North Central Texas Council of Governments

Integrated Transportation & Stormwater Infrastructure Study:

Considering Model Codes for Development and Floodplain Regulations

Funded by the Texas General Land Office, Community Development Block Grant, Disaster Recovery Program

Also funded by the Texas Water Development Board and Texas Department of Transportation

Overview

NCTCOG

Jeff Neal, PTP

Erin Blackman, CFM

Shawn Conrad, PhD

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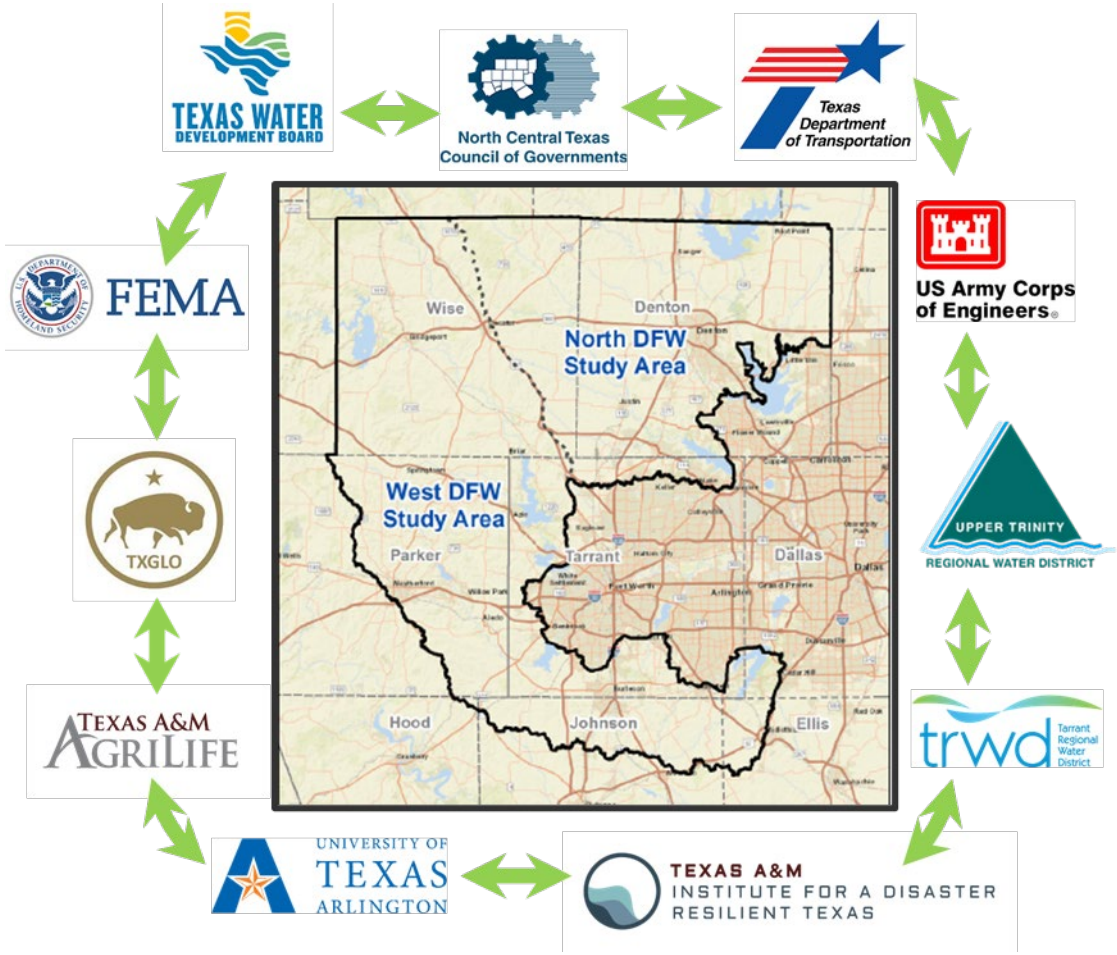
Integrated Transportation & Stormwater Infrastructure (TSI) Study Objectives and Partners

$10 million comprehensive planning effort to address flood risk upstream of the Dallas-Fort Worth (DFW) urban cores:

- Proactive planning
- Stormwater, environmental, and transportation infrastructure integration
- Safety of residents, property, and infrastructure
- State-of-the-art flood hazard area models
- Flood warning system framework
- Innovative infrastructure, nature-based solutions
- Tools, literature, and data to aid with community engagement and floodplain administration



- **Consultant Partners:**
  - Freese and Nichols, Inc.
  - Halff Associates, Inc.
  - Highland Economics
- **Expected Completion:**
  - **Fall 2026**

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Estimated Study Timeline

Fall 2025/Winter 2026
Training, workshops, site visits

Winter/Spring 2026
Complete Hydrologic & Hydraulic (H&H) model, policy recommendations

Spring 2026
Seek stakeholder feedback

Summer 2026
Present final products

Summer/Fall 2026
Submit deliverables to funding agencies

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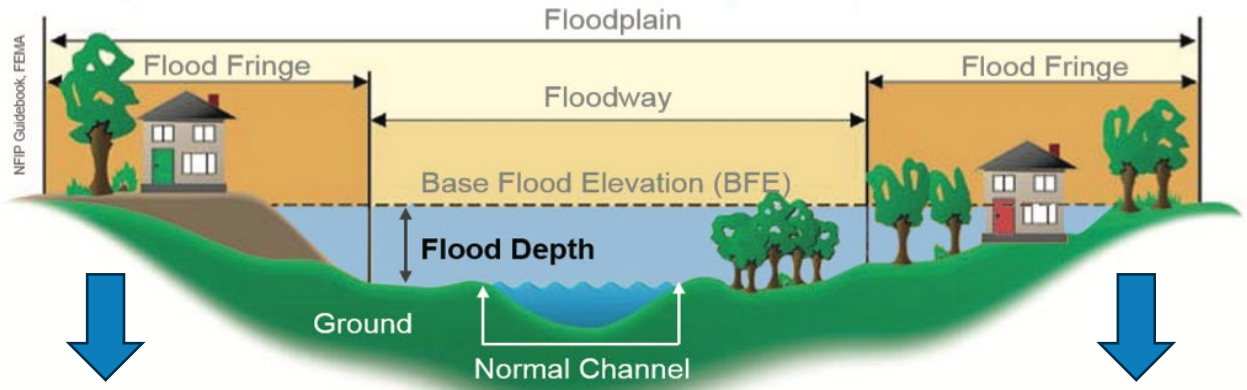
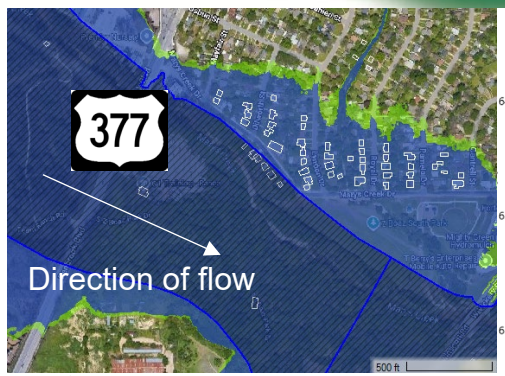
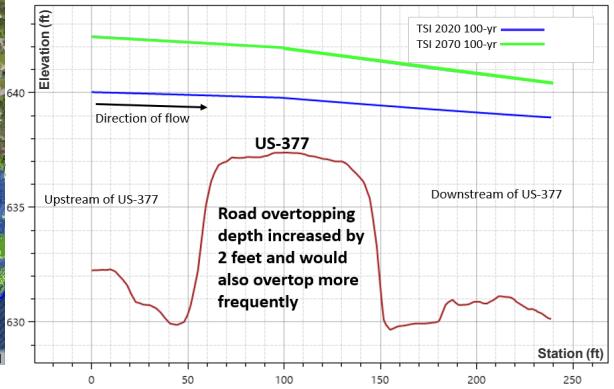
WHY: *Urbanization Increases Flood Risk*

- **Floodplains are among Earth's most valuable ecosystems, but also among the most threatened**
- **Effects of urbanization:**
  - Adds impervious cover ***(see right; runoff ≤ 10% more)***
  - Depletes valley storage ***(see below; runoff ≤ 30% more)***







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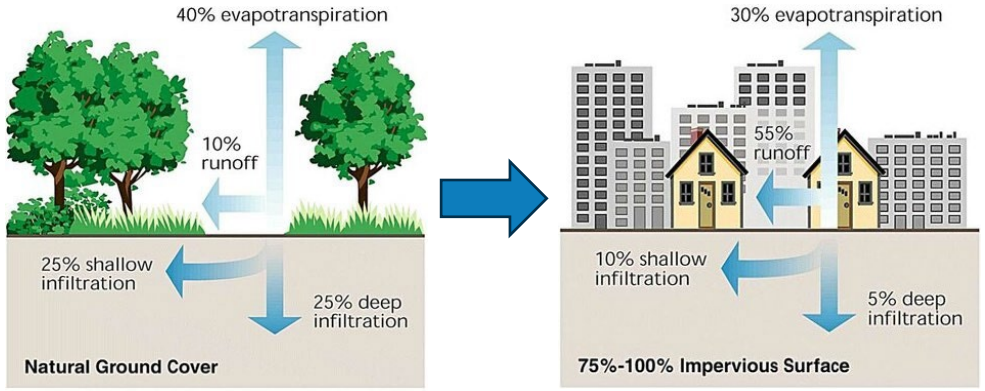
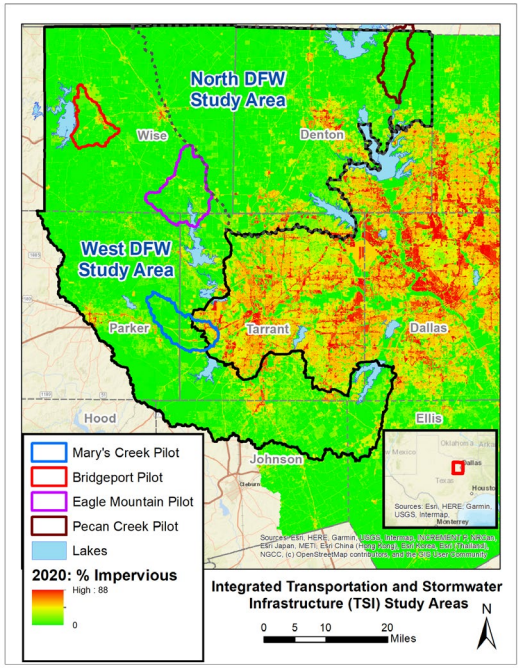
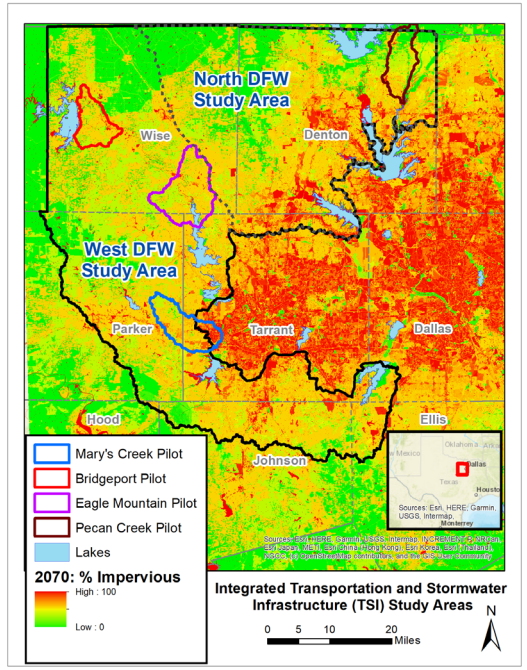
More Impervious Surface = More Runoff





6.4% Impervious
(2020)



35.2% Impervious
(2070)

WHY: *Criticality of Transportation/Stormwater Integration*

- **Transportation stormwater infrastructure costs are some of the most substantial in flood events**
- **Transportation failures impact access and reliability:**
  - Emergency response and evacuation efficiency
  - Connectivity to/from critical services, employment and education needs, and community cohesion
  - Maintenance and asset condition degradation
- **Stormwater failures effect system adaptability:**
  - Lacks consistent regional infrastructure data and modeling
  - Constrains evaluation of accumulated watershed impacts
- **Rebuilding costs/schedules can be excessive and difficult to accommodate with other needs**
- **Most flood fatalities occur at roadway drainage crossings and other water flow/storage bottlenecks**
- **Upstream development has rendered downstream road crossings and drainage systems inadequate**

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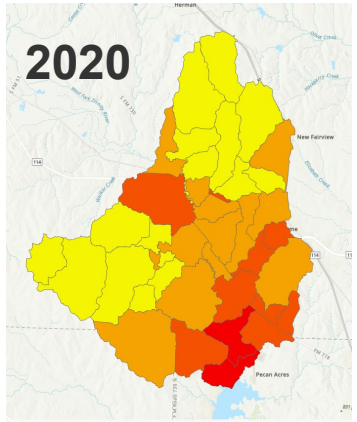
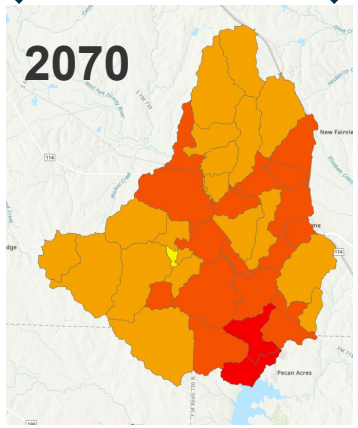
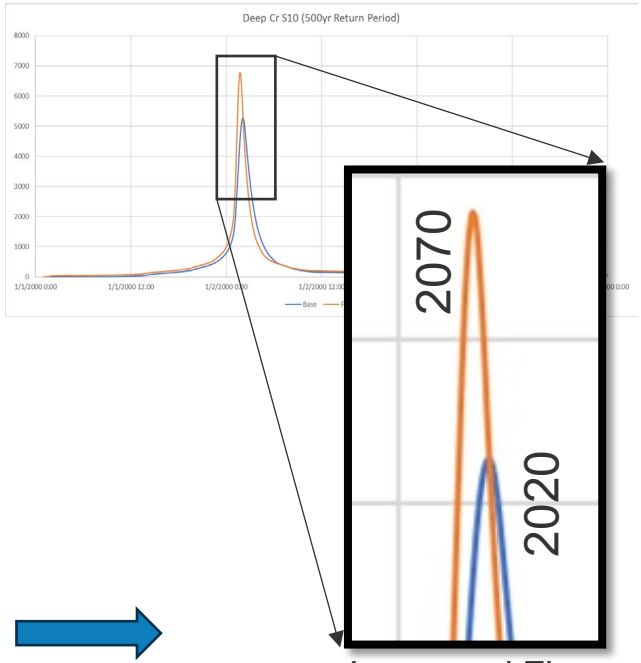
HOW: *Enhanced Drainage Models to Optimize Alternatives*

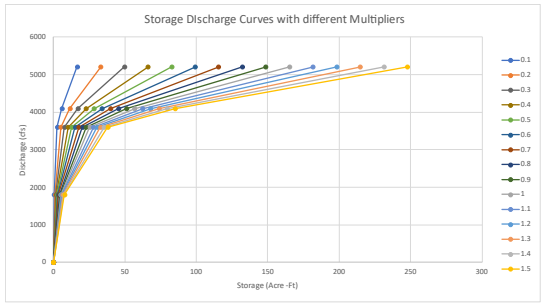


Urbanization Changes to Permeability and Valley Storage





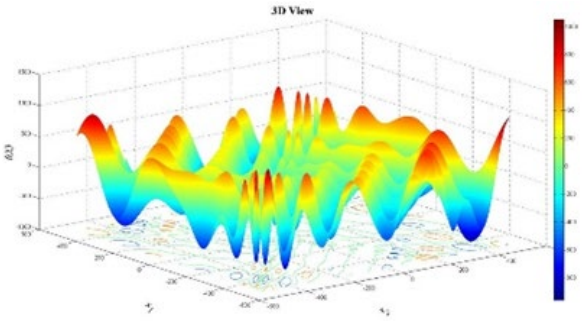
Increased Flow



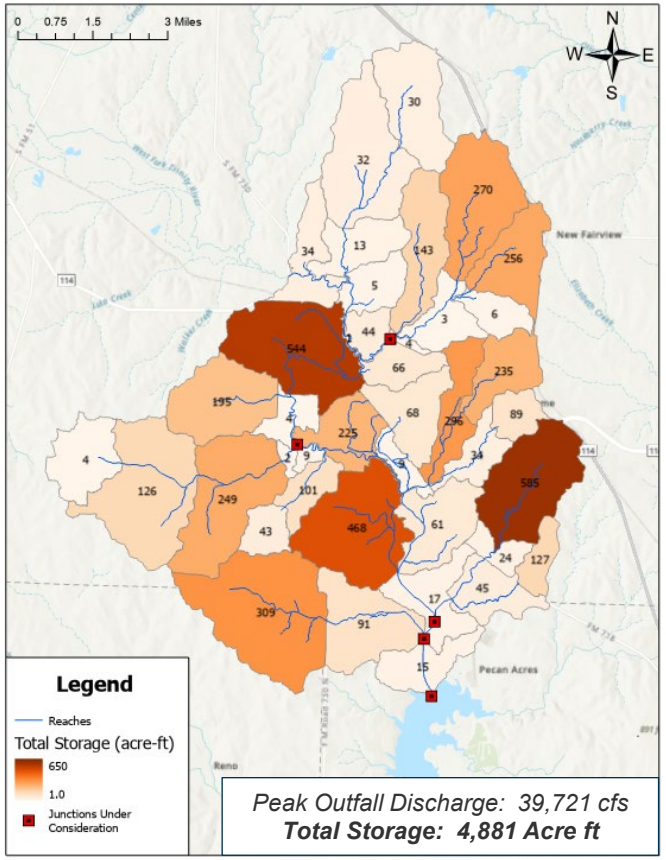
Vary Storage Values to Best Reduce the Peak Flow

Set Up Hydrologic & Hydraulic (H&H) Model w/ Reservoirs at Each Subbasin

Optimize Flow Resistance and Storage Values Generated from H&H Model Runs



Distributed Detention Optimization Example – **Eagle Mountain Pilot**



Focus on Critical Reaches and Transportation Junctions for **Reducing Flow to 2020 Conditions**

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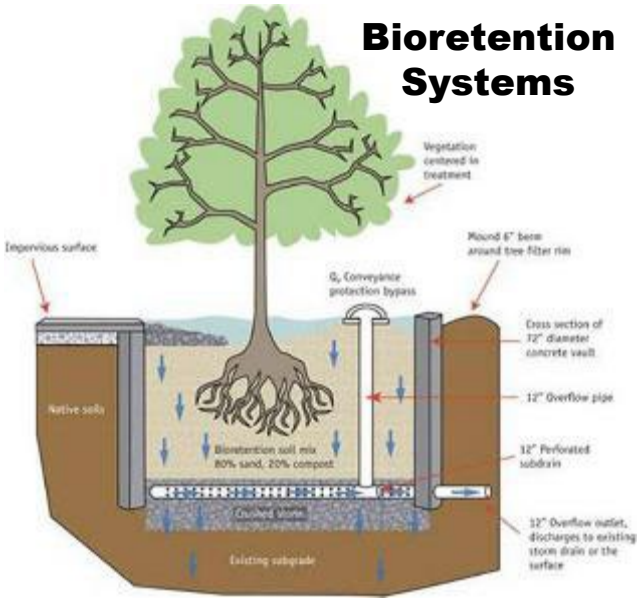
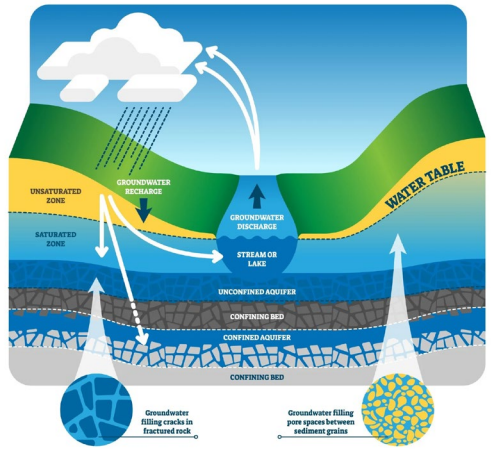
INTEGRATION: *Blend Innovative Assets and Regulations*

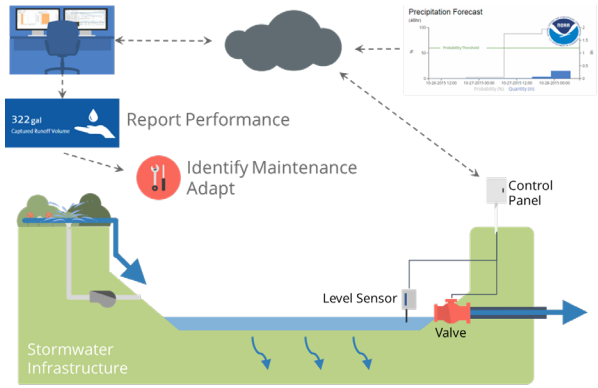
Bioretention Systems



Groundwater Recharge/Reuse



Smart Stormwater Infrastructure



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Model Codes Task Overview

- Develop model development codes that support TSI goals of reducing flood risk and integrating transportation, stormwater, and environmental planning
- Identify enabling or supportive state code provisions
- Receive input from stakeholders on draft code elements
- Incorporate feedback to refine the model codes
- Local governments may choose to use the model codes as a resource for code updates to improve flood prevention and mitigation

Development Regulations Model Code

- **Identifying best practice strategies that can be incorporated into development** *(land use/zoning/subdivision)* **codes to help prevent and/or mitigate future flood events**
- **Model codes can address green stormwater infrastructure, nature-based solutions, low impact development, and other strategies**
- **Examples:**
  - Impervious cover limits
  - Clustered development
  - Creation/preservation and maintenance of open space
  - Green parking lot infrastructure
  - Incentive zoning

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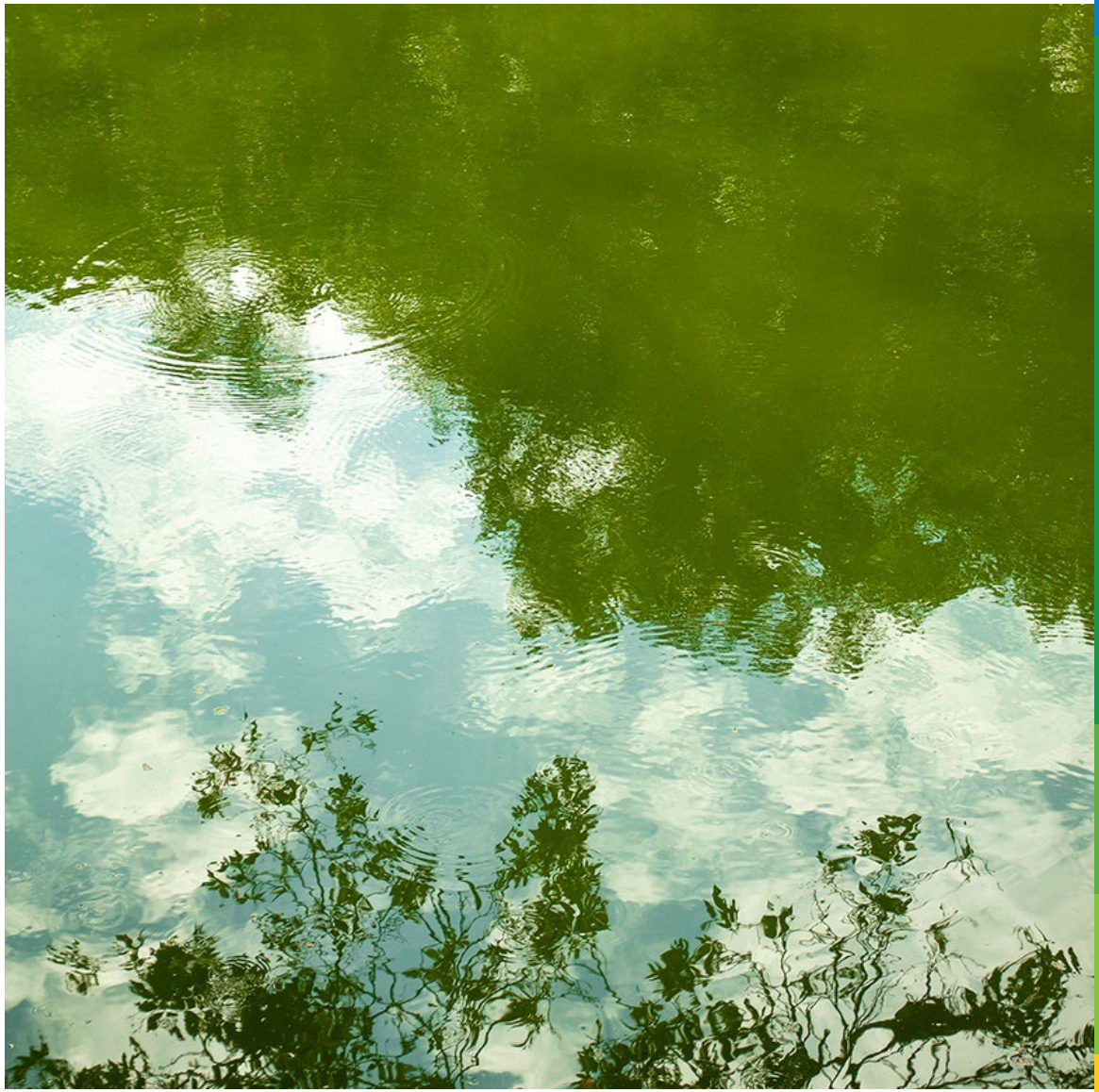
Floodplain Ordinance Model Code

- **Identifying higher standards that can be incorporated into flood damage prevention ordinances to help reduce economic losses, prevent future flood hazards, and protect public health/safety**
- **Model codes can address higher construction standards for development in flood-prone areas**
- **Examples:**
  - Freeboard
  - Ingress/egress
  - Valley storage
  - Critical facilities
  - Setbacks
  - Match pre-developed site runoffs
  - No rise in flood waters



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“What We Did/How We Did It”

- Development Codes
  - Conducted a nationwide review of innovative flood-mitigation development standards and municipal ordinances
  - Connected with in-region and statewide practitioners to understand real-world applications, challenges and successes
  - Assembled a reference of in-region and in-state sample codes/ordinances
- Floodplain Standards
  - Consulted Texas Floodplain Management Association and NCTCOG resources to identify best practices
  - Identified communities in North Central Texas which have implemented these best practices
  - Included sample codes/ordinances for reference

Local Strategies: Built Environment

Stormwater Management/ Low Impact Development

- Low impact development requirements, incentives, and street/ROW standards, impervious cover limits
- Comprehensive stormwater management and innovative infrastructure standards
- Parking lot bioretention, innovative infrastructure, native landscaping, streetscape innovative infrastructure, and rainwater harvesting

Street Design

- Streetscape master plans (with innovative infrastructure emphasis)
- Street design for flood resilience
- Street location in floodplains (site plan review)

Local Strategies: Built Environment

Impervious Cover

- ROW and parking reform
- Parking and impervious cover reductions; permeable alleys and low-traffic accessways
- Parking maximums and reduced parking requirements

Conservation Development/ Subdivision Standards

- Conservation subdivisions, rural conservation development, and conservation zones
- Yield plan options, density flexibility and cluster subdivision design
- Incentive zoning

Local Strategies: Open Space/Environmentally Sensitive Areas

Sensitive Resource/ Habitat Protection

- Critical area overlay (Mississippi River Corridor)
- Conservation buffers, riparian setbacks and sensitive area protection
- Subdivision natural features

Open Space Preservation/ Growth Management

- Landscape standards for stormwater and heat mitigation
- Green space and open space requirements (mixed use)
- Preservation of natural features
- Open space protection, incentives, and funding mechanisms
- Conservation subdivision and transfer of development rights tools

Local Strategies: Floodplains

Freeboard

- Adopt 1-3’ freeboard
- Factor of safety to compensate for many unknowns contributing to flood heights
- Single most effective means for reducing flood risk
- Consider freeboard in all flood risk zones as flooding occurs outside Special Flood Hazard Area (SFHA)

Ingress/Egress

- Ensure access routes to/from building sites during floods by requiring roadways be built above Base Flood Elevation
- Residual risk remains on properties even when buildings are elevated via freeboard
- Accessibility during floods protects emergency personnel and public safety

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Local Strategies: Floodplains

Valley Storage

- Restrict loss of valley storage
- Require compensatory storage
- Valley storage is lost through fill, development, stream channelization
- Impacts include peak flow/water surface elevation increases, deeper and more frequent roadway overtopping, shorter flood response times, etc.

Critical Facilities

- Protect critical facilities (e.g., hospitals, police/fire stations, schools, etc.) and development by requiring them to be built outside the SFHA
- If not feasible, require higher freeboard amounts
- Minimize damage and potential loss of life

Local Strategies: Floodplains

Setbacks

- Require development be set back from adjacent streams
- Used to keep development out of harm's way
- Help protect riparian corridors—important for flood control, water quality, erosion prevention, etc.

Pre-Developed Site Runoffs

- Match pre-developed site runoffs by requiring downstream assessment and installing onsite stormwater management controls
- Prevent increase in downstream flooding
- Maintain hydraulic capacity
- Protect stream stability

Local Strategies: Floodplains

No-Rise

- Prohibit rise in flood waters
- Maintain natural functions of the floodplain
- Prevent worsening flood conditions as development continues

Others to Consider

- Regional (on- or off-stream) detention
- Require higher standards on Natural Resources Conservation Service dams

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Panel Introduction

NCTCOG

Susan Alvarez, PE, CFM

Local Implementation Examples

City of Fort Worth

Allison Docker, PLA, ALSA

Jennifer Dyke, CFM

Fort Worth's Green Space Initiatives & Floodplain Regulations

Model Development Code and Floodplain Ordinances TSI Workshop

January 29, 2026

Presented by: Allison Docker, City Manager's Office Green Space Champion
Jennifer Dyke, Transportation & Public Works Department, Assistant Director
Stormwater Management Program

Agenda

- CFW Good Natured Greenspace Initiatives
  - Open Space Conservation Program
  - Land Assessment & Site Suitability
  - Natural Land Management
  - Riparian Area Initiative

- Floodplain Regulations
  - Citywide Valley Storage (for FEMA floodplains)
  - Non-FEMA City Flood Risk Areas

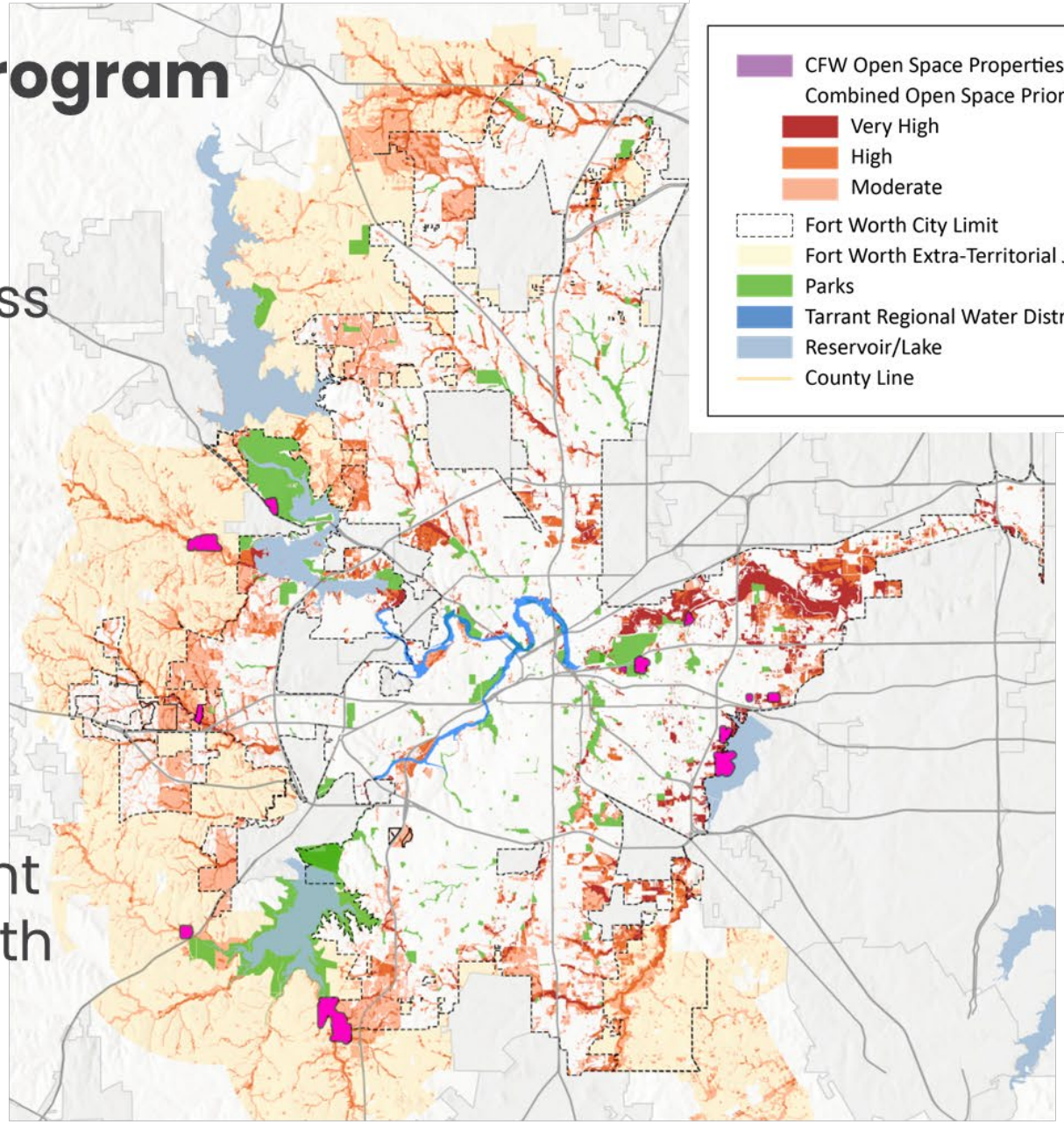
Conserve **high-quality natural areas**

- Providing **environmental benefits,**
  - *Protects our air & water quality*
  - *Helps regulate high temperatures*
  - *Critical to supporting stormwater infrastructure & mitigating flood conditions*
- Encouraging **outdoor recreation,**
- Supporting **economic development,** &
- Enhancing the **livability and desirability** of the City of Fort Worth.

Open Space Conservation Program

Current Status:

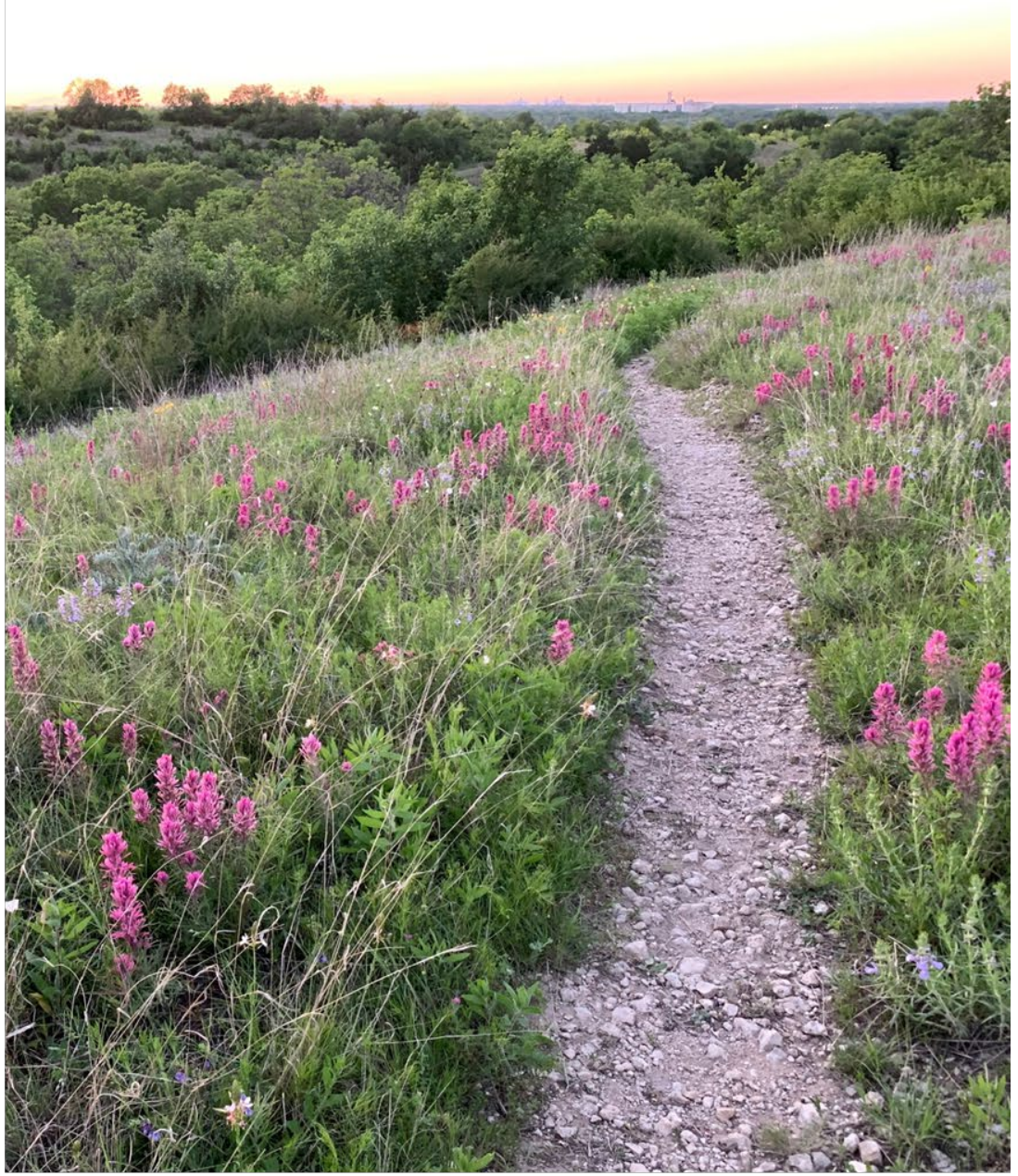
- **693 acres** acquired or in process
- **$26,769,409** total budget
  - 2022 Bond, Gas Lease & private donation
  - 97% Spent
- Average cost - $50k per acre
- Median cost -$35k per acre
- Leverage funding through 6 joint acquisitions with Parks and 1 with Tarrant Regional Water District



Land Assessment & Site Suitability

Planning & Activation:

- Bio-assessments and ecosystem inventory
- Natural Land Management Plans
- Identifying Programmatic Opportunities
- Conceptual Master Planning
- Capital Improvement Plans



Natural Land Management

Invasive Removal

Prescribed Burns

Ecosystem Services - direct and indirect benefits that ecosystems can provide

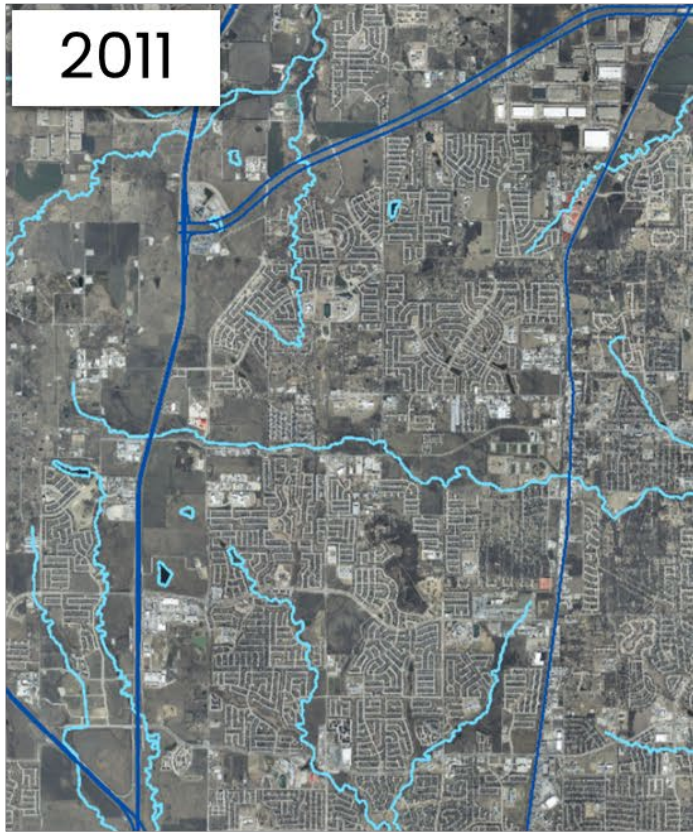
- flood control
- air and water filtration
- urban heat island mitigation
- Physical & mental health
  - opportunities for outdoor recreation
  - access to nature

Riparian Area Initiative

Development Pressure:

- Increases impervious surfaces and soil compaction
- Increases stormwater runoff, sedimentation, and pollutants
- Increases stream flow velocities that cause erosion

Extreme rainfall events in Texas are becoming more frequent and severe, and are expected to worsen in the future



Riparian Area - Proposed Buffer Size

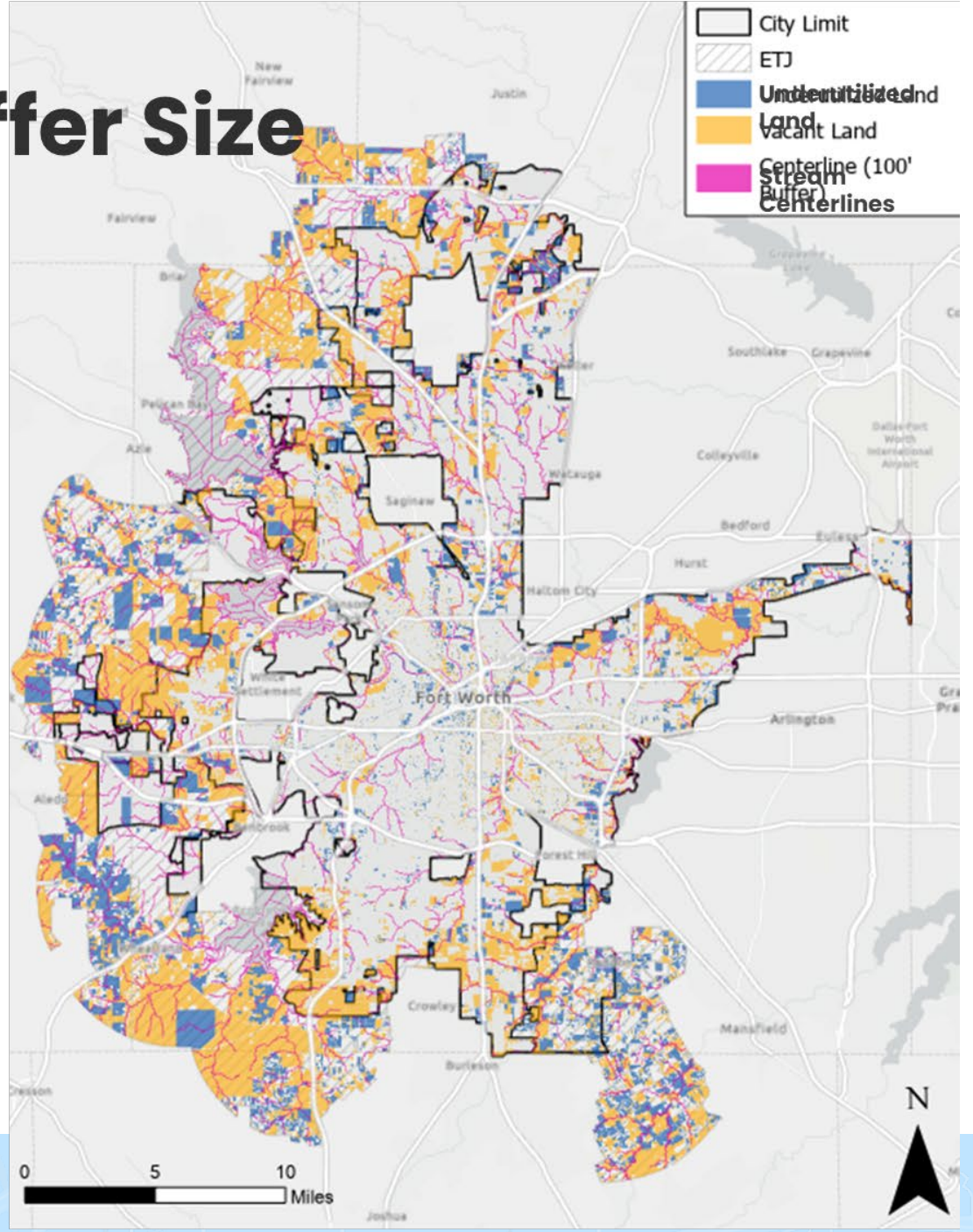
33,951 acres - Total Developable Land in City Limits & ETJ

Current Proposed Buffer Size:

- FEMA Floodplain or 100ft from centerline, whichever is greater
- Includes **15,839.8 acres** of "Developable Land" within City Limits (note that **5,023 acres are not** in the floodway)

Exemptions:

- Utilities, access roads and bridges, trails, stormwater outfalls & infrastructure, kayak/ watercraft launches & ephemeral streams



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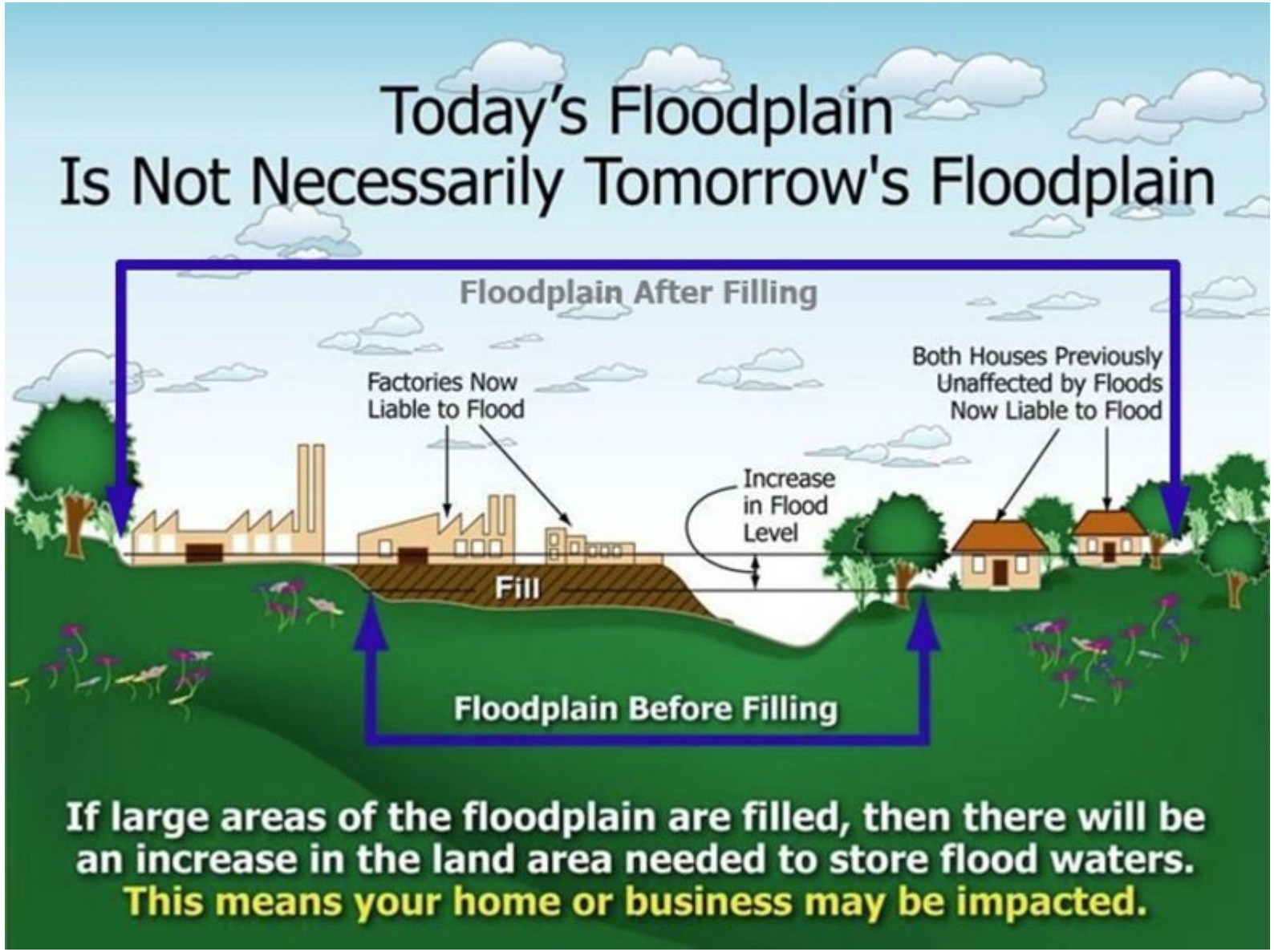
Riparian Area Protection – Anticipated Outcomes

- Adopt a **Riparian Area Ordinance** that implements a protection buffer zone and is seamlessly incorporated into the city's development process
- Provide a clear **map of the buffer area** for developers, residents and City staff
- Provide a clear overlay map showing where **administrative relief** can apply
- **Update manuals, ordinances, and policies** & other applicable development criteria

Floodplain Ordinance Highlights



Driver for Change

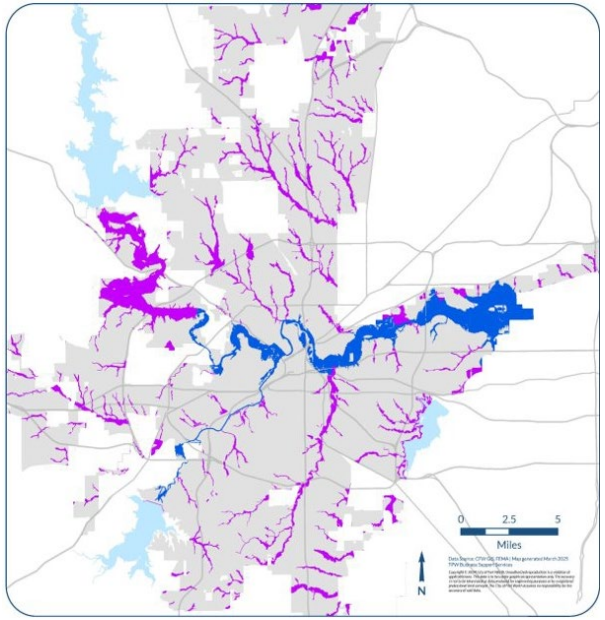
- Case study shows filling in Valley Storage increases flood risk downstream
- Frequent storms most impacted by Valley Storage losses
  - Increases flood risk
  - Increases erosion

Recommendation

- Preserve Valley Storage citywide at 1:1 ratio- No loss (0.0%) in Valley Storage

Valley Storage

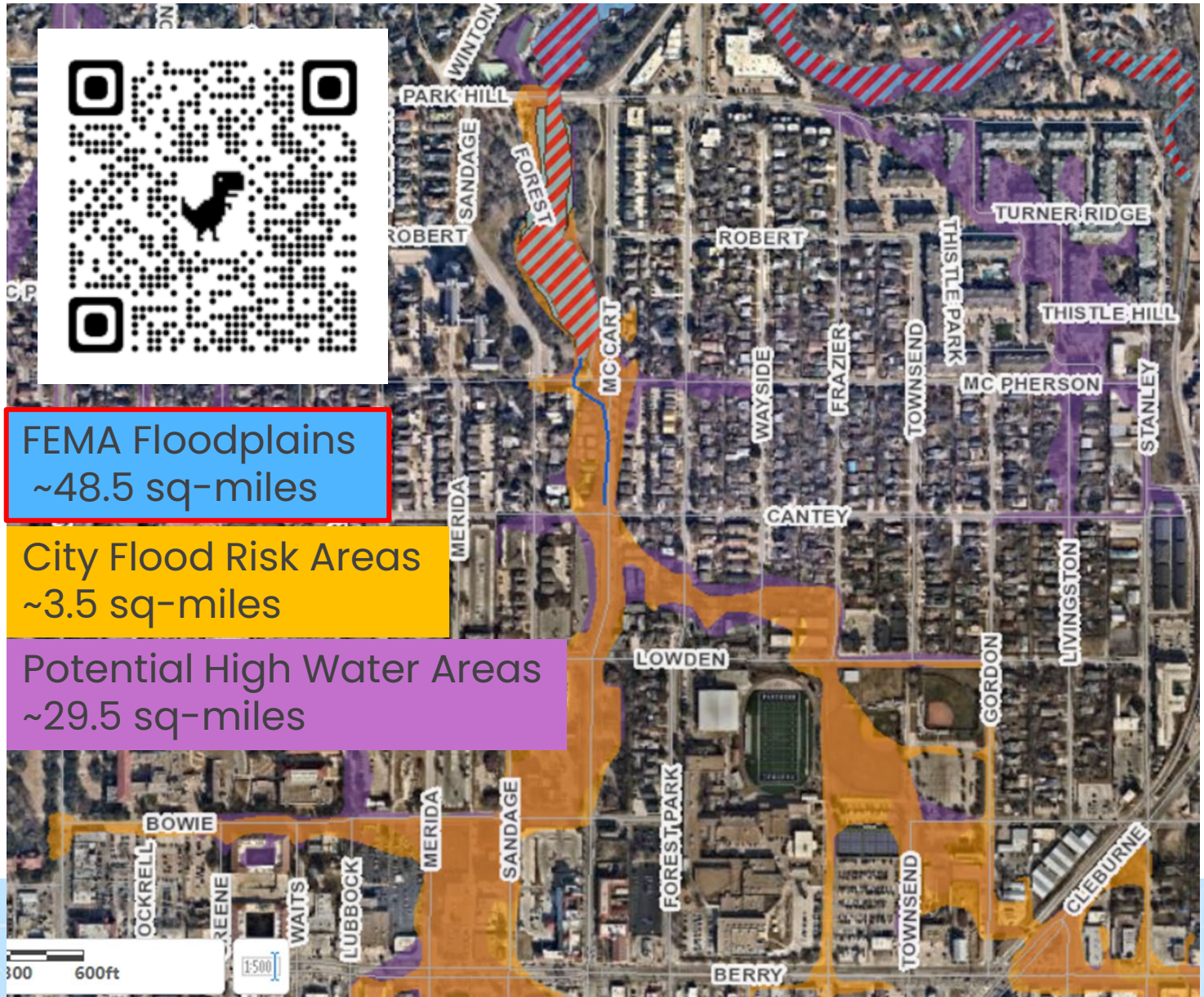
- **Supporting Code/Ordinance**
  - Floodplain Ordinance – Council adopted 12/2025; Takes effect 2/1/2026
  - More detailed Implementation Guidance
- **Challenges to Adoption**
  - Long timeframe
  - Concerns regarding increased time to review/permit development & increased cost to develop
- **Tips for Successful Adoption & Implementation**
  - Don't rush engagement; don't give up (2020 case studies, 2025 adoption)
  - Work closely with stakeholders, especially the Development community
  - Keep City Council updated
  - Use data from Case Studies and benchmarking to demonstrate need
  - Incorporate new process into existing development permitting and review processes
  - Allow for appropriate exemptions
  - Ability to utilize existing data from FEMA model if developer is not modeling
  - Determine appropriate grandfathering - Developments with submitted studies or permits
- **Opportunities (locally or regionally)**
  - Our regulations could apply to FEMA floodplains anywhere and benefit both the implementing community and communities downstream



Initial Valley Storage Regulations

New Valley Storage Regulations

Non-FEMA City Flood Risk Areas



Driver for Change

- Increased reports of structure flooding to new small lot development *outside of* FEMA floodplains

Recommendation

- Require engineer signed Certificate of Compliance documenting elevation or floodproofing 2' over 100-year flood risk & noting consideration of impacts to neighboring properties
- Communicate non-FEMA flood risk – Public Viewer

Non-FEMA City Flood Risk Areas

- **Supporting Code/Ordinance**
  - Floodplain Ordinance – Council adopted June 2024; Took effect July 2024
  - Stormwater Criteria Manual – more detail
- **Challenges to Adoption**
  - Long timeframe - COVID, change in staff and stakeholders
  - Concerns regarding impact on property values, real estate transactions, and development review/permitting
  - Attempted to take regulation updates to Council with other types of updates – Keep topics separate to focus discussions
- **Tips for Successful Adoption & Implementation**
  - Don't give up (2018 kick off to Summer 2024 adoption)
  - Work closely with appropriate stakeholders - Real estate and development community were key for this initiative
  - Benchmarking – show what others are doing and figure out what works best for your community
  - Clearly articulate benefits and impacts to both residents and developers – quantify when feasible
  - Start small and improve over time based on "lessons learned" from implementation
  - Use technical conferences for vetting and feedback of ideas
- **Opportunities (locally or regionally)**
  - Our regulations could be used to regulate non-FEMA flood risks in other communities

Fort Worth Ordinance

ARTICLE VIII: FLOODPLAIN PROVISIONS

Valley Storage

- Ordinance: https://www.fortworthtexas.gov/files/assets/public/v/1/tpw/ord.valley-storage-amendment-mka-v2-11.24.25.pdf
- Guidance Document:

_https://www.fortworthtexas.gov/files/assets/public/v/1/tpw/documents/floodplain_ordinance_valley-storage_guidancedoc_2026.01.09.pdf

Division 7 - City Flood Risk Areas

https://codelibrary.amlegal.com/codes/ftworth/latest/ftworth_tx/0-0-0-75053

For More Information

Questions on:

Good Natured Green Space Initiative & Open Space Program

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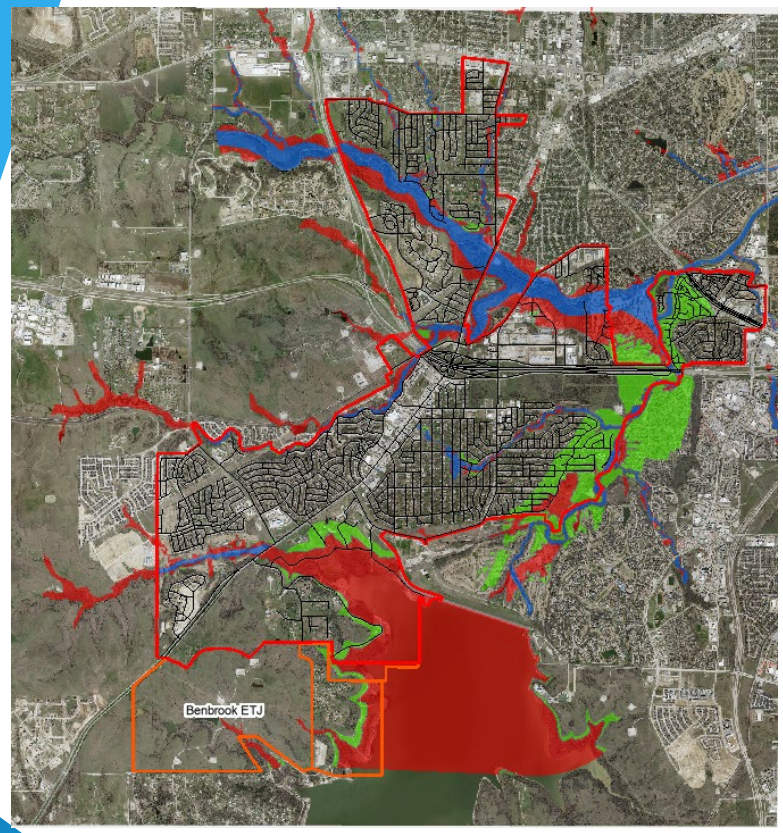
Floodplain Regulations

Floodplain Team - floodplain@fortworthtexas.gov

Local Implementation Examples

City of Benbrook

Bennett Howell, PE, CFM



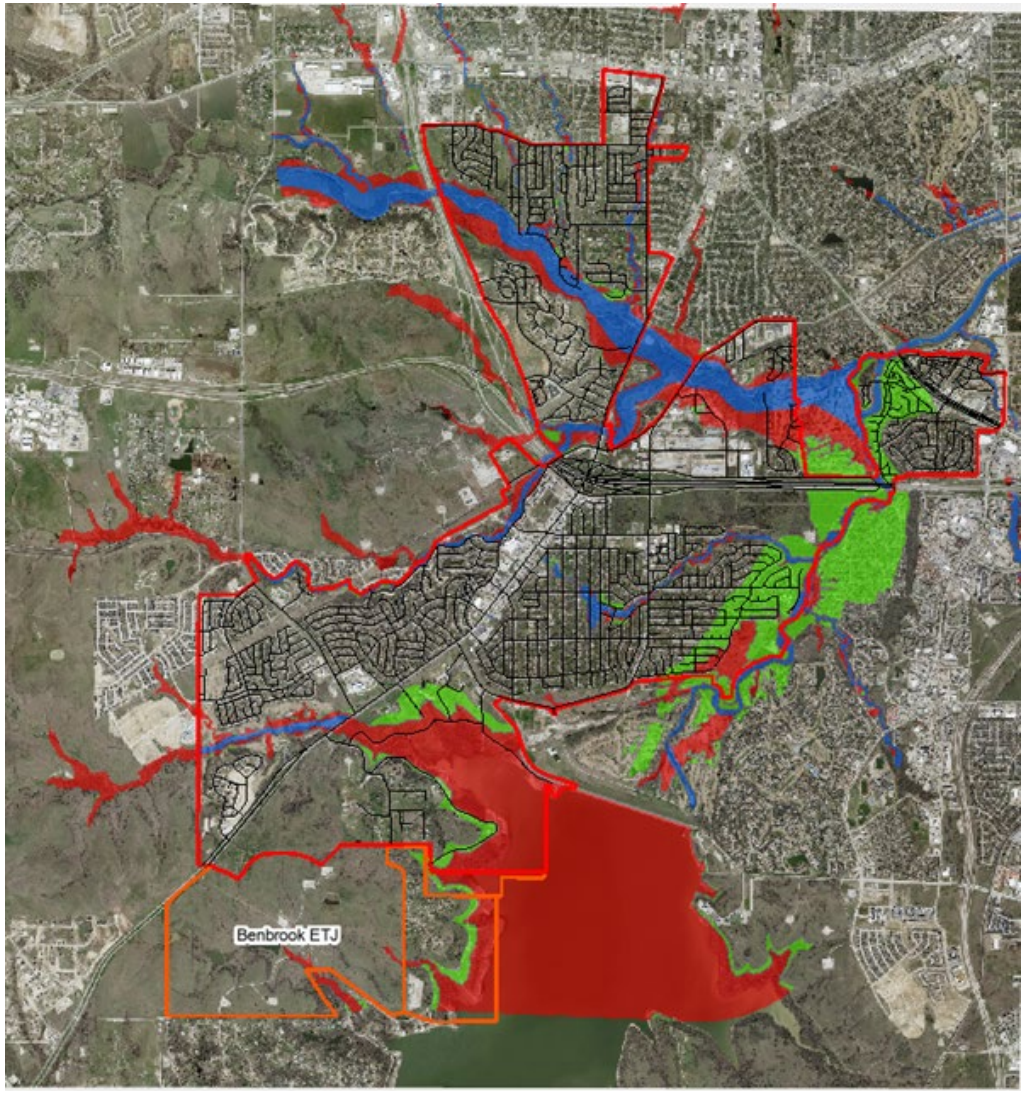
Basic Floodplain Management

January 29, 2026

TSI Model Development
Code/Floodplain Ordinances
Workshop

Bennett Howell, PE, CFM

Benbrook's Floodplain Map



Benbrook Floodplain Facts

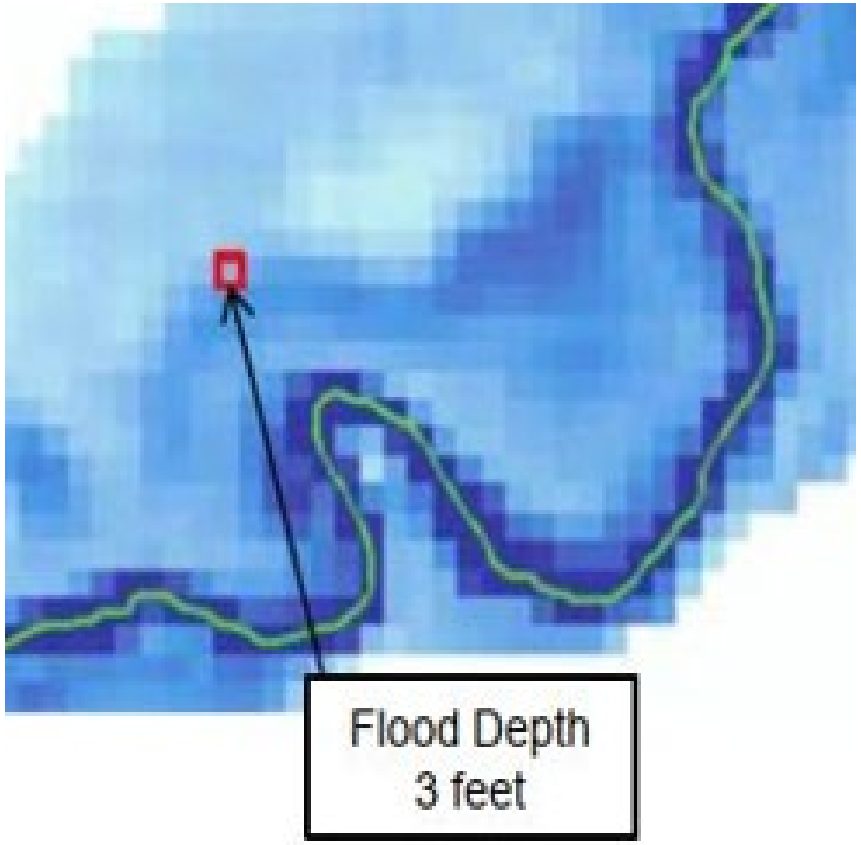
- Initial FIRM Date = July 1979
- Benbrook Floodplain Area = 1,332 acres (18.8%)
  - Residential Properties in Floodplain = 935
  - Commercial Properties in Floodplain = 304
  - Active Insurance Policies = 302 (24%)
- National Flood Insurance Program (NFIP) Claims Paid 1980-2023 in Benbrook
  - Paid Out = $715,400
  - Number of Claims = 55 (1.3 claims/yr)
  - Average Payout = $13,007/claim
  - Reduced Repetitive Loss Properties from five to two.

Where Current Ordinance Exceeds FEMA Requirements – Major Items

- No new development is allowed in the floodplain.
- Elevations of the finished floors, proposed streets, driveways, and parking lots shall be no less than 2 feet above the base flood elevation.
- No minimum acreage for flood studies, and modeled using fully developed conditions in the watershed.
- Zero Rise in water surface elevations and No Adverse Impact.
- 1:1 Compensatory storage requirements.
- Channel velocities cannot be increased over existing conditions.
- Erosion Hazard Zones – 4:1 slope from the toe. First 60% no development, remaining 40% minimal development.
- Every lot must have a buildable area that is entirely outside the floodplain.
- No site work can begin until FEMA approves CLOMR, then only streets and underground utilities.
- No structures shall be approved for construction until after FEMA approves the LOMR, and the final plat is filed with Tarrant County.

Flood Risk Product Map

- Interactive Mapping Program
- Water Surface Elevation Grids
- Depth Grids
- Percent Chance of Flooding Grids
- Percent Chance of Flooding – 30-year time period
- HAZUS Flood Loss Estimates



Potential Revisions to the Floodplain Ordinance

Look to other departments to assist:

- Attorney
- Building Permits
- Code Enforcement
- Economic Development
- Engineering
- Fire
- Floodplain
- Planning
- Police

How Strict is Strict?

- There is a balance between fair and strict.
- Both developed land and undeveloped land fall under the same regulation.
- Make it too strict and existing structures cannot be repaired or it might be considered a regulatory taking.
- Some courts have ruled that if certain regulations are too strict, then cities/counties might have to purchase properties.

Existing Structure Dilemma

- Let's say City Council/Commissioners Court wants to tighten up the floodplain ordinance so that no development in the floodplain is allowed and that floodplain cannot be reclaimed.
- Our current ordinance does not allow new development in the floodplain, so the developer has to go through Conditional Letter of Map Revision/Letter of Map Revision (CLOMR/LOMR) process.
- What about the existing structures (Pre-FIRM) that are located in the floodplain?
  - The owners would not be able to repair their homes; homes would fall into disarray and have to be demolished.
  - Eventually the courts might tell the City to purchase the properties.
  - Our revised ordinance allows existing homes to be maintained, but the owners cannot change the footprint of the home without bringing the property into compliance with the current ordinance. We still use the 50% thres[illegible]

Potential Revisions

- Watch for unattended consequences.
- Do you have the staff and budget to manage a program with stricter requirements?
- Increase the minimum elevation above base flood elevation (BFE). Currently, Benbrook is at 2 feet for homes and businesses.
- Don’t allow businesses to floodproof.
- Don’t allow fill to be brought into the floodplain.
- Have CLOMR/LOMR submittals reviewed by third-party, and pass the costs onto the developer.
- Lower the Substantial Damage/Substantial Improvement threshold of 50% of structure’s value.

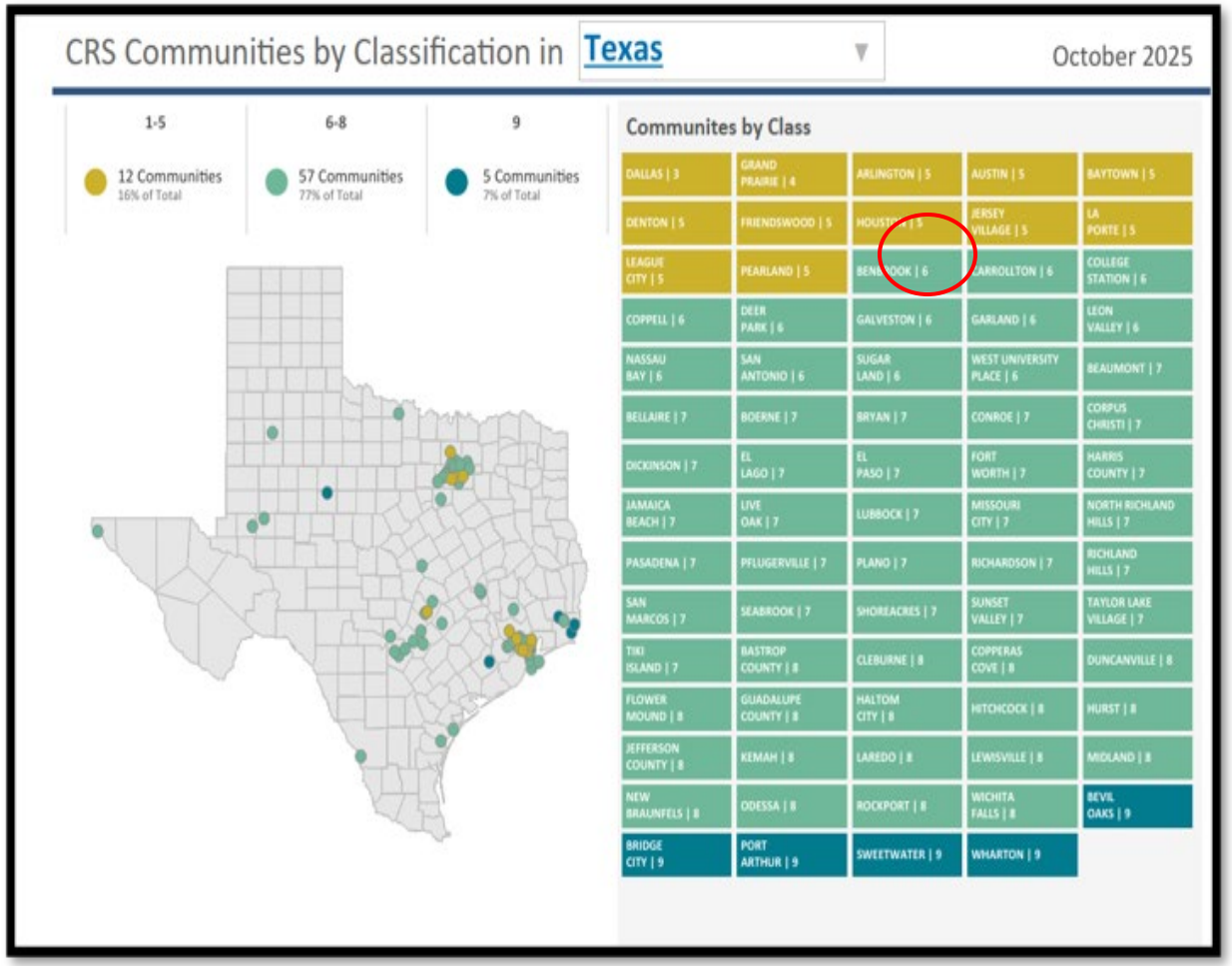
Adopt American Society of Civil Engineers (ASCE) 24-24

- It will eventually be incorporated into the I-codes.
- Expands the flood hazard area to include the 500-year floodplain.
- Class 1 structures (accessory structures) – 100-year interval
- Class 2 structures (most structures) – 500-year interval
- Class 3 structures (public assembly) – 750-year interval
- Class 4 structures (critical facilities) – 1,000-year interval
- Inspection and maintenance requirements for floodproofed areas.
- Stricter construction standards.

Community Rating System (CRS) Program

- Do you want to chase CRS points or develop a better floodplain management program and let the CRS score fall into place?
- How many property owners benefit from a higher CRS score? What is the City's return on investment?
- Benbrook's current policy is to improve our floodplain program and not focus on the CRS score.
- Higher scores usually require more staff commitment, possibly assistance from consultants, and a committed budget.
- Higher CRS scores are not just about having a stricter floodplain ordinance. It is an entire program.

CRS Score Comparison



Benbrook CRS Score:

- Top 17% of Texas CRS communities
- Top 13% of US CRS communities

Benbrook Flood Insurance:

- 302 policies
- Avg Premium = $984/yr
- 1 CRS Point = 5% discount ($49/yr per property)

Lessons Learned

- Watch for unattended consequences.
- Train your management and elected officials about floodplains. You want them to agree with your recommendations before you revise your ordinance.
- Treat your floodplain as a living and breathing organism that will require periodic revisions.
- Determine how strict is strict.
- CRS Program – Do you want to focus on points or focus on developing a good floodplain program?
- There is always room for improvement.

Contact Information

Bennett Howell, PE, CFM

City of Benbrook

Director of Public Services

(817) 249-6063

bhowell@benbrook-tx.gov

Local Implementation Examples

Wise County

Chad Davis, PE, CFM

FLOODPLAIN ISSUES

“I have a Drainage Problem”

“No You Don’t…You’re Experiencing Gravity”

“IQ and Elevation tend to be proportional”

PREDEVELOPOMENT MEETINGS
Encourage Low Impact Development techniques and/or green infrastructure
Design Considerations

Rainfall Intensities 6 in/hr -7 in/hr vs. 9.15-9.20 in/hr

6 in/hr to 9.20 in.hr = 53% increase

Charts vs. Calculations

“Go Green vs Go Native”

Protecting Against Erosive Velocities

- Wise County Development Rules and Regulations;
- Max 6 ft/s AND No more than 5% increase in velocity
- Rock Filter Dams are NOT necessary in most cases, and are a maintenance problem.
- Amended February 10, 2025
- Detention/retention facilities shall be designed for the 2-year, 25-year and 100-year design

Match Pre-development site runoffs

- I HATE CHANGE

- “The Almighty had a good plan…try to stick with it’

Impacts to county infrastructure

Flood Control Dams Work

DO I NEED A FLOODPLAIN PERMIT

Impacts to the public/private property

MAINTAIN ADEQUATE ACCESS

Platted Subdivision

Not in the Zone A floodplain

At least 2 points of access for developments with 25 or more lots

Breach Inundation Zones

Flood Control Dam Encroachments

Easements

Renew/Refresh your easements

Wise County Development Rules and Regulations

Breach Inundation studies are Required

Breach Inundation

Floodplain

Preserve existing conditions (at the boundary of the development)

Wise County Flood Damage Prevention Ord.

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

(6) In order to preserve the existing hydraulic conditions and Base Flood Elevation, any work to be performed in the Special Flood Hazard Areas ZONE A OR ZONE AE will be required to perform a Hydrologic and Hydraulic study to determine the existing Base Flood Elevation as well as a Hydrologic and Hydraulic study for the proposed conditions. The Base Flood Elevation shall not have a difference between the existing and proposed conditions of more than 0.00 feet.

Zero Change…NOT Zero Rise AT THE BOUNDARY OF THE DEVELOPMENT

Recharge Zone for Trinity Acquifer
Reduces Adverse Impacts to neighbors

Breach Inundation

Wise county Development Rules and Regulations

Section 3.07 Drainage

H. Drainage Studies

6. **Building shall not be permitted within the breach inundation limits of a flood control structure, as determined by a breach analysis performed to evaluate a Natural Resources Conservation Service (NRCS) regulated flood control structure or a dam as defined by Texas Commission on Environmental Quality (TCEQ). If a breach analysis has not previously been performed, the Developer is responsible for providing a breach analysis as defined by TCEQ and in accordance with Wise Soil and Water Conservation District No. 548 requirements. Documentation of approval by Wise Soil and Water Conservation District No. 548 must be provided, prior to submittal to the County. A breach analysis must be signed and sealed by a Licensed Engineer in the State of Texas.**

I. **Building shall not be permitted within the breach inundation limits of a flood control structure, as determined by a breach analysis performed to evaluate a Natural Resources Conservation Service (NRCS) regulated flood control structure or a dam as defined by Texas Commission on Environmental Quality (TCEQ). If a breach analysis has not previously been performed, the Developer is responsible for providing a breach analysis as defined by TCEQ and in accordance with Wise Soil and Water Conservation District No. 548 requirements. Documentation of approval by Wise Soil and Water Conservation District No. 548 must be provided, prior to submittal to the County. A breach analysis must be signed and sealed by a Licensed Engineer in the State of Texas.**

Consider regional (on or off stream) detention incentives

I. Detention Rates
Should the result of a downstream assessment and/or reasonable Standard of Care determine
that on-site detention will be required, specific detention criteria will be determined on a case-
by-case basis by the County Engineer. Detention criteria will be dependent upon the significance of downstream impacts. Runoff rates for all land uses shall be limited to the rates
that would be produced from pre-developed conditions single family residential areas.


HEAVY RAIN WASHES OUT DAM
AT EAST TEXAS LAKE

Wise County Development Rules and Regulations
https://www.co.wise.tx.us/DocumentCenter/View/409/Development-Rules-and-Regulations-PDF

Wise County Flood Damage Prevention Ordinance
https://www.co.wise.tx.us/DocumentCenter/View/414/Flood-Damage-Prevention-Ordinance-PDF

Panel Q&A

Facilitated By:

Stephanie Griffin, PE, CFM, FASCE

1

Are there existing ordinance language, standards, or policies in your community that you believe could serve as a strong model or best practice for other communities in the region (for green infrastructure, low impact development (LID), or floodplain regulations)?

2

What types of regulations are you working on now (for green infrastructure, LID, or floodplain)?

3

What changes, clarifications, or additional guidance would help your community adopt, implement, or strengthen green infrastructure, LID, and floodplain regulations?

4

Which green infrastructure or LID codes, standards, or floodplain ordinances in your community have been most effective in practice, and what factors contributed to their success?

5

Are there any green infrastructure/LID, floodplain, or stormwater ordinances that have been challenging to implement or enforce? What specific obstacles or limitations have you encountered?

6

How have *developers* responded to the adoption of ordinances supporting higher floodplain/development standards or green infrastructure in your community?
What about residents?
Elected Officials?

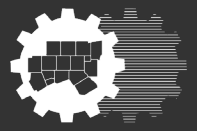
7

If your community wants stronger green infrastructure or floodplain standards but hasn't been able to move forward, what has gotten in the way? What would help make progress?

Corridor Development Certificate Program

U.S. Army Corps of Engineers

Vincent Geracci, PE, CFM



North Central Texas
Council of Governments

Model Development and Floodplain Ordinances Workshop

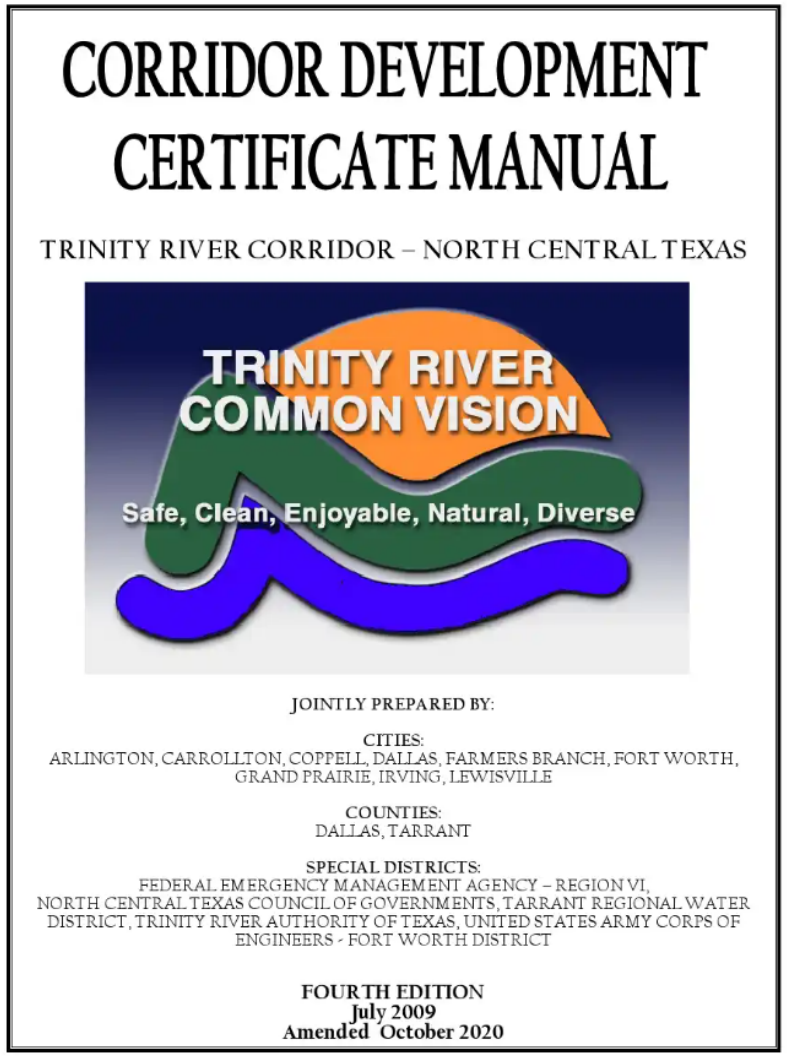
Integrated Transportation and Stormwater Infrastructure (TSI) Study, 1/29/2026

Vincent A. Geracci, PE, CFM

Expansion of the Corridor Development Certificate Process

integrating **Transportation & Stormwater Infrastructure**

Trinity River Corridor Development Certificate



CORRIDOR DEVELOPMENT CERTIFICATE MANUAL

TRINITY RIVER CORRIDOR – NORTH CENTRAL TEXAS

TRINITY RIVER COMMON VISION

Safe, Clean, Enjoyable, Natural, Diverse

JOINTLY PREPARED BY:

CITIES:
ARLINGTON, CARROLLTON, COPPELL, DALLAS, FARMERS BRANCH, FORT WORTH, GRAND PRAIRIE, IRVING, LEWISVILLE

COUNTIES:
DALLAS, TARRANT

SPECIAL DISTRICTS:
FEDERAL EMERGENCY MANAGEMENT AGENCY – REGION VI, NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, TARRANT REGIONAL WATER DISTRICT, TRINITY RIVER AUTHORITY OF TEXAS, UNITED STATES ARMY CORPS OF ENGINEERS - FORT WORTH DISTRICT

FOURTH EDITION
July 2009
Amended October 2020

USACE 1988 Regional Environmental Impact Statement Trinity River and Tributaries:

- the cumulative impact of allowing individual development projects in the Trinity River floodplain could be both **measurable** and **significant**
- The permitting approach adopted by USACE had the potential to significantly reduce flood hazards

USACE 1990 Upper Trinity River Study:

With only National Flood Insurance Program (NFIP) criteria, Standard Project Flood would:

- Flood 42,460 acres in the Upper Trinity River Basin
- Cause $11.1 billion in damages

With CDC criteria, Standard Project Flood would:

- Flood 22,720 acres in the Upper Trinity River Basin
- Cause $4.25 billion in damages

Trinity River Corridor Development Certificate

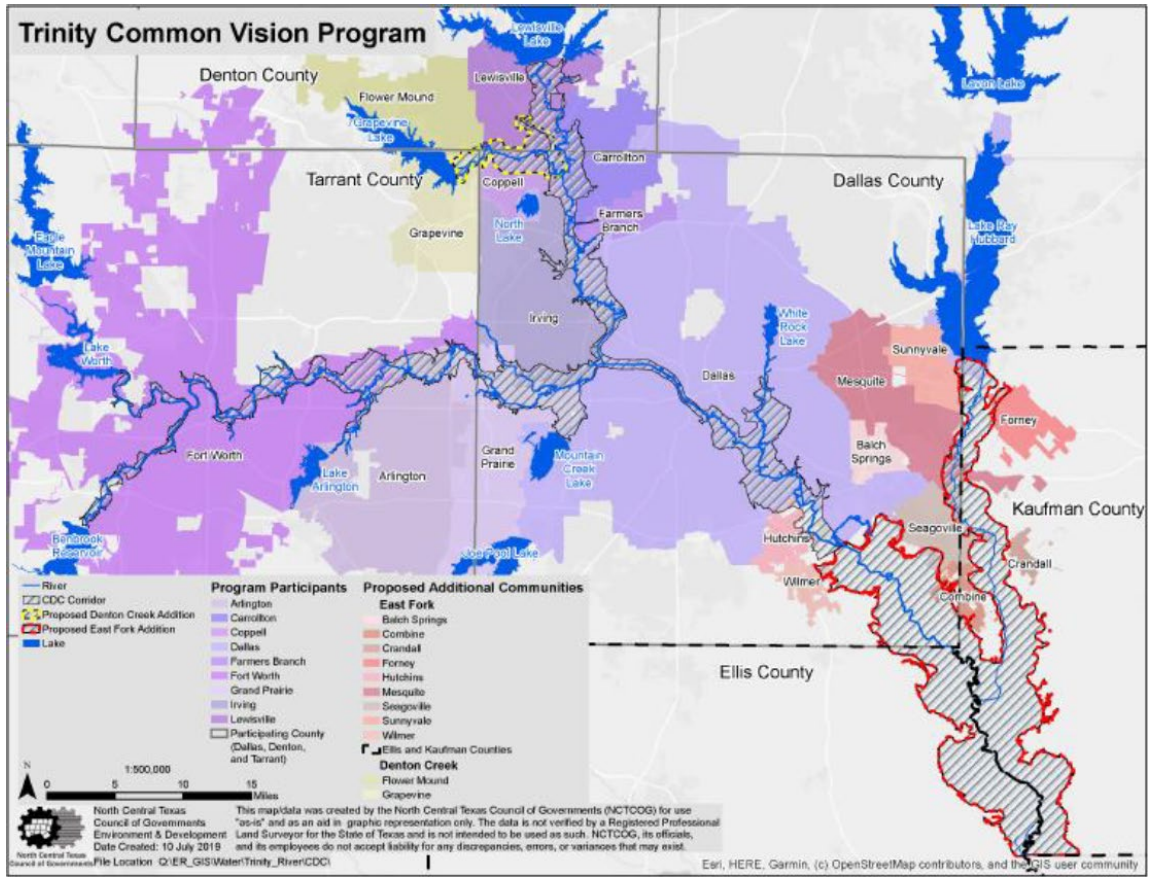
Important Note:

The Corridor Development Certificate Process (CDC) **affirms local government authority** for local floodplain management and establishes a set of Common Regional Criteria and procedures for development within the Trinity River Corridor.

Criteria:

- No increase in the 100-year flood water surface elevation (within 0.04 feet) and no significant increase in the Standard Project Flood water surface elevation
- A maximum allowable decrease of **valley storage** in the 100-year flood and Standard Project Flood discharges of 0.0% and 5.0%, respectively
- No creation, or significant increase, in erosive water velocity on-site or off-site

Current Regulatory Zone

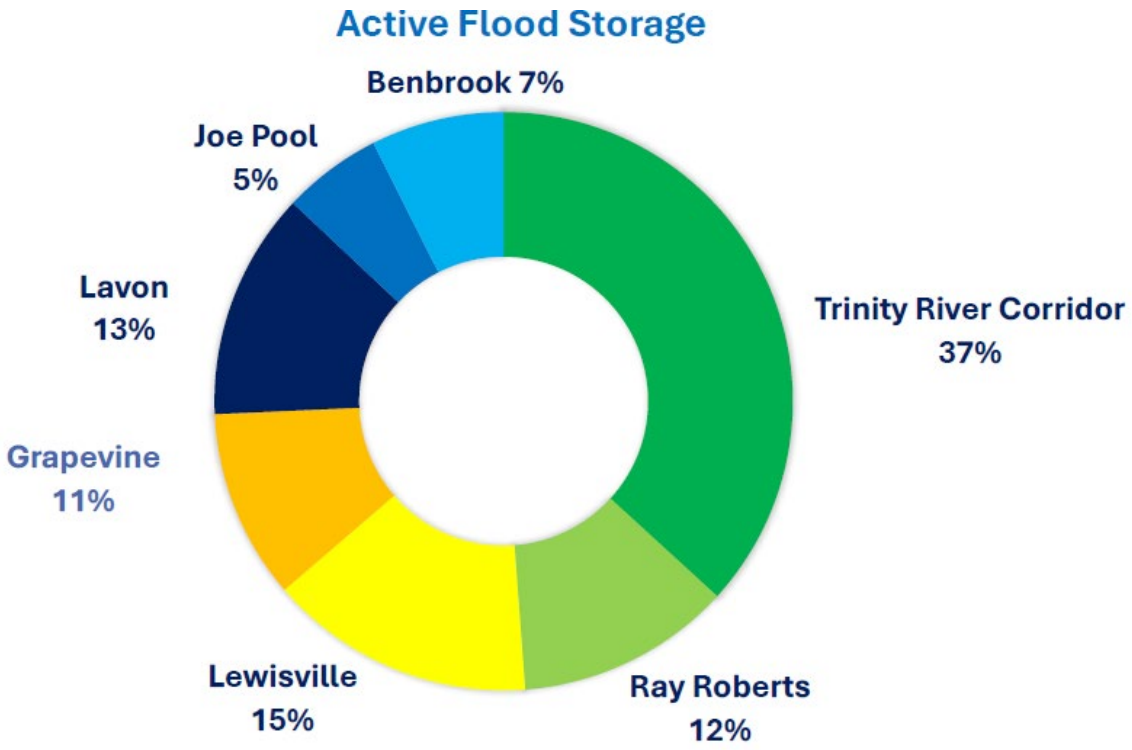


Trinity River Corridor Development Certificate

CDC Application Process:

1. **Pre-CDC Application Conference** Applicant and permitting entity (city/county)
   - Identify if proposed project is located in the Regulatory Zone, effective, or ineffective flow area
   - Provide applicant with overview of the CDC application process
2. **Submission of the CDC Application** to the permitting entity
   - review the application for completeness
   - Assign a CDC “Tracking Code” and upload application to NCTCOG website
   - Indicate if applying for exemption
3. **Regional Review and Comment**
   - CDC participating communities have 30 days to provide comments
4. **Technical Review**
   - Check payable to NCTCOG ($6,000 for effective flow area, $4,000 for ineffective flow area)
   - Permitting entity submits letter to USACE to request review
   - USACE has 30 days to complete review **once funds are processed**
5. **Final CDC Decision**
   - Permitting entity considers Regional and Technical review comments then issues Final CDC Action/Findings Form

Trinity River Corridor Development Certificate



Benefits:

- **Consistent** Common Regional Criteria
- State-of-the-art floodplain mapping
- Hydrologic modeling based on year 2055 Upper Trinity River watershed development
- A **consolidated hydraulic model** incorporating CDC permitted floodplain development
- U.S. Army Corps of Engineers **technical review**
- **Regional** review and comment
- Guarantee of **local control** of floodplain development decisions

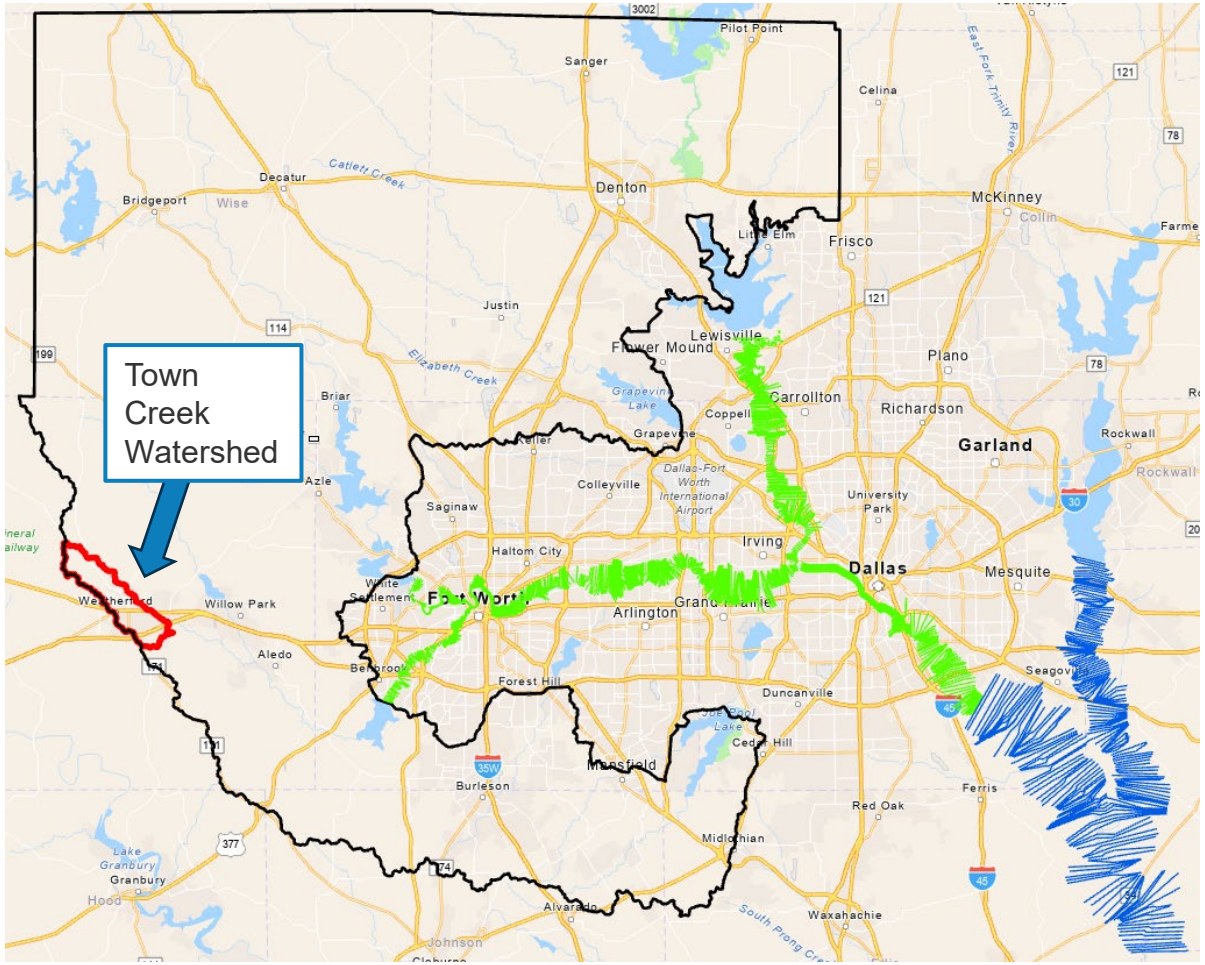
Expansion of the Corridor Development Certificate Process

Pilot Study:

- Communities within the TSI project were presented the opportunity to participate in the Pilot Study
- **City of Weatherford** selected due to high population, not a current CDC participant, and availability of H&H modeling to use as a basis
- **Town Creek** watershed FEMA Flood Risk Identification (FRI) study and models available

Goals and Deliverables:

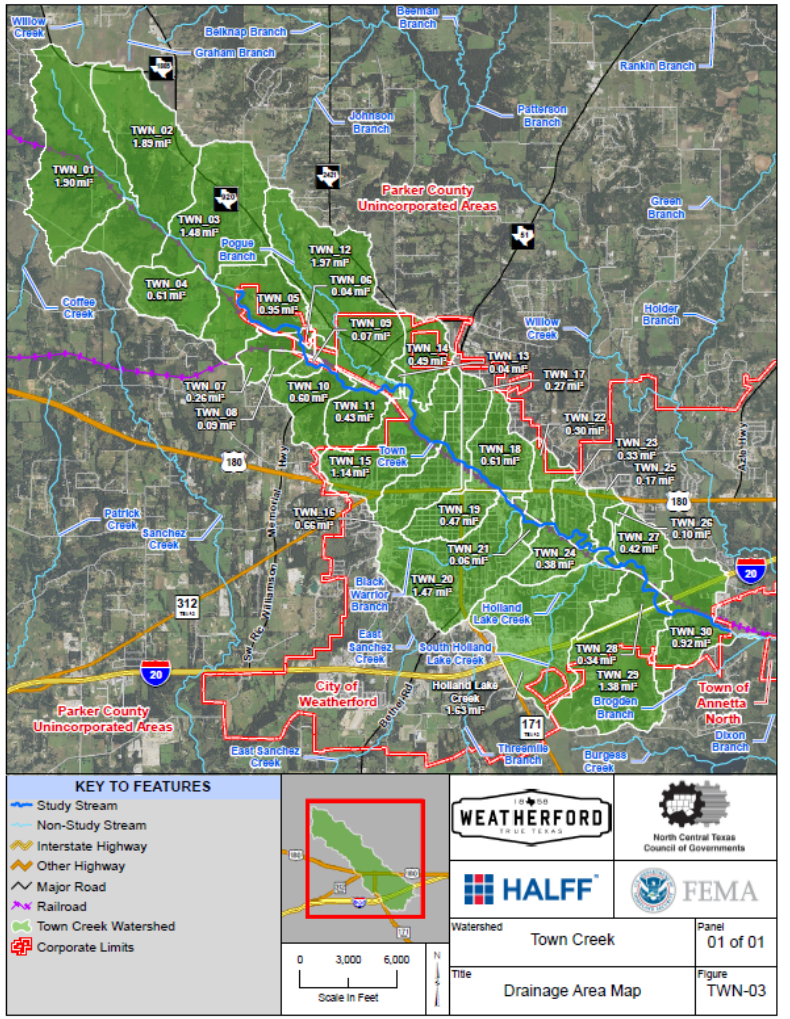
- Use Town Creek FRI study as a basis to develop pilot study CDC H&H **models** as funding allows
- Create scope, **replicable guidance**, and document lessons learned for inclusion in final TSI report
- Provide **template** USACE Floodplain Management Services (FPMS) funding application



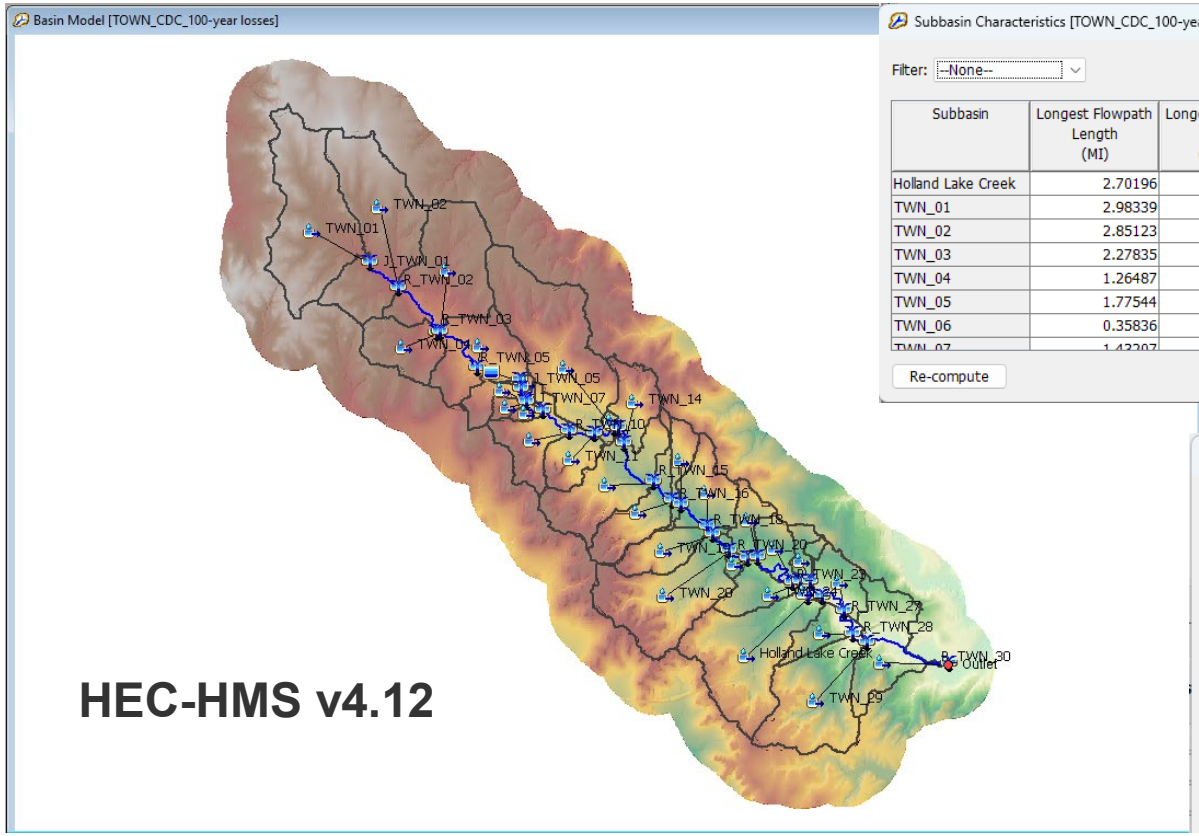
Expansion of the Corridor Development Certificate Process

CDC Expansion Model Development:

1. Convert hydrologic model to CDC Methodology
   - Use subbasin divides and GIS files from city
   - Develop Initial and Constant losses, Snyder Unit Hydrograph parameters
   - Develop 2055 land use % impervious and urbanization
2. Develop Standard Project Flood (SPF)
   - HMR 52 storm in HEC-MetVue
   - HEC-HMS simulation with grided precipitation
3. Add plans to HEC-RAS with CDC 2055 flows
4. Compare CDC 100-year to Existing 100-year results
5. Develop inundation maps
6. Import CDC expansion plans into CDC Consolidated Model



Expansion of the Corridor Development Certificate Process



Subbasin Characteristics [TOWN_CDC_100-year losses]

Filter: --None-- Sorting: Watershed Explorer

Subbasin	Longest Flowpath Length (MI)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length (MI)	Centroidal Flowpath Slope (FT/FT)	10-85 Flowpath Length (MI)	10-85 Flowpath Slope (FT/FT)	Basin Slope (FT/FT)	Basin Relief (FT)	Relief Ratio	Elongation Ratio	Drainage Density (MI/MI²)
Holland Lake Creek	2.70196	0.01406	1.34820	0.01072	2.02647	0.01242	0.05447	200.51819	0.01406	0.53291	2.07165
TWN_01	2.98339	0.00905	1.02285	0.00818	2.23754	0.00866	0.04598	146.69861	0.00931	0.52403	2.61278
TWN_02	2.85123	0.01041	1.15717	0.00622	2.13842	0.01034	0.04808	162.26514	0.01078	0.53964	2.81766
TWN_03	2.27835	0.01223	1.03085	0.00980	1.70876	0.01055	0.04778	149.78491	0.01245	0.60142	2.56994
TWN_04	1.26487	0.02173	0.48598	0.01900	0.94865	0.01976	0.05267	142.96399	0.02141	0.70347	2.09246
TWN_05	1.77544	0.00652	0.78896	0.00201	1.33158	0.00420	0.03948	132.26904	0.01411	0.61866	2.41358
TWN_06	0.35836	0.01491	0.07380	0.00974	0.26877	0.01518	0.06820	52.94580	0.02798	0.63293	3.40779
TWN_07	1.43207	0.01624	0.88024	0.01055	1.07405	0.01300	0.04617	149.78528	0.01081	0.40024	2.28487

Re-compute Apply Close

Snyder Unit Hydrograph [TOWN_CDC_100-year loss...

Filter: --None-- Sorting: Watershed Explorer

Standard Ft Worth Tulsa

Subbasin	Snyder Method	Lag Time (HR)	Peaking Coefficient
Holland Lake Creek	Standard	0.811	0.65
TWN_01	Standard	0.916	0.65
TWN_02	Standard	0.885	0.65
TWN_03	Standard	0.681	0.65
TWN_04	Standard	0.352	0.65
TWN_05	Standard	0.618	0.65
TWN_06	Standard	0.137	0.65

Initial and Constant [TOWN_CDC_100-...

Filter: --None-- Sorting: Watershed Explorer

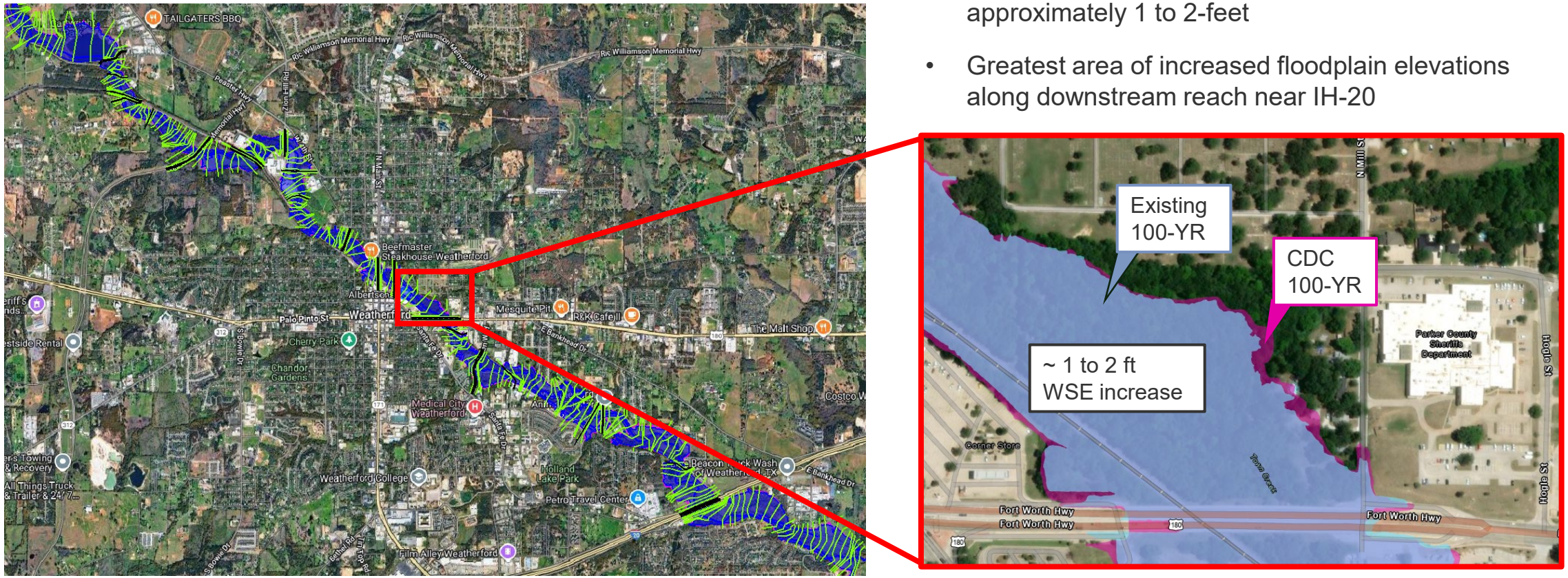
Subbasin	Initial Loss (IN)	Constant Rate (IN/HR)	Impervious (%)
Holland Lake Creek	4.29	0.10	54
TWN_01	0.87	0.09	22
TWN_02	0.87	0.09	23
TWN_03	0.87	0.09	33
TWN_04	0.88	0.10	41
TWN_05	0.86	0.09	40
TWN_06	0.91	0.10	44

Note: USACE Fort Worth District CDC hydrologic parameters and subbasin characteristics can be developed using automated GIS and HEC-HMS tools. Terrain data needed for process (TxGIO, etc.)

Expansion of the Corridor Development Certificate Process

Results:

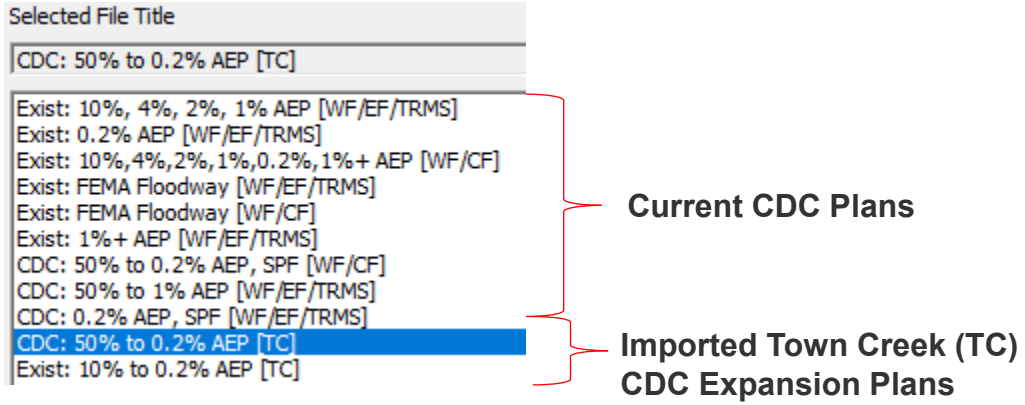
- 100-year peak discharge increases from 9% – 20%
- 100-year water surface elevations increases were approximately 1 to 2-feet
- Greatest area of increased floodplain elevations along downstream reach near IH-20



Expansion of the Corridor Development Certificate Process

Model Consolidation:

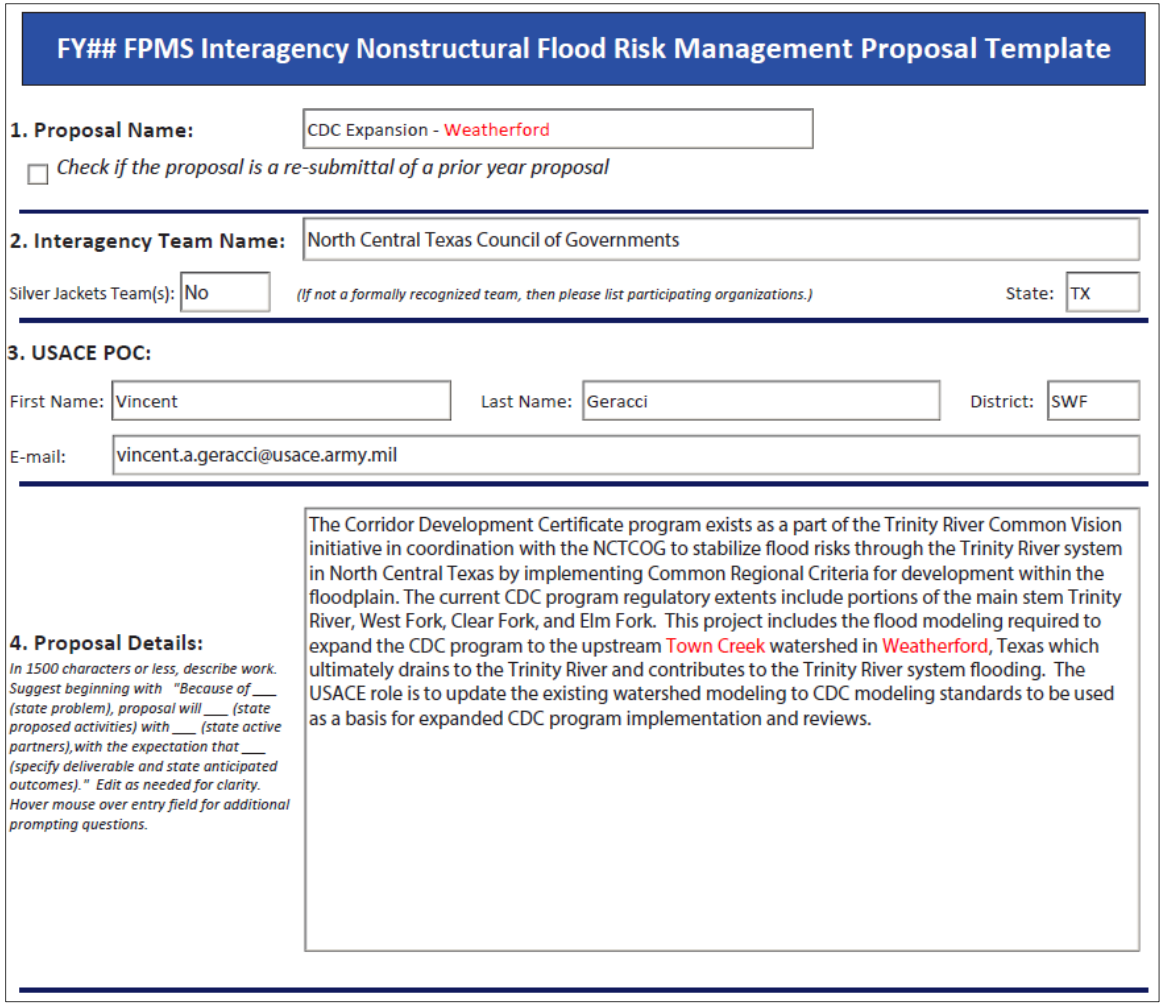
- Not practicable to connect RAS geometries to downstream CDC model
- CDC Expansion Plans can be copied into CDC Consolidated Model so that all plans are in one HEC-RAS .prj file



Expansion of the Corridor Development Certificate Process

Model Development for other communities:

1. Existing **FEMA 1D** HEC-RAS Model and HEC-HMS Model
2. Existing **FEMA 2D** HEC-RAS Model and HEC-HMS Model
3. No existing FEMA model but within **BLE 1D** HEC-RAS coverage
4. No existing FEMA model but within **BLE 2D** HEC-RAS coverage
5. No existing FEMA models and no BLE models



FY## FPMS Interagency Nonstructural Flood Risk Management Proposal Template

1. Proposal Name: CDC Expansion - Weatherford

☐ *Check if the proposal is a re-submittal of a prior year proposal*

2. Interagency Team Name: North Central Texas Council of Governments

Silver Jackets Team(s): No *(If not a formally recognized team, then please list participating organizations.)* State: TX

3. USACE POC:

First Name: Vincent Last Name: Geracci District: SWF

E-mail: vincent.a.geracci@usace.army.mil

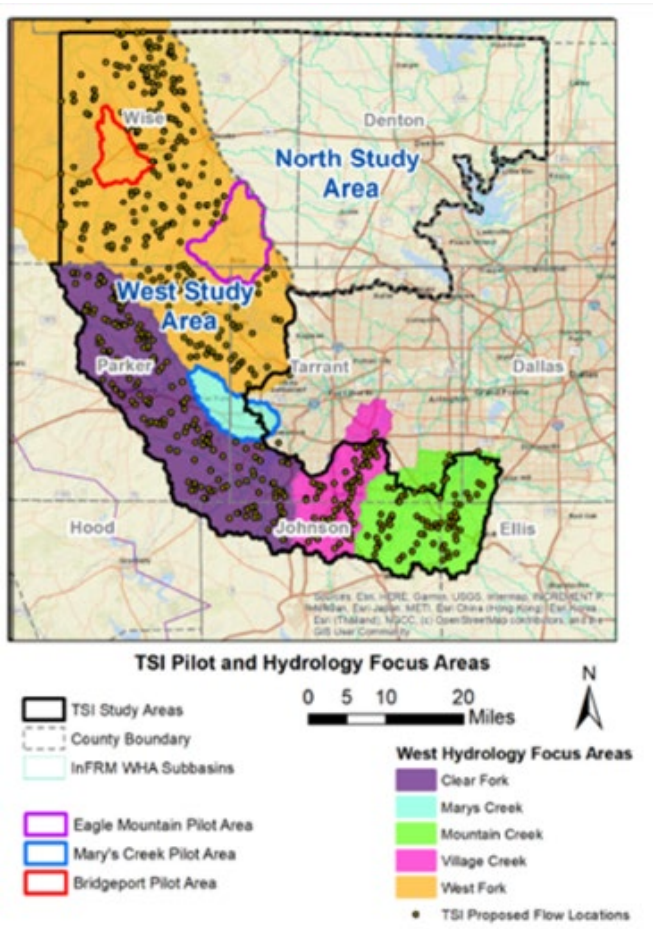
4. Proposal Details:

In 1500 characters or less, describe work. Suggest beginning with "Because of ___ (state problem), proposal will ___ (state proposed activities) with ___ (state active partners),with the expectation that ___ (specify deliverable and state anticipated outcomes)." Edit as needed for clarity. Hover mouse over entry field for additional prompting questions.

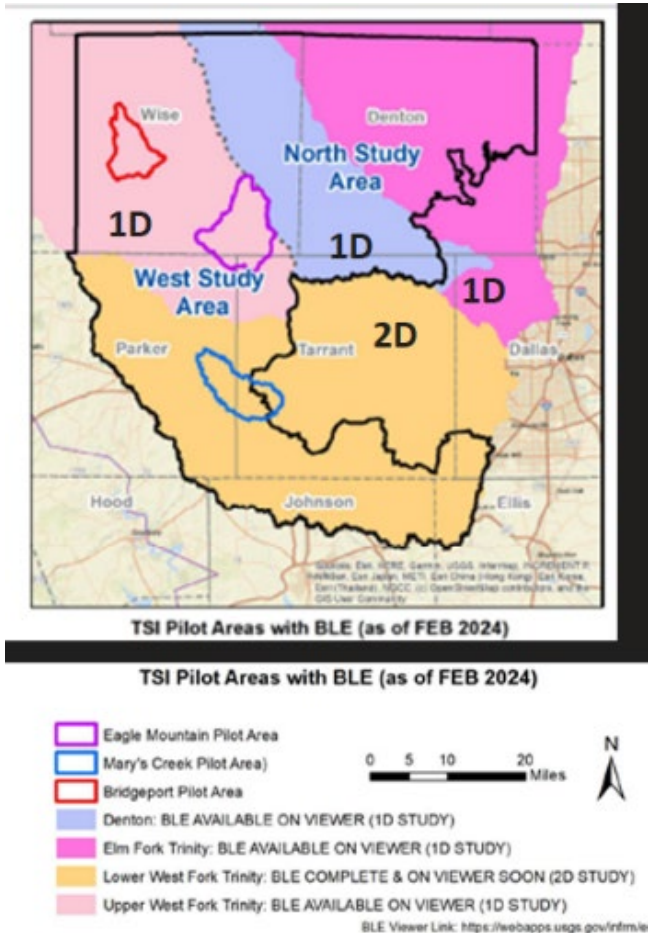
The Corridor Development Certificate program exists as a part of the Trinity River Common Vision initiative in coordination with the NCTCOG to stabilize flood risks through the Trinity River system in North Central Texas by implementing Common Regional Criteria for development within the floodplain. The current CDC program regulatory extents include portions of the main stem Trinity River, West Fork, Clear Fork, and Elm Fork. This project includes the flood modeling required to expand the CDC program to the upstream Town Creek watershed in Weatherford, Texas which ultimately drains to the Trinity River and contributes to the Trinity River system flooding. The USACE role is to update the existing watershed modeling to CDC modeling standards to be used as a basis for expanded CDC program implementation and reviews.

Expansion of the Corridor Development Certificate Process

TSI Hydrology Models:



TSI Hydraulic Models:



Expansion of the Corridor Development Certificate Process

City of Dallas Development Code (example):

SEC. 51A-5.107. TRINITY RIVER CORRIDOR DEVELOPMENT CERTIFICATE PROCESS.

(a) Definitions. In this section:

(1) CORRIDOR DEVELOPMENT CERTIFICATE (CDC) MANUAL means the manual by that title dated January 31, 1992, or its latest revision.

(2) FLOODPLAIN ALTERATION means any construction of buildings or other structures, mining, dredging, filling, grading, or excavation in the floodplain.

(3) TRINITY RIVER CORRIDOR means the portion of the floodplain of the West Fork, Elm Fork, and mainstem segments of the Trinity River floodplain within the Dallas city limits, as delineated on the latest CDC Regulatory Map.

(b) Certificate required. A person commits an offense if he makes any floodplain alteration within the Trinity River Corridor without first obtaining a corridor development certificate (CDC) from the director of water utilities. It is a defense to prosecution that an exemption or variance has been obtained in accordance with CDC criteria.

Floodplain Ordinances:

- Community must **adopt floodplain ordinance changes** requiring CDC application process
- Local floodplain administrator retains **authority** and **enforcement**
- The current CDC member communities include Arlington, Carrollton, Coppell, Dallas, Dallas County, Farmers Branch, Fort Worth, Grand Prairie, Irving, Lewisville, Seagoville, and Tarrant County

Expansion of the Corridor Development Certificate Process

Dallas County Code (example):

F. **Standards for the Trinity River Corridor and the East Fork of the Trinity and the Corridor Development Certificate** - Dallas County is a member of the Trinity River Common Vision program, meaning that the County subscribes to higher floodplain management standards along the Trinity River Corridor and the East Fork of the Trinity. Therefore, if the proposed project is located in the Special Flood Hazard Area along the Trinity River Corridor or the East Fork of the Trinity, the Corridor Development Certificate (CDC) is necessary. The application requires the study of the stream (hydrology and hydraulics analysis) using future flow rates (year 2055). Additionally, the proposed project will need to meet the following criteria:

1. No rise in the one hundred (100) year elevation or the Standard Project Flood for the proposed condition will be allowed.
2. No loss in storage capacity.
3. Alterations in the floodplain may not create or increase an erosive water velocity on or off-site.

Table of Contents

Chapter 42 Page 17

Expansion of the Corridor Development Certificate Process

Floodplain Administrator Responsibilities:

1. Hold **pre-application meeting**. Determine if project is located in CDC Regulatory Zone.
2. Perform **completeness check** of CDC application, ensure that current CDC Model has been used.
3. Assign **tracking number**.
4. Request Technical Review by the USACE via **written letter**.
5. Forward **copies of application** to USACE, NCTCOG, and CDC communities for technical and regional review.
6. Coordinate CDC **Cost Recovery Fee** payment.
7. Based on regional comments, Technical Review, and the floodplain administrator's own judgment, **determine final CDC action**.
8. Issue **Final CDC Action/Findings Form** to applicant, NCTCOG, USCAE and CDC participants
9. Request **annual status reports** from applicant. Forward copies to NCTCOG.
10. Re-evaluate CDC in the event of **significant changes** in project.
11. Submit responses to **CDC extension requests**. (Initial CDC valid for 5-years, can request up to 3-year extension)

Expansion of the Corridor Development Certificate Process

Participation in the Trinity River COMMON VISION:

- **Steering Committee**
  - Policy guidance
  - Voting representatives from communities that provide funding
  - Annual meeting
  - Votes on adding new members
- **Flood Management Task Force**
  - Technical support for execution of work plan
  - Quarterly meeting
- **Program Funding Shares (min. $1,000 annually)**
  - Based on acreage of floodplain within community

Expansion of the Corridor Development Certificate Process

Integrating Transportation and Stormwater Infrastructure (TSI)

Evaluation of Opportunities to Expand the Corridor Development Certificate Process into the TSI Project Area

General Steps to Joining CDC:

- CDC expansion **model development**
- Amend **Floodplain Ordinances** to require/enforce CDC process
- Become member of **Trinity River COMMON VISION**
- Participate in ongoing regional floodplain management to **higher standards**

Key Takeaways:

- Floodplain volume is a **significant** source of detention storage in a watershed and should be maintained
- At a minimum, communities could amend floodplain ordinances to **maintain valley storage** (City of Fort Worth)
- Pilot Study details and outcomes to be included in **Final TSI Report**

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Next Steps and Post Workshop Survey

NCTCOG

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integrating Transportation & Stormwater Infrastructure

Thank you!

- For more information about TSI, please visit www.nctcog.org/tsi

- Upcoming TSI events:
  - Hybrid Flood Early Warning Systems Workshop, February 17, 2026
  - Spring 2026 Subarea Meetings: TBD

- Please take the post-workshop survey https://www.surveymonkey.com/r/NLZ3SLR

integrating Transportation & Stormwater Infrastructure