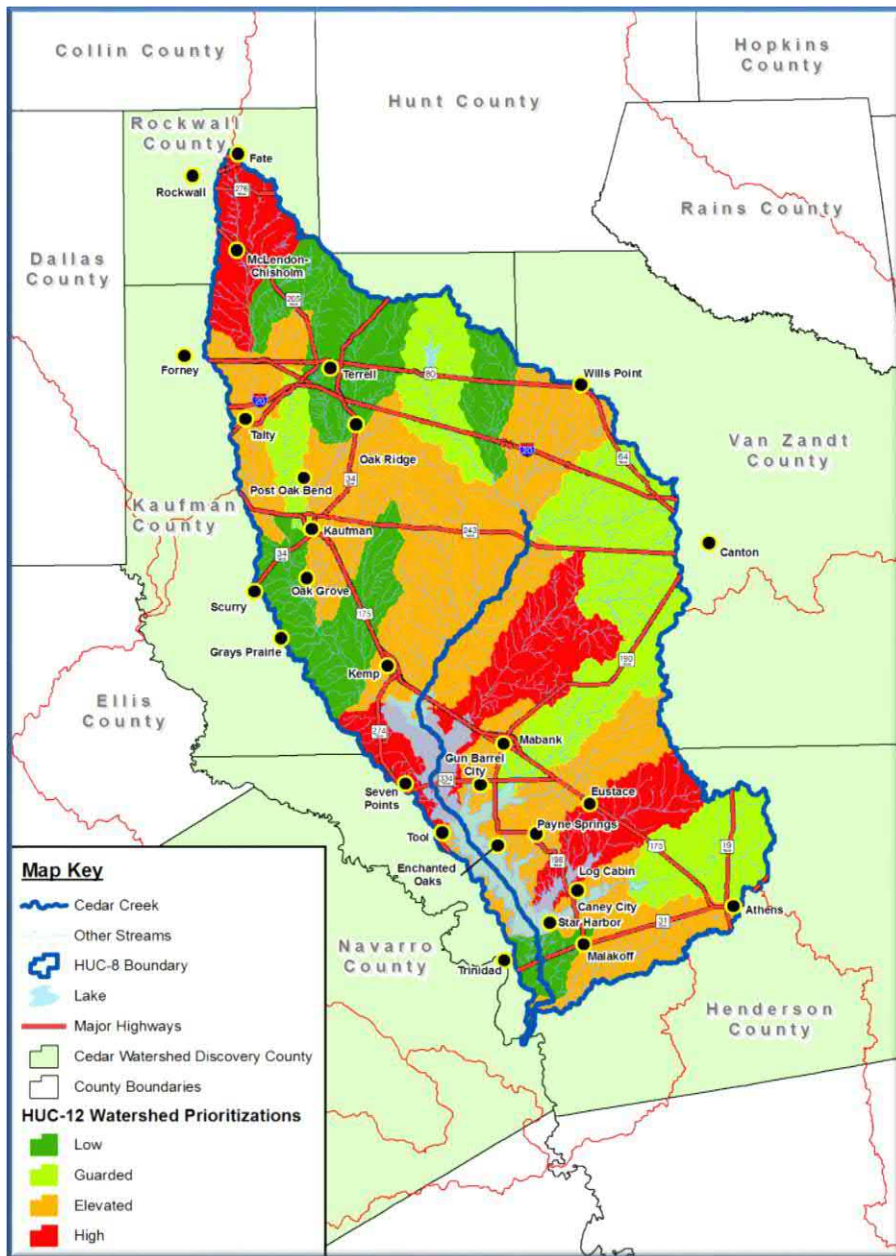
**HALFF**



# Discovery Findings

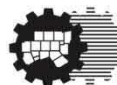
## Meeting Results: Cedar

- Cedar HUC-12 sub-watersheds Prioritization



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# Discovery Findings

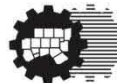
## Meeting Results: Denton

- Denton HUC-12 sub-watersheds Prioritization



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# Base Level Engineering(BLE)

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What is it?

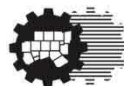
Large scale automated engineering process to identify flood risks for an entire watershed.

- **Uses:**
  - High resolution ground elevation data
  - Automated hydrologic and hydraulic modeling
- **To create:**
  - Baseline modeling equivalent to Zone A floodplains
  - Scalable models that can be further refined
  - Watershed-wide flood risk data for Immediate use



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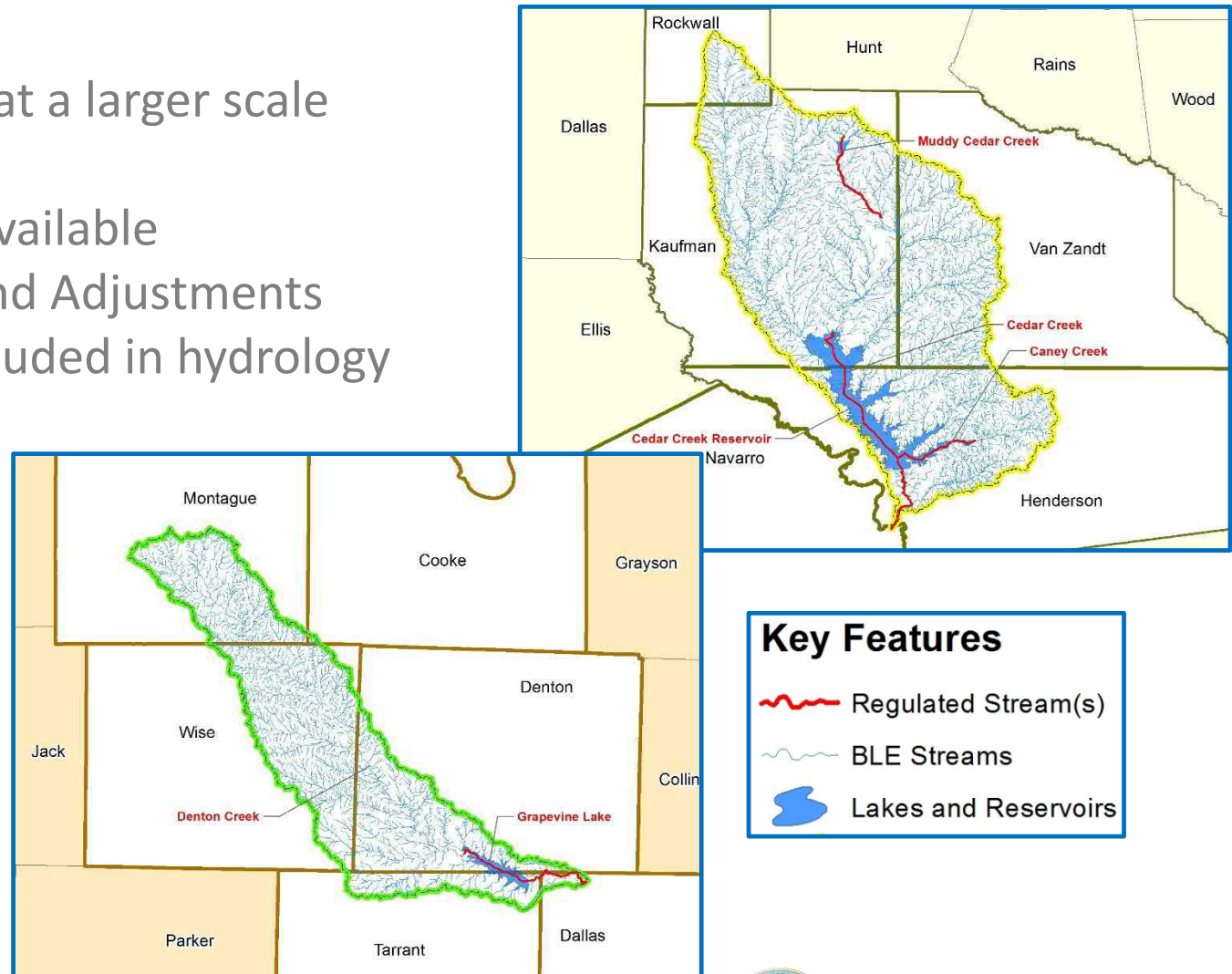


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# Base Level Engineering(BLE)

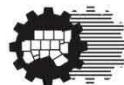
## Overview

- BLE is best used at a larger scale (HUC8)
- LiDAR must be Available
- Model Review and Adjustments
- Gage Review included in hydrology



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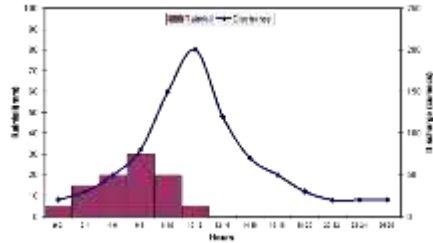


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# Base Level Engineering(BLE)

MODELING

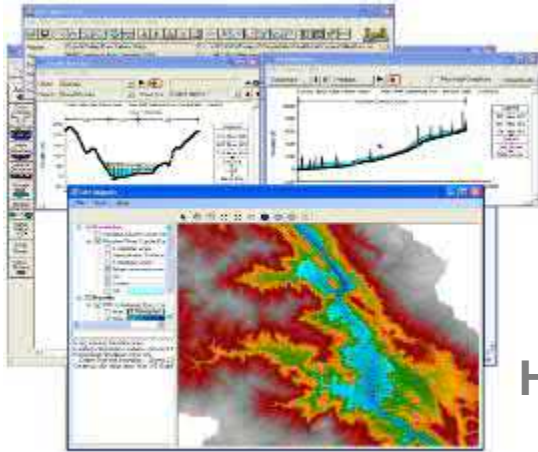


Hydrology

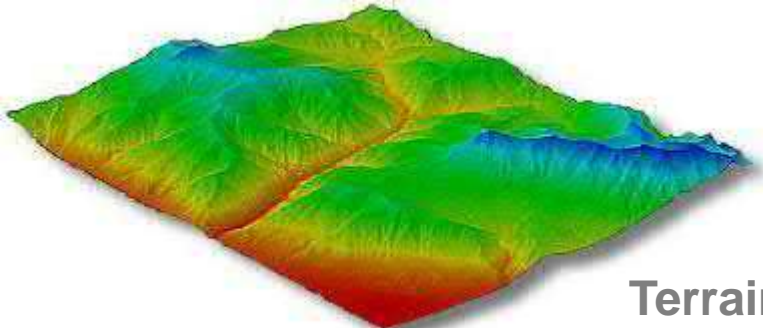
Overview



Mapping



Hydraulics



Terrain

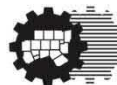
## OUTPUTS

- Hydrology modeling (Regression) flows w/gage analysis
- Hydraulic modeling (HEC-RAS) for 10%, 4%, 2%, 1% and 0.2% storm events
- 10%, 1% and 0.2% floodplain boundaries
- Areas of Expanded Flood Risk
- Depth and WSEL Grids (1% and 0.2% )
- Flood Risk Assessment



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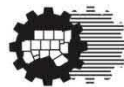
# Base Level Engineering(BLE)

Overview



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# Base Level Engineering(BLE)

## Applications

- Building Block for Future Model Refinement
- Creates a data-based starting point for conversations about existing flood risk.
- Assists FEMA in understanding where current FIRM does not adequately identify flood risk



**COST-EFFECTIVE**



**DATA FOR REVIEW**



**COLLABORATIVE**

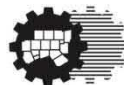


**FASTER**



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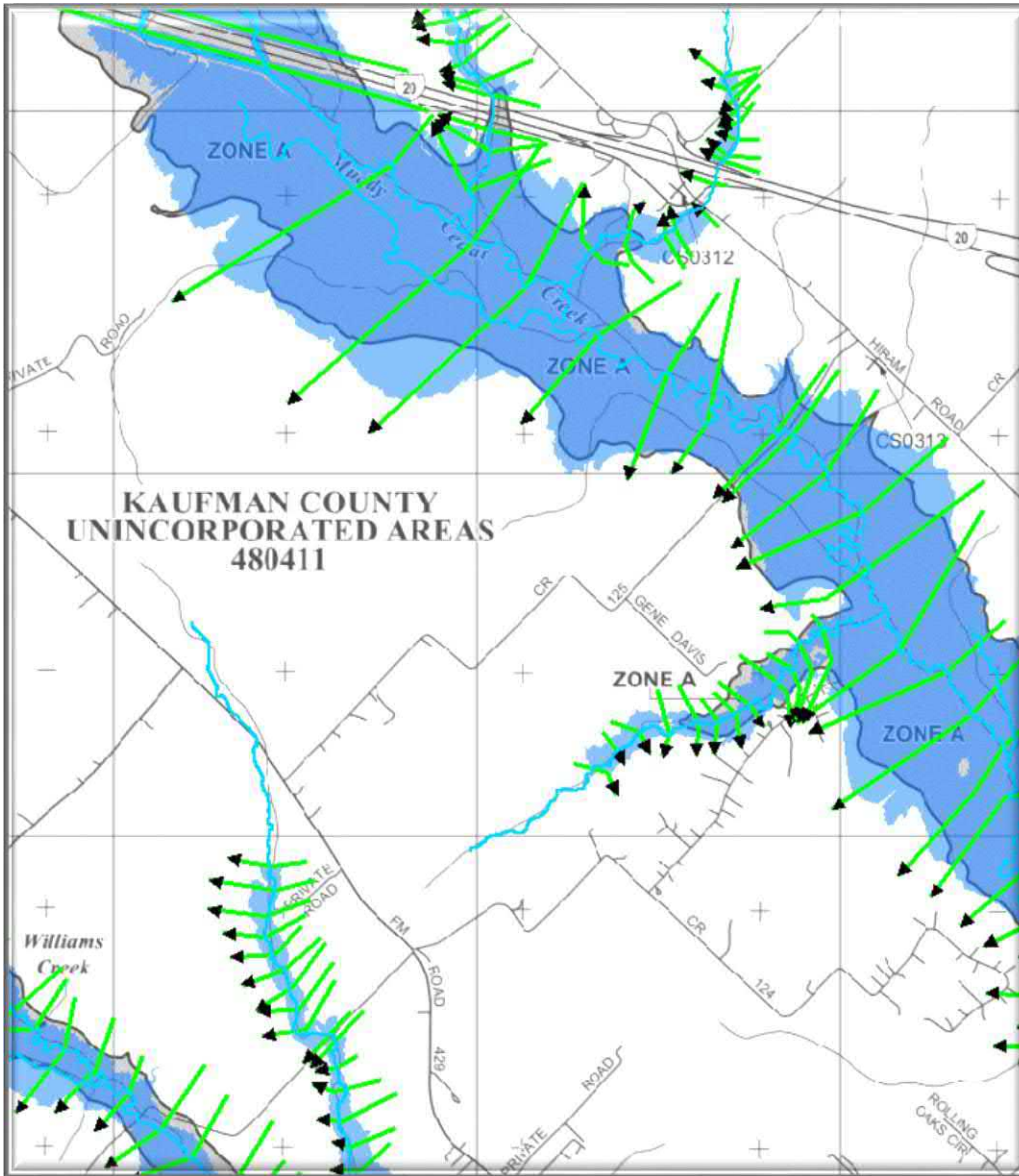
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# BLE Products

## Mapping



- Model-backed

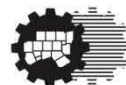
### Key to Features

-  BLE Model Stream
-  BLE Cross Section
-  BLE Mapping: 100-Year



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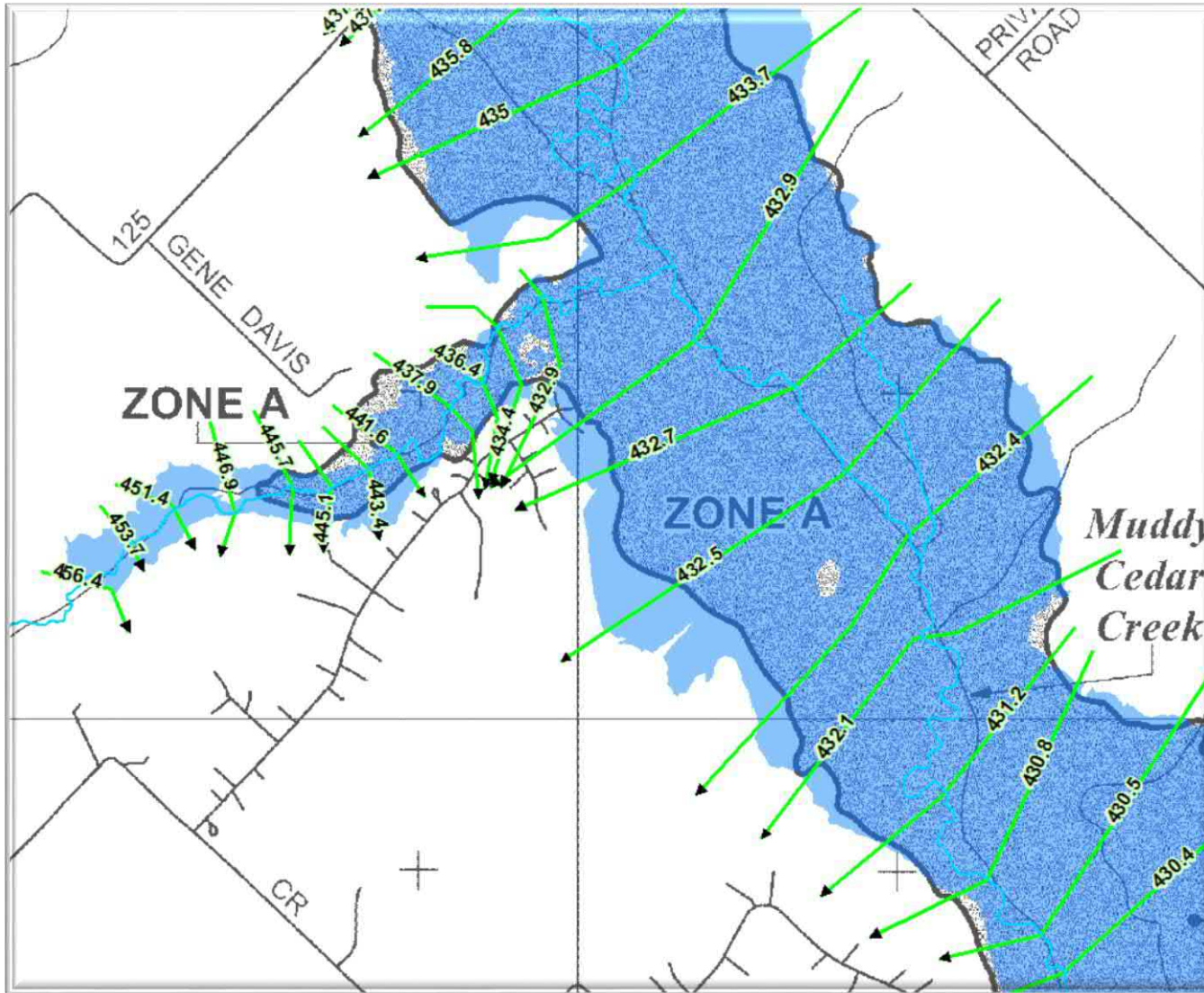


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# BLE Products

## Mapping



- Cross Sections with WSELs
- Estimated BFEs

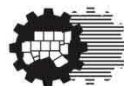
**Key to Features**

-  BLE Model Stream
-  BLE Cross Section
-  BLE Mapping: 100-Year



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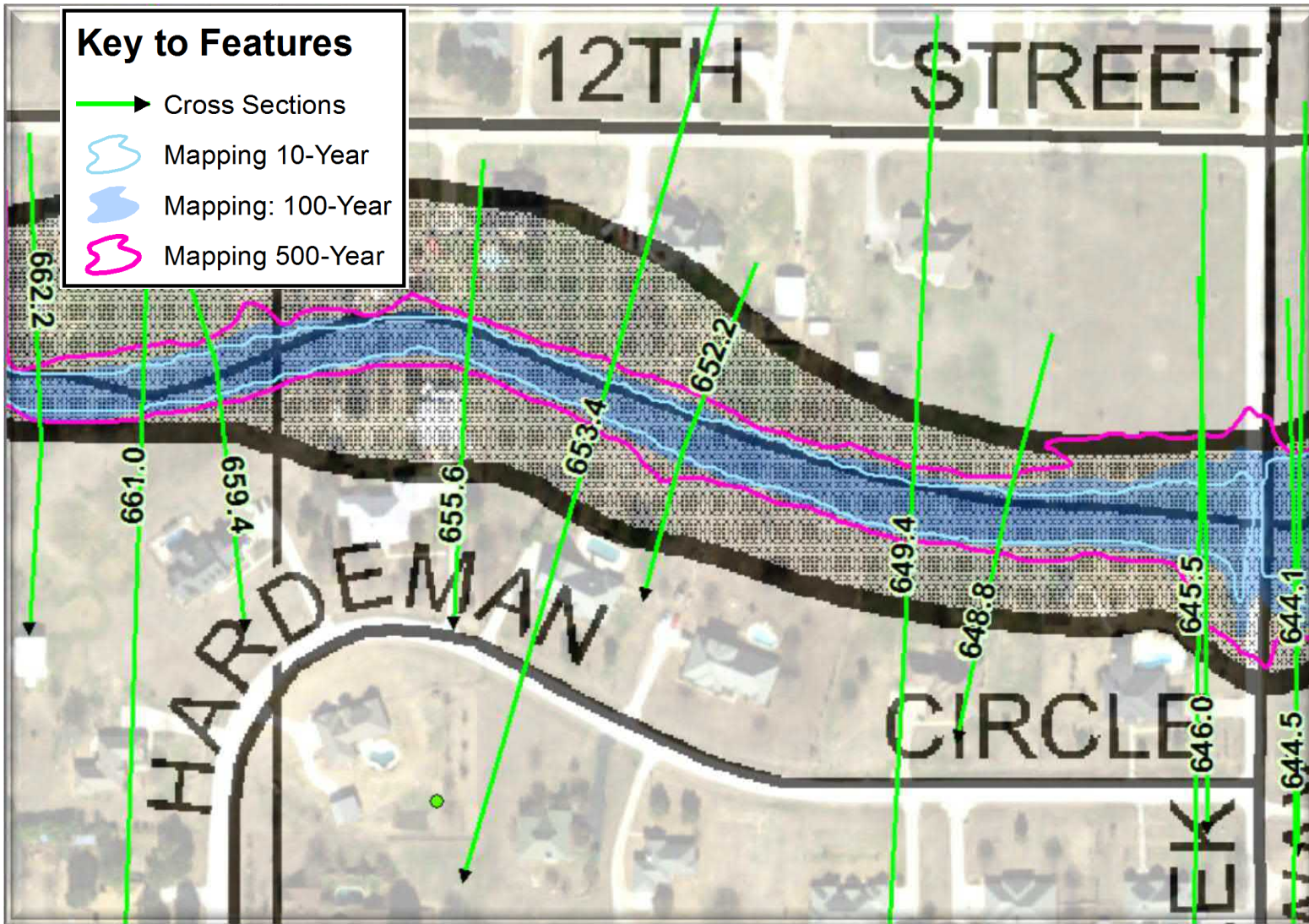
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# BLE Products

## Mapping

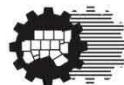


10%, 1% and 0.2% floodplain boundaries  
Estimated BFEs



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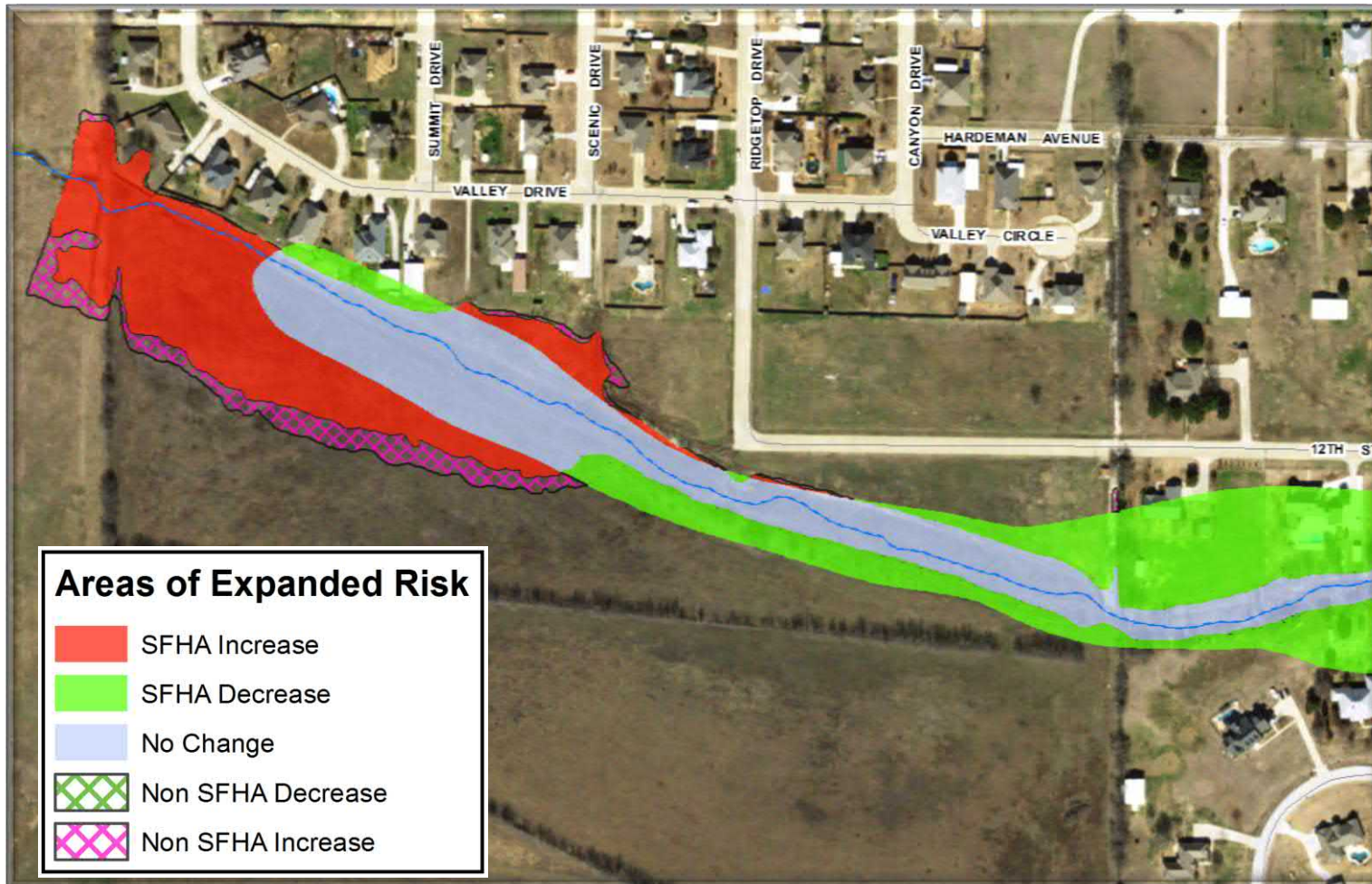


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# BLE Products

## Mapping

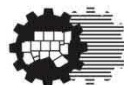


- Horizontal changes between old and new mapping



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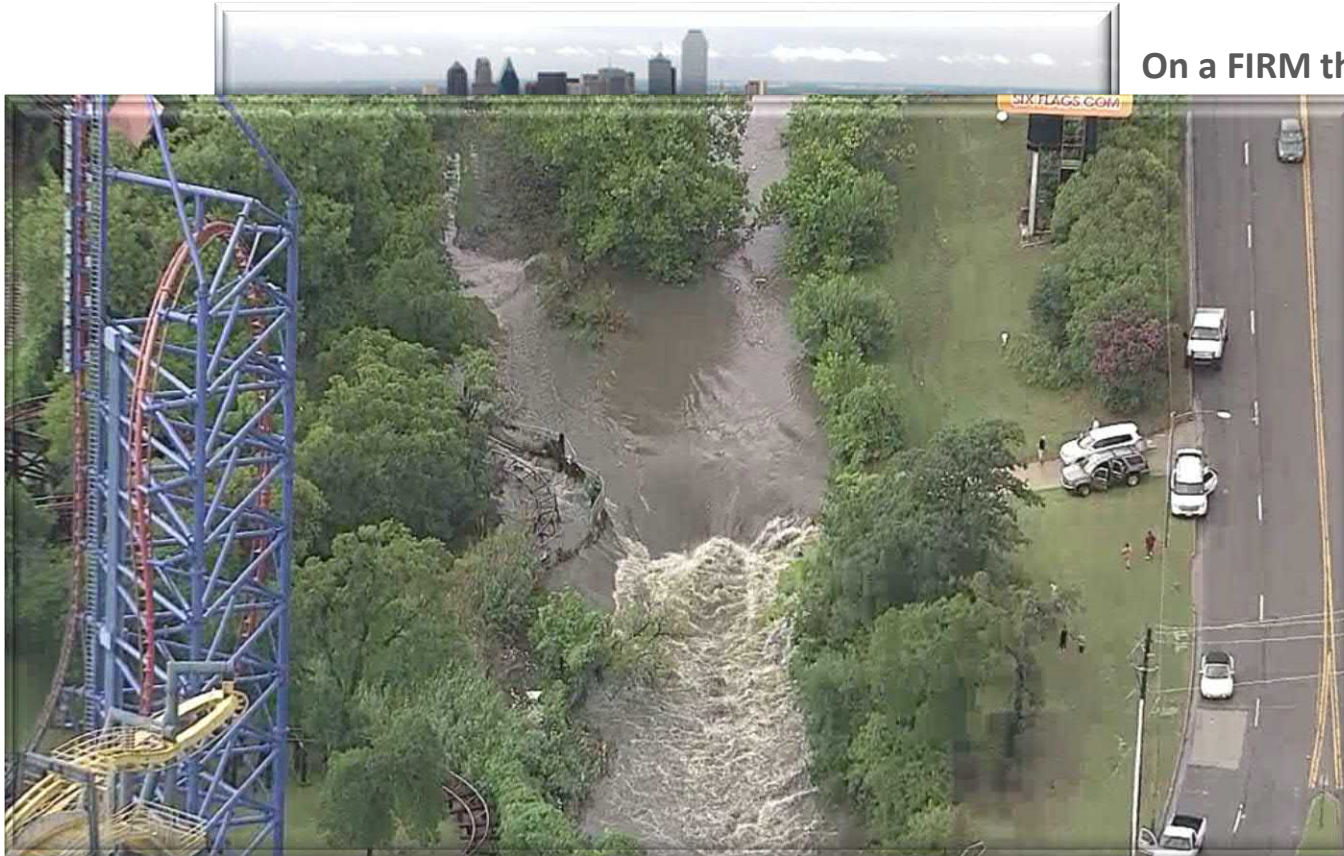
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# BLE Products

## Depth Grids



On a FIRM this type of flooding

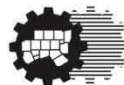
On a FIRM this type of flooding and this type of flooding have the same horizontal extent

Is the risk the same?



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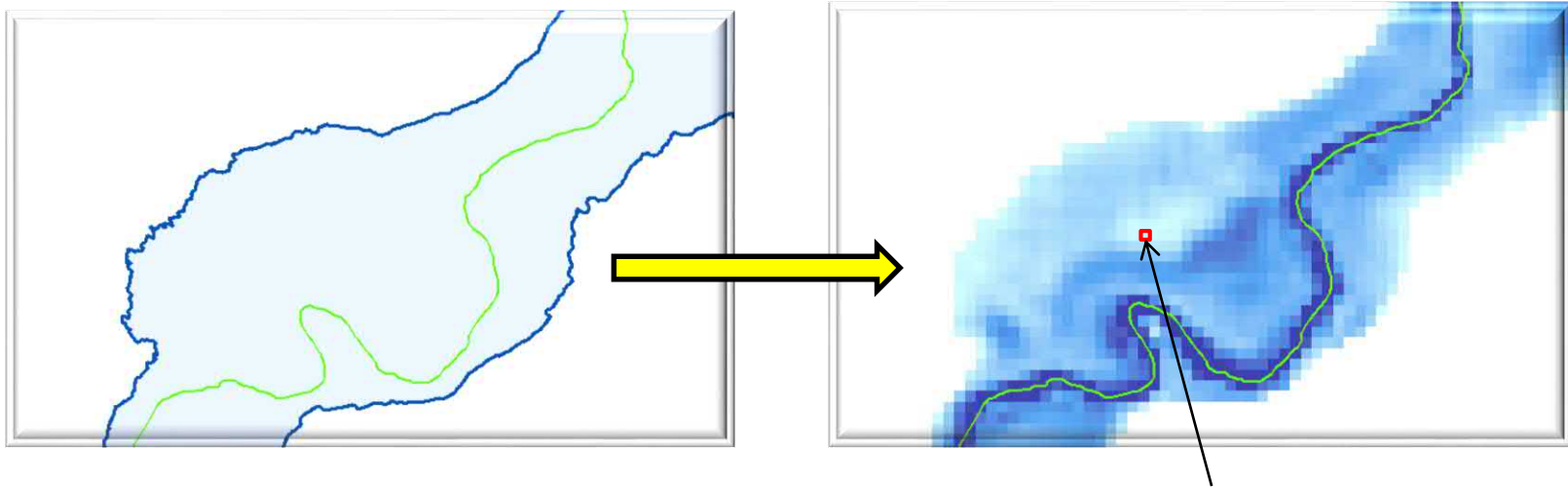


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# BLE Products

## Depth Grids



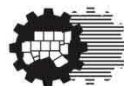
Individual Grid Cell

Each Grid Cell has a Unique Value



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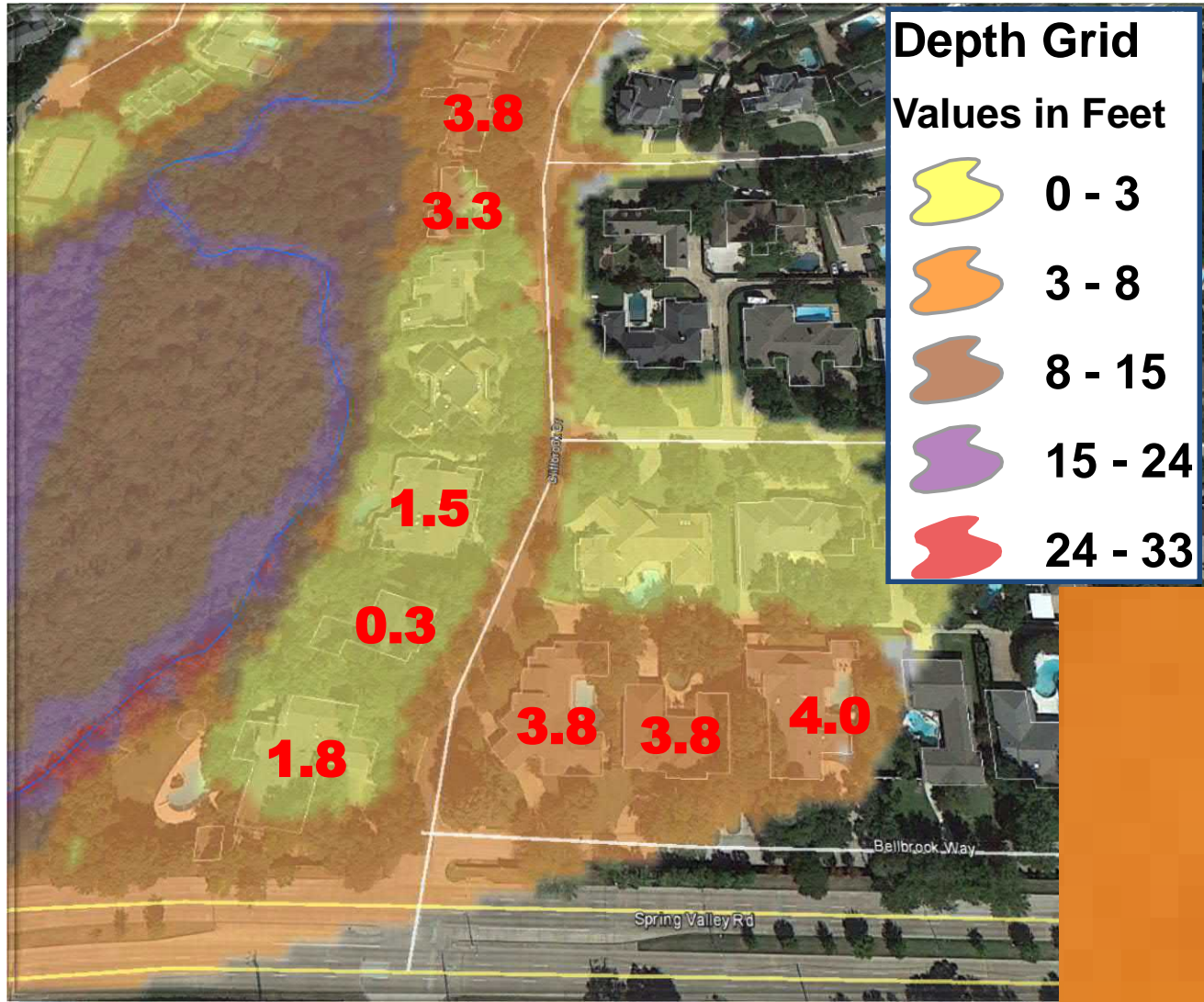
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# BLE Products

Depth Grids

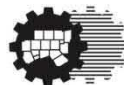


Floodplain  
Boundary  
Depth Grid  
Individual Cell



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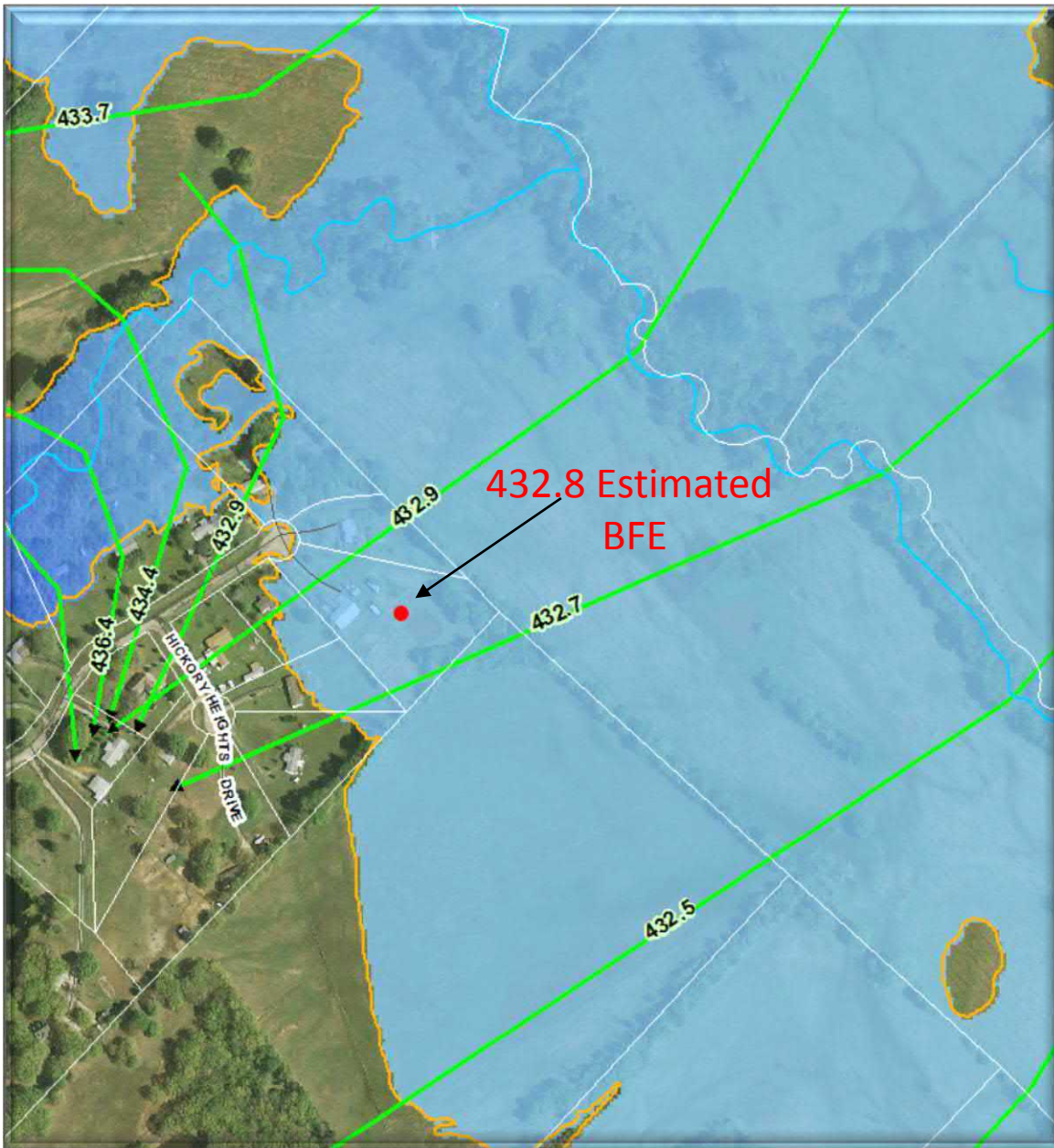


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# BLE Products


Depth Grids




- Estimated BFEs on-the-go

## Key to Features


 BLE Model Stream


 BLE Cross Section

 BLE Mapping: 100-Year

**BLE WSE: 100-Year**

**Depth in Feet**

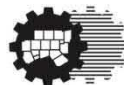
 High : 446.5

 Low : 431.4



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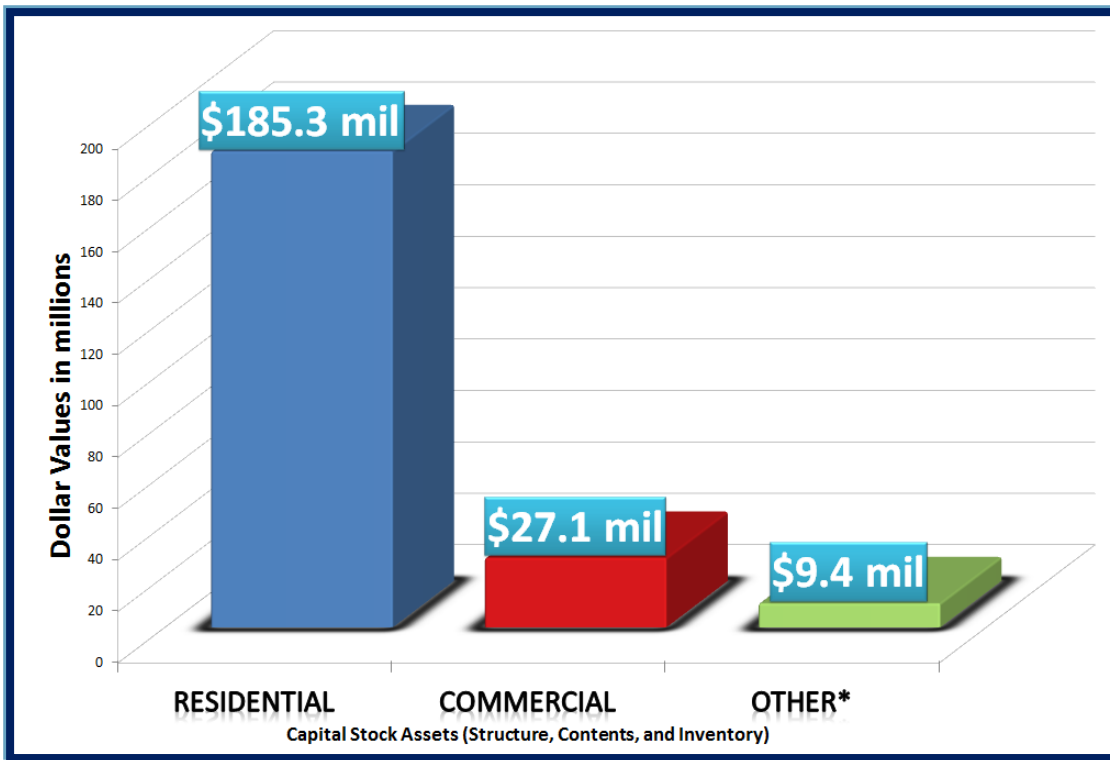
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# BLE Products

## Flood Risk Assessment



- Inventory of built environment
- Demographics

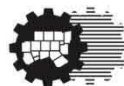


\* Other - include Industrial, Agricultural, Education, Religious, and Government structures.



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# BLE Products

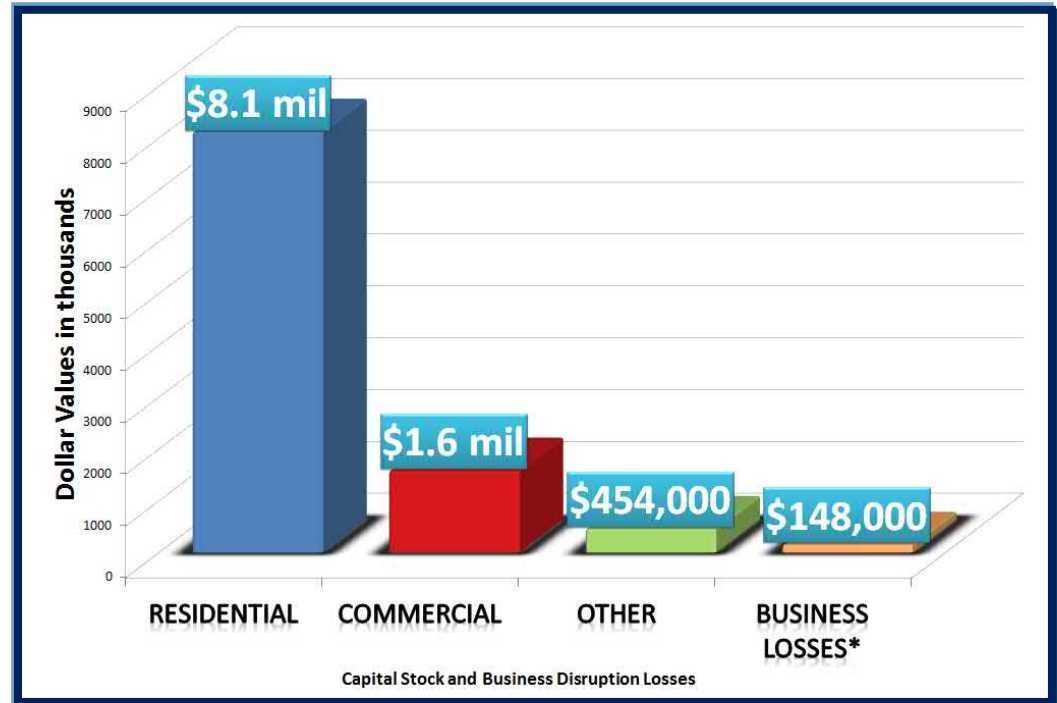
## Flood Risk Assessment



- Estimate Damages



- Estimate Losses/Needs

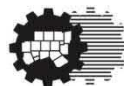


\* Business Losses - are the sum of Inventory Loss, Relocation Cost, Income Loss, Rental Income Loss, Wage Loss and Direct Output Loss.



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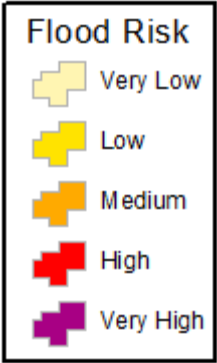
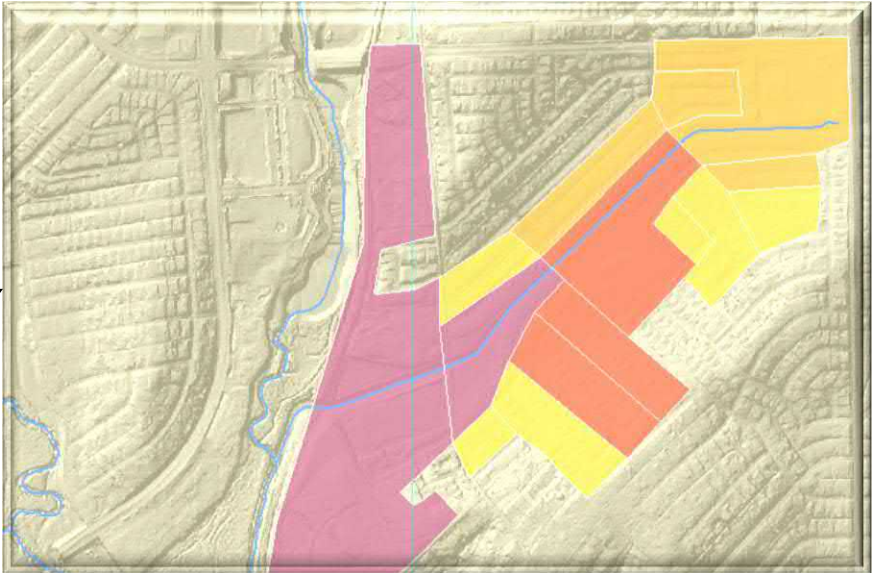
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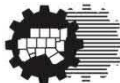
# BLE Products

## Flood Risk Assessment



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# BLE Products

## Flood Risk Assessment



### Building-Related Losses

X (Y%) of buildings at least moderately damaged (11-50%)



### Total Economic Losses

\$X million total  
Y% residential



### Displaced Populations

X households displaced  
Y individuals requiring short-term shelter



### Critical Facility Losses

At least moderate damage to:

- X Fire Station
- Y Police Station
- Z Schools



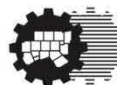
### Debris Generation

X tons of debris  
Y truckloads of debris



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# BLE Products

## Areas of Mitigation Interest (AoMI)

- Structure inventory for future Discovery/Mitigation Efforts



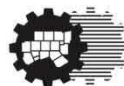
### Key to Features

- AOMI Points
- ~ Model Stream
- Mapping: 100-Year



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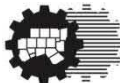
**COME AT ME BRO**

Invited Floodplain Manager  
Confident Floodplain Manager



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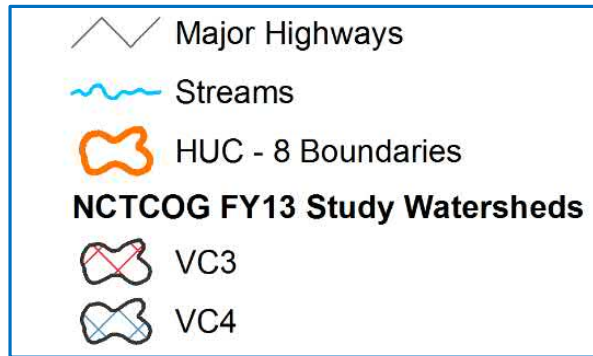
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# Example Post-Discovery Projects

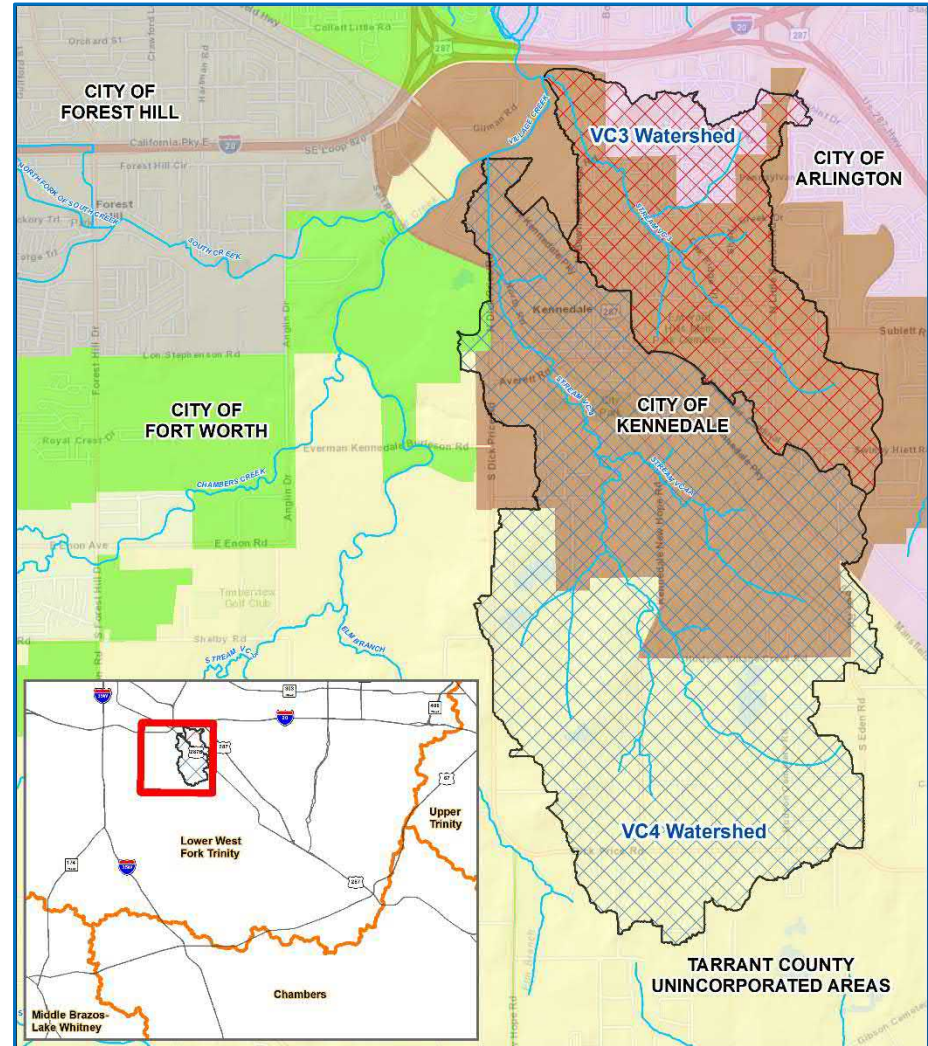
2013

## 2013 Village Creek Study – Arlington, Kennedale, and Tarrant County

- New Hydrology, Hydraulics, and Mapping for 13 streams
- Flood Risk Products including Flood Risk Assessment

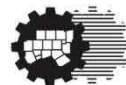


75% Federal Grant  
25% Local Cost match



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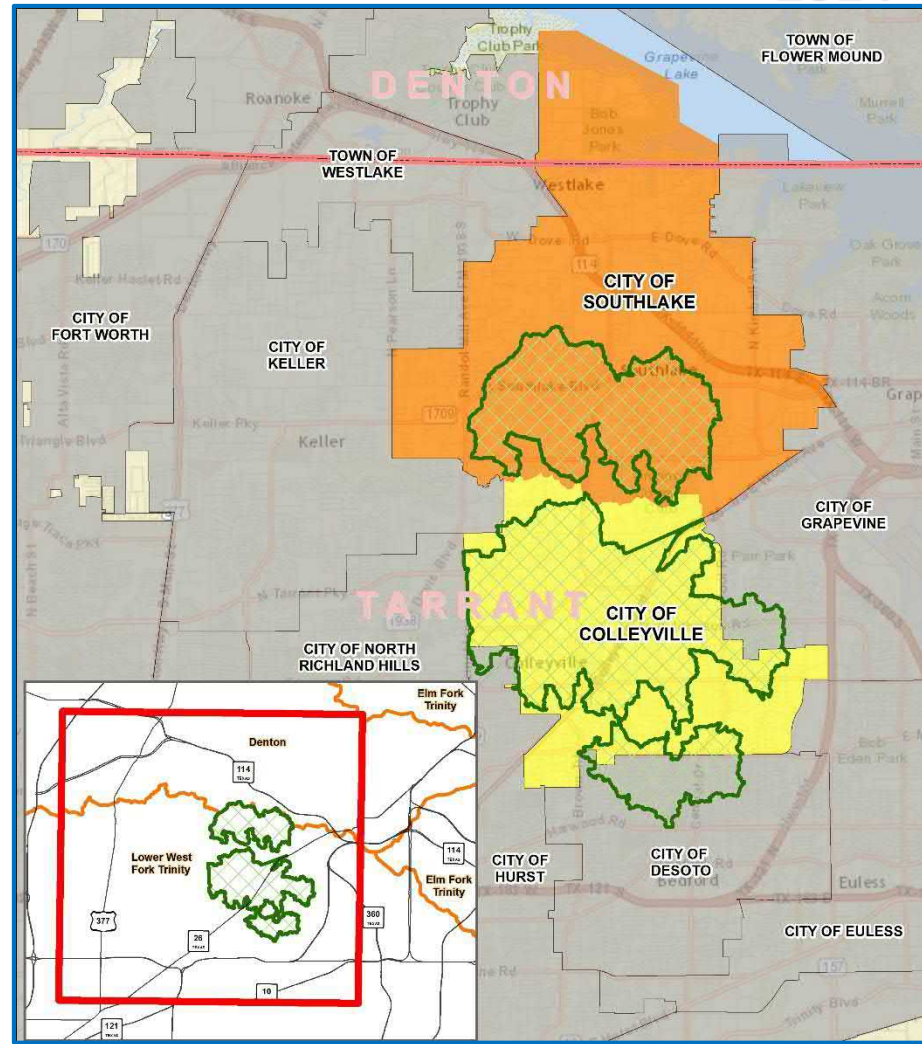
# Example Post-Discovery Projects

2014

## 2014 Bear Creek Study – Southlake and Colleyville

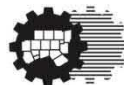
- New Hydrology, Hydraulics, and Mapping for 19 streams (Colleyville) and 8 streams (Southlake)
- Flood Risk Products including Flood Risk Assessment

75% Federal Grant  
25% Local Cost match



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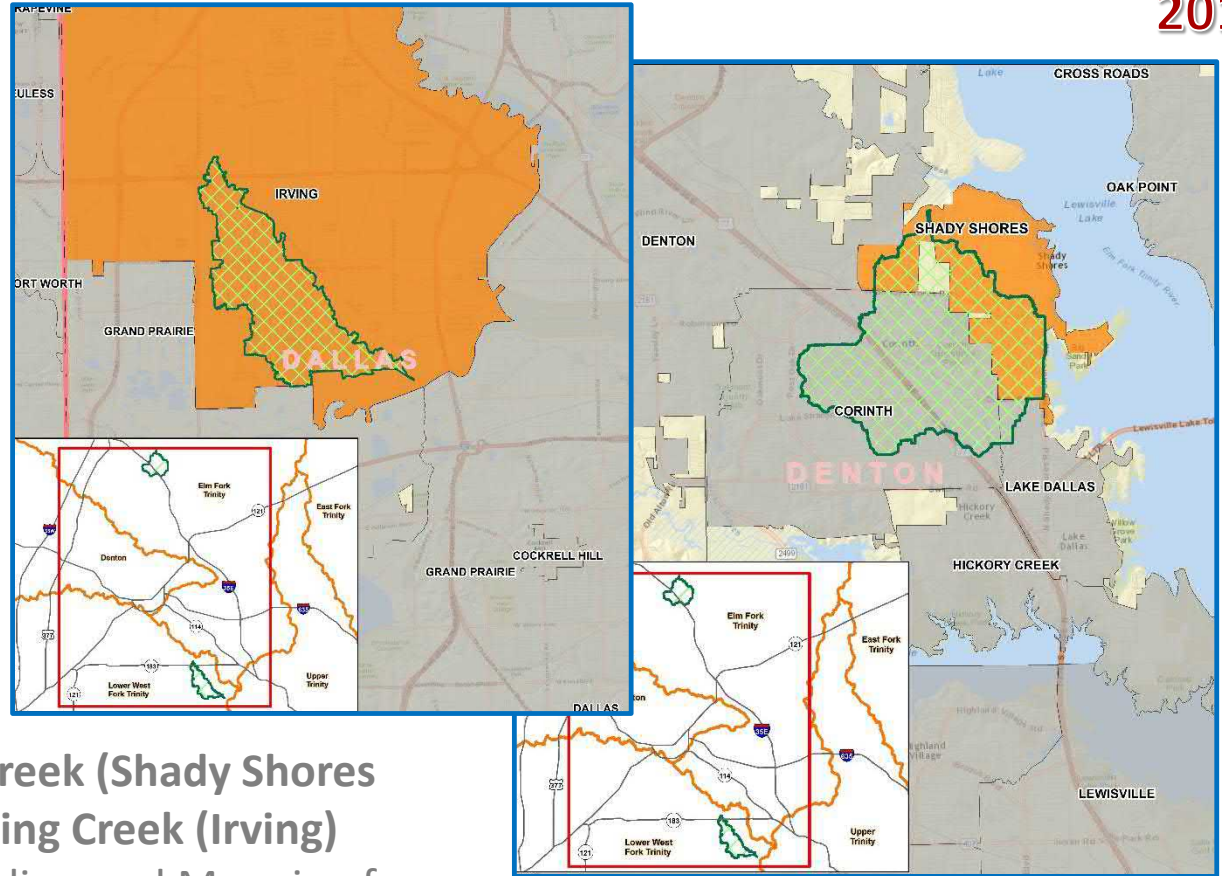
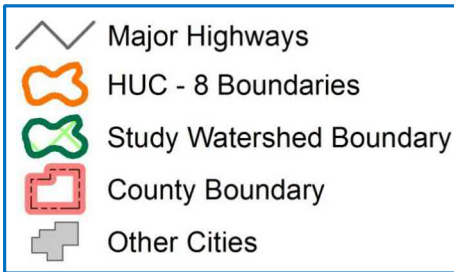
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# Example Post-Discovery Projects

2015



## 2015 Study – Lynchburg Creek (Shady Shores and Corinth) and West Irving Creek (Irving)

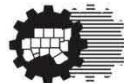
- New Hydrology, Hydraulics, and Mapping for a total of 10 streams
- Flood Risk Products including Flood Risk Assessment

75% Federal Grant  
25% Local Cost match



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# 2017 NCTCOG Discovery

## Flood Risk Report



### Flood Risk Report

#### Denton Watershed

HUC8 12030104

*October 2017*



### Flood Risk Report

#### Cedar Watershed

HUC8 12030107

*October 2017*



# Next Steps

<https://www.riskmap6.com>

RiskMAP6.com

Helping communities understand a complete picture of their natural hazard risk

Home What is Risk MAP? The Risk MAP Process Path **Communities: Know the Risk** Take Action: Empowering Communities Contact Us Resources and Related Links

## Communities: Know the Risk

Arkansas  
Louisiana  
New Mexico  
Oklahoma  
Texas

Crane County  
Crockett County  
Crosby County  
Culberson County  
Dallam County  
Dallas County  
Dawson County  
Deaf Smith County  
Delta County  
**Denton County**  
Dewitt County  
Dickens County

Elm Fork Trinity Wat... Upper Trinity Waters... Denton County Mappin...

On November 29, 2012, FEMA issued a Letter of Map Amendment (LOMA) that removed approximately 1,400 structures and properties from the Special Flood Hazard Area (SFHA), shown on the Flood Insurance Rate Maps for Denton County.

For those removed from the SFHA by the LOMA, Federal flood insurance requirements no longer apply, however flood risk still exists, and property owners may be eligible for a Preferred Risk Policy (PRP) at a lower rate. If you were removed from the SFHA by the LOMA, you should provide a copy of the letter to your lender and discuss PRP flood insurance options with your insurance agent.

For more information, and to see if your structure or property has been included, please click the Mapping Information button above, and see the links below. For mapping questions, contact the FEMA Mapping Information eXchange (FMDX) – 1-877-336-2627 (toll free).

### What's Next on the Path?

Flood Risk Review Meeting



### Community-specific Documents

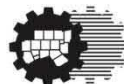
- Elm Fork Trinity Discovery Report
- Elm Fork Trinity Watershed Locator Map
- Elm Fork Trinity Discovery Newsletter
- Lower West Fork Trinity-Elm Fork Trinity-Upper Trinity Project Kickoff Presentation
- Meeting Locator Map

### Community-specific Links

To register or for more information from the North Central Texas Council of Governments (NCTCOG) for this watershed please follow this link.



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# Next Steps

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<https://nctcogdiscovery.halff.com>

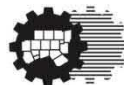
Login: EMAIL ADDRESS

Password: NCTCOG\_2017!



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# Next Steps

<https://apps.femadata.com/estbfe>

**Estimated BFE Viewer** Drop Pin Location (Long/Lat) Current View Scale 1:18,489,300

ABOUT THIS TOOL  
LEGEND  
Base Flood Elevation  
FEMA Region 6  
States  
Watershed  
Base Level Engineering (BLE) - Study Status  
BLE Data Available  
Some Data Available  
BLE Data In Development  
Some Data In Development  
Future BLE Development Planned

**GET PROPERTY REPORT**  
DISCLAIMER  
TERMS AND DEFINITIONS

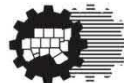
**Flood Information For This Location (1 of 4)**  
View Detailed Flood Report  
At the chosen location (-96.818397,32.336451) the Estimated Base Flood Elevation is 536.3 R (NAVD 88).  
Note: A zoom level of 1:5,000 or smaller will improve the geocoding of the map location.  
Zoom to

Base Flood Elevation	Year
536.3 R (NAVD 88)	2006



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# Next Steps

There are four possible outcomes dependent upon where the **Drop Pin** is placed: Detailed Study Available, High Risk, Low to Moderate Risk and Low Risk. More information is available in Table below.

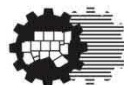
Detailed Study	High Flood Risk	Moderate Flood Risk	Low Flood Risk
<p><b>Flood Information For This Location</b></p> <p><a href="#">View Detailed Flood Report</a></p> <p>At the chosen location a more detailed study is available on the current effective FIRM panel, 48139CD190F. Please review the current effective FIRM to identify the BFE your structure will be rated against.</p> <p><i>Hint: Search the FEMA Map Service Center to create a FIRMette in your property area.</i></p> <p>Zoom to</p>	<p><b>Flood Information For This Location</b></p> <p><a href="#">View Detailed Flood Report</a></p> <p>At the chosen location (-96.839457,32.192638) the Estimated Base Flood Elevation is 447.4 ft (NAVD 88).</p> <p><i>Hint: A zoom level of 1:5,000 or smaller will improve the positioning of the map locator.</i></p> <p>Zoom to</p>	<p><b>Flood Information For This Location</b></p> <p><a href="#">View Detailed Flood Report</a></p> <p>At the chosen location (-96.841923,32.193993) the Estimated Base Flood Elevation is Not Applicable.</p> <p><i>Hint: A zoom level of 1:5,000 or smaller will improve the positioning of the map locator.</i></p> <p>Zoom to</p>	<p><b>Flood Information For This Location</b></p> <p><a href="#">View Detailed Flood Report</a></p> <p>At the chosen location (-96.824539,32.371995) the Estimated Base Flood Elevation is Not Applicable.</p> <p><i>Hint: A zoom level of 1:5,000 or smaller will improve the positioning of the map locator.</i></p> <p>Zoom to</p>
<p><b>Flood Risk Report Details:</b></p> <ul style="list-style-type: none"> <li>- Effective FIRM panel that should be reviewed to determine current Base Flood Elevation</li> <li>- Longitude/Latitude</li> <li>- Model Location</li> </ul>	<p><b>Flood Risk Report Details:</b></p> <ul style="list-style-type: none"> <li>- Estimated Flood Elevation</li> <li>- Estimated Flood Depth</li> <li>- Longitude/Latitude</li> <li>- Model Location</li> </ul>	<p><b>Flood Risk Report does not include Flood Elevations at this time.</b></p> <p>Land and structures in the lighter shaded areas may experience flooding during an event that exceeds the 1% annual chance.</p>	<p><b>Flood Risk Report does not include Flood Elevations at this time.</b></p> <p>Land and structures outside of any indicated flood extent may experience flooding during an event that exceeds the 0.2% annual chance.</p>

**Note: At this time, flood elevations are only available in the High Flood Risk extent area**



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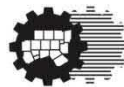
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# Questions



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# Contact Information

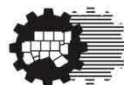
THANK  
YOU

- NCTCOG:
  - Edith Marvin – [EMarvin@nctcog.org](mailto:EMarvin@nctcog.org)
  - Mia Brown – [MBBrown@nctcog.org](mailto:MBBrown@nctcog.org)
  - Kori Mullen - [KMullen@nctcog.org](mailto:KMullen@nctcog.org)
- Halff Associates:
  - Jessica Baker – [JBaker@halff.com](mailto:JBaker@halff.com)
  - Jack Young – [JYoung@halff.com](mailto:JYoung@halff.com)
  - Jarred Overbey – [JOverbey@halff.com](mailto:JOverbey@halff.com)
  - Samuel Amoako-Atta – [SAmoako-Atta@halff.com](mailto:SAmoako-Atta@halff.com)
- FEMA:
  - Alan Johnson – [Alan.Johnson@fema.dhs.gov](mailto:Alan.Johnson@fema.dhs.gov)
- TWDB / TNRIS:
  - Manuel Razo – [Manuel.Razo@twdb.texas.gov](mailto:Manuel.Razo@twdb.texas.gov)
  - Michael Segner – [Michael.Segner@twdb.texas.gov](mailto:Michael.Segner@twdb.texas.gov)



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## Appendix IV: Resources



## Watershed Follow-up Points of Contact

Subject/Topic of Interest	Name	Contact Information
FEMA Region 6 Risk MAP Lead <i>Project Manager</i>	Alan Johnson Risk Analysis Branch FEMA Region 6	Phone: 940-898-5171 Email: <a href="mailto:alan.johnson@fema.dhs.gov">alan.johnson@fema.dhs.gov</a>
FEMA Technical Monitor	Jennifer Knecht Risk Analysis Branch FEMA Region 6	Phone: (940) 898-5553 Email: <a href="mailto:jennifer.knecht@fema.dhs.gov">jennifer.knecht@fema.dhs.gov</a>
<ul style="list-style-type: none"> <li>• Floodplain Management</li> <li>• Floodplain Ordinance</li> <li>• Community Assistance Visits</li> <li>• Higher Standards</li> </ul>	John Bowman	Phone: 940-898-5556 Email: <a href="mailto:john.bowman@fema.dhs.gov">john.bowman@fema.dhs.gov</a>
<ul style="list-style-type: none"> <li>• Community Rating System</li> <li>• Flood Insurance</li> </ul>	Jonathan Smith	Phone: 228-235-6506 Email: <a href="mailto:jsmith@iso.com">jsmith@iso.com</a>
<ul style="list-style-type: none"> <li>• How to find and read FIRMs</li> <li>• Letters of Map Change and Elevation Certificates</li> <li>• Flood zone disputes</li> <li>• Mandatory insurance purchase guidelines</li> <li>• Map Service Center (MSC) and National Flood Hazard Layer</li> </ul>	FEMA Map Information eXchange (FMIX)	Phone: 877-FEMA-MAP (336.2627) Email: <a href="mailto:FEMAMapSpecialist@riskmapcds.com">FEMAMapSpecialist@riskmapcds.com</a> Live Chat: <a href="https://www.floodmaps.fema.gov/fhm/fmx_main.html">https://www.floodmaps.fema.gov/fhm/fmx_main.html</a>

## State Partners

Organization/Title	Name	Partner Location	Contact Information
Texas Water Development Board (TWDB)  State NFIP Coordinator	Michael Segner, CFM	P.O. Box 13231 Austin, TX 78711	Phone: 512-463-3509 Email: <a href="mailto:michael.segner@twdb.texas.gov">michael.segner@twdb.texas.gov</a> Web Page: <a href="http://www.twdb.texas.gov">http://www.twdb.texas.gov</a>
Texas Division of Emergency Management (TDEM)  State Hazard Mitigation Officer	David Jackson	P.O. Box 4087 Austin, TX 78773	Phone: 512-424-7820 Email: <a href="mailto:David.Jackson@dps.texas.gov">David.Jackson@dps.texas.gov</a> Web Page: <a href="http://www.dps.texas.gov/dem/">http://www.dps.texas.gov/dem/</a>
North Central Texas Council of Governments (NCTCOG) <i>Environment &amp; Development Director</i>	Edith Marvin, P.E., CFM	616 Six Flags Drive Arlington, TX 76005	Phone: 817-695-9211 Email: <a href="mailto:emarvin@nctcog.org">emarvin@nctcog.org</a> Web Page: <a href="http://www.nctcog.org/envir/index.asp">http://www.nctcog.org/envir/index.asp</a>
North Central Texas Council of Governments (NCTCOG) <i>Environment &amp; Development Planner</i>	Kori Mullen	616 Six Flags Drive Arlington, TX 76005	Phone: 817-695-9215 Email: <a href="mailto:kmullen@nctcog.org">kmullen@nctcog.org</a> Web Page: <a href="http://www.nctcog.org/envir/index.asp">http://www.nctcog.org/envir/index.asp</a>
North Central Texas Council of Governments (NCTCOG) <i>Environment &amp; Development Planner</i>	Mia Brown, CFM	616 Six Flags Drive Arlington, TX 76005	Phone: 817-695-9227 Email: <a href="mailto:mabbrown@nctcog.org">mabbrown@nctcog.org</a> Web Page: <a href="http://www.nctcog.org/envir/index.asp">http://www.nctcog.org/envir/index.asp</a>

## Texas Water Development Board

<http://www.twdb.texas.gov/>

Louisiana is a high-risk state for emergency events and disasters. The Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) is the agency responsible for coordinating the state's efforts throughout the emergency management cycle to prepare for, prevent where possible, respond to, recover from, and mitigate against hazards to lessen the effects of man-made or natural disasters that threaten the state. GOHSEP can save lives and reduce property damage by understanding risks and taking action to address those risks, as well as minimizing disaster impacts and increasing the resiliency in our communities, environment, and economy.



## North Central Texas Council of Governments

<http://nctcog.org/>

The North Central Texas Council of Governments (NCTCOG) is a voluntary association of, by and for local governments, established to assist local governments in planning for common needs, cooperating for mutual benefit, and coordinating sound regional development. Serving a 16-county region of North Central Texas, NCTCOG is centered around the two urban centers of Dallas and Fort Worth. NCTCOG has over 230 member governments including 16 counties, numerous cities, school districts, and special districts. NCTCOG has been a Cooperating Technical Partner (CTP) with FEMA since 2004. From providing critical Light Detection and Ranging (LiDAR) data for Map Modernization (Map Mod) activities to offering up-to-date floodplain management training for floodplain managers and community leaders in the region, NCTCOG has served as a key stakeholder for risk reduction in North Texas.



### **NCTCOG FLOOD INFORMATION AND RESOURCES**

NCTCOG is a proactive agency that has a long history of supporting floodplain management activities in the region. NCTCOG led and implemented new strategies over the past decades such as the Corridor Development Certificate for local floodplain permit decision making along the Trinity River Corridor since 1993. NCTCOG has been a Cooperating Technical Partner (CTP) with FEMA since 2004. From providing critical LiDAR data for map modernization activities to offering up-to-date floodplain management training for floodplain managers and community leaders in the region, NCTCOG has served as a key stakeholder for risk reduction in North Texas.

NCTCOG and TWDB worked hard to integrate our efforts with FEMA's Coordinated Needs Management Strategy (CNMS) to ensure that the work aligned with FEMA's Risk MAP goals and procedures.

### **POINTS OF CONTACT:**

Edith Marvin  
Director of Environment & Development  
**Phone:** (817) 695-9211  
**Fax:** (817) 640-7806  
**Email:** [emarvin@nctcog.org](mailto:emarvin@nctcog.org)



Mia Brown  
Planner II  
**Phone:** (817) 695-9227  
**Email:** [mbrown@nctcog.org](mailto:mbrown@nctcog.org)

Kori Mullen  
Planner I  
**Phone:** (817) 695-9215  
**Email:** [kmullen@nctcog.org](mailto:kmullen@nctcog.org)

## Texas Floodplain Management Association (TFMA)

The Texas Floodplain Management Association (TFMA) is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program (NFIP), flood preparedness, warning and disaster recovery. The Association has become a respected voice in floodplain management practice and policy in Texas. The Association includes flood hazard specialists from local, state, and Federal government; the mortgage, insurance and research communities; and the associated fields of flood zone determination, engineering, hydraulic forecasting, emergency response, water resources, geographic information systems, and others.

Organization	Contact Information	Website
Texas Floodplain Management Association	Phone: 512-260-1366	<a href="http://www.tfma.org">http://www.tfma.org</a>

## Certified Floodplain Manager (CFM) Certification

The Association of State Floodplain Managers (ASFPM) established a national program for certifying floodplain managers. This program recognizes continuing education and professional development that enhances the knowledge and performance of local, state, Federal, and private-sector floodplain management professionals.

The role of the nation's floodplain managers is expanding due to increases in disaster losses, the emphasis on mitigation to alleviate the cycle of damage-rebuild-damage, and a recognized need for professionals to adequately address these issues. This certification program will lay the foundation for ensuring that highly qualified individuals are available to meet the challenge of breaking the damage cycle and stopping its negative drain on the nation's human, financial, and natural resources.

CFM® is a registered trademark and available only to individuals certified and in good standing under the ASFPM Certified Floodplain Manager Program.

For more information, you may want to review these available CFM Awareness Videos:

- [What is the CFM Program?](#)
- [Who can be a CFM?](#)
- [What are the Benefits of a CFM?](#)

Study materials for those interested in applying for the CFM certification can be found on the ASFPM Website at: <http://www.floods.org/index.asp?menuID=215>

Check the [calendar on TFMA's website](#) for in-person training sessions near you.

For information on becoming a member and the exam application process in the State of Texas visit <http://www.tfma.org/?page=Renewal>.

## Interactive Preliminary Data Viewer ([maps.riskmap6.com](http://maps.riskmap6.com))

To support community review of the study information and promote risk communication efforts, FEMA launched an interactive web tool accessible on-line at <http://maps.RiskMAP6.com> for the project areas.

For more information on the Interactive Preliminary Data Viewer, refer to the Region 6 Fact sheet: [What is your Flood Risk?](#)

## Estimated Base Flood Elevation (BFE) Viewer

As a part of the Risk MAP process, FEMA is completing **Base Level Engineering (BLE)** to provide a complete picture of flood hazard throughout a watershed. The BLE analysis uses high resolution ground elevation data, flood flow calculations, and fundamental engineering modeling techniques to define flood extents for streams.

To provide a look at BLE data availability and relative engineering analysis, FEMA developed the **Estimated BFE Viewer** for community officials, property owners, and land developers to identify the flood risk (high, moderate, low), expected flood elevation, and estimated flood depth near any property or structure within watersheds where BLE has been prepared.

Visit the Estimated BFE Viewer (<https://apps.femadata.com/estbfe>) application to learn the status of BLE in your area of interest or surrounding communities, to view the flood hazard data developed, or to utilize the tool's flood risk reporting features for a location where BLE has been made available.

## Map Service Center – Available Map Data

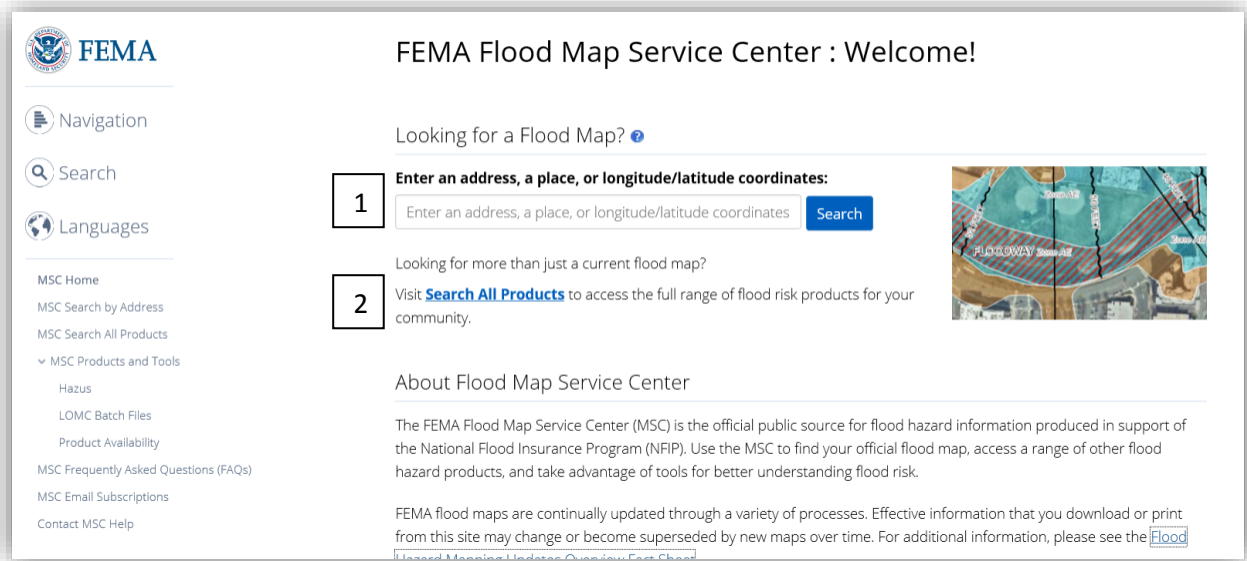
The [FEMA Flood Map Service Center \(MSC\)](#) is the official public source for flood hazard information produced in support of the NFIP. Use the MSC to find your official effective flood map, preliminary flood maps, and access a range of other flood hazard products.

FEMA flood maps are continually updated through a variety of processes. Effective information that you download or print from this site may change or become superseded by new maps over time. For additional information, please see the [Flood Hazard Mapping Updates Overview Fact Sheet](#).

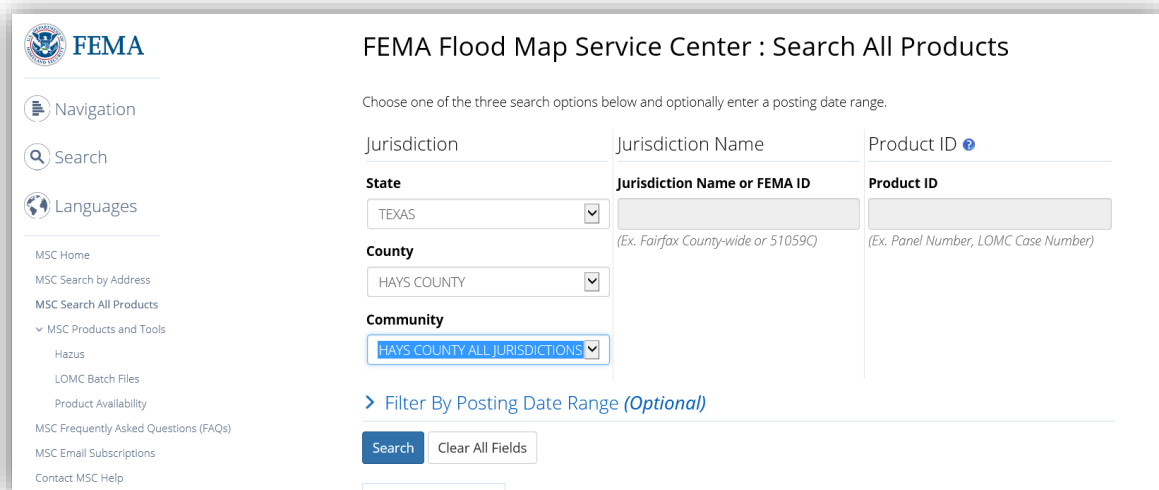
At the MSC, there are two ways to locate flood maps in your vicinity.

1. Enter an address, place name, or latitude/longitude coordinates and click search. This will provide the current effective FIRM panel where the location is shown.
2. Or [Search All Products](#), which will provide access to the full range of flood risk information available.



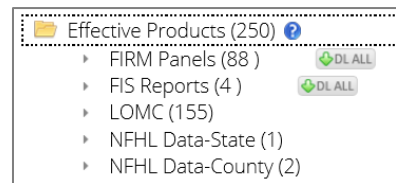


By using the more advanced search option, “Search All Products,” users may access current, preliminary, pending, and historic flood maps. Additionally, GIS data and flood risk products may be accessed through the site with these few steps.

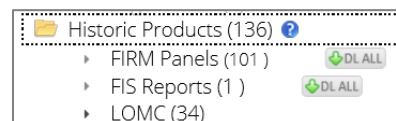


Using the pull down menus, select your state, county, and community of interest. For this example, we selected Hays County - All Jurisdictions. After the search button is selected, the MSC will return all items in the area. There are five types of data available.

**Effective Products.** The current effective FIS, FIRM, and DFIRM database (if available) is available through the MSC. If users click on the available effective products, they are presented a breakdown of the available products. FIRM panels, FIS reports, LOMRs, statewide National Flood Hazard Layer (NFHL) data, and countywide NFHL data may be available, as indicated in the breakdown on the right of the page.



**Historic Products.** A range of historic flood hazard maps, FIS texts, and Letters of Map Change are available through the MSC.



**Flood Risk Products.** The Flood Risk Report, Flood Risk Map, and Flood Risk Database will be made available through the MSC once they have been compiled and completed. These products are made available after the flood study analysis and mapping have been reviewed and community comments incorporated.



