Appendix I: Community-Specific Reports

The following list depicts the county and community-specific reports contained within this appendix.

CID	Community	*Total Community Population[1]*	Percent of Population in Study watershed	Total Community Land Area (sq. mi)	Percent of Land Area in Study watershed	NFIP Participant
481078	Archer County	8,560	12%	925.2	12%	Yes
480742	Clay County	10,444	11%	1110.4	11%	Yes
480939	Montague County	19,640	15%	935.7	15%	Yes
480481	Town of Bowie	5,448	99%	5.5	99%	Yes
480377	Jack County	8,472	26%	920.2	26%	Yes
480378	City of Jacksboro	4,184	100%	4.5	100%	Yes
480520	Parker County	138,447	10%	906.1	10%	Yes
480969	City of Reno	2,878	100%	13.0	100%	Yes
481285	Town of Sanctuary	337	100%	0.9	100%	Yes
480521	Town of Springtown	3,064	100%	3.0	100%	Yes
480582	Tarrant County	420,861	6%	903.6	6%	Yes
480584	City of Azle	13,369	99%	8.9	99%	Yes
480596	City of Fort Worth	918,915	2%	345.1	2%	Yes
481653	City of Pelican Bay	2,049	100%	0.8	100%	Yes
481051	Wise County	67,884	70%	922.4	70%	Yes
481617	Town of Alvord	1,351	100%	1.5	100%	No
481561	City of Aurora	1,390	100%	3.8	100%	Yes
480676	Town of Boyd	1,416	100%	4.1	100%	Yes
480677	City of Bridgeport	5,923	100%	7.7	100%	Yes
481053	Town of Chico	946	100%	1.5	100%	Yes
480678	City of Decatur	6,538	69%	8.8	69%	Yes
481616	City of Lake Bridgeport	339	100%	0.4	100%	Yes
481629	City of Rhome	1,386	9%	15.8	9%	Yes
481126	City of New Fairview	1,096	100%	0.8	100%	Yes
480503	City of Newark	475	100%	2.0	100%	Yes
481054	City of Paradise	1,630	80%	5.3	80%	Yes

CID	Community	*Total Community Population[1]*	Percent of Population in Study watershed	Total Community Land Area (sq. mi)	Percent of Land Area in Study watershed	NFIP Participant
481618	City of Runaway Bay	1,546	100%	7.2	100%	Yes
480684	Young County	17,867	12%	930.4	12%	Yes
[1]2020 United States Census Bureau Population Estimate						

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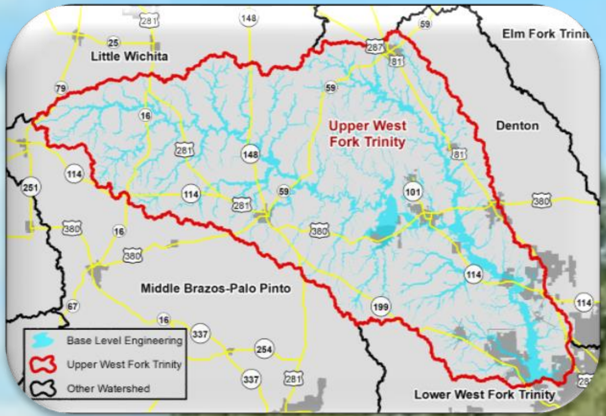
UPPER WEST FORK TRINITY WATERSHED

KNOW YOUR RISK



1,956
sq. mi.
Land area in the study watershed

168,701
Population based on 2020 Census data in the study watershed

20.6% expected population growth predicted from 2020-2030 in the community

95
policies totaling approximately $2,389,921.84 in coverage

86
claims submitted to NFIP in the watershed

$12,204,100
total paid on claims in the watershed

10.8%
Average years since last effective FIRM*

27 communities participating in the National Flood Insurance Program

CNMS Studies Stream Miles in the study watershed
2,482.8

Percentage of stream miles which are detailed study in the study watershed
5.4%

72
Major Flood Events in the study watershed

*National Flood Hazard Layer (NFHL)

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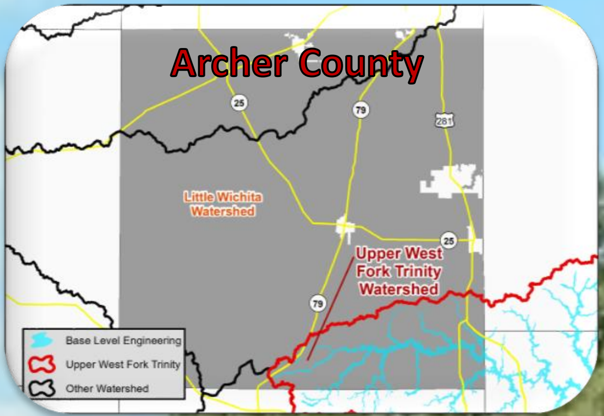
ARCHER COUNTY

KNOW YOUR RISK



107.8 sq. mi.
of the community's land area is in the study watershed

997
Population based on 2020 Census data in the study watershed

-5.5% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the County

10.3%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
101.1

There are no detailed study stream miles in the study watershed
N/A

2
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

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ARCHER COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **June 29, 2025.**

The hazard mitigation goals identified projects for:

- Adopt on-site retention basin program in conjunction with development to address excessive stormwater/firefighting water source
- Acquire and install generators with hard wired quick connections at all critical facilities
- Develop and implement options to improve access and/or add redundant access routes in high-risk areas

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. 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. HMGP and PDM allow for the funding of generators at critical facilities. HMGP also offers funding for post disaster code enforcement, including debris removal strategies. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information.

Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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/.

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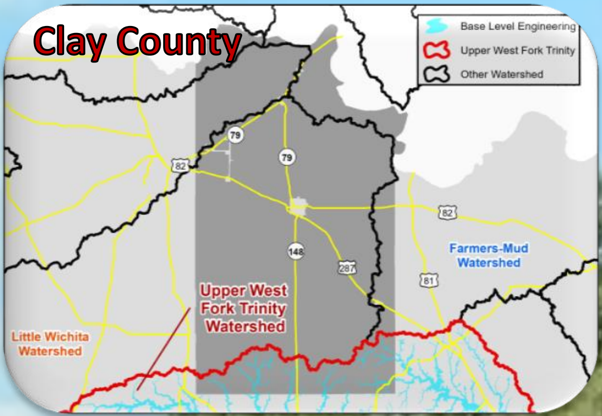
CLAY COUNTY

KNOW YOUR RISK



123 sq. mi.
of the community's land area is in the study watershed

1,168
Population based on 2020 Census data in the study watershed

95.3% expected population growth predicted from 2020-2030 in the community

2
policies totaling approximately $38,799.65 in coverage

2
claims submitted to NFIP in the community

$90,000
total paid on claims in the County

0%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
82.4

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CLAY COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **August 23, 2025.**

The hazard mitigation goals identified projects for:

- Acquire and install generators with hard wired quick connections at all critical facilities
- Obtain certification in the National Weather Service StormReady Program
- Implement and enhance an area-wide telephone Emergency Notification System ("Reverse 911")
- Upgrade undersized stormwater drains and culverts

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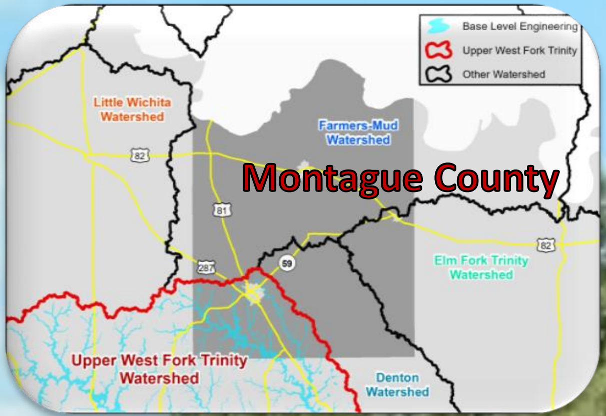
MONTAGUE COUNTY

KNOW YOUR RISK



141 sq. mi.
of the community's land area is in the study watershed

2,989
Population based on 2020 Census data in the study watershed

89.2% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the County

20%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
180.9

Percentage of stream miles which are detailed study in the study watershed
8.6%

5
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

MONTAGUE COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **August 24, 2025.**

The hazard mitigation goals identified projects for:

- Adopt and implement a program for clearing debris from bridges, drains, and culverts
- Develop alternative evacuation routes/plans and designate emergency thoroughfares, particularly in areas with limited capacity
- Harden/retrofit critical facilities to hazard-resistant levels
- Restrict future development in high-risk areas

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. There may be eligibility, benefit cost analysis, and cost-share requirements. HMGP also offers funding for post disaster code enforcement, including debris removal strategies. The 5% Initiative in the HMGP and PDM allow for the funding of generators at critical facilities. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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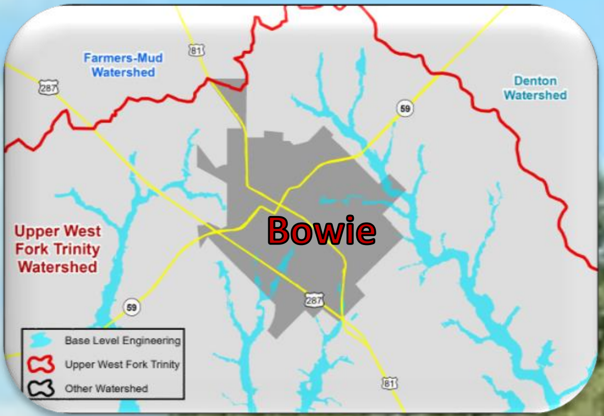
TOWN OF BOWIE

KNOW YOUR RISK



5.5 sq. mi.

of the community's land area is in the study watershed

5,399

Population based on 2020 Census data in the study watershed

3.5% expected population growth predicted from 2020-2030 in the community

0

policies totaling approximately $0 in coverage

0

claims submitted to NFIP in the community

$0

total paid on claims in the City

100%

Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed

1.9

There are no detailed study stream miles in the study watershed

N/A

6

Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

TOWN OF BOWIE

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **August 24, 2025.**

The hazard mitigation goals identified projects for:

- Adopt and implement a program for clearing debris from bridges, drains, and culverts
- Develop alternative evacuation routes/plans and designate emergency thoroughfares, particularly in areas with limited capacity
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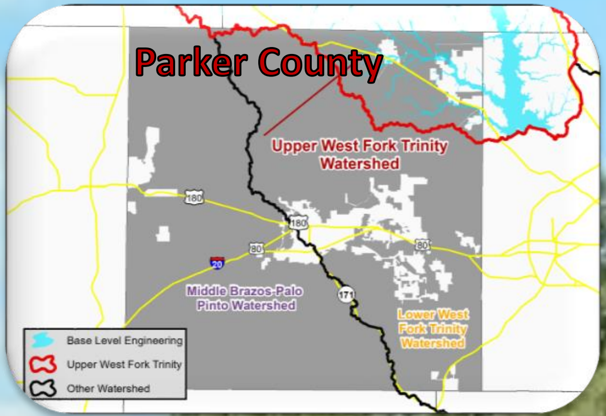
PARKER COUNTY

KNOW YOUR RISK



82.3 sq. mi.
of the community's land area is in the study watershed

13,924
Population based on 2020 Census data in the study watershed

13.6% expected population growth predicted from 2020-2030 in the community

5
policies totaling approximately $702,999.17 in coverage

3
claims submitted to NFIP in the community

$188,000
total paid on claims in the County

5.5%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
94.3

Percentage of stream miles which are detailed study in the study watershed
2.1%

6
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

PARKER COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **May 4, 2026.**

The hazard mitigation goals identified projects for:

- Increase the capacity of the storm drainage system at low water crossings and other areas where water collects by installing larger culverts and adding drainage points along vulnerable or critical roads
- Become a NFIP Community Rating System (CRS) participant
- Develop and implement a public awareness campaign to educate residents about hazard risks and personal mitigation actions

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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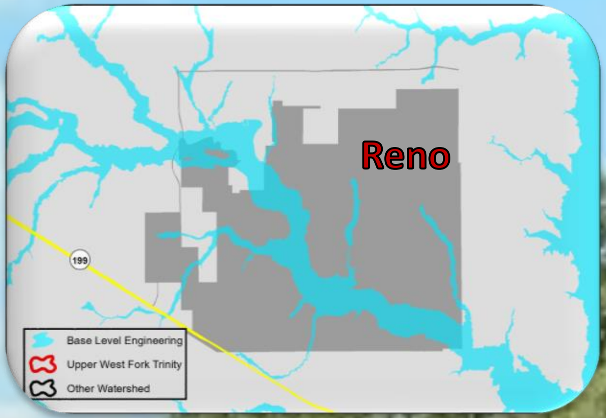
CITY OF RENO

KNOW YOUR RISK



13
sq. mi.
of the community's land area is in the study watershed

2,878
Population based on 2020 Census data in the study watershed

15.4% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the County

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
9.2

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF RENO

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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

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TOWN OF SANCTUARY

KNOW YOUR RISK

0.86
sq. mi.
of the community's land area is in the study watershed

337
Population based on 2020 Census data in the study watershed

2.4% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

RiskMAP
Increasing Resilience Together

TOWN OF SANCTUARY

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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TOWN OF SPRINGTOWN

KNOW YOUR RISK

3 sq. mi.
of the community's land area is in the study watershed

3,064
Population based on 2020 Census data in the study watershed

15.3% expected population growth predicted from 2020-2030 in the community

16
policies totaling approximately $54,974.47 in coverage

5
claims submitted to NFIP in the community

$879,700
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
5.2

Percentage of stream miles which are detailed study in the study watershed
86.5%

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

TOWN OF SPRINGTOWN

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **May 4, 2026.**

The hazard mitigation goals identified projects for:

- Increase the capacity of the storm drainage system at low water crossings and other areas where water collects by installing larger culverts and adding drainage points along vulnerable or critical roads
- Become a NFIP Community Rating System (CRS) participant
- Develop and implement a public awareness campaign to educate residents about hazard risks and personal mitigation actions

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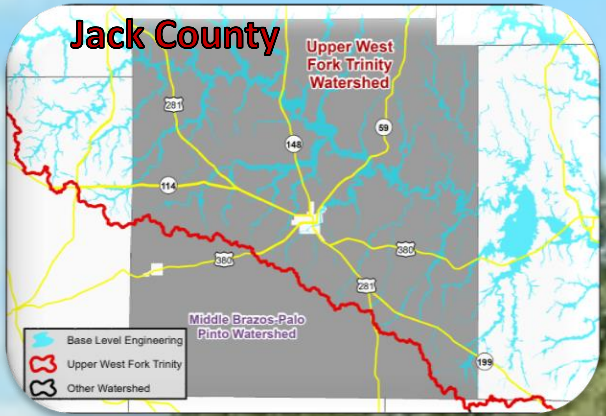
JACK COUNTY

KNOW YOUR RISK



654.8
sq. mi.
of the community's land area is in the study watershed

2,170
Population based on 2020 Census data in the study watershed

58.5% expected population growth predicted from 2020-2030 in the community

4
policies totaling approximately $148,279.53 in coverage

3
claims submitted to NFIP in the community

$500,000
total paid on claims in the County

77.3%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
676.4

Percentage of stream miles which are detailed study in the study watershed
91.7%

4
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

JACK COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **August 24, 2025.**

The hazard mitigation goals identified projects for:

- Require standards for burial of electrical, telephone, cable lines and other utilities in new developments
- Upgrade undersized stormwater drains and culverts
- Undertake an initiative to increase the number of flood insurance policies
- Flood-proof sewage treatment plans in flood hazard/low-lying areas

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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 JACKSBORO

KNOW YOUR RISK

4.5 sq. mi.
of the community's land area is in the study watershed

4,184
Population based on 2020 Census data in the study watershed

-7.3% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
11.1

Percentage of stream miles which are detailed study in the study watershed
41.4%

4
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF JACKSBORO

TAKE ACTION: Potential Next Step

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The hazard mitigation goals identified projects for:

- Require standards for burial of electrical, telephone, cable lines and other utilities in new developments
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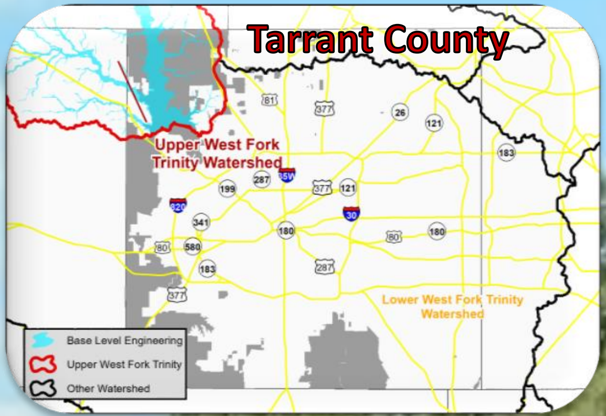
3. https://www.twdb.texas.gov/financial/programs/.

RiskMAP
Increasing Resilience Together

TARRANT COUNTY

KNOW YOUR RISK



51.3 sq. mi.
of the community's land area is in the study watershed

23,872
Population based on 2020 Census data in the study watershed

16.7% expected population growth predicted from 2020-2030 in the community

16
policies totaling approximately $252,208.44 in coverage

26
claims submitted to NFIP in the community

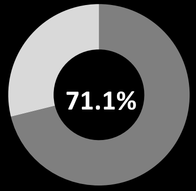
$3,532,141
total paid on claims in the County

42.4%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
95.9

Percentage of stream miles which are detailed study in the study watershed



2
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

TARRANT COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **March 22, 2025.**

The hazard mitigation goals identified projects for:

- Evaluate the effectiveness of past mitigation projects to determine if follow up on actions are necessary
- Research and distribute to all stakeholder's current data related to the condition of an hazards associated with the city's dams
- Conduct NFIP community workshops to provide information and incentives for property owners to acquire flood insurance

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

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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/.

RiskMAP
Increasing Resilience Together

CITY OF AZLE

KNOW YOUR RISK

8.9
sq. mi.
of the community's land area is in the study watershed

13,222
Population based on 2020 Census data in the study watershed

22.1% expected population growth predicted from 2020-2030 in the community

10
policies totaling approximately $222,865.14 in coverage

16
claims submitted to NFIP in the community

$2,098,714
total paid on claims in the City

43.2%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
10.8

Percentage of stream miles which are detailed study in the study watershed
48.1%

4
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF AZLE

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **March 22, 2025.**

The hazard mitigation goals identified projects for:

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- Conduct NFIP community workshops to provide information and incentives for property owners to acquire flood insurance

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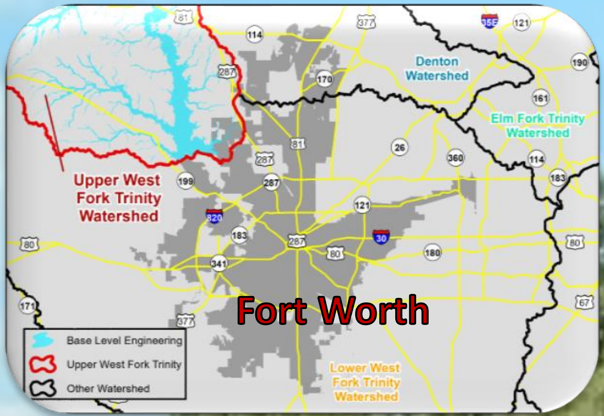
3. https://www.twdb.texas.gov/financial/programs/.

RiskMAP
Increasing Resilience Together

CITY OF FORT WORTH

KNOW YOUR RISK



8.5 sq. mi.
of the community's land area is in the study watershed

22,678
Population based on 2020 Census data in the study watershed

23.4% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

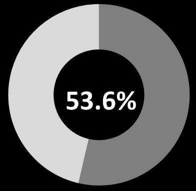
$0
total paid on claims in the City

0.1%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
6.9

Percentage of stream miles which are detailed study in the study watershed



1
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF FORT WORTH

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **March 22, 2025.**

The hazard mitigation goals identified projects for:

- Evaluate the effectiveness of past mitigation projects to determine if follow up on actions are necessary
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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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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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/.

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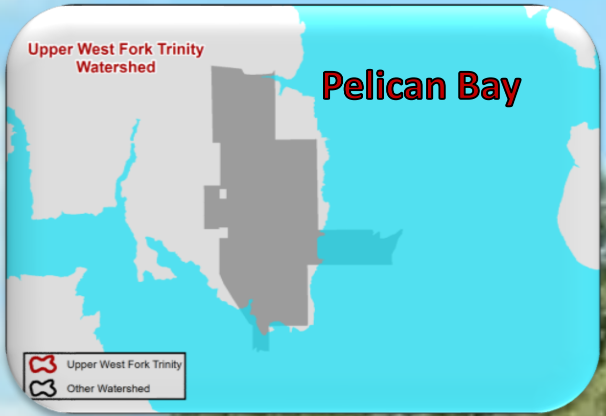
Increasing Resilience Together

CITY OF PELICAN BAY

KNOW YOUR RISK



0.8 sq. mi.
of the community's land area is in the study watershed

2,049
Population based on 2020 Census data in the study watershed

32.4% expected population growth predicted from 2020-2030 in the community

1
policy totaling approximately $15.933.52 in coverage

3
claims submitted to NFIP in the community

$428,046
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0

There are no detailed study stream miles in the study watershed
N/A

2
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF PELICAN BAY

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

Texas Water Development Board's[4] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

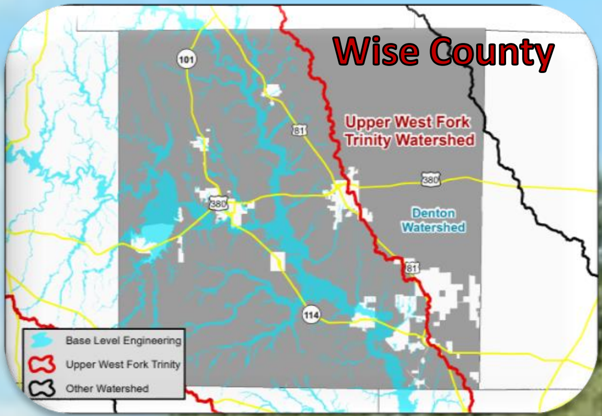
The minimum requirements for floodplain regulations are outlined in 44 Code of Federal Regulations 60.3, and local communities may choose to adopt more restrictive codes. FEMA Regional Office VI offers assistance in developing stricter codes, such as regulating construction or elevational changes in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

1. https://www.fema.gov/hazard-mitigation-assistance.
2. https://www.dps.texas.gov/dem/downloadableforms.htm#hmgpgrants.
3. https://www.fema.gov/national-flood-insurance-program-community-rating-system
4. https://www.twdb.texas.gov/financial/programs/.

RiskMAP
Increasing Resilience Together

WISE COUNTY

KNOW YOUR RISK



598.4 sq. mi.
of the community's land area is in the study watershed

47,194
Population based on 2020 Census data in the study watershed

27.0% expected population growth predicted from 2020-2030 in the community

16
policies totaling approximately $578,416.69 in coverage

3
claims submitted to NFIP in the community

$1,944,533
total paid on claims in the County

77.6%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
912.3

Percentage of stream miles which are detailed study in the study watershed
2.1%

27
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

WISE COUNTY

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
- Develop a buyout program for repetitive flood loss areas within the county

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

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RiskMAP
Increasing Resilience Together

TOWN OF ALVORD

KNOW YOUR RISK

1.5
sq. mi.
of the community's land area is in the study watershed

1,351
Population based on 2020 Census data in the study watershed

1.3% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

0%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Not participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
1.3

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

TOWN OF ALVORD

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
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Texas Water Development Board's[4] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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

RiskMAP
Increasing Resilience Together

CITY OF AURORA

KNOW YOUR RISK

3.8 sq. mi.
of the community's land area is in the study watershed

1,390
Population based on 2020 Census data in the study watershed

13.9% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF AURORA

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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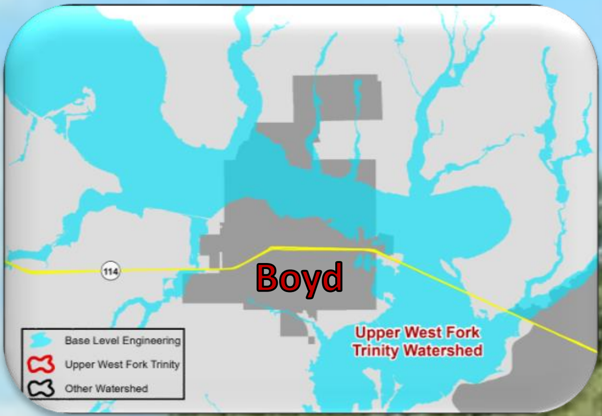
3. https://www.fema.gov/national-flood-insurance-program-community-rating-system
4. https://www.twdb.texas.gov/financial/programs/.

RiskMAP
Increasing Resilience Together

TOWN OF BOYD

KNOW YOUR RISK



4.1 sq. mi.

of the community's land area is in the study watershed

1,416

Population based on 2020 Census data in the study watershed

17.3% expected population growth predicted from 2020-2030 in the community

0

policies totaling approximately $0 in coverage

0

claims submitted to NFIP in the community

$0

total paid on claims in the City

100%

Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed

4.9

There are no detailed study stream miles in the study watershed

N/A

4

Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

TOWN OF BOYD

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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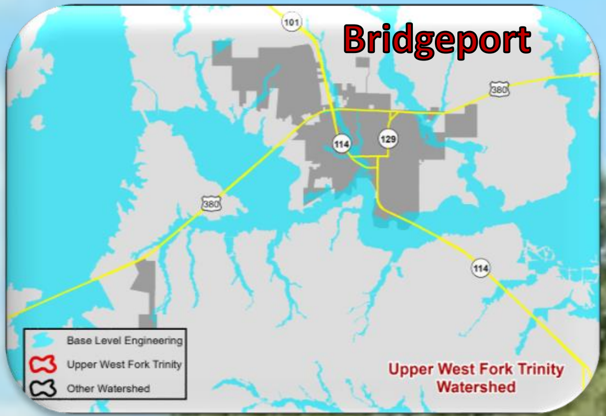
3. https://www.fema.gov/national-flood-insurance-program-community-rating-system
4. https://www.twdb.texas.gov/financial/programs/.

CITY OF BRIDGEPORT

KNOW YOUR RISK



7.7 sq. mi.
of the community's land area is in the study watershed

5,923
Population based on 2020 Census data in the study watershed

6.2% expected population growth predicted from 2020-2030 in the community

6
policies totaling approximately $75,857.46 in coverage

4
claims submitted to NFIP in the community

$551,800
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
7.8

Percentage of stream miles which are detailed study in the study watershed
30.8%

2
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF BRIDGEPORT

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
- Develop a buyout program for repetitive flood loss areas within the county

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

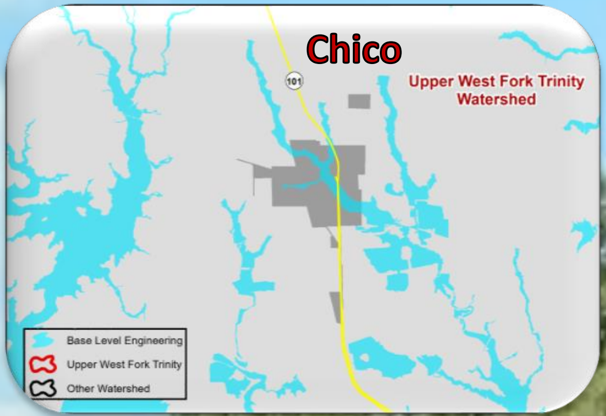
Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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 CHICO

KNOW YOUR RISK



1.5
sq. mi.
of the community's land area is in the study watershed

946
Population based on 2020 Census data in the study watershed

-5.6% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0.7

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

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TOWN OF CHICO

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
- Develop a buyout program for repetitive flood loss areas within the county

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

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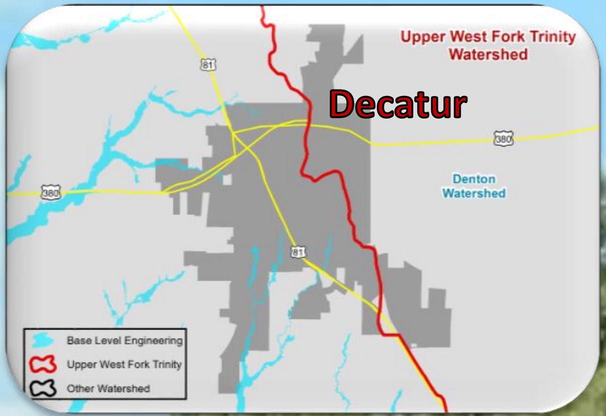
CITY OF DECATUR

KNOW YOUR RISK



6 sq. mi.
of the community's land area is in the study watershed

4,518
Population based on 2020 Census data in the study watershed

8.2% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

79.4%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
6.7

There are no detailed study stream miles in the study watershed
N/A

4
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF DECATUR

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is **expired.**

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Promote the use of Early Warning Systems
- Educate the public about emergency preparedness
- Create and implement buyout program for structures within the 100-year floodplain

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. 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. HMGP and PDM allow for the funding of generators at critical facilities. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

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CITY OF LAKE BRIDGEPORT

KNOW YOUR RISK

0.4 sq. mi.
of the community's land area is in the study watershed

339
Population based on 2020 Census data in the study watershed

-0.3% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

0%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

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CITY OF LAKE BRIDGEPORT

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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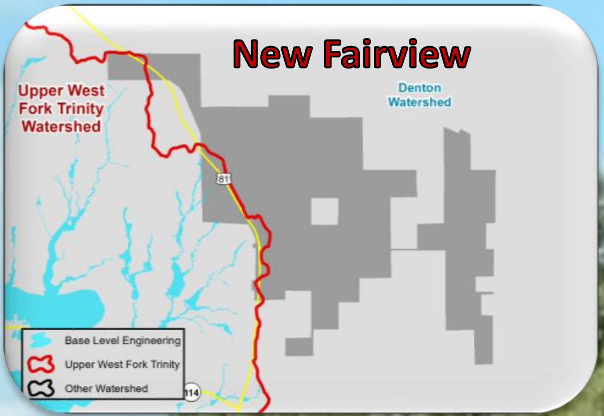
CITY OF NEW FAIRVIEW

KNOW YOUR RISK



1.5 sq. mi.
of the community's land area is in the study watershed

130
Population based on 2020 Census data in the study watershed

10.0% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the City

0.2%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0.5

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF NEW FAIRVIEW

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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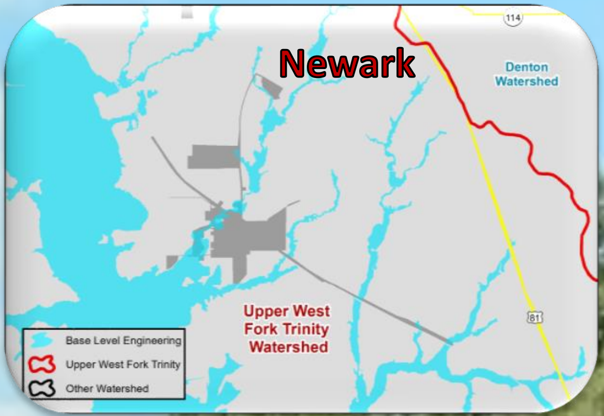
RiskMAP
Increasing Resilience Together

CITY OF NEWARK

KNOW YOUR RISK



0.8 sq. mi.
of the community's land area is in the study watershed

1,096
Population based on 2020 Census data in the study watershed

9.0% expected population growth predicted from 2020-2030 in the community

4
policies totaling approximately $15,956.13 in coverage

5
claims submitted to NFIP in the community

$1,054,800
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
0

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF NEWARK

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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CITY OF PARADISE

KNOW YOUR RISK

2 sq. mi.

of the community's land area is in the study watershed

475

Population based on 2020 Census data in the study watershed

7.6% expected population growth predicted from 2017-2023 in the community

2

policies totaling approximately $242,808 in coverage

2

claims submitted to NFIP in the community

$649,466.67

total paid on claims in the City

N/A

The community does not have FEMA mapped* floodplains

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed

2.3

There are no detailed study stream miles in the study watershed

N/A

0

Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF PARADISE

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
- Develop a buyout program for repetitive flood loss areas within the county

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. 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[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. The State Hazard Mitigation Officer may be contacted for additional information.

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RiskMAP
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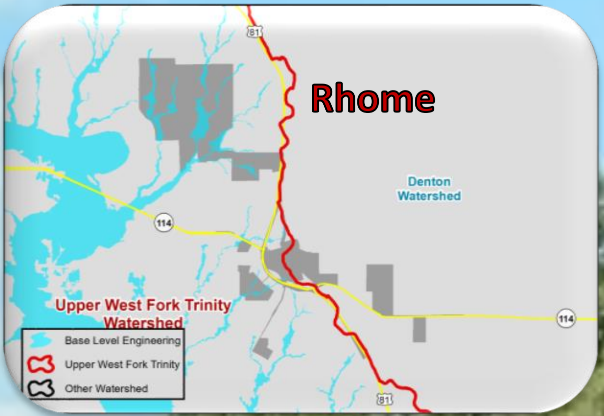
CITY OF RHOME

KNOW YOUR RISK



4.3 sq. mi.

of the community's land area is in the study watershed

1,297

Population based on 2020 Census data in the study watershed

5.0% expected population growth predicted from 2020-2030 in the community

0

policies totaling approximately $0 in coverage

0

claims submitted to NFIP in the community

$0

total paid on claims in the City

80%

Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed

4.2

There are no detailed study stream miles in the study watershed

N/A

0

Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

CITY OF RHOME

TAKE ACTION: Potential Next Step

You do not have a Hazard Mitigation Plan.

The hazard mitigation goals identified projects for:

- Create and adopt a Hazard Mitigation Plan
- Become a NFIP Community Rating System (CRS) participant
- Use Early Warning Systems
- Educate the public on actions to take to prevent or reduce loss of life or property
- Maximize the use of outside sources of funding

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. There may be eligibility, benefit cost analysis, and cost-share requirements. Information about FEMA's HMA grants[1] can be found on our website, as well as on the Texas Department of Public Safety's Emergency Management Forms and Publications[2] website. The State Hazard Mitigation Officer may be contacted for additional information. Participation in FEMA's Community Rating System[3] (CRS) reduces insurance premiums up to 45%, and FEMA will provide free technical assistance in designing and implementing programs designed to reduce flood damage. The State Hazard Mitigation Officer may be contacted for additional information.

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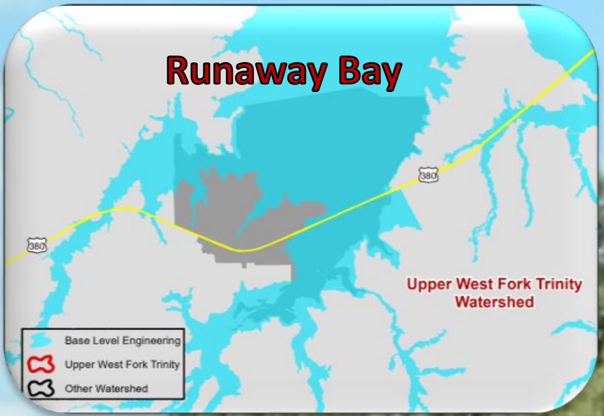
CITY OF RUNAWAY BAY

KNOW YOUR RISK



7.2
sq. mi.
of the community's land area is in the study watershed

1,546
Population based on 2020 Census data in the study watershed

20.2% expected population growth predicted from 2020-2030 in the community

4
policy totaling approximately $10,861.74 in coverage

1
claims submitted to NFIP in the community

$117,000
total paid on claims in the City

100%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
13.4

There are no detailed study stream miles in the study watershed
N/A

1
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

CITY OF RUNAWAY BAY

TAKE ACTION: Potential Next Step

Hazard Mitigation Plan is **in progress.**

The hazard mitigation goals identified projects for:

- Retrofit an existing county structure to serve as a hardened county emergency operations center
- Increase the ability of residents and businesses to receive early warning and hazard information from the National Weather Service
- Create a Storm water Management Plan
- Develop a buyout program for repetitive flood loss areas within the county

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RiskMAP
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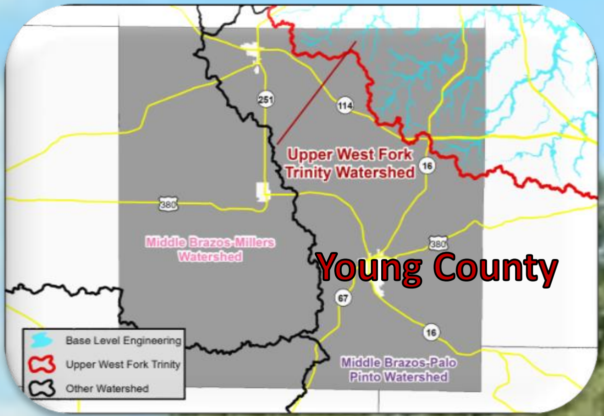
YOUNG COUNTY

KNOW YOUR RISK



112
sq. mi.
of the community's land area is in the study watershed

2,149
Population based on 2020 Census data in the study watershed

-5.2% expected population growth predicted from 2020-2030 in the community

0
policies totaling approximately $0 in coverage

0
claims submitted to NFIP in the community

$0
total paid on claims in the County

6.4%
Of the community's FEMA mapped* 1%-annual-chance storm flood extent areas are in the study watershed

Participating in the National Flood Insurance Program

CNMS Stream Miles in the study watershed
180.1

There are no detailed study stream miles in the study watershed
N/A

0
Major Flood Events in the community

*National Flood Hazard Layer (NFHL)

RiskMAP
Increasing Resilience Together

YOUNG COUNTY

TAKE ACTION: Potential Next Step

Your Hazard Mitigation Plan is set to expire **September 23, 2025.**

The hazard mitigation goals identified projects for:

- Adopt on-site retention basin program in conjunction with development to address excessive stormwater/firefighting water source
- Relocate critical facilities out of high hazard area
- Undertake an initiative to increase the number of flood insurance policies
- Evaluate access and road conditions for response vehicles

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Texas Water Development Board's[3] Flood Protection Planning (FPP) Grant, Clean and Drinking Water State Revolving Fund (CWSRF), and Texas Water Development Fund (DFund) provide additional funding or loans for hazard mitigation planning, Emergency Action plans for High Hazard dams, and other planning studies. Both CWSRF and DFund are long term-fixed interest loans which can be used for acquisition or flood-proofing insured structures, building water quality and green infrastructure.

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/.

Appendix II: Base Level Engineering Reports

Base Level Engineering (BLE)

Archer County, TX
(MIP # 17-06-1172S)
Jack County, TX
(MIP # 17-06-1175S)

STARR Strategic Alliance for Risk Reduction

August 30, 2017

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1. Introduction

1.1. Purpose of Study

As part of FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) project, FEMA Region 6 is continuing to produce large-scale floodplain mapping efforts to provide quality flood and other natural hazard risk data to increase public awareness and achieve mitigation actions to reduce the risk to life and property. The primary of objectives of the Washita and Cache Watersheds in OK Base Level Engineering (BLE) Analysis are as follows:

- Prepare base level engineering (map ready Zone A, no structures) for a complete stream network within the selected HUC4 basin area depicted in support of CNMS validation and non-regulatory product development throughout the study basin.
- Stream network modeling shall be produced in a manner to assist increase of technical creditability throughout the study area
- Grow partnerships and generate support for base level modeling throughout the Region

1.2. Scope of Work

The scope of work includes conduction Base Level Engineering Analysis of Jack and Archer Counties in TX. Figure 1 depicts the study area and scope of work.

- Base level engineering analysis consistent with Guidance for Flood Risk Analysis and Mapping, First Order Approximation, November 2014 (and updates through the date of this report)
- Minimal model refinement to produce Zone A (no structures) analysis in accordance with SID #84
- Delivery of all network H&H models and shape files prepared for the study basin required for model refinement by future mapping partner.
- Produce seamless floodplain coverage of 1-percent and 0.2% annual chance floodplains, stream centerlines and study cross-section within the project area.

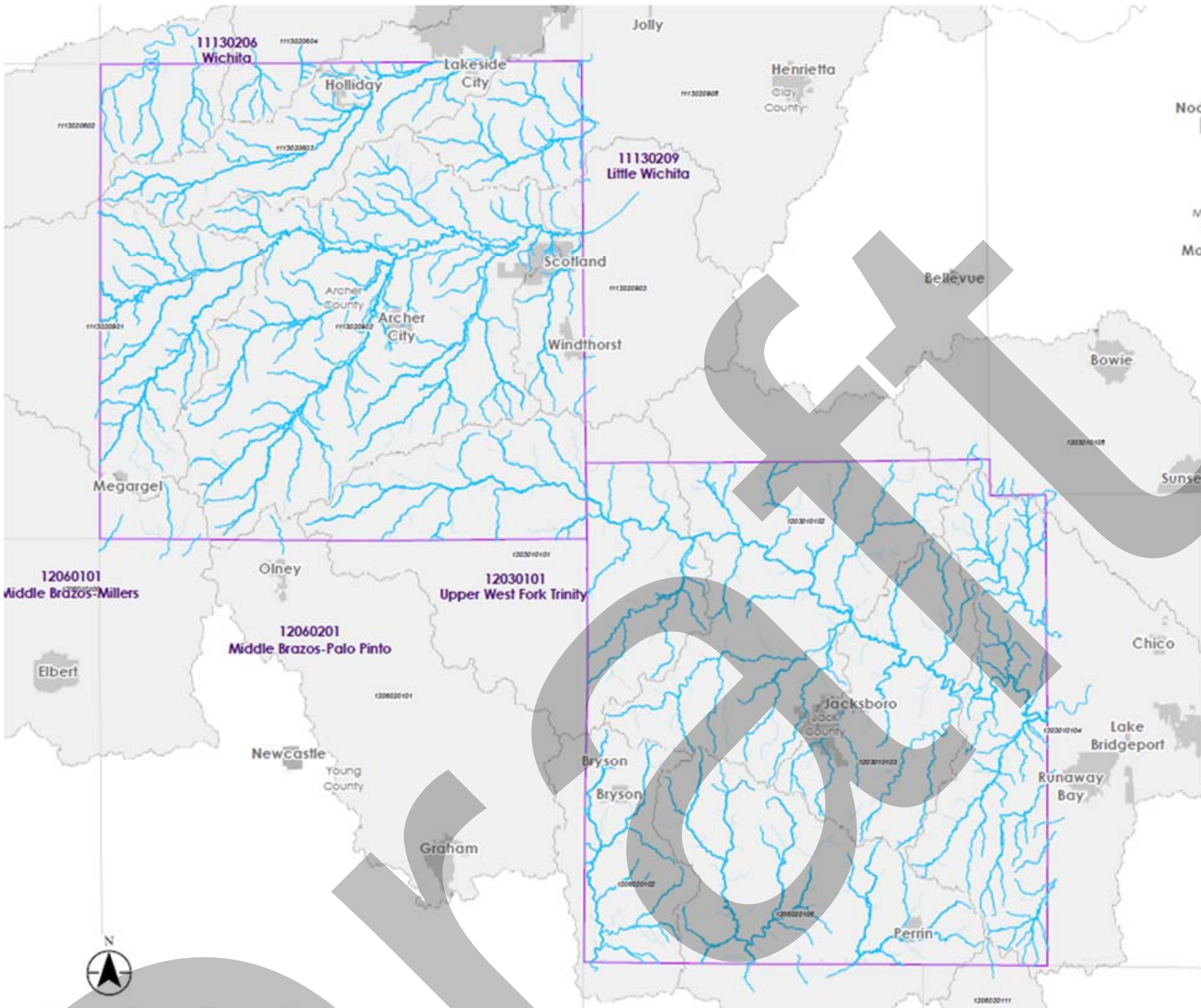


Figure 1: Location and Study Area Map of Jack and Archer Counties, TX

2. Hydrology

STARR II's hydrology process is summarized in a work flow chart and is included as part of Appendix A. Following sections provide details of the hydrology process

The study area was divided into five watersheds for the hydrologic analysis (see Table 1 and Figure 1). These watersheds were extended beyond the study streams in order to capture the upstream drainage areas.

Peak flows for the 10%, 4%, 2%, 1%, 1% plus, 1% minus, and 0.2% events were computed utilizing the published USGS regression equations (Asquith and Roussel, 2009). For each watershed, a grid was generated for each of the regression parameters and each of the flow events described above. Each grid cell has a value for the drainage area and other regression parameters associated with the basin draining to that cell. Due to limited data and to be conservative, the effects of regulation on the flow rates were not included in this analysis.

The primary steps for the development of hydrologic data include:

1. Prepare stream network, hydrologic network, and delineate watersheds

2. Develop gridded input parameters and peak flows from the rural regression equations

The details for each of these steps are included in the following sections.

Table 1.Description of watersheds defined for hydrologic analysis

Watershed Identifier	Description
1113a	Covers four HUC-8 watersheds: 11130204 (North Wichita), 11130205 (South Wichita), 11130206 (Wichita, only to the downstream limit of the study streams), and 11130207 (Southern Beaver)
1113b	Part of the HUC-8 watershed 11130209 (Little Wichita)
1203	Part of the HUC-8 watershed 12030101 (Upper West Fork Trinity)
1206a	Includes small areas in two HUC-8 watersheds: 12060101 (Middle Brazos-Millers) and 12060201 (Middle Brazos-Palo Pinto)
1206b	Part of the HUC-8 watershed 12060201 (Middle Brazos-Palo Pinto)

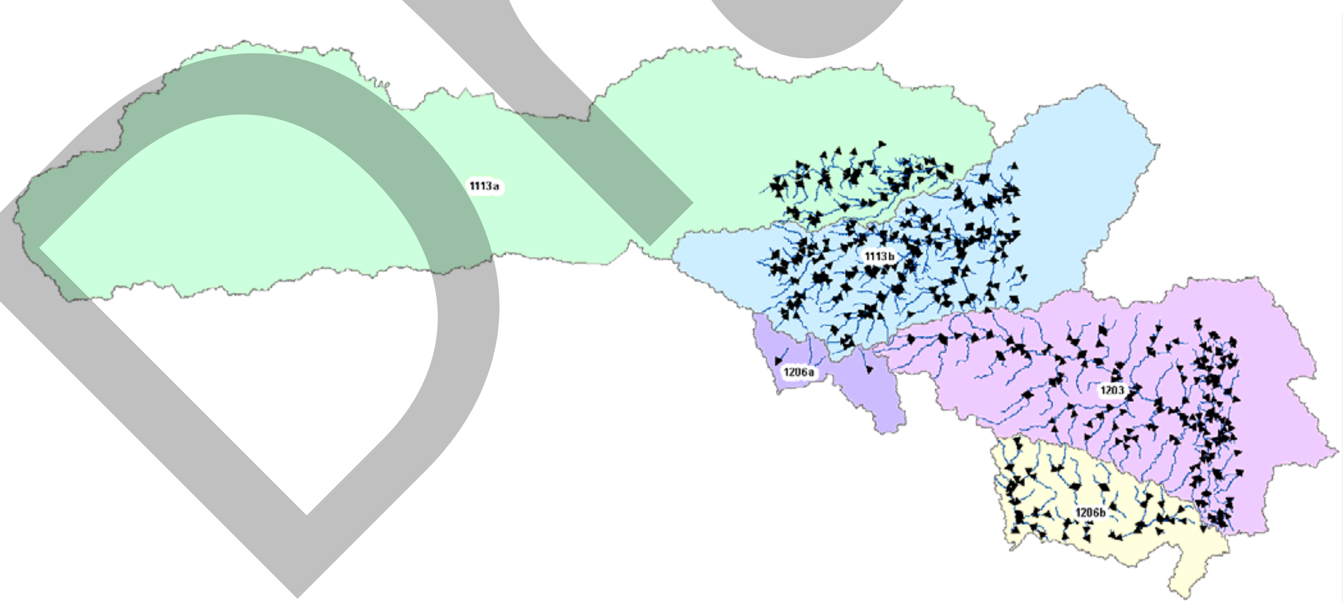


Figure 2: Watersheds defined for hydrologic analysis

2.1. Stream Network Preparation and Watershed Delineation

The stream network was derived from the NHD high-definition flow lines for the watershed and used as a basis for stream centerlines and to develop hydrologic flow paths and drainage basins. The NHD lines are currently available at http://prd-tnm.s3-website-us-west-2.amazonaws.com/?prefix=StagedProducts/Hydrography/ . These features are frequently updated, and the versions used for the project were from about May 2016.

The steps used to develop the stream network, delineate watersheds, and compute drainage areas are listed below:

1. Initially, the approximate contributing basins for those reaches for which hydraulic models are required were identified using NHD Plus (http://www.horizon-systems.com/nhdplus/) flow direction grids and watersheds derived from them. USGS stream gage locations that have drainage area information attached were also used to identify or confirm the size of contributing basins and to identify large streams with contributing flow outside the basin. There were no flows from streams outside of the basins identified in this study.
2. A 30-meter DEM topography sets for the approximate contributing basin was created. These DEMs were extracted from National Elevation Dataset 1/3 arcsecond (about 10 meter) rasters, downloaded from ftp://rockyftp.cr.usgs.gov/vdelivery/Datasets/Staged/Elevation/13/GridFloat. The National Elevation Dataset (NED) 1/3 data as it existed around mid-2014 was used. These were mosaiced as needed and re-projected into USGS Albers North American Datum of 1983 (NAD 83), 30 meter grids to cover the candidate contributing basin. The sampling method during re-projection was bilinear resampling. Note that this DEM is used only to develop hydrologic parameters and will not be used for hydraulic modeling.
3. All NHD high-definition lines that intersected the contributing basins were extracted and the lines classified as coastlines, if any, were deleted.
4. The NHD lines were joined to create the stream network with higher priority given to longer lengths.
5. The stream network was reviewed and modified as follows:
   - Split flow locations were reviewed and the primary flow path identified. The alternate flow paths were deleted from the network.
   - NHD lines classified as canals, underground conduits, and pipelines were removed from the network if they did not correspond to “natural” flow paths or scoped streams (CNMS lines).
   - Streamlines were added where there was no NHD flowline associated with a CNMS line.
6. All streamlines within 50 meters of CNMS lines were reviewed. At locations where the two alignments were noticeably different, the aerial photography and topography were reviewed to determine the correct alignment and the NHD flow line modified if appropriate.
7. The NHD stream network was then used as the basis for the “burn” layer. In the burn process, DEM cells that crossed burn lines were modified to have lower elevations.
8. There were no sinks in the watersheds. So, the DEM was filled to remove depressions so that there were continuous flow paths to the basin outlets.

9. A flow direction grid was created from the filled DEM, where each cell points to the next downstream cell.

10. Watershed delineation was performed (i.e., flowlines and basins are created from the flow direction grids). Basins were delineated up to a threshold of 0.1 square miles, and hydrologic flowlines were also created up the 0.1 square miles of drainage area, which is the threshold recommended for hydrologic computations. Other drainage area thresholds were delineated (see table below), for review and informational purposes.

11. The following quality checks were performed:

    a. Delineated watersheds and flow lines were examined for consistency with the expected flow paths for the basin. The flow directions and alignments between the NHD stream network and the hydrologic network were checked. Differences were highlighted with automated tools. Generally, differences occurred when two burn lines were too close together and the flow direction grid was incorrect. At these locations, the stream line was not burned into the DEM in order to correct the direction.

    b. A drainage area grid was computed along the flow paths and checked against stream gage drainage areas. If the flowlines or basins appeared to be in error, then the NHD stream network was modified.

    c. If modifications were made, the fill / flow direction / watershed delineation steps were repeated and drainage areas recalculated and the flagged locations checked again.

The delivered spatial files are described in the table below. All files listed below are projected in USGS Albers NAD 1983.

Table 2: Spatial files delivered for stream network preparation and watershed delineation. These files were generated for each of the watersheds described above. The "*" refers to the watershed identifier.

File Name	Type	Description
*_poly.shp	polygon	Polygon depicting estimated contributing drainage area
*_nhd.shp	polyline	NHD high-definition flow lines in the contributing drainage area
*_topo.bil	grid	Mosaiced 30-meter USGS DEM covering the contributing drainage area
*_burn_reaches.shp	polyline	Connected stream network derived from modified NHD flow lines. Attributes include names of major reaches that were in the NHD database.
*_topo_burn.bil	grid	30-meter topography with stream network (i.e., burn reaches) burned in

File Name	Type	Description
*_fd.bil	grid	Flow direction grid
*_fa.bil	grid	Flow accumulation grid
*_sqmi.tif	grid	Contributing drainage area (in square miles) for all drainage areas of 0.1 square miles or greater
*_basinpolys_0.1.shp	polygon	Basins delineated up to a threshold of 0.1 square miles of drainage area
*_basinpaths_0.1_join.shp	polyline	Hydrologic flow paths up to 0.1 square miles of drainage area
*_basinpolys_1.shp	polygon	Basins delineated up to a threshold of 1 square mile of drainage area
*_basinpaths_1_join.shp	polyline	Hydrologic flow paths up to 1 square mile of drainage area
*_basinpolys_10.shp	polygon	Basins delineated up to a threshold of 10 square miles of drainage area
*_basinpaths_10_join.shp	polyline	Hydrologic flow paths up to 10 square miles of drainage area
*_basinpolys_50.shp	polygon	Basins delineated up to a threshold of 50 square miles of drainage area
*_basinpaths_50_join.shp	polyline	Hydrologic flow paths up to 50 square miles of drainage area
*_basinpolys_100.shp	polygon	Basins delineated up to a threshold of 100 square miles of drainage area
*_basinpaths_100_join.shp	polyline	Hydrologic flow paths up to 100 square miles of drainage area
*_poly.shp	polygon	Polygon depicting estimated contributing drainage area

2.2. Peak Flows Computed from Unregulated Regression Equations Only

Peak flows for the 10%, 4%, 2%, 1%, 1% plus, 1% minus, and 0.2% events were computed utilizing the published USGS regression equations (Asquith and Roussel, 2009). The contributing drainage area (*A*), mean-annual precipitation (*P*), dimensionless channel slope (*S*), and the OmegaEM parameter (Ω) were the basin characteristics used to estimate the flows based on Table 3 in the regression report. Flow grids were developed for each flow event and input parameters described above for drainage areas of 0.1 square mile or greater.

So for each hydrologic basin, a grid of contributing drainage (in square miles) was created, for all drainage areas of 0.1 square miles or greater. Note that 0.1 square mile corresponds to the lower limit of the drainage areas used in the development of the regression equations. The computed drainage areas did not exceed the upper limit of 9,329 square miles used to develop the regression equations.

The mean annual precipitation (1971-2000) gridded spatial data was obtain from PRISM (http://www.prism.oregonstate.edu/). The precipitation values were converted to inches, clipped to the study area and re-projected to USAG Albers NAD 83. A grid of the area-weighted basin average precipitation was created for all of the drainage areas of 0.1 square mile or more. The lower and upper values in the regression analysis were 8 and 57 inches, respectively. All basin averaged precipitation values were within this range for the study area.

The dimensionless main channel slope (*S*) is defined as the magnitude of the change in elevation between the two end points of the main channel divided by the main channel length. The main channel length (*DD*) is defined as the length of the longest defined channel from the watershed headwaters to the outlet. The USGS 30-meter DEM, the flow accumulation, and flow direction grids were used to derive the grids for the elevations in meters and the distance to the divide (main channel length) in meters. The following equation was used to compute the main slope grid in feet per mile:

$$S = \frac{E_{divide} - E_{outlet}}{DD}$$

The lower and upper limits of the slope in the regression analysis were 0.00023 and 0.0703, respectively. The computed flows are sensitive to the channel slope and unreasonable flows tend to be computed when slopes are outside of the range used in the regression analysis. Therefore, when the channel slope was less than 0.00023, 0.00023 feet per mile was used in place of the computed value; and similarly, when the channel slope exceeded 0.070, 0.0703 was used in place of the computed values.

The OmegaEM parameter (Ω) was assigned to each grid cell based on the 1-degree quadrangle containing the cell based on Figure 2 in the regression report.

The regression equations used to compute the gridded unregulated peak flows for the 10%, 4%, 2%, 1%, and 0.2% chance exceedances for basins with drainage areas of 0.1 square mile shown below:

$$Q_{10} = P^{1.203} \cdot S^{0.403} \cdot 10^{\left[0.918 \cdot \Omega + 13.62 - 11.97 \cdot A^{(-0.0289)}\right]}$$

$$Q_{25} = P^{1.140} \cdot S^{0.446} \cdot 10^{\left[0.945 \cdot \Omega + 11.79 - 9.819 \cdot A^{(-0.0374)}\right]}$$

$$Q_{50} = P^{1.105} \cdot S^{0.476} \cdot 10^{\left[0.961 \cdot \Omega + 11.17 - 8.997 \cdot A^{(-0.0424)}\right]}$$

$$Q_{100} = P^{1.071} \cdot S^{0.507} \cdot 10^{\left[0.969 \cdot \Omega + 10.82 - 8.448 \cdot A^{(-0.0424)}\right]}$$

$$Q_{500} = P^{0.988} \cdot S^{0.569} \cdot 10^{\left[0.976 \cdot \Omega + 10.40 - 7.605 \cdot A^{(-0.0554)}\right]}$$

The average standard error of prediction for the 1% chance exceedance 64.8%, based on the PRESS statistic in Table 3 of the regression report. The 1% plus and 1% minus gridded flows were computed using the standard error of prediction as shown in the equations below:

$$Q_{1\%plus} = Q_{100} \cdot (1.648)$$

$$Q_{1\%minus} = \frac{Q_{100}}{1.648}$$

The delivered spatial files are described in the table below. All files listed below are projected in USGS Albers NAD 1983.

Table 3: These files were generated for each of the watersheds described above. The "*" refers to the watershed identifier.

File Name	Type	Description
***_sqmi.tif**	grid	Contributing drainage area in square miles (A) for all drainage areas of 0.1 square miles or greater
***_precip.bil**	grid	PRISM precipitation grid clipped to the contributing drainage area, re-projected to USGS Albers NAD83, adjusted to 30-meter grid cells, and converted to inches
***_basinaverageprecip.tif**	grid	Area-weighted basin average precipitation (P) for all drainage areas of 0.1 square miles or greater

File Name	Type	Description
***_elevat100pcup.tif**	grid	Elevations in meters of the channels at the basin divide (Edivide) for all drainage areas of 0.1 square mile or greater
***_elevatzero.tif**	grid	Elevations in meters of the channels at the basin outlet (Eoutlet) for all drainage areas of 0.1 square mile or greater
***_disttodivide_mtrs.tif**	grid	Distance along the channel from the basin outlet to the divide in meters (DD)
***_chanslope_final.tif**	grid	Dimensionless main channel slope (S) clipped to the upper and lower regression limits for all drainage areas of 0.1 square miles or greater
***_omega.tif**	grid	Omega EM parameters (Ω) within the watershed
***_Q10_final.tif**	grid	Unregulated peak streamflows with 10% chance exceedance for all drainage areas of 0.1 square miles or greater
***_Q25_final.tif**	grid	Unregulated peak streamflows with 4% chance exceedance for all drainage areas of 0.1 square miles or greater
***_Q50_final.tif**	grid	Unregulated peak streamflows with 2% chance exceedance for all drainage areas of 0.1 square miles or greater
***_Q100_final.tif**	grid	Unregulated peak streamflows with 1% chance exceedance for all drainage areas of 0.1 square miles or greater
***_Q100_minus1_eqs_only.tif**	grid	Unregulated 1% minus peak stream flows
***_Q100_plus1_eqs_only.tif**	grid	Unregulated 1% plus peak stream flows

3. Hydrology Results

3.1. Comparison of Flows

Once the flow grids were computed for the 10%, 4%, 2%, 1%, 1% plus, 1% minus, and 0.2% events, the results were compared to StreamStats data. To compare the gridded flows to StreamStats outputs, the project team placed 80 points evenly distributed across the three study watersheds making sure to place points in a wide range of drainage areas, slopes, and precipitation values. The team submitted these points to the StreamStats Batch Processor and queried results for drainage area, channel slope, and mean-area precipitation. Using the StreamStats results, the project team calculated the peak flow for each event and then compared the StreamStats data to the gridded data computed by the project team.

For the first comparison, the mean-area precipitation obtained from StreamStats was compared to the gridded mean-area precipitation computed by the project team. Out of the 80 points analyzed, five points had a percent difference greater than 5.0%. The outlying point was found to be near a confluence where the StreamStats flow line differed from the flow line computed by the project team. Overall, the two data sets match very closely and the average of the absolute value percent difference between the data sets is only 0.7%.

The next data sets that were analyzed were the StreamStats output for drainage area and the gridded drainage area computed. Five points out of the 80 points analyzed resulted in a percent difference greater than 5.0%. The cause of these differences can be attributed to three factors:

1. The project team's 30-meter grid deviated from the StreamStats 10-meter grid,

2. Points with very small drainage areas are much more sensitive to small differences in results, which result in higher percent differences, and

3. The StreamStats drainage areas do not account for NRCS structures whereas the project team's grids account for these structures.

The underlying cause of much of the difference in the gridded analysis versus StreamStats is the use of the 30-meter topographic data. The project team concluded that using a smaller grid size would have alleviated some of the problem areas and given results closer to the StreamStats outputs; however, the average of the absolute value percent difference was only 4.0%, which is still within an acceptable range.

The next data sets studied were the main channel slopes. The main channel slopes had a percent difference of 5% or greater in approximately 26% of the 87 points analyzed. The source of the difference in these values is directly related to the use of a 30-meter grid size. Using a 30-meter grid results in shorter stream lengths because it doesn't capture small changes in stream sinuosity, and shorter stream lengths result in higher channel slopes. Channel slope in the Oklahoma regression equations has the least impact on peak flow of the three parameters included in the equations. Since the slopes calculated using the 30-meter grid are typically higher than the StreamStats slopes, this results in peak flows that are slightly more conservative.

The peak flows computed by the project team were compared to the StreamStats peak flows. The average percent difference was less than 5%. The points that have the highest percent difference in peak flow are all areas that were previously discussed due to discrepancies with the computed precipitation, drainage area, and/or slope.

4. Hydraulics

For the hydraulic analysis, the Jack and Archer Counties was divided into five HUC-10 watersheds as shown in Figure 3

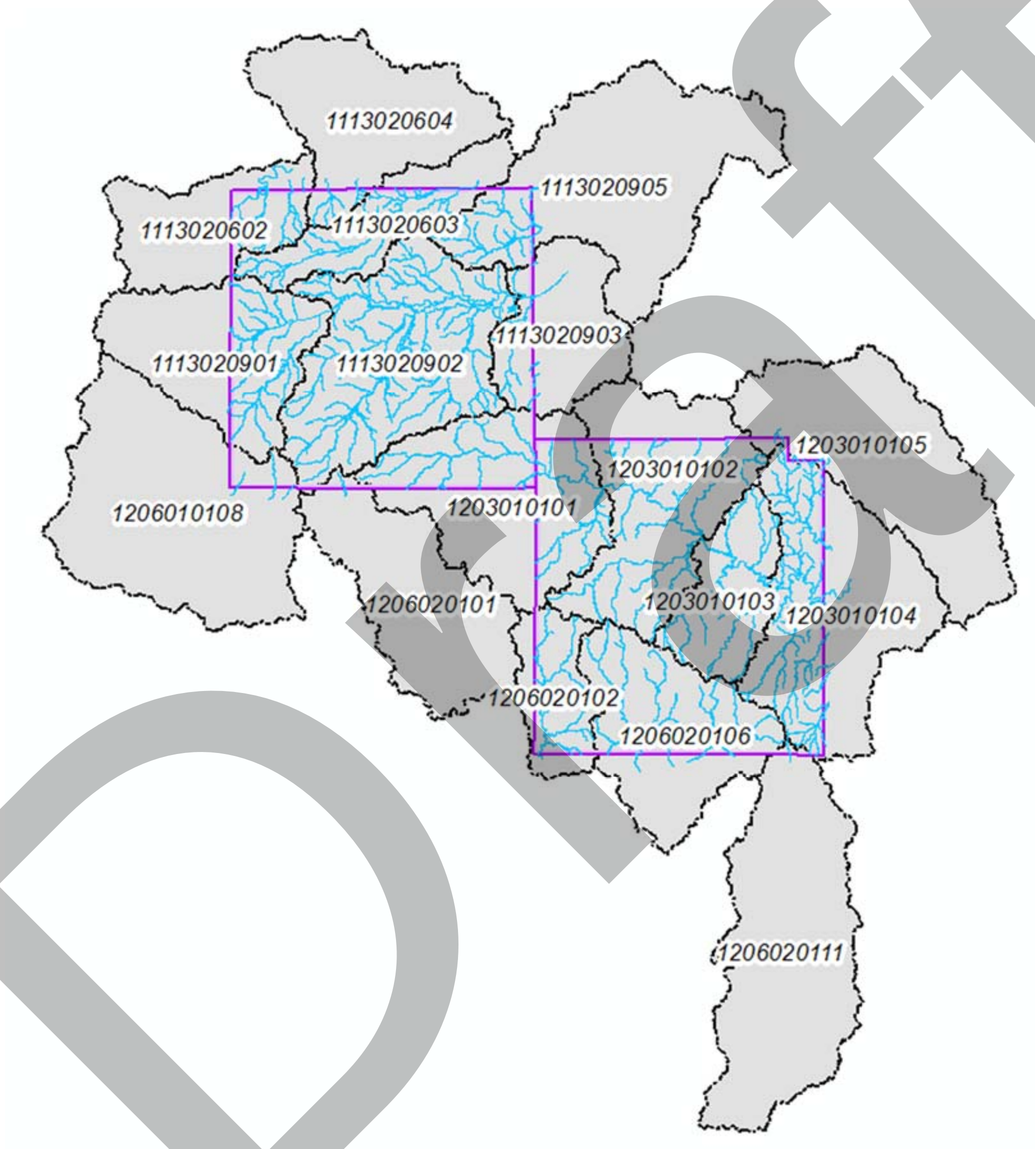


Figure 2: HUC-10 Watershed Boundaries that are within Jack and Archer Counties

Steady flow HEC-RAS models were developed for the 10%, 4%, 2%, 1%, 1% plus, 1% minus, and 0.2% flood events. Model geometry and mapping were developed automatically using GIS tools and scripts and then refined as needed. Some common modeling practices not considered in this analysis are inclusion of bridges, culverts, or levees or split flow analysis.

The NHD high-definition streamlines were used to create the initial hydraulic centerlines for the models. These lines were then reviewed and modified to more closely follow the thalweg of the stream. A single conveyance area was used for each cross-section, e.g. bank stations were set at the outer limits of the cross-section. This method has been found to give good results, especially when Manning's n-values are set based on land-use coverage.

No supercritical flows were permitted in the models, so the lowest possible water surface elevation for any cross-section was critical depth.

After automated models were developed, the floodplains and cross-sections were visually reviewed. Cross sections with unusual changes in hydraulic parameters (water surface and energy grade slopes, water surface elevations, and velocity) were examined. In numerous cases cross-sections were deleted or modified, to improve the quality of the hydraulic model.

Water surface grids and floodplains (10% and 1% events) were processed once the models were finalized.

4.1. Discharges

Discharges for all events were imported into HEC-RAS using automated tools such that the corresponding computed USGS rural regression discharge was assigned for each cross-section location

4.2. Boundary Conditions

The downstream boundary condition for almost all models was set at critical depth. For areas of interest, where the streamline did not terminate at a confluence with another river, the reach was extended by about 3,200 feet downstream, to allow the water surface to stabilize, so that the area of interest was already outside the influence of the downstream limit of the model. Through confluences in most situations reaches were also extended downstream to parallel the main channel that they join. In the model extensions downstream of confluences the discharge applied was not increased to represent the increased discharge computed for the main channel, instead the highest computed discharge upstream of the confluence is used. This process allows for a smooth transition in water surface elevation and thus floodplains between tributaries and main channels

Typically "normal" depth is used for hydraulic models for the downstream boundary. However, the use of normal depth requires an estimate of the "normal slope," which depends on the method used to estimate it. Fully automated methods to estimate the normal slope for large numbers of reaches are not completely reliable, in particular there is a risk that the slope may be estimated too low, which can cause a significant and unrealistic backwater condition at the start of the model, which may perpetuate for a long distance upstream. When critical depth is used, the models will typically stabilize to a "normal" depth within just a few cross-sections.

The only place where the model results should be used in this stabilization region would be when the downstream end of a reach was in the confluence with another modeled stream. For most confluences, the downstream main channel was modeled also. Typically the higher water surface elevation (backwater) of the main channel would govern when the water surface grids and floodplains are merged, negating any inaccuracies associated with the critical depth boundary condition on the tributary stream.

4.3. Cross Sections

Although some cross sections were edited manually, cross section placement was primarily automated. Cross sections were placed perpendicular to the flow direction. Cross section spacing was typically at 250 feet or less. Cross section geometries were obtained by overlaying the cross-section on the DEM topography.

After automated placement, a series of checks was performed to look for unusual changes in water surface elevation, slope, or velocity between cross-sections for the water surface profile of the 1% plus annual chance exceedance event. Places flagged as exhibiting unusual behavior were examined, and cross-sections were sometimes modified (or deleted) in these areas. This process resulted in the final cross-sections location and orientation, however the cross-section extent or width was determined with a separate process based on the estimated limits of effective flow.

4.4. Ineffective Areas

Ineffective flow limits were not used. Instead, cross-sections were trimmed back to the extent of the estimated effective flow region. The cross-section extents were determined first using the 1% plus event such that under normal conditions the cross-section would be wide enough to contain the determined discharge for that cross-section. In some cases the cross-section width was limited based on an estimation of the allowable change in cross-section width for contraction or expansion of effective top width. Allowable ratios for flow contraction and expansion were set at 1:1 and 4:1, respectively.

The determined final cross-section orientation and width from review and hydraulic analysis using the 1% plus event were applied for all other events with the exception of the 10% or 10-year event. For the 10-year event a second pass was done to decrease the effective top width of cross-sections, this would force the flow to be contained mostly within the low flow channel if it has significant capacity to allow it. Because the previously determined cross-sections from the 1% plus event were used as the input sections for this process the cross-sections for the 10-year event can only be shorter and must be a section of the cross-section created from the 1% plus hydraulic model.

4.5. Channel Roughness Values

Manning's n values were assigned to each class in the National Land Cover Database 2011 (NLCD, http://www.mrlc.gov/nlcd11_data.php). The correspondence between land use codes and the Manning's n-values are provided in Appendix C. For each model cross-section, the n-value was computed by compositing the land cover Manning's n values along a cross section using the Lotter method (Chow, 1959, p. 136-137), which included an estimate of the 1% plus water surface elevation so the wetted extents could be used to perform the compositing. The compositing was done by each cross-section using the 1% plus discharges and estimated wetted extents. These composite n-values were then used for all other event simulations, including the 10% for which shorter cross sections are used to limit conveyance to the smallest overall width that may provide containment.

4.6. Expansion and Contraction

Default contraction and expansion coefficients (0.1 and 0.3) were used.

4.7. Special Issues

Flow was not decreased due to model breakouts, nor were models modified to take them into account.

4.8. Floodplain and Water Surface Elevation Grids

Floodplains were generated for the 1%, 10% and 0.2% annual chance exceedance events for the hydraulic model reaches. A GIS shapefile of streamlines are provided that show the actual reaches modeled. These floodplains were utilized to determine if the hydraulic model results looked reasonable, and if the models needed adjustment

The floodplains are based on water surfaces interpolated from the hydraulic model cross-sections. In most locations where flow containment was lost at the limits of the models, backwater conditions were considered and the floodplains adjusted with an automated post-processing step to include additional backwater areas. Figure 2 shows backwater that was added beyond the limits of the hydraulic model. Figure 3 shows an example of backwater that required additional area because the water surface elevations extend upstream beyond the upstream limits of most models.

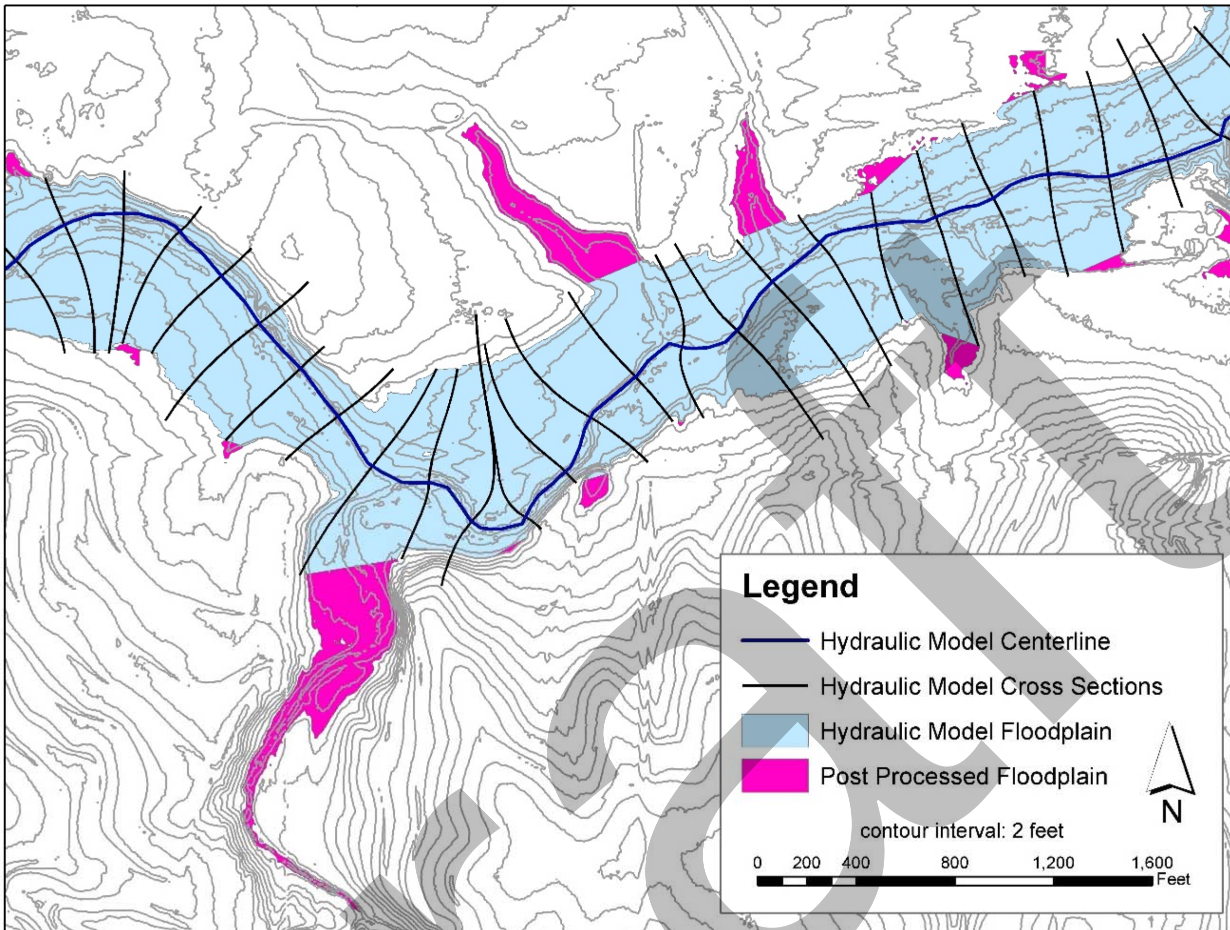


Figure 3: Post processed floodplain to add backwater areas along a modeled reach that would be flooded but were not reflected in the hydraulic model, typically these occur as small tributaries join a larger reach.

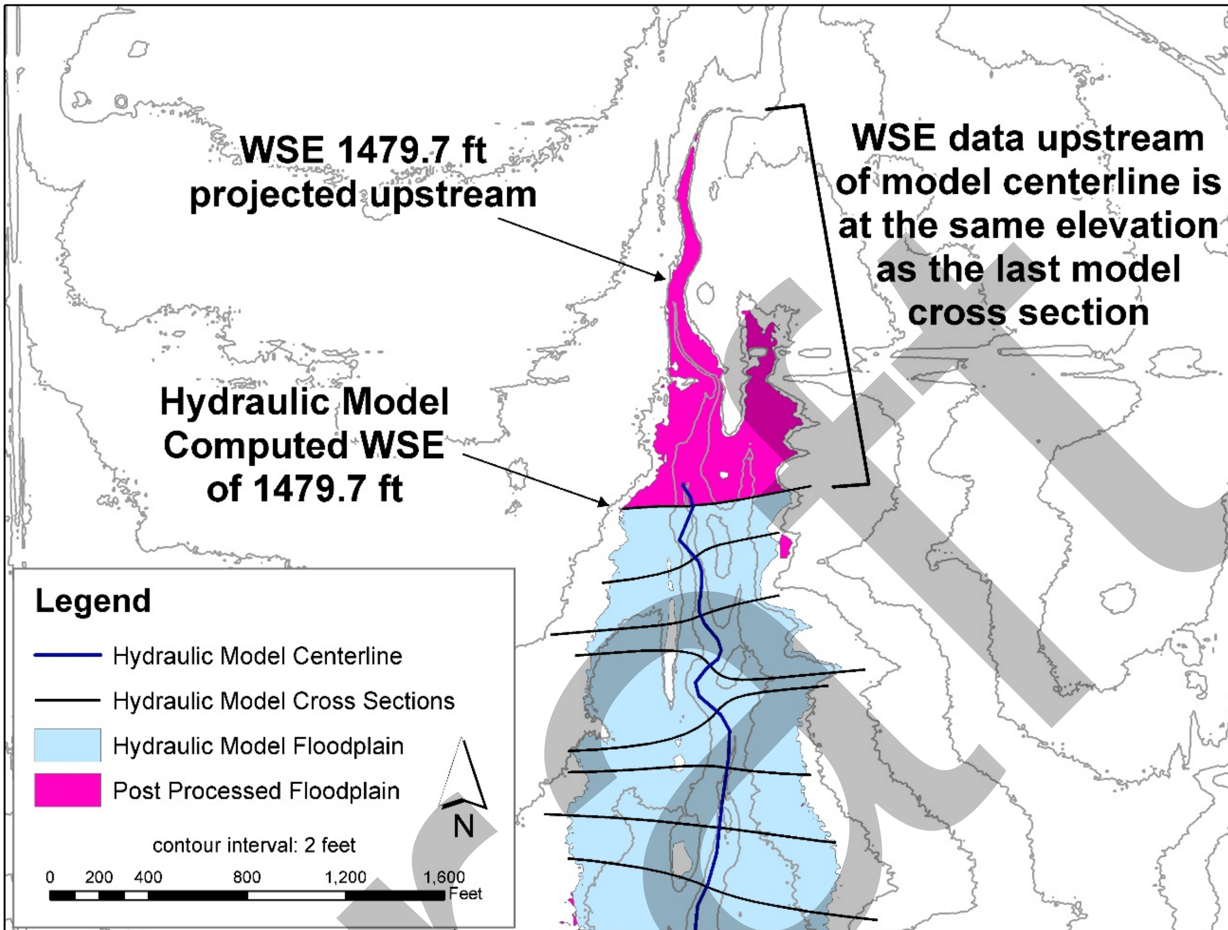


Figure 4: The post processing of floodplains also adds backwater areas upstream of the hydraulic model, these areas have the projected water surface from the most upstream cross section.

For locations where the models overlap, e.g. at confluences, the highest water surface elevation across all models dominates and results in the largest delineated floodplain by definition.

Dams and reservoirs are accounted for by simply placing a model cross-section along the upstream face of the dam at the same elevation as the emergency spillway

4.9. Deliverables

The HEC-RAS models have been created for the following flood profiles: 10-, 25-, 50-, 100-, and 500-year events. Two additional profiles the 100-year plus and 100-year minus have been created, that alter the 100-year profiles based on the standard error reported for applicable regression equations.

For all these profiles the same HEC-RAS geometries are used with the exception of the 10-year peak flow model.

Under HydraulicModels folder, North Fork Little Washita River and West Fork Trinity along 17 HUC10 folders are include. Each of these 17 HUC10 folder contain individual hydraulic models for each stream. Streamline_model_Index spatial file provides the location of the streams and their corresponding model number. See Figure 5 below for the HUC10 Folder structure.

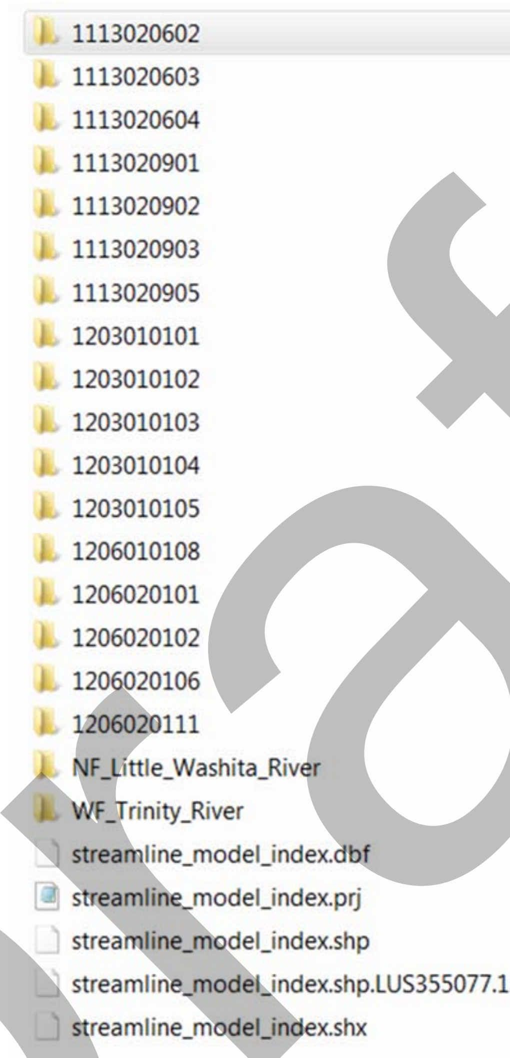


Figure 5: HEC-RAS HUC10 Folder structure

For the 10-year model the same cross-sections as the other events have been used but shortened or trimmed to limits that contain the 10-yr flow.

For all events an identical file and folder structure has been established and provided in the supplemental folder.

Inside each folder for a given event are folders for each individual reach (each reach has been assigned a reach number that is assigned to the folder)

Each reach folder contains the following files as describe in the Table 6 below

File Name	Type	Description
stream centerline (reach number).shp	Shape files	For example for reach number 35447 the stream centerline is 35447.shp
floodplain: (reach_number)_flood_00XX.shp	Shape files	for which the the XX represents the part number, large reaches are divided into multiple parts
cross sections: (reach_number)_xsecs_results.shp	Shape files	shapefile shows cross section locations and contains attributes with hydraulic model results
backwater floodplain: expand_(reach_number)_00XX_flood_redelin.shp	Shape files	floodplains expanded to include backwater areas beyond the cross section limits *Note: backwater processing has only been run for the 10-, 100-, and 500-year events
water surface grids	Grid format	similar naming convention to floodplains and backwater processed floodplains, provided as .tif files
Topo Grids	Grid format	similar naming convention to floodplains and backwater processed floodplains, provided as .tif files
HEC-RAS files: (reach_number)_ras.XXX	HEC-RAS	XXX represents all the HEC-RAS standard file and formats (flow -.f01, geometry - .g01, etc.)

Table 4: Data contents in each folder for various flood events

For each event the individual model GIS files have been merged into the following files (where XX is the event name: 10yr, 25yr, etc).

5. Flood Risk Products and Datasets

The Flood Risk Database (FRD) is the key product that will support all other flood risk products and datasets. It is a database of non-regulatory flood risk data which contains the digital data used to prepare the Flood Risk Report (FRR) and Flood Risk Map (FRM), as well as other ancillary data generated during Base Level Engineering analysis.

As part of this project, Multi-Frequency Depth Grid and Water Surface Grids are produced. For BLE study areas, it is required to produce 1% and 0.2% annual chance profiles. However, as part of the project additional depth and water surface grids (including 10%, 4%, and 2%) are produced and delivered as part of the BLE deliverables, which are further discussed in section 9 of this report.

All depth and water surface grids (rasters) within the FRD are floating point with data rounded to the nearest tenth of a unit (i.e., 0.1 feet, 0.1 feet/second, or 0.1%) and have the same spatial reference, origin, resolution and rotation as one another. All elevation data in depth and water surface elevation rasters, are reference the North American Vertical Datum of 1988 (NAVD88) with units of US Survey Feet.

6. CNMS Validation

Under Title 42 of the Code of Federal Regulations, Chapter III, Section 4101(e), FEMA is to revise and update all floodplain areas and flood risk zones identified, delineated, or established, based on an analysis of all natural hazards affecting flood risks on a five-year cycle. To accomplish this goal, the Coordinated Needs Management Strategy (CNMS) establishes criteria by which to evaluate flood hazard studies and stores the study validation results and validation status in a database. Further, progress towards this goal is measured through the New, Valid, and Updated Engineering (NVUE) program metric.

As part of this project, CNMS validation of 32 miles was completed, which included 32miles of detailed study miles and 0 miles of approximate study miles. Detailed studies were subjected to the complete validation processes as documented in the CNMS User's Guide Version 6.0 (FEMA, November 2016), which includes the review of 17 separate elements of a study's input data. The approximate studies were reviewed first for the A1 through A4 checks based on the November 2016 procedures. Base Level Engineering analysis (A5 check) was completed for those studies that failed at least one of the A1 through A4 checks.

6.1. Detailed Validation

Detailed study validation resulted in a x % revalidation rate calculated by mileage for all detailed miles that were part of this project. The following critical and secondary checks were evaluated based on the latest FEMA CNMS guidance.

- Critical Checks
    - (C1) Major change in gage record since effective analysis that includes major flood events
    - (C2) Updated and effective peak discharges differ significantly
    - (C3) Model methodology no longer appropriate
    - (C4) Addition/removal of a major flood control structure
    - (C5) Current channel reconfiguration outside effective SFHA
    - (C6) Five or more new or removed hydraulic structures that impact BFEs
    - (C7) Significant channel fill or scour

- Secondary Checks
    - (S1) Use of rural regression equations in urbanized areas
    - (S2) Repetitive losses outside the SFHA

- (S3) Increase in impervious area in the sub-basin of more than 50 percent
- (S4) One to four new or removed hydraulic structures that impact BFEs
- (S5) Channel improvements / Shoreline changes
- (S6) Availability of better topography/bathymetry
- (S7) Changes to vegetation or land use
- (S9) Significant storms with High Water Marks
- (S10) New regression equations

6.2. Approximate Study Validation

The Zone A validation process begins with an assessment of three checks (A1-A3) which serve as an initial screening to efficiently categorize some Zone A studies as “Valid” or “Unverified” in the CNMS Inventory. Additional assessments include checking if the effective Zone A study is backed by technical data (A4) and the comparison of the effective Zone A study against a Refined Zone A Engineering study (A5). For the purposes of these Zone A validation assessment procedures, either Large Scale Automated Engineering (LSAE) or Base Level Engineering (BLE) are appropriate sources for a Refined Zone A Engineering study. For regulatory FIRM production work, only Base Level Engineering would be appropriate. The following checks were evaluated based on the latest FEMA CNMS guidance.

- (A1) Check for Significant Topography Updates
- (A2) Check for Significant Hydrology Changes
- (A3) Check for Significant Development in the Watershed
- (A4) Check if Study was backed by Technical Data
- (A5) Comparison of Refined Zone A Engineering and Effective Zone A

7. Quality Assurance / Quality Control (QA/QC)

STARR II conducted a detailed review of the data utilized for this analysis at task level as part of STARR II Quality Management Plan (QMP). As part of QMP framework, STARR II maintains a consistent quality checklists and folder structure. Individual checklists and Technical review form are provided in Appendix D.

8. Base Level Engineering Deliverables

As described in the Regional BLE Submittal Guidance, dated June 2017, following datasets are included in the FRD as shown in the table below. Appendix E of this report provides additional details about Base Level Engineering Database.

Category	File Name	File Type	Description
Base Dataset	S_FRD_Pol_AR	Polygon	Political/Community Layer
	S_HUC_AR	Polygon	HUC8 Basin
EBFE Dataset	XS	Line	Hydraulic Cross-Sections
	WTR_LN	Line	Stream Centerline
	DTL_STUD_LN	Line	Stream Centerline – Detailed Study on FIRM
	DTL_STUD_AR	Polygon	Bounding Area – Detailed Study on FIRM
	FLD_HAZ_AR	Polygon	Seamless 1% and 0.2% floodplains included
	TENPCT_FP	Polygon	Seamless 10% floodplain
Mitigation Datasets	A_AOMI_PT	Point	Location of structures where information may refine H&H analysis
	S_CenBlk_AR	Polygon	Census Blocks within HUC8
CNMS Datasets	S_Studies_Ln	Line	CNMS validation status for streams included on current FIRMs
	S_UnMapped_Ln	Line	CNMS stream centerlines for streams not currently included on the FIRM
Hazus Dataset	LA_RA_Results	Table	Loss analysis results
Grids	BLE_WSE1PCT	Raster	Water Surface Elevation Grid – 1% annual chance
	BLE_WSE0_2PCT	Raster	Water Surface Elevation Grid – 0.2% annual chance
	BLE_DEP01PCT	Raster	Flood Depth Grid – 1% annual chance
	BLE_DEP0_2PCT	Raster	Flood Depth Grid – 0.2 % annual chance

9. References

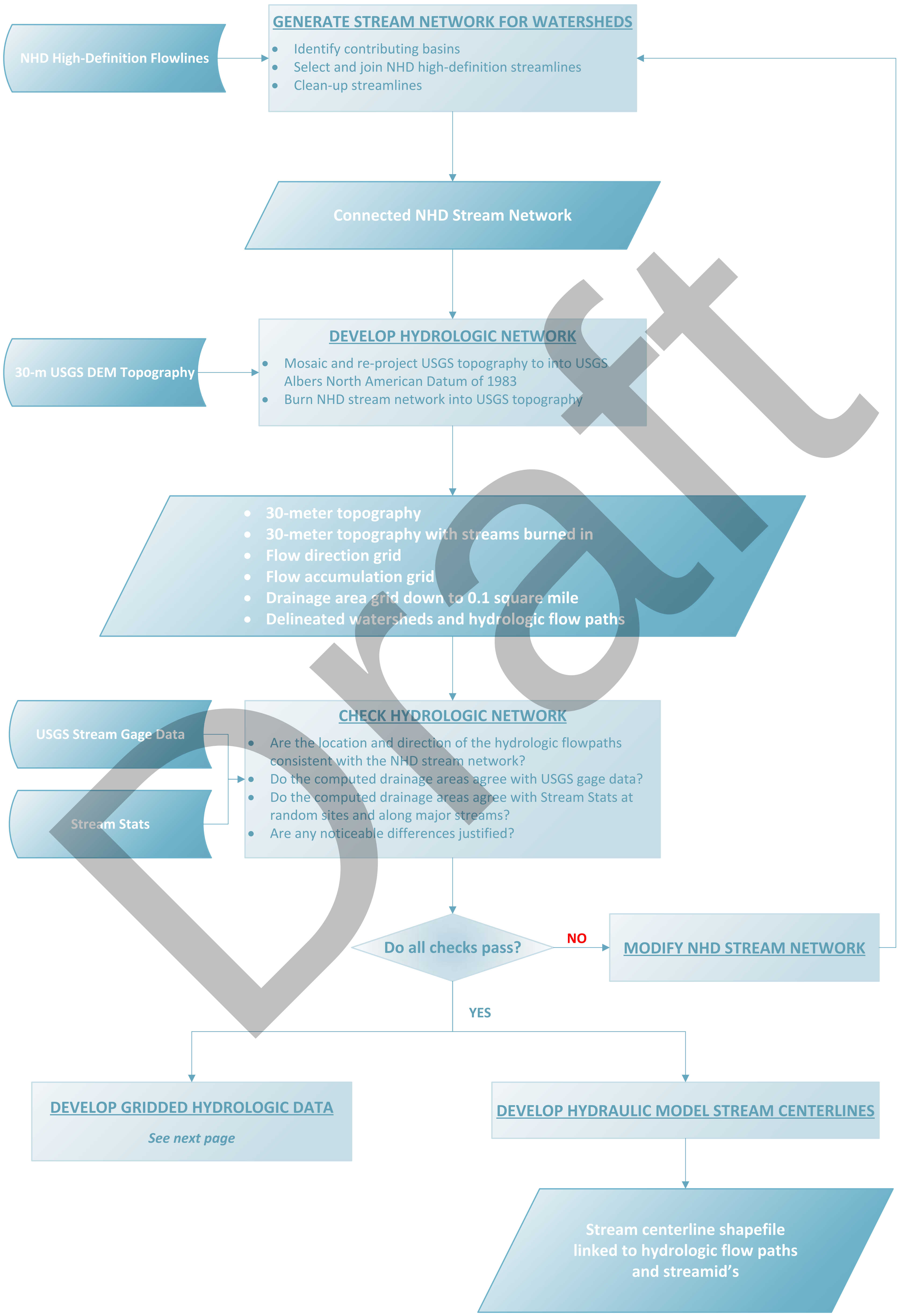
Asquith, W.H. and Roussel, M.C., 2009, Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach, U.S. Geological Survey Scientific Investigations Report 2009-5087 (Texas Department of Transportation Research Report 0-5521-1).

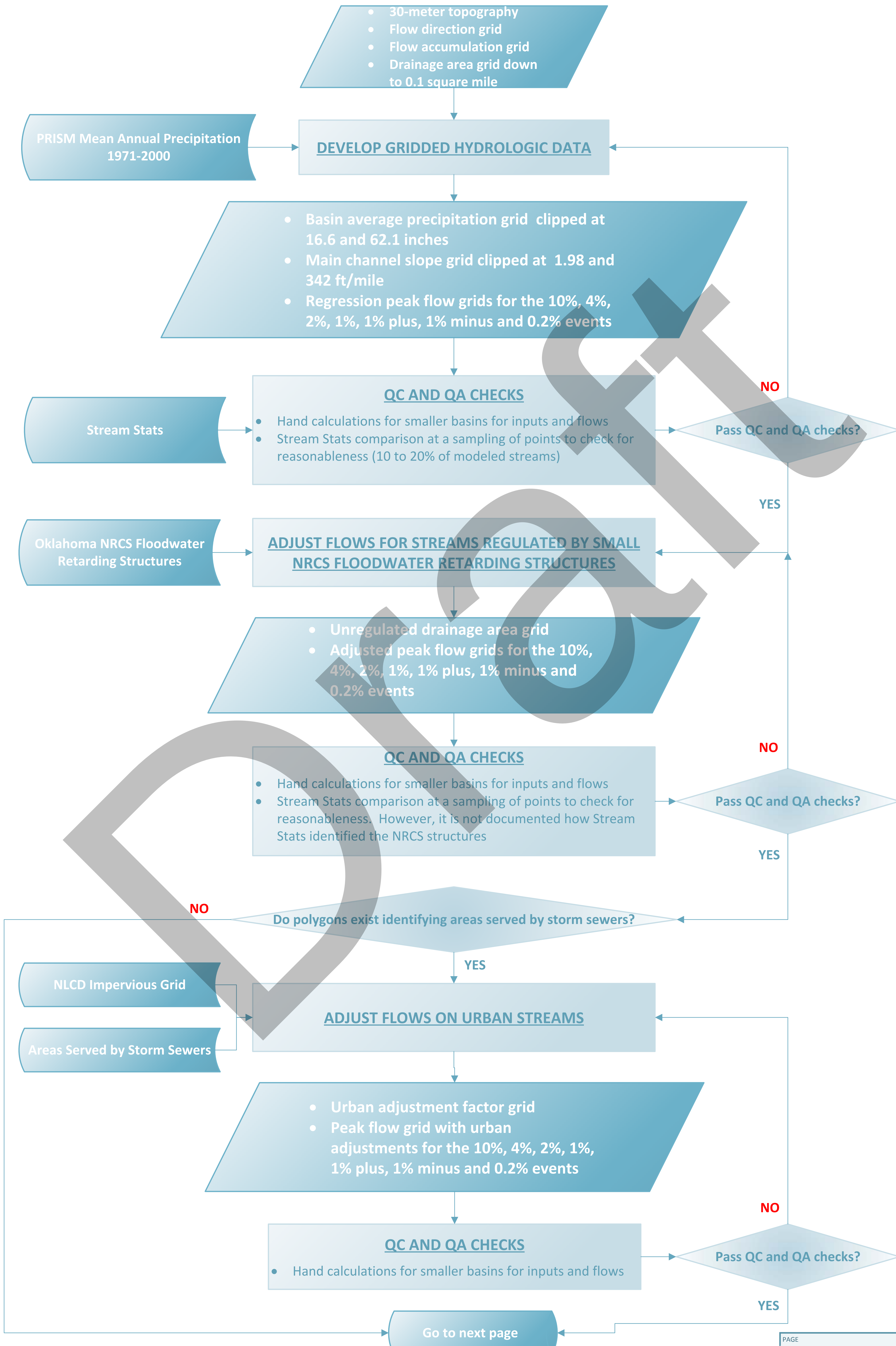
Federal Emergency Management Agency, First Order Approximation- Methodology, Validation, and Scalability Guidance Procedures, Verson 1.5, April 2014.

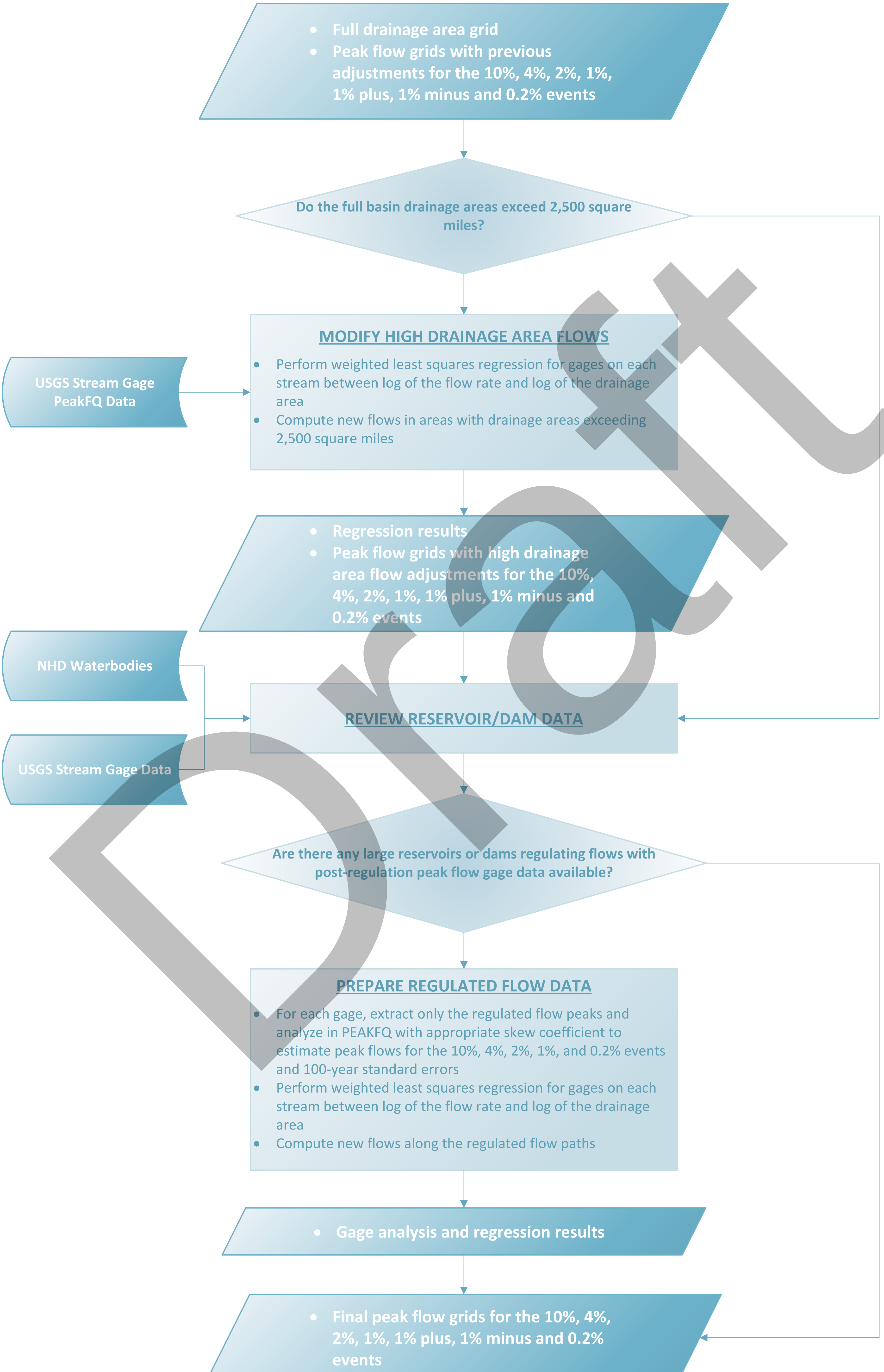
Hydrologic Engineering Center, HEC-RAS River Analysis System, Version 4.1, U.S. Army Corps of Engineers, Davis, California, March 2011.

Water Resources Council, Hydrology Committee, Guidelines for Determining Flood Flow Frequencies, Bulletin #17B, U.S. Department of the Interior, September 1981.

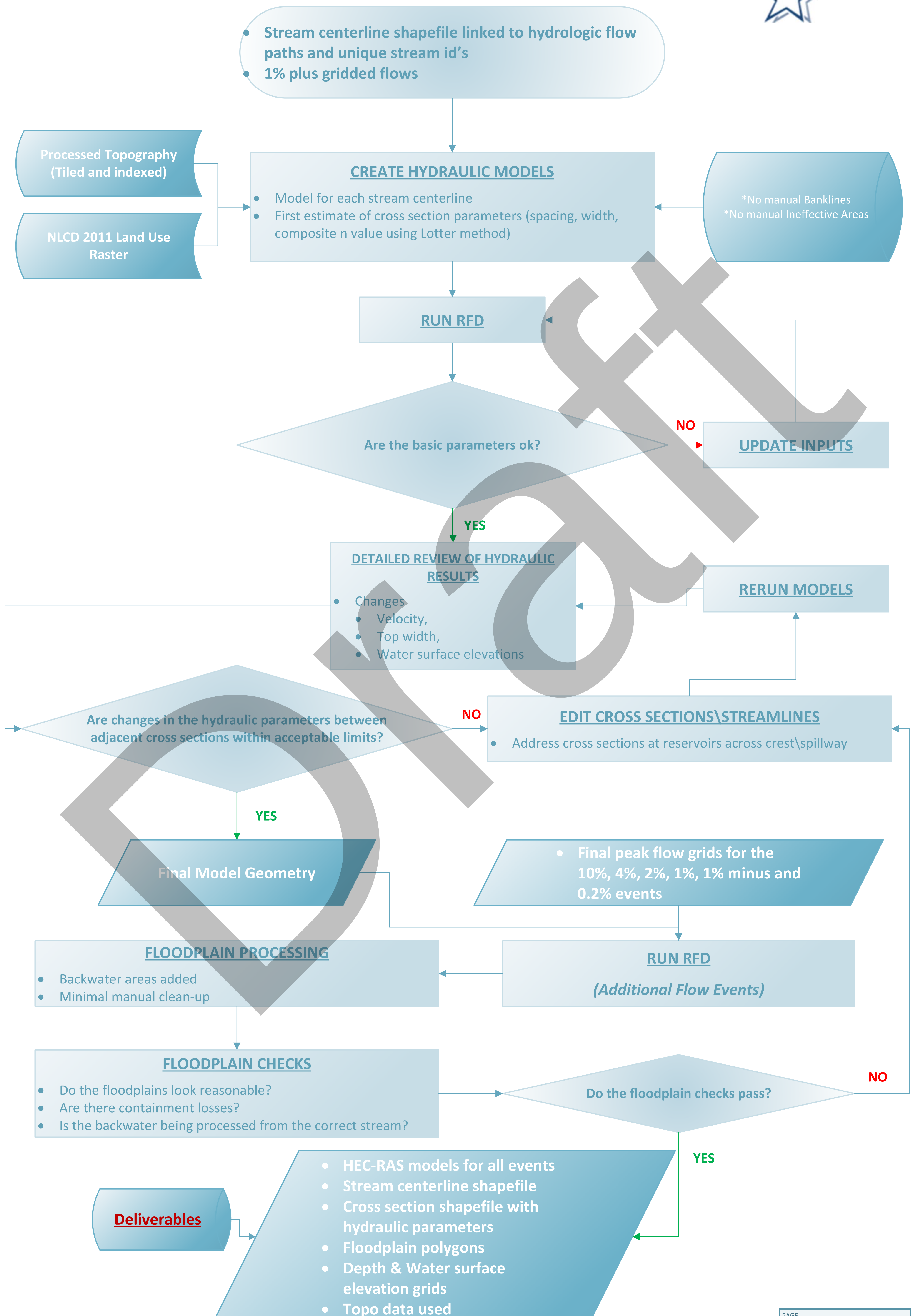
Appendix A - STARR II Hydrology and Hydraulics Process Flow Chart


NHD High-Definition Flowlines
GENERATE STREAM NETWORK FOR WATERSHEDS
• Identify contributing basins
• Select and join NHD high-definition streamlines
• Clean-up streamlines
Connected NHD Stream Network
30-m USGS DEM Topography
DEVELOP HYDROLOGIC NETWORK
• Mosaic and re-project USGS topography to into USGS Albers North American Datum of 1983
• Burn NHD stream network into USGS topography
• 30-meter topography
• 30-meter topography with streams burned in
• Flow direction grid
• Flow accumulation grid
• Drainage area grid down to 0.1 square mile
• Delineated watersheds and hydrologic flow paths
USGS Stream Gage Data
Stream Stats
CHECK HYDROLOGIC NETWORK
• Are the location and direction of the hydrologic flowpaths consistent with the NHD stream network?
• Do the computed drainage areas agree with USGS gage data?
• Do the computed drainage areas agree with Stream Stats at random sites and along major streams?
• Are any noticeable differences justified?
Do all checks pass?
NO
MODIFY NHD STREAM NETWORK
YES
DEVELOP GRIDDED HYDROLOGIC DATA
See next page
DEVELOP HYDRAULIC MODEL STREAM CENTERLINES
Stream centerline shapefile linked to hydrologic flow paths and streamid's


30-meter topography
Flow direction grid
Flow accumulation grid
Drainage area grid down to 0.1 square mile
PRISM Mean Annual Precipitation 1971-2000
DEVELOP GRIDDED HYDROLOGIC DATA
Basin average precipitation grid clipped at 16.6 and 62.1 inches
Main channel slope grid clipped at 1.98 and 342 ft/mile
Regression peak flow grids for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events
Stream Stats
QC AND QA CHECKS
Hand calculations for smaller basins for inputs and flows
Stream Stats comparison at a sampling of points to check for reasonableness (10 to 20% of modeled streams)
NO
Pass QC and QA checks?
YES
Oklahoma NRCS Floodwater Retarding Structures
ADJUST FLOWS FOR STREAMS REGULATED BY SMALL NRCS FLOODWATER RETARDING STRUCTURES
Unregulated drainage area grid
Adjusted peak flow grids for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events
QC AND QA CHECKS
Hand calculations for smaller basins for inputs and flows
Stream Stats comparison at a sampling of points to check for reasonableness. However, it is not documented how Stream Stats identified the NRCS structures
NO
Pass QC and QA checks?
YES
NO
Do polygons exist identifying areas served by storm sewers?
YES
NLCD Impervious Grid
Areas Served by Storm Sewers
ADJUST FLOWS ON URBAN STREAMS
Urban adjustment factor grid
Peak flow grid with urban adjustments for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events
QC AND QA CHECKS
Hand calculations for smaller basins for inputs and flows
NO
Pass QC and QA checks?
YES
Go to next page


Full drainage area grid
Peak flow grids with previous adjustments for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events
Do the full basin drainage areas exceed 2,500 square miles?
USGS Stream Gage PeakFQ Data
MODIFY HIGH DRAINAGE AREA FLOWS
Perform weighted least squares regression for gages on each stream between log of the flow rate and log of the drainage area
Compute new flows in areas with drainage areas exceeding 2,500 square miles
Regression results
Peak flow grids with high drainage area flow adjustments for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events
NHD Waterbodies
USGS Stream Gage Data
REVIEW RESERVOIR/DAM DATA
Are there any large reservoirs or dams regulating flows with post-regulation peak flow gage data available?
PREPARE REGULATED FLOW DATA
For each gage, extract only the regulated flow peaks and analyze in PEAKFQ with appropriate skew coefficient to estimate peak flows for the 10%, 4%, 2%, 1%, and 0.2% events and 100-year standard errors
Perform weighted least squares regression for gages on each stream between log of the flow rate and log of the drainage area
Compute new flows along the regulated flow paths
Gage analysis and regression results
Final peak flow grids for the 10%, 4%, 2%, 1%, 1% plus, 1% minus and 0.2% events

STARR II Strategic Alliance for Risk Reduction



Appendix B - Overview map

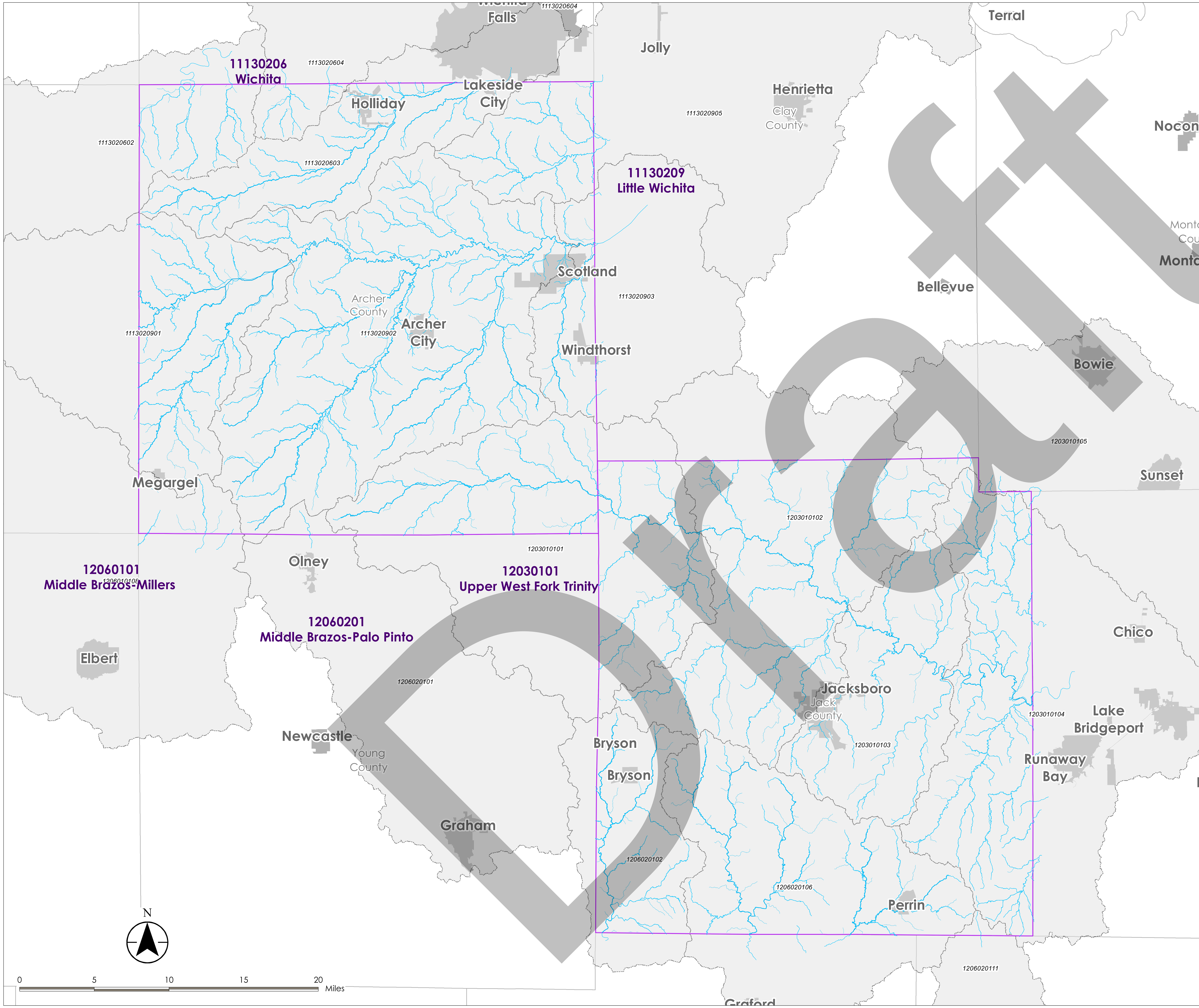


Figure No. 1 of 1

Project Area Overview

Title

Archer and Jack Counties, Texas
Base Level Engineering Analysis & Detail Studies

Client/Project

FEMA Region 6

Project Location:

HUC 8 Code:
- 11130206 - Wichita
- 11130209 - Little Wichita
- 12030101 - Upper West Fork Trinity
- 12060201 - Middle Brazos-Palo Pinto
- 12060101 - Middle Brazos-Millers

Project Area
Streams
Highways
Cities and Towns
County Boundaries

1:197,937 (at original document size of 24" x 36")

Notes

1. Coordinate System: NAD 1983 2011 UTM Zone 14N
2. Drainage areas shown are for visualization purpose only.
   For detailed results, refer to hydrology grids.

STARR II Strategic Alliance for Risk Reduction

FEMA

Appendix C - Manning's n Values by NLCD 2011 Land Use Code

Appendix 5: Manning n values

NLCD 2011 Land Use Code		Range of n values in literature	Utilized n-value
Water			
11	Open Water - areas of open water, generally with less than 25% cover of vegetation or soil.	0.001 - 0.06	0.013
12	Perennial Ice/Snow - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.	.01 - 0.027	0.020
Developed			
21	Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	0.01 -0.048	0.040
22	Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	0.01 - 0.12	0.060
23	Developed, Medium Intensity – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	0.01 - 0.1	0.075
24	Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.	0.01 - 0.12	0.100
Barren			
31	Barren Land (Rock/Sand/Clay) - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	0.011 - 0.09	0.030
Forest			
41	Deciduous Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	0.07 - 0.36	0.120
42	Evergreen Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	0.07 - 0.32	0.120
43	Mixed Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	0.1 - 0.4	0.120

NLCD 2011 Land Use Code		Range of n values in literature	Utilized n-value
Shrubland			
51	Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.	0.04	0.040
52	Shrub/Scrub - areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.	0.035 - 0.4	0.055
Herbaceous			
71	Grassland/Herbaceous - areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	0.022 - 0.36	0.040
72	Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.	0.03	0.040
73	Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.	0.027	0.035
74	Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.	0.025	0.030
Planted/Cultivated			
81	Pasture/Hay – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	0.033 - 0.325	0.040
82	Cultivated Crops – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.	0.035 - 0.04	0.040
Wetlands			
90	Woody Wetlands - areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	0.037 - 0.14	0.090
95	Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	0.045	0.045

Appendix D - Quality Assurance / Quality Control (QA/QC)

	Jack And Archer - Base Level Engineering	Date: 07/20/2017			Date:		
		Technica Selena Foreman			QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	General Requirements						
1	Is the metadata complete and correct?	P					
2	Are deliverables complete and consistent?	P					
3	Is the geodatabase in the proper projection?	P					
4	Does the geodatabase have the proper file structure?	P					

	Jack And Archer - Base Level Engineering	Date: 07/20/2017 Technica Selena Foreman			Date: QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	S_FRD_Pol_Ar						
5	Does the feature class follow the *Flood Risk Database Technical Reference* ?	P					
6	Are values in POL_AR_ID unique?	P					
7	Is DFIRM_ID populated for all records?	P					
8	Is CID populated for all records?	P					
9	Is POL_NAME1 populated for all records	P					
10	Is POL_NAME2 populated where necessary?	P					
11	Is CO_FIPS populated correctly for all records?	P					
12	Is ST_FIPS populated correctly for all records?	P					
13	Is COMM_NO populated for all records?	P					
14	Is POPULATION populated for all records?	P					
15	Is TOT_POP populated for all records?	P					
16	Is PCT_POP populated for all records?	P					
17	Is LND_AR_SM populated for all records?	P					
18	Is TOT_LND_AR populated for all records?	P					
19	Is PCT_LND_AR populated for all records?	P					
20	Is NFIPSTATUS populated for all records?	P					
21	Is CRS_RATING populated for all records?	P					
22	Is PASTDECLAR populated for all records?	P					
23	Is FLD_POLICY populated for all records?	P					
24	Is POLICY_COV populated for all records?	P					
25	Is HMP_STATUS populated for all records?	P					
26	Is HMP_NAME populated where HMP_STATUS is "T"?	P					
27	Is HMP_EXPIRE populated where HMP_STATUS is "T"?	P					
28	Is POL_TYPE populated for all records?	P					
29	Is HUC8_CODE populated for all records?	P					
30	Is CASE_NO populated for all records?	P					
31	Is VERSION_NO populated for all records?	P					
32	Is SOURCE_CIT populated for all records?	P					
33	Are source citations used recorded in L_SOURCE_CIT?	P					
34	Does the feature class appear free of spatial errors or irregularities?	P					
No.	S_HUC_Ar						

35	Does the feature class follow the *Flood Risk Database Technical Reference* ?	P					
36	Is HUC_CODE populated for all records?	P					
37	Is HUC_NAME populated for all records?	P					
38	Is DIGITS populated for all records?	P					
39	Is CASE_NO populated for all records?	P					
40	Is VERSION_NO populated for all records?	P					
41	Is SOURCE_CIT populated for all records?	P					
42	Are source citations used recorded in L_SOURCE_CIT?	P					
43	Does the feature class appear free of spatial errors or irregularities?	P					

	Jack And Archer - Base Level Engineering	Date: 07/20/2017			Date:		
		Technica Selena Foreman			QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	EBLE_Dtl_Stud_Ar						
44	Is DTL_AR_ID populated for all records?	P					
45	Is VERSION_ID populated for all records?	P					
46	Is EFF_DATE populated for all records?	P					
47	Is SOURCE_CIT populated for all records?	P					
48	Are source citations used recorded in L_SOURCE_CIT?	P					
49	Is FIRM_PAN populated for all records?	P					
50	Is TYPE populated for all records?	P					
51	Is CD_YN populated for all records?	P					
52	Is CD_POC populated for all records?	P					
53	Is CD_ADD1 populated for all records?	P					
54	Is CD_ADD2 populated for all records?	P					
55	Is CD_CTY populated for all records	P					
56	Is CD_STATE populated for all records?	P					
57	Is CD_ZIP populated for all records?	P					
58	Is CD_PHONE populated for all records?	P					
59	Is CD_EMAIL populated for all records?	P					
60	Are hidden fields populated appropriately?	P					
61	Does the feature class appear free of spatial errors or irregularities?	P					
No.	EBLE_Dtl_Stud_Ln						
62	Is DTL_AR_ID populated for all records?	P					
63	Is VERSION_ID populated for all records?	P					
64	Is EFF_DATE populated for all records?	P					
65	Is SOURCE_CIT populated for all records?	P					
66	Are source citations used recorded in L_SOURCE_CIT?	P					
67	Is FIRM_PAN populated for all records?	P					
68	Is TYPE populated for all records?	P					
69	Is CD_YN populated for all records?	P					
70	Is CD_POC populated for all records?	P					
71	Is CD_ADD1 populated for all records?	P					
72	Is CD_ADD2 populated for all records?	P					
73	Is CD_CTY populated for all records	P					
74	Is CD_STATE populated for all records?	P					

75	Is CD_ZIP populated for all records?	P					
76	Is CD_PHONE populated for all records?	P					
77	Is CD_EMAIL populated for all records?	P					
78	Are hidden fields populated appropriately?	P					
79	Does the feature class appear free of spatial errors or irregularities?	P					
No.	**EBLE_Fld_Haz_Ar**						
80	Is EST_ID populated for all records?	P					
81	Is VERSION_ID populated for all records?	P					
82	Are values in EST_AR_ID unique?	P					
83	Is EST_FLD_ZONE populated for all records?	P					
84	Is EST_ZONE_SUBTY populated where necessary?	P					
85	Is V_DATUM populated for all records?	P					
86	Is LEN_UNIT populated for all records?	P					
87	Is SOURCE_CIT populated for all records?	P					
88	Are source citations used recorded in L_SOURCE_CIT?	P					
89	Are hidden fields populated appropriately?	P					
90	Does the feature class appear free of spatial errors or irregularities?	P					
No.	**EBLE_Wtr_Ar**						
91	Is EST_ID populated for all records?	P					
92	Is VERSION_ID populated for all records?	P					
93	Are values in WTR_AR_ID unique?	P					
94	Is WTR_NM populated where necessary?	P					
95	Is SOURCE_CIT populated for all records?	P					
96	Are source citations used recorded in L_SOURCE_CIT?	P					
97	Are hidden fields populated appropriately?	P					
98	Does the feature class appear free of spatial errors or irregularities?	P					
No.	**EBLE_Wtr_Ln**						
99	Is EST_ID populated for all records?	P					
100	Is VERSION_ID populated for all records?	P					
101	Are values in WTR_LN_ID unique?	F	Value "23" occurs twice.				
102	Is WTR_NM populated where necessary?	P					
103	Is SOURCE_CIT populated for all records?	P					
104	Are source citations used recorded in L_SOURCE_CIT?	P					
105	Is STATUS populated for all records?	P					
106	Is DT_AVAIL populated for all records?	P					
107	Is EST_MODEL_URL populated for all records?	P					
108	Are hidden fields populated appropriately?	P					

109	Does the feature class appear free of spatial errors or irregularities?	P					
No.	**EBLE_XS**						
110	Is EST_ID populated for all records?	P					
111	Is VERSION_ID populated for all records?	P					
112	Are values in XS_LN_ID unique?	P					
113	Is WTR_NM populated where necessary?	P					
114	Is STREAM_STN populated for all records?	P					
115	Is START_ID populated for all records?	P					
116	Is XS_LN_TYP populated where necessary?	P					
117	Is EST_WSEL_1PCT populated for all records?	P					
118	Is V_DATUM populated for all records?	P					
119	Is MODEL_ID populated for all records?	P					
120	Is EST_WSEL_10PCT populated for all records?	P					
121	Is EST_WSEL_4PCT populated for all records?	P					
122	Is EST_WSEL_2PCT populated for all records?	P					
123	Is EST_WSEL_1PCTPLUS populated for all records?	P					
124	Is EST_WSEL_1PCTMINUS populated for all records?	P					
125	Is EST_WSEL_0PT2PCT populated for all records?	P					
126	Is EST_Q_10PCT populated for all records?	P					
127	Is EST_Q_4PCT populated for all records?	P					
128	Is EST_Q_2PCT populated for all records?	P					
129	Is EST_Q_1PCT populated for all records?	P					
130	Is EST_Q_1PCTPLUS populated for all records?	P					
131	Is EST_Q_1PCTMINUS populated for all records?	P					
132	Is EST_Q_0PT2PCT populated for all records?	P					
133	Is SOURCE_CIT populated for all records?	P					
134	Are source citations used recorded in L_SOURCE_CIT?	P					
135	Are hidden fields populated appropriately?	P					
136	Does the feature class appear free of spatial errors or irregularities?	P					
No.	**EBLE_10YRFP**						
137	Is EST_ID populated for all records?	P					
138	Is VERSION_ID populated for all records?	P					
139	Are values in EST_AR_ID unique?	P					
140	Is EST_FLD_RISK populated as "Extreme" for all records?	P					
141	Is SOURCE_CIT populated for all records?	P					
142	Are source citations used recorded in L_SOURCE_CIT?	P					
143	Are all other fields populated with null values?	P					

144	Does the feature class appear free of spatial errors or irregularities?	P					

	Jack And Archer - Base Level Engineering	Date: 07/20/2017			Date:		
		Technica Selena Foreman			QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	S_AOMI_Pt						
145	Does the feature class follow the *Flood Risk Database Technical Reference* ?	NA					
146	Is AOMI_ID unique for all records?	NA					
147	Is CID populated where necessary?	NA					
148	Is POL_NAME1 populated where necessary?	NA					
149	Is AOMI_CLASS populated for all records?	NA					
150	Is AOMI_TYPE populated for all records?	NA					
151	Is AOMI_CAT populated for all recordS?	NA					
152	Is AOMI_SRCE populated for all records	NA					
153	Is AOMI_INFO populated where necessary?	NA					
154	Is NOTES populated where necessary?	NA					
155	Is HUC8_CODE populated for all records?	NA					
156	Is CASE_NO populated for all records?	NA					
157	Is VERSION_ID populated for all records?	NA					
158	Is SOURCE_CIT populated for all recordS?	NA					
159	Are source citations used recorded in L_SOURCE_CIT?	NA					
160	Does the feature class appear free of spatial errors or irregularities?	NA					
No.	S_CenBlk_Ar						
161	Does the feature class follow the *Flood Risk Database Technical Reference* ?	P					
162	Is CEN_BLK_ID populated for all records?	P					
163	Is POPULATION populated for all records?	P					
164	Is ARV_BG_TOT populated for all records?	P					
165	Is ARC_CN_TOT populated for all records?	P					
166	Is ARV_BG_RES populated for all records?	P					
167	Is ARV_CN_RES populated for all records?	P					
168	Is ARV_BG_COM populated for all records?	P					
169	Is ARV_CN_COM populated for all records?	P					
170	Is ARV_BG_OTH populated for all records?	P					
171	Is ARV_CN_OTH populated for all records?	P					
172	Is HUC8_CODE populated for all records?	P					

173	Is CASE_NO populated for all records?	P						
174	Is VERSION_ID populated for all records?	P						
175	Is SOURCE_CIT populated for all recordS?	P						
176	Are source citations used recorded in L_SOURCE_CIT?	P						
177	Does the feature class appear free of spatial errors or irregularities?	P	See Note 6 below.					

	Jack And Archer - Base Level Engineering	Date: 07/20/2017			Date:		
		Technica Selena Foreman			QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	**L_AOMI_Summary**						
178	Does the table follow the *Flood Risk Database Technical Reference* ?	NA	See Note 7 below.				
179	Is AOMISUMMID populated for all records?	NA	See Note 7 below.				
180	IS POL_NAME1 populated for all records?	NA	See Note 7 below.				
181	IS AOMI_CLASS populated for all records?	NA	See Note 7 below.				
182	IS AOMI_TYP populated for all records?	NA	See Note 7 below.				
183	IS AOMI_CAT populated for all records?	NA	See Note 7 below.				
184	Is AOMI_SRCE populated for all records?	NA	See Note 7 below.				
185	Is TOTAL populated for all records?	NA	See Note 7 below.				
186	Is HUC8_CODE populated for all records?	NA	See Note 7 below.				
187	Is CASE_NO populated for all records?	NA	See Note 7 below.				
188	Is VERSION_ID populated for all records?	NA	See Note 7 below.				
No.	**L_RA_Results**						
189	Does the feature class follow the *Flood Risk Database Technical Reference* ?	NA	See Note 8 below.				
190	Is CEN_BLK_ID populated for all records?	NA	See Note 8 below.				
191	Is HAZARD_TYP populated for all records?	NA	See Note 8 below.				
192	Is RETURN_PER populated for all records?	NA	See Note 8 below.				
193	Is SCENAR_ID populated where necessary?	NA	See Note 8 below.				
194	Is RA_SOURCE populated for all records?	NA	See Note 8 below.				
195	Is TOT_LOSSES populated for all records?	NA	See Note 8 below.				
196	Is BL_TOT populated for all records?	NA	See Note 8 below.				
197	Is CL_TOT populated for all records?	NA	See Note 8 below.				
198	Is BL_RES populated for all records?	NA	See Note 8 below.				
199	Is CL_RES populated for all records?	NA	See Note 8 below.				
200	Is BL_COM populated for all records?	NA	See Note 8 below.				
201	Is CL_COM populated for all records?	NA	See Note 8 below.				
202	Is BL_OTH populated for all records?	NA	See Note 8 below.				
203	Is CL_OTH populated for all records?	NA	See Note 8 below.				
204	Is BUS_DISRPT populated for all records?	NA	See Note 8 below.				
205	Is HUC8_CODE populated for all records?	NA	See Note 8 below.				
206	Is CASE_NO populated for all records?	NA	See Note 8 below.				

207	Is VERSION_ID populated for all records?	NA	See Note 8 below.				
No.	**L_Source_Cit**						
208	Is SOURCE_CIT populated for all records?	P					
209	Is DFIRM_ID populated for all records?	P					
210	Is CITATION populated for all records?	P					
211	Is PUBLISHER populated for all records?	P					
212	Is TITLE populated for all records?	P					
213	Is AUTHOR populated where necessary?	P					
214	Is PUB_PLACE populated where necessary?	P					
215	Is PUB_DATE populated for all records?	P					
216	Is WEBLINK populated where necessary?	P					
217	Is SRC_SCALE populated where necessary?	P					
218	Is MEDIA populated for all records?	P					
219	Is CASE_NO populated for all records?	P					
220	Is VERSION_ID populated for all records?	P					

Note 7: This feature class was not checked because AOMI data was not collected for this study.

Note 8: The tables **L_RA_AAL**, **L_RA_Composite**, and **L_RA_Refined** are deprecated and were officially removed from the *Flood Risk Database Technical Reference* in May 2016, and replaced with **L_RA_Results**. Thus, the *Base Level Engineering Guidance* is outdated, but is in the process of being revised and updated. I've reviewed these tables against an older, superseded version of the *Flood Risk Database Technical Reference* , included as a separate section below.

	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	**L_RA_AAL**						
A	Not Checked	NA	See Note A below.				
No.	**L_RA_Composite**						
B	Is CEN_BLK_ID populated for all records?	P	See Note B below.				
C	Is HAZARD_TYP populated for all records?	P					
D	Is RETURN_PER populated for all records?	P					
E	Is RA_SOURCE populated for all records?	P					
F	Is TOT_LOSSES populated for all records?	P					
G	Is BL_TOT populated for all records?	P					
H	Is CL_TOT populated for all records?	P					
I	Is BL_RES populated for all records?	P					
J	Is CL_RES populated for all records?	P					
K	Is BL_COM populated for all records?	P					
L	Is CL_COM populated for all records?	P					
M	Is BL_OTH populated for all records?	P					
N	Is CL_OTH populated for all records?	P					
O	Is BUS_DISRPT populated for all records?	P					

P	Is HUC8_CODE populated for all records?	P					
Q	Is CASE_NO populated for all records?	P					
R	Is VERSION_ID populated for all records?	P					
No.	**L_RA_Refined**						
S	Is CEN_BLK_ID populated for all records?	P	See Note B below.				
T	Is HAZARD_TYP populated for all records?	P					
U	Is RETURN_PER populated where necessary?	P					
V	Is SCENAR_ID populated where necessary?	P					
W	Is TOT_LOSSES populated for all records?	P					
X	Is BL_TOT populated for all records?	P					
Y	Is CL_TOT populated for all records?	P					
Z	Is BL_RES populated for all records?	P					
AA	Is CL_RES populated for all records?	P					
BB	Is BL_COM populated for all records?	P					
CC	Is CL_COM populated for all records?	P					
DD	Is BL_OTH populated for all records?	P					
EE	Is CL_OTH populated for all records?	P					
FF	Is BUS_DISRPT populated for all records?	P					
GG	Is HUC8_CODE populated for all records?	P					
HH	Is CASE_NO populated for all records?	P					
II	Is VERSION_ID populated for all records?	P					

Note A: This table was not checked because no records were included.
Note B: This table includes the SOURCE_CIT field not included in the supersed version of the *Flood Risk Database Technical Reference* I'm using as a guide. Since this table is deprecated and has been replaced with **L_RA_Results**, I'm not marking this as an error.

	Jack And Archer - Base Level Engineering	Date: 07/20/2017 Technica Selena Foreman			Date: QC Verif Michael Wilson		
	QC Check and Description	P/F/NA	Comments	Corr. By: Init/Date	P/F/NA	Comments	Corr. By: Init/Date
No.	Depth Grids						
221	Are there any non-spatial issues with the grids?	P					
222	Do the grids appear free of spatial errors or irregularities?	P					
No.	Water Surface Elevation Grids						
223	Are there any non-spatial issues with the grids?	P					
224	Do the grids appear free of spatial errors or irregularities?	P					

Appendix E - Base Level Engineering Database

1.0 BASE LEVEL ENGINEERING GEODATABASE

1.1 OVERVIEW

The BLE geodatabase consists of three types of data: spatial data (feature classes), tabular data (database tables), and gridded data (rasters). Additionally, the spatial data is grouped into four themes (feature datasets) based on function and interconnectivity with other related FEMA datasets in this study, such as the Flood Risk Database (FRD) and the DFIRM Database, as well as the Coordinated Needs Management Strategy (CNMS) program.

The BLE Database does not represent a flood risk study, but is intended to serve as a data- and model-based foundation for future flood risk studies as well as to assist communities in better determining their flood risk by providing *estimated* base flood elevations (BFEs). The primary means of achieving this goal is through the *Estimated Base Flood Elevation Viewer* (https:\\apps.femadata.com\estbfe).

Some of the data files in the geodatabase exactly match corresponding data files in other related FEMA datasets, while others are based on corresponding data files in other related FEMA datasets but have been modified for use with the *Estimated Base Flood Elevation Viewer*. These modifications are necessary since the automated processes create a foundational dataset for future studies, but do not meet minimum requirements themselves. For example, it is inappropriate to label a flood zone delineated by automated processes as Zone A, rather it can be described by its relative risk. These data files are described below.

1.2 BASE LAYERS

1.2.1. S_FRD_POL_AR

Flood Risk Database Political Areas: This polygon feature class is the combination of the S_Pol_Ar feature class from all FIRM databases in the project area. It shows political area boundaries and includes community-specific data. This feature class matches the S_FRD_Pol_Ar feature class in the FRD. For additional information, see the *Flood Risk Database (FRD) Technical Reference*.

1.2.2. S_HUC_AR

Hydrologic Unit Code Areas: This polygon feature class depicts the watersheds in and around the project area. It shows watershed boundaries and includes identifying information about these watersheds. This feature class matches the S_HUC_Ar feature class in the FRD. For additional information, see the *Flood Risk Database (FRD) Technical Reference*.

1.3 CNMS LAYERS

1.3.1. S_STUDIES_LN

Studies Lines: This polyline feature class depicts stream reaches recorded and assessed as part of the CNMS program. This feature class matches the S_Studies_Ln feature class in the CNMS database. For additional information, see the *Coordinated Needs Management Strategy (CNMS) Technical Reference*.

1.3.2. S_UNMAPPED_LN

Unmapped Lines: This polyline feature class depicts stream reaches known to FEMA but which have not been assessed or mapped on a FIRM. This feature class matches the S_Unmapped_Ln feature class in the CNMS database. For additional information, see the *Coordinated Needs Management Strategy (CNMS) Technical Reference*.

1.4 EBFE LAYERS

1.4.1. DTL_STUD_AR

Detailed Studies Areas: This polygon feature class was created for the purposes of the *Estimated Base Flood Elevation Viewer*, and identifies areas that have detailed study depicted on the current effective Flood Insurance Rate Map (FIRMs) that may be available in portions of the study area. Additionally, it can also show areas of new detailed study that are currently in process and not yet effective, and which will be shown on updated FIRMs which may also be updated based on studies launched from the BLE dataset. It includes FIRM panel numbers where detailed studies are located, effective dates of the detailed study, the production stage of the detailed study (*e.g.* Preliminary, Effective, *etc*.), contact information for inquiries about the detailed study, and LOMR information for areas revised by Letters of Map Revision. Its purpose is to indicate to users of the *Estimated Base Flood Elevation Viewer* that flood data more detailed than the estimated base flood elevations produced by the automated processes are available.

1.4.2. DTL_STUD_LN

Detailed Studies Lines: This polyline feature class was created for the purposes of the *Estimated Base Flood Elevation Viewer*, and identifies stream reaches that have detailed study depicted on the current effective Flood Insurance Rate Map (FIRMs) that may be available in portions of the study area. Additionally, it can also show reaches of new detailed study that are currently in process and not yet effective, and which will be shown on updated FIRMs which may also be updated based on studies launched from the BLE dataset. It includes FIRM panel numbers where detailed studies are located, effective dates of the detailed study, the production stage of the detailed study (*e.g.* Preliminary, Effective, *etc*.), contact information for inquiries about the detailed study, and LOMR information for areas revised by Letters of Map Revision. Its purpose is to indicate to users of the *Estimated Base Flood Elevation Viewer* that flood data more detailed than the estimated base flood elevations produced by the automated processes are available.

1.4.3. FLD_HAZ_AR

Flood Hazard Areas: This polygon feature class is based on the S_Fld_Haz_Ar feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It contains information about flood risks in the study area and their geographic extents. This feature class includes an additional field EST_RISK (Estimated Risk) which substitutes in the *Estimated Base Flood Elevation Viewer* for the Flood Zone. Values in the EST_RISK field include:

- High, which corresponds to areas of 1 Percent Annual Chance Flood Hazard
- Moderate, which corresponds to areas of 0.2 Percent Annual Chance Flood Hazard; and
- Low, which corresponds to Areas of Minimal Flood Hazard.

Twelve fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*. For complete details on modifications to this feature class and which fields are visible to users, see the *Base Level Engineering, Region 6 Submittal Guidance*.

1.4.4. SUBBASINS

Subbasins: This polygon feature class is based on the S_Subbasins feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It collects data and calculations used in the preparation of Base Level Engineering hydrology, which uses the Regional Regression Equations to calculate the flow volumes expected throughout study reaches. This feature class includes several additional fields:

- US_1 (Upstream Basin 1)
- US_2 (Upstream Basin 2)
- US_3 (Upstream Basin 3)
- US_4 (Upstream Basin 4)
- PRECIP_IN (Precipitation in Inches)
- MAINCHSL (Main Channel Slope)
- E_Q_10PCT (Estimated Discharge of the 10-percent-annual-chance Event)
- E_Q_04PCT (Estimated Discharge of the 4-percent-annual-chance Event)

- E_Q_02PCT (Estimated Discharge of the 2-percent-annual-chance Event)
- E_Q_01PCT (Estimated Discharge of the 1-percent-annual-chance Event)

- E_Q_01PLUS (Estimated Discharge of the 1-percent-plus-annual-chance Event)
- E_Q_01MIN (Estimated Discharge of the 1-percent-minus-annual chance Event), and
- E_Q_0_2PCT (Estimated Discharge of the 0.2-percent-annual-chance Event).

Four fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*. For complete details on modifications to this feature class and which fields are visible to users, see the *Base Level Engineering, Region 6 Submittal Guidance*.

1.4.5. TENPCT_FP

Ten Percent Floodplain: This polygon feature class is based on the S_Fld_Haz_Ar feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It contains information about the 10-percent-annual-chance-flood event flood risks in the study area and their geographic extents. This feature class includes an additional field EST_RISK (Estimated Risk) which substitutes in the *Estimated Base Flood Elevation Viewer* for the Flood Zone. Values in the EST_RISK field include:

- Extreme.

Thirteen fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*. However, since the 10-percent-annual-chance flood event is not reflected in any established flood zone, most fields are populated with null values. For complete details on modifications to this feature class and which fields are visible to users, see the *Base Level Engineering, Region 6 Submittal Guidance*.

1.4.6. WTR_AR

Water Areas: This polygon feature class is based on the S_Wtr_Ar feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It contains information about and depicts the locations of waterbodies throughout the study area and/or those included in the automated hydrologic and hydraulic modeling. Two fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*.

1.4.7. WTR_LN

Water Lines: This polyline feature class is based on the S_Wtr_Ln feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It contains information about and depicts the locations of streams and stream reaches throughout the study area and/or those included in the automated hydrologic and hydraulic modeling. Two fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*.

1.4.8. XS

Cross Sections: This polyline feature class is based on the S_XS feature class (*q.v.*) in the DFIRM database, but has been modified for use with the *Estimated Base Flood Elevation Viewer*. It contains information about and depicts the locations of streams and stream reaches throughout the study area and/or those included in the automated hydrologic and hydraulic modeling. Two fields, while populated in the database, are hidden in the *Estimated Base Flood Elevation Viewer*.

1.5 MITIGATION LAYERS

1.5.1. S_AOMI_PT

Areas of Mitigation Interest Points: This point feature class depicts the location of hydraulic structures (inline structures, dams, weirs, culverts, bridges, *etc*.) and other types of locations that may be used to refine future hydraulic models and mapping efforts. This feature class matches the S_FRD_Pol_Ar feature class in the FRD. For additional information, see the *Flood Risk Database (FRD) Technical Reference*.

1.5.2. S_CENBLK_AR

Census Block Areas: This polygon feature class contains the sptial location of census blocks intersecting the study area. It contains basic inventory and population data that is used as the basis for flood risk assessments in Hazus or similar software. This feature class matches the S_FRD_Pol_Ar feature class in the FRD. For additional information, see the *Flood Risk Database (FRD) Technical Reference*.

1.6 GRIDS

1.6.1. BLE_DEP01PCT

Depth 1 Percent: This raster dataset depicts the estimated flood water depth for the 1-percent-annual-chance flood event within the 1-percent-annual-chance floodplain as determined by the automated methods of the Base Level Engineering assessment.

1.6.2. BLE_DEP0_2PCT

Depth 0.2 Percent: This raster dataset depicts the estimated flood water depth for the 0.2-percent-annual-chance flood event within the 0.2-percent-annual-chance floodplain as determined by the automated methods of the Base Level Engineering assessment.

1.6.3. BLE_WSE01PCT

Water Surface Elevation 1 Percent: This raster dataset depicts the estimated water surface elevation (or *estimated base flood elevation*) for the 1-percent-annual-chance flood event within the 1-percent-annual-chance floodplain as determined by the automated methods of the Base Level Engineering assessment.

1.6.4. BLE_WSE0_2PCT

Water Surface Elevation 0.2 Percent: This raster dataset depicts the estimated water surface elevation (or *estimated base flood elevation*) for the 0.2-percent-annual-chance flood event within the 0.2-percent-annual-chance floodplain as determined by the automated methods of the Base Level Engineering assessment.

1.7 TABLES

1.7.1. L_RA_RESULTS

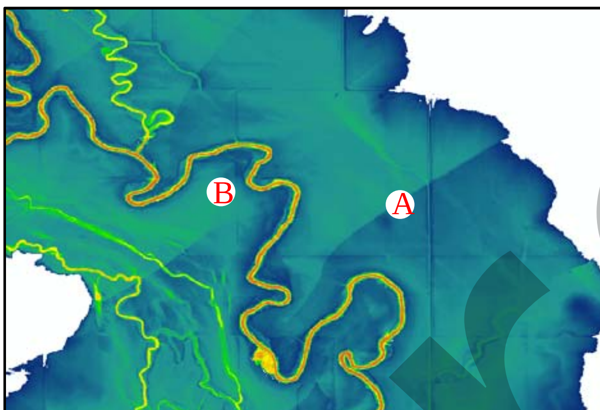
Risk Assessment Results: This table includes results from a flood risk assessment conducted in Hazus or similar software and are reported at the census block level. It is used in conjunction with the S_CenBlk_Ar feature class. This table matches the L_RA_Results table in the FRD. For additional information, see the *Flood Risk Database (FRD) Technical Reference*.

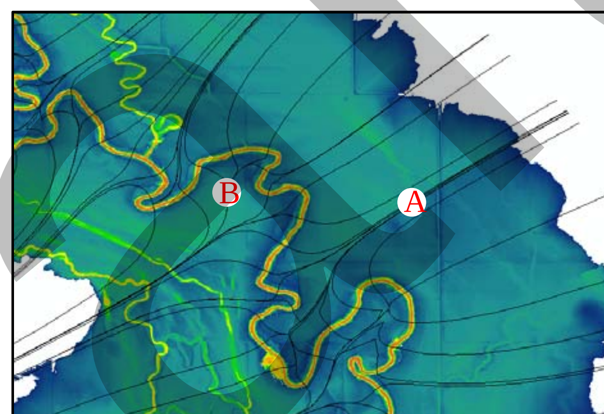
1.7.2. L_SOURCE_CIT

Source Citations: This table includes bibliographic data for references and data sources used in the compilation of the Base Level Engineering database. This table matches the L_Source_Cit table in the FIRM database and the FRD. For additional information, see the *Flood Insurance Rate Map (FIRM) Database Technical Reference* or the *Flood Risk Database (FRD) Technical Reference.*

2.0 KNOWN ISSUES

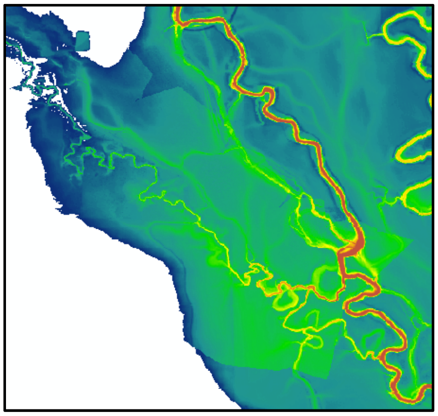
Irregularities in depth values may appear in the depth grids due to parameters within the automated modeling. In most cases, these are caused by the orientation of cross sections as they were automatically created by the processing software. Per the rules of hydraulic modeling, cross sections must intersect the stream channel perpendicularly. And no irregularities are observed along or near the stream channel. However, in the overbank areas, which are sensitive to the orientation of cross sections, these irregularities appear. This is likely because in the overbank areas, flood waters are not flowing along the channel, but the cross sections are modeled as if they are. This becomes an issue in areas where the perpendicular requirement of cross sections along a highly meandering stream inside a wide floodplain causes cross sections to "bunch up" together. There are several possible ways to address this situation, but these may not be applicable for a low-level (base level) analysis and instead may be applicable for a full FIRM-level analysis or even a detailed analysis.





The image at left shows the depth grid without cross sections, so that these irregularities are easier to see. The image at right shows the depth grid with cross sections superimposed on it. Note that a Location A, the bunched up cross sections create an irregularity in the depth where the values change rather abruptly. Note that at Location B, where the cross sections near the channel and are no longer bunched up, these irregularities disappear.

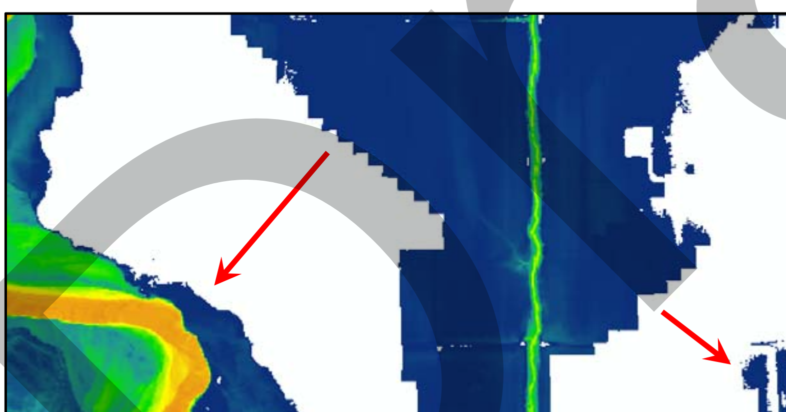
In other cases, irregularities appear at stream confluences. Generally, in hydraulic modeling, the main receiving stream has higher flows than tributary streams, and therefore exert backwater effects on these tributaries. However, in some portions of these watersheds, tributary streams have higher flows at their confluences with the main receiving stream than the main receiving stream itself. This is likely due to various factors such as geology, climate, contributing watershed area, floodplain geometry, and so on.



In this example, the tributary stream has a higher water surface elevation than the main receiving stream, and therefore backwater effects do not eliminate a “cliff” or “waterfall” in the water surface calculated by automated modeling. It appears here that this result may be influenced by the shared floodplain of the tributary and the main receiving streams.

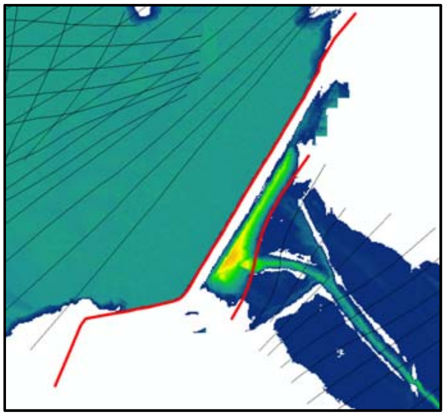
Efforts have been made to account for all manner backwater effects in the automated modeling, but the possibility still exists that this issue remains.

Next, in some areas, the automated modeling was unable to “close” a floodplain and determine a boundary. In most cases this appears to be the results of the limitations of automated 1D modeling that cannot account for split flows or areas of low topographic relief causing weir flow or sheet flow of water outside of a floodplain into another. These particular examples mentioned require 2D modeling to accurately determine flood prone areas subject to these conditions, which is usually reserved for detailed study areas, and is beyond the scope of low-level (base level) automated engineering methods. Other situations may also exist. In places where the model could not “close” a floodplain, usually because the water surface elevation did not intersect the ground on one side, the program eventually chose a location and stopped processing. This causes “stair step” boundaries to appear in the dataset, revealing which grid sectors were processed by the program and which were not.



“Stair step” boundaries caused by the program’s inability to “close” the floodplain. Note that the depths here are very shallow, usually less than six inches. It is possible that there may be weir flow or sheet flow into adjacent floodplains (indicated by red arrows), which is not in included in basic 1D modeling.

Finally, values in the depth grids at dams are another irregularity. At some identified dam sites, automatically generated cross sections were not used, and instead an engineer manually added cross sections at the top and bottom of the dam structure. Depth values at dams between these two cross sections represent waterfall-type conditions and may show water depth deeper than it may actually occur. Again, at structures like dams, modeling the flow of water over or around das and spillways is usually conducted for detailed studies and is beyond the scope of low-level (base level) analysis.



The cross sections at the top and bottom of this dam are indicated by heavy red lines. All others are indicated by thin black lines. Note that the water depths between the two dam cross sections, especially at the head of the channel at the foot of the dam, have higher depth values than elsewhere in the flood plain. These values may be erroneous. The cross sections do manage to pick up two tiny portions of the unmodeled spillway, located in the lower center portion of this image.

3.0 EXCEPTIONS AND SPECIAL CONSIDERATIONS

S_FRD_Pol_Ar: Some fields, such as those relating to hazard declarations, flood policies, and hazard mitigation plans, are populated with null values since information for those fields is not available at this time.

S_HUC_Ar: No comments.

S_Studies_Ln: This feature class has no records since conducting a CNMS assessment is not included in the scope for this study.

S_Unmapped_Ln: This feature class has no records since conducting a CNMS assessment is not included in the scope for this study.

Dtl_Stud_Ar: Fields relating to point-of-contact information are populated with null values since this information is not available. Fields relating to LOMRs are populated with null values since no applicable LOMRs exist within the study area. Additionally, polygons covering the two HUC8 watersheds of the Canadian River and outside the BLE data area were added since this area is being studied separately by the United States Army Corps of Engineers. Their results are expected to be combined with the BLE assessment when the next map revision is made. Thus, to indicate this future detailed study, these polygons have been attributed with FIRM panel numbers with the next (future) suffix and a null value for the effective date.

Dtl_Stud_Ln: Fields relating to point-of-contact information are populated with null values since this information is not available. Fields relating to LOMRs are populated with null values since no applicable LOMRs exist within the study area. Additionally, polylines extracted from the National Hydrography Dataset and representing the Canadian River were added, since this area is being studied separately by the United States Army Corps of Engineers. Their results are expected to be combined with the BLE assessment when the next map revision is made. Thus, to indicate this future detailed study, these polylines have been attributed with FIRM panel numbers with the next (future) suffix and a null value for the effective date.

Fld_Haz_Ar: Automated processing usually produces “dirty” areas and “noise”, such as including small, low-lying areas adjacent to a flood zone as being in the flood zone even if they are not hydrologically connected to it. Additionally, it can generate polygons that are near-microscopic in size. To correct for these issues, to “clean” the dataset, and to conform to general FEMA mapping standards, polygons smaller than 1 acre in size (43,560 square feet) have been eliminated. Additionally, the largest polygon representing the area of “low” flood risk and analogous to “Area of Minimal Flood Hazard” could not be shown as a single polygon due to exceeding the vertex limit in ArcGIS. Thus, it has been divided into smaller polygons at HUC8 boundaries, and along major streams that divide the study area into approximate quadrants. Finally, the area within the Canadian River drainage and that is being studied by the United States Army Corps of Engineers is shown as Zone D *only for BLE database purposes*. However, in the *Estimated Base Flood Elevation Viewer*, flood zone designations are not shown and users will only see this area as “low” flood risk.

Subbasins: This feature class has no records since the automated processes used do not generate subbasins as part of its hydrologic modeling.

TenPct_FP: Automated processing usually produces "dirty" areas and "noise", such as including small, low-lying areas adjacent to a flood zone as being in the flood zone even if they are not hydrologically connected to it. Additionally, it can generate polygons that are near-microscopic in size. To correct for these issues, to "clean" the dataset, and to conform to general FEMA mapping standards, polygons smaller than 1 acre in size (43,560 square feet) have been eliminated

Wtr_Ar: This feature class has no records since waterbodies with static elevations were not used in the hydraulic modeling.

Wtr_Ln: Water line features were taken directly from the profile base lines in the hydraulic modeling. These lines were previously refined to the terrain data as described in Section 2.3 above. However, for hydraulic modeling purposes it was necessary for these profile base lines to extend for some distance beyond the downstream confluence (mouth) of the stream. This creates overlapping features for most streams in the study area. For the Wtr_Ln feature class, these polylines were edited to remove these overlaps, and stream lines end at their downstream confluences. Stream names were taken from the National Hydrography Dataset or from published FIRMs. Name identifiers were not generated for unnamed streams. However, each stream, whether named or unnamed, has a unique Model ID, which is recorded in the corresponding XS file.

XS: Cross sections were extracted directly from the hydraulic modeling.   Start ID points and cross sections letters were not identified for the Base Level Engineering database. Due to the density of the cross sections generated by the automated processes, not every cross section is attributed as "Mapped" (it will be visible in the *Estimated Base Flood Elevation Viewer*). Any cross section affected by backwater effects in the modeling (where the water surface elevation value in the cross section is different from the value in the water surface elevation grid at that location) is attributed as "Not Mapped" (it will not be visible in the *Estimated Base Flood Elevation Viewer*). Thereafter, every fourth cross section on a stream is shown as "Mapped" and the intervening three cross sections are shown as "Not Mapped".

S_AOMI_Pt: Dam features within this feature class were obtained from the Oklahoma Water Resources Board. The source metadata indicates the spatial accuracy of the data "is low" and a reference scale value is not provided. Thus, the scale value for this reference is not populated in the L_Source_Cit table. Where possible the dam points were snapped to the water line at the top of the dam structure as it is visible in the terrain data. If a dam was located elsewhere not on a modeled stream, its location was placed at the top of the dam where the thalweg would otherwise intersect it. If a dam was not visible in the terrain data (*e.g.* dams located in the Canadian River drainage), it was refined in the same way using aerial photography. Road crossing locations were not generated within the Canadian River drainage basin because the extents of the Canadian River model being developed by the United States Army Corps of Engineers is unknown at this time.

S_CenBlk_Ar: No comments.

BLE_Dep01Pct: Per FEMA Region 6 guidance, the BLE database uses a geographic projection system, but grid data are to be in Universal Transverse Mercator projection. Grid data, therefore are in the UTM projection. The 1-percent-annual-chance event depth grid has been clipped to match the cleaned 1-percent-annual-chance event boundaries shown in the Fld_Haz_Ar feature class. Per FEMA guidance, cell values have been rounded to the nearest 0.1 foot. Cell values that rounded down to 0.0 feet were rounded up to 0.1 feet instead.

BLE_Dep0_2Pct: Per FEMA Region 6 guidance, the BLE database uses a geographic projection system, but grid data are to be in Universal Transverse Mercator projection. Grid data, therefore are in the UTM projection. The 0.2-percent-annual-chance event depth grid has been clipped to match the cleaned 0.2-percent-annual-chance event boundaries shown in the Fld_Haz_Ar feature class. Per FEMA guidance, cell values have been rounded to the nearest 0.1 foot. Cell values that rounded down to 0.0 feet were rounded up to 0.1 feet instead.

BLE_WSE01Pct: Per FEMA Region 6 guidance, the BLE database uses a geographic projection system, but grid data are to be in Universal Transverse Mercator projection. Grid data, therefore are in the UTM projection. The 1-percent-annual-chance event water surface elevation grid has been clipped to match the cleaned 1-percent-annual-chance event boundaries shown in the Fld_Haz_Ar feature class. Per FEMA guidance, cell values have been rounded to the nearest 0.1 foot. Cell values that rounded down to 0.0 feet were rounded up to 0.1 feet instead.

BLE_WSE0_2Pct: Per FEMA Region 6 guidance, the BLE database uses a geographic projection system, but grid data are to be in Universal Transverse Mercator projection. Grid data, therefore are in the UTM projection. The 0.2-percent-annual-chance event water surface elevation grid has been clipped to match the cleaned 0.2-percent-annual-chance event boundaries shown in the Fld_Haz_Ar feature class. Per FEMA guidance, cell values have been rounded to the nearest 0.1 foot. Cell values that rounded down to 0.0 feet were rounded up to 0.1 feet instead.

L_RA_Results: This table has no records since conducting a flood risk assessment is not included in the scope for this study. This assessment is scheduled to be conducted at a later time.

L_Source_Cit: No comments.

4.0 REFERENCES

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Federal Emergency Management Agency; *Domain Tables Technical* Reference; Washington, DC; May 2016.

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Upper West Fork Trinity Watershed, TX
Base Level Engineering (BLE) Results

TWDB Contract No. 1800012224, Task Order 7 (MAS No. 22)
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APPROVALS

This document requires the approval of the following persons:

Role	Name	Review Date	Approved Date
Project Manager	Sean Sutton	September 14, 2021	September 15, 2021

CLIENT DISTRIBUTION

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Manuel Razo	Project Manager/TWDB	Austin, Texas

Table of Contents

Executive Summary

Texas Water Development Board (TWDB) contracted AECOM to complete a Base Level Engineering (BLE) analysis for the Upper West Fork Trinity Hydrologic Unit Code (HUC) 8 in North Central Texas, to support FEMA's Discovery process and validation of effective Zone A Special Flood Hazard Areas (SFHAs). This BLE study will provide significant data for several Texas counties previously lacking modernized flood models.

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 the United States Geological Survey (USGS) regression equations and gage analysis, where stream gages with sufficient record exist. Regression equations were 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).

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) program version 5.0.7 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 Zone A stream miles associated with this validation analysis.

Table ES-1: Summary of Stream Miles

Source	Upper West Fork Trinity Stream Miles
CNMS	891.2

The full inventory of Zone A studies in the watershed were 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	Total Miles
VALID	BEING STUDIED	318.5
UNVERIFIED	BEING STUDIED	572.6

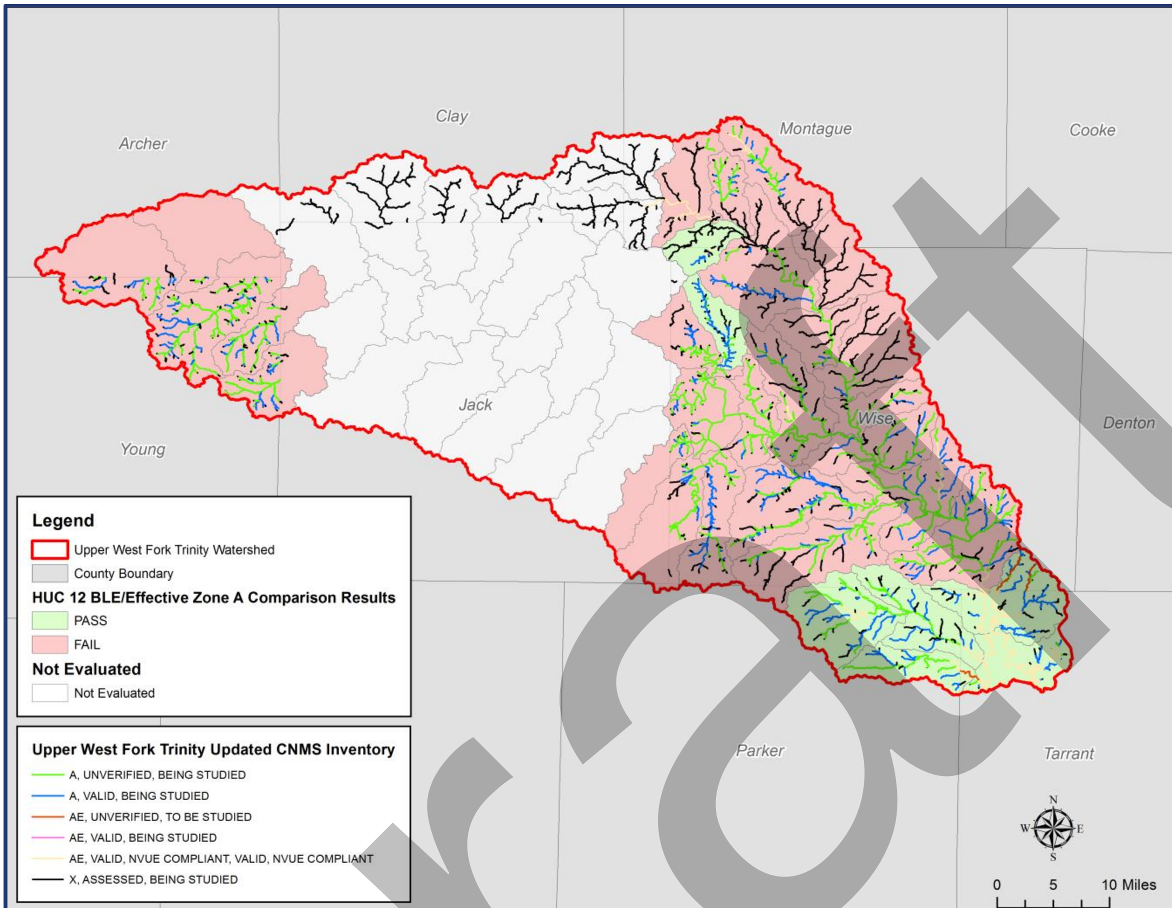

Figure ES-1: Upper West Fork Trinity Watershed CNMS Validation Results

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 Upper West Fork Trinity HUC-8 priority scores which can be used to initiate discussions during the Discovery phase.

Chicken Creek-Big Sandy Creek HUC-12 was determined to have the highest priority score and the most need while Indian Creek-Eagle Mountain Lake HUC-12 had the lowest scores.

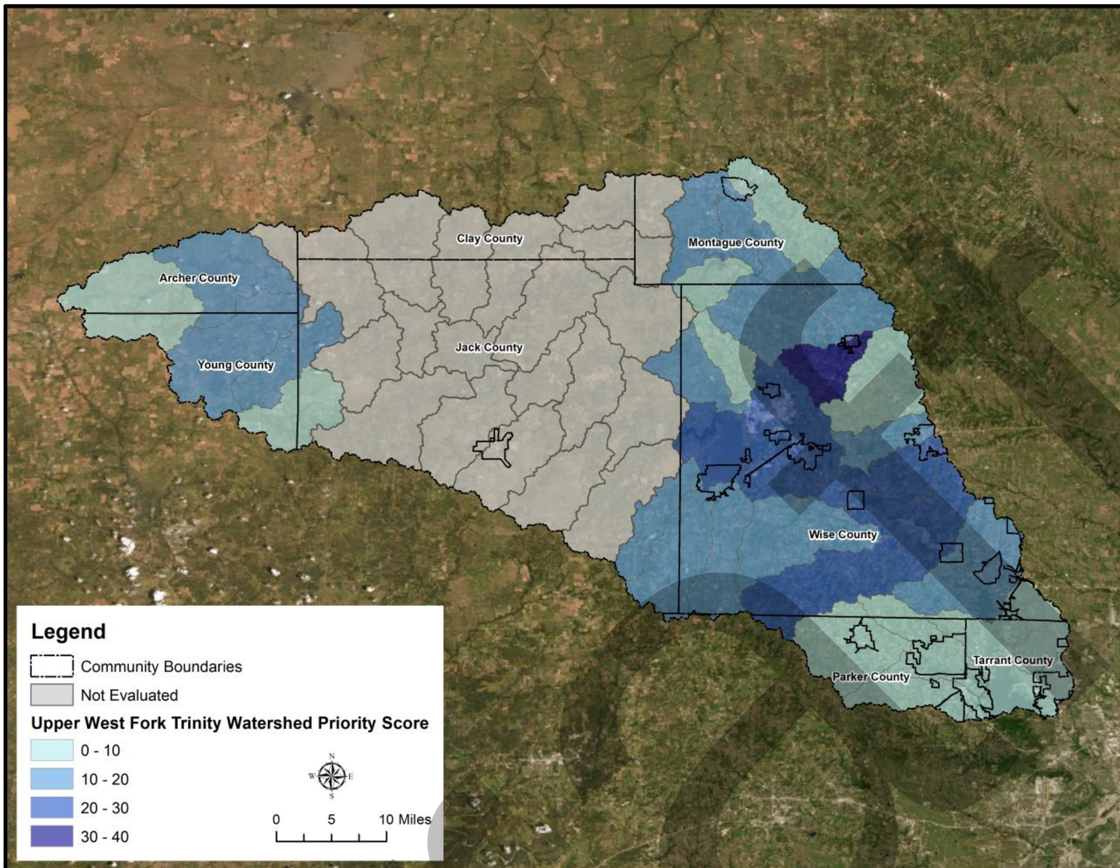

Figure ES-2: Ranking of Upper West Fork Trinity Watershed HUC-12s

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 flood-prone 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 Mapping, Assessment and Planning (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.

TWDB contracted AECOM to complete a BLE analysis for the Upper West Fork Trinity Watershed in North Central Texas to support FEMA's Discovery process and validation of effective Zone A Special Flood Hazard Areas (SFHA). The study extents include portions of Clay, Montague, Parker, Tarrant, Wise, and Young County and include the following communities: the Cities of Alvord, Aurora, Azle, Bowie, Boyd, Bridgeport, Chico, Decatur, Forth Worth, Lake Bridgeport, New Fairview, Newark, Paradise, Pelican Bay, Reno, Rhome, Runaway Bay, Sanctuary, and Springtown. Archer and Jack County were previously studied and were not included in this study. The study area consists of portions of 5 HUC-10 basins: Cameron Creek-West Fork Trinity River, Big Cleveland Creek-West Fork Trinity River, Lake Bridgeport-West Fork Trinity River, Big Sandy Creek, and West Fork Trinity River-Eagle Mountain Lake. Figure 1 shows the orientation of the Upper West Fork Trinity HUC-10 basins with respect to the county boundaries.

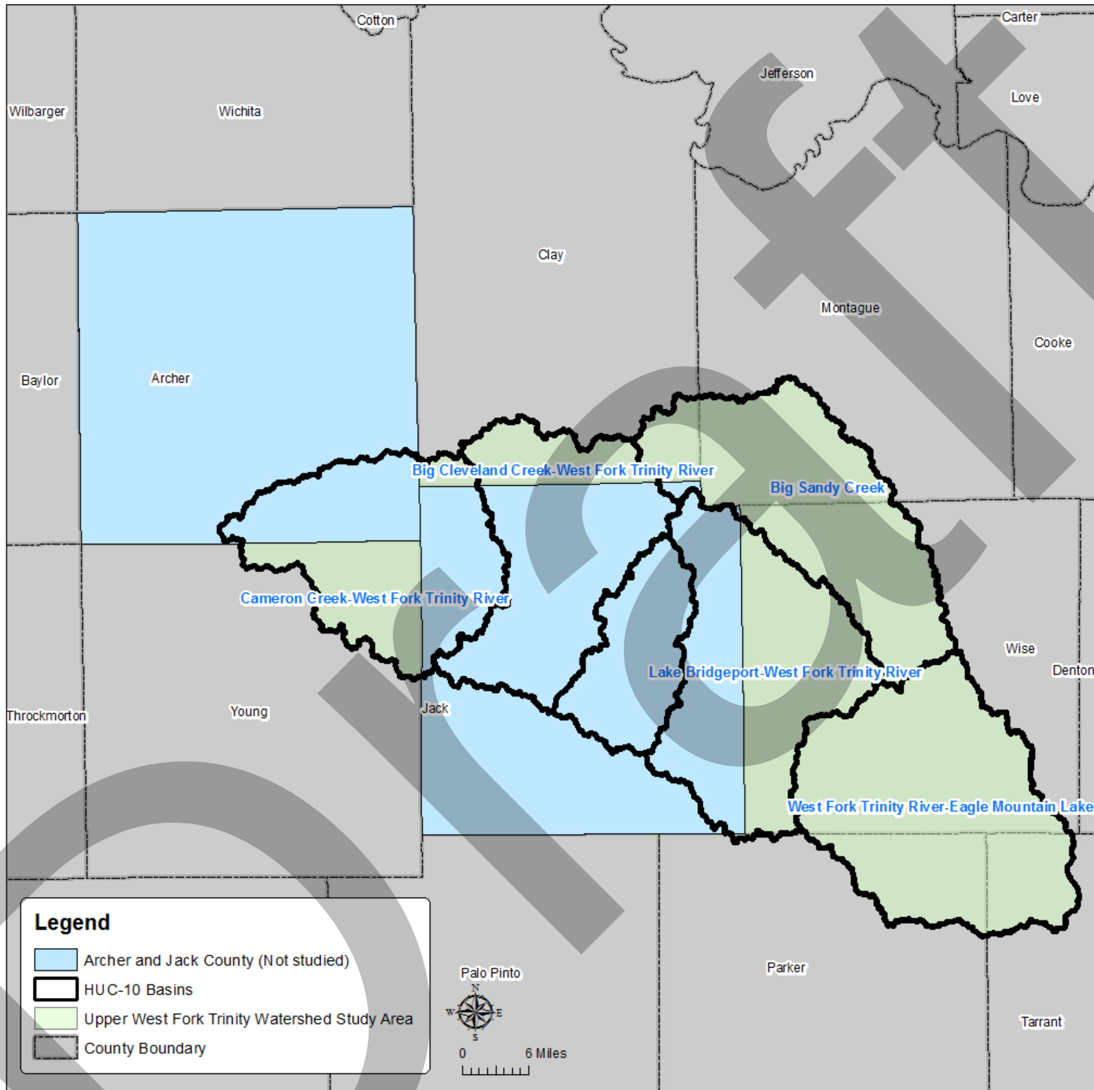

Figure 1: Upper West Fork Trinity Watershed HUC-10 Basins

AECOM studied approximately 1,405 miles of stream reaches within the Upper West Fork Trinity Watershed with a minimum drainage area tolerance of one square mile outside of population centers and half a square mile inside population centers. The selection and extent of stream reaches studied were based upon the number of stream miles with a minimum drainage area of one square mile (or half a square mile, where appropriate) 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 flood areas received an updated analysis. Topographic data from multiple sources were used to determine the hydrologic and hydraulic characteristics of the watershed.

The following sections summarize the BLE process and discuss the results along with their recommended use.

1.1 Topographic Data

Topographic data from multiple sources were used to determine the hydrologic and hydraulic characteristics of the watershed. Topographic data were obtained from the Texas Natural Resources Information System (TNRIS), and the United States Geological Survey (USGS).

All available metadata, survey reports, and other leverage documentation are available with the source dataset. Figure 2 shows the extents of the source Digital Terrain Model (DTM) data used for the Upper West Fork Trinity Watershed.

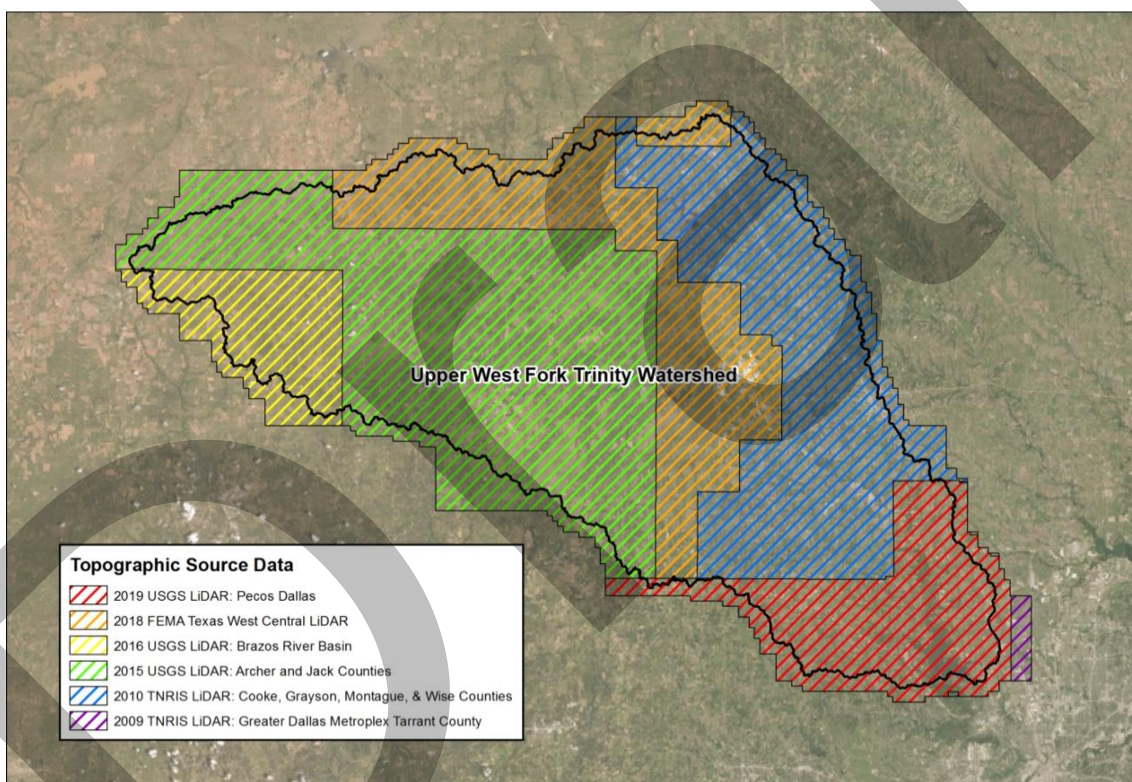

Figure 2: Extent of LiDAR Data for Upper West Fork Trinity Watershed

1.1.1 Source Terrain Data

Six topographic datasets were used in the development of the BLE hydraulic models. Table 1 depicts the complete list of source elevation data leveraged for the Upper West Fork Trinity Watershed. All datasets used for hydraulic analyses and mapping meet the highest specification level defined by FEMA vertical accuracy requirements. The following datasets were evaluated and prioritized as best available and details on each dataset are outlined in the subsections below.

Table 1: LiDAR Topographic Data Available for Upper West Fork Trinity

Year	Description	Source/Owner	Accuracy[1]	Approximate Footprint (Sq.Mi.)[2]
2019	2019 Pecos Dallas, TX LiDAR	USGS	12.9 cm	316
2018	2018 FEMA Texas West Central LiDAR	FEMA	9.1 cm	440
2016	2016 USGS LiDAR: Brazos River Basin	USGS / FEMA	18.8 cm	177
2015	FEMA Region 6: Archer and Jack Counties, TX QL2 LiDAR	FEMA	10.6 cm	825
2010	2010 TNRIS LiDAR: Montague, Cooke, Grayson, and Wise Counties	TNRIS/TWDB	9.25 cm	568
2009	2009 TNRIS LiDAR: Greater Dallas Metroplex Tarrant County	TNRIS/TWDB	7.5 cm	14

[1]RMSEz reported at the 95% confidence level

[2]Size of LiDAR DEM footprint utilized for BLE study

1.1.1.1 2019 Pecos Dallas, TX LiDAR

The 2019 Pecos Dallas, TX Light Detection and Ranging (LiDAR) was acquired from the USGS. Digital Aerial Solutions, LLC (DAS) was tasked to collect and process a LiDAR derived elevation dataset for the 140G0219F0014-TX_Pecos_Dallas_2018. The area encompasses approximately 9,557 square miles Aerial LiDAR data was collected utilizing a Leica ALS80. The ALS80 is a discrete return topographic LiDAR mapping system manufactured by Leica Geosystems. LiDAR data collected for the 140G0219F0014-TX_Pecos_Dallas_2018 QL2 LiDAR survey has an Aggregate Nominal Pulse (ANPS) spacing of (QL2 0.71 meters), and includes up to 2 discrete returns per pulse, along with intensity values for each return.

LiDAR datasets were post processed to generate elevation point cloud swaths for each flight line. Deliverables include the point cloud swaths, tiled point clouds classified by land cover type, breaklines to support hydro-flattening of digital elevation models (DEM), intensity tiles, and bare-earth DEM tiles. The point cloud deliverables are stored in the LAS version 1.4, point data record format 6. The tiling scheme for tiled deliverables is a 1,500-meter x 1,500-meter grid. Tile number is the appropriate cell number values found in the National Geospatial Program index. All deliverables were generated in conformance with the U.S. Geological Survey National Geospatial Program Guidelines and Base Specifications, Version 1.3.

The Root Mean Square Error (RMSE)z reported for the dataset was 12.9 cm at the 95% confidence level which meets project accuracy specifications of the National Standard for Spatial Data Accuracy (NSSDA).

1.1.1.2 2018 FEMA Texas West Central LiDAR

The primary purpose of this project is to support the 3DEP mission and the FEMA Risk MAP program for the TX West Central 2018 D18 Project Area.

The LiDAR data were processed and classified according to project specifications. Detailed breaklines and bare-earth DEMs were produced for the project area. Data was formatted according to tiles with each tile covering an area of 1,500-meter x 1,500-meter. A total of 50,901 tiles were produced for the project encompassing an area of approximately 42,557 square miles. Airborne Imaging, AXIS, Eagle, LEG and Precision Aerial Reconnaissance completed LiDAR data acquisition and data calibration for the project area.

The project area falls within the New Mexico counties of Chaves, Lea and Roosevelt, the Oklahoma counties of Bryan, Choctaw, Cotton, Crane, Jackson, Jefferson, Love, Marshall and Tillman, and the Texas counties of Andrews, Baylor, Borden, Brown, Clay, Cochran, Coke, Coleman, Concho, Cooke, Crosby, Dawson, Delta, Dickens, Ector, Fannin, Fisher, Gaines, Garza, Glasscock, Grayson, Haskell, Hockley, Hopkins, Howard, Hunt, Irion, Kent, King, Knox, Lamar, Lubbock, Lynn, Martin, Midland, Mitchell, Montague, Nolan, Reagan, Runnels, Scurry, Sterling, Stonewall, Taylor, Terry, Tom Green, Upton, Wichita, Wilbarger, Winkler, Wise and Yoakum.

The LiDAR aerial acquisition was conducted from February 1, 2018 thru May 27, 2018. Re-flights were collected on November 5, 2018.

The RMSEz reported for the dataset was 9.1 cm at the 95% confidence level which meets project accuracy specifications of the NSSDA.

1.1.1.3 2016 USGS LiDAR: Brazos River Basin

The primary purpose of this project was to develop a consistent and accurate surface elevation dataset derived from high-accuracy LiDAR technology for the Brazos portion of the Texas Red River FEMA Region 6 Project Area.

The LiDAR data were processed and classified according to project specifications. Detailed breaklines and bare-earth DEMs were produced for the project area. Data was formatted according to tiles with each tile covering an area of 1,500-meter x 1,500-meter. A total of 15,254 tiles were produced for the project encompassing an area of approximately 12,660 square miles. LEG completed LiDAR data acquisition and data calibration for the project area.

The project area addressed by this report falls within the Brazos Basin, TX, which includes the counties of Archer, Baylor, Bell, Bosque, Brown, Callahan, Coleman, Comanche, Coryell, Dickens, Eastland, Erath, Fisher, Hamilton, Jack, Jones, King, Knox, Lampasas, McLennan, Mills, Palo Pinto, Runnels, Shackelford, Stephens, Stonewall, Taylor, Throckmorton, and Young.

The LiDAR aerial acquisition was conducted from November 17, 2016 and May 28, 2018.

The RMSEz reported for the dataset was 18.8 cm at the 95% confidence level which meets project accuracy specifications of the NSSDA.

1.1.1.4 2015 FEMA Region 6 - Archer and Jack Counties, TX QL2 LiDAR

The primary purpose of this project was to develop a consistent and accurate surface elevation dataset derived from high-accuracy LiDAR technology for the FEMA Region 6 Archer and Jack Counties, TX QL2 LiDAR Project Area.

The LiDAR data were processed to a bare-earth DTM. Detailed breaklines and bare-earth DEMs were produced for the project area. Data was formatted according to tiles with each tile covering an area of 1,500-meter x 1,500-meter. A total of 2,252 tiles were produced for the project encompassing an area of approximately 1,671 square miles. Precision Aerial Reconnaissance (PAR) completed LiDAR data acquisition and data calibration for the project area.

The project area addressed by this report falls within the Texas counties of Archer and Jack.

The LiDAR aerial acquisition was conducted from January 4, 2015 to March 12, 2015.

The RMSEz reported for the dataset was 10.6 cm at the 95% confidence level which meets project accuracy specifications of the NSSDA.

1.1.1.5 2010 TNRIS LiDAR: Cooke, Grayson, Montague, and Wise Counties

This project comprises areas in Cooke, Montague, Wise, and Grayson County Texas. The project design of the LiDAR data acquisition was developed to support a nominal post spacing of 4 points per meter. Data was acquired by Surdex Inc. and The Atlantic Group under sub-contract to Surdex from May 20 through August 4, 2010. LiDAR data collection was performed with a Cessna 375 aircraft, utilizing a Leica ALS50-II MPiA sensor and utilizing an Optech Sensor collecting multiple return x, y, and z data as well as intensity data. The boresight of the LiDAR was processed against the ground control consisted of 163 LiDAR ground survey points and 2 airborne GPS base station at the operation airport. The RMSEz reported for the dataset was 9.25 cm at the 95% confidence level which meets project accuracy specifications of the NSSDA.

1.1.1.6 2009 TNRIS LiDAR: Greater Dallas Metroplex Tarrant County

The 2009 TNRIS LiDAR: Greater Dallas Metroplex Tarrant County project area spans 322 tiles covering 1,061 square miles and supports the National Flood Insurance Program in the development of accurate flood zone maps as well as the USGS's efforts in maintaining its National Elevation Data. The sensor used to acquire the data was the Leica ALS-50. The RMSEz reported for the dataset was 7.8 cm at the 95% confidence level which meets project accuracy specifications of the NSSDA.

1.1.2 Terrain Data Processing

A qualitative visual inspection of the composite DEM was performed, and no indications of 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. A small, triangular data gap was detected in between source LiDAR-derived datasets, however, and it was decided that this would be best filled by using a nearest neighbor interpolation of the closest LiDAR points. The result matched well with existing topographical maps. Because the gap was so small, no backup source data was necessary.

The Watershed Information System (WISE) software platform was used in order to create a digital surface model for the Upper West Fork Trinity Watershed project area. This module, in conjunction with ArcGIS, allows source data from a variety of sources to be prioritized based on level of accuracy or preference of the user. The 2019 Pecos Dallas, TX LiDAR dataset was prioritized as the best data source for the Upper West Fork Trinity Watershed, followed by the 2018 FEMA Texas West Central LiDAR, the 2016 USGS LiDAR: Brazos River Basin, the 2015 FEMA Region 6 - Archer and Jack Counties, TX QL2 LiDAR, the 2010 TNRIS LiDAR: Montague, Cooke, Grayson, and Wise Counties, and lastly the 2009 TNRIS LiDAR: Greater Dallas Metroplex Tarrant County.

These LiDAR datasets, described more thoroughly in Section 2.2 above, were compiled in order of vertical accuracy into a mosaic dataset using ArcMap. From this mosaic, a seamless 10-foot bare earth DEM was exported. Visual inspection of the 10-foot DEM was performed to ensure no voids and/or artifacts were present. The DEM surface model was affirmed to be suitable for hydraulic takeoffs and supporting other hydraulic analyses. A tile index was created for the project area, and the exported DEM was clipped into 40,000-foot tiles, converted to ascii files and imported into Wise Terrain Analyst (WTA).

Stream centerlines were created from the 10-foot DEM using proprietary software that is used to identify natural sinks, peaks and flat areas. 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 flowed downstream correctly and routed to outside of the project area. A rigorous visual QC was performed to ensure proper stream alignment through dams and culverts and to ensure the stream lines represented the stream bed channel correctly. Manual adjustment was applied where necessary as well as ensuring the stream did not jump a channel bank and flow into a neighboring stream. In open water areas, a more generalized line was used to flow through the middle of the water body.

These stream centerlines were then merged with those from two other sources: existing verified study streams from Archer and Jack Counties, and major streams (greater than 0.9 square miles of drainage area) that had been manually corrected from ArcHydro. The merged stream lines were then used as the basis for the hydraulic analysis and the hydro-enforcement of the 50-foot DEM. Several routines were subsequently used to take localized elevations from the source topographic data and apply them to the streams. This transferred vertical elevation information to each of the stream lines' vertices. The resulting elevations ensured that the streams were 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 was then "burned" into the 50-foot DEM to force flow through structures while preventing it from jumping out of the channel banks. This 50-foot DEM was used for hydro enforcement of the project area. Similar processes were performed to automate and manually route the flow through the 50-foot DEM to the outfall of the project area.

1.2 Hydrology

Flood discharges for this study were calculated using both the USGS regression equations and gage analysis, where stream gages with sufficient record exist. Regression equations utilized were 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). Bulletin 17C guidelines were utilized to perform a Flood Frequency Analysis (FFA) for the gages within the Upper West Fork Trinity watershed, and consideration was given to an on-going detailed hydrologic analysis by the U.S. Army Corps of Engineers (USACE) Fort Worth District of the Trinity River basin (see below for further discussion).

1.2.1 Regression Analysis

The WISE software was used to delineate drainage basins in shapefile format using the 50-foot DEM. WISE was also used to calculate the main-channel slope for each basin. The basin shapefile attribution was automated by WISE with drainage area, main-channel slope, precipitation, and OmegaEM. Table 2 shows the published equations used in 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 (cfs), P represents mean annual precipitation in inches, S represents dimensionless main-channel slope, Ω represents the OmegaEM parameter, and A represents cumulative drainage area in square miles.

Table 2: Summary of Regression Equations in Texas (SIR 2009-5087)

Recurrence Interval	Equation[1]
$Q_{10\%}$	$PREC^{1.203}S^{0.403} * 10^{[0.908*\Omega + 13.62 - 11.97*CONTDA\wedge(-0.0289)]}$
$Q_{4\%}$	$PREC^{1.140}S^{0.446} * 10^{[0.945*\Omega + 11.79 - 9.819*CONTDA\wedge(-0.0374)]}$
$Q_{2\%}$	$PREC^{1.105}S^{0.476} * 10^{[0.961*\Omega + 11.17 - 8.997*CONTDA\wedge(-0..0424)]}$
$Q_{1\%}$	$PREC^{1.071}S^{0.507} * 10^{[0.969*\Omega + 10.82 - 8.448*CONTDA\wedge(-0.0467)]}$
$Q_{0.2\%}$	$PREC^{0.988}S^{0.569} * 10^{[0.976*\Omega + 10.40 - 7.605*CONTDA\wedge(-0.0554)]}$

Variables:

Q_i, peak flow for i recurrence interval (a.c.e.), in cubic feet per second;
PREC, mean annual precipitation, in inches;
S, Main-channel slope (dimensionless);
Ω, OmegaEM parameter;
CONTDA, Contributing 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 as $Q_{1\%+/-} = Q_{1\%} \times (10^{\pm 0.30})$ where 0.30 is the residual standard error in $\log_{10}$-unit of cubic feet per second for the $Q_{1\%}$ equation (Table 3 in SIR 2009-5087). In other words, these values were computed by multiplying the $Q_{1\%}$ discharges by 1.995 and 0.501 respectively, which account for the $\log_{10}$ format residual standard error of 0.30 associated with the $Q_{1\%}$ regression equation.

The mean annual precipitation values were determined based on a shapefile coverage obtained from the TWDB and is available for download at the following location: https://www.twdb.texas.gov/mapping/gisdata.asp

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

Main-channel slope was calculated in WISE. An automated routine determined the longest flowpath from upstream of a reach to the outlet of the sub-basin of interest. Two points along the channel, one at 0 percent and the other at 100 percent of the channel length, determined the endpoints of the segment used in the main-channel slope calculation. The elevations for those endpoints were based on the 10-foot DEM developed from the LiDAR.

From 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 Omega EM values on a sub-basin basis. For sub-basins spanning more than one OmegaEM grid, the sub-basin's centroid determined its OmegaEM parameter.

Drainage area for each sub-basin was determined based on automated basin delineations performed by WISE. Basin break points were set by the user with a sub-basin target size of one square mile. Break points were also set immediately 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.

The sub-basin shapefile was attributed with the computed discharges, and those discharges were incorporated into the HEC-RAS 5.0.7 models using an automated routine in WISE. Discharges, as well as water surface elevation results, were associated with the hydraulic cross sections prior to generation of floodplain boundaries and grid mapping. Those results are available in GIS format as part of this BLE submittal package.

1.2.2 Stream Gage Analysis

Figure 3 shows the location of the (5) USGS stream gages in the Upper West Fork Trinity River watershed that were utilized in developing discharges for the Upper West Fork Trinity mainstem (see Table 3 for details related to each gage). Flood frequency analyses (FFA) were performed in Peak FQ Version 7.3 for these gages, according to Bulletin 17C guidelines.

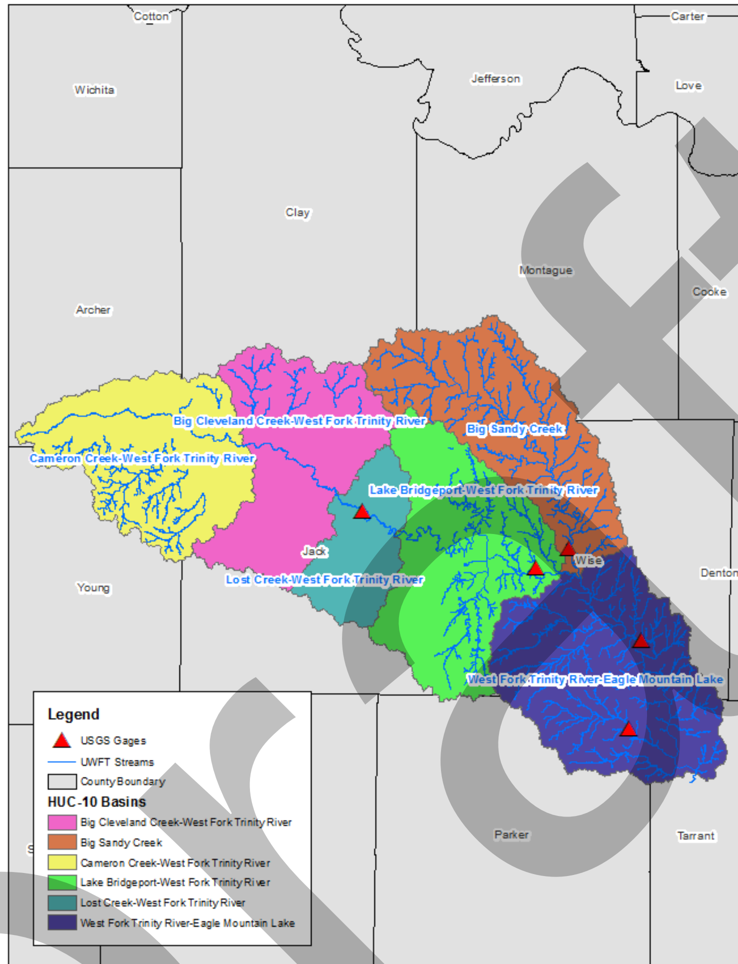

Figure 3: Locations of USGS Gages Utilized in Flood Frequency Analyses

Table 3: USGS Stream Gages in Upper West Fork Trinity Watershed

Gage ID	Flooding Source and Location	Computed Drainage Area (mi.^{2})	Published Drainage Area (mi.^{2})	Period of Record
08044000	Big Sandy Creek nr Bridgeport, TX	333	333	1956-2020
08043500	W Fk Trinity Rv at Bridgeport, TX	1,147	1,147	1908-1932
08044500	W Fk Trinity Rv nr Boyd, TX	1,725	1,725	1948-2019
08042800	W Fk Trinity Rv nr Jacksboro, TX	683	683	1915-1973
08044800	Walnut Ck at Reno, TX	62.4	75.6	1993-2020

After discussion with USACE Fort Worth District and the Tarrant Regional Water District, it was suggested to utilize flows from the Interagency Flood Risk Management (InFRM) study on the Trinity River Basin for the West Fork Trinity River mainstem. The flows utilized for this study were obtained from the September 2020 draft report due to the timing of this study. A newer version of this report is available as of July 2021 which has updates to the reported mainstem peak flows that were considered too minor to significantly impact the mainstem BLE modeling results.

However, stream gage analysis was incorporated in the development of the final discharges for the Big Sandy Creek and Walnut Creek tributaries. The flood flow frequency data from these gages were weighted with the regression developed discharges using the procedures described in SIR 2009-5087. Gage adjusted discharges were held constant if the adjustment resulted in flows decreasing the downstream direction. Gage variances were used for each storm event to develop the weighted discharges.

For Big Sandy Cr, the period of record used for the gage analysis excludes records prior to 1956. These records were not affected by diversion/regulation and do not reflect current conditions. For the West Fork Trinity Rv near Jacksboro, TX gage, an upper limit of 27,000 cfs was used in PeakFQ to represent the years with missing gage records. Records after 1973 were not used for the Jacksboro gage due to regulation. For the Big Sandy Creek and Walnut Creek gage analysis, a confidence interval of 0.84. However, for the W Fork Trinity Rv gage analysis, a confidence interval of 0.95 was used for comparison with the InFRM flows. Stream gage analysis worksheets are available as a part of this BLE submittal package.

1.2.3 InFRM Trinity River Basin Watershed Hydrology Assessment for Trinity River - Basin Flows

As mentioned above, the West Fork Trinity River mainstem utilized flows from the USACE InFRM Trinity River Watershed Hydrology Assessment Draft Report (September 2020). The following table shows the flow locations used from the report and the computed 1% discharge.

Table 4: InFRM Trinity River Basin Study – Mainstem Discharges

Flooding Source and Location	Drainage Area (mi.^{2})	1% Discharge (cfs)
Upper West Fork Trinity below Beans Creek	874.6	62,900
Bridgeport Reservoir Inflow	1,095.7	132,300
Bridgeport Reservoir Outflow	1,095.7	22,200
Upper West Fork Trinity above Dry Creek	1,136.2	22,200
Upper West Fork Trinity above Big Sandy Creek	1,169.5	28,000
Upper West Fork Trinity below Big Sandy Creek	1,523.5	49,300
Upper West Fork Trinity near Boyd, TX	1,710.8	55,100
Eagle Mountain Reservoir Inflow	1,956.6	102,700
Eagle Mountain Reservoir Outflow	1,956.6	29,000

Flows for the other events were also incorporated from the InFRM report. However the 1% plus and 1% minus flows were not included in the InFRM Report. The 1% plus and minus flows were calculated using the methodology listed in Bulletin 17B. Using the 2-year flows from the InFRM report resulted in unreasonable results in the 1% plus, therefore a 2-year flow was estimated using a log-log best-fit equation and then applied to the 1% plus and minus methodology.

1.3 Hydraulics

The hydraulic approach for this BLE analysis of the Upper West Fork Trinity Watershed consisted of using the terrain model described in Section 1.1 in combination with the hydrologic outputs from Section 1.2 to establish water surface elevations using 1-D steady state analysis. The HEC-RAS program version 5.0.7 was chosen as the computer model to compute water surface elevations on a stream by stream basis. The WISE software was used to establish model stream orientation, generate initial hydraulic cross section layout and stationing, assign n-values to cross sections, and 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 that varies cross section spacing based on the cumulative 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. Next, a second pass inspection for cross-section placement and alignment 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 and other locations deemed by the engineer to be ineffective at conveying flow downstream.

Cross-sections were drawn on dam crests for dams with well-defined spillways in order to better represent ponded water upstream of the structures. In so doing, it was assumed 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 effective Zone A boundaries, and the results were deemed reasonable.

The relationship between cumulative drainage area and assigned channel geometry is shown in Table 5. These default values for dimensions and spacing were subject to change based on engineering judgment.

Table 5: Cross-Section Default Parameters

Drainage area (upper limit) (sq. mi)	XS Spacing (ft)	Channel Top Width (ft)	Channel Bottom Width (ft)	Channel Depth (ft)
1	300	6	5	0.8
2	300	7	6	0.8
4	300	10	8	0.8
8	400	12	11	0.8
10	500	13	12	0.8
15	500	18	13	0.8
20	500	19	14	0.8
25	500	20	15	0.8
30	500	21	16	0.8
40	500	25	17	0.8
50	600	28	18	0.8
75	600	30	19	1
100	750	33	20	1
150	750	36	21	1
250	1000	38	22	2
500	1500	40	23	2
1000	2500	100	50	3
2000	2500	150	75	3
5000	2500	200	100	3

In typical BLE projects, Manning’s roughness coefficients (n-values) are determined using the 2016 National Land Cover Data (NLCD) dataset in combination with n-values from Chow (1959) and Calenda et al. (2005). For this watershed, the n-values for the developed areas indicated an underestimation of the roughness coefficients when compared to the aerial imagery and were adjusted accordingly. The association between the n-values and the NLCD Classification is shown in Table 6. Manning’s n-value takeoffs are performed by WISE (default values taken from the “Normal” column). N-values within channel banks are constrained by the automated routine to a range of 0.030 to 0.070. Then, overbank and channel n-values are manually adjusted in certain locations based on engineering judgment.

Table 6: Manning's "n" Roughness Based on 2016 NLCD Classification (Moore, 2011)

NLCD Classification	Selected Manning's N	Minimum	Normal	Maximum	Source
Open Water	0.033	0.025	0.03	0.033	Chow 1959
Developed, Open Space	0.04	0.01	0.013	0.016	Calenda et al. 2005
Developed, Low Intensity	0.08	0.038	0.05	0.063	Calenda et al. 2005
Developed, Medium Intensity	0.1	0.056	0.075	0.094	Calenda et al. 2005
Developed, High Intensity	0.15	0.075	0.1	0.125	Calenda et al. 2005
Barren Land	0.025	0.025	0.03	0.035	Chow 1959
Deciduous Forest	0.16	0.1	0.12	0.16	Chow 1959
Evergreen Forest	0.16	0.1	0.12	0.16	Chow 1959
Mixed Forest	0.16	0.1	0.12	0.16	Chow 1959
Scrub/Shrub	0.1	0.035	0.05	0.1	Chow 1959
Grassland/Herbaceous	0.035	0.025	0.03	0.035	Chow 1959
Pasture/Hay	0.03	0.03	0.04	0.05	Chow 1959
Cultivated Crops	0.035	0.025	0.035	0.045	Chow 1959
Woody Wetlands	0.12	0.08	0.1	0.12	Chow 1959
Emergent Herbaceous Wetland	0.07	0.07	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 large drainage areas (generally greater than 8 square miles), the normal depth slope was calculated based on the channel inverts of the downstream cross sections.

In cases where streams tie in to a lake, a normal depth slope was calculated based on the channel inverts of the downstream cross sections (typically between 0.0001 and 0.001 ft/ft). Several HUC-10s within this watershed are located in urban areas with storm drain systems, which are unaccounted for in the BLE models. Implications of these systems may considerably affect risk.

1.3.1 InFRM Trinity River Basin Study Reservoir Elevations

Coordination with the Tarrant Regional Water District and USACE was initiated for discharges and reservoir elevations, particularly for the Bridgeport Reservoir. The InFRM Watershed Hydrology Assessment for the Trinity River Basin provided recommended frequency pool elevations for large reservoirs/dams. The pool elevations were incorporated into the HEC-RAS model as known WSELs. The 1% plus and minus pool elevations were not provided in the report, but were calculated based on a discharge interpolation. Table 7 below shows the water surface elevations incorporated at each location for the Upper West Fork Trinity HEC-RAS model.

Table 7: InFRM Trinity River Basin - Reservoir Elevations

Reservoir	Drainage Area (sq. mi)	10%	4%	2%	1%	0.2%	1% minus	1% plus
Bridgeport Reservoir	1095.7	839.5’	842.2’	845.5’	848.8’	855.6’	846.3’	851.9’
Eagle Mountain Reservoir	1956.6	651.3’	654’	656.5’	659.5’	666’	656.9’	663.8’

1.3.2 Jack and Archer County Tie-ins

A BLE analysis was previously conducted for Jack and Archer Counties as part of a separate BLE study. That study has since been incorporated largely into the effective mapping for Jack and Archer Counties. Several streams in this UWFT study area (outside of Jack and Archer Counties) continue upstream or downstream into Jack and Archer Counties. Cross-sections from the Jack and Archer studies were incorporated into this BLE study at the county boundary and known water surface elevations were applied to the HEC-RAS model to ensure a proper tie-in at the county boundary. In some instances, a scoped stream was not studied in Jack and Archer County. For those streams, the model study was extended downstream into Jack or Archer County in order to tie-in to the effective mapping.

1.4 Quality Control

Following the initial hydraulic model analysis in each watershed, the resulting flood hazard area delineations were reviewed for areas where the results were not ideal.

Quality Control (QC) review 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 effective SFHA data.

Typical revisions 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 75 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 the addition of cross-sections at confluence areas (see Figure 5 below), modifications to improve perpendicular orientation at the channel, adjustment of discharge breaks to better represent flow addition points, revisions to cross sections at dams, additional cross-sections bounding major hydraulic structures, 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 any other frequency 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.

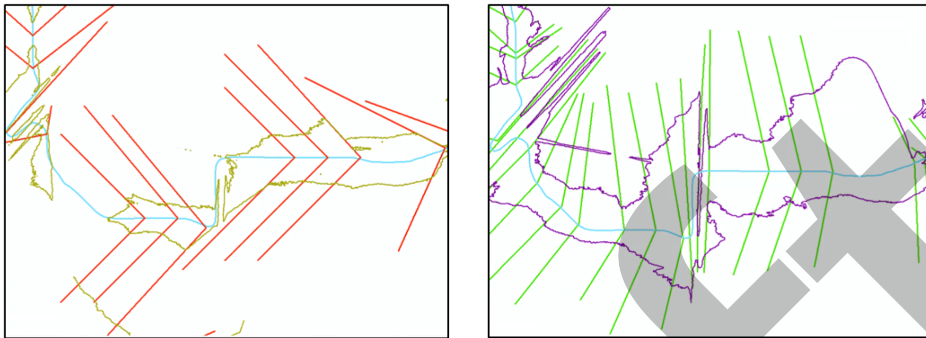

Figure 4: Default "V" angle cross-sections automated by WISE (left). Manually edited cross-sections to more accurately capture terrain (right). Resulting flood boundaries shown in gold (left) or purple (right) for clarity.

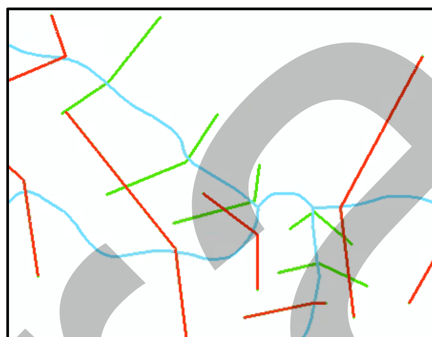

Figure 5: Manually added cross-sections (green) to improve accuracy of tie-ins at confluences.

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, all polygons greater than 5,000 square feet are investigated, but all polygons, including those less than 5,000 square feet that intersect the stream lines were included in the final output. 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. In general, islands less than 2 acres were inspected and 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

There are a handful of dams throughout the watershed of different sizes. Flow differences from these structures were not considered with the calculated regression equations used. There are also three levees located in the watershed, the Wise Lake Levees, Garrett Creek Levees, and Salt Creek Lake Levee. All of these levees are non-accredited and do not meet the 44 CFR Part 65.10. BLE mapping reflects a natural valley floodplain approach, and therefore flood impacts of the levees were not considered. There may be need for further investigation in areas that include these structures, particularly the dams designed for flood control.

There are several containment issues in the West Fork Trinity-Eagle Mountain Lake watershed. Many of the issues occurred in areas where multiple streams converged in low lying areas were containment could not easily be obtained. All streams where overtopping errors occur should be considered for detailed study. These streams are discussed further in the following paragraphs.

The outflow of Salt Creek and Garret Creek should also be considered for detailed study. The two streams both have large flows, between 20,000-30,000cfs during the 100-yr event, and run almost parallel to each other. Salt Creek in this area has been confined to a small undersized ditch that does not contain the 100-yr event. This has caused most of the flow to shift to Garrett Creek. Since the flows are high and the floodplains are shared, this area is recommended for detailed study.

There are a few additional areas with shared floodplains including South Fork Rush Creek and North Fork Rush Creek, UNT 109 and Salt Creek, and UNT 180 and UNT 034. In these areas two streams run parallel to each other and share a floodplain, causing issues with mapping. These areas are recommended for detailed study.

There are also some streams where cross sections are overtopping because the stream is confined to one side of a road or within a confined ditch. These streams, including UNT 166, UNT 003, UNT 178, UNT 049 could spill over into adjacent low-lying areas are recommended for detailed study.

A few additional streams in the work area are not contained and tend to flow into adjacent low-lying areas including areas of Browder Creek, UNT 098 wants to flow into Walnut Cr, and UNT 044 wants to flow into UNT 045. Similarly, there are streams with adjacent low-lying areas like pools and ponds. These streams including UNT 264, UNT 230, UNT 190, and UNT 196 should be studied further to determine how much flow is contained within these ponds.

There were no discernable containment issues across the Big Sandy Creek watershed. UNT 203, however, was a unique scenario that had cross section vertices set on top of road US Highway 380 as opposed to typical ground terrain in an effort to contain flows. UNT 203 for the Waggoner Branch watershed is recommended for further detailed study.

Along Big Sandy Creek there are several confluences with the main stem that have shared floodplains where streams run in parallel to each other. The confluence of Big Sandy Creek and Waggoner Branch poses a unique scenario in which the Waggoner Branch tributary takes the place of Big Sandy Creek as the mainstem based on previous NFHL data. The Big Sandy Creek and Waggoner Branch streams also run parallel to each other with 100-yr flows exceeding 40,000cfs. Consequently these streams are recommended for detailed study.

There were a few additional locations with shared floodplains including Briar Branch and UNT 178, Brushy Creek and UNT 156, Big Sandy Creek and Sandy Creek, Big Sandy Creek and Turkey Creek, and Big Sandy Creek and Jones Creek. These locations have been modeled as shared floodplain locations with a significant portion of these streams running parallel.

The Briar Branch and UNT 178 location had an issue pertaining to mapping and it is recommended this area be upgraded for detailed study. UNT 079 was also a location that had issues mapping and may benefit from detailed study.

In the Big Sandy Creek watershed, these streams bordered Jack County: UNT 020, UNT 214, South Creek, UNT 212, UNT 023, Kiel Creek and UNT 047. Tying into the downstream cross section for these streams however was not possible due to resulting differences in water surface elevation between Jack County BLE and Big Sandy Creek BLE models exceeding 0.5ft and overtopping issues when attempting to tie in. These discrepancies were likely due to difference in terrain data cell size between the Jack County BLE study and the Big Sandy Creek BLE study. Consequently, these streams were restudied and incorporated within the scope of the Big Sandy Creek Watershed basin BLE study efforts. Cross sections were adopted from the Jack County BLE models and adjusted or added to as needed for overtopping scenarios or hydraulic structures.

In the Cameron Creek watershed, there were some streams that are overtopping and flow was unable to be contained. These streams include UNT 100, UNT 090, UNT 089, UNT 164, UNT 065, UNT 166, UNT 083, UNT 162, and UNT 188. These streams are recommended for detailed study.

In the Big Cleveland Creek watershed, some cross sections on North Fork Crooked Creek were overtopped and flow was unable to be contained. This stream is recommended for detailed study.

In the Lake Bridgeport watershed, there were some streams that are overtopping and flow was unable to be contained. These streams include Barton Branch, Boons Creek, Dry Creek, Ramsey Creek, UNT 338, UNT 332, UNT 280, UNT 276, UNT 174, UNT 176, UNT 215, UNT 126, UNT 202, UNT 285, UNT 320, and Village Creek. Several of these streams are adjacent to the quarries in the watershed. In particular, Dry Creek, Village Creek, UNT 126, and UNT 133 were difficult to model due to their proximity to the quarries. Additional detailed study is recommended for the streams near the quarry area.

For the Upper West Fork Trinity mainstem, an upstream tie-in with the Jack/Archer County study and effective study was not achieved. The upstream study did not consider the effects from the downstream reservoir (Lake Bridgeport) and appeared to underestimate the water surface elevations at that study's downstream boundary.

Results and Recommendations

The BLE results for this study produced a SFHA that compares favorably with the effective SFHA. These boundaries provide an estimated SFHA in areas that have not been previously studied and therefore 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.

A map showing the BLE results is included as Appendix A.

3.1 CNMS Validation of Effective Zone A SFHA

The inventory of Zone A studies (891.2 miles) in the Upper West Fork Trinity Watershed were classified in CNMS with validation status of “UNVERIFIED” (572.6 miles) or “VALID” (318.5 miles), and with status type of “BEING 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 the Upper West Fork Trinity Watershed, the effective Zone A topographic data leveraged was based primarily upon USGS Topographic maps. The LiDAR sources discussed in Section 1.1 are a significant improvement from the effective Zone A topographic source and, therefore, nearly the entire effective Zone A inventory fails this check. There are three reaches within the HUC-8 watershed that that were updated via a LOMR study that did utilize LiDAR data for the effective study that pass this check.

INITIAL ASSESSMENT A2 – CHECK FOR SIGNIFICANT HYDROLOGY CHANGES

This check involves first determining if regression equations were used for the effective study. Next, it must be determined 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.

Regression equations were not used for any effective Zone A study areas located in the Upper West Fork Trinity Watershed and, therefore, all reaches pass this assessment check.

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. The entire study area is still classified as rural, so all reaches pass this check.

All of the initial assessment results are shown in Table 8.

Table 8: Zone A Initial Assessment Results

Assessment Check	Pass / Fail	Notes
A1 – Topography	Pass/Fail	LiDAR used in effective study/LiDAR sources available are a significant improvement from effective topography
A2 – Hydrology	Pass	Regression equations not used in effective study
A3 – Development	Pass	HUC-12 watershed does not meet urban threshold

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. Almost all Zone A studies within the Upper West Fork Trinity Watershed are old studies not known to be model-backed studies and, therefore, fail this check. There are four effective Zone A reaches within the entire watershed that were updated via a LOMR that are known to be model-backed that pass this check.

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).

Comparison results for these streams were grouped at the HUC-12 level and are summarized in

Table 9 to better understand the general health of the HUC-12 watershed, but the validation check was performed at the stream 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".

Table 9: BLE Comparison Results

HUC-12 Watershed		Total FBS points	Fail	Pass	%Pass	BLE Comparison Pass? (>85%)	Priority Score
Watershed Name	Watershed Number						
Upper West Fork Trinity Watershed	All Streams	44,157	9,304	34,853	79%	FAIL	
Ash Creek	120301010609	1,590	180	1,410	89%	PASS	9.5
Big Creek-Lake Bridgeport	120301010405	1,032	188	844	82%	FAIL	14.6
Blue Creek-Eagle Mountain	120301010605	3,832	717	3,115	81%	FAIL	15.4
Boons Creek	120301010407	1,041	173	868	83%	FAIL	14.8
Briar Branch-Big Sandy Creek	120301010510	500	138	362	72%	FAIL	8.1
Brier Creek-Lake Amon G	120301010503	118	26	92	78%	FAIL	14.1
Chicken Creek-Big Sandy Creek	120301010509	574	330	244	43%	FAIL	33.2
Cowskin Creek-Big Sandy Creek	120301010505	275	24	251	91%	PASS	7.0
Dead Horse Creek-Brushy	120301010103	3,330	803	2,527	76%	FAIL	12.1
Dosier Creek-Eagle Mountain	120301010610	357	31	326	91%	PASS	8.3
Dry Creek-West Fork Trinity	120301010411	2,055	656	1,399	68%	FAIL	23.8
Garrett Creek	120301010602	2,617	483	2,134	82%	FAIL	16.6
Indian Creek-Eagle Mountain	120301010606	1,436	83	1,353	94%	PASS	5.3
Jasper Creek	120301010406	483	93	390	81%	FAIL	11.8
Lake Bridgeport	120301010409	1,923	628	1,295	67%	FAIL	26.1
Lower Brushy Creek	120301010507	32	21	11	34%	FAIL	16.4
Lower Walnut Creek	120301010608	1,694	239	1,455	86%	PASS	9.5
Martin Branch-West Fork	120301010601	1,922	582	1,340	70%	FAIL	26.4
Oak Creek-Jones Creek	120301010504	769	156	613	80%	FAIL	14.5
Plum Creek	120301010104	1,483	325	1,158	78%	FAIL	11.0
Prickly Pear Branch-West Fork	120301010102	94	25	69	73%	FAIL	14.5
Pringle Creek-Big Sandy Creek	120301010508	1,811	346	1,465	81%	FAIL	12.2
Salt Creek	120301010603	1,822	561	1,261	69%	FAIL	25.3
South Fork Trinity River-West	120301010101	1,057	193	864	82%	FAIL	7.3
Upper Brushy Creek	120301010506	849	127	722	85%	FAIL	8.5
Upper Cameron Creek	120301010105	1,288	248	1,040	81%	FAIL	9.6
Upper Walnut Creek	120301010607	2,477	295	2,182	88%	PASS	9.2
Venchoner Creek	120301010404	1,105	116	989	90%	PASS	8.4
Village Creek-West Fork Trinity	120301010410	1,368	427	941	69%	FAIL	26.2
Waggoner Branch-Big Sandy	120301010511	878	203	675	77%	FAIL	16.7
Walnut Creek-West Fork	120301010604	2,517	591	1,926	77%	FAIL	20.6
Willow Creek	120301010408	1,828	296	1,532	84%	FAIL	14.7

VALIDATION RESULTS

Based on the validation assessments and BLE comparison results described above, the CNMS inventory of Zone A studies in the Upper West Fork Trinity Watershed has been updated as summarized in Table 10 and illustrated in Figure 6 below.

Table 10: Zone A Validation Results

Validation Status	Status Type	Total Miles
VALID	BEING STUDIED	318.5
UNVERIFIED	BEING STUDIED	572.6

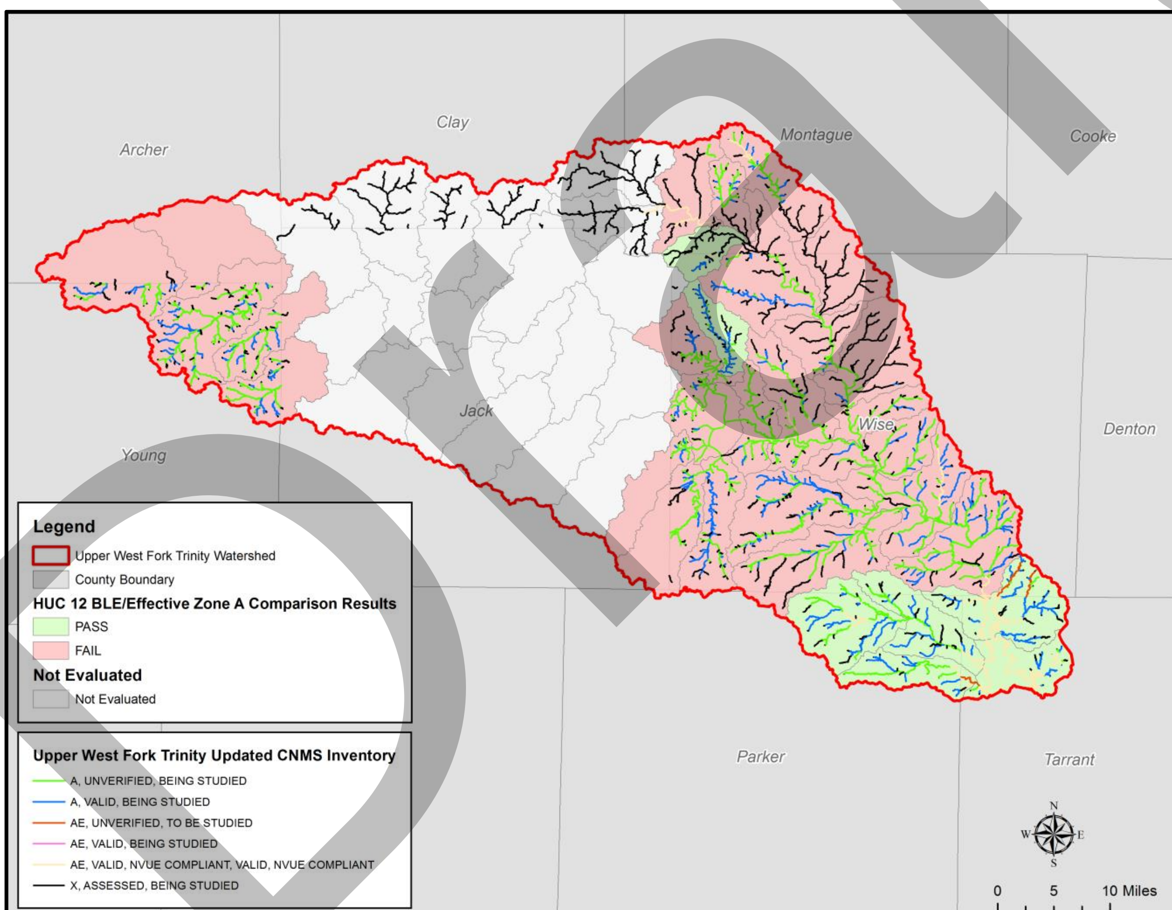

Figure 6: Upper West Fork Trinity Watershed CNMS Validation Results

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 HUC-12 priority scores which can be used to initiate discussions during the Discovery phase.

Chicken Creek-Big Sandy Creek HUC-12 was determined to have the highest priority score and the most need while Indian Creek-Eagle Mountain Lake HUC-12 had the lowest scores.

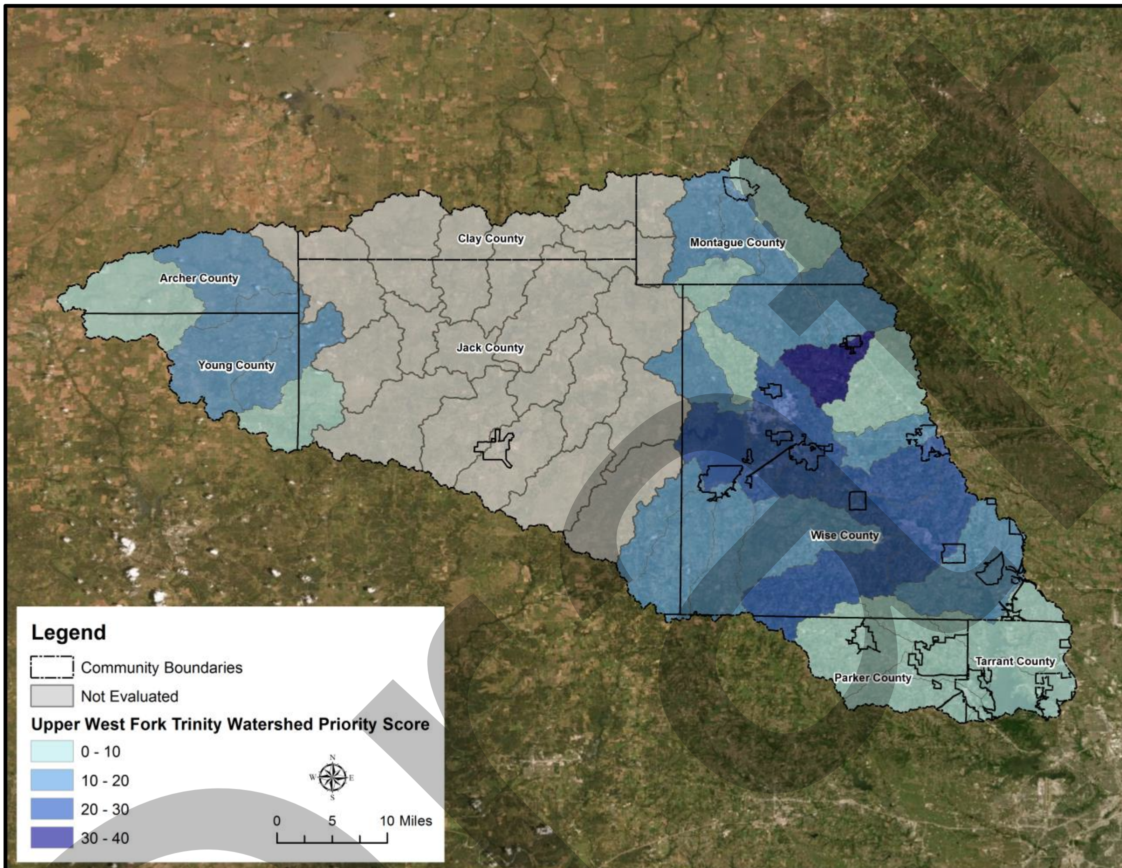

Figure 7: Ranking of Upper West Fork Trinity Watershed HUC-12s

3.2 Flood Risk Analysis

A flood risk analysis was performed for this project. The updated 1% annual chance and 0.2% annual chance depth grids were used to calculate the potential flood losses. The loss results are stored in the S_FRAC_AR spatial file within the FRD geodatabase. All results are reported in whole dollar values.

Hazus version 4.2 (SP03) was used for the basic and refined loss analysis.

The losses are reported via census blocks. It is important to note that Hazus version 4.2 (SP03) 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.

Hazus analysis was performed by county within the project watershed extents for each return period to ensure proper model processing. A summary of results for the 1-percent a.c.e. scenarios are shown in Table 11.

Table 11: Hazus 4.2 (SP02) Results for 1-percent-annual-chance (100 year) scenario

County	Full Replacement - Total Loss	Dollar Exposure (Replacement Value) - Buildings	Dollar Exposure (Replacement Value) - Contents
Archer	3,000	2,000	1,000
Clay	934,000	507,000	263,000
Jack	24,000	14,000	6,000
Montague	52,582,000	21,806,000	13,318,000
Parker	68,693,000	21,930,000	18,497,000
Tarrant	118,826,000	43,067,000	34,222,000
Wise	225,460,000	79,524,000	67,282,000
Young	339,000	165,000	98,000

References

1. Asquith, William H. and Roussel, Meghan C., "Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach," United States Geological Survey Scientific Investigations Report 2009-5087, 2009.
2. Chow, Ven T. "Development of Uniform Flow and It Formulas." *Open Channel Hydraulics*. Caldwell, NJ: Blackburn, 1959. 109-113. Print.
3. 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).
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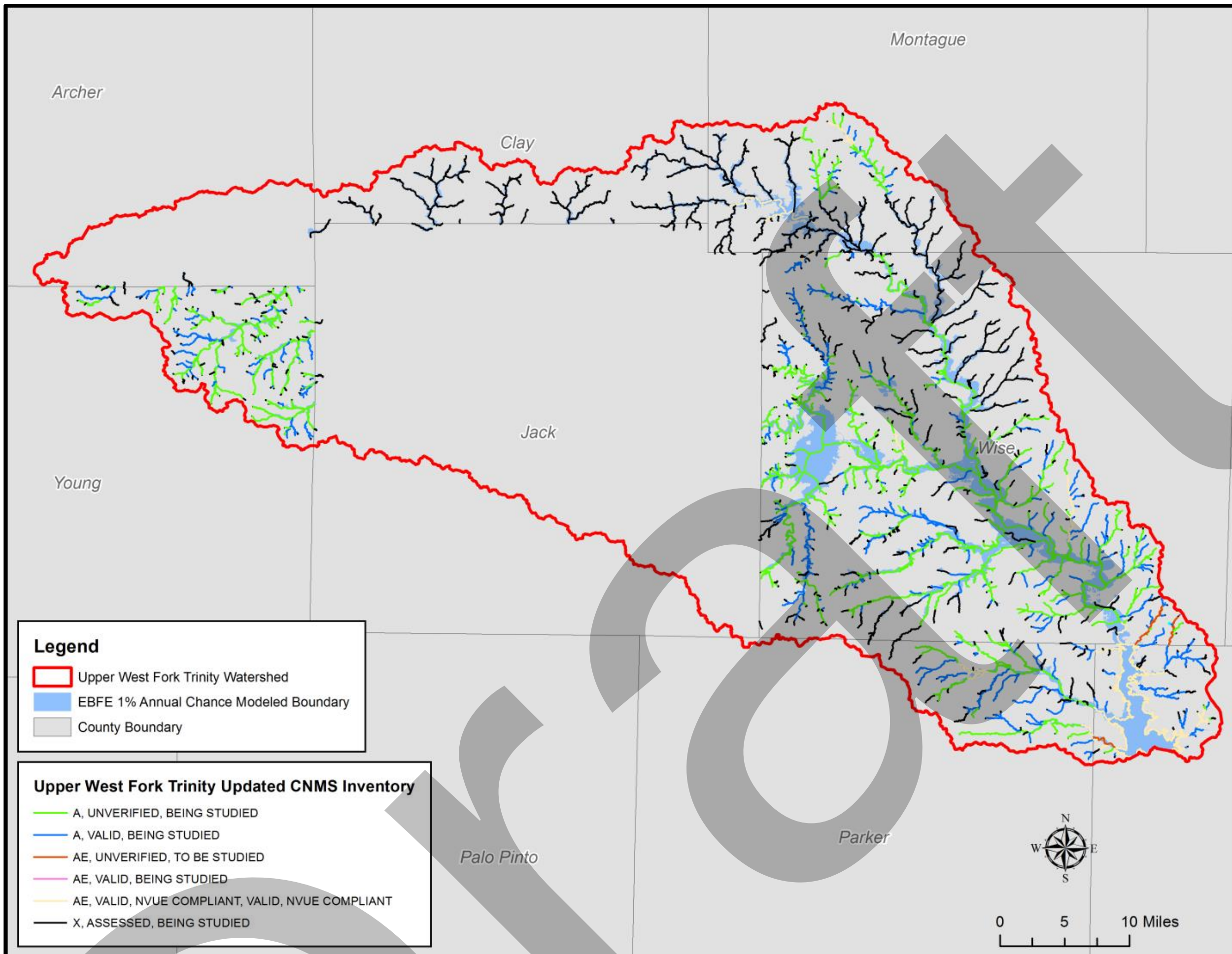
7. United States Geological Survey, "Estimating Magnitude and Frequency of Floods Using PeakFQ Program: USGS Fact Sheet", 2006.
8. United States Geological Survey. Multi-Resolution Land Characteristics Consortium. *National Land Cover Database 2016*. (http://www.mrlc.gov/nlcd2011.php).
9. United States Geological Survey, Interagency Advisory Committee on Water Data. "Guidelines for determining Flood Flow Frequency", Bulletin #17B of the Hydrology Subcommittee, Revised September 1981, Editorial Corrections March 1982. Reston, VA.
10. Watershed Concepts, a Division of Hayes, Seay, Mattern & Mattern. *Watershed Information System (WISE,)* Version 4.1.0. 2008.

Appendix A BLE Map



Appendix III: Additional Data

Discovery Figures

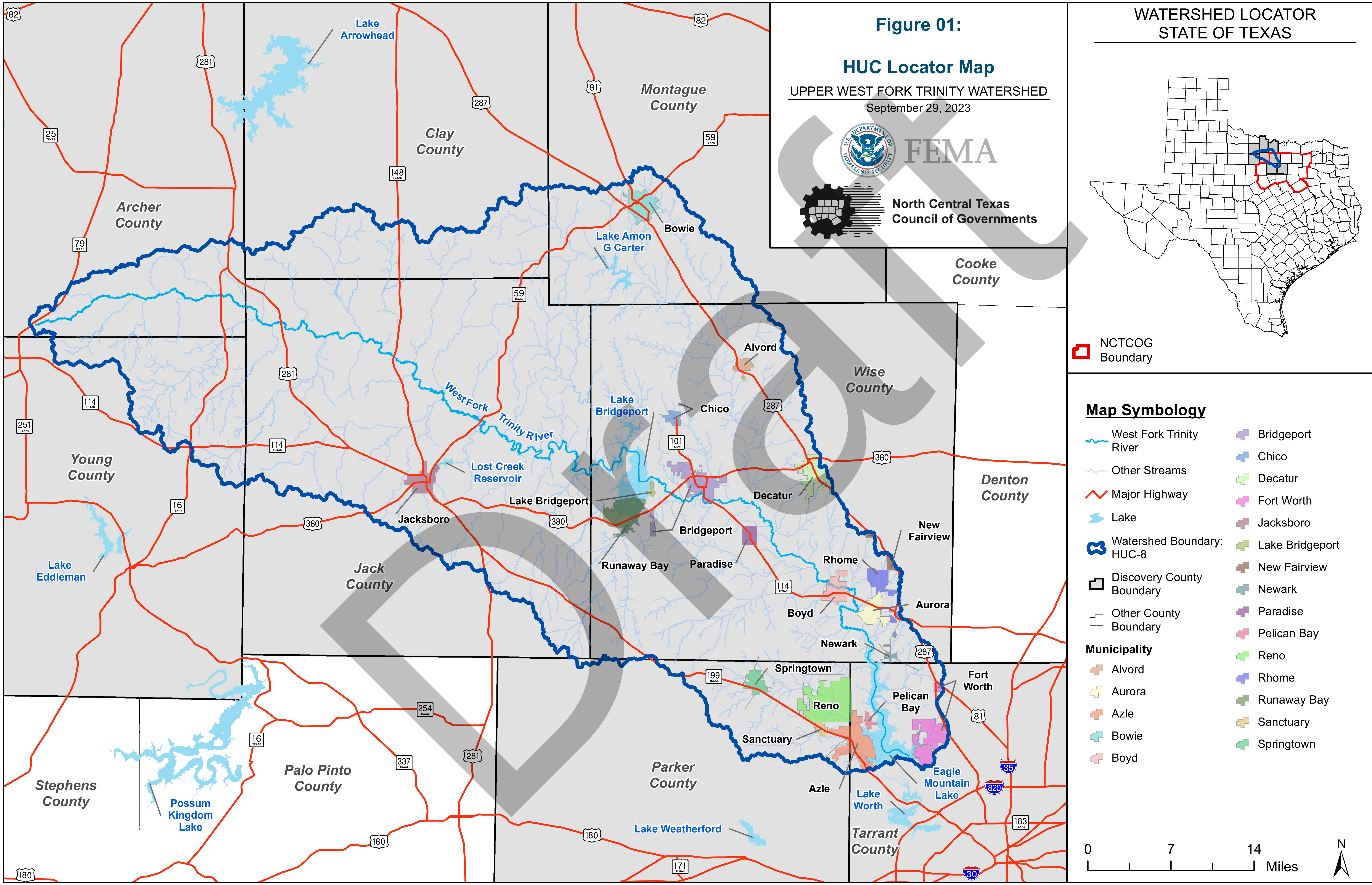


Figure 01:
HUC Locator Map
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas Council of Governments
WATERSHED LOCATOR STATE OF TEXAS
NCTCOG Boundary
Map Symbology
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Municipality
Alvord
Aurora
Azle
Bowie
Boyd
Bridgeport
Chico
Decatur
Fort Worth
Jacksboro
Lake Bridgeport
New Fairview
Newark
Paradise
Pelican Bay
Reno
Rhome
Runaway Bay
Sanctuary
Springtown
0 7 14 Miles
N
Archer County
Clay County
Montague County
Cooke County
Young County
Jack County
Wise County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Lake Worth
Eagle Mountain Lake
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Jacksboro
Lake Bridgeport
Bridgeport
Runaway Bay
Paradise
New Fairview
Rhome
Aurora
Boyd
Newark
Springtown
Reno
Pelican Bay
Fort Worth
Sanctuary
Azle
82
281
25
79
287
81
59
148
114
251
16
380
101
199
254
337
180
171
183
820
35
30
Draft

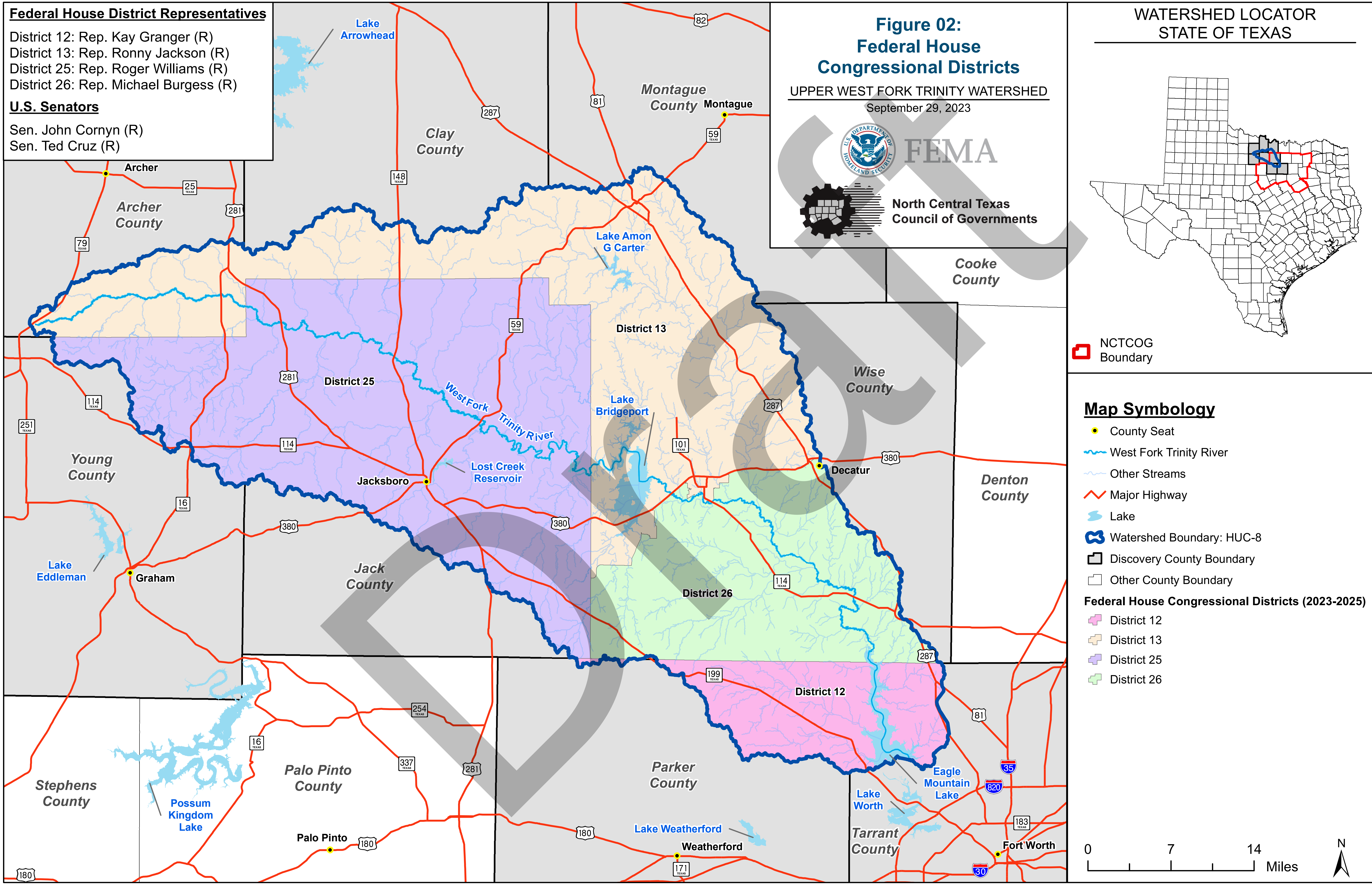
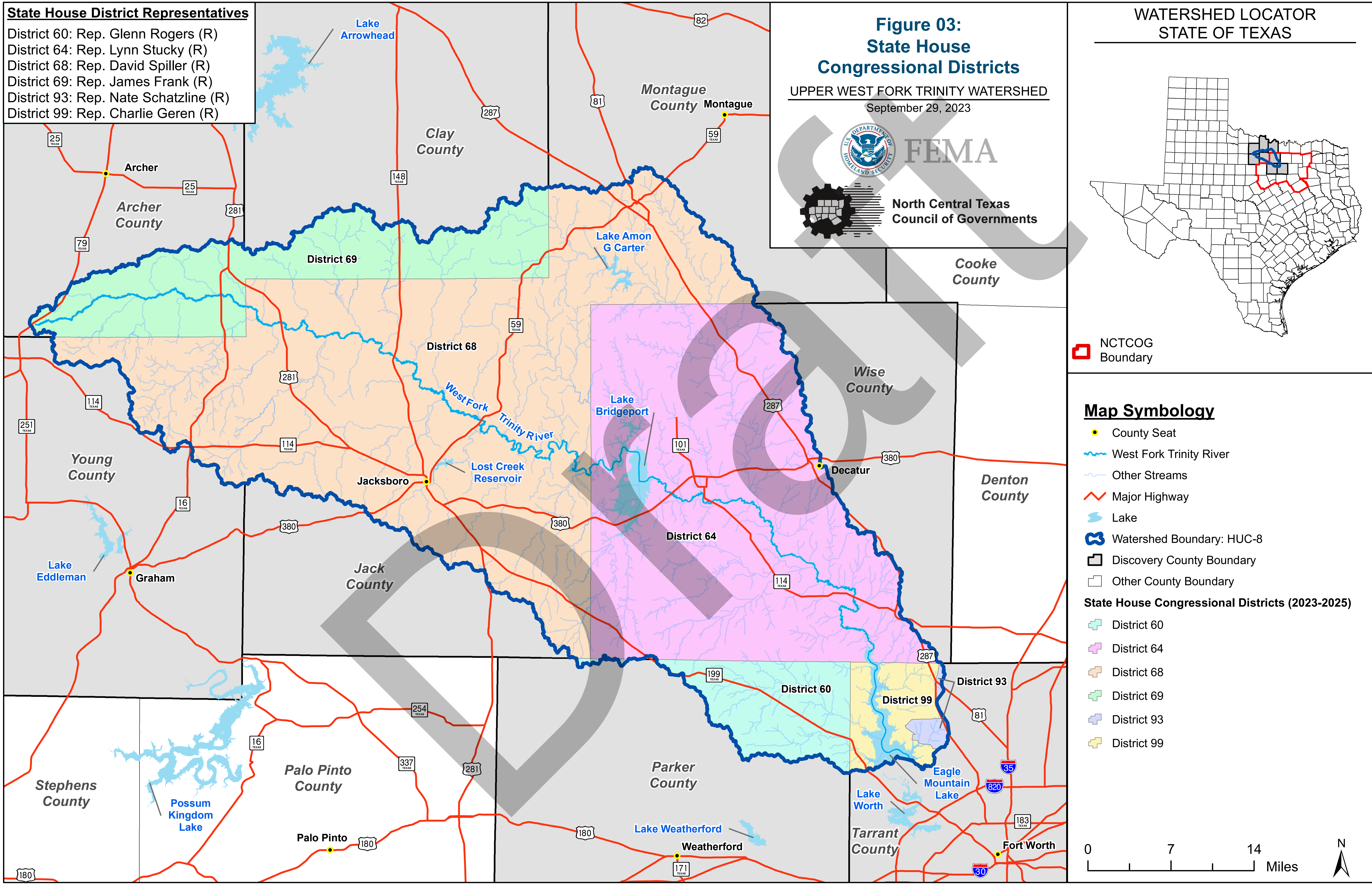


Figure 02:
Federal House
Congressional Districts
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
Federal House District Representatives
District 12: Rep. Kay Granger (R)
District 13: Rep. Ronny Jackson (R)
District 25: Rep. Roger Williams (R)
District 26: Rep. Michael Burgess (R)
U.S. Senators
Sen. John Cornyn (R)
Sen. Ted Cruz (R)
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
County Seat
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Federal House Congressional Districts (2023-2025)
District 12
District 13
District 25
District 26
0
7
14
Miles
N
Lake Arrowhead
Clay County
Montague County
Montague
Archer
Archer County
Lake Amon G Carter
Cooke County
District 13
District 25
West Fork
Trinity River
Wise County
Lake Bridgeport
Young County
Lost Creek Reservoir
Jacksboro
Decatur
Denton County
Lake Eddleman
Graham
Jack County
District 26
District 12
Stephens County
Possum Kingdom Lake
Palo Pinto County
Palo Pinto
Parker County
Lake Weatherford
Weatherford
Eagle Mountain Lake
Lake Worth
Tarrant County
Fort Worth
82
81
287
59
148
25
281
79
114
251
16
380
101
199
254
337
180
171
35
820
183
30



State House District Representatives
District 60: Rep. Glenn Rogers (R)
District 64: Rep. Lynn Stucky (R)
District 68: Rep. David Spiller (R)
District 69: Rep. James Frank (R)
District 93: Rep. Nate Schatzline (R)
District 99: Rep. Charlie Geren (R)
Figure 03:
State House
Congressional Districts
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
County Seat
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
State House Congressional Districts (2023-2025)
District 60
District 64
District 68
District 69
District 93
District 99
0
7
14
Miles
N
Lake Arrowhead
Clay County
Montague County
Montague
Archer
Archer County
District 69
District 68
Lake Amon G Carter
Cooke County
Wise County
West Fork Trinity River
Lake Bridgeport
Young County
Jacksboro
Lost Creek Reservoir
Decatur
Denton County
District 64
Lake Eddleman
Graham
Jack County
District 60
District 93
District 99
Stephens County
Possum Kingdom Lake
Palo Pinto County
Palo Pinto
Parker County
Lake Weatherford
Weatherford
Eagle Mountain Lake
Lake Worth
Tarrant County
Fort Worth

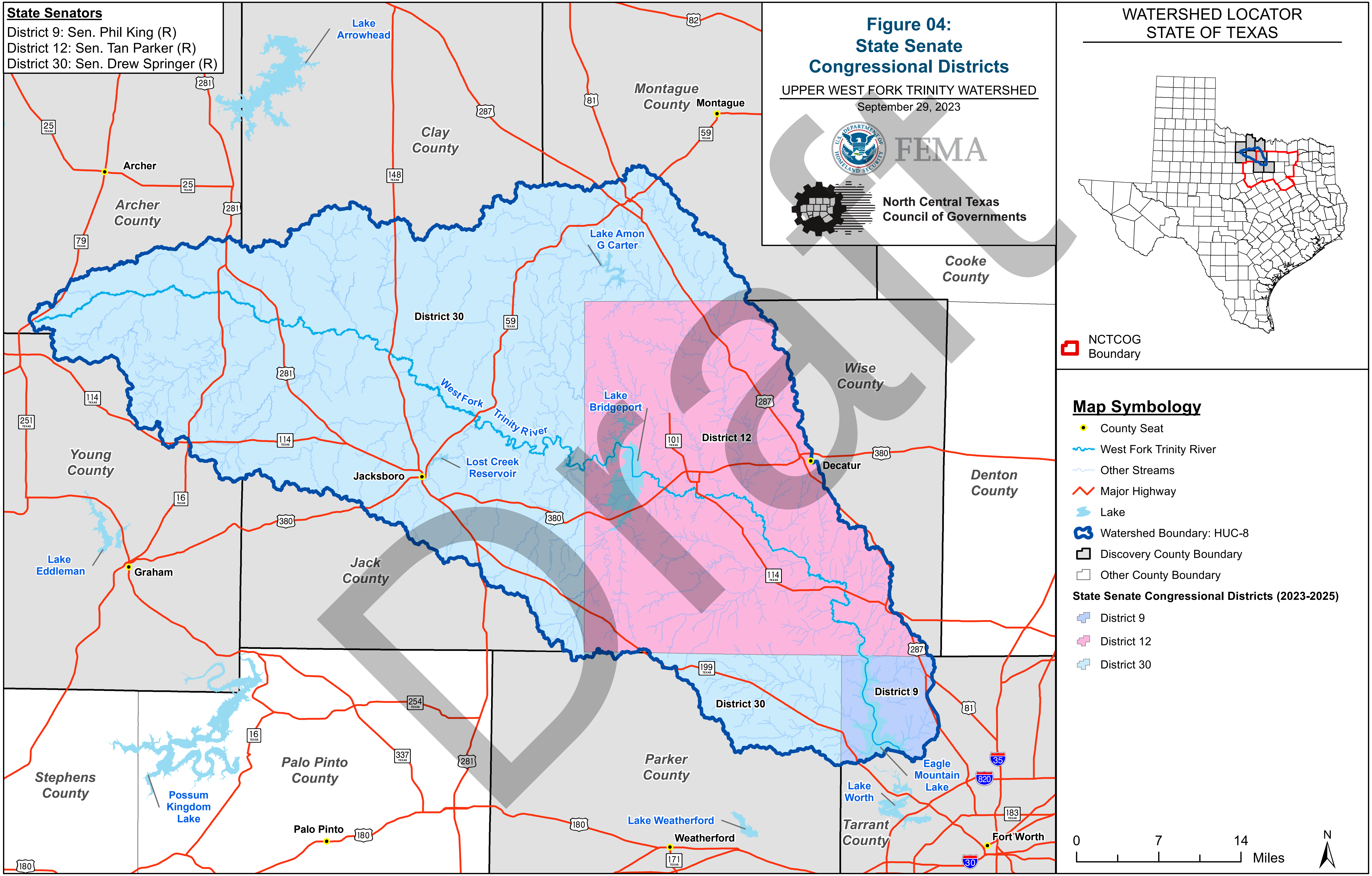


Figure 04:
State Senate
Congressional Districts
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
State Senators
District 9: Sen. Phil King (R)
District 12: Sen. Tan Parker (R)
District 30: Sen. Drew Springer (R)
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
County Seat
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
State Senate Congressional Districts (2023-2025)
District 9
District 12
District 30
0
7
14
Miles
N
Archer County
Clay County
Montague County
Cooke County
Wise County
Denton County
Young County
Jack County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Archer
Montague
Jacksboro
Decatur
Graham
Palo Pinto
Weatherford
Fort Worth
District 30
District 12
District 9
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Lake Worth
Eagle Mountain Lake
West Fork Trinity River
Draft

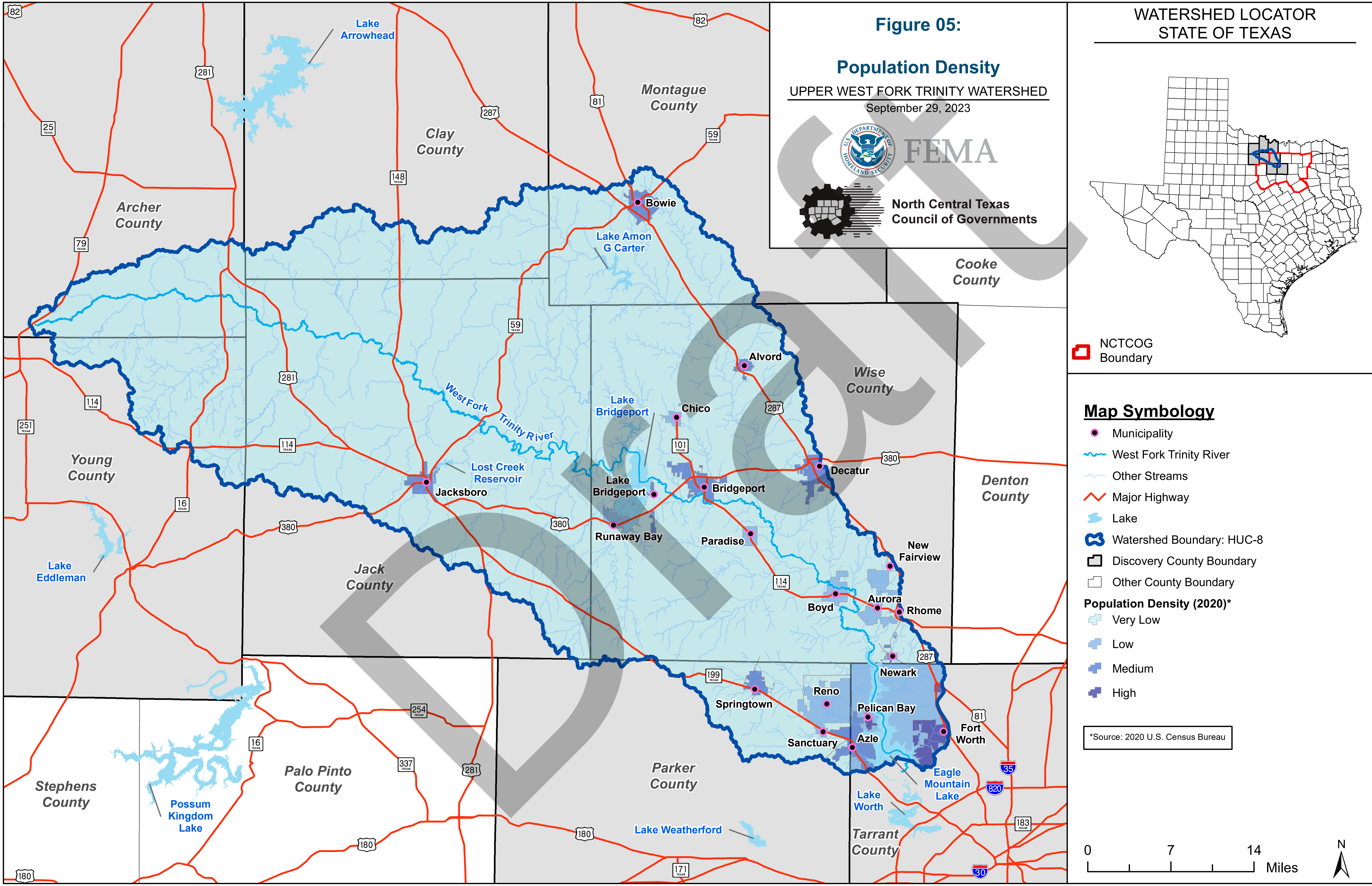


Figure 05:

Population Density

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023

FEMA

North Central Texas Council of Governments

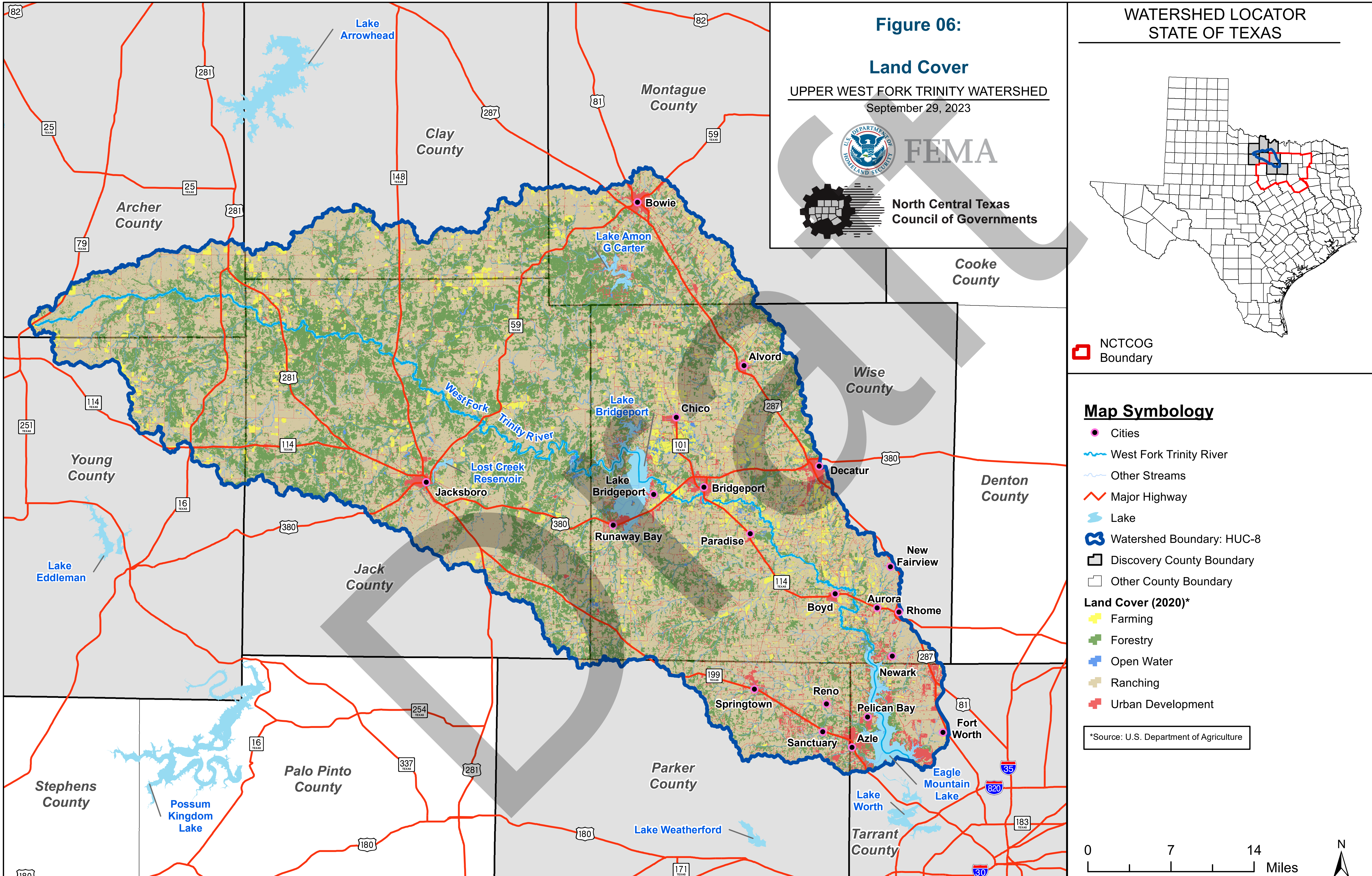


Figure 06:
Land Cover
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas Council of Governments
Draft
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG Boundary
Map Symbology
Cities
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Land Cover (2020)*
Farming
Forestry
Open Water
Ranching
Urban Development
*Source: U.S. Department of Agriculture
0
7
14
Miles
N
Archer County
Clay County
Montague County
Cooke County
Young County
Jack County
Wise County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Azle
Sanctuary
Fort Worth

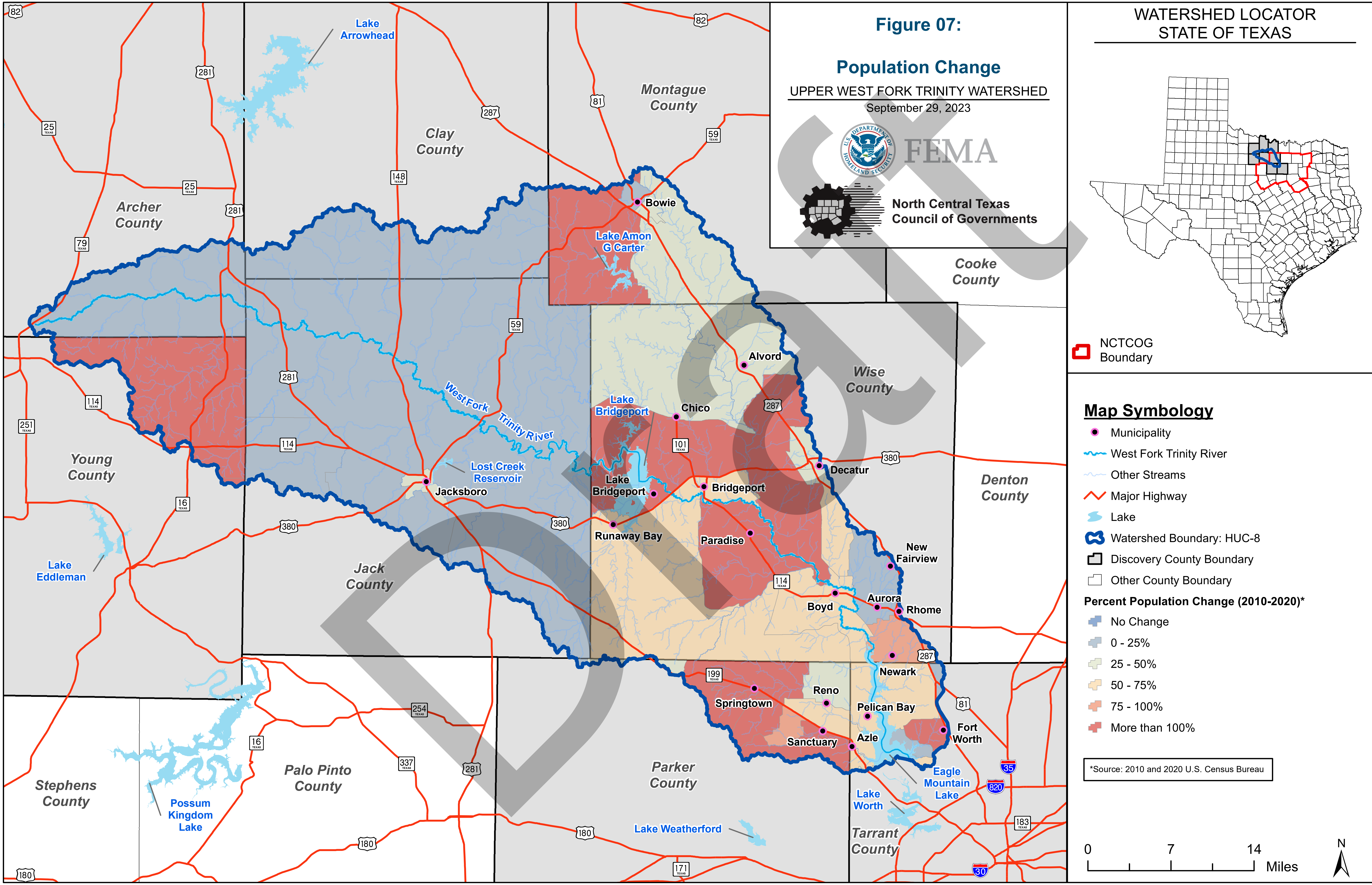


Figure 07:
Population Change
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Percent Population Change (2010-2020)*
No Change
0 - 25%
25 - 50%
50 - 75%
75 - 100%
More than 100%
*Source: 2010 and 2020 U.S. Census Bureau
0
7
14
Miles
N
DRAFT
Archer County
Clay County
Montague County
Cooke County
Wise County
Denton County
Young County
Jack County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Sanctuary
Azle
Fort Worth
82
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30

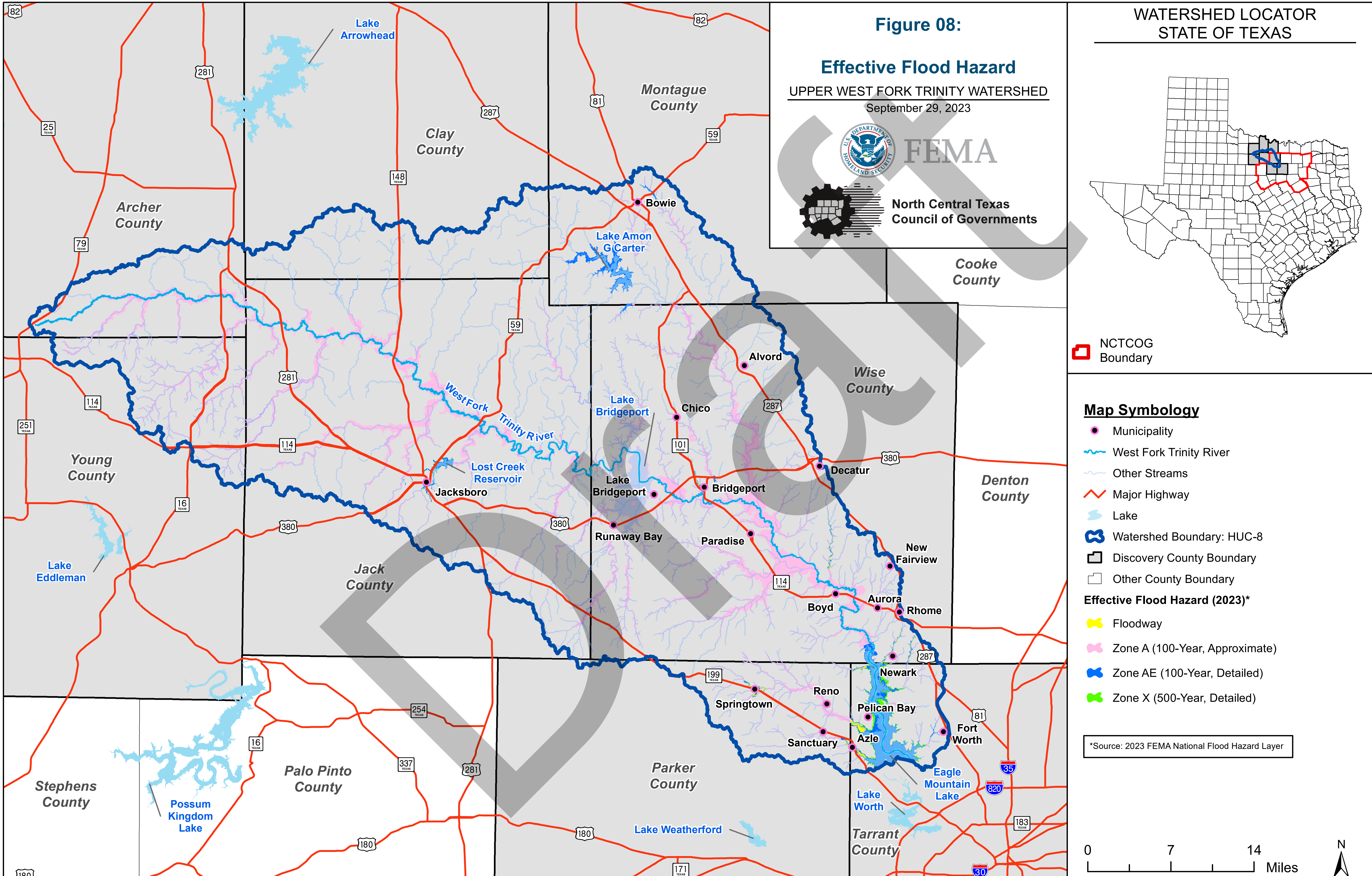

Figure 08:
Effective Flood Hazard
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas Council of Governments
Draft
WATERSHED LOCATOR STATE OF TEXAS
NCTCOG Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Effective Flood Hazard (2023)*
Floodway
Zone A (100-Year, Approximate)
Zone AE (100-Year, Detailed)
Zone X (500-Year, Detailed)
*Source: 2023 FEMA National Flood Hazard Layer
0 7 14 Miles
N
Archer County
Clay County
Montague County
Cooke County
Young County
Jack County
Wise County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lost Creek Reservoir
Lake Bridgeport
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Jacksboro
Lake Bridgeport
Bridgeport
Runaway Bay
Paradise
New Fairview
Aurora
Boyd
Rhome
Newark
Reno
Springtown
Pelican Bay
Sanctuary
Azle
Fort Worth

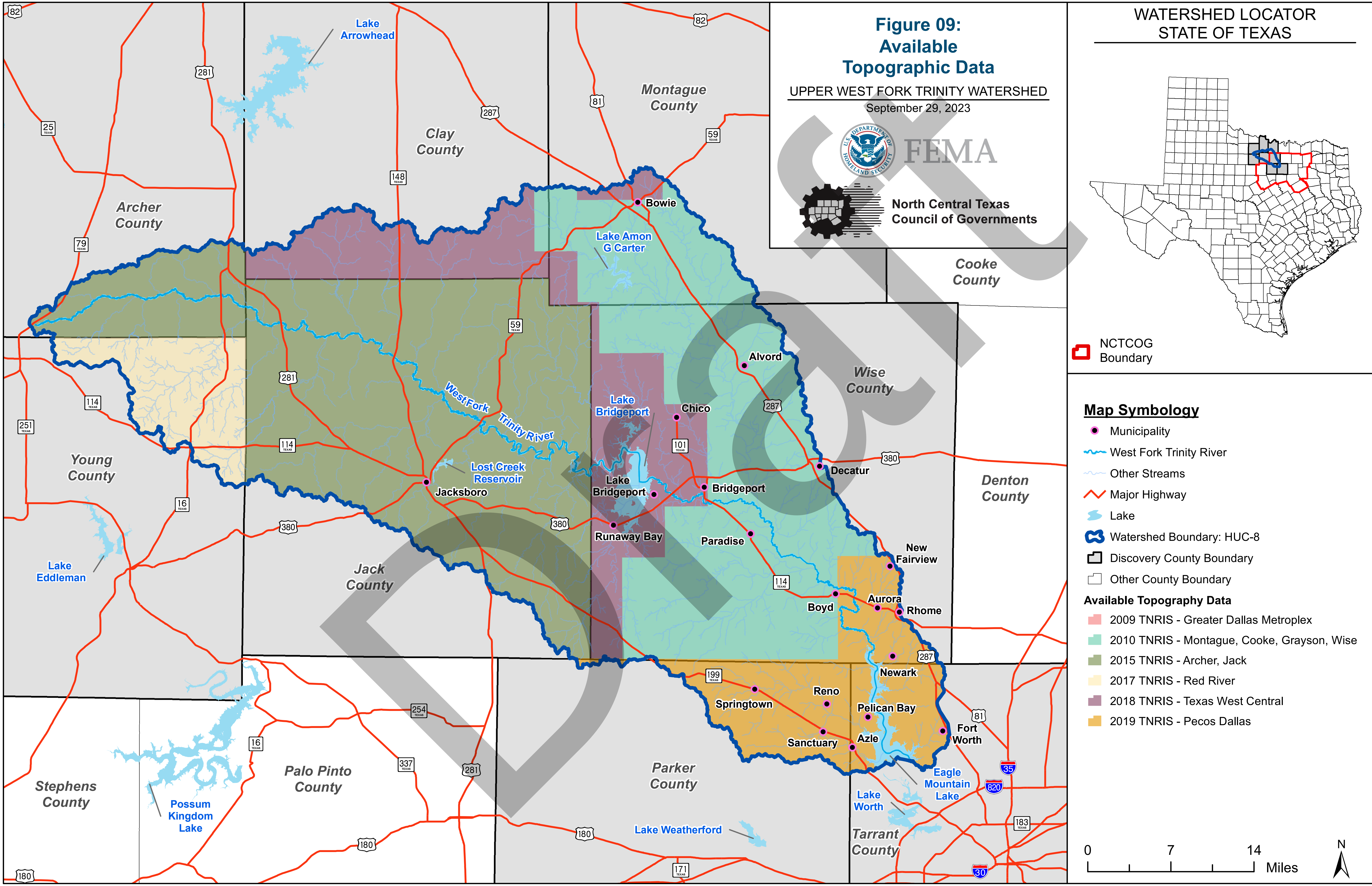

Figure 09: Available Topographic Data

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023

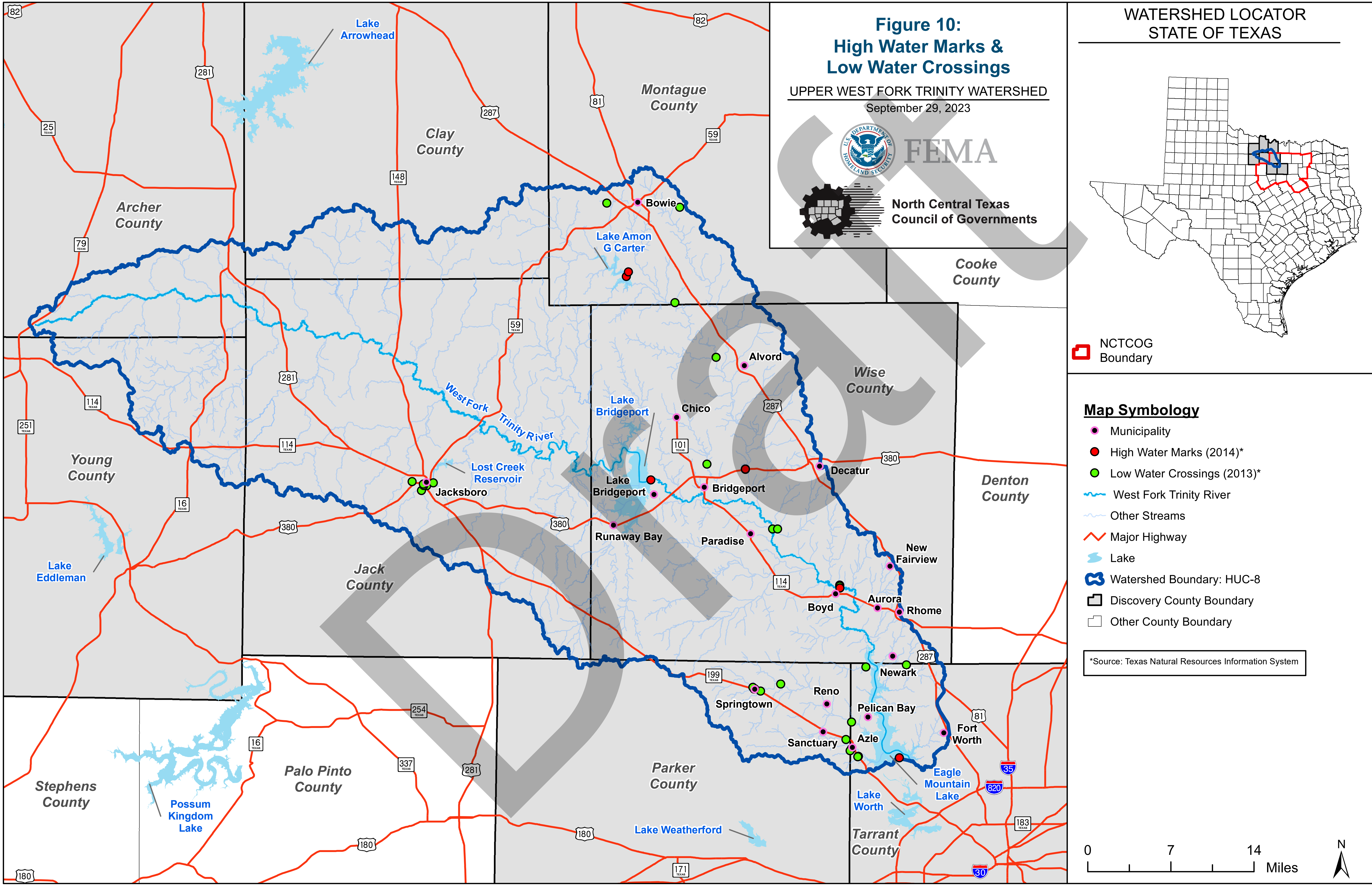

Figure 10:
High Water Marks &
Low Water Crossings
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
Draft
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
Municipality
High Water Marks (2014)*
Low Water Crossings (2013)*
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
*Source: Texas Natural Resources Information System
0
7
14
Miles
N
Archer County
Clay County
Montague County
Cooke County
Young County
Jack County
Wise County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Sanctuary
Azle
Fort Worth
82
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114
251
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171
183
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820
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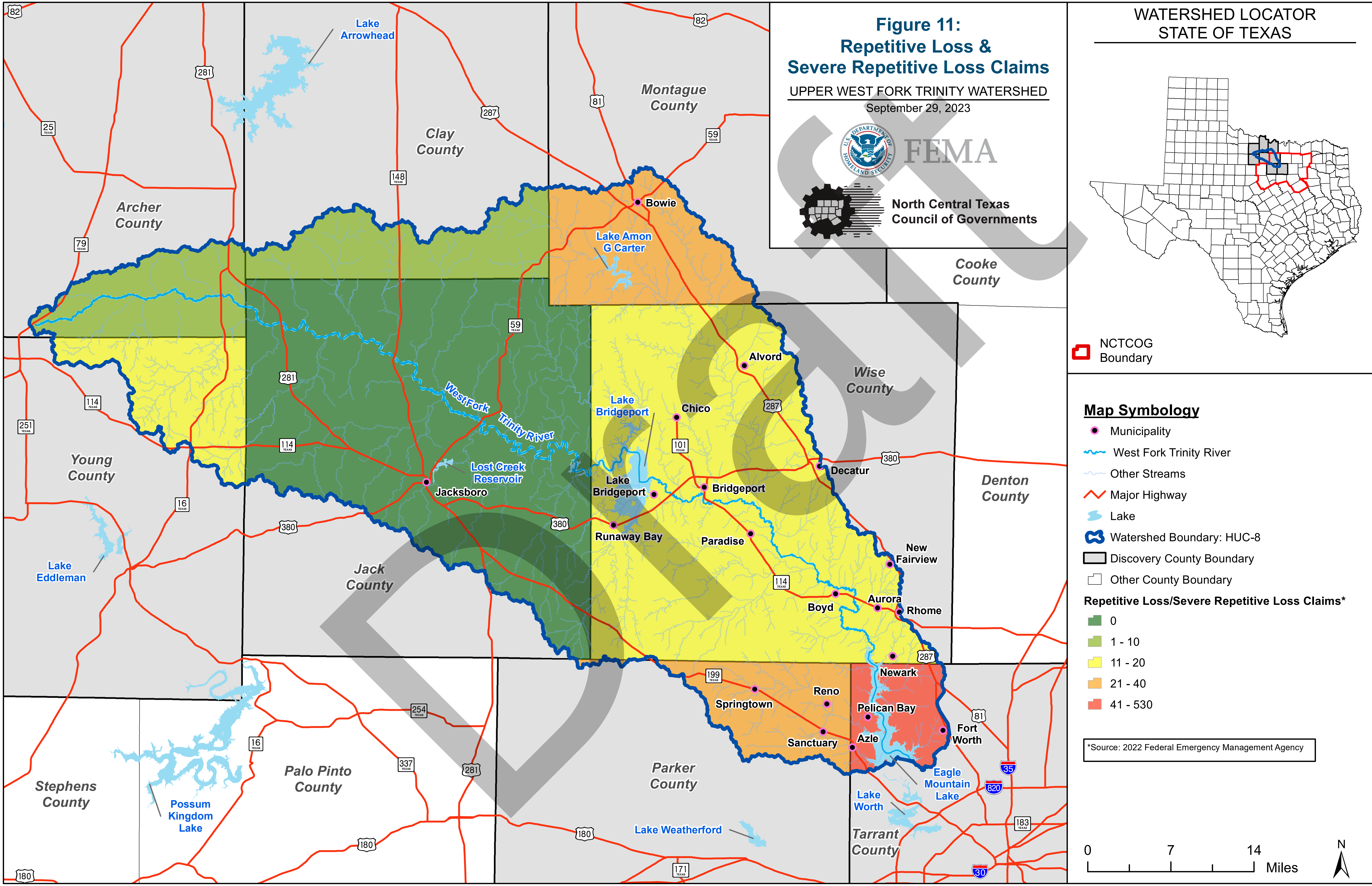

Figure 11: Repetitive Loss & Severe Repetitive Loss Claims

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023

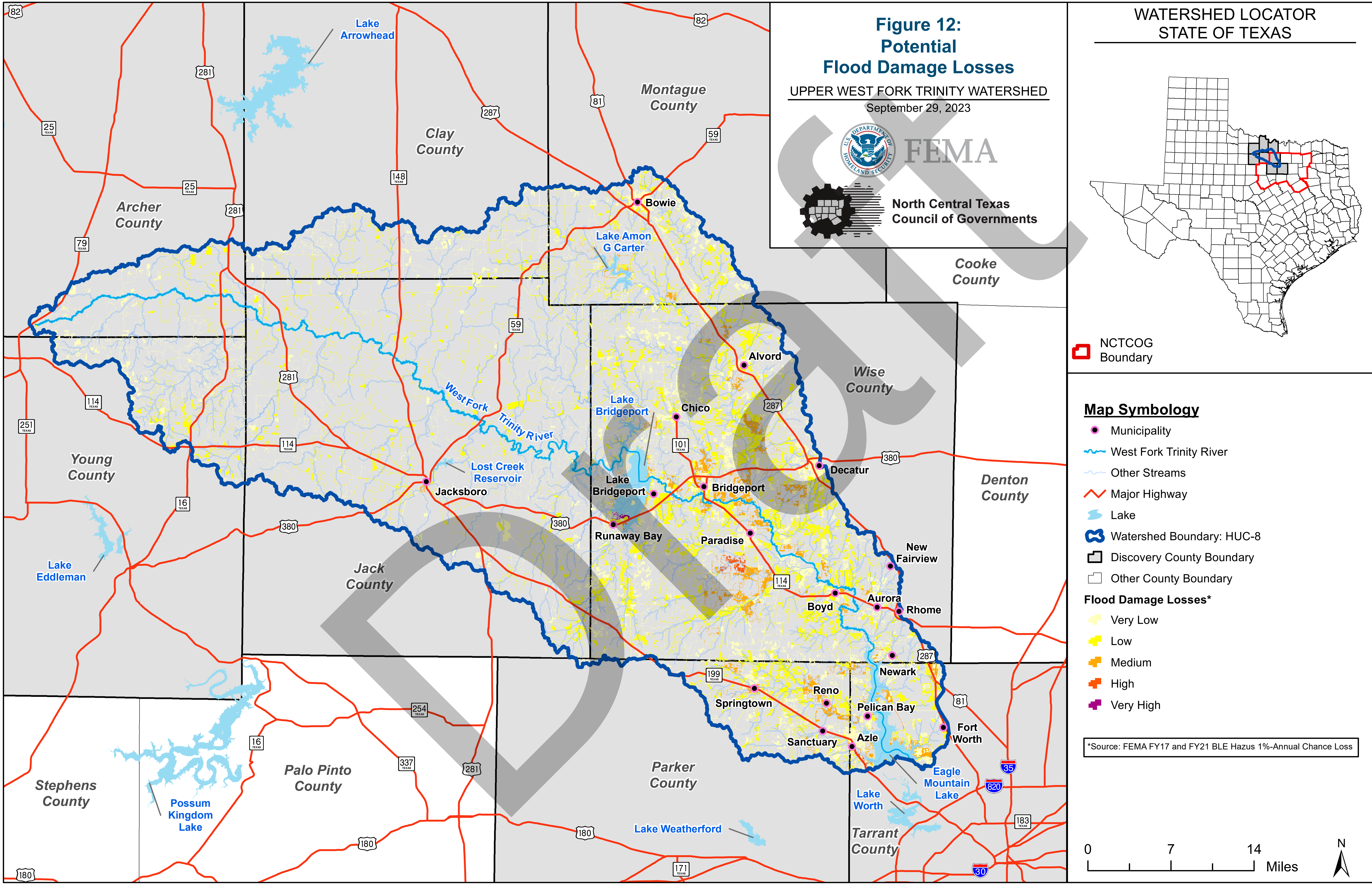
Figure 12:
Potential
Flood Damage Losses
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Flood Damage Losses*
Very Low
Low
Medium
High
Very High
*Source: FEMA FY17 and FY21 BLE Hazus 1%-Annual Chance Loss
0
7
14
Miles
N
Draft
Montague County
Clay County
Archer County
Cooke County
Wise County
Young County
Jack County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Lake Worth
Eagle Mountain Lake
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Fort Worth
Azle
Sanctuary
82
281
25
79
148
287
81
59
114
251
16
380
101
199
254
337
180
171
183
820
35
30

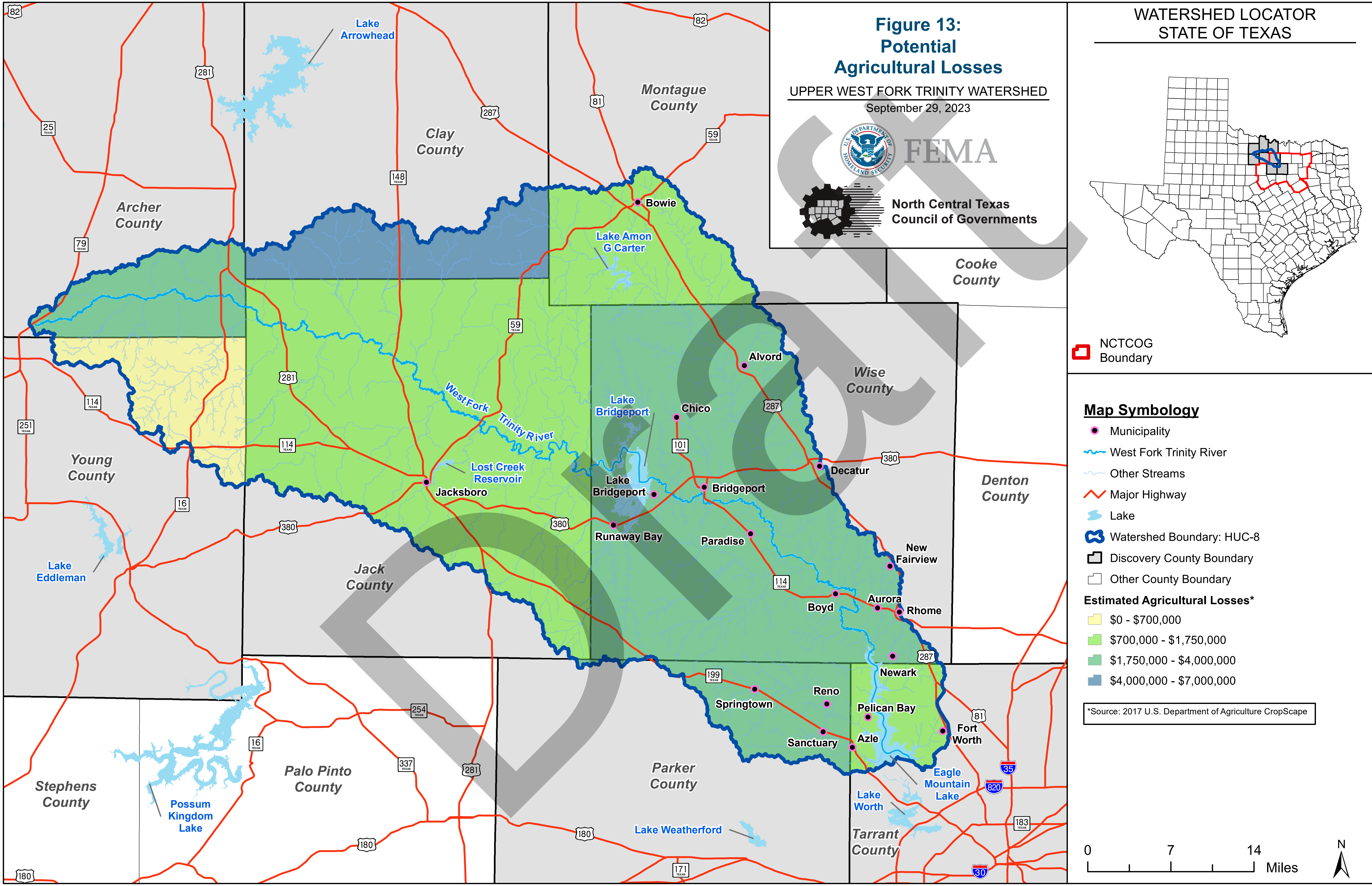
Figure 13:
Potential
Agricultural Losses
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Estimated Agricultural Losses*
$0 - $700,000
$700,000 - $1,750,000
$1,750,000 - $4,000,000
$4,000,000 - $7,000,000
*Source: 2017 U.S. Department of Agriculture CropScape
0
7
14
Miles
N
Draft
Archer County
Clay County
Montague County
Cooke County
Wise County
Denton County
Young County
Jack County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Boyd
Rhome
Newark
Reno
Springtown
Pelican Bay
Sanctuary
Azle
Fort Worth
82
281
25
79
287
81
59
148
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251
16
380
101
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254
337
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183
35
820
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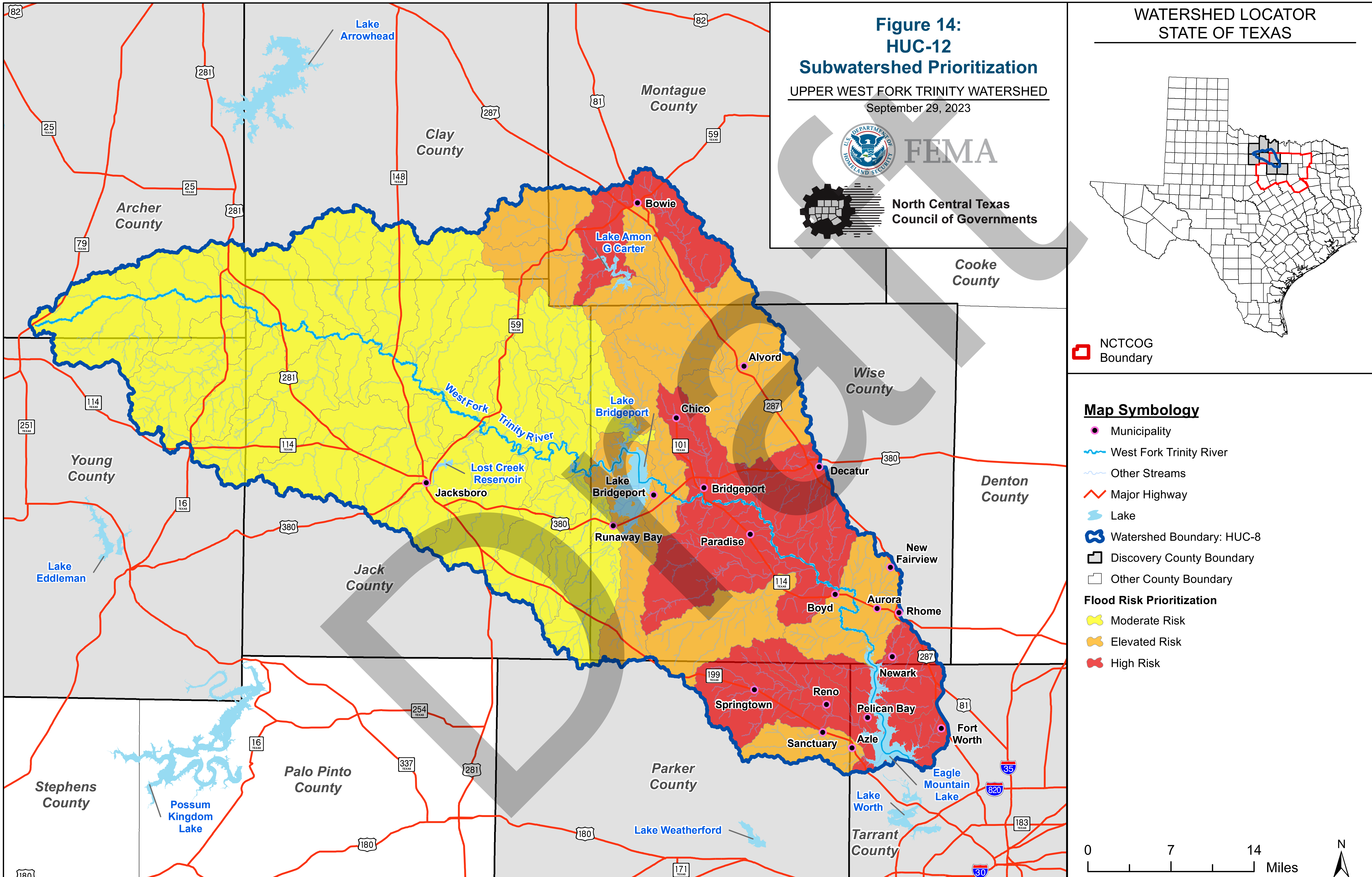


Figure 14:
HUC-12
Subwatershed Prioritization
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas
Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG
Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Flood Risk Prioritization
Moderate Risk
Elevated Risk
High Risk
0
7
14
Miles
N
Archer County
Clay County
Montague County
Cooke County
Wise County
Denton County
Young County
Jack County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Fort Worth
Azle
Sanctuary
Draft

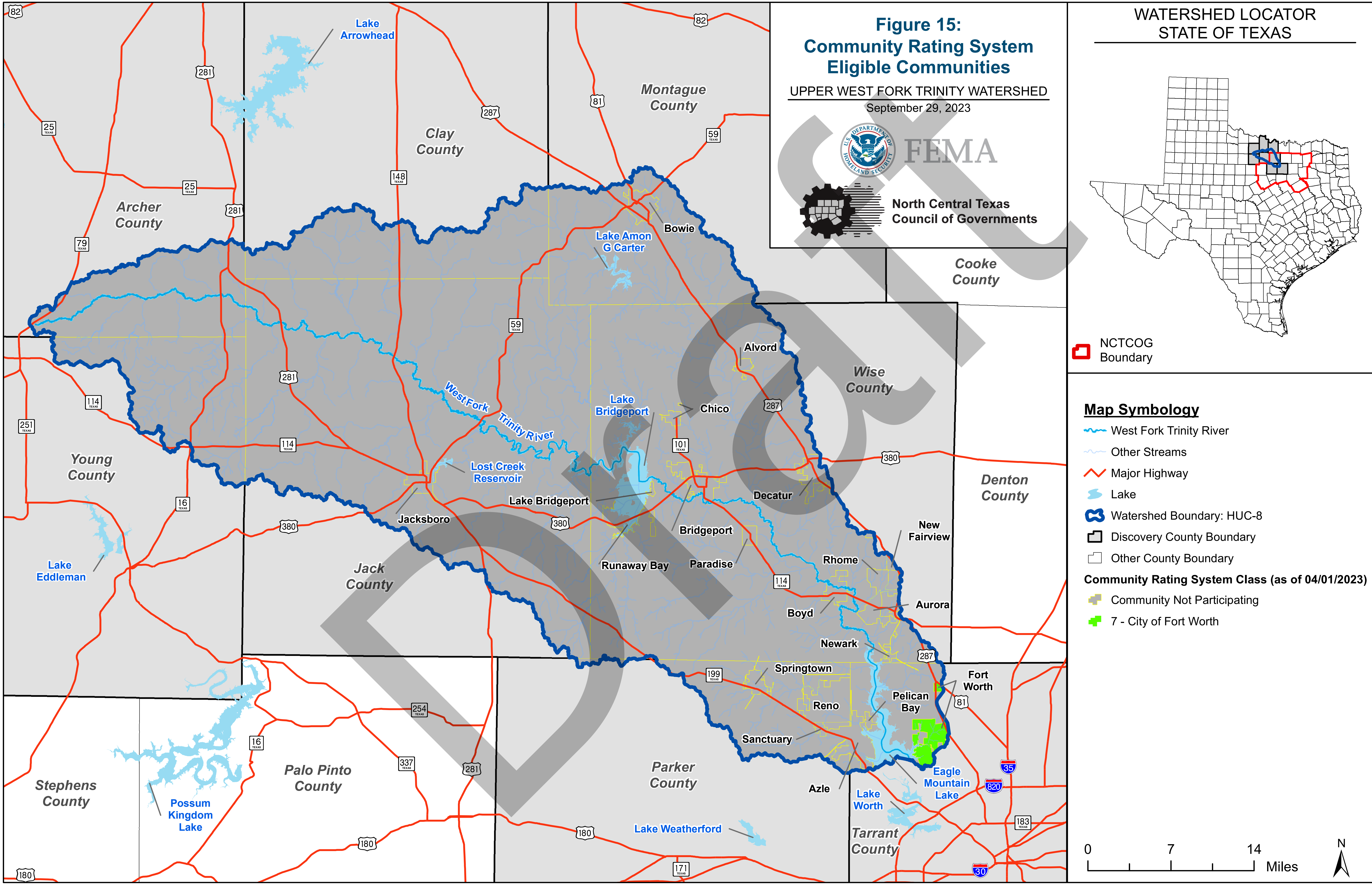


Figure 15: Community Rating System Eligible Communities

UPPER WEST FORK TRINITY WATERSHED

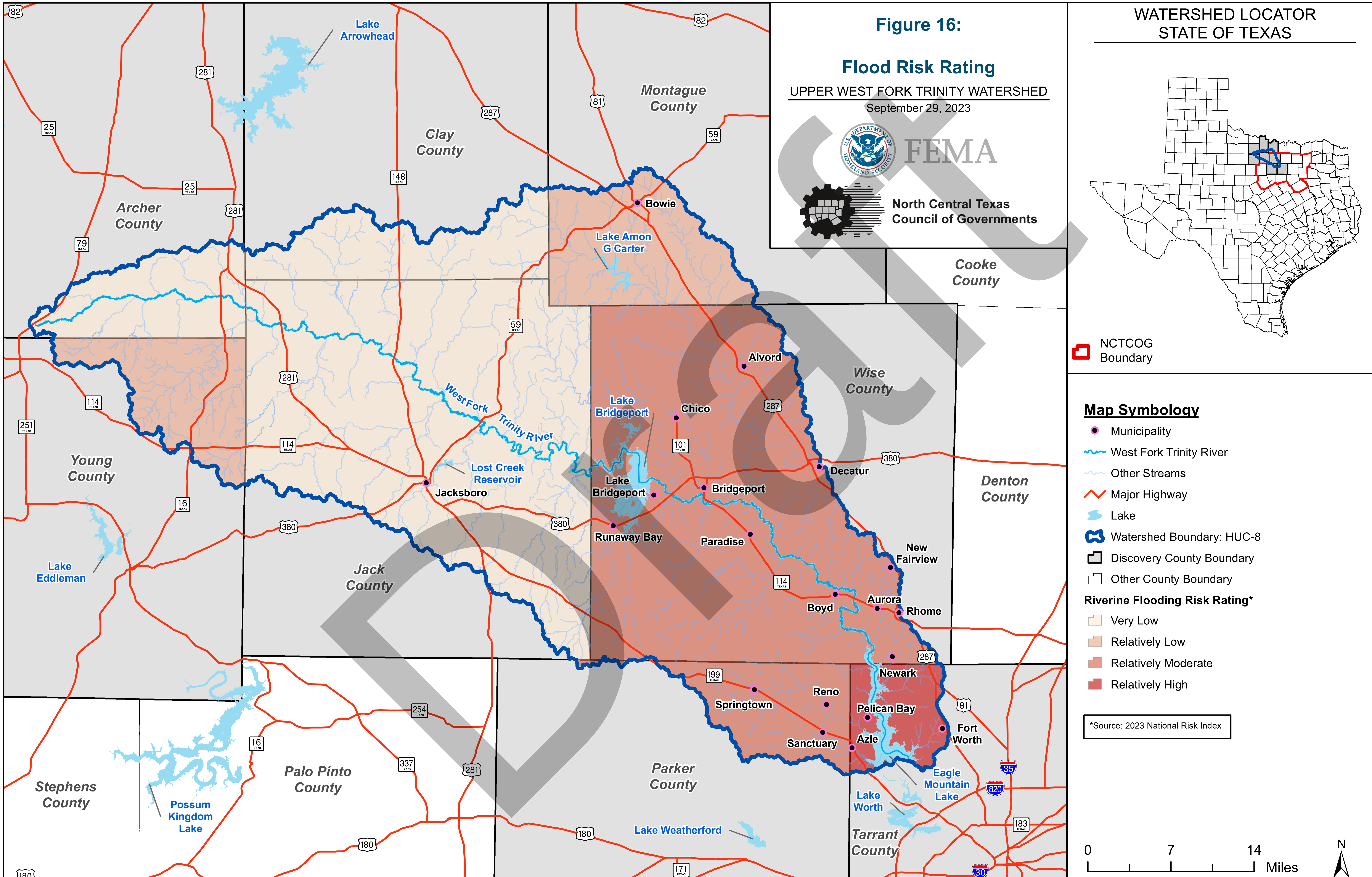
September 29, 2023

Figure 16:

Flood Risk Rating

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023



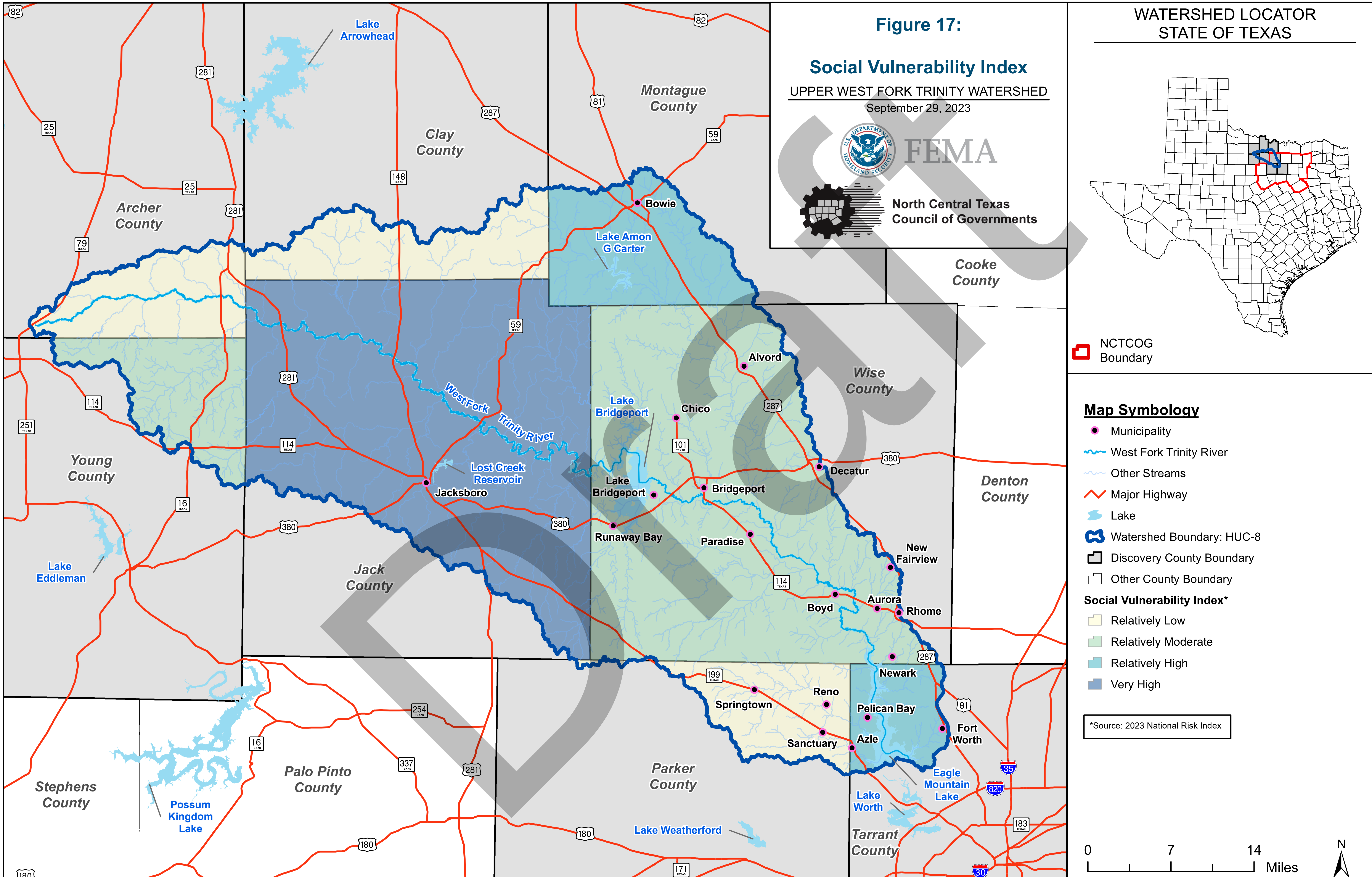


Figure 17:
Social Vulnerability Index
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas Council of Governments
WATERSHED LOCATOR
STATE OF TEXAS
NCTCOG Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Social Vulnerability Index*
Relatively Low
Relatively Moderate
Relatively High
Very High
*Source: 2023 National Risk Index
0
7
14
Miles
N
Draft
Archer County
Clay County
Montague County
Cooke County
Young County
Jack County
Wise County
Denton County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Lake Bridgeport
Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Boyd
Rhome
Newark
Reno
Springtown
Pelican Bay
Sanctuary
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Fort Worth
82
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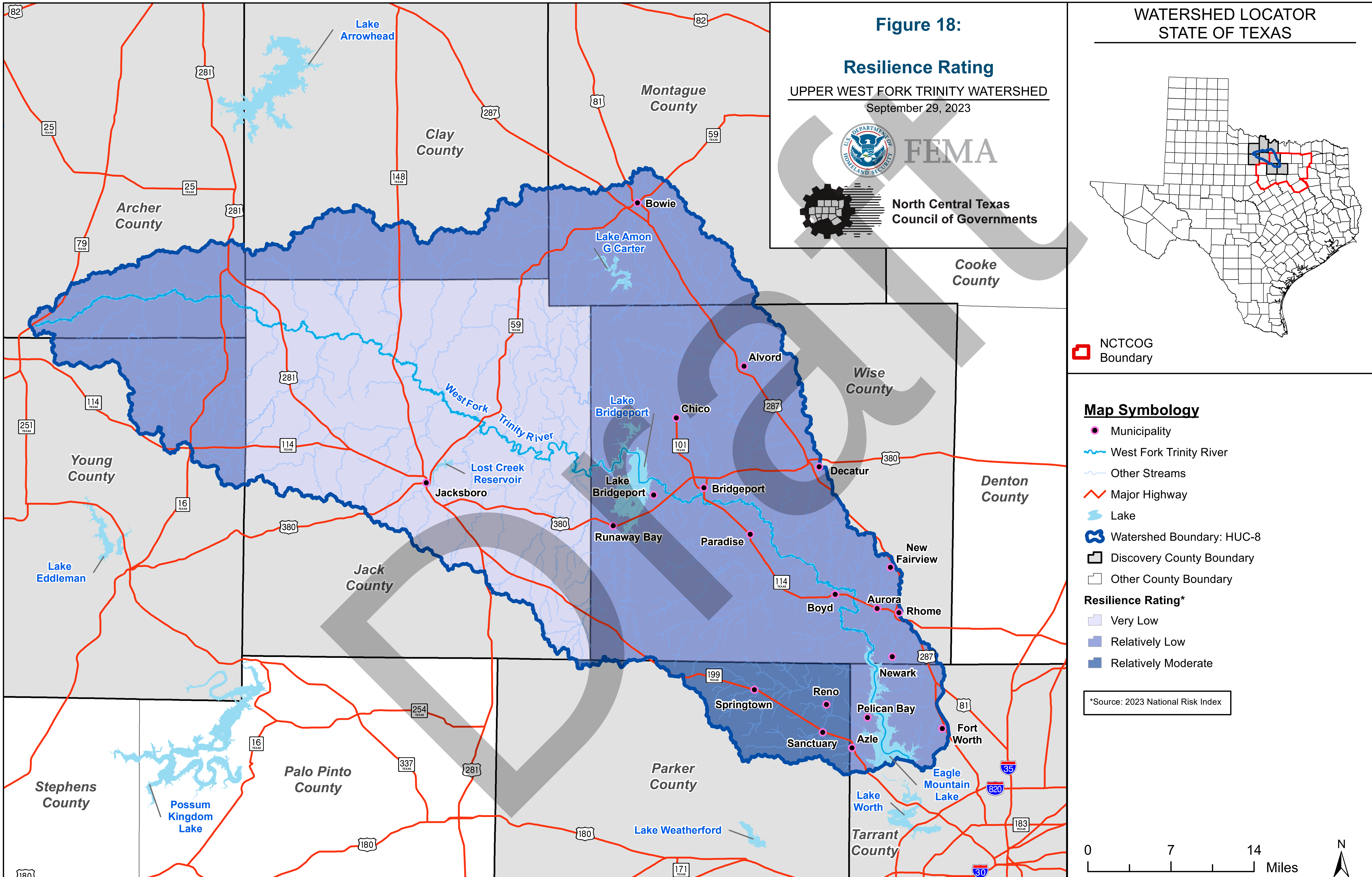


Figure 18:
Resilience Rating
UPPER WEST FORK TRINITY WATERSHED
September 29, 2023
FEMA
North Central Texas Council of Governments
WATERSHED LOCATOR STATE OF TEXAS
NCTCOG Boundary
Map Symbology
Municipality
West Fork Trinity River
Other Streams
Major Highway
Lake
Watershed Boundary: HUC-8
Discovery County Boundary
Other County Boundary
Resilience Rating*
Very Low
Relatively Low
Relatively Moderate
*Source: 2023 National Risk Index
0 7 14 Miles
N
Archer County
Clay County
Montague County
Cooke County
Wise County
Denton County
Young County
Jack County
Stephens County
Palo Pinto County
Parker County
Tarrant County
Lake Arrowhead
Lake Amon G Carter
Lake Bridgeport
Lost Creek Reservoir
Lake Eddleman
Possum Kingdom Lake
Lake Weatherford
Eagle Mountain Lake
Lake Worth
West Fork Trinity River
Bowie
Alvord
Chico
Decatur
Bridgeport
Lake Bridgeport
Jacksboro
Runaway Bay
Paradise
New Fairview
Aurora
Rhome
Boyd
Newark
Reno
Springtown
Pelican Bay
Sanctuary
Azle
Fort Worth

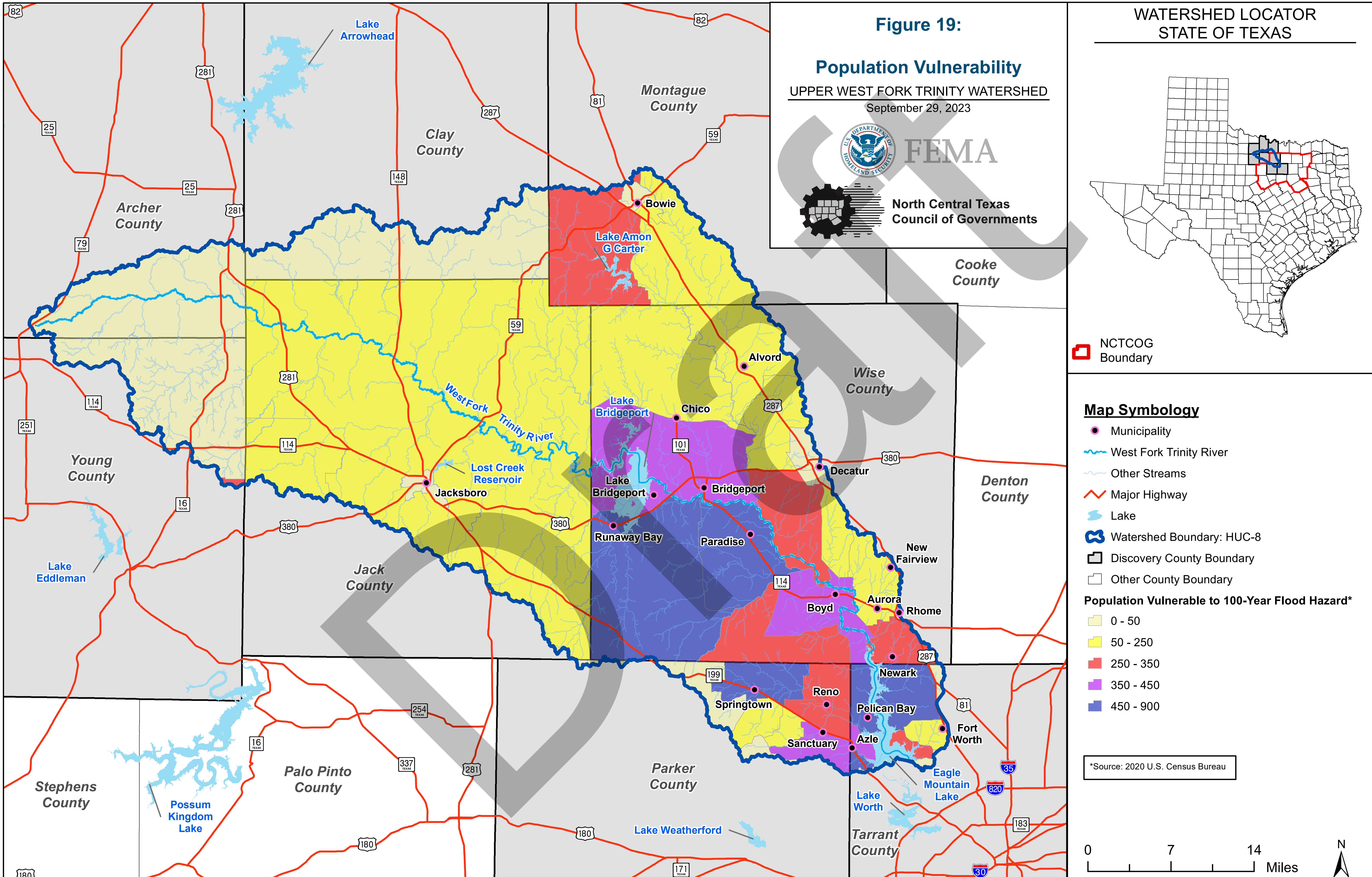


Figure 19:

Population Vulnerability

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023

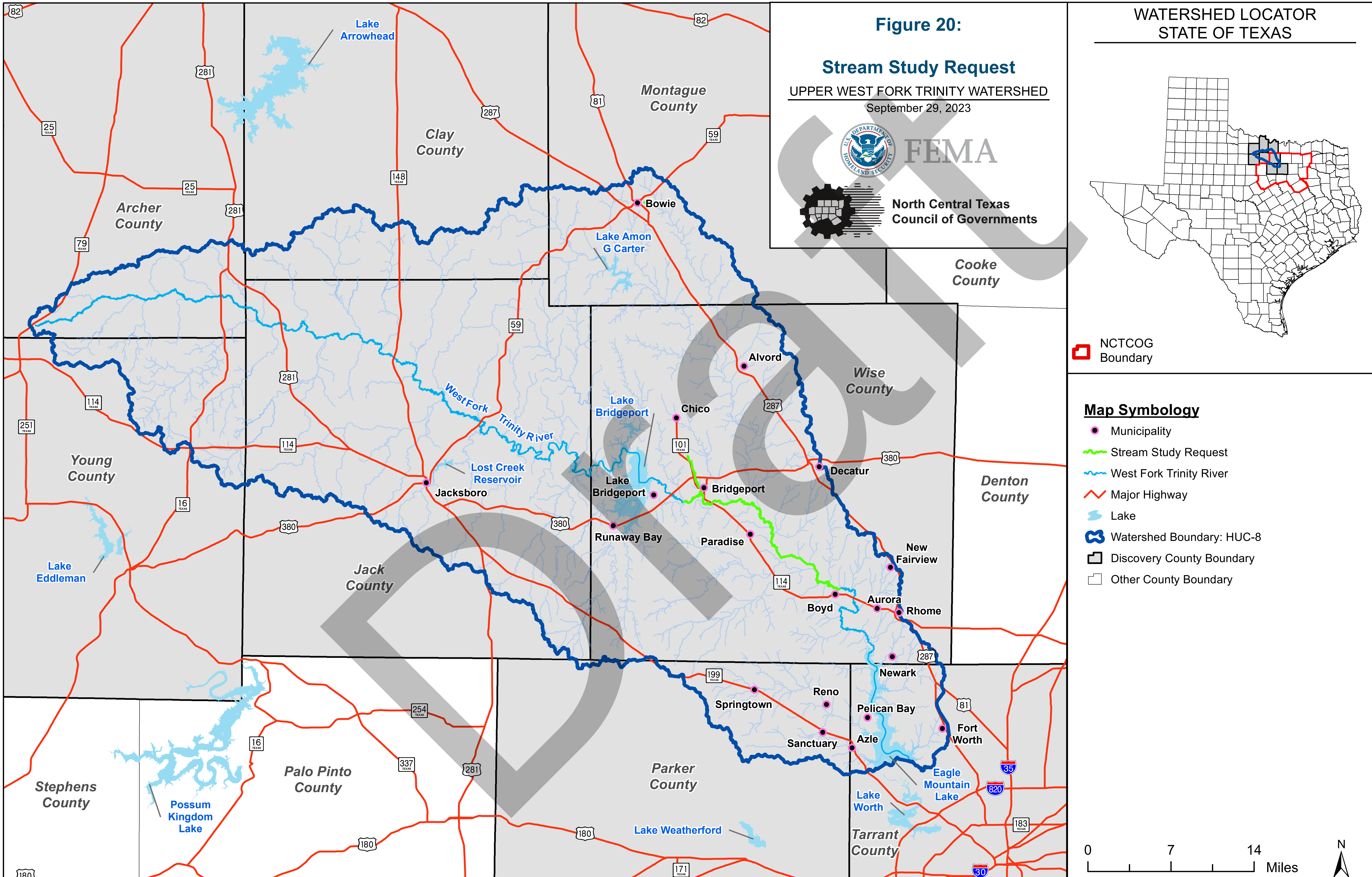


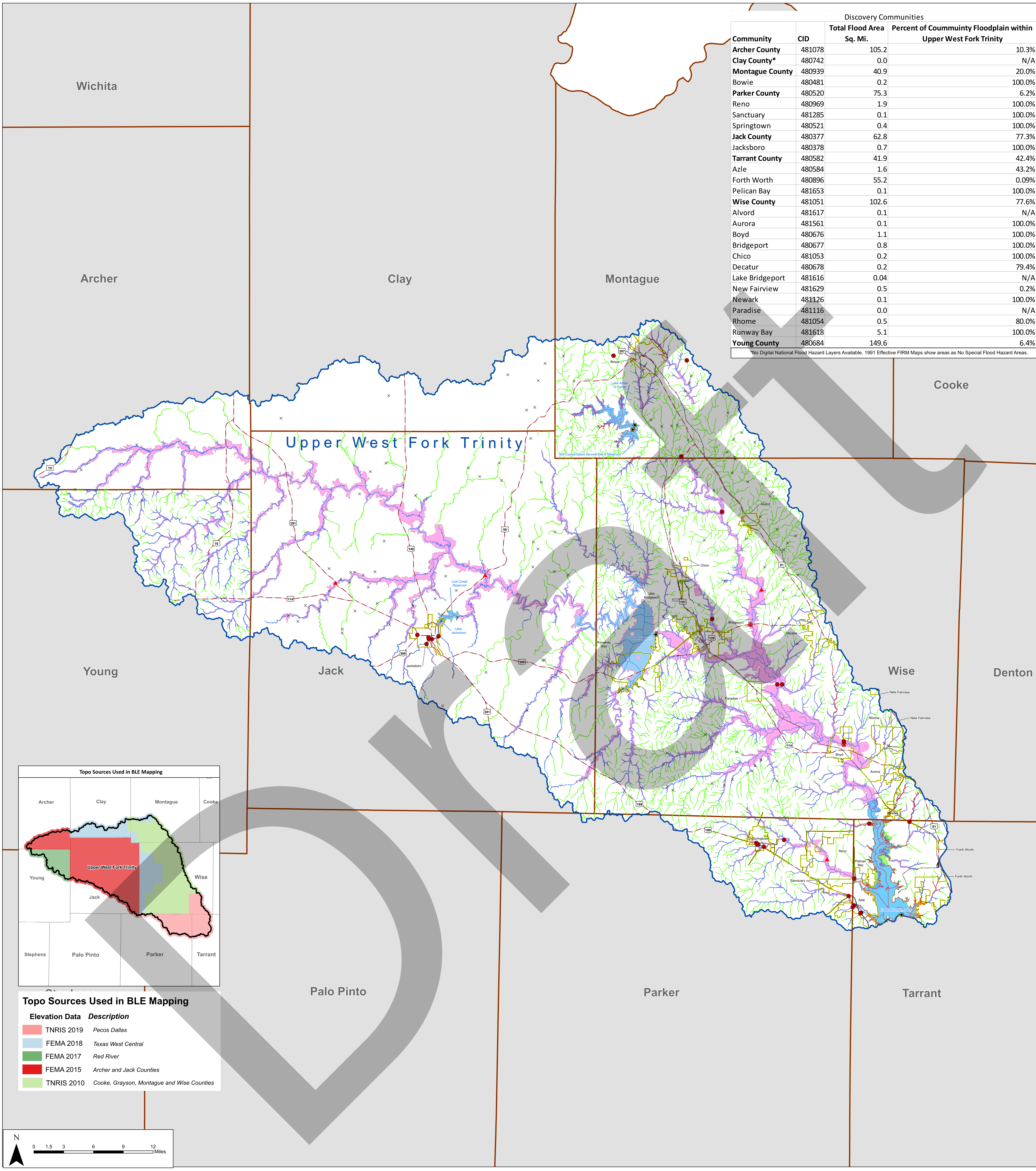
Figure 20:

Stream Study Request

UPPER WEST FORK TRINITY WATERSHED

September 29, 2023

Figure 21: Pre-Discovery Map



Discovery Communities

Community	CID	Total Flood Area Sq. Mi.	Percent of Coummuinty Floodplain within Upper West Fork Trinity
Archer County	481078	105.2	10.3%
Clay County*	480742	0.0	N/A
Montague County	480939	40.9	20.0%
Bowie	480481	0.2	100.0%
Parker County	480520	75.3	6.2%
Reno	480969	1.9	100.0%
Sanctuary	481285	0.1	100.0%
Springtown	480521	0.4	100.0%
Jack County	480377	62.8	77.3%
Jacksboro	480378	0.7	100.0%
Tarrant County	480582	41.9	42.4%
Azle	480584	1.6	43.2%
Forth Worth	480896	55.2	0.09%
Pelican Bay	481653	0.1	100.0%
Wise County	481051	102.6	77.6%
Alvord	481617	0.1	N/A
Aurora	481561	0.1	100.0%
Boyd	480676	1.1	100.0%
Bridgeport	480677	0.8	100.0%
Chico	481053	0.2	100.0%
Decatur	480678	0.2	79.4%
Lake Bridgeport	481616	0.04	N/A
New Fairview	481629	0.5	0.2%
Newark	481126	0.1	100.0%
Paradise	481116	0.0	N/A
Rhome	481054	0.5	80.0%
Runway Bay	481618	5.1	100.0%
Young County	480684	149.6	6.4%

*No Digital National Flood Hazard Layers Available. 1991 Effective FIRM Maps show areas as No Special Flood Hazard Areas.

Topo Sources Used in BLE Mapping

Elevation Data	Description
TNRIS 2019	*Pecos Dallas*
FEMA 2018	*Texas West Central*
FEMA 2017	*Red River*
FEMA 2015	*Archer and Jack Counties*
TNRIS 2010	*Cooke, Grayson, Montague and Wise Counties*

Map Symbology

- USGS Gages
- Low Water Mark
- Dams
- Lakes
- County Boundary
- Watershed Boundary

Transportation

- State Highway
- US Highway

Effective FEMA Floodplains*

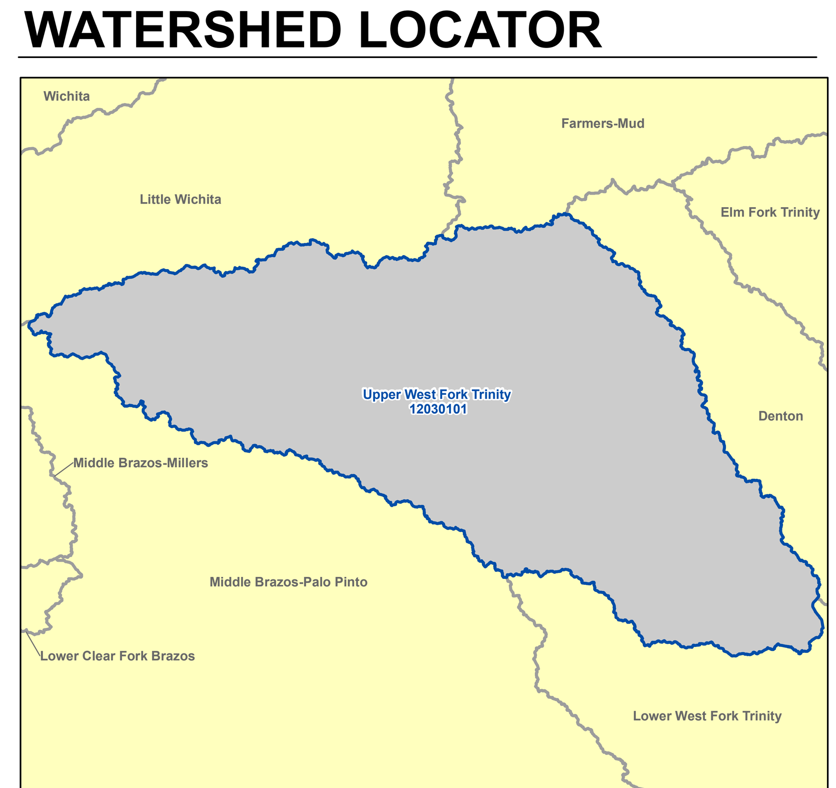
- AE, FLOODWAY
- Zone AE (100-Year, Detailed)
- Zone A (100-Year, Approximate)
- Zone X500 (500-Year, Detailed)

Effective Streams Study Type*

- Zone AE (100-Year, Detailed)
- Zone A (100-Year, Approximate)
- Zone X (Unshaded X, Areas of Minimal Flood Risk)

*Date as of April 2022

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Pre-Discovery Map

UPPER WEST FORK TRINITY, TEXAS

Stream Miles:	3,656
Zone AE Miles:	221
Zone A Miles:	1528
Zone X Miles:	1907
Population:	168,701

HUC-8 Code
12030101

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Figure 22: Discovery Map

County	CID	Population[1]	Total Policies[2]	Total Claims[2]	Total Coverage[2]	Total Payments[2]	Current FEMA DFIRM Status*	Effective Date
Archer	481078	997	-	-	$ -	$ -	Effective	2/12/2021
Clay	480742	1,168	2	2	$ 38,799.65	$ 90,000.00	None	4/2/1991
Jack	480377	6,354	3	4	$ 148,279.53	$ 500,000.00	Effective	2/12/2021
Montague	480939	8,388	-	-	$ -	$ -	Effective	8/16/2011
Parker	480520	26,814	24	31	$ 869,406.21	$ 2,117,056.82	Effective	9/26/2008
Tarrant	480582	55,210	37	22	$ 379,574.53	$ 5,009,543.18	Effective	9/25/2009
Wise	481051	67,621	25	32	$ 923,900.02	$ 4,317,600.00	Effective	12/16/2011
Young	480684	2,149	3	9	$ 29,961.90	$ 169,900.00	Effective	7/18/2011

[1] 2020 US Census Data, normalized to the watershed.

[2] FEMA NFIP Statistics from 1978 to June 30, 2022 (https://nfipservices.floodsmart.gov/reports-flood-insurance-data)

Total Policies-Number of Policies within the county in the watershed.

Total Claims-Number of Claims filed within the county in the watershed, regardless of status.

Total Coverage-Amount of money covered by policies within the county in the watershed.

Total Payments-Total amount paid on losses.

*No Flood Insurance Rate Maps Available. 1991 Effective FIRMs show areas as No Special Flood Hazard Areas.

Discovery Communities

Community	CID	Total Flood Area Sq. Mi.	Percent of Coummuinty Floodplain within Upper West Fork Trinity
Archer County	481078	105.2	10.3%
Clay County*	480742	0.0	N/A
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Parker County	480520	75.3	6.2%
Reno	480969	1.9	100.0%
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Jacksboro	480378	0.7	100.0%
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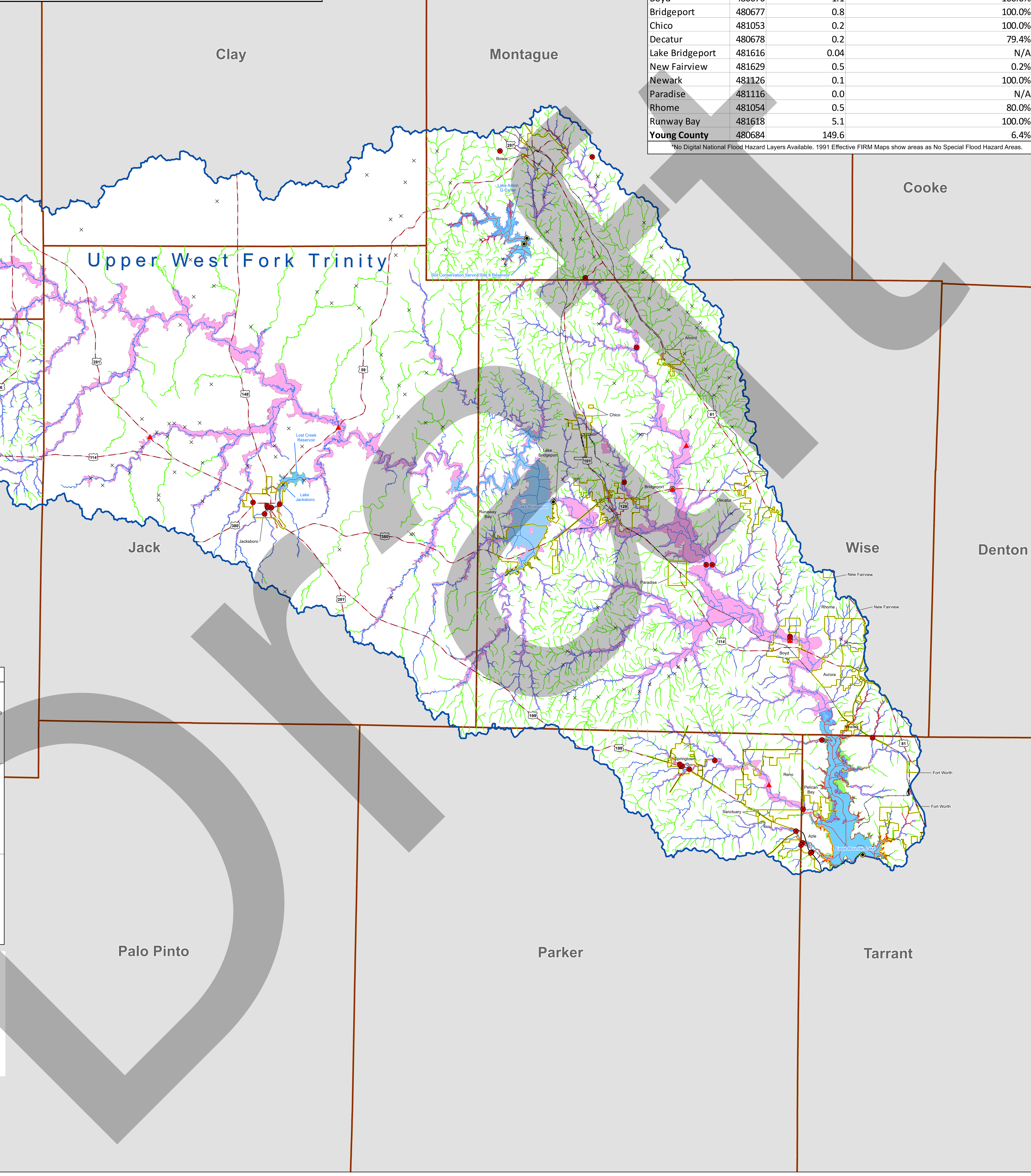
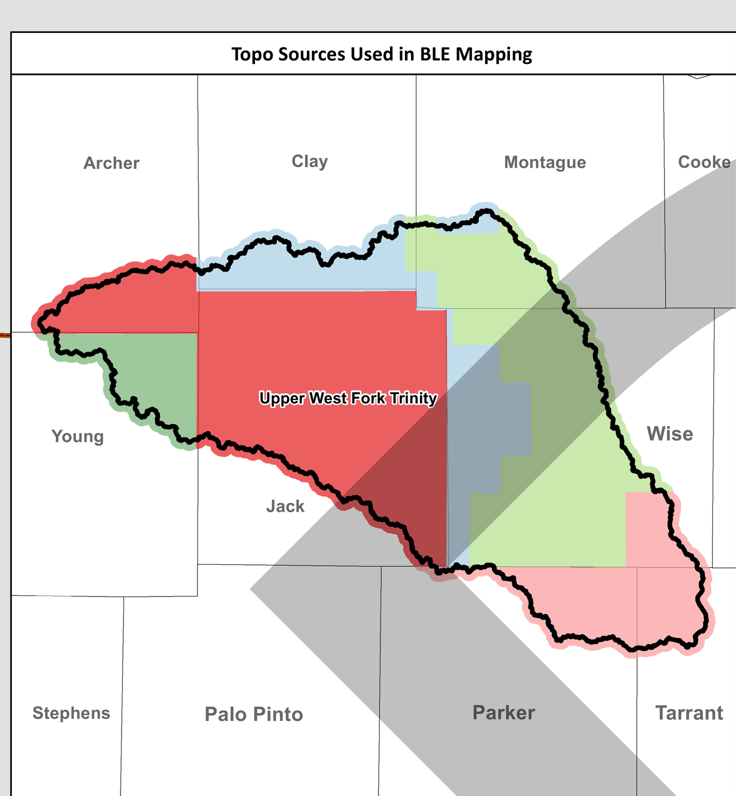
Azle	480584	1.6	43.2%
Forth Worth	480896	55.2	0.09%
Pelican Bay	481653	0.1	100.0%
Wise County	481051	102.6	77.6%
Alvord	481617	0.1	N/A
Aurora	481561	0.1	100.0%
Boyd	480676	1.1	100.0%
Bridgeport	480677	0.8	100.0%
Chico	481053	0.2	100.0%
Decatur	480678	0.2	79.4%
Lake Bridgeport	481616	0.04	N/A
New Fairview	481629	0.5	0.2%
Newark	481126	0.1	100.0%
Paradise	481116	0.0	N/A
Rhome	481054	0.5	80.0%
Runway Bay	481618	5.1	100.0%
Young County	480684	149.6	6.4%

*No Digital National Flood Hazard Layers Available. 1991 Effective FIRM Maps show areas as No Special Flood Hazard Areas.





Topo Sources Used in BLE Mapping

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FEMA 2018	*Texas West Central*
FEMA 2017	*Red River*
FEMA 2015	*Archer and Jack Counties*
TNRIS 2010	*Cooke, Grayson, Montague and Wise Counties*

N 0 1.5 3 6 9 12 Miles

Map Symbology

- USGS Gages
- Low Water Mark
- Dams
- Lakes
- County Boundary
- Watershed Boundary

Transportation

- State Highway
- US Highway

Effective FEMA Floodplains*

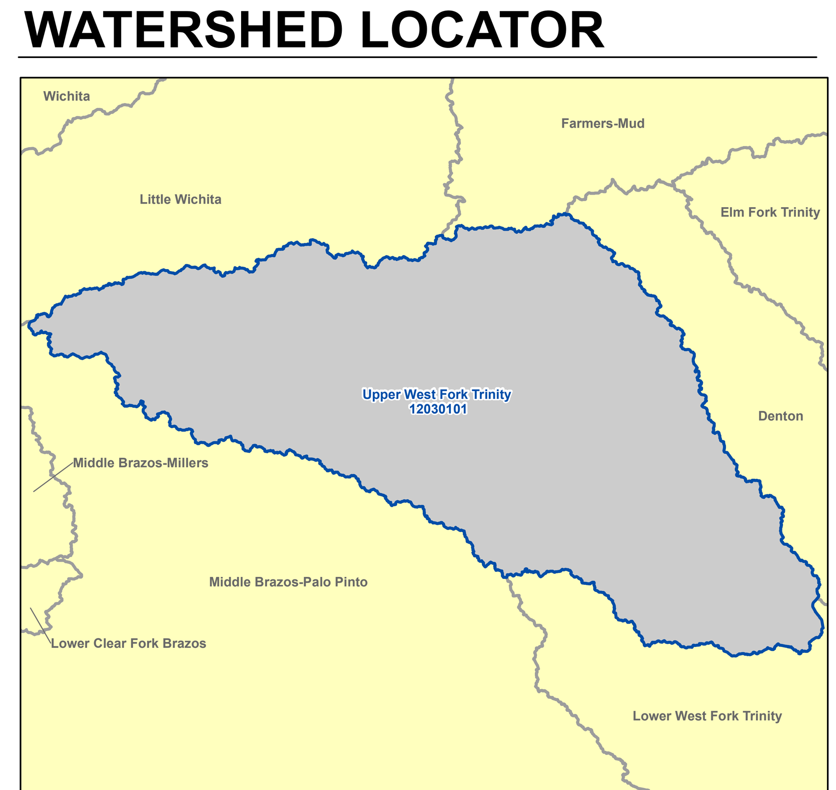
- AE, FLOODWAY
- Zone AE (100-Year, Detailed)
- Zone A (100-Year, Approximate)
- Zone X500 (500-Year, Detailed)

Effective Streams Study Type*

- Zone AE (100-Year, Detailed)
- Zone A (100-Year, Approximate)
- Zone X (Unshaded X, Areas of Minimal Flood Risk)

*Date as of April 2022

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Discovery Map

UPPER WEST FORK TRINITY, TEXAS

Stream Miles:	3,656
Zone AE Miles:	221
Zone A Miles:	1528
Zone X Miles:	1907
Population:	168,701

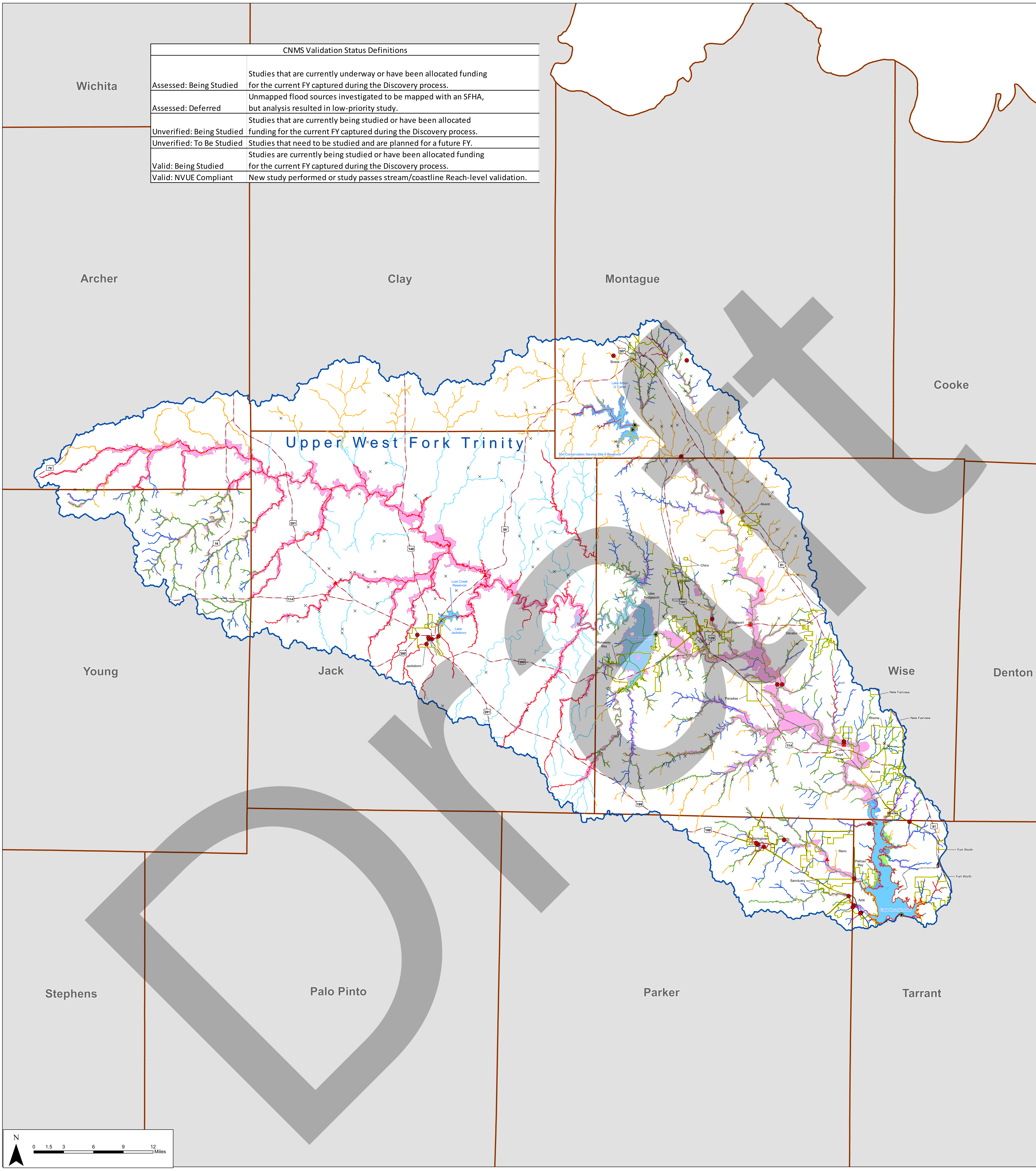
HUC-8 Code
12030101

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Figure 23: Post-Discovery Map

CNMS Validation Status Definitions	
Assessed: Being Studied	Studies that are currently underway or have been allocated funding for the current FY captured during the Discovery process.
Assessed: Deferred	Unmapped flood sources investigated to be mapped with an SFHA, but analysis resulted in low-priority study.
Unverified: Being Studied	Studies that are currently being studied or have been allocated funding for the current FY captured during the Discovery process.
Unverified: To Be Studied	Studies that need to be studied and are planned for a future FY.
Valid: Being Studied	Studies are currently being studied or have been allocated funding for the current FY captured during the Discovery process.
Valid: NVUE Compliant	New study performed or study passes stream/coastline Reach-level validation.



Map Symbology

- USGS Gages
- Low Water Mark
- Dams
- Lakes
- County Boundary
- Watershed Boundary

Transportation

- State Highway
- US Highway

Effective FEMA Floodplains*

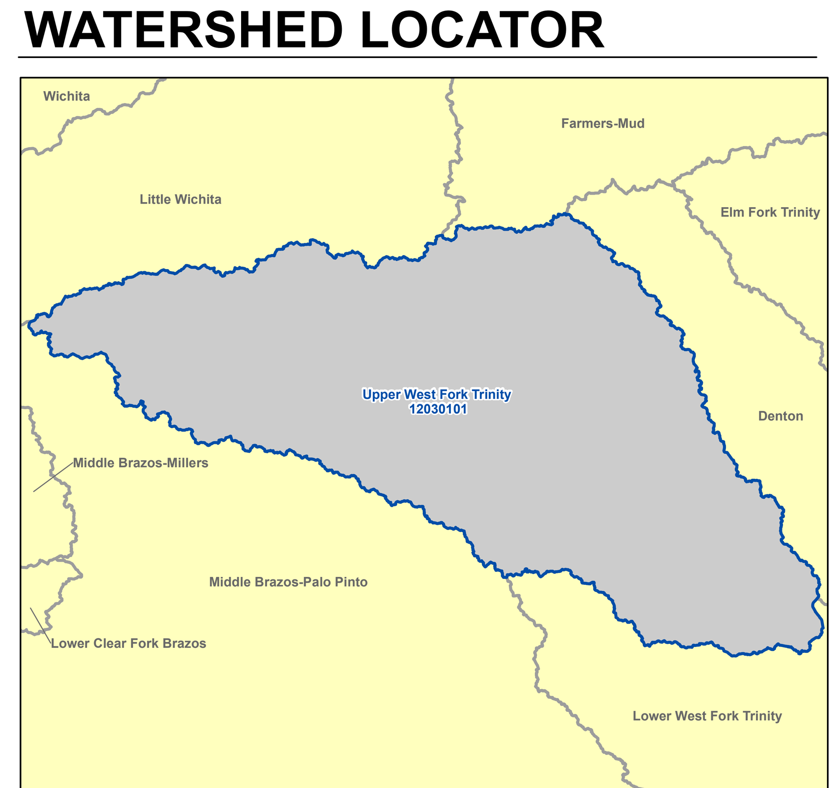
- AE, FLOODWAY
- Zone AE (100-Year, Detailed)
- Zone A (100-Year, Approximate)
- Zone X500 (500-Year, Detailed)

Validation Status, Status Type*

- Assessed: Being Studied
- Assessed: Deferred
- Unverified: Being Studied
- Unverified: To Be Studied
- Valid: Being Studied
- Valid: NVUE Compliant

***Date as of April 2022**

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Post-Discovery Map

UPPER WEST FORK TRINITY, TEXAS

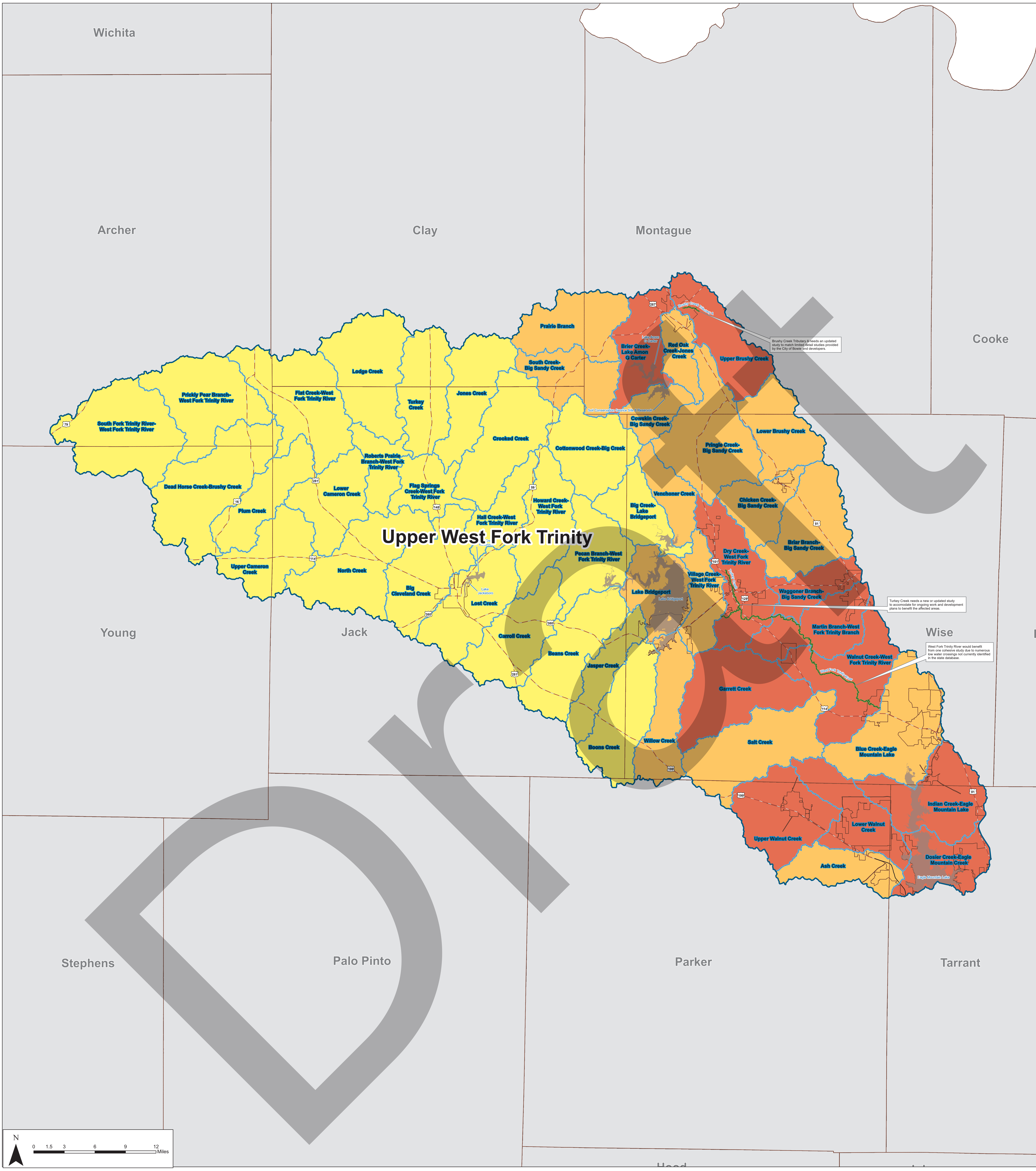
Stream Miles:	2,483
Assessed, Being Studied Miles:	706
Assessed, Deferred Miles:	345
Unverified, Being Studied Miles:	582
Unverified, To Be Studied Miles:	10
Valid, Being Studied Miles:	321
Valid, NVUE Compliant Miles:	518

HUC-8 Code
12030101

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Figure 24: HUC-12 Subwatershed Prioritization and Potential Projects



Map Symbology

- Potential Study Stream
- Incorporated Area
- Lake
- County Boundary
- HUC-8 Watershed Boundary
- HUC-12 Watershed Boundary

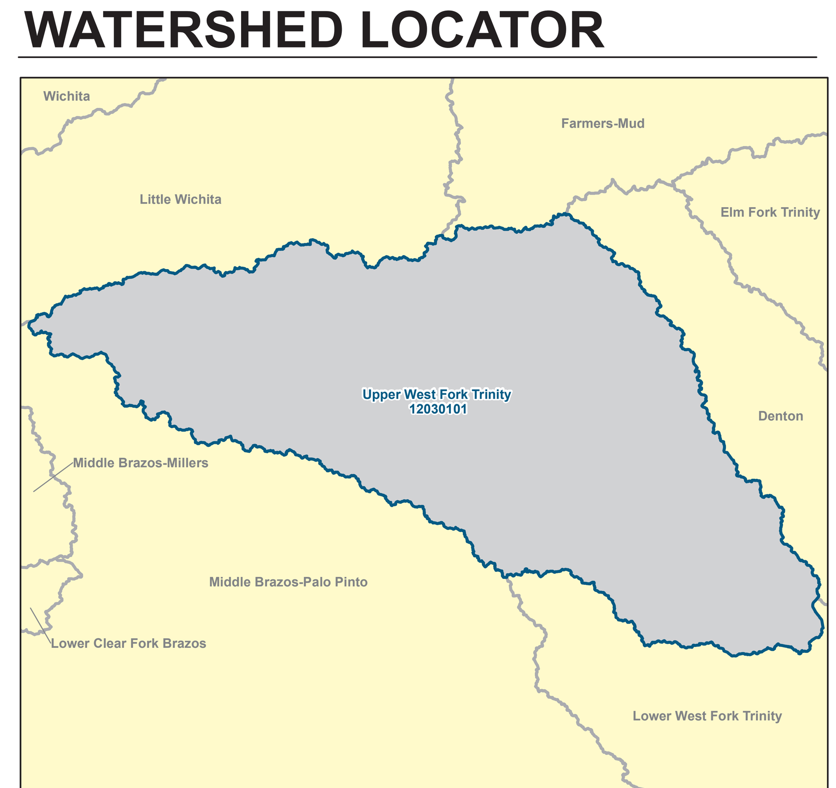
Transportation

- US Highway
- State Highway

HUC-12s - Prioritization Rank

- High Risk
- Elevated Risk
- Moderate Risk

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Watershed Prioritizations and Potential Projects Map

UPPER WEST FORK TRINITY, TEXAS

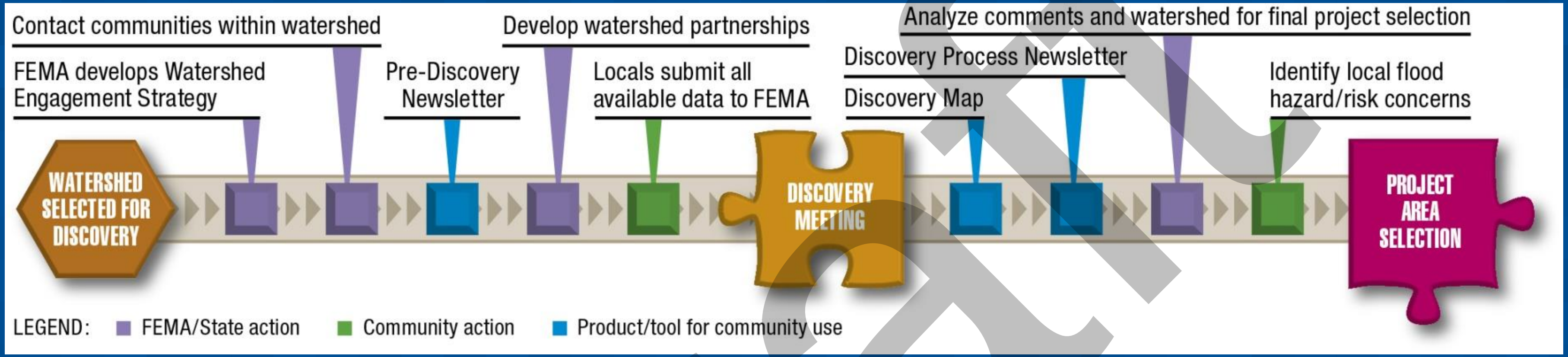
Total Watersheds Area:	1,954 sq. mi.
High Risk Area:	432 sq. mi.
Elevated Risk Area:	513 sq. mi.
Moderate Risk Area:	1,009 sq. mi.

HUC-8 Code
12030101

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Pre-Discovery Meeting Slides



NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS

UPPER WEST FORK TRINITY WATERSHED PRE-DISCOVERY MEETING

North Central Texas Council of Governments

FEMA

HALFF

DISCOVERY | CONTACT

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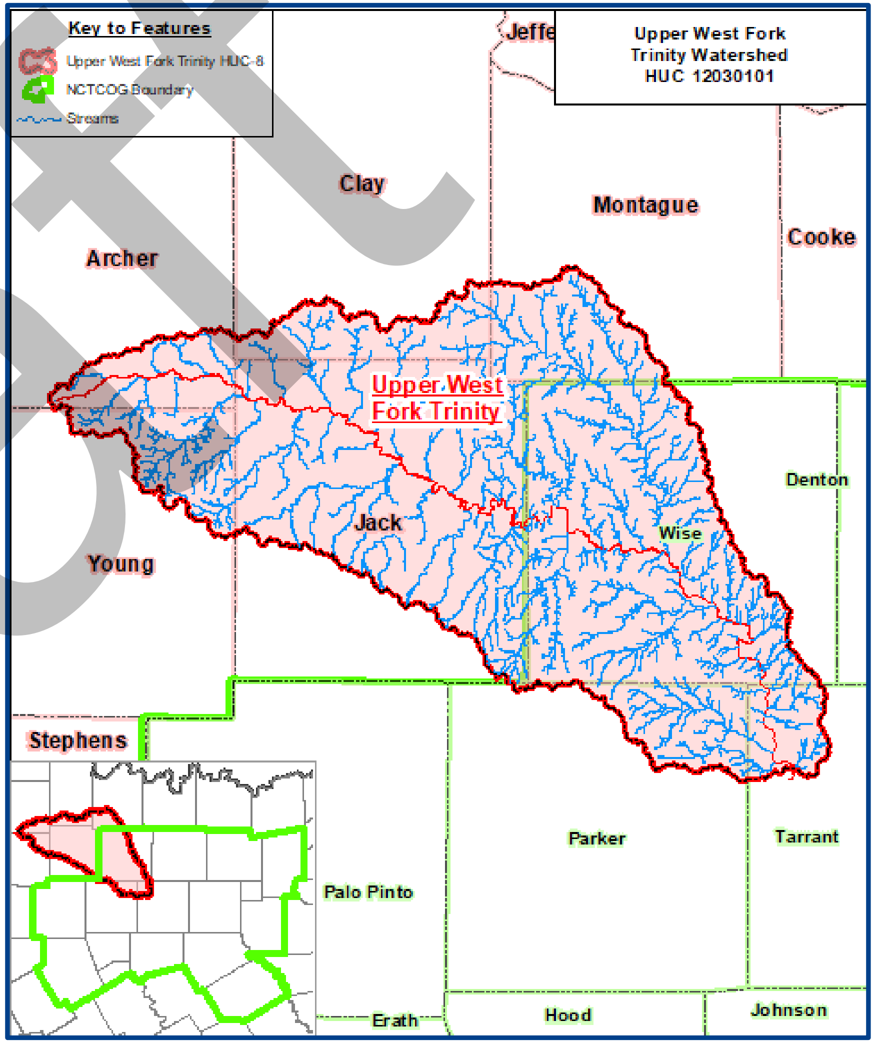
- Samuel Amoako-Atta – sAmoako-Atta@halff.com
- Alison Hanson – aHanson@halff.com
- Katy Overbey – kOverbey@halff.com

FEMA:

- Cameron Cornett – Cameron.Cornett@fema.dhs.gov

DISCOVERY | AGENDA

- NCTCOG Overview
- Risk MAP Overview
- Discovery Overview
- NCTCOG Discovery
  - Upper West Fork Trinity Watershed
  - Pre-Discovery Activities
  - Discovery Activities
  - Post Discovery Activities
- Data Gathering and Website walk through

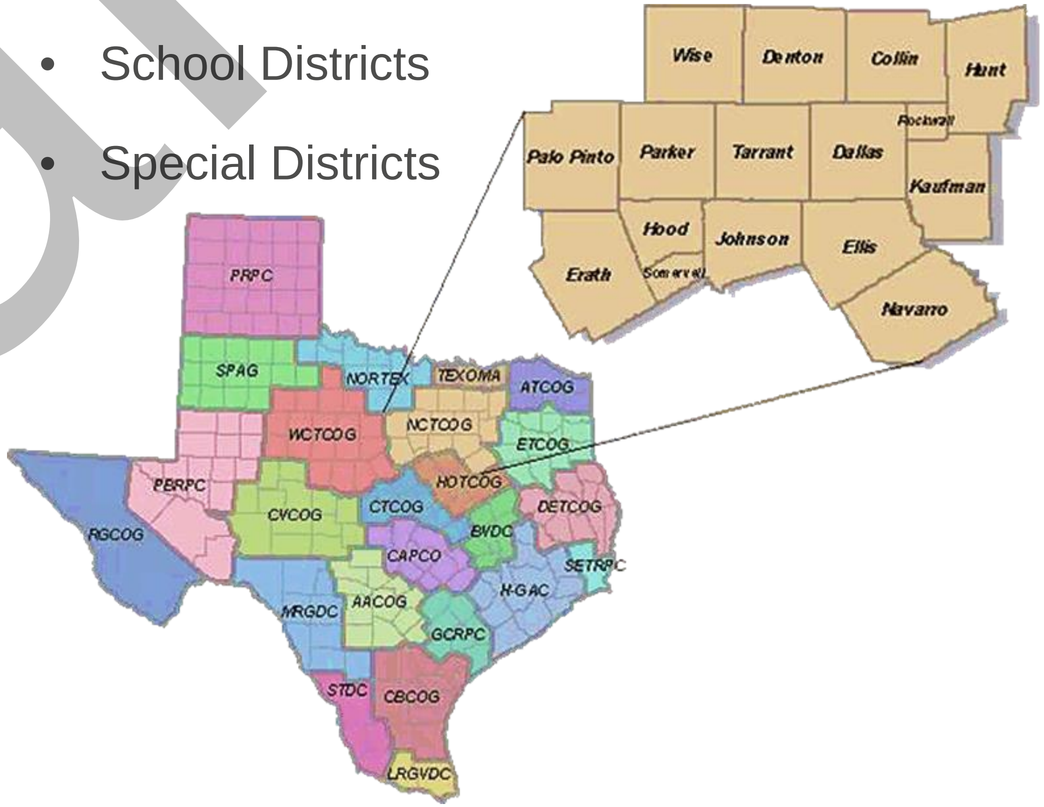


NCTCOG | WHAT IS NCTCOG'S ROLE?

VOLUNTARY ASSOCIATION OF, BY, AND FOR LOCAL GOVERNMENTS, ESTABLISHED IN 1966, TO HELP THEM:

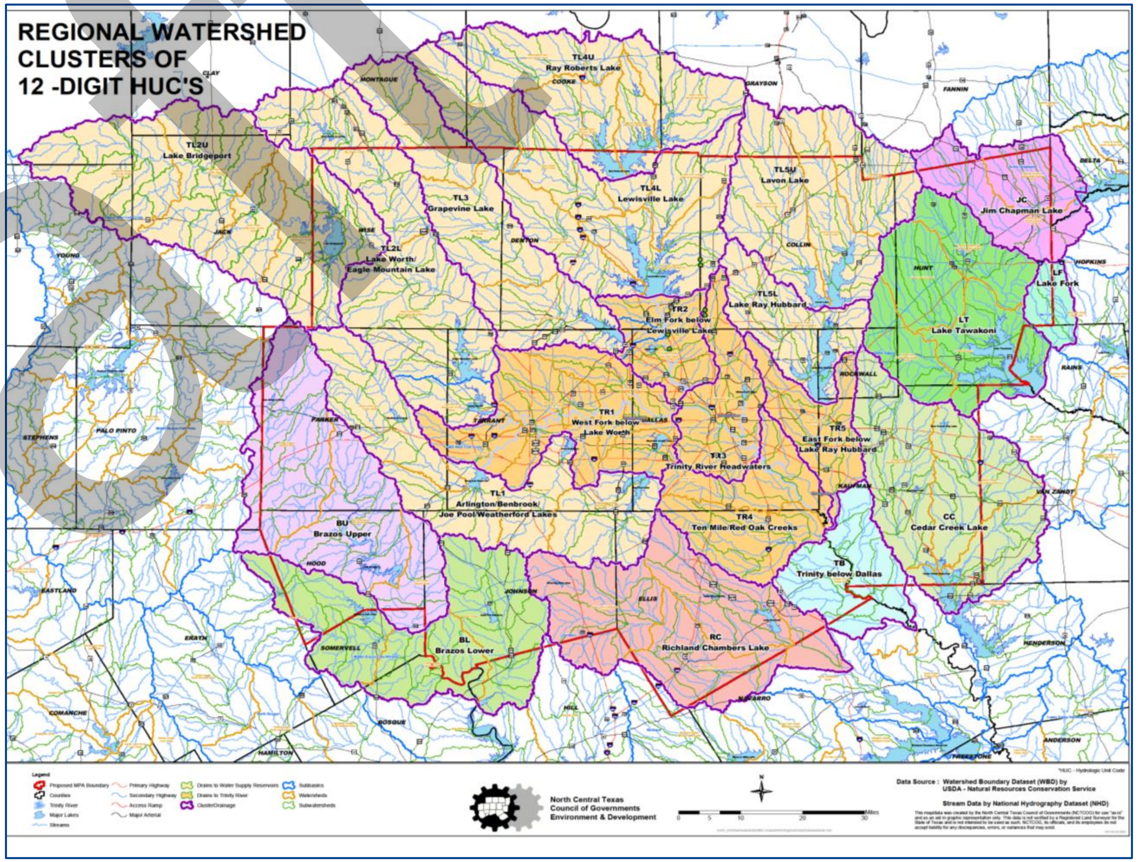
- Plan for common needs
- Strengthen their individual and collective power
- Recognize regional opportunities
- Resolve regional problems
- Make joint decisions/cooperate for mutual benefit

- 230+ Member Governments
  - Cities
  - Counties
  - School Districts
  - Special Districts



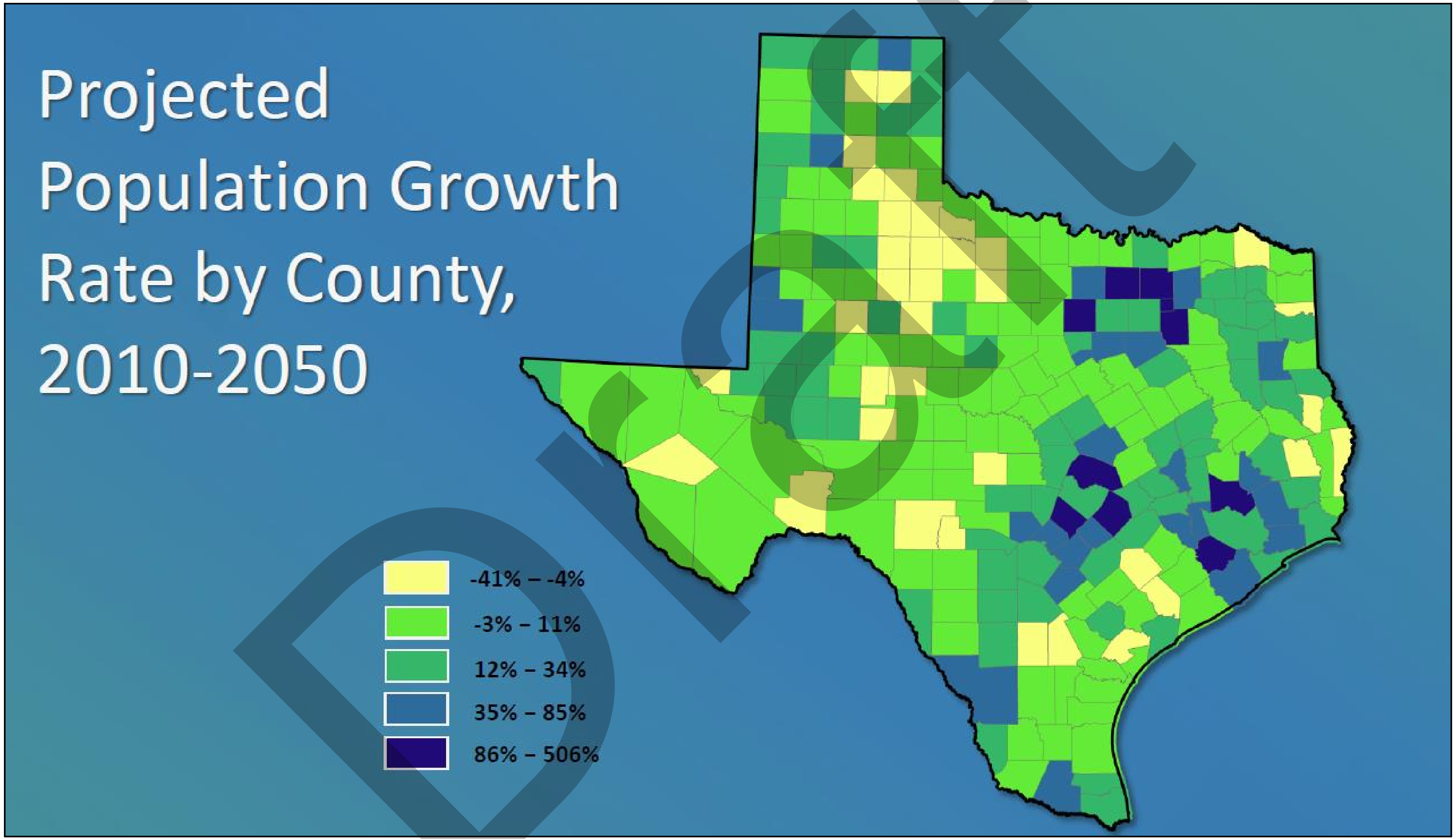
NCTCOG ENVIRONMENT AND DEVELOPMENT WATERSHED MANAGEMENT PROGRAM:

- Focus on water quality, stormwater, and floodplain topics/issues
- Floodplain
  - NCT region does not have a flood control district. Lots of local/regional entities working in their own jurisdictions
  - NCTCOG will never replace a flood control district, but as an agency, we work toward regional cooperation on flooding issues to help everyone accomplish common goals together

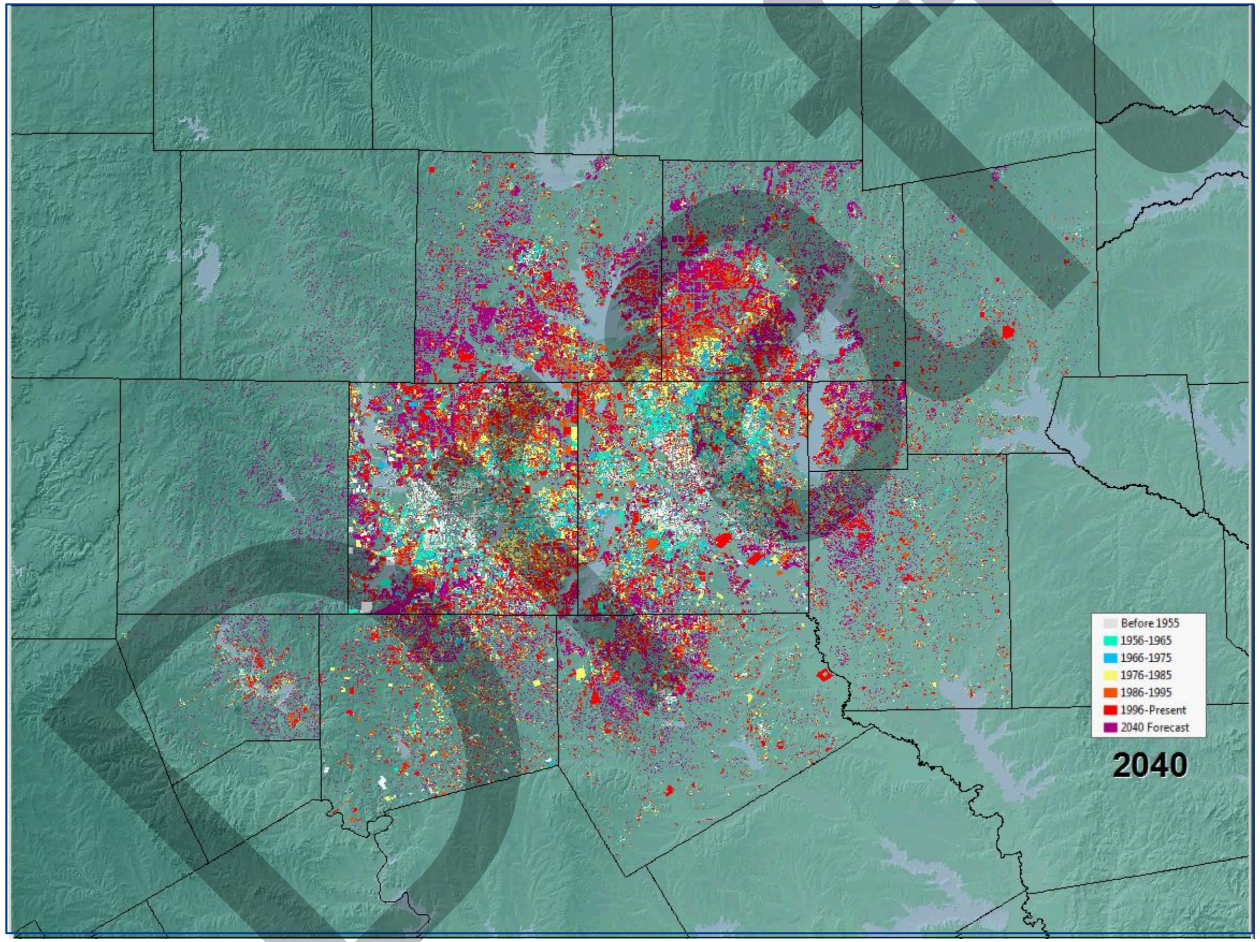


NCTCOG | WHAT IS NCTCOG'S ROLE?

Source : Dr. Lloyd Potter, Texas State Demographer



NORTH CENTRAL TEXAS 1950-2040 GROWTH



NCTCOG GOALS AS A COOPERATING TECHNICAL PARTNER

- Direct Goals:
  - Better data for better decision making
  - Coordination between communities and local/regional/state/federal organizations (what COGs do best!)
  - Partnerships
- Indirect Goals:
  - Higher Standards

FEMA'S RISK MAPPING, ASSESSMENT, AND PLANNING (MAP) PROGRAM

- Provide flood information and tools for better **protection**
- **Action-Driven**, not Map-Driven, through local understanding and ownership of risk

DISCOVERY | OVERVIEW

FEMA'S RISK MAPPING, ASSESSMENT, AND PLANNING (MAP) PROGRAM

- Provide flood information and tools for better **protection**
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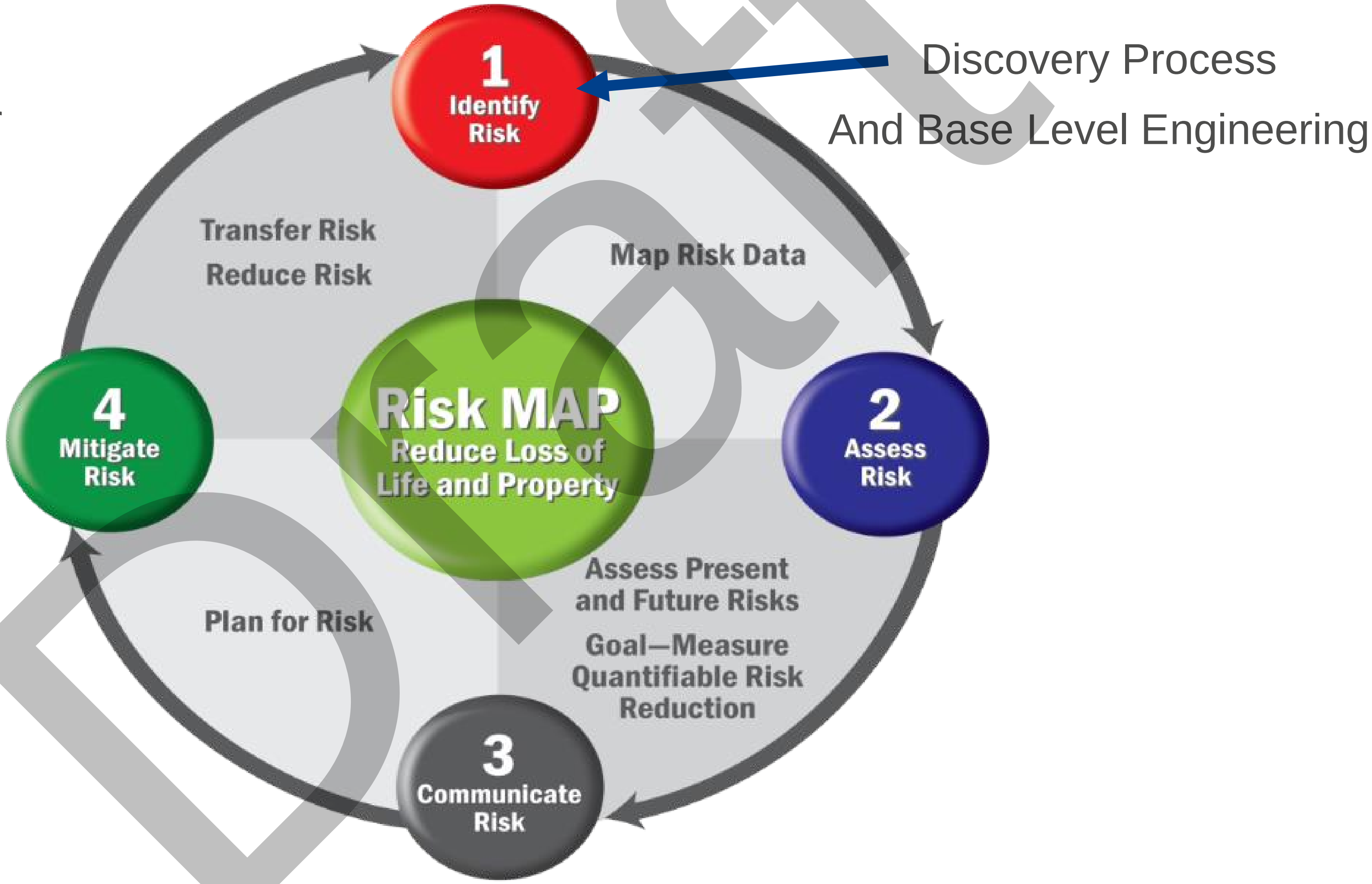


DISCOVERY | OVERVIEW

- ***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 Flyer
- Discovery Newsletter
- Pre-Discovery Webinars
- Gather all available data
  - Data needs
  - Issues / Concerns
  - Areas of Mitigation

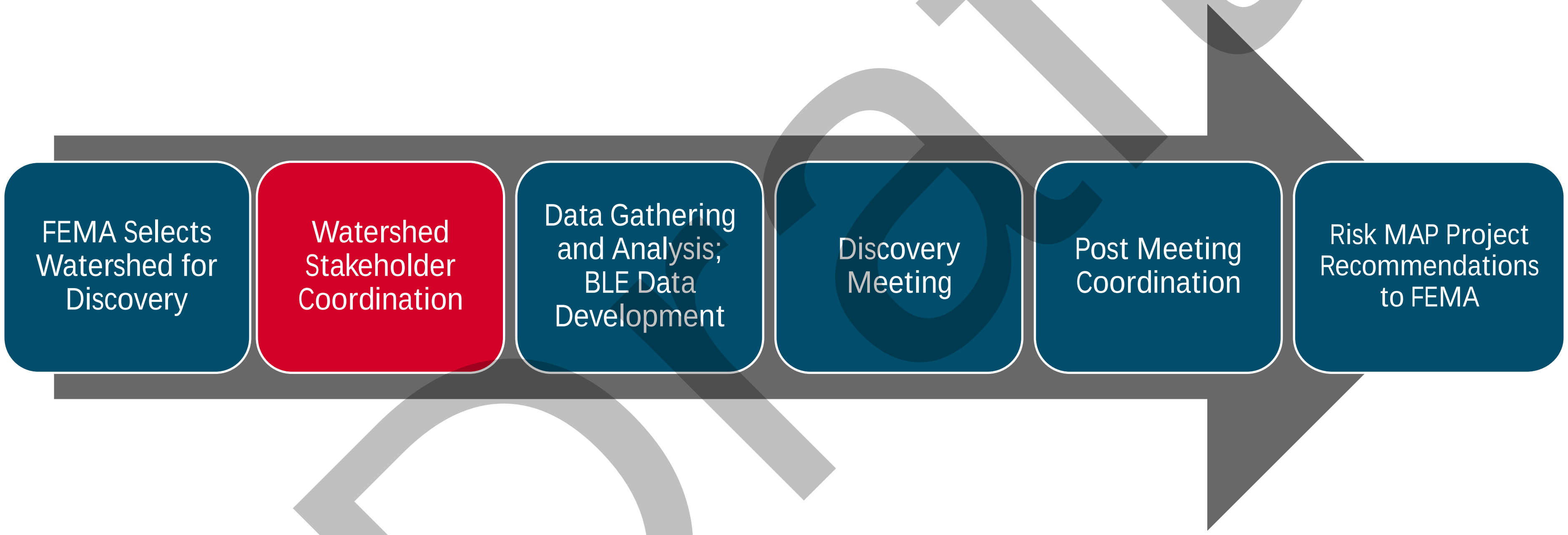
Discovery Meeting

- 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

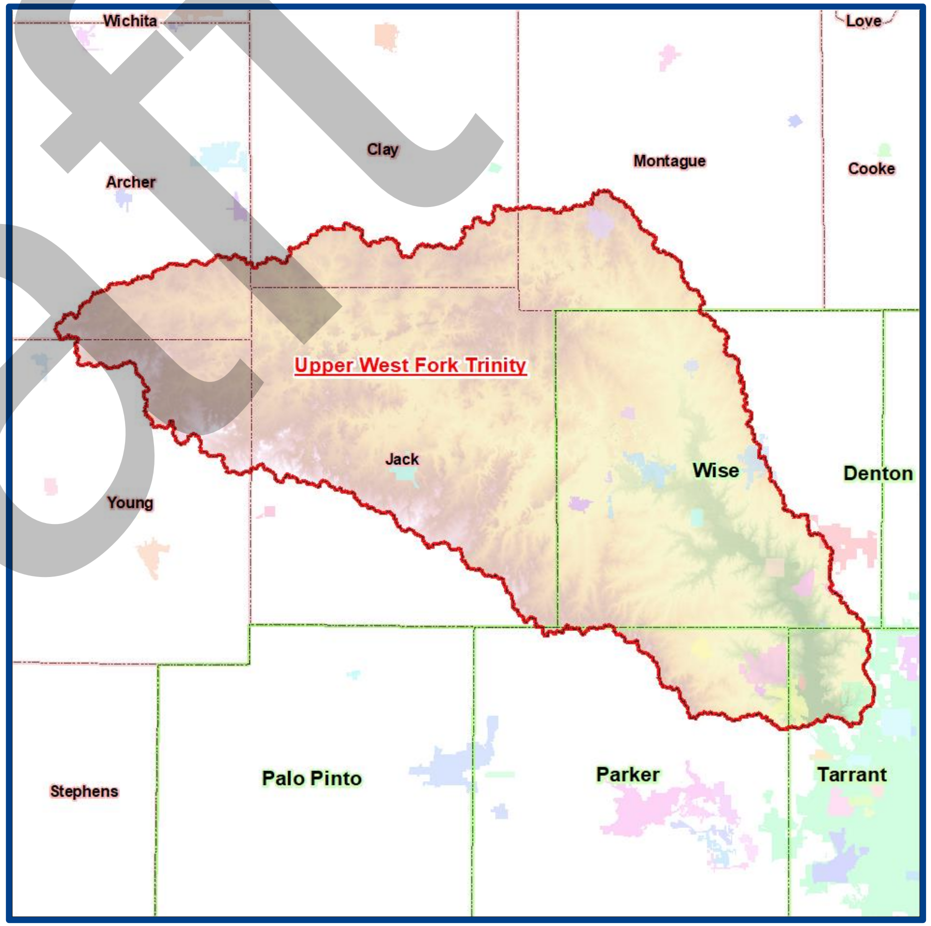
DISCOVERY | DISCOVERY PROCESS



DISCOVERY | GOALS

NCTCOG LEADING UPPER WEST FORK TRINITY DISCOVERY

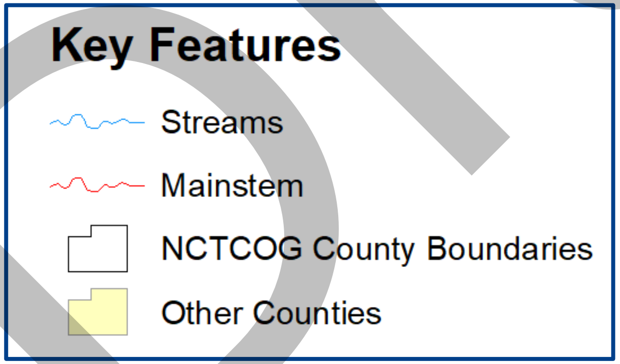
- Gather Information
  - Local flood risks and hazards
  - Current mitigation efforts
- Provide Information
  - Mitigation planning and actions
  - Risk communication

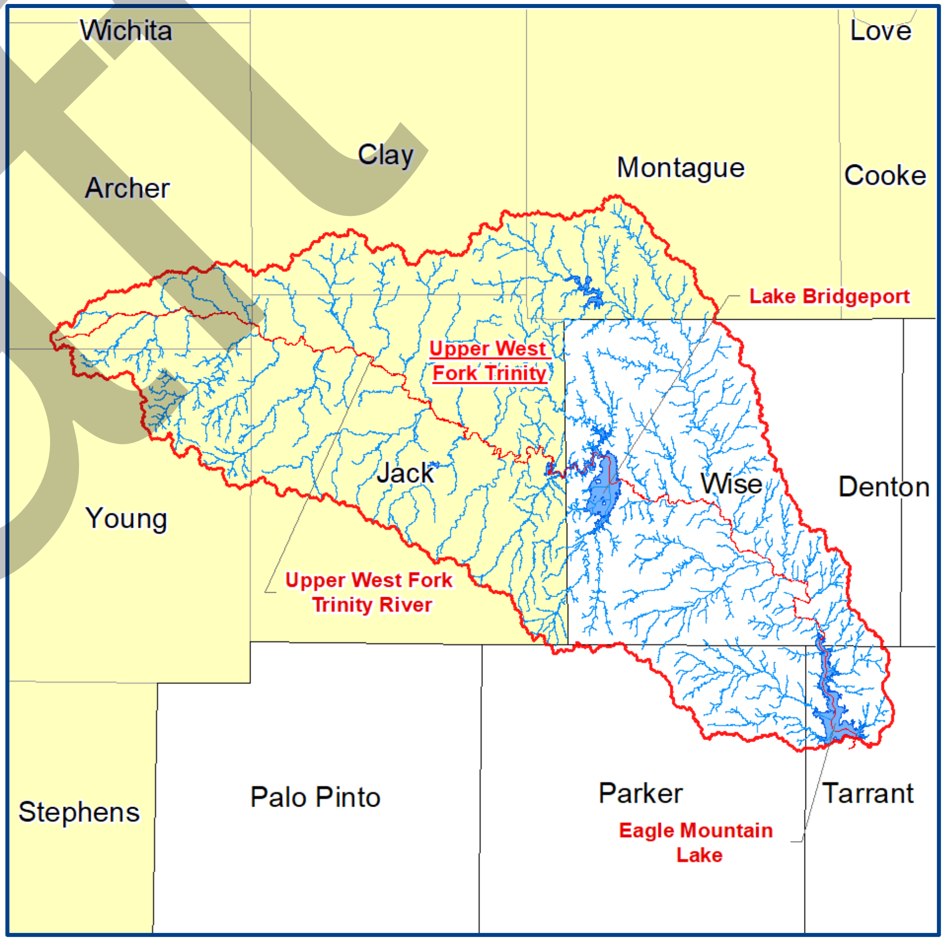


BASE LEVEL ENGINEERING (BLE) | OVERVIEW

LARGE SCALE AUTOMATED ENGINEERING (LSAE) PROCESS

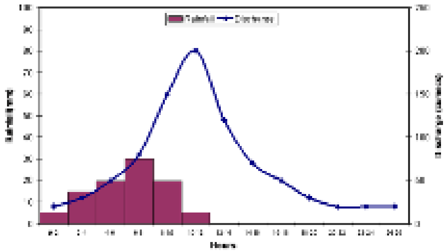
- BLE is best used at a larger scale (HUC8)
- LiDAR must be available
- Model review and adjustments
- Gage review included in hydrology



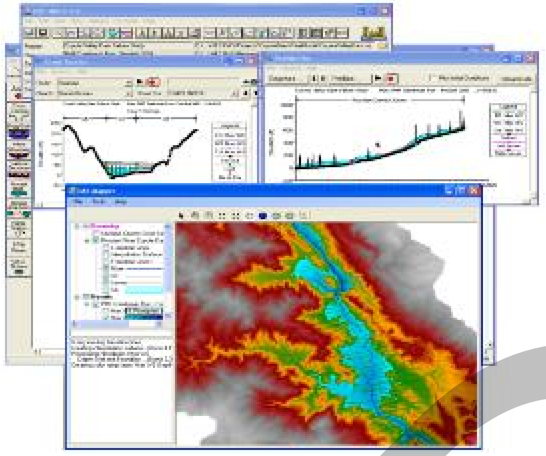


BASE LEVEL ENGINEERING (BLE) | OVERVIEW

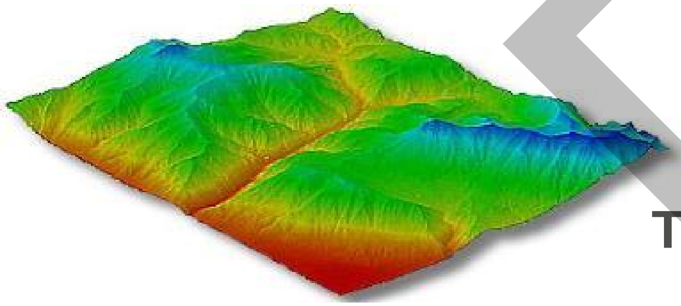
MODELING



Hydrology



Hydraulics



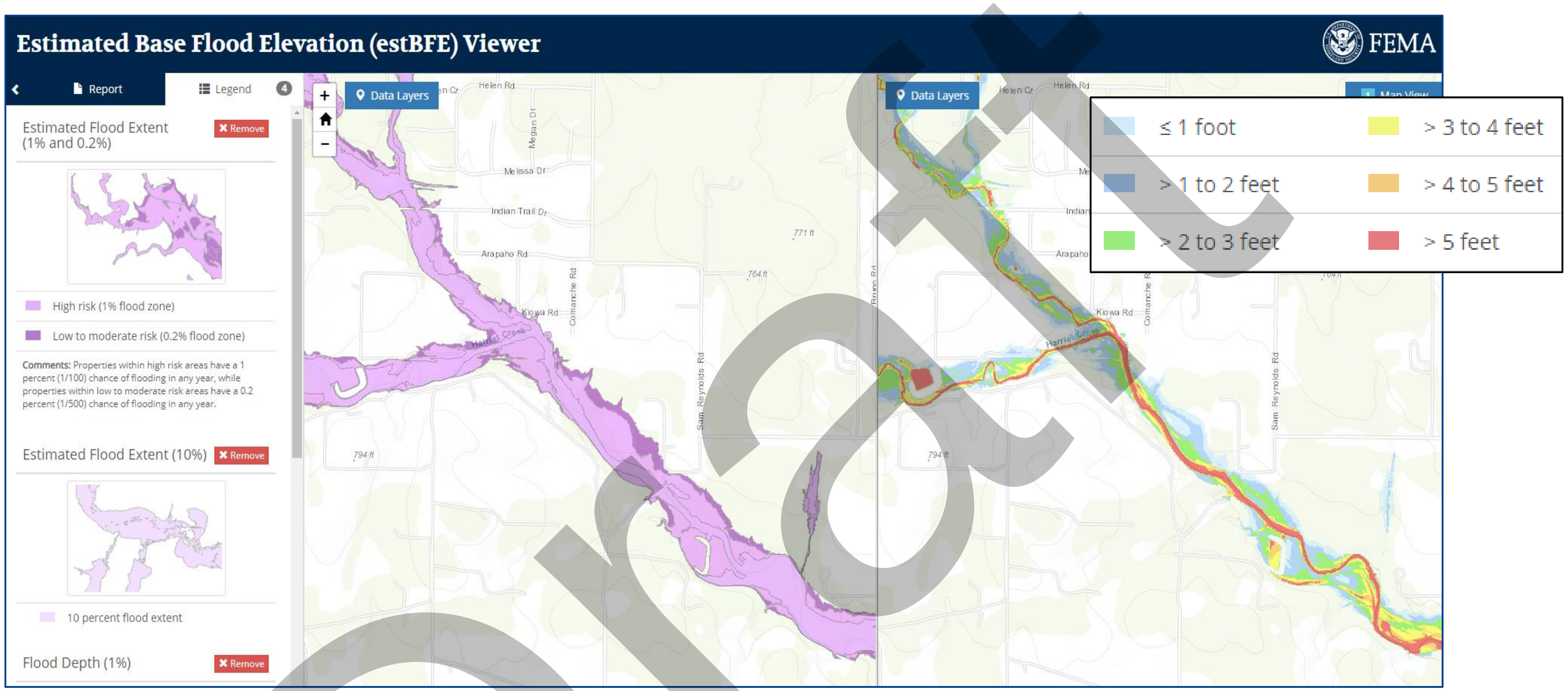
Terrain

Mapping

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

BASE LEVEL ENGINEERING (BLE)

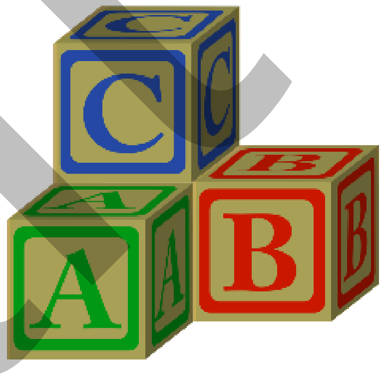


Non-Regulatory

- Areas of Expanded Flood Risk
- Depth and Analysis Grids
- Flood Risk Assessment

BASE LEVEL ENGINEERING (BLE) | OVERVIEW

- Building Block for Future Model Refinement



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

CHEAPER

FASTER

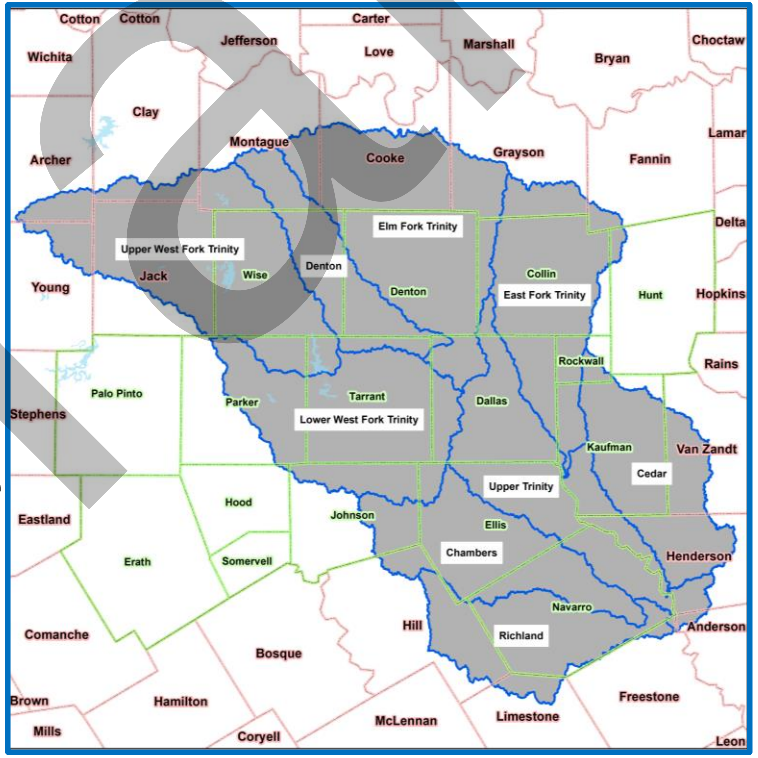
DATA FOR REVIEW

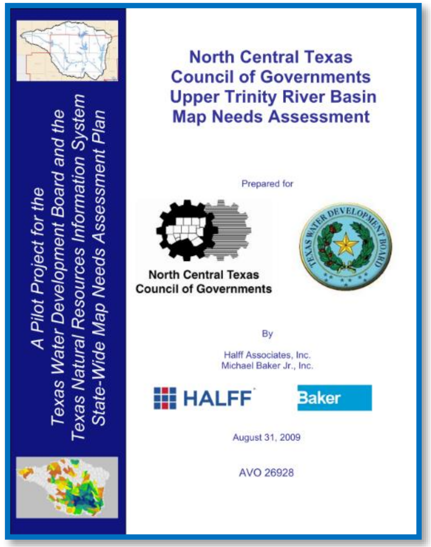
COLLABORATIVE

NCTCOG DISCOVERY ACTIVITIES

2004-2008 FEMA Map Modernization → **2009** Map Needs Assessment → 2012 Partnered with FEMA for CTP Grant → 2013 Discovery → 2017 Discovery → 2018 Discovery → 2019 Discovery → 2021 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. 2021 Discovery will do the same.

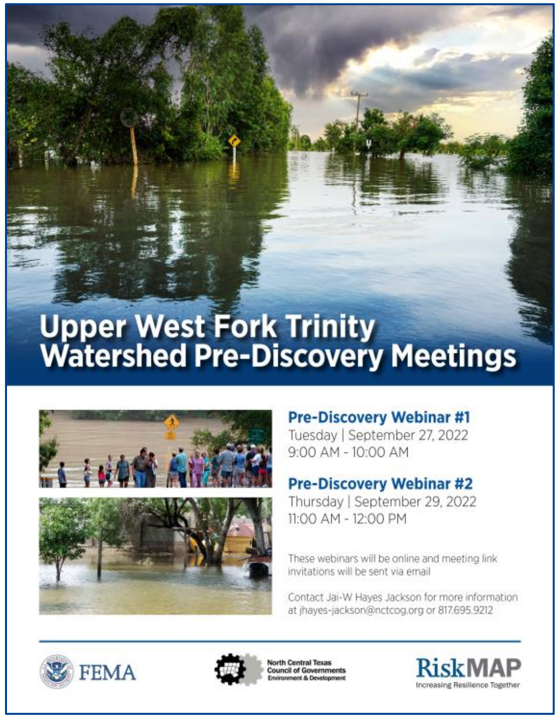


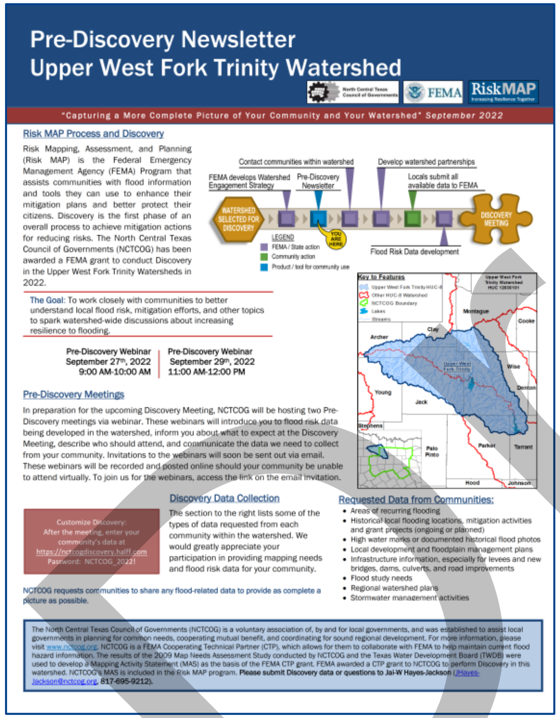


DISCOVERY | ACTIVITIES

PRE-DISCOVERY MEETING

- Inform communities of process and timeline





Pre-Discovery Newsletter
Upper West Fork Trinity Watershed

"Capturing a More Complete Picture of Your Community and Your Watershed" September 2022

Risk MAP Process and Discovery

Risk Mapping, Assessment, and Planning (Risk MAP) is the Federal Emergency Management Agency (FEMA) Program that assists communities with flood information and tools they can use to enhance their mitigation plans and better protect their citizens. Discovery is the first phase of an overall process to achieve mitigation actions for reducing risks. The North Central Texas Council of Governments (NCTCOG) has been awarded a FEMA grant to conduct Discovery in the Upper West Fork Trinity Watersheds in 2022.

The Goal: To work closely with communities to better understand local flood risk, mitigation efforts, and other topics to spark watershed-wide discussions about increasing resilience to flooding.

Pre-Discovery Webinar September 27th, 2022 9:00 AM-10:00 AM | Pre-Discovery Webinar September 29th, 2022 11:00 AM-12:00 PM

Pre-Discovery Meetings

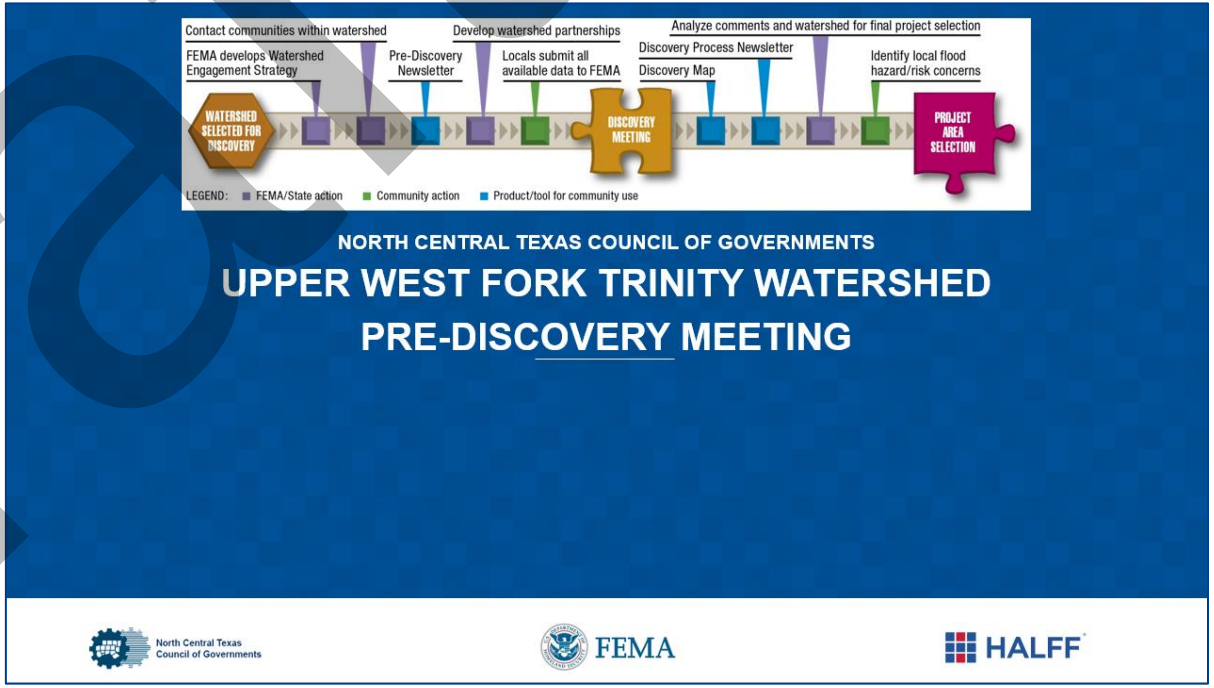
In preparation for the upcoming Discovery Meeting, NCTCOG will be hosting two Pre-Discovery meetings via webinar. These webinars will introduce you to flood risk data being developed in the watershed, inform you about what to expect at the Discovery Meeting, describe who should attend, and communicate the data we need to collect from your community. Invitations to the webinars will soon be sent out via email. These webinars will be recorded and posted online should your community be unable to attend virtually. To join us for the webinars, access the link on the email invitation.

Discovery Data Collection

The section to the right lists some of the types of data requested from each community within the watershed. We would greatly appreciate your participation in providing mapping needs and flood risk data for your community.

Requested Data from Communities:
- Areas of recurring flooding
- Historical local flooding locations, mitigation activities and grant projects (ongoing or planned)
- High water marks or documented historical flood photos
- Local development and floodplain management plans
- Infrastructure information, especially for levees and new bridges, dams, culverts, and road improvements
- Flood study needs
- Regional watershed plans
- Stormwater management activities

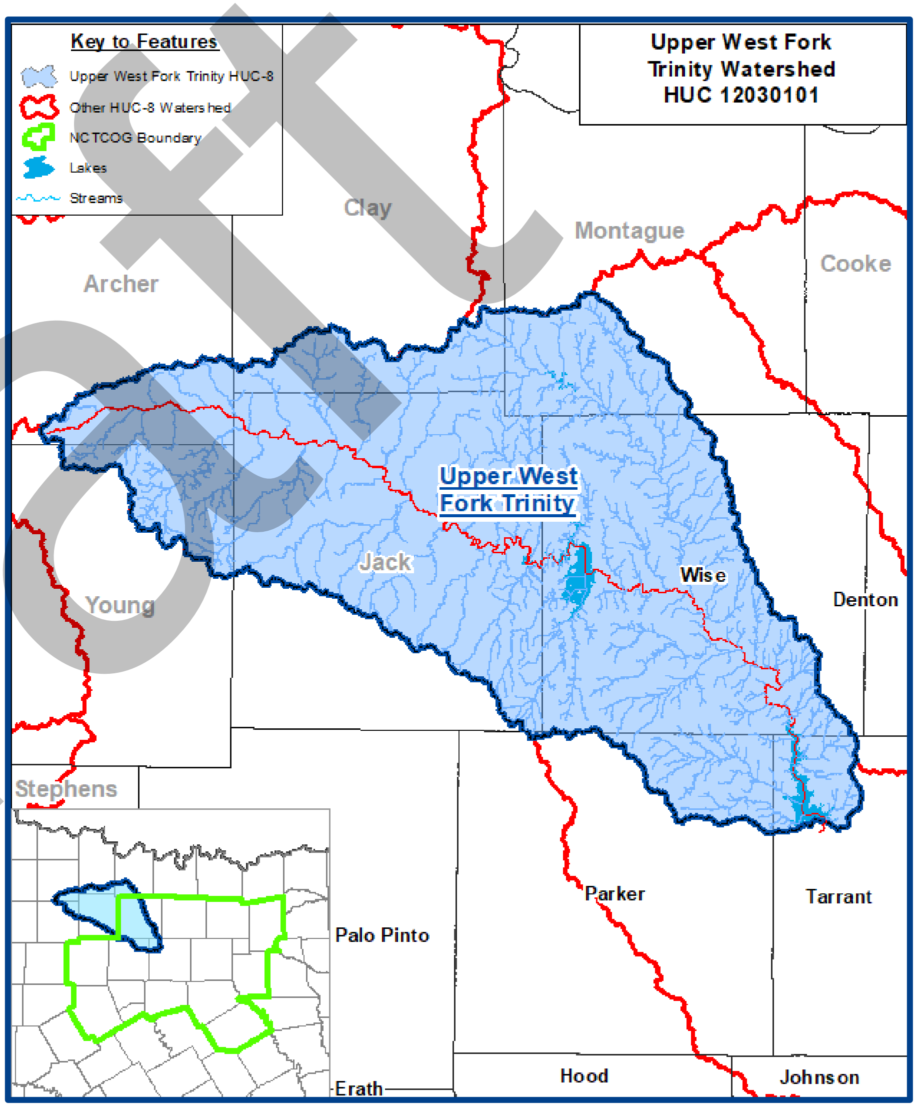
NCTCOG requests communities to share any flood-related data to provide as complete a picture as possible.



DISCOVER THE DATA | PRE-DISCOVERY ACTIVITIES

SUBMITTING INFORMATION

- Record flooding issues concerns on our website
- Demonstrate later in presentation



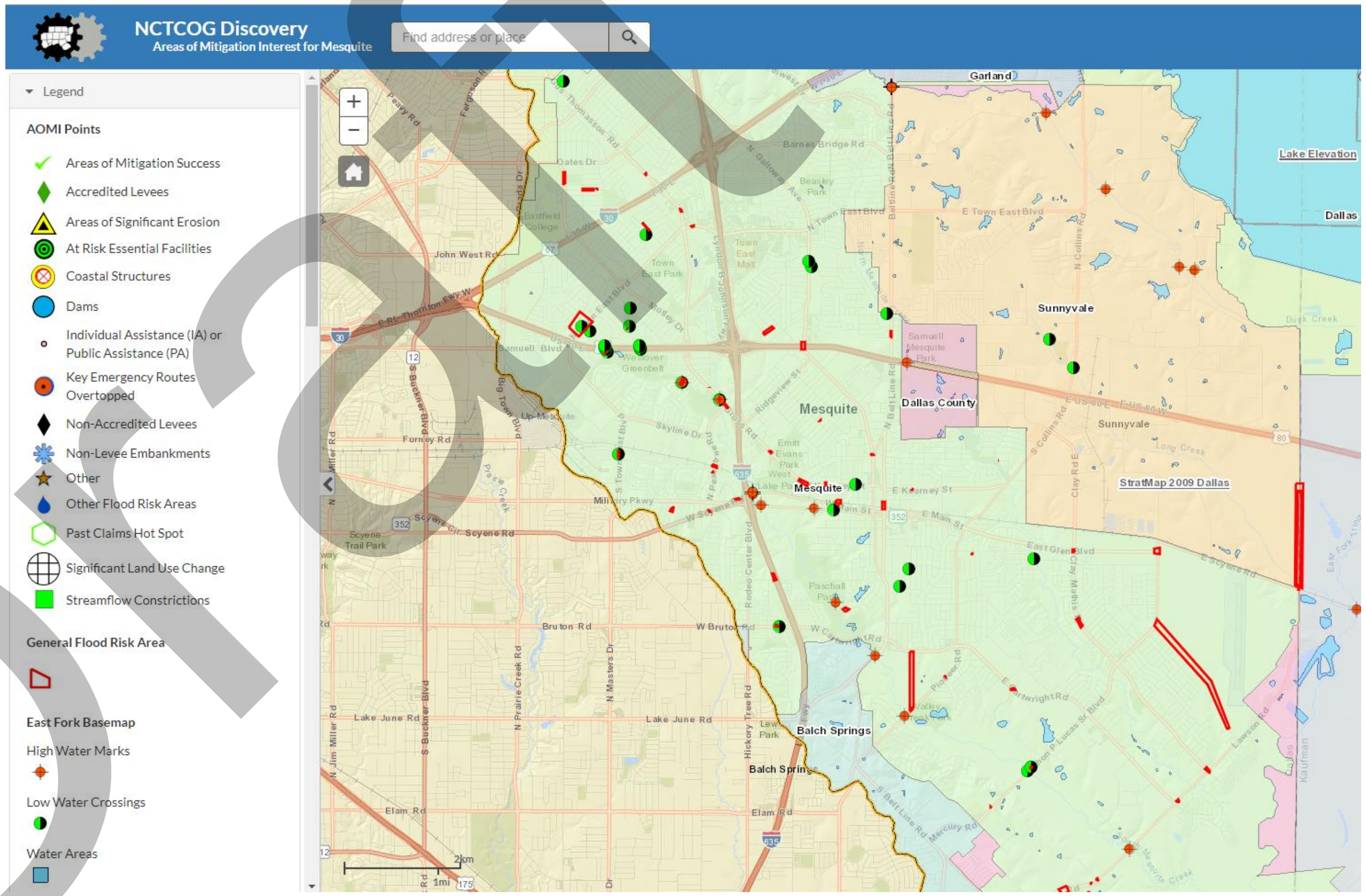
Draft

What information are we interested in?

DISCOVERY MEETINGS COMING… | PRE-DISCOVERY ACTIVITIES

SUBMITTING INFORMATION

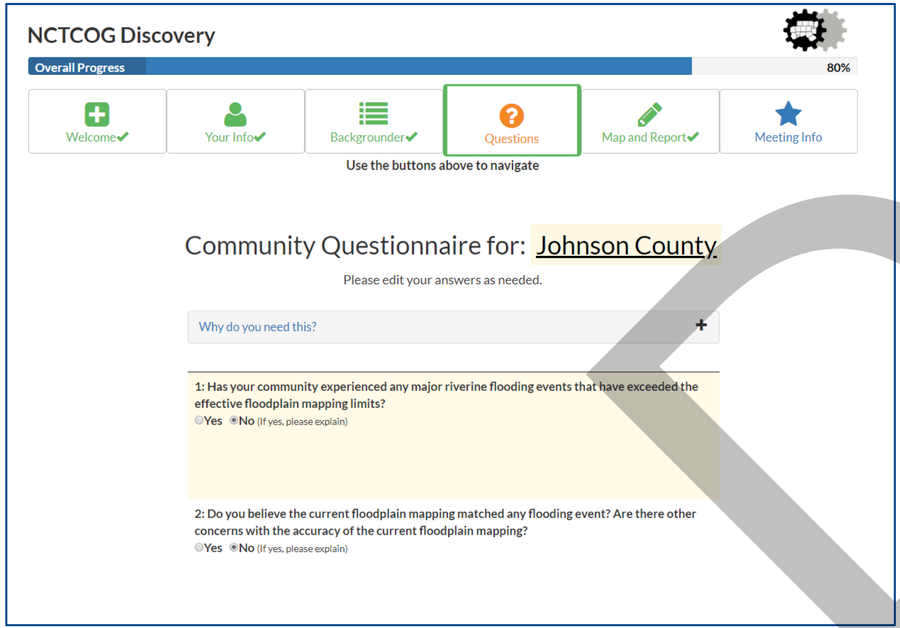
- Enter your data online before the meeting
- Discovery meetings early 2023
- All community stakeholders are encouraged to attend

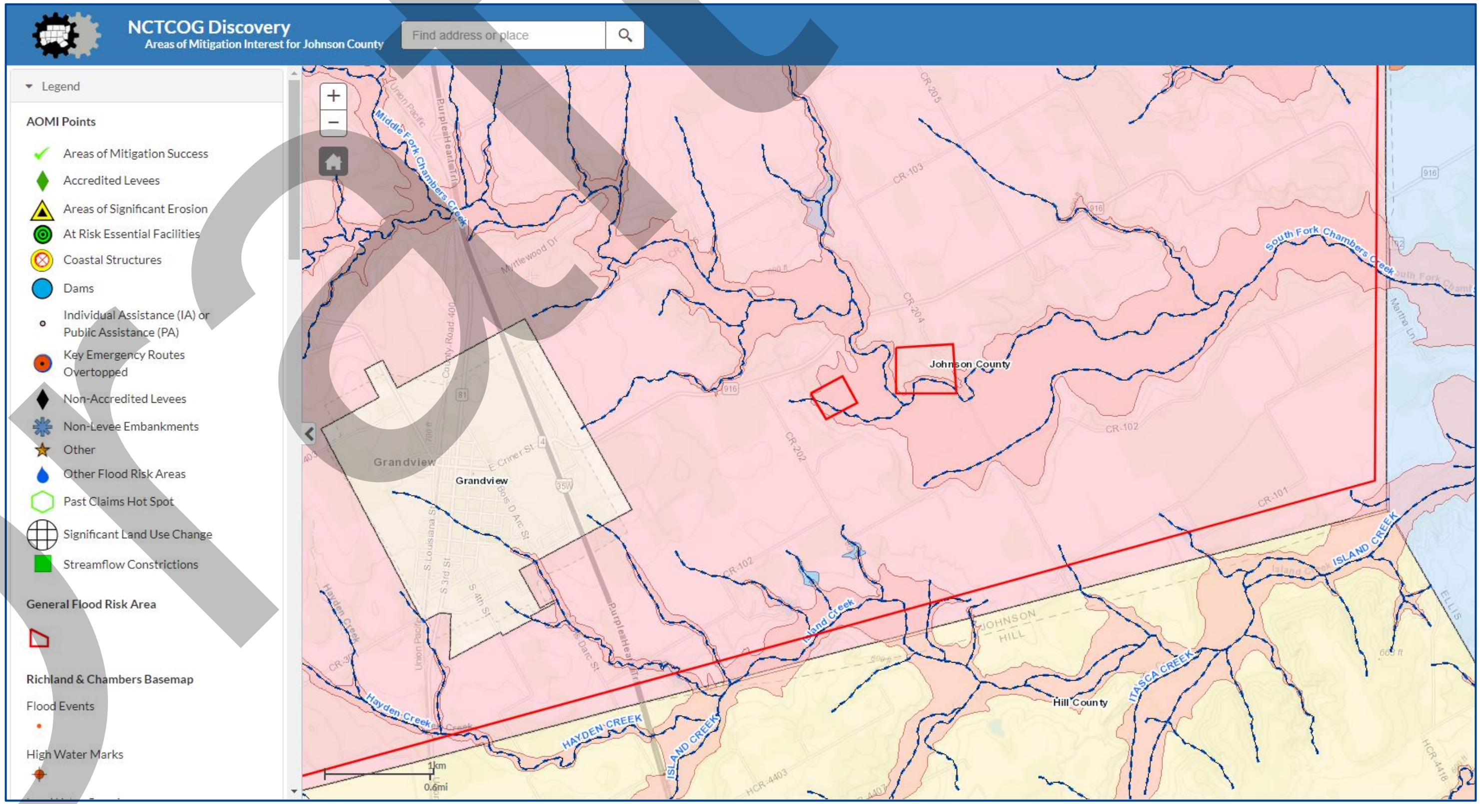


DISCOVERY | ACTIVITIES

COMMUNITIES SUBMITTED FLOOD RISKS ONLINE

- Low Water Crossings
- Flooding Concerns
- Significant Land Use Change
- Issues with Effective Mapping





DISCOVERY MEETINGS – OPEN HOUSE | DISCOVERY ACTIVITIES

Open House Style Meetings – Come and Go

Discovery Map and Changes Since Last FIRM Maps

Check-in

TWDB

USACE

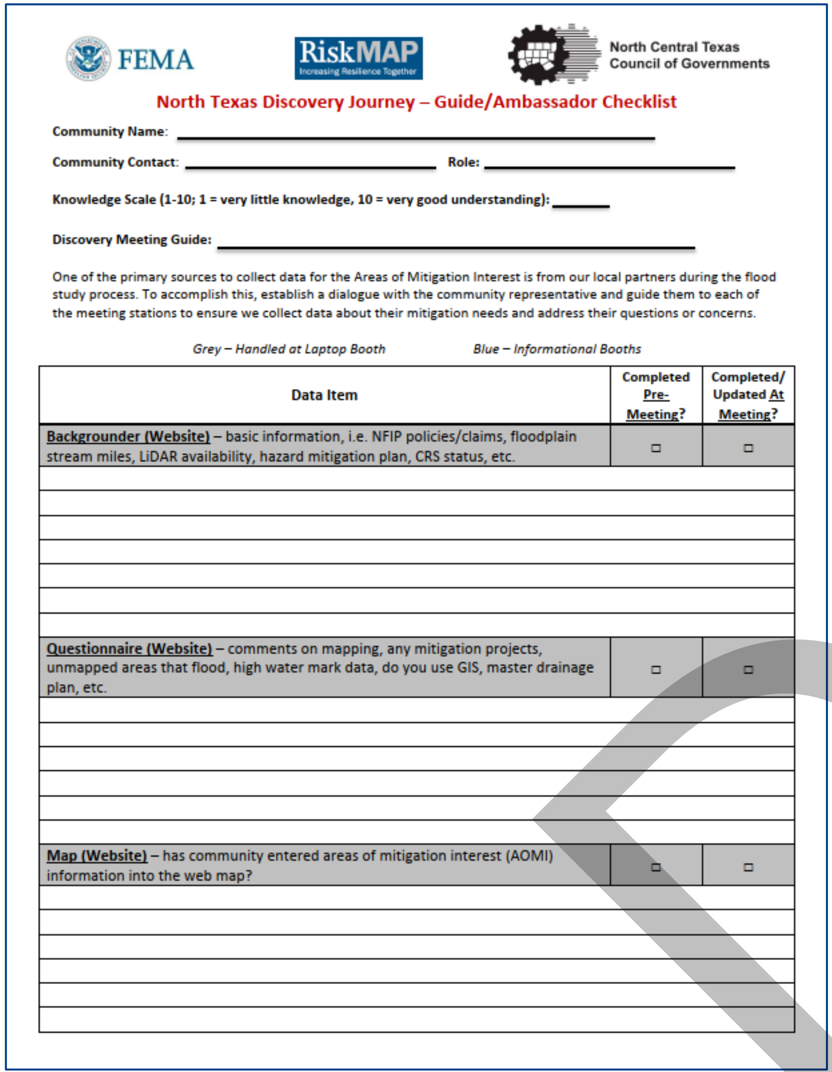
FEMA

NTMWD

NCTCOG Programs

Data Collection

DISCOVERY | ACTIVITIES



FEMA RiskMAP Increasing Resilience Together North Central Texas Council of Governments

North Texas Discovery Journey – Guide/Ambassador Checklist

Community Name: ______________________________

Community Contact: ____________________ **Role:** ____________________

Knowledge Scale (1-10; 1 = very little knowledge, 10 = very good understanding): ______

Discovery Meeting Guide: ______________________________

One of the primary sources to collect data for the Areas of Mitigation Interest is from our local partners during the flood study process. To accomplish this, establish a dialogue with the community representative and guide them to each of the meeting stations to ensure we collect data about their mitigation needs and address their questions or concerns.

Grey – Handled at Laptop Booth *Blue – Informational Booths*

Data Item	Completed Pre-Meeting?	Completed/ Updated At Meeting?
Backgrounder (Website) – basic information, i.e. NFIP policies/claims, floodplain stream miles, LiDAR availability, hazard mitigation plan, CRS status, etc.	☐	☐
Questionnaire (Website) – comments on mapping, any mitigation projects, unmapped areas that flood, high water mark data, do you use GIS, master drainage plan, etc.	☐	☐
Map (Website) – has community entered areas of mitigation interest (AOMI) information into the web map?	☐	☐

DISCOVERY MEETING – JANUARY 2023

- Receive flooding issues
- Facilitate discussion among stakeholders

DISCOVERY MEETINGS – WHAT TO EXPECT | DISCOVERY ACTIVITIES

North Central Texas Council of Governments

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WHO SHOULD ATTEND MEETINGS:

- 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

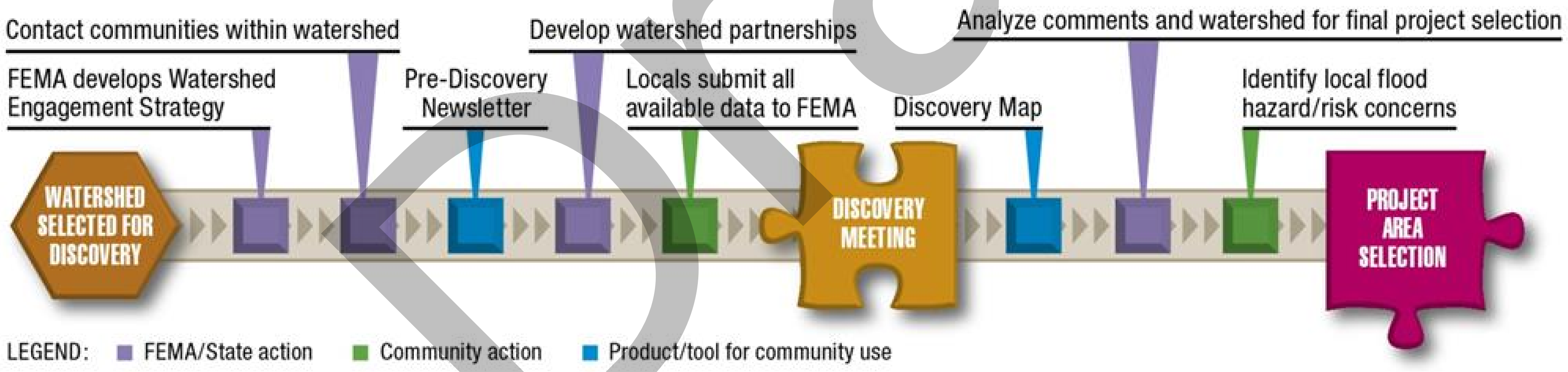
DISCOVERY MEETINGS – WHAT TO EXPECT | DISCOVERY ACTIVITIES

WHAT SHOULD BE BROUGHT TO MEETINGS:

- 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

POST-DISCOVERY ACTIONS:

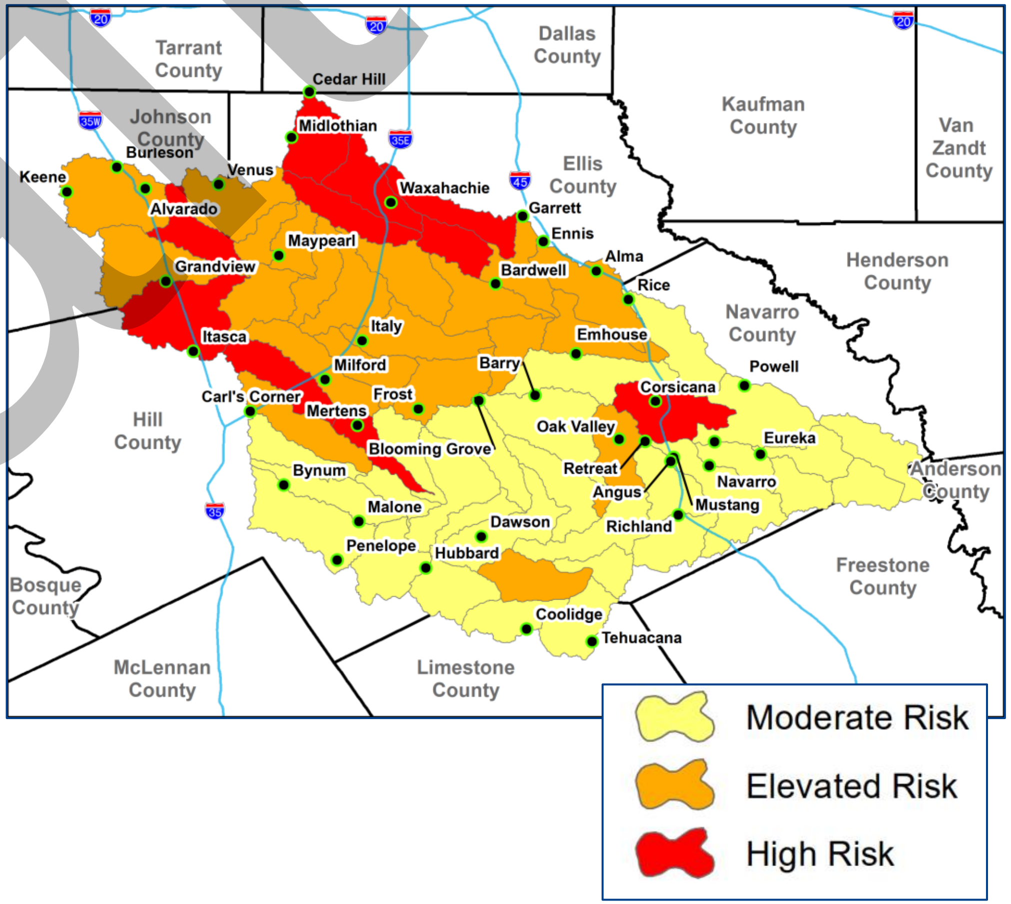
- Analyze data collected
- Review findings with NCTCOG



POST-DISCOVERY ACTIONS | POST-DISCOVERY ACTIVITIES

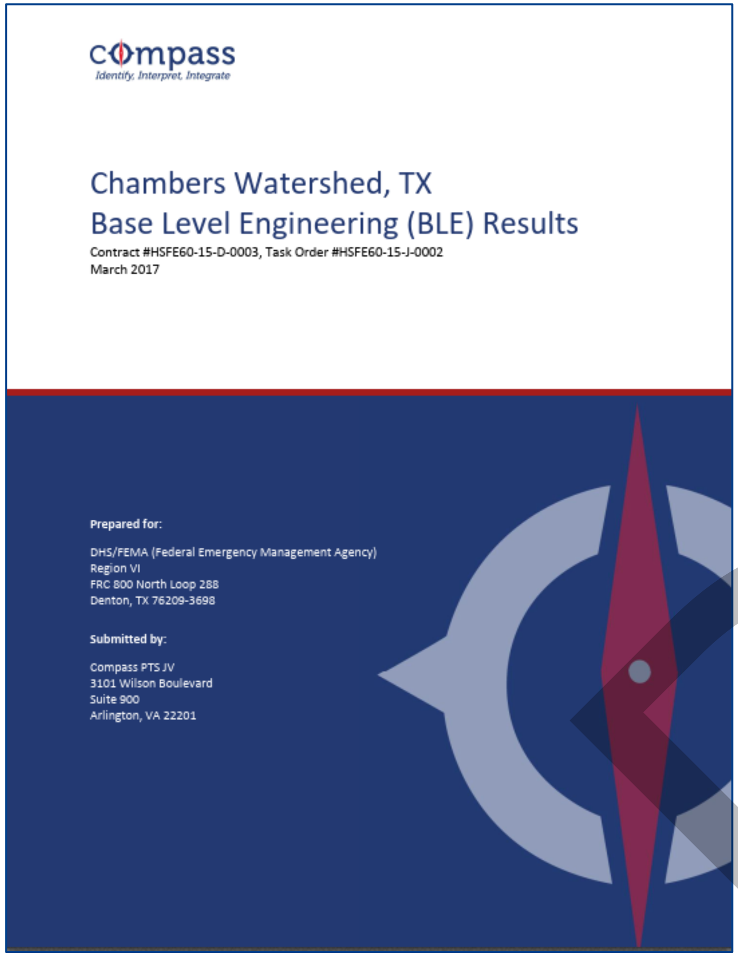
HUC-12 WATERSHED PRIORITIZATION

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

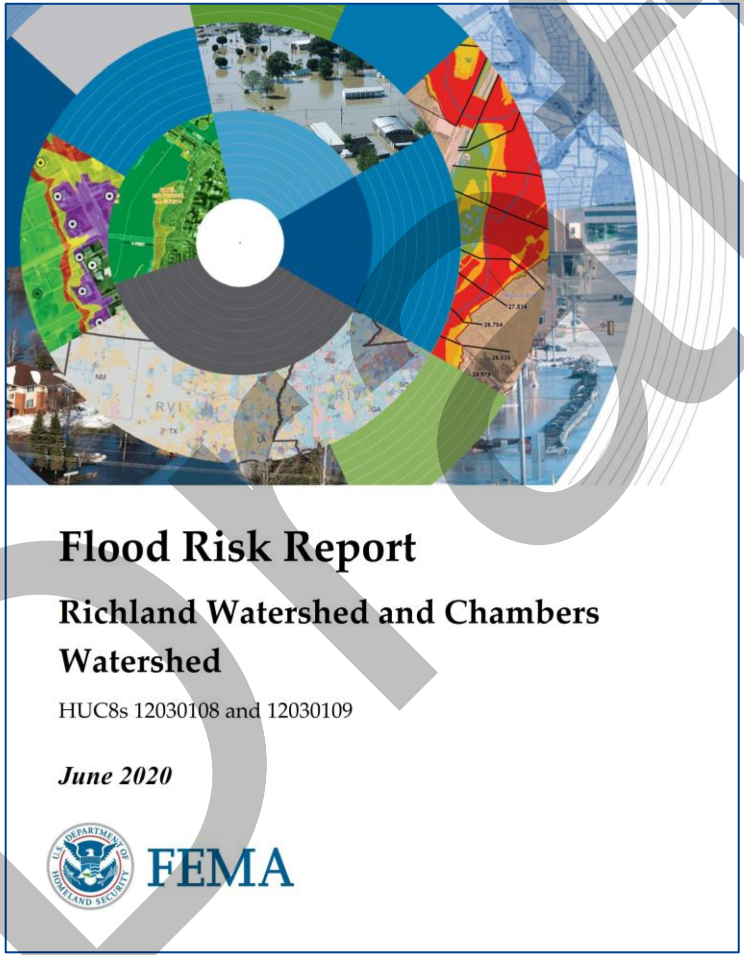


POST-DISCOVERY ACTIONS | POST-DISCOVERY ACTIVITIES

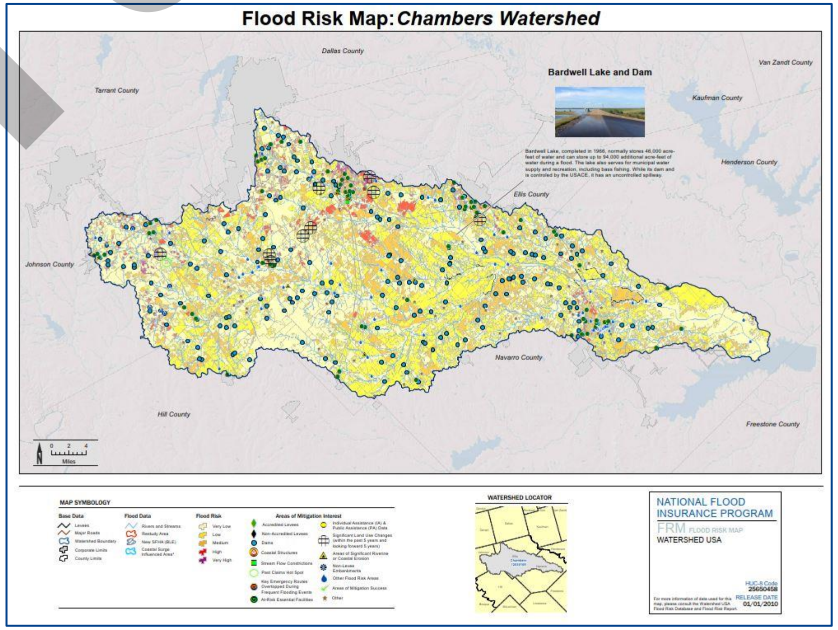
BLE DATASET AND REVIEW



FLOOD RISK REPORT



FLOOD RISK MAP



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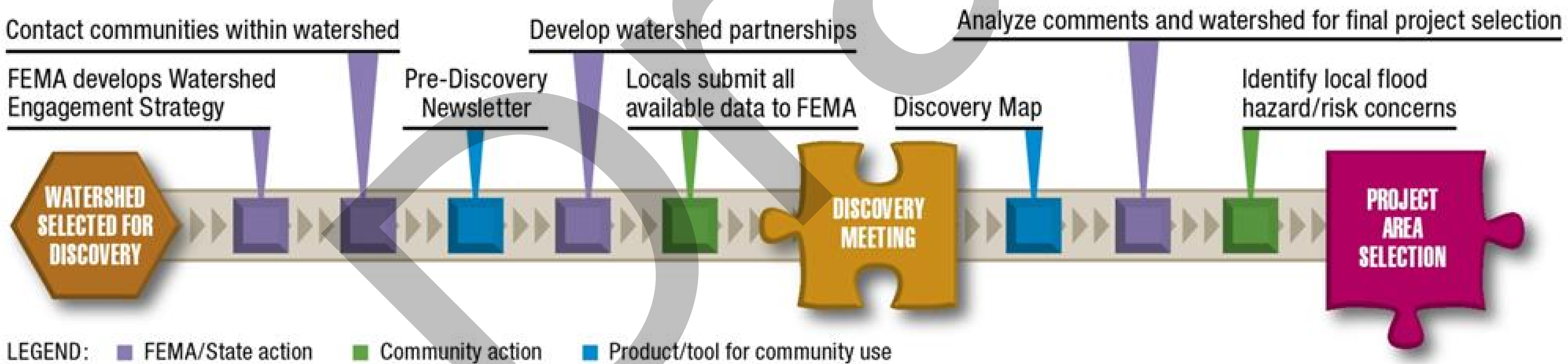
POST-DISCOVERY ACTIONS | POST-DISCOVERY ACTIVITIES

- Preliminary project selections provided to communities
- Evaluate community input
- Findings Meeting – Spring 2023
- Discovery Report – Late Summer 2023



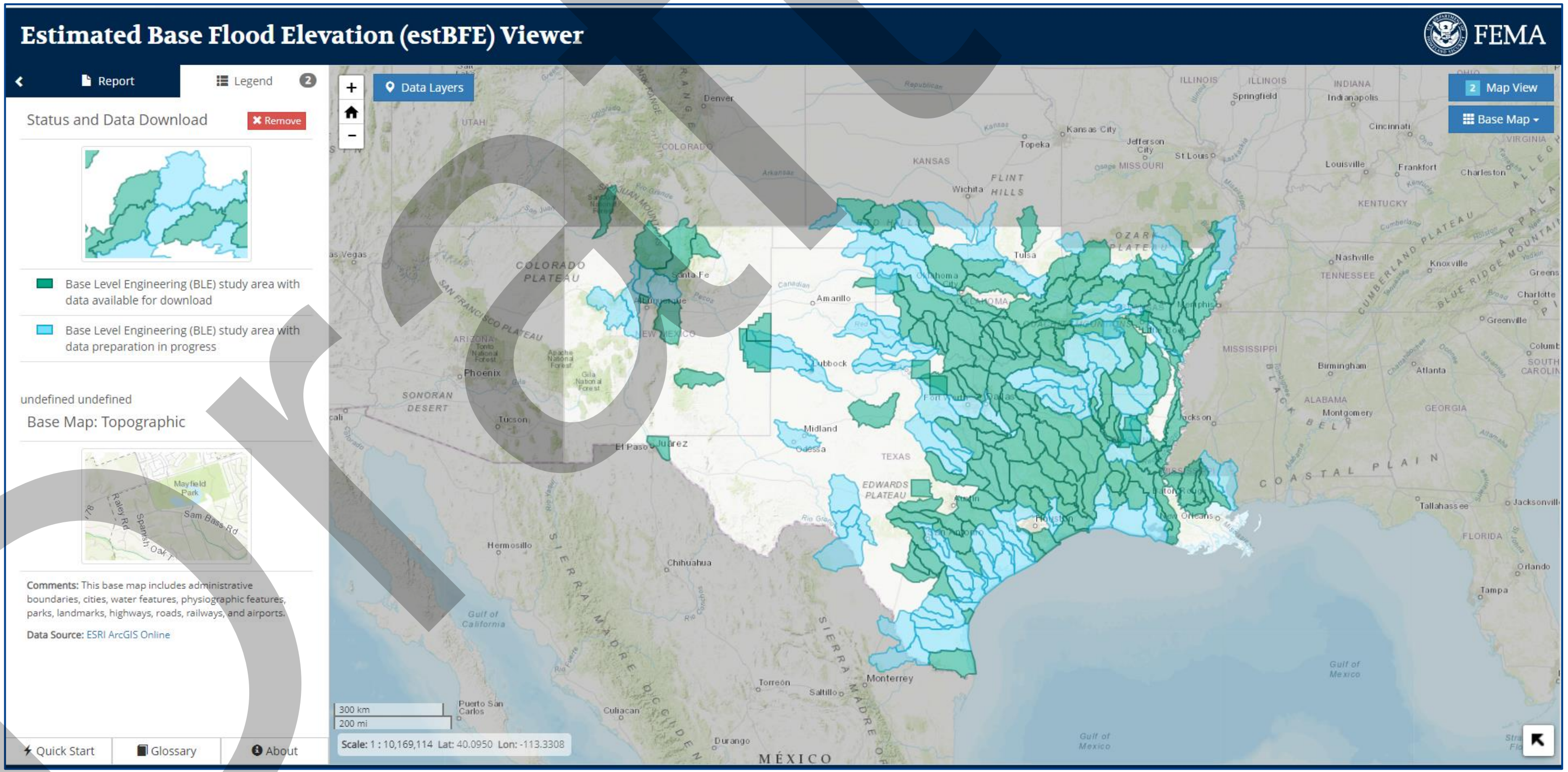
BLE OVERVIEW | BFE VIEWER

FEMA BFE VIEWER

- View and download completed BLE data
- Useful for determining BFEs for development
- Demonstrated during Pre-Discovery Meeting
- Watch recording here: https://youtu.be/PWt3epwHofU
  - BFE Viewer Tutorial

    starts at minute 52:50

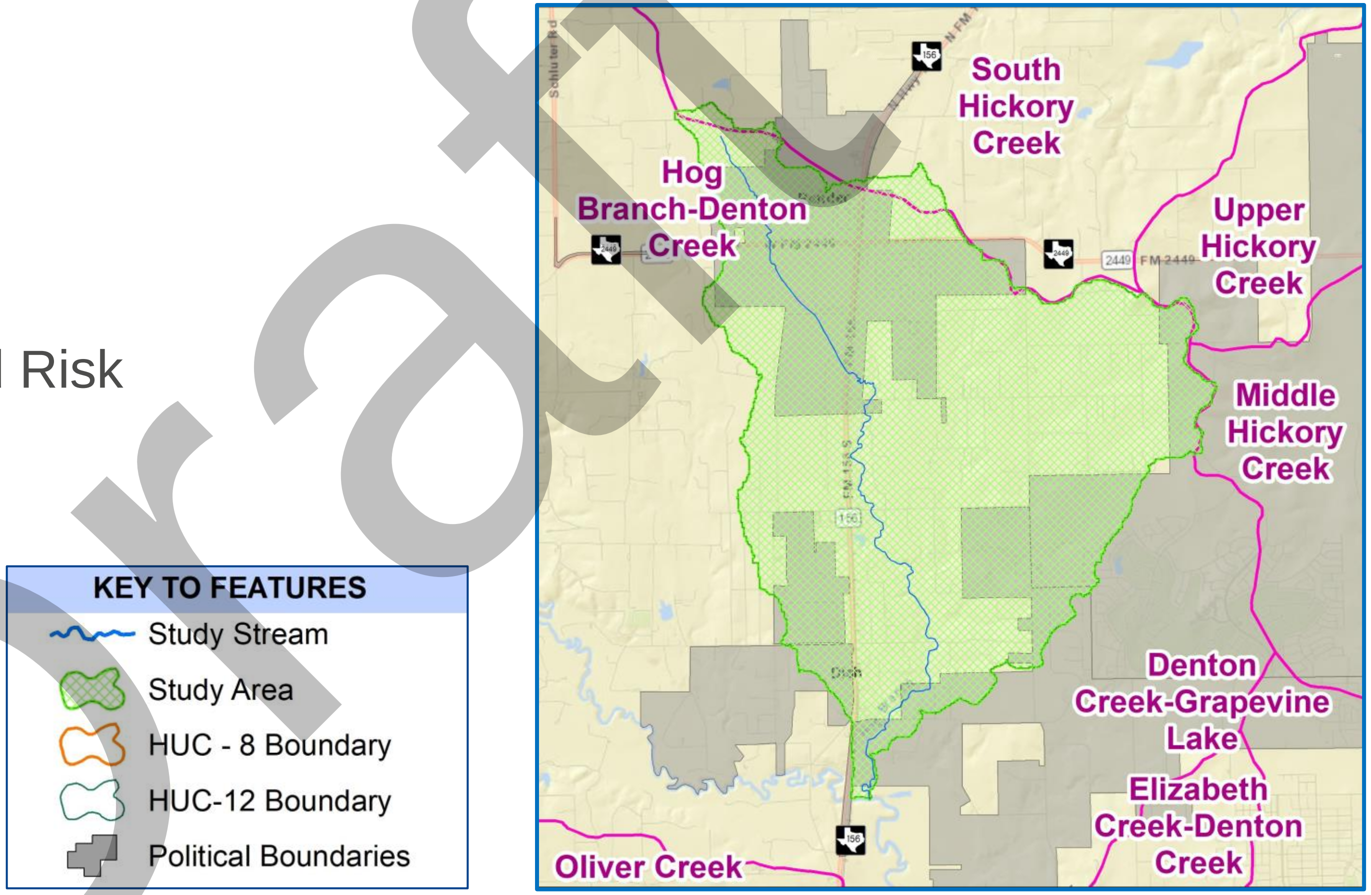
https://webapps.usgs.gov/infrm/estBFE/



RECENT POST-DISCOVERY PROJECTS | 2021

2021 HOG BRANCH STUDY – DENTON COUNTY

- New H&H and Mapping
- Flood Risk Products including Flood Risk Assessment
- Result of Denton Creek Discovery

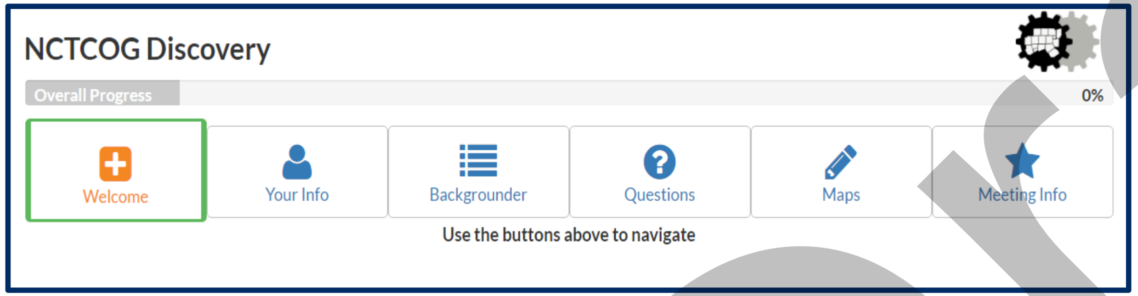


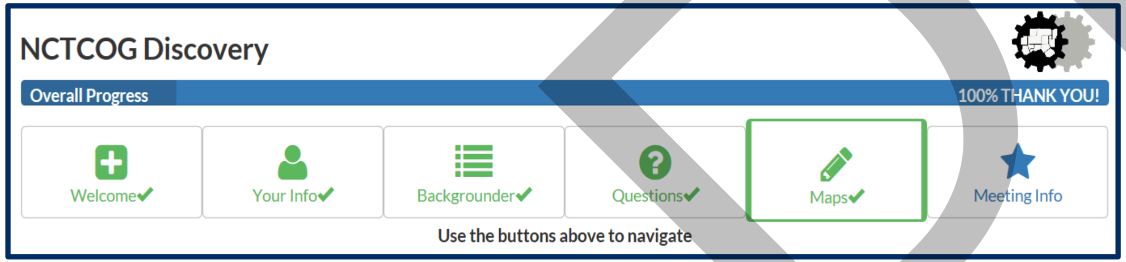
ENTER YOUR FLOOD RISK INFORMATION ON OUR WEBSITE

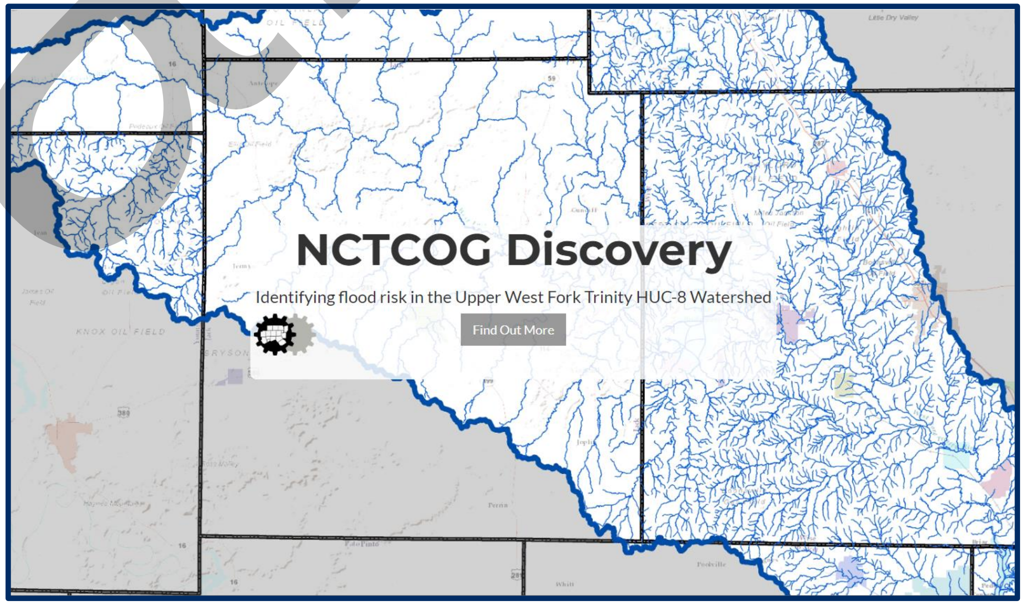
https://nctcogdiscovery.halff.com

Login: **EMAIL ADDRESS**

Password: **NCTCOG_2022!**







North Central Texas Council of Governments

FEMA

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QUESTIONS?

DISCOVERY | CONTACT

NCTCOG:

- Edith Marvin – EMarvin@nctcog.org
- Jai-W Hayes-Jackson – JHayes-Jackson@nctcog.org
- Kate Zielke – KZielke@nctcog.org

TWDB:

- Manuel Razo – Manuel.Razo@twdb.texas.gov
- Paul Gutierrez – Paul.Gutierrez@twdb.texas.gov

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- Alison Hanson – aHanson@halff.com
- Katy Overbey – kOverbey@halff.com

FEMA:

- Cameron Cornett – Cameron.Cornett@fema.dhs.gov

Discovery Findings Webinar Slides

North Central Texas Council of Governments (NCTCOG)

Upper West Fork Trinity Watershed

Discovery Findings Meeting

June 26, 2023

Agenda

- NCTCOG Overview
- Risk MAP Overview
- Upper West Fork Trinity Discovery
  - Activities
  - Findings
- Base Level Engineering
- Post Meeting Coordination

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CONTACTS

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Paul Gutierrez
Paul.Gutierrez@twdb.texas.gov

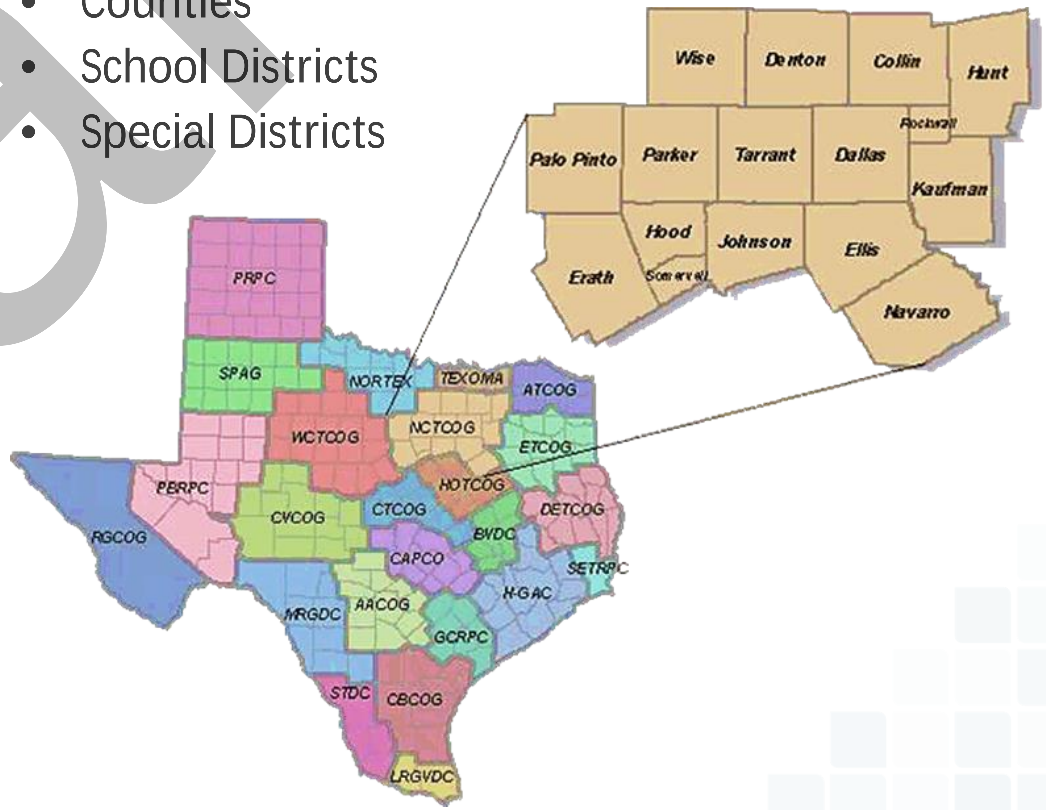
WHAT IS NCTCOG'S ROLE?

VOLUNTARY ASSOCIATION OF, BY, AND FOR LOCAL GOVERNMENTS, ESTABLISHED IN 1966, TO HELP THEM:

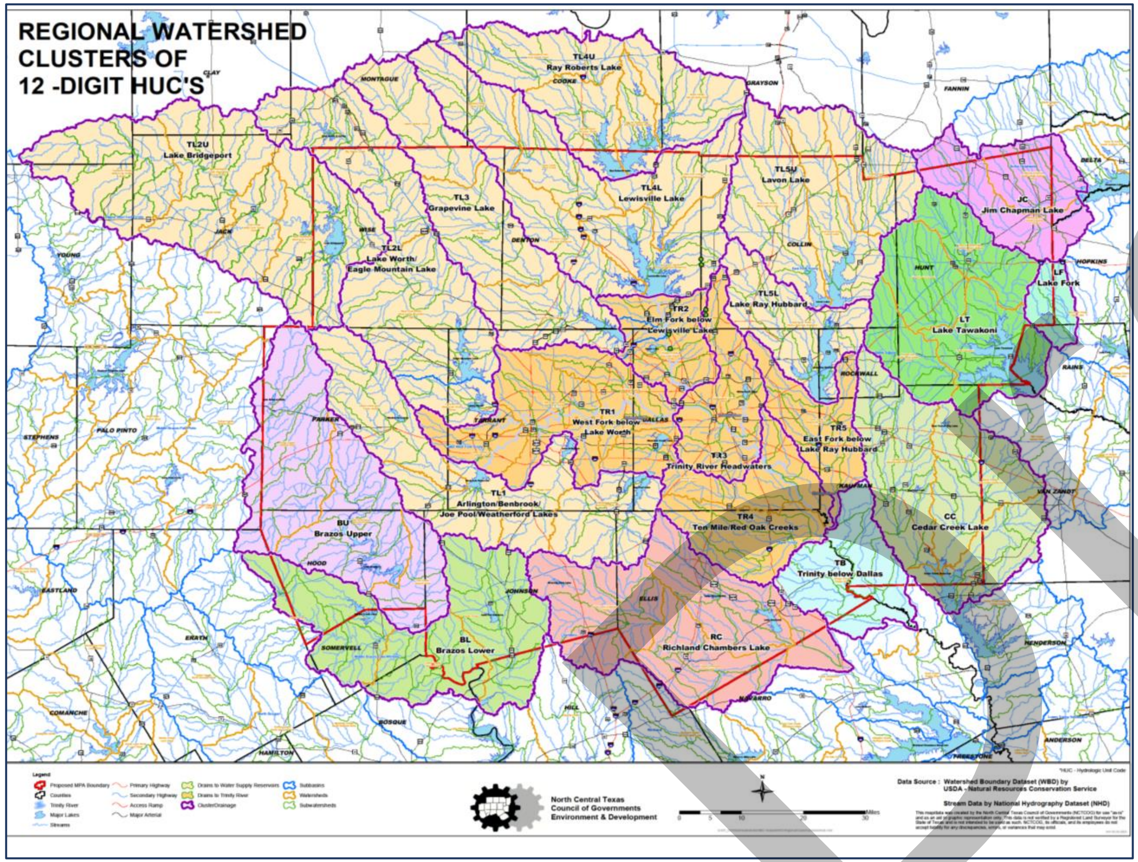
- Plan for common needs
- Strengthen their individual and collective power
- Recognize regional opportunities
- Resolve regional problems
- Make joint decisions/cooperate for mutual benefit

228 Member Governments

- Cities
- Counties
- School Districts
- Special Districts



WHAT IS NCTCOG'S ROLE?

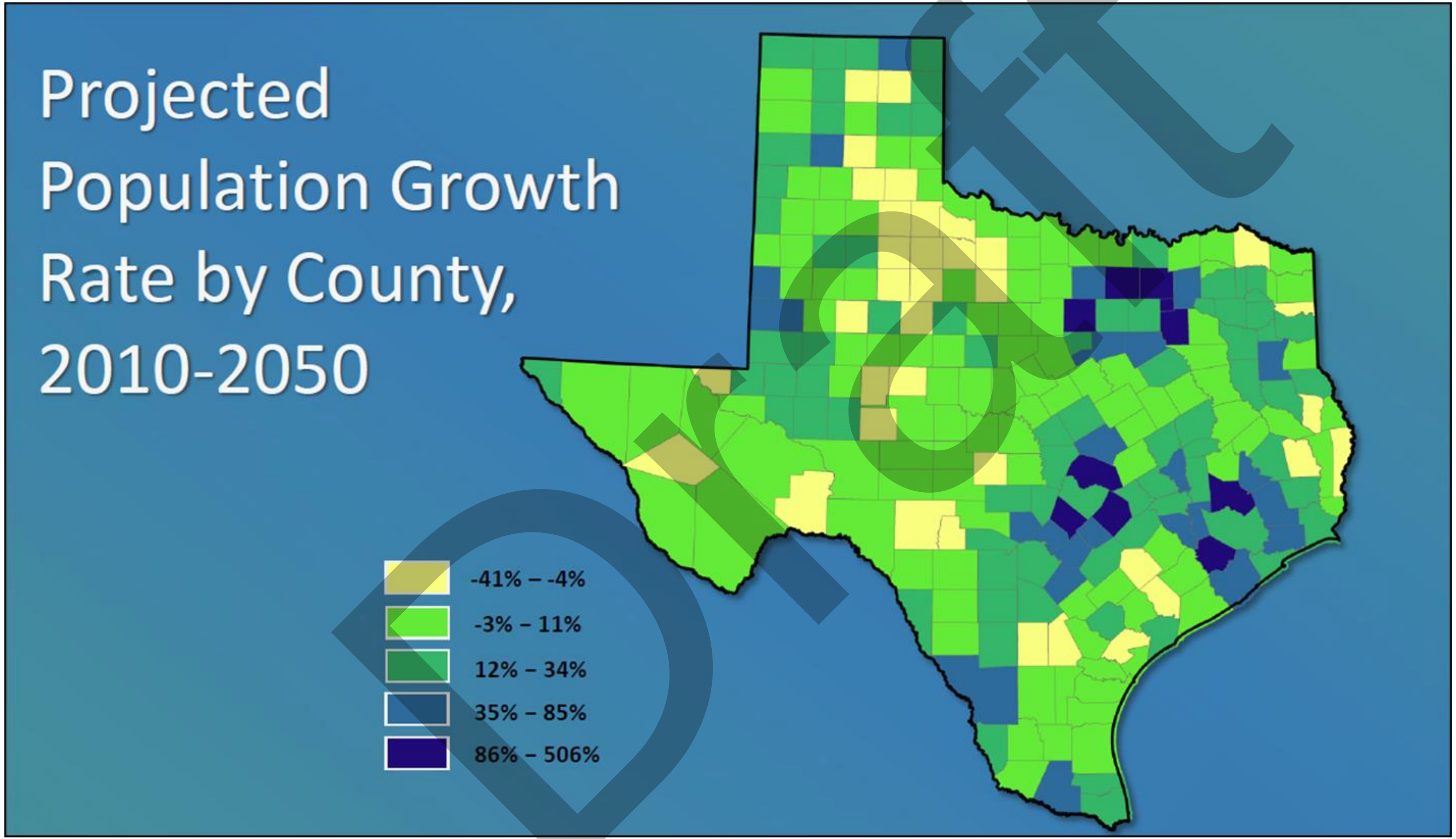


NCTCOG Environment and Development Watershed Management Program:

Focuses on water quality, stormwater, and floodplain topics/issues.

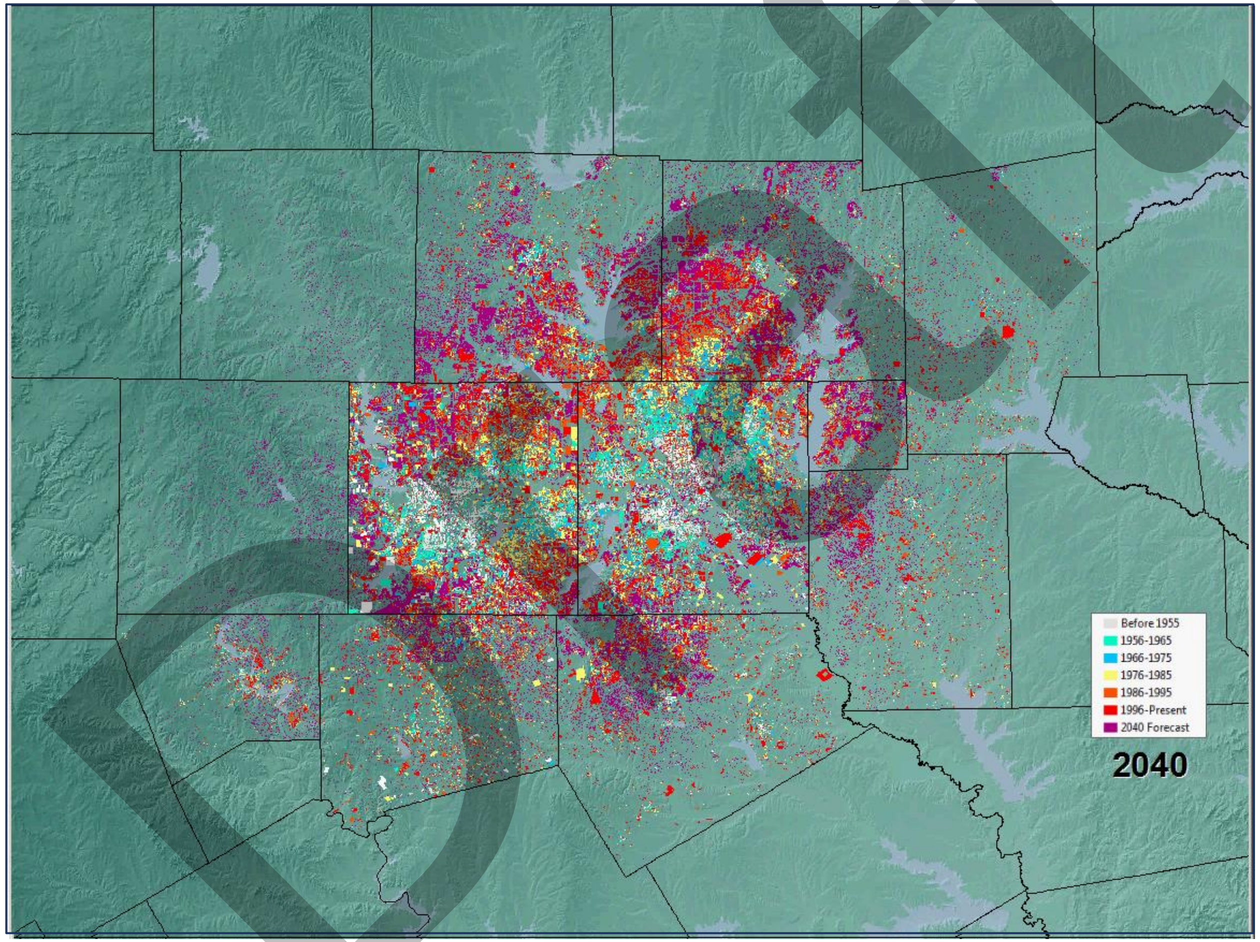
- North Central Texas region does not have a flood control district. Lots of local/regional entities working in their own jurisdictions.
- NCTCOG will never replace a flood control district, but as an agency, we work toward regional cooperation on flooding issues to help everyone accomplish common goals together.

WHAT IS NCTCOG'S ROLE?



WHAT IS NCTCOG'S ROLE?

North Central Texas 1950-2040 Growth



WHAT IS NCTCOG'S ROLE?

NCTCOG GOALS AS A COOPERATING TECHNICAL PARTNER

- **Direct Goals:**
  - Better data for better decision making
  - Coordination between communities and local/regional/state/federal organizations (what COGs do best!)
  - Partnerships

- **Indirect Goals:**
  - Higher Standards

North Central Texas Council of Governments

DISCOVERY OVERVIEW

FEMA's Risk Mapping, Assessment, and Planning (MAP) Program

- Provide flood information and tools for better protection
- Action-Driven through local understanding and ownership of risk

DISCOVERY OVERVIEW

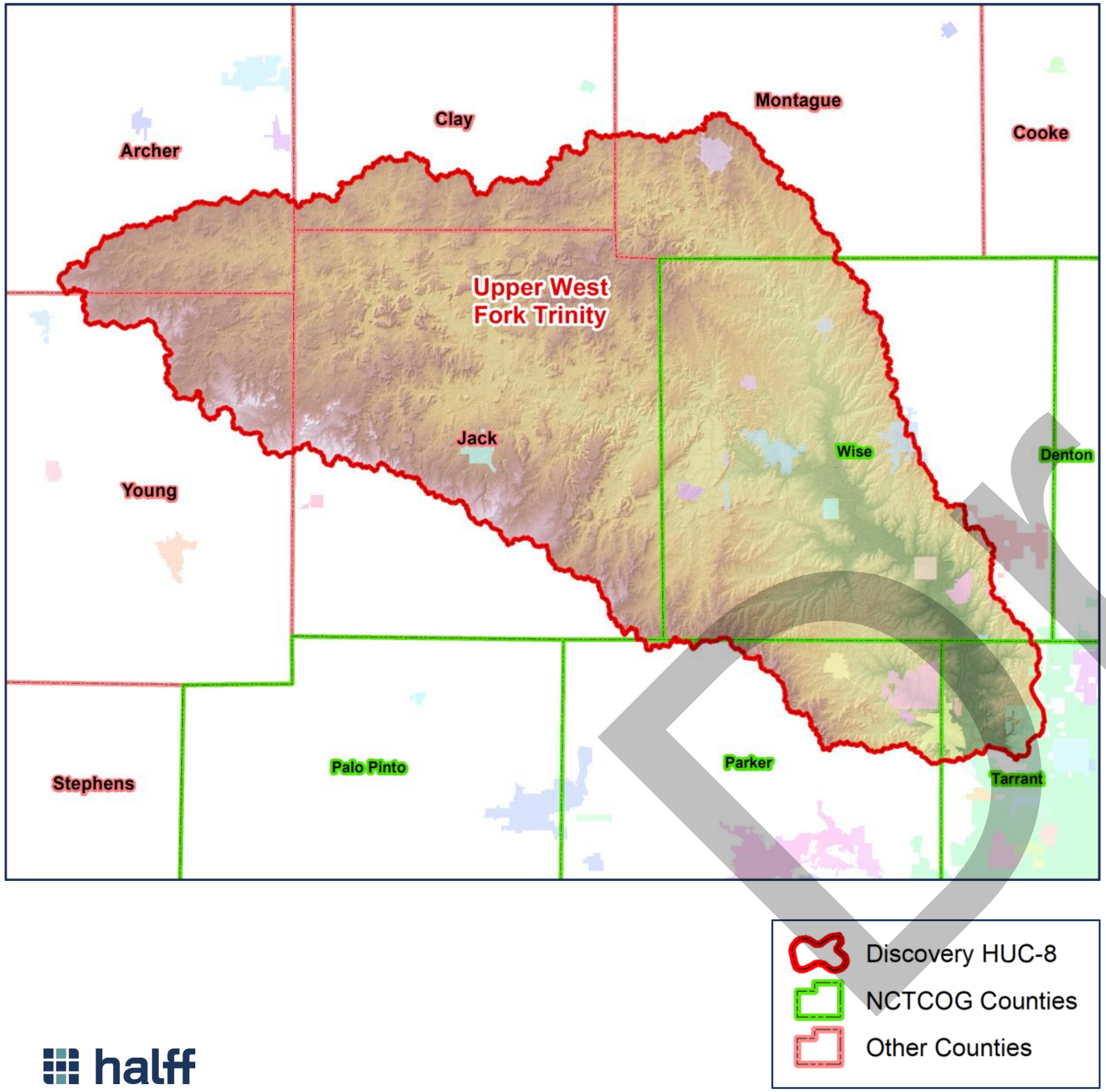
Discovery Process

And Base Level Engineering

FEMA's Risk Mapping, Assessment, and Planning (MAP) Program

- Provide flood information and tools for better protection
- Action-Driven through local understanding and ownership of risk

DISCOVERY GOALS



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NCTCOG LEADING UPPER WEST FORK TRINITY DISCOVERY

Gather Information

- Local flood risks and hazards
- Current mitigation efforts

Provide Information

- Mitigation planning and actions
- Risk communication

DISCOVERY PROCESS

FEMA Selects Watershed for Discovery

Watershed Stakeholder Coordination

Data Gathering and Analysis; BLE Data Development

Discovery Meeting

Post Meeting Coordination

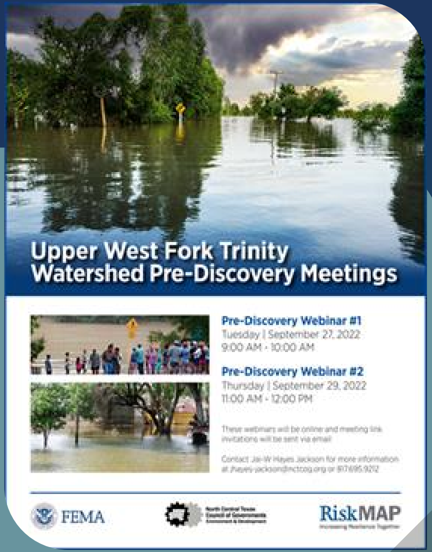
Risk MAP Project Recommendations to FEMA

Currently in the Post-Meeting Coordination Phase

DISCOVERY ACTIVITIES

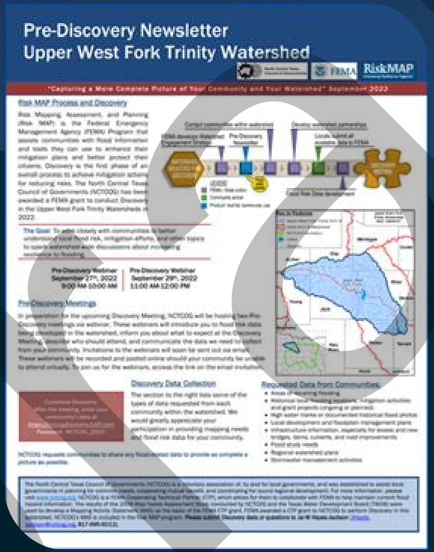
Pre-Discovery: Inform communities of process and timeline

1



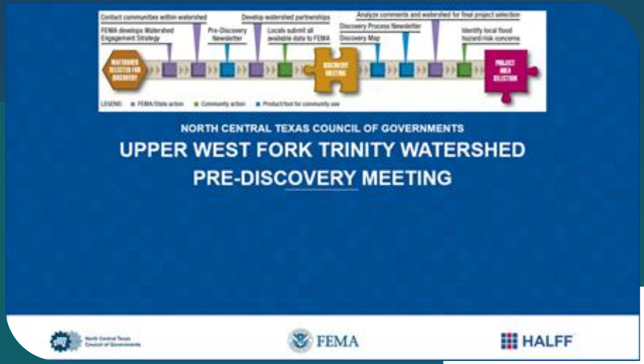
Discovery Flyer

2



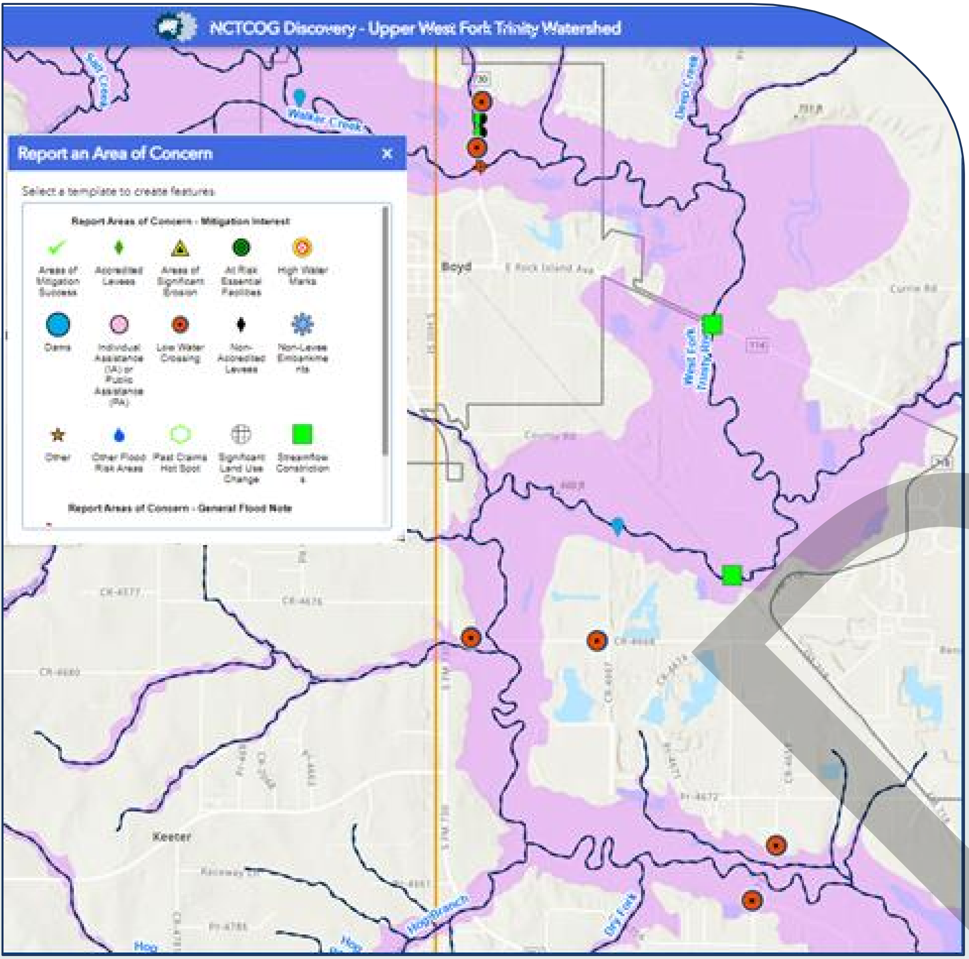
Newsletter

3

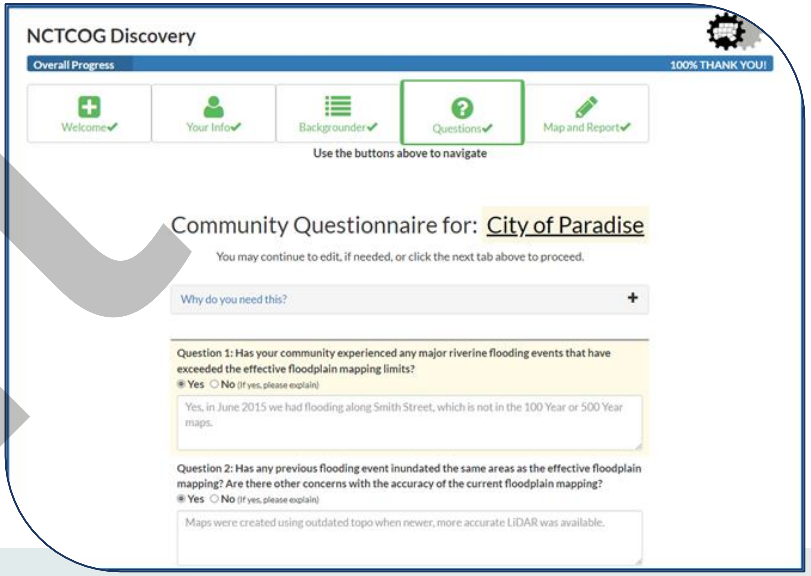


Pre-Discovery Webinars

DISCOVERY ACTIVITIES

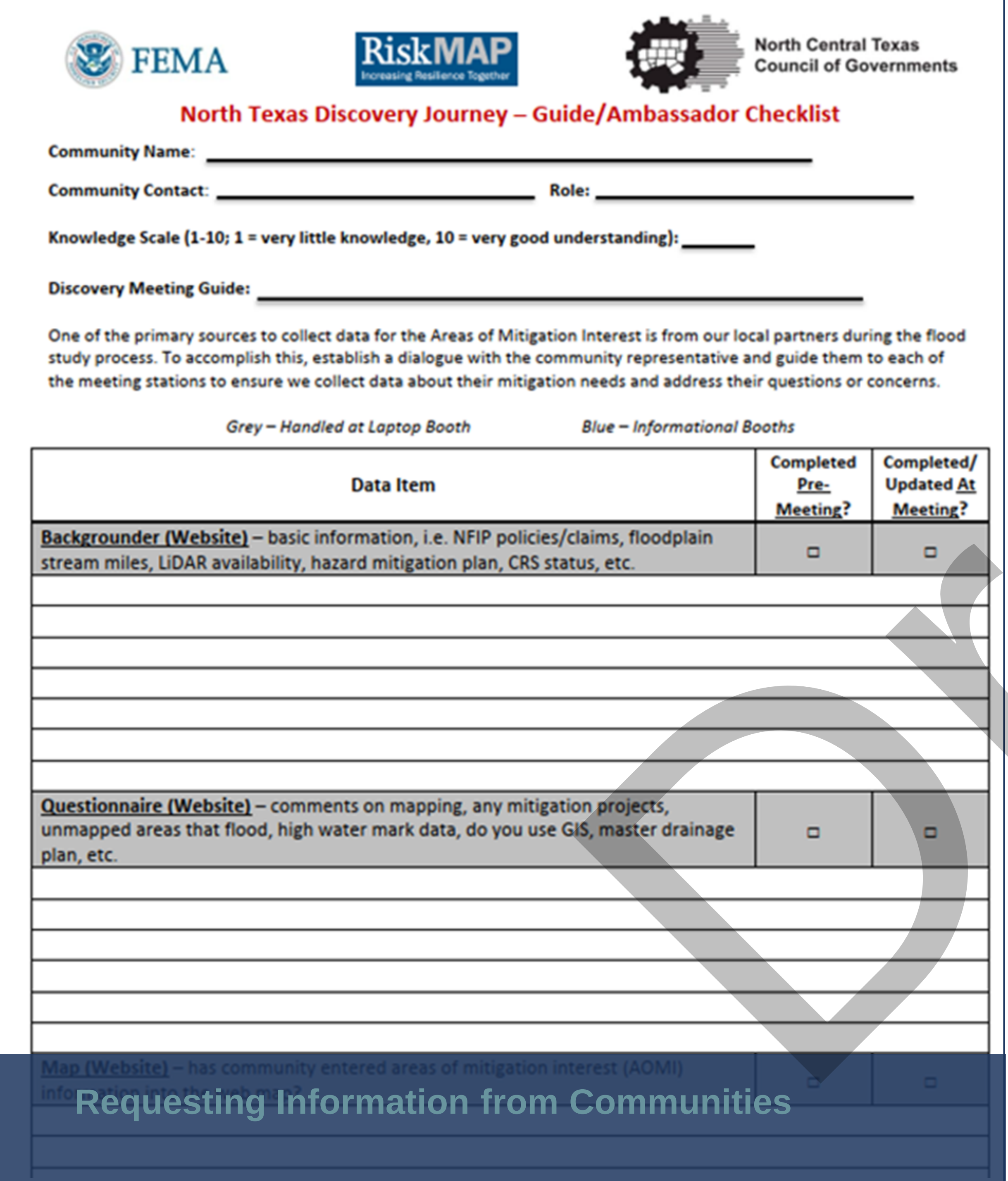


Communities used Discovery Website to submit their flood risk concerns



DATA SUBMITTED

- Low Water Crossings
- Highwater Marks
- Significant Landuse Change
- Streamflow Constrictions
- Flooding Concerns



FEMA RiskMAP Increasing Resilience Together North Central Texas Council of Governments

North Texas Discovery Journey – Guide/Ambassador Checklist

Community Name: ____________________

Community Contact: ____________________ **Role:** ____________________

Knowledge Scale (1-10; 1 = very little knowledge, 10 = very good understanding): ______

Discovery Meeting Guide: ____________________

One of the primary sources to collect data for the Areas of Mitigation Interest is from our local partners during the flood study process. To accomplish this, establish a dialogue with the community representative and guide them to each of the meeting stations to ensure we collect data about their mitigation needs and address their questions or concerns.

Grey – Handled at Laptop Booth *Blue – Informational Booths*

Data Item	Completed Pre-Meeting?	Completed/ Updated At Meeting?
Backgrounder (Website) – basic information, i.e. NFIP policies/claims, floodplain stream miles, LiDAR availability, hazard mitigation plan, CRS status, etc.	☐	☐
Questionnaire (Website) – comments on mapping, any mitigation projects, unmapped areas that flood, high water mark data, do you use GIS, master drainage plan, etc.	☐	☐
Map (Website) – has community entered areas of mitigation interest (AOMI) info... into the web map?	☐	☐

Requesting Information from Communities

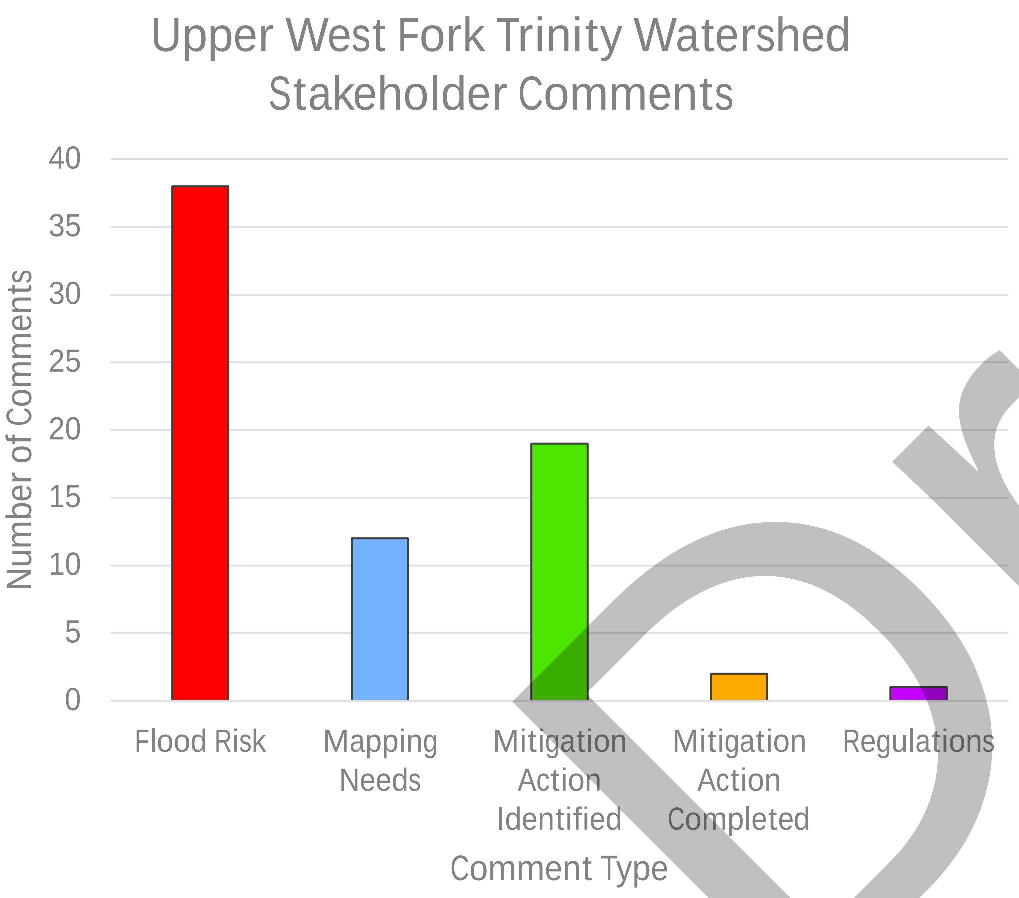
DISCOVERY MEETING – JANUARY 17TH

Receive flooding issues

Facilitate discussion among stakeholders

Meet With Other Stakeholders

DISCOVERY FINDINGS



Flood Risk- Areas that have flooded and pose a risk to structures or people

Mapping Need- Areas that may need updated floodplain studies

Mitigation Action Identified- Areas that may need projects to minimize flooding risks

Mitigation Action Completed- Areas where mitigation projects have already occurred that minimized flooding risks

Regulations- Areas where the regulations may need updates

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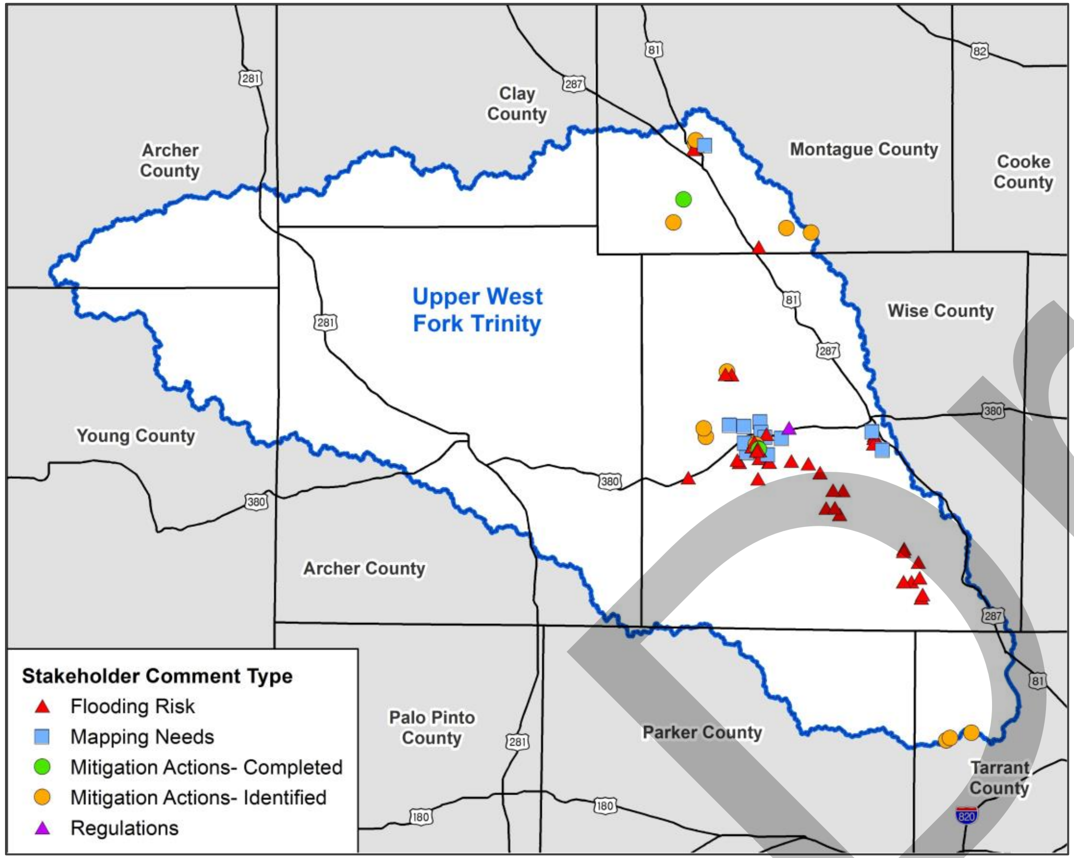
DISCOVERY FINDINGS

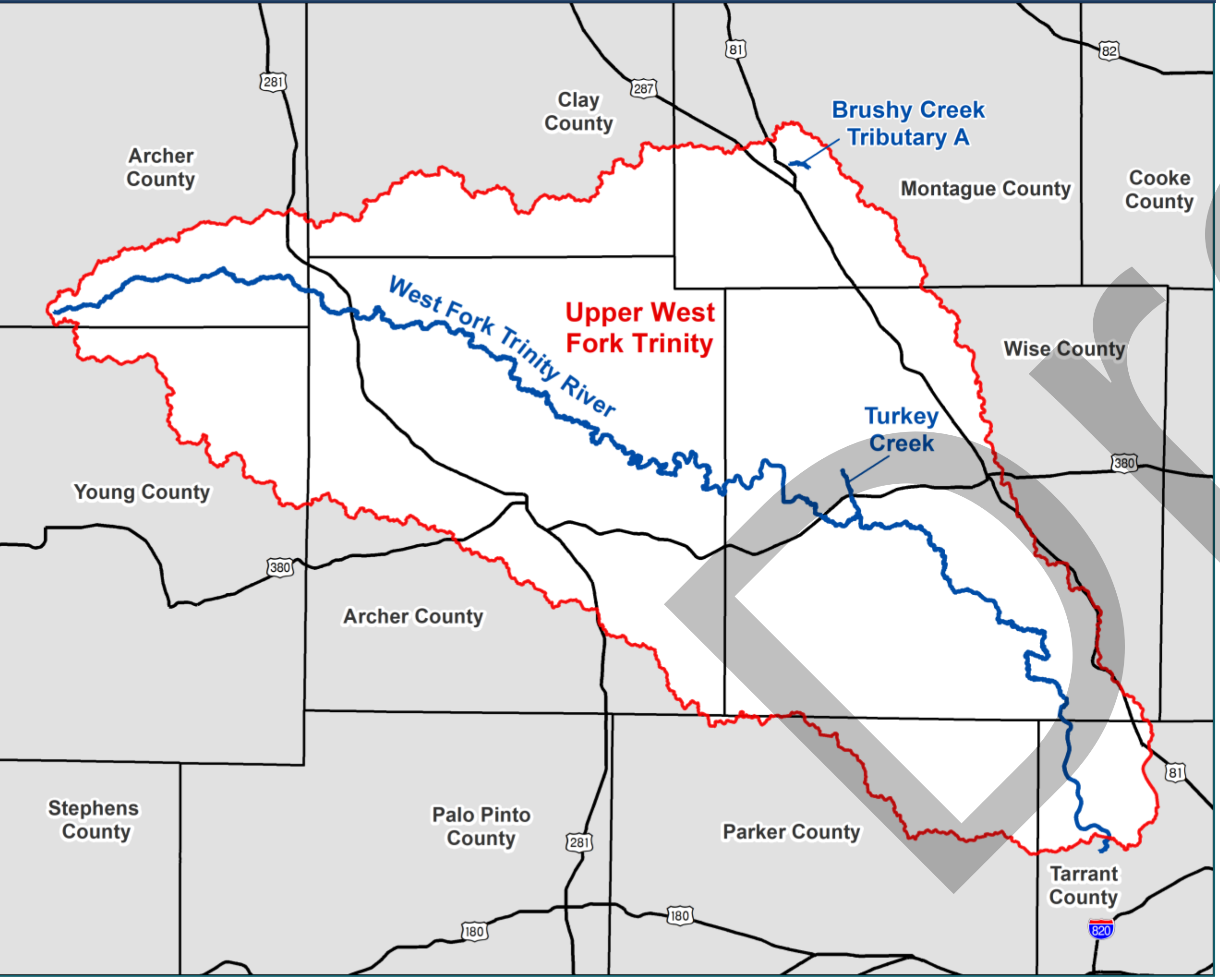
72 Stakeholder Map Comments



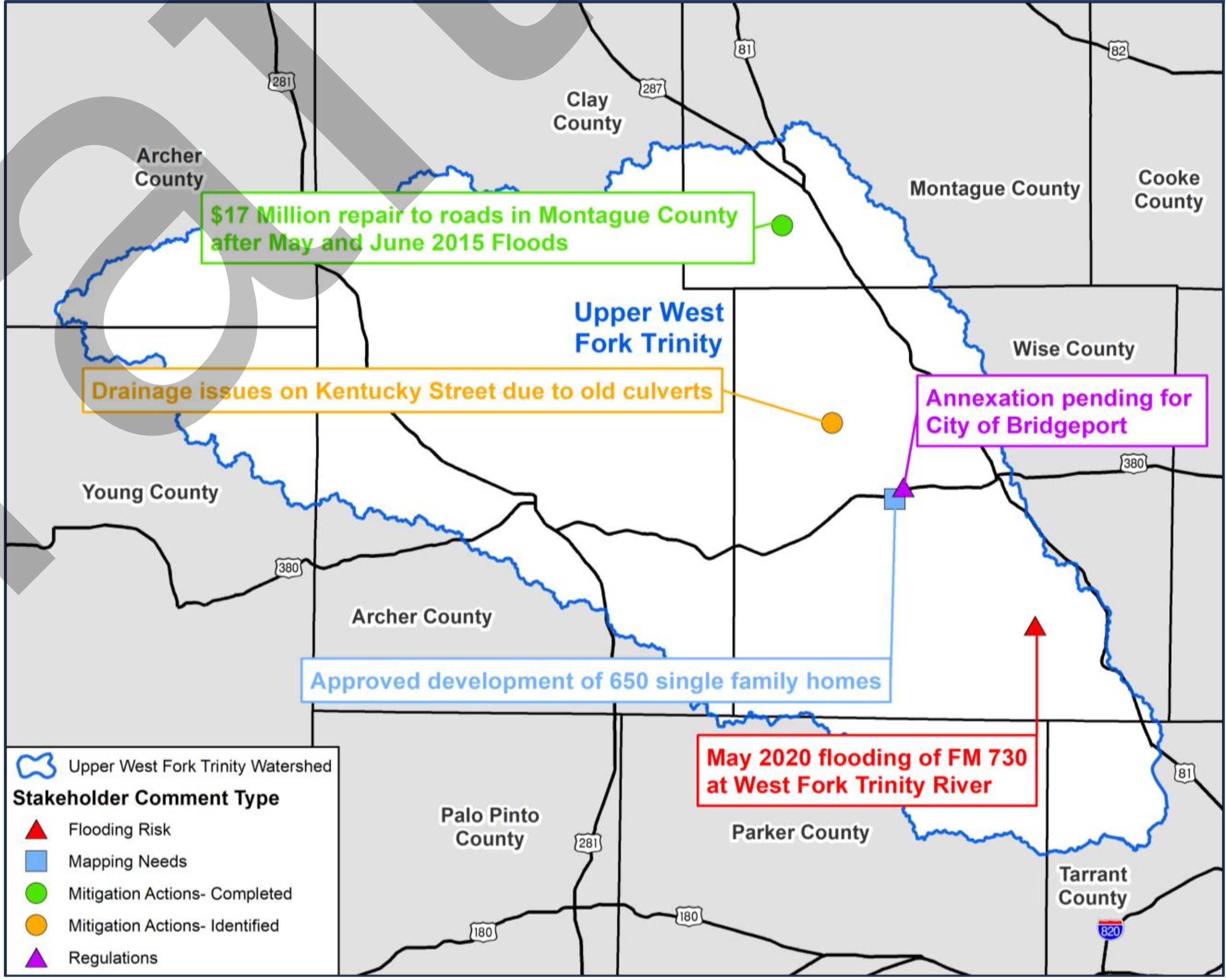
Number of Comments	Community
9	Bowie
2	Boyd
17	Bridgeport
4	Chico
5	Decatur
1	Fort Worth
5	Montague County
1	Runaway Bay
2	Tarrant County
26	Wise County

DISCOVERY FINDINGS

Requested Study Streams

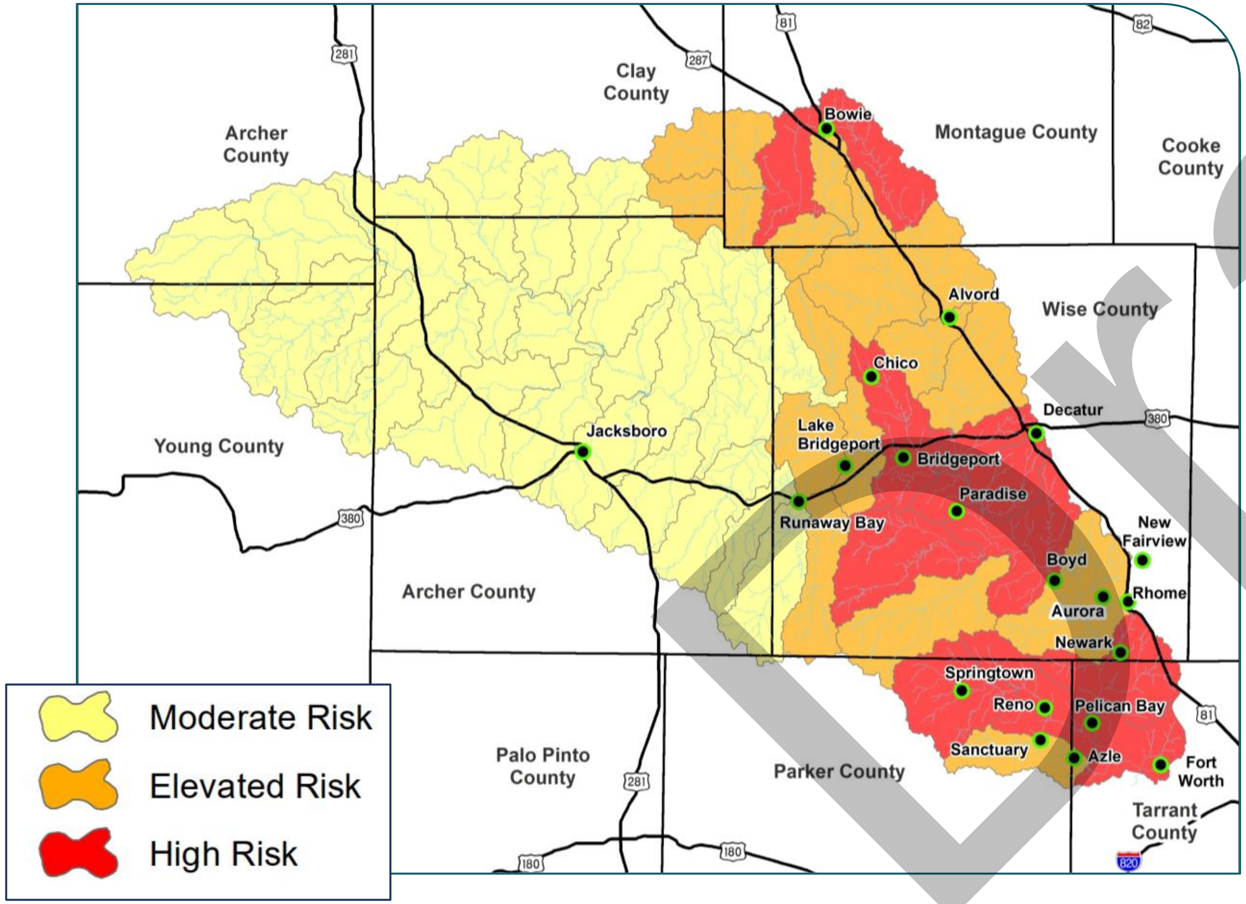


Sample Comments Submitted



DISCOVERY FINDINGS

HUC-12 Watershed Prioritization

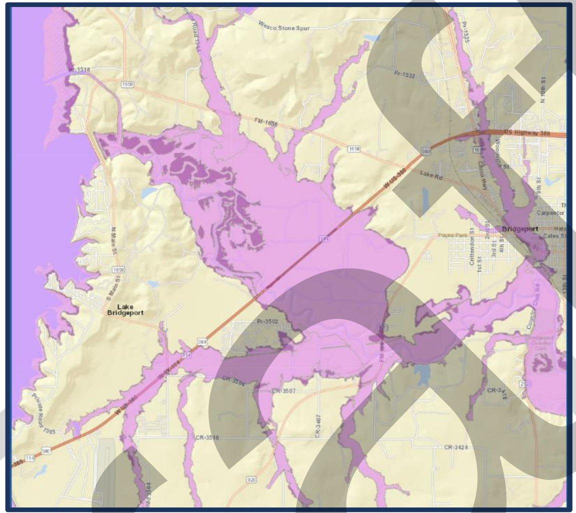


Criteria No.	Description	Max Weight
1	Population density	10
2	Population change	10
3	Predicted population growth	10
4	History of flood claims	10
5	History of flood events	10
6	Number of Letters of Map Change (LOMR/LOMA)	5
7	National Risk Index- Flooding Score	10
8	Age of technical data – hydrology (num.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

BASE LEVEL ENGINEERING

1

- Automated hydraulic modeling
- Model Review and Adjustments
- Gage Review included in hydrology



2

Hydraulic modeling

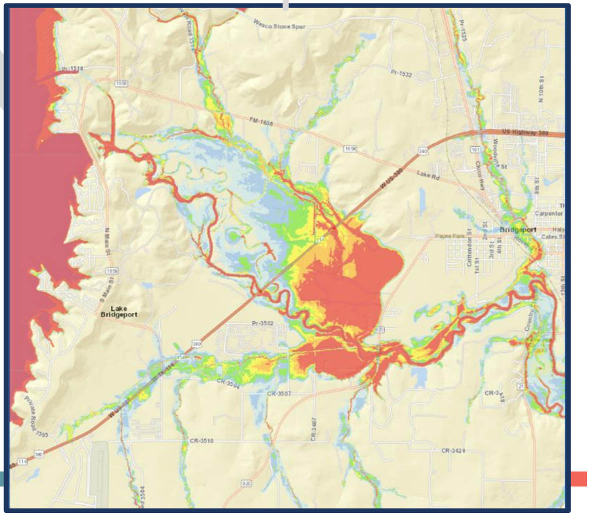
- 10%, 4%, 2%, 1% and 0.2% storm events

Floodplain Boundaries

- 10%, 1% and 0.2%

3

- Depth and Analysis Grids
- Areas of Expanded Flood Risk
- Flood Risk Assessment



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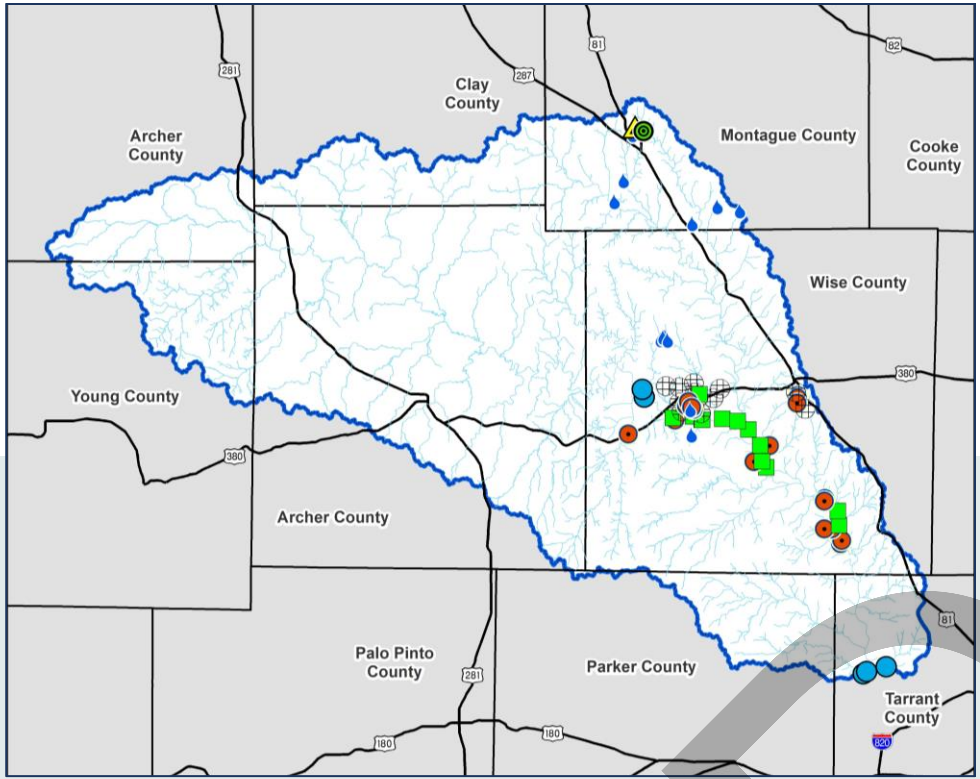
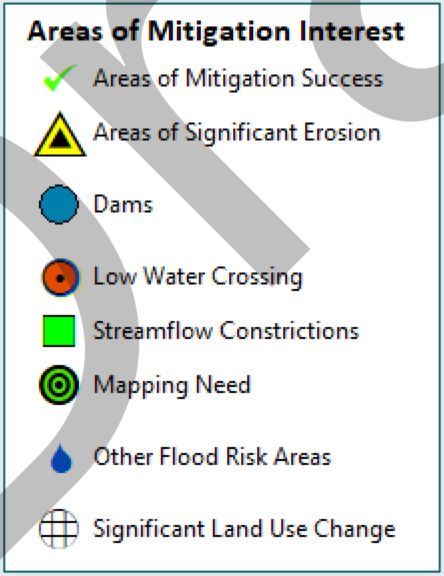
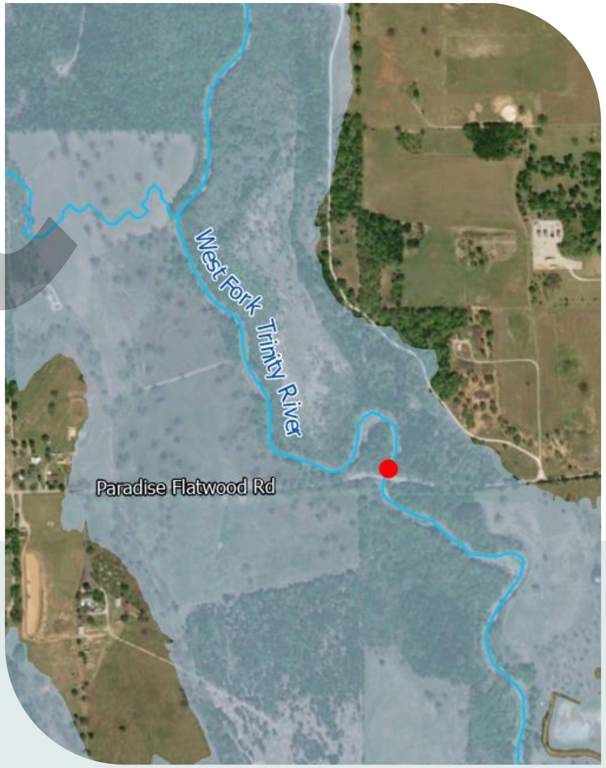
DISCOVERY FINDINGS

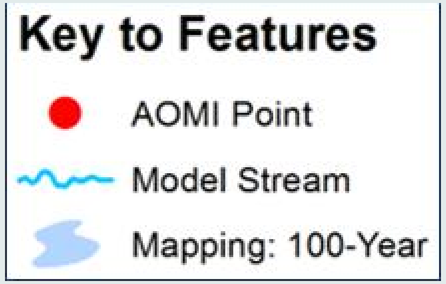


AREAS OF MITIGATION INTEREST (AOMI)

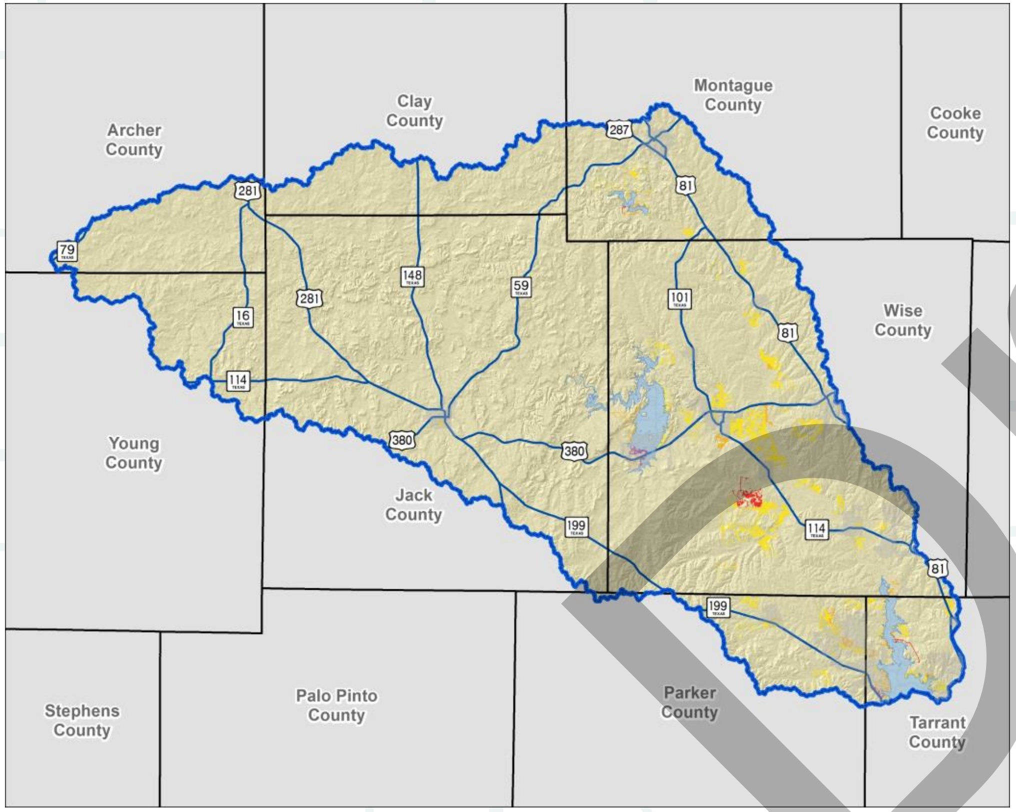
- Structure inventory for future Discovery/Mitigation efforts
- Places with unknown or increased flood risk
- Identified by communities







DISCOVERY FINDINGS

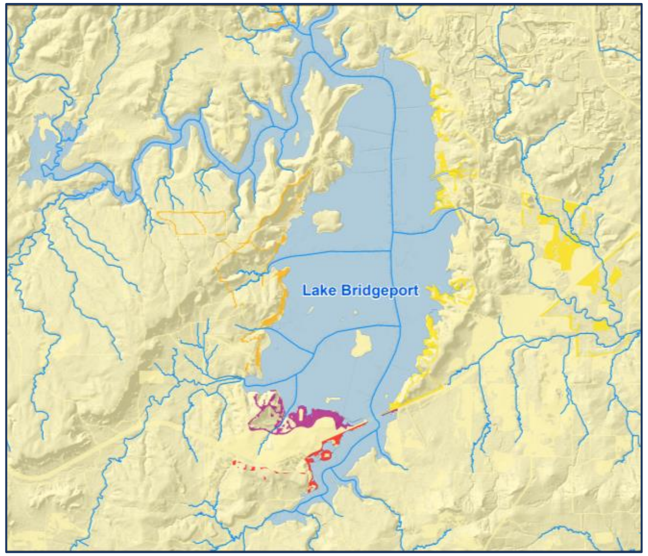


Hazus-Based 100-Year Potential Loss Estimates

- Identify flooding consequences in damages and other losses
- Based on 100 Year Depth Grids and at-risk assets
- Can be further refined

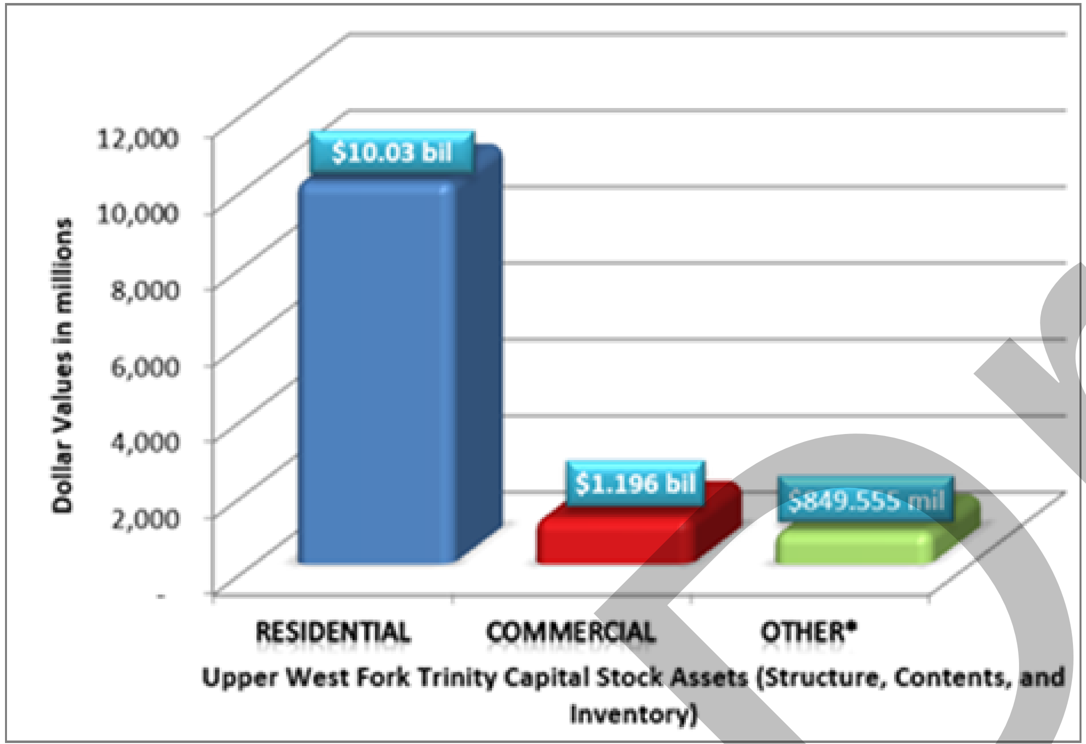
Flood Risk (Potential Losses in Dollars)

- Very Low Risk (Up to $722 Thousand)
- Low Risk (Up to $2.8 Million)
- Medium Risk (Up to $6.9 Million)
- High Risk (Up to $13.5 Million)
- Very High Risk (Up to $30 million)



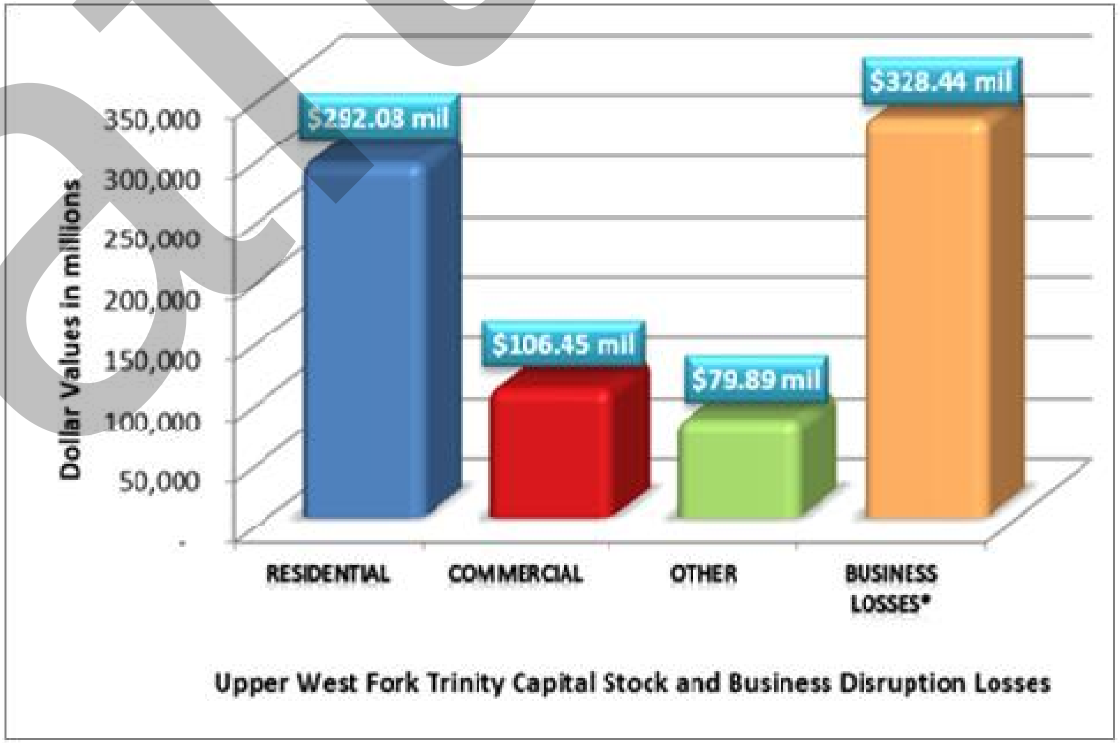
DISCOVERY FINDINGS

Asset Inventory Values



*Other structure types include Industrial, Agricultural, Education, Religious and Government structures.

100-Year Flood Event Potential Losses

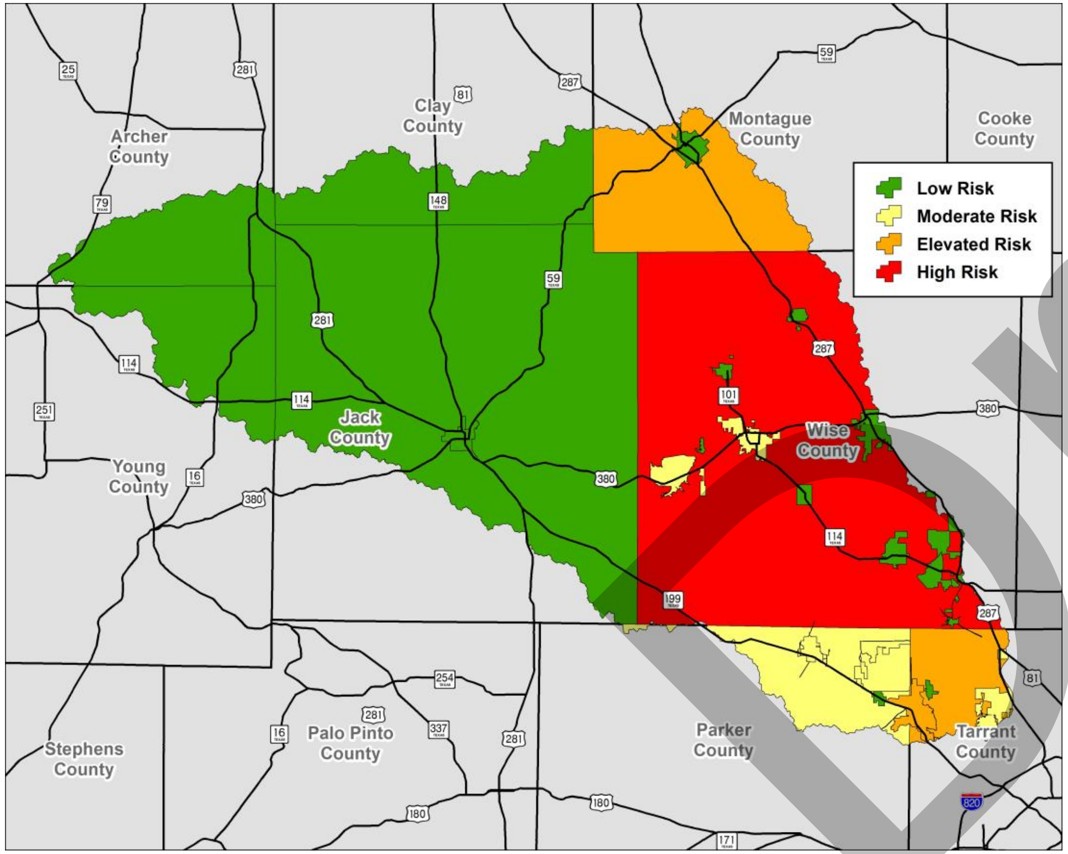


*Business Losses are the sum of inventory Loss, Relocation Cost, Income Loss, Rental Income Loss, Wage Loss, and Direct Ouput Loss.

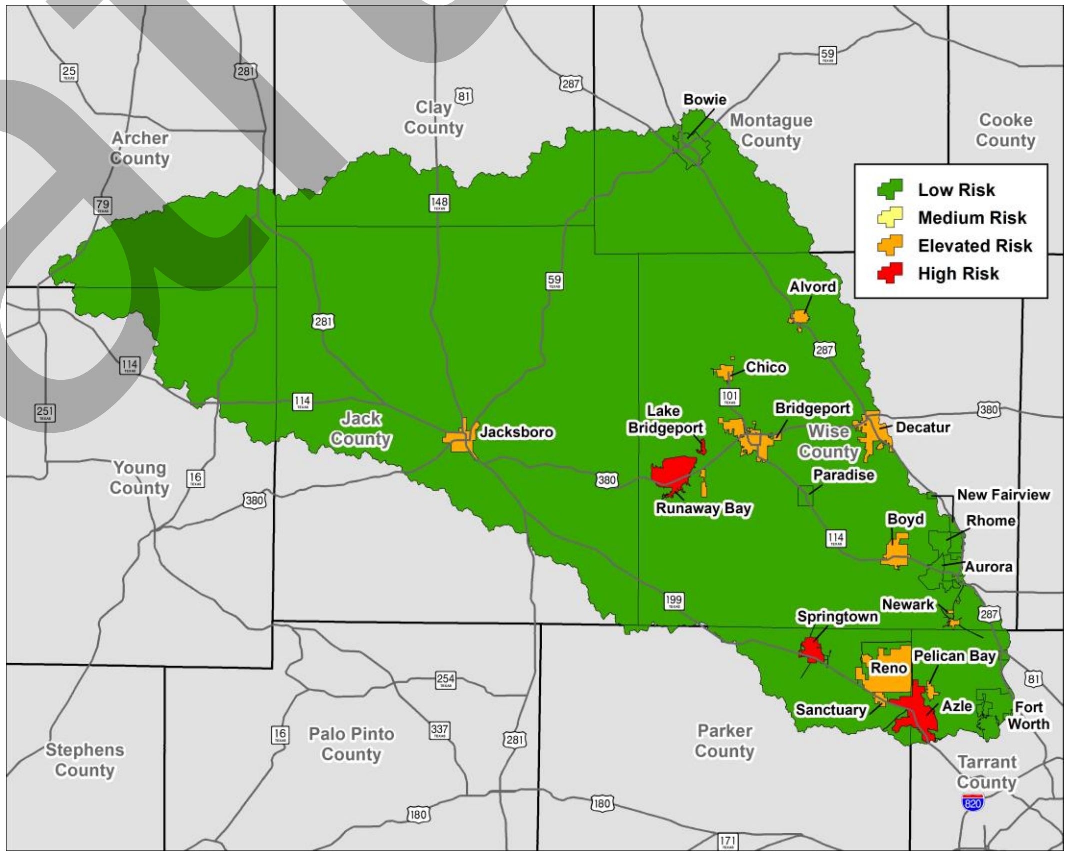
DISCOVERY FINDINGS

HAZUS-BASED 1% ANNUAL CHANCE LOSS ESTIMATES

Total Community Loss

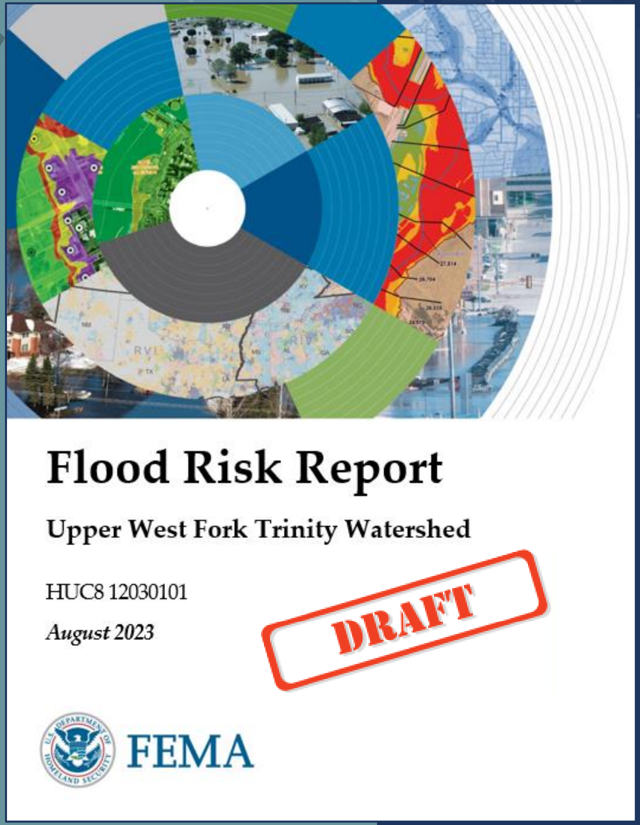


Community Loss By Area



DISCOVERY FLOOD RISK REPORT

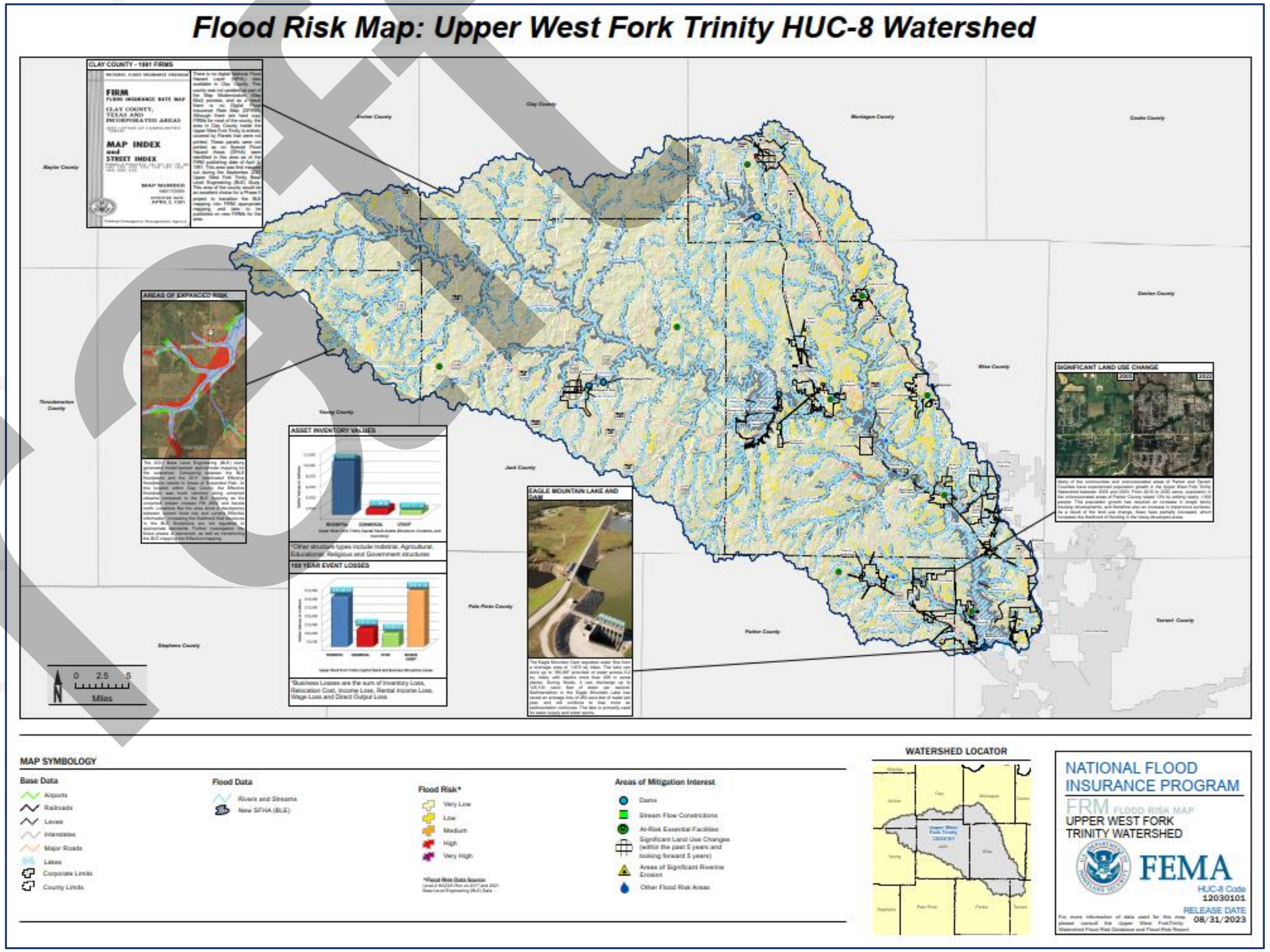
Prioritization Results	Records of Historical Flooding	Summary of Discovery Activities
Stakeholder Comments	Community Snapshots	Figures and Maps



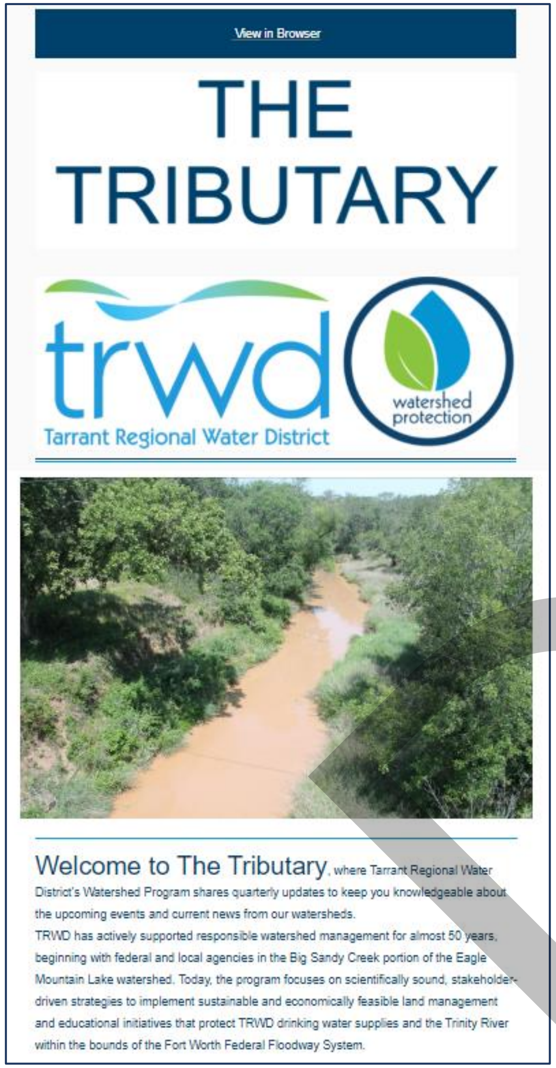
DISCOVERY FLOOD RISK REPORT

DISCOVERY FLOOD RISK MAP

- Shows Flood Risk, including:
    - Community Comments
    - BLE Data
    - HAZUS Losses
    - Land Use Change



TARRANT REGIONAL WATER DISTRICT NEWSLETTER


View in Browser

THE TRIBUTARY

Welcome to The Tributary, where Tarrant Regional Water District's Watershed Program shares quarterly updates to keep you knowledgeable about the upcoming events and current news from our watersheds.

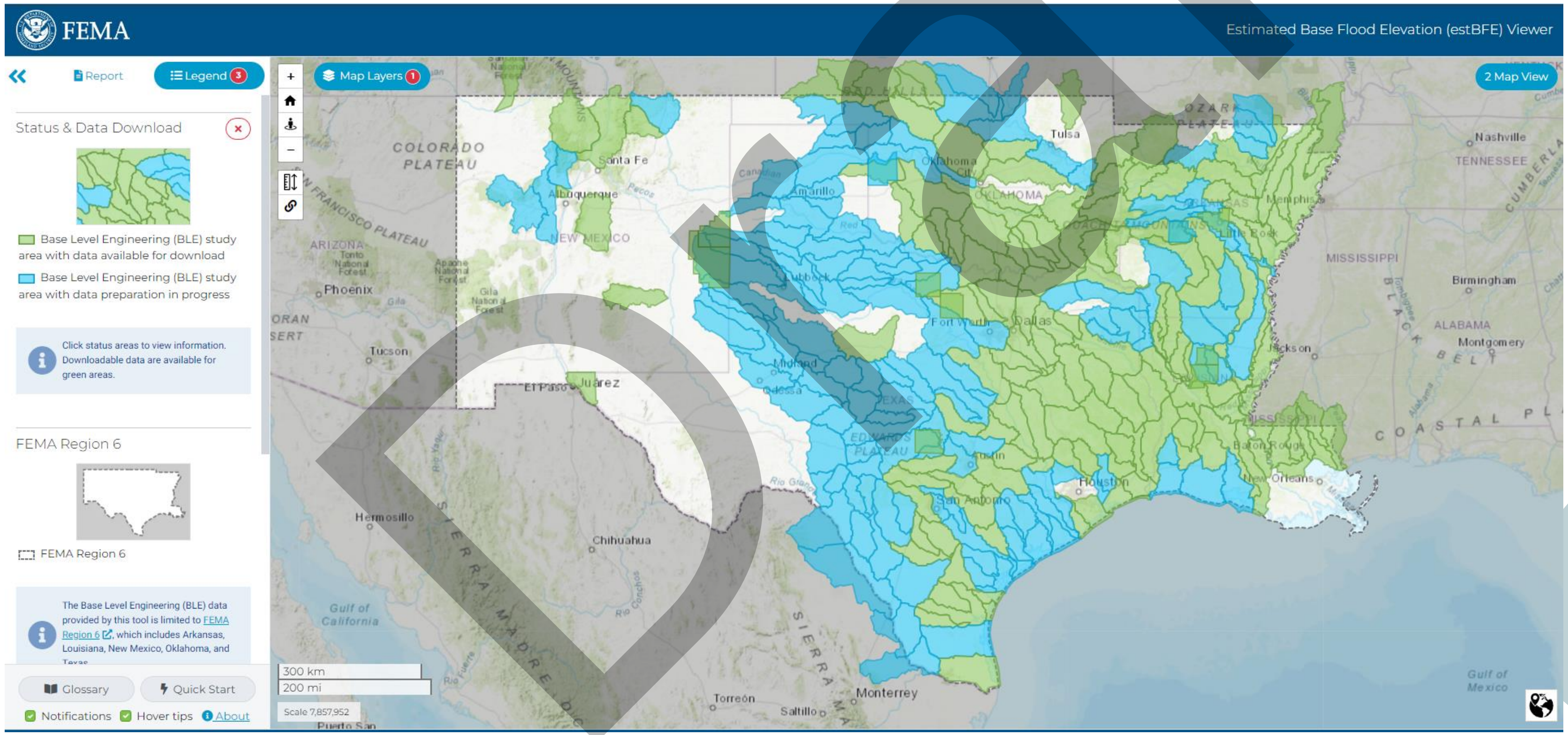
TRWD has actively supported responsible watershed management for almost 50 years, beginning with federal and local agencies in the Big Sandy Creek portion of the Eagle Mountain Lake watershed. Today, the program focuses on scientifically sound, stakeholder-driven strategies to implement sustainable and economically feasible land management and educational initiatives that protect TRWD drinking water supplies and the Trinity River within the bounds of the Fort Worth Federal Floodway System.

- Newsletter for Tarrant Regional Water District
- Discusses land management strategies and educational incentives
- Jurisdiction covers Lake Bridgeport, Eagle Mountain Lake, and their watershed
- Subscribe here:
  - https://trwd.us12.list-manage.com/subscribe?u=d62a6eab917276b12327e6786&id=bbe12d0ae4

FEMA BFE VIEWER

HTTPS://WEBAPPS.USGS.GOV/INFRM/ESTBFE

- View and download completed BLE data
- Useful for determining BFEs for development
- Watch recording here: https://youtu.be/PWt3epwHofU
- BFE Viewer Tutorial starts at minute 52:50



DISCOVERY OVERVIEW

Discovery Process

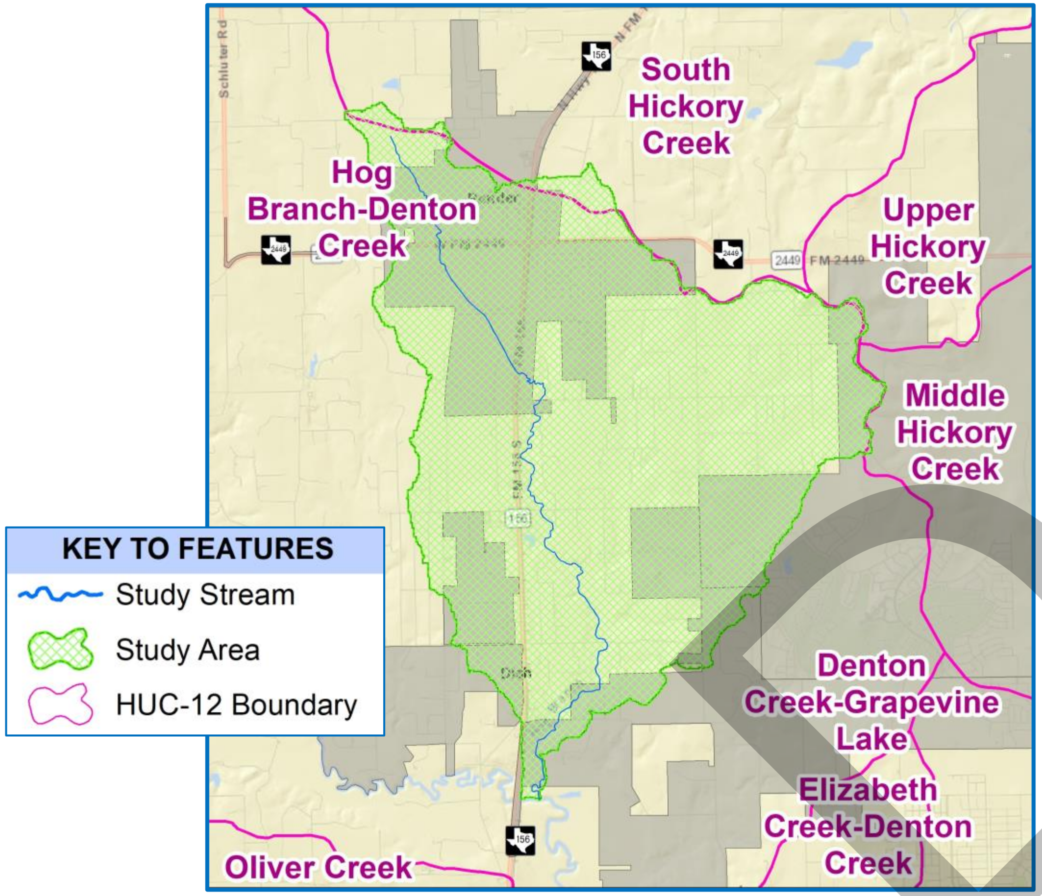
And Base Level Engineering

End of Phase 1

Up Next: Phase 2

- Coordinate with FEMA and NCTCOG
- Perform Flood Hydrology and Hydraulics Studies

RECENT POST-DISCOVERY PROJECT



2021 HOG BRANCH STUDY – DENTON COUNTY

New H&H and Mapping

Flood Risk Products including Flood Risk Assessment

Result of Denton Discovery

Q&A

CONTACTS

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Manuel Razo
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Paul Gutierrez
Paul.Gutierrez@twdb.texas.gov

Appendix IV: Resources

Watershed Follow-up Points of Contact

Subject/Topic of Interest	Name	Contact Information
FEMA Region 6 Risk MAP Lead *Project Outreach*	Cameron Cornett Risk Analysis Branch FEMA Region 6	Phone: 940-208-6383 Email: cameron.cornett@fema.dhs.gov
FEMA Technical Monitor	Jennifer Knecht Risk Analysis Branch FEMA Region 6	Phone: (940) 898-5553 Email: jennifer.knecht@fema.dhs.gov
• Floodplain Management • Floodplain Ordinance • Community Assistance Visits • Higher Standards	John Bowman	Phone: 840-297-0185 Email: john.bowman@fema.dhs.gov
• Community Rating System • Flood Insurance	Diedra Mares	Phone: 830-832-3506 Email: dmares@iso.com
• How to find and read FIRMs • Letters of Map Change and Elevation Certificates • Flood zone disputes • Mandatory insurance purchase guidelines • Map Service Center (MSC) and National Food Hazard Layer	FEMA Mapping and InsuranceeXchange (FMIX)	Phone: 877-FEMA-MAP (336-2627) Email: FEMA-FMIX@fema.dhs.gov Live Chat: https://www.floodmaps.fema.gov/fhm/fmx_main.html

State Partners

Organization/Title	Name	Partner Location	Contact Information
Texas Water Development Board (TWDB) State NFIP Coordinator (Interim)	Gayle Davidson	P.O. Box 13231 Austin, TX 78711	Phone: 512-475-1790 Email: gayle.davidson@twdb.texas.gov Web Page: https://www.twdb.texas.gov
Texas Division of Emergency Management (TDEM) State Hazard Mitigation Officer	Dave Jackson, CEM	P.O. Box 4087 Austin, TX 78773	Phone: 512-424-7820 Email: Dave.Jackson@tdem.texas.gov Web Page: https://tdem.texas.gov/hazard-mitigation
North Central Texas Council of Governments (NCTCOG) *Environment & Development Senior Planner*	Jai-W Hayes-Jackson	616 Six Flags Drive Arlington, TX 76005	Phone: 817- 695-9212 Email: jhayes-jackson@nctcog.org Web Page: https://www.nctcog.org/envir/index.asp

Texas Water Development Board

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

The Mission of the Texas Water Development Board (TWDB) is to lead the state's efforts in ensuring a secure water future for Texas and its citizens. The TWDB's mission is a vital part of Texas' overall vision and the state's mission and goals that relate to maintaining the viability of the state's natural resources, health, and economic development. The TWDB's main responsibilities include: collecting and disseminating water-related data; assisting with regional water supply and flood planning that contributes to preparing the state water plan and state flood plan; and administering cost-effective financial programs for constructing water supply, wastewater treatment, flood control, and agricultural water conservation projects.

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 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 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:

Jai-W Hayes-Jackson
Environment & Development Planner
Phone: (817) 695-9212
Email: jhayes-jackson@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 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 governments; 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	https://www.tfma.org

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

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.Risk MAP6.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 **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.

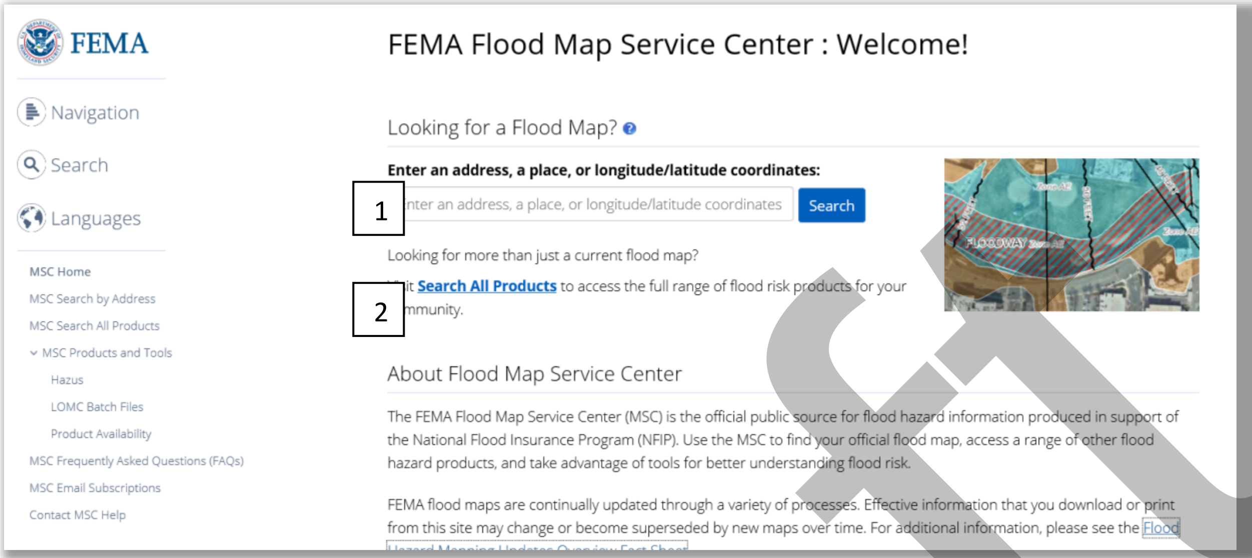
FEMA Flood Map Service Center (MSC)

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.

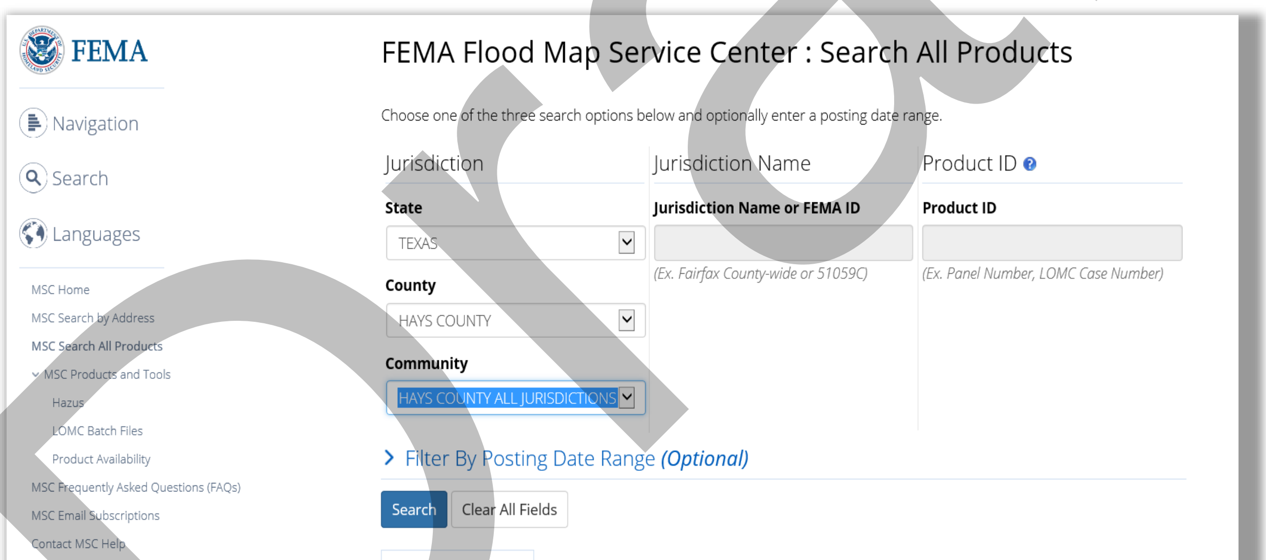
FEMA flood maps are continually updated through a variety of processes. Effective information that you download or print from this site may change or become superseded by new maps over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet.

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

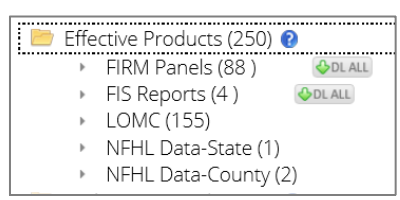
1. Enter an address, place name, or latitude/longitude coordinates and click search. This will provide the current effective FIRM panel where the location is shown.
2. Or Search All Products, which will provide access to the full range of flood risk information available.



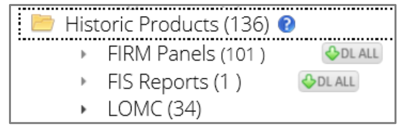
By using the more advanced search option, "Search All Products," users may access current, preliminary, pending, and historic flood maps. Additionally, GIS data and flood risk products may be accessed through the site with these few steps.



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 LOMCs 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.