

# PREVENTION VS. RESPONSE:

## INTEGRATED TRANSPORTATION AND STORMWATER INFRASTRUCTURE (TSI) PLANNING INITIATIVE IN NORTH TEXAS

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2 December 2022



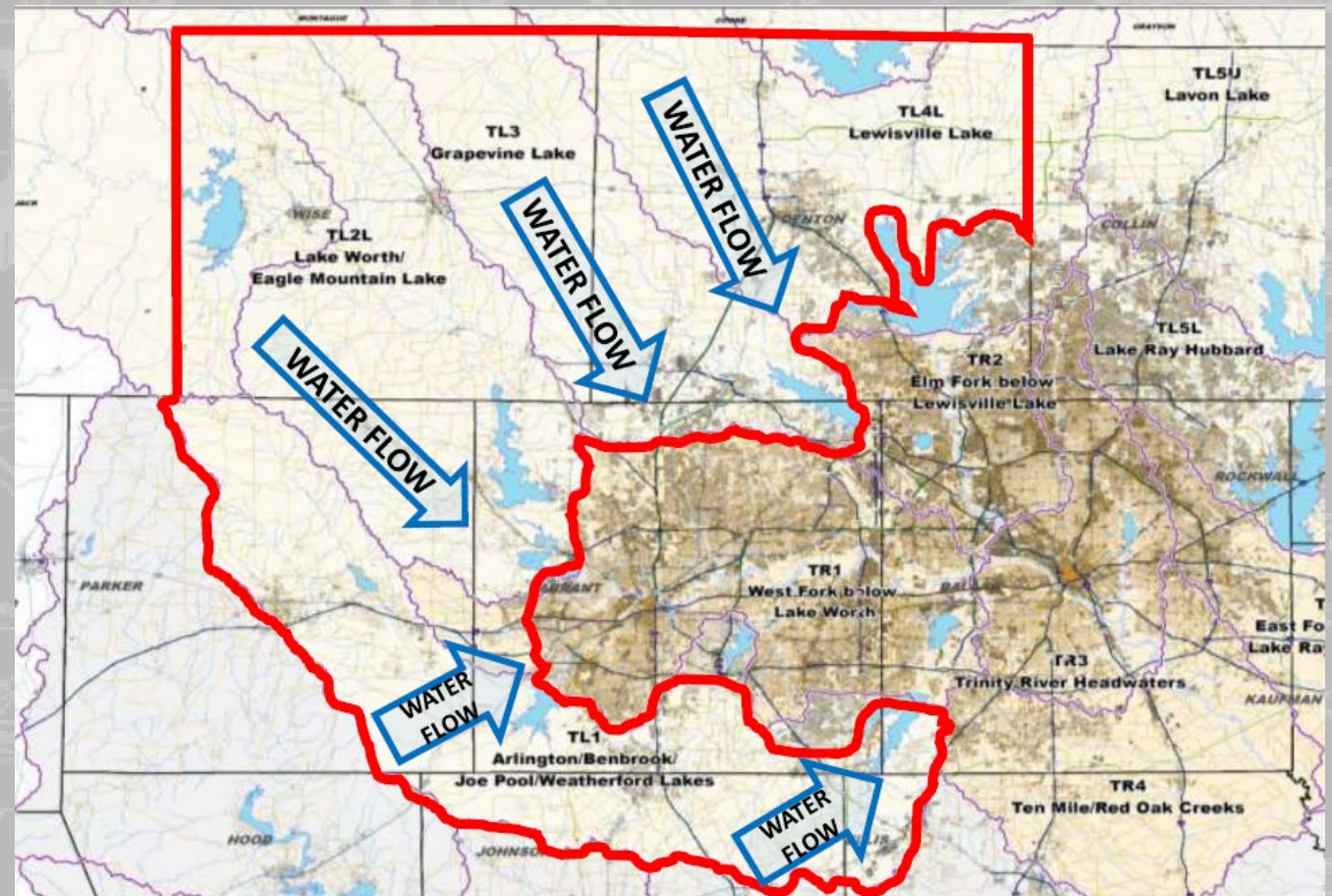
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Council of Governments



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Integrated Transportation and Stormwater Management Initiative



# PREVENTION VS. RESPONSE:

## INTEGRATED TRANSPORTATION AND STORMWATER INFRASTRUCTURE (TSI) PLANNING INITIATIVE IN NORTH TEXAS



### NCTCOG:

Voluntary association of member governments

A political subdivision of the state – non taxing entity

Established in 1966 to assist member governments in:

- Planning for common needs
- Cooperating for mutual benefit
- Strengthen their individual and collective power
- Coordinating for sound regional development

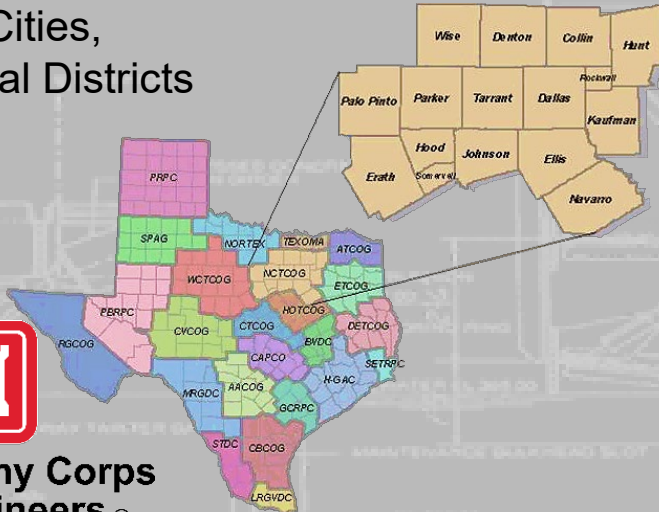
16 Counties, 169 Cities,  
53 School & Special Districts



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- NCTCOG and the USACE have a long history of collaborative efforts in our region towards assisting our communities with flood risk reduction.
- Programs such as Trinity River Common Vision, iSWM, FEMA CTP Discovery and Flood Studies, Recommended strategies for counties, Public Works Construction Standard Specifications, and others have helped to bring our communities together to build the development standards that can be adopted to reduce flood risks.
- Despite those regional efforts, reports of flooding continue to emerge with any notable storm event.
- Despite being the 4<sup>th</sup> (soon to be 3<sup>rd</sup>) largest metropolitan area in the U.S., with a population of over 8 million, growing by 150,000 residents each year, North Central Texas does not have a flood control district to fund and oversee progress.
- Flooding is managed by local governments on a voluntary basis.



# PREVENTION VS. RESPONSE:

INTEGRATED PLANNING OF REGIONAL TRANSPORTATION AND STORMWATER MANAGEMENT TOGETHER AS A SYSTEM OF INFRASTRUCTURE IMPROVEMENTS (TSI)



NCTCOG is charged with regional planning for our 16-county area.

So, can we do better?

Would the transportation industry be an ideal partner?

Can we enhance prospects for quality of life here?



Should we just keep repeating mistakes that lead to flooding?

What would be a highly cost-effective strategy?

Like many other infrastructure aspects of growth and development, can we get in front of watershed growth and plan ahead to avoid problems?

Through progressive development practices, can we prevent flooding to begin with, rather than address the challenges and costs after it has been created?

We are now going to describe for you now a project that we've brainstormed and funded that we believe will become a new national standard as an approach to prevent flooding, rather than just respond to it.



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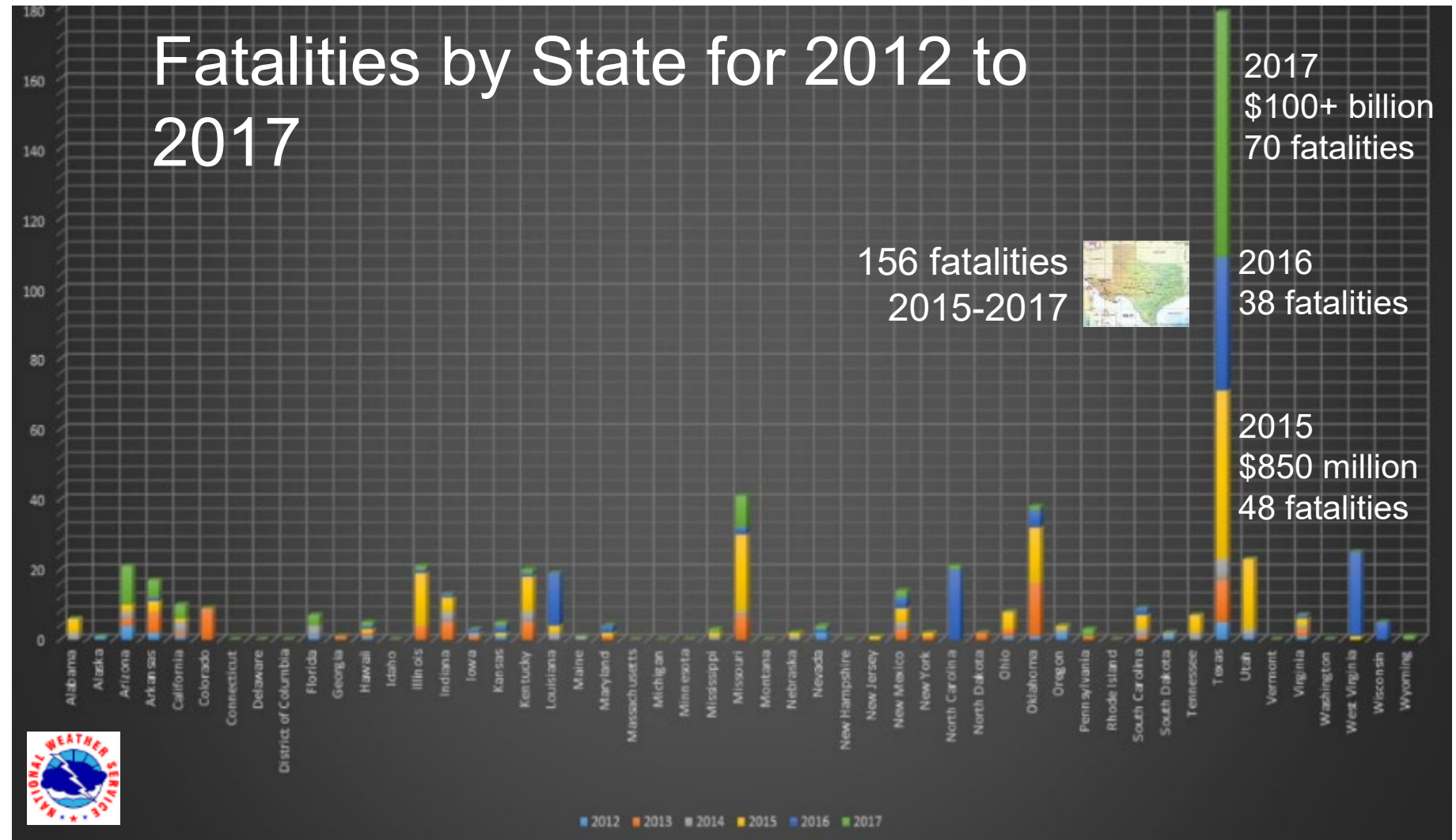


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# FLOODING FATALITIES AND DAMAGES

Texas far  
outpaces other  
states in flood  
related fatalities  
& flood related  
damages

## Fatalities by State for 2012 to 2017



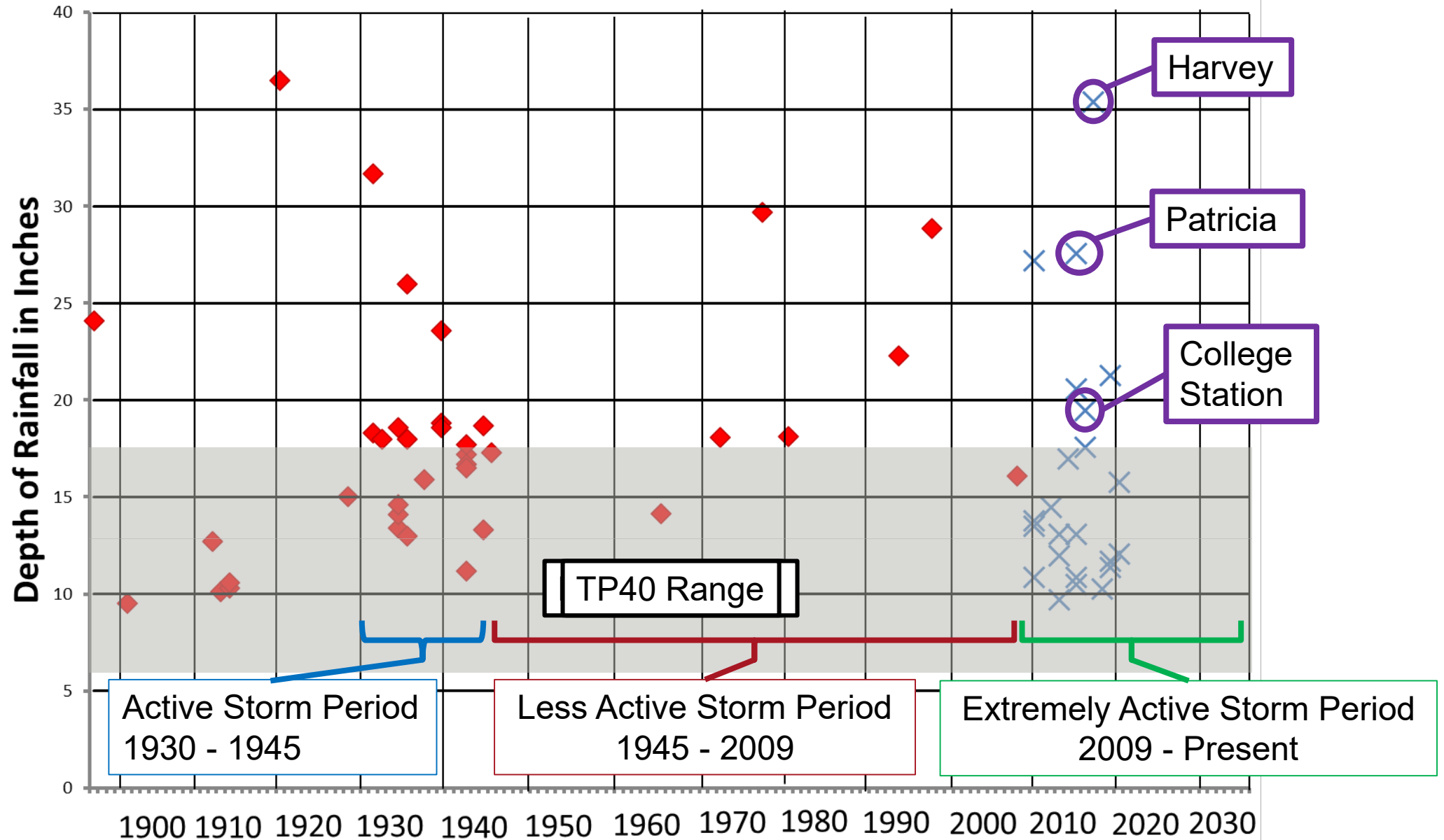
## 5 Year Tally of Flood Fatalities

(Source: Gregory Waller, Service Coordination Hydrologist, NWS – West Gulf River Forecast Center, <http://www.nws.noaa.gov/om/hazstats.shtml>, 11/18 TFMA)



# EXTREME STORMS... A HISTORY LESSON

## 24 Hour Rainfall Total

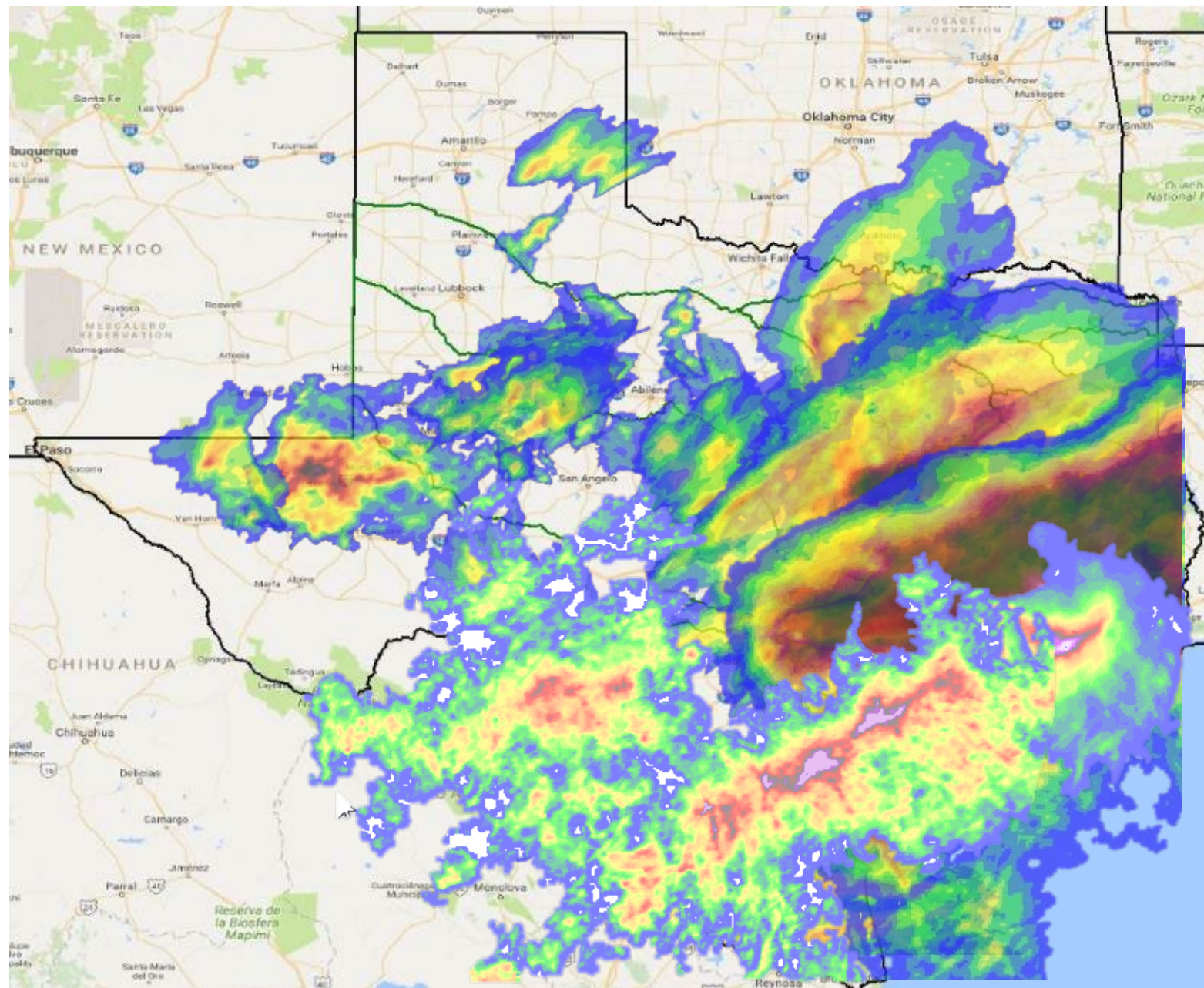






# EXTREME STORMS (2010-2019)

- Texas and the DFW area can experience extreme precipitation events
- The region transitions from periods of drought to wet periods
- These events exceed infrastructure and neighborhood design levels





# RESPONSE VS PREVENTION?



## Sources:

<https://ms-my.facebook.com/photo/?fbid=10157516869922955&set=in-april-1922-a-devastating-flood-occurred-in-fort-worth-the-massive-flood-cause>

<https://www.trwd.com/100-years-since-the-big-flood-in-fort-worth/>

## Fort Worth - April 1922 (11 inches of rain in 2 days):

- 17 breaches in the Trinity River levees
- Killed at least 10 people and \$1M+ in damages
- Motivated countywide effort to prevent further flooding of the Trinity and provide adequate water supply.
- Resulted in an election held by Tarrant County commissioners in 1924 to create the Tarrant County Water Improvement District No. 1, which would later change to Tarrant Regional Water District in 1996.

# RESPONSE VS PREVENTION?



## Fort Worth – May 1949 (approximately 11 inches of rain overnight):

- Clear Fork Trinity levees breached
- Killed 10 people and \$11M+ in damages
- Resulted in extensive improvements/maintenance of levee system by Water District and USACE Fort Worth District, established in 1950 after disastrous floods in the area
  - USACE Fort Worth District has constructed 25 lakes, 2 floodways, and other local projects (\$2.6B to build but prevented \$68B+ in damages)
  - Operates/maintains reservoirs/lakes and 35% of Texas's water supply

## Sources:

<https://www.onlyinyourstate.com/texas/dallas-fort-worth/deadly-flooding-struck-fort-worth-in-1949/>

<https://www.swf.usace.army.mil/About/History/#:~:text=The%20Fort%20Worth%20District%2C%20established%20in%201950%20after,parts%20of%20Louisiana%20and%20New%20Mexico.%20The%20District%3A>





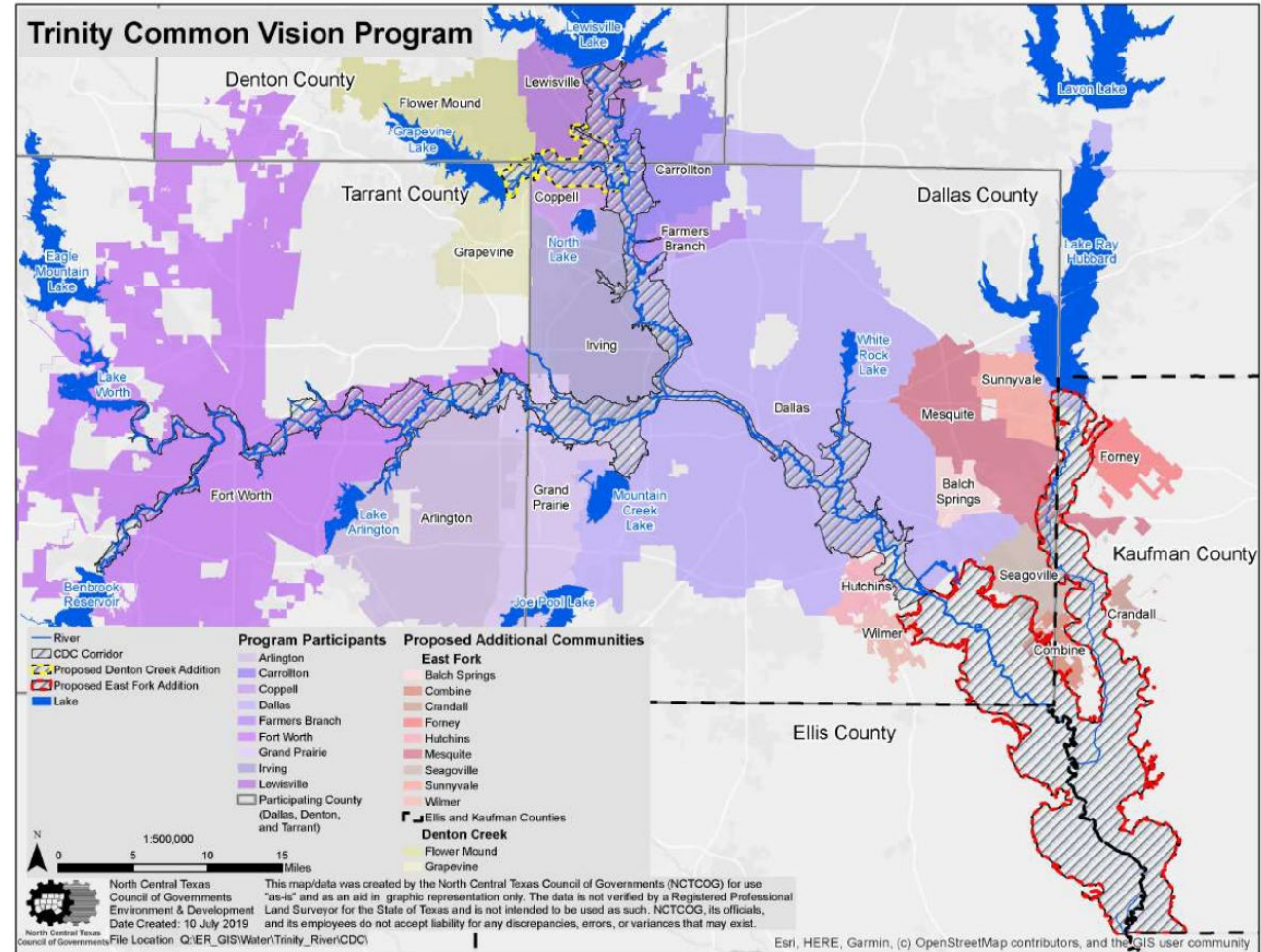
# PREVENTION VS RESPONSE: TRINITY RIVER CDC PROGRAM



## Upper Trinity Corridor Development Certificate (CDC) Program

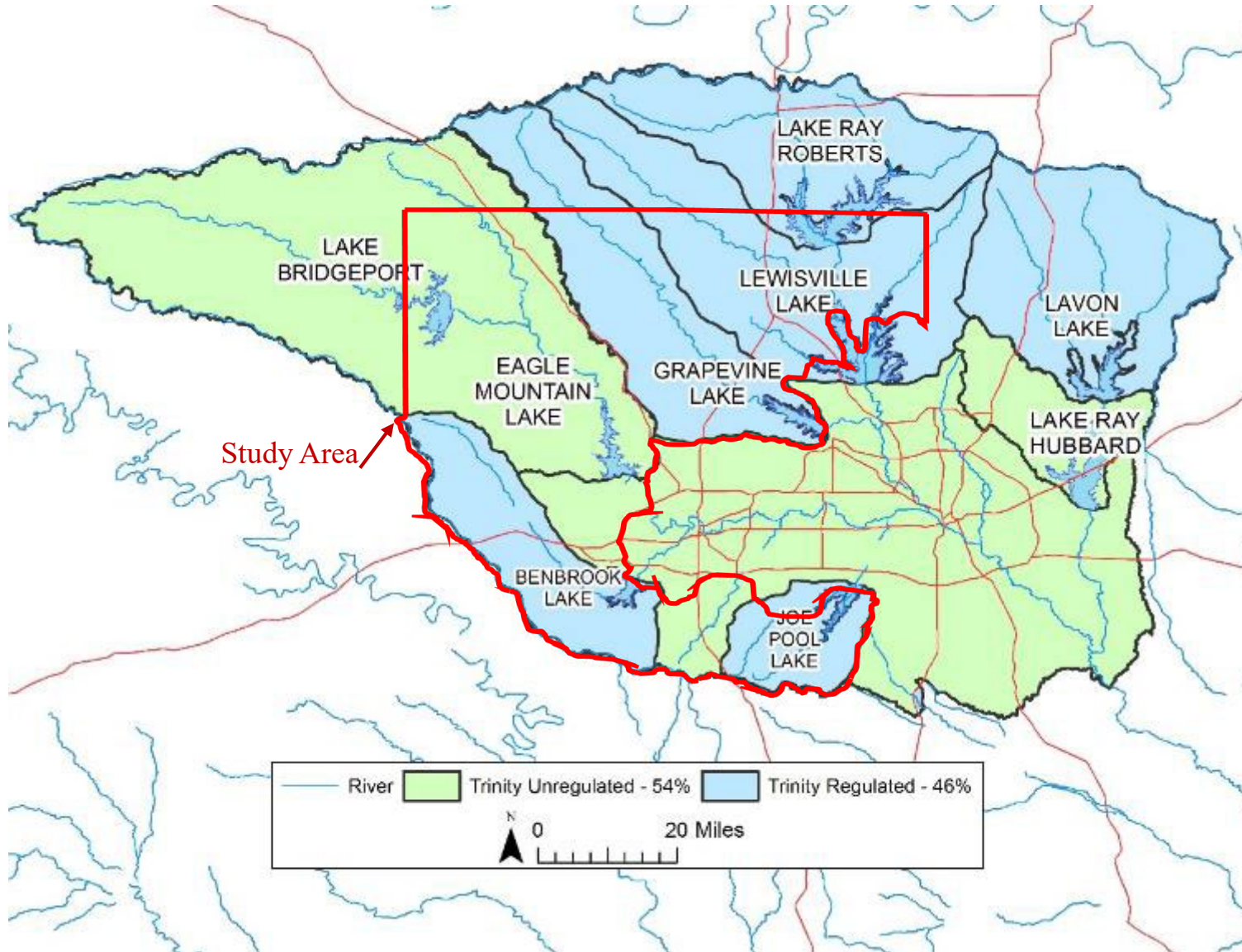
### Goal: Stabilization of flood risk along Trinity River

- CDC program originated in 1991
- Understood that commercial/residential development could compromise existing flood control “protections” and may impact wetlands/natural resources
- CDC model based on future (2055) anticipated development
  - Must obtain a CDC prior to start of construction
- CDC does not prohibit floodplain development
  - Ensures that any development that does occur in the floodplain will not adversely raise flood water levels or significantly reduce flood storage capacity
- *As the Metroplex economy continues to grow and develop, the CDC process is helping prevent increased flood risks.*



Source:  
<http://trinityrivercdc.com/>

# PROBLEM SOLVED OR A WORK IN PROGRESS?

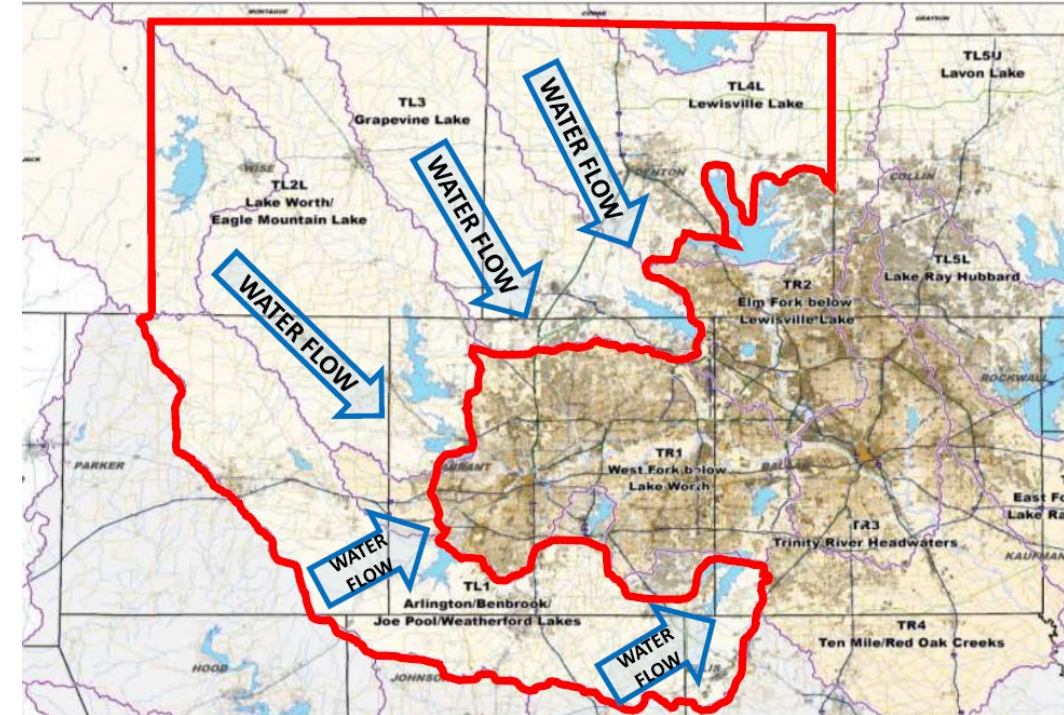


- Devastating floods, 1908, 1942, 1949
- 6 multi-purpose reservoirs
- 2 federal levee systems
- DFW Flood Control System
  - ▶ 7.4 million people
  - ▶ \$100 billion in damages prevented
  - ▶ \$2 - \$3 billion annually
- Water supply system
- Total cost \$2.5 billion
- ***Must be operated as a system***



# PROBLEM SOLVED OR A WORK IN PROGRESS?

- **Recent flood events in Texas have highlighted the need for more comprehensive stormwater planning**
  - Development of Texas's first-ever state flood plan is underway through the efforts of 15 Regional Flood Planning Groups
  - The regional flood plans will be due in January 2023, and state flood plan is due September 1, 2024
- **Lack of regulation outside floodplains leads to a “in or out” mindset about flooding**
  - Flooding doesn't stop at lines on a map.
  - FEMA Future of Flood Risk Data (FFRD) and other initiatives are helping provide a more comprehensive picture of the country's flood hazards and risk by leveraging new technologies
- **Rapidly developing TSI study area drains into densely populated DFW-metroplex and there is currently no comprehensive regional plan to address this**
  - 85 Cities and portions of 8 counties within study area
  - Population expected to increase 126% by 2045
  - 60% undeveloped as of 2015
- **Questionable historic records & lack of safety factors**



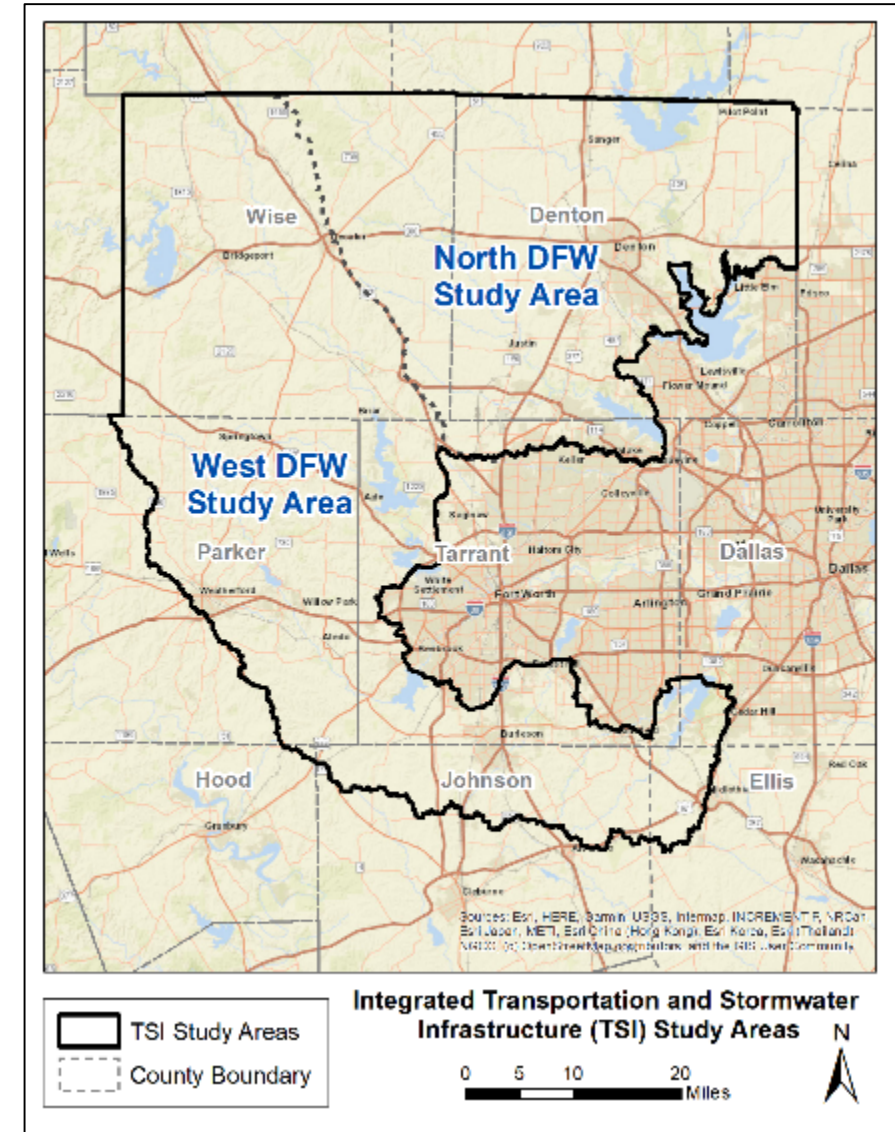
**The TSI initiative intends to learn from mistaken approaches that have resulted in flooded roadways, neighborhoods, and critical infrastructure, and can assist communities with an improved approach to efficiently minimize these impacts before they occur.**

# INTEGRATED TRANSPORTATION AND STORMWATER INFRASTRUCTURE (TSI) INITIATIVE

## ► What is the TSI project?

- **Purpose:** Integration of regional planning for transportation, stormwater management, urban development, and environmental features in order to decrease flood risk, minimize overall life cycle costs of infrastructure, and reduce impacts to the natural environment in the rapidly developing study area.
- **Timeline & Budget:** 3+ years and \$10
- **Benefits:** Study area as well as downstream
  - Promotes sound flood risk management decisions
  - Enables actionable local flood risk awareness and resiliency opportunities

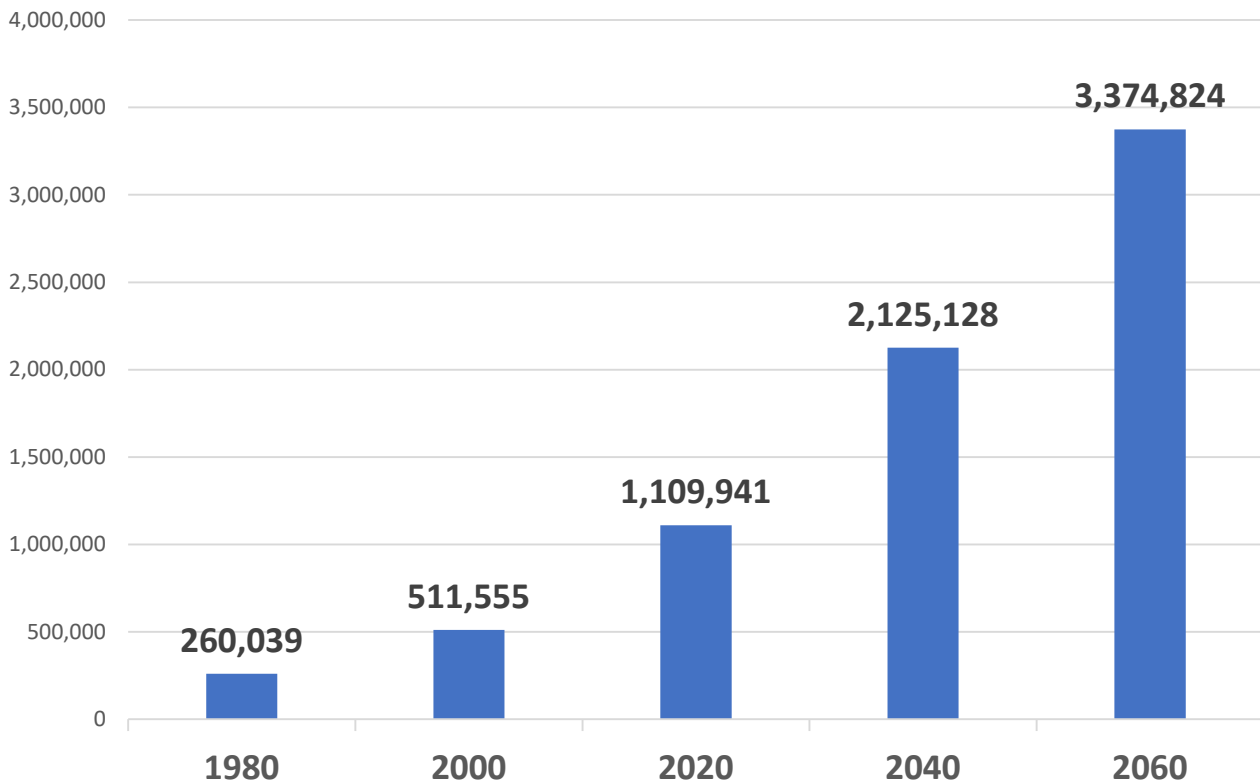
**Objective:** a 'roadmap' for communities



**WHERE: Focus on Vulnerable Areas**



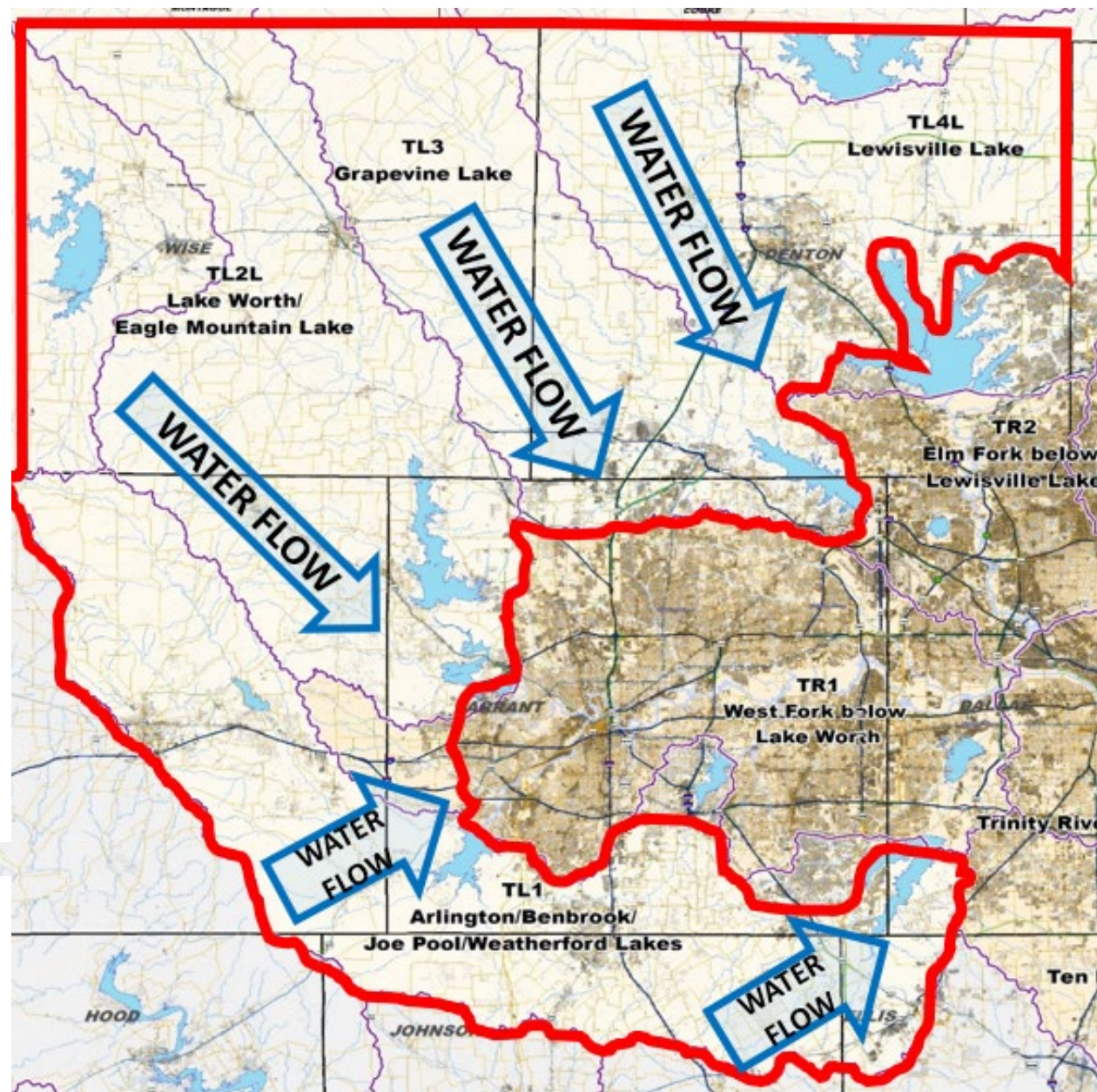
# TSI STUDY AREA HOUSEHOLD POPULATION INCREASE



## Sources:

- 2000 & 2020 - NCTCOG using US Census data normalized to 2010 geographies
- 2040 & 2060 - NCTCOG with 2040 controlled to Perryman county control totals and 2060 using a regional control total without feedback loops

\*Excludes group quarters (dormitories, senior living facilities, prisons, and other non-household institutional living facilities)





# IMPACT OF DEVELOPMENT... A LOCAL PERSPECTIVE



Wise County



Tarrant County



... may contribute to  
downstream flooding and  
water quality concerns





# GOALS AND OUTCOMES

## Proactive Planning

- Reimagine transportation design to integrate stormwater, environmental, and flood reduction benefits
- Protect current and future infrastructure
- Develop model for replication

## Reduce Flooding

- Reduce flooding downstream of rapidly growing upstream communities
- Increase resiliency to flooding disasters
- Inform decision-making
- Implement stormwater infrastructure with transportation infrastructure

## Tools/ Resources

- Empower communities to adopt higher floodplain management standards
- Develop GIS based tools and resources



Integrated Transportation and Stormwater Management Initiative

## Local-Scale Innovation

- Enhance Trinity River Watershed Hydrology Assessment
- Enhance existing hydraulic models such as BLE
- Emergency management modeling tool
- Optimization study for drainage/flood control structures

## Community Roadmap

- Produce planning-level designs for transportation, stormwater detention, and environmental
- Integrate these layers to identify what needs to be built and achieved benefits
- Establish ways to fund planned infrastructure

# TSI SCOPED TASKS

## 1.0 Data Collection and Analysis

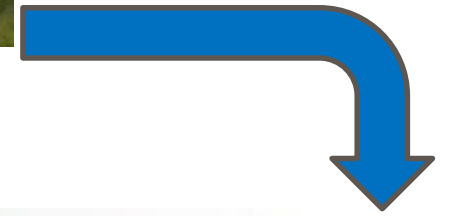
## 2.0 Stakeholder Engagement

## 3.0 Integrated Transportation, Stormwater, and Environmental Planning

- 3.1 Project Area H&H Assessment and Scenarios
- 3.2 Assess Transportation Infrastructure Impacts and Develop Decision-Making Tools
- 3.3 Environmental Planning
- 3.4 Project Area Real-Time Flood Warning System
- 3.5 Managing Land through Strategic Planning and Development Regulations

## 4.0 Project Management and Project Replication

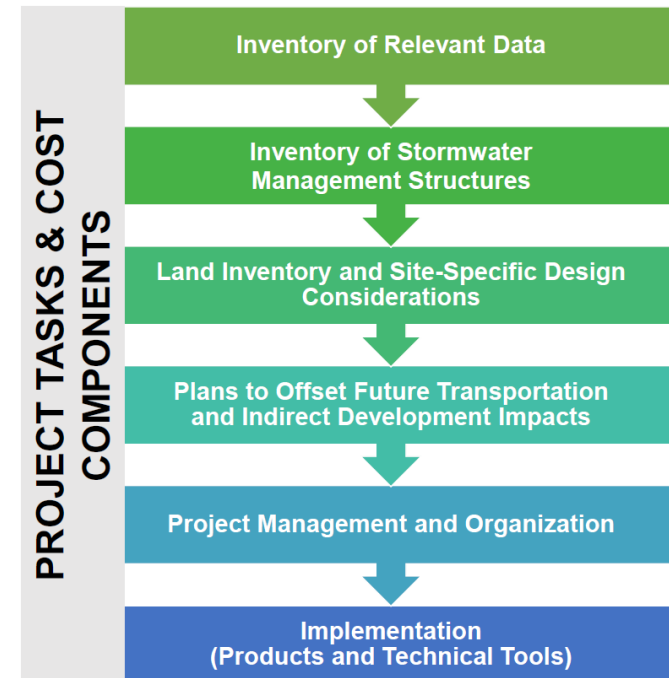
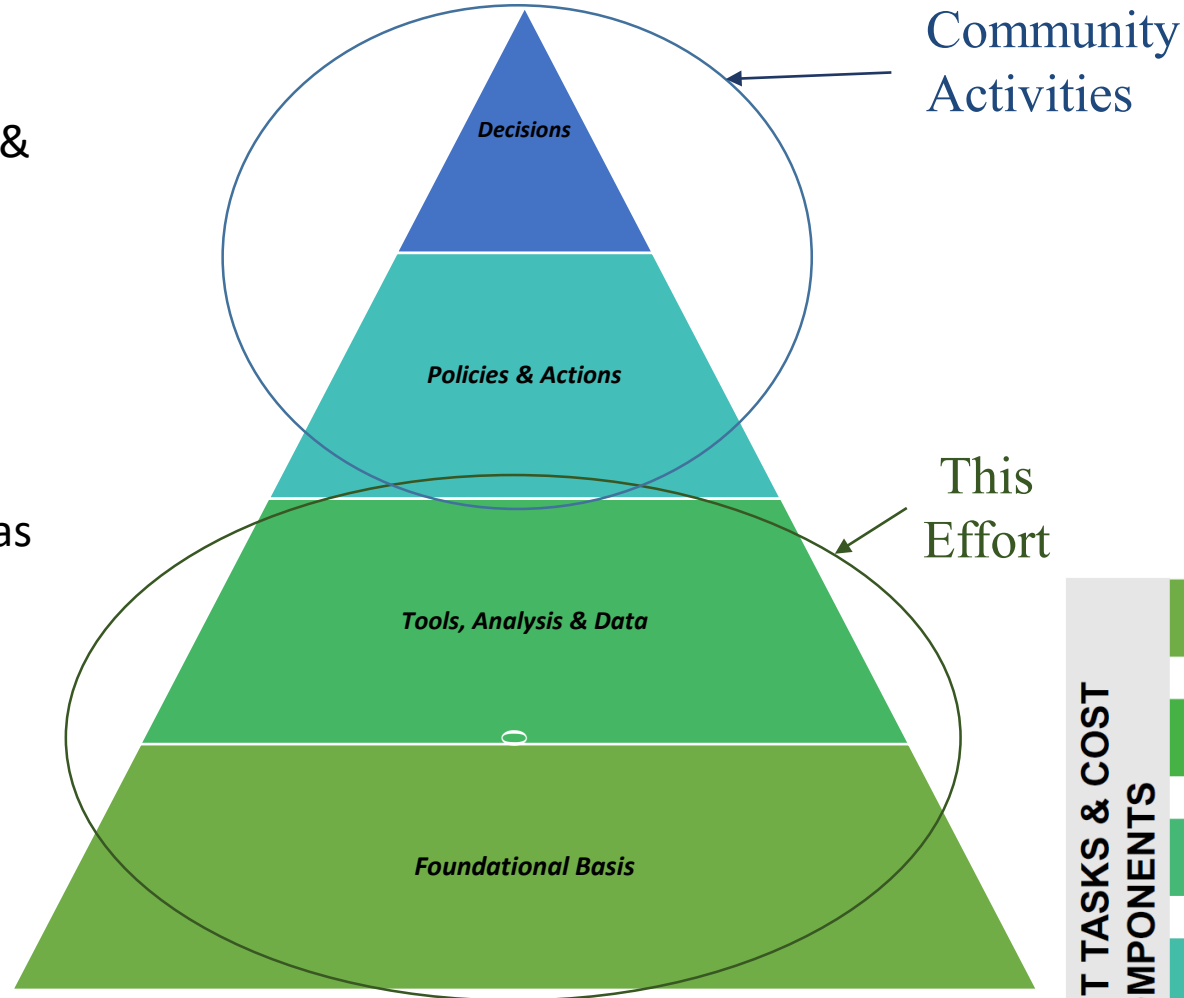
- 4.1 Project Management
- 4.2 Replicate and Amplify Outcomes





# HOW CAN WE ACCOMPLISH THIS?

- Inventory of existing data, information and structures
- Develop state-of-the-art data, tools & analysis for:
  - Modeling
  - Emergency response
  - Emergency preparedness
  - Planning for infrastructure and neighborhoods
  - Regulating the flood prone areas
- Develop planning level storm water infrastructure options
- Develop environmental areas for enjoyment
- Develop environmental mitigation areas
- Groundwater recharge
- Open space connectivity opportunities
- Roadmap or documentation to allow duplication of this effort elsewhere



# PREVENTION VS. RESPONSE: BRAINSTORMING

## Transportation Infrastructure

Structure Elevation / Culverts /  
Model Growth  
Mechanical Culverts?  
Transportation “LEED” Certified  
(Ray Roberts / Lewisville)  
Green Parkway Widths / Detention



## Safety

Technology / Routing  
Prioritization / Low Lying Facilities

## Stormwater

Minimize / Reduce Downstream  
Detention  
Tools, Data, Experts



## Environmental Features

Tree Farms /  
Intentional Saturation  
Filtration / Recharge



## Wetland and Stream Bed Mitigation Banking



## Environmental Stewardship as a Revenue Element

Mitigation Banking  
Horse Farms  
Eco-Tourism



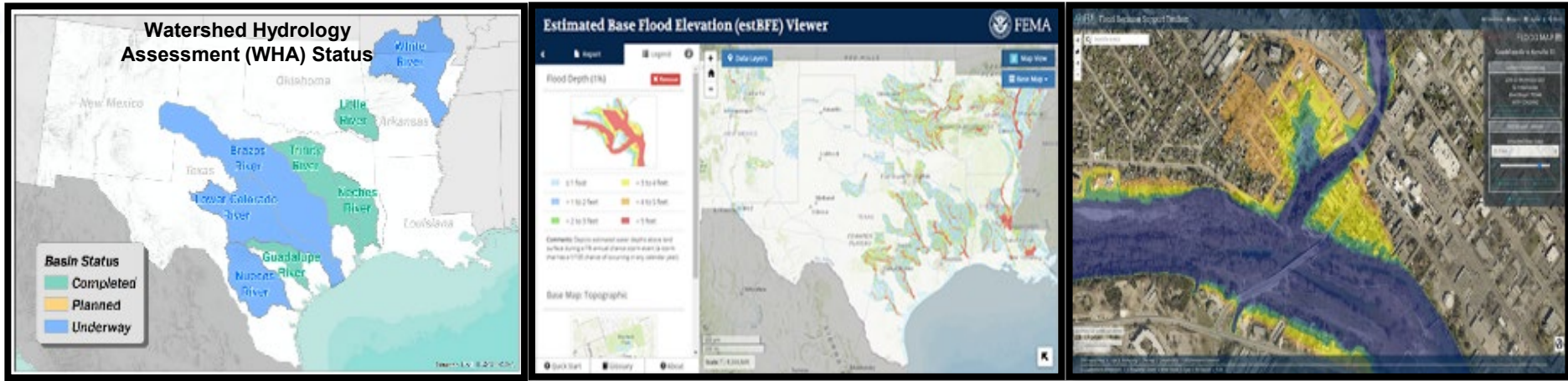
**To provide a menu of options and the  
location(s) where they make sense**





# HYDROLOGIC AND HYDRAULIC SUPPORT TO TSI

## Leverage existing Flood Risk Management initiatives...

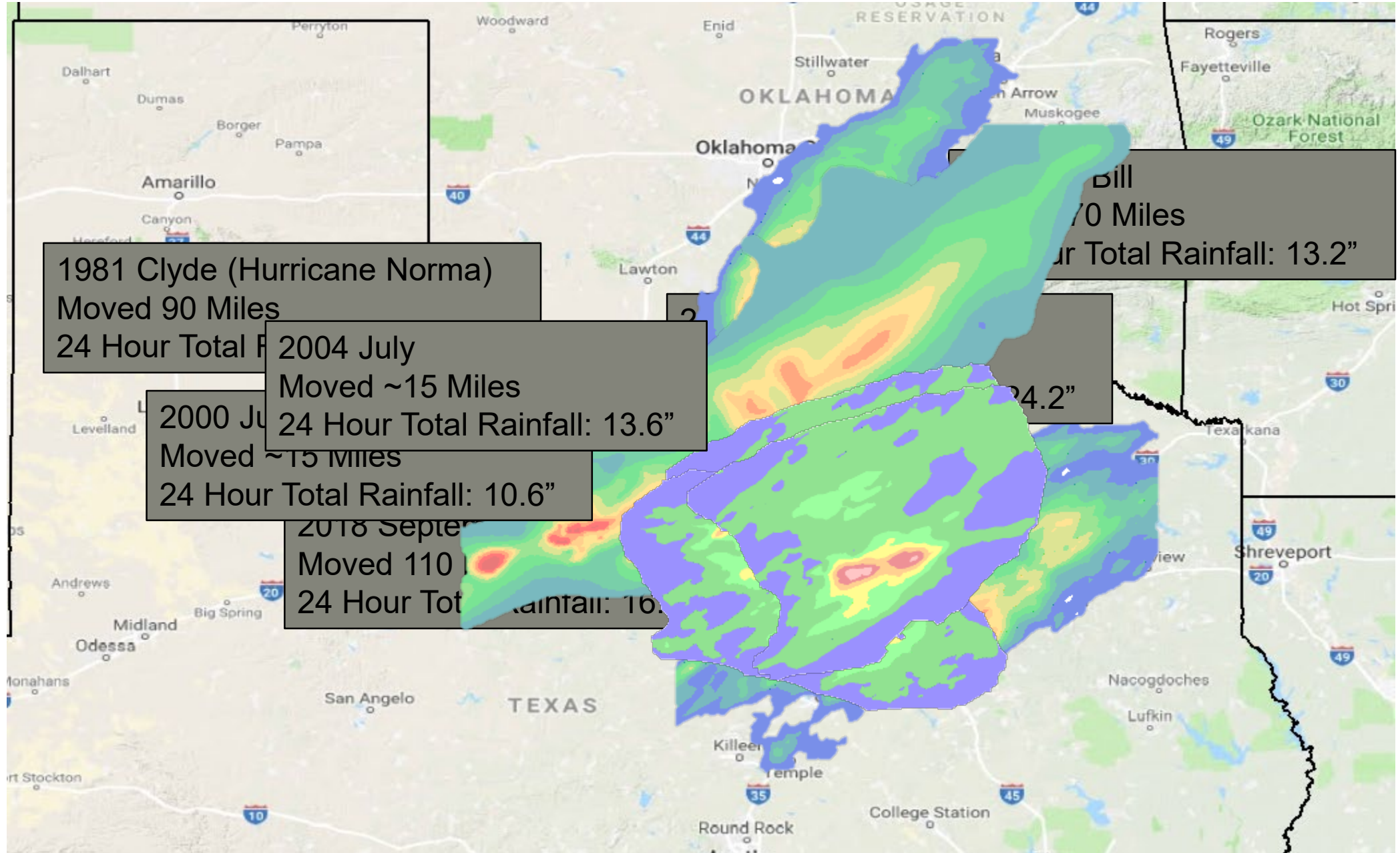


## ► ... to innovate at a regional scale

- Provide a roadmap for communities in the study area through integration of key layers such as infrastructure, transportation, stormwater, planning, and environmental
- Investigate and enhance Trinity River Watershed Hydrology Assessment (WHA)
- Review & enhance existing hydraulic models such as Base Level Engineering (BLE)
- Storm shifting to simulate the impact of larger regional storms
- Response and emergency management modeling tool
- Optimization study for ideal locations and sizing for smaller/regional ponds and other drainage/flood control structures, **considering more than just the 100-year event**



# CASE STUDY: STORM SHIFTING



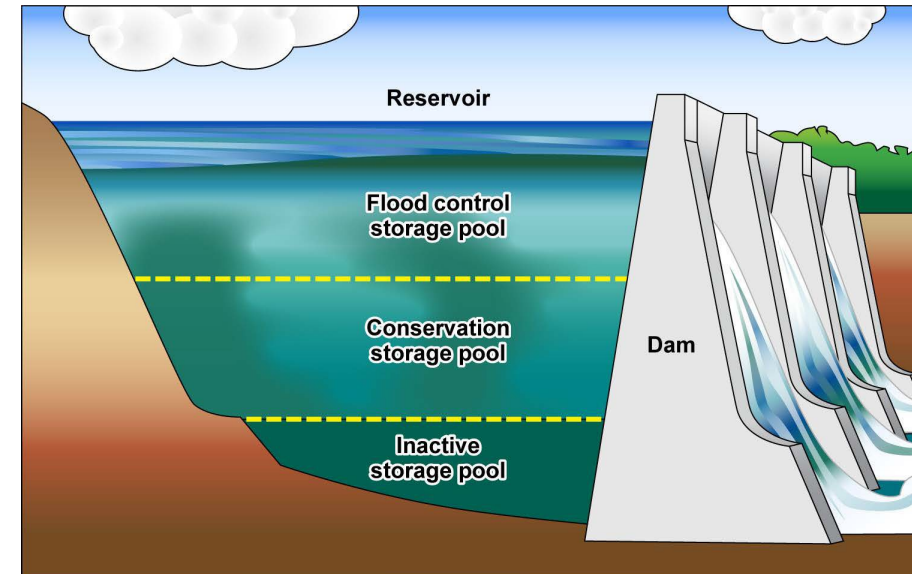
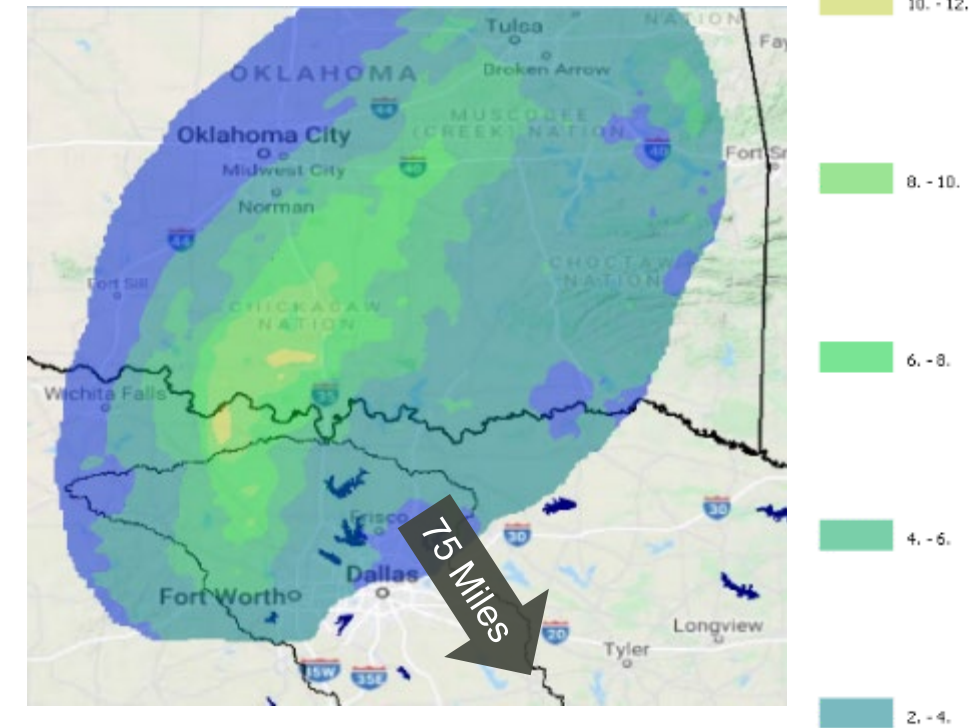




# UPPER TRINITY STORM SHIFT STUDY SCENARIOS

**Example: Tropical Storm Bill (13.6" in 48 hours):**

- **Dry Scenario:** Reservoirs at 85% of conservation pool (uses driest loss and baseflow parameters from Trinity Watershed Hydrology Assessment (WHA) study).
- **Best Estimate Scenario:** Reservoirs at top of conservation pool (uses final 100-year Trinity WHA parameters).
- **Wet Scenario:** Reservoirs at 85% of flood pool (uses wettest loss and baseflow parameters from Trinity WHA study).



# UPPER TRINITY STORM SHIFT RESULTS

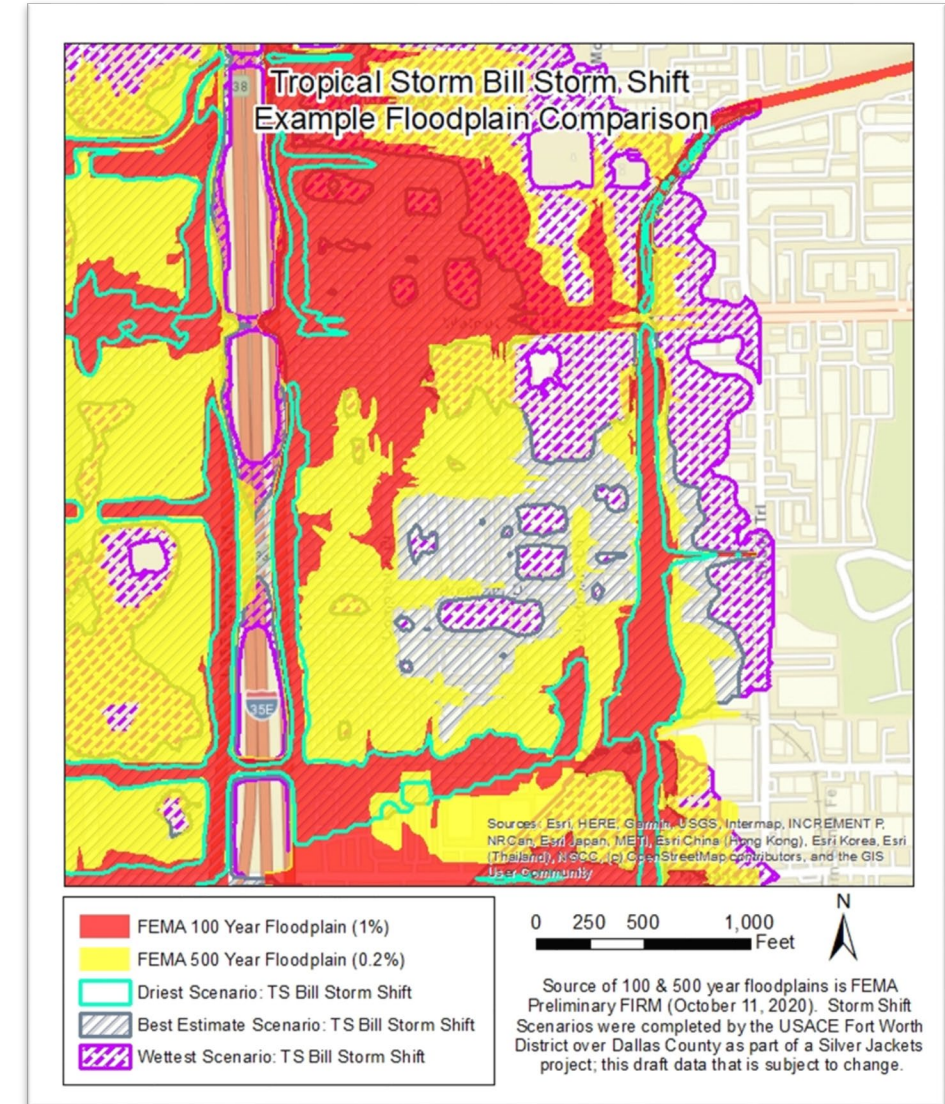
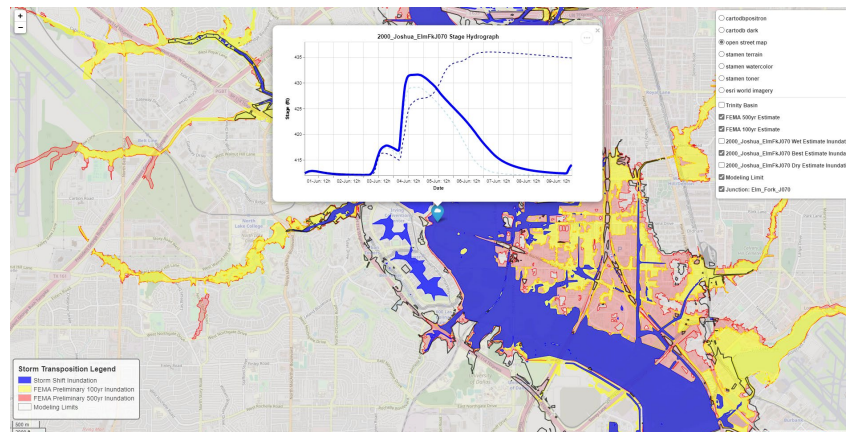


## Tropical Storm Bill (13.6" in 48 hours):

- Flows for Dry, Best Estimate, and Wet scenarios shown below (includes comparison to Trinity WHA)
- Map to right shows example comparison of these scenarios against FEMA 100 and 500-year floodplains

TS BILL STORM SHIFTS	Upper Trinity Silver Jackets Study			Trinity InFRM WHA Study		
	Dry	Best Estimate	Wet	100-yr	200-yr	500-yr
Junction	PeakFlow (cfs)	PeakFlow (cfs)	PeakFlow (cfs)	PeakFlow (cfs)	PeakFlow (cfs)	PeakFlow (cfs)
Elm Fork Junction 070	30,404	51,911	105,369	45,100	52,800	62,400

- Report, Factsheet, and interactive results/data are available at the link below.



<https://www.nctcog.org/envir/watershed-management/storm-shifting>



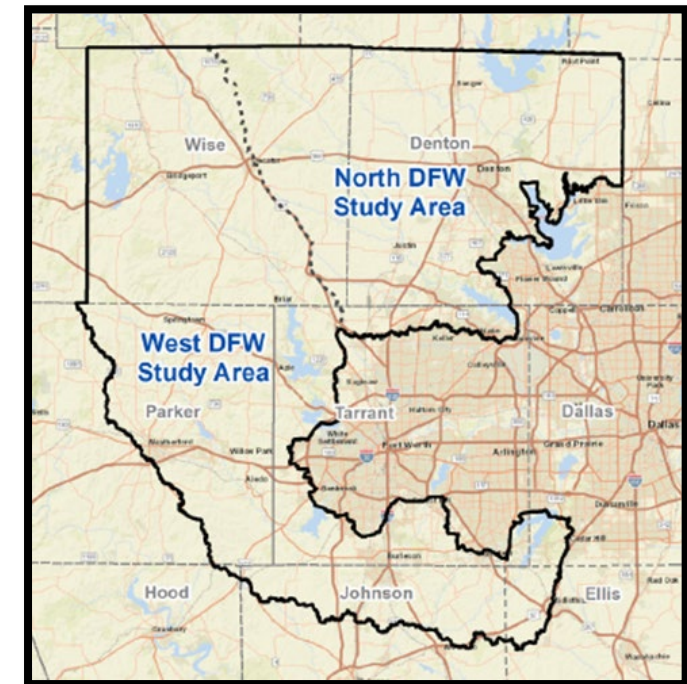


# \$10 Million

**No funding is being requested of our local governments; only your engagement, participation, and follow-through with the tools and resources that we develop for your use.**

## **Thank you to our Funding Partners:**

- Federal Emergency Management Agency
- Texas Water Development Board
- Texas Department of Transportation / Federal Highway Administration
- Texas General Land Office





# Upper Trinity River Basin Integrated Transportation and Stormwater Infrastructure (TSI) Plan



## CONTEXT

Recent flood events in Texas have highlighted the need for more comprehensive stormwater planning. This is important in the upstream portions of the Trinity watershed, where the population is expected to grow significantly.

## PROJECT PURPOSE

Proactively integrate regional stormwater management, urban development, transportation, and environmental planning in the face of rapid development, resulting in a **transferable 'roadmap' for risk awareness and resiliency.**

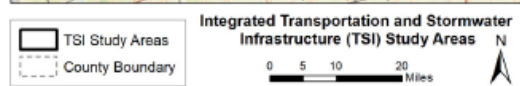
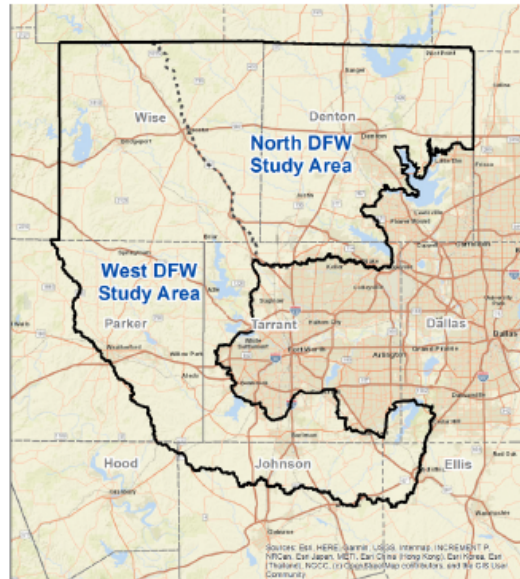
## IMPORTANCE

To learn from past mistakes that have resulted in flooded roadways, neighborhoods, and critical infrastructure, and to assist communities with an improved approach to efficiently minimize these impacts before they occur.

## About the Project

The North Central Texas Council of Governments (NCTCOG) and the United States Army Corps of Engineers (USACE), along with several other key partners, are collaborating on the Upper Trinity River Basin Integrated Transportation and Stormwater Infrastructure (TSI) project to address the long-term planning needs of communities in North Central Texas. This multi-year effort in these North and West DFW study areas will include transferable TSI plans to aid communities in identifying projects and policies that:

- address vulnerable and critical infrastructure assets;
- reduce flood risk;
- minimize overall lifecycle costs;
- provide environmental and ecosystem benefits to accommodate future population growth; and
- respond to changing storm frequency, duration, and intensity.



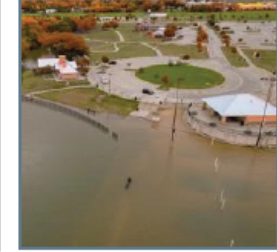
## Project Area Facts

- 85 cities and portions of 8 counties
- Expected to grow to 2,000,000 residents by 2045 (126% increase from 2020)
- 19% growth in impervious surface from 2006 – 2016
- 60% undeveloped (2015)

## Project Goals and Outcomes

### REDUCE FLOODING

- Reduce flooding in growing communities.
- Reduce or prevent downstream flood impacts from rapidly growing upstream communities.
- Increase resiliency to flooding disasters in communities by encouraging a proactive approach to stormwater management.
- Provide flood-related data to community officials to inform decision making in incorporated and unincorporated areas



### PROVIDE TOOLS / RESOURCES

- Empower communities to adopt higher floodplain management standards and current building codes.
- Encourage communities to collaborate and strategize on common flooding issues through regional initiatives.
- Develop GIS based tools and resources that identify opportunities for green stormwater infrastructure.



### PROACTIVE PLANNING

- Comprehensively plan stormwater, transportation, and environmental infrastructure/features.
- Protect current and future transportation and stormwater infrastructure investments by planning for future conditions.
- Develop a planning model that can be replicated in other areas across the United States.

## Partner Organizations



## Funding Partners

- Texas Water Development Board
- Texas Department of Transportation – Federal Highway Administration
- Texas General Land Office
- Federal Emergency Management Agency

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# QUESTIONS & DISCUSSION