

North Central Texas  
Council of Governments

# Flood Early Warning System Workshop

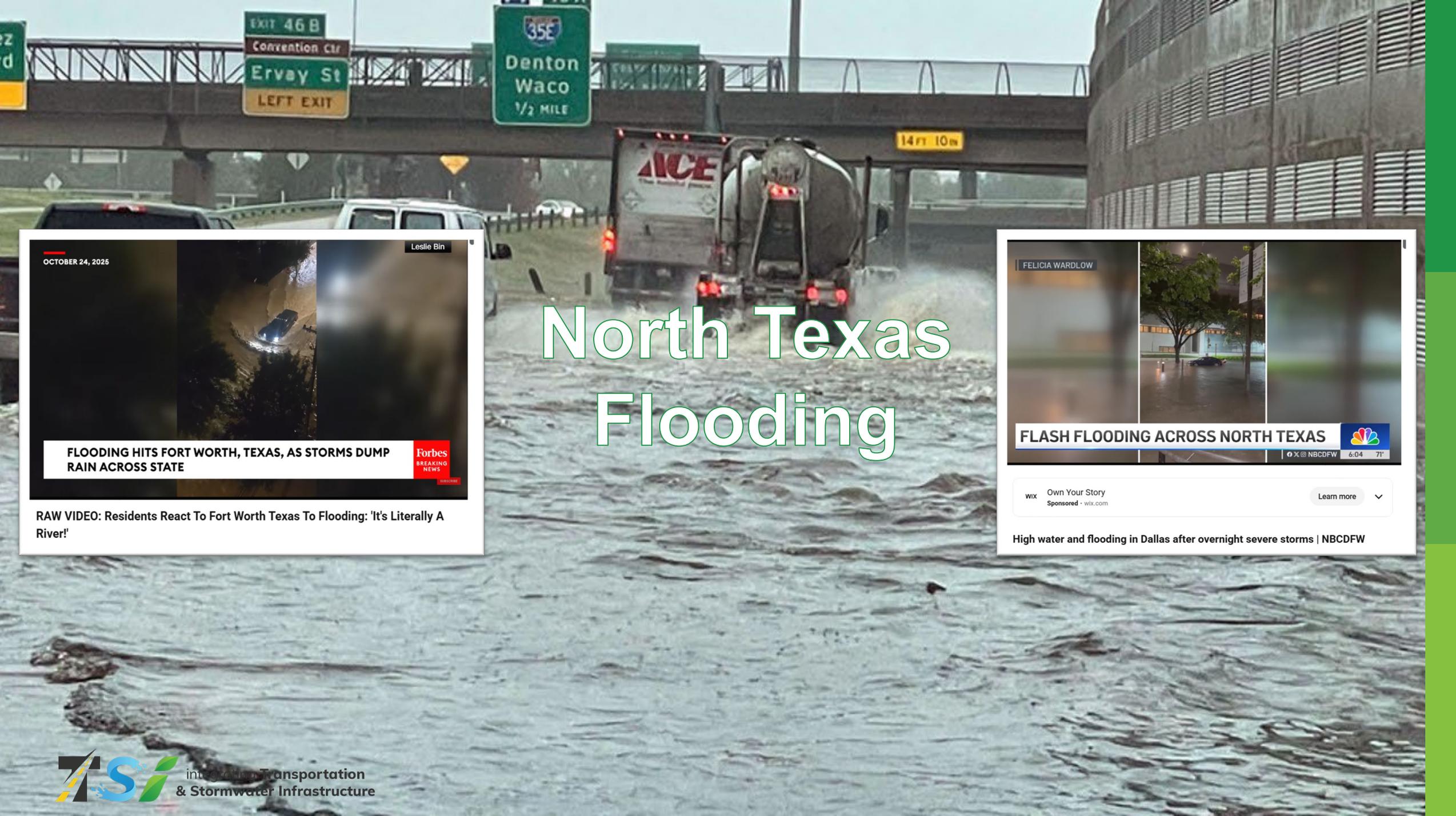
February 17, 2026



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.



# North Texas Flooding

OCTOBER 24, 2025

Leslie Bin

**FLOODING HITS FORT WORTH, TEXAS, AS STORMS DUMP RAIN ACROSS STATE**

Forbes  
BREAKING NEWS

RAW VIDEO: Residents React To Fort Worth Texas To Flooding: 'It's Literally A River!'

FELICIA WARDLOW

**FLASH FLOODING ACROSS NORTH TEXAS**

X @ NBCDFW 6:04 71°

wix Own Your Story  
Sponsored · wix.com

Learn more

High water and flooding in Dallas after overnight severe storms | NBCDFW

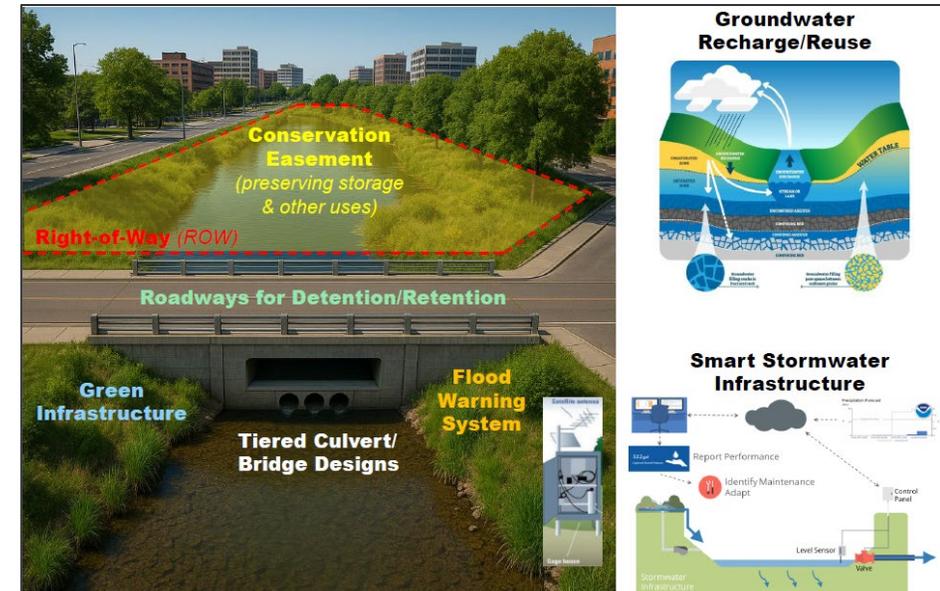


# TSI Study Overview

*TSI: Integrated Transportation and Stormwater Infrastructure*

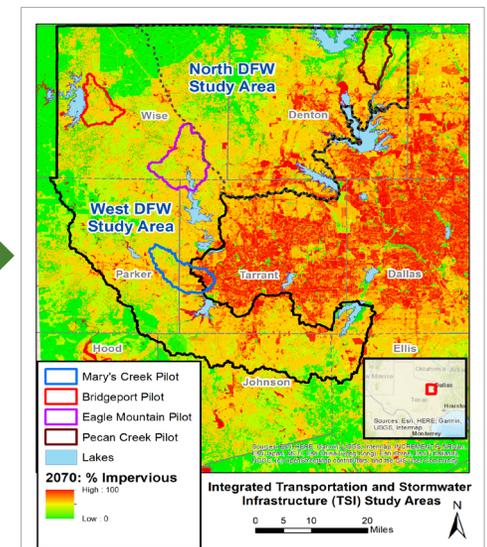
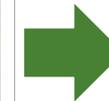
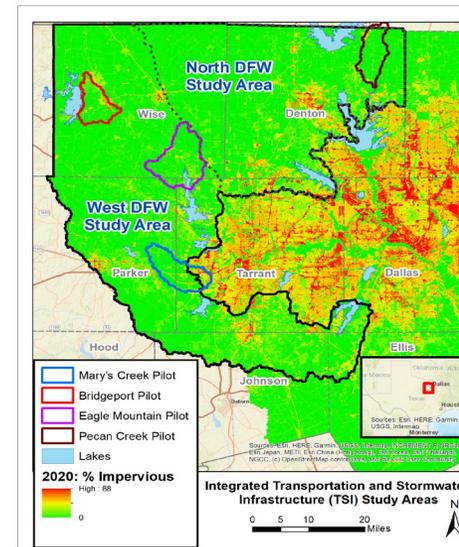
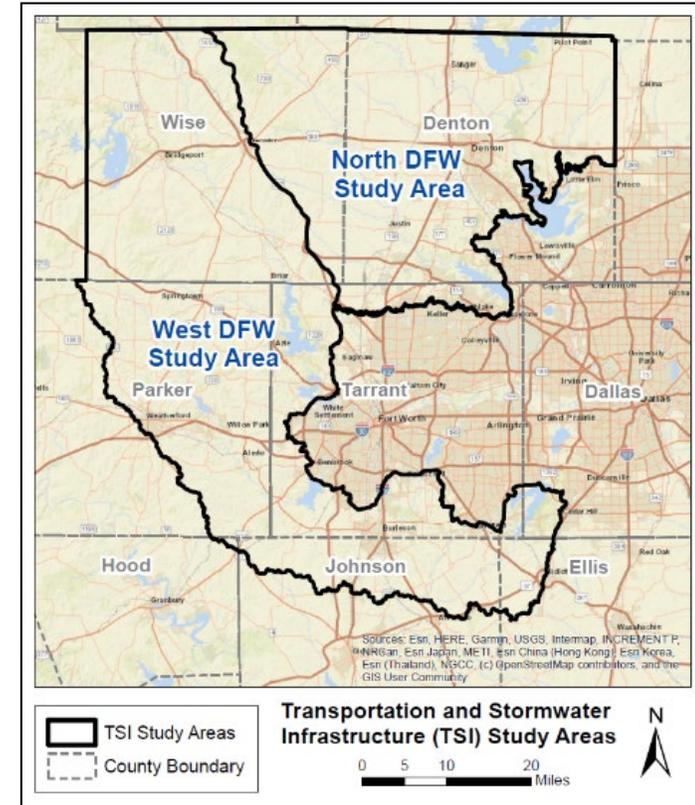
- Proactive vs. Reactive
- Regional “System” Approach

**Objective:** a ‘roadmap’ for communities



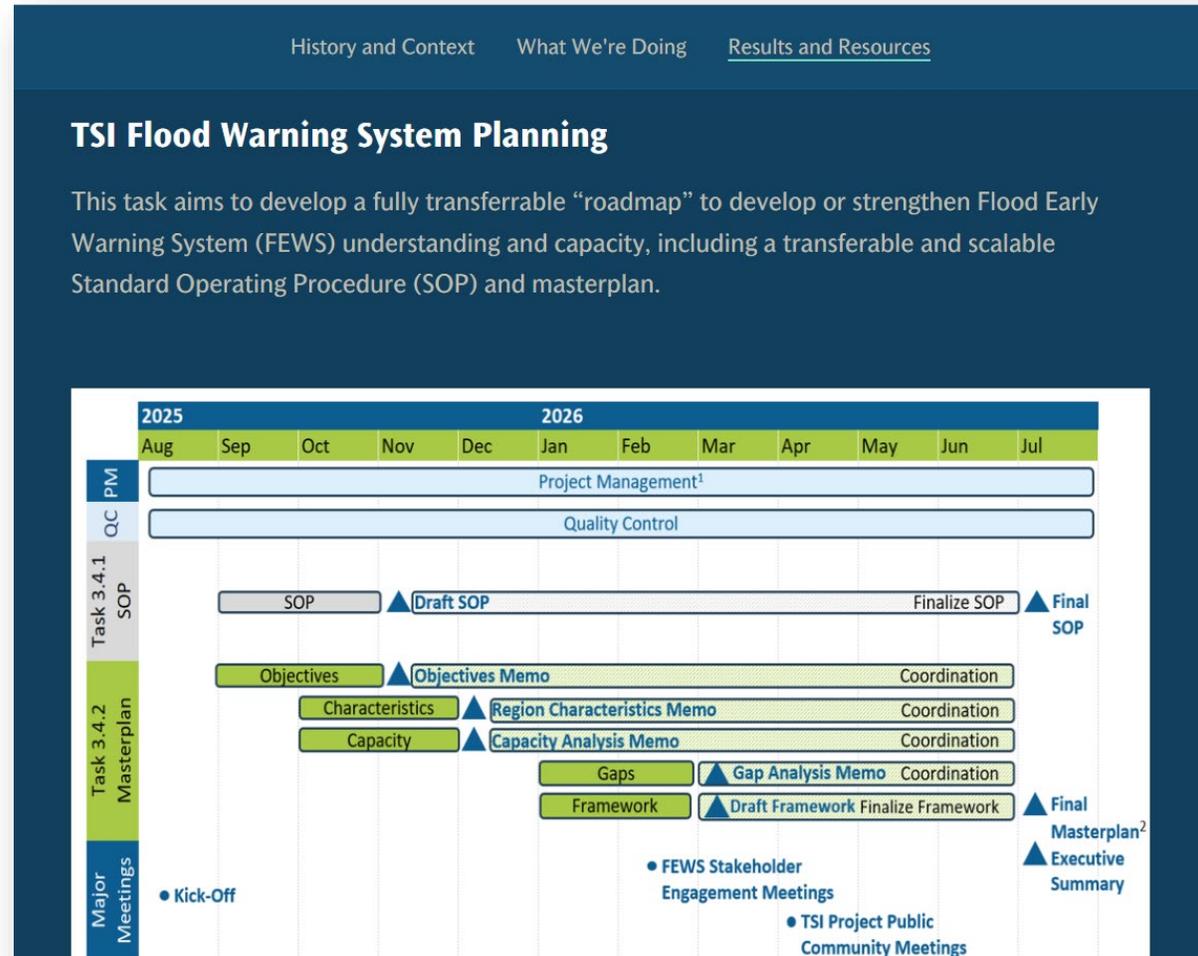
# By the End of Today's Session...

- You will:
  - Recognize the TSI concept and its resources related to **proactive and integrated regional planning**
  - Understand the TSI Flood Early Warning System (FEWS) approach, including application of the **FEWS SOP and Masterplan**
  - Learn from public works professionals about other **tools to enhance community resiliency**
  - Have the opportunity to provide **input to impact TSI results**



# Why TSI? A Story Map Demo

- History and Context
- What We're Doing
- Results and Resources

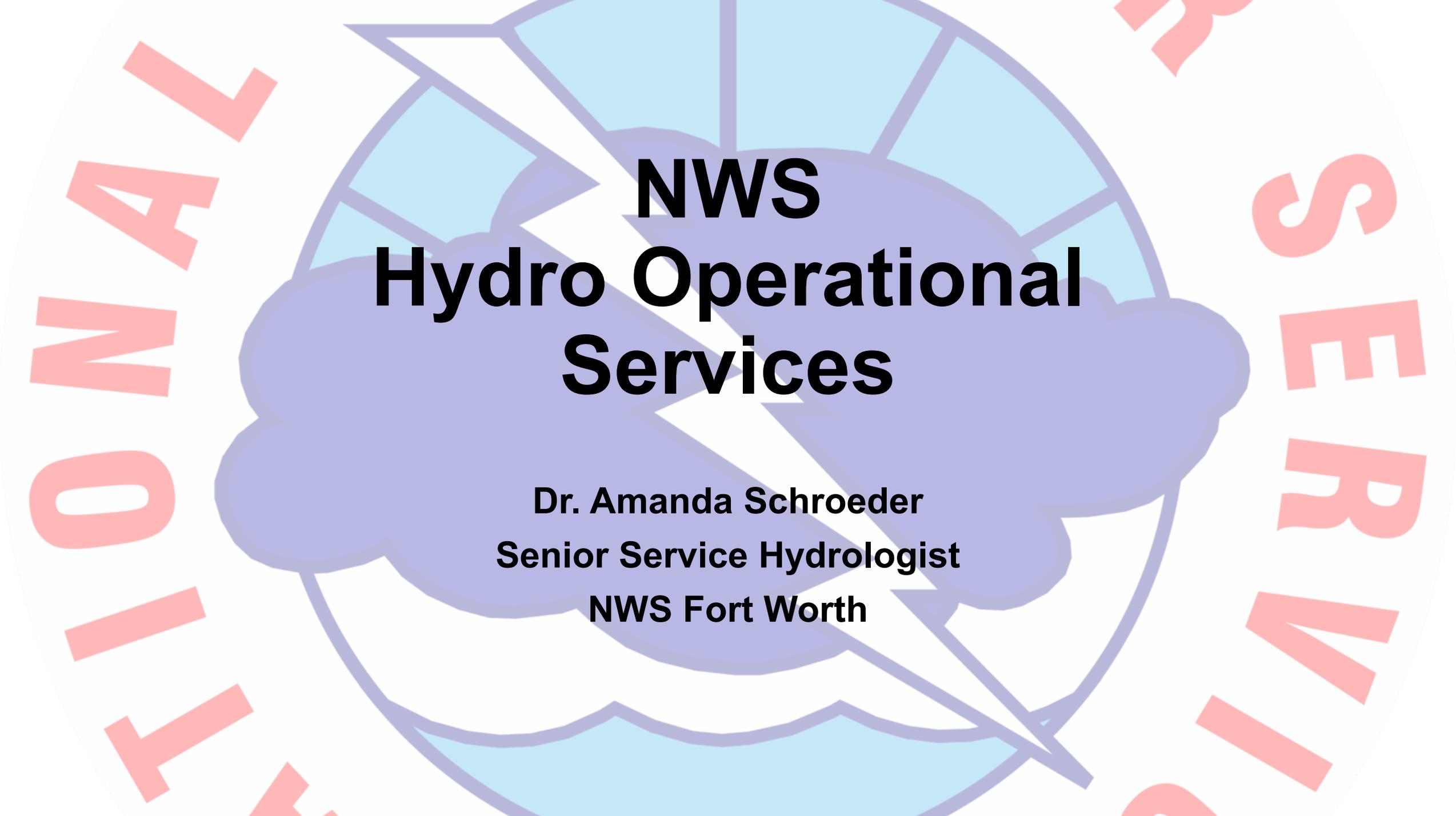


[www.nctcog.org/tsi](http://www.nctcog.org/tsi)

# Presentation from NWS

**Presenter:** Dr. Amanda Schroeder (Senior Service Hydrologist)

- Discuss flood forecasting processes, uncertainties, limitations, and evolving products, including flash flood and river flood warning decision-making and the value of coordinated warning systems.



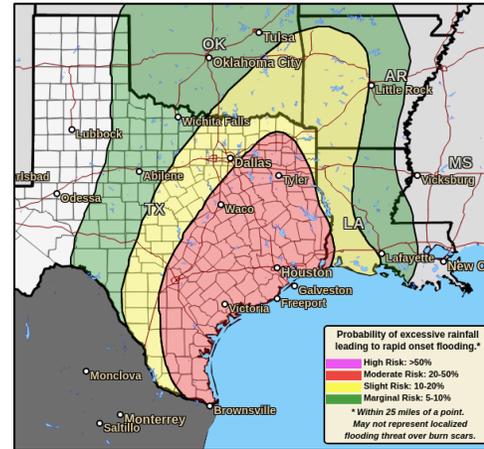
**NWS**  
**Hydro Operational**  
**Services**

**Dr. Amanda Schroeder**  
**Senior Service Hydrologist**  
**NWS Fort Worth**

# NWS “Pre-event” Hydro Products



- Excessive Rainfall Outlook (ERO)
  - Issued by WPC up to 5 days before event



- Flood Watch
  - Typically issued ~ 24-48 hrs. prior to heavy rain event onset
  - Can expect flash flooding AND river flooding due to excessive rainfall
- Flash Flood Watch
  - Reserved to cover areas immediately downstream of possible dam failure

Hydro Hazard Simplification (since Nov 2021)



# NWS Hydro Event Products



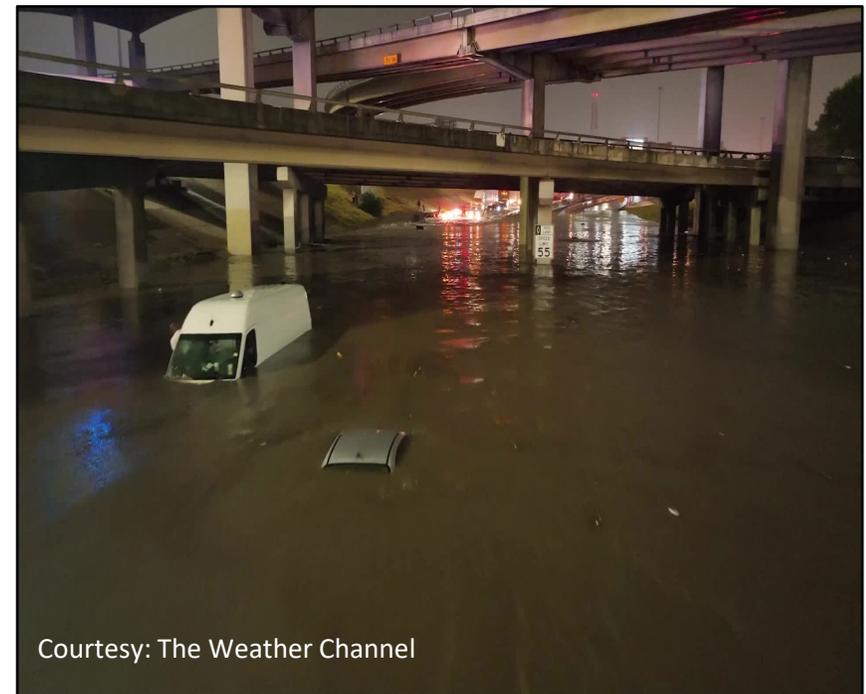
- Flood Advisory
  - Issued to alert the public about possible imminent/ongoing “nuisance” flooding (i.e. “ponding” on roadways, etc.)
- Flash Flood Warning (FFW)
  - Issued to alert the public about expected/ongoing flash flooding (potentially life-threatening flooding)
  - Can also be issued for areas downstream of an imminent dam failure (*not just for flooding from heavy rain*)



# Flash Flood Warnings w/IBW tags



- Since late 2019, flash flood warnings (FFW) can have impact-based warning (IBW) tags attached to them
- IBW tags automatically activate Wireless Emergency Alerts (WEA) to enabled cell phones when used
- FFWs w/o an IBW tag do NOT activate WEA
- FFW IBW Tag Categories:
  - Considerable
  - Catastrophic



Courtesy: The Weather Channel



# IBW Tag Location in Text Product



```
BULLETIN - EAS ACTIVATION REQUESTED
Severe Thunderstorm Warning
National Weather Service Fort Worth TX
240 PM CDT Thu Mar 16 2023

The National Weather Service in Fort Worth has issued a

* Severe Thunderstorm Warning for...
Southeastern Jack County in north central Texas...
Northwestern Parker County in north central Texas...
Northern Palo Pinto County in north central Texas...

* Until 330 PM CDT.

* At 240 PM CDT, a severe thunderstorm was located near Possum
Kingdom Lake, or 18 miles west of Mineral Wells, moving east at 45
mph.

HAZARD...Two inch hail and 60 mph wind gusts.

SOURCE...Radar indicated.

IMPACT...People and animals outdoors will be injured. Expect hail
damage to roofs, siding, windows and vehicles. Expect
wind damage to roofs, siding and trees.

* Locations impacted include...
Mineral Wells, Graford, Palo Pinto, Cool, Possum Kingdom Lake, Lake
Mineral Wells, Possum Kingdom State Park, Millsap, Perrin, Adell,
Advance, Salesville, Whitt, Abtown, Joplin, Authon, Oran, Garner,
Peadenville and Bennett.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A Tornado Watch remains in effect until 800 PM CDT for north central
Texas.

For your protection get inside a sturdy structure and stay away from
windows.

&&

LAT...LON 3295 9857 3295 9843 3299 9843 3314 9792
3272 9790 3277 9858
TIME 240 3295 9840

THUNDERSTORM DAMAGE THREAT...CONSIDERABLE
WIND THREAT...RADAR INDICATED
MAX HAIL SIZE...1.50
MAX WIND GUST...60 MPH

$$

30
```

Severe  
T-storm  
Warning

```
BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service Fort Worth TX
Issued by National Weather Service Nashville TN
951 AM CDT Mon Aug 22 2022

The National Weather Service in Fort Worth has issued a

* Flash Flood Warning for...
Dallas County in north central Texas...

* Until 100 PM CDT.

* At 951 AM CDT, Doppler radar indicated thunderstorms producing
heavy rain across the warned area. Up to 10 inches of rain have
fallen. Additional rainfall amounts of 2 to 4 inches are possible
in the warned area. Flash flooding is ongoing or expected to begin
shortly.

HAZARD...Life threatening flash flooding. Thunderstorms
producing flash flooding.

SOURCE...Radar.

IMPACT...Life threatening flash flooding of creeks and streams,
urban areas, highways, streets and underpasses.

* Some locations that will experience flash flooding include...
Dallas, Garland, Irving, Grand Prairie, Mesquite, Carrollton,
Richardson, Lewisville, Flower Mound, Rowlett, Desoto, Grapevine,
Cedar Hill, Wylie, Coppell, Duncanville, Lancaster, Farmers
Branch, Balch Springs and University Park.

Additional rises along White Rock Creek are expected.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Turn around, don't drown when encountering flooded roads. Most flood
deaths occur in vehicles.

&&

LAT...LON 3298 9652 3255 9652 3255 9704 3299 9703
TIME 0951 3298 9652

FLASH FLOOD DAMAGE THREAT...CONSIDERABLE

$$

Whitehead
```

Flash  
Flood  
Warning

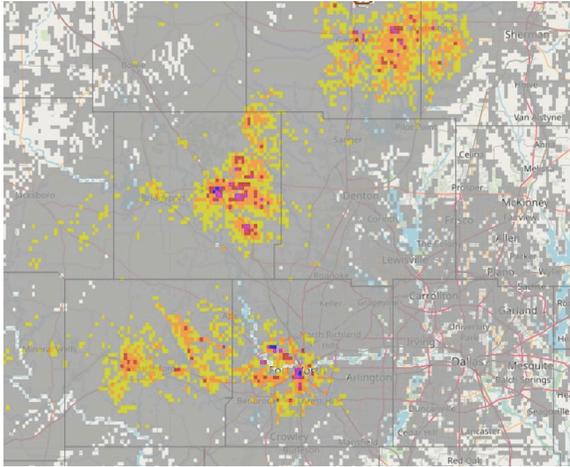


# Warning Decision Data Sources

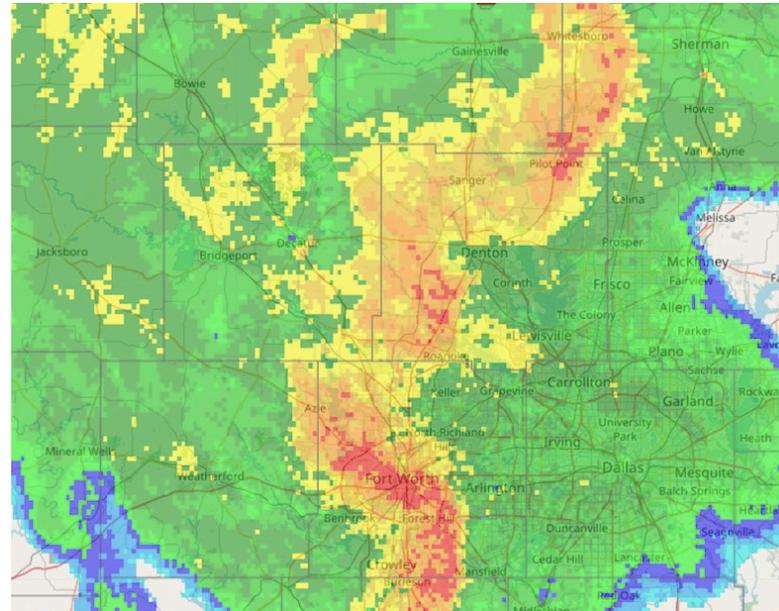


*among others...*

## Hydrologic Model Output



## Radar Data



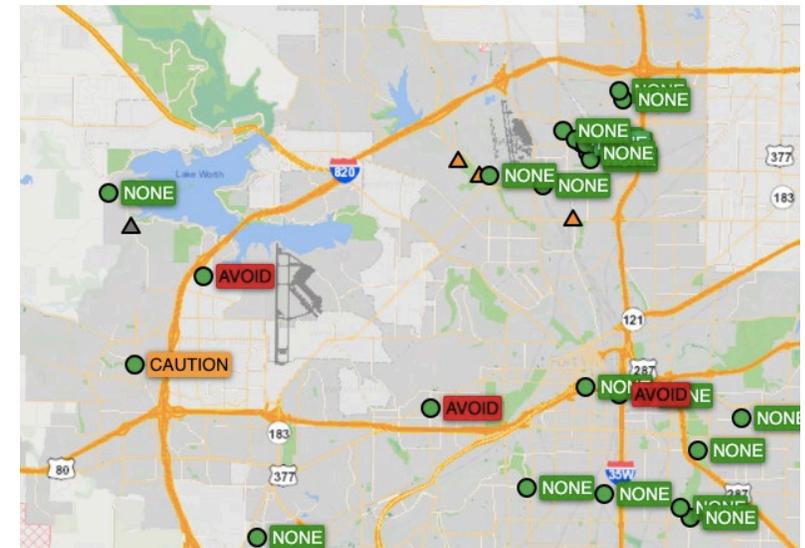
## Rainfall Observations



## Reports



## Flood Warning Systems



# Flood Reports

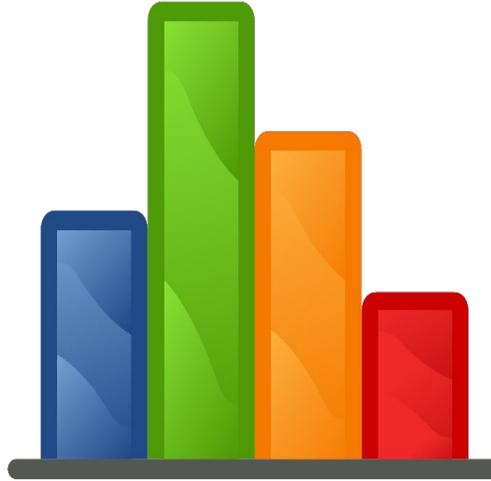


## Flood Impacts



- Are roads or structures flooded?
- Is the road impassable?
- Are rescues being done?

## Flood Frequency



- How often does it flood here?

## Flood Magnitude

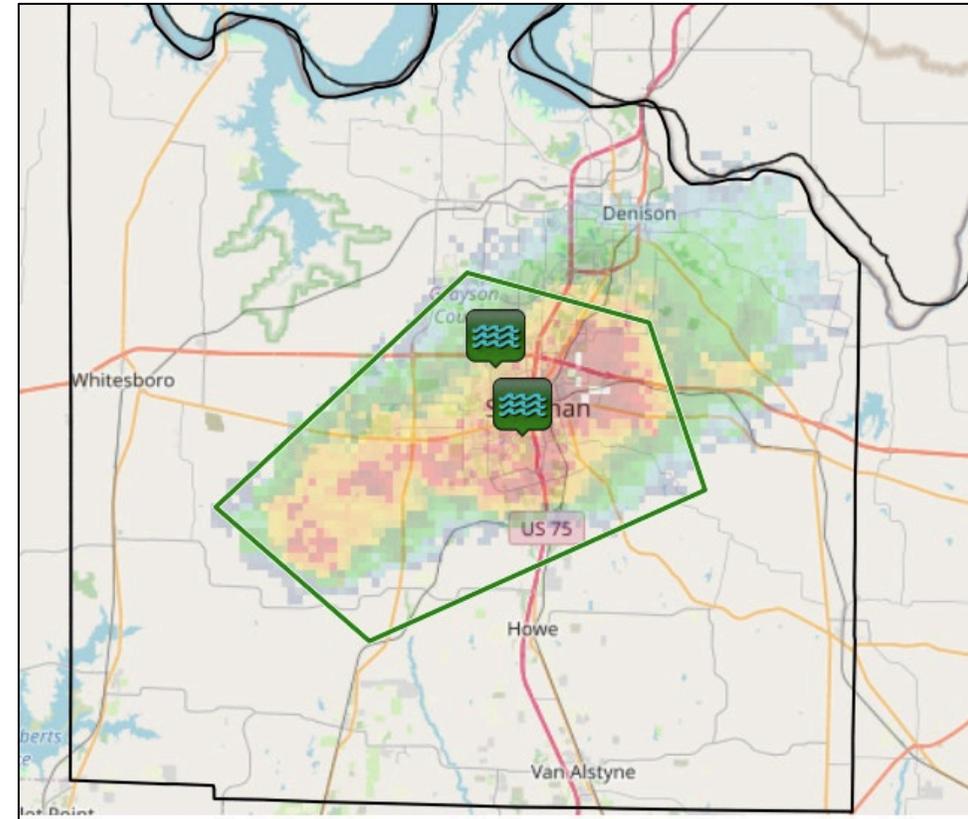


- How high is the water?
- Is it flowing?

# What happens to the report?



- An LSR (Local Storm Report) is generated, which is used to verify the warning
- Info from LSR can be put directly into the warning text
- The geo-tagged report provides guidance to forecasters on possible impacts elsewhere based on data comparisons
  - Reports are MOST helpful when received DURING the event (but still useful afterwards, too)



# NWS River Flood Products



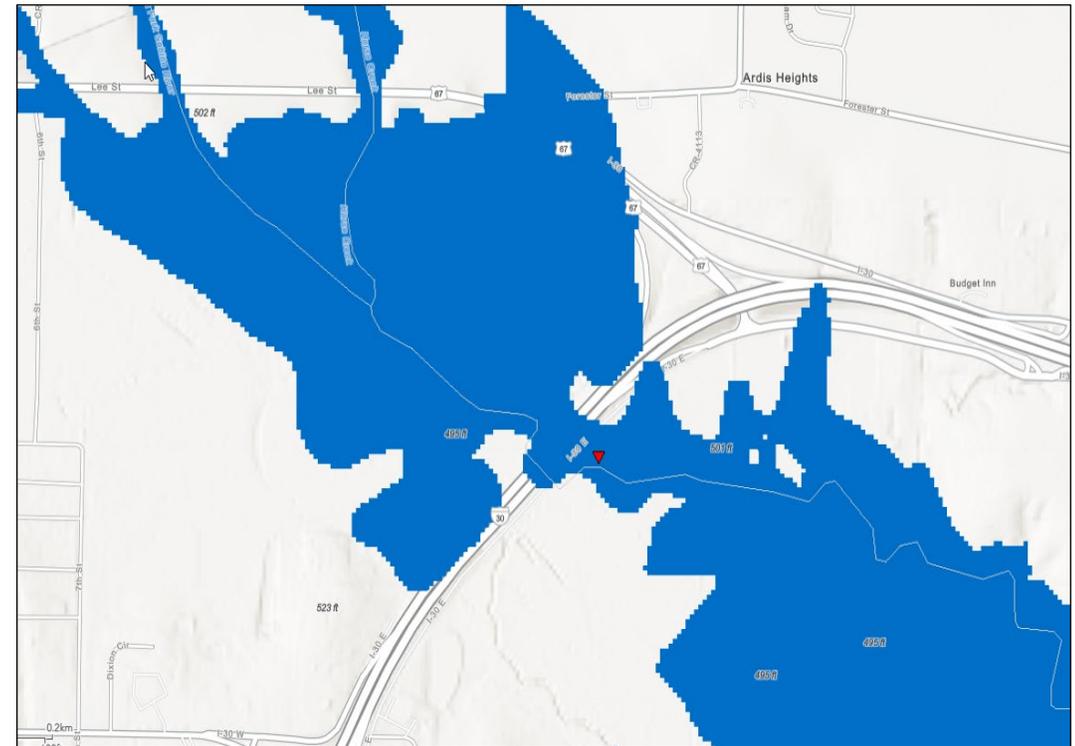
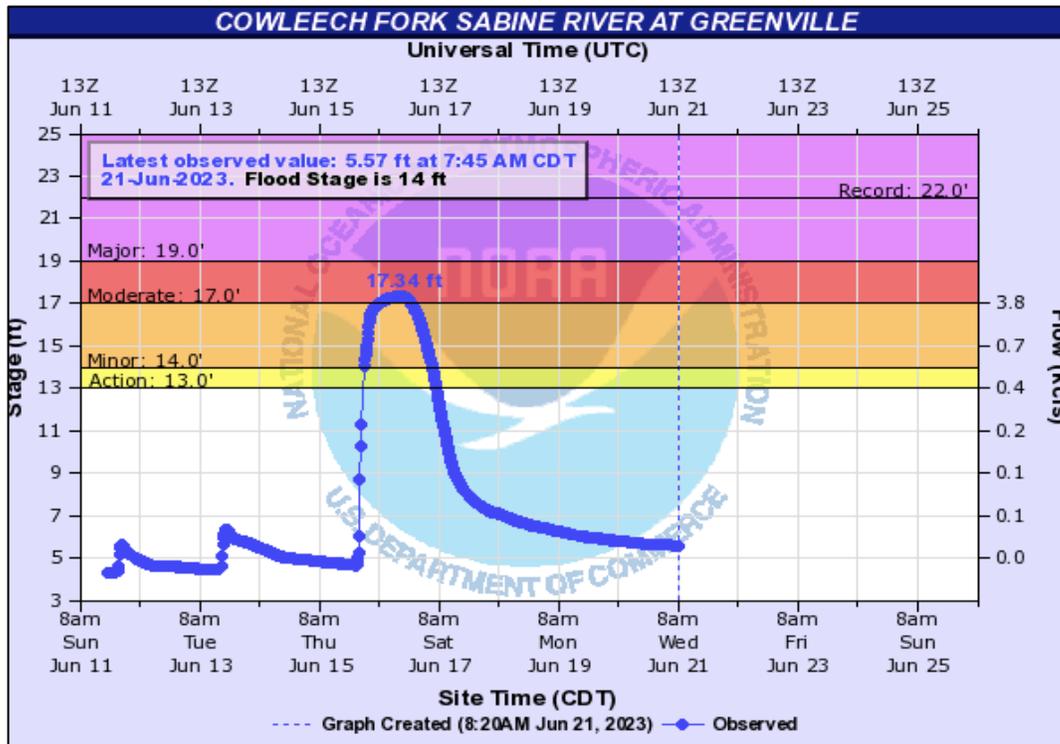
- River Flood Warning (FLW)
  - Issued to show when/where flooding is expected/ongoing along a river reach near specific forecast point locations
- Flood stage categories (w/corresponding impact statements)
  - Minor
  - Moderate
  - Major
- Reservoir releases are coordinated and included in the river forecasts
- Forecast rainfall also included but length of time varies



# Flood Inundation Maps (FIM)



Putting “water on a map” to improve risk communication



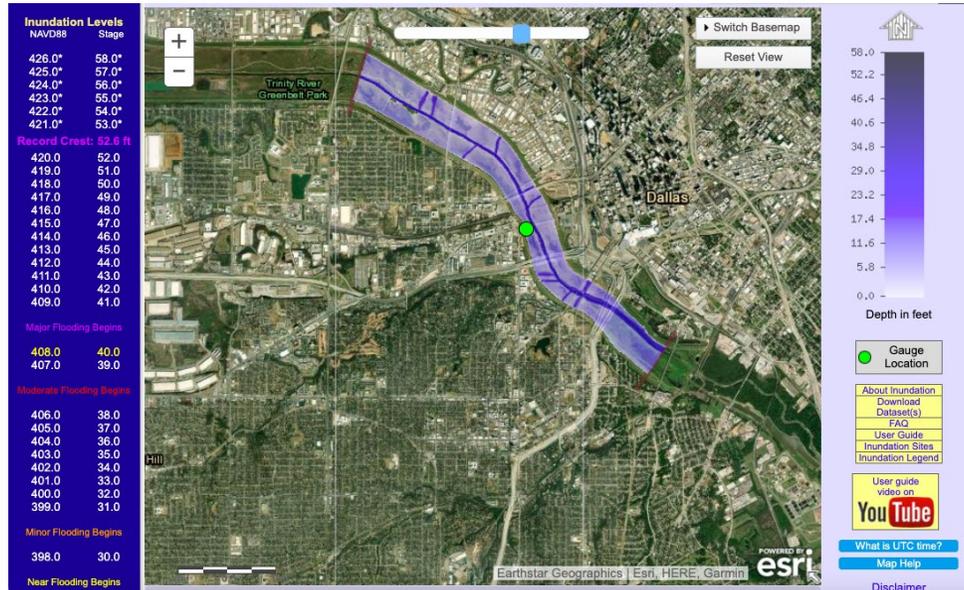
# FIM



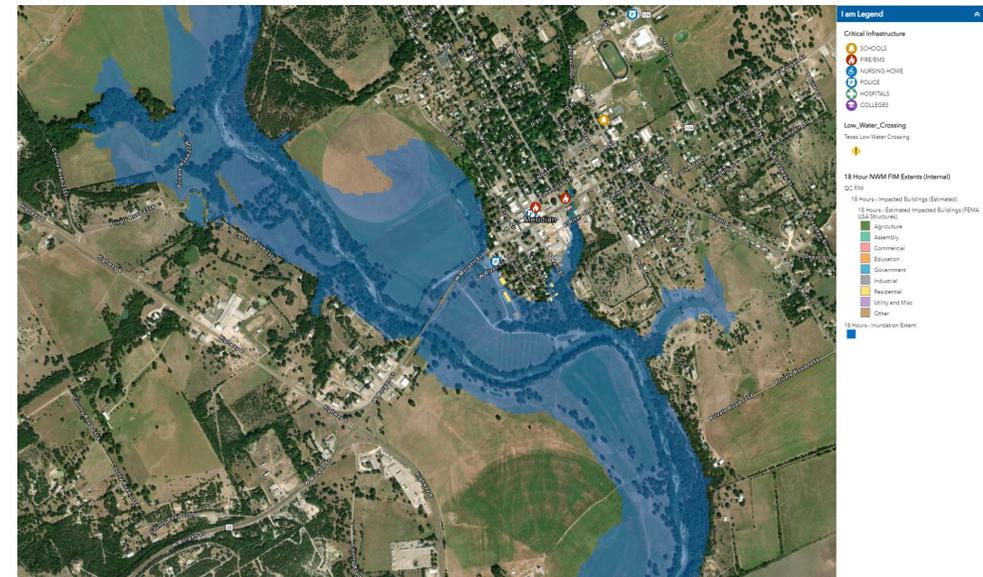
- **IMPORTANT!!** FIM are only intended for river flooding, NOT flash flooding (and have some important caveats for proper use)!
- Types of FIM:
  - Flood depth maps: show where floodwaters are located AND how deep the water is
  - Flood extent maps: ONLY show where floodwaters are located
- The new dynamic NWS FIMs provide different map options (and only display flood extent, NOT depth)
- Accuracy and usefulness vary among FIM types
- Multiple federal agencies are producing maps (NWS, InFRM/USGS, USACE, etc.) and they all vary



# NWS FIM Capabilities



**Static maps:** Developed ahead of time and available as static images from an online repository; static maps provided by the NWS are **derived from complex hydraulic models** that **provide flood extent AND depth**



**Dynamic maps:** Developed during the **flood event** and change depending on the initial conditions used by the model; dynamic maps provided by the NWS are **derived from simplified hydrologic modeling** and **only provide extent**



# Improving FIM w/field surveys



Damage Assessment Toolkit (v2.1.2) Editor

Find address or place

**Flood Points: Bosque River Flooding**

Storm Date	10/28/2023, 10:46 AM
Survey Date	11/2/2023, 10:46 AM
Event ID	Bosque River Flooding
Surveyor	NWS.FWR_noaa
Comments	Debris line on ground above bank 2 ft below bridge abutment 1 ft below gage house base
Flood Type	River/Stream
Flood Point Type	High Water Mark
Flood Damage Category	
Datum	N/A

A map of the Bosque River area in Texas, showing flood points marked with blue dots at Meridian, Clifton, and Valley Mills. Arrows point from the photos to these locations. The map includes labels for Meridian Creek, Cedron Creek, and various FM roads. A scale bar at the bottom left indicates 4 miles.

# National Weather Service Contacts and Resource Websites



- Local NWS Office
  - Fort Worth/Dallas, TX Weather Forecast Office
    - <https://www.weather.gov/fwd/>
    - Senior Service Hydrologist: Amanda Schroeder ([amanda.schroeder@noaa.gov](mailto:amanda.schroeder@noaa.gov))
  - NWS River Forecast Center
    - NWS West Gulf River Forecast Center (WGRFC)
      - <https://www.weather.gov/wgrfc/>
      - Service Coordination Hydrologist: Greg Waller ([greg.waller@noaa.gov](mailto:greg.waller@noaa.gov))
- NWS – national page
  - <https://www.weather.gov>
- NWS WPC Excessive Rainfall Outlook (ERO)
  - <https://www.wpc.ncep.noaa.gov/#page=ero>
- NWS River and Precipitation Observations, Forecasts, and FIM
  - <https://water.noaa.gov/>
- InFRM
  - [www.infrm.us](http://www.infrm.us)



# Presentation from USGS

**Presenter:** Kristine Blickenstaff, P.E.

(Branch Chief - Integrated Hydrology + Data Science)

- Present a demo of the Interagency Flood Risk Management (InFRM) program website ([www.InFRM.us](http://www.InFRM.us)).
  - Includes national water data platforms and the Flood Decision Support Toolbox (FDST), highlighting decision-support value, inundation mapping examples, data gaps, and opportunities to expand regional capability.

# Flood Decision Support Toolbox

## Collaborating Nationally, Empowering Locally: The Flood Decision Support Toolbox

Thursday, February 17, 2026

By Kristine Blickenstaff



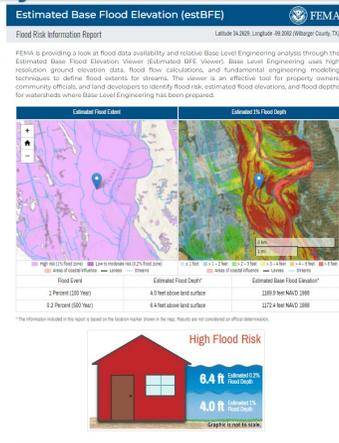
# A Web Presence for InFRM



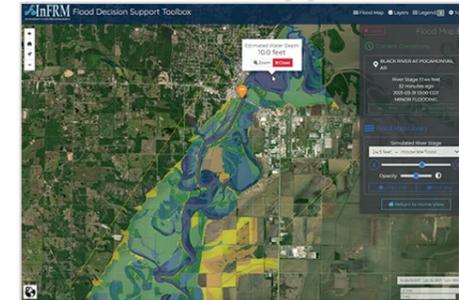
## Interagency Flood Risk Management

Collaborating Nationally. Empowering Locally.

### Estimate your base flood elevation (estBFE)



### Flood Decision Support Toolbox



### Watershed Hydrology Assessments

#### WHAV Viewer

**InFRM Watershed Hydrology Assessment for the Trinity River Basin**

Report Appendices



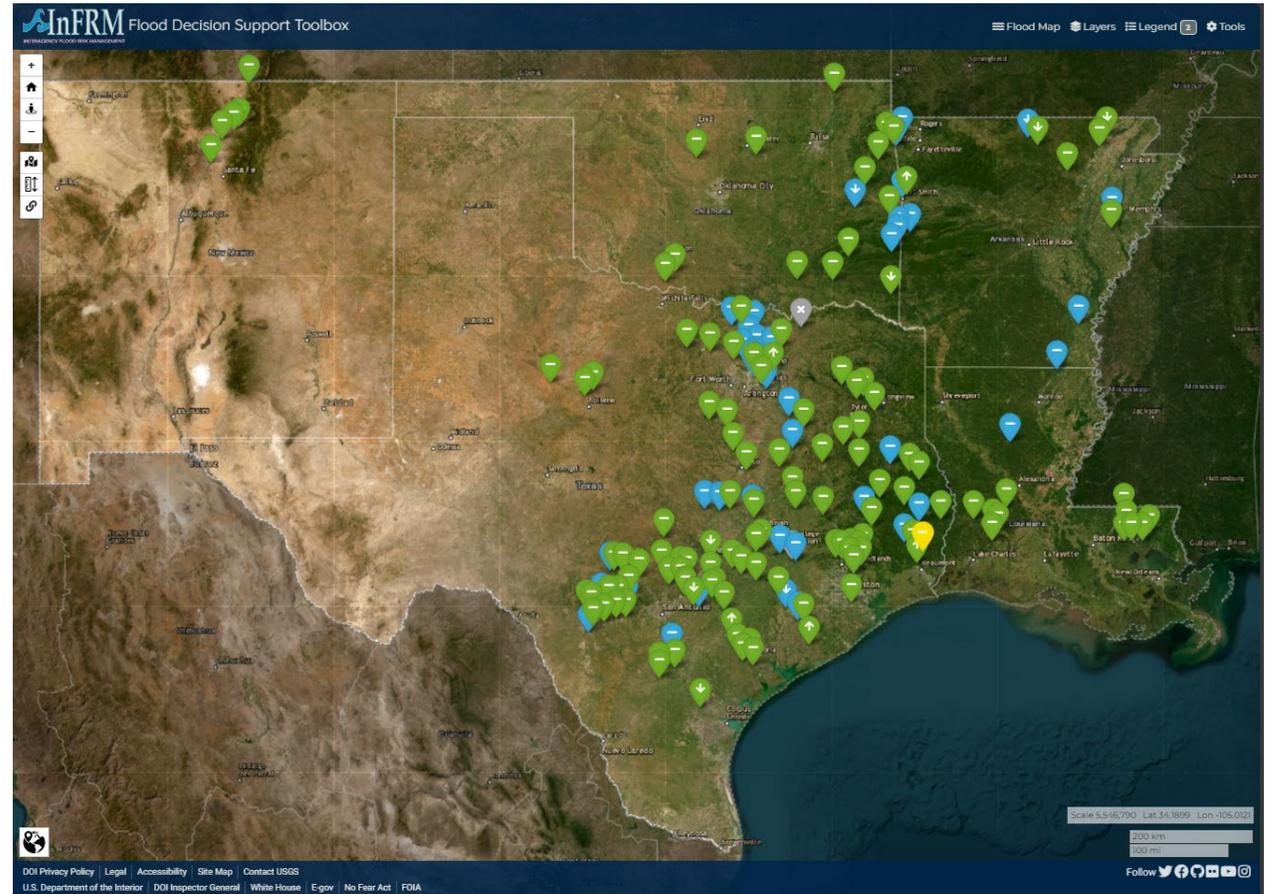
# Flood Decision Support Toolbox

## Scenario Planning

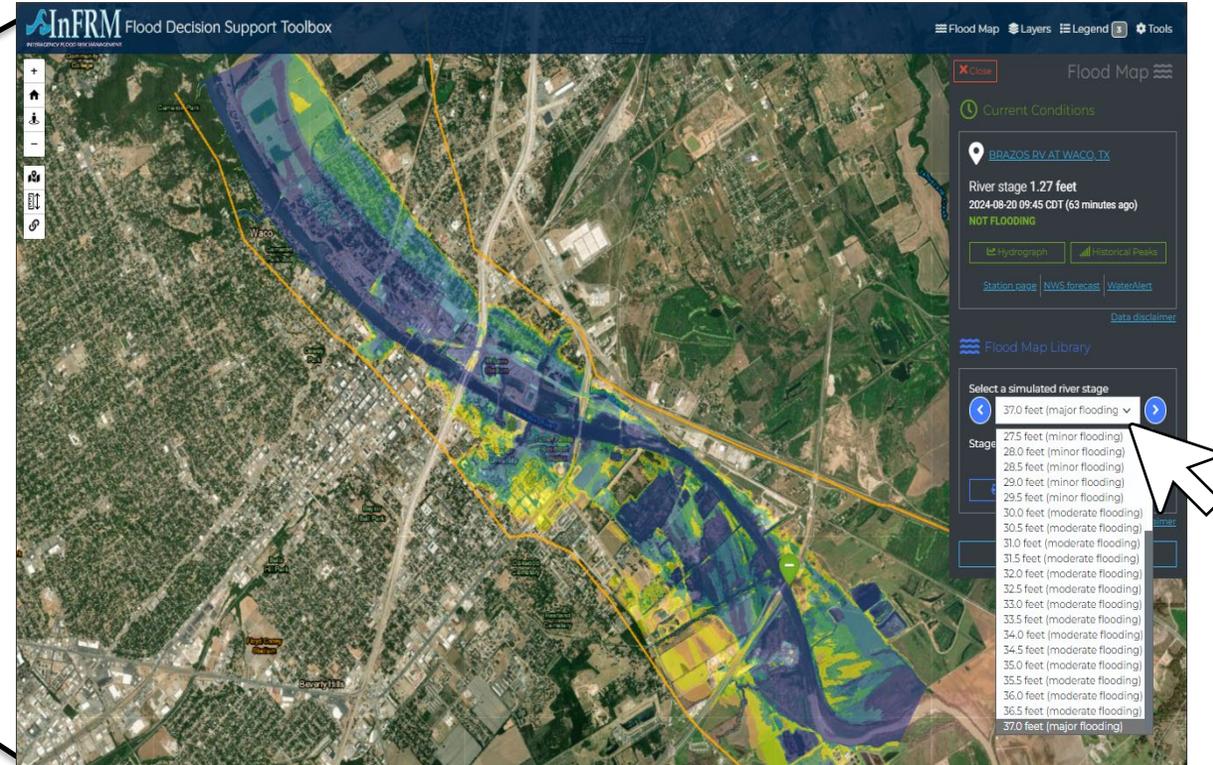
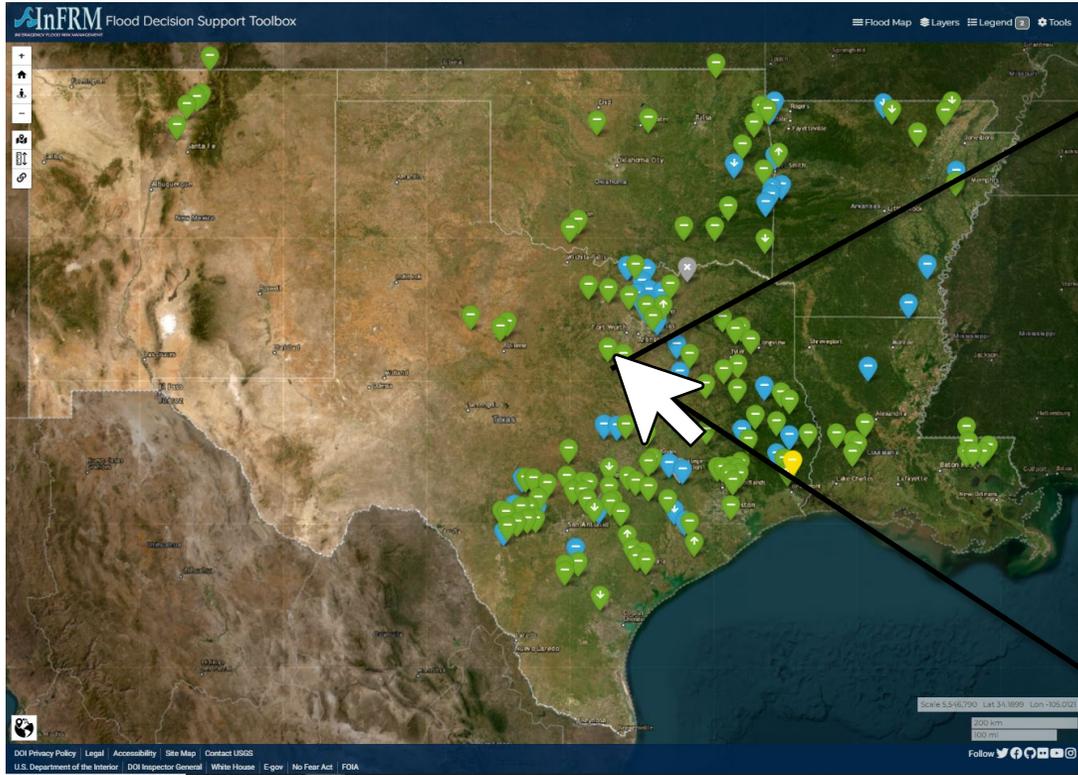
- Pre-positioned map libraries
- NWS Flood Categories
- Historical Flood viewing
- Critical infrastructure
- Damage Estimates

## Real-Time Event Response

- USGS Streamgaging
- NWS FIM mapping
- NWS Forecasts
- Weather Conditions
- Transportation Conditions
- Reservoir Conditions



# FDST Functionality



# FDST Functionality

The screenshot displays the InFRM Flood Decision Support Toolbox interface. The main map area shows a flood map of a residential area with a yellow callout box indicating an estimated water depth of 5.1 feet. A mouse cursor is pointing at the callout. The interface includes a top navigation bar with the InFRM logo, Texas Water Development Board logo, and the title 'Flood Decision Support Toolbox'. On the right side, there is a 'Flood Map' panel with 'Current Conditions' for 'BRAZOS RV AT WACO, TX', showing a river stage of 1.28 feet and a 'NOT FLOODING' status. Below this, there are controls for 'Flood Map Library' and 'Buildings'. The bottom of the interface features a footer with various links and social media icons.

Select anywhere in the map to view estimated water depth



# FDST Functionality

**Flood Map**

Close

Current Conditions

ELM FK TRINITY RV AT SPUR 348, IRVING, TX

River stage 12.15 feet  
2024-08-21 08:45 CDT (26 minutes ago)  
**FLOOD STAGES NOT ESTABLISHED**

Hydrograph | Historical Peaks

Station page | WaterAlert

Data disclaimer

Flood Map Library

Select a simulated river stage

30.5 feet

Stage

Opacity

Print Map | Library Info

Data disclaimer

Buildings

Select a map layer

All buildings

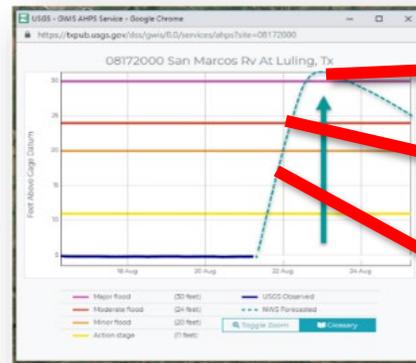
OFF

Opacity

Data disclaimer

Return to Home View

## Linked NWS River Forecast



## Historical Peaks

Top 10 Historical Peak Stages

Elm Fk Trinity Rv at Spur 348, Irving, TX

Sat May 30 2015	27.39 feet	<a href="#">View Flood Map</a>
Fri Nov 27 2015	25.34 feet	<a href="#">View Flood Map</a>
Fri Sep 21 2018	25.2 feet	<a href="#">View Flood Map</a>
Sat Jun 15 2019	24.9 feet	<a href="#">View Flood Map</a>
Tue Sep 07 2010	24.29 feet	<a href="#">View Flood Map</a>
Sat May 15 2021	23.88 feet	<a href="#">View Flood Map</a>
Tue Mar 18 2008	23.76 feet	<a href="#">View Flood Map</a>
Tue Jan 24 2012	23.39 feet	<a href="#">View Flood Map</a>
Tue Feb 11 2020	23.17 feet	<a href="#">View Flood Map</a>
Wed Jun 10 2009	21.67 feet	<a href="#">View Flood Map</a>

Stages reported in feet above gage datum, which is 400 feet above NAVD88.

[Station page](#) | [WaterAlert](#) | Close

## Setup WaterAlert

USGS

WaterAlert Sign in

WaterAlert My Alerts User Guide Settings

Elm Fk Trinity Rv at Spur 348, Irving, TX - 08055560

My Alerts  
This Location | All My Alerts

Sign in to see your alert notifications  
[Show me how to start using WaterAlert](#)

Create Alerts for This Location

Gage height, feet  
Latest Value: 12.15 ft  
on Wed, 21 Aug 2024 13:45:00 GMT UTC

What values have been seen in the past?

Your alert's trigger range -- units: ft

6 32

What does this graphic tell me?

Reminder: you're not signed in.

Send alert when current condition value is greater than \_\_\_\_\_ ft  
less than \_\_\_\_\_ ft  
sign in to enter values

I'd like to use a value range

While the alert conditions are true notify me

Once per day  
 Once per hour

Summary:  
Sign in to create your alert.

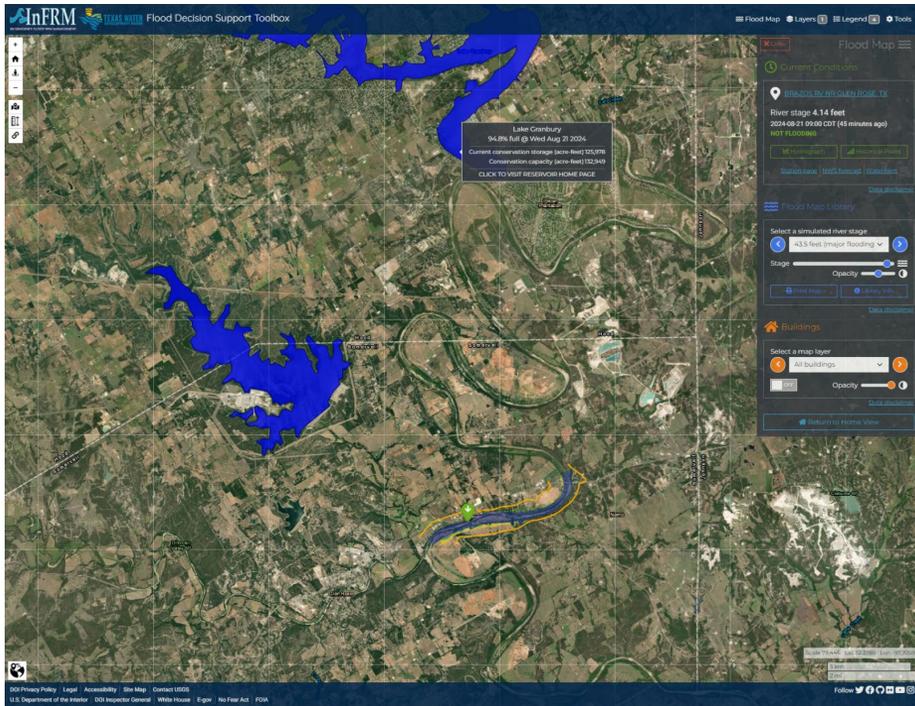
Messages will be sent to  
Sign in to see your information

Create alert Questions or Comments

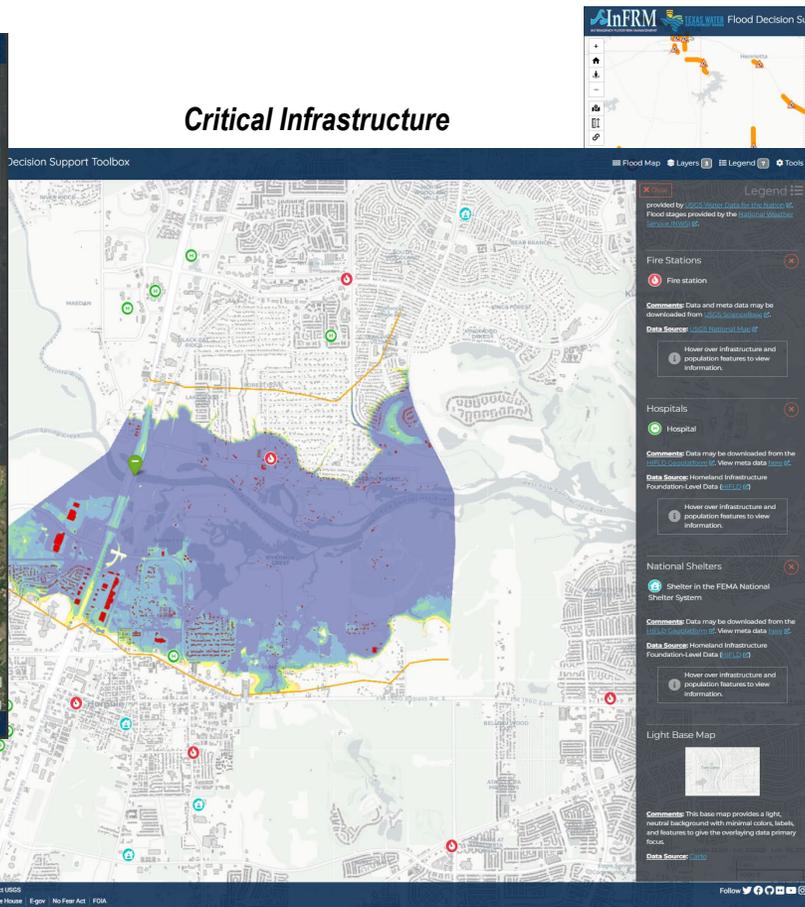


# FDST Functionality – Texas – TWDB Partnership

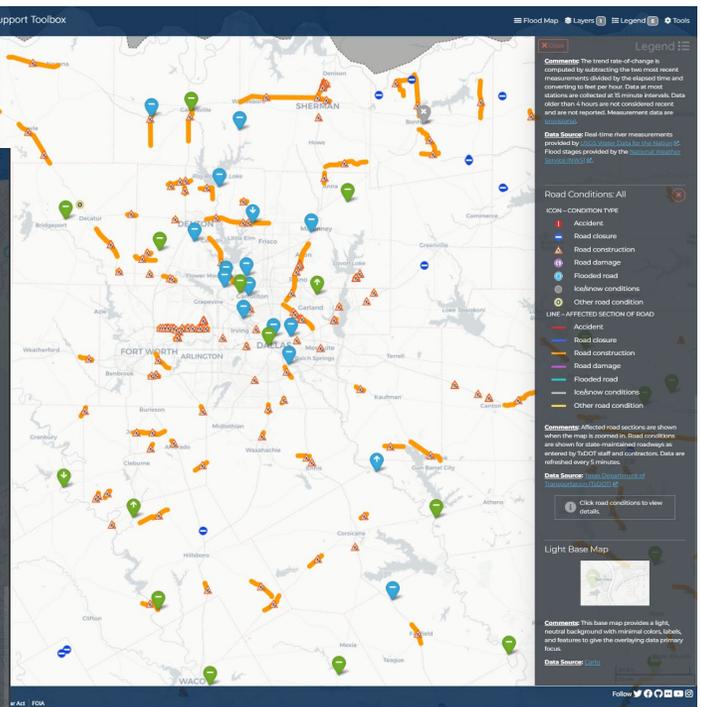
## Reservoir Conditions



## Critical Infrastructure

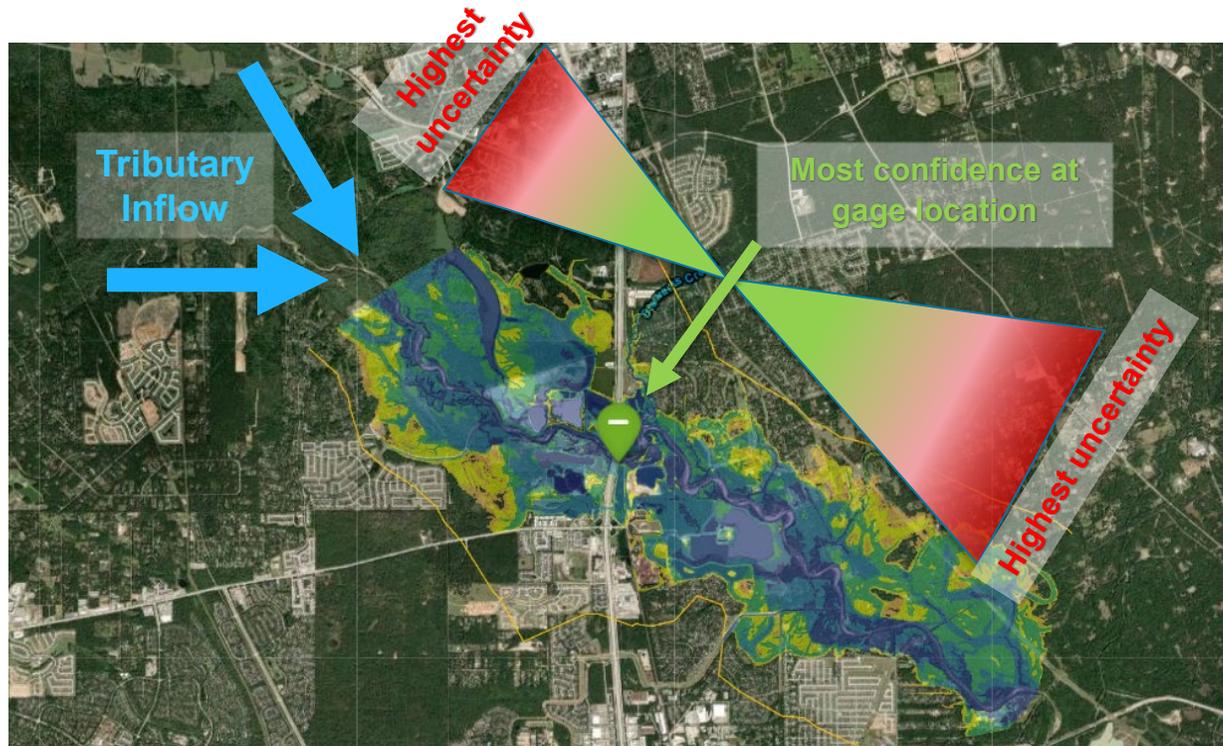


## Road Conditions





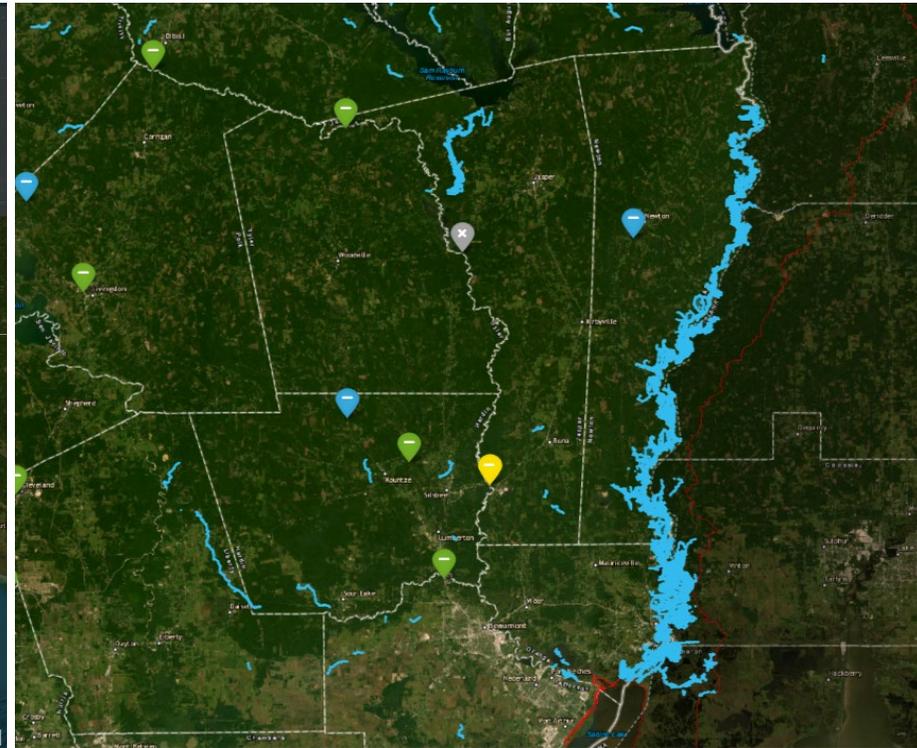
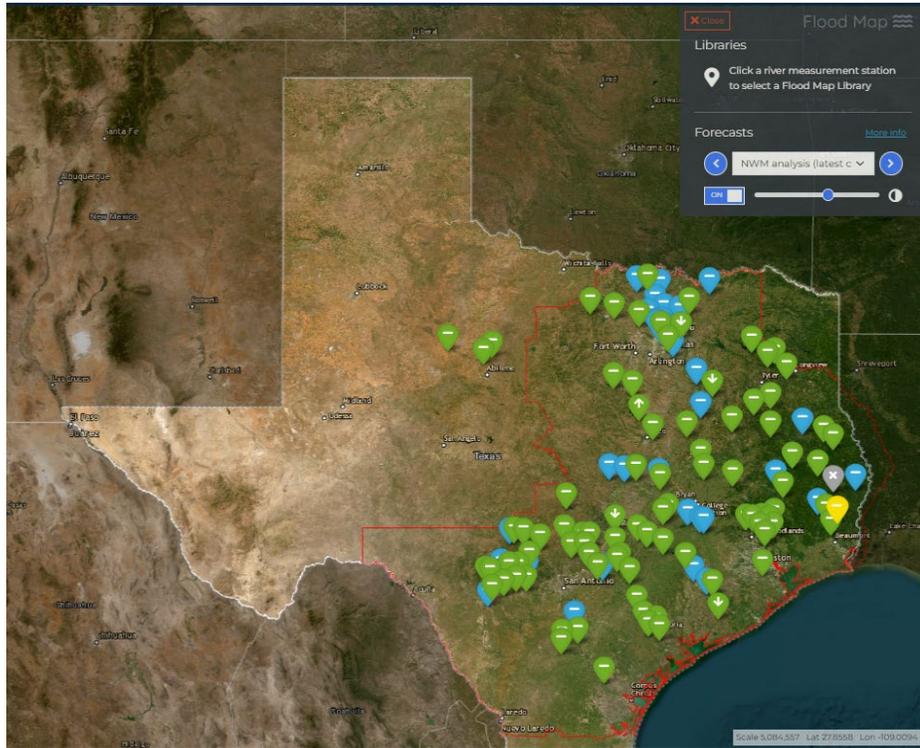
# Uncertainty in Modeling



- “All models are wrong, but some are useful”
- **Model Uncertainty**
  - Tier A/B
  - Rating Curve RMSE
  - Uncertainty in forecasts
  - NWS FIMS



# National Weather Service FIMs





## Kristine Blickenstaff, PE

Integrated Hydrology +  
Data Science

Branch Chief

USGS

kblickenstaff@usgs.gov

817-614-0642

[InFRM.us](http://InFRM.us)

[webapps.usgs.gov/infrm/fdst/](http://webapps.usgs.gov/infrm/fdst/)

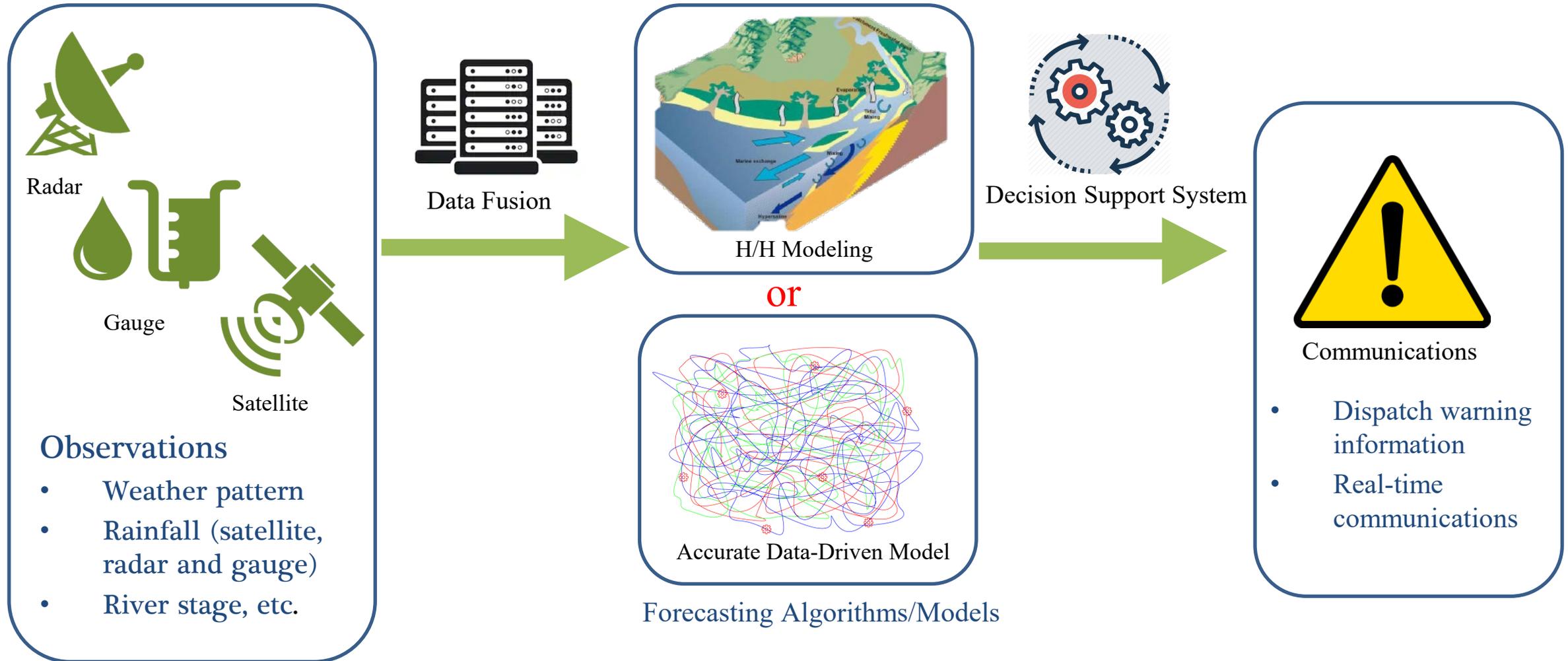


# Presentation from UTA

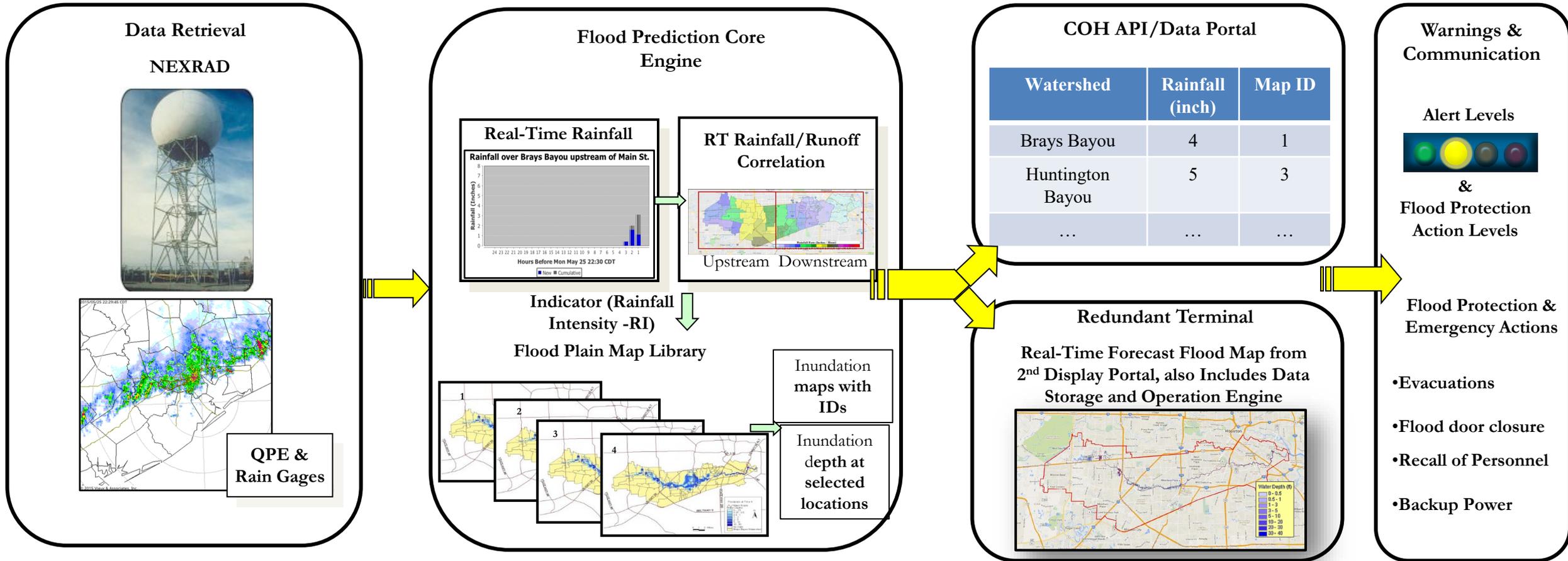
**Presenter:** Dr. Nick Fang, PhD, PE (Professor and Director of the Water Engineering Research Center (WERC))

- Present a North Texas flood early warning system in operation at the DFW airport and additional FEWS information and context

# FLOOD ALERT SYSTEM-CONCEPT



# FLOOD ALERT SYSTEM 5



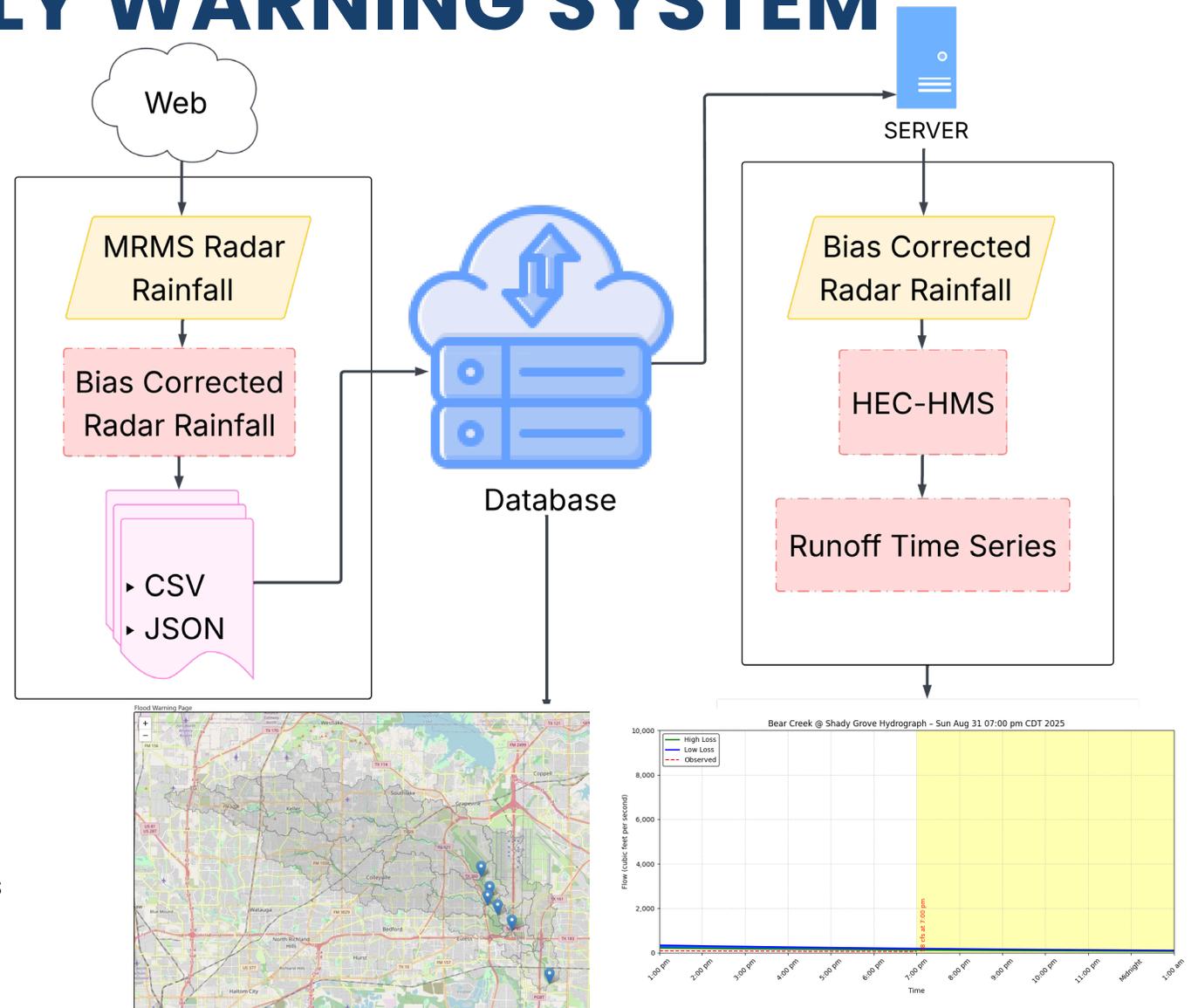
# DFW FLOOD EARLY WARNING SYSTEM



DALLAS  
FORT WORTH  
INTERNATIONAL  
AIRPORT

## Technology Framework

- Digital Twinning Coupled Atmosphere/Land Surface/Hydrologic systems
- Hydrologic Models Development & Calibration
- Advanced Radar-based Rainfall Monitoring/Correction
- Cloud Computing and Web-based Platform Integration



- Developed for the **Bear Creek Watershed**, North Texas
- Provide **2–4 hours** of hydrologic lead time.
- Calibrated over the entire data time span.
- Incorporates **real-time radar-based precipitation** with **bias correction**.
- Enables **sensor calibration** and creation of **virtual gages** across the watershed.

# Guidance Document of Flood Early Warning Systems

PROJECT REPORT

Grant Sponsor



PROJECT MANAGEMENT

Principal Investigators



Nick Fang, PhD, PE



Phil Bedient, Ph.D., P.E.



Sam Brody, Ph.D.



Michael Zaretsky, AIA



COMMUNITY OUTREACH



Flood Early Warning Systems (FEWS)  
Guidance Document

for Texas  
Contract Number 2101792481  
DRAFT

# InFRM Academic Council Members



Philip Bedient



Collaborators



Nick Fang



Clint Dawson



John Nielsen-Gammon



Sam Brody



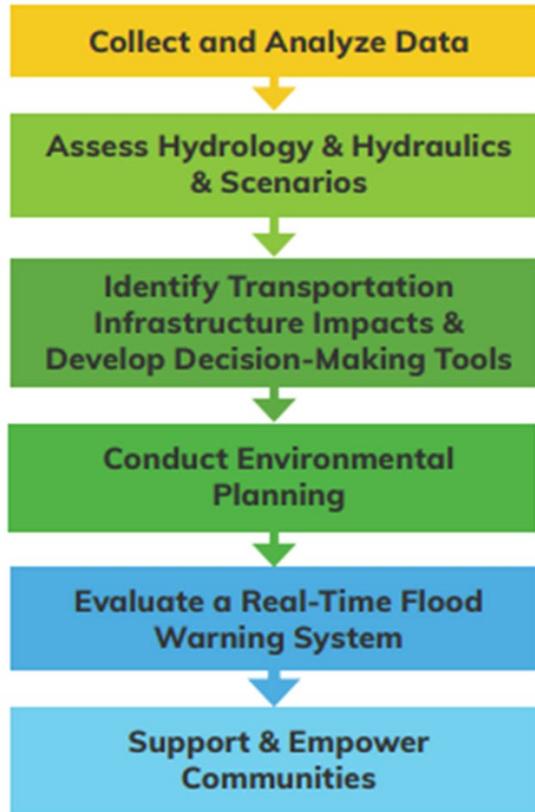
Hatim Sharif



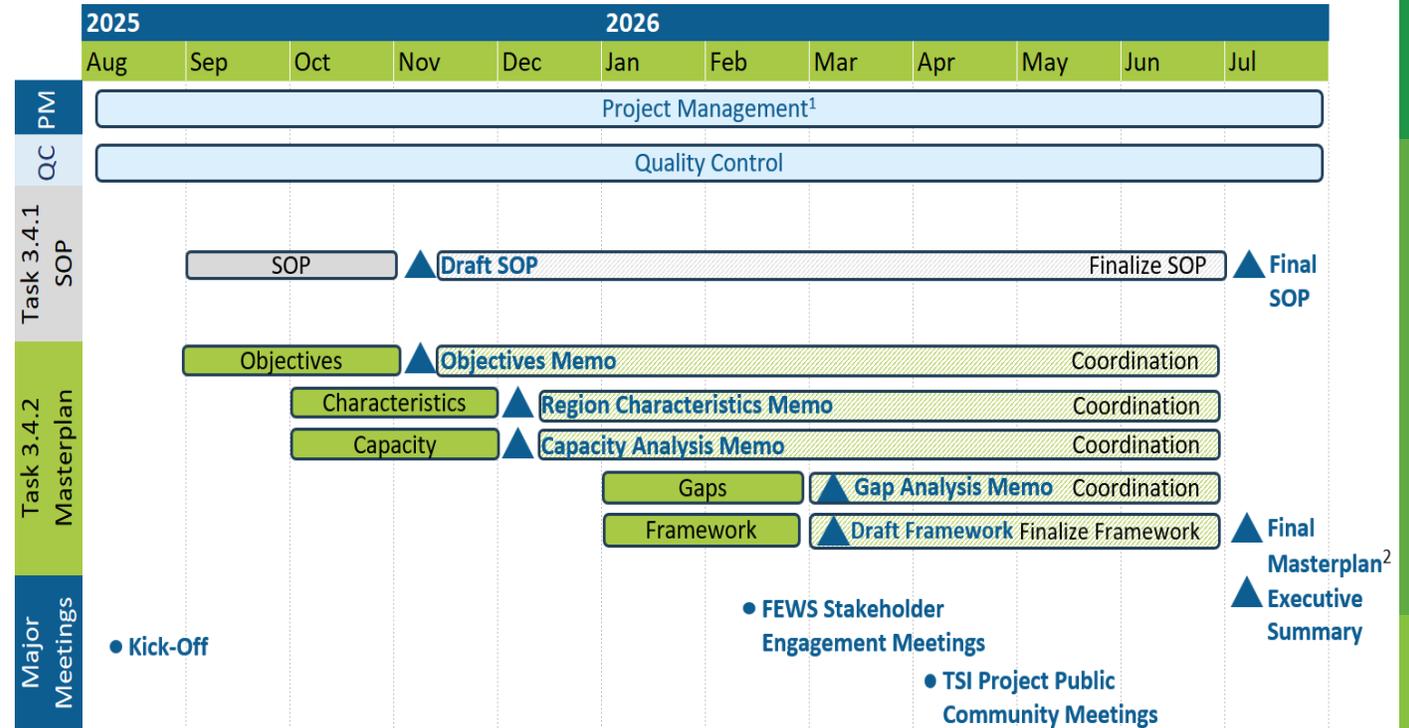
Jamie Padgett



# No Single Entity Can Solve This Alone



- Role of TSI
- How does FEWS fit into it?
- Timeline and results



1. Includes monthly status meetings with task leads and, as needed, team partners

2. Although it is not within the scope to develop a detailed implementation plan for the TSI region, it is a recommended next step

# Flood Early Warning Systems – End to End –



1<sup>st</sup> Mile

Last Mile

# Roadmap for Success – Master Plan –

**Kickstart FEWS Development**

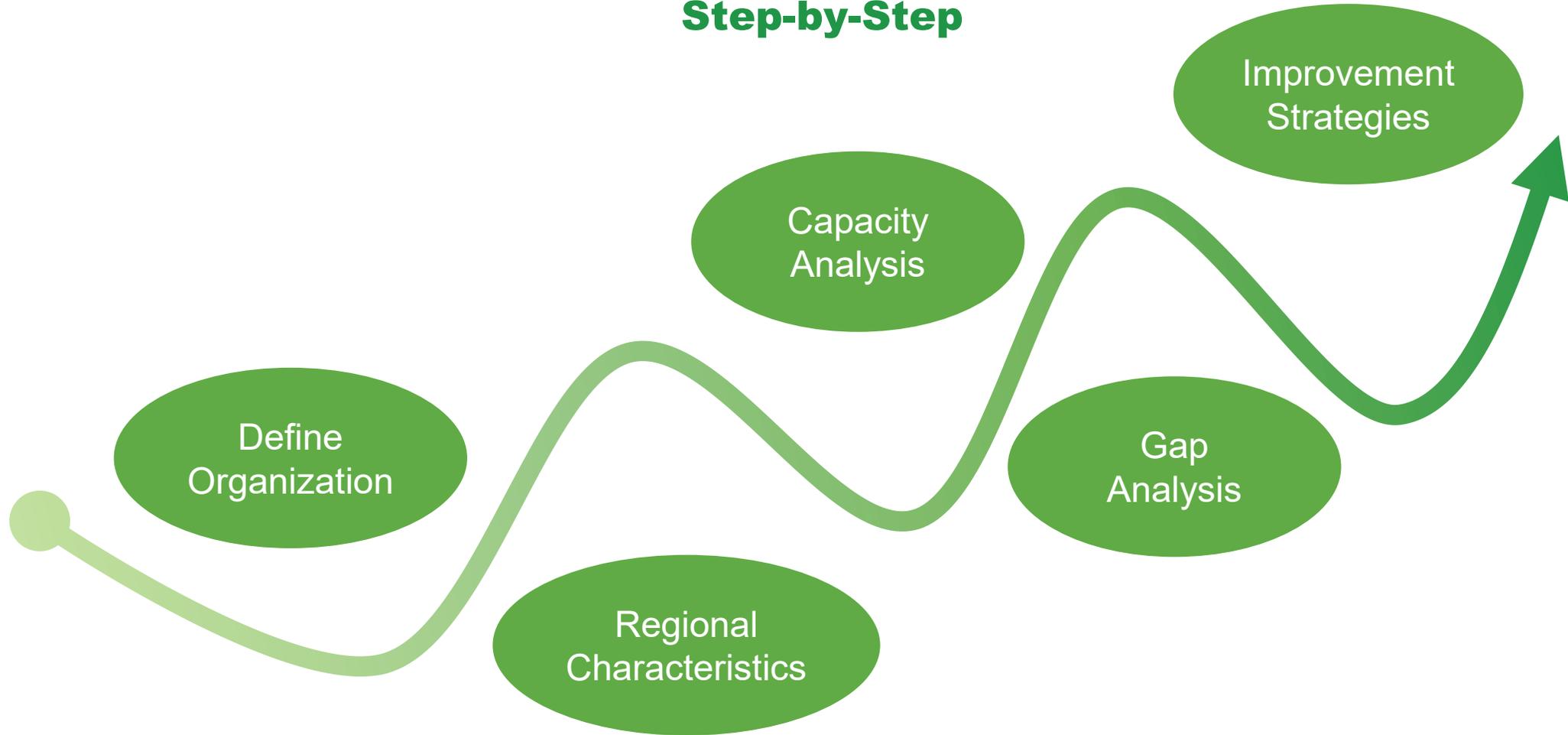


**Fully Transferable**

# TSI Flood Warning Master Plan

## Standard Operating Procedure

### Step-by-Step



# Objectives Analysis

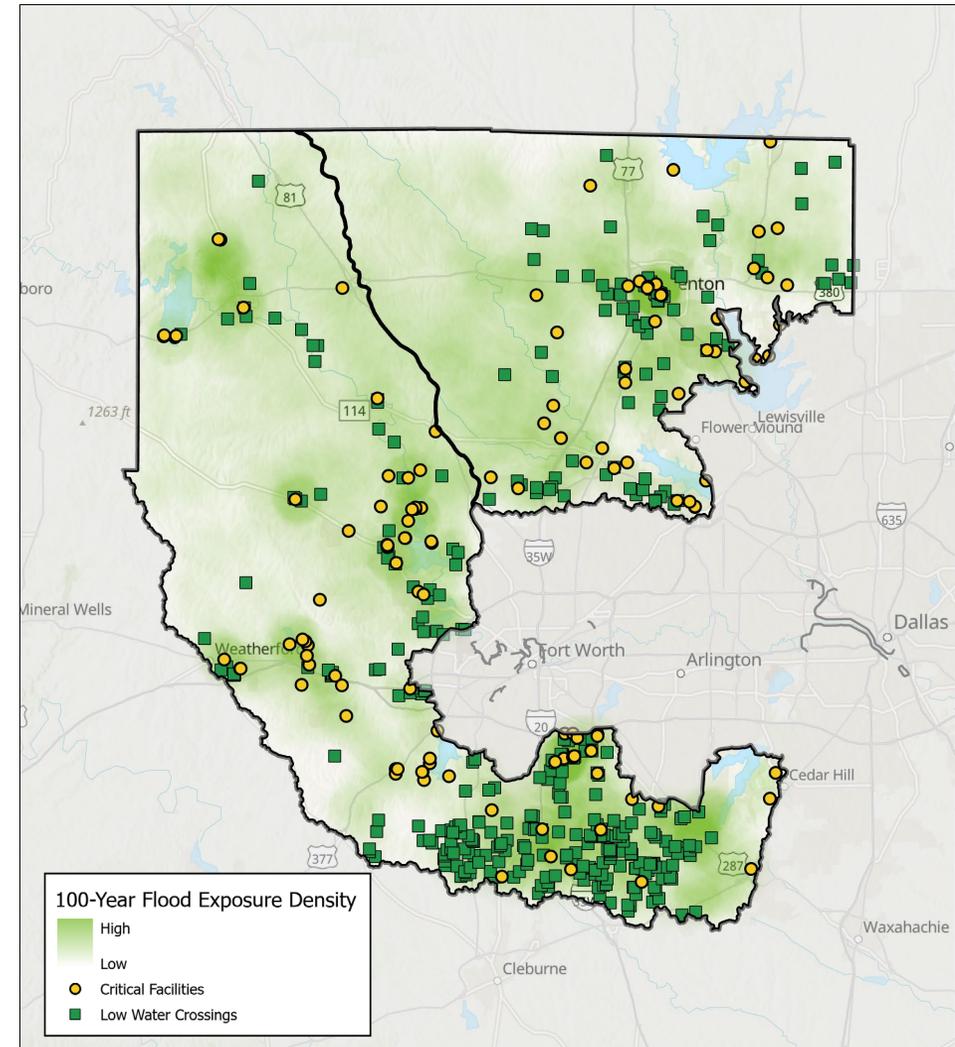
- Objectives Analysis Memo
  - Document FEWS goals, vision, and expectations for the TSI region.
  - Key memo information includes:
    - Apr 2025 Survey Results
    - Jan 2026 Survey Results
    - Jan 2026, Pre-Workshop Meeting Follow-up
    - Community Site Visits
    - Engagement in Masterplan Process
    - Texas Examples



# Regional Characteristics

- Regional Characteristics Memo
  - Key information:
    - Geographic Extent and Political Boundaries
    - Climate
    - Natural Environment
    - Built Environment
    - Hydrology and Watershed Response

County	2025 Population Estimate	TSI Study Region
Dallas	2,762,279	West
Tarrant	2,260,330	West, North
Denton	1,068,355	North
Ellis	239,923	West
Johnson	217,867	West
Parker	163,878	West
Wise	72,674	West, North
Hood	66,549	West



Structures at Risk, Critical Infrastructure, and Low Water Crossings (Source: TWDB)

# Capacity Analysis

- **Capacity Analysis Memo**
  - Inventory resources
  - **Key information includes:**
    - FEWS Hardware
    - FEWS Software
    - FEWS Operations

Entity	Rain	Stage	Rain & Stage	Weather Stations with Rain	Comms.
City of Fort Worth (COFW)	8	28	34	0	ALERT2 Radio
City of Grand Prairie (COGP)	0	39	0	0	ALERT2 Radio
National Weather Service (NWS)	0	0	0	33	GOES? Satellite
Tarrant Regional Water District (TRWD)	12	3	22	0	Cellular; ALERT2
Texas Department of Transportation (TxDOT)	0	0	0	80	Cellular; IP
Texas Water Development Board (TWDB)	0	0	0	6	Cellular
United States Geological Survey (USGS)	0	114	0	0	GOES? Satellite
Wise County	0	16	0	0	Cellular

# Gap Analysis

## Identify flood risk.

### Are key flood hazards and related threats identified?

Summarize what's known about geographical extent, magnitude, intensity, historical data, future risks.

What are the watershed response times at key locations of significant flood impact?

What flood hazard maps are available?

### Are flood risks and vulnerabilities identified?

Critical facilities mapped (e.g., hospitals, water treatment, fire/police stations, etc.)

Impacts to critical infrastructure evaluated.

### Are roles and responsibilities of stakeholders identified?

Who are the key agencies. (e.g. Host agency, NWS, NWSRFC, USGS, USACE, etc.)?

Describe roles.

Hazard identification and risk information coordination. Who is responsible?

Available experts to assess quality of risk data and information. (e.g., PW Engineer, Consultant, etc.)

Process in place to engage rural and urban communities in risk assessment.

### Is risk information consolidated?

Is there a centralized database of events, disasters, and risk information, including GIS.

Where? Who is responsible?

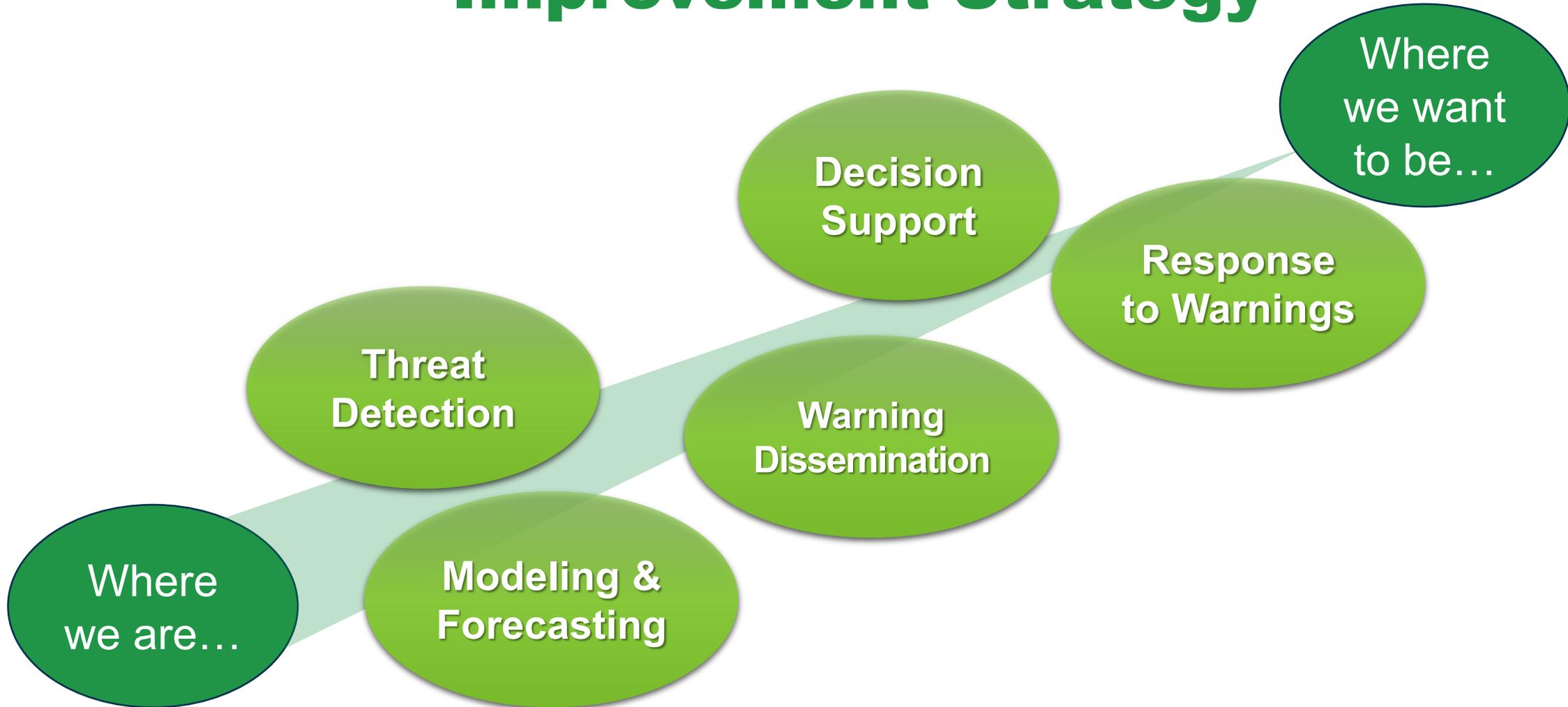
Is process in place for systematic collection, sharing, and assessment of risk data?

Process in place for regular review and updating of risk information, including new or emerging vulnerabilities.

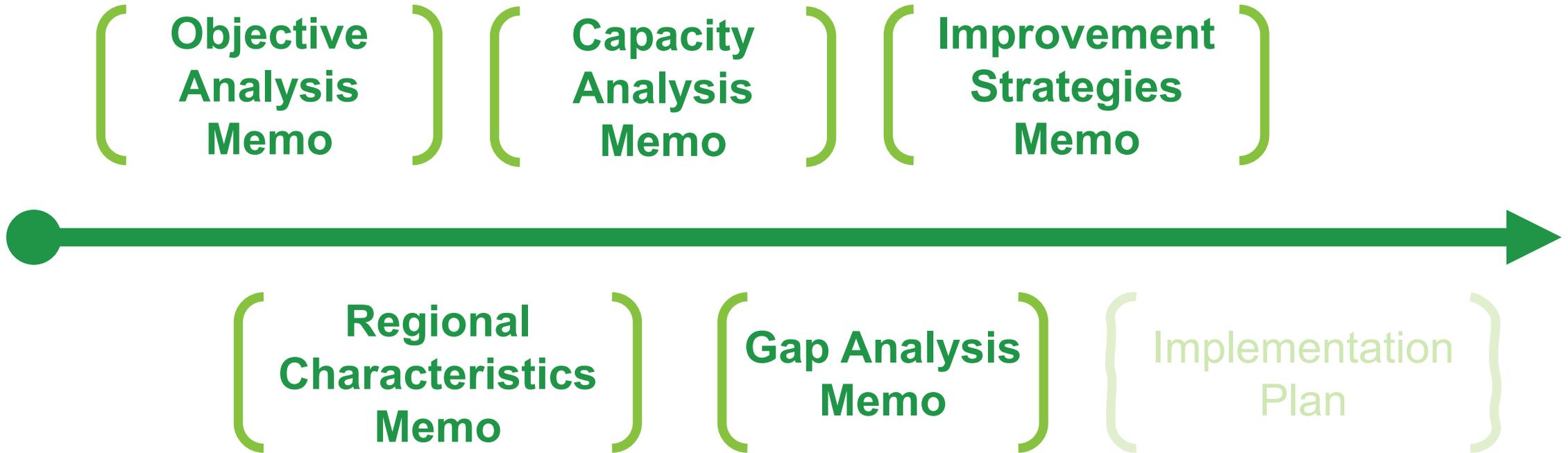
Where  
we want  
to be...

Where  
we are...

# Improvement Strategy



# TSI Flood Warning Master Plan



# Local Perspective

# Questions and Feedback

1. **Where are the biggest flood risk blind spots in your community today?**  
(Geographic areas, vulnerable populations, infrastructure gaps.)
2. **When a warning is issued, what most often slows action** (operationally or behaviorally)?
3. **What's the biggest gap between the tools presented today and what your community currently has in place?**
4. **Does your current approach to flood response feel more reactive or proactive? Why?**
5. **If you could advance one element of a FEWS** (implementation or enhancement) **in the next 12 months, what would you prioritize?**

# Takeaways and Next Steps

## What We Know

- **Flood risk is local and dynamic:** Blind spots exist and there's not a single solution.
- **Early warning only works when it triggers action:** Integration, clarity, and coordination are essential.
- **Proactive, integrated systems reduce risk:** A FEWS strengthens resilience when paired with planning and partnership.

## What's Next

- Explore the **TSI results and resources** at [www.nctcog.org/TSI](http://www.nctcog.org/TSI)
- Leverage **TSI FEWS Masterplan** coming soon.
- Regional FEWS implementation through the NCTCOG **Flooded Roads Information System** project.
- **We must work together** and use our **menu of tools** to reduce flood risk.

# Please Complete Our Survey



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