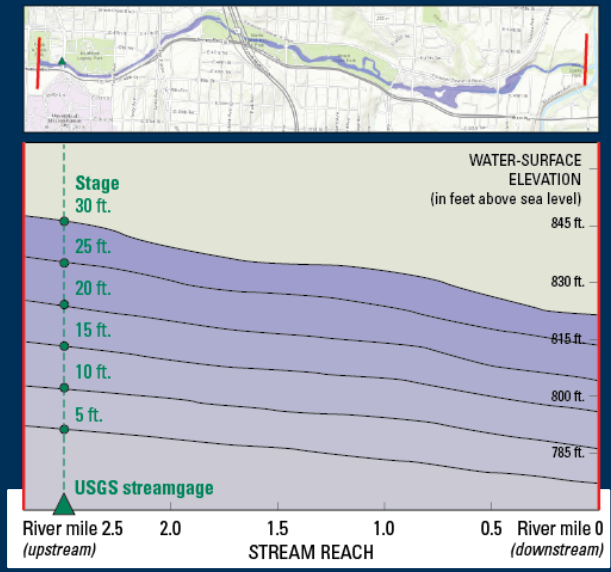
U.S. Geological Survey Streamflow- and Precipitation-based Flood Warning and Mapping

With Integrated USGS tools

USGS Central Midwest Water Science Center

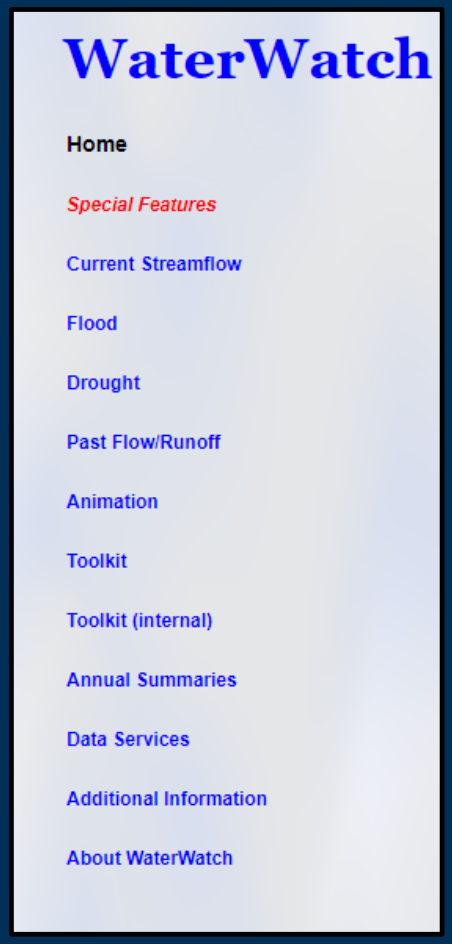
Illinois Association for Floodplain and Stormwater Management Annual 2020 Conference

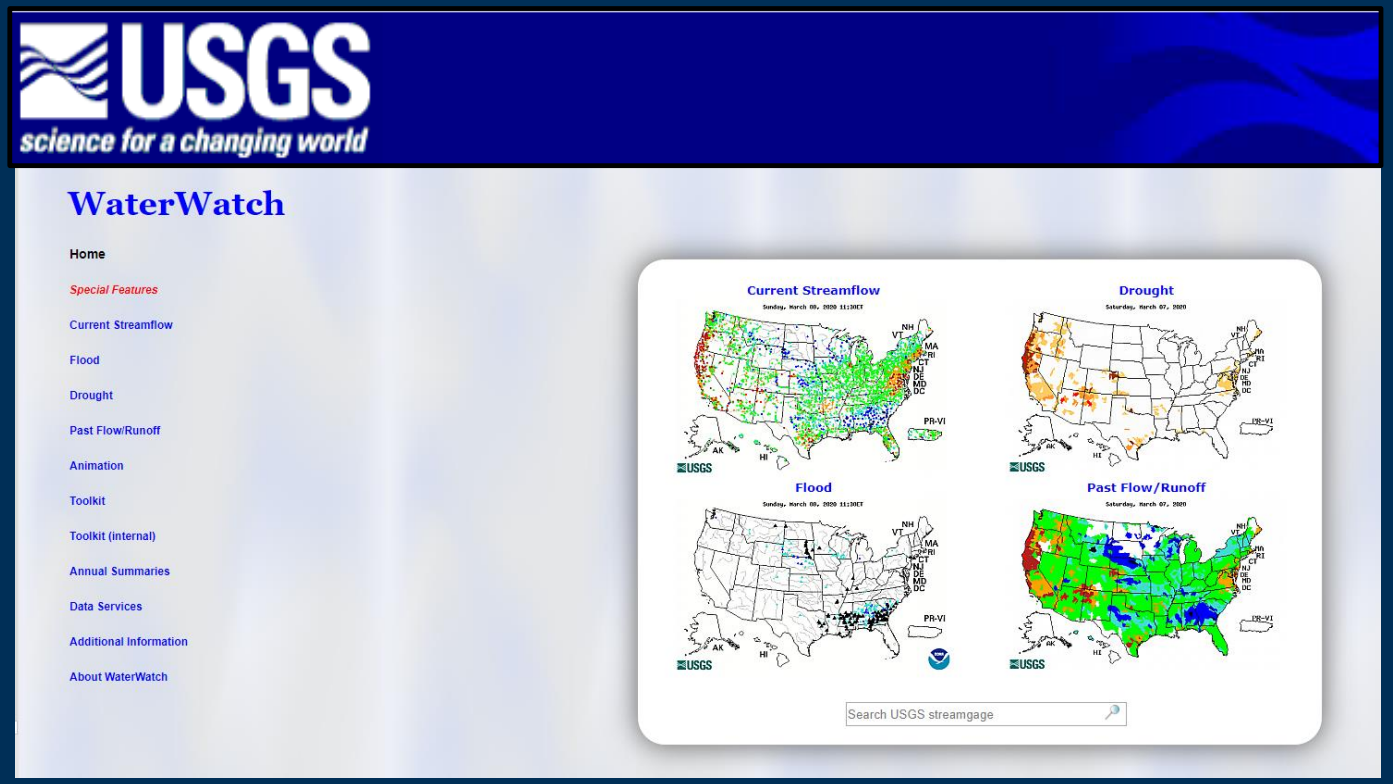


U.S. Department of the Interior
U.S. Geological Survey

USGS WaterWatch https://waterwatch.usgs.gov/

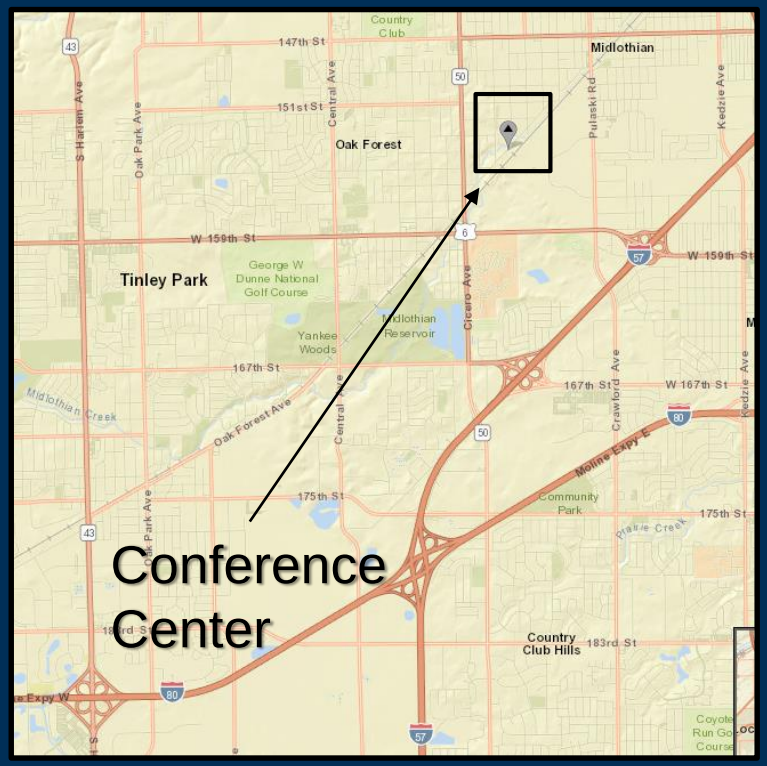
Streamgage-based maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the United States

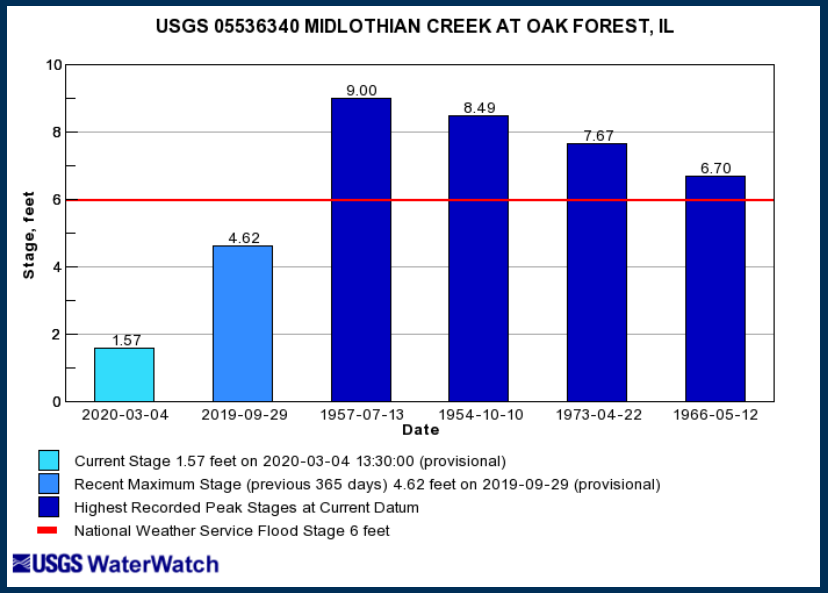


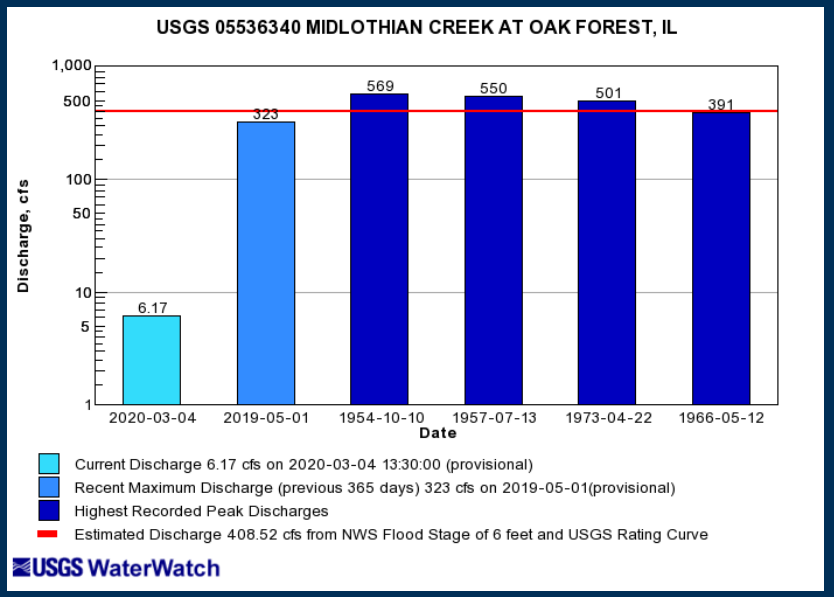


Midlothian Creek at Oak Forest, IL

WaterWatch : Flood Tracker





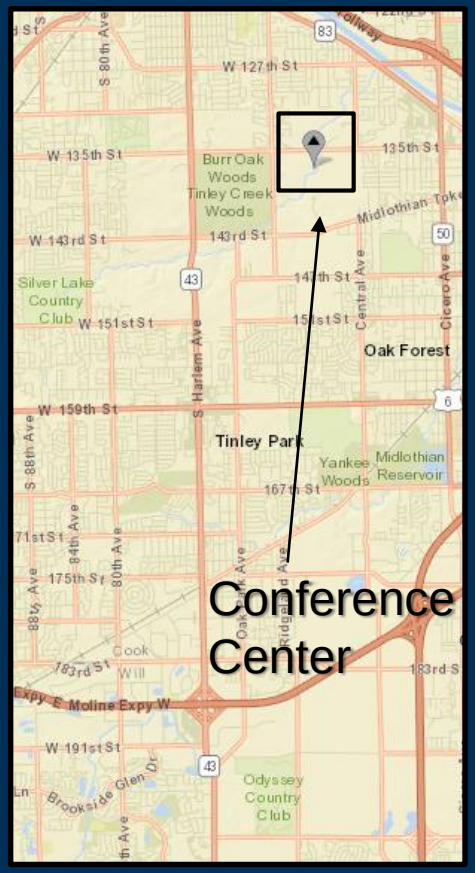


USGS

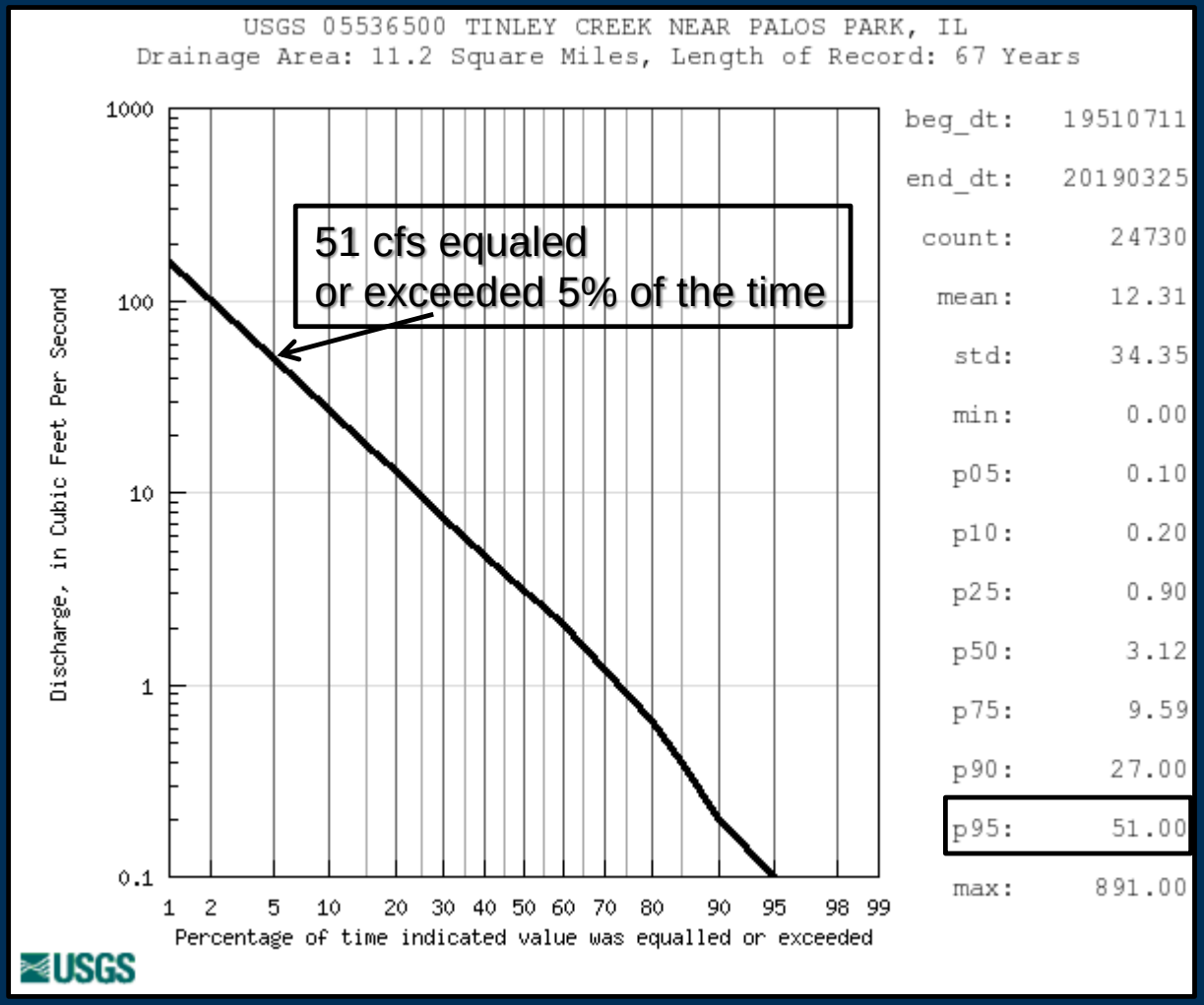
Tinley Creek near Palos Park, IL

Waterwatch : Streamgage Stats

Daily Flow Equal or Exceeded Percentages

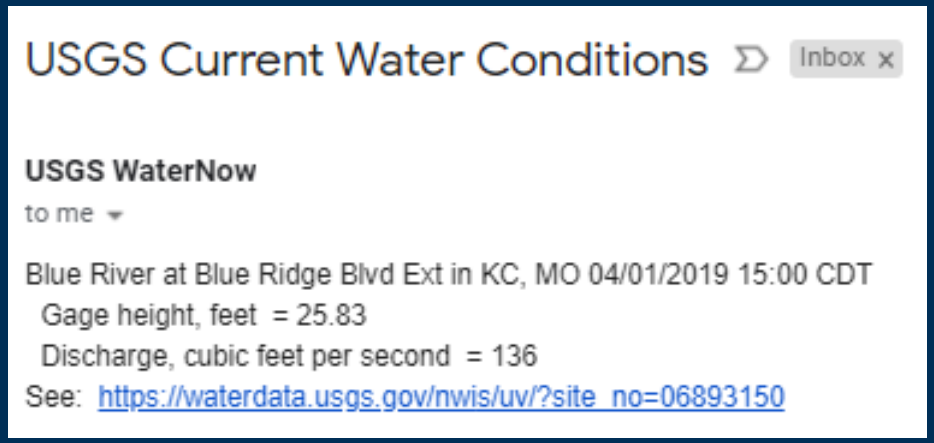


USGS



Waternow
http://water.usgs.gov/waternow

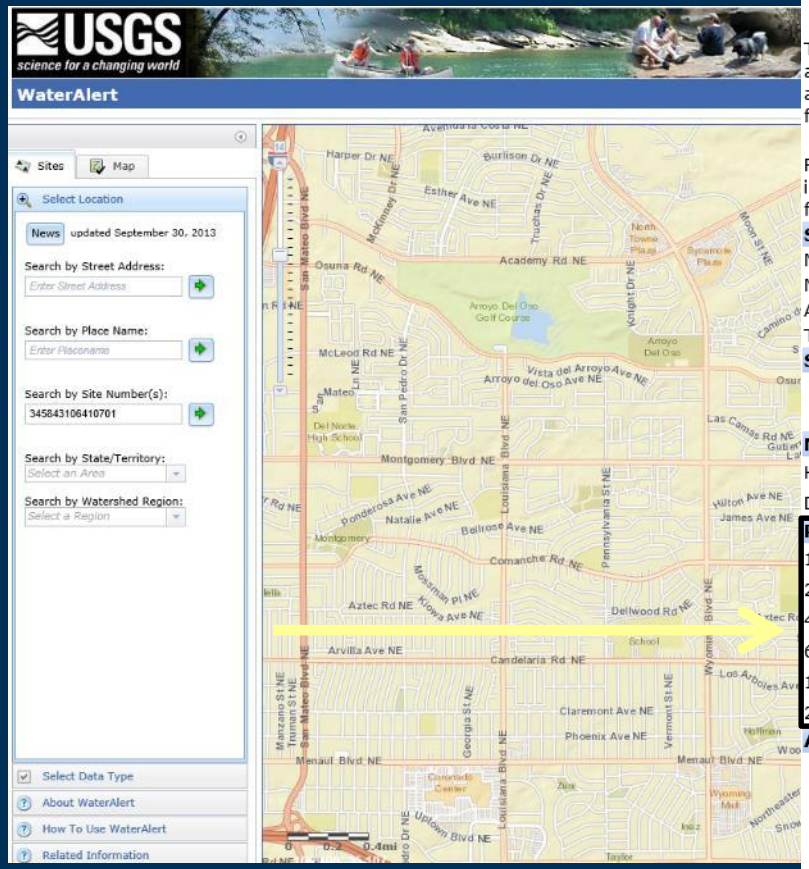
Text or email station number to WaterNow@usgs.gov to receive current conditions



USGS

Wateralert
http://water.usgs.gov/wateralert

Sign up to receive alert messages by text or email



Subscription Form

The U.S. Geological Survey WaterAlert service sends e-mail or text (SMS) messages when certain parameters, as measured by a USGS real-time data-collection station, exceed user-definable thresholds. The development and maintenance of the WaterAlert system is supported by the USGS and its partners, including numerous federal, state, and local agencies.

Real-time data from USGS gages are transmitted via satellite or other telemetry to USGS offices at various intervals; in most cases, 1 to 4 times per hour. Emergency transmissions, such as during floods, may be more frequent. *Notifications will be based on the data received at these site-dependent intervals.*

Site Info:

Number:	350726106314230
Name:	MITCHELL ELEMENTARY
Agency:	USGS
Transaction ID:	fG3gv

Send Notification To: about this...

- ○ My mobile phone
- ○ My email address

Notification Frequency: about this...

- Hourly ○
- Daily ◉

Precipitation Parameter(s): about this...

- 1 hour ◉
- 2 hours ○
- 4 hours ○
- 6 hours ○
- 12 hours ○
- 24 hours ○

Alert Threshold Condition: about this...

- ◉ Greater than (>)
- ○ Less than (<)
- ○ Outside a range (< or >)
- ○ Inside a range (> and <)

Real-time value isgreater than: _____ undefined

☐ I have read and acknowledge the Provisional Data Statement and Disclaimer.

Preempted **Decision Support**

Consequence-based flood scenarios

Step 1

Stage
Streamflow
Precipitation

Gaging

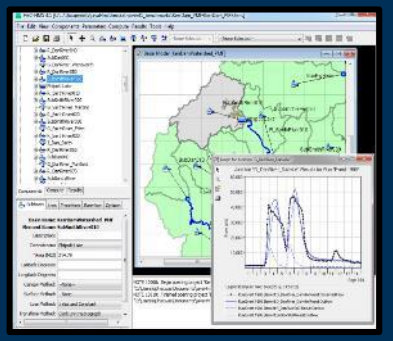
- *Calibration & Prediction*

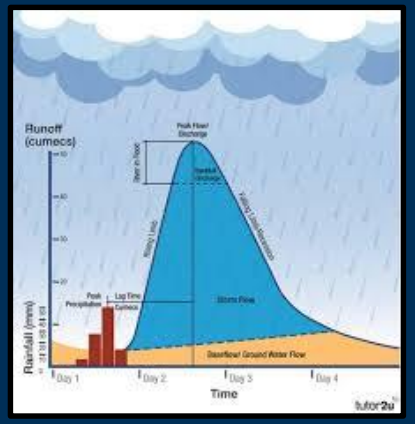
Precipitation

Step 2

HEC-HMS / PRMS

- *Rainfall-Runoff*





USGS

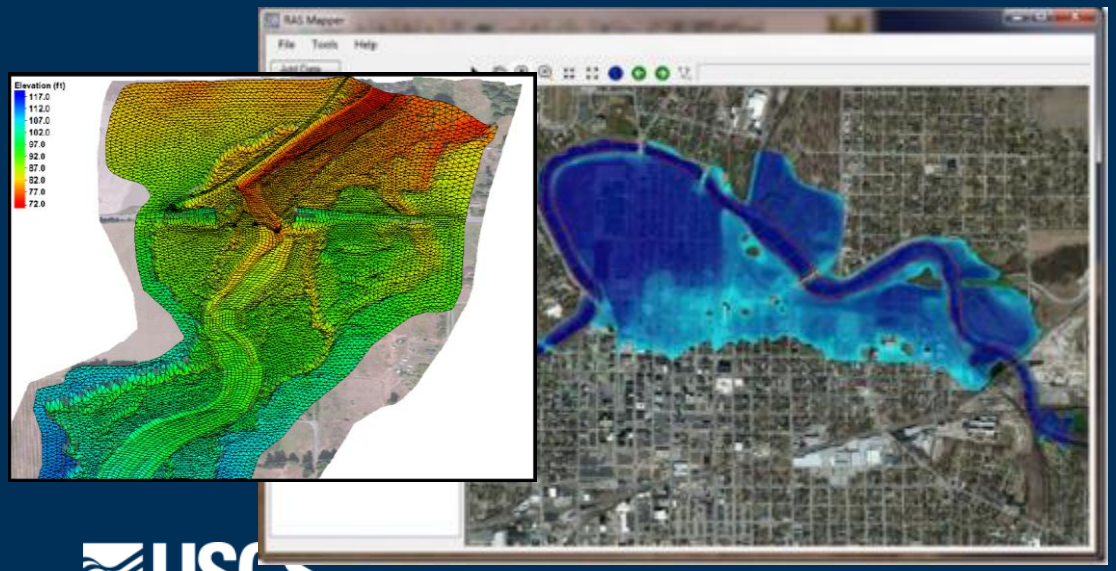
Preempted Decision Support

Consequence-based flood scenarios

Step 3

HEC-RAS / SRH2D Mapper

- *Hydraulics and Inundation*



Step 4

Consequence-based product dissemination

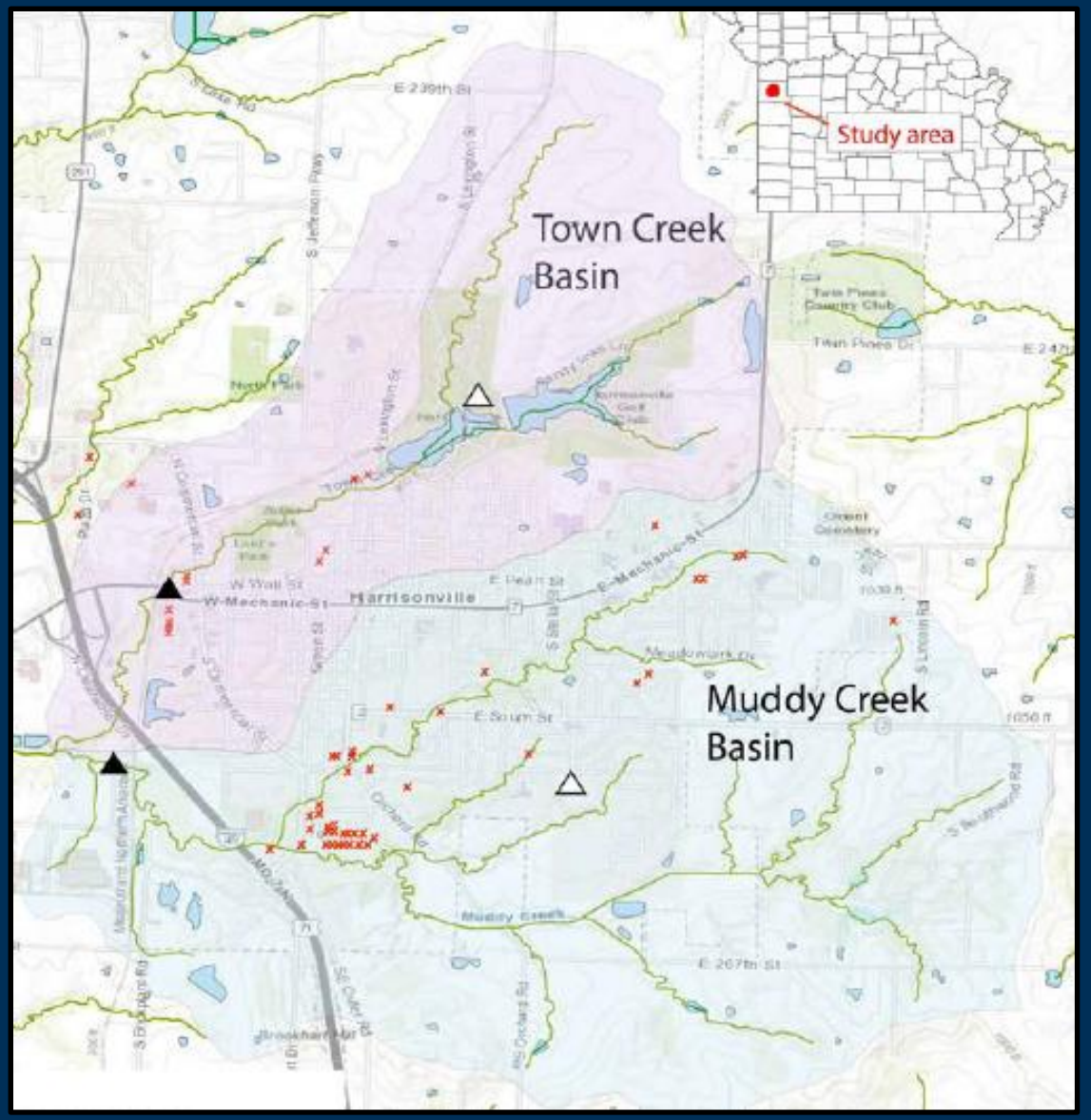
- *Scenarios defined*
- *Gage / Radar observed conditions correlated to flood inundation mapping*

USGS science for a changing world — Flood Inundation Mapper

USGS

City of Harrisonville, Missouri

Proposed

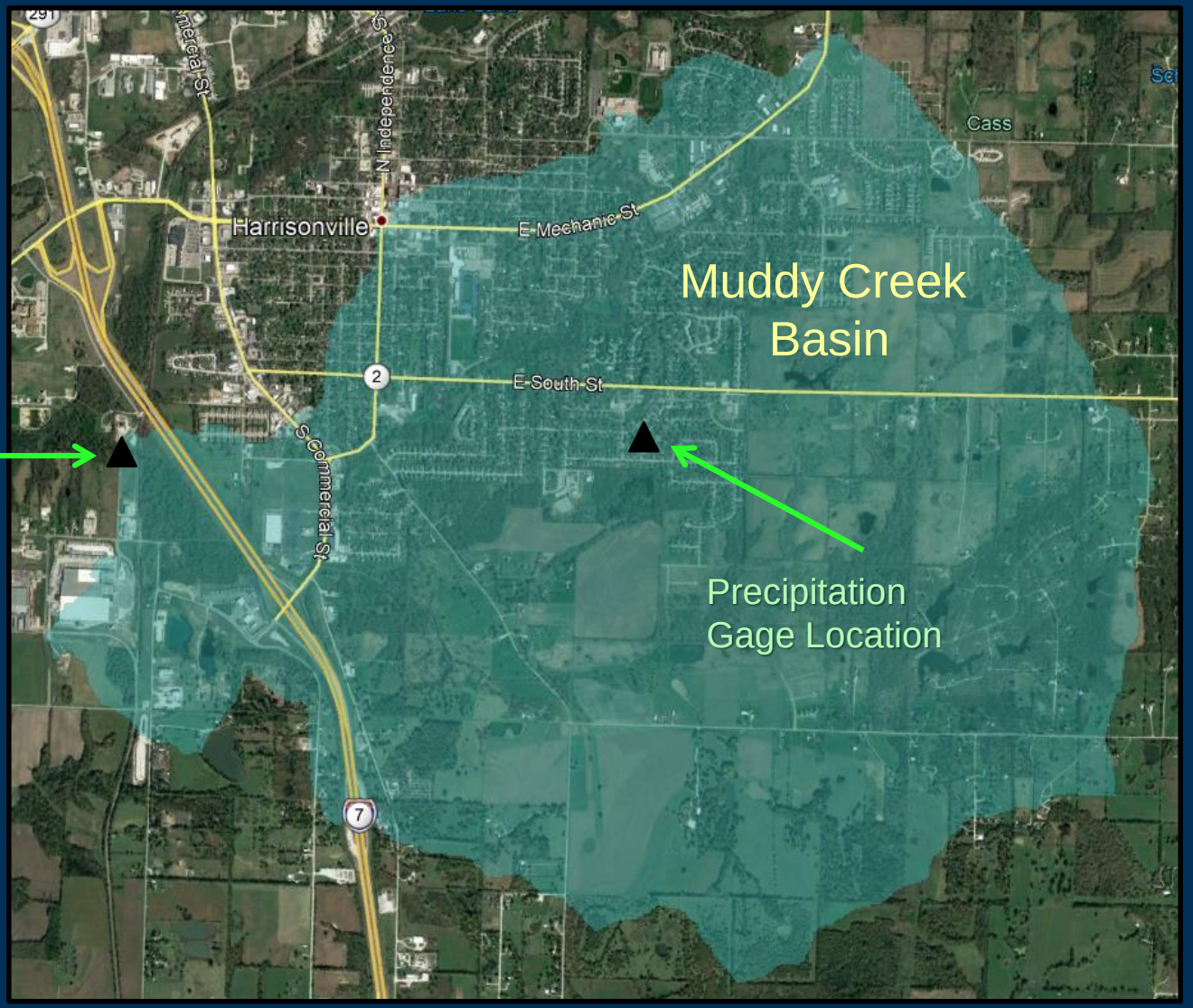


USGS

Muddy Creek Data Collection

City of Harrisonville, Missouri

- *Drainage Area*
- *~ 5 sq. mil*
- *Partial-record gage*
- *Precipitation gage*



USGS

Flood Warning Support Systems

Precipitation-based gaging/mapping

Duration (hr.)	Incremental Magnitude (in)							
1	1.5	2.0	2.5	3.0	3.5			
2	2.0	2.5	3.0	3.5	4.0	4.5		
4	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
6	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0

USGS

USGS Water Alert !

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Notification Frequency: about this...

- Hourly ○
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Precipitation Parameter(s): about this...

- 1 hour ◉
- 2 hours ○
- 4 hours ○
- 6 hours ○
- 12 hours ○
- 24 hours ○

Alert Threshold Condition: about this...

- ◉ Greater than (>)
- ○ Less than (<)
- ○ Outside a range (< or >)
- ○ Inside a range (> and <)

Real-time value isgreater than: [ ] undefined

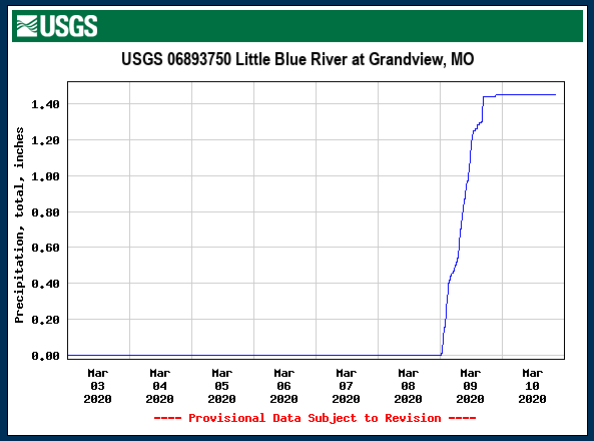
☐ I have read and acknowledge the Provisional Data Statement and Disclaimer.

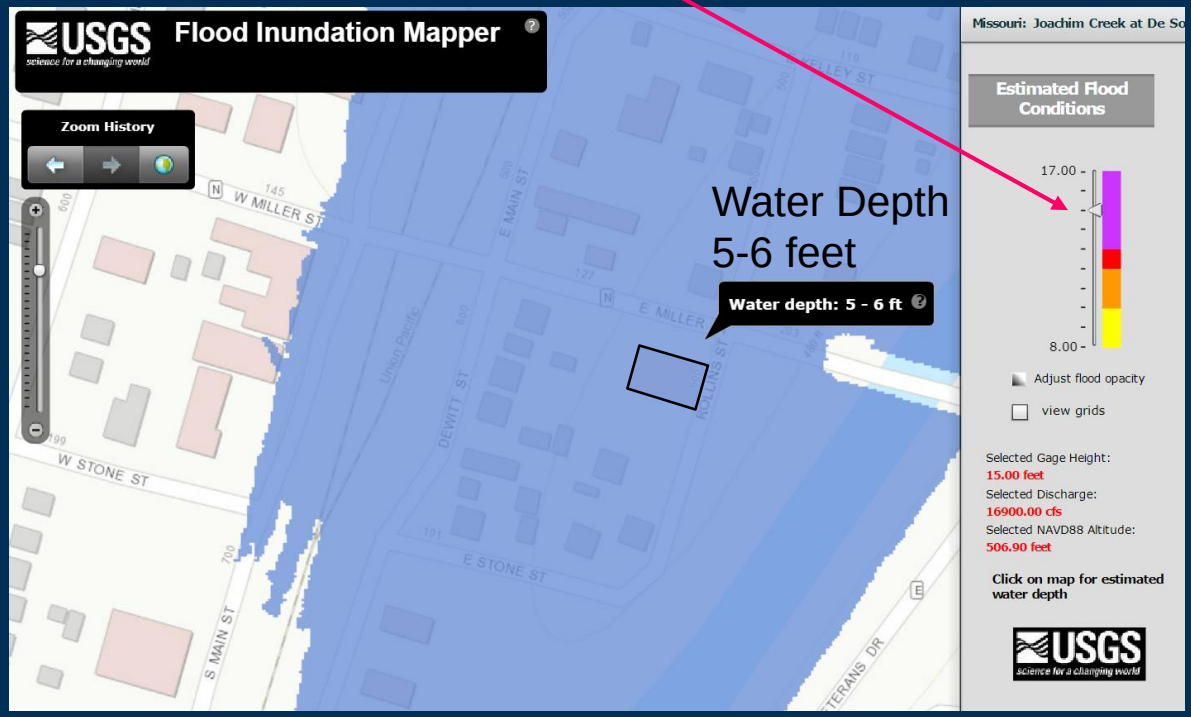
Flood Warning Support Systems

Precipitation-based gaging/mapping

Recent Installation for Flood Warning at the City of Grandview

Duration (hr.)	Incremental Magnitude (in)								
1	1.5	2.0	2.5	3.0	3.5				
2	2.0	2.5	3.0	3.5	4.0	4.5			
4	2.0	2.5	3.0	3.5	4.0	4.5	5.0		
6	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	





USGS

Flood Warning Support Systems

Precipitation-based gaging/mapping

Duration (hr.)	Incremental Magnitude (in)								
1	1.5	2.0	2.5	3.0	3.5				
2	2.0	2.5	3.0	3.5	4.0	4.5			
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Precipitation Parameter(s): about this...

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- 12 hours ○
- 24 hours ○

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- ○ Inside a range (> and <)

Real-time value isgreater than: 6.0

USGS Water Alert !

Flash Flooding – First Line of Defense

National Weather Service - Notifications

Notifications – “What do they mean?”

1. Flood Watch: Preparation, issued when conditions are favorable for a hazardous weather event to occur. Flooding possible.

2. Flood Advisory: Weather event that is forecast to occur may become a nuisance. Issued when flooding is not expected to be bad enough to issue a warning. However, it may cause significant inconvenience, and if caution is not exercised, it could lead to situations that may threaten life and/or property

USGS

https://www.weather.gov/safety/flood-watch-warning

Flash Flooding – Second Line of Defense

USGS / National Weather Service - Notifications

Notifications – Implementation and Definition

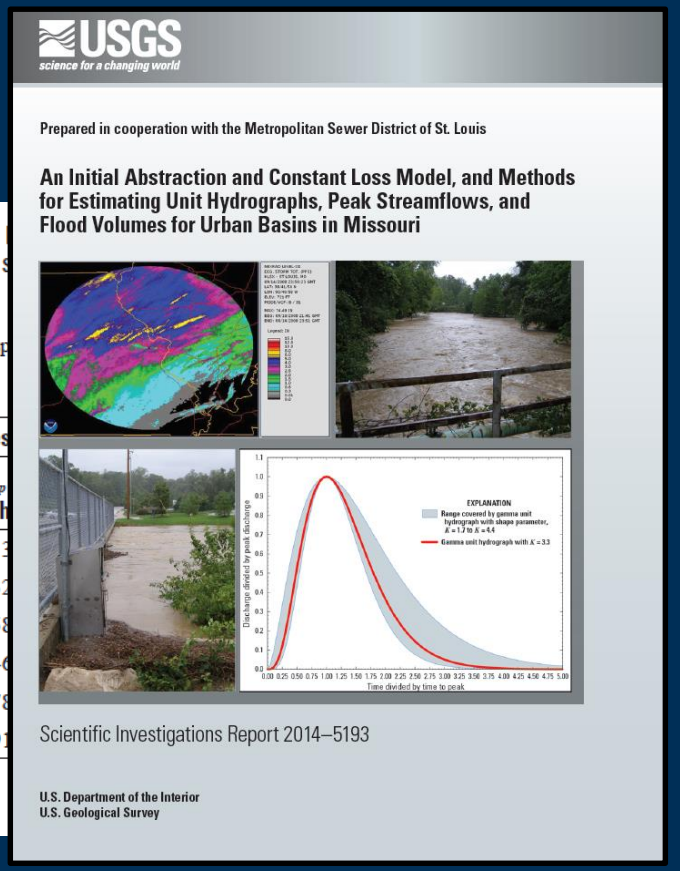
3. Flood Warning: USGS Precipitation-Based Mapping/Warning System.
   Rain to Peak Estimate ~ 2+ hours

Table 3. Listing and summary statistics of the basin-specific and regressed values of the unit hydrograph time to
associated 5-minute time interval, the basin-depth peak streamflow (q_p), and the basin shape parameter (K) for 39
urban areas in and adjacent to Missouri.—Continued

[no., number; in/hr, basin inches per hour; dim., dimensionless; cell shading is to help identify different urban areas and roughly corresp
colors in figs. 11, 12]

	Basin-specific (mean) values				Regressed values		
	T_p (hours)	5-minute time interval	q_p (in/hr)	Computed K[a] (dim.)	T_p (hours)	5-minute time interval	q_p (in/h
Minimum	0.333	4.00	0.137	1.67	0.417	5.00	0.1
First quartile	0.875	10.50	0.297	2.76	0.875	10.50	0.3
Mean	1.810	21.72	0.614	3.52	1.793	21.51	0.5
Median	1.500	18.00	0.469	3.18	1.417	17.00	0.4
Third quartile	2.583	31.00	0.841	3.93	2.250	27.00	0.7
Maximum	5.000	60.00	2.116	7.00	5.333	64.00	1.9

[a]Shape parameter K is computed from T_p and q_p using equation 4 with $V = 1$, using a numerical root solver (appendix 1).



Flash Flooding – Second Line of Defense

USGS / National Weather Service - Notifications

Notifications – Implementation and Definition

4. Flood Warning: Flash flooding is imminent or occurring.
   **Less than 1 hour*

5. CodeRed Weather Alert: Advanced warning of sever weather as a bulletin is issued by the National Weather Service.

- Two-Way Messaging
- Social Media Capabilities
- Real-Time Reporting

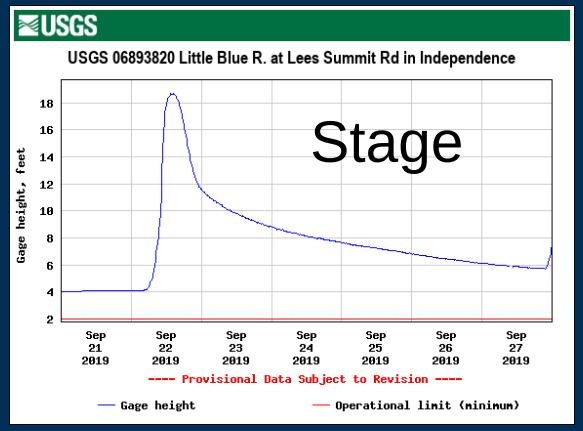
USGS

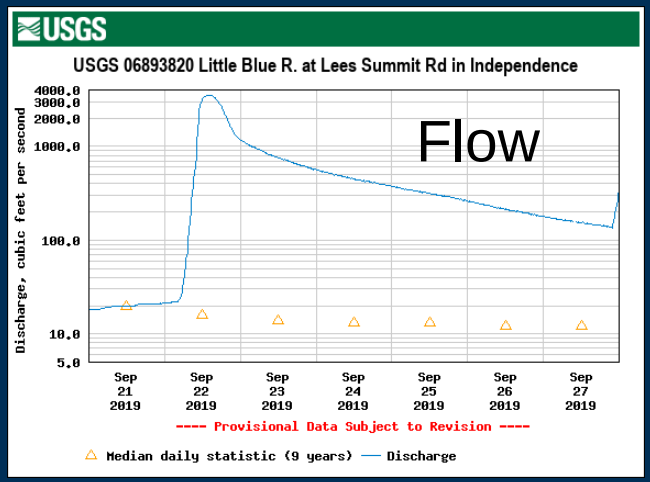
https://www.weather.gov/safety/flood-watch-warning

Flood Warning Support Systems

Streamflow-based validation

Also serves to monitor best management practices in terms of development





USGS

Flood Warning Support Systems

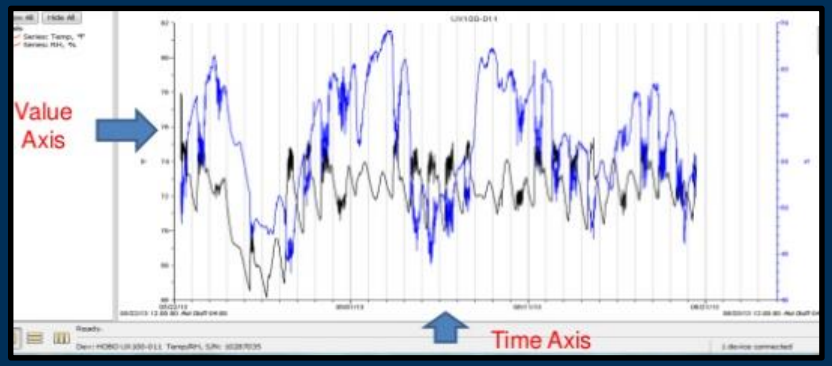
Streamflow-based validation

Are there more economical alternatives in streamflow gaging for warning systems?

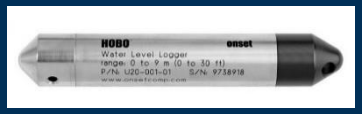
Consideration ⟶ Hybrid Crest Stage Gage

Submersible sensors

Graphical output example



USGS

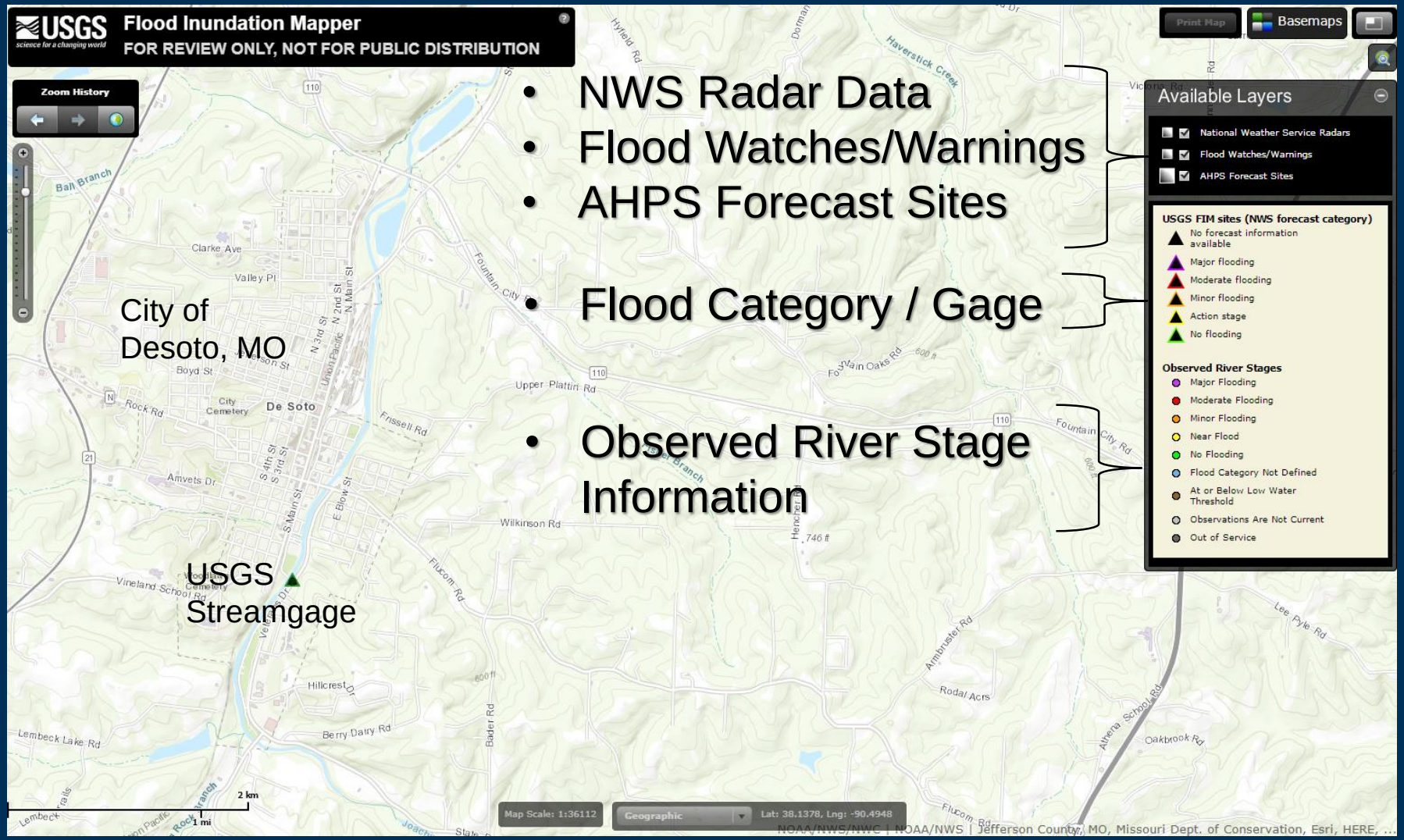


*Would not be broadcast / telemetered

*Only high flow measurements made

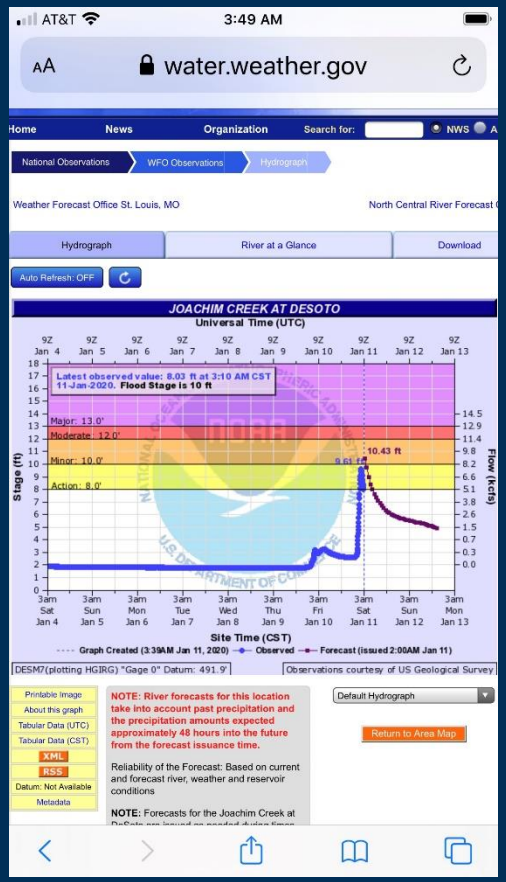
USGS Flood Inundation Mapping

Available Layers – Example: Joachim Creek at Desoto, Missouri



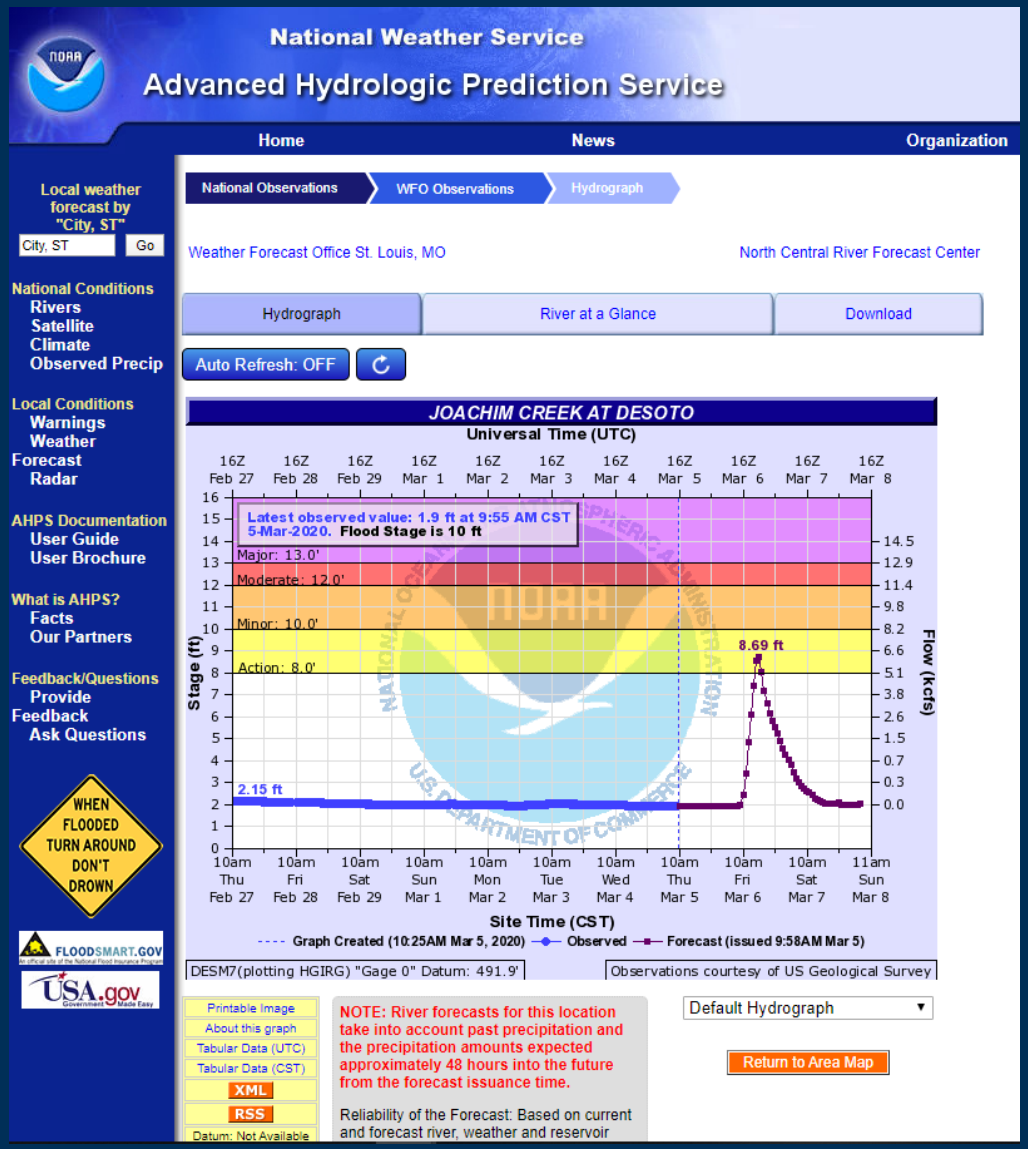
USGS Flood Inundation Mapping

Forecasting – Example: Joachim Creek at Desoto, Missouri



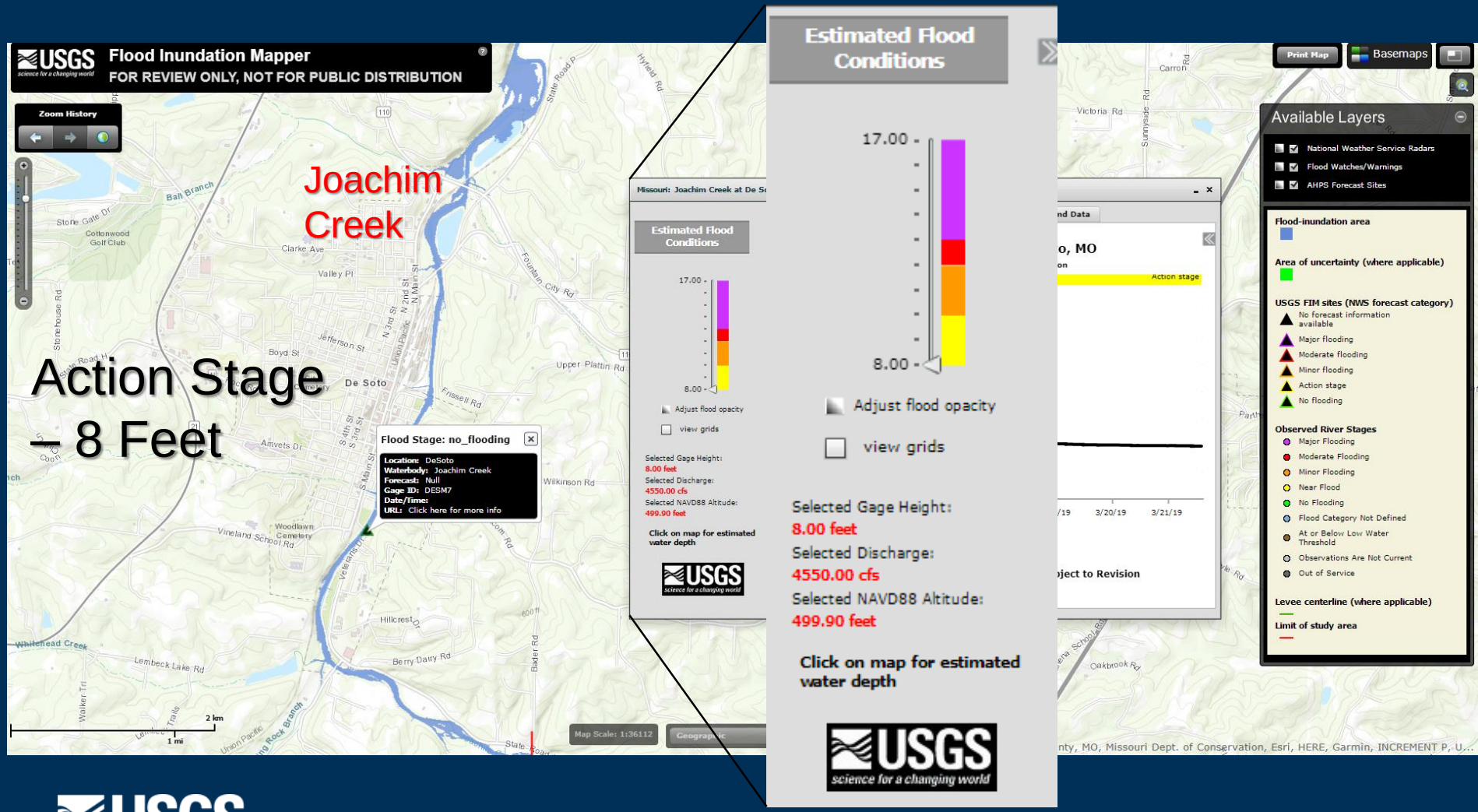
USGS

App



USGS Flood Inundation Mapping

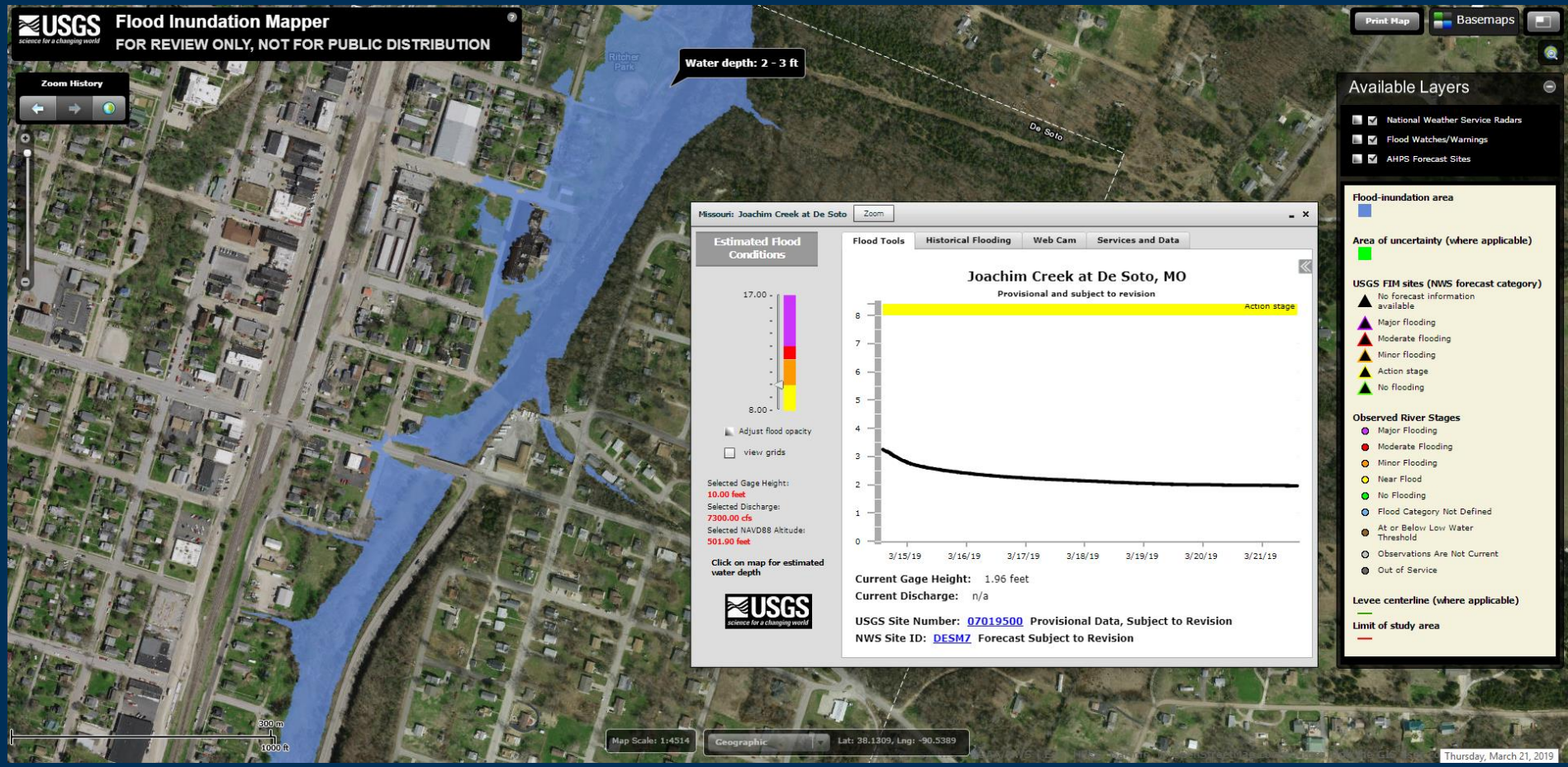
Inundation Mapping Tied to Flood Categories – Action Stage



Joachim Creek at Desoto, Missouri

USGS Flood Inundation Mapping

Minor or Flood Stage – 10 Feet – Base Layer Option Display

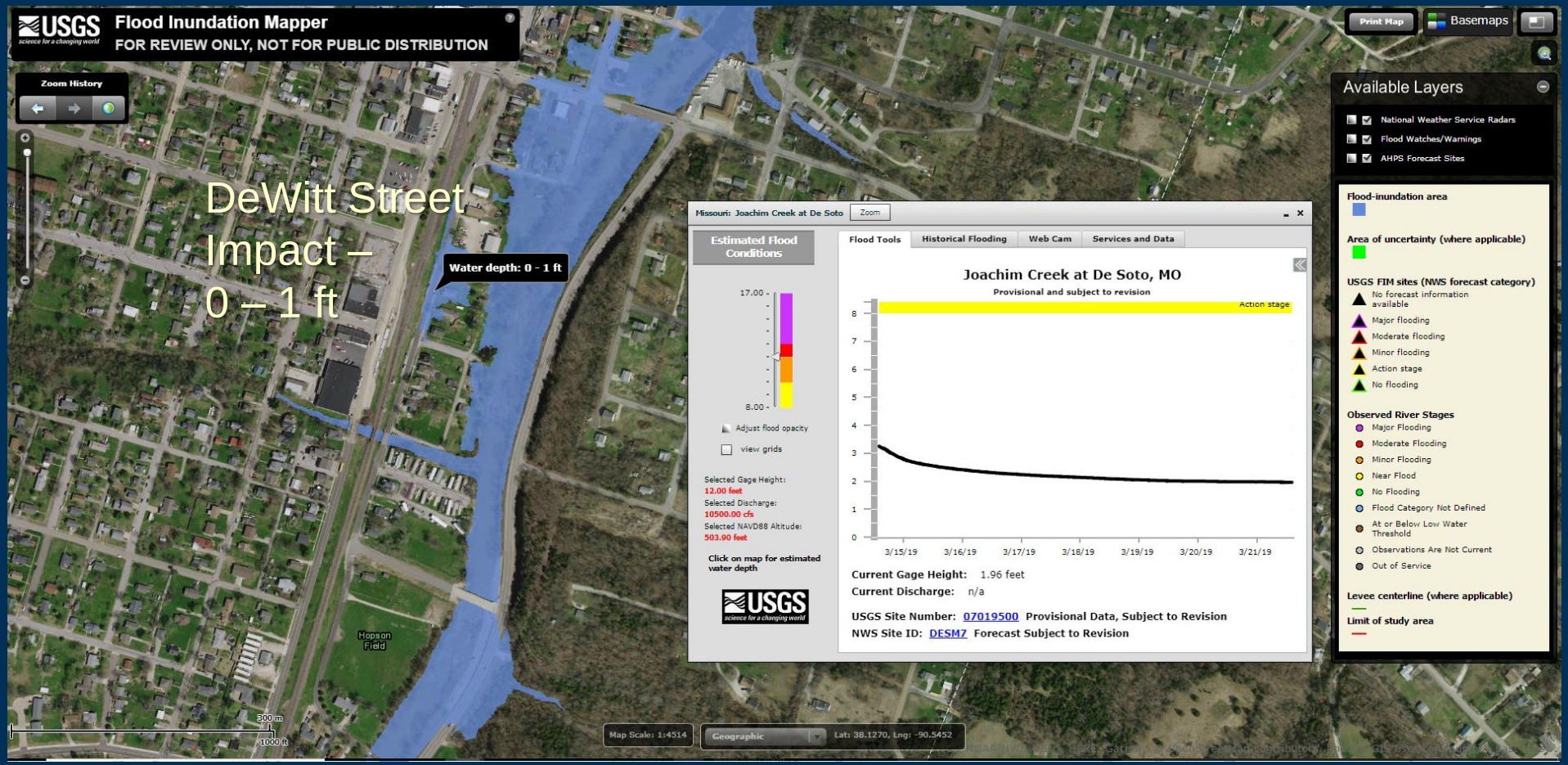


USGS

Joachim Creek at Desoto, Missouri

USGS Flood Inundation Mapping

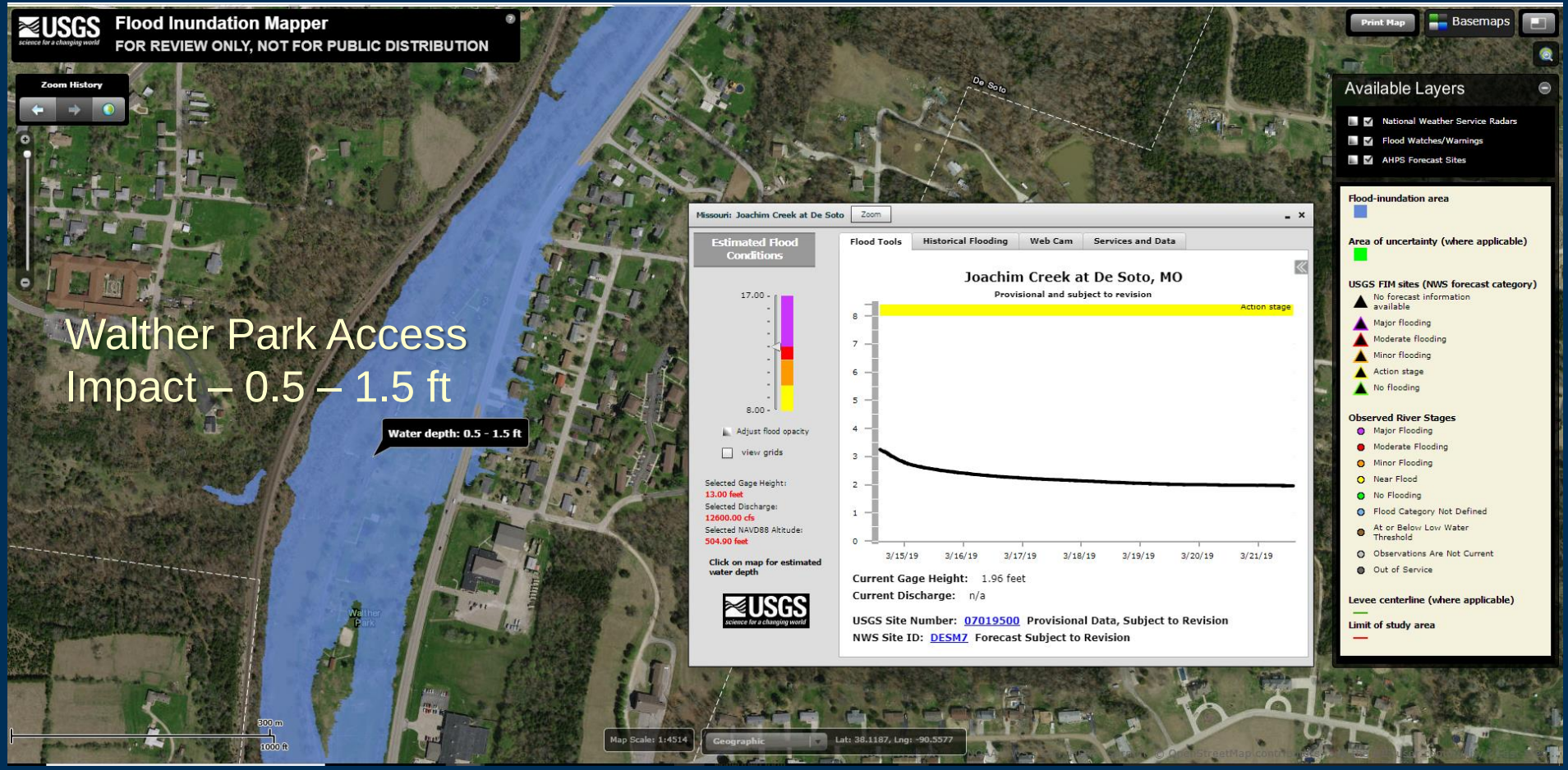
Moderate Stage – 12 Feet



Joachim Creek at Desoto, Missouri

USGS Flood Inundation Mapping

Major Stage – 13 Feet

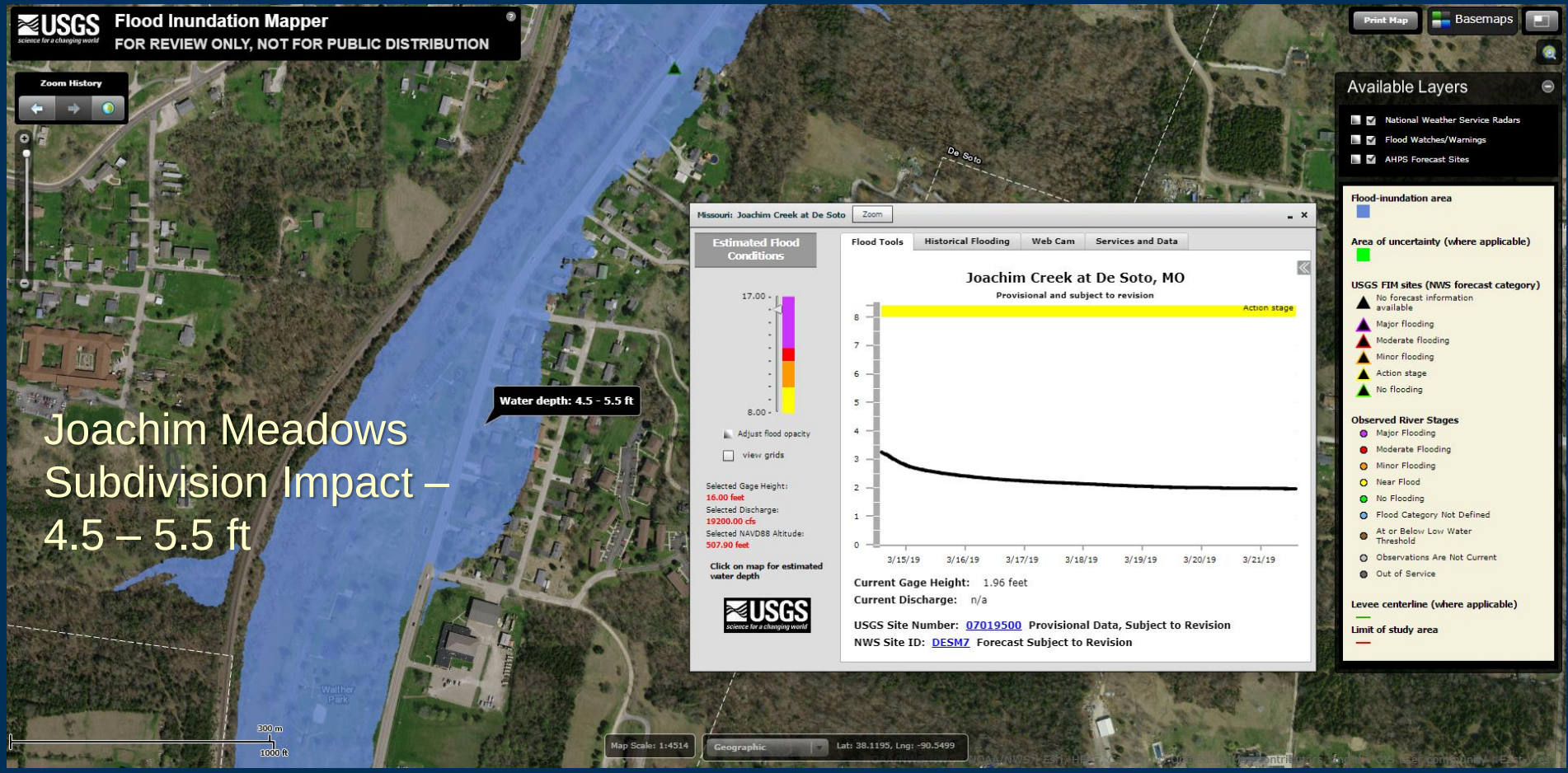


USGS

Joachim Creek at Desoto, Missouri

USGS Flood Inundation Mapping

Stage of 16 feet in the Major flood category



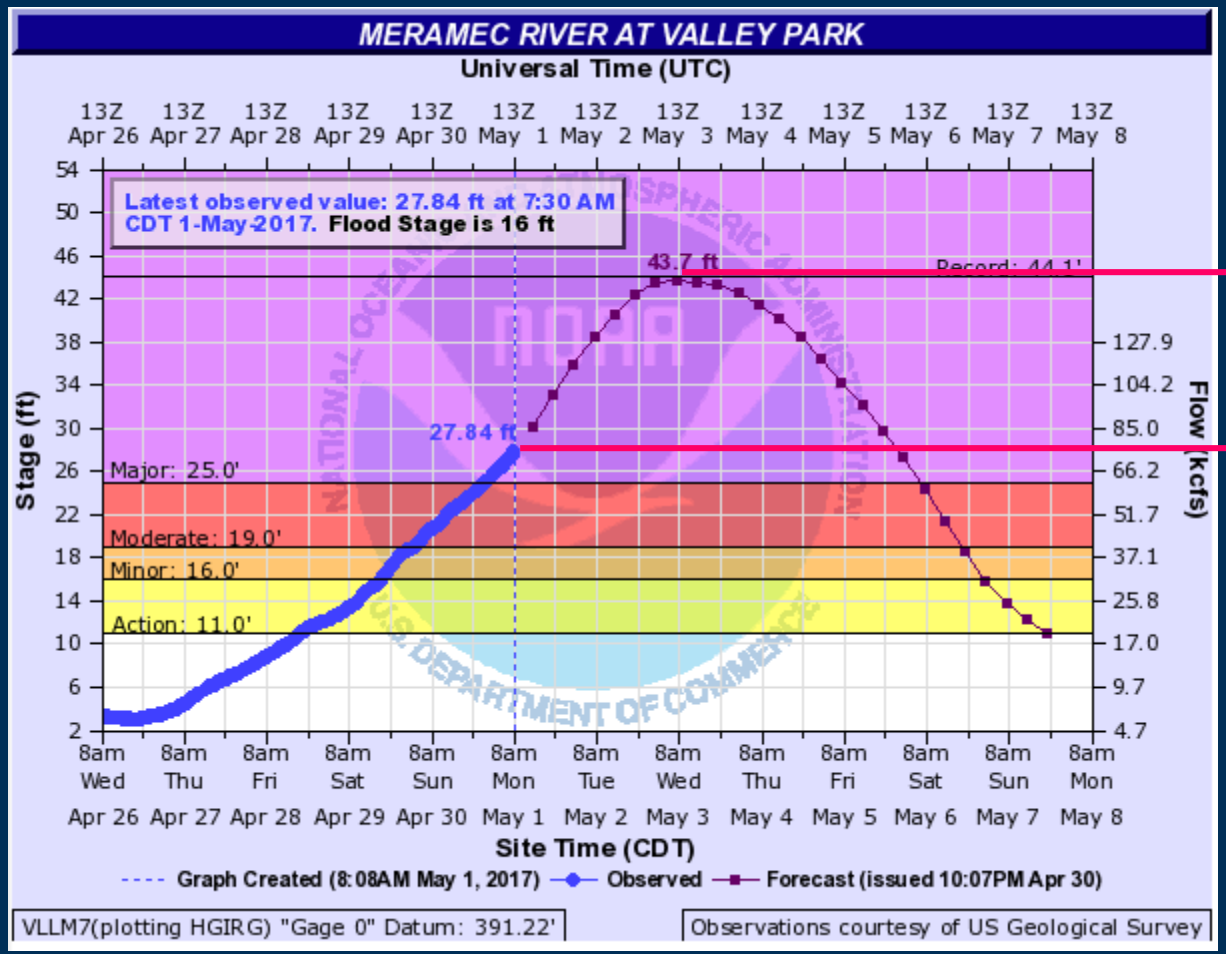
USGS

Joachim Creek at Desoto, Missouri

Meramec River Flooding

Flood Inundation Mapping Effort – Valley Park / Keyes Summit

2017 Flood In Practice



44 feet

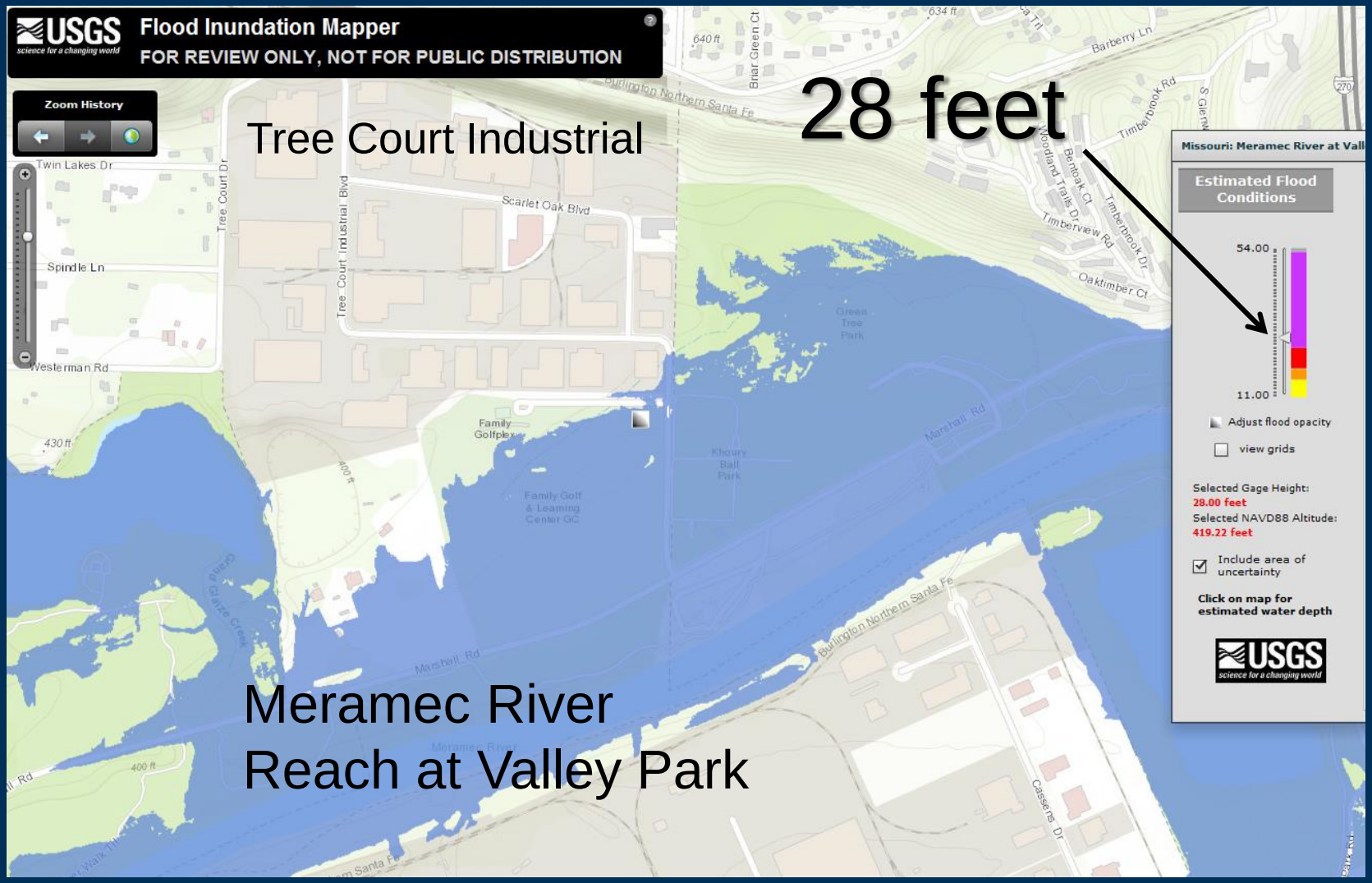
16 foot rise in 2 days

28 feet

Meramec River Flooding

Flood Inundation Mapping Effort – Keyes Summit

2017 Flood In Practice



Meramec River Flooding

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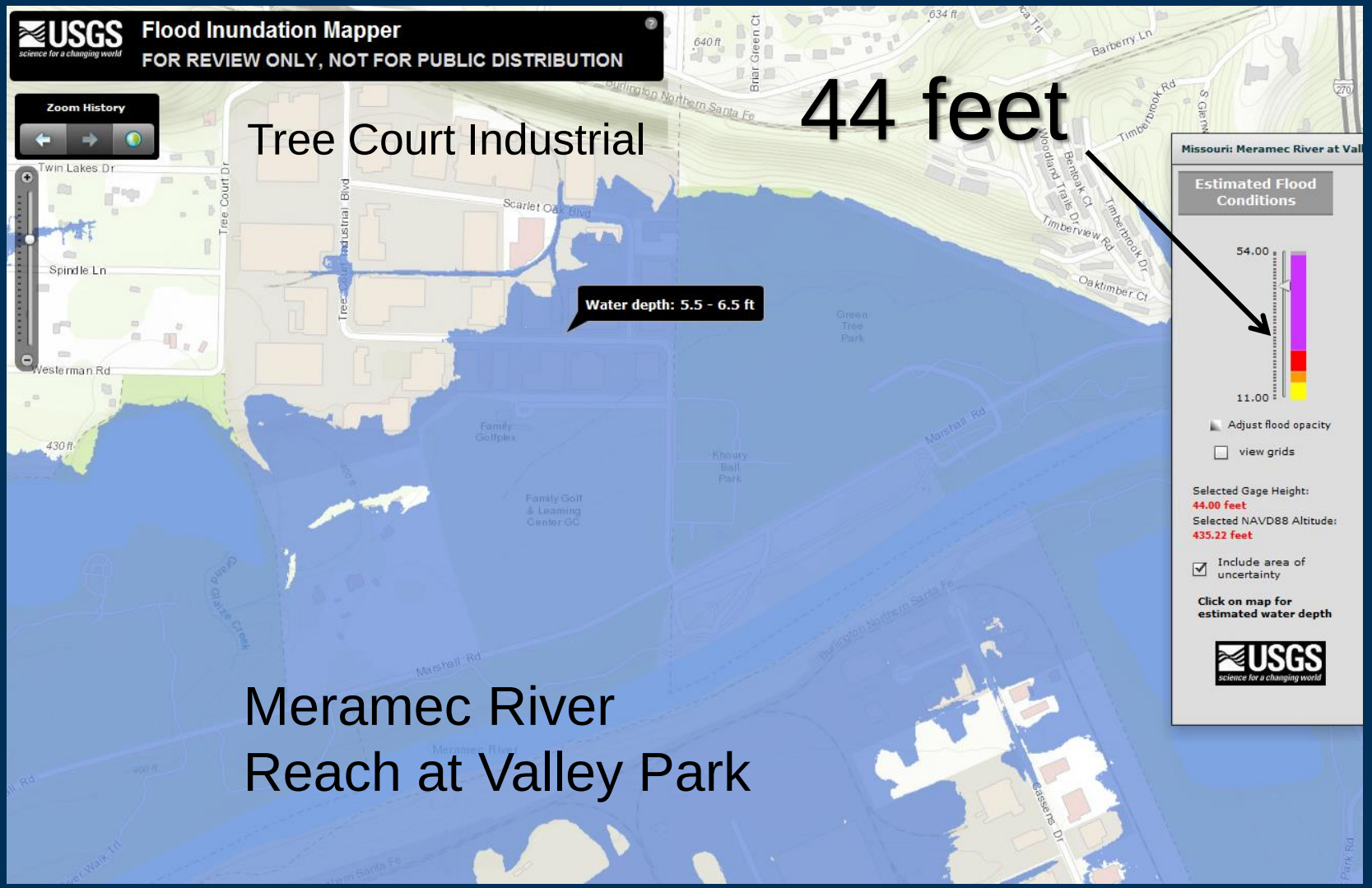
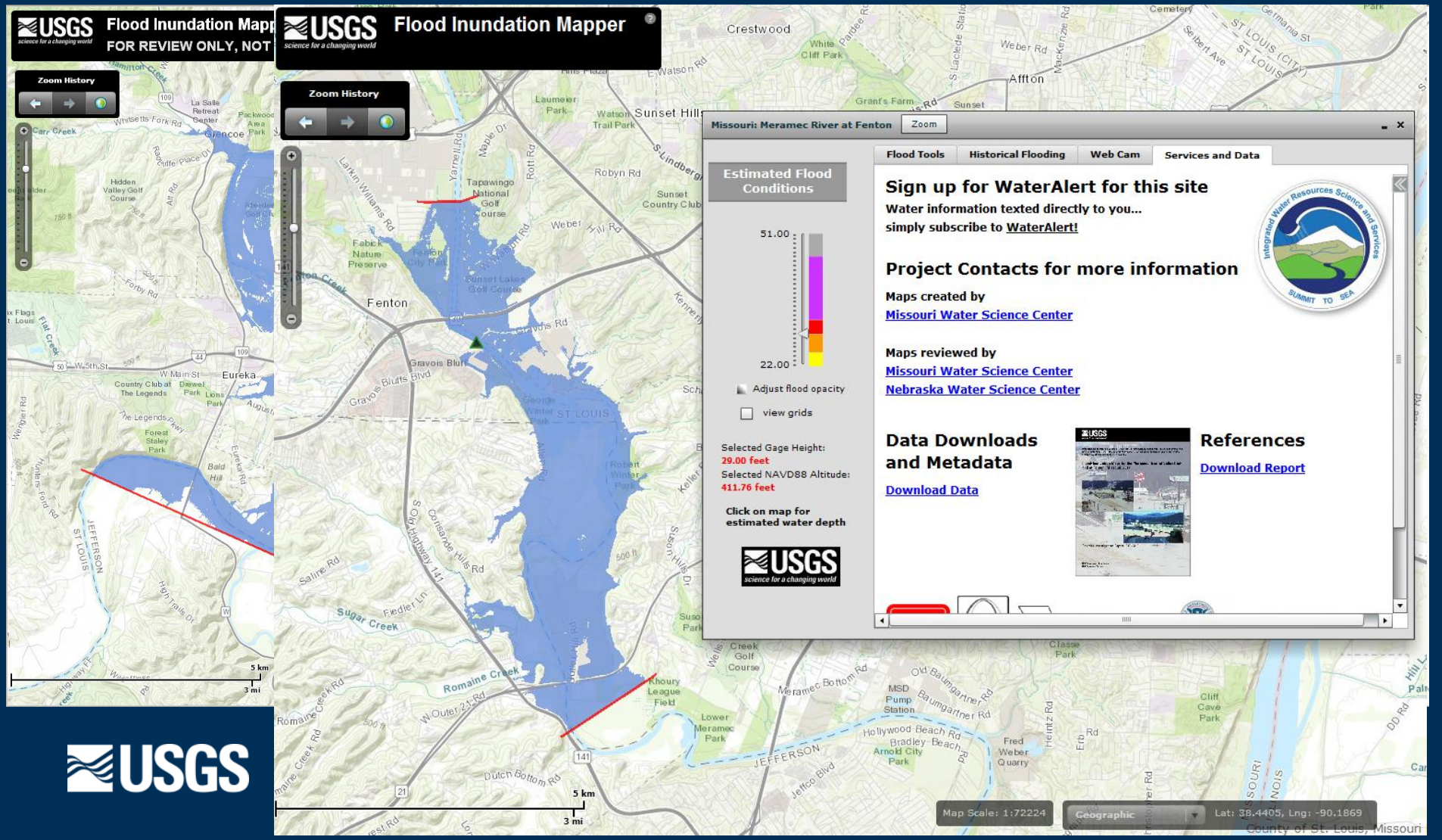


Flood Inundation Mapper

Meramec River Example

Value Added – Historic Flooding and Documentation

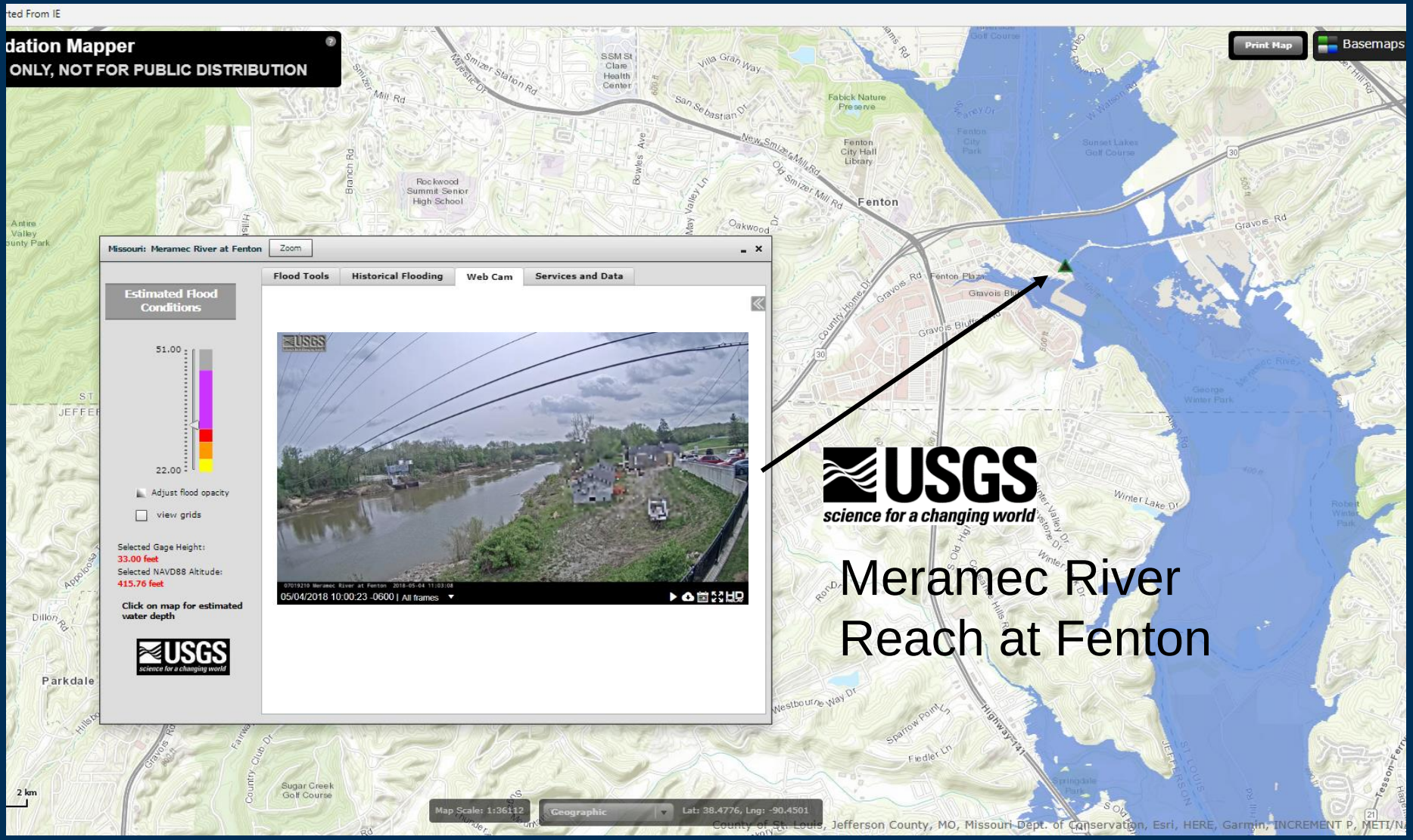


USGS

Flood Inundation Mapper

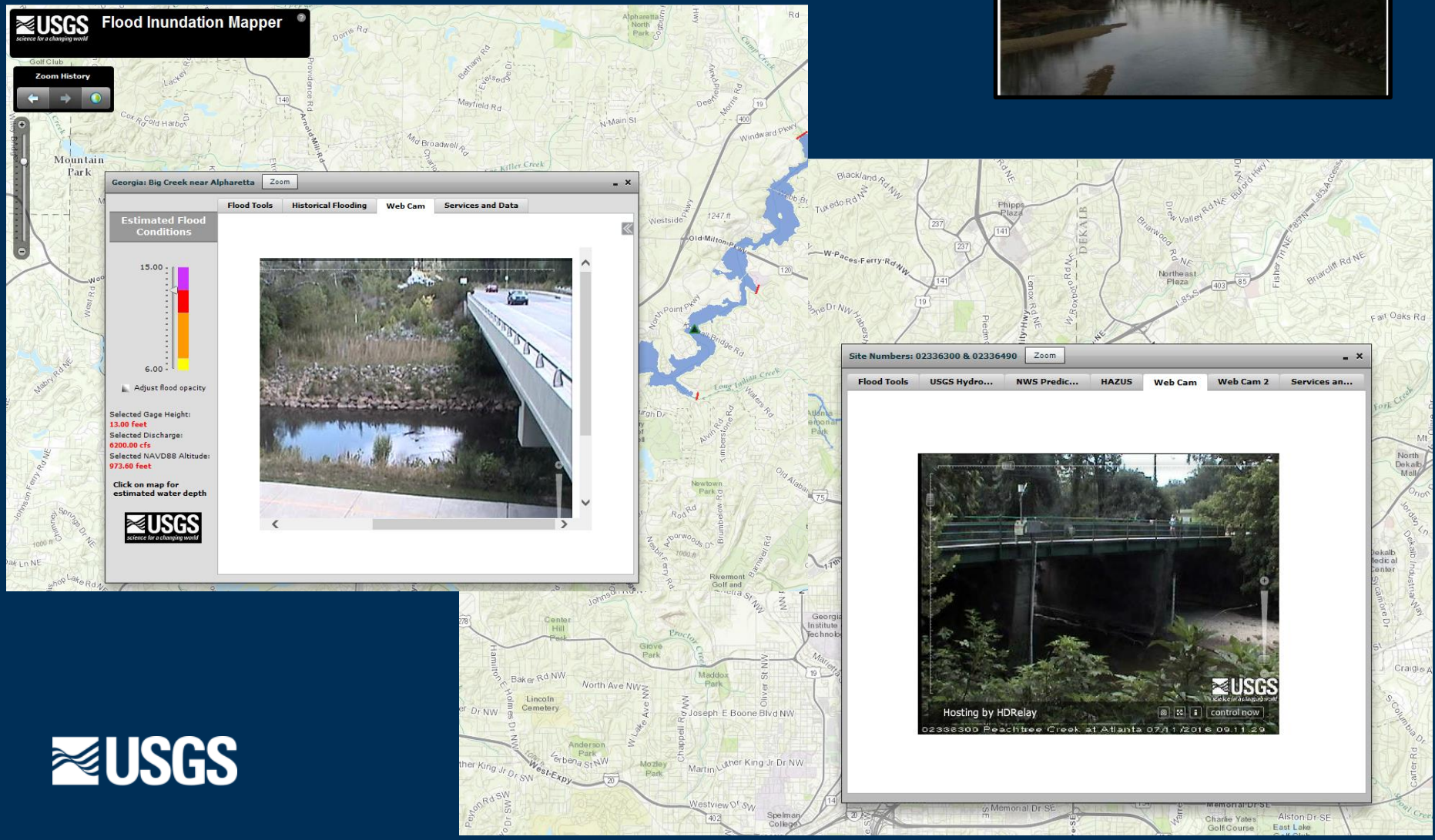
Meramec River Example

Value Added – Web Camera



Value Added Web Camera

Examples

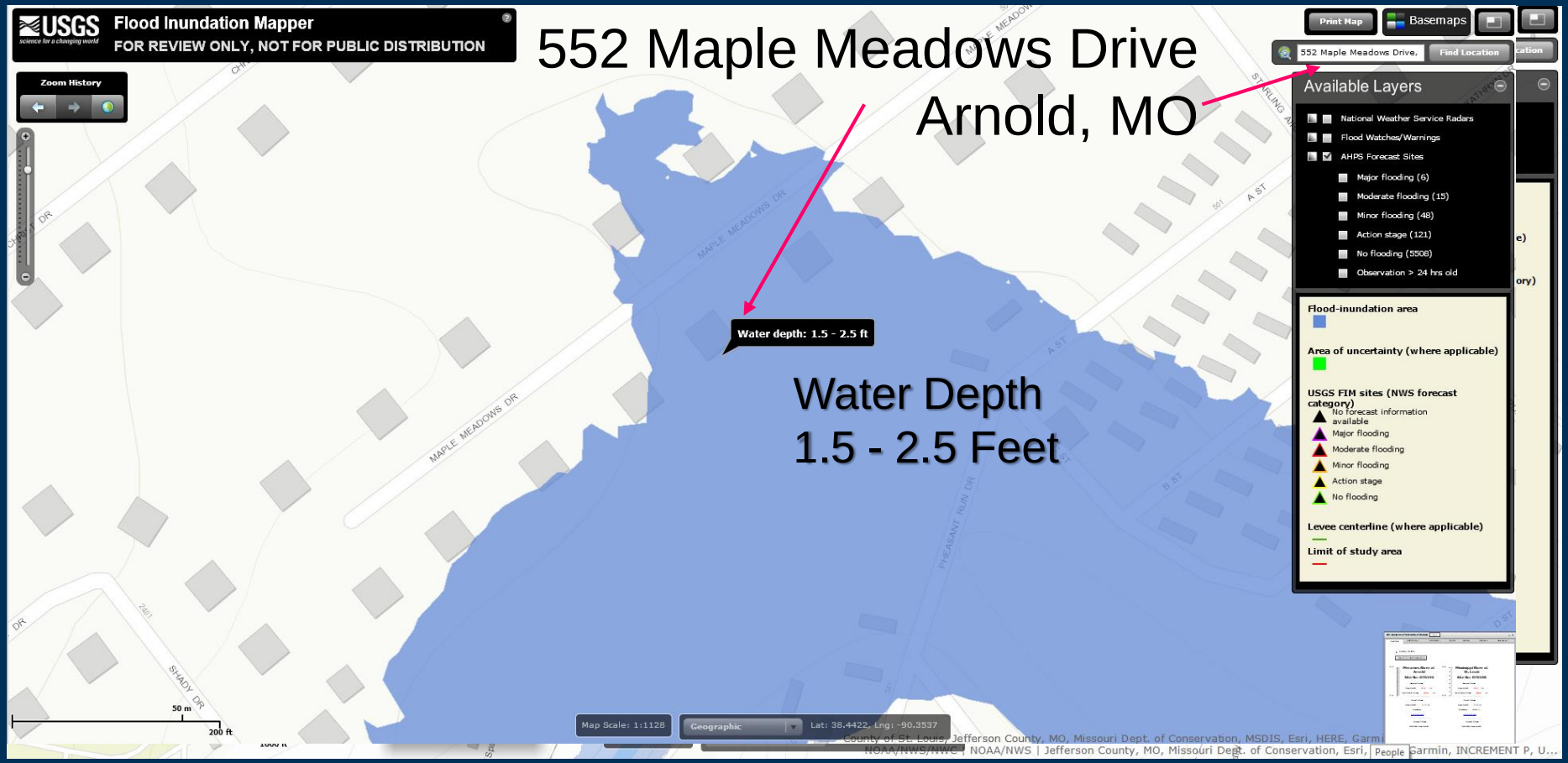


USGS

Flood Inundation Mapper

Value Added – Location Specific

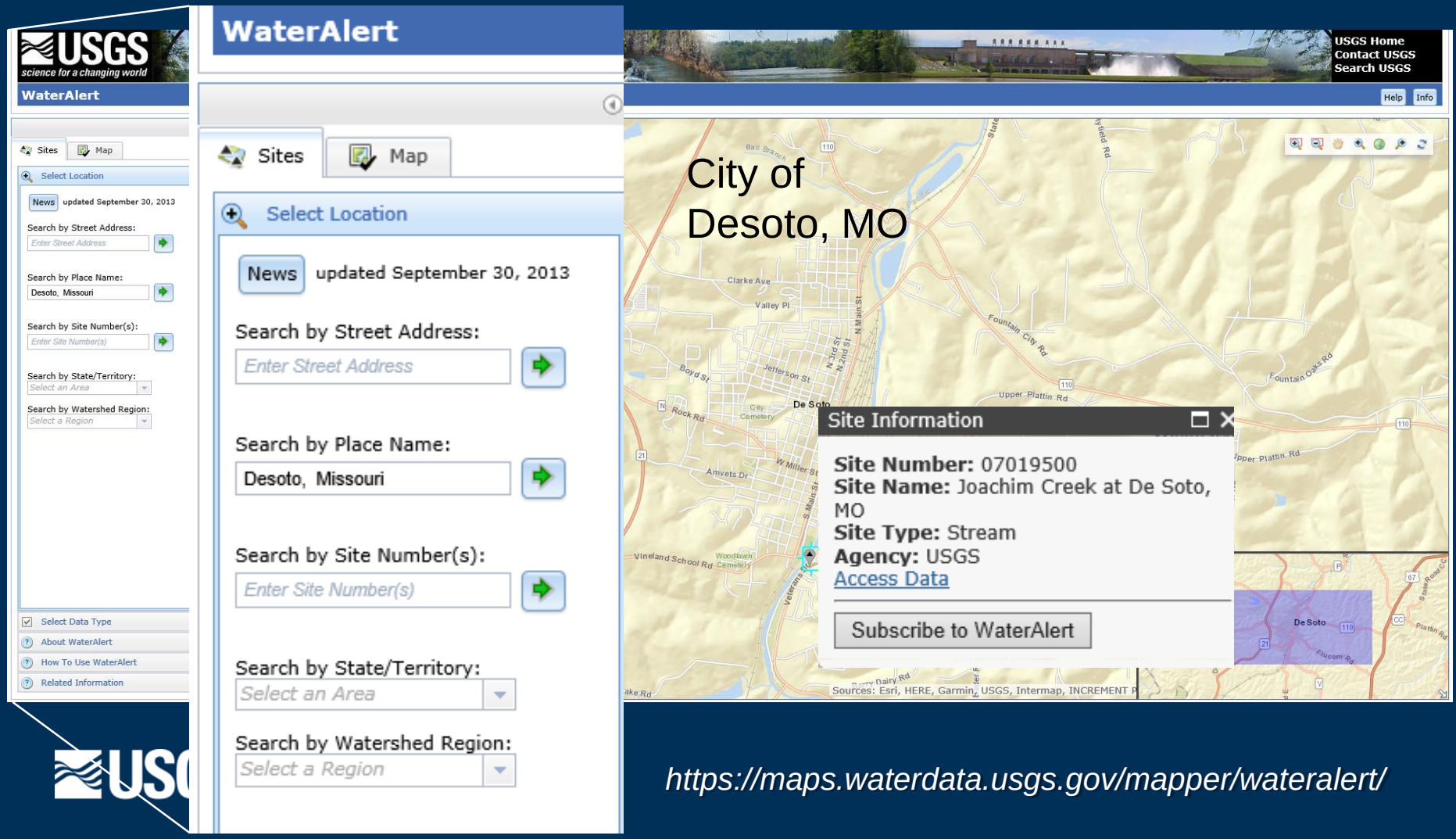
Joachim Creek and Meramec River



USGS

USGS Water Alert

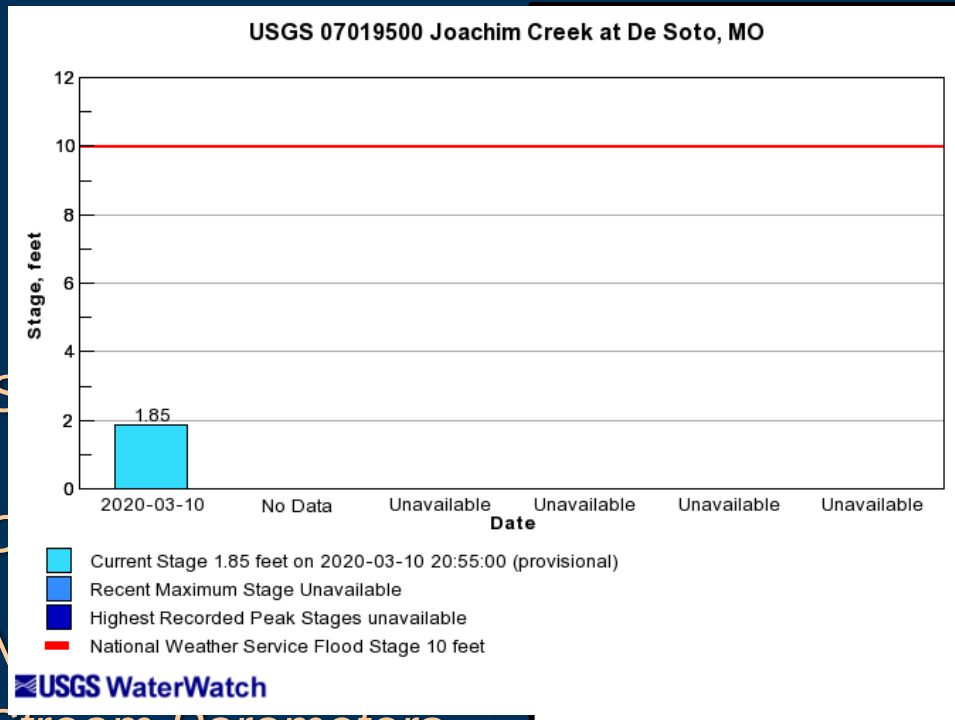
The "where and why" for subscription



https://maps.waterdata.usgs.gov/mapper/wateralert/

USGS Water Alert

Joachim Creek at Desoto – Linked to Gage and Mapper



Stream Parameters ➡

Alert Thresholds ➡

ervice sends e-mail or text (SMS) messages when certain parameters, collection station, exceed user-definable thresholds. The development em is supported by the USGS and its partners, including numerous

nsmitted via satellite or other telemetry to USGS offices at various r hour. Emergency transmissions, such as during floods, may be more *he data received at these site-dependent intervals.*

07019500
Joachim Creek at De Soto, MO
USGS
bJMFP
about this...
10-digit phone number -my carrier-
For a one-time confirmation only*: email address
about this...
about this... Recent value:
Gage height, in ft 1.96 [peak chart Flood Inundation Map]
Alert Threshold Condition: about this...
- Greater than (>)
- Less than (<)
- Outside a range (< or >)
- Inside a range (> and <)

Real-time value isgreater than: 7.0 × ft

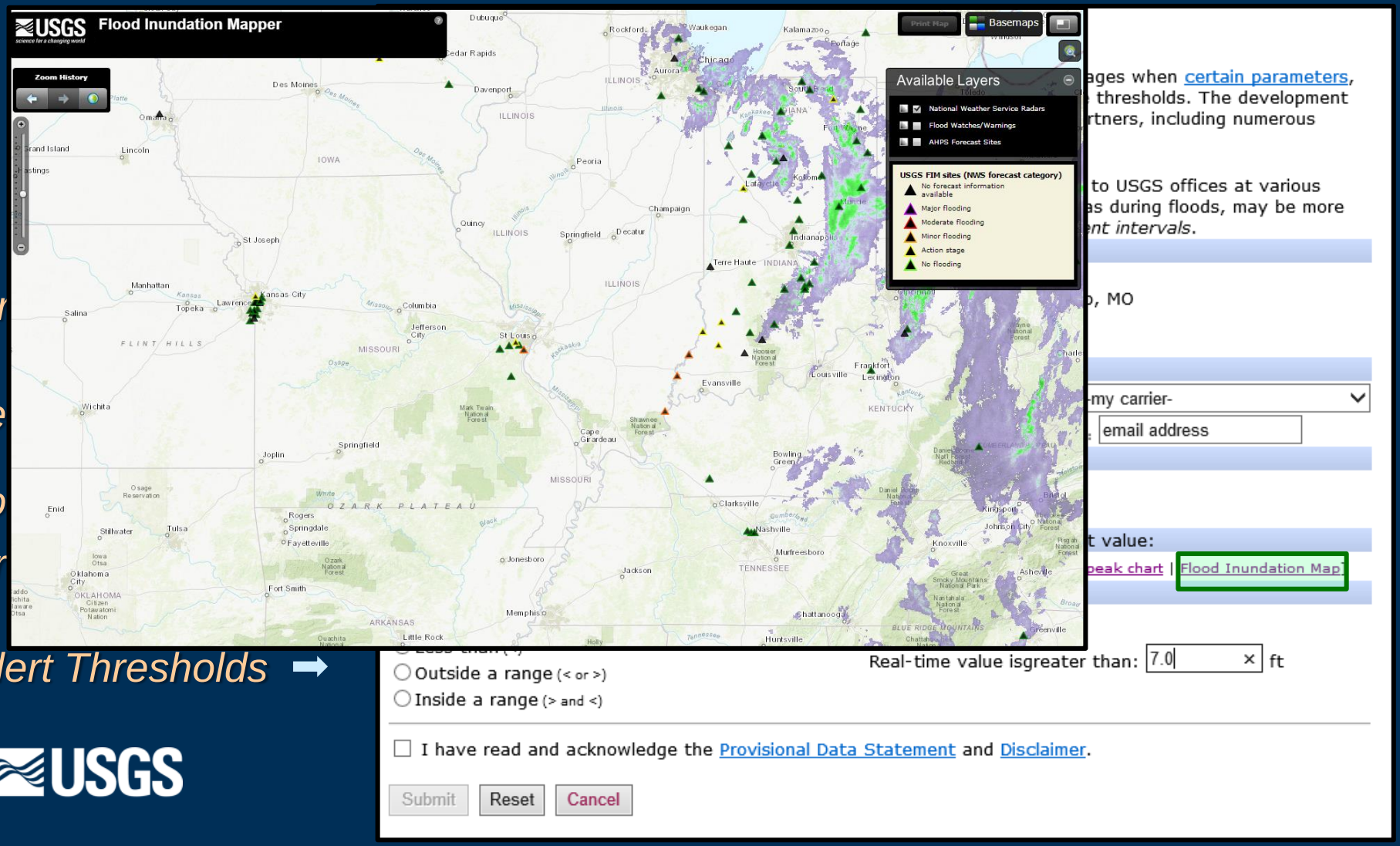
I have read and acknowledge the Provisional Data Statement and Disclaimer.

Submit Reset Cancel

USGS

USGS Water Alert

Joachim Creek at Desoto – Linked to Gage and Mapper



Str

Ce

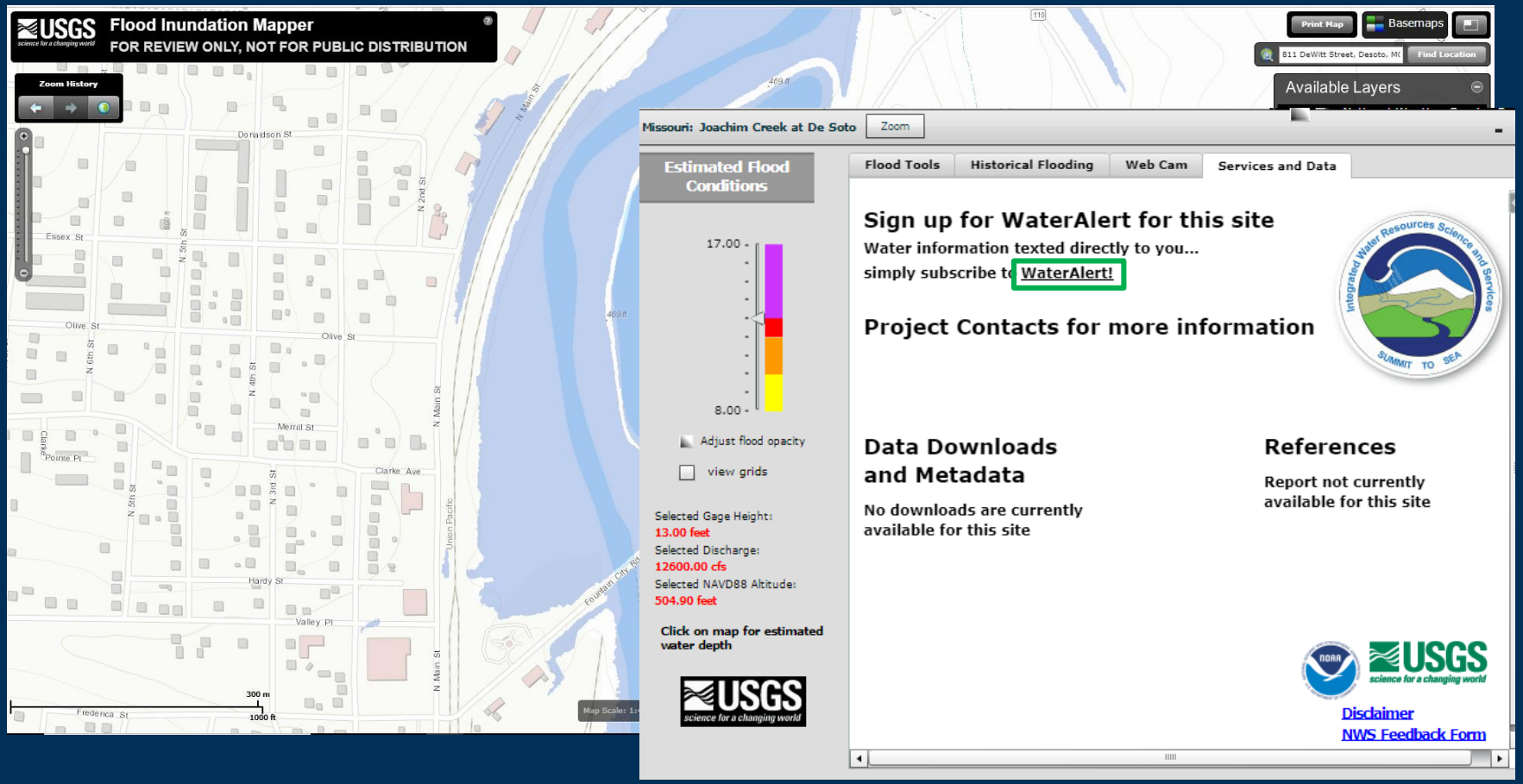
No

Str

Alert Thresholds ➡

USGS

USGS Water Alert / Flood Inundation Mapper – *Services and Data*

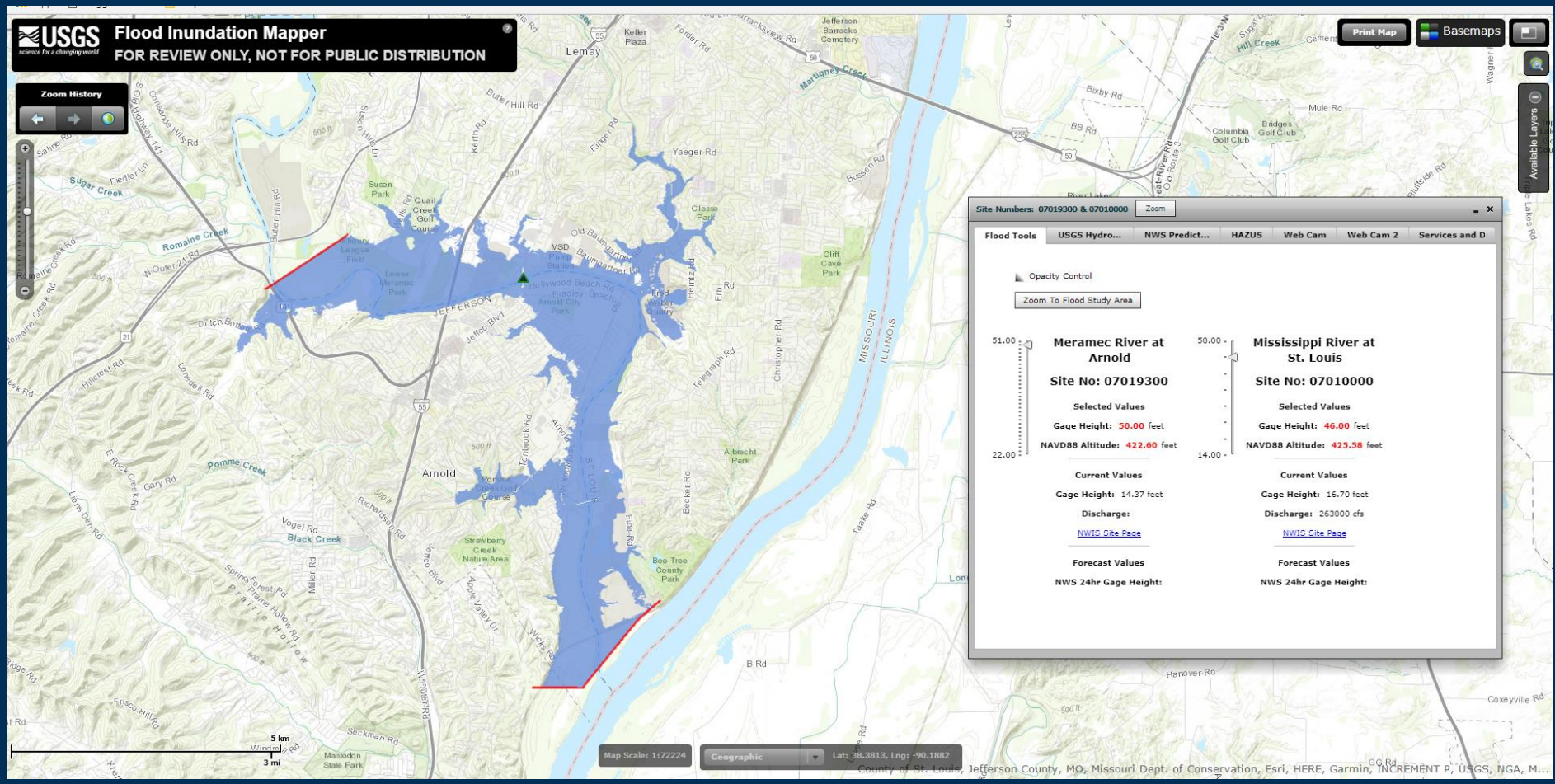


USGS *Joachim Creek at Desoto – Mapper Linked to Water Alert*

Flood Inundation Mapper

Meramec River Example

Value Added – Multi-Layer Flood Tool



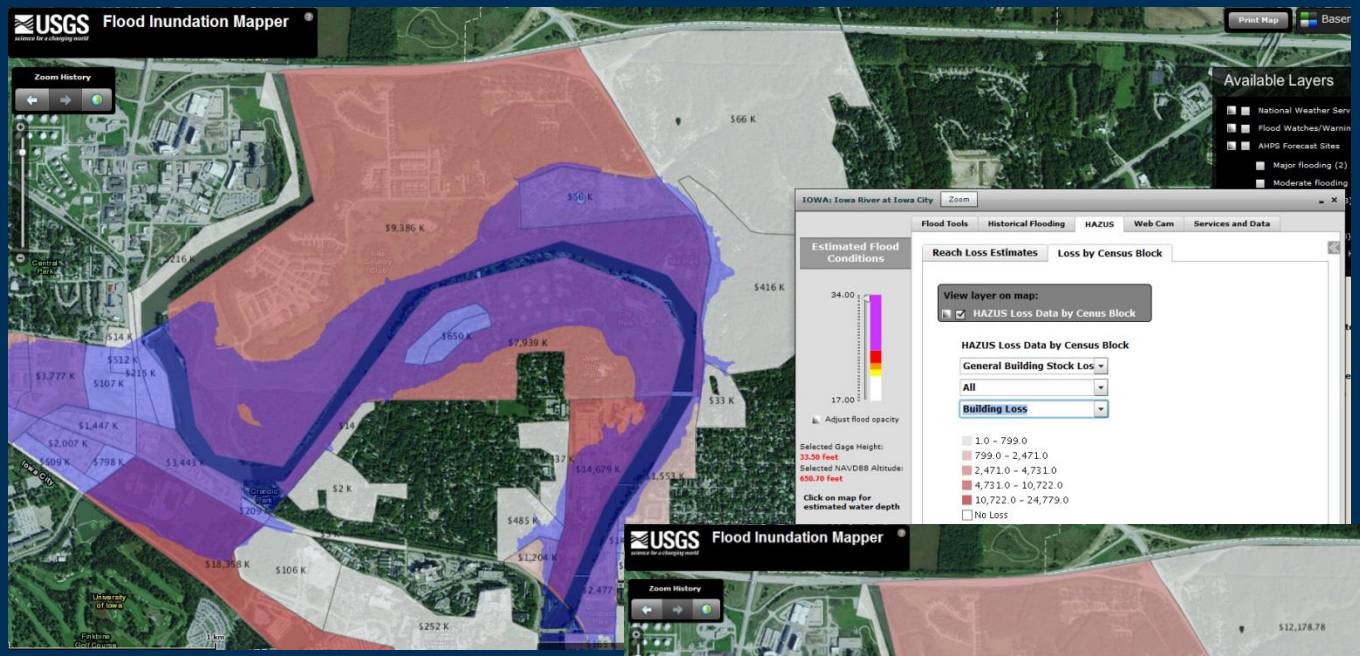
USGS

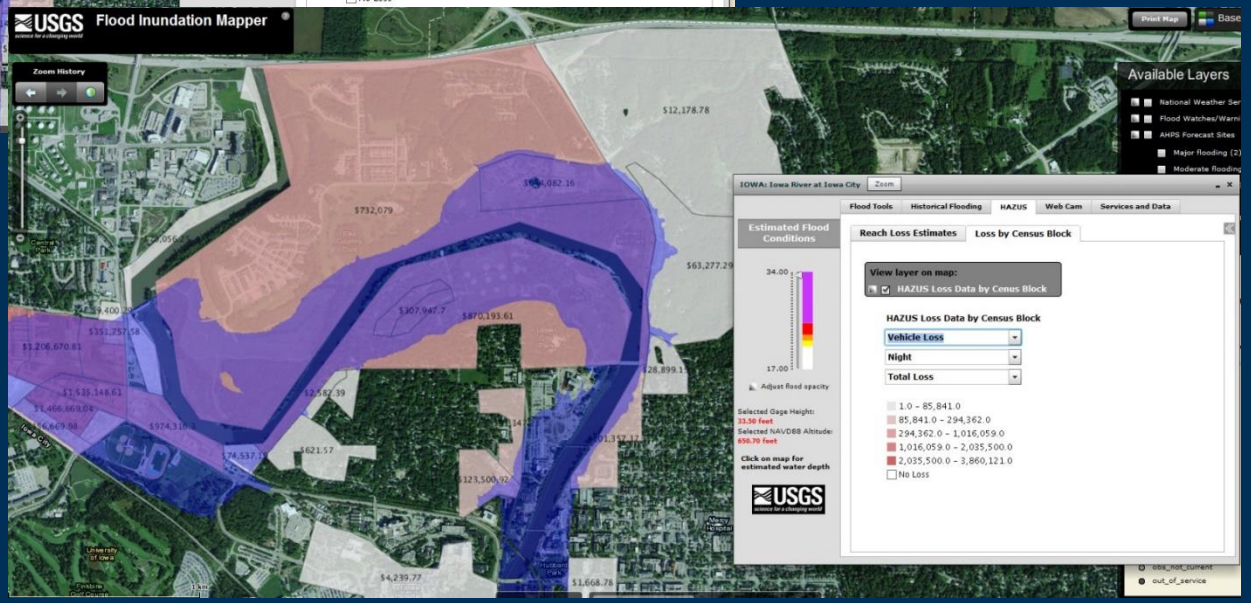
Application for Lower Meramec River and Mississippi River interaction

Flood Inundation Mapper

Value Added – HAZUS (Building/Vehicle Loss)

Loss Estimation Application

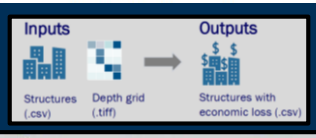




Potential Integration

FEMA's Flood Assessment Structure Tool (FAST)

An open source tool to rapidly analyze structure-level flood risk



HEC-LifeSim

Version 1.0

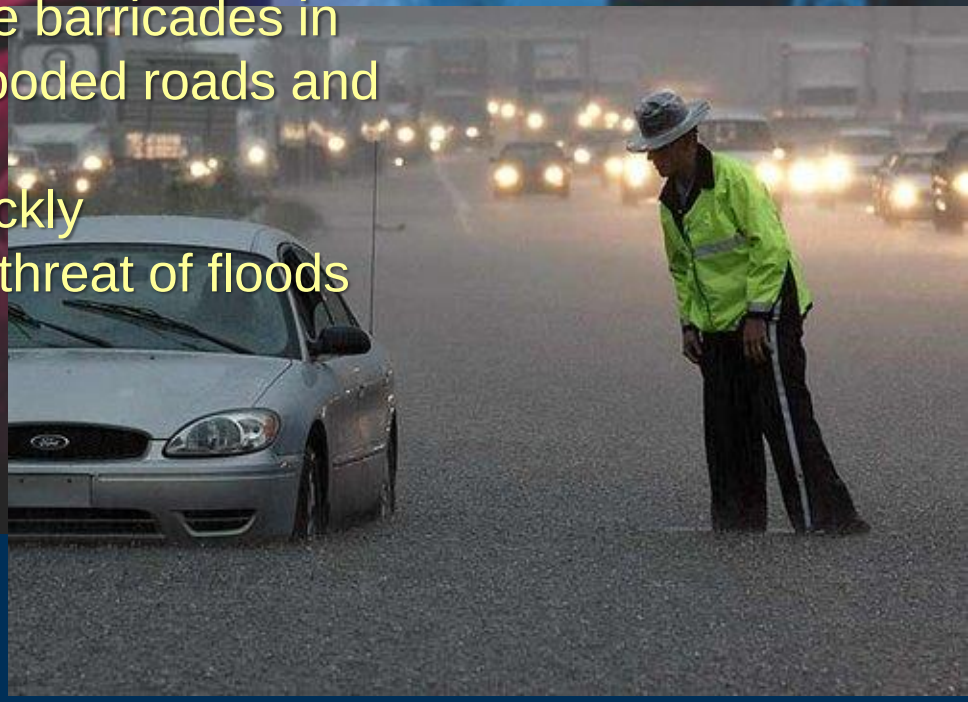
Hydrologic Engineering Center
Institute for Water Resources
U.S. Army Corps of Engineers
609 Second Street
Davis, CA 95616

http://www.hec.usace.army.mil

BENEFITS of Flood Inundation Mapping

Local Agencies

- EMA director can focus warnings using automated technologies to get people/property out of harm's way
- Evacuation routes can be assessed quickly for flood access
- Police would know where to place barricades in advance of flood crest to block flooded roads and prevent accidents
- Officials would have answers quickly
- Public can be better educated to threat of floods



USGS

NATIONAL WEATHER SERVICE
U.S. DEPARTMENT OF COMMERCE-NOAA

National Flood Insurance Program

What is the value in USGS Flood Warning Gages and Mapping ?

Community Rating System

"Credit for measures that protect life and property during a flood, through flood warning and response programs."

600 Series

610 – Flood Warning and Response

USGS