InFRMed Flood Decisions

Federal Partnerships at Work

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NCTCOG
April 10, 2018

Overview

- **InFRM**
  - What is InFRM?
  - InFRM Projects
  - InFRM Website
- **estBFE Viewer**
  - Base Level Engineering
  - Demo
- **InFRM FIM**
  - Purpose
  - Products
  - Distribution of products

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

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IWRSS - InFRM

- **Participating agencies**
  - Same for both initiatives
- **Goals**
  - Integrate information and simplify access to data
  - Increase accuracy and timeliness of information
  - Provide high resolution information and forecasts
  - Enrich stakeholder participation
- **So… what's the difference?**
  - InFRM is developing products
  - InFRM will be working under IWRSS standards

FEMA

USGS
science for a changing world

NATIONAL WEATHER SERVICE

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A Web Presence for InFRM

InFRM

Background & Partners | Estimate Your Base Flood Elevation | Flood Inundation Mapping | Hydrologic Basin Studies

Interagency Flood Risk Management

Collaborating Nationally. Empowering Locally.

Flooding remains the leading cause of natural-disaster loss across the United States. The Integrated 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.

Supercells in central Texas, April 26, 2015. Photo courtesy of Brian Khoury under creative commons license.

Partner Agencies

This effort will be accomplished by an interagency coalition comprised of the Federal Emergency Management Agency, U.S. Army Corps of Engineers, U.S. Geological Survey, and the National Weather Service. These agencies are currently in partnership through the group known as the Interagency Flood Risk Management (InFRM) team and this effort will be undertaken by this group. The InFRM team will reach out to state and local government organizations as well as private industry to aid in moving this monumental effort forward.

Federal Emergency Management Agency (FEMA)	U.S. Army Corps of Engineers (USACE)	U.S. Geological Survey (USGS)	National Weather Service (NWS)
• Standards • Disaster/rebuilding aid through the flood insurance program • Mappings products	• 2013 USACE CWMS watershed model development • Numerous watershed and planning studies • Watershed regulation	• Stream gage program • Collect and disseminate reliable, timely data • Impartial, unbiased science	• Precipitation estimates • Real-time forecasting and precipitation products • River forecasting
Region 6 (Sponsor)	Districts: Fort Worth, Tulsa, Galveston, Albuquerque, Little Rock, Vicksburg	Water Science Centers: Texas, Oklahoma, Arkansas, New Mexico, Louisiana	River Forecast Centers: West Gulf, Arkansas-Red Basin, Lower Mississippi

FEMA

USGS

www.InFRM.us

InFRM Projects – estBFE Viewer

InFRM

Background & Partners | Estimate Your Base Flood Elevation | Flood Inundation Mapping | Hydrologic Basin Studies

Estimate Your Base Flood Elevation

Base Level Engineering is a watershed-wide engineering modeling method that leverages high resolution ground elevation, automated model building techniques, and manual model review to prepare broad and accurate flood risk information for FEMA to assess its current flood hazard inventory. Base Level Engineering prepares flood risk information with scalable engineering, allowing FEMA to both assess its current flood hazard inventory and expand the coverage and availability of flood risk information to communities and individuals interested in reviewing their potential flood risk.

Goal: Centralized and available flood hazard analysis to support floodplain management activities and development review, while increasing risk awareness for individuals.

Benefits:

- The Estimated Base Flood Elevation Viewer allows users to determine the flood risk (High, Moderate, Low) throughout watersheds that have been assessed using Base Level Engineering methods.
- Estimated base flood elevations and flood depths for site specific locations (within the estimated 1% annual chance floodplain)
- Immediate point-click-download access to engineering models and Base Level Engineering datasets.
- Allows Federal, State, and local governments, as well as individuals, access to flood risk information.

FEMA is working with its Federal and State partners to identify watershed basins in need of flood risk information. Additional watersheds will be invested in each fiscal year, if your community is interested in having watersheds in your vicinity assessed, contact us to let us know of your interest.

Find Out More »

- BLE Data visualization
- Point, click & download
- Search functionality
- My estBFE report

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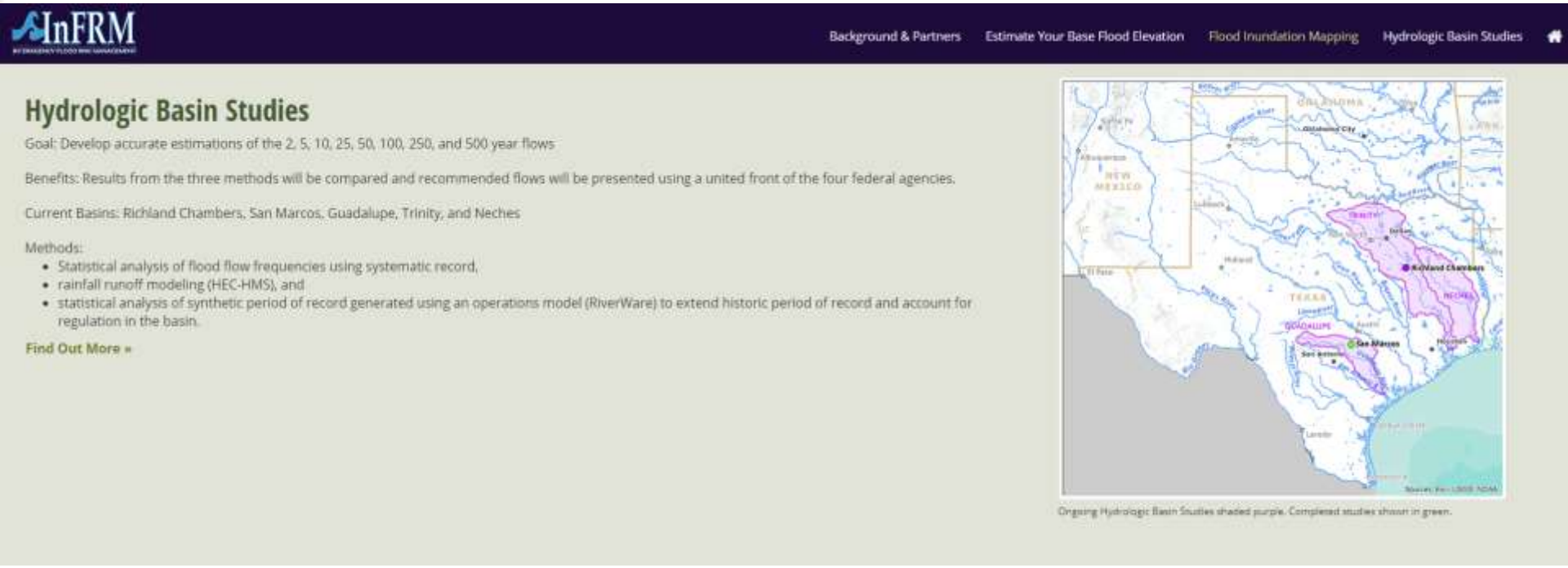
InFRM Projects – Hydrologic Basin Studies



- 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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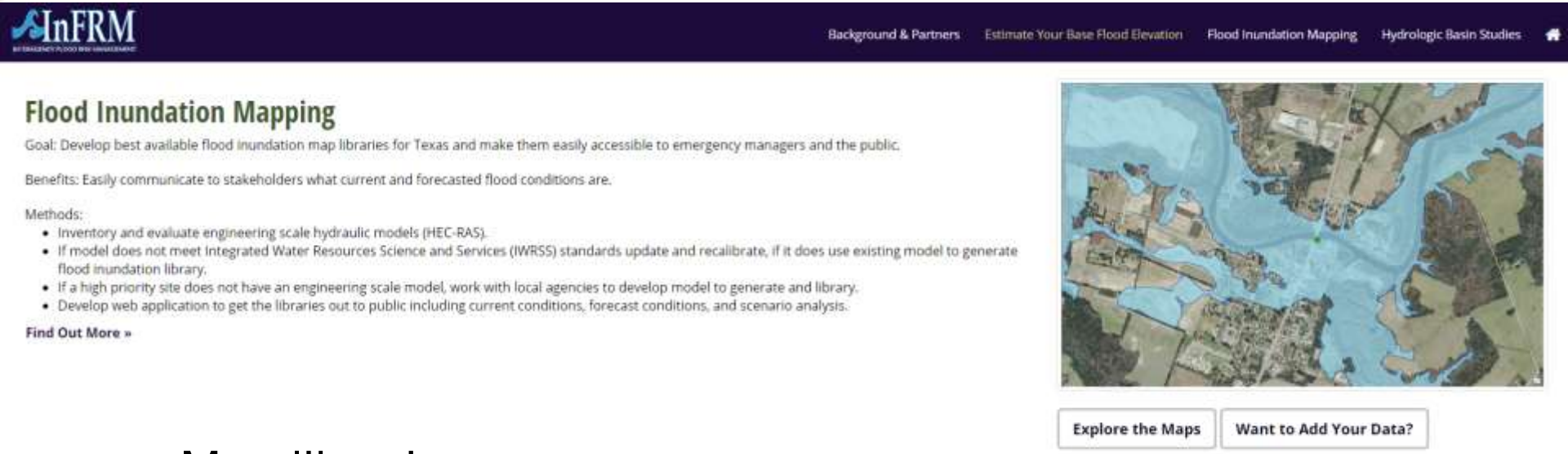
InFRM Projects – FIM Viewer



- Map libraries
- Web application
  - Current
  - Forecast
  - Scenarios
- Hydraulic model database

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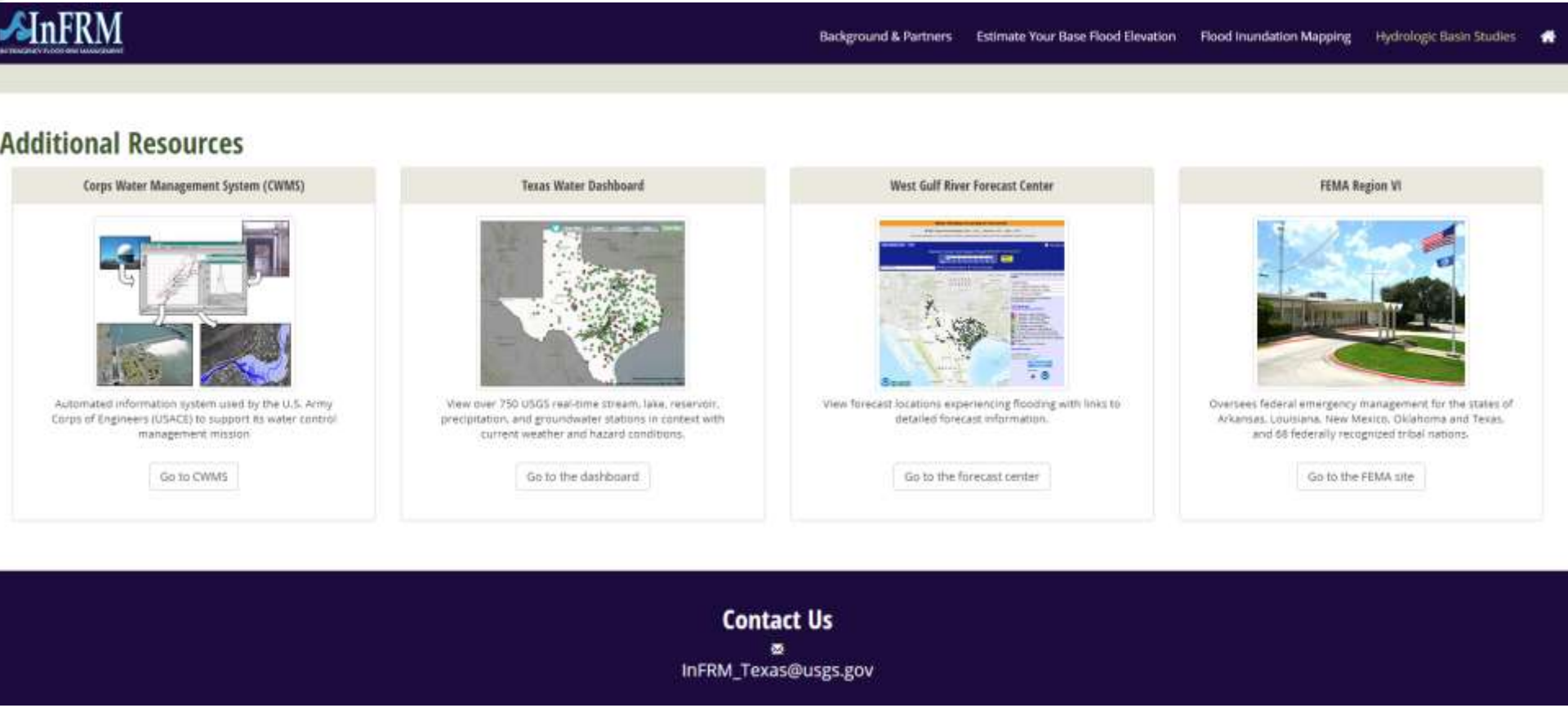
InFRM Resources



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estBFE – Point, Click, & Download

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Base Level Engineering

an Evolution in Flood Risk Mapping

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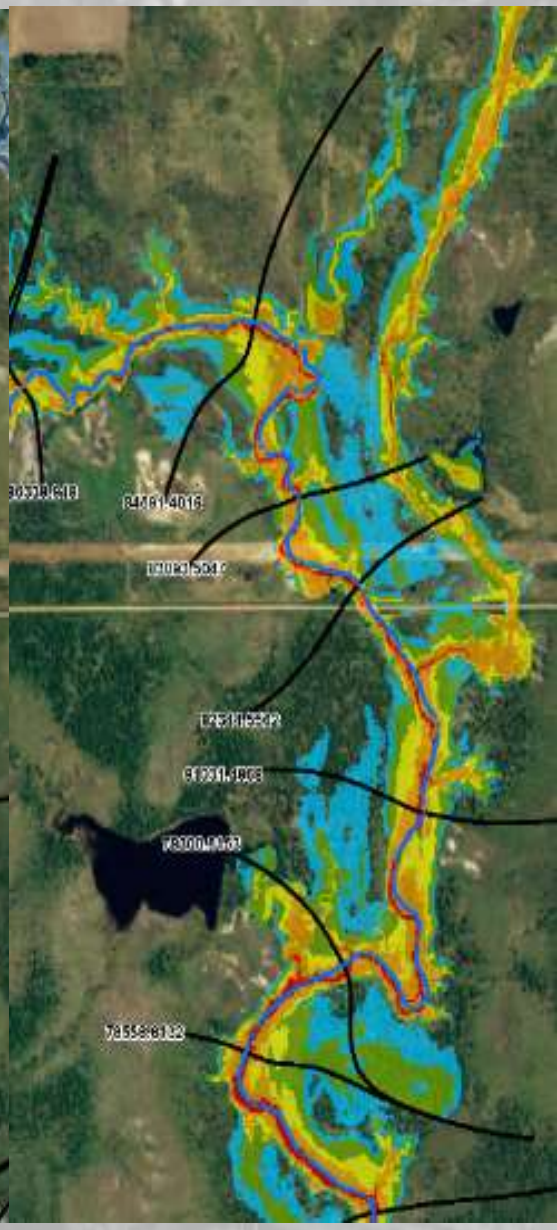
What is Base Level Engineering?

1

Base Level Engineering provides cursory flood risk modeling and mapping produced using high resolution elevation data and the latest modeling technologies. As it's name suggests, Base Level Engineering modeling meets FEMA's minimum engineering and mapping requirements, producing a flood study equivalent to a Zone A floodplain.

Once a Base Level Engineering assessment is prepared, FEMA and its State and Local Mapping Partners compare the results against the current flood risk information shown on the Nation's Flood Insurance Rate Maps (FIRMs). FEMA is required to review the validity of its flood risk information once each five years.

Base Level Engineering – Floodplains



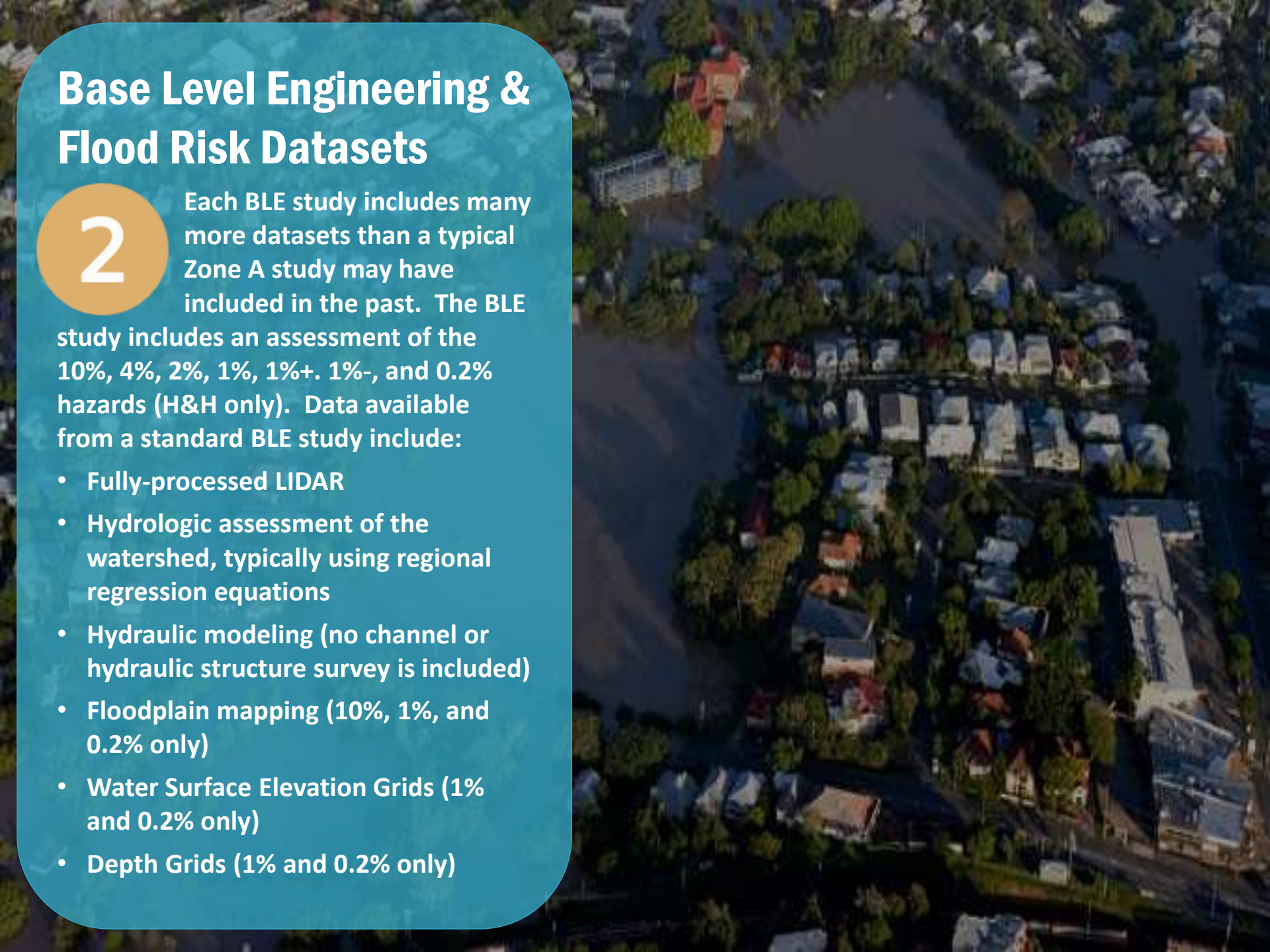
Base Level Engineering – Flood Depth Grids

Base Level Engineering & Flood Risk Datasets

2

Each BLE study includes many more datasets than a typical Zone A study may have included in the past. The BLE study includes an assessment of the 10%, 4%, 2%, 1%, 1%+. 1%-, and 0.2% hazards (H&H only). Data available from a standard BLE study include:

- Fully-processed LIDAR
- Hydrologic assessment of the watershed, typically using regional regression equations
- Hydraulic modeling (no channel or hydraulic structure survey is included)
- Floodplain mapping (10%, 1%, and 0.2% only)
- Water Surface Elevation Grids (1% and 0.2% only)
- Depth Grids (1% and 0.2% only)



Base Level Engineering & Local Development

3

Base Level Engineering supports local community development review by...

estBFE Website

- **Scope: Data access, download and visualization for FEMA BLE models and data**
- **Accomplishments**
  - Collect, inventory, organize FEMA data
  - Build data management structure
  - Produce map services
  - Development of the model inventory and download application
  - Data visualization viewer

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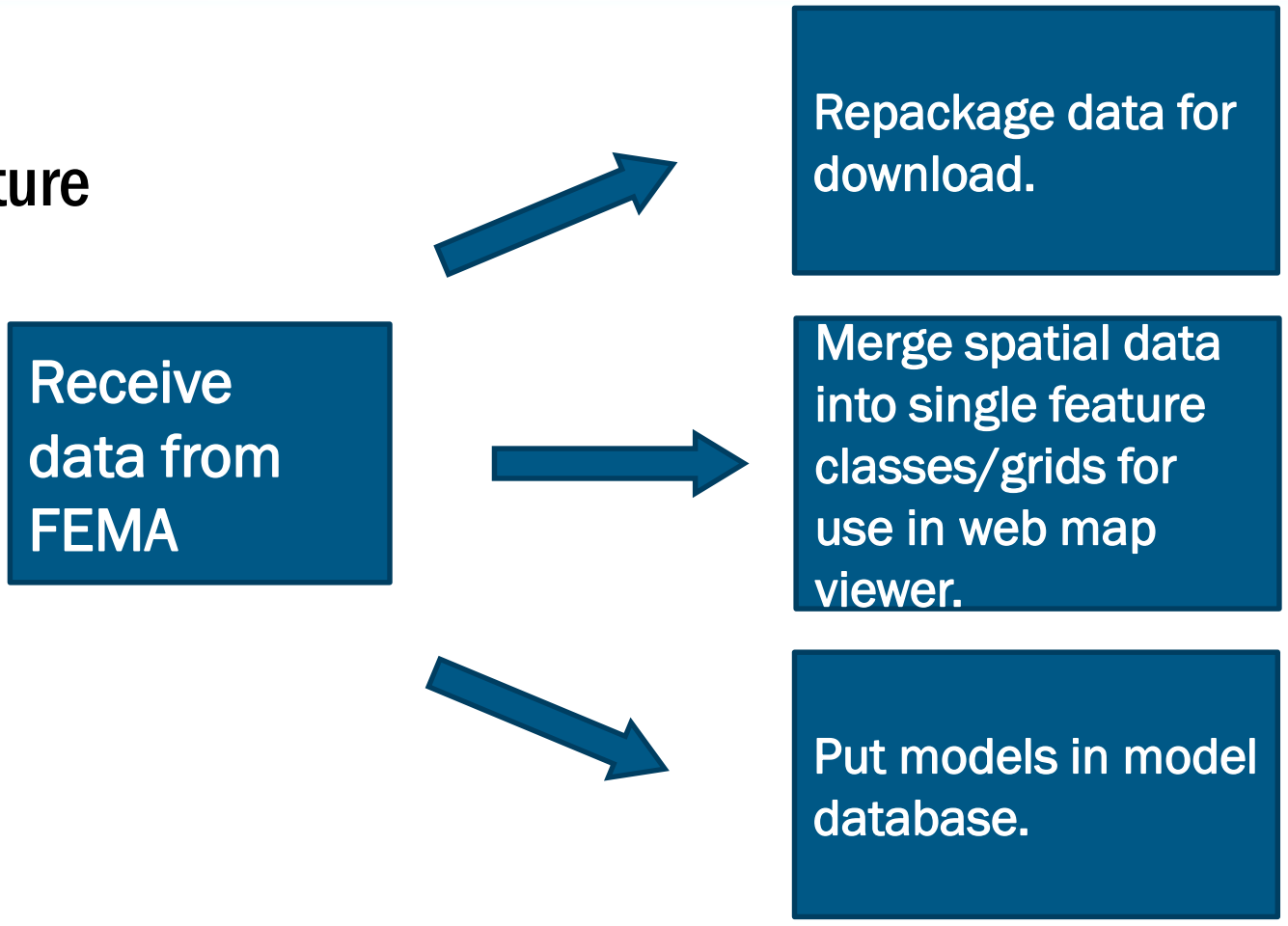
Data Management Paths

- Inventory
- File structure



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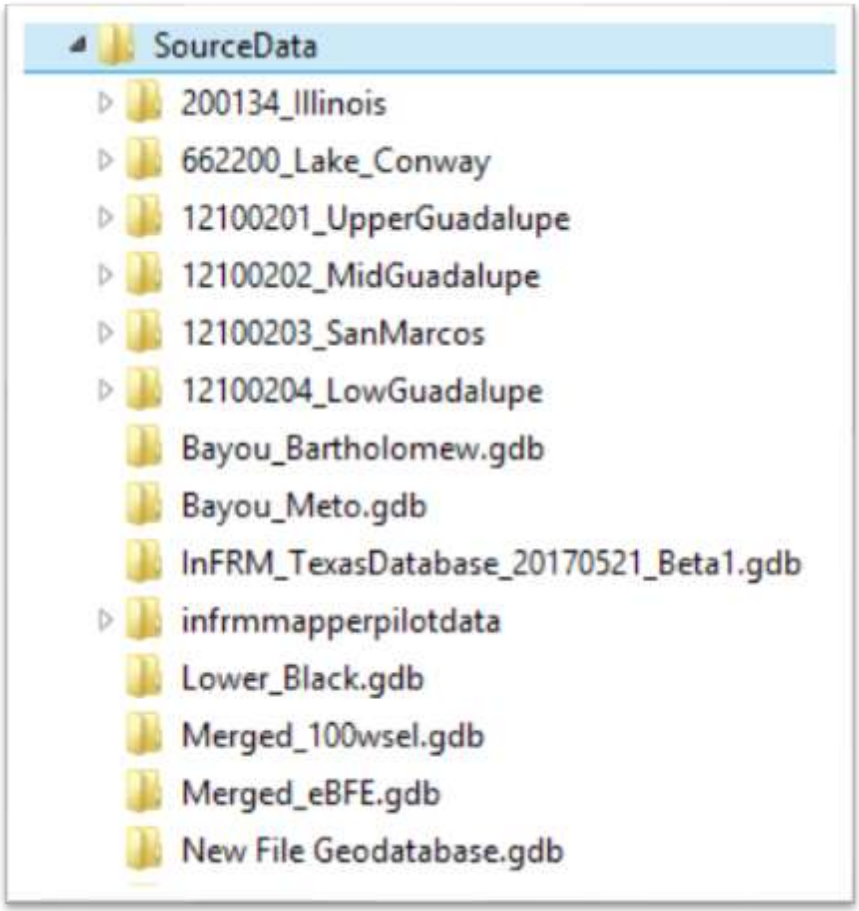
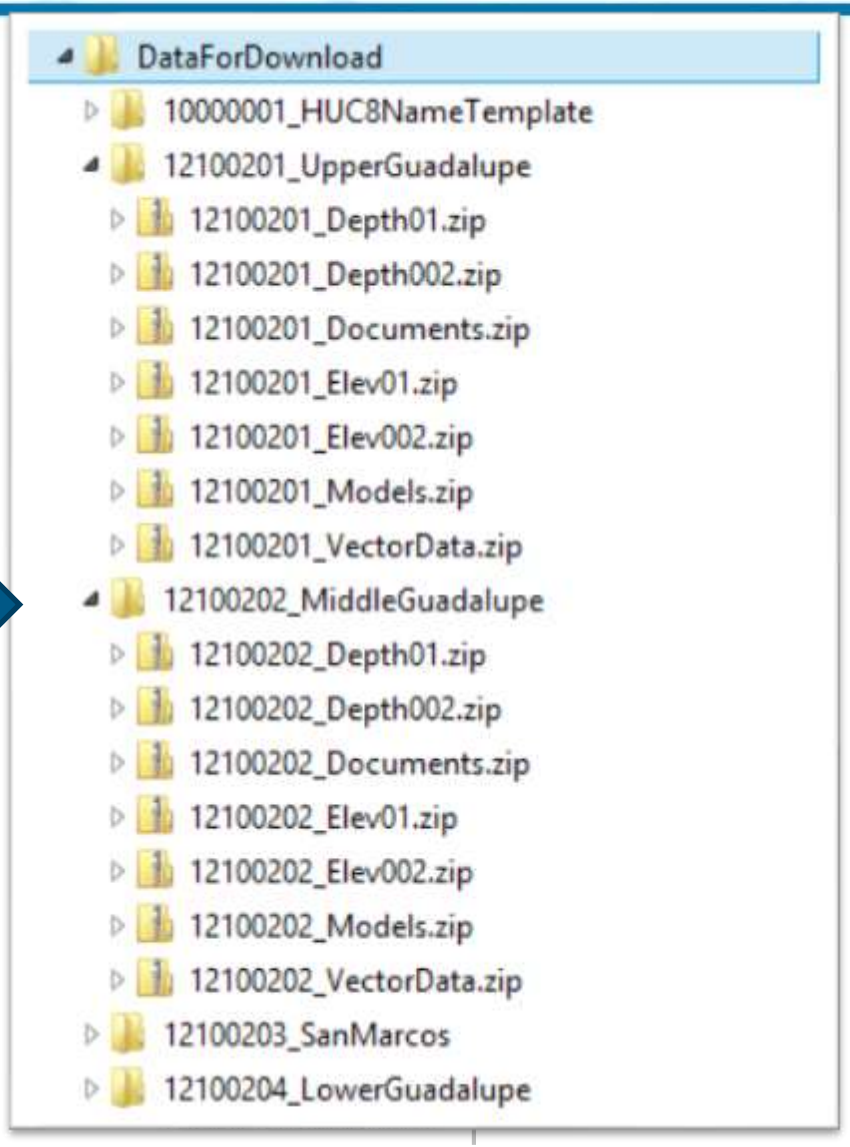
Data Repackaging for Download

Uniform content, uniform naming conventions.





Index map and download application

https://dev-webapps.usgs.gov/estBFE/

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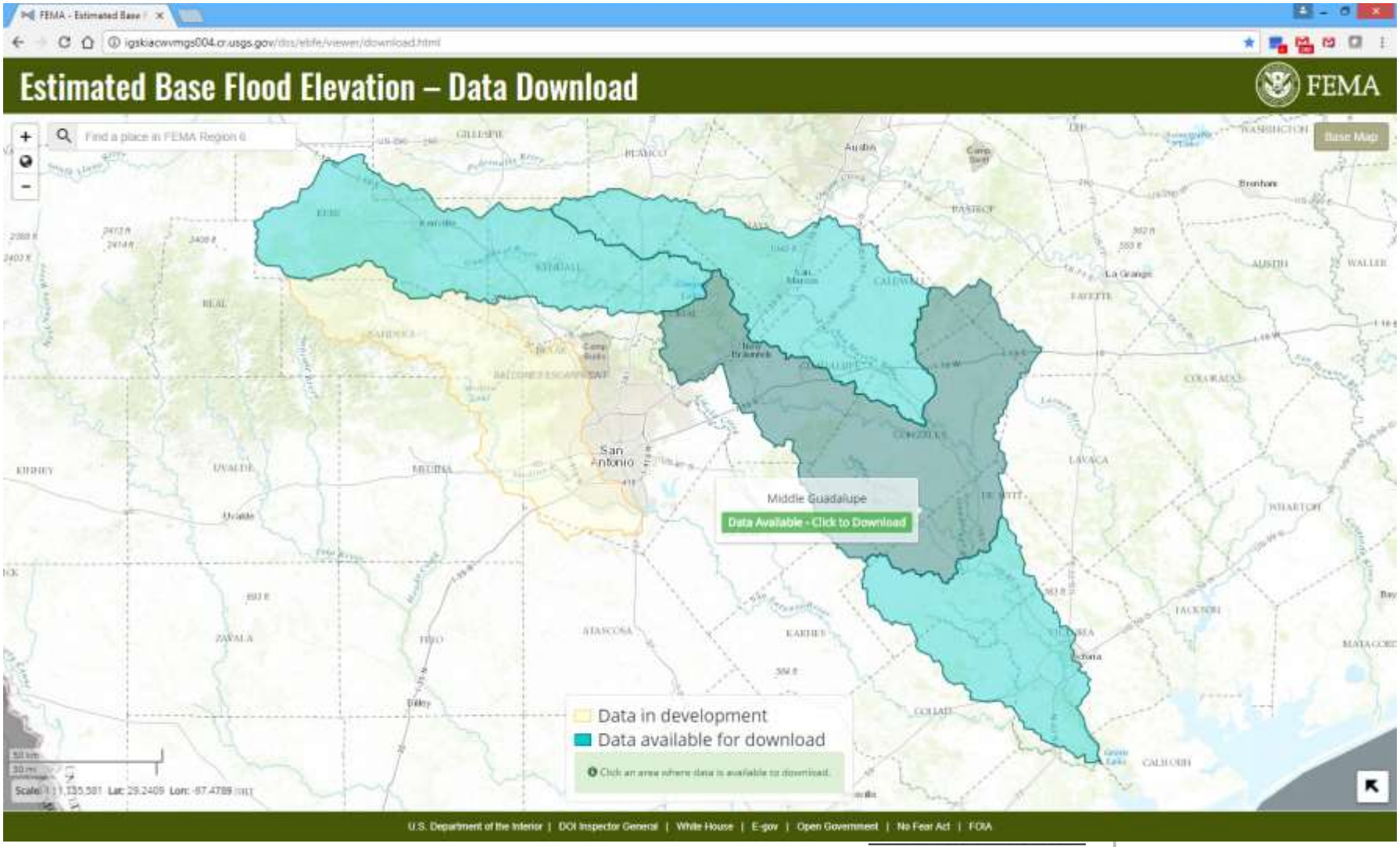
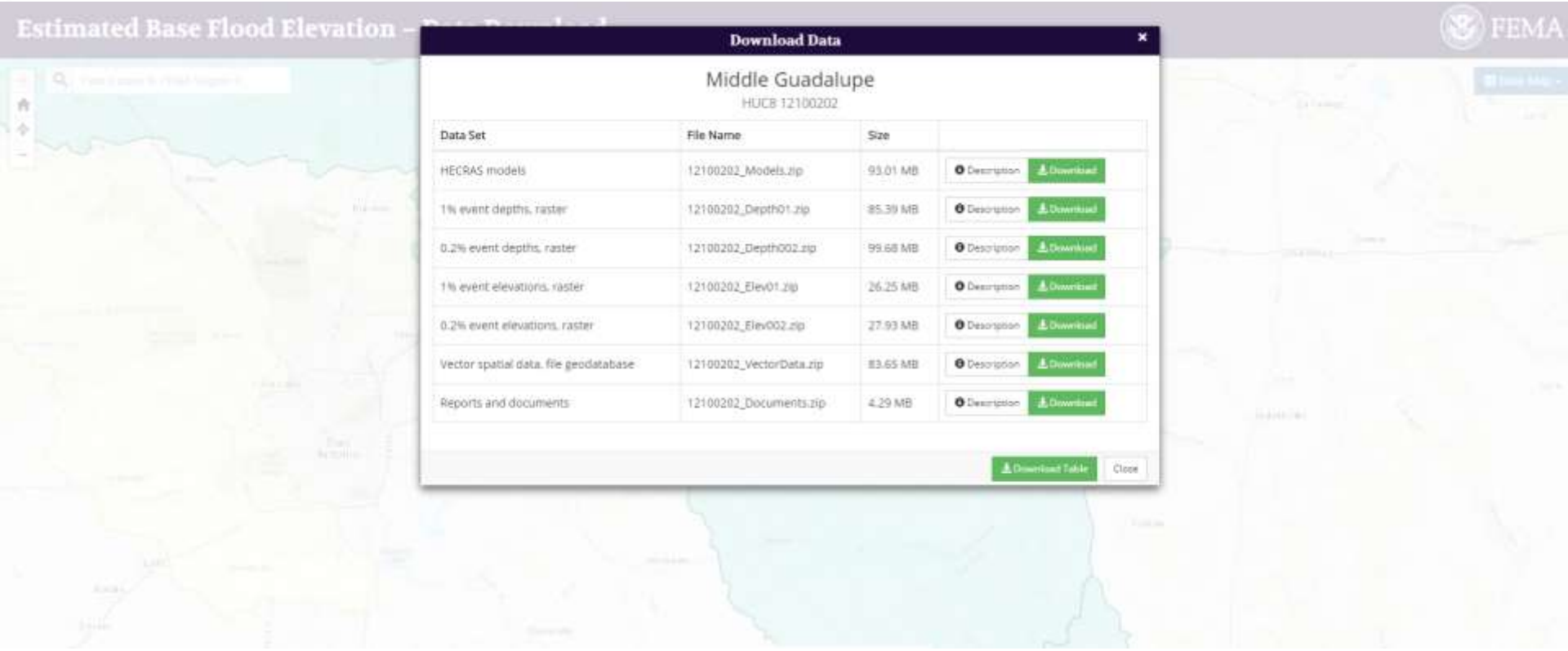
Select area of interest



Download functionality



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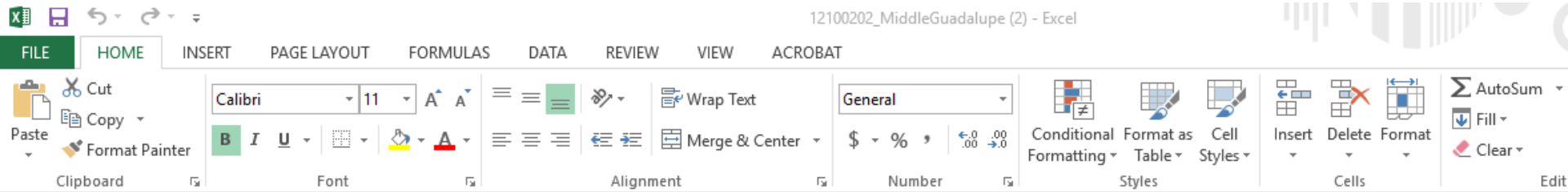
Download functionality



A1 | Download

	A	B	C	D	E
1	Download	FileName	FileSize	DataSet	Description
2	Download	12100202_Models.zip	93.01 MB	HECRAS models	A folder containing HECRAS models for streams.
3	Download	12100202_Depth01.zip	85.39 MB	1% event depths, raster	A raster representing the estimated depth of floodwaters from a 1% event.
4	Download	12100202_Depth002.zip	99.68 MB	0.2% event depths, raster	A raster representing the estimated depth of floodwaters from a 0.2% event.
5	Download	12100202_Elev01.zip	26.25 MB	1% event elevations, raster	A raster representing the estimated elevation of floodwaters from a 1% event.
6	Download	12100202_Elev002.zip	27.93 MB	0.2% event elevations, raster	A raster representing the estimated elevation of floodwaters from a 0.2% event.
7	Download	12100202_VectorData.zip	83.65 MB	Vector spatial data, file geodatabase	A file geodatabase containing vector spatial data representing stream centerlines, stu
8	Download	12100202_Documents.zip	4.29 MB	Reports and documents	A folder containing the Base Level Engineering report, and other documents.
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Map Services Demo

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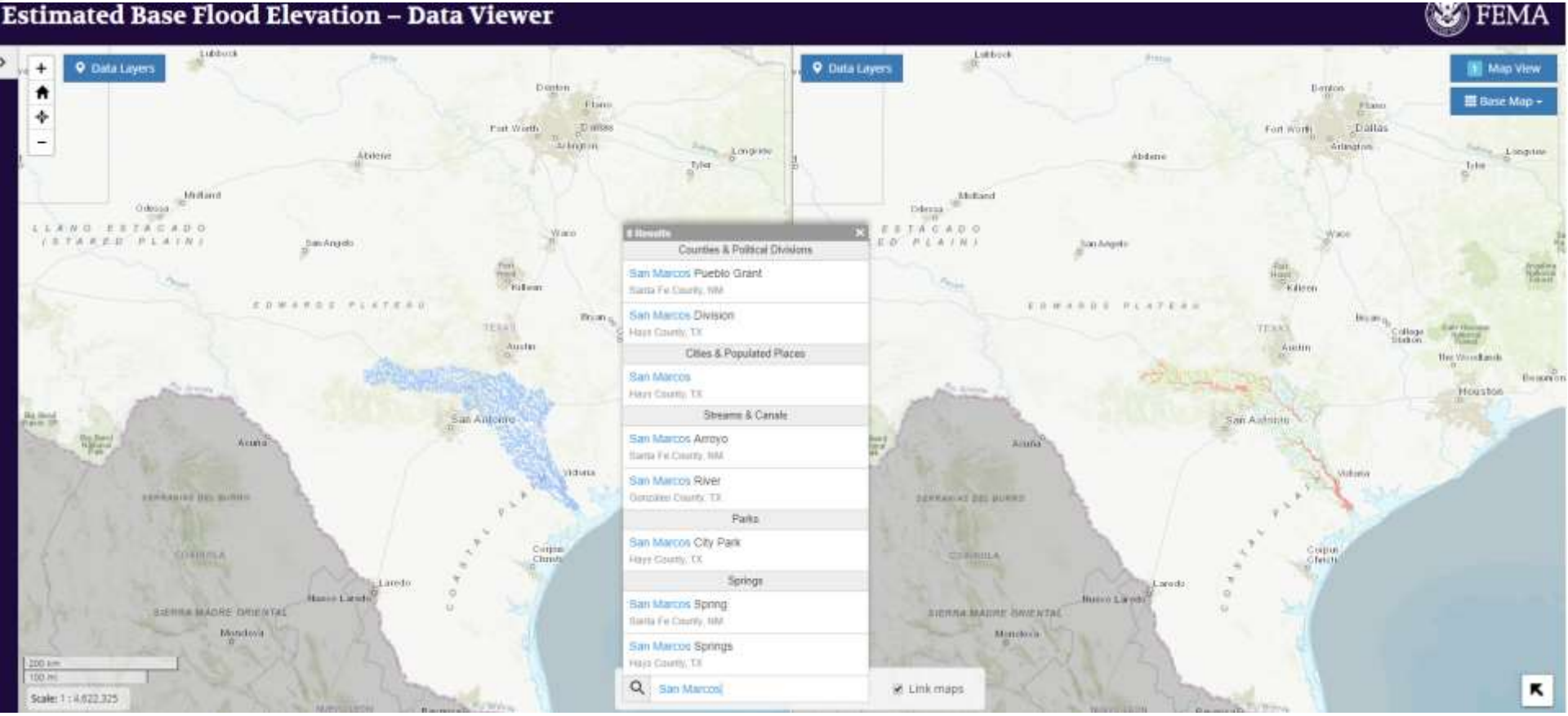
Map services demo



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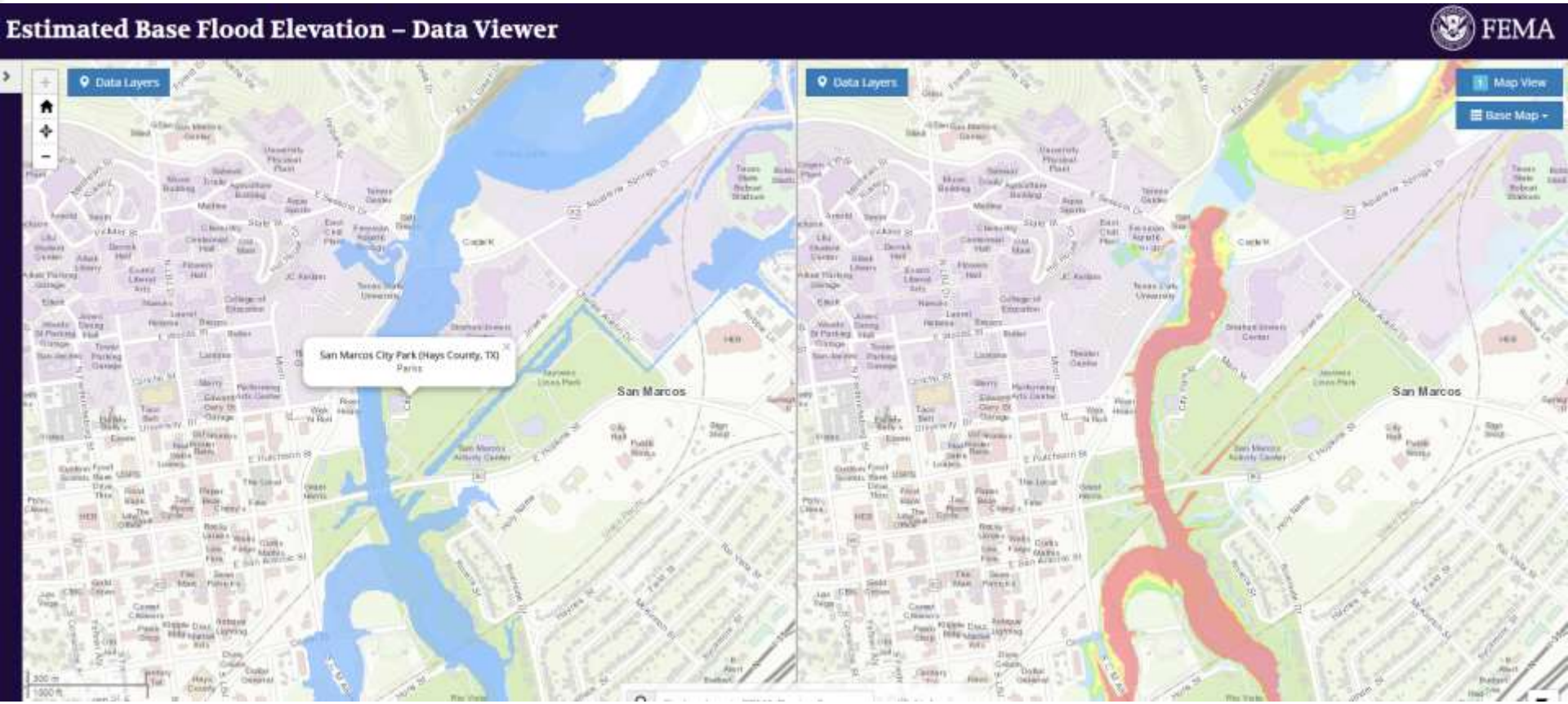
Map services demo



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My Flood Report

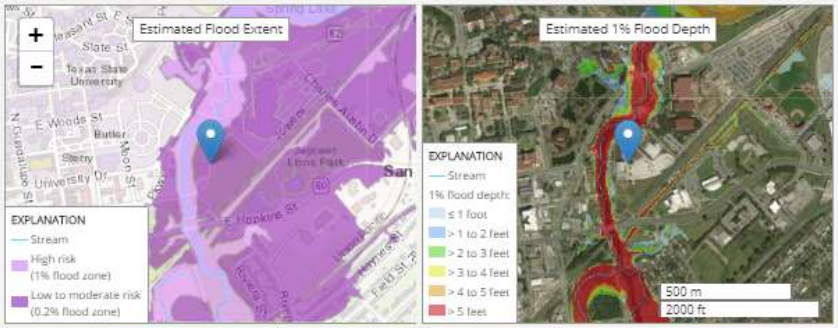
Estimated Base Flood Elevation (estBFE)

FEMA

Flood Risk Information Report

FEMA is providing a look at flood data availability and relative Base Level Engineering analysis through the Estimated Base Flood Elevation Viewer (Estimated BFE Viewer). Base Level Engineering uses high resolution ground elevation data, flood flow calculations, and fundamental engineering modeling techniques to define flood extents for streams. The viewer is an effective tool for property owners, community officials, and land developers to identify flood risk, estimated flood elevations, and flood depths for watersheds where Base Level Engineering has been prepared.

Hays County, Texas — Latitude 29.8861 Longitude -97.9347



Flood Event	Estimated Flood Depth*	Estimated Base Flood Elevation*
1 Percent (100 Year)	No Data	No Data
0.2 Percent (500 Year)	1.520344 feet above land surface	577.400024 feet above sea level

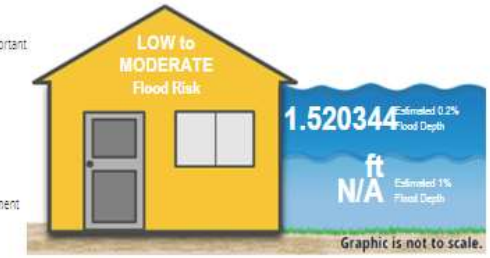
* The information included in this report is based on the location marker shown in the map. Results are not considered an official determination.

There is an effective study or more detailed report for this area. Please review the Flood Insurance Rate Map (FIRM) on the FEMA Flood Map Service Center website (https://msc.fema.gov). On effective FIRM panels, Special Flood Hazard Areas (SFHAs), or areas impacted by the 1-percent-annual-chance flood event, are indicated by a Zone A (Riverine) or V (Coastal). Zones AE and VE depict high hazard areas that have been studied in detail and provide Base Flood Elevations rounded to the nearest whole foot.

Knowing Your Risk

Base Level Engineering data availability and analysis information is important because it can be used to:

- Inform floodplain management decisions and ordinance administration;
- Identify significant floodplain changes;
- Serve as base modeling for map revisions; and
- Support the Zone A BFE information for a Letter of Map Amendment (LOMA) request.



https://dev-webapps.usgs.gov/estBFE/report.html?lat=29.8860526&lng=-97.9347273

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InFRM Flood Inundation Mapping

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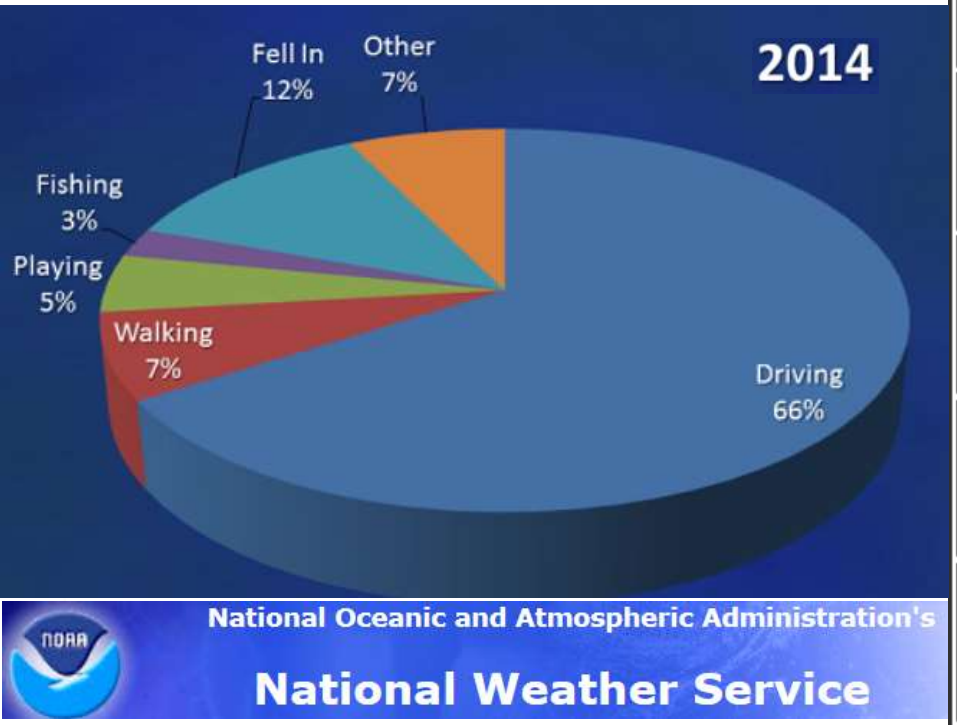
Background – Flooding in the US

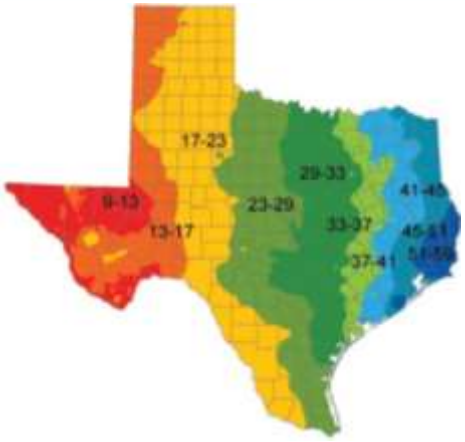
- Floods are the leading cause of natural disaster losses in the US
- 30yr average = $7.96 billion in damages/yr, 82 fatalities/yr
- 2016 - TX 30% of fatalities (38/126)



Year	Flood Damages (Water Year) Adjusted to 2014 Inflation Water year (e.g. WY 2014 is Oct 1, 2013 through Sep 30, 2014)	Flood Fatalities *Calendar Year (Jan 1-Dec 31)*
2014	$2,861,426,089	38
2013	$2,210,809,876	80
2012	$522,119,985	29
2011	$9,102,294,087	113
2010	$5,615,860,859	103

Background – Flooding in Texas

- Texas annual precipitation 10” – 60”
- Extreme variability in annual totals
  - DFW 2015 – 60”
  - DFW 2014 – 25”



Trinity River below Dallas 5/26/2015

Trinity River at Dallas 5/26/2015

Background – Flooding in Texas

- **Intense storm events**
  - 10” – 20” in less than a day
  - Trigger significant flooding
  - Threat to life, property, and infrastructure

Wimberley 2015

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A better warning system is needed!

- Inundation requests during 2015/2016 floods
- USACE/USGS/Others?
- Over 1,500 river miles
- Requests came from
  - Federal Agencies
  - State Agencies
  - Cities
  - Municipalities
- Disadvantages
  - Lack of quality models
  - Prioritizing
  - Pressure for time
  - Potential for error

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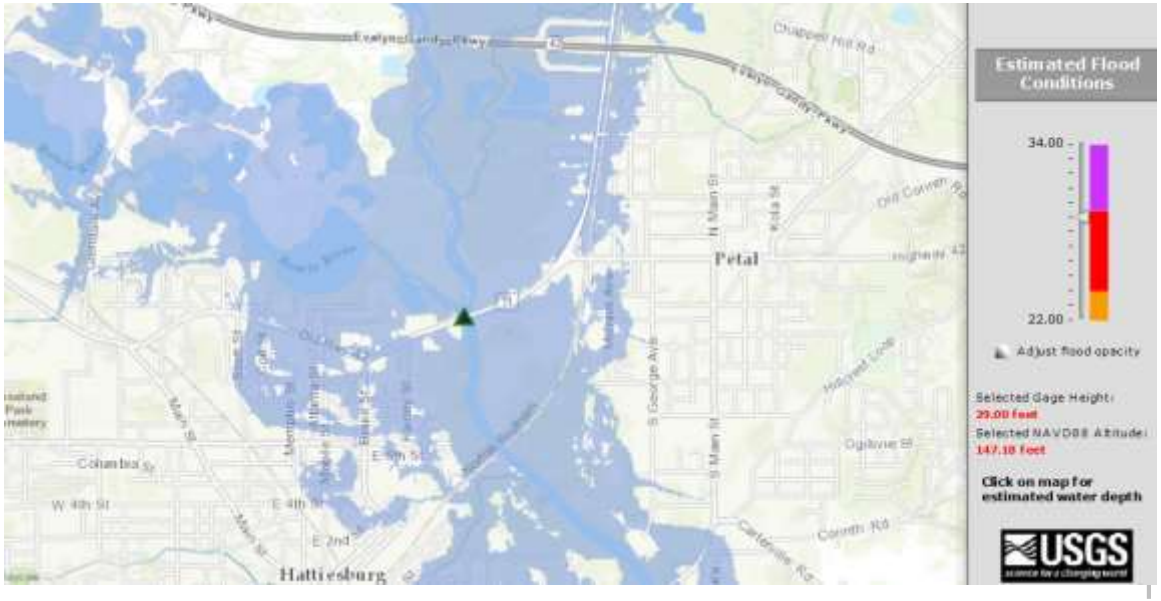
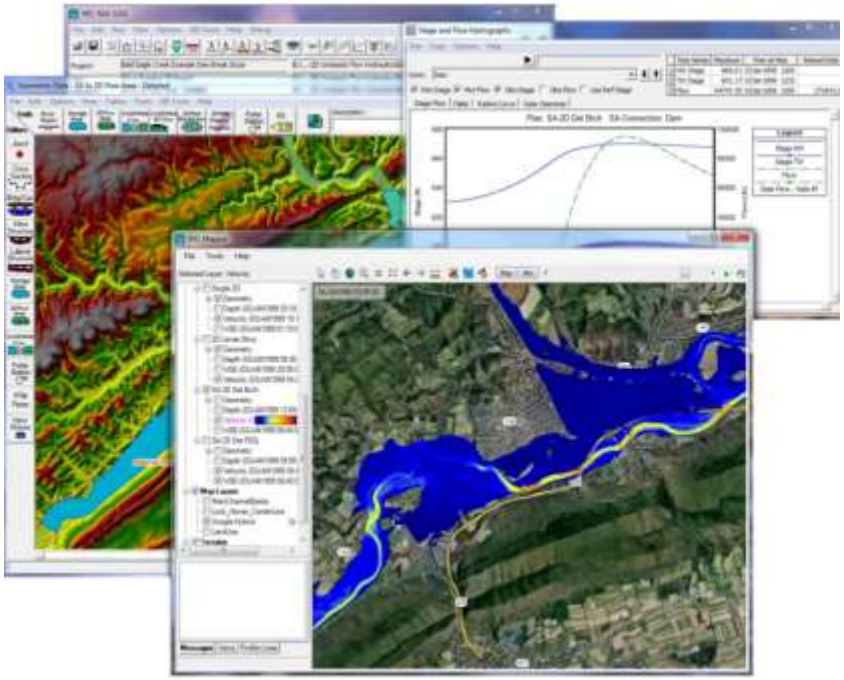
InFRM Flood Inundation Mapping Program Goals

- **Develop inundation mapping libraries using best available science**
  - Readily available to emergency managers via web
  - Begin at minor flood state, end at max expected flood
  - Produced at appropriate intervals for the reach (1’ max)
  - Correlated to nearest NWS-RFC forecast point
  - Maps automatically update when new forecast is released



Techniques and Methods

- **Types of Models**
  - HEC-RAS, MIKE
  - Base Level Engineering
  - FESM, R&R
  - Others?
- **Existing model inventory**
  - FEMA effective models
  - State funded models
  - Local governments
  - River authorities
  - USGS Scientific Investigations
  - USACE Corps Water Managements Systems (CWMS)
  - Consulting firms
  - Others?



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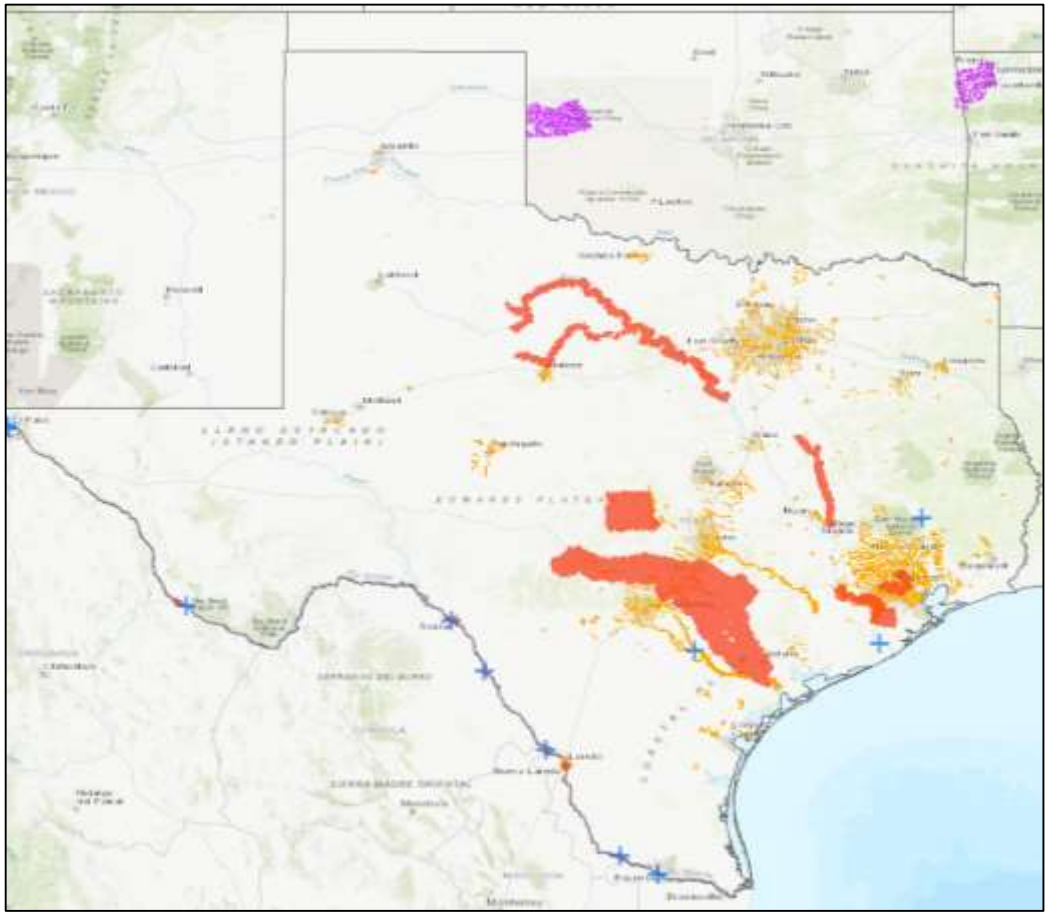
Hydraulic Model Inventory Database

- 3,780 models described in inventory
- 3,773 centerlines imported
- 105,960 cross-sections imported
- Database is still undergoing development



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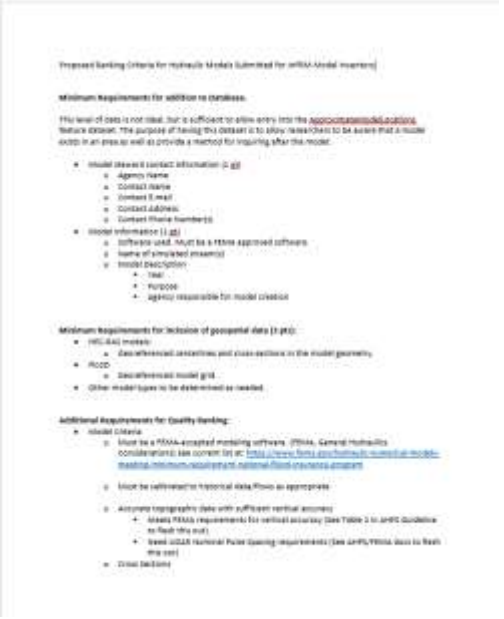
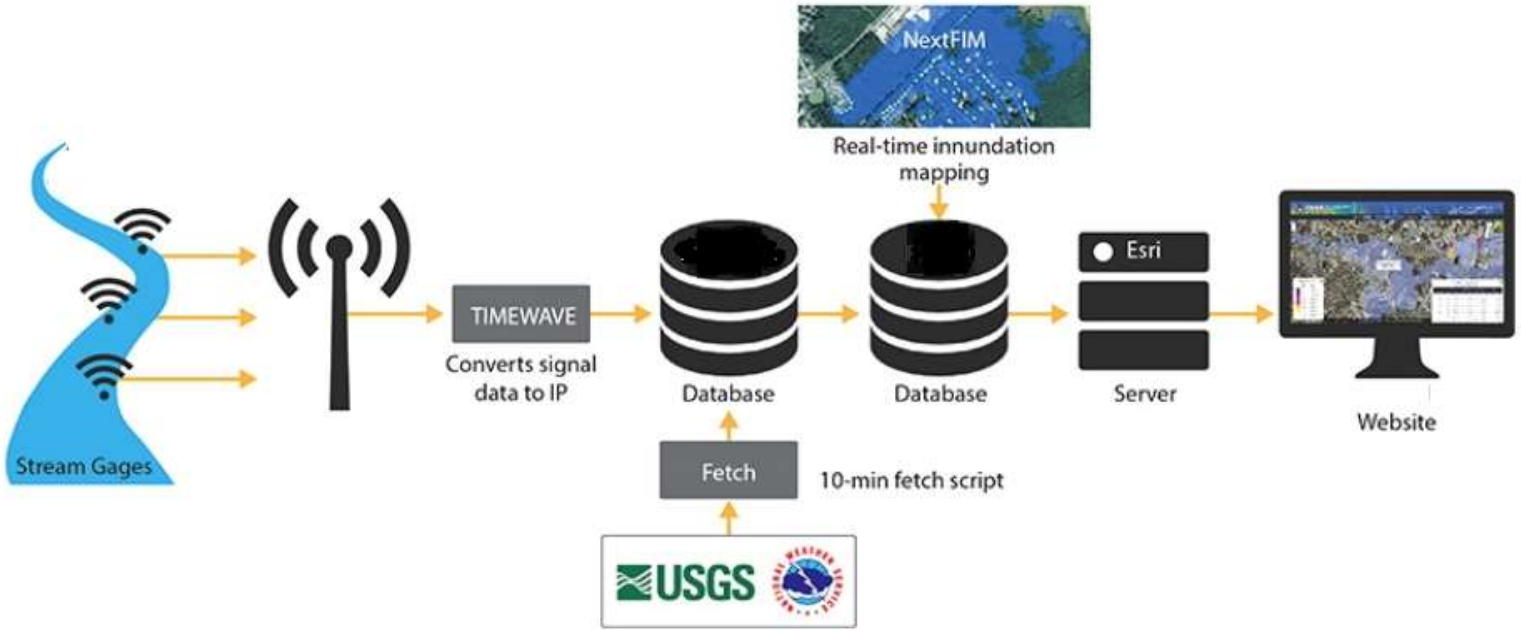
Evaluation of Existing Models

- Is the model geo-referenced?
- Is the scale appropriate?
- What datasets were used?
- How much work does the model need?
- Does the model include inline structures?
- Is there a correlating RFC flood forecast point?
- Model categorizing
  - Checklist
  - Metadata



I have a model, now what?

- Model update and calibration
- Generate flood map libraries
- Get those products out to the stakeholders



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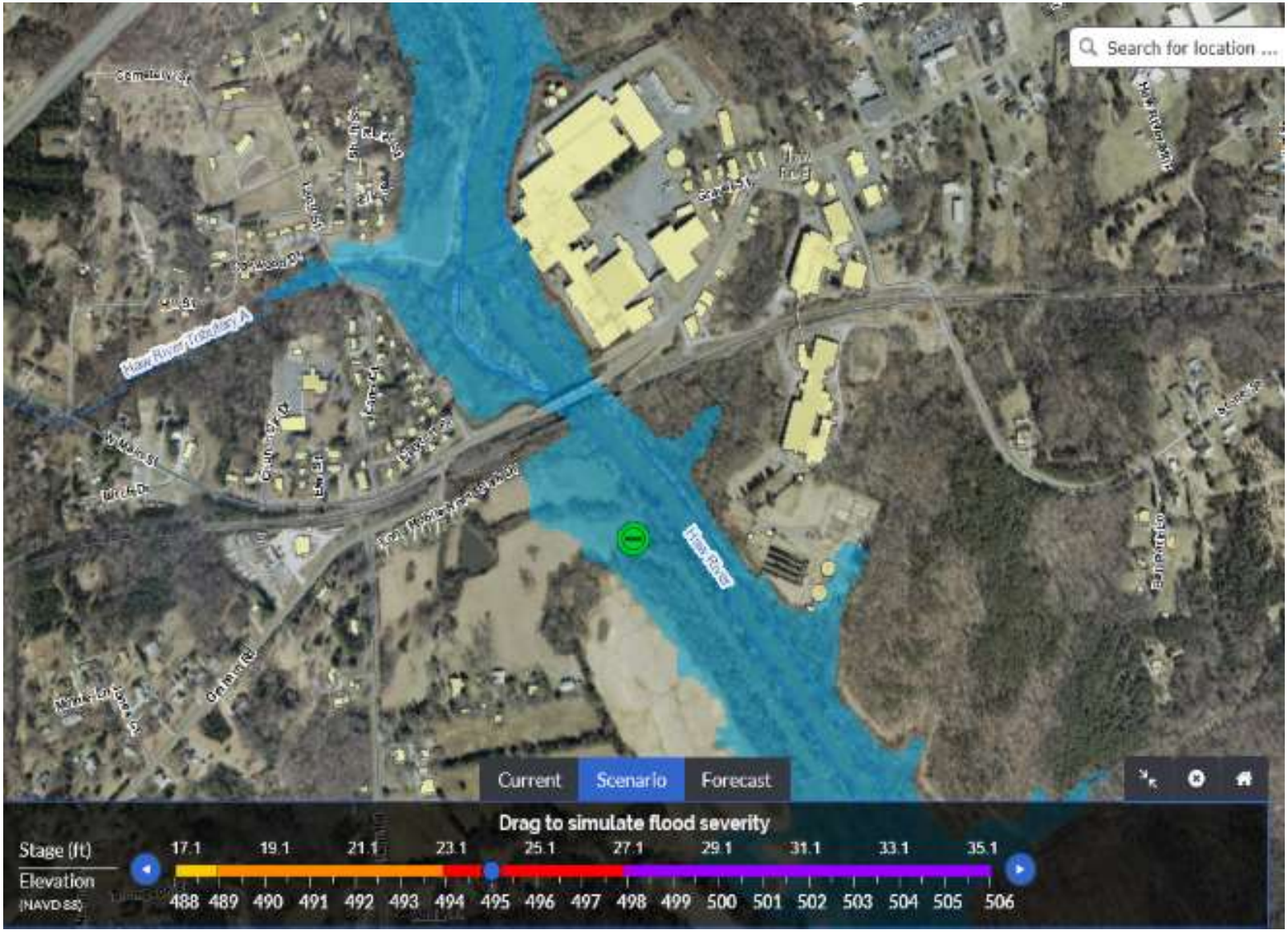
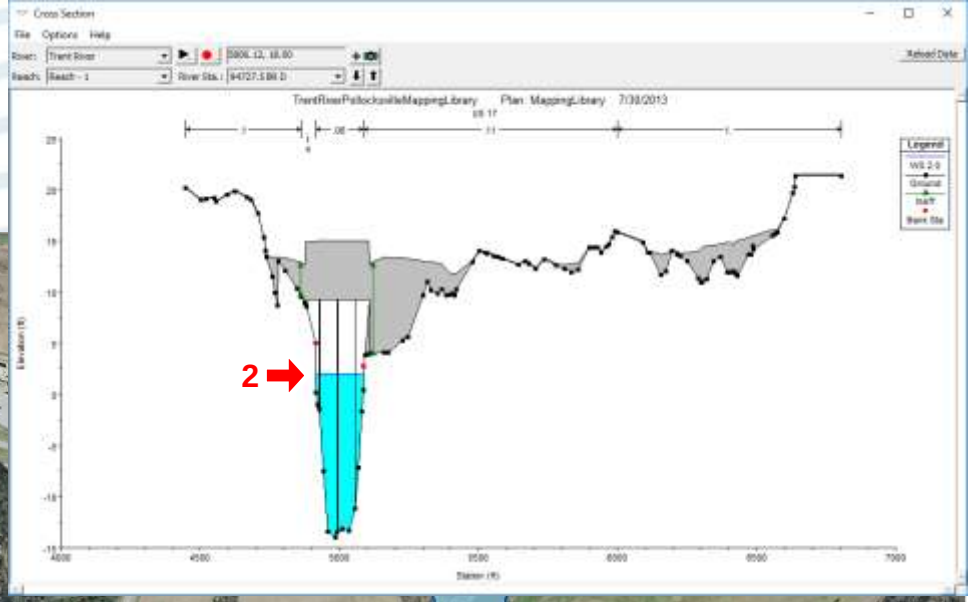
InFRM Web Application



Library Creation



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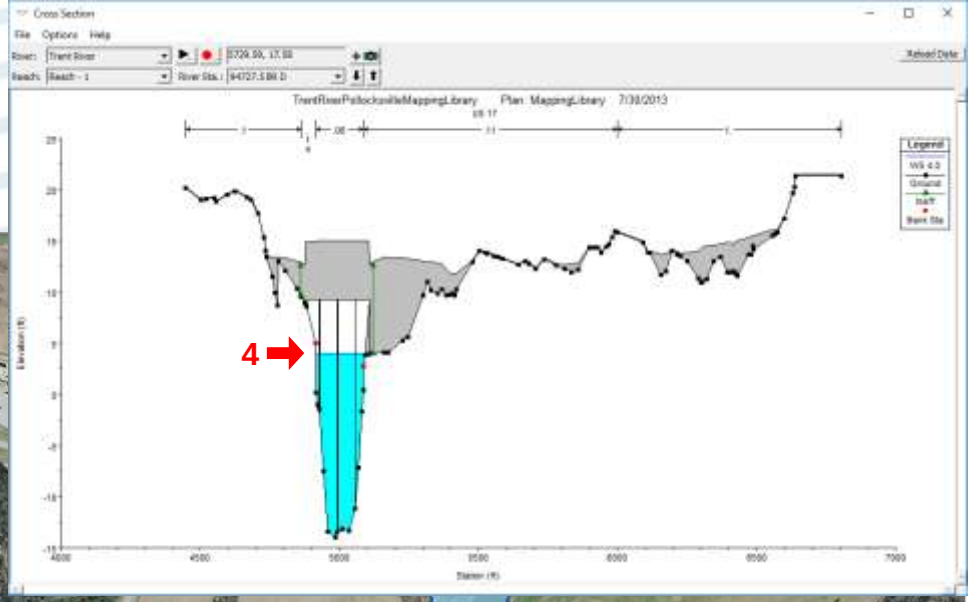

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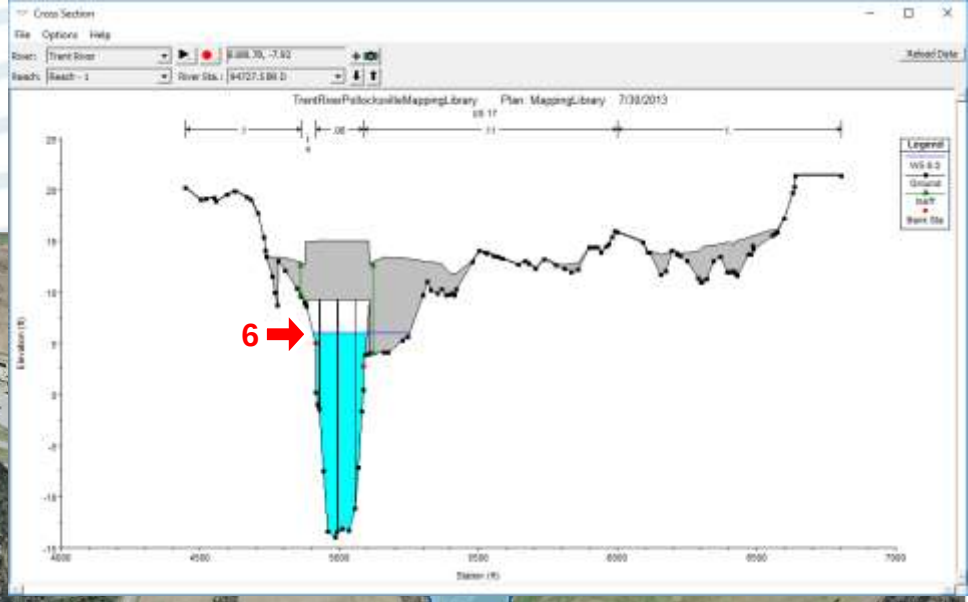

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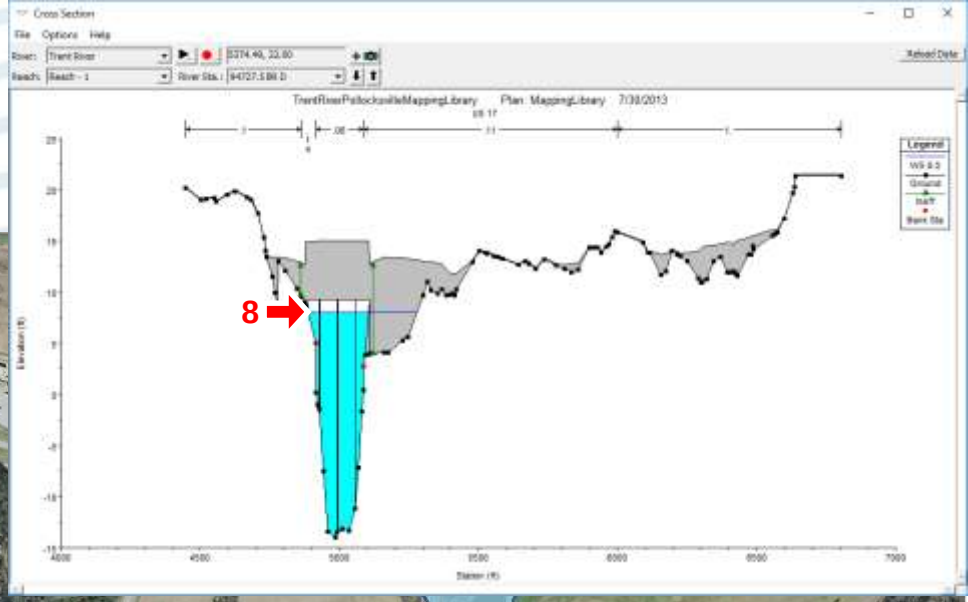

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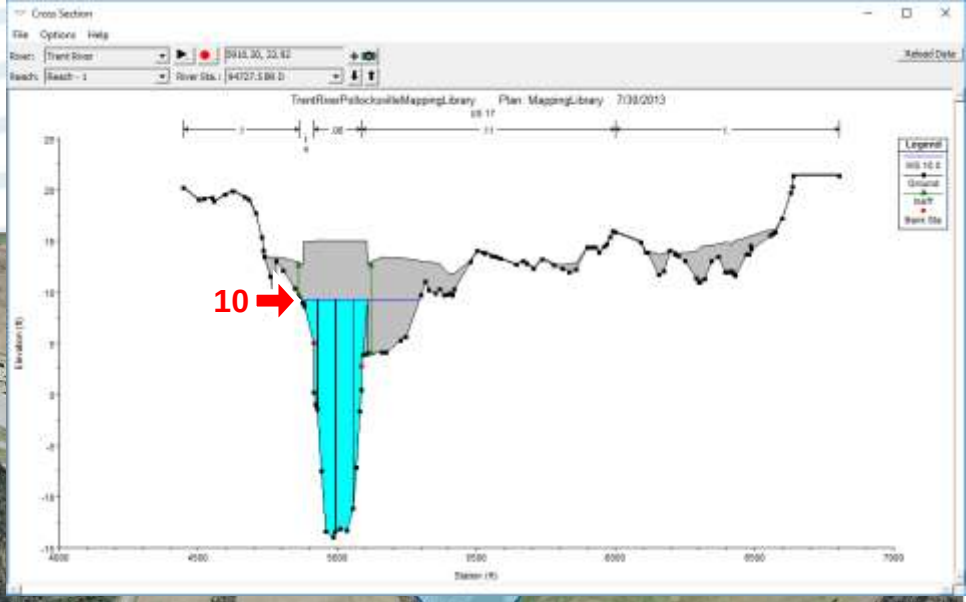

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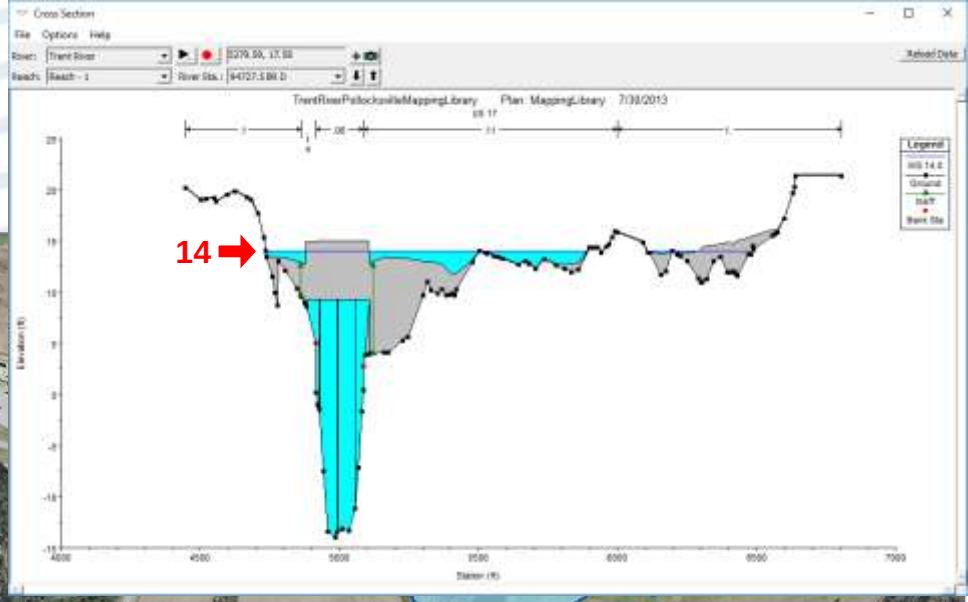

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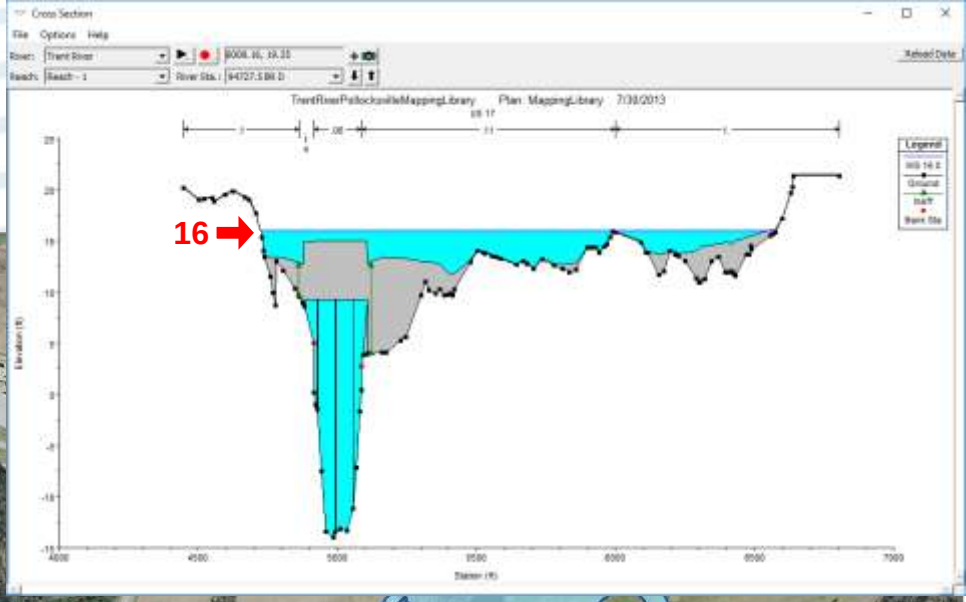


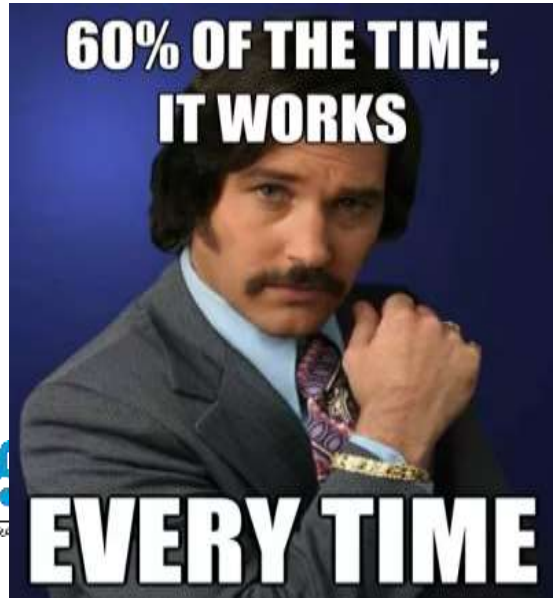
Library Pros

1. Inexpensive to develop
2. Accurate with measured stages and elevations
3. Easily communicated to stakeholders
4. Rapid web mapping deployment
5. Impacts can be pre-computed
6. North Carolina has worked through many of the issues with FIMAN

InFRM
INTERAGENCY FLOOD RISK MANAGEMENT

Uncertainty in Modeling

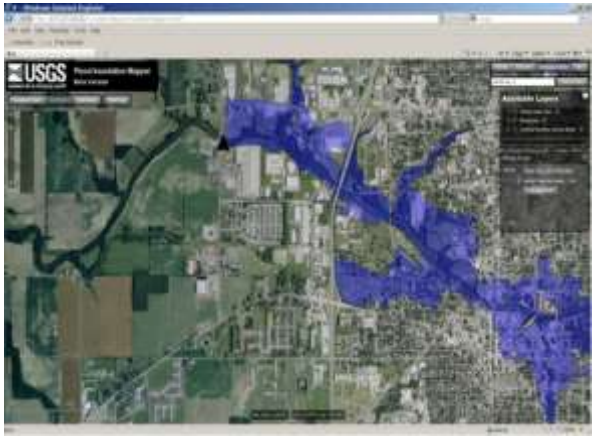
- **"All models are wrong but some are useful"**
  - You get out what you put in
- **The goal of calibration**
  - Get the "right" answer – Yikes!
  - Focus on bracketing the "right" answer
- **Best available data**
  - LiDAR vs. 10m DEM
  - DEM vs. surveyed cross sections
  - Engineering scale model vs. R&R
- **Understanding your flood inundation product**
  - Which product is available to you
  - Knowing which product is right for you



InFRM Flood Inundation Products

- **Web viewer for flood inundation maps**
  - Will provide quick easy access for stakeholders
  - Real-time updates with RFC forecasts
  - Scenario planning tool for emergency management

- **Produce flood inundation map libraries**
  - Leverage off of existing models
  - Use best available product
  - Minor flood stage to max expected flood



- **Model database**
  - Collect, compile, and evaluate
  - When needed, update and calibrate
  - Make available to the public
- **Build new models**
  - When appropriate

InFRM
INTERAGENCY FLOOD RISK MANAGEMENT

Advantages

- **Multi-agency approach**
  - Advanced scientific team
  - Leverage knowledge within each agency
  - Leverage existing flood inundation models
  - Represents multiple federal agencies working to support FEMA and their flood risk program
- **Cooperation between federal, state, and city government**
- **Leverages funding from multiple programs**
- **Results readily available to stakeholders**
- **Brings more federal tax dollars back to Texas for flooding**
- **Improved life safety**
- **Decreased property damages**

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INTERAGENCY FLOOD RISK MANAGEMENT

Stakeholder Driven

Just a sampling…I could not fit them all

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