Texas flood forecasting

A test bed for the National Flood Interoperability Experiment

Produce high spatial resolution (1 mile^2) flood forecasting products:

1. Local flood emergency planning and response
2. Web services for information sharing

National Water Model based on:

1. Radar precipitation
2. Detailed river hydraulic modeling
3. Flood inundation mapping

Funding support from UT system
Collaboration among UT system institutions

The project lead is Dr. David Maidment (maidment@utexasedu)
Presented by May Yuan (myuan@utdallas.edu)
NGAC Meeting, September 28, 2016

This presentation is based on a briefing to Texas Association of Regional Councils Texas Flood Response Study by

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Center for Research in Water Resources
University of Texas at Austin

Briefing for TARC, 9-1-1 Coordinators Association, 21 September 2016

Acknowledgements: Austin Fire Department, COA Watershed Protection, e-911 Coordinators, CSEC National Weather Service, Texas Division of Emergency Management

New tech can forecast when and where creeks, rivers will flood

By Robert Maxwell
Published: May 3, 2016, 8:30 pm | Updated: May 5, 2016, 1:07 pm

http://kxan.com/2016/05/03/new-technology-hopes-to-predict-flash-floods-before-it-happens/

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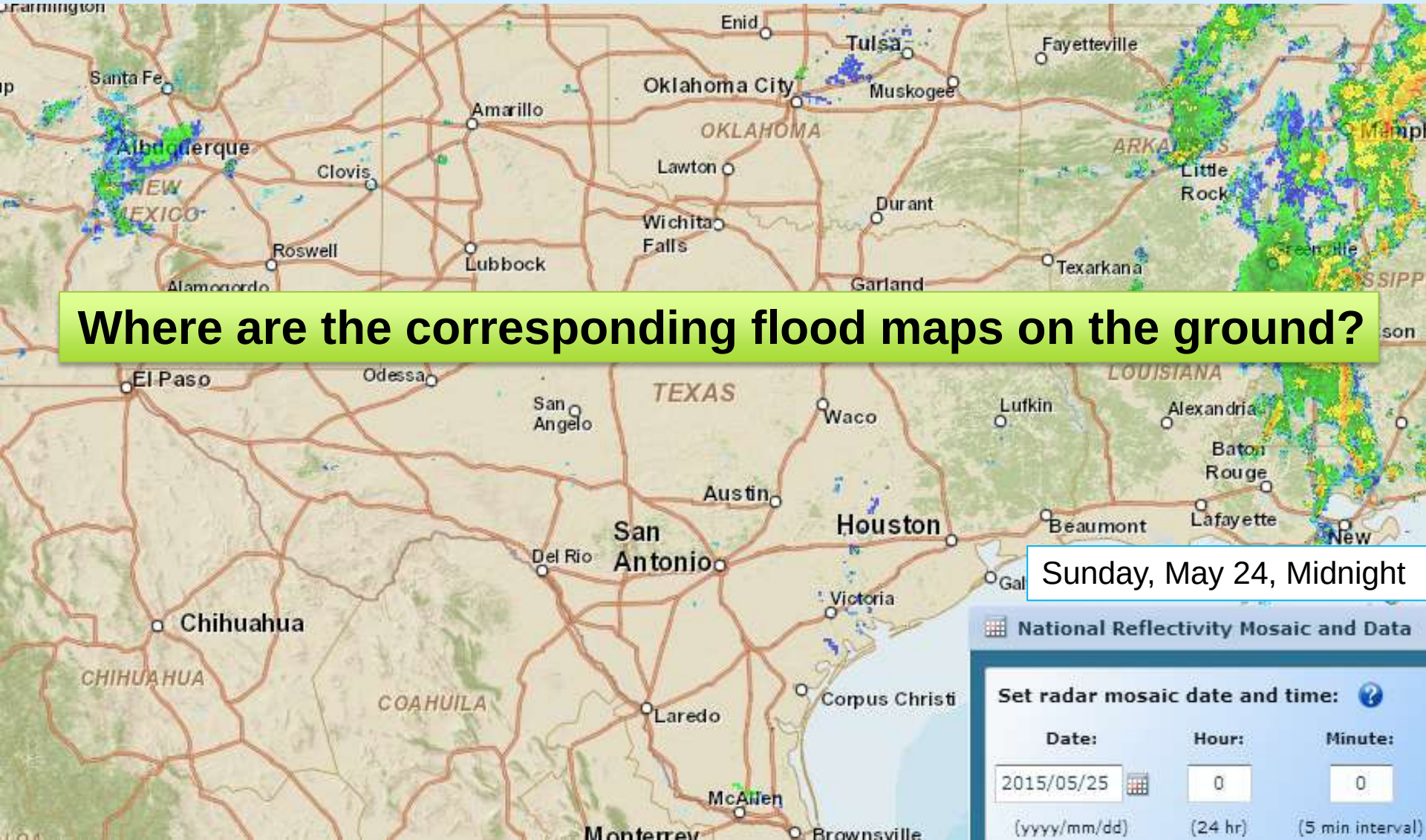
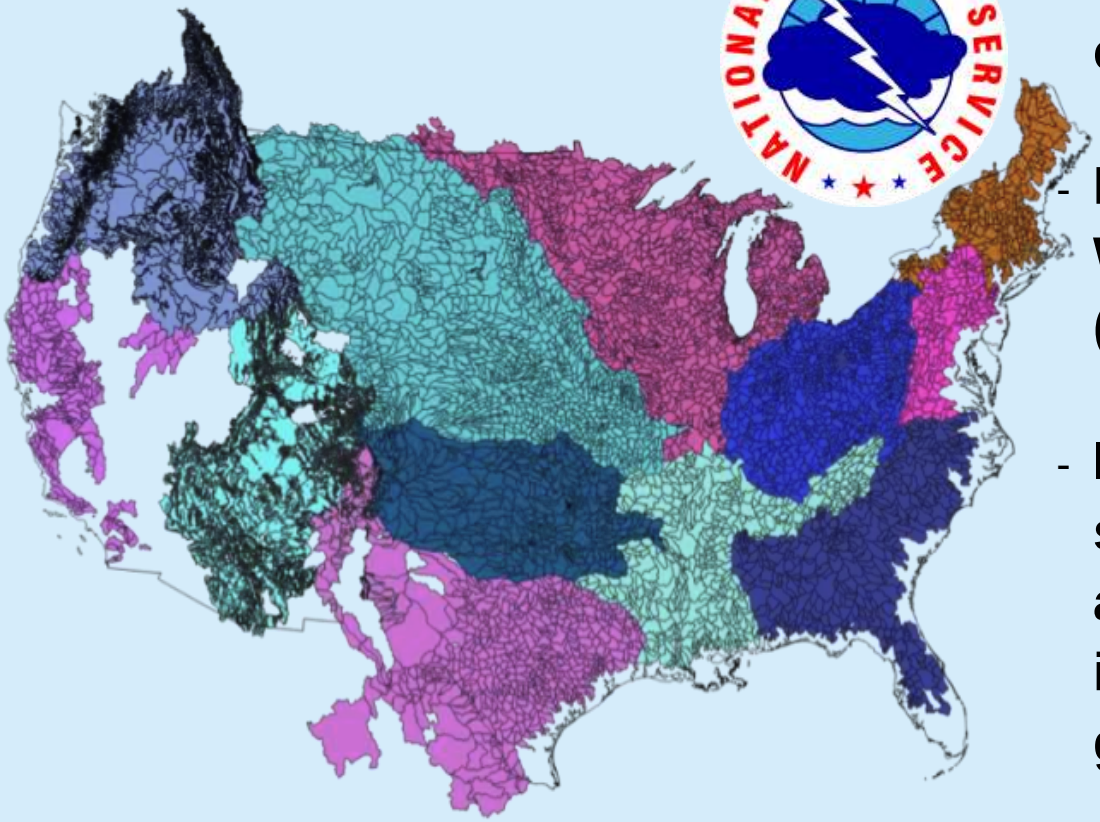
Storm Rainfall during 2015 Memorial Day Weekend

http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=radar&theme=radar&display=nexrad

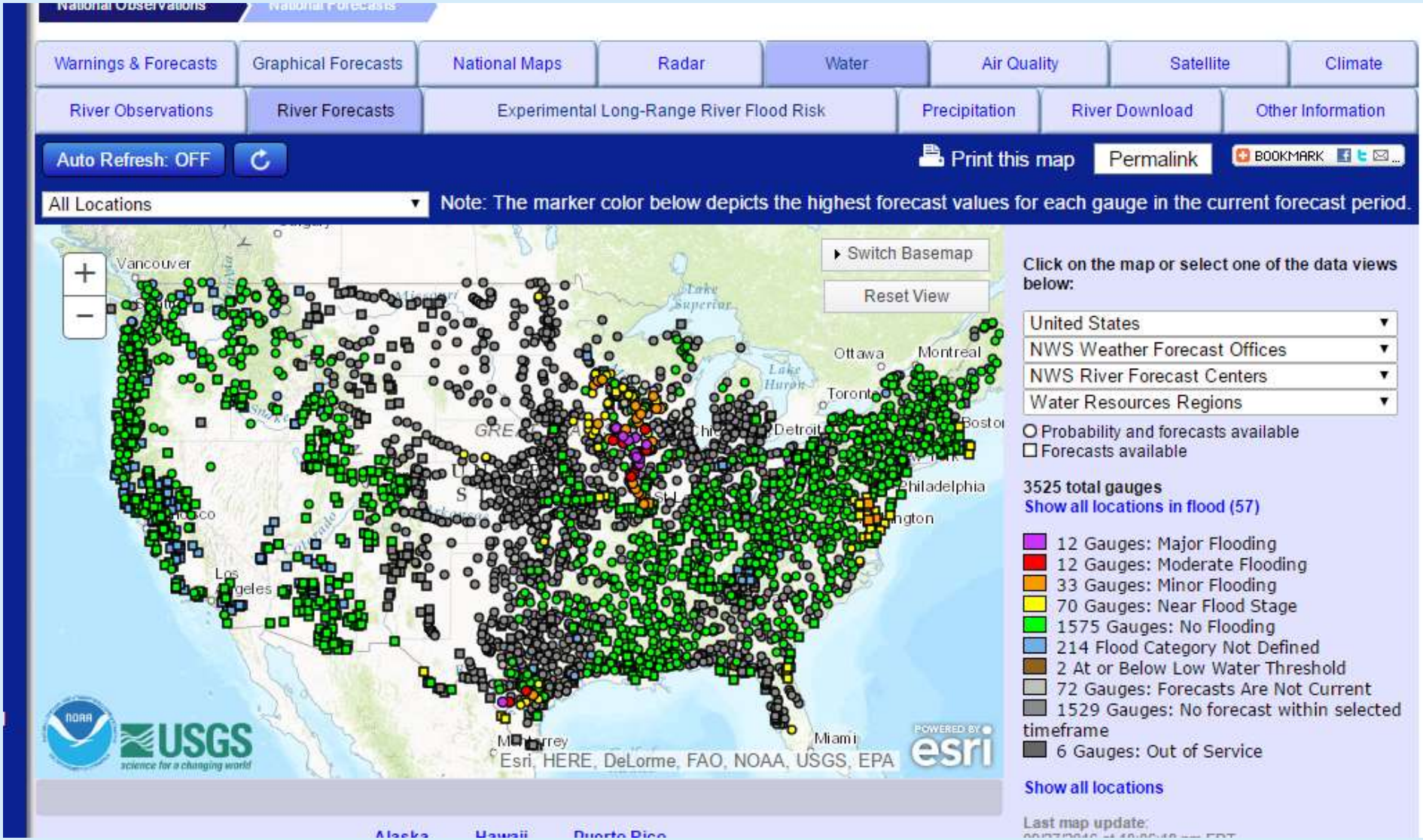


13 NWS River Forecast Centers (RFCs)



6600 sub-basins in continental US

- **Prepare river and flood forecasts using models based on average basin characteristics**
- **Provide forecast guidance to Weather Forecast Offices (WFOs)**
- **Issue daily stage and streamflow forecasts, rainfall and drought data and information, and flash flood guidance**
- **Work with water managers and other Federal Agencies**


National Observations
National Forecasts
Warnings & Forecasts
Graphical Forecasts
National Maps
Radar
Water
Air Quality
Satellite
Climate
River Observations
River Forecasts
Experimental Long-Range River Flood Risk
Precipitation
River Download
Other Information
Auto Refresh: OFF
Print this map
Permalink
BOOKMARK
All Locations
Note: The marker color below depicts the highest forecast values for each gauge in the current forecast period.
Switch Basemap
Reset View
Vancouver
Ottawa
Montreal
Toronto
Detroit
Philadelphia
Miami
Esri, HERE, DeLorme, FAO, NOAA, USGS, EPA
USGS
science for a changing world
POWERED BY esri
Click on the map or select one of the data views below:
United States
NWS Weather Forecast Offices
NWS River Forecast Centers
Water Resources Regions
Probability and forecasts available
Forecasts available
3525 total gauges
Show all locations in flood (57)
12 Gauges: Major Flooding
12 Gauges: Moderate Flooding
33 Gauges: Minor Flooding
70 Gauges: Near Flood Stage
1575 Gauges: No Flooding
214 Flood Category Not Defined
2 At or Below Low Water Threshold
72 Gauges: Forecasts Are Not Current
1529 Gauges: No forecast within selected timeframe
6 Gauges: Out of Service
Show all locations
Last map update:
Alaska
Hawaii
Puerto Rico

An Opportunity

New National Water Center established on the Tuscaloosa campus of University of Alabama by the National Weather Service and federal agency partners

Has a mission to assess hydrology in a new way at the continental scale for the United States

Flow Continuum Model – a national stream network, atmosphere to oceans, coast to coast

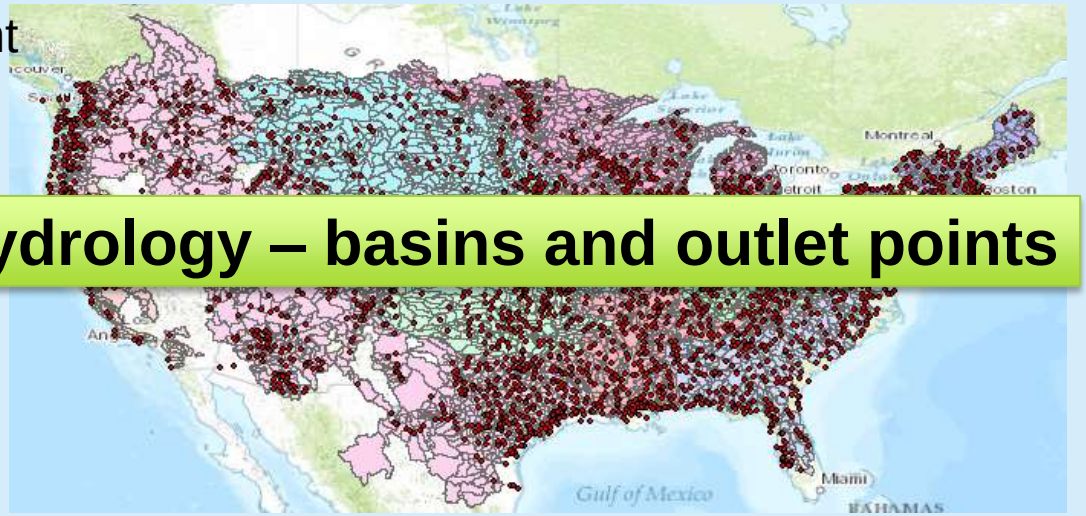
Blanco River at Wimberley

Two basins and one forecast point

becomes ⇩

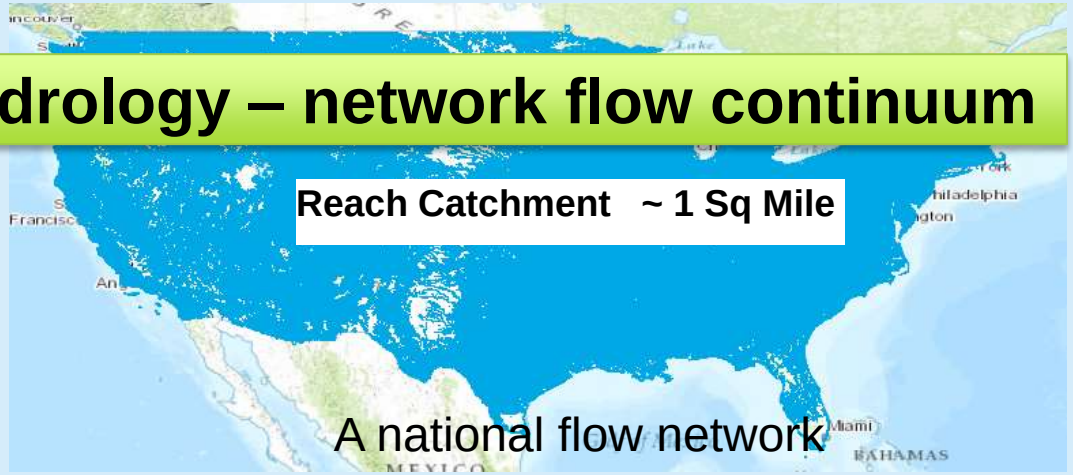
130 Catchments and Flowlines uniquely labelled

Current: 6600 basins and 3600 forecast points



Watershed Hydrology – basins and outlet points

NFIE: 2.7 million stream reaches and catchments

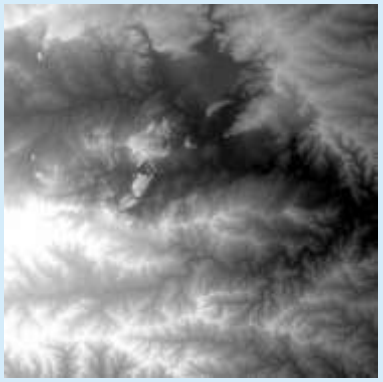


Continental Hydrology – network flow continuum

A national flow network

NHDPlus Version 2.1

Foundation for a Geospatial Hydrologic Framework for the United States



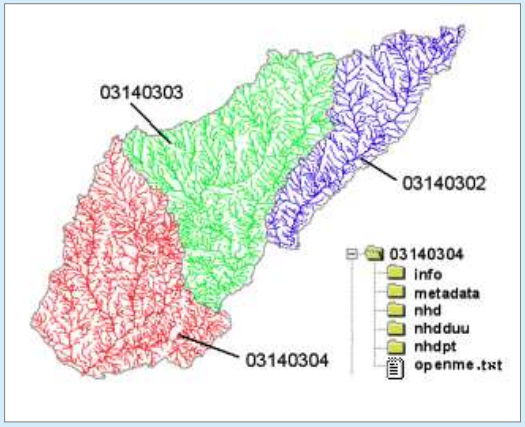
National Elevation Dataset

NHDPlus

2.7 million reach catchments in US
average area 3 km^2
reach length 2 km
Uniquely labelled

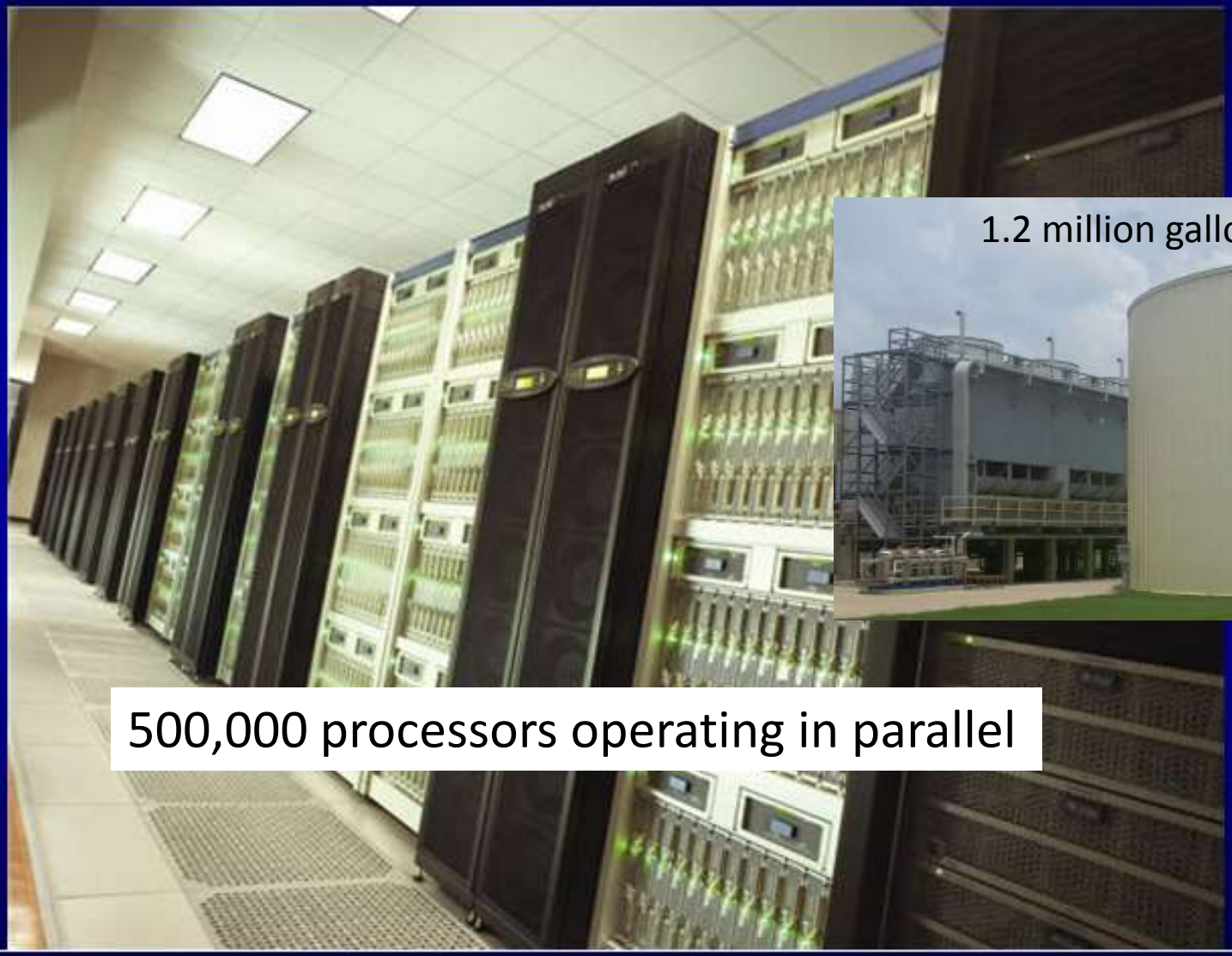
Watershed Boundary Dataset

National Hydrography Dataset



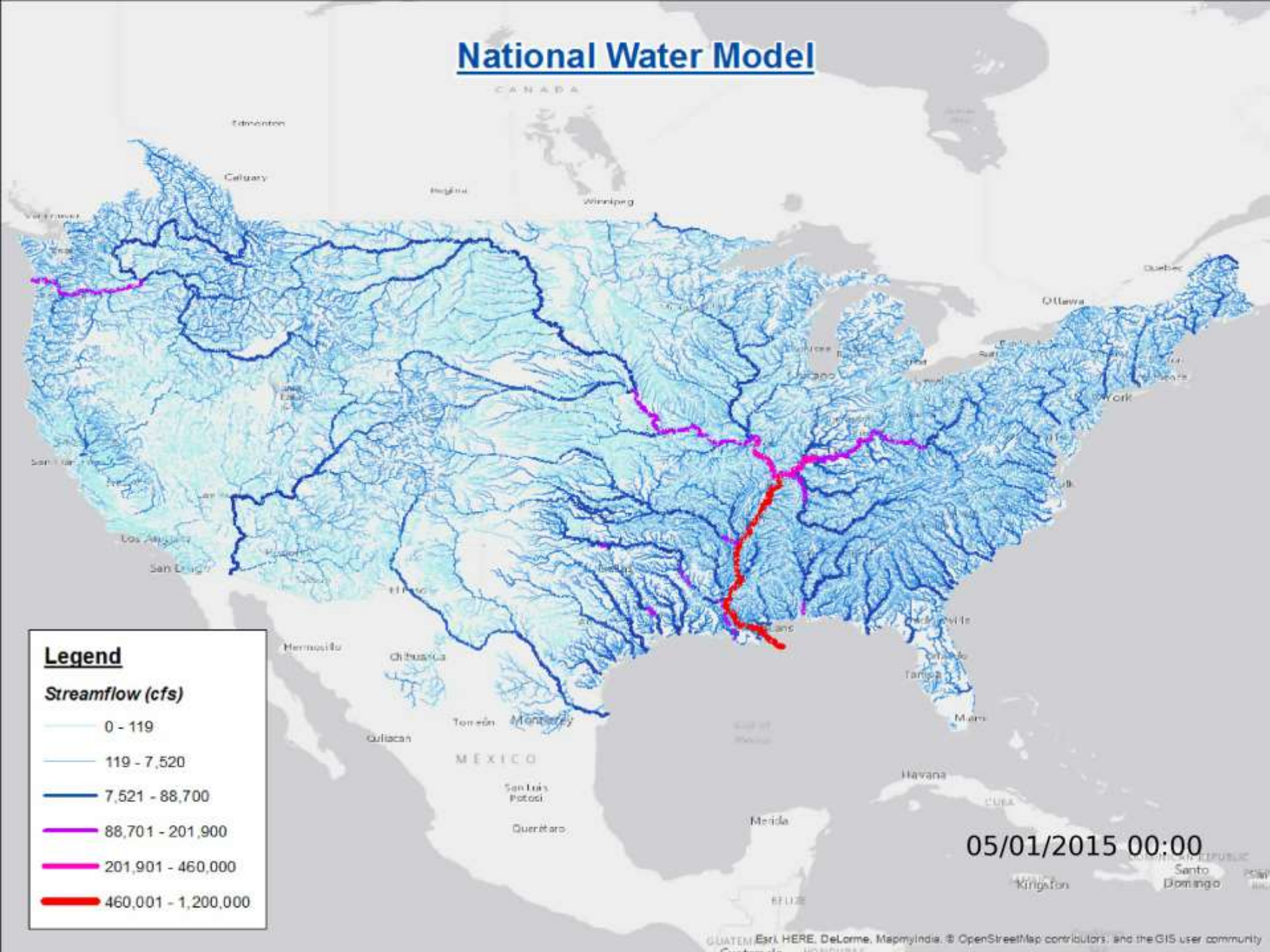
National Land Cover Dataset

Stampede



500,000 processors operating in parallel

National Water Model



TDEM Project Stakeholders

County Partners

- Travis County Commissioners
- Capital Area Fire Chief
- Association *(CAFCA)*
- Travis County Emergency Management
- Travis County Sheriff's Office
- Williamson County Emergency Management
- Williamson County Sheriff's Office
- Williamson County Fire Chiefs
- Upper Brushy Creek Water Control District
- San Marcos Emergency Management
- Hays County Emergency Management

State Partners

- Texas Division of Emergency Management *(TDEM)*
- Texas Natural Resource Information Systems (*TNRIS*)
- Texas Water Development Board *(TWDB)*
- Texas Commission on Environmental Quality *(TCEQ)*
- Texas Department of Transportation *(TxDOT)*
- Texas Floodplain Managers

City Partners

- City of Austin
- Austin Fire Department
- Austin Flood Early Warning System *(FEWS)*
- Austin Homeland Security Emergency Management *(HSEM)*
- Houston Office of Emergency Management

Federal Partners

- National Weather Service *(NWS)*
- National Oceanic Atmospheric *Administration (NOAA)*
- Federal Emergency Management Agency *(FEMA)*
- US Geological Survey *(USGS)*
- US Army Corps of Engineers *(USACE)*

Types of Flood Maps for First Response

1) Strategic Flood Map

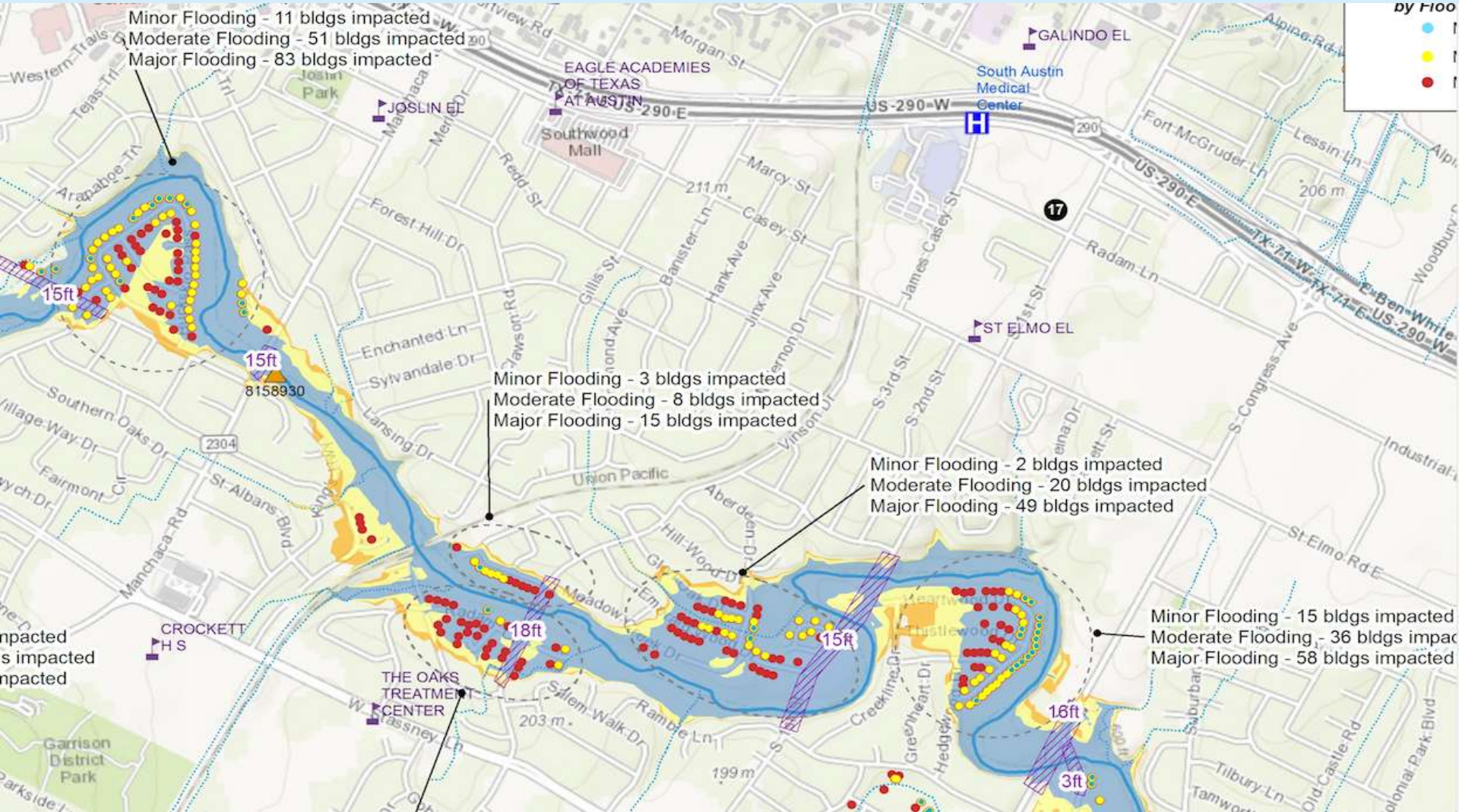
- Used at Emergency Operations Center
- Overview map of entire area
- Identifies scope/magnitude of overall problem
- Used to keep track of several area commands, groups of units

2) Pre-planning Flood Maps

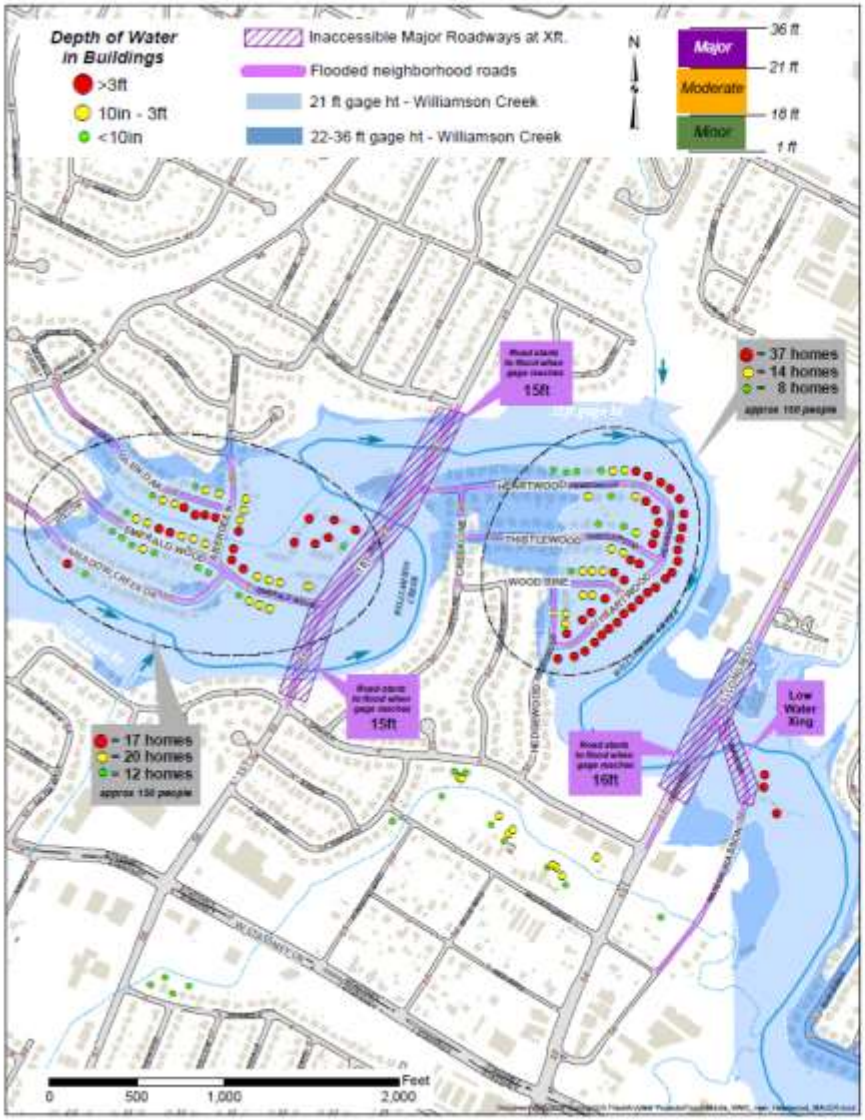
3) Operations Flood Map

Onion Creek Watershed Study:
AFD / FEWS Strategic Planning Map

This could be greatly automated…



Preplanning Flood Response Map



MAJOR FLOOD LEVELS (>21ft)

WMS Williamson Creek

Williamson Creek (Middle) - Near Heartwood Road
Forecasts Associated w/ USGS gage for WMS At Manchaca 08158930

Fire Department Information

Flood Early Warning Systems (FEWS) Info

When Williamson Creek is experiencing MAJOR FLOODING (over 21ft gage ht)

- ✓ Crossing Williamson Creek will be impossible via....
  - ***South 1st*** – When creek gage is at **15ft**, road will have water over it
  - ***South Congress*** - When creek gage is at **16ft**, road will have water over it
  - ***Wasson*** – (low water crossing) When creek gage is at **3ft**, road will have 3ft of water
- ✓ Travel is possible south from IH 35 to Stassney Dr and from MoPac to William Cannon eastbound

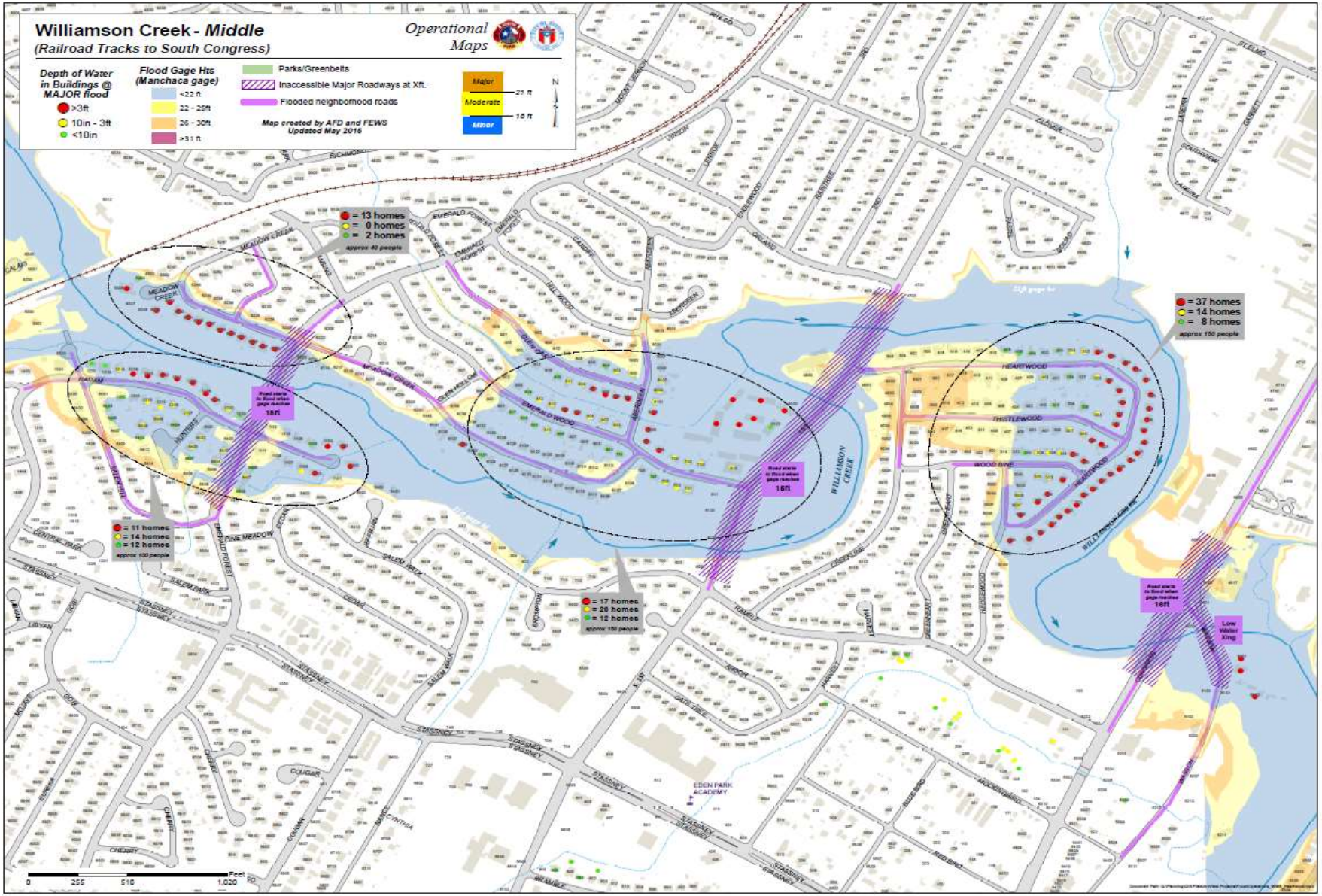
How much water is over the road during MAJOR FLOODING (over 21ft gage ht)

- **Wasson Rd** - low water crossing, entire gage ht is over roadway (ex: 21ft gage ht + 21ft over Wasson)
- **Heartwood Dr** (300-500 block) – 2-3 ft over roadway at 21ft gage ht
- **South Congress** (5100 block/Williamson Creek crossing) – 5 ft over roadway at 21ft gage ht
- **South 1st** (4700-5200 block) – 3 ft over roadway at 21ft gage ht
- **Emerald Forest Dr** (5300 block/Williamson Creek crossing) – 4 ft over roadway at 21ft gage ht
- **Emerald Wood** (800 block) – 2 ft over roadway at 21ft gage ht
- **Manchaca Rd** (5000 block/William Creek crossing) – 3ft over roadway at 121ft gage ht
- **Aberdeen** (5100 block) - 4ft over roadway at 21ft gage ht

Map produced by City of Austin Flood Early Warning System (FEWS) and Austin Fire Department - Updated May 2016

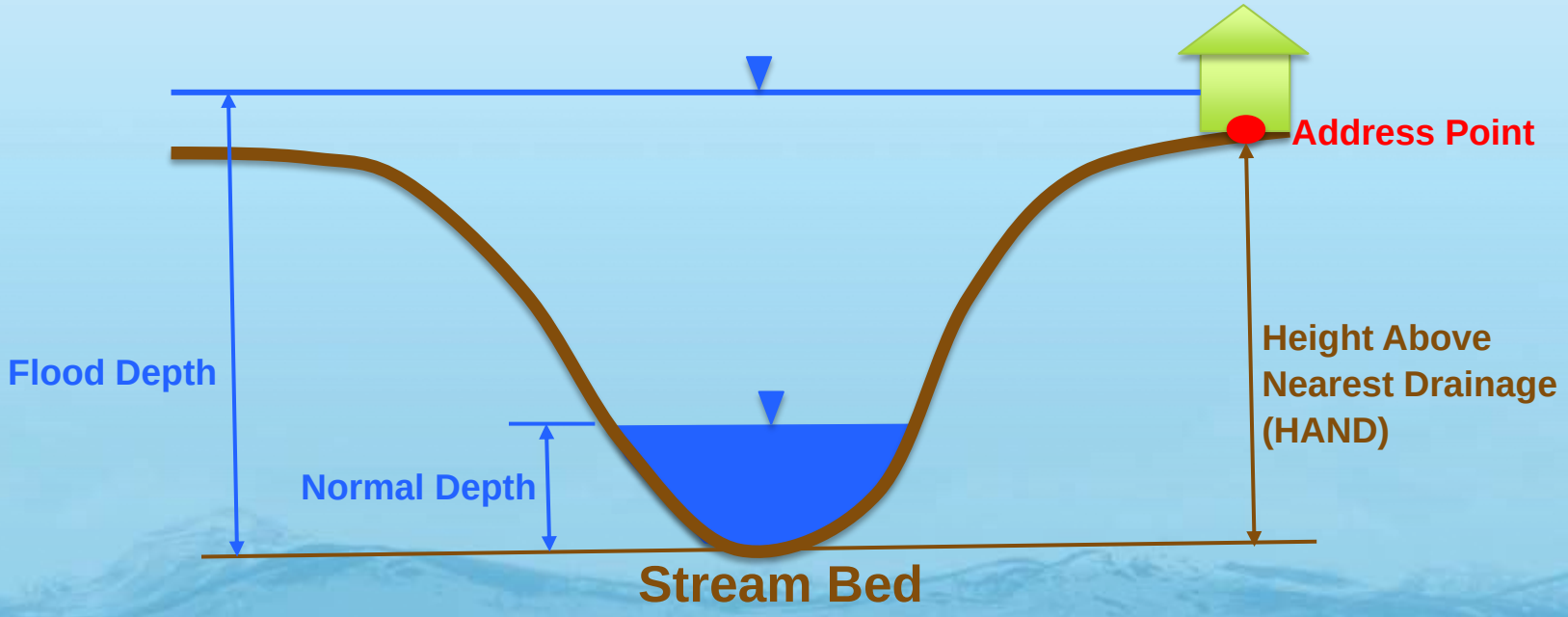
Williamson Creek (Middle) near Heartwood Road -- MAJOR FLOODING

Operations Flood Response Map



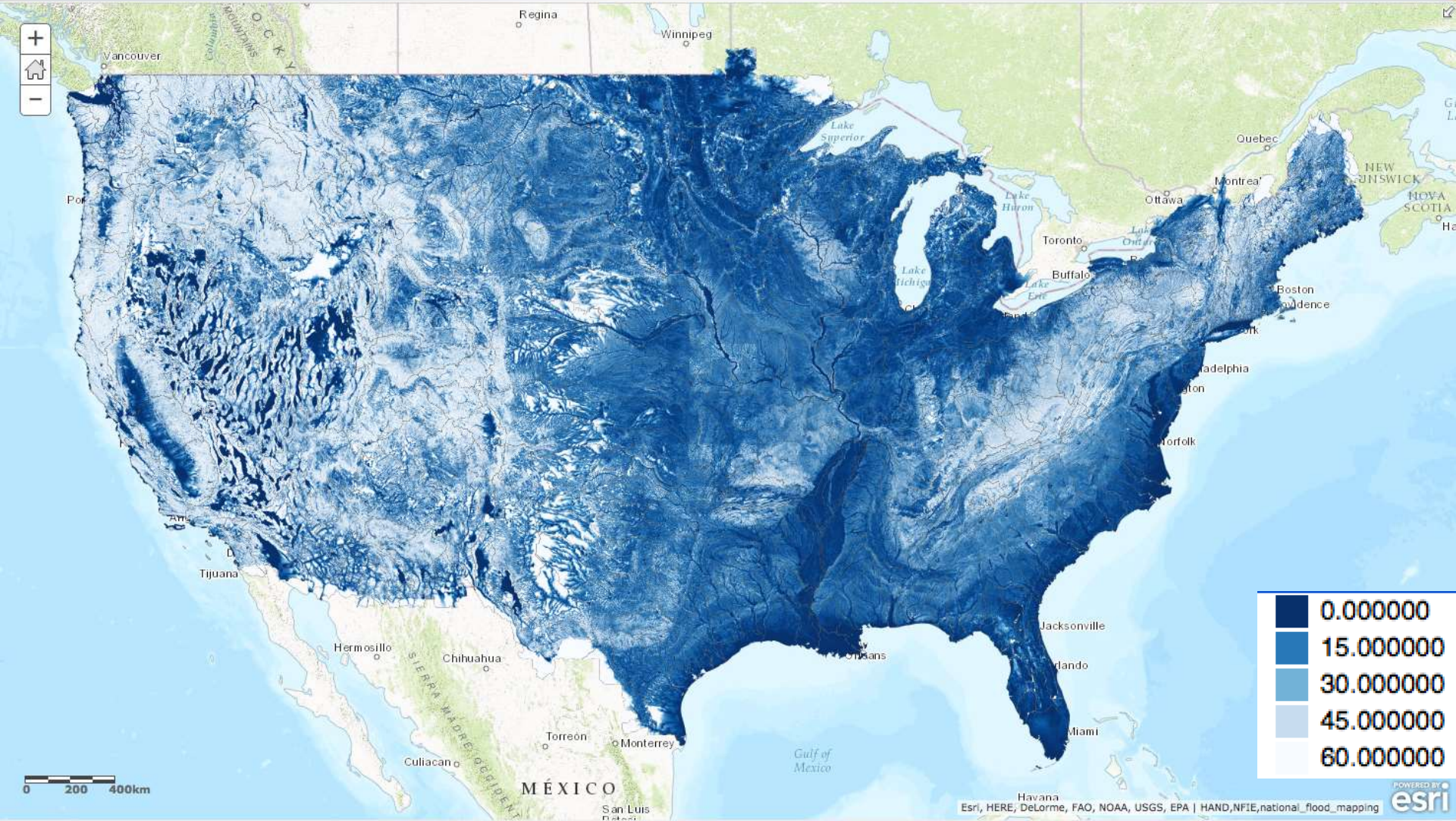
Method for Determining Flood Risk:
Height Above Nearest Drainage (HAND)

Flooding occurs when Water Depth is greater than HAND



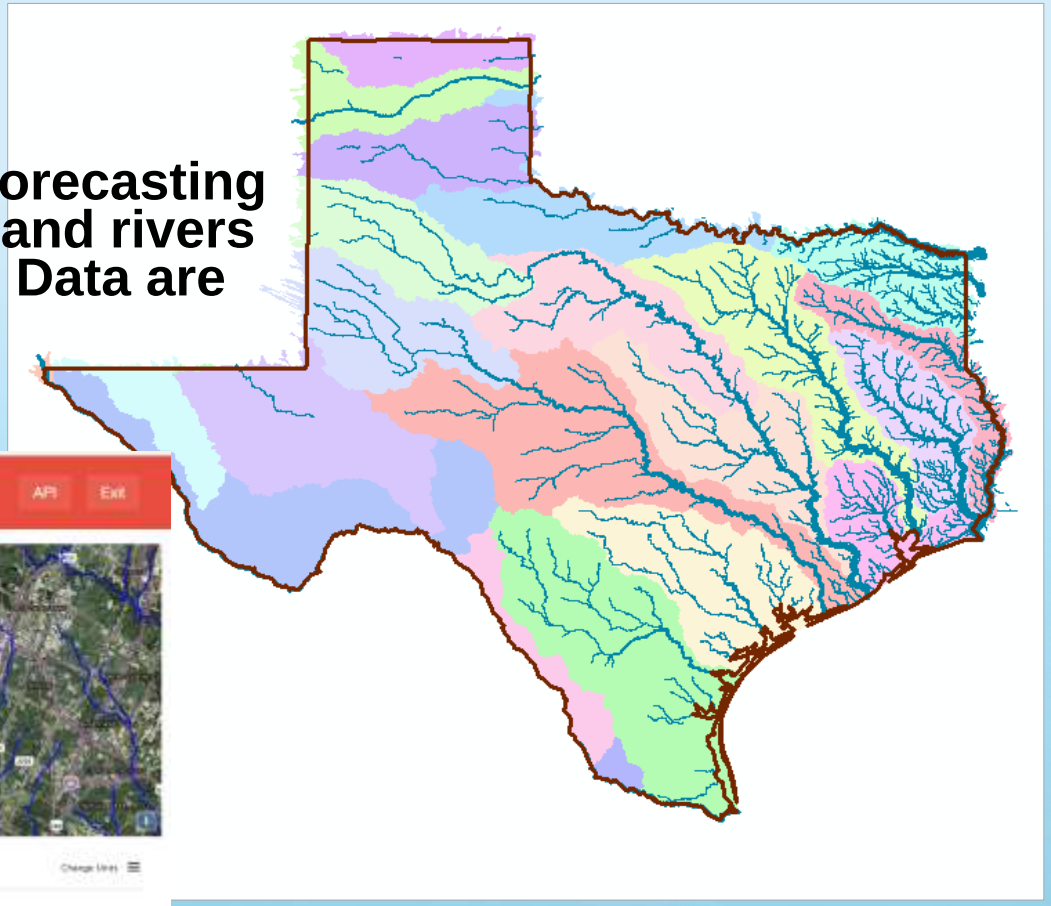
Height Above Nearest Drainage

(180 billion cells in a grid mesh covering continental US)



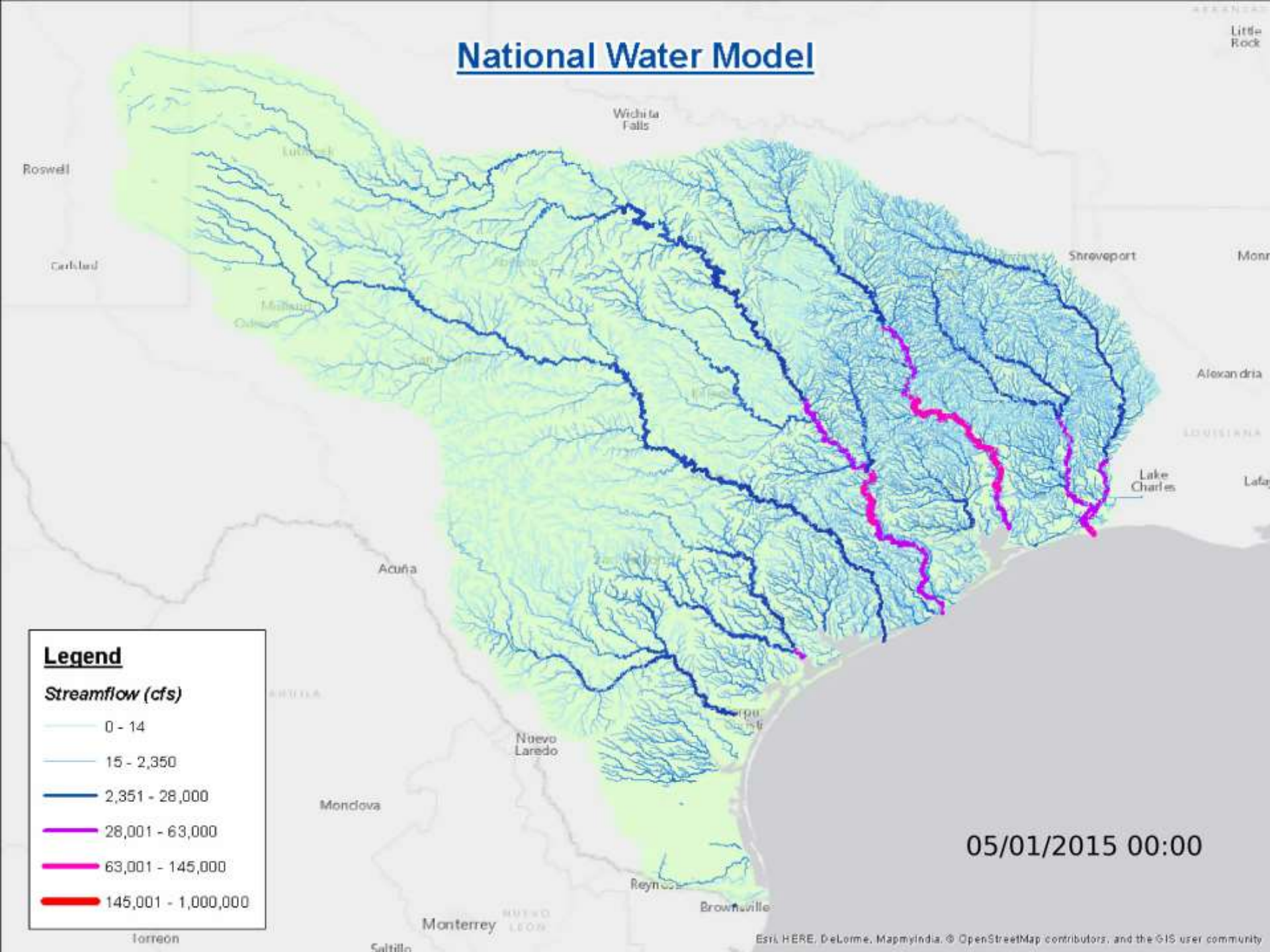
NOAA National Water Model in Texas

Continuous real-time water forecasting on 190,000 miles of streams and rivers divided into 98,000 reaches. Data are publicly accessible now

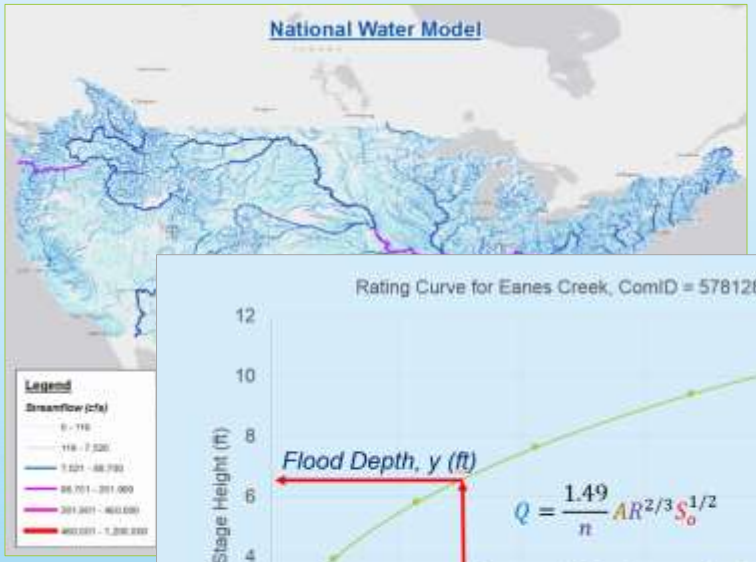


A transformative improvement for flood resilience in our state!

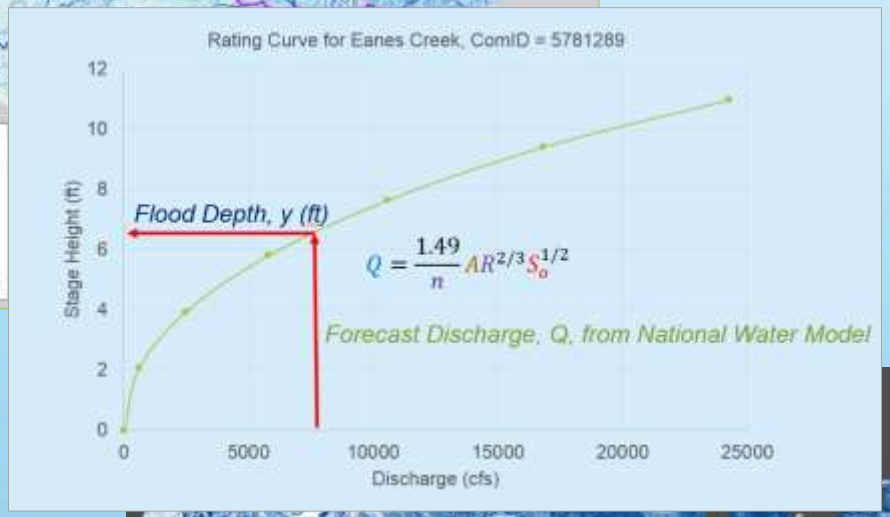
National Water Model



Continental-Scale Flood Inundation Mapping



1



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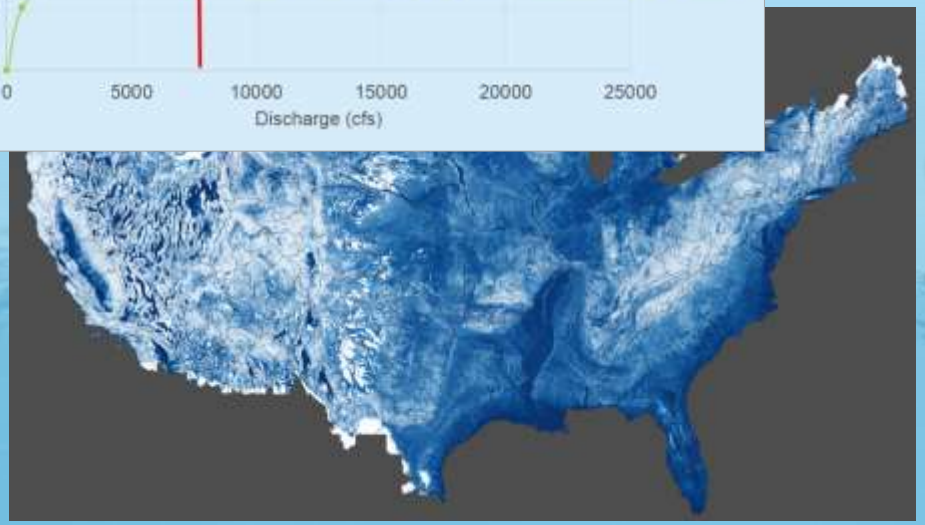

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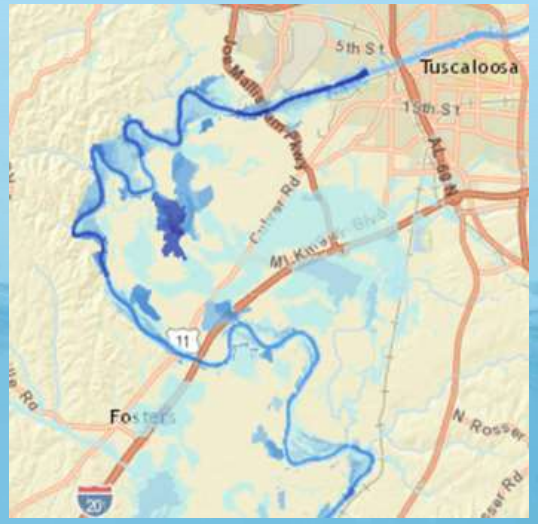
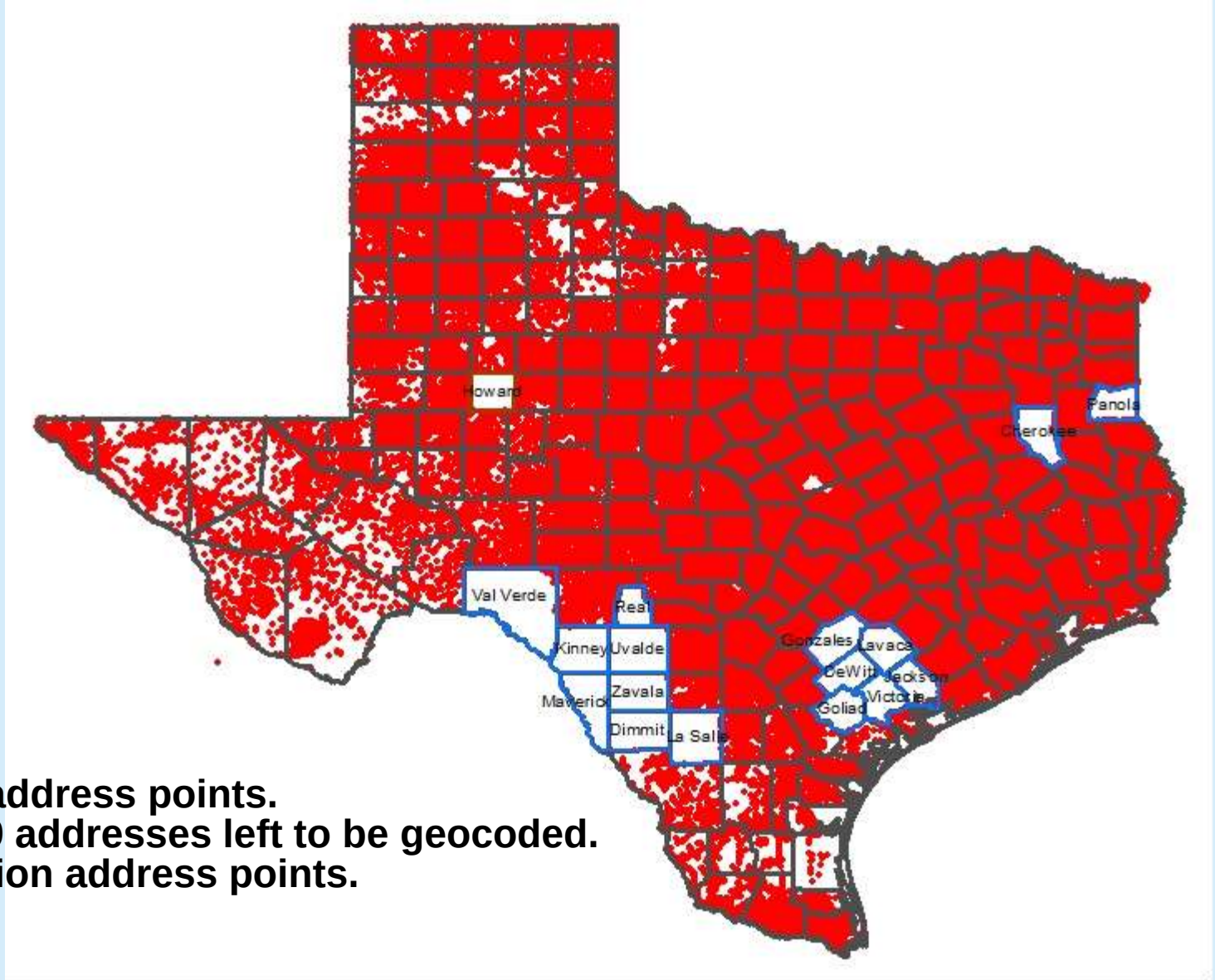


1. Forecast discharge with National Water Model

2. Convert discharge to depth using rating curve

3. Convert depth to inundation using HAND

Address Points Compiled from E-911 Services



8.45 million address points.
About 65,589 addresses left to be geocoded.
Total 8.5 million address points.

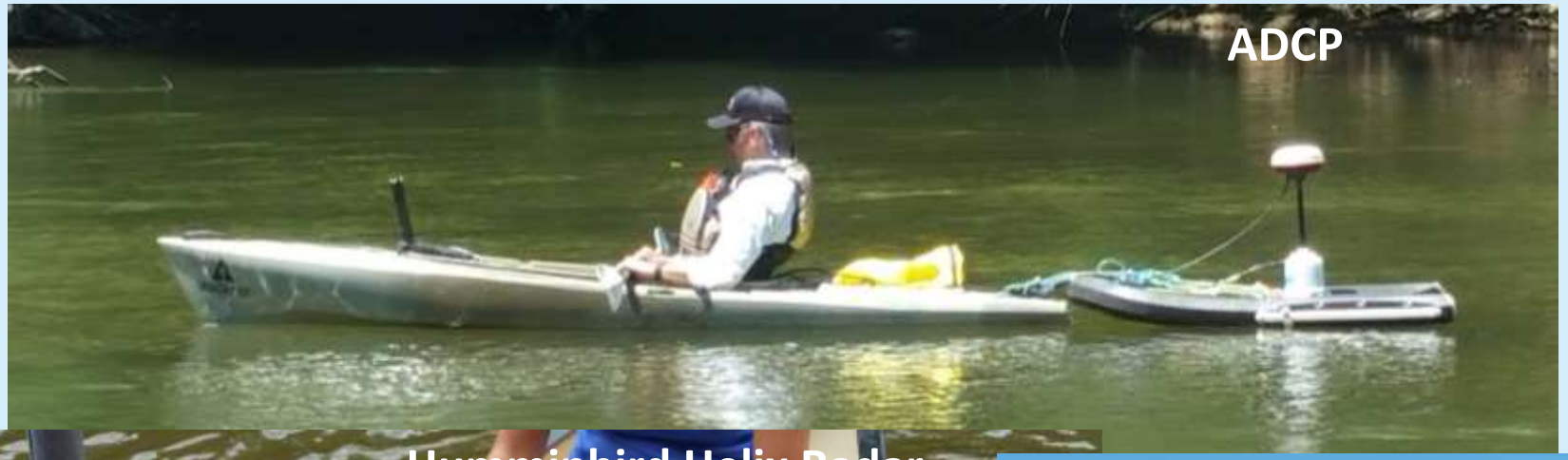
Height Above Nearest Drainage for Address Points in Williamson Creek

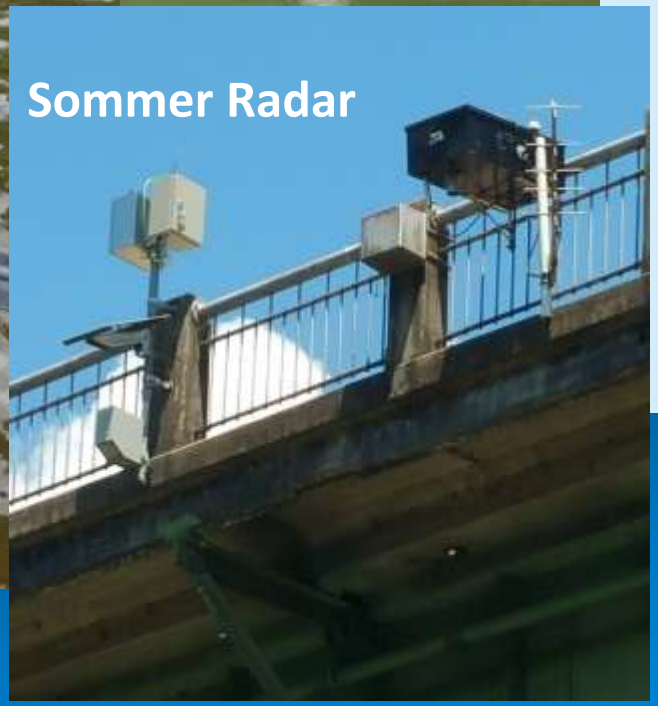
Texas Inundation Mapping

Precipitation Rate=100mm/day

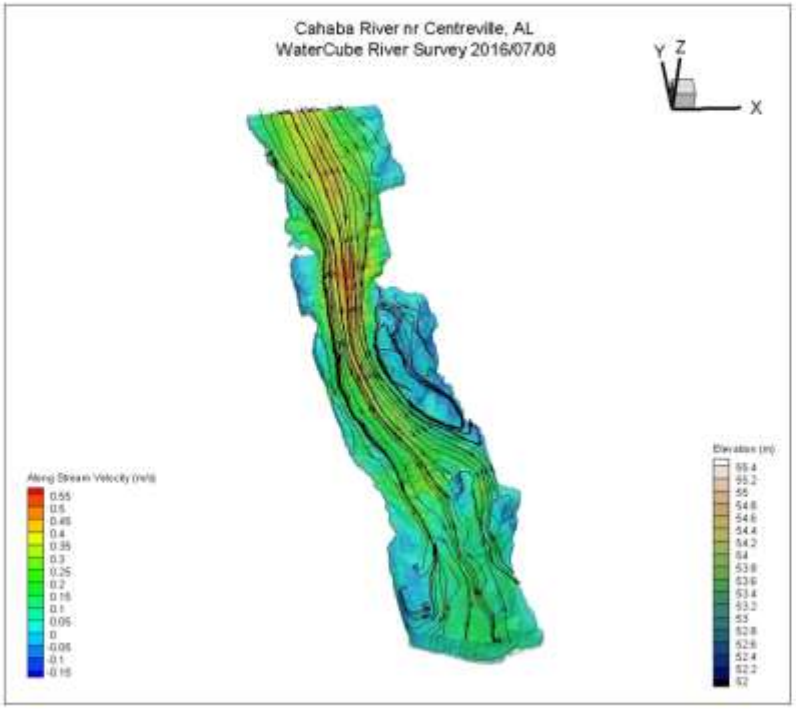
Next Step: UT system collaboration

1. Densified Measurements

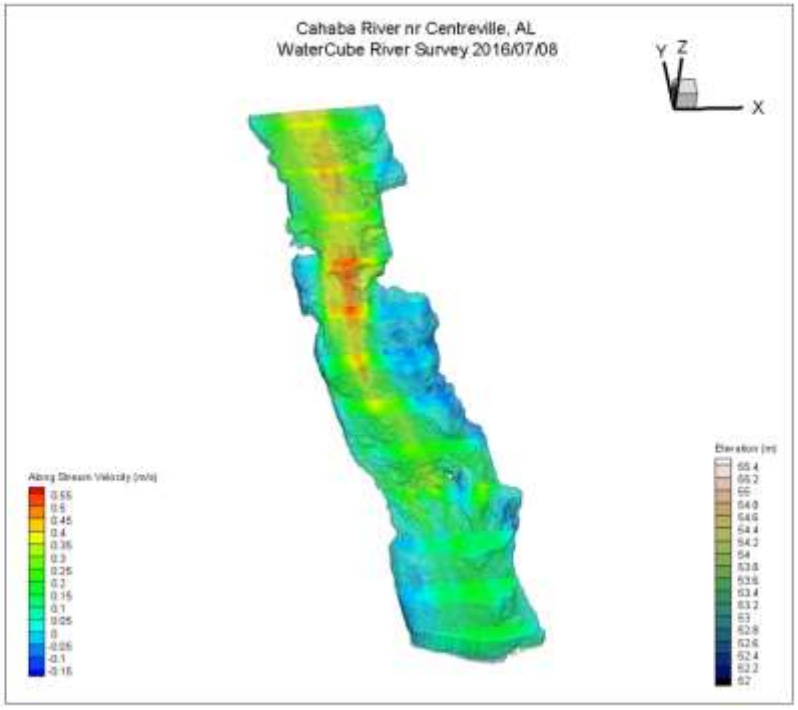




Cahaba River Processed Results using CubeIt Unlimited to Visualize and Analyze



"Stream Traces" with 3D Velocity Model



"Velocity Cross-Sections" with 3D Velocity Model

County for Each Institution