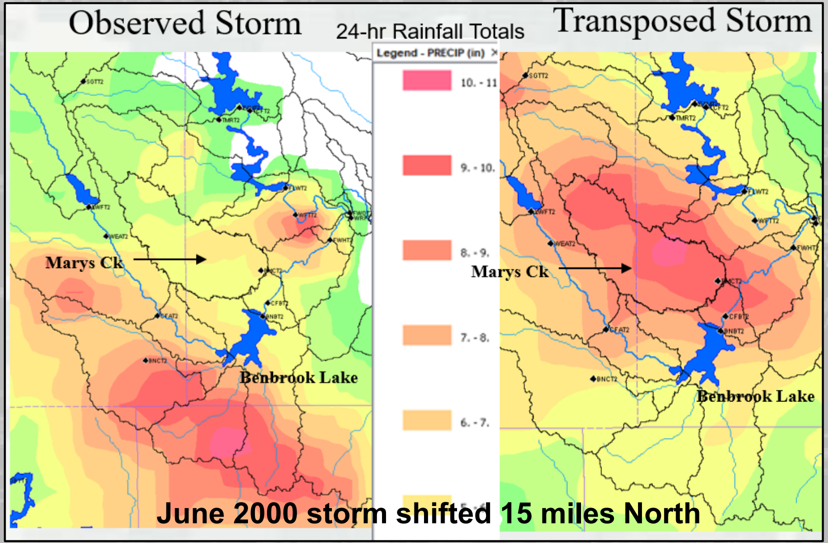
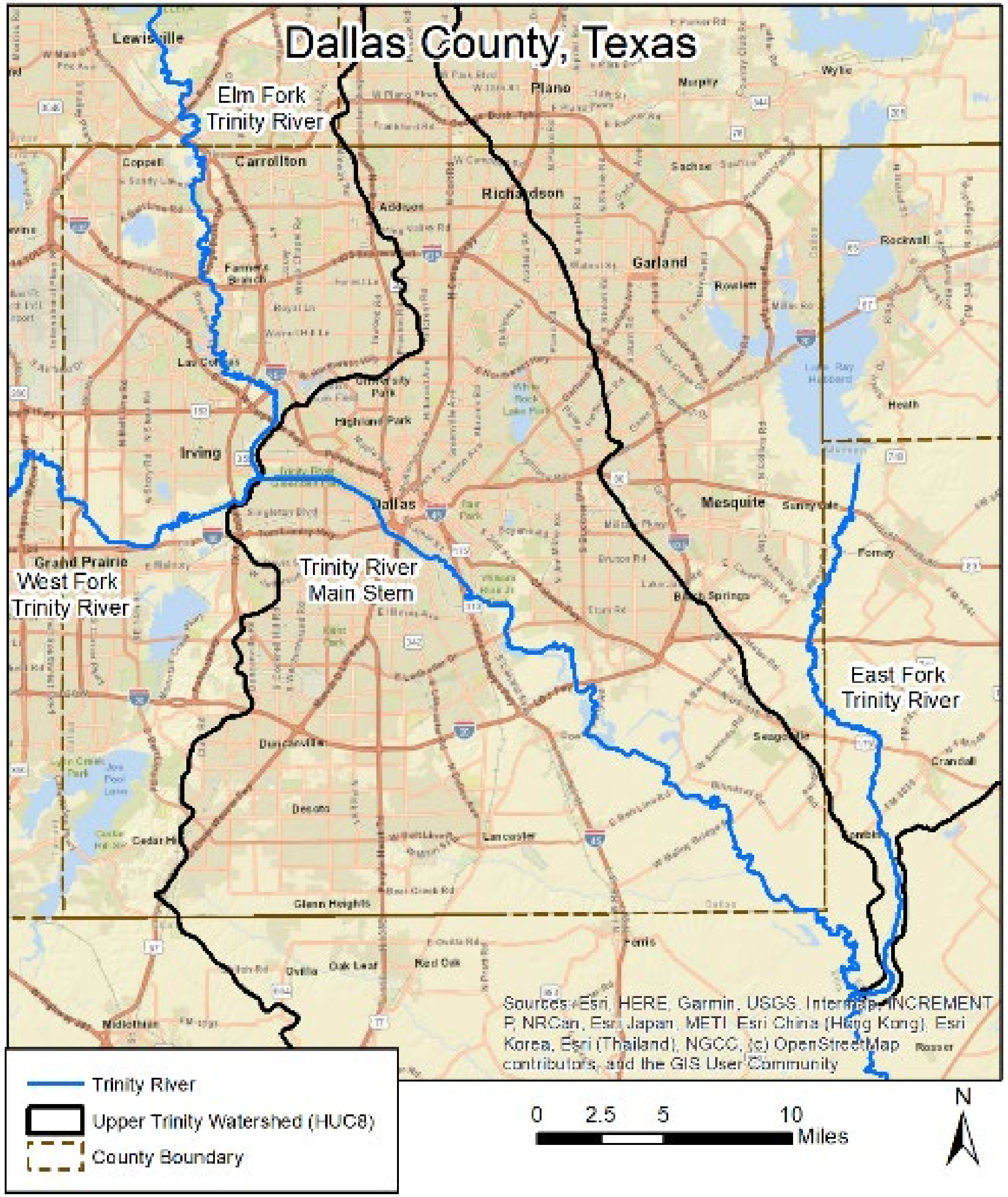
CRS USERS GROUP: UPPER TRINITY STORM SHIFTING SILVER JACKETS STUDY

March 22nd, 2022

U.S. Army Corps of Engineers
Fort Worth District - Water Resources Branch





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UPPER TRINITY STORM SHIFT SILVER JACKETS STUDY

Summary:

- Shift storms that have occurred in/around North Texas and demonstrate their resulting floodplains and related impacts if they had occurred in Dallas County
- Partnership and community collaboration is essential
- Silver Jackets application identified NCTCOG, FEMA Region 6, Dallas County, and Texas General Land Office as partners
- Coordinating with additional stakeholders and partners such as Dallas County, Dallas County Utility and Reclamation District, City of Irving, and Town of Highland Park

$100,000 Budget

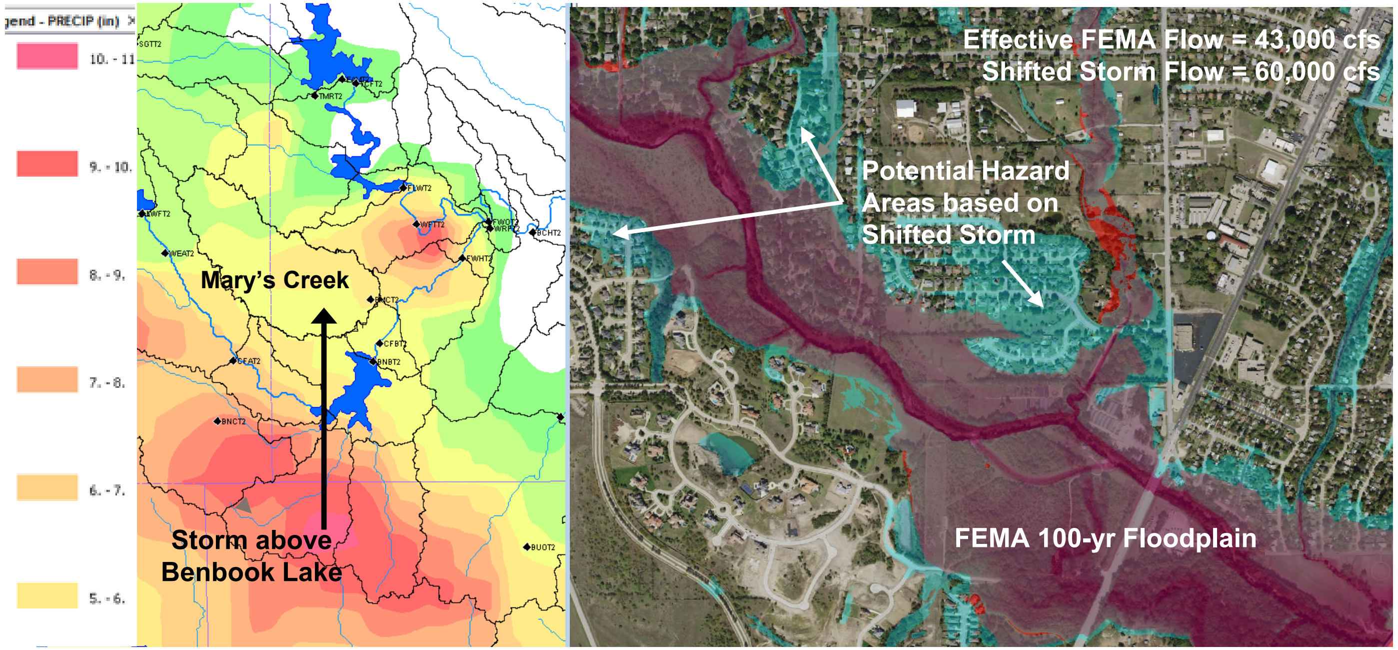
- Silver Jackets project funded through USACE Flood Plain Management Services (FPMS) program that provides USACE technical and planning support to local, state, and federal entities

- **Scoped Tasks:**
  - Determine storm number & locations
  - Obtain existing data
  - Storm selection
  - Storm shifting
  - Inundation mapping
  - Documentation
  - Post-analysis collaboration

- **12-month Timeline**

UPPER TRINITY STORM SHIFT SILVER JACKETS STUDY

- Introducing storm shifting
- Upper Trinity storm shifting study update
- Next steps and discussion



STORM SHIFTING STUDY – WHY SHOULD I CARE?

Flooding doesn’t stop at lines on a map…
- But it appears to on your current flood map.
- Flood maps don’t account for all flood scenarios.

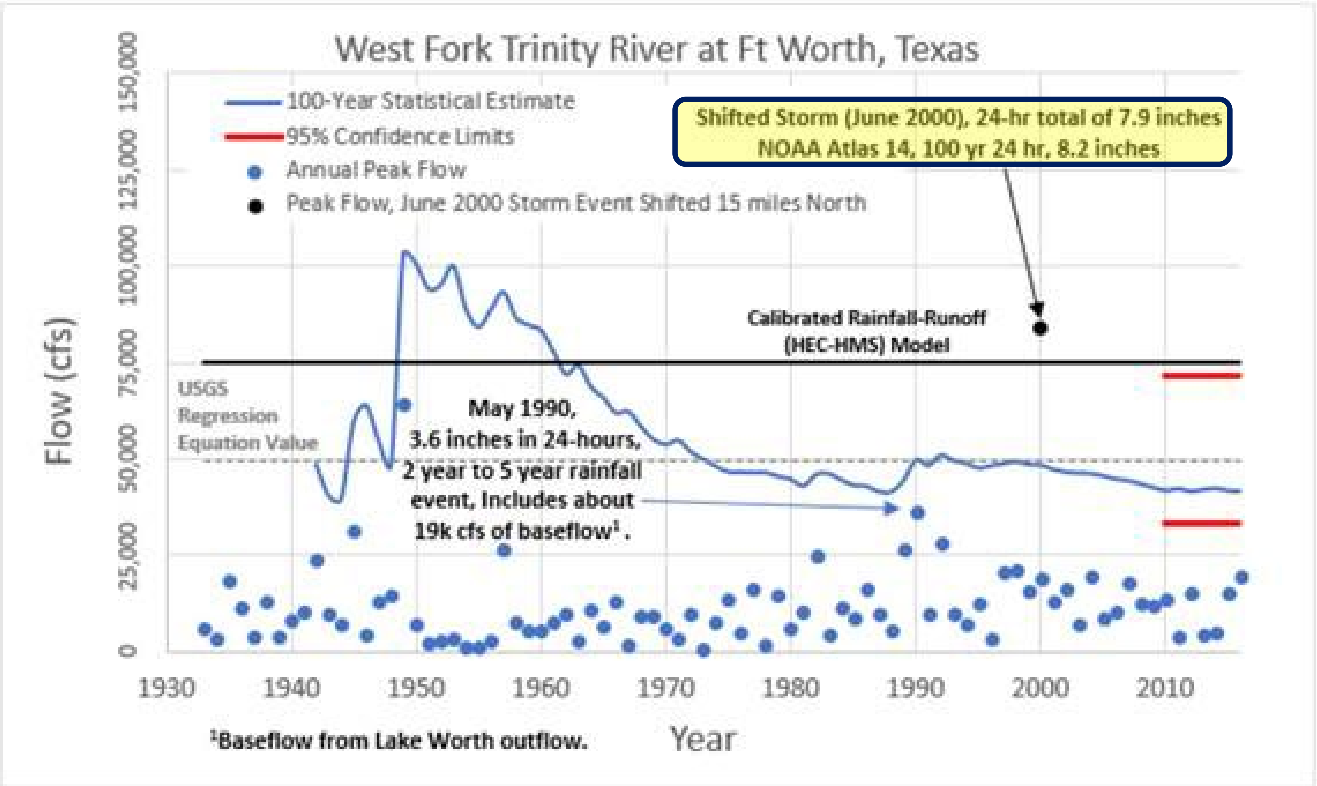
Commonly asked questions:
- “Does a 100-year storm mean I’ll get a 100-year flood?”
- “What is my flood risk?”
- “What if that storm hit where I live?
- “Is this area safe from flooding?”

There’s a tool for that…
- **Storm shifting** provides informative, relatable, and non-regulatory data to help communities better understand and mitigate their flood risk
- Valuable non-regulatory planning and design guidance for more resilient communities
- Can be used in EM Action/Hazard Mitigation Plans

WHY: QUESTIONABLE HISTORIC RECORDS & LACK OF SAFETY FACTORS

A watershed may have experienced a disproportionate number of small or large historic rainfall events

- May negatively distort gauge records/data that are used to develop floodplain maps
- The example location to the right hasn't experienced very large flood events



No factor of safety in Flood Risk Management

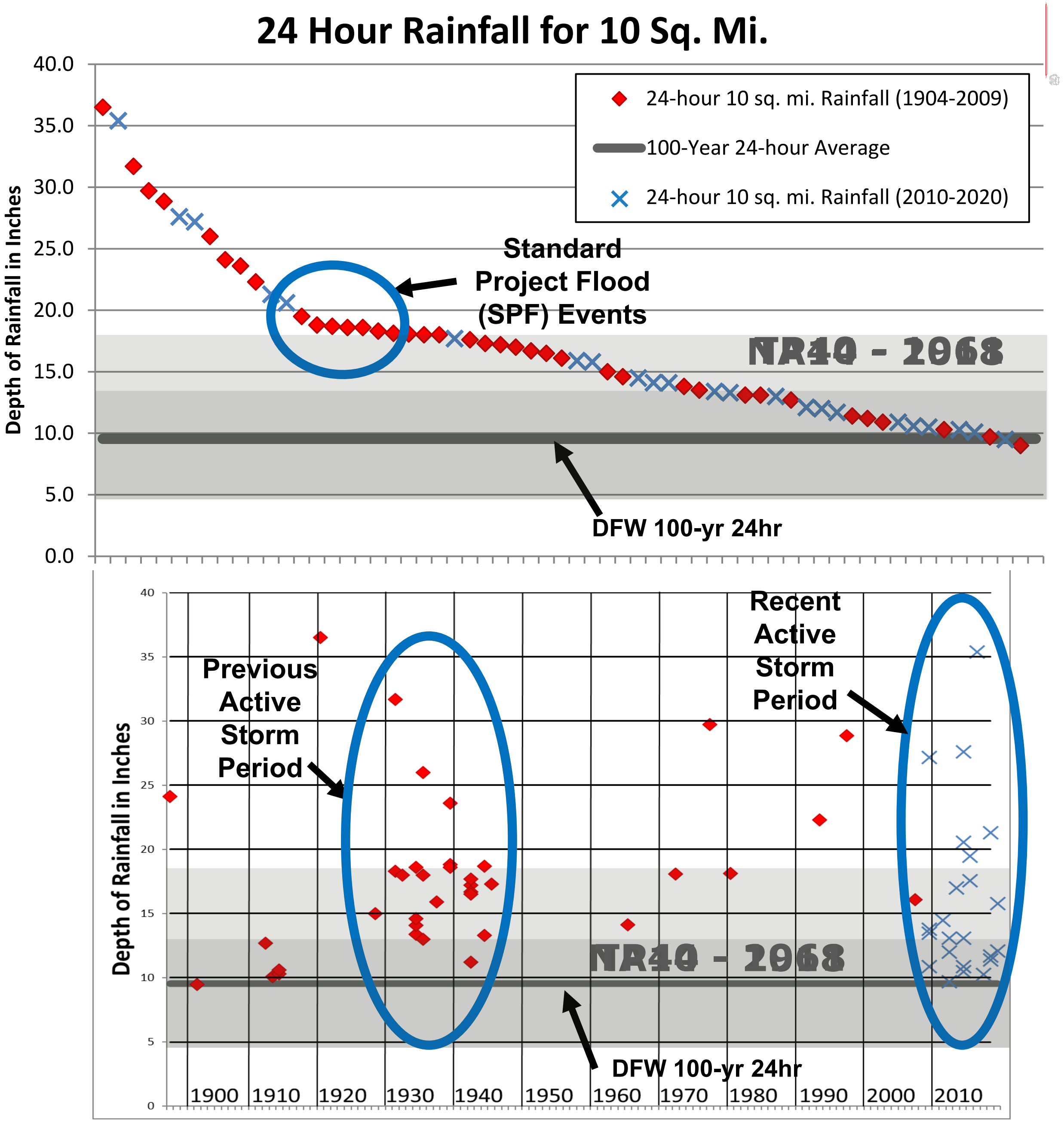
- Freeboard is the most likely & widely used solution
- Storm shifting can inform freeboard ordinance discussions

WHY: INCREASING FREQUENCY AND MAGNITUDE OF PRECIPITATION EVENTS

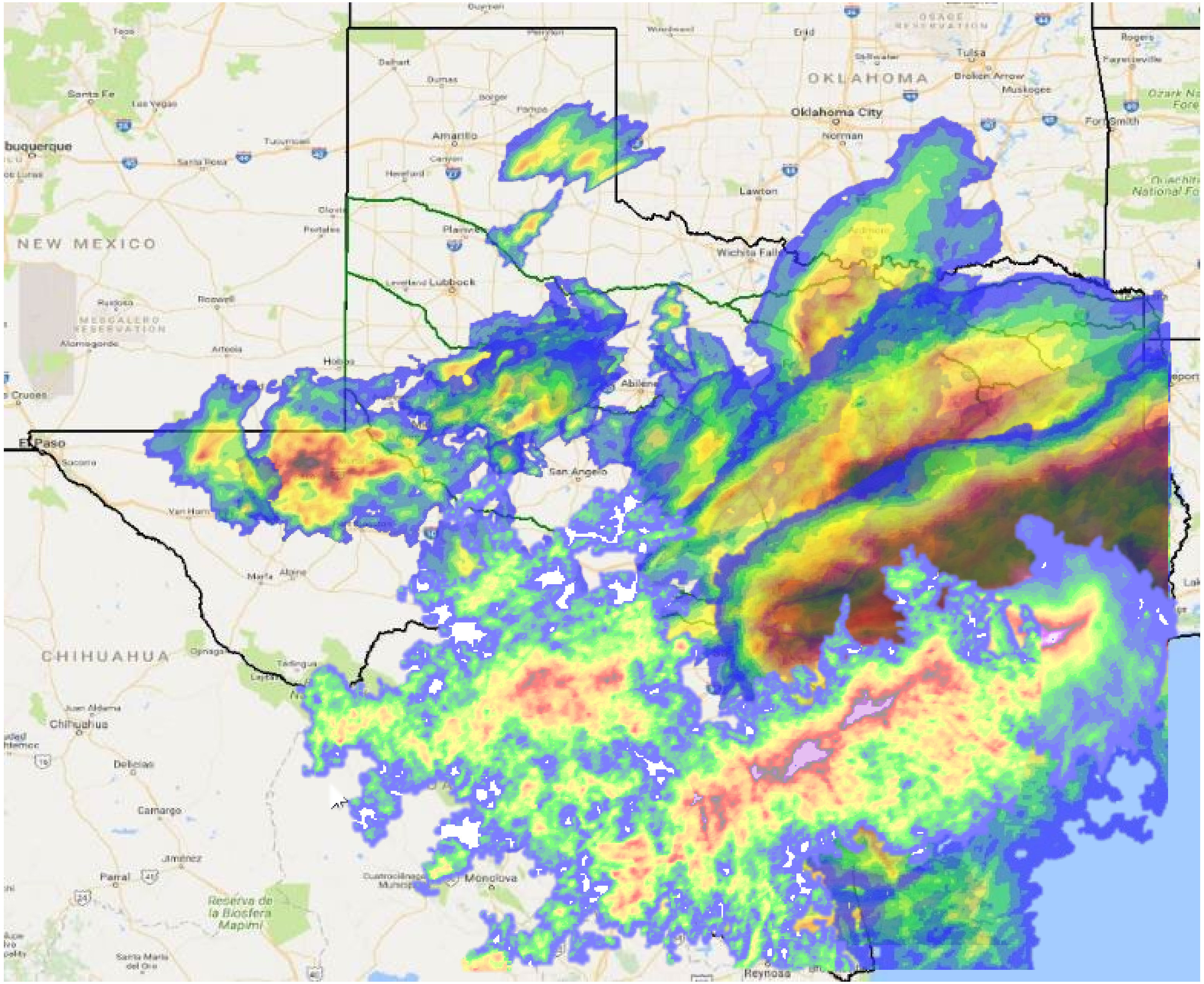
Regional observed storms

- USACE extreme storm database
  - 24 Hour Rainfall for 10 square mile area
- Gray TP40 band was design standard (100-year) until 2018
- Gray NA14 (NOAA Atlas 14) is design standard (100-year) since 2018
- Blue X's are 2010-2019 storms that exceeded the 100-year
  - 20+ events exceeded the 100-year design standard

Region is experiencing abnormally active storm period

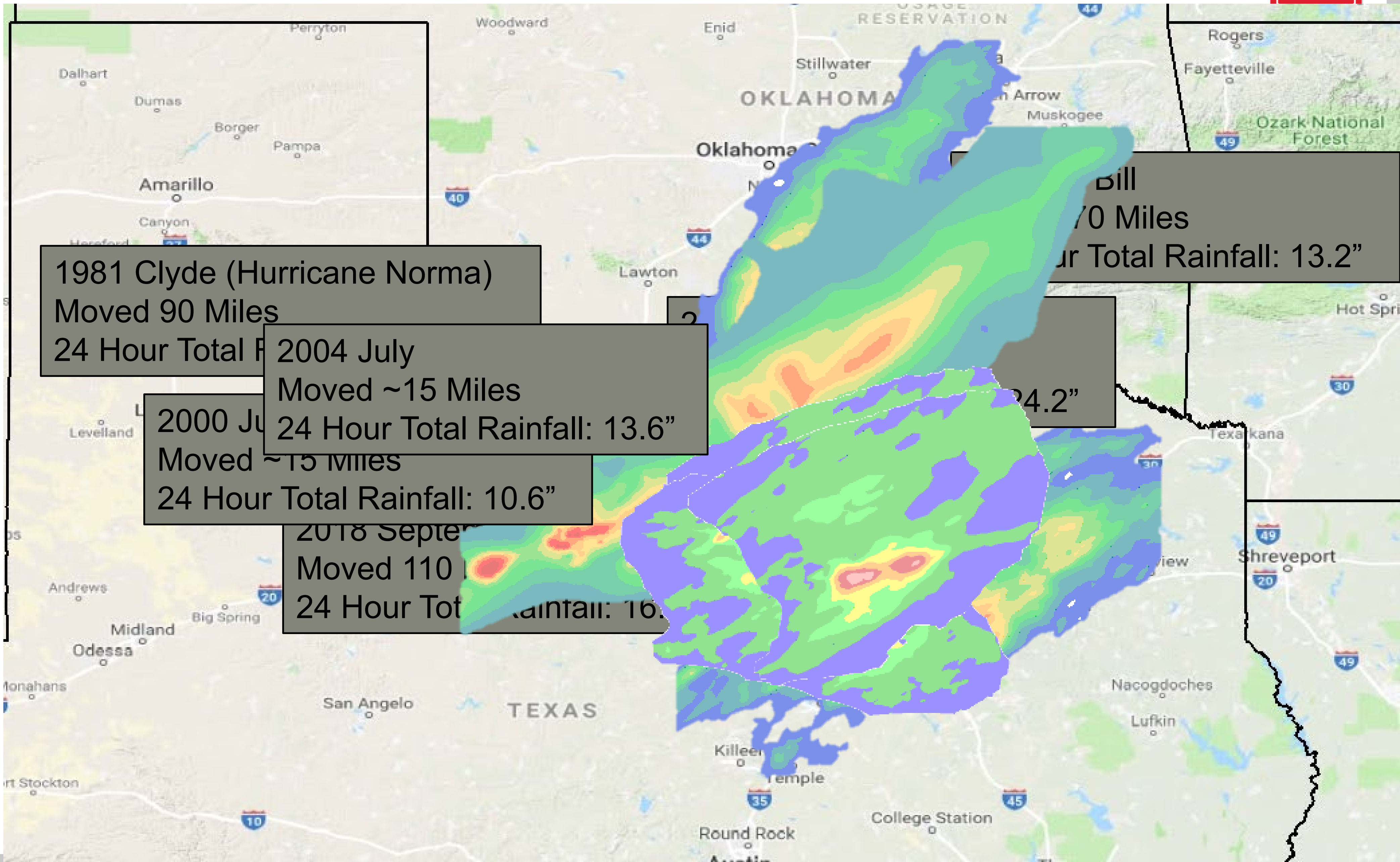


WHY: EXTREME STORMS (2010-2019)



SCARY STORMS ARE EVERYWHERE…

- What if one hit where I live?



INTRODUCING STORM SHIFTING

- Planning and design-level guidance for various organizations and projects
- Planning, design and operational data for dams and levees
- Evaluation criteria for civil works projects, real estate actions, risk assessments, dam and levee safety studies
- Support for response, mitigation, and higher standards
- Helps address gaps in coverage and questions with existing/historic data

TECHNICALLY SOUND AND REPEATABLE PROCESS

- Uses innovative resources such as HEC-MetVue, a new program that facilitates viewing and shifting of rainfall datasets
- Relies on NOAA Climate Atlas Data
- Leverages best available Engineering Data/Models
- Technically supported and repeatable approach in other areas

2.4 Transposition

2.4.1 Definition

Transposition means relocating isohyetal patterns of storm precipitation within a region that is homogeneous relative to terrain and meteorological features important to the particular storm rainfall under concern.

2.4.2 Transposition Limits

Topography is one of the more important controls on limits to storm transposition. If observed rainfall patterns show correspondence with underlying terrain features, or indicate triggering of rainfall by slopes, transposition should be limited to areas of similar terrain. Identification of broadscale meteorological features is important, e.g., surface and upper air high and low pressure centers that are associated with the storm, and how they interact to produce the rainfall. Also useful in determining transposition limits are storm isohyetal charts, weather maps, storm tracks and rainfalls of record for the type of storm under consideration, and topographic charts.

The more important guidelines to storm transposition for this study were:

a. Transposition was not permitted across the generalized Appalachian Mountain ridge.

b. Tropical storm rainfall centers were not transposed farther away from nor closer to the coast without an additional adjustment (section 2.4.4).

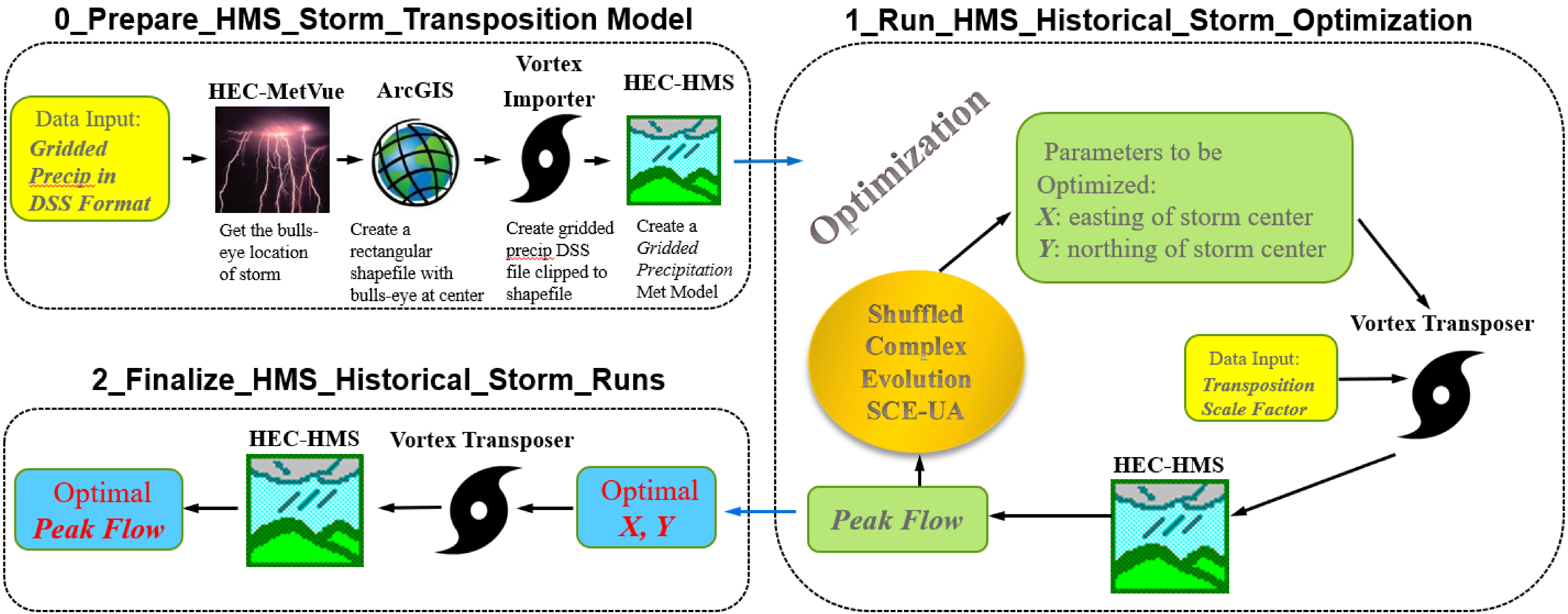
APPENDIX C

Table of Precipitable Water

DEPTH OF PRECIPITABLE WATER (W, .01 in.)
BETWEEN 1000-MB SURFACE AND INDICATED HEIGHT (H, 1000 ft) ABOVE 1000-MB SURFACE,
AS A FUNCTION OF 1000-MB TEMPERATURE (T_{1000}, F),
IN A SATURATED ATMOSPHERE WITH PSEUDOADIABATIC LAPSE RATE

Height 100's ft	Temperature at 1000 mb																				
	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	02	02	02	02	02	02	02	02	02	02	02	02	02	02	03	03	03	03	03	03	03
2	03	03	03	04	04	04	04	04	04	04	04	05	05	05	05	05	05	06	06	06	06
3	05	05	05	05	05	06	06	06	06	06	07	07	07	07	07	08	08	08	08	09	09
4	06	06	07	07	07	07	08	08	08	08	09	09	09	10	10	10	11	11	11	12	12
5	08	08	08	09	09	09	10	10	10	11	11	11	12	12	12	13	13	14	14	15	15

TECHNICALLY SOUND AND REPEATABLE PROCESS



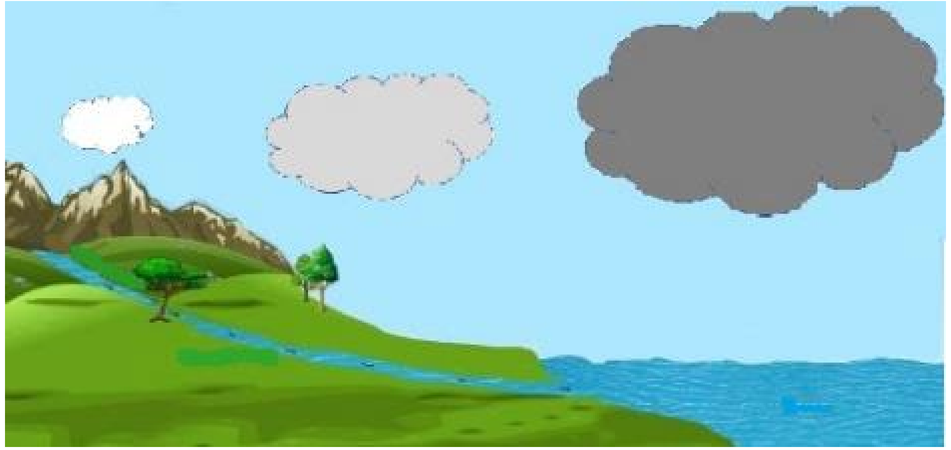
UPPER TRINITY STORM SHIFTING CONSIDERATIONS

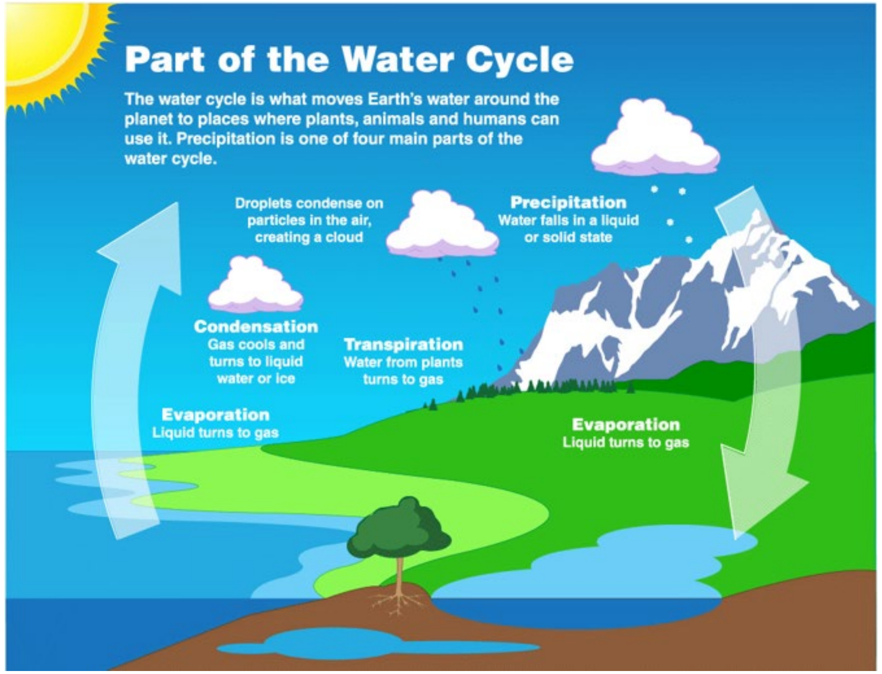
- Limits to what storms *should* be shifted due to meteorological parameters and atmospheric mechanisms.

- A storm occurring over an area is just as likely to occur somewhere nearby so long as there isn't a meteorological reason a storm wouldn't shift.

- Much of the relatively flat area in North Central Texas is subject to similar storm threats and is therefore at similar risk.

- Existing Hydraulic and Hydrologic models and terrain are used and/or provided by the Sponsor(s).





UPPER TRINITY STORM SHIFTING MODELING APPROACH

Hydraulic and Hydrologic Modeling and Inundation Mapping

Hydrology (how much water):

- Will utilize recently completed InFRM Upper Trinity Watershed Hydrology Assessment data

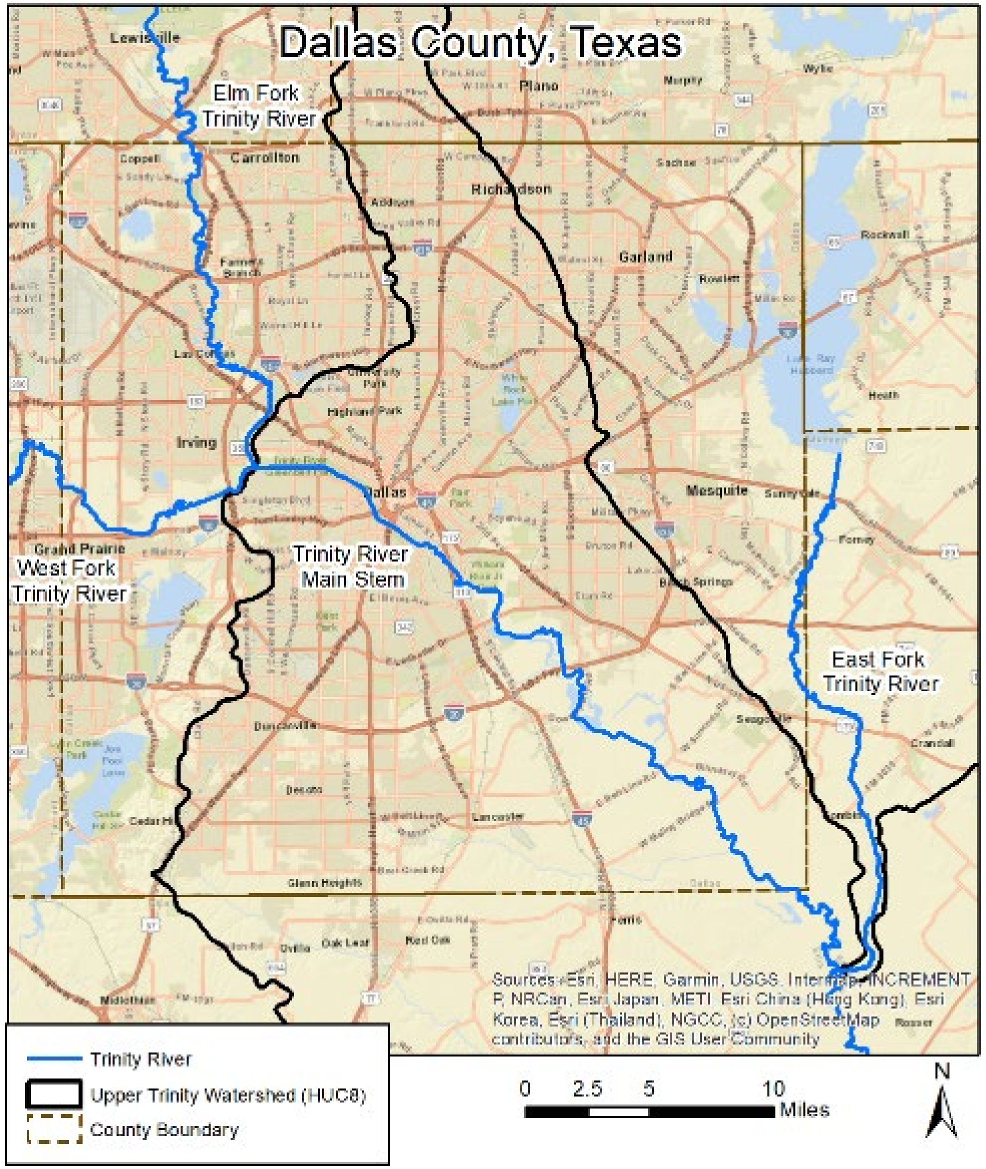
Hydraulics (how water conveys):

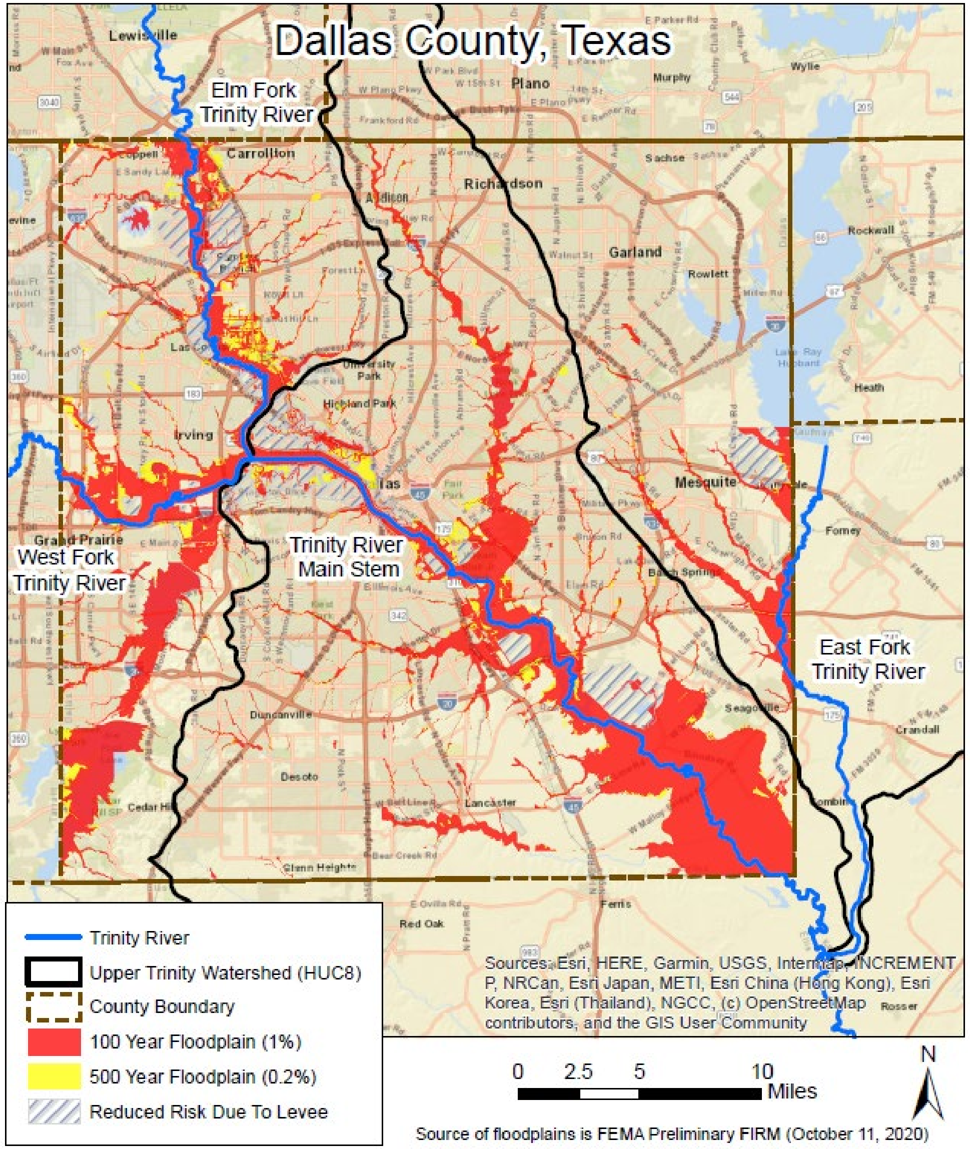
- Depending on exact areas of interest, will use 2017 or newer studies obtained through collaboration with project partners

Inundation mapping and documentation (report):

- Will tailor the data and documentation to fit the needs of project partners, thereby ensuring maximum utility

AREA OF INTEREST





Source of floodplains is FEMA Preliminary FIRM (October 11, 2020)

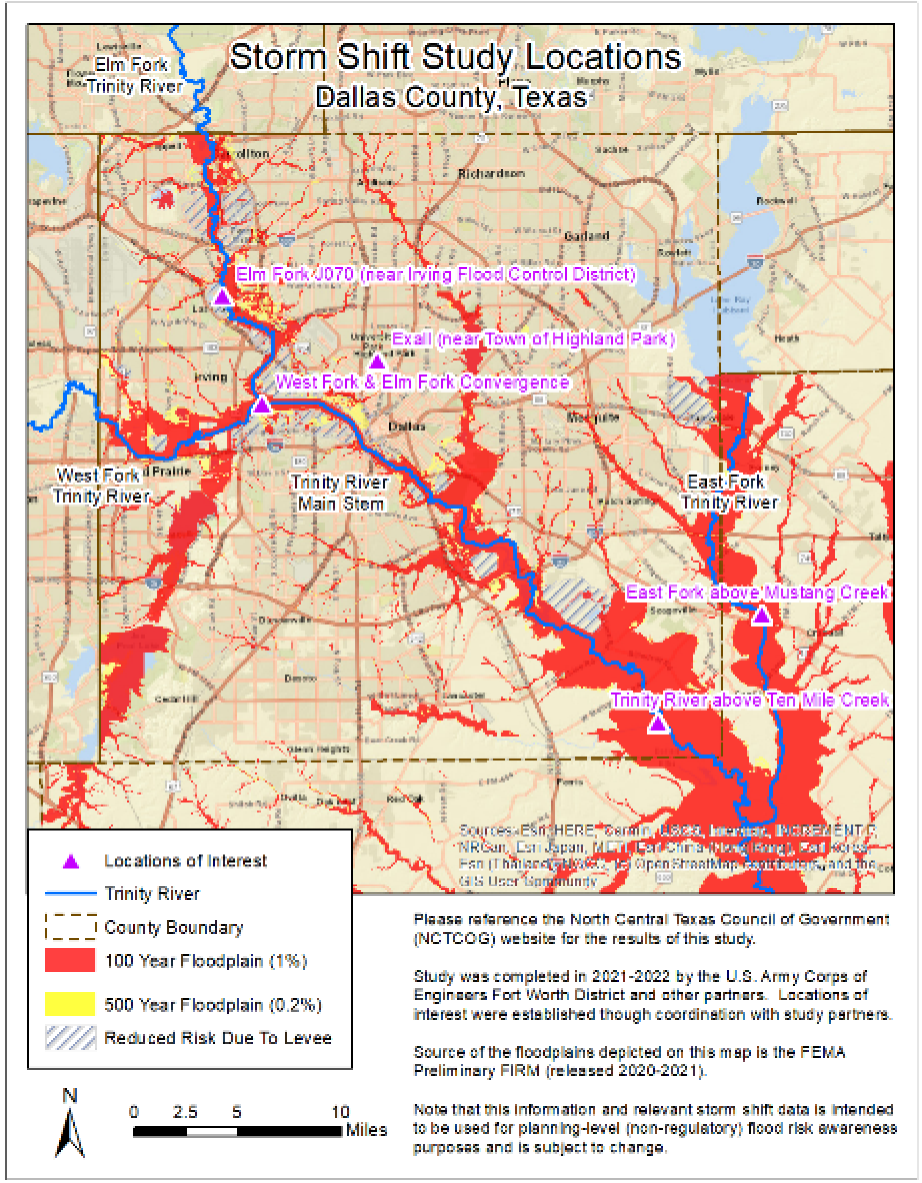
SELECTED UPPER TRINITY STORMS & SHIFTED LOCATIONS

Selected 5 storms to shift over Dallas County

Location/Storm Name	Date	Total Rainfall Depth	Rainfall Duration	Distance to Dallas County	Type of Storm
Joshua, TX	Jun 2000	11.4”	48 hours	55 miles	Convective
Nocona, TX – TS Bill	Jun 2015	13.6”	48 hours	75 miles	Tropical
Tropical Storm Hermine	Sep 2010	14.3”	48 hours	150 miles	Tropical
Mansfield, TX	Jul 2004	17.4”	48 hours	40 miles	Convective
Dawson, TX – TS Patricia	Oct 2015	22.7”	48 hours	68 miles	Tropical

Chose 5 different focus areas in/around Dallas County based on local coordination

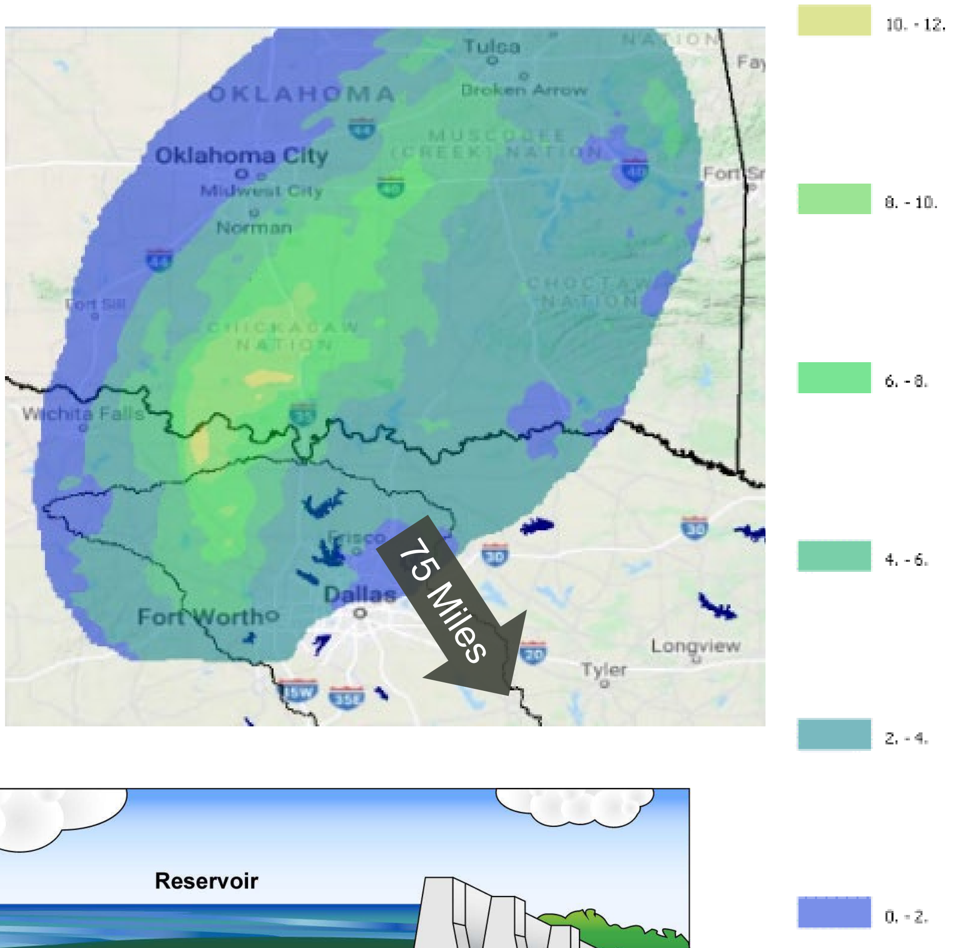
1. **Elm Fork Junction 070:** This junction is near Irving Flood Control District and is representative of three locations of interest identified during coordination meetings
2. **West Fork & Elm Fork convergence:** Another area of interest identified by Irving Flood Control District
3. **Trinity River above Ten Mile Creek:** Sand Branch area with along Trinity Mainstem in SE Dallas County
4. **East Fork above Mustang Creek:** Near Seagoville area in SE Dallas County and NW Kaufman County
5. **Exall/Turtle Creek area:** Town of Highland Park expressed interest during discussions and shared models for use in this study

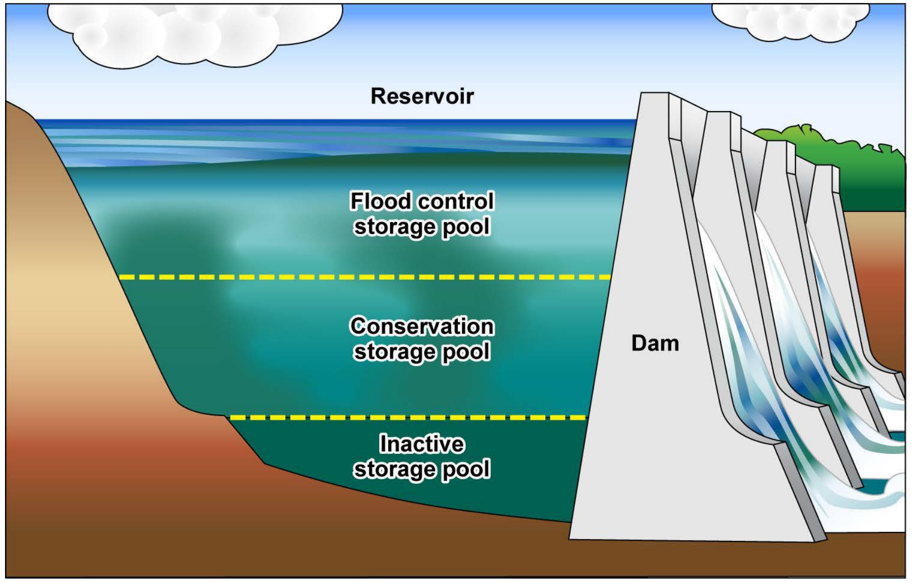


UPPER TRINITY STORM SHIFT SCENARIOS

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 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).





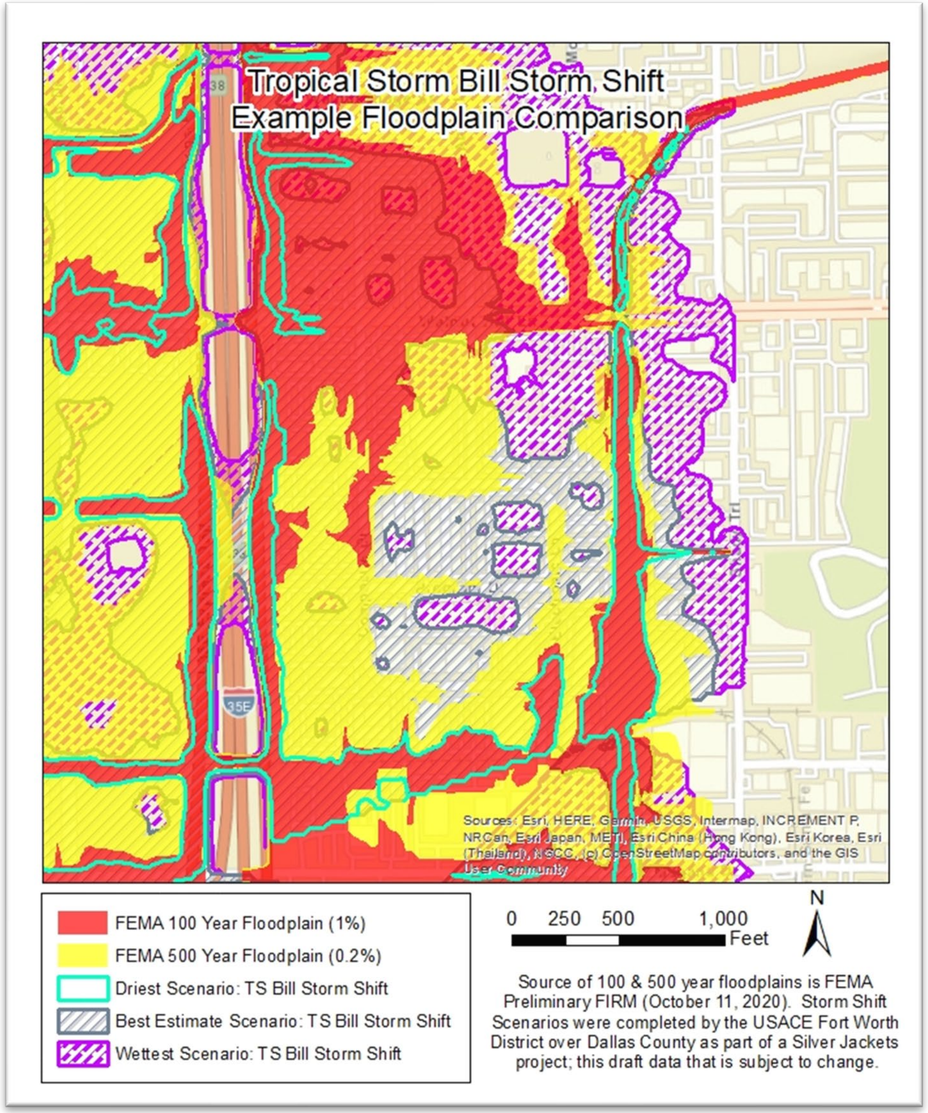
Source: GAO. | GAO-16-685

UPPER TRINITY STORM SHIFT INITIAL RESULTS

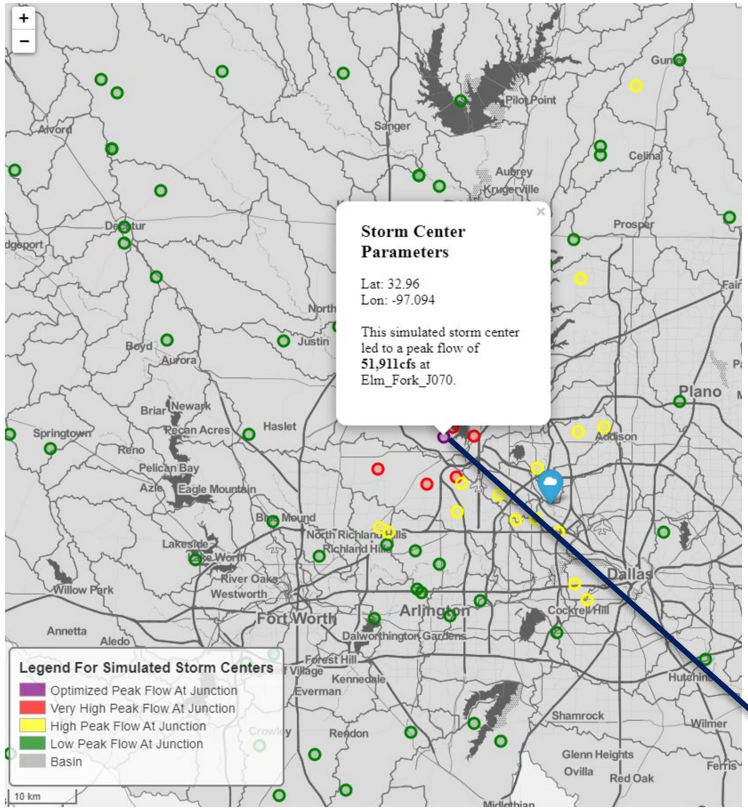
Tropical Storm Bill (13.6” in 48 hours):

- Sample peak flows for Dry, Best Estimate, and Wet scenarios shown below
- Includes comparisons between storm shift scenarios and Trinity Watershed Hydrology Assessment (WHA) 100, 200, & 500 year flows
- Comparison between storm shift scenarios and FEMA 100 and 500 year floodplains shown in image to right

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

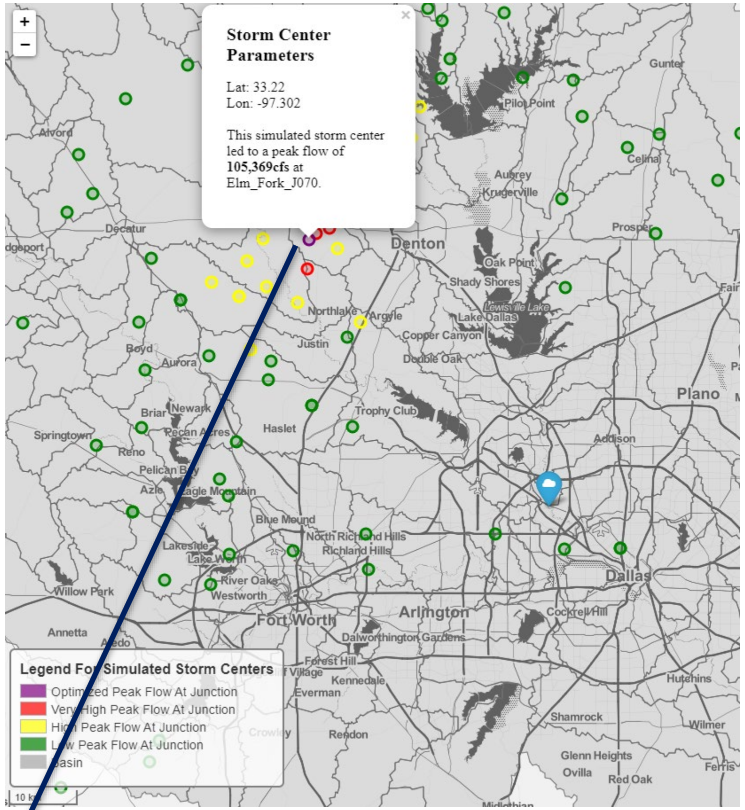


UPPER TRINITY STORM SHIFT INITIAL RESULTS



Irving Convention Center (Elm Fork Junction 070) example:

- Highest flows at Irving Convention Center for scenario on left occur when storm center is located downstream of Grapevine and Lewisville Lakes
- Highest flows at Irving Convention Center for the scenario on right occur when storm center is well above (upstream of) these two lakes
- Emphasizes the significant role of reservoirs in flood control and that the storm location that yields highest flooding varies by scenario



Note that this is draft data that is subject to change

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

HTML MAP DEMONSTRATION

STATUS UPDATE & NEXT STEPS

- **Status Update:**
  - ✓ Determine storm number & locations
  - ✓ Obtain existing data
  - ✓ Storm selection
  - ✓ Storm shifting
  - ✓ Inundation mapping
  - ☐ Documentation: In progress (by ~end of March)
  - ☐ Post-analysis collaboration: In progress (March - April)

Next Steps and Discussion:

- Sharing draft html maps, spatial (GIS) data, and other relevant visuals/data for review
- If engineering H&H models and/or depth and water surface elevation grids are needed, they are available upon request
- Study report will be subsequently shared for review
- Other data requirements or additional considerations?

STORM SHIFTING – OTHER EXAMPLES

Waco, TX completed

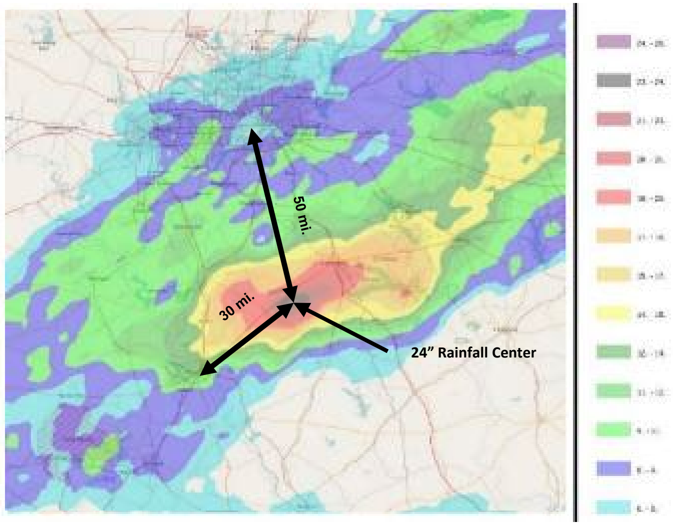
- Issue: Uncertainty associated with determination of flood potential (dams)
- Shifted several storms (30+ mi)
- Examined different operational constraints, multiple scenarios
- Outcome: showed flood potential is greater than 100-year

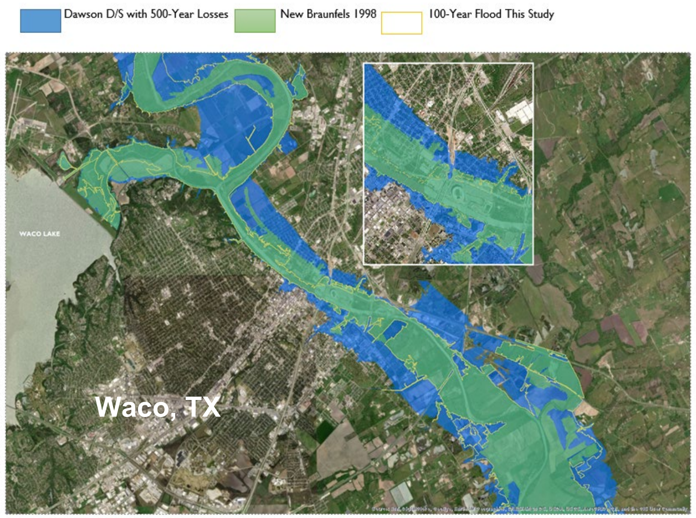
Mary's Creek, DFW, TX area

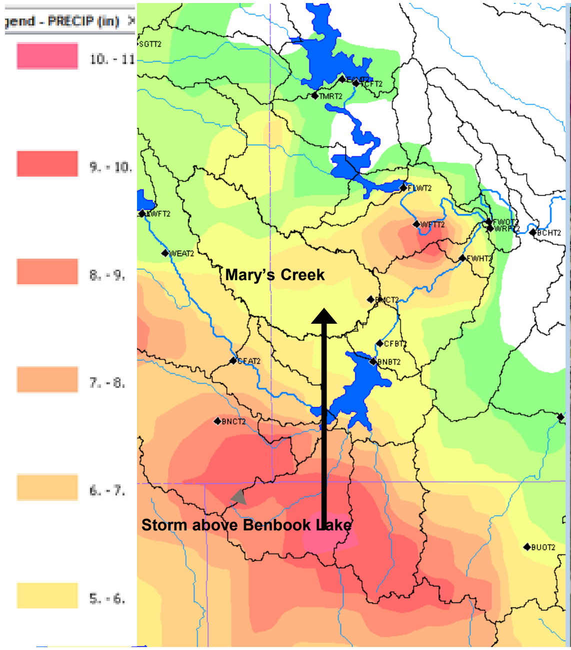
- Issue: Uncertainty associated with determination of flood potential
- Shifted 2000 100-year± storm 15 miles
- Outcome: Flood potential is greater than previously understood

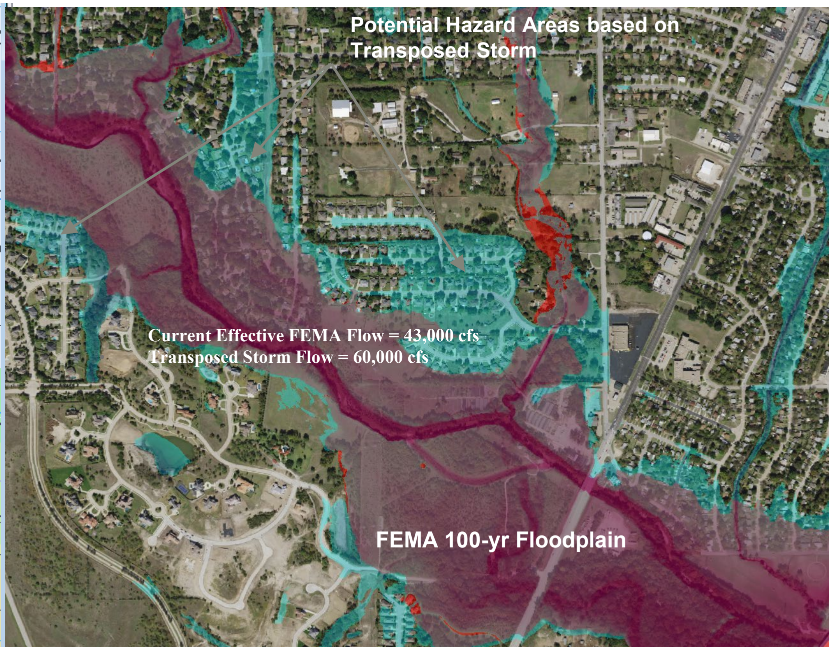
Future

- Interagency Flood Risk Management (InFRM)
- Watershed Hydrology Assessment (WHA) integration
- Integrated Transportation and Stormwater Infrastructure (TSI) project
- San Marcos study
- DFW Airport project and other regional projects









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QUESTIONS?