

Best Practices in GIS Use for Flood Response and Recovery from Recent Disasters

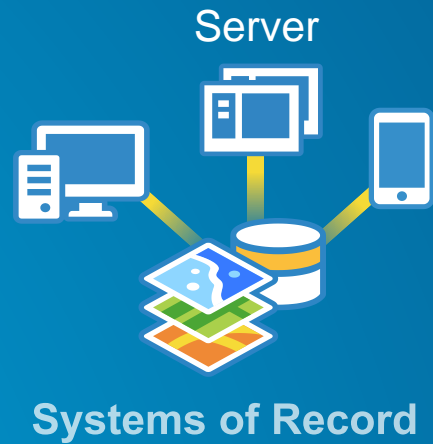
Jeff Baranyi – jbaranyi@esri.com

Jon Pedder – jpedder@esri.com

Evolution of GIS

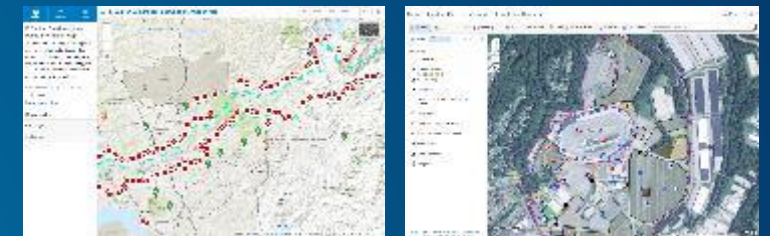
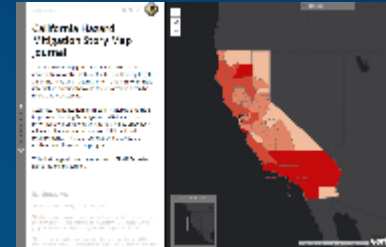


Spatial Analysis /
Map Production



Evolution of GIS Products

Expectation set by Consumerization of IT is that there is “an App for that”



Apps

Viewers



Maps



Esri Disaster Response Program

Helping users in times of need

- Replacement / Additional Software
- Data
- Workflow Support
- Premium Tech Support
- Occasionally Onsite Support

esri Industries Products Support & Services About Community Sign In

Services

Disaster Response Program

Request Assistance →

Main Severe Weather Earthquakes Hurricanes Wildfire Flooding Humanitarian

↑

Help when you need it most.

When disaster strikes, Esri's Disaster Response Program (DRP) is here to support you around the clock, 24/7. Monitor events online, explore rich content, augment software, and request assistance from Esri experts as part of our corporate citizenship. We're here when you need us most — during the darkest of times.

Cal OES Leveraging ArcGIS

<http://www.esri.com/disaster>

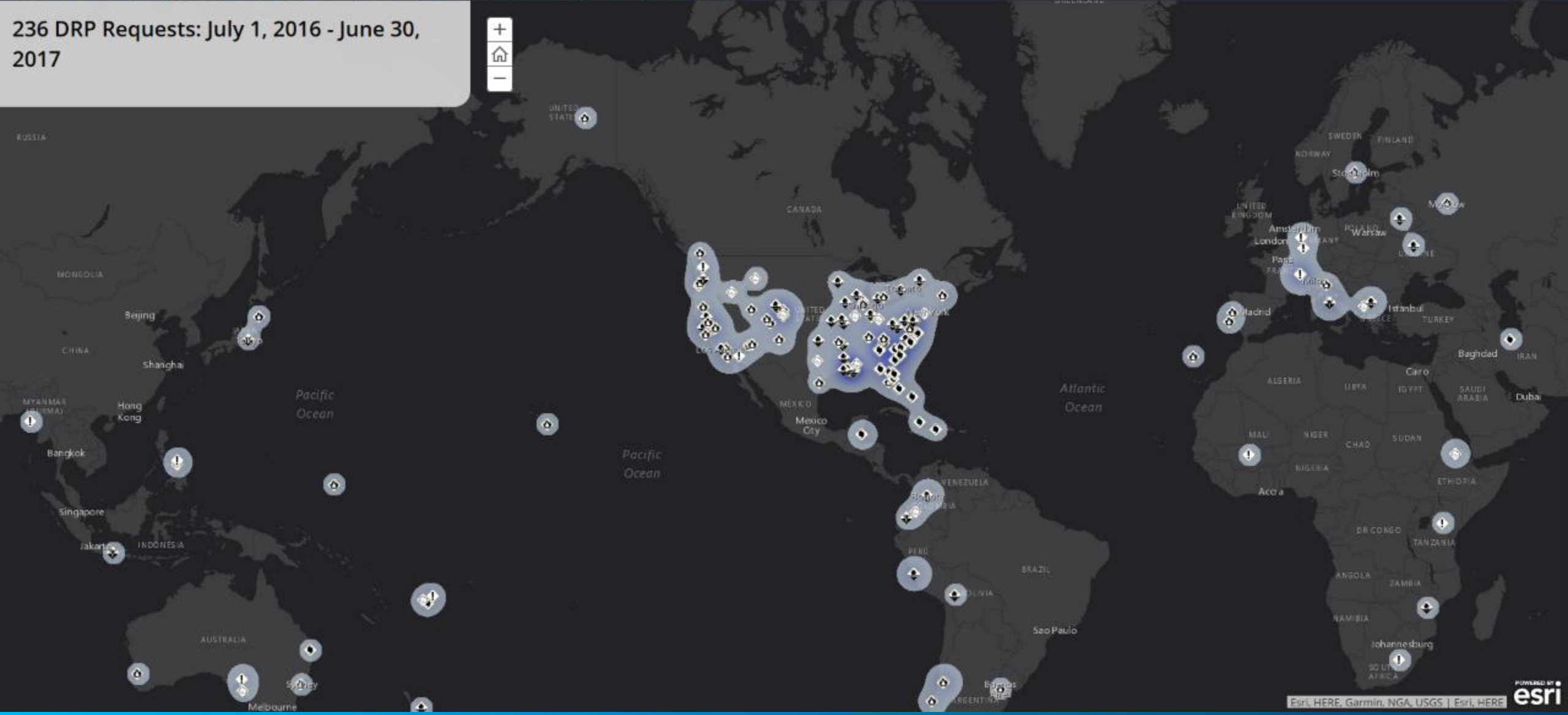
Major Esri Disaster Response Program Activations

- Northridge Earthquake 1994
- Oklahoma City Bombing 1995
- Hurricane Mitch 1997
- FEMA Project Impact 1998
- WTC and Pentagon Attacks 2001
- Space Shuttle Columbia Disaster 2003
- La Conchita Laguna Landslides 2004
- Indian Ocean Tsunami 2004
- Pakistan Earthquake 2005
- Indonesian Earthquake 2006
- Peru Earthquake 2007
- Niigata Earthquake Japan 2007
- China Earthquake 2008
- Australia Bush Fires 2009
- Influenza A – H1NA Outbreak 2009
- Haiti Earthquake 2010
- Chile Earthquake 2010
- 2010 Tennessee Flooding
- 2010 Deepwater Horizon Oil Spill
- 2010 Pakistan Flooding
- 2010 Atlantic Hurricane Season
- 2010 Fourmile Canyon Fire
- 2010 Australia Flooding
- 2011 Spring Tornadoes
- 2011 Japan Earthquake and Tsunami
- 2011 US National Level Exercise
- 2011 Thailand Flooding
- 2011 Turkey Earthquake
- 2012 Duluth (MN) Flooding
- 2012 Philippines Flooding
- 2012 Hurricane Sandy
- 2013 Boston Marathon Bombing
- 2013 West Text Explosion
- 2013 Colorado Flooding
- 2013 Typhoon Yolanda/Haiyan
- 2014 Washington Mudslide
- 2014 CUSEC CAPSTONE Exercise
- 2014 Napa Earthquake
- 2014 MH17
- 2014 Ebola Outbreak
- 2015 Nepal Earthquake
- 2015 South Carolina Flooding
- 2015 Flint Water Crisis
- 2015 European Refugee Crisis
- 2016 Texas Flooding
- 2016 Wisconsin Flooding
- 2016 Louisiana Flooding
- 2016 Hurricane Matthew
- 2016 Gatlinburg / Southeast Fires
- 2017 Louisiana Tornadoes
- 2017 Atlanta I-85 Collapse

Esri Public Safety Assistance Program: Year In Review

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236 DRP Requests: July 1, 2016 - June 30, 2017



Wisconsin Flooding 2016 - Story Map Tour

Severe Flooding and Storm Damage Story Map

Storms from the morning of July 12, 2016

Wisconsin Emergency Management



17 Hwy 2 Ashland County, WI flooding.



18 Hwy 2 Ashland County, WI flooding.



19 Hwy 2 Ashland County, WI flooding.



20 Hwy 2 Ashland County, WI flooding.



21 Ashland County, WI flooding.



22 Ashland County, WI flooding.

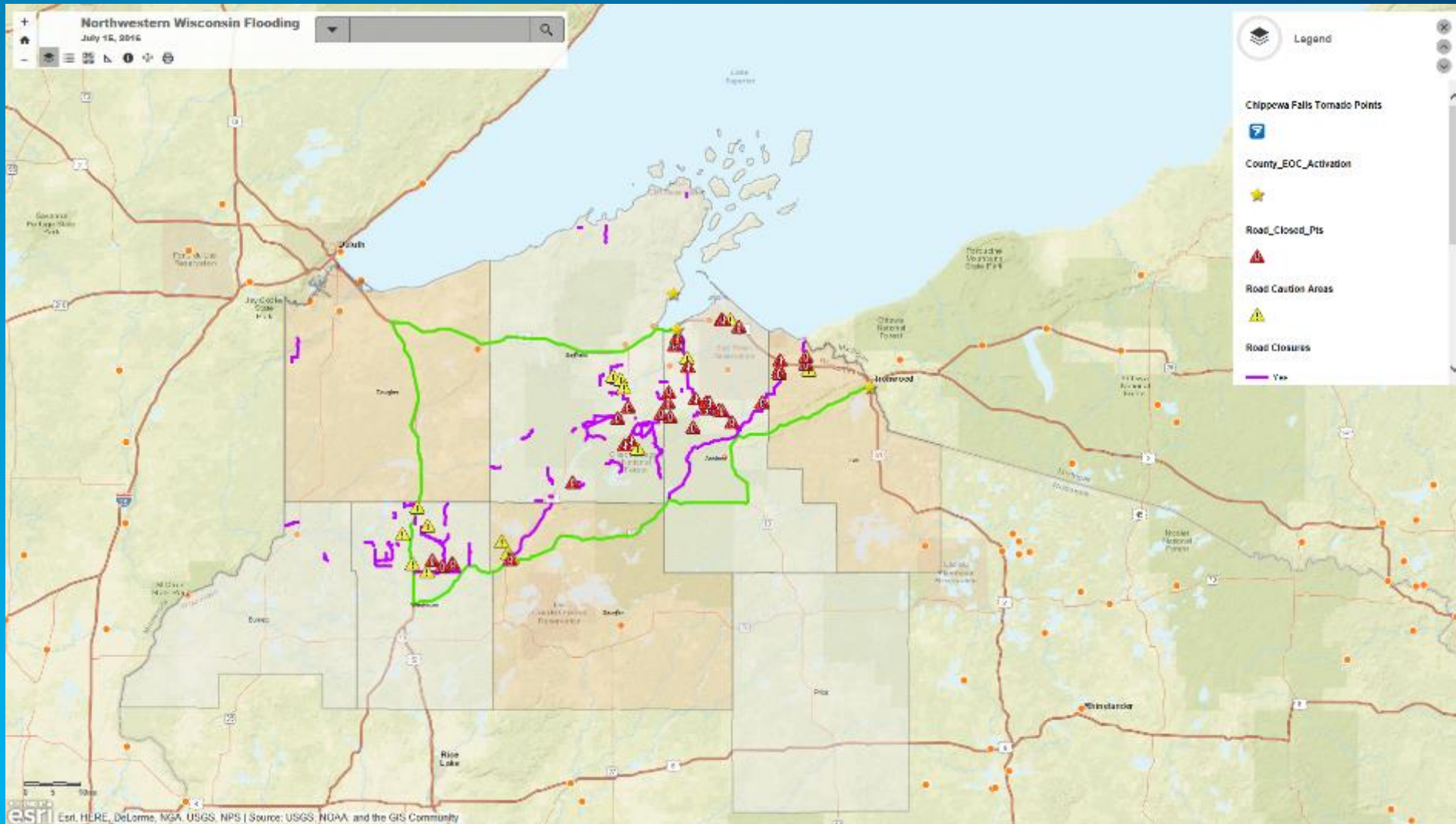


23 Ashland County, WI flooding.

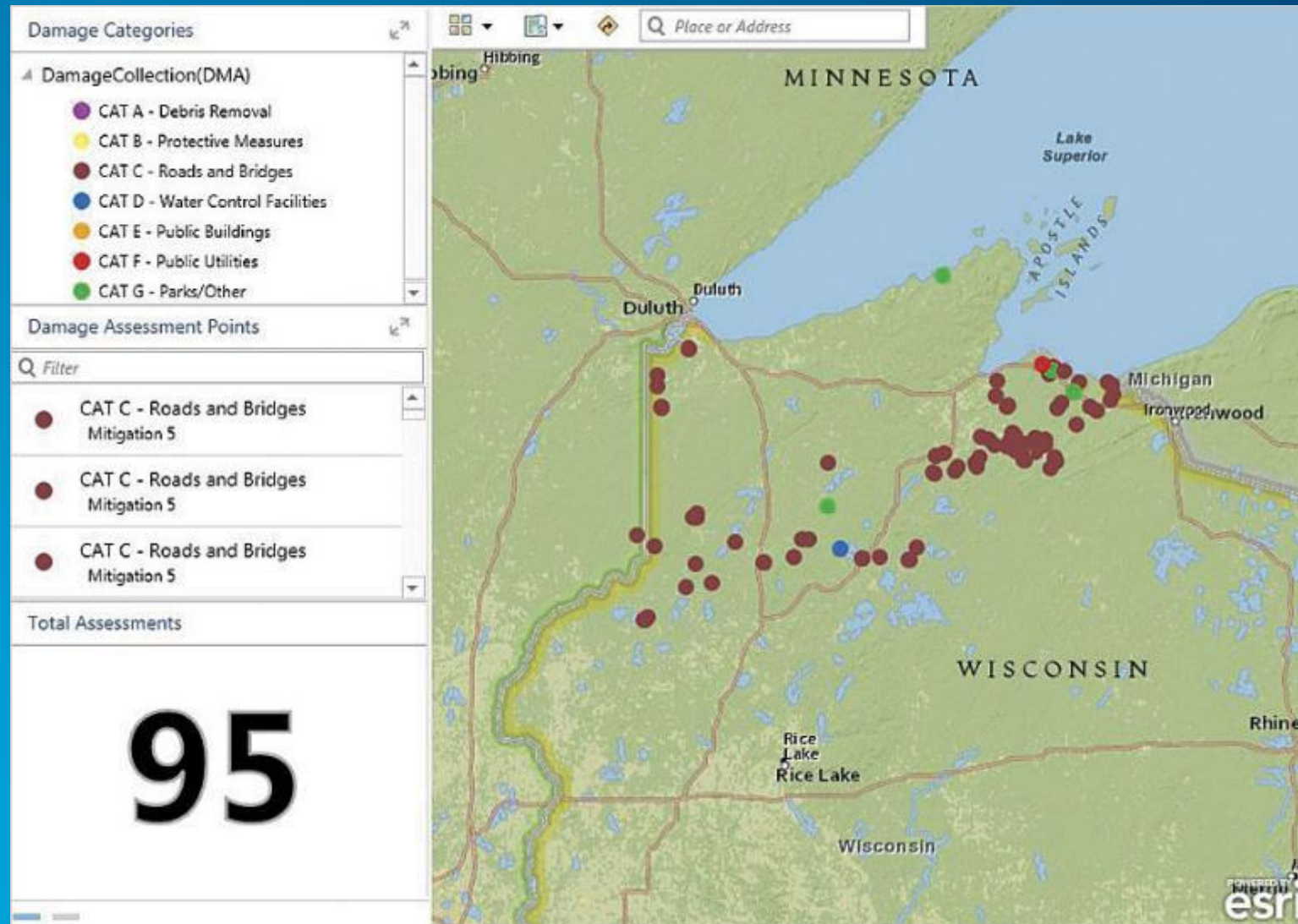


24 Ashland County, WI flooding.

Wisconsin Flooding 2016 – Sharing Information with the Public



Wisconsin Flooding 2016 – Damage Assessment





SCOTT WALKER
OFFICE OF THE GOVERNOR
STATE OF WISCONSIN

115 EAST STATE CAPITOL
MADISON, WI 53702

August 3, 2016

The Honorable Barack Obama
President of the United States
The White House
Washington, D. C.

Through: Regional Administrator Andrew Velasquez III
FEMA Region V
536 South Clark Street, 6th Floor
Chicago, IL 60605-1521

Dear Mr. President:

Under the provisions of Section 401 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5121-5206 and 44 CFR § Major Disaster citation (206.36), I request the State of Wisconsin as a result of the heavy rains at Bad River on July 11-12, 2016. This request is for the Bad River Bar and the counties of Ashland, Bayfield, Burnett, and Washburn.

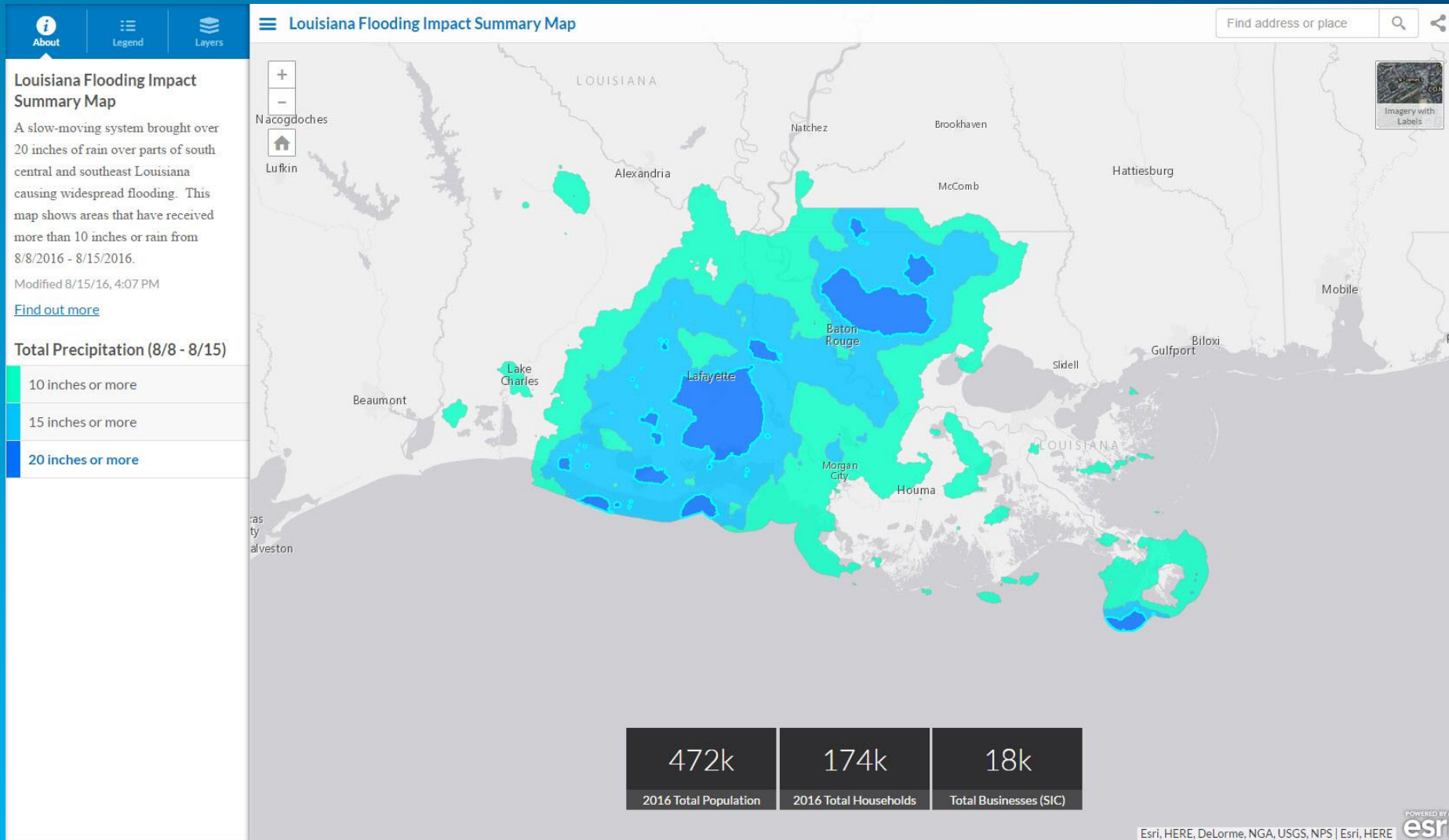
Beginning on Monday, July 11 and extending through the night of July 12, several rounds of severe thunderstorms impacted much of the northwestern part of Wisconsin. During a 24-hour period there was a total of 10.5 inches of precipitation with the worst of the heavy rain and wind occurring during the evening hours. As an example, according to the National Weather Service, the town of Washburn, Wisconsin received 10.5 inches of rain and 15 mph winds during the storm.

borrowed generators to support Bad River's response efforts.

The State Emergency Operations Center opened at Level III early on July 12 for this event, before elevating to a Level II later that day through July 22, and finally scaling back to a Level IV from July 23 to July 29. Wisconsin Emergency Management acted on requests for assistance, obtaining needed personnel and equipment, and coordinated the compilation of damage assessment information from local assessment teams. Wisconsin Emergency Management's Response Section Supervisor and Regional Directors deployed to the hardest hit counties to provide guidance and assistance to county directors and elected officials. The team also relayed information back to the SEOC and played a major role in allocating vital state assets to the areas that needed them. Wisconsin Emergency Management's Geographic Information System staff provided up-to-date road closure maps and story maps with aerial photos in addition to supporting the PDA by configuring ESRI's Collector application. Wisconsin Emergency Management's Public Information Officers shared information with counties, municipalities, and the 211 program, monitored media reports, and issued regular press releases.

The Wisconsin Department of Natural Resources assisted 20 people on the Snake River during the storm.

Louisiana Flooding 2016 – Impact Summary Map



Louisiana Flooding 2016 – FEMA Story Map Journal

FEMA's GeoPlatform



DR 4277 and Baton Rouge Area Flooding

An overview of current operations related to DR-4277 and Baton Rouge area flooding. You can pan and zoom, as well as select JFO's, DRC's, and Declared Counties to view more information as needed. Flood extents shown are approximate and being worked on around the clock. To view flood extents from the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), please use the Layer List button to toggle them on or off.

FEMA's [Baton Rouge Area Flooding Open Data site](#).

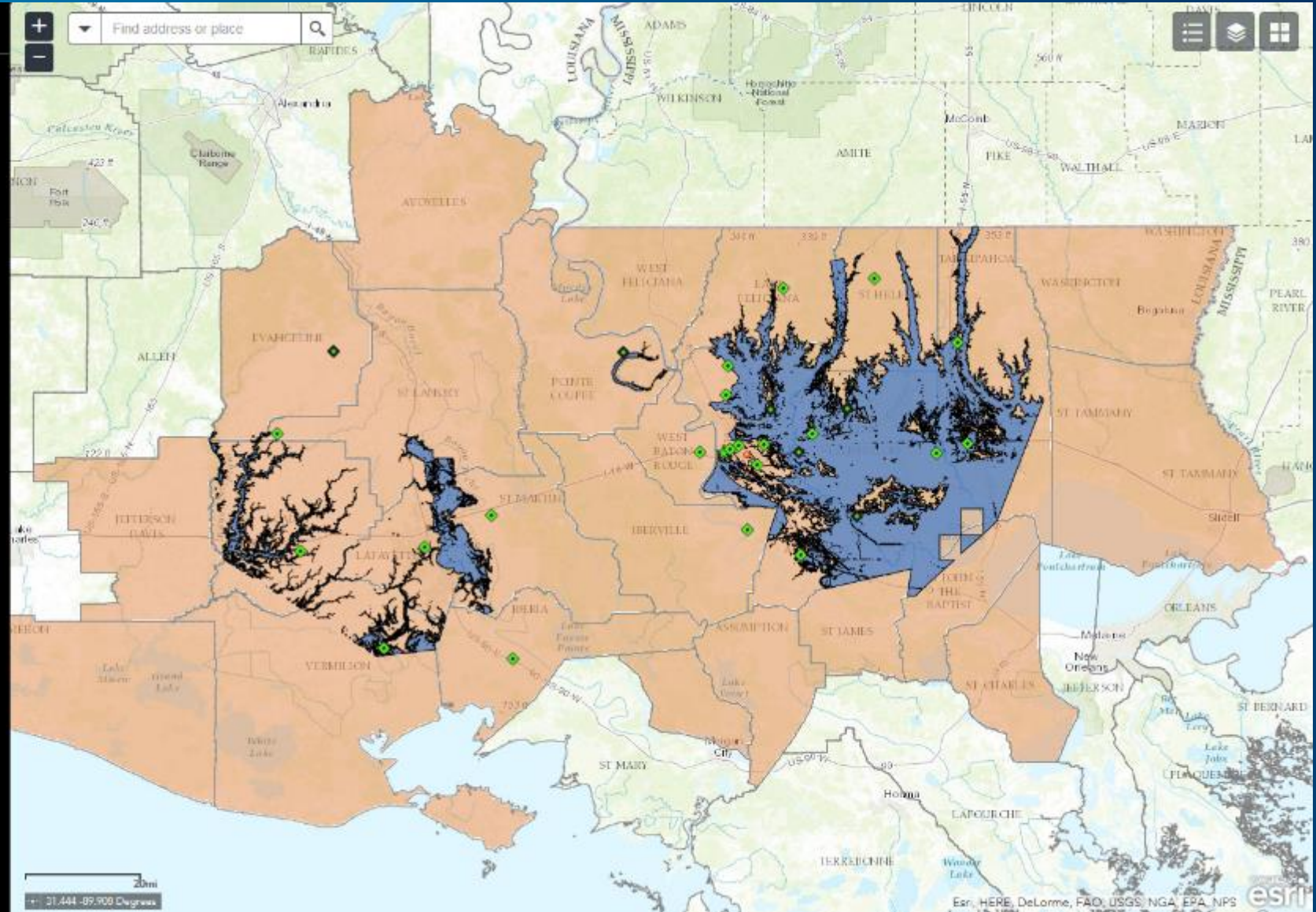
FEMA's GIS REST Service links can be viewed [here](#).

Several "before and after" image comparisons are available for viewing on NOAA's [National Geodetic Survey website](#).

NOAA Watches, Warnings, and Precipitation

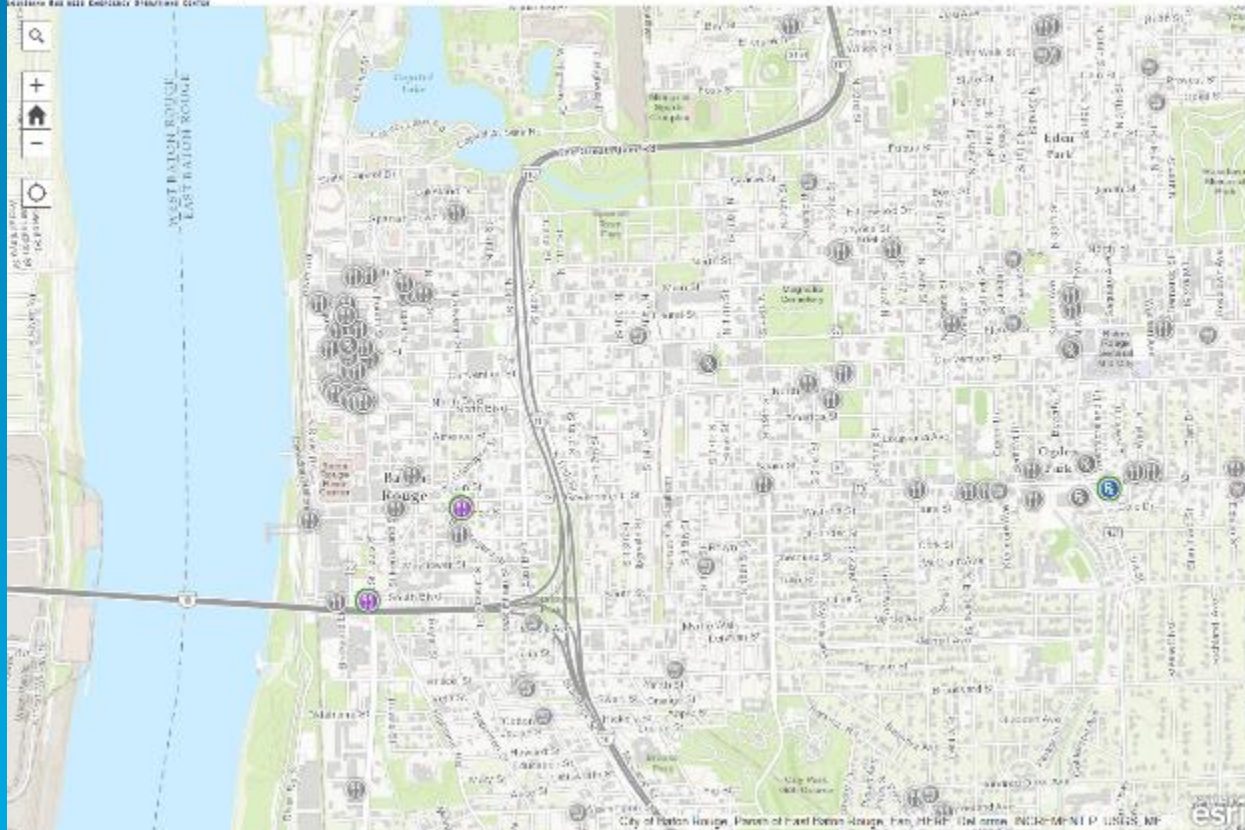
This map outlines the cumulative precipitation over the last 72 hours, with significant flood threats and stream gauge flood stage. You may turn layers on and off with the Layer button at the top right.

Information provided by NOAA's nowCAST Mapping Portal.



Louisiana Flooding 2016 - Crowdsourcing

LA BEOC Report Businesses Open or Closed



Wallgreens #13875

Wallgreens #13875

Name: Wallgreens #13875
State: 64th District
City: Lake
State: LA
Zip:
Phone:
Open or Closed: Close
Picked on: 10/22/16 10:41

Comments



LOUISIANA BUSINESS EMERGENCY OPERATIONS CENTER

Add a Grocery Store, Pharmacy, or Restaurant to the Crowdsourcing Map

Please provide Name, Address, Phone Number, and whether or not the store is Open or Closed for business. Once you have submitted your location, it should be immediately available on the Crowdsourcing Map here:

<https://www.arcgis.com/apps/CrowdsourcingPolling/index.html?appid=9edf8bb80cc74d46afe9cbf2f2de822c>

1. Enter Information

Store Type
Select...

Grocery, Pharmacy, or Restaurant

Name

Street

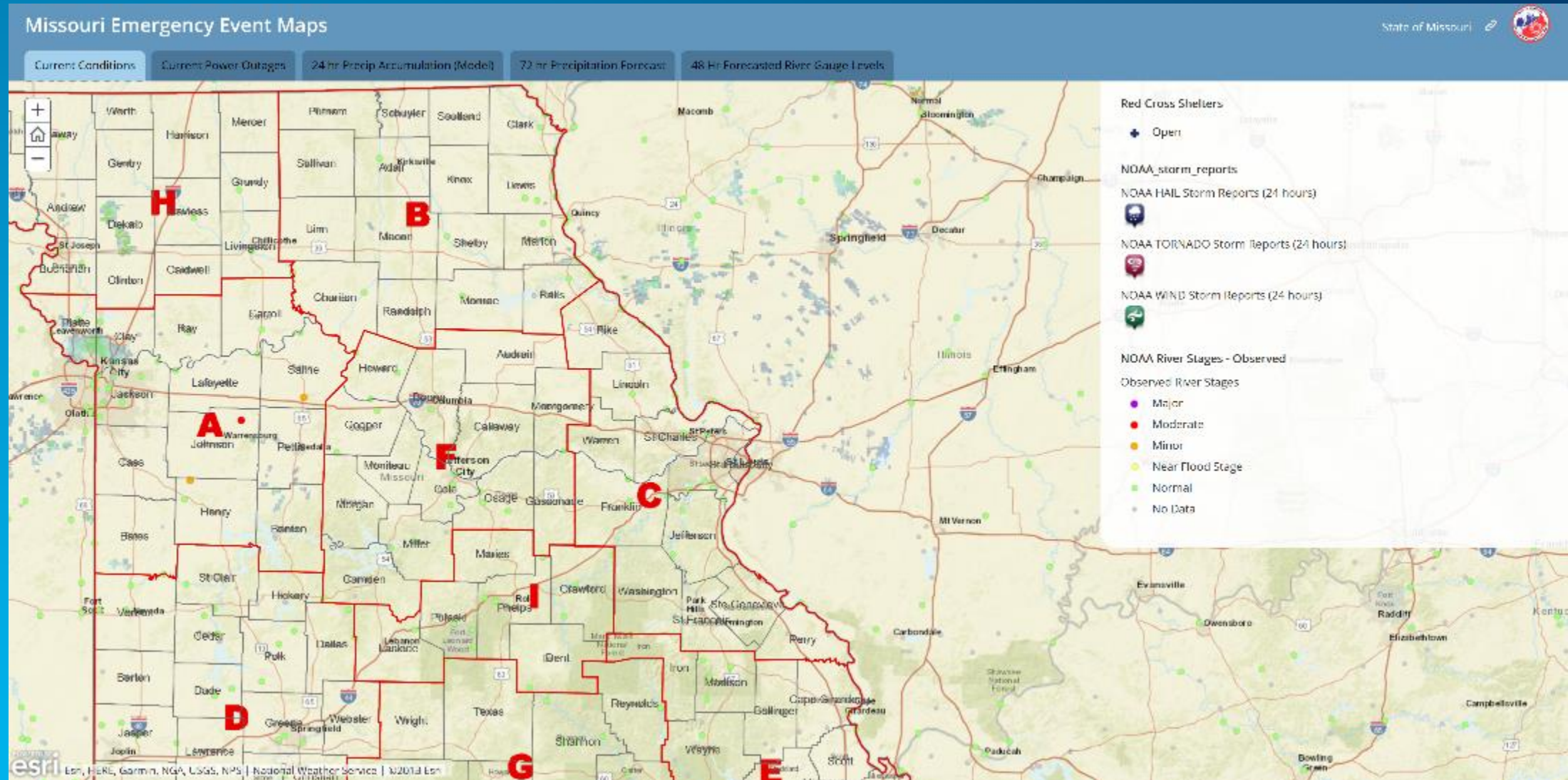
City

State

Zip

Missouri Flooding 2017 – Situational Awareness

<https://mosema.maps.arcgis.com/apps/MapSeries/index.html?appid=f6c6883ac4e54a48a3804729af926849>



Missouri Flooding 2017 – CAP Photos

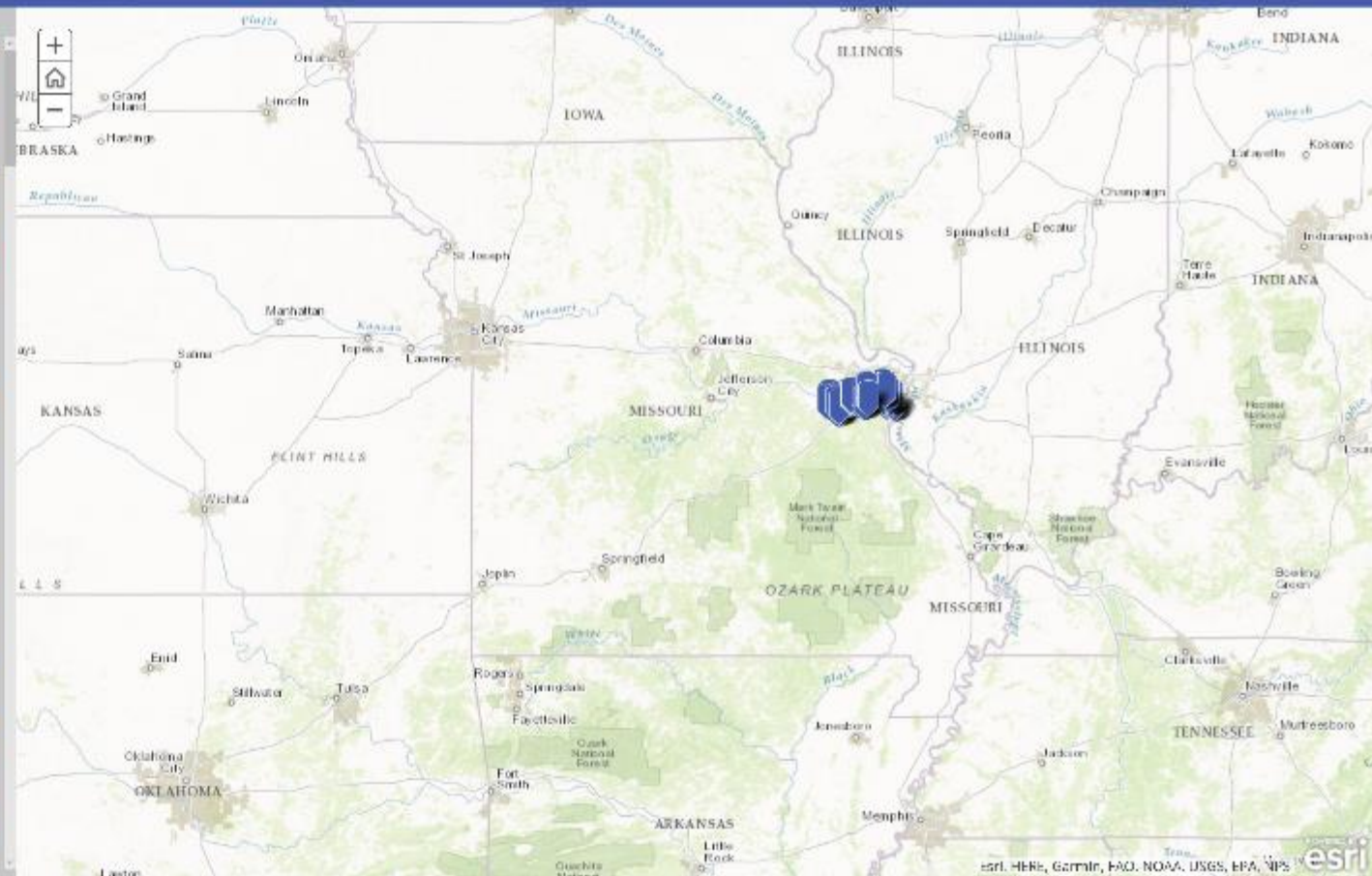
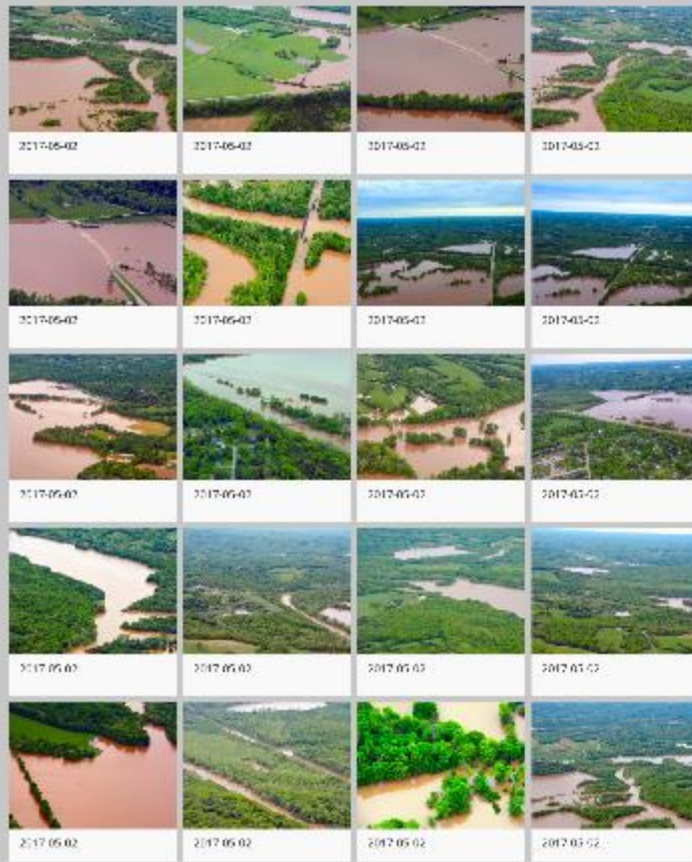
May 2017 Missouri Flooding CAP Photos

May 2017 / Missouri Flooding CAP Photos

A story map [f](#) [t](#) [e](#)



Black James Meramec Eleven Points Big Piney Current Saint Francis



esri HERE Garmin FAO NOAA USGS EPA NPS

Missouri Flooding 2017 – Swipe Map



Southeast Wisconsin Flooding 2017



Top Ten Information Products

- **Public Information Map**
- **Impact Summary Map**
- **Story Map Journal for Briefings**
- **Initial Damage Assessment**
- **Preliminary Damage Assessment**
- **Story Map Tour**
- **Operations Dashboard for Situational Awareness**
- **Post-event Imagery Swipe Map**
- **Situational Awareness Viewer**
- **Crowdsourcing**

Live Stream Gauges - Flooding

<https://www.arcgis.com/home/item.html?id=61003c853d2c4c338841429610b5747f>

The screenshot shows an ArcGIS web application interface. The browser address bar displays the URL: [arcgisforem.maps.arcgis.com/home/webmap/viewer.html?layers=61003c853d2c4c338841429610b5747f](https://www.arcgis.com/home/webmap/viewer.html?layers=61003c853d2c4c338841429610b5747f). The page title is "Live Stream Gauges (Flooding)".

The map displays the United States with various cities labeled. Several colored dots represent live stream gauges. A pop-up window titled "St. Marys River at Macclenny [NOAA]" is open, showing the following data:

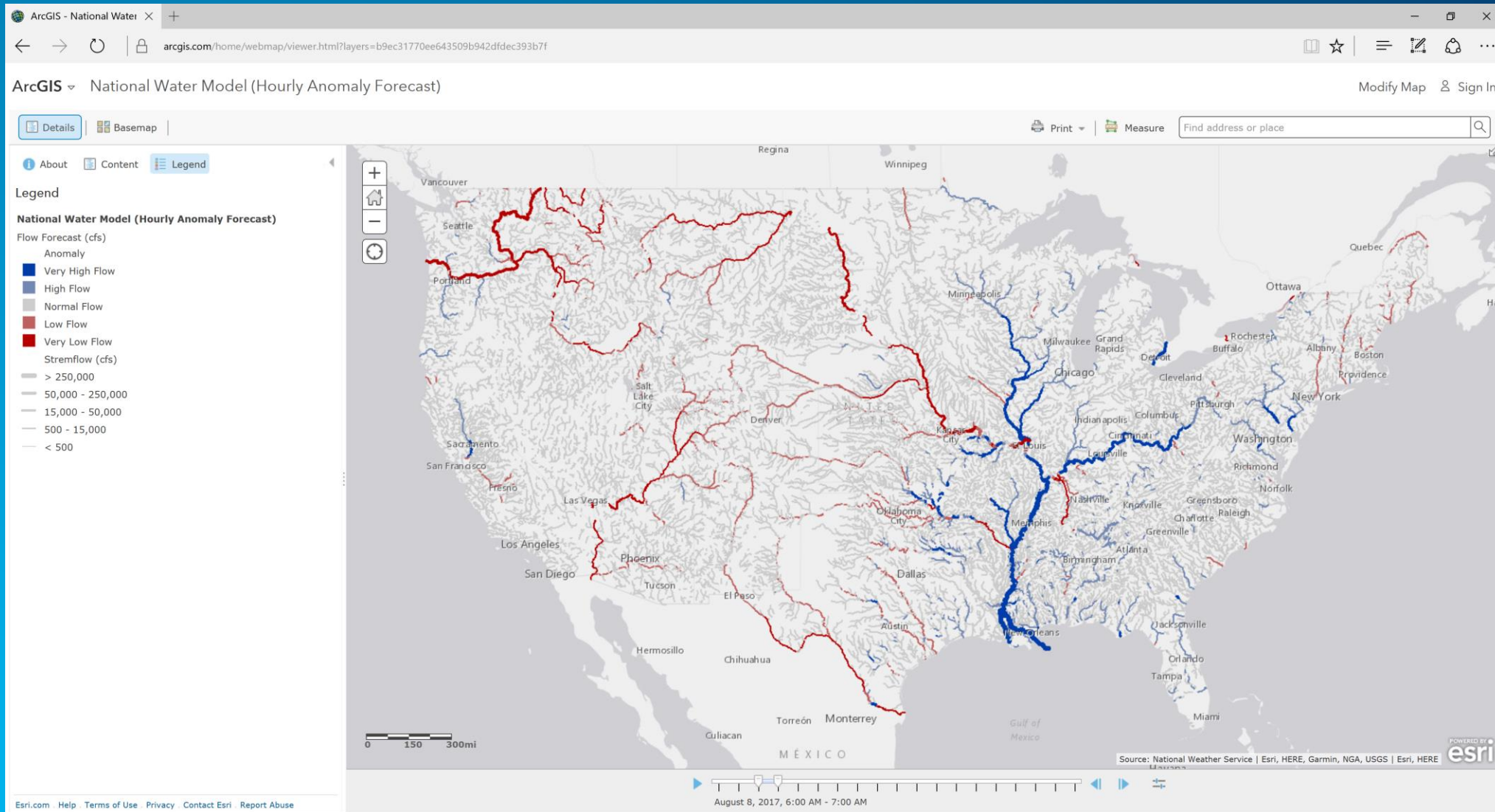
Property	Value
Status	Minor Flood
Last Update	8/8/2017, 3:45 AM
Depth (ft)	12.39
Flow (cfs)	2,350.00
Station Page	More info

The pop-up window also includes a small graph showing water level and flow over time, and buttons for "Zoom to" and "Get Directions".

The footer of the application includes the Esri logo and text: "Eri.com ArcGIS Marketplace Help Terms of Use Privacy Contact Esri Report Abuse Contact Us". The source is listed as "Source: USGS; NOAA; and the GIS Community | Esri, HERE, Garmin, NGA, USGS | Esri, HERE".

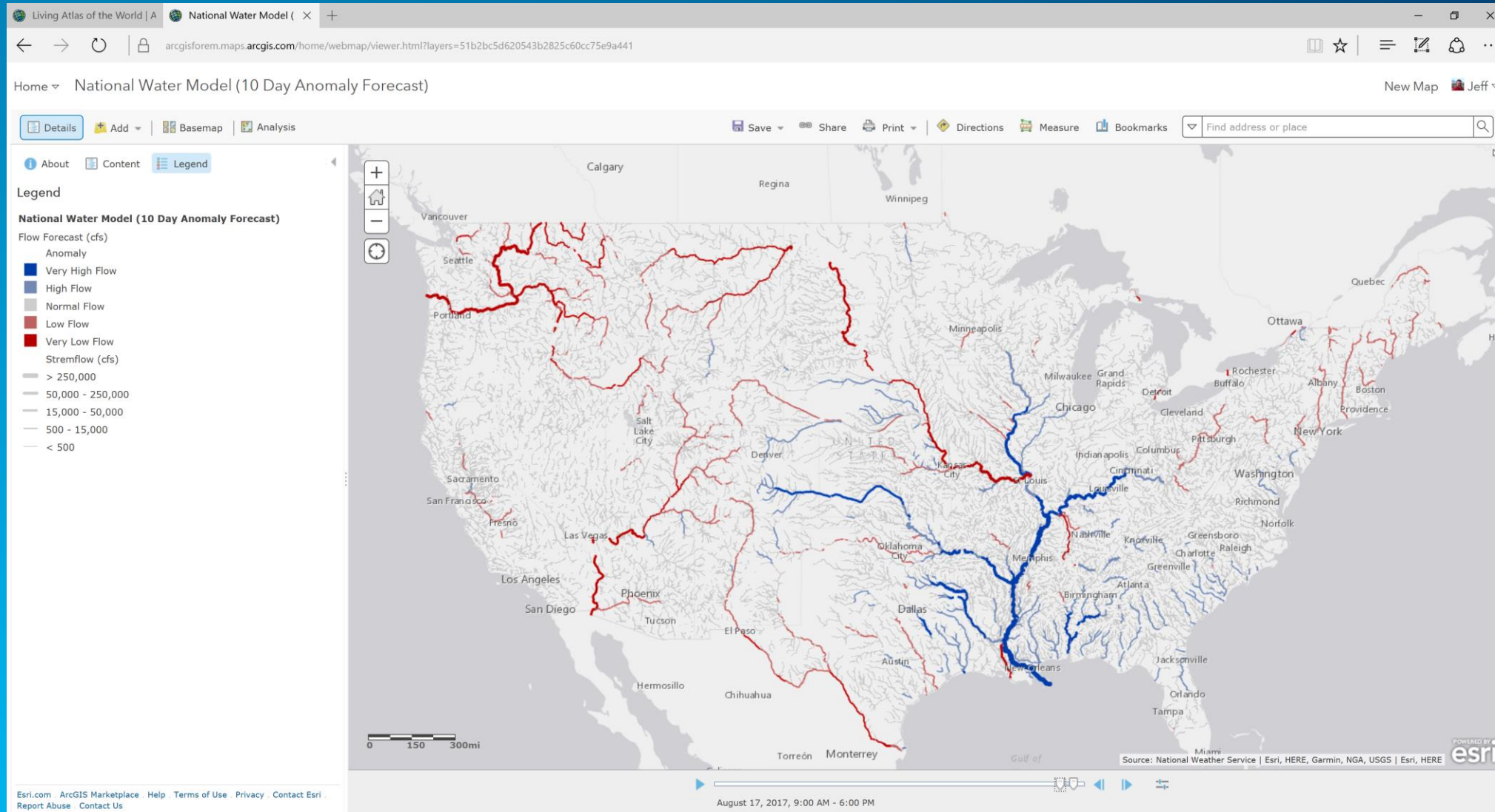
National Water Model (Hourly Anomaly Forecast)

<https://www.arcgis.com/home/item.html?id=b9ec31770ee643509b942dfdec393b7f>

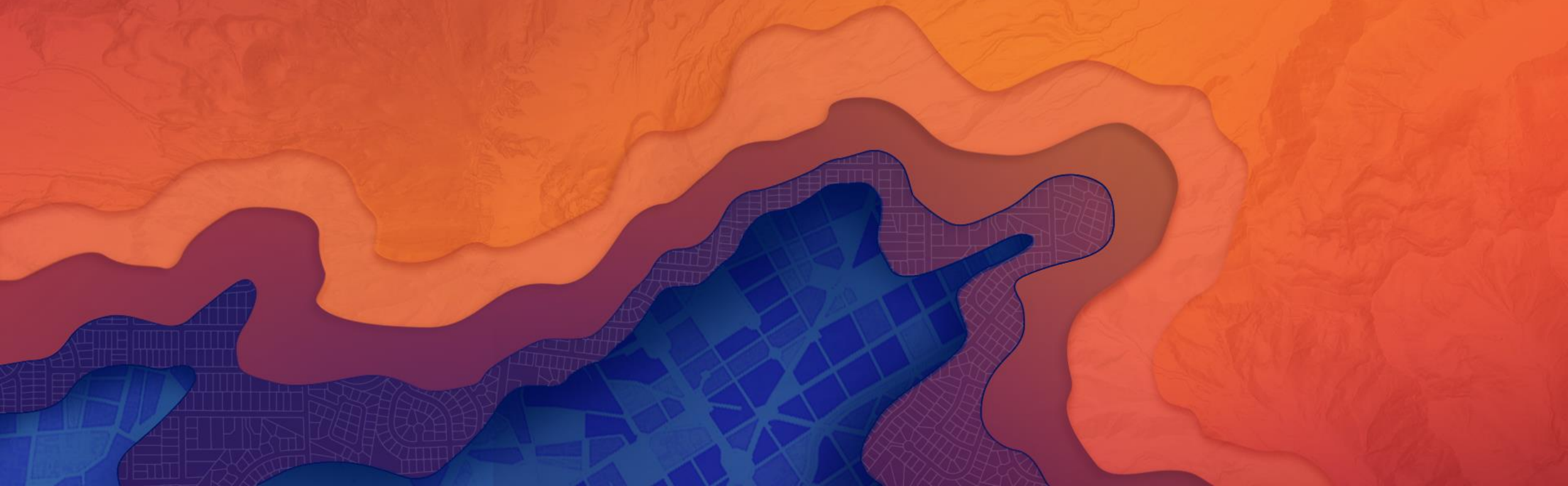


National Water Model (10 Day Anomaly Forecast)

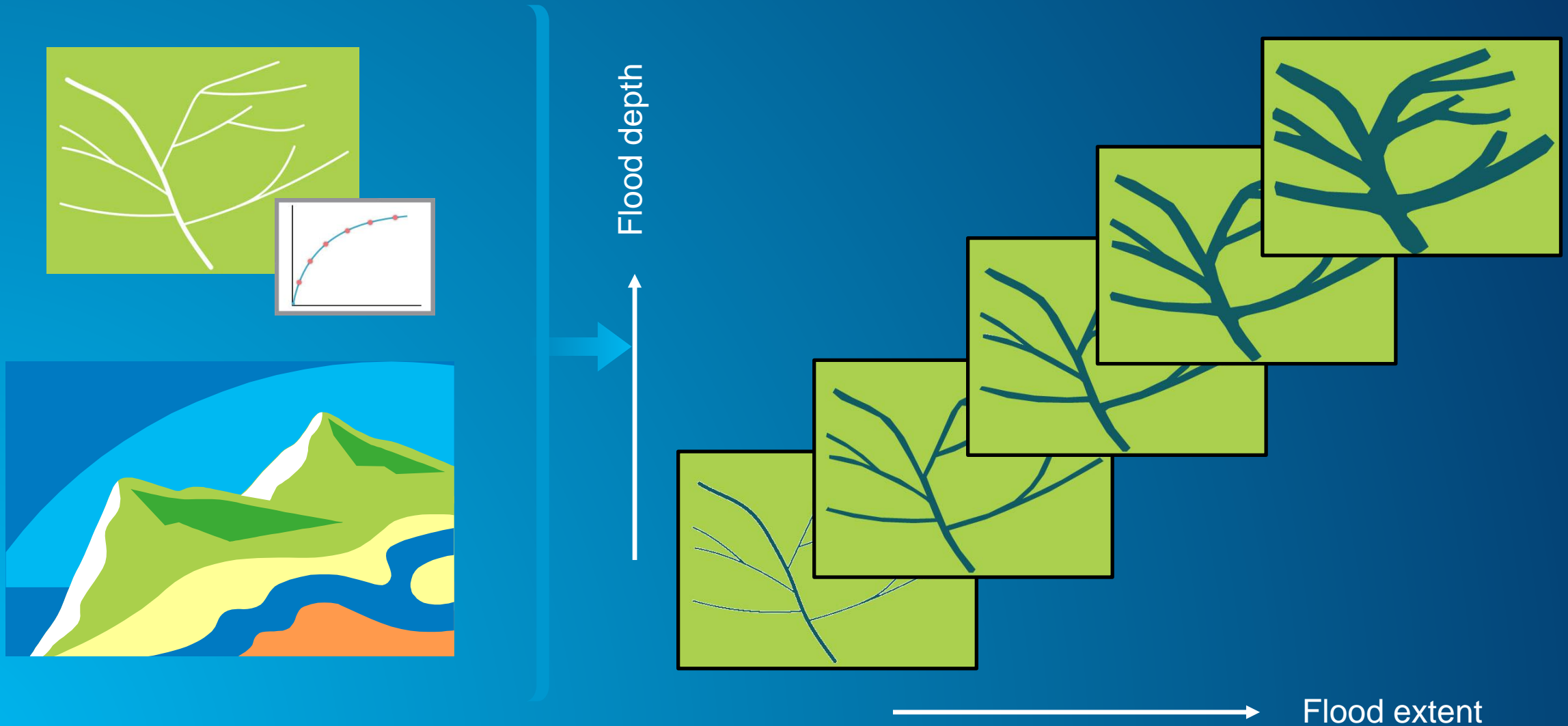
<https://www.arcgis.com/home/item.html?id=51b2bc5d620543b2825c60cc75e9a441>



Flood Inundation Modeling



Developing a Flood Inundation Dataset



Onion Creek Flood Inundation Levels

No issues detected x

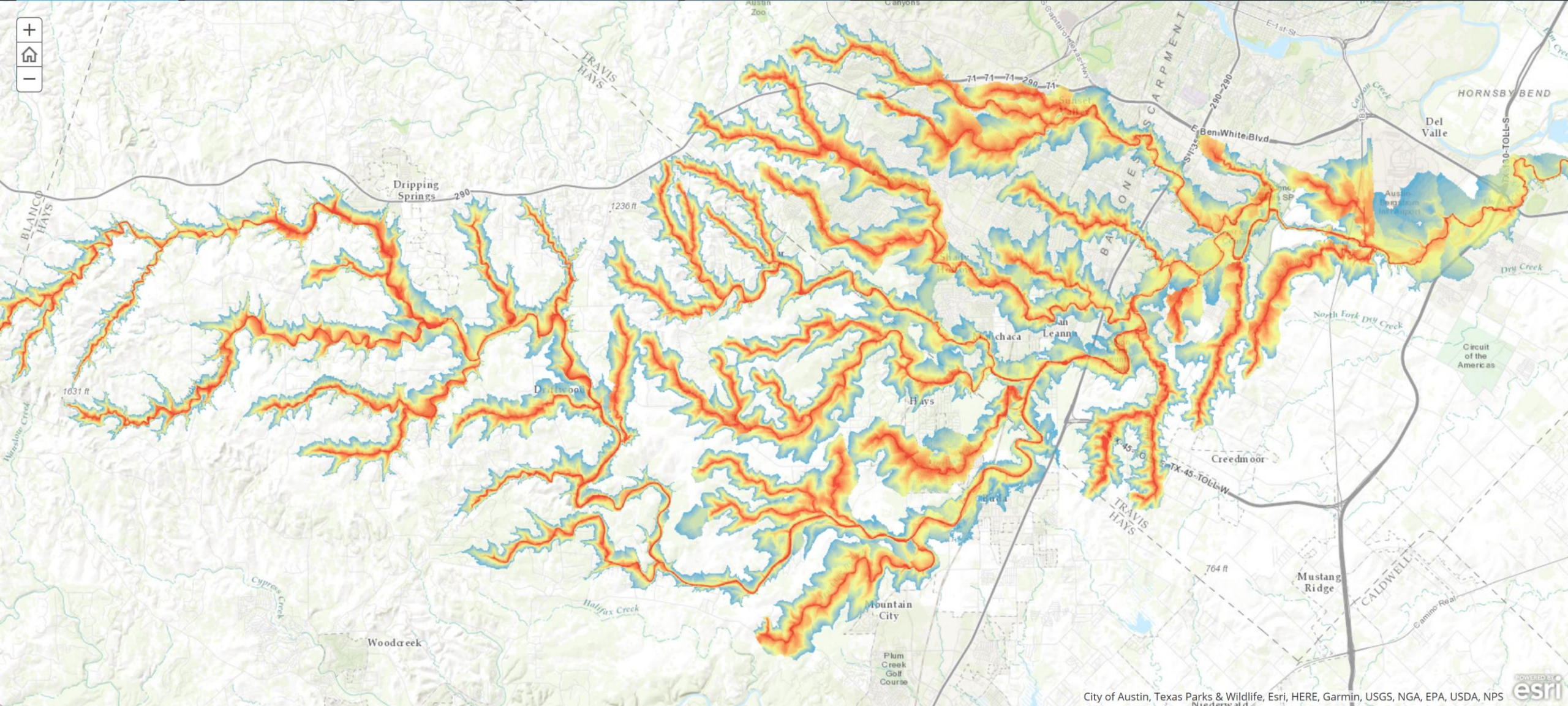
Story not shared x

Edit x

A story map



- 20m Depth Above Channel
- 15m Depth Above Channel
- 10m Depth Above Channel
- 5m Depth Above Channel
- 0.5m Depth Above Channel



Onion Creek Flood Planning Impact Map

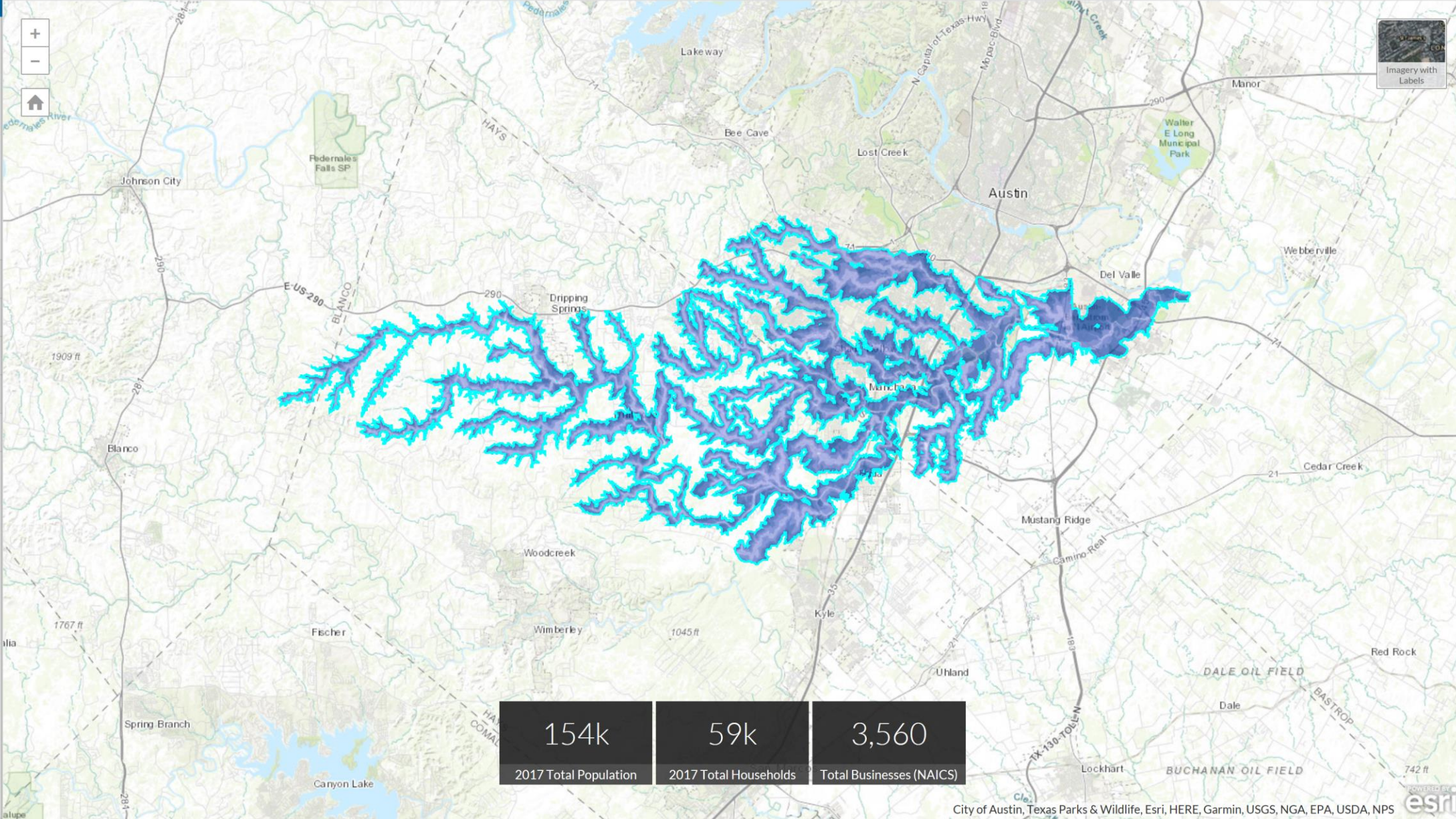
This map presents the results of flood inundation modeling and its impact to the area.

Modified 7/2/17, 11:07 AM

[Find out more](#)

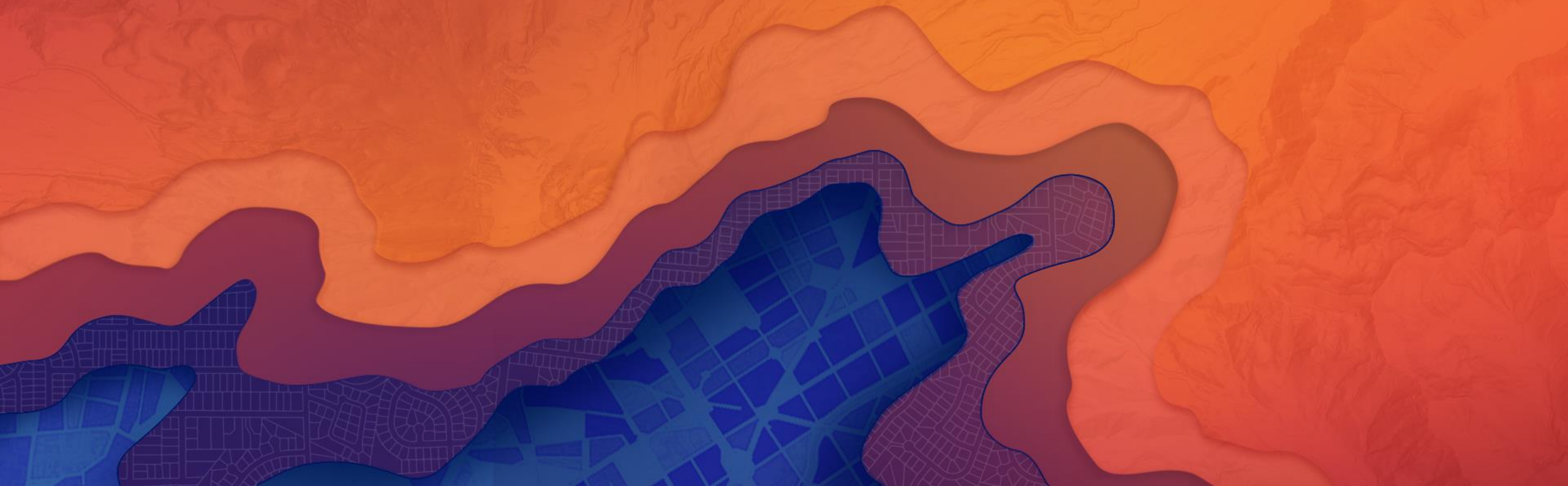
Enriched Depth Above Channel

- 0.5m above channel depth
- 5m above channel depth
- 10m above channel depth
- 15m above channel depth
- 20m above channel depth



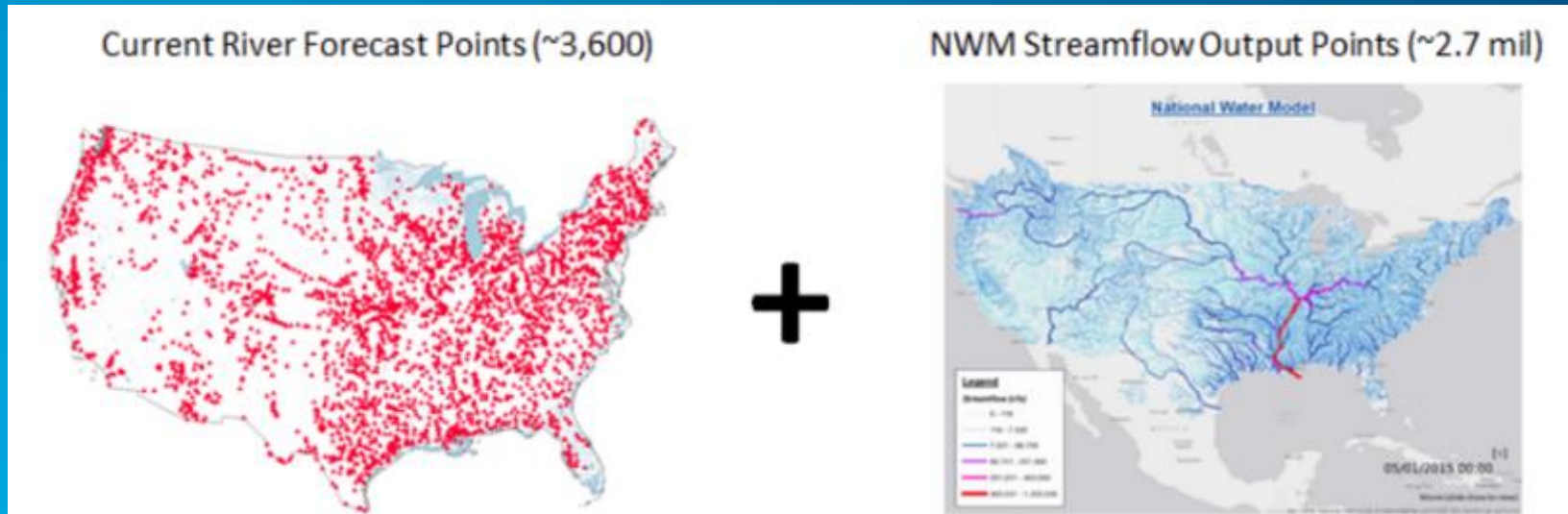
154k	59k	3,560
2017 Total Population	2017 Total Households	Total Businesses (NAICS)

The National Water Model



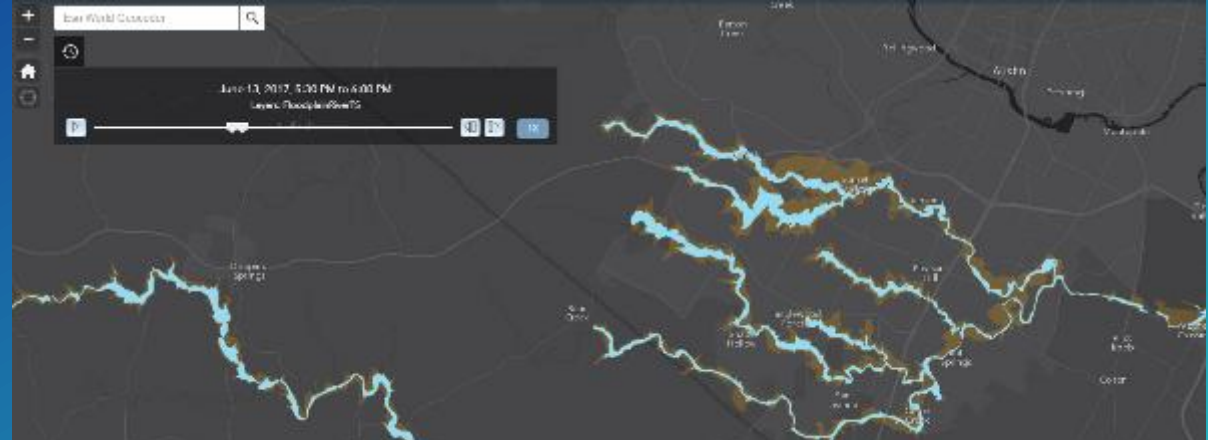
What is the National Water Model?

- Simulates observed and forecasted streamflow
- Four different models:
 - Analysis and assimilation: snapshot of current hydrologic conditions
 - Short-Range: 18-hour deterministic (single value) forecast
 - Medium-Range: 10-day deterministic (single value) forecast
 - Long-Range: 30-day ensemble forecast

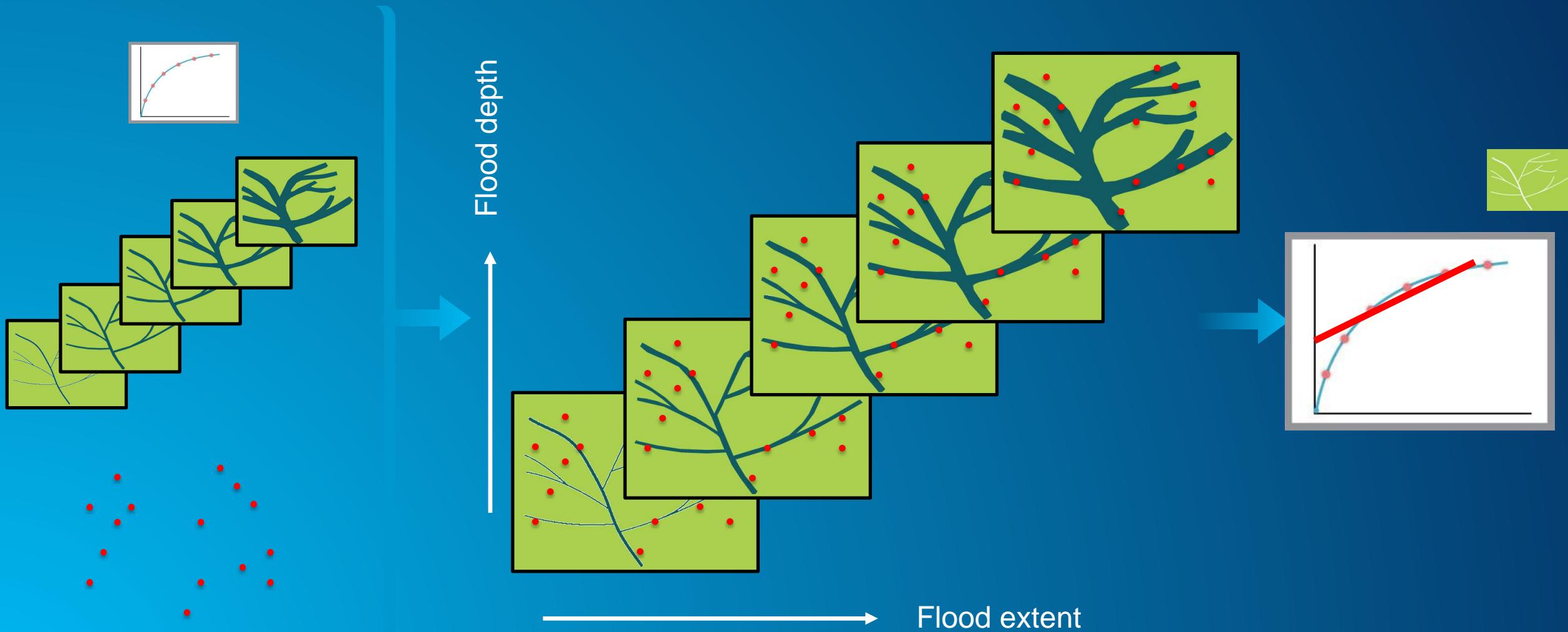


How can the National Water Model be Extended?

- What areas might be flooded, how deeply, and when?
- What infrastructure might be impacted by the flood and when?

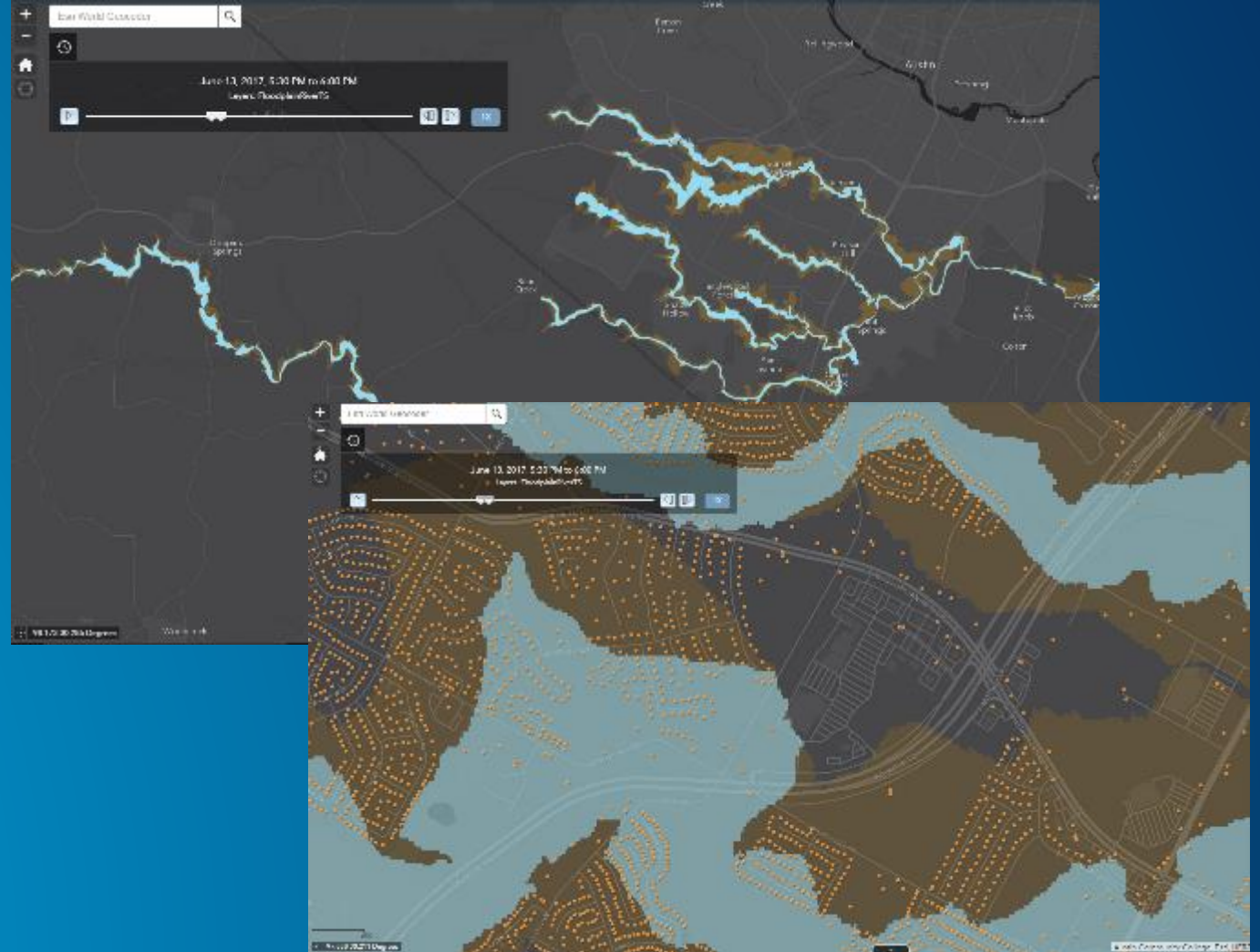


Developing an Impact Dataset

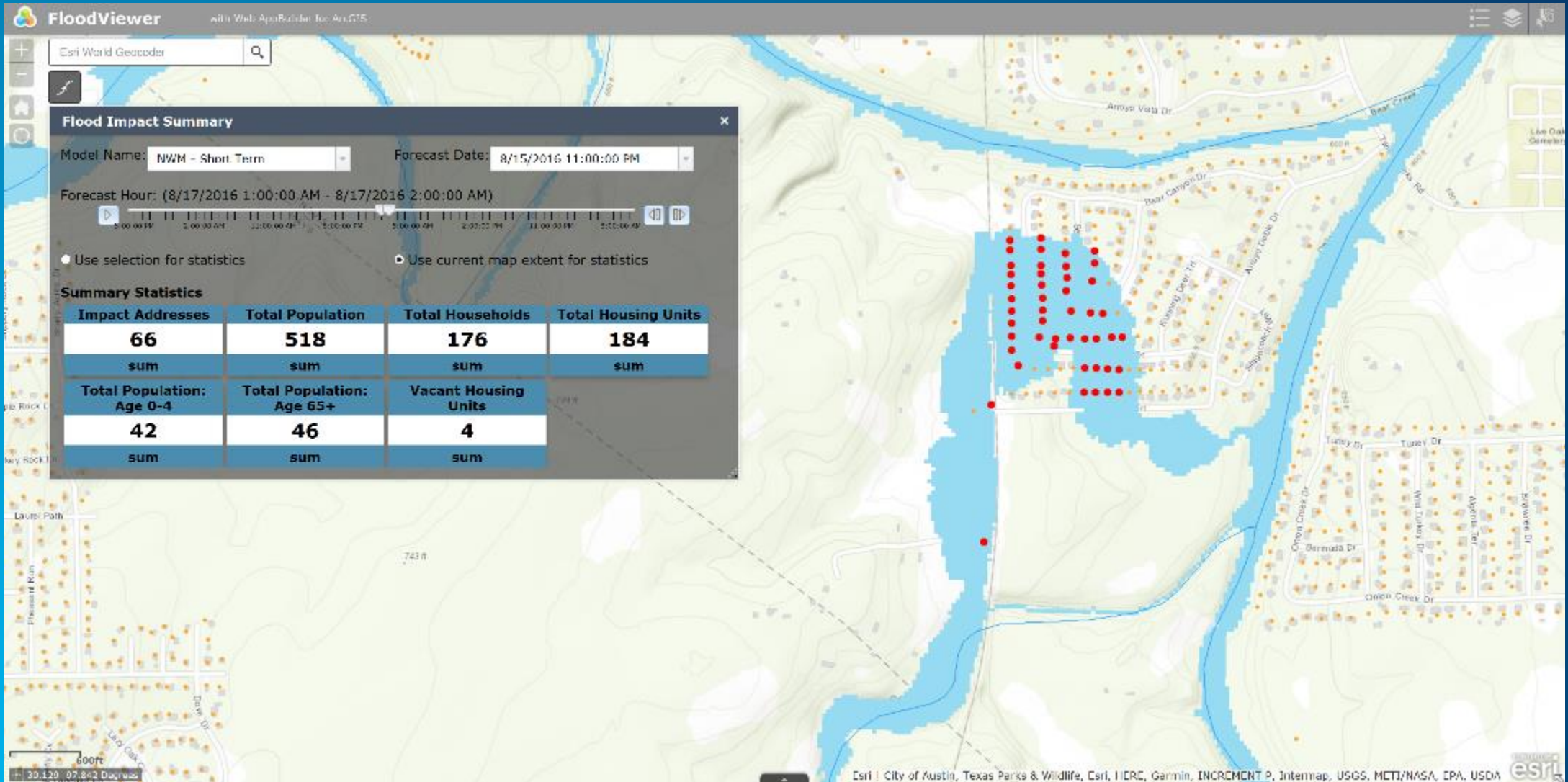


Creating Multi-Scale Temporal Map Services

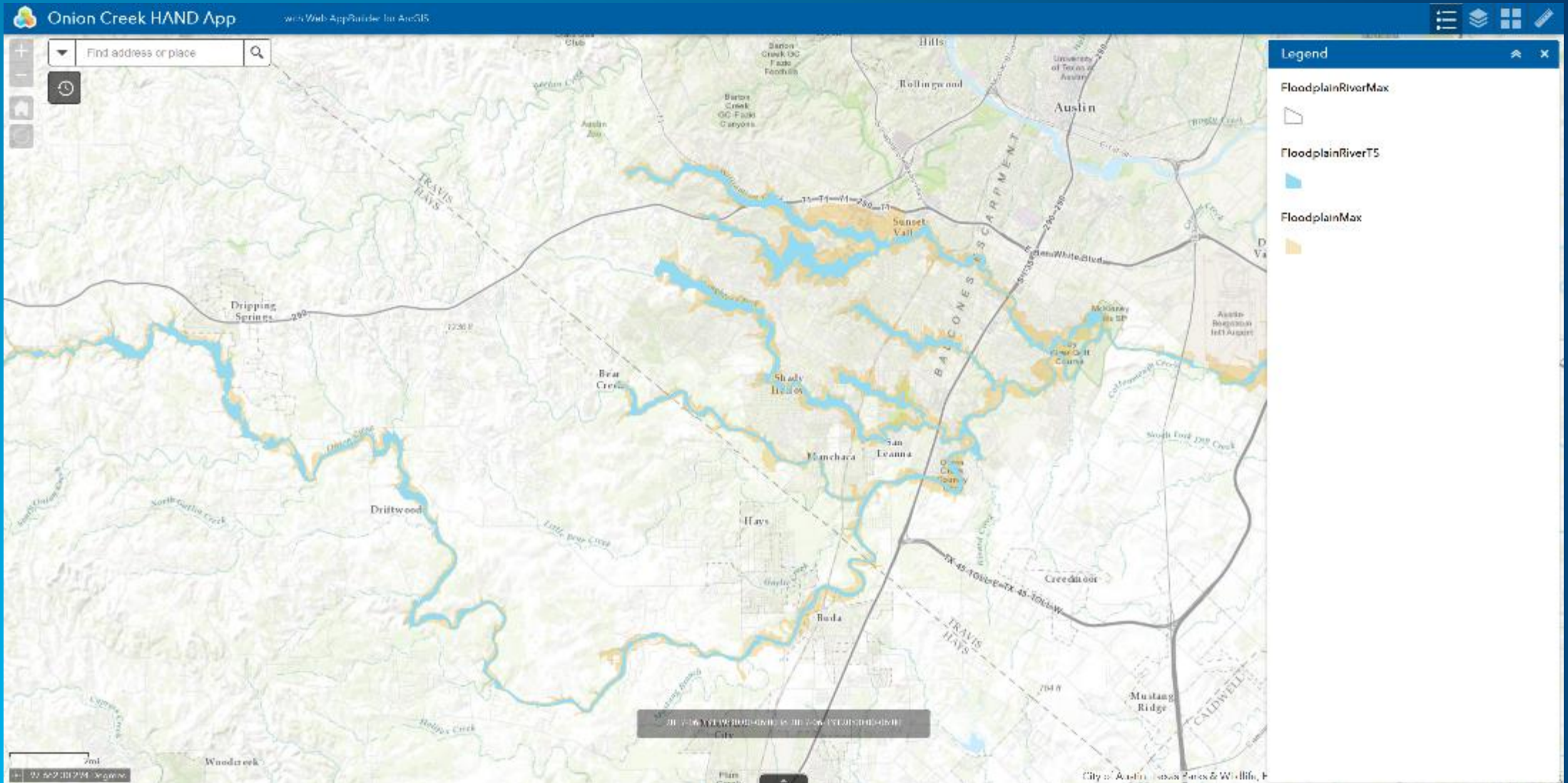
- Flooded Area
- Flood Depth
- Impacted Address Points
- Impacted Demographics



Predicting Impact based on National Water Model Forecasts



Predicting Inundation through National Water Model Forecasts



Lessons Learned - Orchestrate - Do the Plumbing

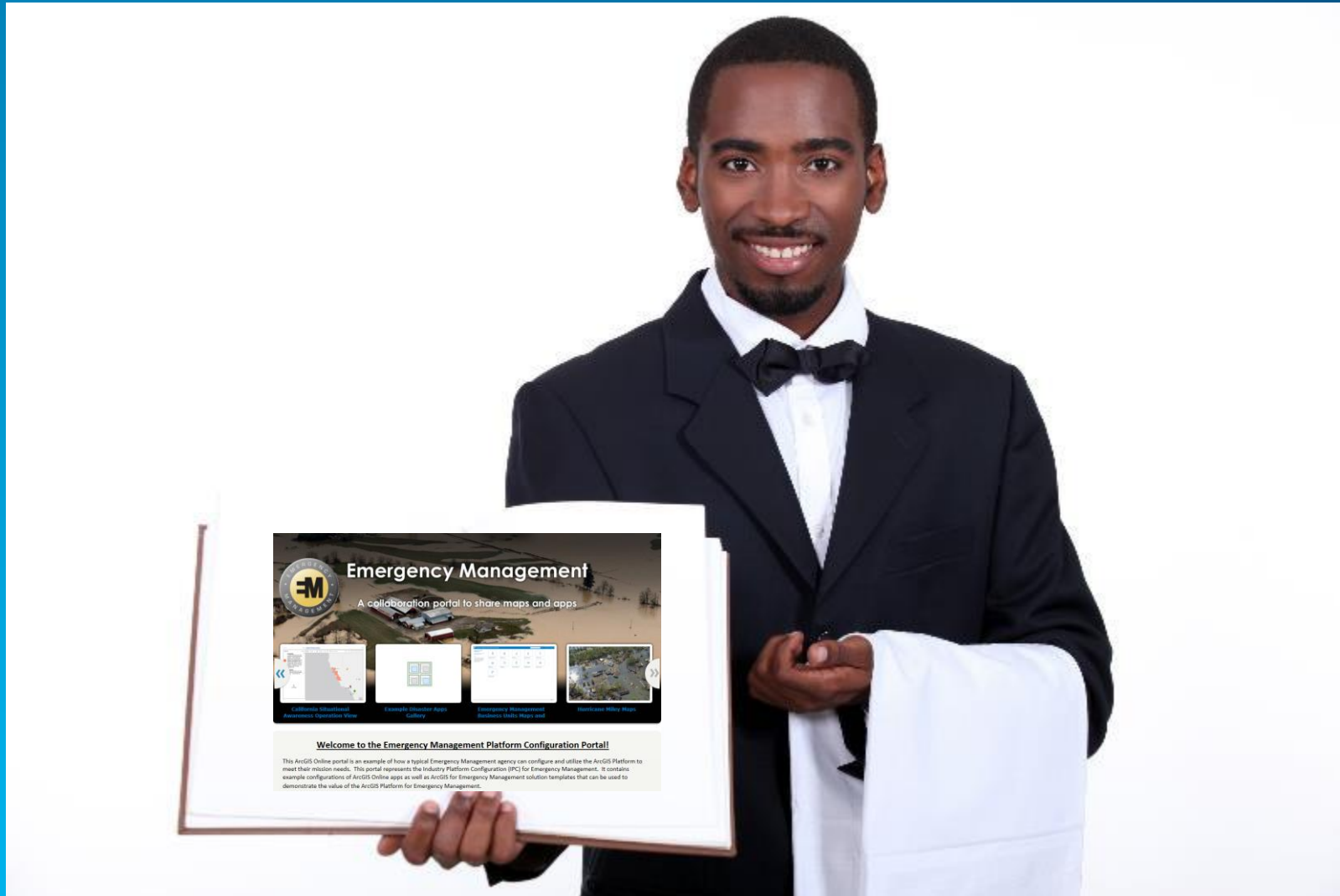
Make the data and modeling flow!



- **Connect “Systems of Record” to provide a “System of Engagement”**
 - Live Feeds
 - Traffic
 - Shelters
 - Sensors
 - Incident Information
 - Resources
 - Critical Infrastructure
- **Models**
- **Plans**

Photo Credit: Bradley Johnson

Lessons Learned - Educate



- **What can GIS provide in “business terms”**
 - **Situational Awareness**
 - **Damage Assessment**
 - **Briefings**
- **Have conversations with your Directors and Operations Staff**

Train - Exercise, Exercise, Exercise!!!

Don't let your next disaster be the first time you and your organization leverage ArcGIS Online

- Even short, spontaneous exercises!
- Get folks out of the office (even if it is in the parking lot) using Collector or Survey123
- Apply Lessons Learned to SOPs



Regional Wildland Fire Exercise for the Colorado North Central Region (May 19-21, 2016)



Central US Earthquake Consortium (CUSEC) CAPSTONE 2014



Annual Florida Hurricane Exercise



esri

**THE
SCIENCE
OF
WHERE**