USGS
science for a changing world

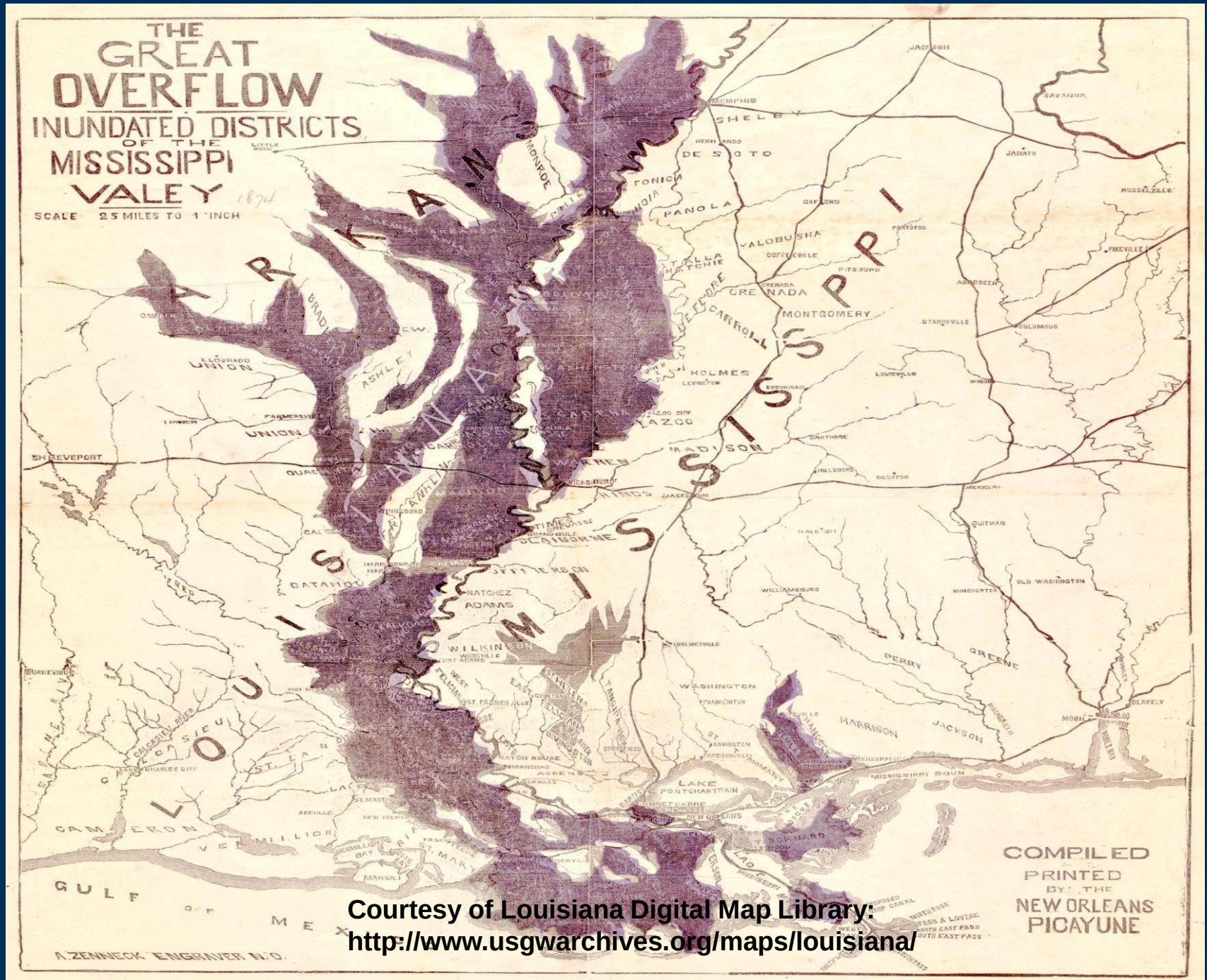
The USGS Flood Inundation Mapping Initiative

USGS Texas Water Science Center Technical Talk

Scott Morlock

USGS Indiana Water Science Center

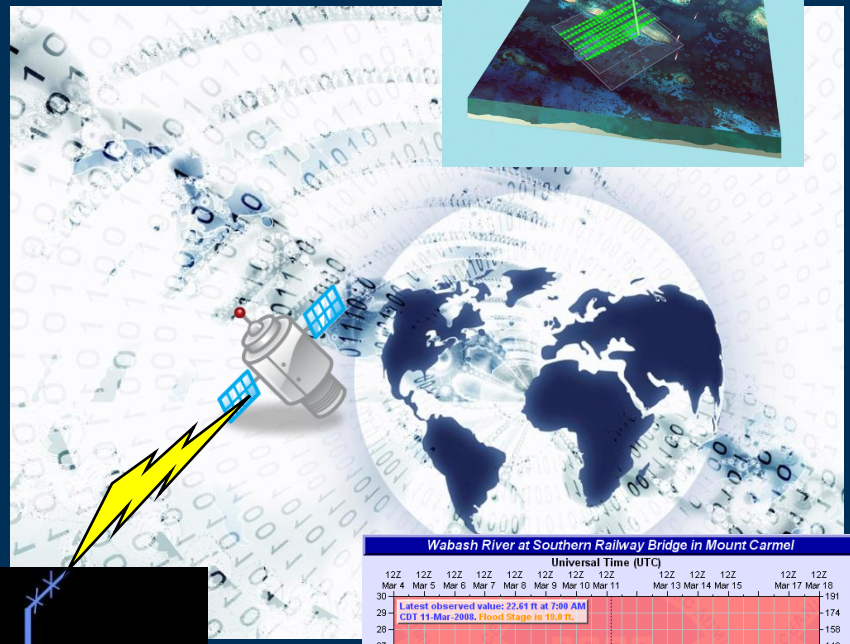
U.S. Department of the Interior
U.S. Geological Survey

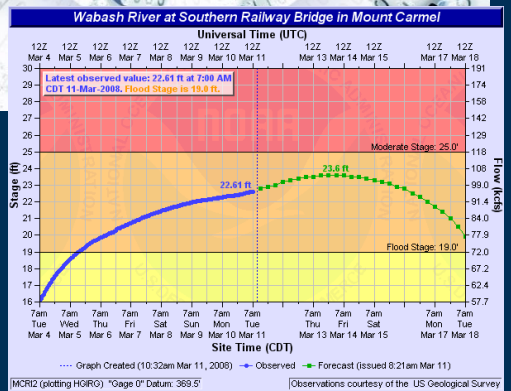


Courtesy of Louisiana Digital Map Library:
http://www.usgwarchives.org/maps/louisiana/

Leveraging Evolving Technologies

- Real-time and forecast hydrologic data
- LiDAR- DEMs
- GIS
- Internet
- Interactive flood map viewers





USGS

Flood Inundation Mapping Initiative

1. Consistent visual and electronic format for USGS inundation geospatial products.
2. Static flood inundation map libraries linked to gages/flood forecasts
3. State-of-the art dynamic, real-time flood inundation applications
4. A core of USGS and partner agencies
5. National USGS FIMI Web portal

USGS

Products

- Designed to have consistent “look and feel,” meet minimum USGS standards
- Designed for the broadest base of users
  - From “expert” to the general public
  - Fit multiple Fed, State, local missions
  - Served through multiple outlets

USGS

FIMI – partner oriented

- State/local level, to leverage resources for inundation
  - e.g. State Silver Jackets
- On a Federal level, getting the agencies to work together
  - USGS
  - NWS
  - USACE
  - FEMA
  - Integrated Water Resources Science and Services (IWRSS)

USGS

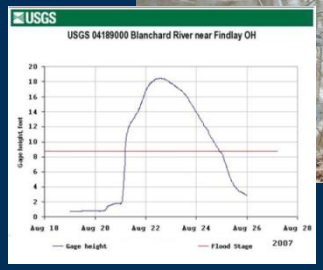
FIMI Partner Vision

- Long term vision is to get appropriated dollars for a National flood inundation program.
- In the short term, the USGS initiative is relying on cooperative projects with partners:
  - Other federal agencies – e.g. FEMA, DOD
  - State agencies – transportation, water resource/environmental, emergency mgmt
  - Regional/local agencies – counties, towns/cities, even an art museum!

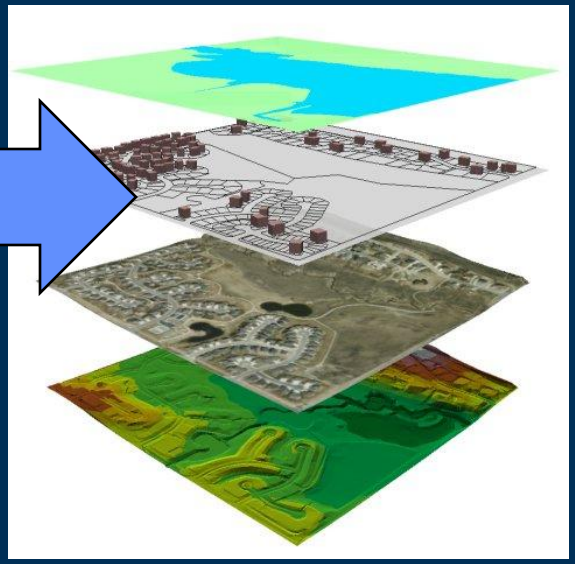
USGS

Flood info – from a point on the landscape to geospatial products

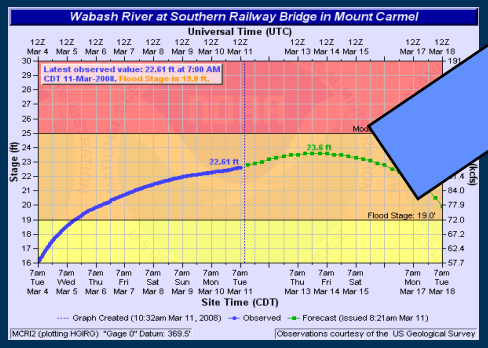
High-water marks



USGS Real-time streamgage data



http://las.depaul.edu/geography/images/Misc_Images/gis.jpg

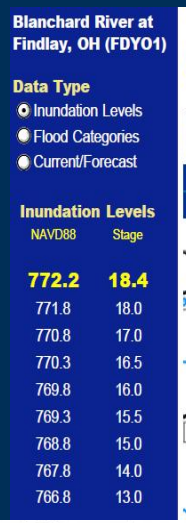


USGS

National Weather Service flood forecasts

I.M. becomes a tool for flood…..

- Preparedness
  - "What-if" scenarios
- Response
  - Tied to gage & forecast data
- Recovery
  - Damage assessment – e.g. HAZUS-MH
- Mitigation & planning
  - Flood risk analyses

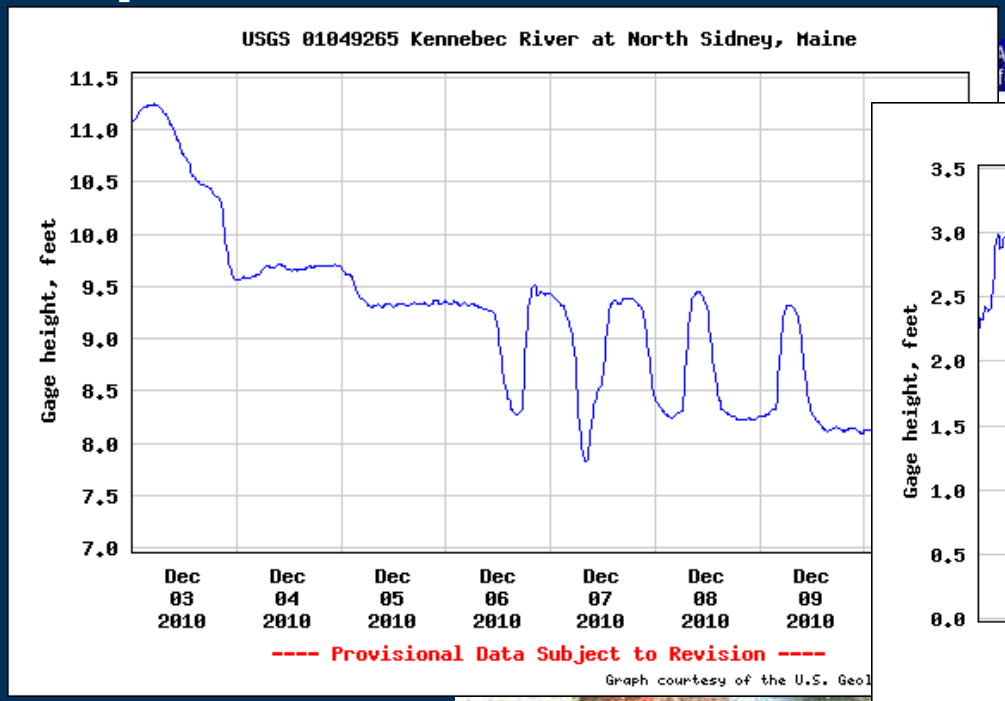


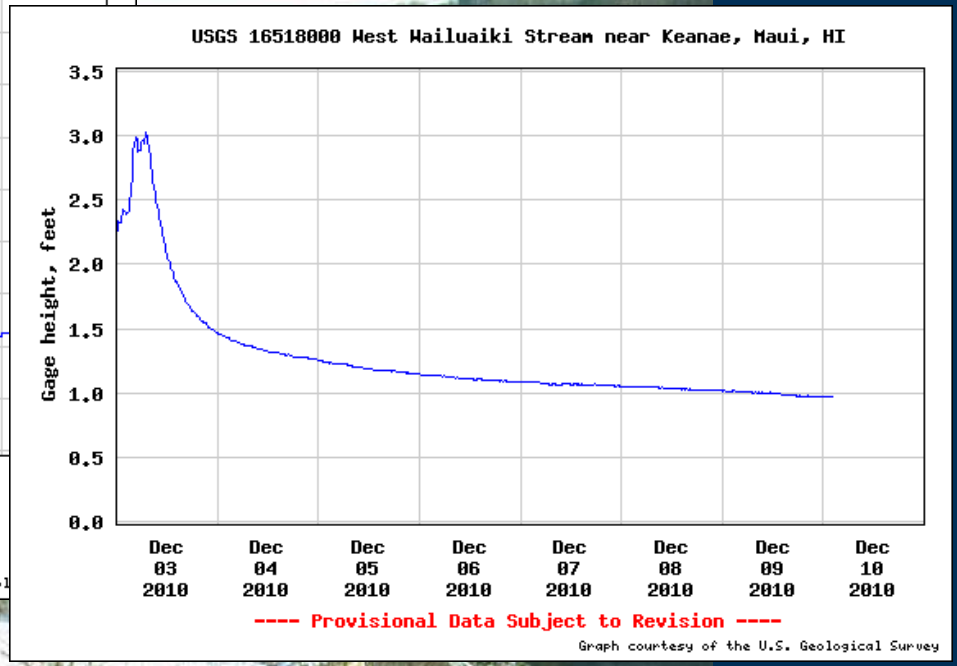
Flooded underpass, Beaumont, TX (photo courtesy of L. Roll/FEMA)

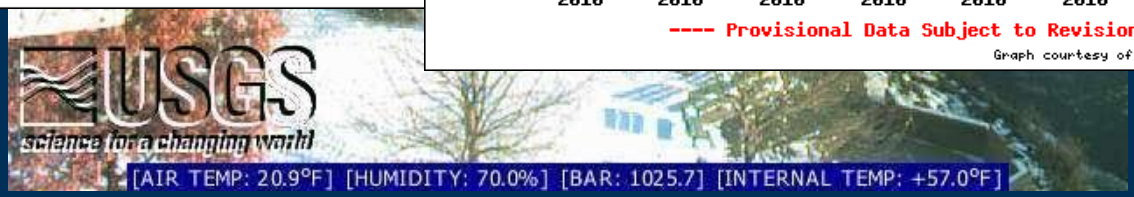
USGS

Quality assurance, standard metadata, and consistent presentation of products

- Goal – consistent “look and feel” to products, like USGS network data



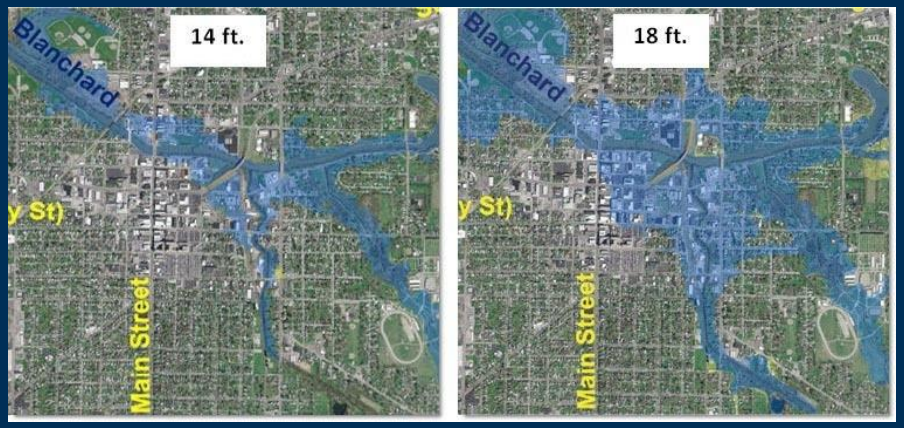




USGS

USGS FIMI Focus Areas

- Major flood documentation: high-water marks
- Static inundation map libraries at gages/flood forecast points
- Real-time, dynamic applications for the future



USGS

Major Flood Documentation

- In Cooperation with FEMA
- Many partners
- USGS report
- Flood causes, magnitudes, & impacts
- Peak profiles and inundation maps

USGS
science for a changing world

In Cooperation with the Federal Emergency Management Agency and th
Indiana Department of Natural Resources, Division of Water

Flood of June 7–9, 2008, in Central and Southe

Open-File

U.S. Departm
U.S. Geologic

USGS
science for a changing world

In Cooperation With the Federal Emergency Management Agency and the
Indiana Department of Natural Resources, Division of Water

Flood of September 2008 in Northwestern Indiana

Open-File Report 2010–1098

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

SILVER JACKETS
MANY AGENCIES ONE SOLUTION
Be Risk Aware!

USGS

N

EXPLANATION

Limit of study

Direction of flow

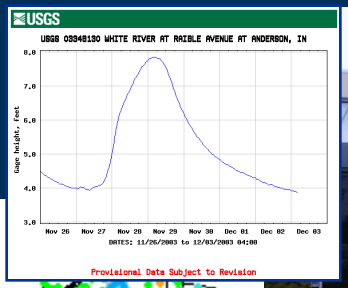
Flood Depth

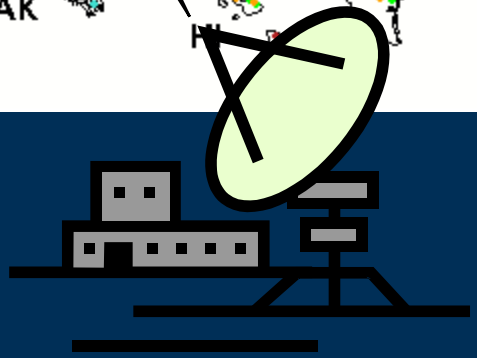
22.4 feet (deep)

0.1 foot (shallow)

0 1,050 2,100 4,200 Feet

Static Inundation Map Libraries



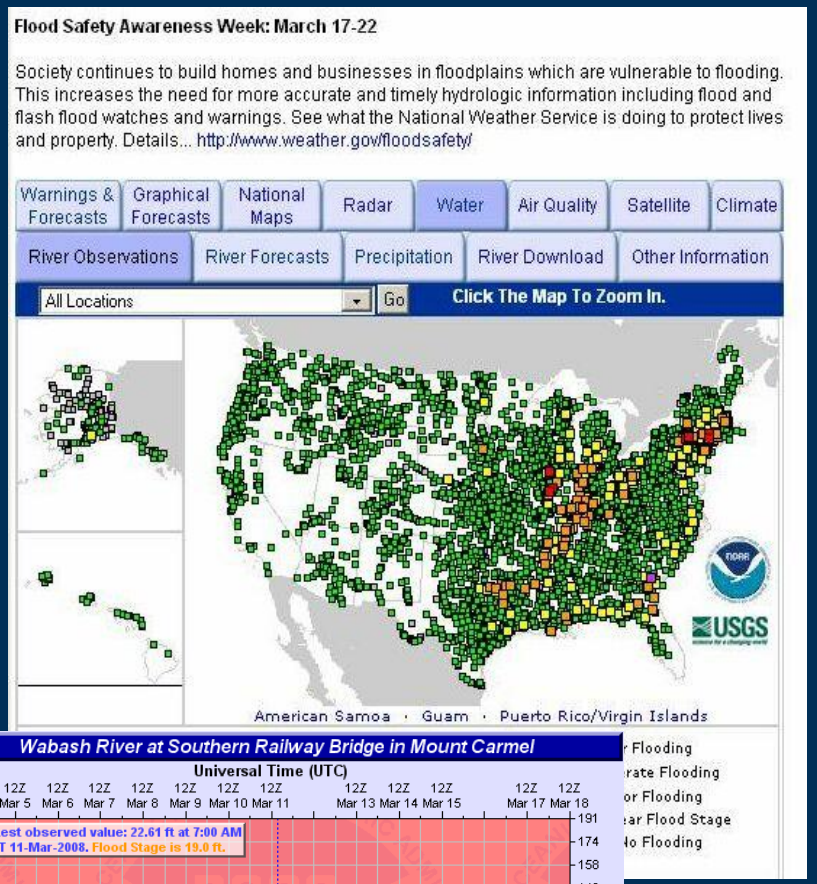


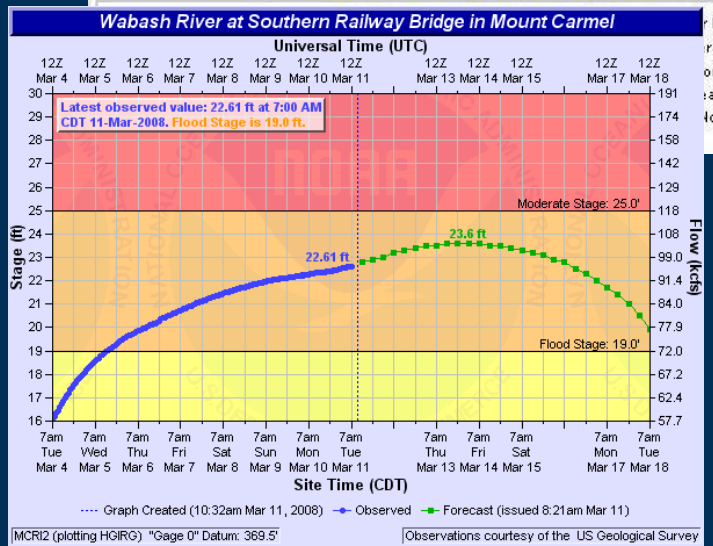
USGS streamgages: 8000 points

NWS AHPS: Advanced Hydrologic Prediction Service

- Forecast stage at flood forecast points
- Most collocated at USGS gages

http://www.weather.gov/ahps/



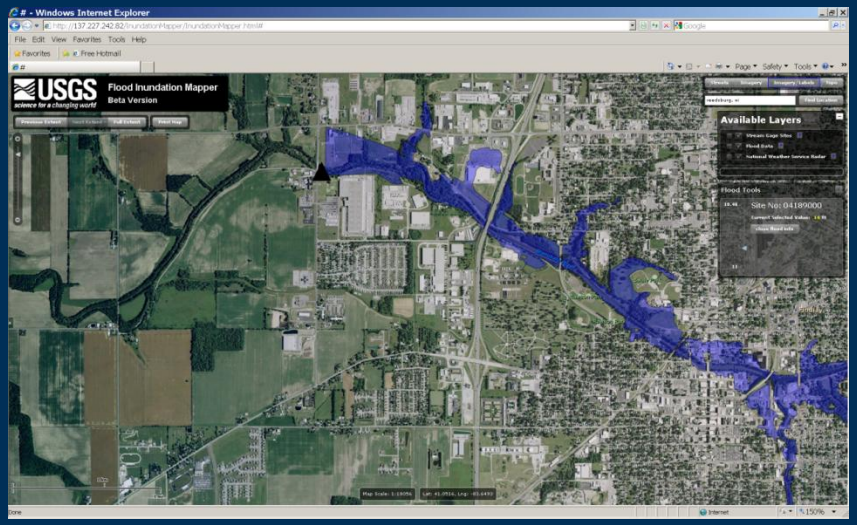


USGS

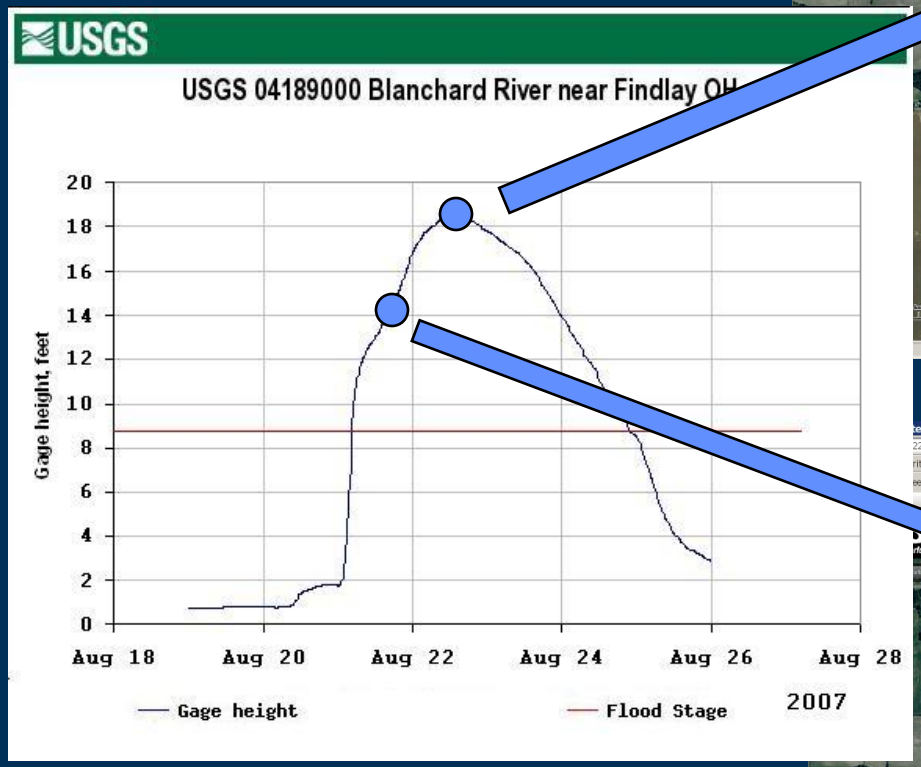
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

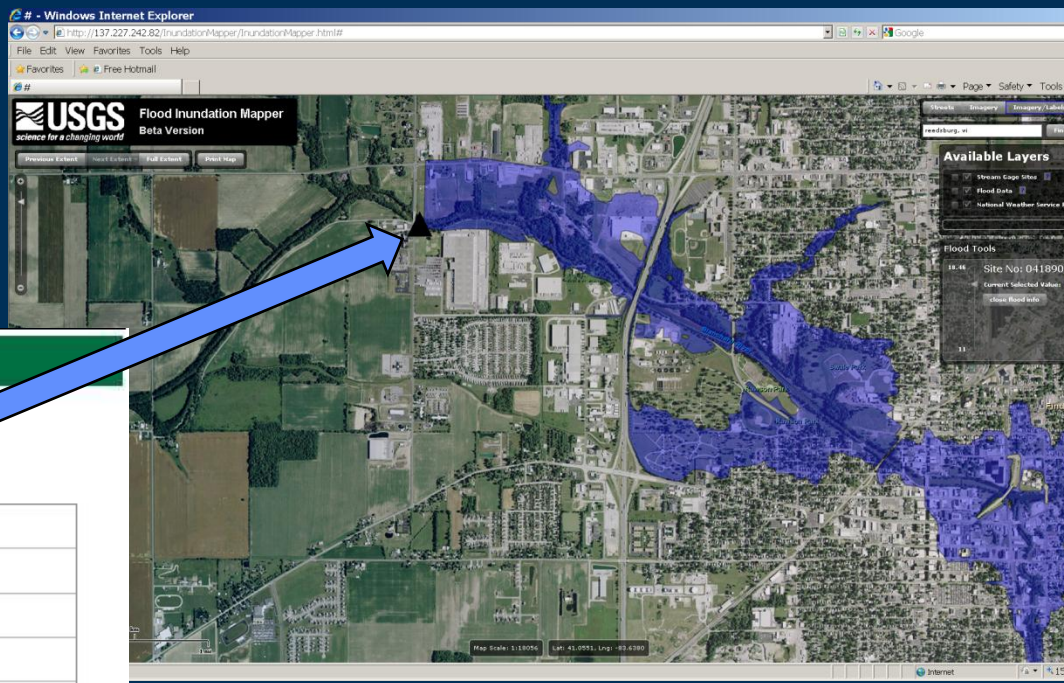
Inundation-map Libraries

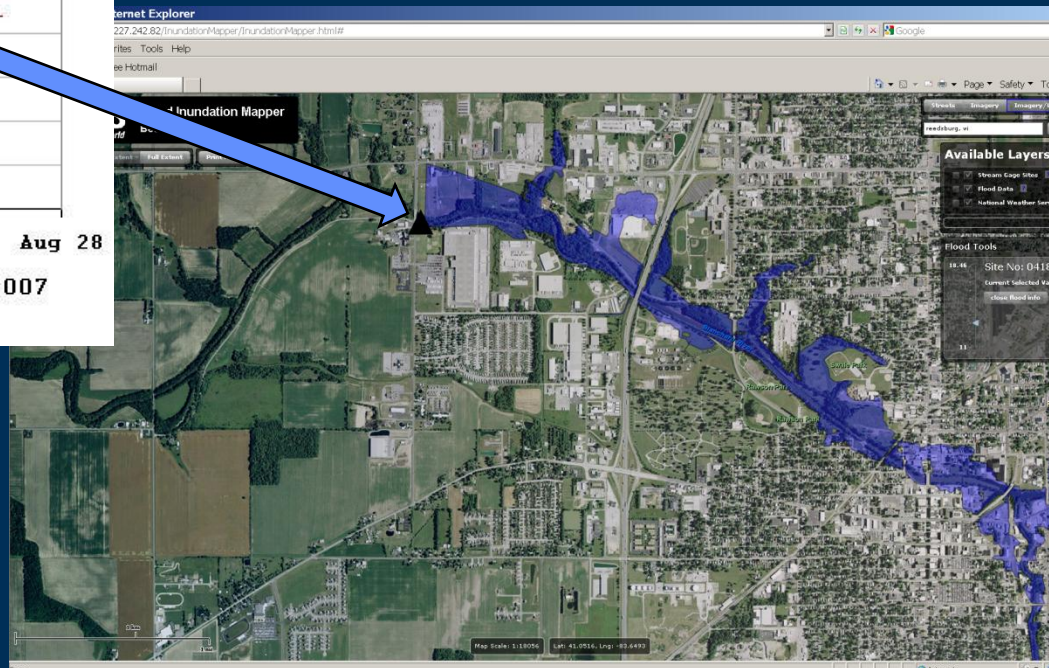
- DEMs + hydraulic model
- Gage/HWMK calibration data
- GIS generated maps
  - bankfull-record stage
  - Predefined map interval
- Linked to USGS real-time gage and NWS flood forecast



USGS


USGS
USGS 04189000 Blanchard River near Findlay OH
Gage height, feet
20
18
16
14
12
10
8
6
4
2
0
Aug 18
Aug 20
Aug 22
Aug 24
Aug 26
Aug 28
2007
Gage height
Flood Stage

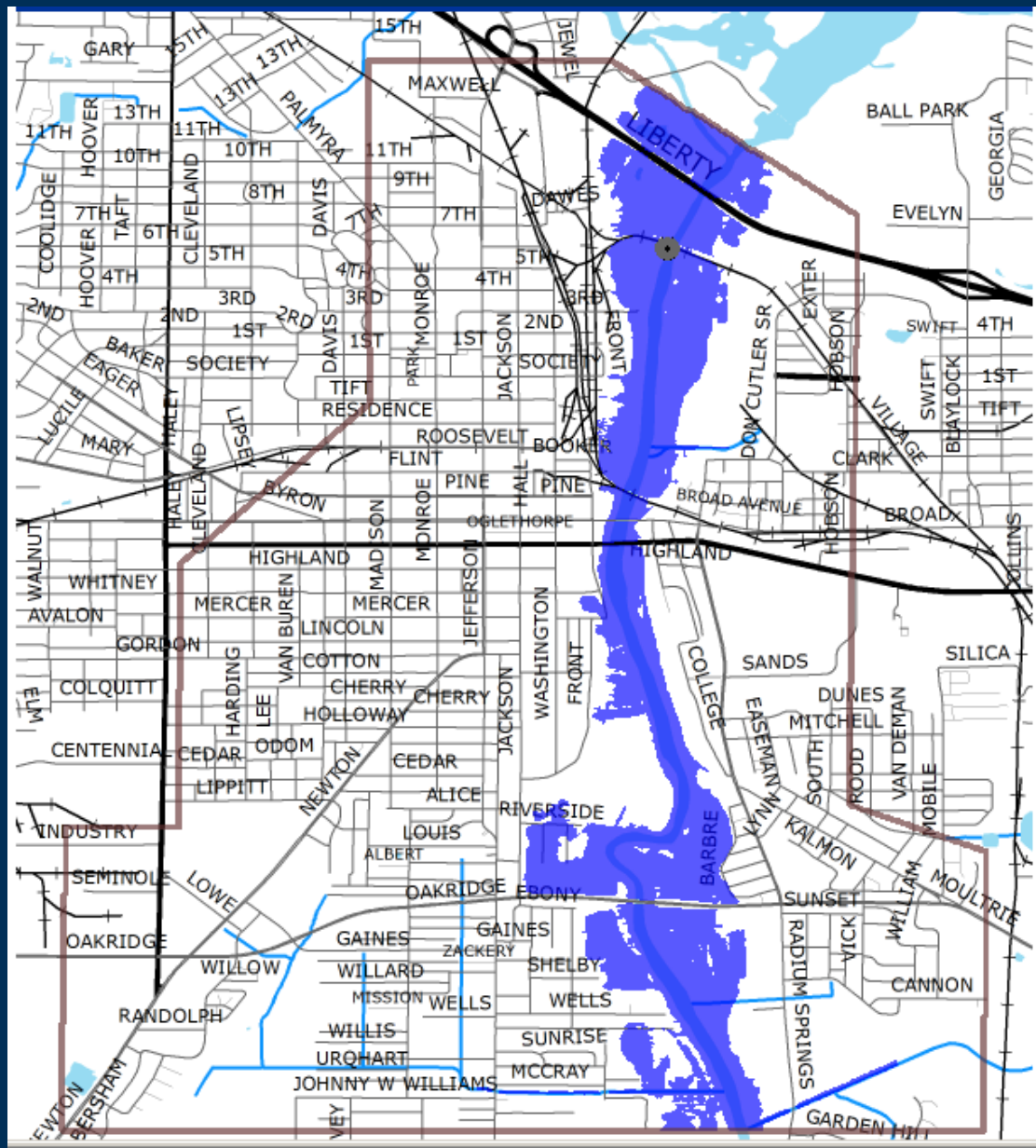

- Windows Internet Explorer
USGS
Flood Inundation Mapper
Beta Version
Available Layers
Flood Tools


Available Layers
Flood Tools

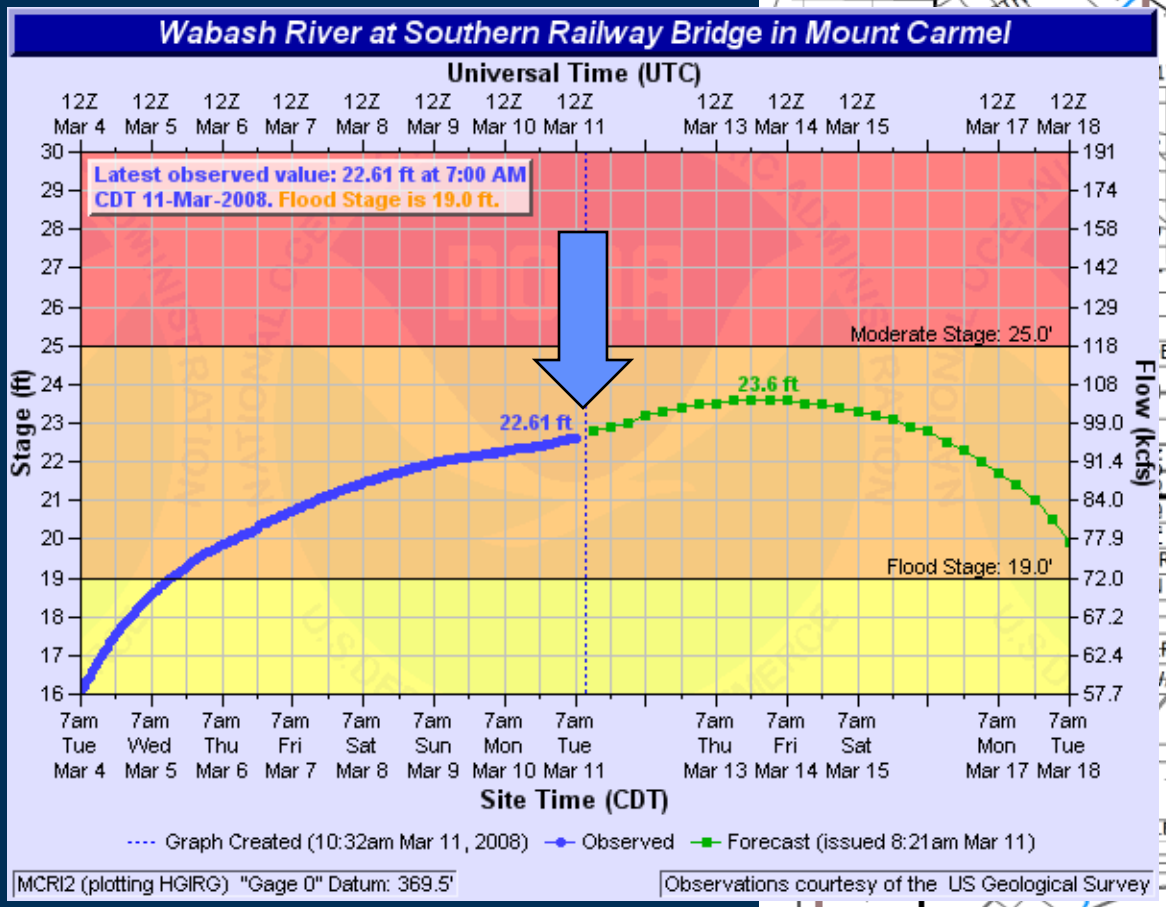
USGS

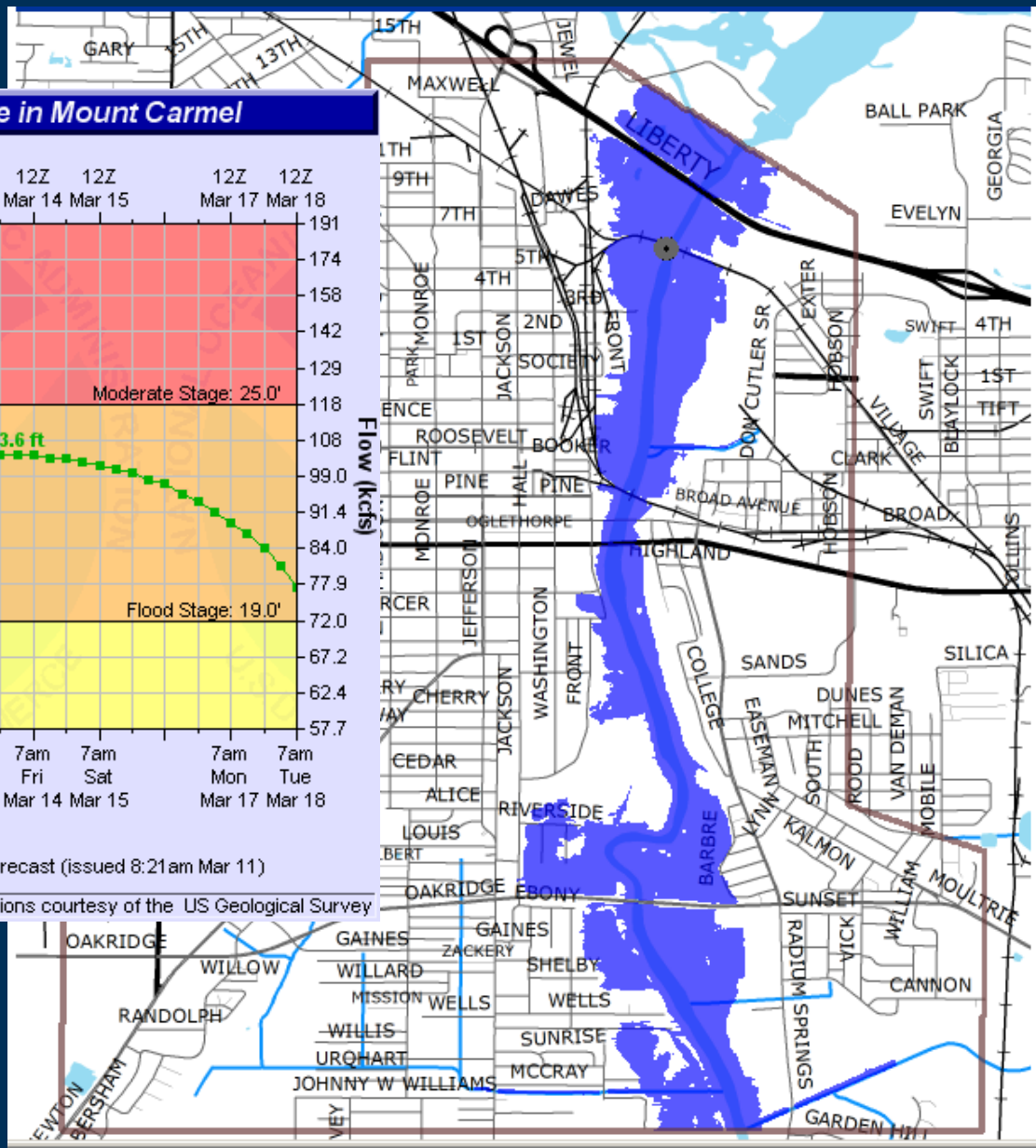
Static Libraries – served through AHPS

Flooded underpass, Beaumont, TX (photo courtesy of L. Roll/FEMA)



Static Libraries



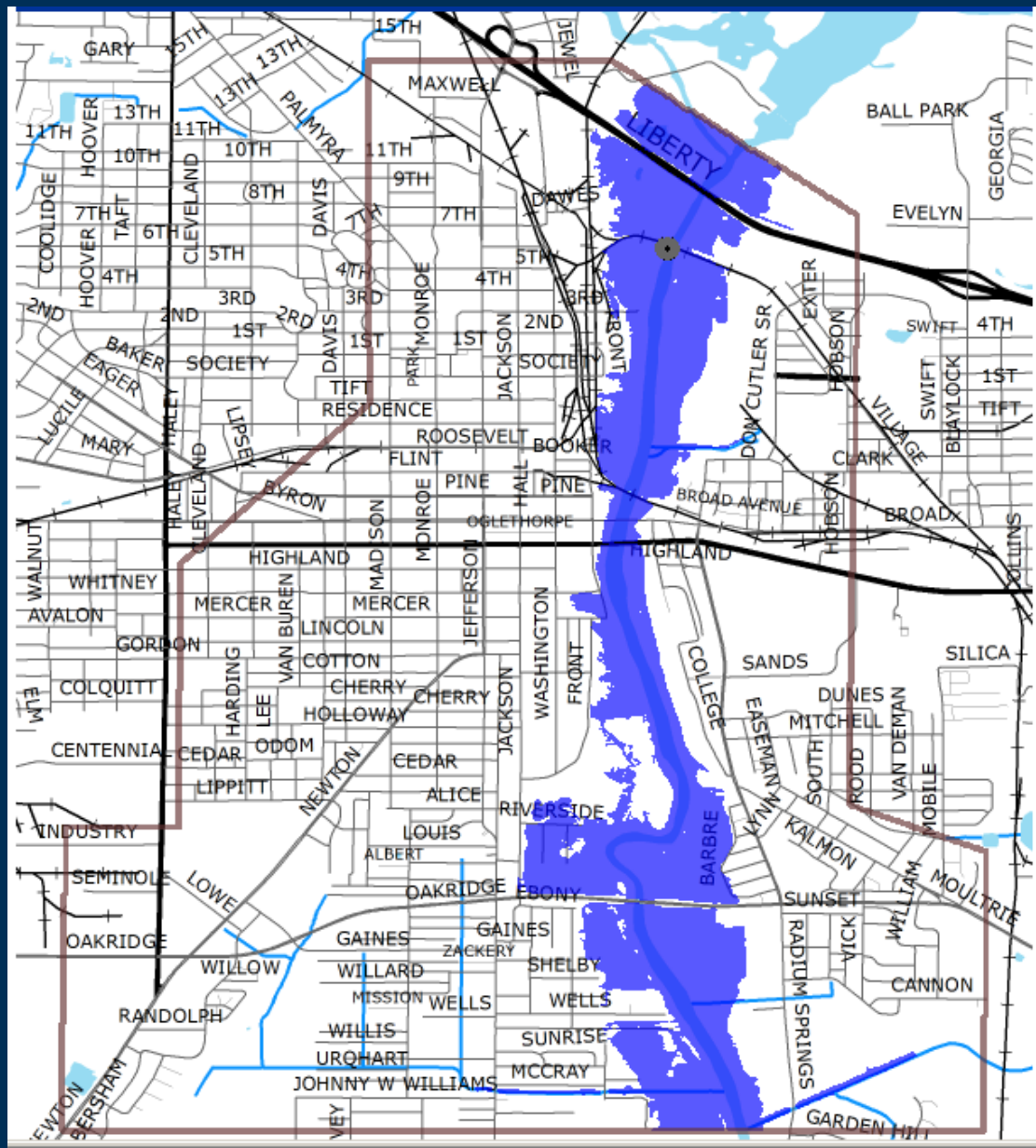


USGS

NATIONAL WEATHER SERVICE

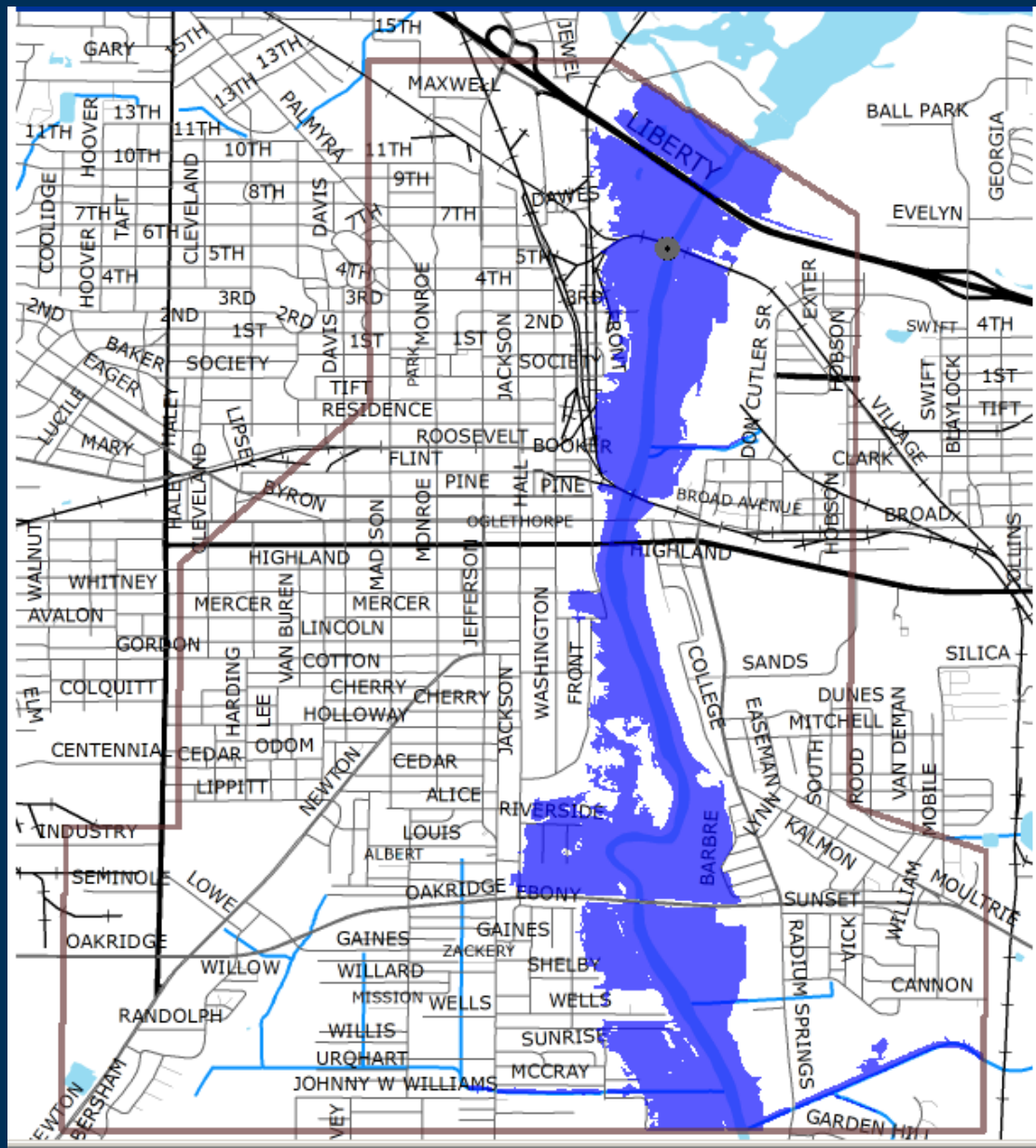
Static Libraries

12 feet



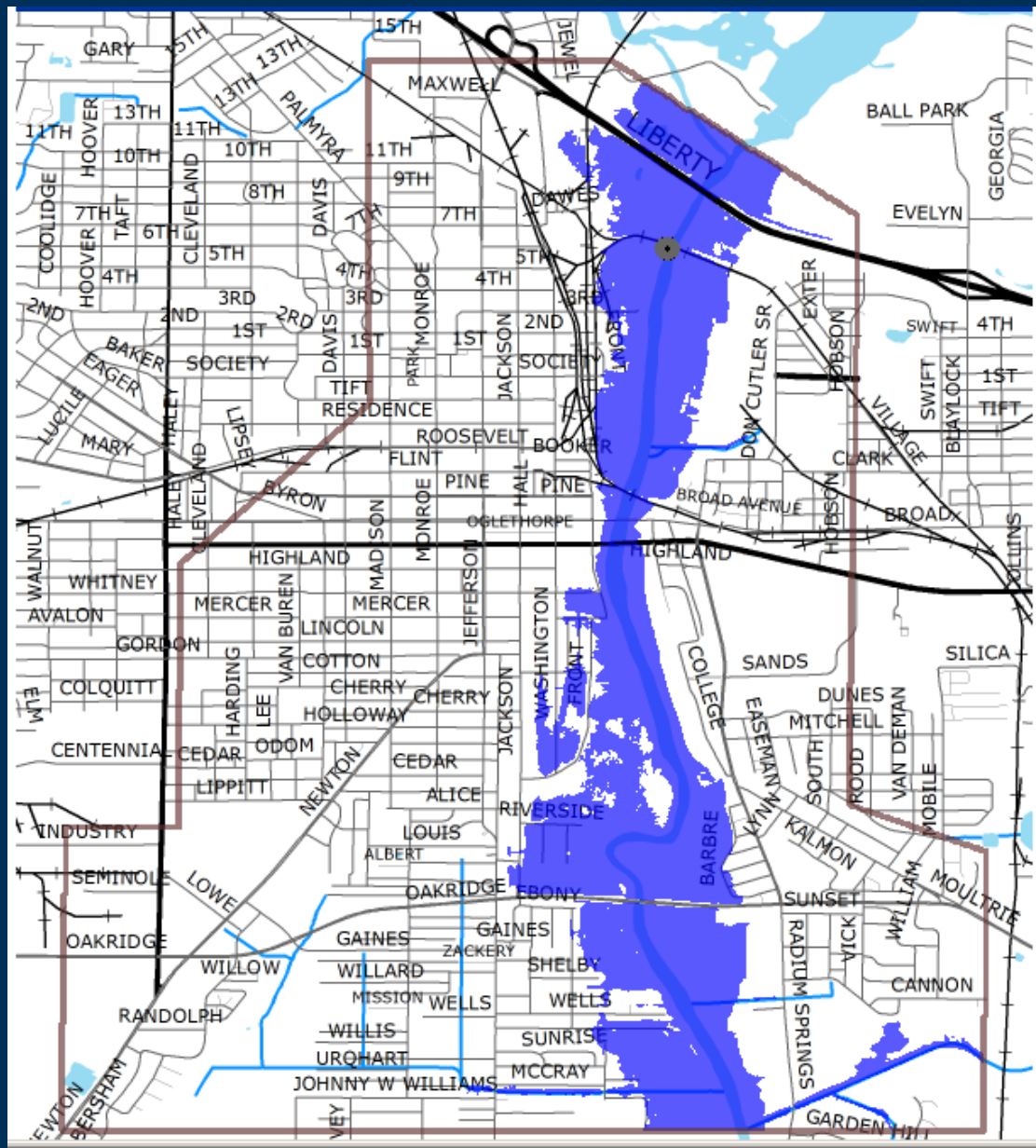
Static Libraries

13 feet



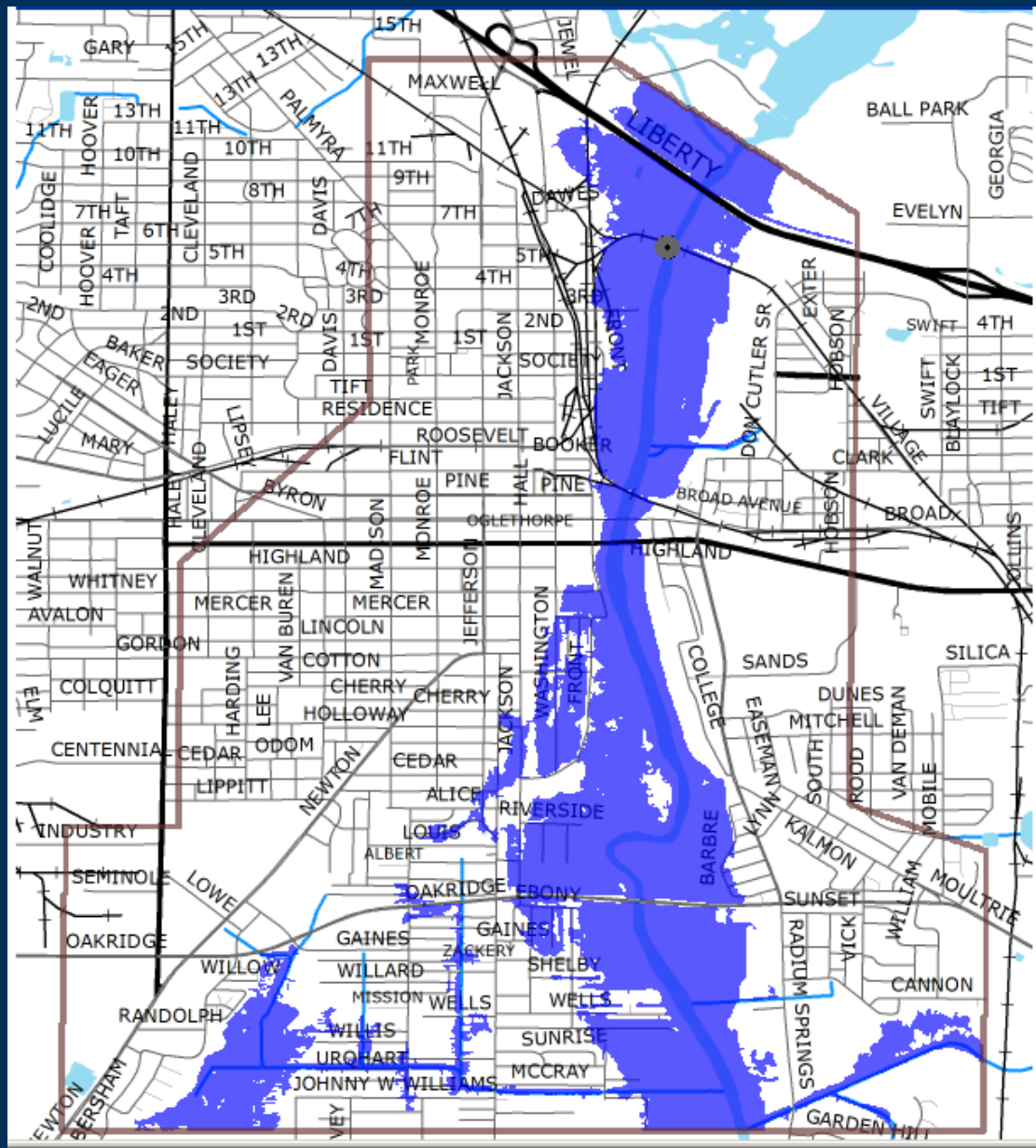
Static Libraries

14 feet



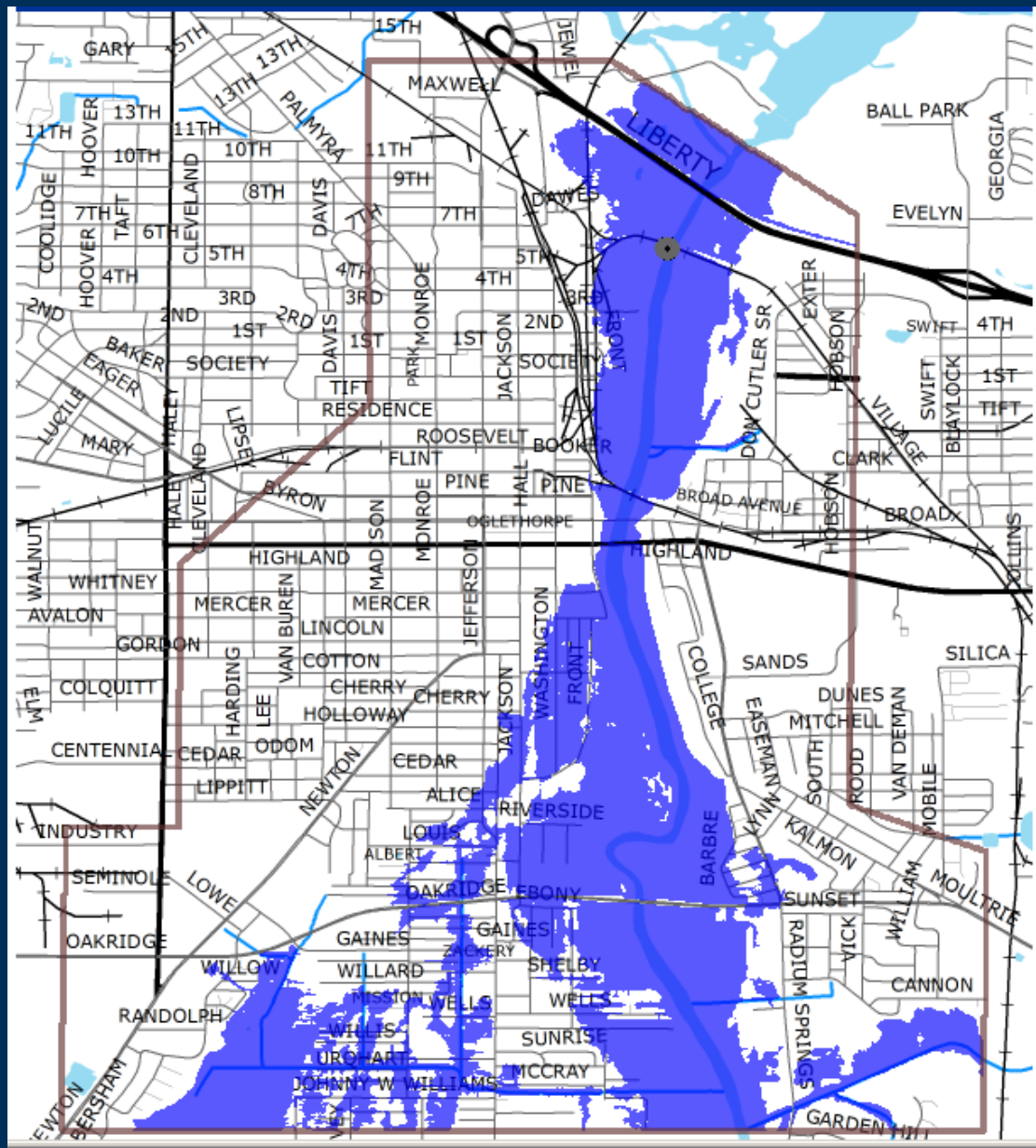
Static Libraries

15 feet



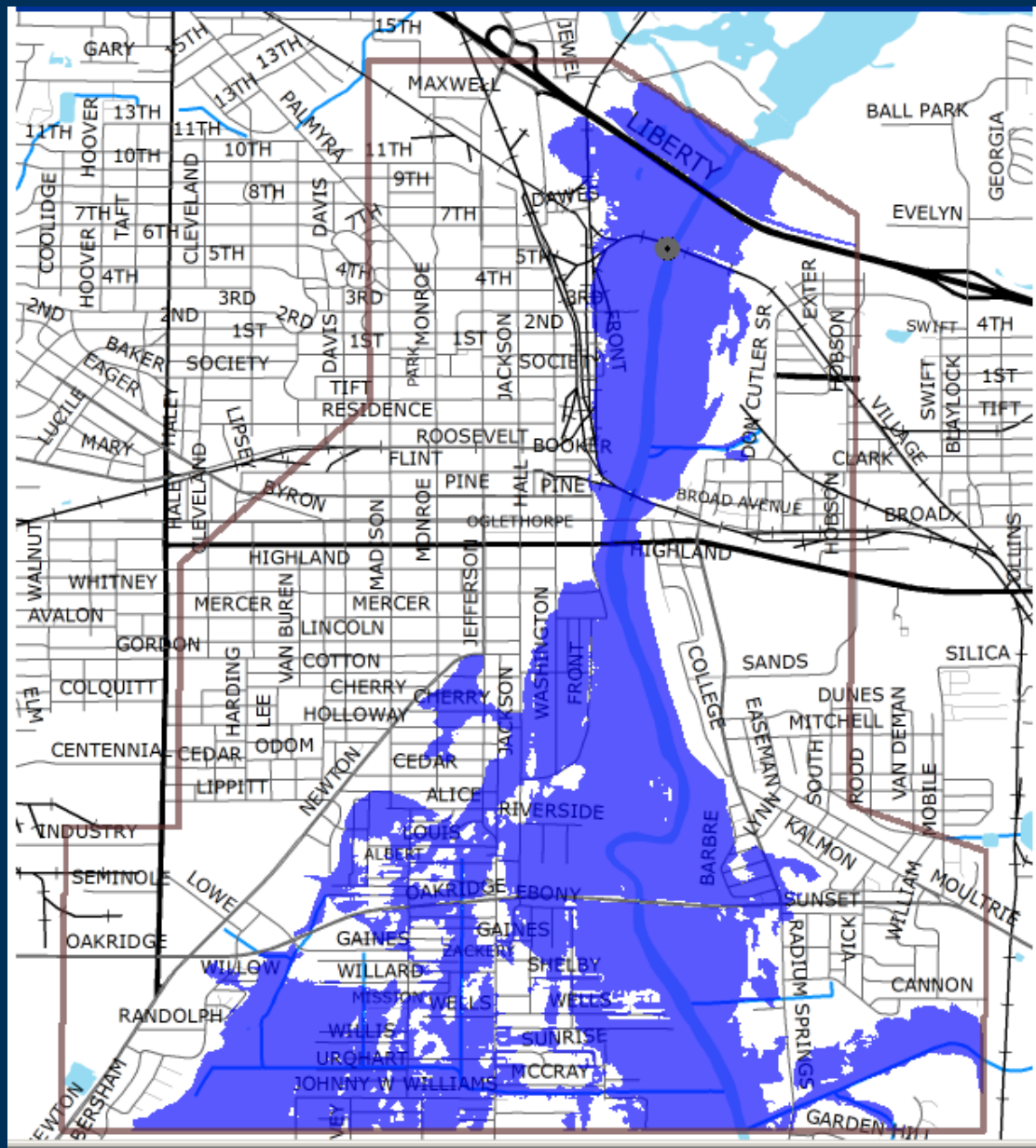
Static Libraries

16 feet



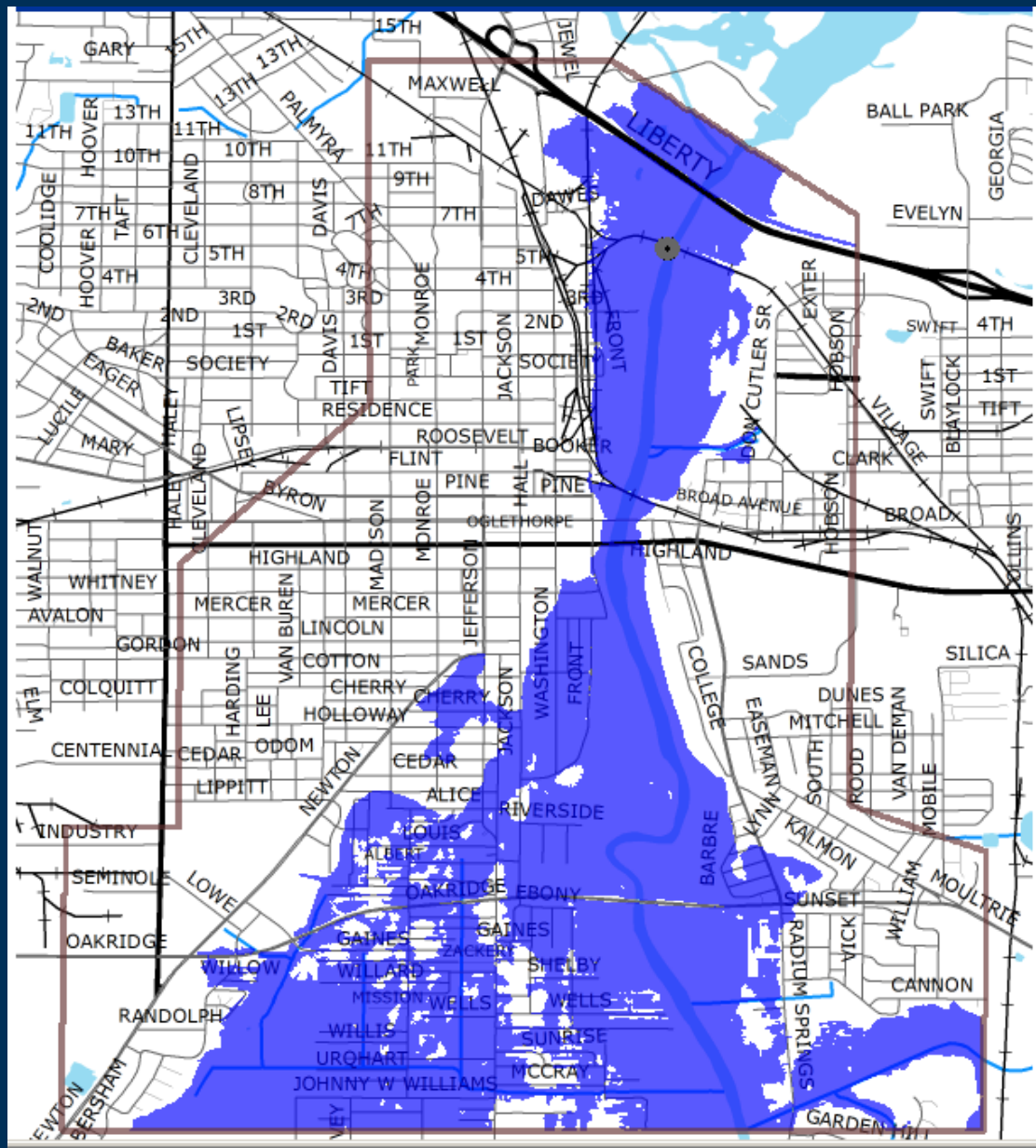
Static Libraries

17 feet



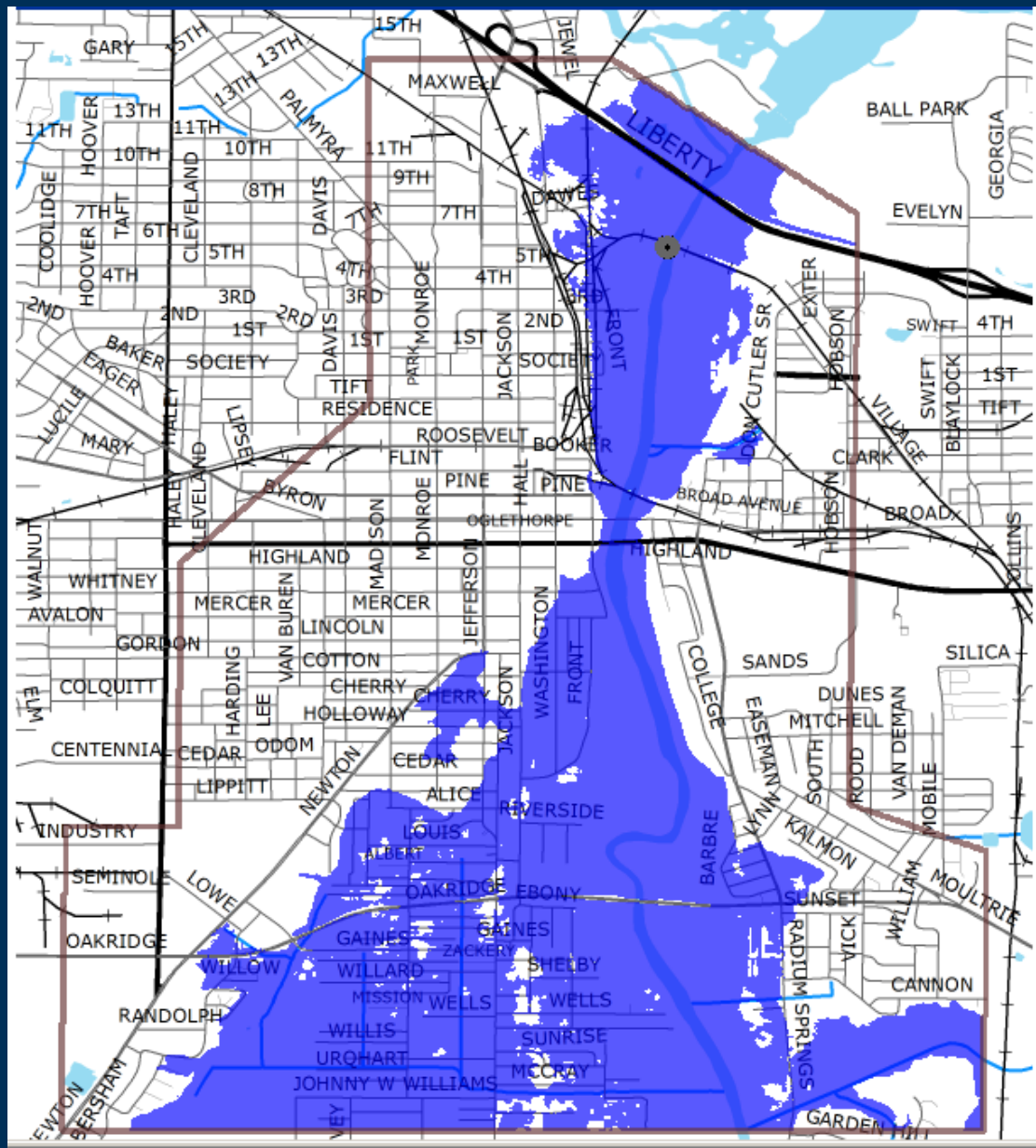
Static Libraries

18 feet



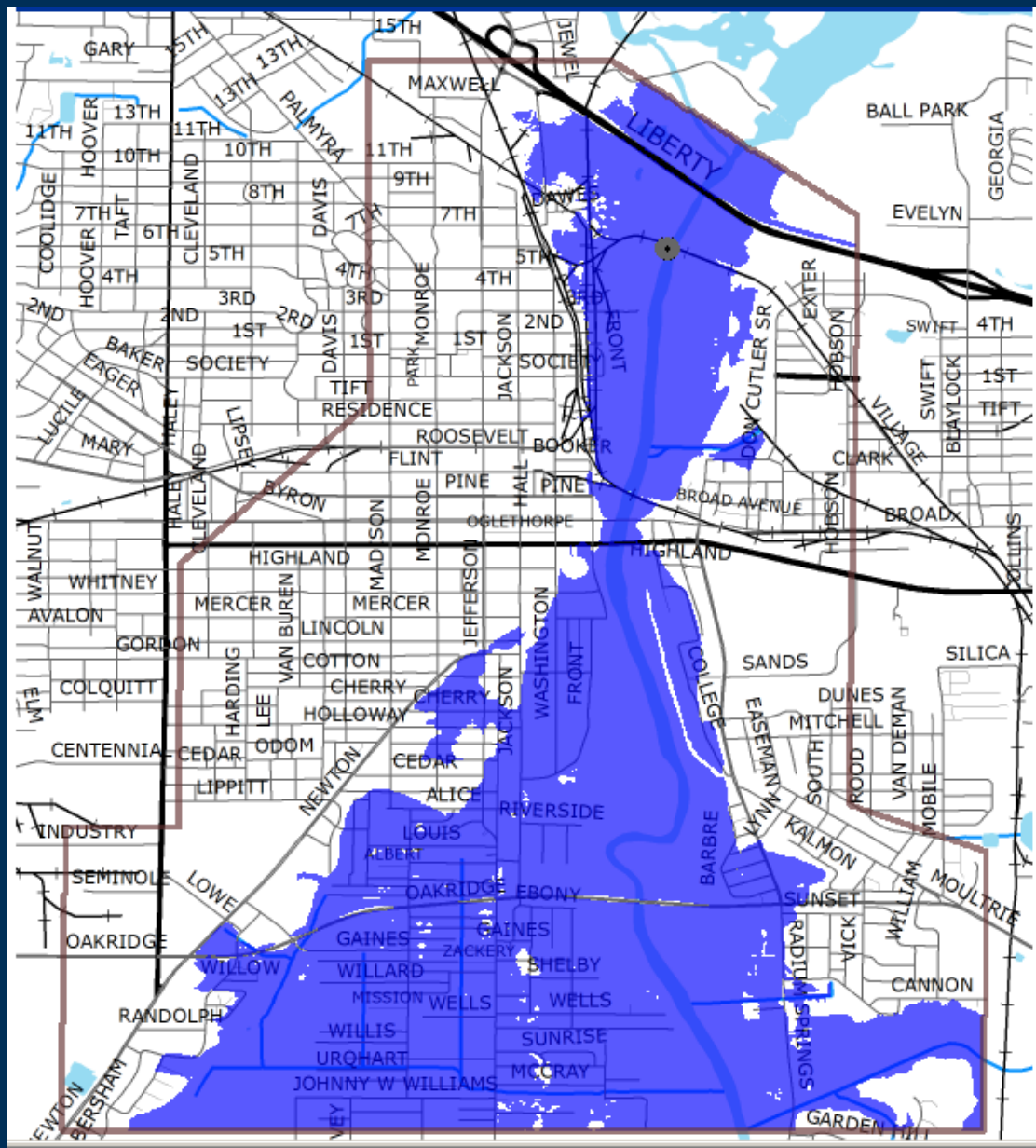
Static Libraries

19 feet



Static Libraries

20 feet

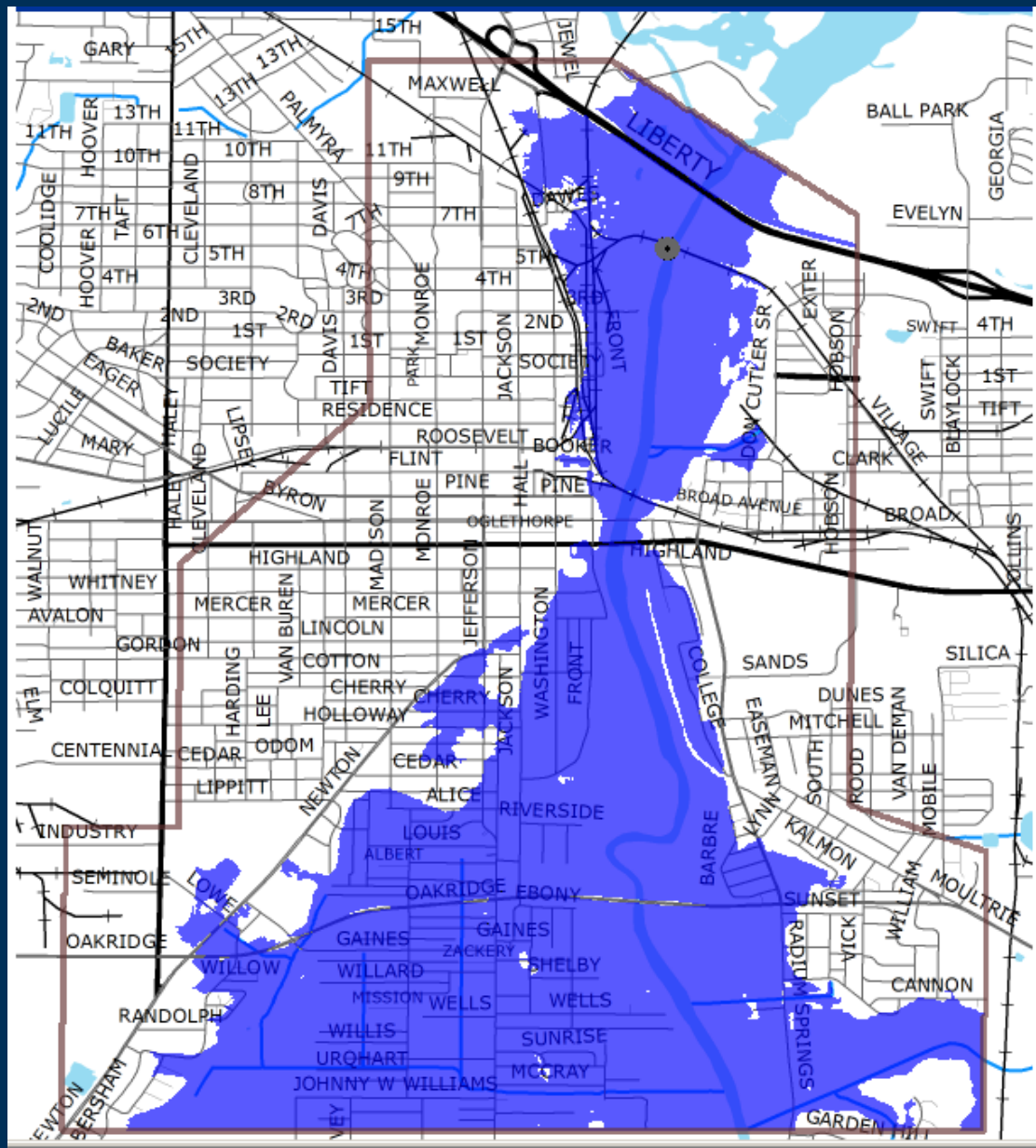


USGS

NATIONAL WEATHER SERVICE

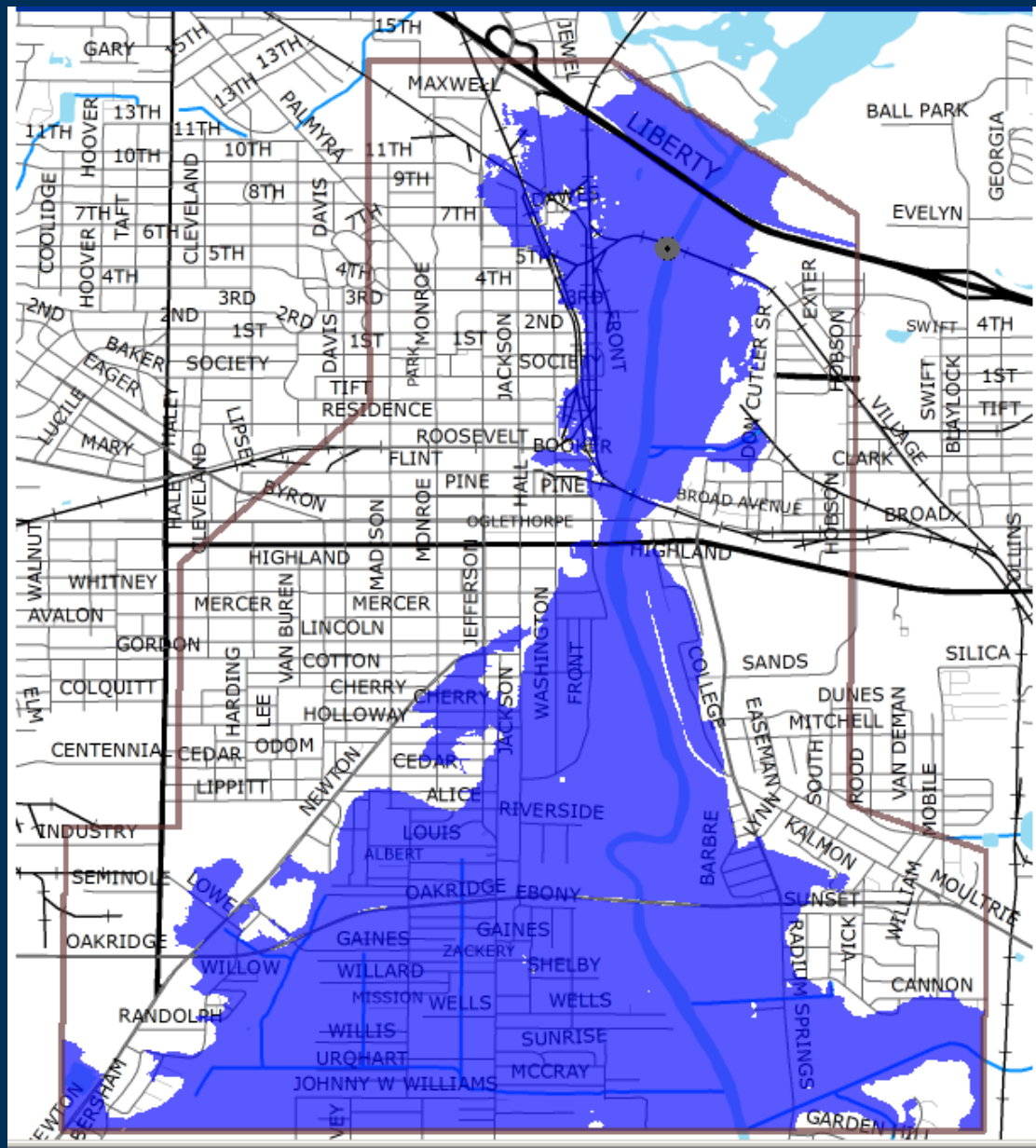
Static Libraries

21 feet



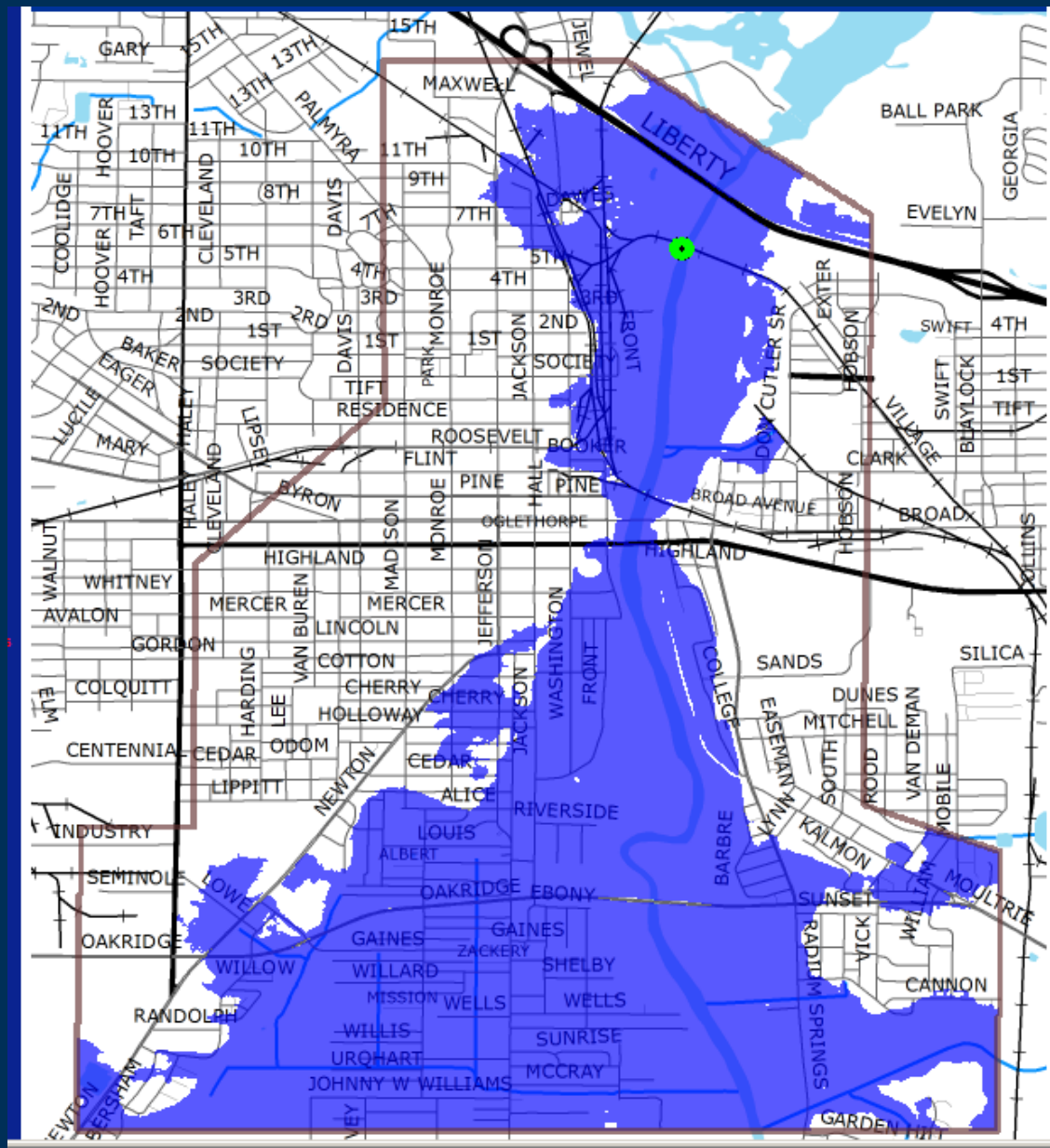
Static Libraries

22 feet



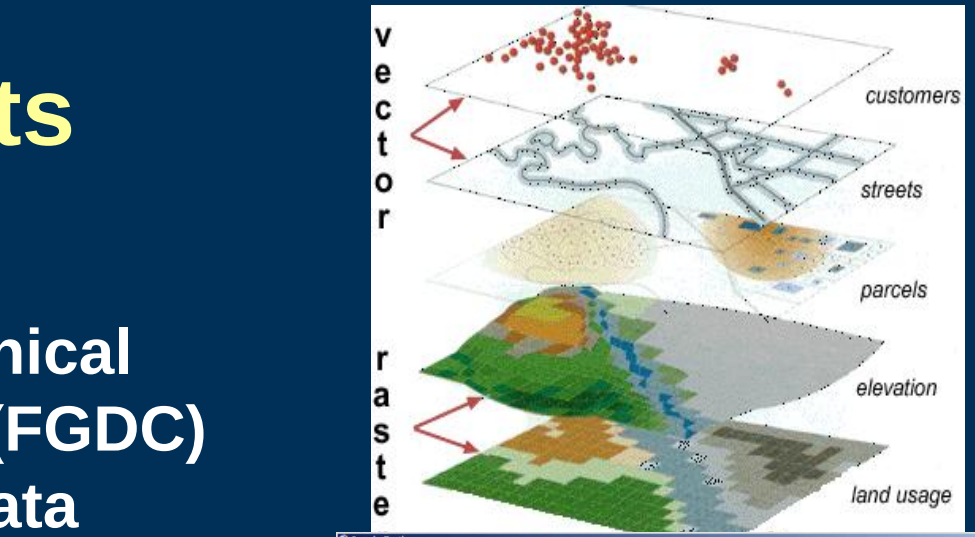
Static Libraries

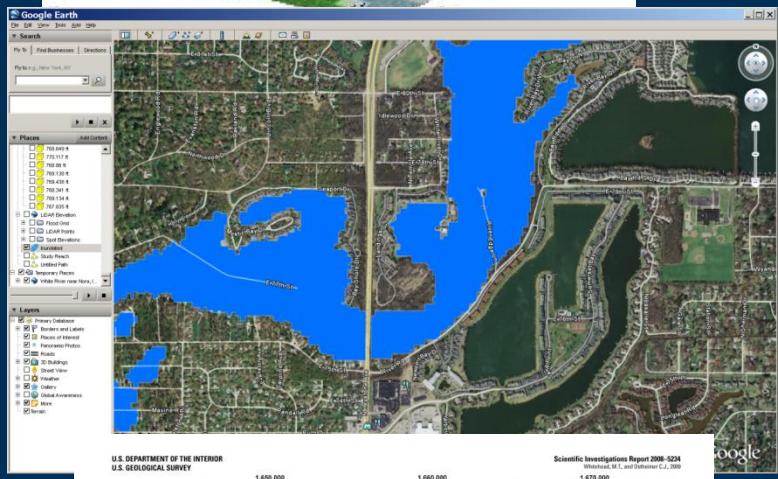
Forecast
Peak



FIMI File Formats

- GIS
  - Federal Geographical Data Committee (FGDC) compliant metadata
- KML/KMZ – Keyhole Markup Language (Zip)
- PDF/JPG
- Available through FIMI Web Portal

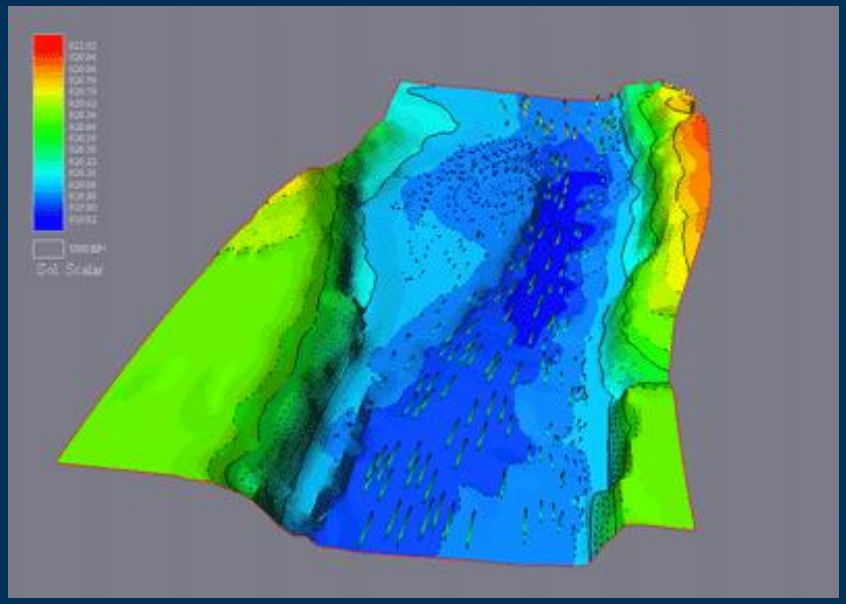




USGS

Dynamic applications

- Real-time dynamic map applications run flood simulations and create maps "on the fly" during a flood
- Can provide flood extent, depth, & even arrival time and water speed
- State of the art, ultimate destination for FIMI



USGS

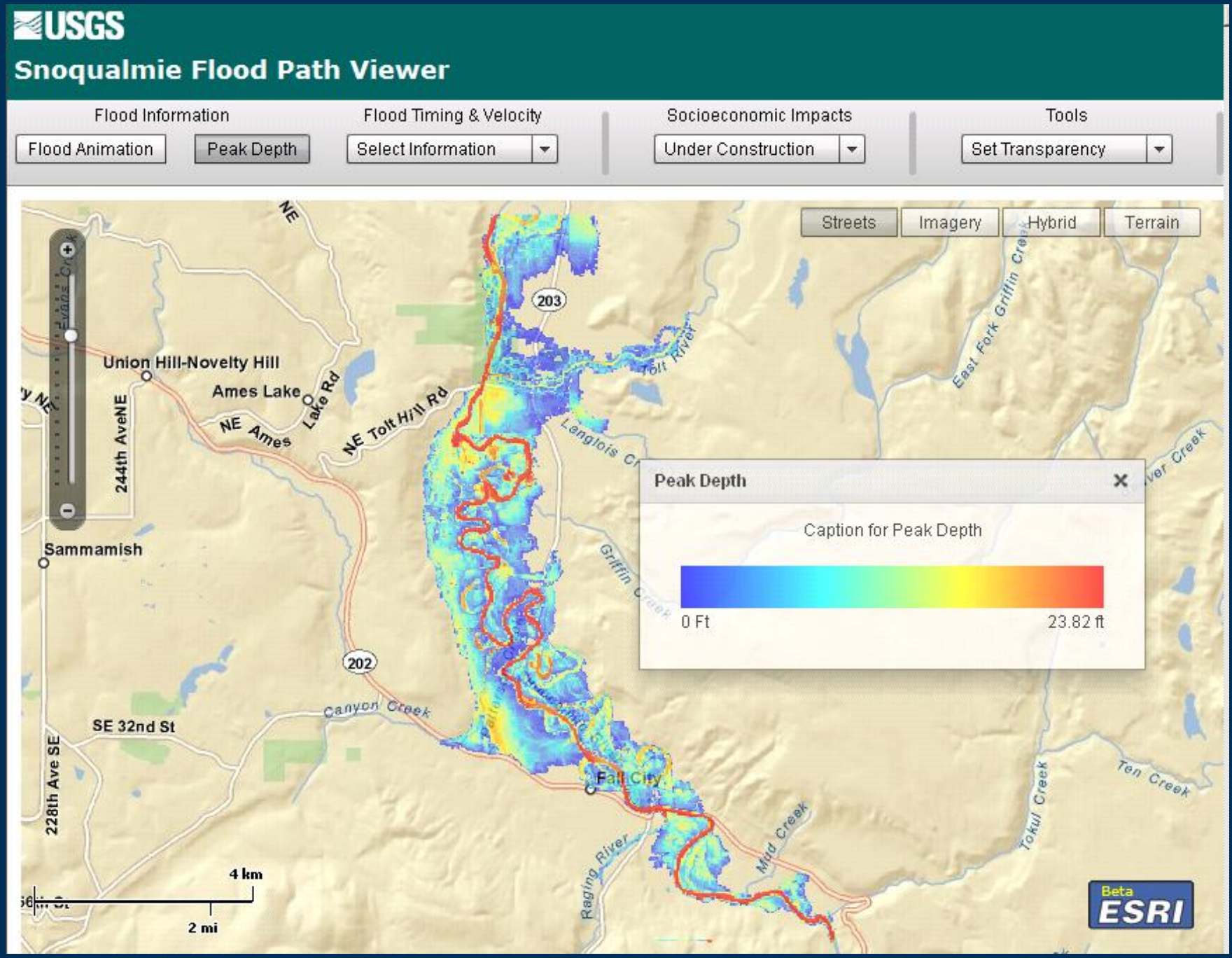
floodpath

Mapping a Flood...Before it Happens

- Washington State – Snoqualmie River
- NWS flow forecasts fed to hydraulic model
- Model results GIS: flood timing, depth, etc.
- Maps to Web serving software
- Available soon after forecast issued
- Updated every 6 hours

http://wa.water.usgs.gov/cgi/flood_snoqualmie.cgi

USGS


USGS
Snoqualmie Flood Path Viewer
Flood Information
Flood Animation
Peak Depth
Flood Timing & Velocity
Select Information
Socioeconomic Impacts
Under Construction
Tools
Set Transparency
Streets
Imagery
Hybrid
Terrain
Peak Depth
Caption for Peak Depth
0 Ft
23.82 ft
Union Hill-Novelty Hill
Ames Lake
NE Ames
Lake Rd
NE Tolt Hill Rd
244th AveNE
Sammamish
203
202
Tolt River
East Fork Griffin Creek
Griffin Creek
Canyon Creek
SE 32nd St
228th Ave SE
Fall City
Raging River
Mud Creek
Tokul Creek
Ten Creek
4 km
2 mi
Beta
ESRI

USGS

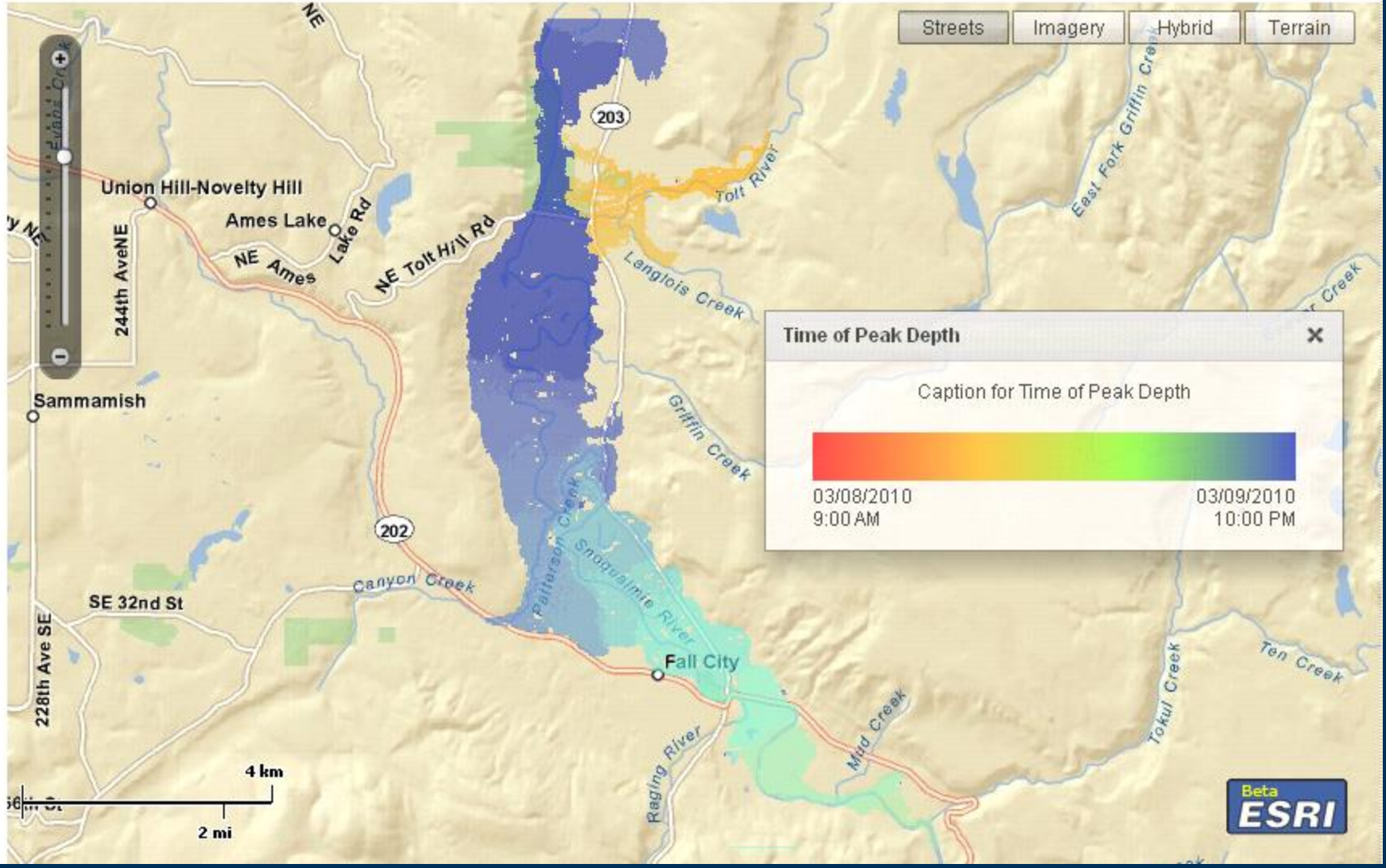
Snoqualmie Flood Path Viewer

Flood Information: Flood Animation | Peak Depth

Flood Timing & Velocity: Time of Peak Depth

Socioeconomic Impacts: Under Construction

Tools: Set Transparency



Example of exposure analysis

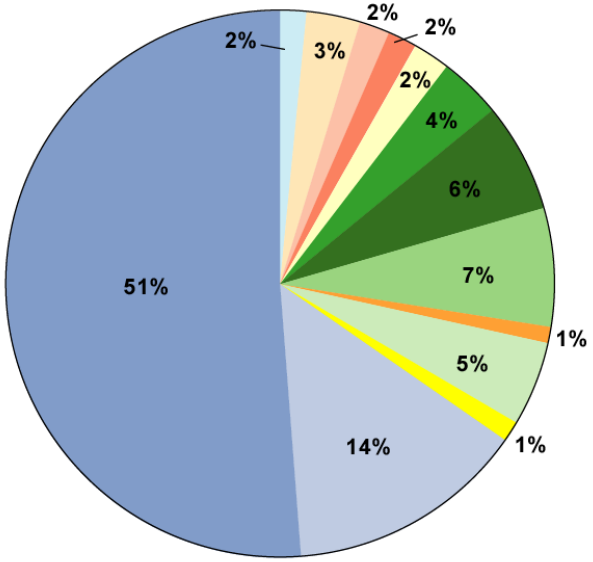
Exposure when forecast flood stage reaches 15 feet at Nisqually River at McKenna

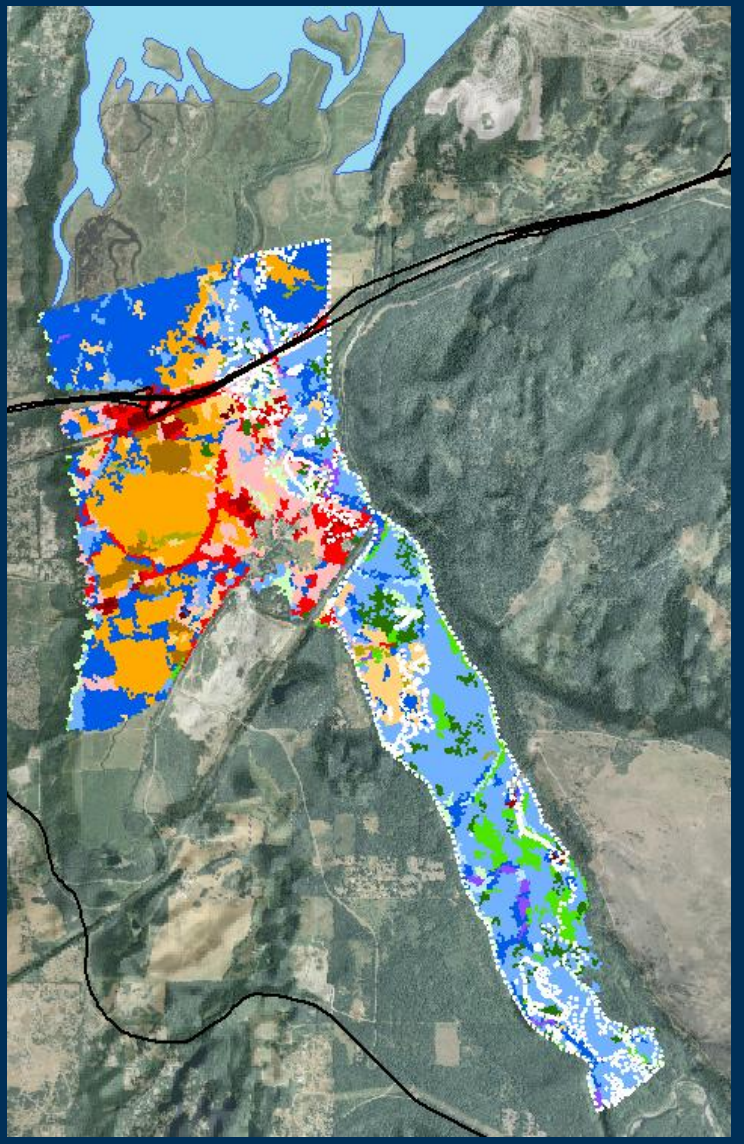
- Residents – 262
- Businesses - 4
- Employees – 49
- Business types – school, campground, nonprofit organization, construction
- Land cover types:

Amount of land in flood hazard zone (sq. km)

Open Water	0.1
Developed, Open Space	0.2
Developed, Low Intensity	0.1
Developed, Medium Intensity	0.1
Developed, High Intensity	0.0
Barren Land (Rock/Sand/Clay)	0.2
Deciduous Forest	0.3
Evergreen Forest	0.4
Mixed Forest	0.5
Shrub/Scrub	0.1
Grasslands/Herbaceous	0.3
Pasture/Hay	0.1
Cultivated Crops	0.0
Emergent Herbaceous Wetlands	1.0
Woody Wetlands	3.6

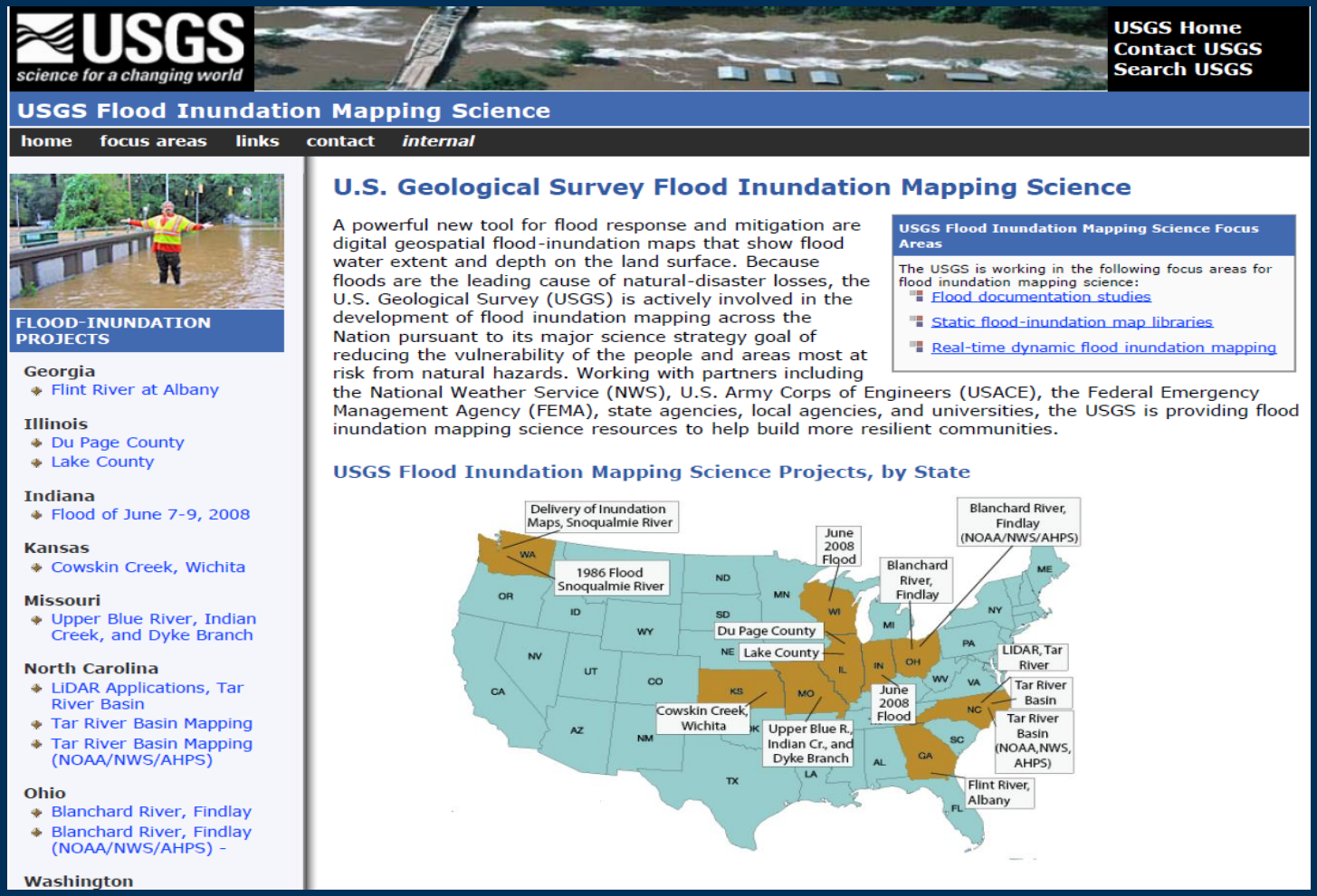
Percentage of land, by type, in flood hazard zone





Dotted white line denotes15-ft hazard zone

Web Portal



USGS

http://water.usgs.gov/osw/flood_inundation/

Flood-peak inundation areas for selected streams in Northwestern Indiana during the Flood of September 2008

Use the links below to download flood-inundation images and geospatial data. For each site, data is offered in three formats:

- JPG: Low resolution images (300 Kb)
- PDF: High resolution images (25-50 Mb)
- KMZ: Used by applications, as in Google Earth, to display geospatial data (8 Kb)

	JPG (low resolution)	PDF (high resolution)	KMZ *
Deep River near Hobart, Lake County		 (50 Mb)	
Little Calumet River (east) near Hammond, Lake County		 (45 Mb)	
Little Calumet River (west) near Hammond, Lake County		 (40 Mb)	
Turkey Creek near Schererville, Lake		 (25	

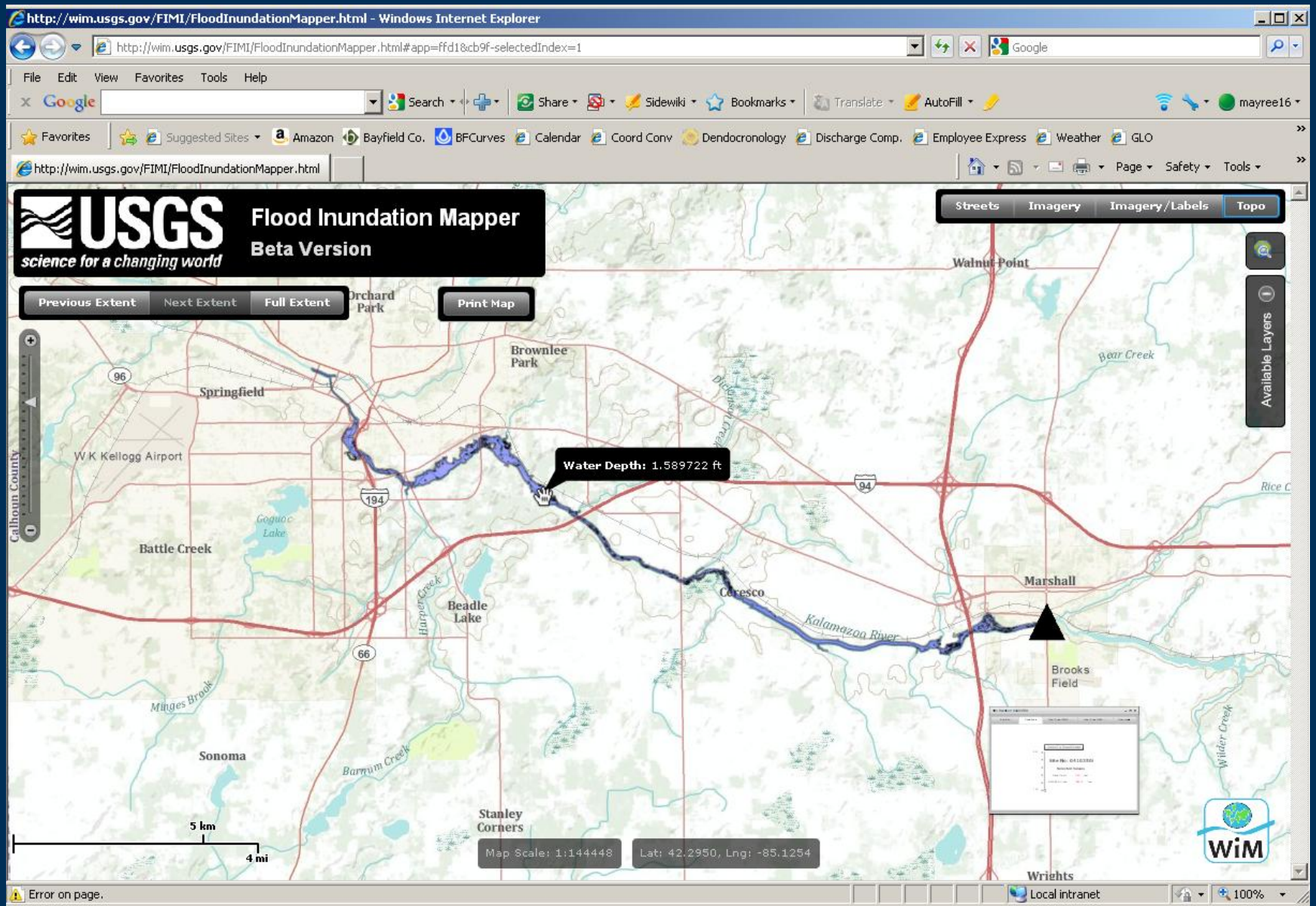
 GIS layers; ESRI raster and vector files, and associated metadata files (19 Mb ZIP file)

Products

- Broad-based and universal
- Useable for many outlets and applications
  - USGS Web Mapping Application
  - AHPS
  - HAZUS
  - Google Map
  - SAGE
  - USGS Web Mapping Application
  - National Map
  - FLEX viewers
  - Mobile Apps

USGS

USGS Web Mapping Application



WaterAlert

- WaterAlert allows you to receive test or email alerts
- Subscriber based
- You choose alert thresholds
- Works for any USGS real-time parameter
  - Stage
  - Streamflow
- Planning a FIMI tie in

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

Food for thought

Flood maps – not just for urban flooding

- Agricultural applications
  - IN project with USDA to map 7-day inundation areas for Wetland Reserve Program
- Ecological applications
  - MI Kalamazoo River Oil Spill

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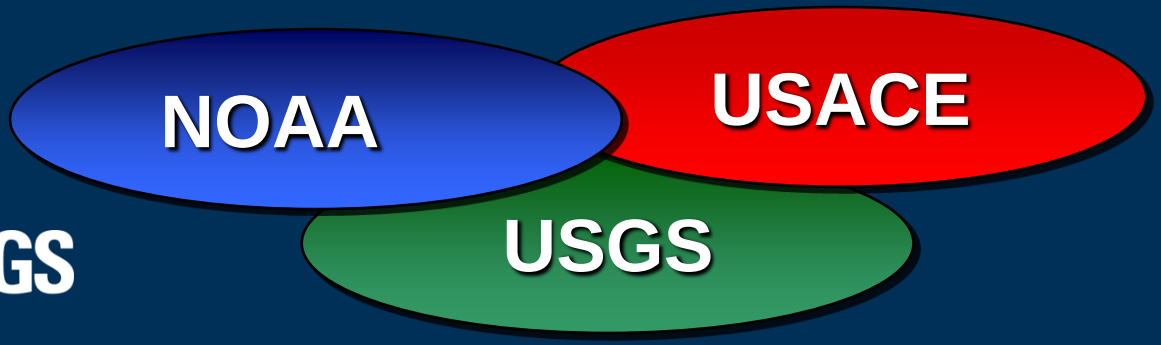
Next Steps

- Map libraries - continue to add States and sites as resources allow (collaborative efforts)
- Continue partner building
  - Solidify Federal Tech Standards through IWRSS
  - Work with FEMA e.g. HAZUS and Risk MAP
- National Hydrologic Warning Council meeting, San Diego, May 9-12



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Mid- to long-term issues

- Uncertainty
- Coastal inundation
- Breach analysis/inundation

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THANK YOU!

Scott Morlock

317-290-3333 x153

smorlock@usgs.gov

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