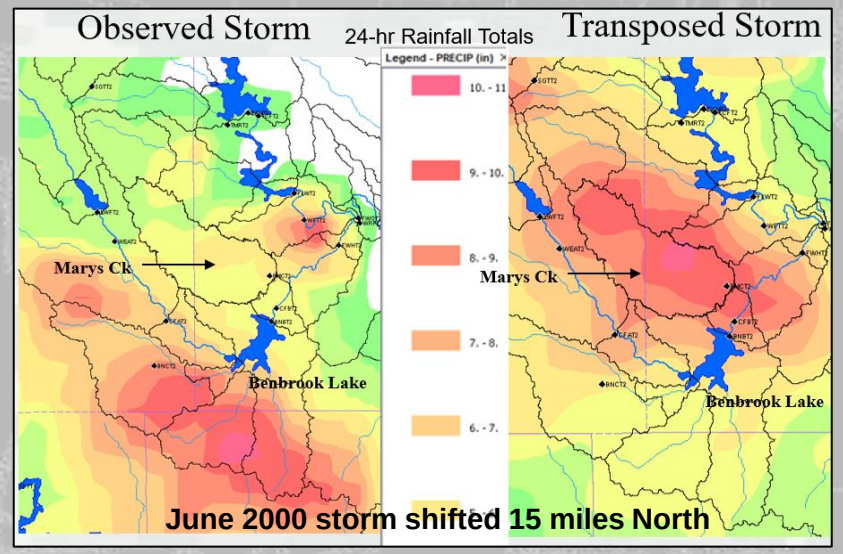
PROJECT UPDATE: UPPER TRINITY STORM SHIFTING SILVER JACKETS STUDY

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



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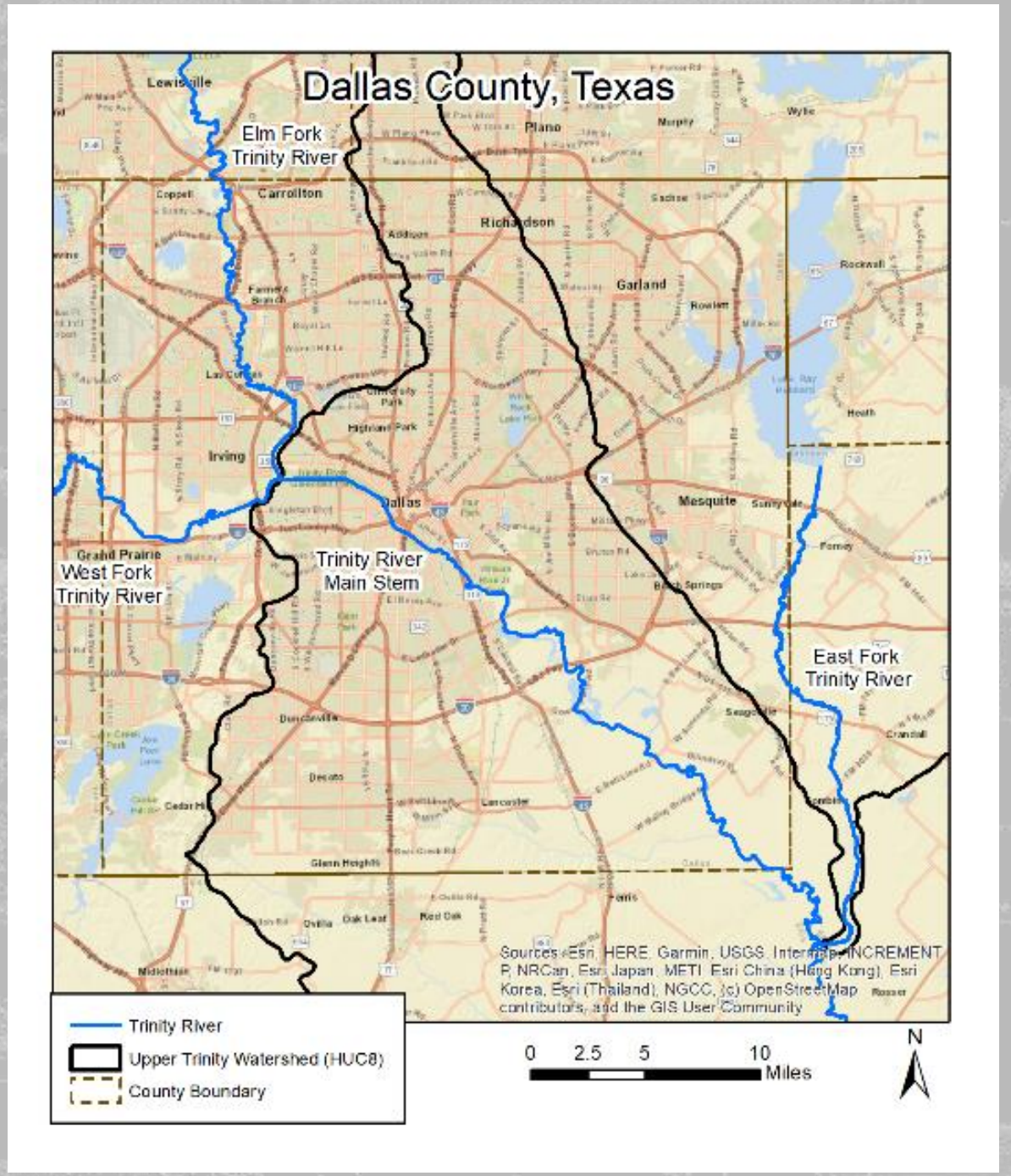


UPPER TRINITY STORM SHIFT SILVER JACKETS STUDY

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

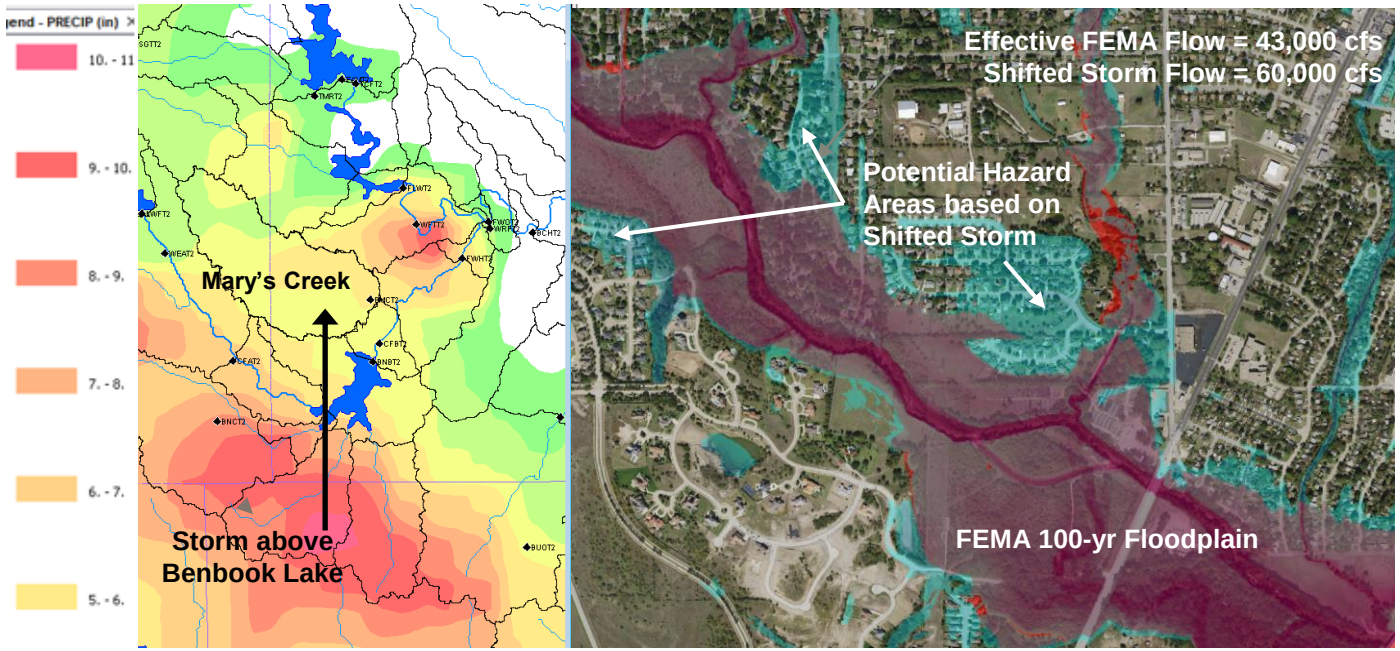
- Silver Jackets project funded through USACE Flood Plain Management Services (FPMS) program that provides USACE technical and planning support to local, state, and federal entities

- **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

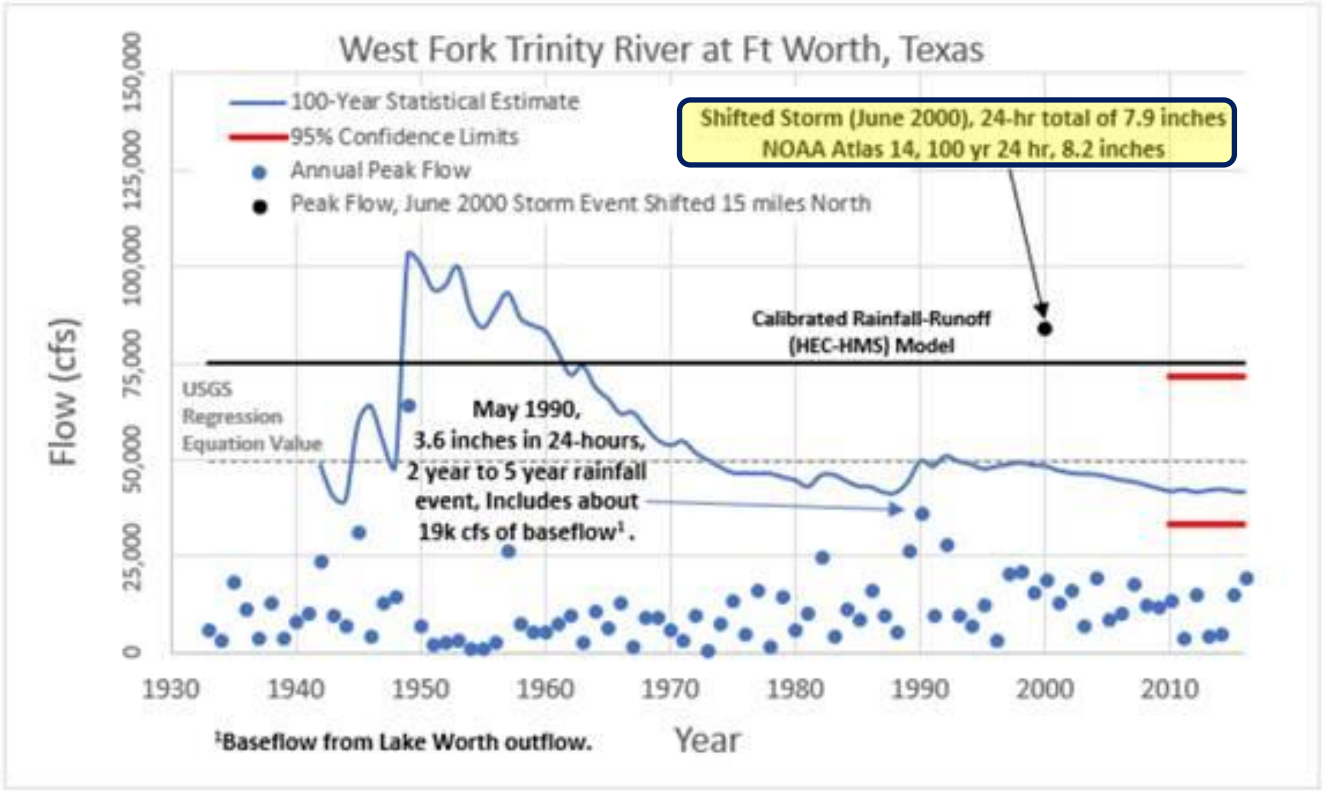
WHY: QUESTIONABLE HISTORIC RECORDS & LACK OF SAFETY FACTORS

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

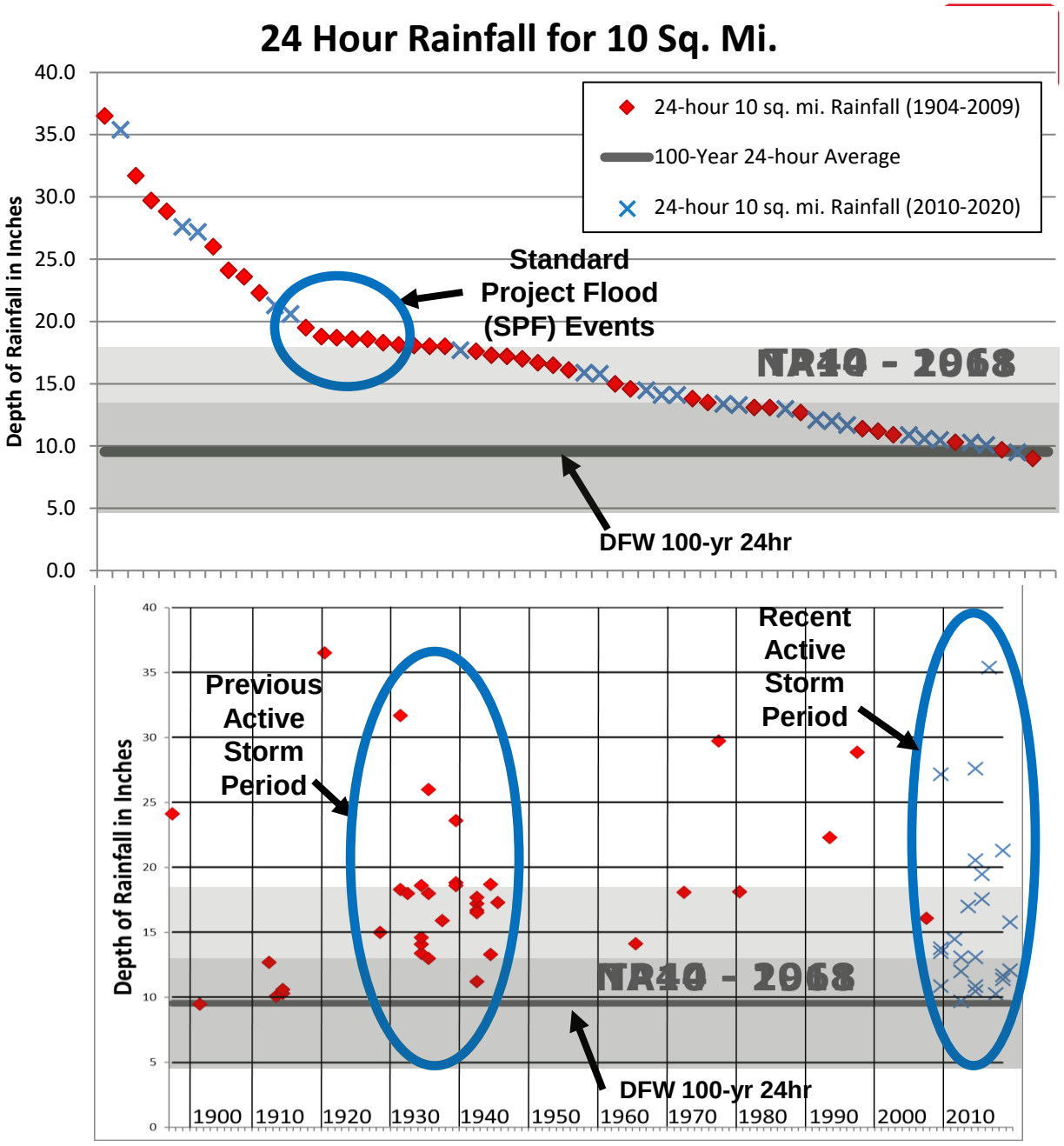


WHY: INCREASING FREQUENCY AND MAGNITUDE OF PRECIPITATION EVENTS

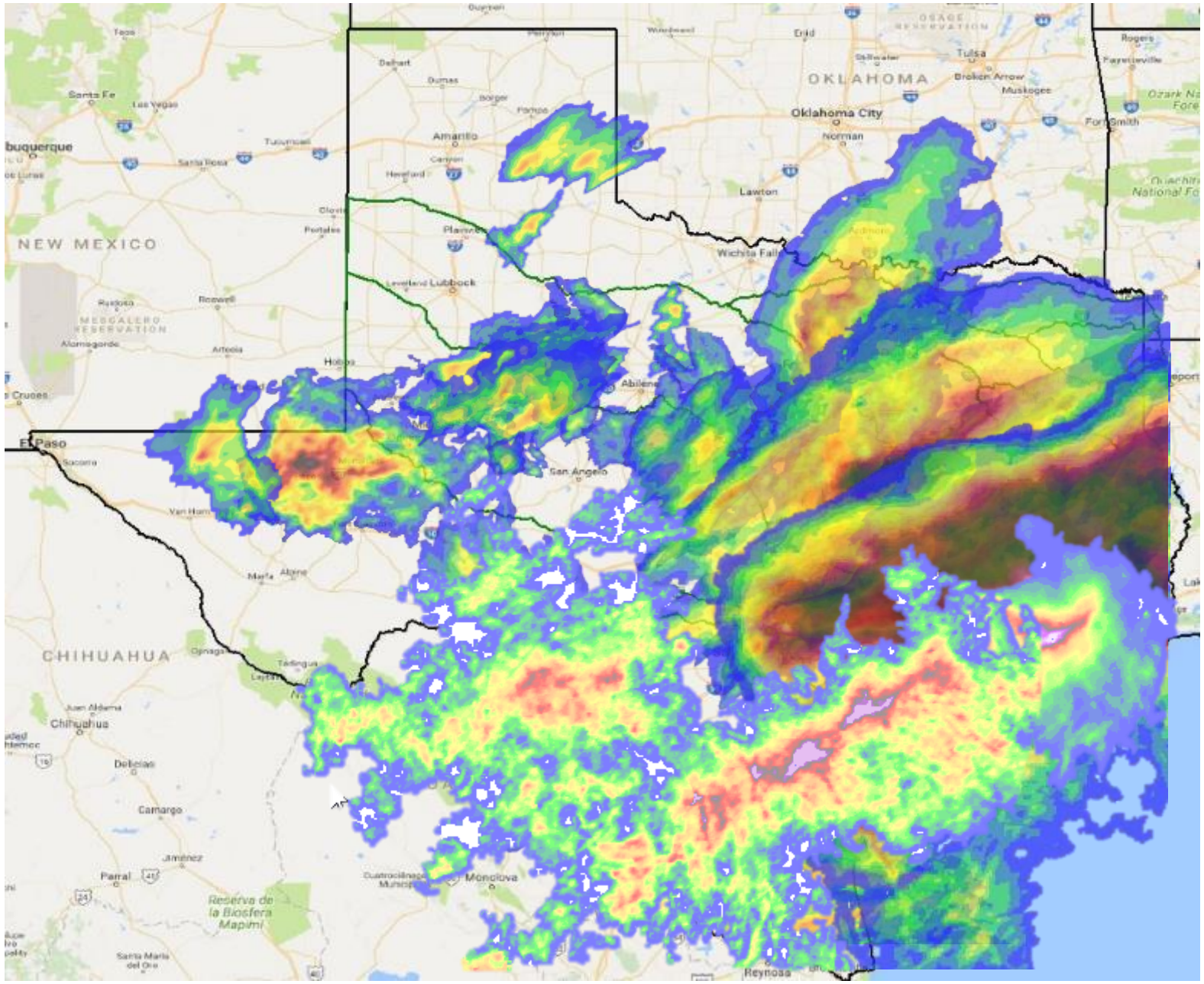
Regional observed storms

- 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

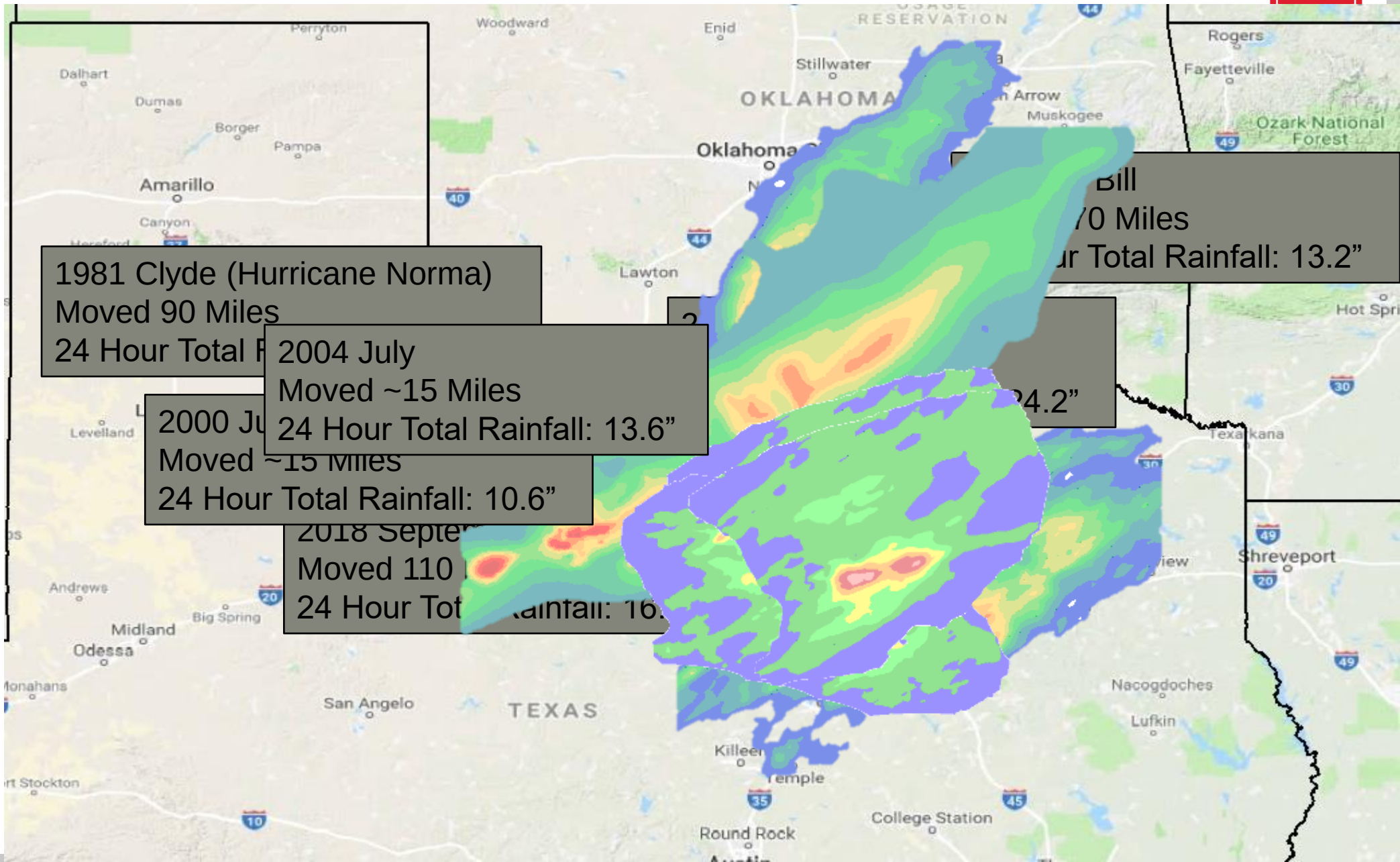


WHY: EXTREME STORMS (2010-2019)



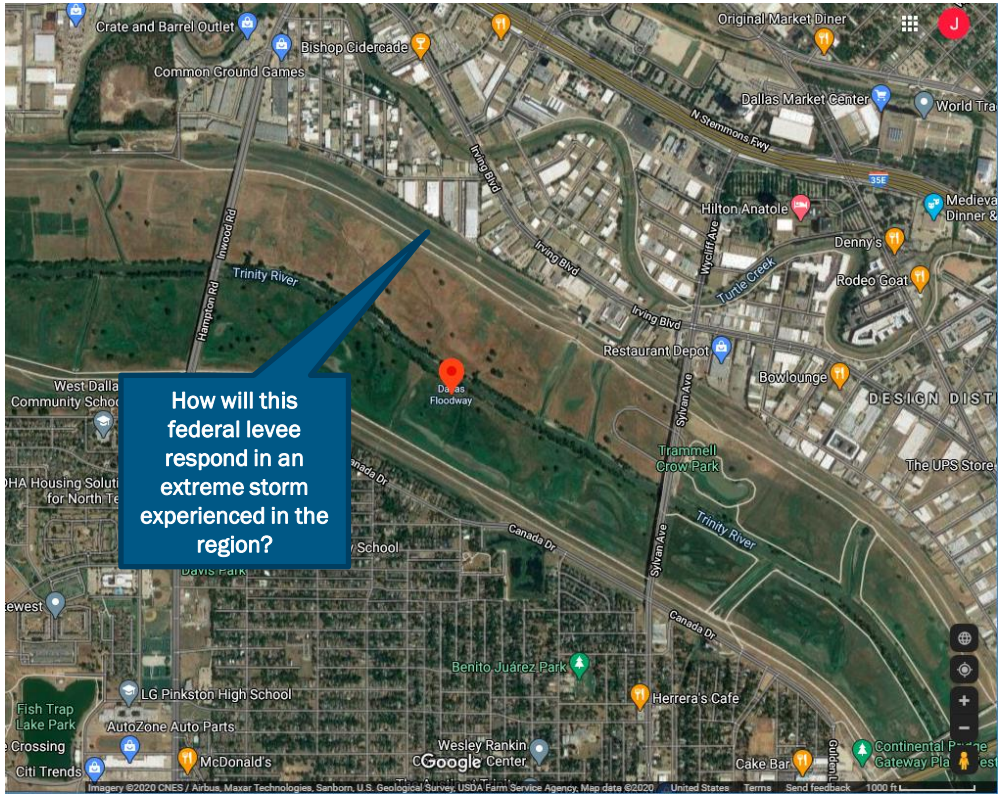
SCARY STORMS ARE EVERYWHERE…

- 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

0_Prepare_HMS_Storm_Transposition Model

Data Input: *Gridded Precip in DSS Format*

HEC-MetVue

Get the bulls-eye location of storm

ArcGIS

Create a rectangular shapefile with bulls-eye at center

Vortex Importer

Create gridded precip DSS file clipped to shapefile

HEC-HMS

Create a *Gridded Precipitation* Met Model

1_Run_HMS_Historical_Storm_Optimization

Optimization

Parameters to be Optimized:
X: easting of storm center
Y: northing of storm center

Shuffled Complex Evolution SCE-UA

Data Input: *Transposition Scale Factor*

Vortex Transposer

HEC-HMS

Peak Flow

Optimal *X, Y*

2_Finalize_HMS_Historical_Storm_Runs

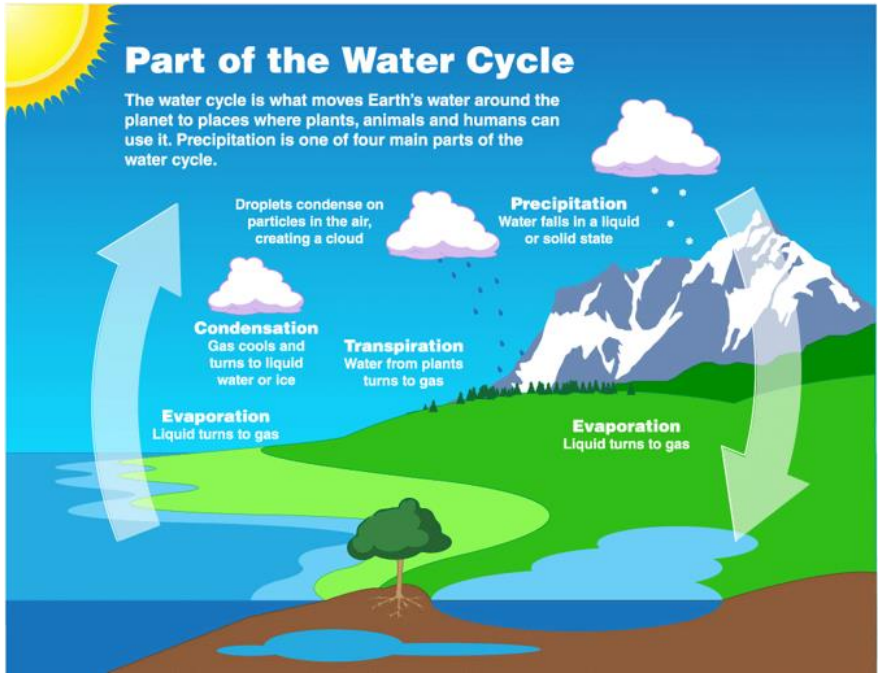
Vortex Transposer

HEC-HMS

Optimal *Peak Flow*

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

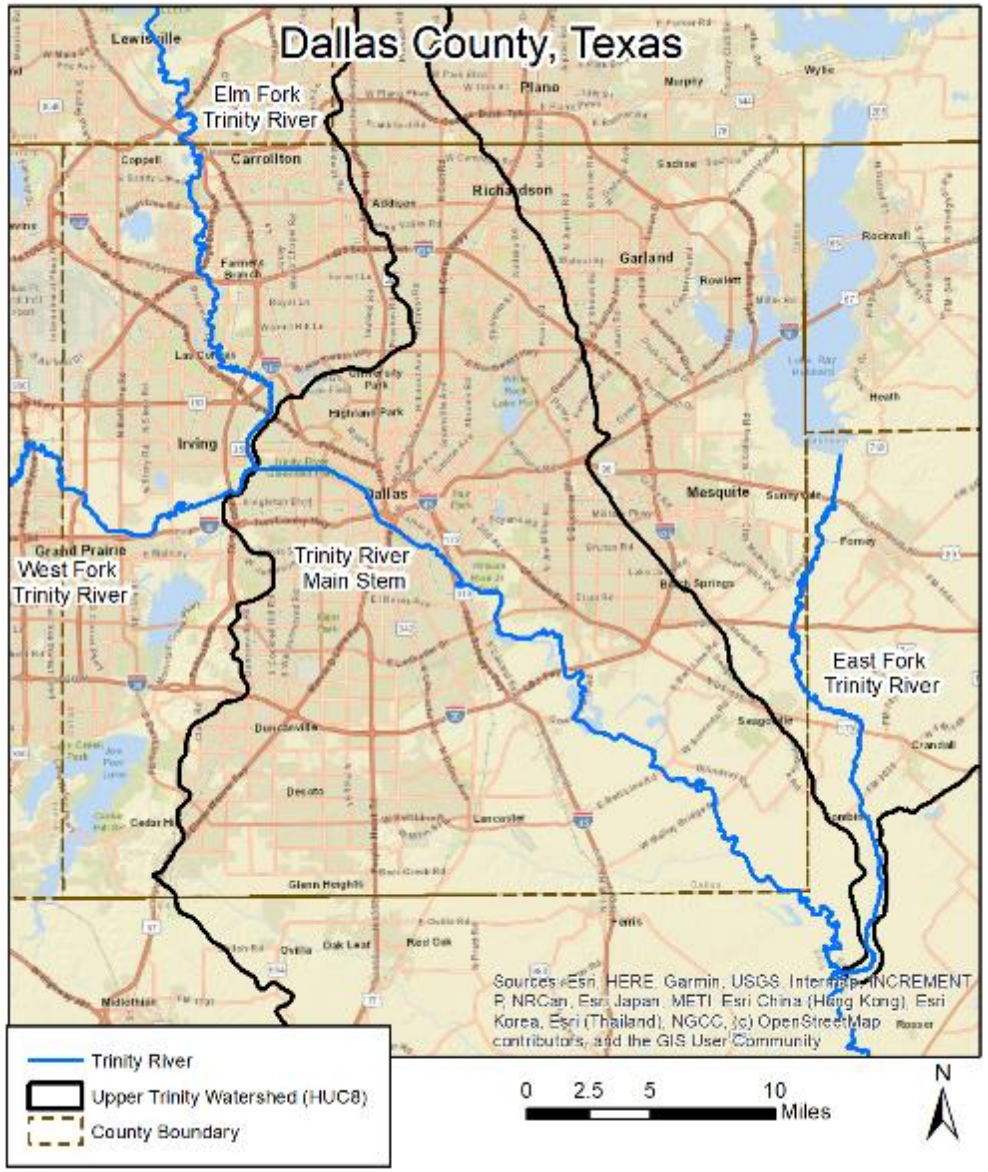
Hydraulics (how water conveys):

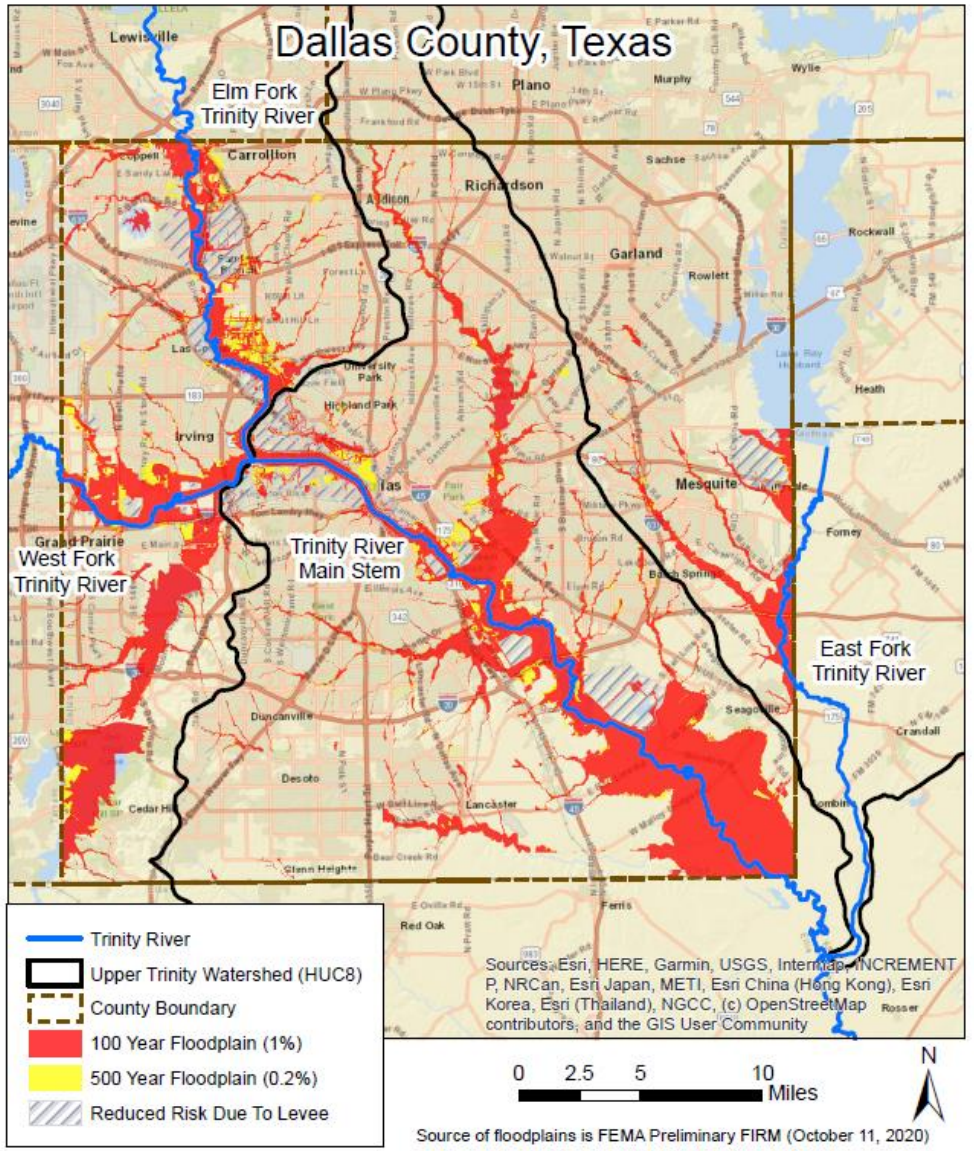
- Depending on exact areas of interest, will use 2017 or newer studies obtained through collaboration with project partners

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





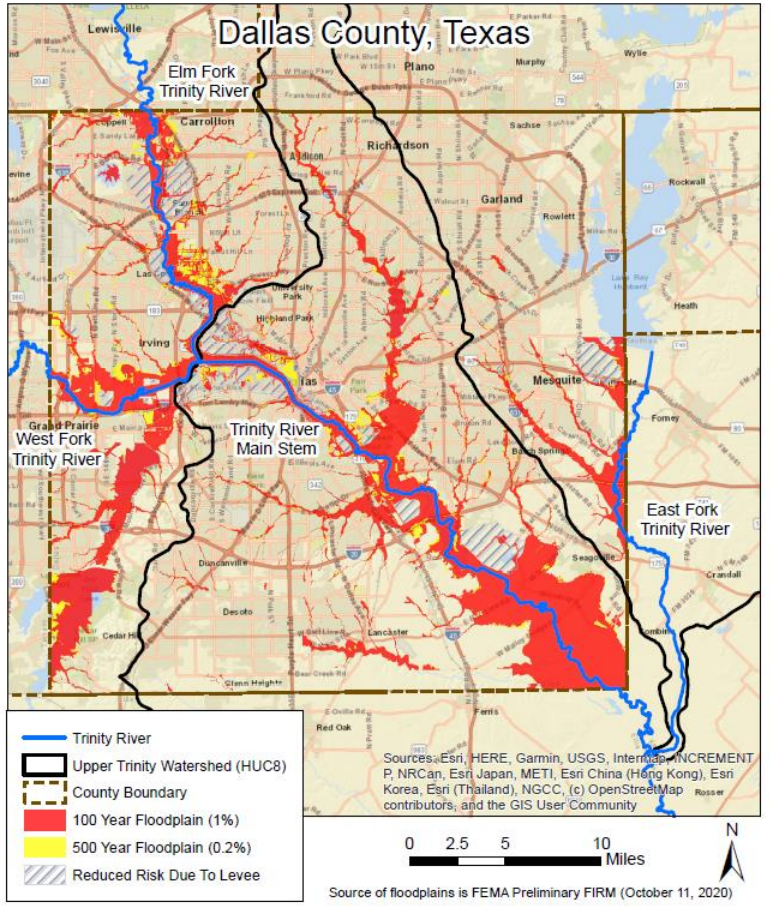
Source of floodplains is FEMA Preliminary FIRM (October 11, 2020)

UPPER TRINITY STORM SELECTION

Initially selected 4 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
Mansfield, TX	Jul 2004	17.4”	48 hours	40 miles	Convective
Dawson, TX – Hurricane Patricia	Oct-2015	22.7”	48 hours	68 miles	Tropical

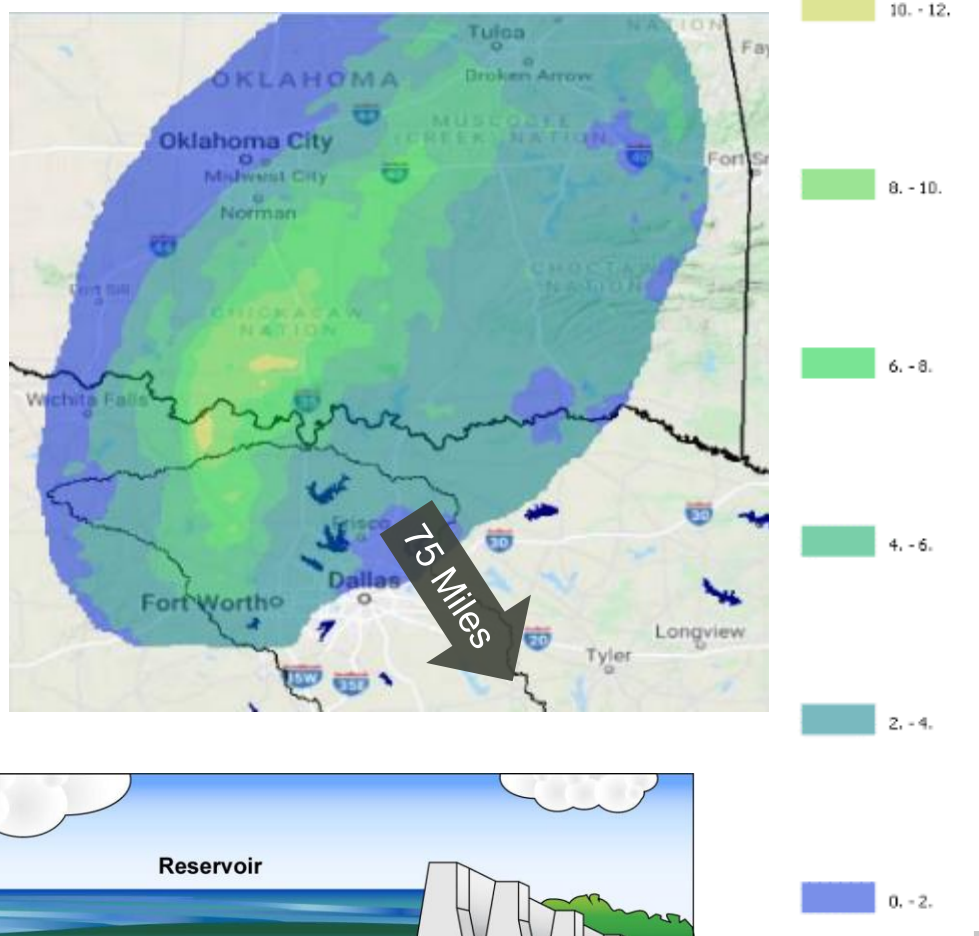
Chose 5-6 different focus areas in Dallas County based on local coordination

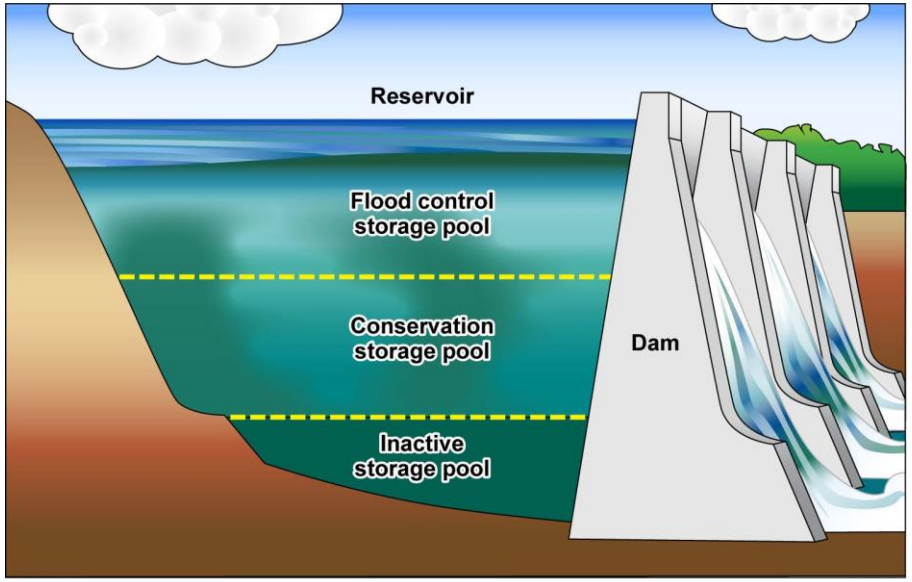


UPPER TRINITY STORM SHIFT SCENARIOS

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).





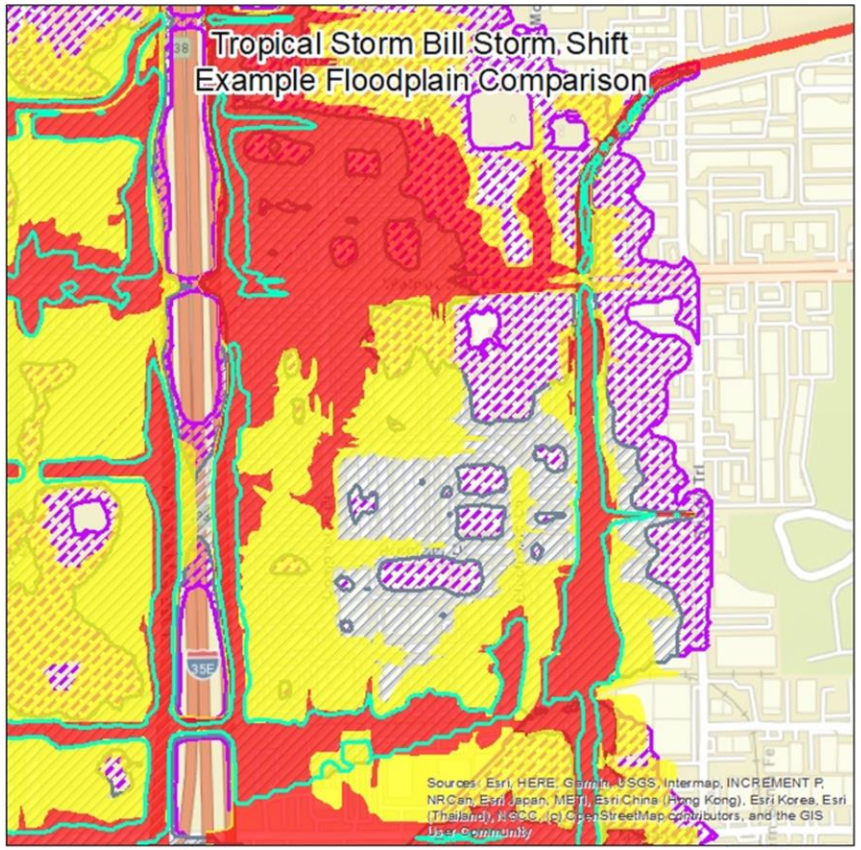
Source: GAO. | GAO-16-685

UPPER TRINITY STORM SHIFT INITIAL RESULTS

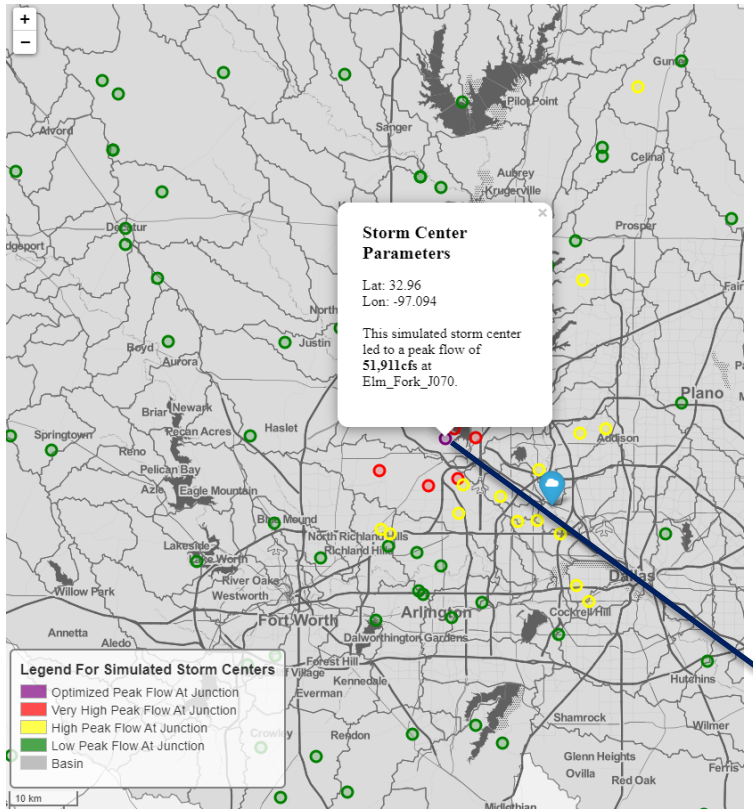
Tropical Storm Bill (13.6” in 48 hours):

- Sample peak flows for 5 different locations and 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
West Fork & Elm Fork Converge	95,917	148,428	193,525	113,800	140,200	182,800
White Rock Lake Inflow	33,880	46,720	51,203	46,600	53,200	62,200
Trinity River above Ten Mile Creek	76,966	124,719	182,803	104,000	125,700	161,300
East Fork above Mustang Creek	50,521	60,895	123,840	57,200	72,200	96,100

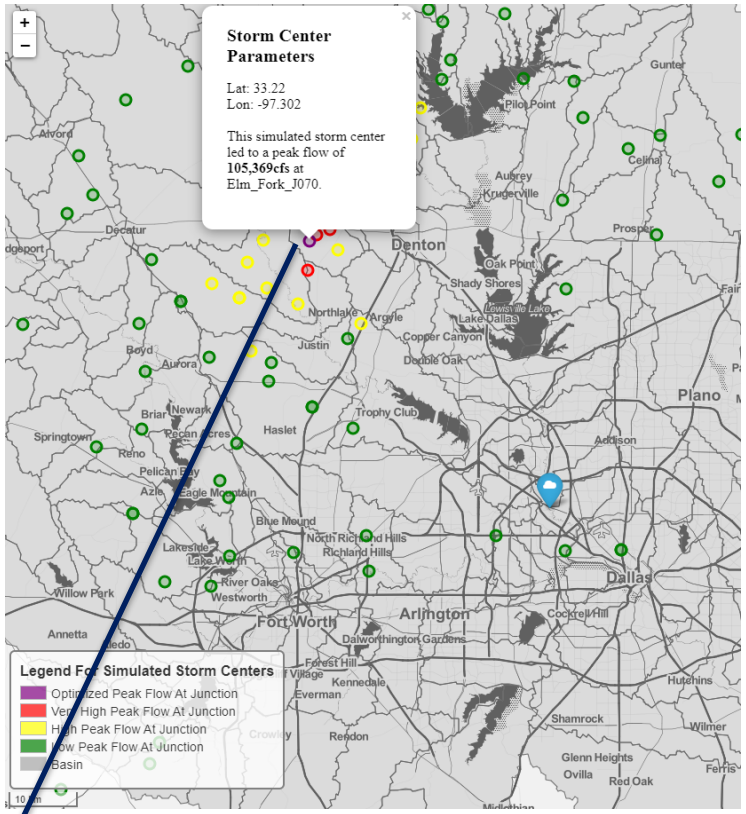


UPPER TRINITY STORM SHIFT INITIAL RESULTS



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
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Trinity River above Ten Mile Creek	76,966	124,719	182,803	104,000	125,700	161,300
East Fork above Mustang Creek	50,521	60,895	123,840	57,200	72,200	96,100

HTML MAP DEMONSTRATION

STATUS UPDATE & NEXT STEPS

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

Next Steps and Discussion:

- Will share draft html maps, spatial (GIS) data, and other relevant visuals/data for review soon (will request feedback comments by ~end of February)
- If engineering H&H models are needed, we can share via FTP or other
- Study report will be subsequently shared for review
- Other data requirements or additional considerations?

STORM SHIFTING – OTHER EXAMPLES

Waco, TX completed

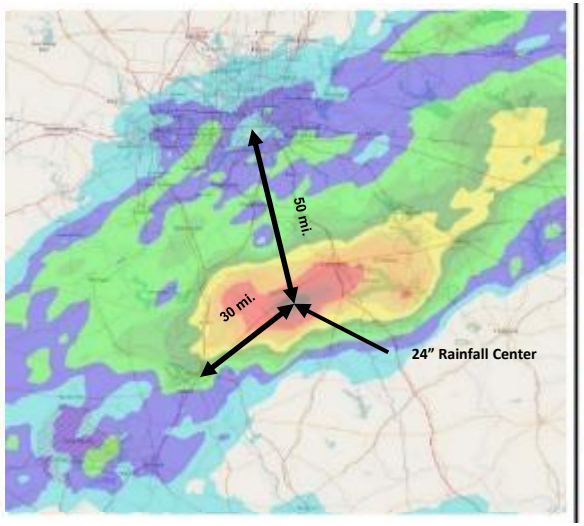
- Issue: Uncertainty associated with determination of flood potential (dams)
- Shifted several storms (30+ mi)
- Examined different operational constraints, multiple scenarios
- Outcome: showed flood potential is greater than 100-year

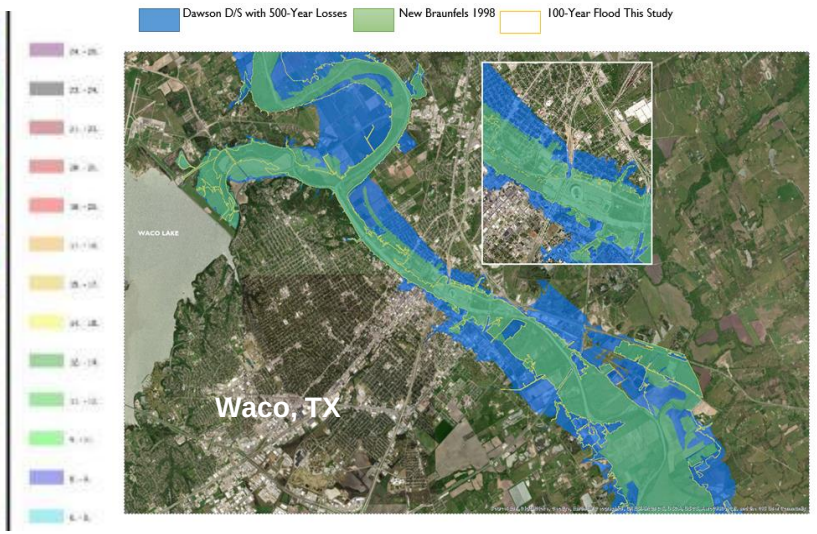
Mary's Creek, DFW, TX area

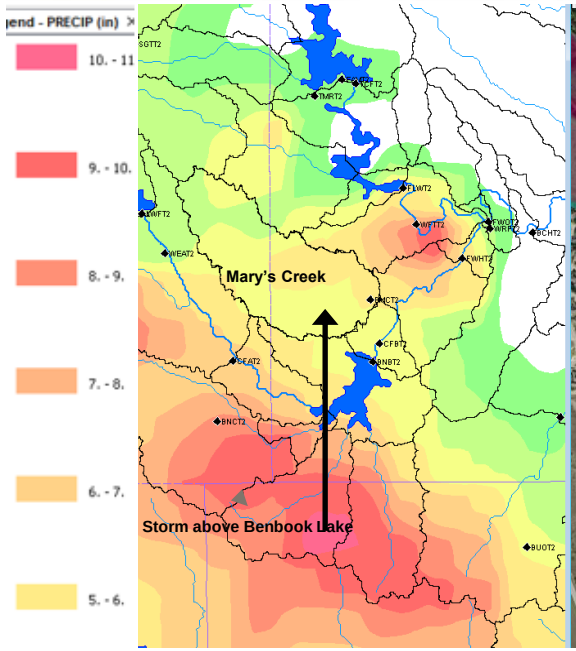
- Issue: Uncertainty associated with determination of flood potential
- Shifted 2000 100-year± storm 15 miles
- Outcome: Flood potential is greater than previously understood

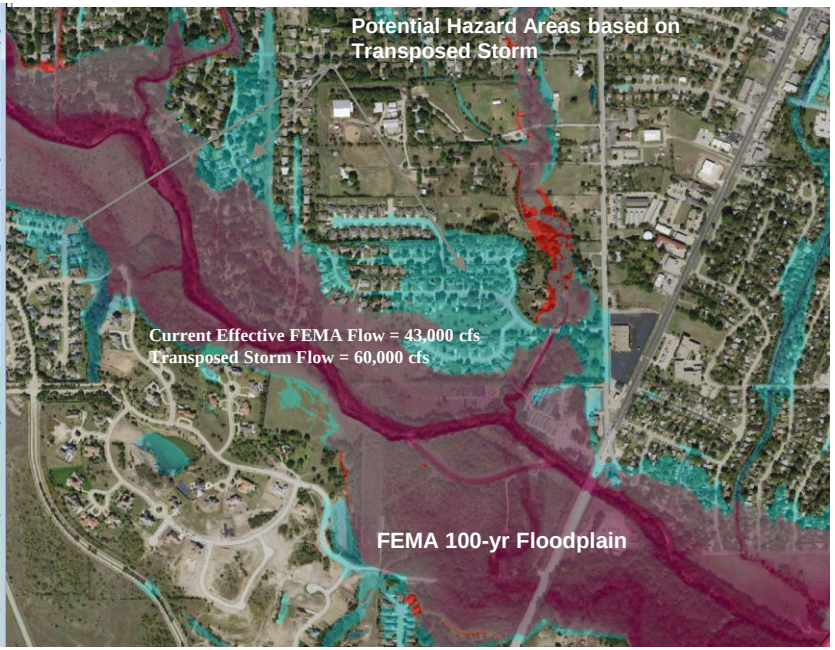
Future

- 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









CONTACT

Matt Lepinski, P.E.
Water Resources Branch
U.S. Army Corps of Engineers
Matthew.T.Lepinski@usace.army.mil
817.886.1683

Josh Willis, P.E.
Hydrology and Statistics Division
U.S. Army Corps of Engineers
Joshua.R.Willis@usace.army.mil
503-302-3703

Simeon Benson, P.E.
Water Resources Branch
U.S. Army Corps of Engineers
Simeon.A.Benson@usace.army.mil
817.886.1544

Jodie Foster
Silver Jackets Coordinator
U.S. Army Corps of Engineers
Jodie.R.Foster@usace.army.mil
817.886.1679

QUESTIONS?

UPPER TRINITY RIVER HYDRAULIC MODEL COLLABORATION

E&C/SWF/Water Resources Branch

US Army Corps of Engineers®

SUMMARY

Upper Trinity Corridor Development Certificate (CDC) Program and Model History

Goal: Stabilization of flood risk along the Trinity River

- Program and model history:
  - CDC program originated in 1991
  - Understood that commercial/residential development could compromise existing flood control “protections” and may impact wetlands/natural resources
  - CDC model (USACE) and FEMA model developed in the 1990’s
  - CDC program will benefit from one consolidated model

Geo-Referenced CDC Model Project

- Update to geo-referenced model FEMA developed based on CDC geometry and 2005 flows
- Among other differences, doesn’t include CDC projects that have been approved since 2017

Trinity Main Stem and East Fork Trinity CDC Model Extension Project

- Will result in the development of future condition (CDC) modeling and floodplain delineations for the East Fork below Ray Hubbard and for the Trinity River from Southeaster Dallas County to Henderson County

Consequence

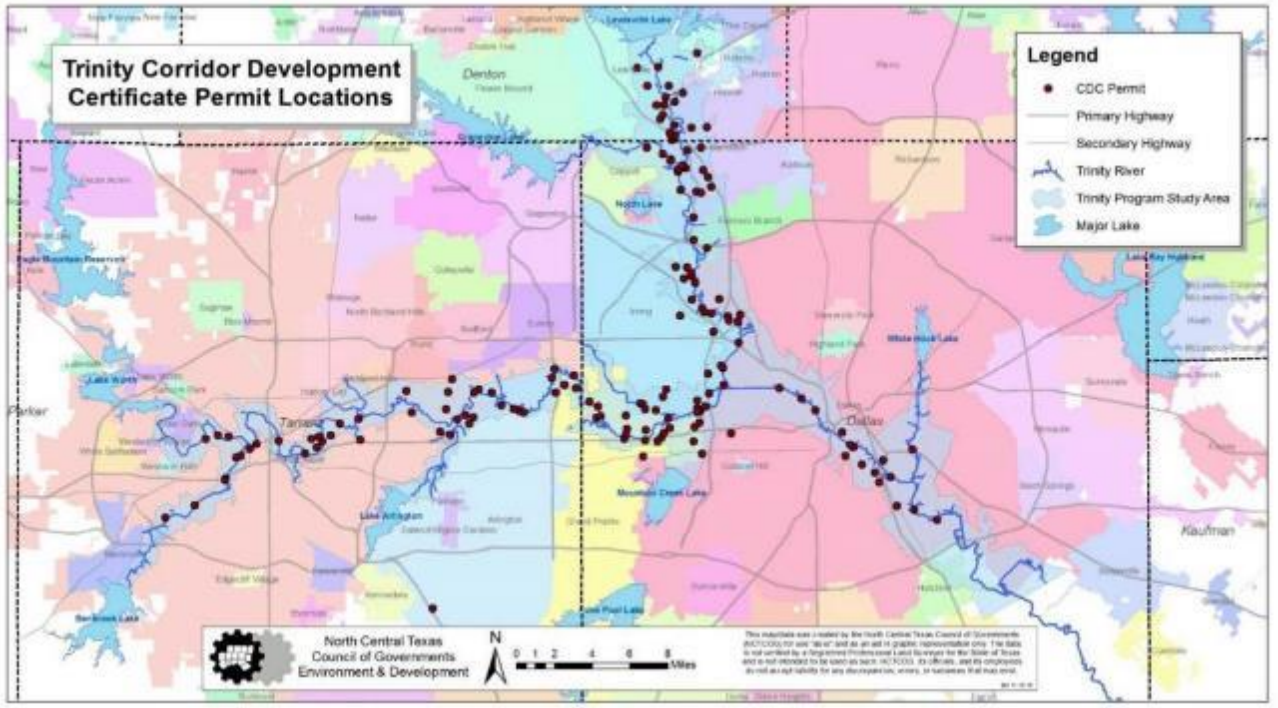
- New modeling will be joined with existing NFIP and CDC modeling to create a single Consolidated NFIP-CDC HEC-RAS model (under a single RAS prj file)
- Discoverable via interactive Trinity River CDC website: http://trinityrivercdc.com/
- Collaboration and innovation despite hurdles

MODEL CONSOLIDATION

Differences between current CDC and FEMA models

- The CDC Model consists of constructed projects along with un-constructed CDC and USACE Section 404 permitted projects and future conditions flows
- FEMA Model consists of constructed projects and 2005 flows.
- Should reflect development along East Fork Trinity River and Main Stem from SE Dallas County to Rosser (Ellis County)

Trinity River Corridor



One Consolidated Model – Two (or more) Purposes

- FEMA investment to georeferenced and merge $$$
- Watershed/floodplain changes reflected in both models
- Consolidated review process
- Simplify, streamline and transparency
- Manages WS elevations

- Existing conditions
- Future conditions
- Must manage floodways (FEMA)
- Must manage storage (CDC)
- Promotes flood risk awareness and resiliency

CDC MODEL EXTENSION PROJECT

Trinity Main Stem and East Fork Trinity

Study extents:

East Fork Trinity - 30 miles
Lake Ray Hubbard to Trinity River

Trinity Main Stem - 38 miles
South of IH 20 to Henderson County

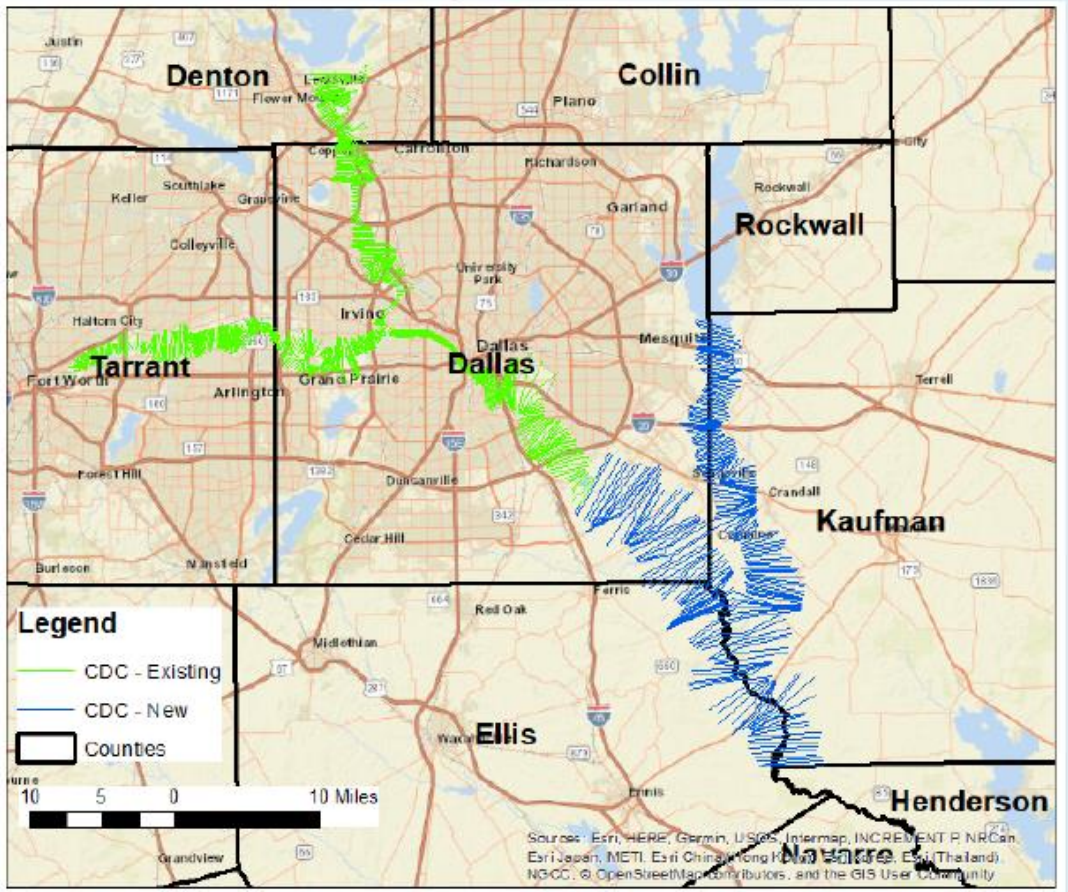
3 Impacted Counties:

- Dallas
- Ellis
- Kaufman

CDC MODEL EXTENSION PROJECT

CDC Model Extension – Trinity Main Stem and East Fork Trinity

- Incorporation of East Fork and Main Stem extension into Consolidated NFIP-CDC HEC-RAS model.
  - East Fork below Ray Hubbard
  - Main Stem to Henderson County
- Leverage FEMA modeling being developed by Compass PTS JV
- Develop and incorporate <u>future flows</u>
- $270,000 24 months



North Central Texas Council of Governments
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CDC MODEL EXTENSION PROJECT

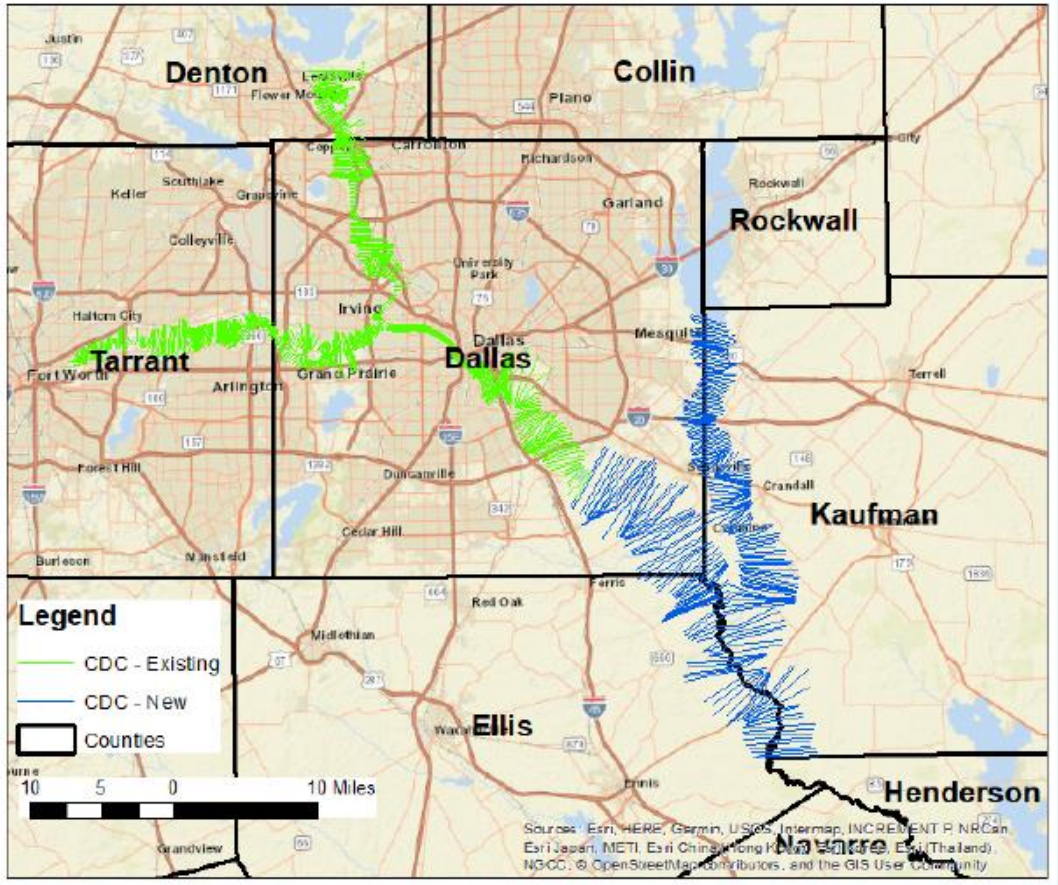
CDC Model Extension – Trinity Main Stem and East Fork Trinity

Deliverables

- Future land use HEC-HMS Model (Trinity Main Stem extension and East Fork)
- Consolidated NFIP-CDC HEC-RAS model
- Inundation area shapefiles for future 100-yr and SPF events
- Project study report

Benefits

- Stabilization of flood risk along East Fork and Main Stem to Henderson County



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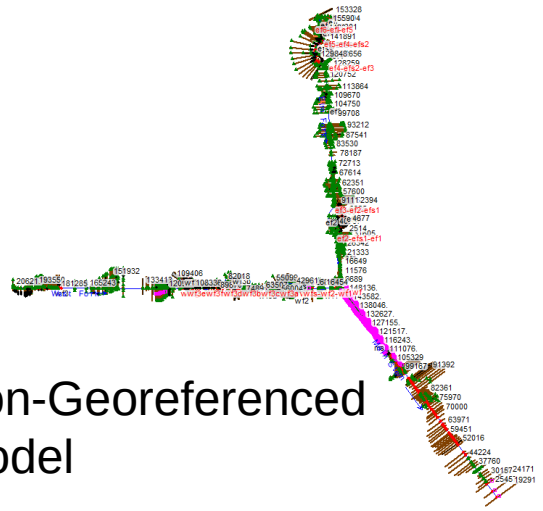
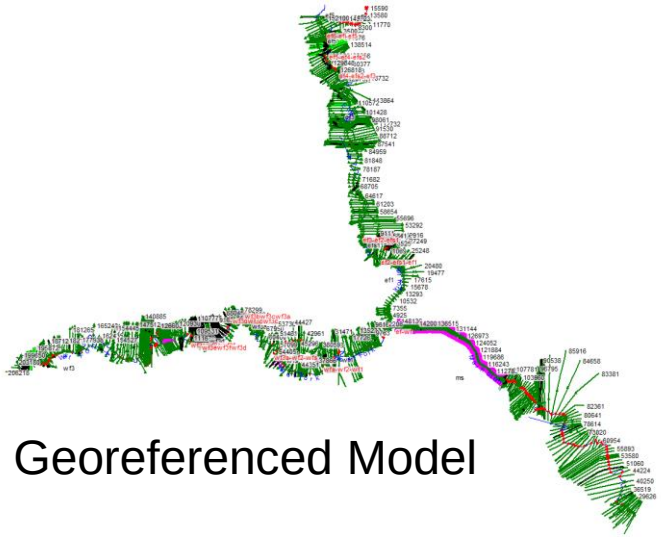
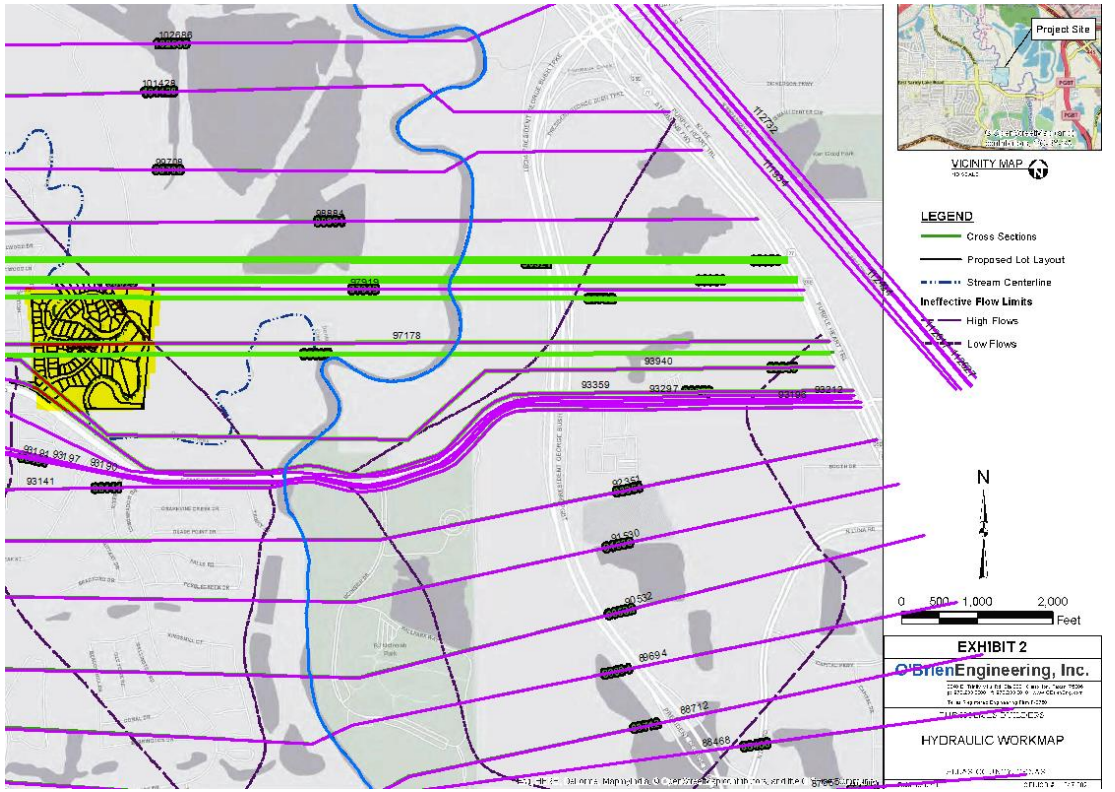
GEO-REFERENCED CDC MODEL PROJECT



Non-Georeferenced Model



Georeferenced Model



Methodology:

- Digitize workmaps (example above) and trace new cross-section(s) (see green lines)
- Verify against new project geometry
- Import new project geometry into geo-referenced model and review/document results

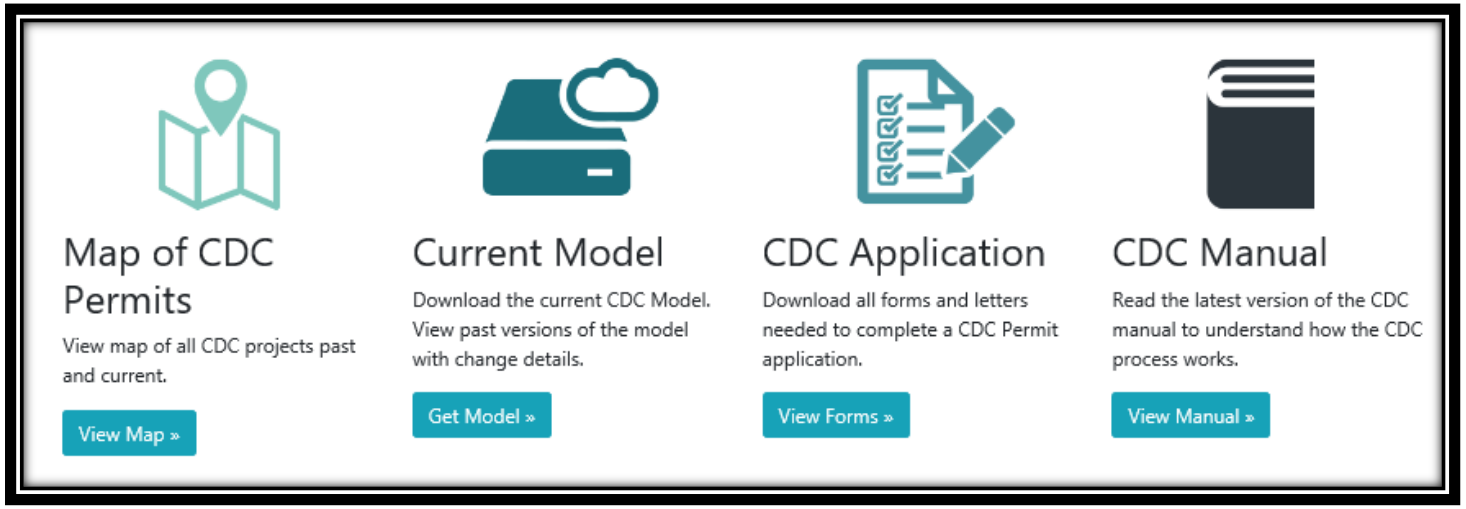
Status Update:

- Added ~40% of latest CDC projects (since 2017) to the model geometry.
- Project is currently scheduled to complete in the first quarter of 2022 (March 2022), subject to continued access to funding and other considerations.

INTERACTIVE CDC WEBSITE

Collaborative and user-friendly resource

- http://trinityrivercdc.com/



Status Definitions

Granted: The CDC Application has gone through the full CDC process and the permitting entity has granted a CDC.
Exemption Granted: The permitting entity has determined the project is exempt from the CDC criteria (Section 1.6.1 of the CDC Manual 4th Edition).
Variance Granted: The permitting entity has given this project a variance from the CDC criteria (Section 1.6.2 of the CDC Manual 4th Edition).
Comment Period: The CDC Application is currently in the 30-day review period by the CDC participating entities (Section 1.3.6 of the CDC Manual 4th Edition).
Under Review: The CDC Application is currently under Technical Review by the United States Army Corps of Engineers (USACE) (Section 4.1.7 of the 4th Edition CDC Manual).

CDC Tracking Number	Project Name	Jurisdiction	Status	Last Updated
LEW 022521-1	KSKY Salem Radio Media Towers	Lewisville	Comment Period	03/12/2021
DC12172020	P&K Stone, LLC	Grand Prairie	Technical Review	03/11/2021
IRV101320-1	Lakeview Preserve	-	Comment Period	03/11/2021
CDC FW 030221-1	Gateway Park Shared Use Path and Sidewalk Connection	Fort Worth	Comment Period	03/11/2021
CDC FW 020321-1	Gemelle Restaurant	Fort Worth	Comment Period	03/05/2021
GP122820-1	DMO Property Holdings Dallas	Grand Prairie	Exemption Granted	02/26/2021
CAR122120-01	4.65 ac Office Building Site at Furneaux Creek/	Carrollton	Comment Period	01/20/2021
FW022021-01	Village Creek Wastewater Treatment Plant Lift Station	Fort Worth	Comment Period	01/20/2021
CAR 102120-01	Cotton Belt Regional Rail Design-Build	Carrollton	Technical Review	01/11/2021
CAR 092120-1	Western Extrusions Expansion	Carrollton	Granted	12/18/2020
FW 052019-1	West Pond (Largent Lake) Wetland Mitigation	Fort Worth	Technical Review Complete – Meets Criteria	10/02/2020

The latest Corridor Development Certificate (CDC) model is available for download here. The U.S. Army Corps of Engineers is responsible for updating the official CDC model and the latest version will be uploaded here after each update. Previous versions of the model are available as a reference. CDC applicants must submit projects utilizing the most recent version of the model.

Having trouble downloading the model or have questions? Please contact the NCTCOG Environment & Development Department at (817) 695-9210 or EandD@nctcog.org.

- Current Model -

Trinity River CDC Regulatory Model - 01/14/2021

Provided from USACE and uploaded January 14, 2021.

Model Update Date: 01/14/2021

File Contents: UTCDC_Model_v3.f01, UTCDC_Model_v3.fo2, UTCDC_Model_v3.fo3, UTCDC_Model_v3.g01, UTCDC_Model_v3.g02, UTCDC_Model_v3.g03, UTCDC_Model_v3.p01, UTCDC_Model_v3.p02,UTCDC_Model_v3.p03, UTCDC_Model_v3.prj

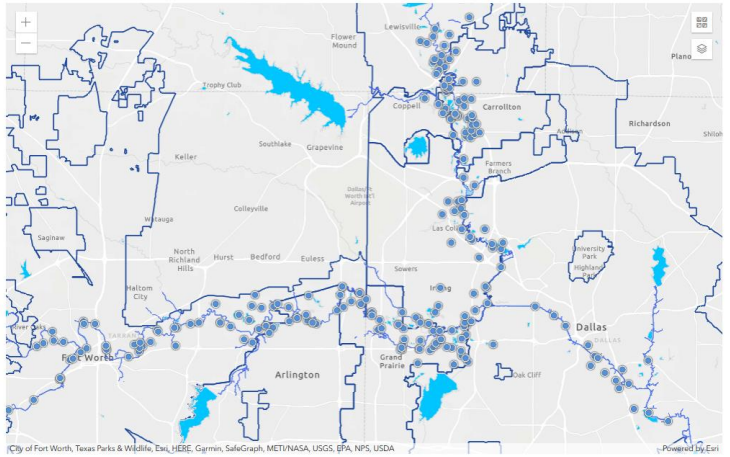
Download Current Model (.zip)

CORRIDOR DEVELOPMENT CERTIFICATE MANUAL

TRINITY RIVER CORRIDOR – NORTH CENTRAL TEXAS

TRINITY RIVER COMMON VISION

Safe, Clean, Enjoyable, Natural, Diverse



QUESTIONS?