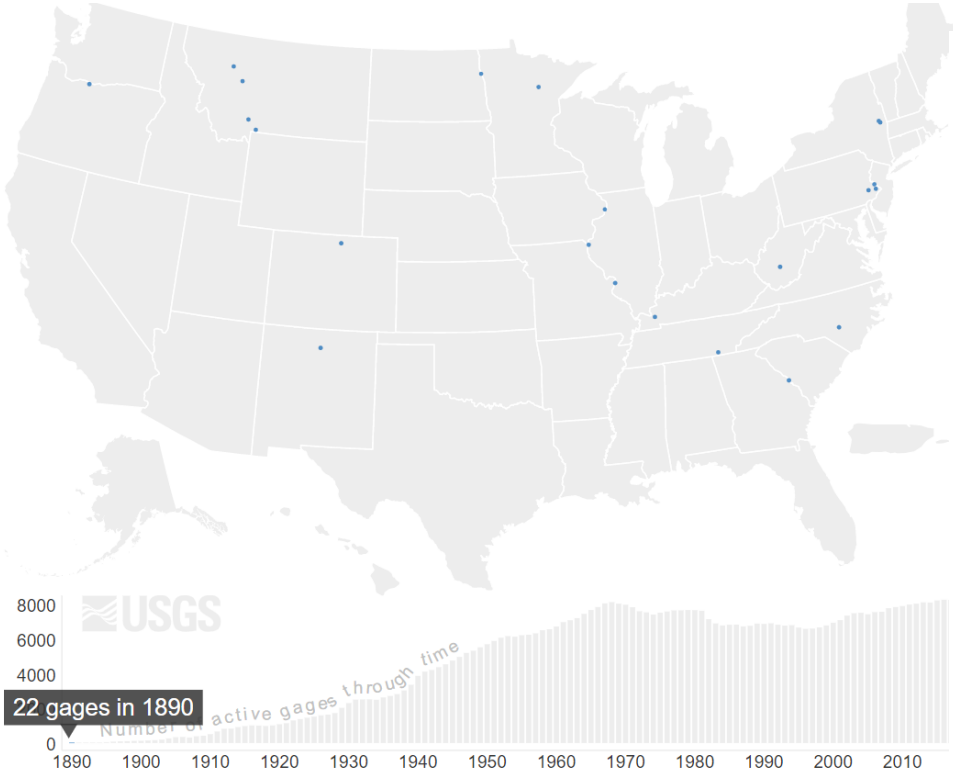
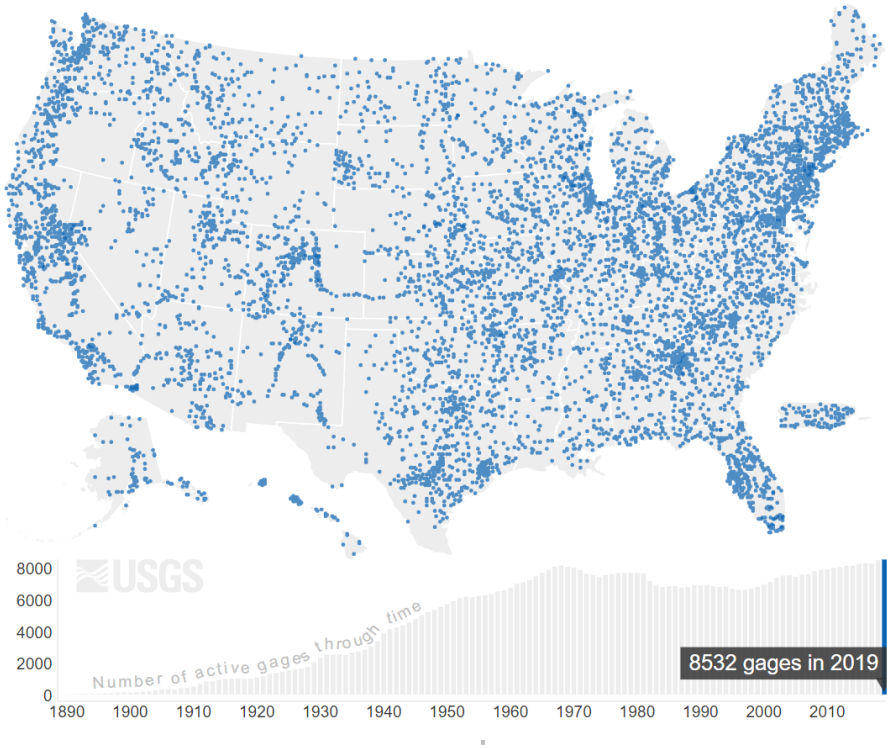
USGS
science for a changing world

Gages Through the Ages

How the history of streamgaging reflects the evolving water needs of the nation





Integrated Hydrology + Data Science

The Integrated Hydrology + Data Science Branch intersects science and technology using interdisciplinary expertise to deliver critical information to the public and stakeholders.

Science for a Changing World: Your Evolving Water Resource Data Needs

Kristine Blickenstaff

NWC Annual Meeting

October 27, 2022

InFRM

Interagency Flood Risk Management (InFRM) Team -

- FEMA Region 6 - Sponsor
- U.S. Army Corps of Engineers (USACE)
- U.S. Geological Survey (USGS)
- National Weather Service (NWS)

Collaborating Nationally and Empowering Locally

InFRM
INTERAGENCY FLOOD RISK MANAGEMENT

A Web Presence for InFRM

Collaborating Nationally. Empowering Locally.

Flooding remains the leading cause of natural-disaster loss across the United States. The Interagency Flood Risk Management (InFRM) team brings together Federal Partners with mission areas of hazard mitigation, emergency management, floodplain management, natural resources management or conservation to leverage the skillsets, resources and programs to determine the needs of communities and define solutions and implement measures to reduce long term flood risk throughout the States of Arkansas, Louisiana, New Mexico, Oklahoma and Texas.

In 2014, the Federal Emergency Management Agency (FEMA) began sponsorship of the InFRM team initiative to allow Federal teams across the States of Texas, Oklahoma, New Mexico, Louisiana and Arkansas to better align and integrate. Currently, the InFRM team is comprised of FEMA, US Army Corps of Engineers, US Geological Survey, and the National Weather Service. No single agency has all the answers, but through a coordinated effort of multiple programs and various perspectives, a cohesive solution can be found. By applying their shared knowledge, the InFRM team can also enhance response and recovery efforts when flood events do occur.

While floods are impossible to prevent completely, and there is no way to guarantee protection of property, loss of life can be greatly reduced when communities have access to good data, practice sound land use, floodplain management and development practices and incorporate warning systems. Local communities can partner with the InFRM team to investigate solutions to reduce their communities flood risk.

www.InFRM.us

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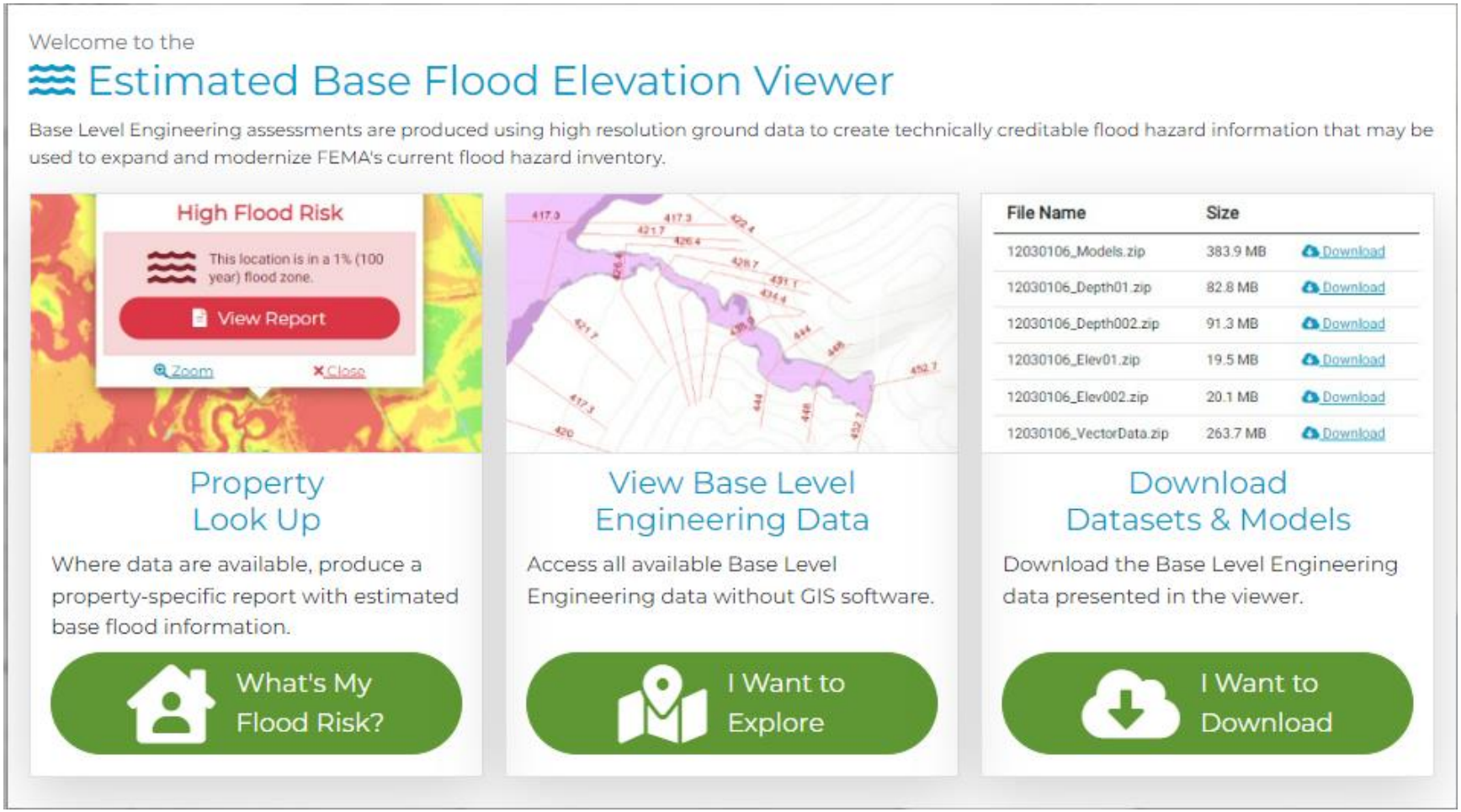
Projects – estBFE Viewer



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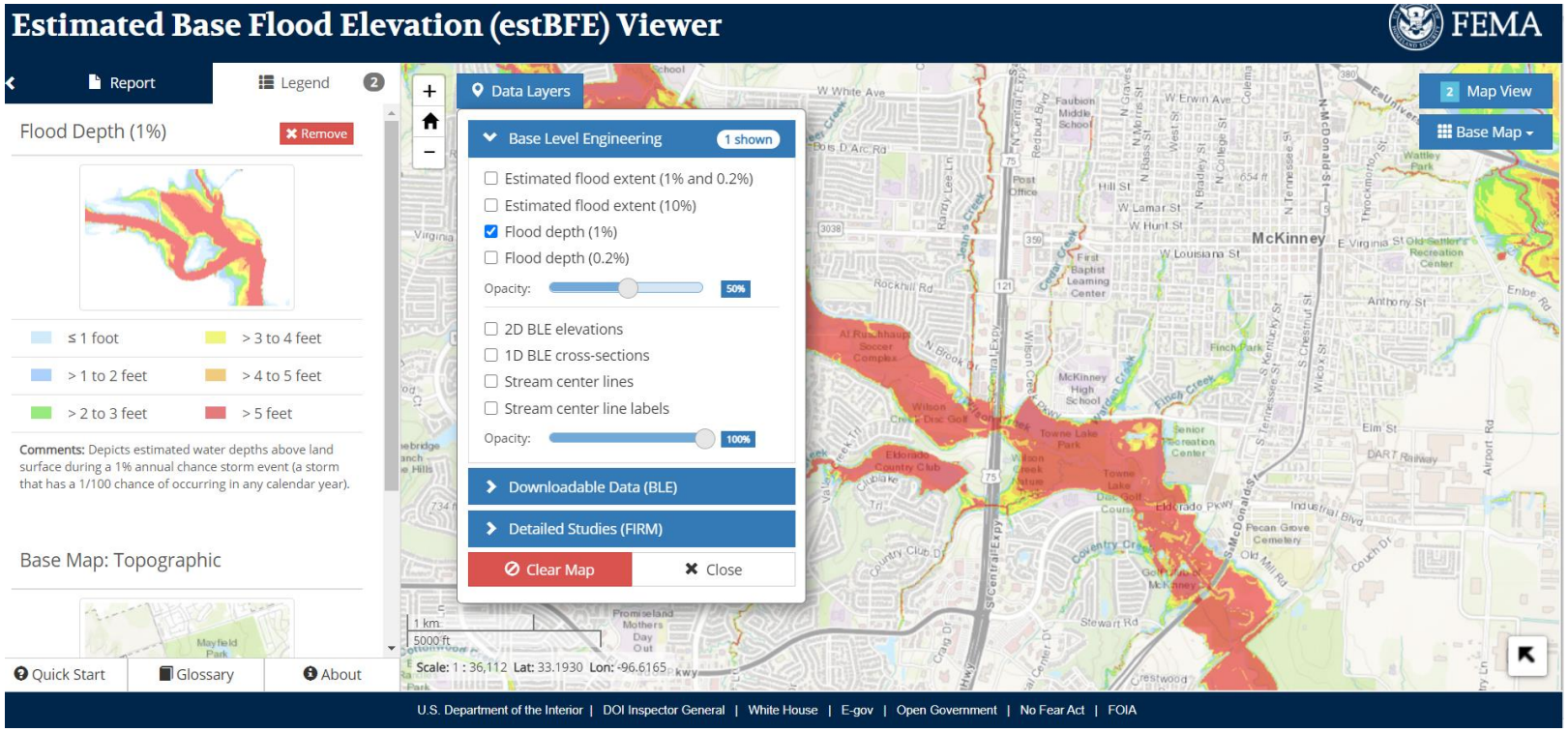
estBFE Viewer – View Base Level Engineering Data



- **Base Level Engineering** – *approach to flood risk reduction that combines high-resolution ground elevation data and modeling advancements to create engineering models and flood hazard data on a watershed-level scale*

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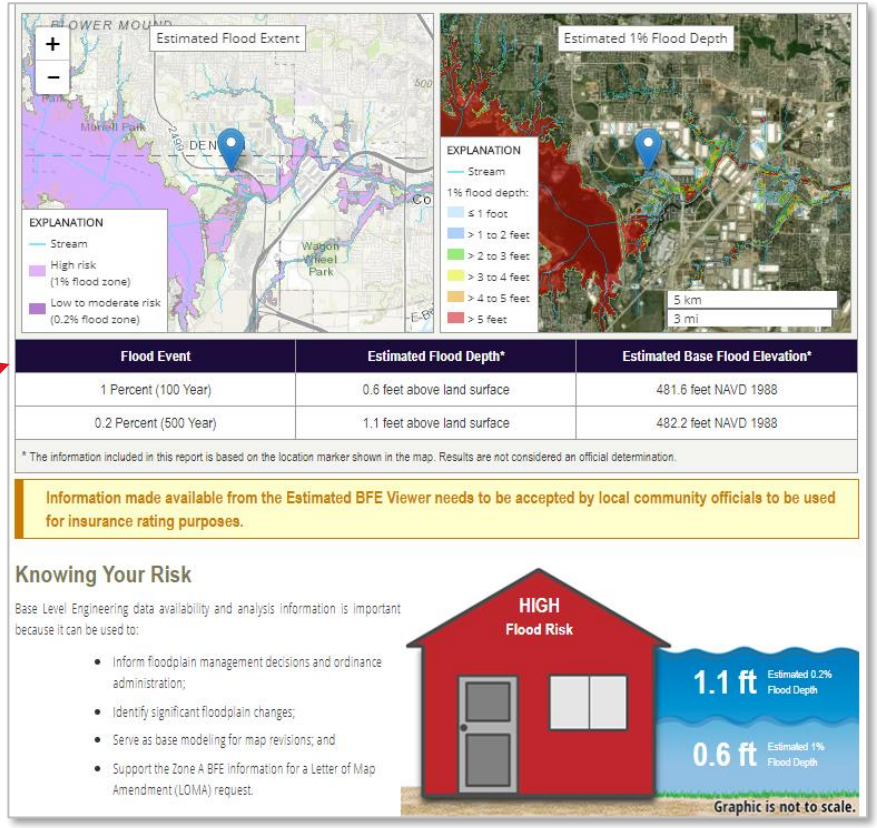
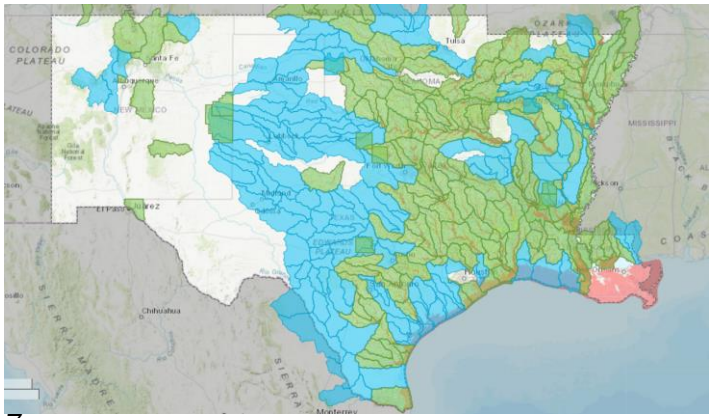
estBFE Viewer – Multi-functionality InFRM

- Base Level Engineering Data visualization
- Point, click & download
- Search functionality
- My estBFE report





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InFRM Projects – Watershed Hydrology Assessments (WHAs)

Watershed Hydrology Assessments

As hydrology remains the single largest source of uncertainty in our understanding of flood risk, the InFRM team has been performing Watershed Hydrology Assessments to update flood risk estimates in large, complex river basins using suites of models developed by USACE.

The InFRM Watershed Hydrology Assessments (WHAs) are performed by an expert team of engineers and scientists from multiple federal agencies using the latest advances in hydrologic science and technology. The watershed assessments examine the hydrology across the entire basin, reviewing non-stationary influences, such as regulation, land use changes, and wet/dry climate variation, to ensure all variables affecting flood risk in the watersheds are considered. The multi-layered analysis employs a range of hydrologic methods, including rainfall runoff modeling, statistical hydrology, and reservoir simulations, and then compares the results of those methods to one another.

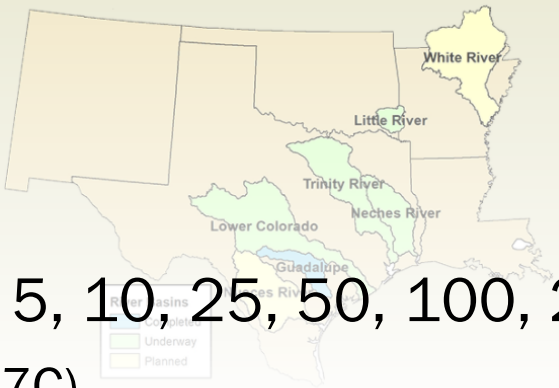
The goal of the watershed hydrology assessments is to produce consistent 1% annual chance (100-yr) and other frequency flows across the river basin, based on all available hydrologic information. The results of the hydrology assessments represent the best available estimate of flood risk across the entire river basin and provide suggestions for areas where the current flood hazard information may need to be updated.

River basins within the region are selected for hydrology assessments based on watersheds where USACE already had sufficiently detailed modeling products available as a starting point for the assessments and where FEMA had future floodplain mapping activities scheduled.

InFRM watershed hydrology assessments are currently underway for the following river basins:

- the Guadalupe,
- the Trinity,
- the Neches, and
- the lower Colorado River basins in Texas, and
- the Little River basin in Oklahoma.

Additional basins will be added to the program as funding allows.



DOCUMENTS

InFRM Hydrology Report for the San Marcos River Basin

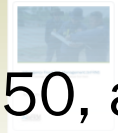
Summarizes new analyses completed to estimate frequency flows for various stream reaches in the San Marcos River Basin.

InFRM Watershed Hydrology Assessment for the Guadalupe River Basin

Summarizes new analyses completed to estimate frequency flows, for various stream reaches in the Guadalupe River Basin.

InFRM Watershed Hydrology Assessments Factsheet

Highlights and description of the Watershed Hydrology Assessments



InFRM Watershed Hydrology Assessment for the Trinity River Basin

Summarizes new analyses completed to estimate frequency flows, for various stream reaches in the

Report Appendices

- Flood flow frequency for 2, 5, 10, 25, 50, 100, 250, and 500 yr
  - Statistical analysis (Bulletin 17C)
  - Rainfall-runoff modeling (CWMS)
  - RiverWare generated period of record

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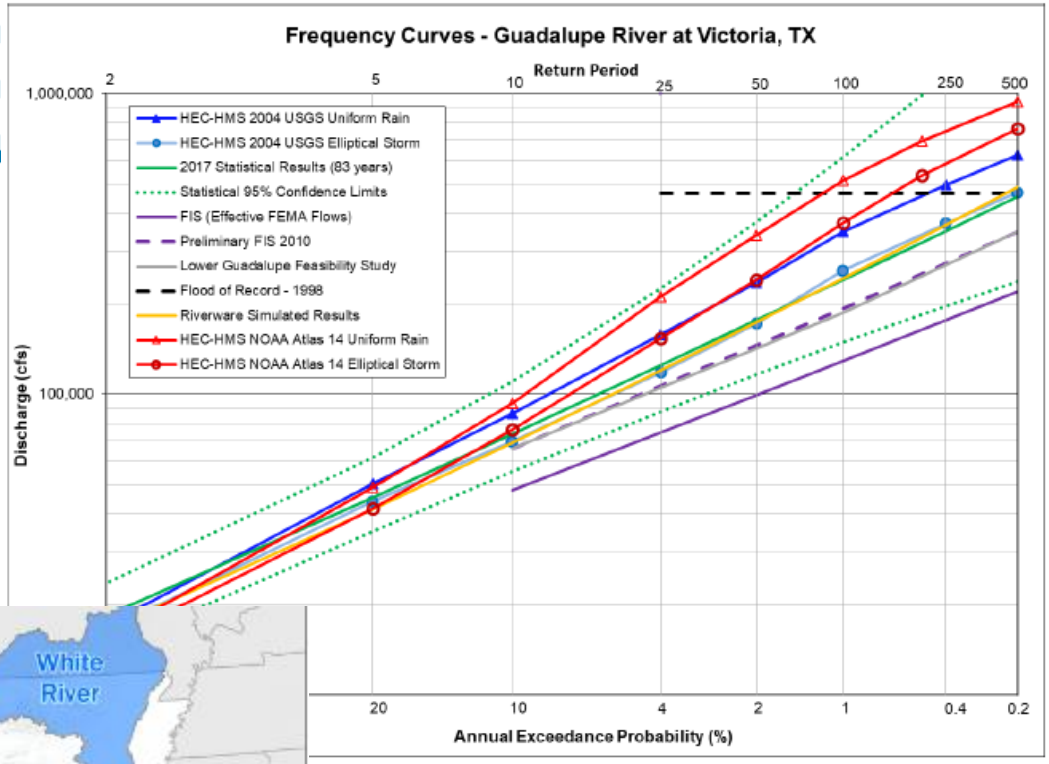
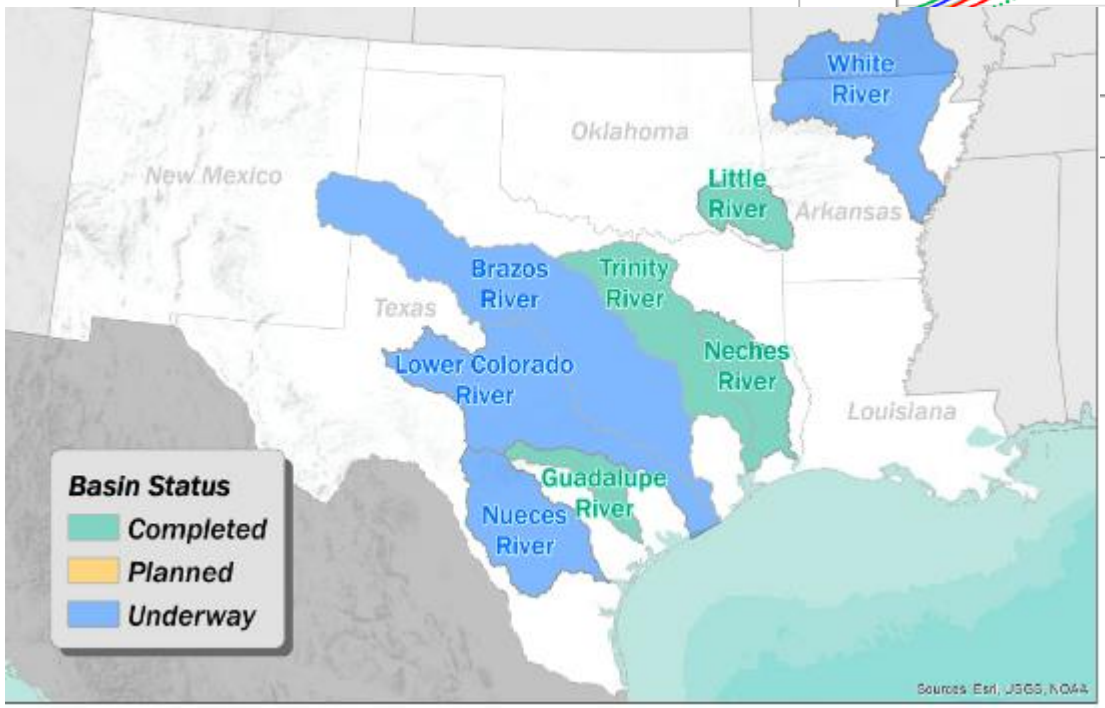
WHA - Results

- Statistical flood frequency results compared to previous effective flows, basin models to produce recommended results.

- Reports available at infrm.us





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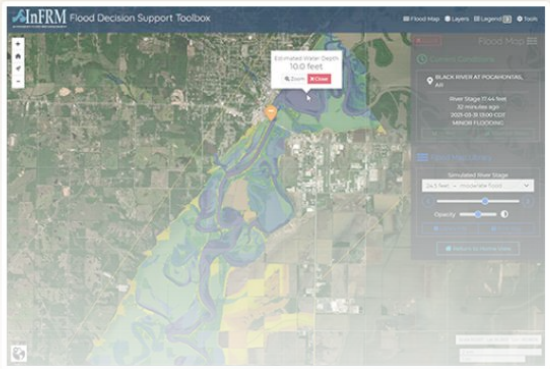
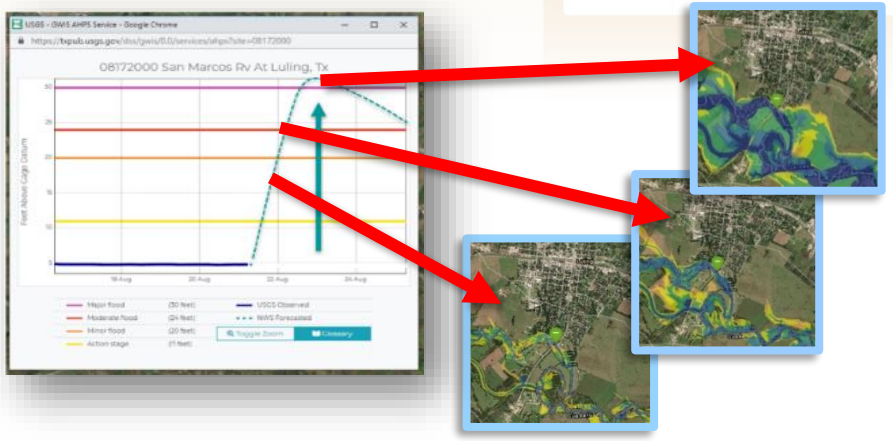
InFRM Projects – Flood Decision Support Toolbox (FDST)

Flood Decision Support Toolbox

The InFRM Flood Decision Support Toolbox (FDST) is an interactive web application (WebApp) which:

- visualizes current flood-related weather conditions in FEMA region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, Texas),
- allows peace-time analysis by emergency planners, local governments, and other stakeholders preparing for potential response activities (such as planned evacuation routes, identification of vulnerable areas requiring road closure, and resource planning in advance of flood events),
- leverages federal, state, regional and local engineering model information to develop pre-positioned flood inundation libraries for micro-level efforts (neighborhood level),
- connects National Water Model predictions for macro-level planning (community, county, state level),
- uses pre-positioned flood inundation libraries to display flood inundation areas in relation to a field reported streamgage height,
- can be updated with data submittals by other Federal/State agencies, river





- Pre-positioned map libraries
- Tied to:
  - USGS streamgage data
  - NWS River Forecasts
  - NWS Flood Categories
- Scenario Planning
- Historical Flood viewing
- Print Map Generation

DOCUMENTS

FDST User Guide

How to use FDST for estimating flood extent and depth for possible flood scenarios based on the underlying models.

FDST Executive Summary and Submittal Guidance

Provide standardized guidelines, quality assurance checks, and data input format for submitting flood inundation data for inclusion on the FDST viewer.

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The Flood Decision Support Toolbox

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Flooding in the South-Central U.S.
A better warning system is needed!

Harvey 2017

Mississippi River 2019

TS Imelda 2019

Wimberly 2015

Ida 2021

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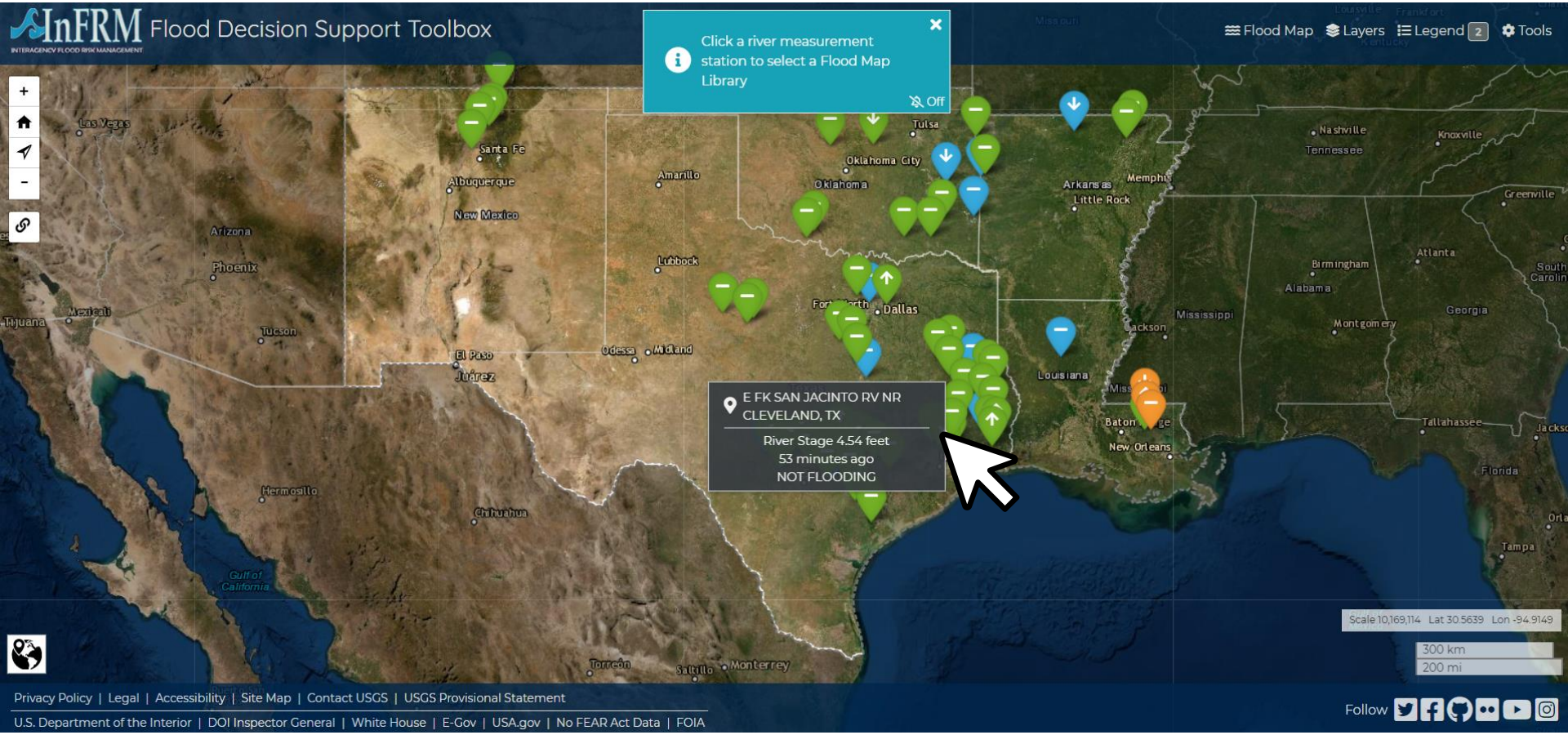
FDST Functionality



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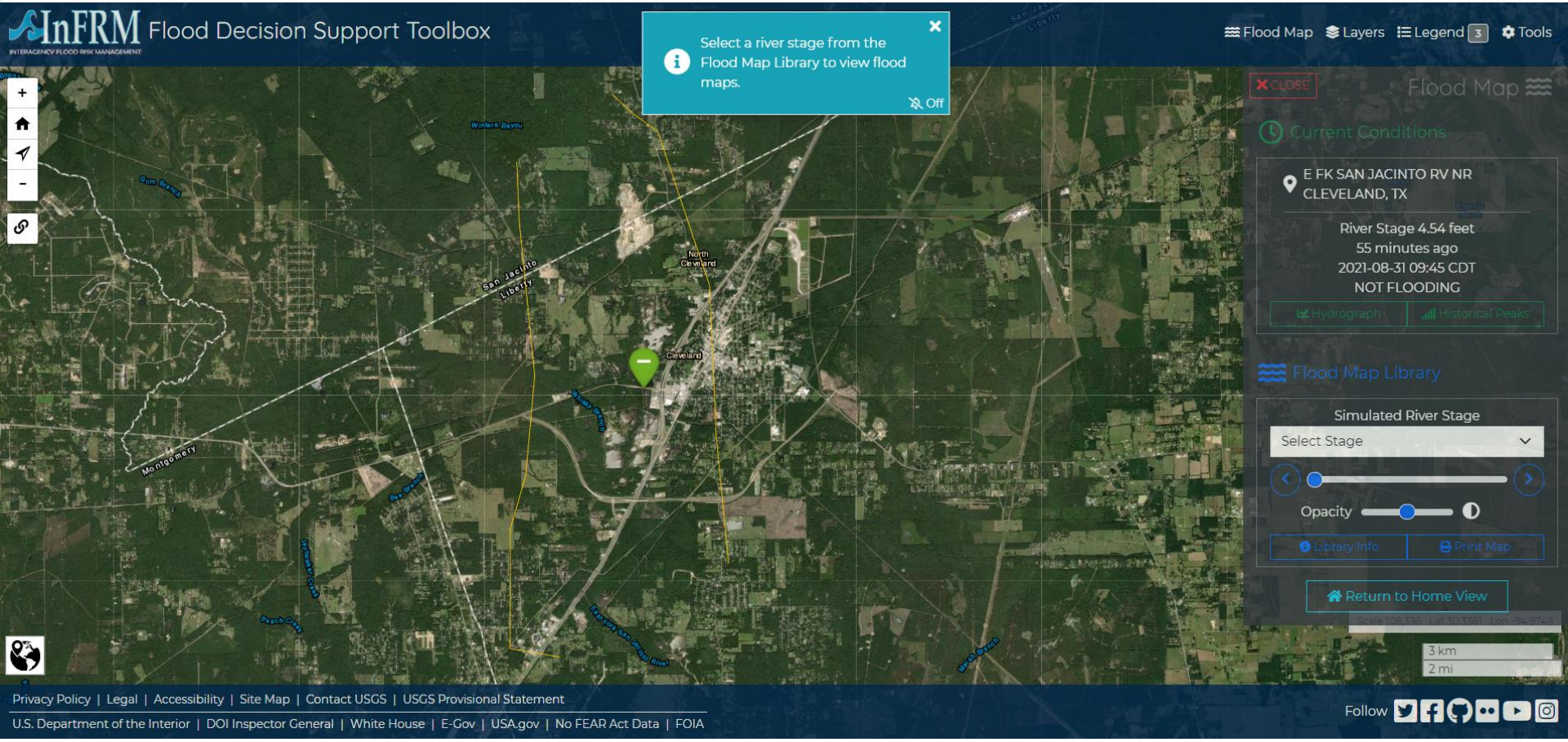
FDST Functionality



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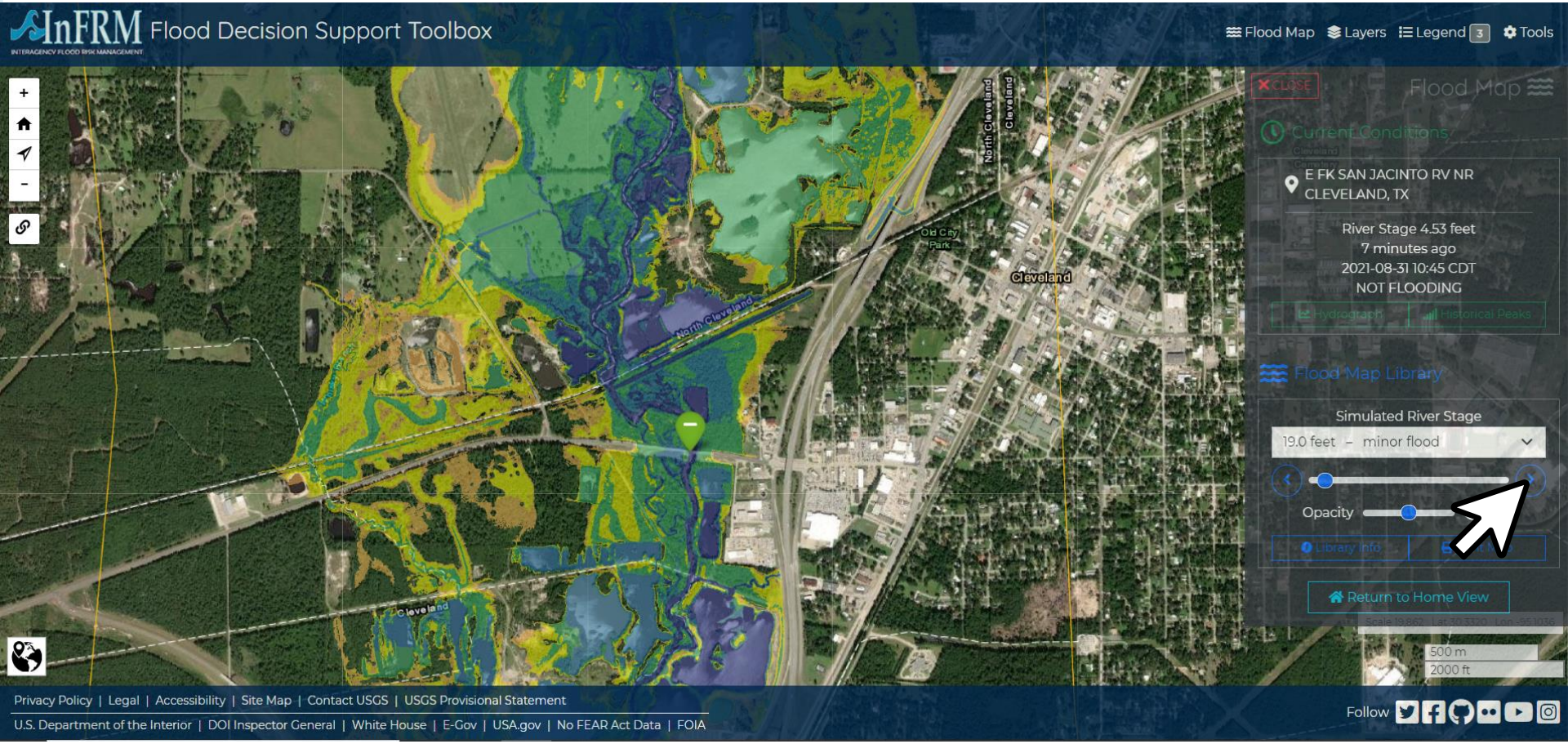

Map library extends from **NWS Minor Flood** stage to maximum expected flood (**max observed** OR **500-year event**)

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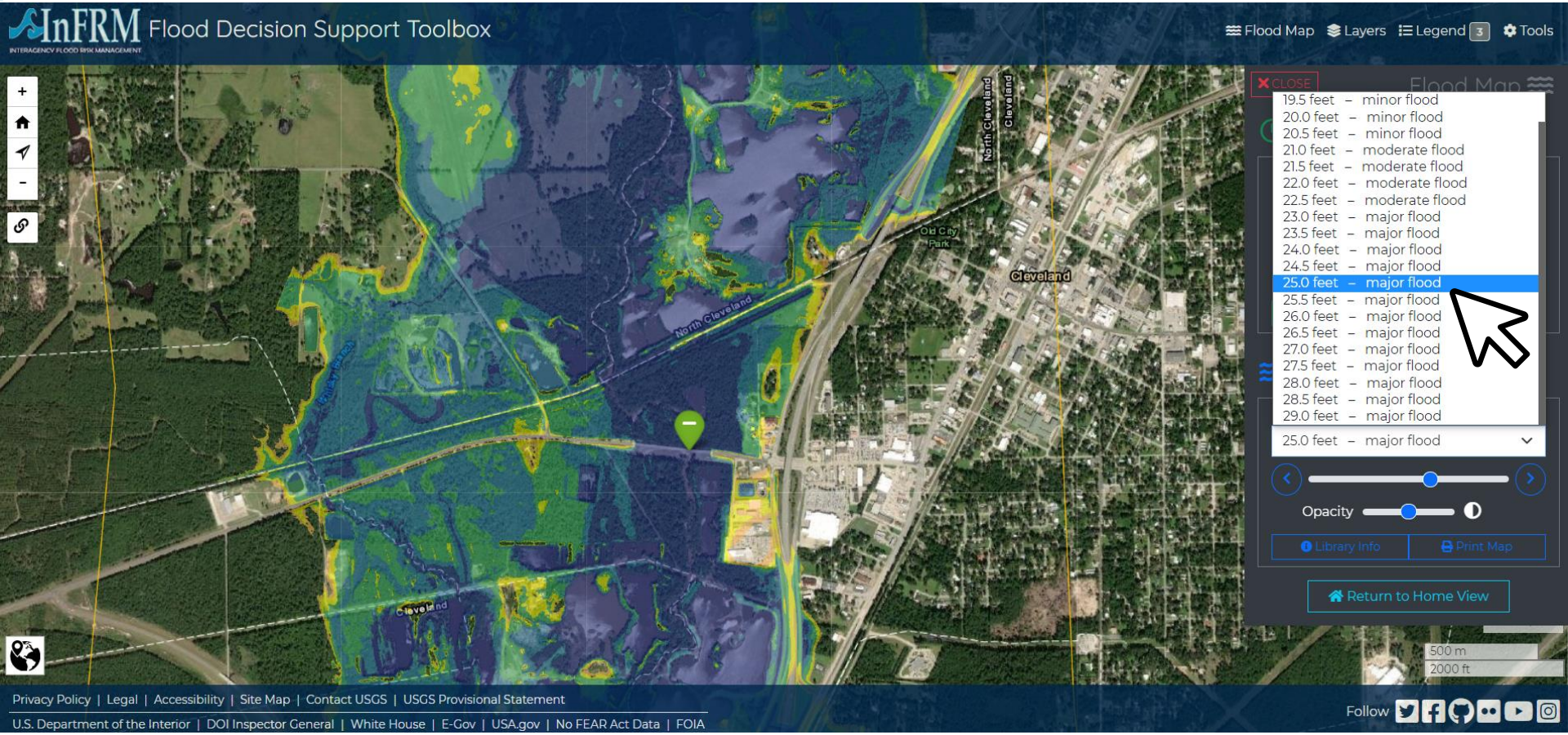
INTERAGENCY FLOOD RISK MANAGEMENT

FDST Functionality



Map library extends from **NWS Minor Flood** stage to maximum expected flood (**max observed** OR **500-year event**)

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FDST Functionality

Select anywhere in the map to view estimated water depth

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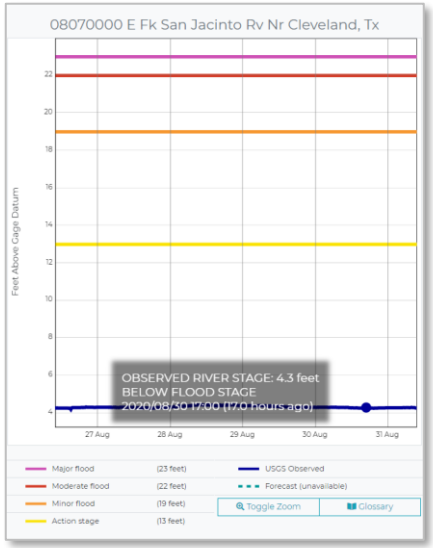
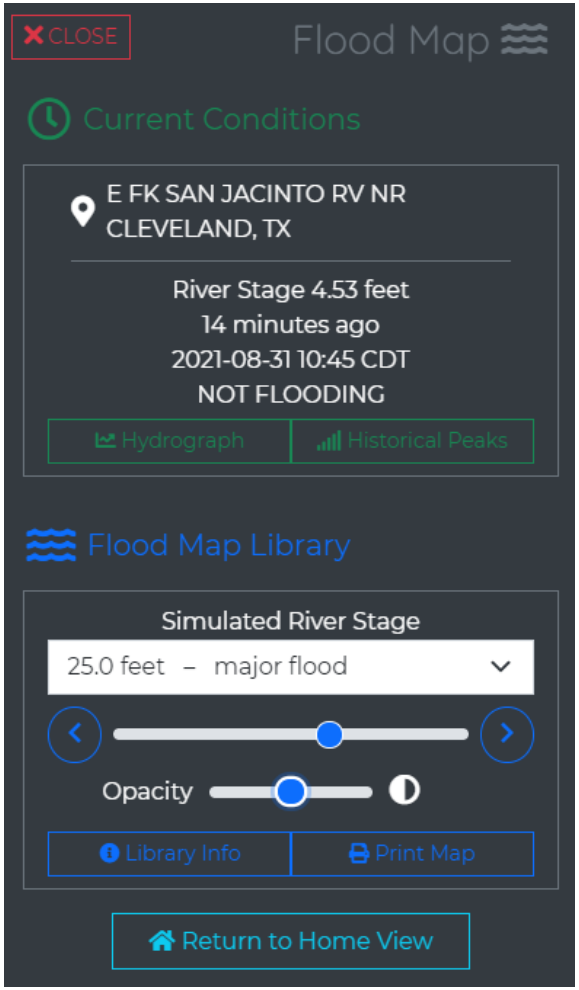
FDST Functionality

- **Hydrograph:**
  - Tied to USGS streamgage data, NWS AHPS prediction service
  - Stage forecast*
  - Flood categories*

** If available*





- **Historical Peaks:**
  - Top 10 historical stages
  - Enables user to view the effects of a historical flood as if it were to happen today

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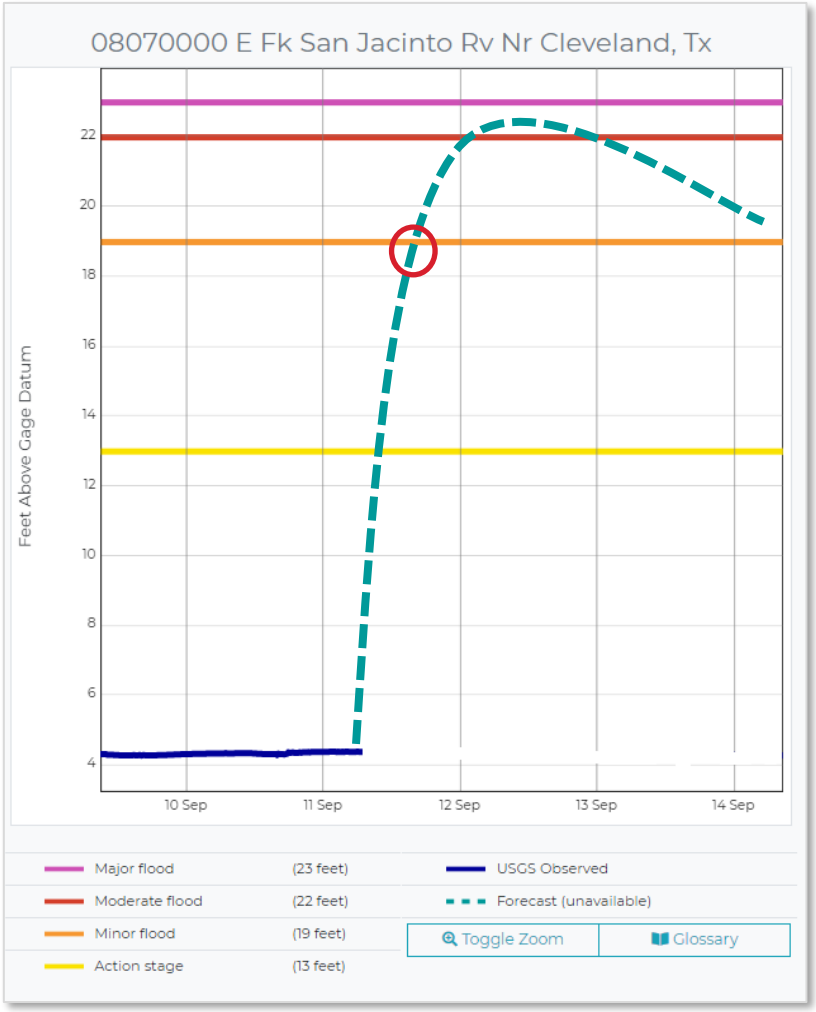
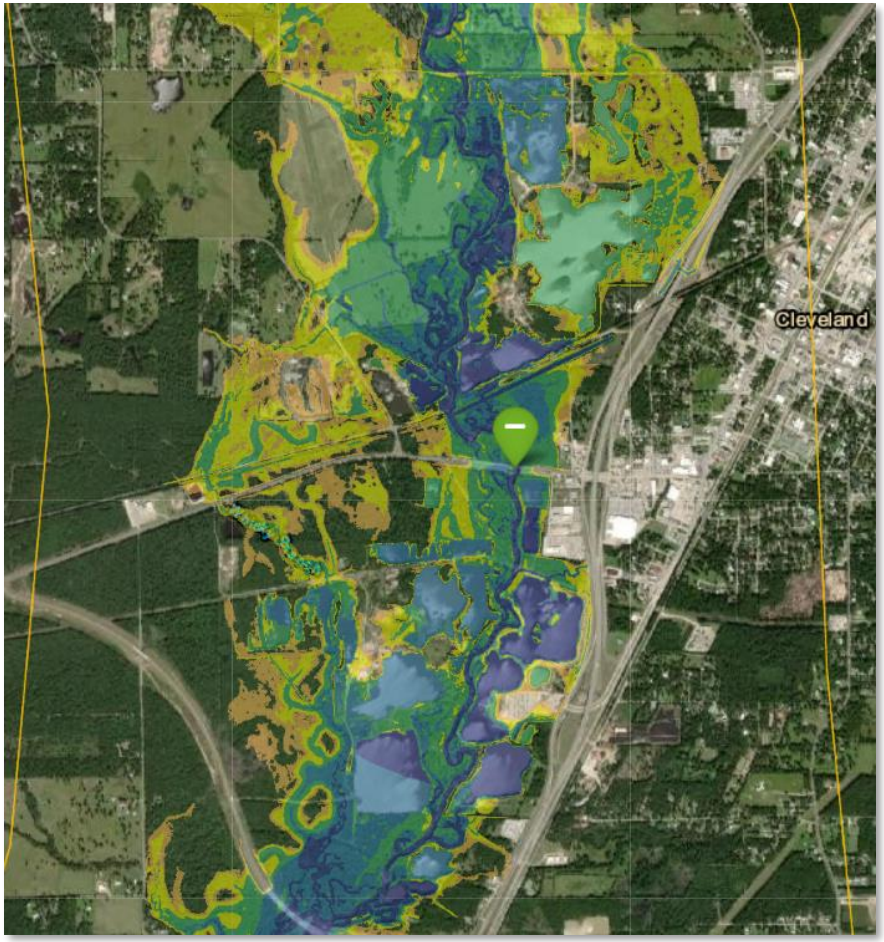
INTERAGENCY FLOOD RISK MANAGEMENT

FDST Functionality





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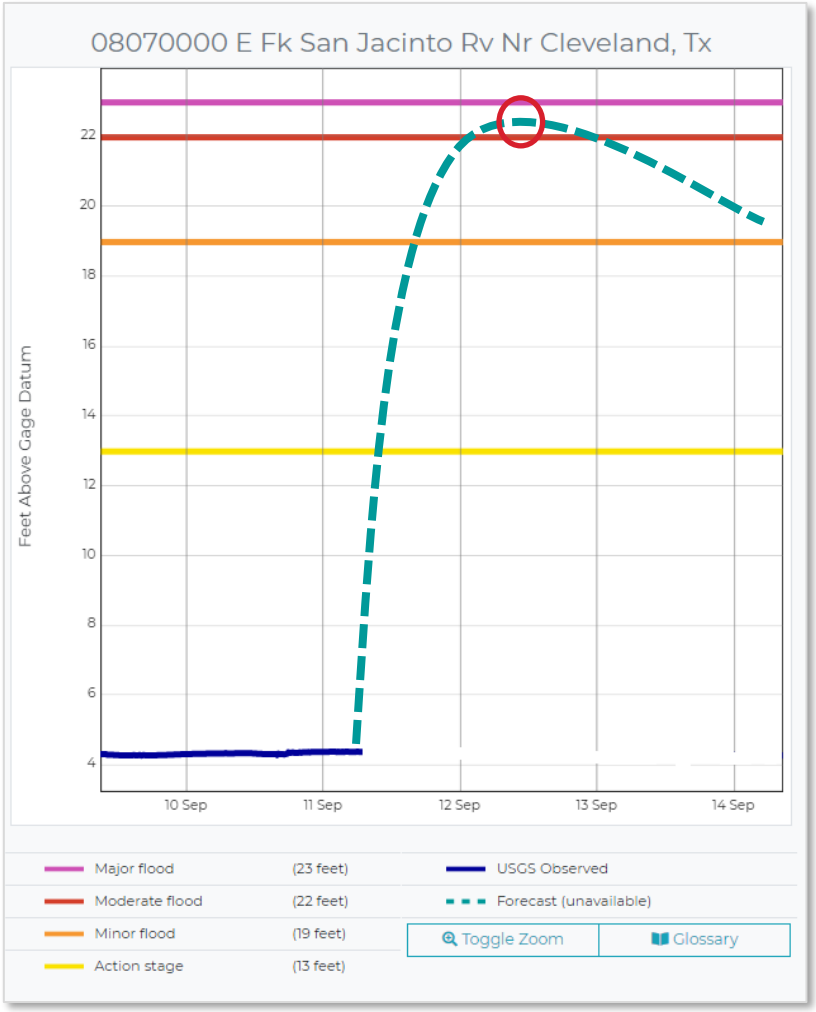
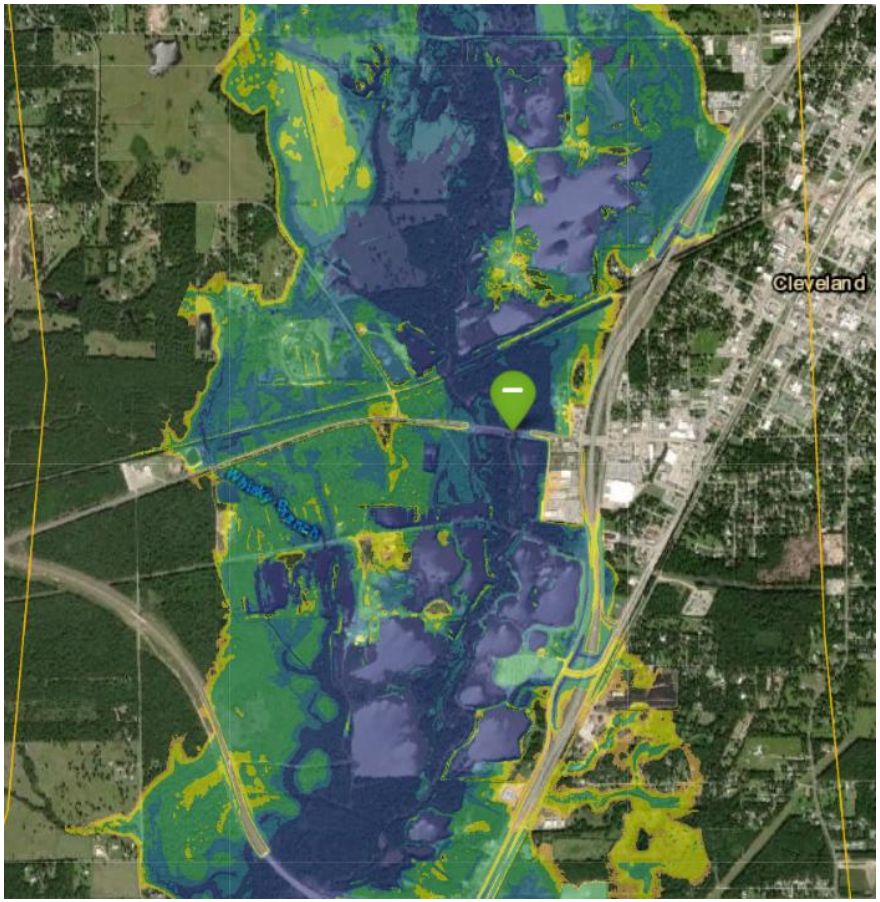
INTERAGENCY FLOOD RISK MANAGEMENT

FDST Functionality





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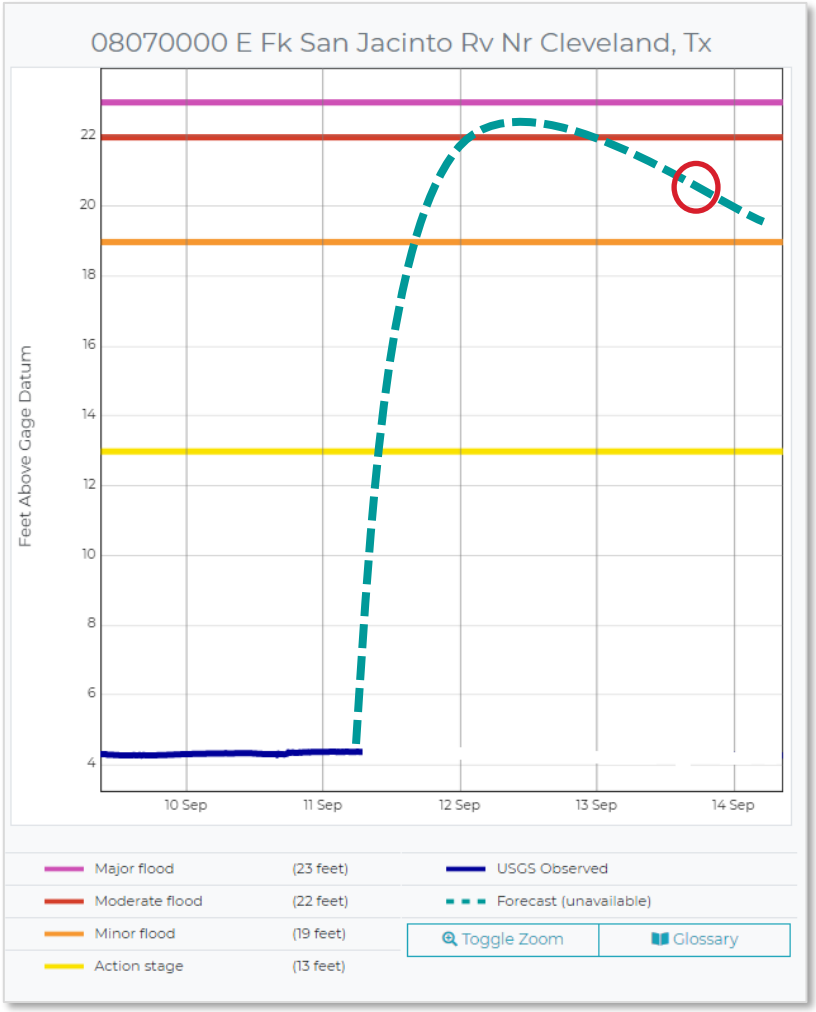
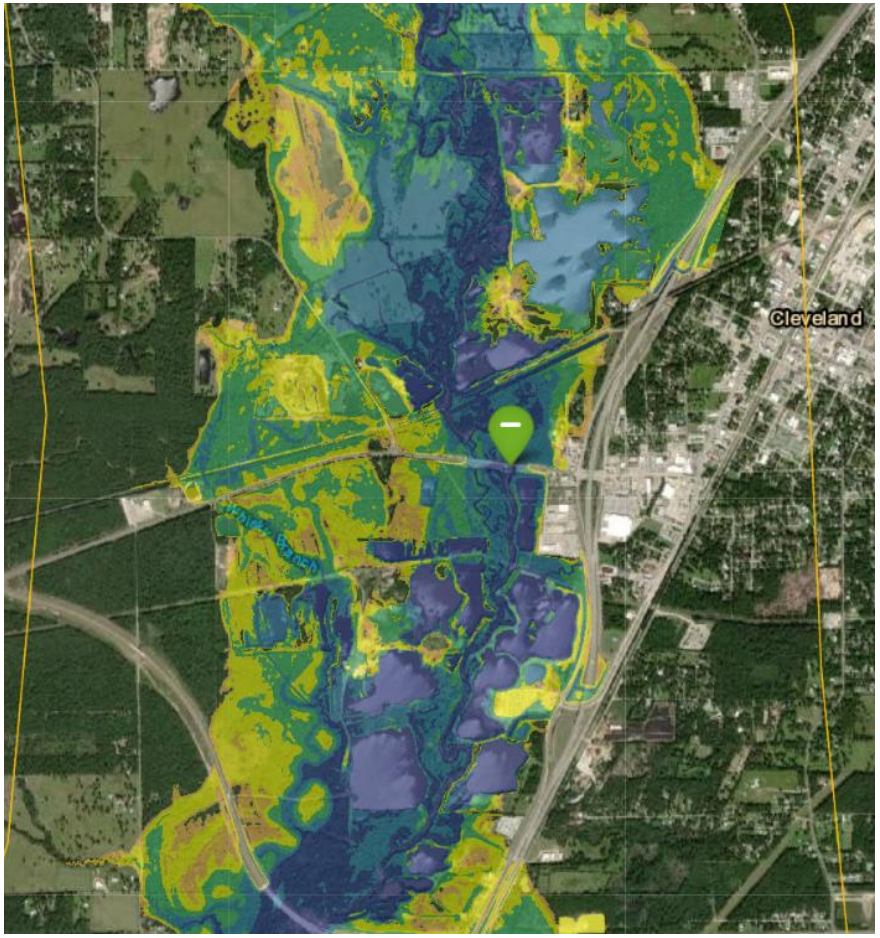
FDST Functionality





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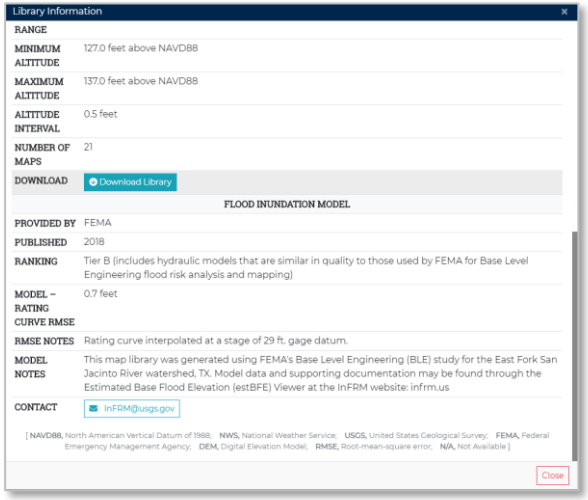
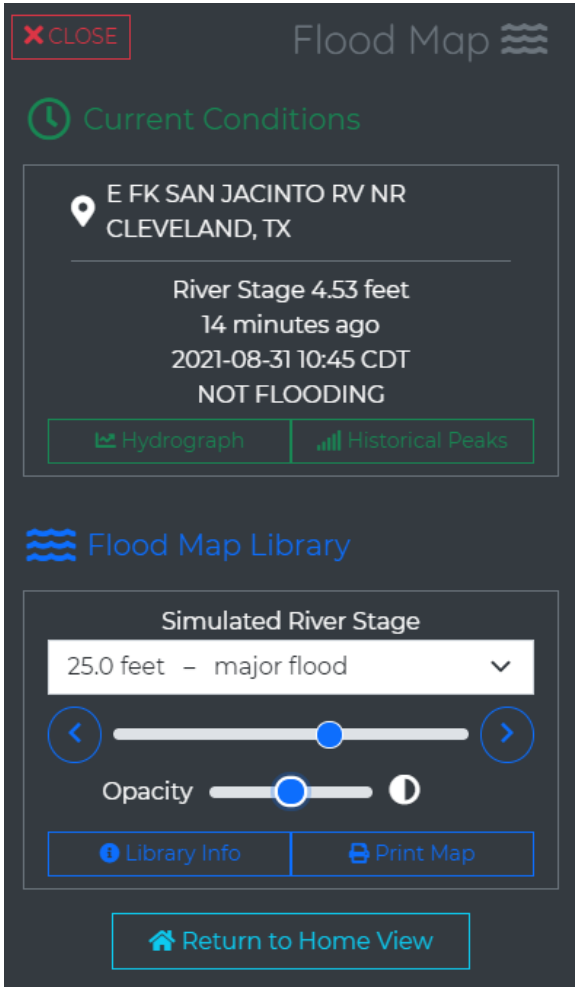
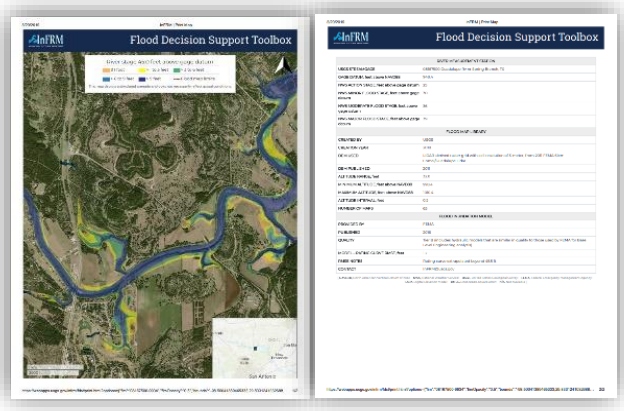
FDST Functionality

- **Library Info:**
  - Model metadata
  - Model source
  - Model error, ranking (Tier A, Tier B)
  - ‘Download Library’ option





- **Print Map:**
  - PDF or print snapshot of map view
  - Enables distribution of flood map in field
  - Includes map view and library info



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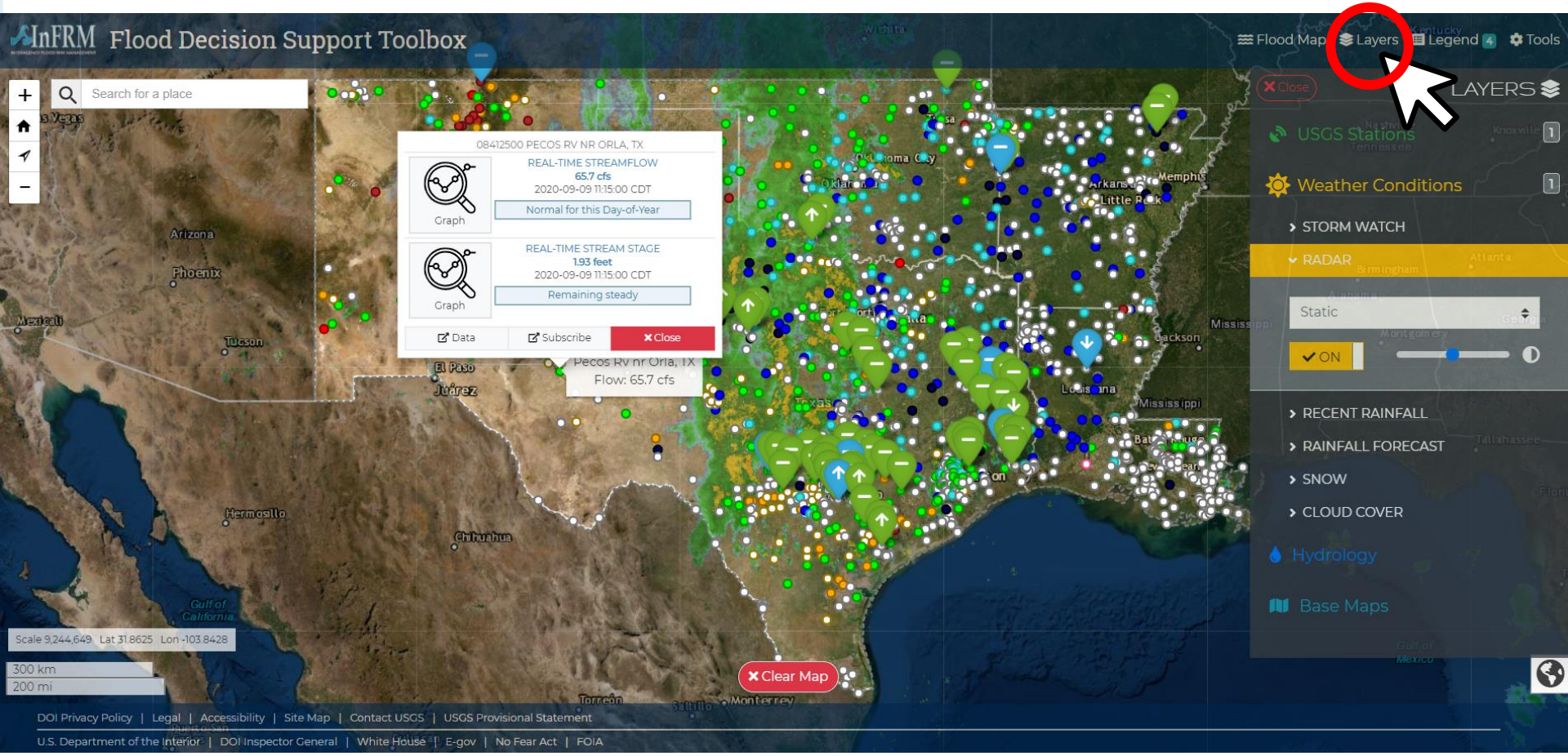
FDST Functionality



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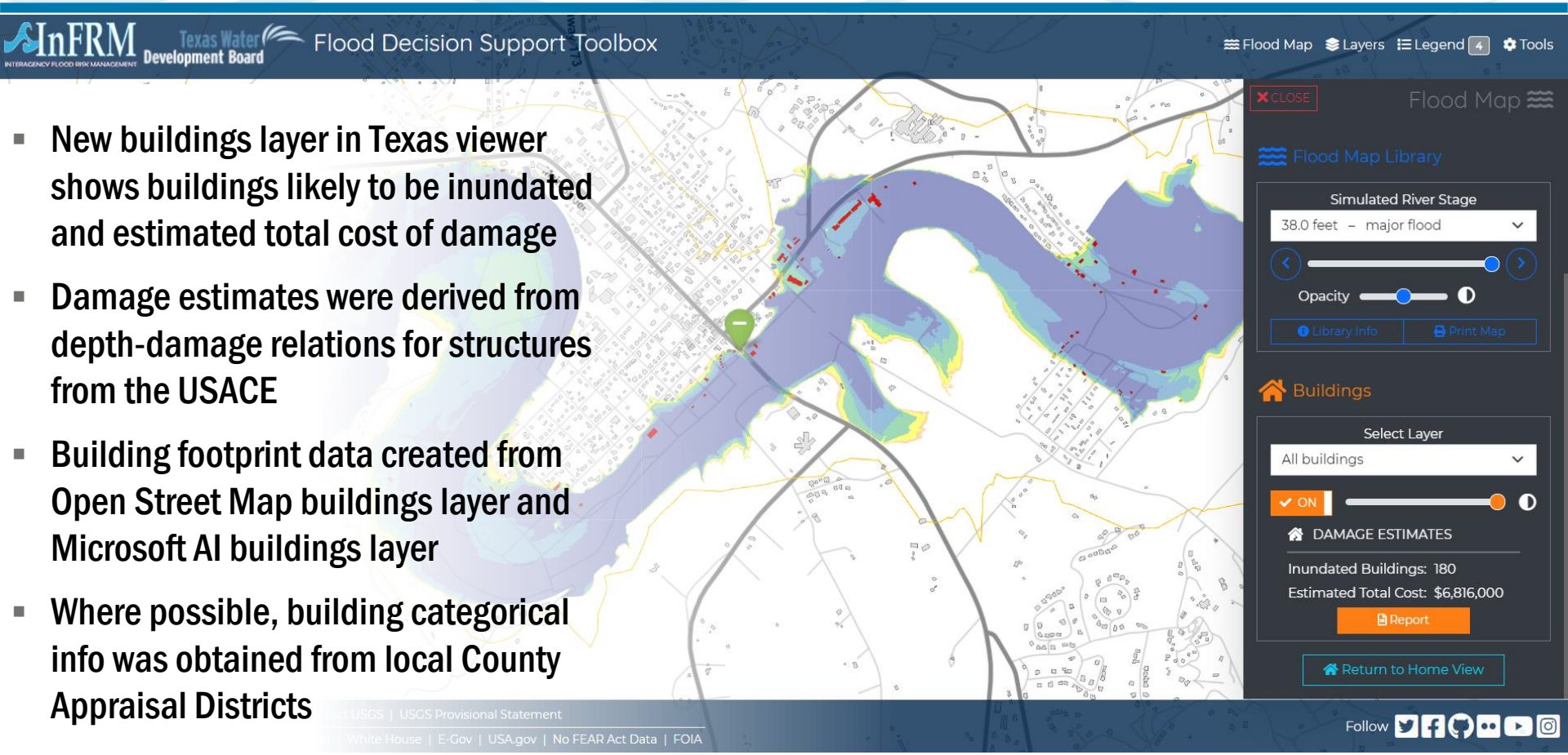
INTERAGENCY FLOOD RISK MANAGEMENT

FDST Functionality – Texas

- New buildings layer in Texas viewer shows buildings likely to be inundated and estimated total cost of damage
- Damage estimates were derived from depth-damage relations for structures from the USACE
- Building footprint data created from Open Street Map buildings layer and Microsoft AI buildings layer
- Where possible, building categorical info was obtained from local County Appraisal Districts



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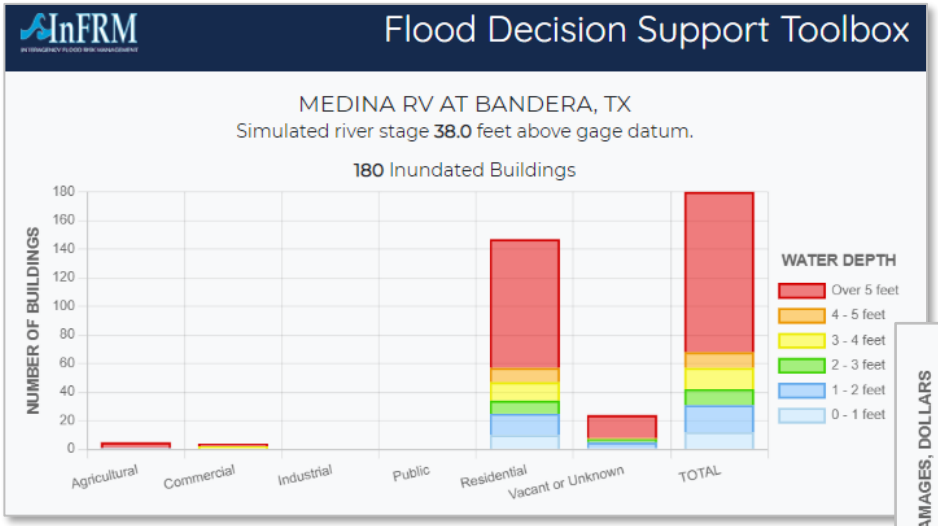
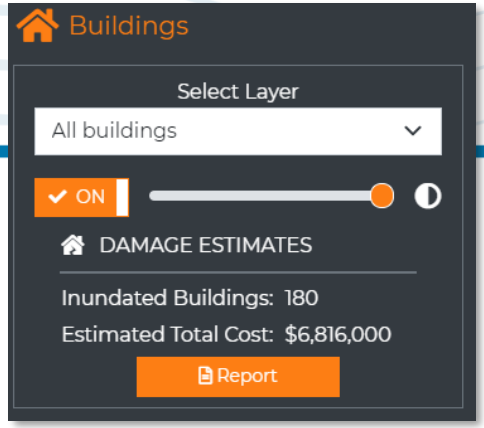
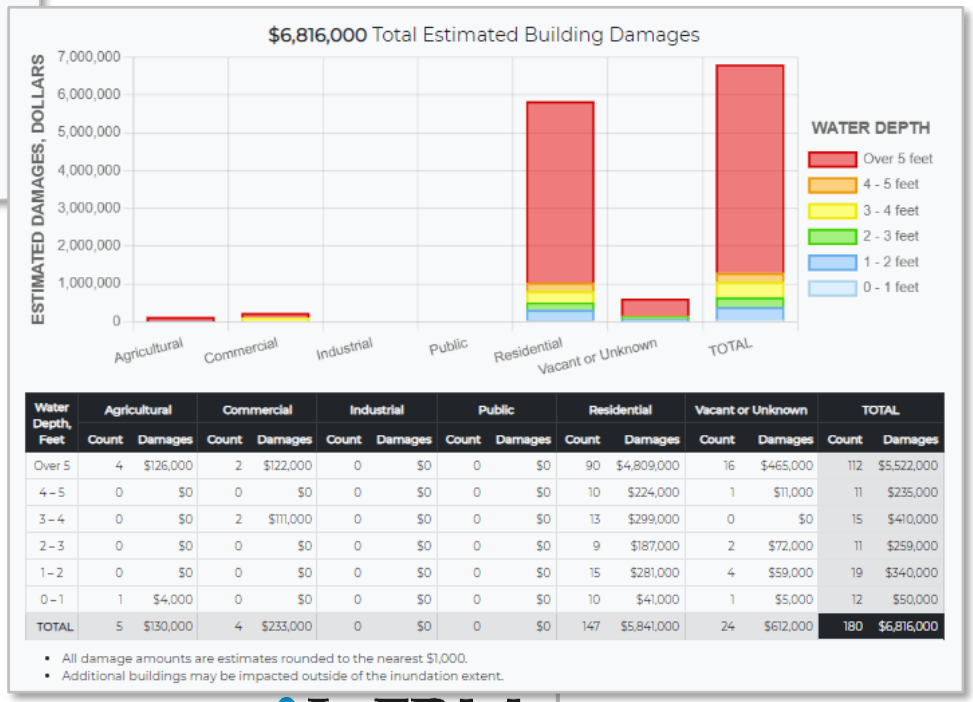
FDST Functionality – Texas







Water Depth, Feet	Agricultural		Commercial		Industrial		Public		Residential		Vacant or Unknown		TOTAL	
	Count	Damages	Count	Damages	Count	Damages	Count	Damages	Count	Damages	Count	Damages	Count	Damages
Over 5	4	$126,000	2	$122,000	0	$0	0	$0	90	$4,809,000	16	$465,000	112	$5,522,000
4 - 5	0	$0	0	$0	0	$0	0	$0	10	$224,000	1	$11,000	11	$235,000
3 - 4	0	$0	2	$111,000	0	$0	0	$0	13	$299,000	0	$0	15	$410,000
2 - 3	0	$0	0	$0	0	$0	0	$0	9	$187,000	2	$72,000	11	$259,000
1 - 2	0	$0	0	$0	0	$0	0	$0	15	$281,000	4	$59,000	19	$340,000
0 - 1	1	$4,000	0	$0	0	$0	0	$0	10	$41,000	1	$5,000	12	$50,000
TOTAL	5	$130,000	4	$233,000	0	$0	0	$0	147	$5,841,000	24	$612,000	180	$6,816,000

- All damage amounts are estimates rounded to the nearest $1,000.
- Additional buildings may be impacted outside of the inundation extent.

- Click 'Report' to see more details on estimated building damages and estimated costs
- Print Map function also summarizes building damage in Texas
- NOTE: costs CANNOT be tied back to individual buildings

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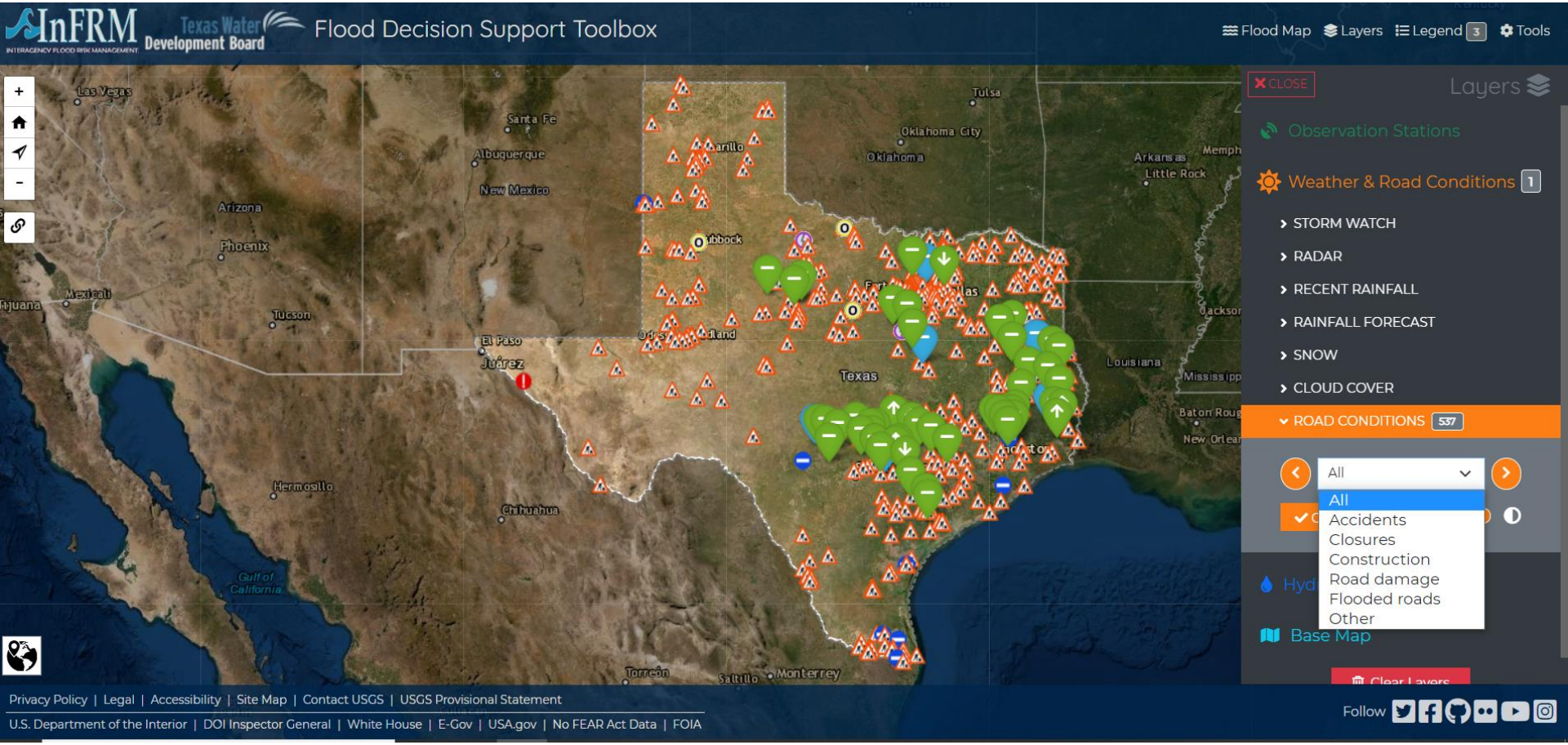
FDST Functionality – Texas



- Texas viewer shows TXDOT road conditions

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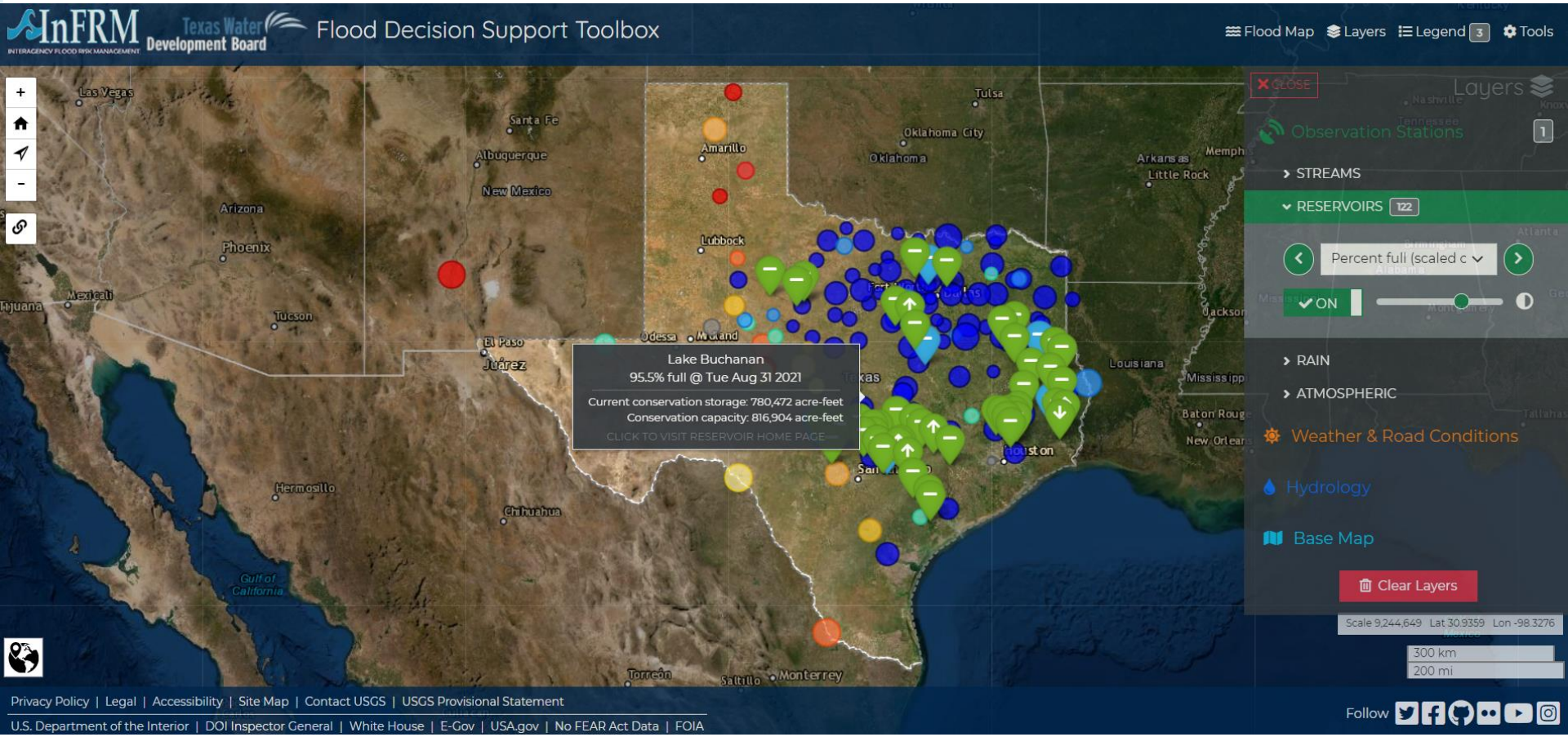
FDST Functionality – Texas



- Reservoir status available through ***Water Data for Texas*** (% full and % flood height)

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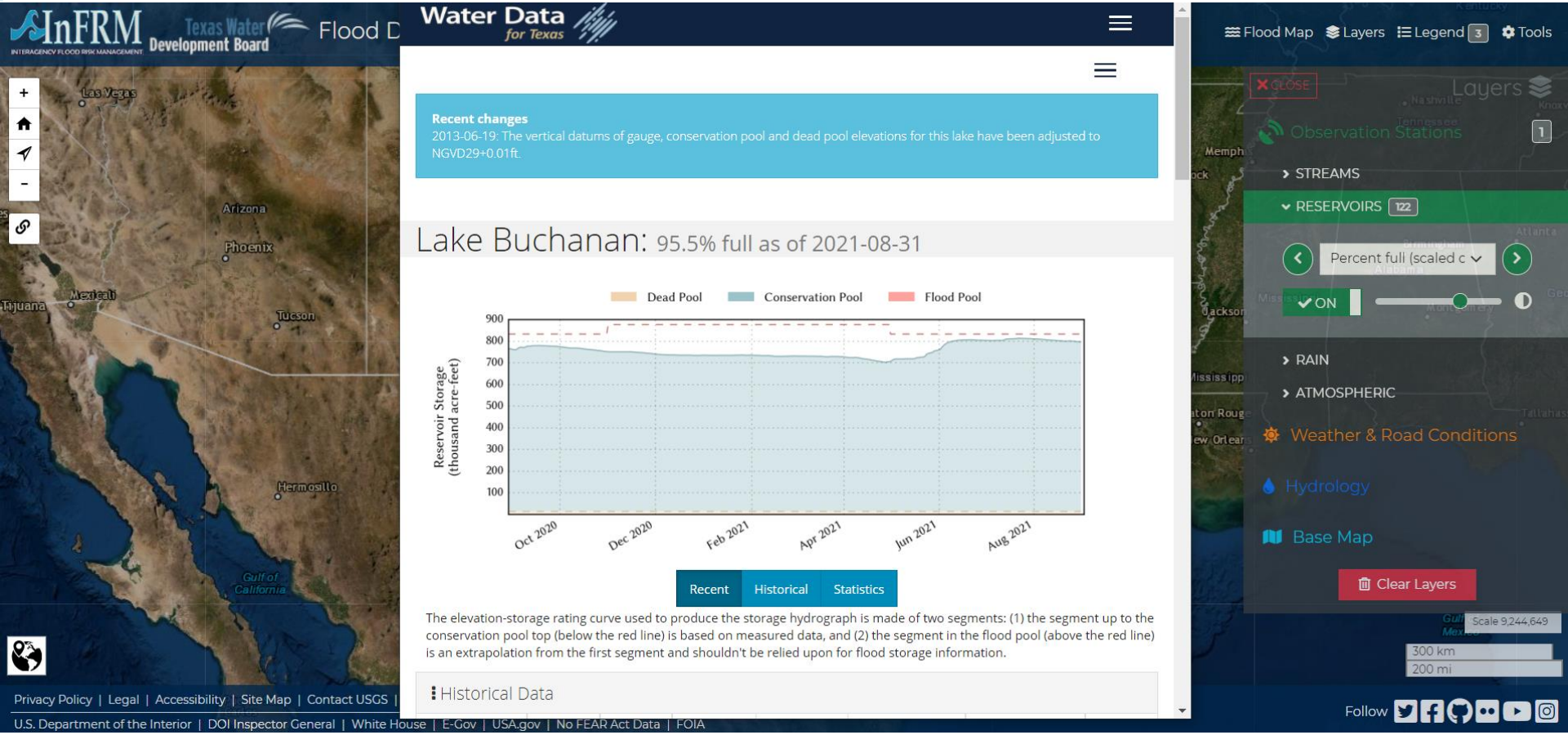
FDST Functionality – Texas



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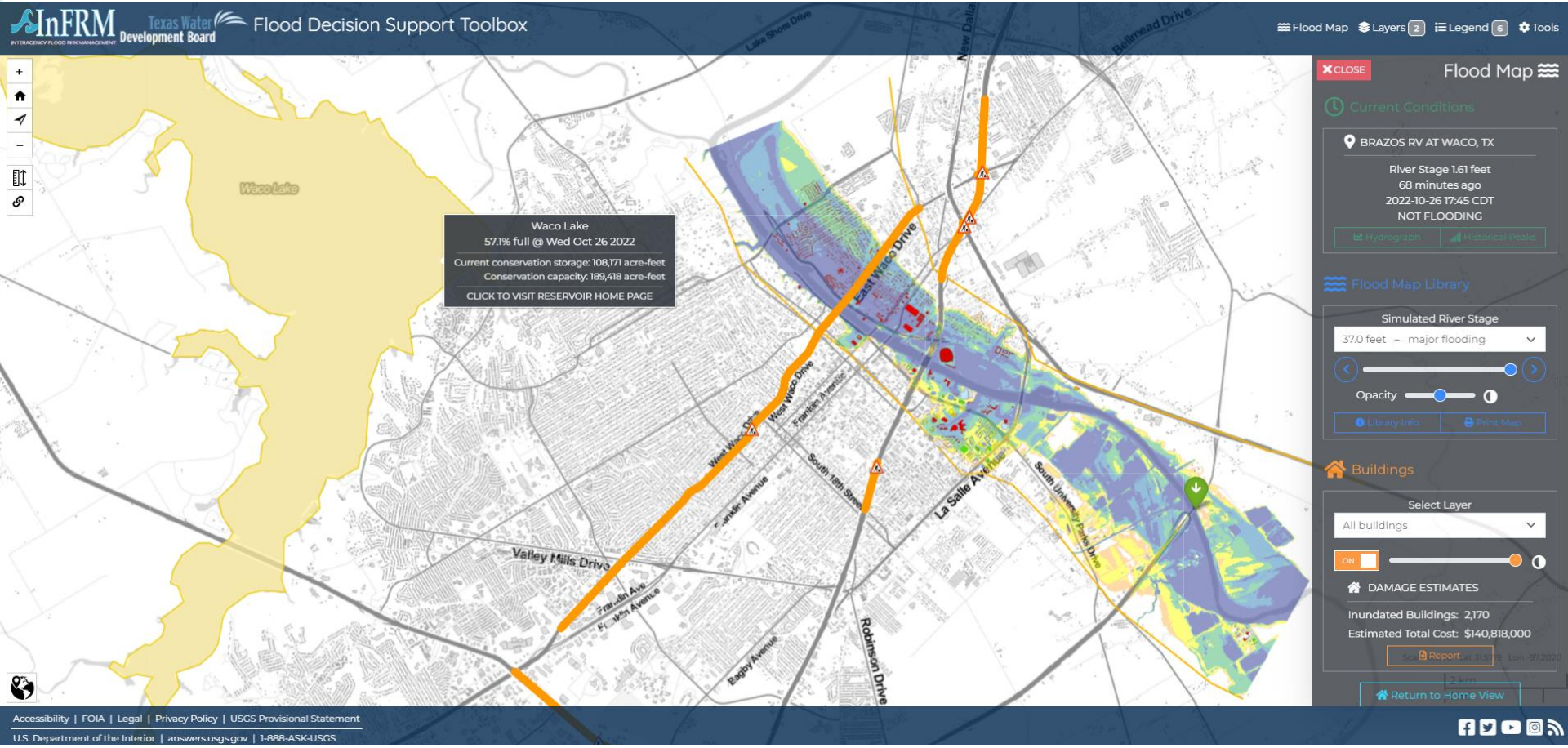
FDST Functionality – Texas



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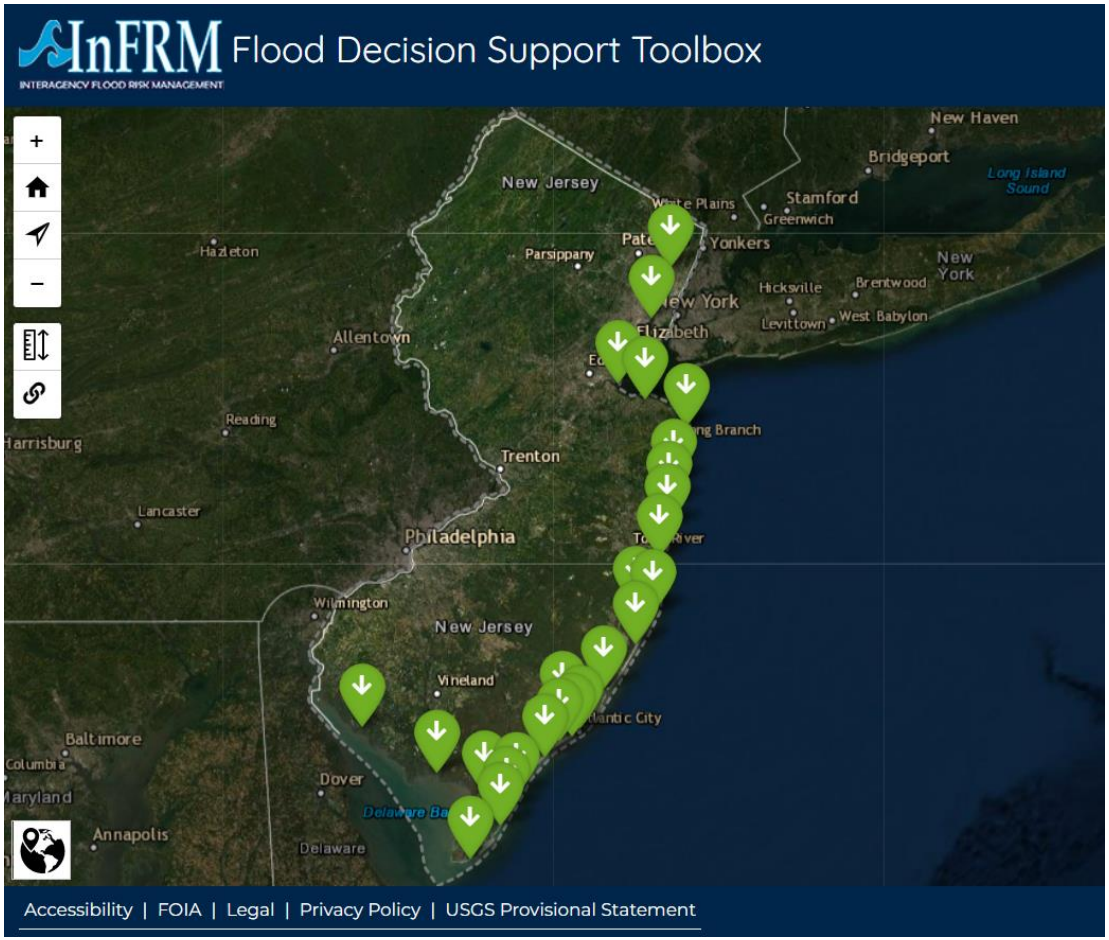
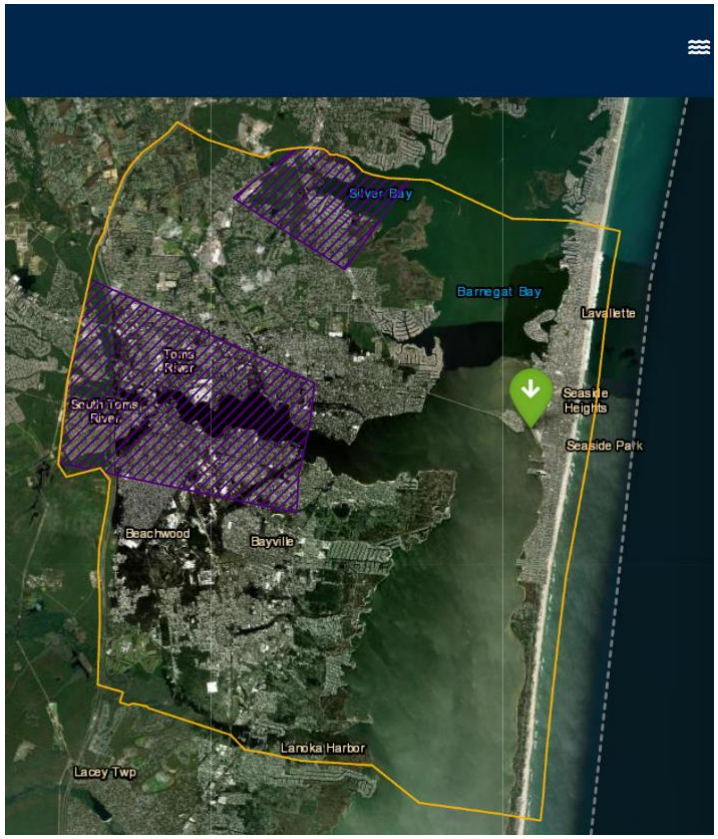
FDST Functionality – New Jersey





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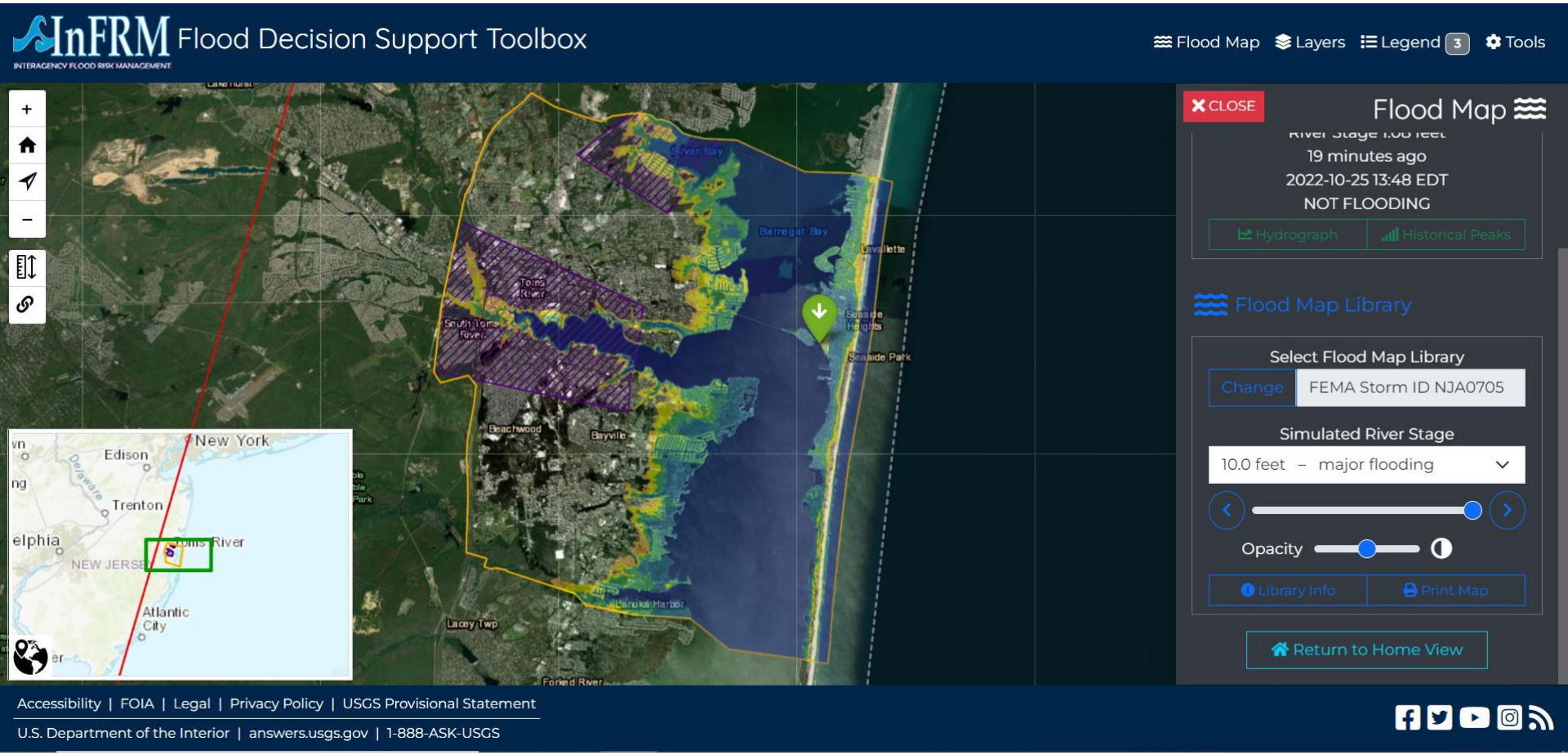
FDST Functionality – New Jersey



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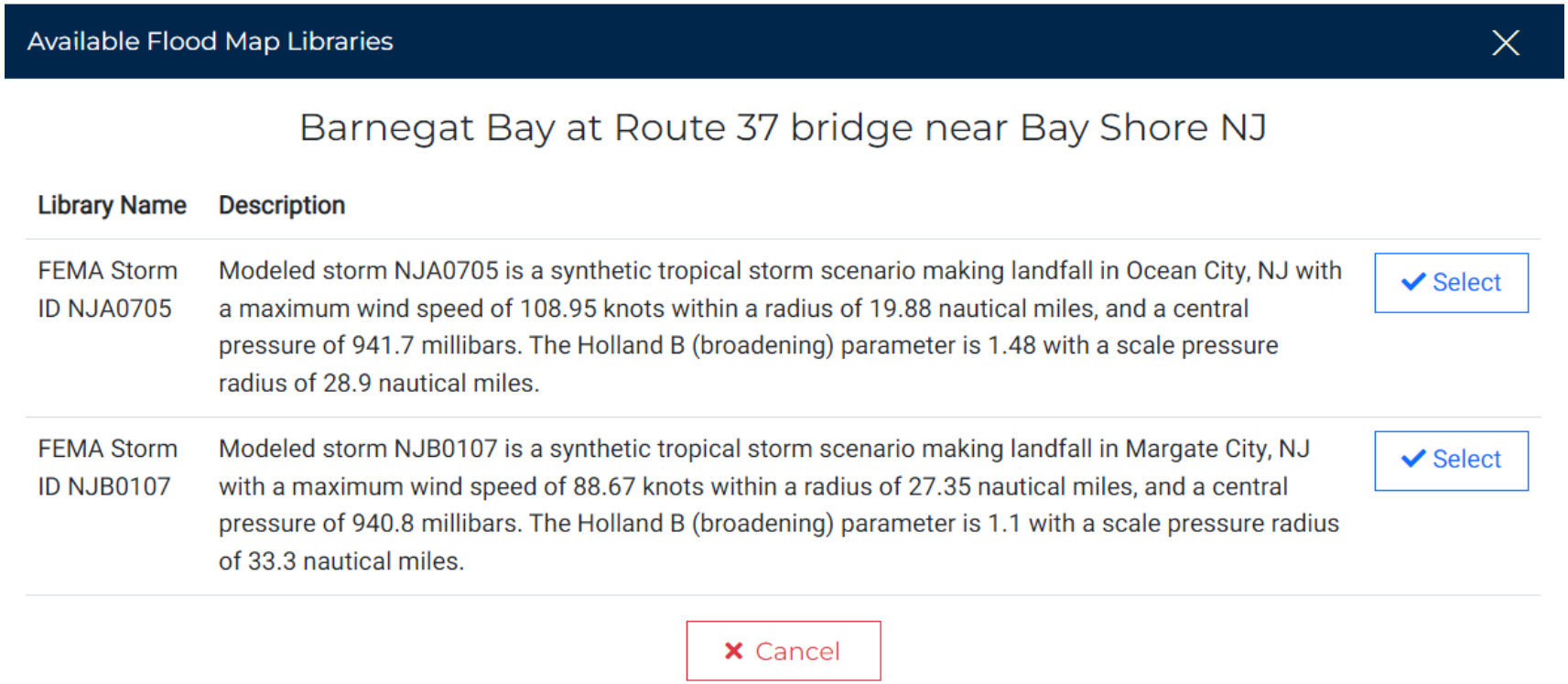
FDST Functionality – New Jersey



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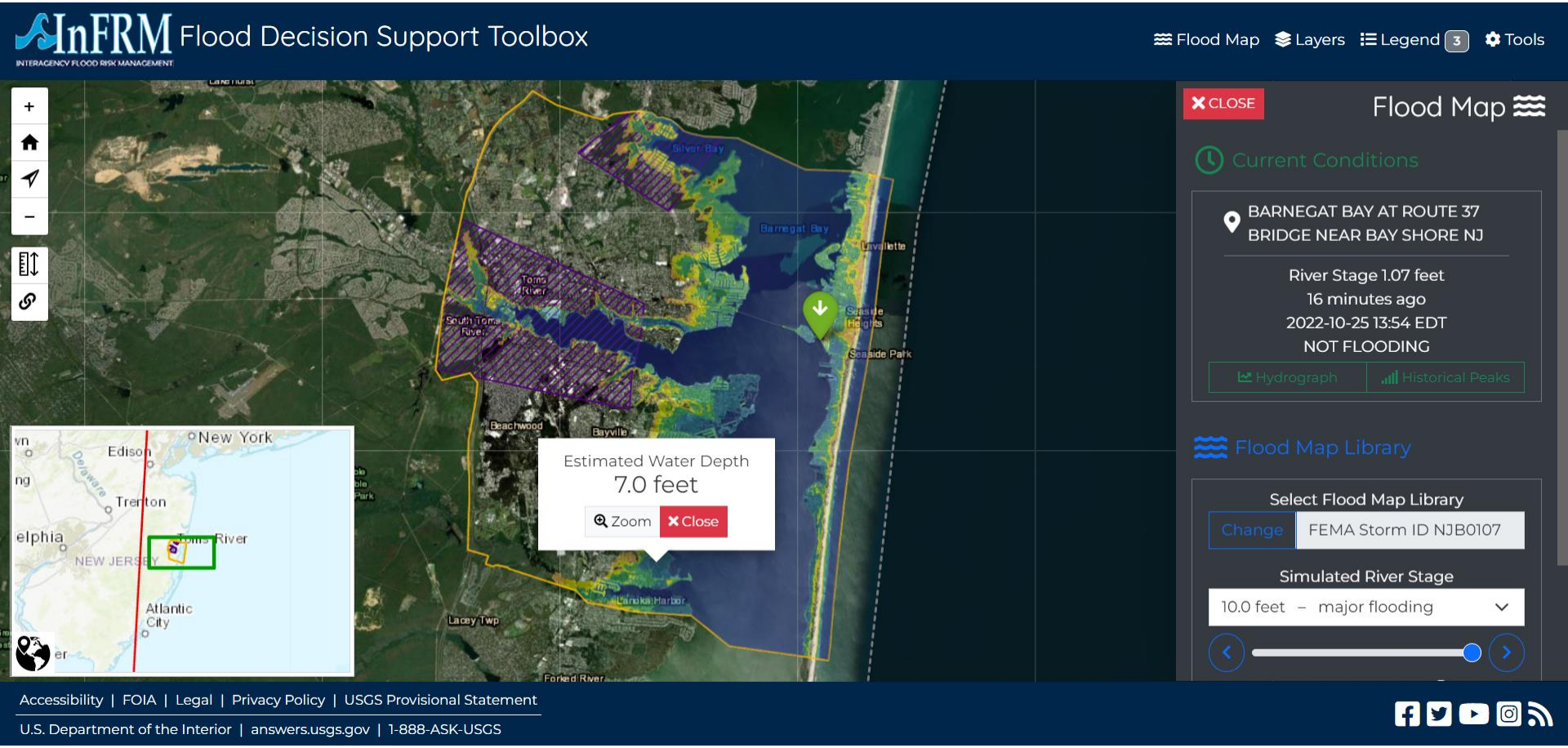
FDST Functionality – New Jersey



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