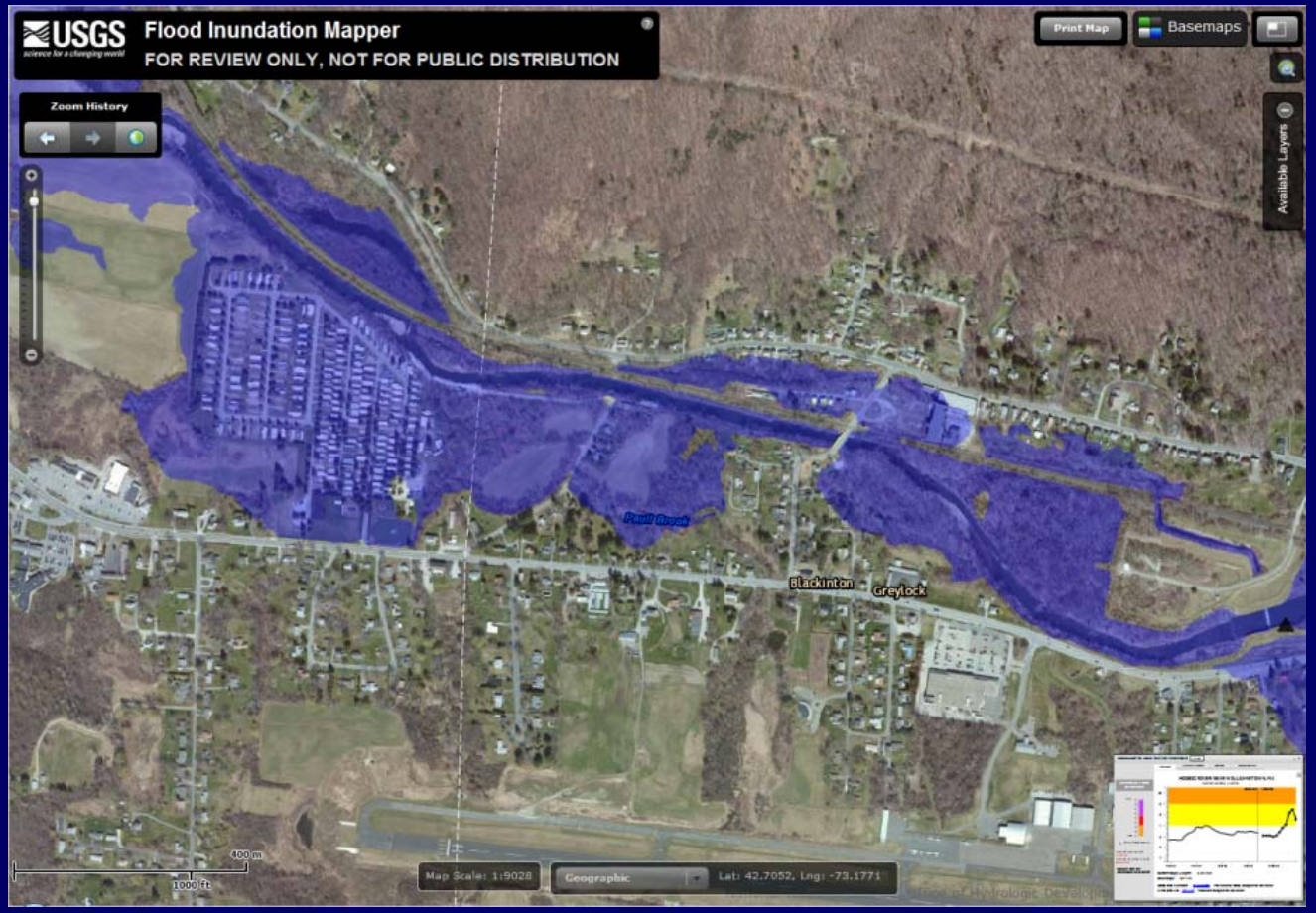
FLOOD INUNDATION MAPPING SCIENCE



USGS science for a changing world

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

FEMA

Integrated Water Resources Science and Services SUMMIT TO SEA

What is Flood Inundation Mapping?

Flood Inundation Mapping (FIM) is a real-time, floodplain mapping tool that visually relates USGS streamgage data and NWS forecasts to flood risk for the primary purpose of ***public safety***, but also has significant benefits of:

- Effectively reduce vulnerability and repetition of loss to infrastructure
- Promotion of risk-wise behavior
- Allows planners to update mitigation plans and activities while accounting for potential flood risk increases caused by development and climate change effects

USGS Flood-Inundation Mapping

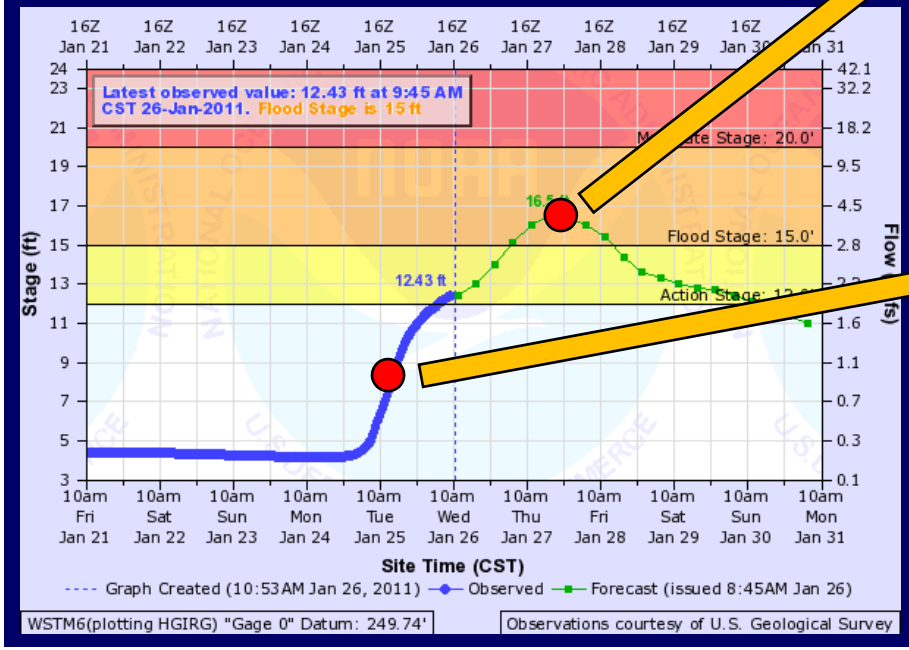
In 2009, the USGS initiated a national flood-inundation mapping program in collaboration with NWS, USACE, and FEMA.

Main function of the FIM program

- To promote a uniform approach and consistent products for flood-mapping efforts (partnered guidelines, quality assurance, and documentation)
- To provide online flood-inundation maps with real-time streamflow data, flood forecasts, and potential loss estimates

Flood Inundation Maps (FIM)

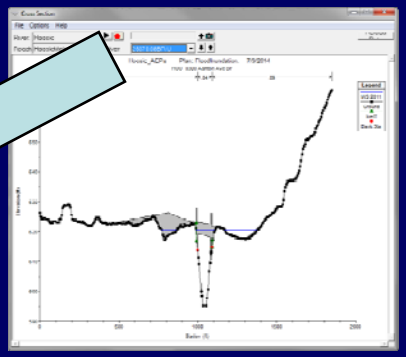
Translates a flood hydrograph into operational FIMs showing the areal extent and depth of flooding which communicates risk and consequences

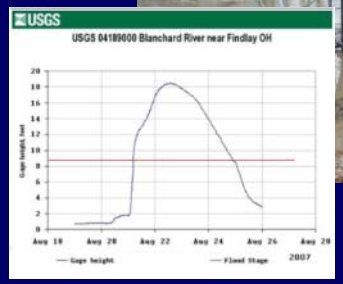


Flood Information – from a point on the landscape to geospatial products

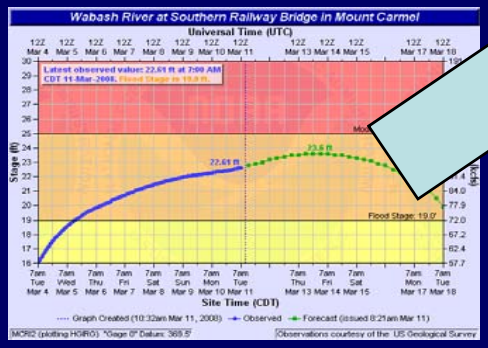
High-water marks

Lidar and hydraulic model



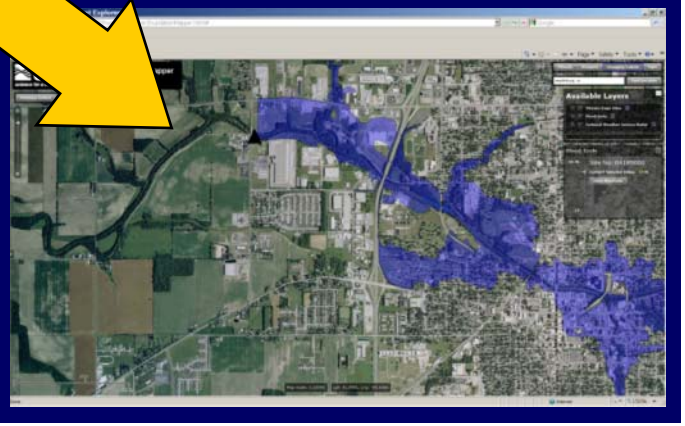


USGS Real-time streamgage data



National Weather Service flood forecasts

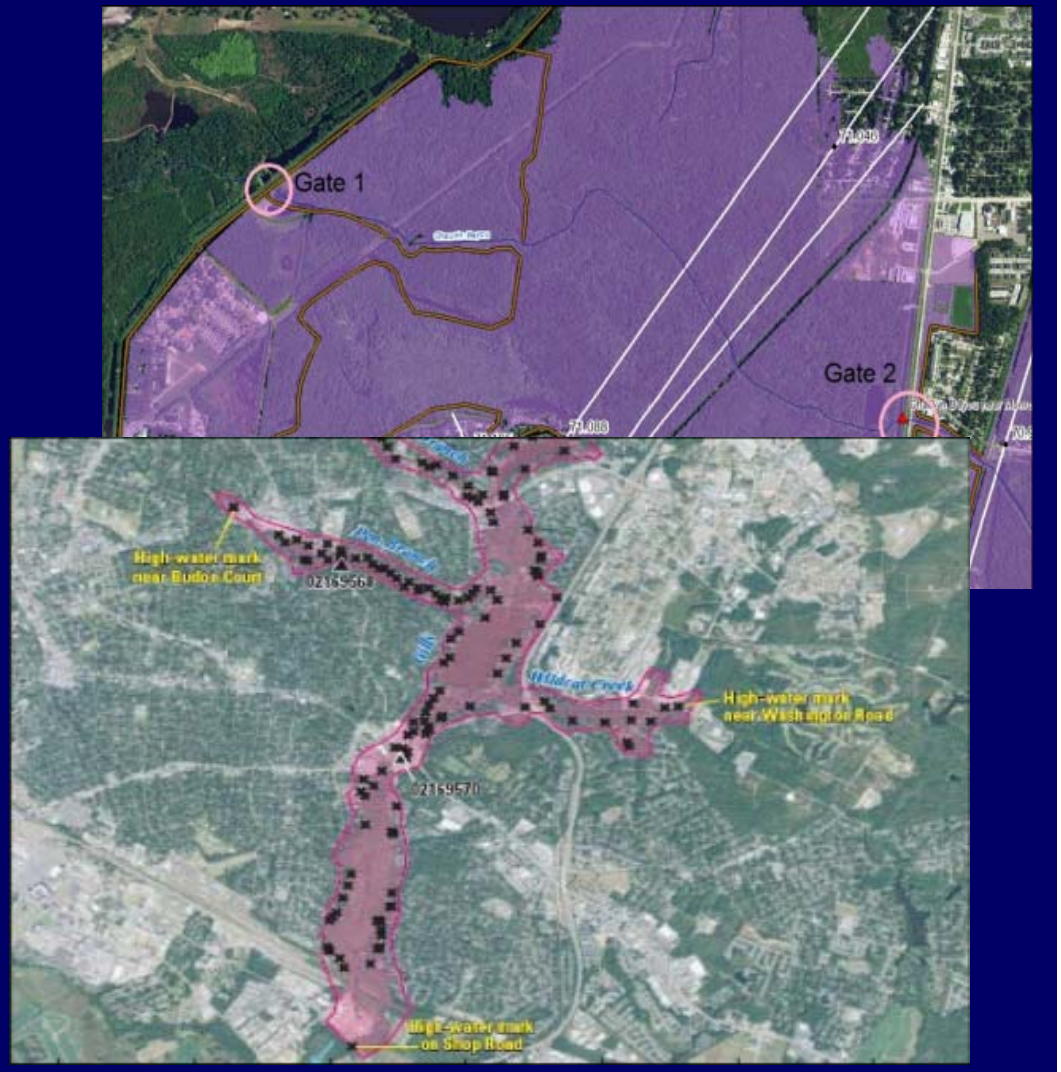
Flood-Inundation Map



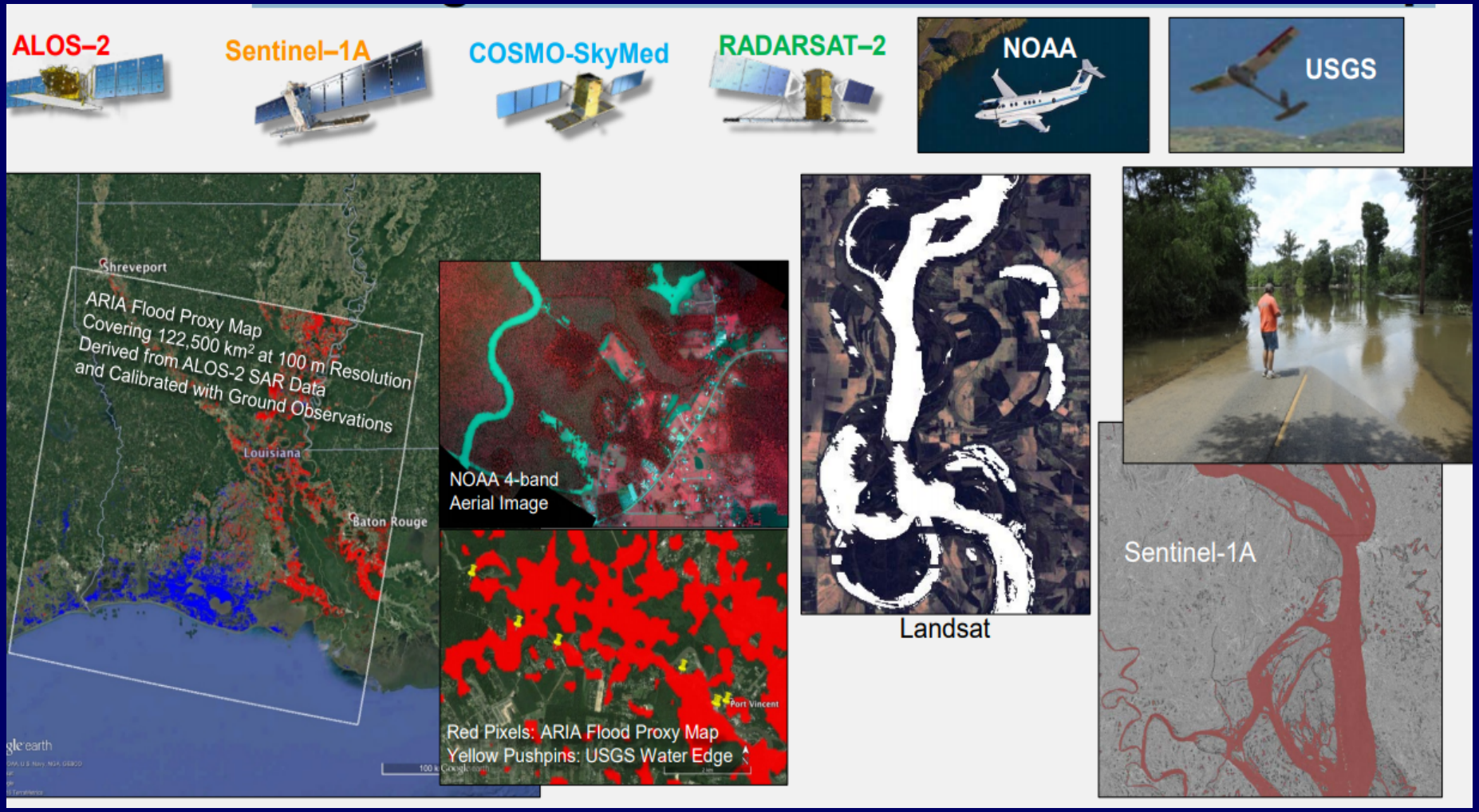
High-Water-Mark Derived Flood Documentation Map

- Use the High-Water Mark information with DEMs to extend the marks out on the landscape

- Can be used for riverine or coastal flooded areas (with some modifications)



Remote-Sensing Derived Flood Documentation Map



Creation of Flood Inundation Maps

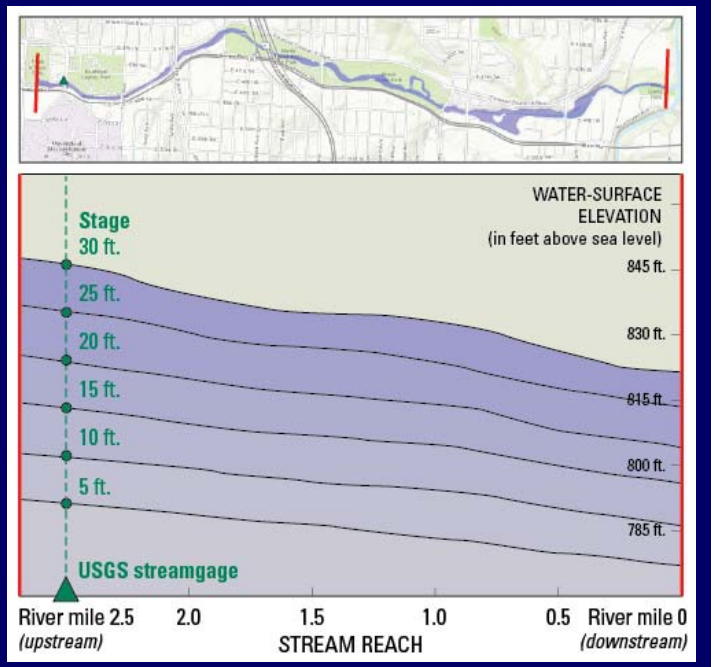
Chose Reach and Data needed

- Critical infrastructure, populations, escape routes needed
- Streamgage and flood forecast
  - Stable high-end rating, peakflow analyses
  - Can also do with stage-only
- Elevation data availability
  - Topography - lidar
- Recent survey
  - Hydraulic structures and x-sections
- High-water marks
  - Recent or historic flood

Creation of Flood Inundation Maps

Modeled and mapped flood elevations

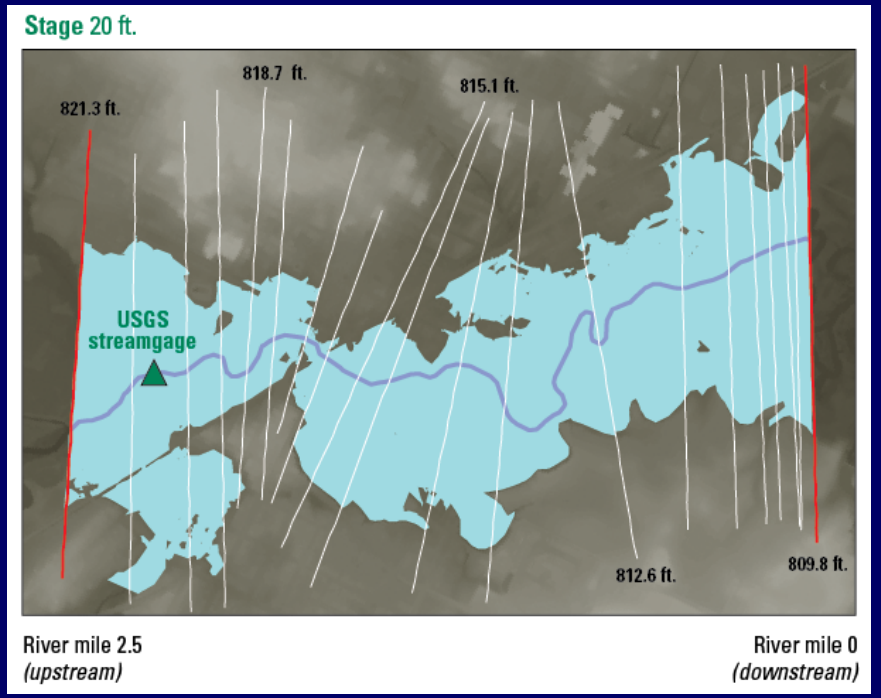
- Hydraulic model (typically using HEC-RAS) calibrated to USGS streamgage (stage-discharge relation) and high-water marks
- Maps: 1 or 2 ft increments from bankfull to peak of record
- Maps: associated with peakflow annual exceedance probabilities (AEPs) such as 50-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent (2-, 10-, … 500-year flood)



Creation of Flood Inundation Maps

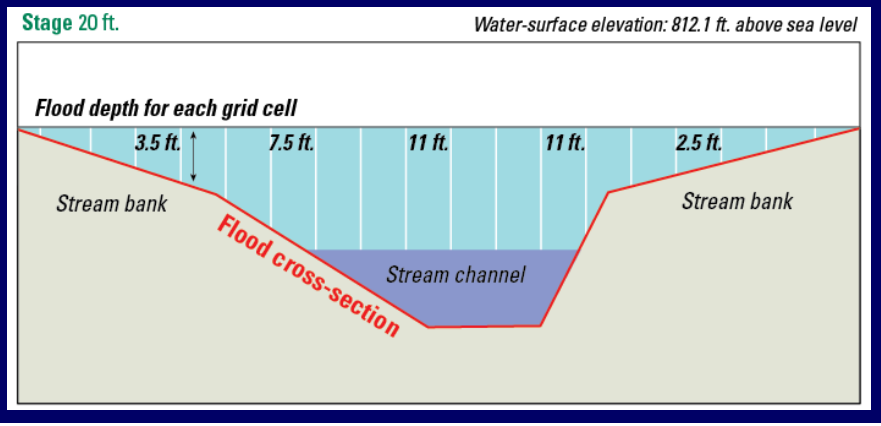
Delineation of inundation

- Data for incremental stages are combine with Lidar – based DEM
- Spatial grid of where flooding occurs based on stages

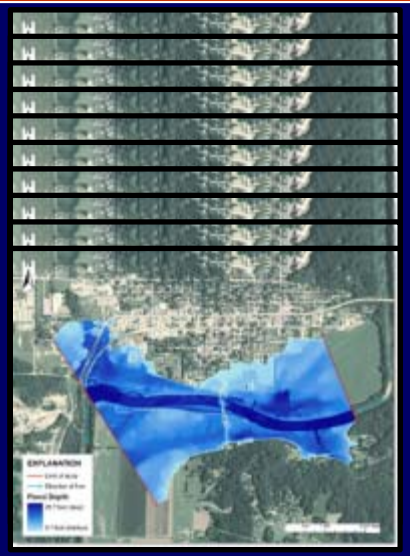


Inundation depth

- Depth grids are determined for stage increments

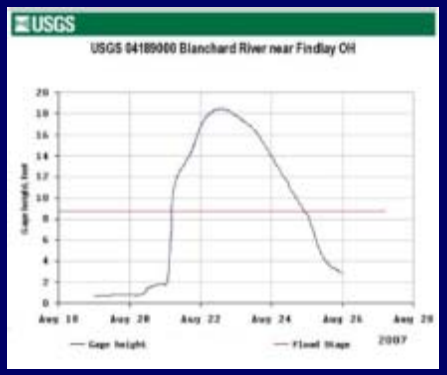


FIM Mapper – more than just maps



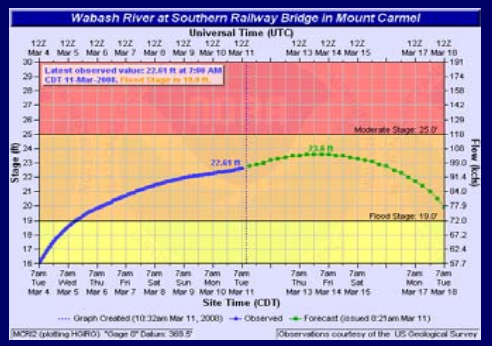
Flood Library

+



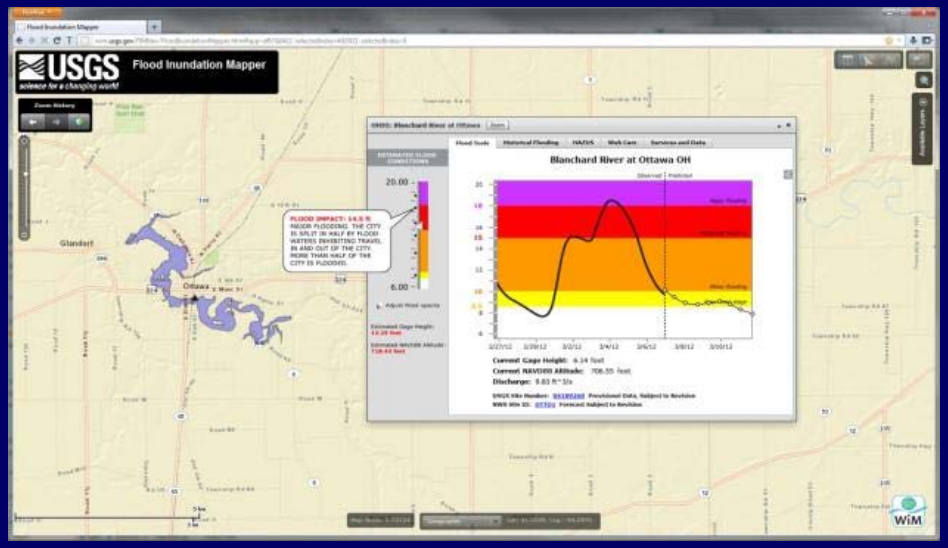
USGS Real-time streamgage

+



NWS Flood Forecast

=



http://wim.usgs.gov/FIMI/

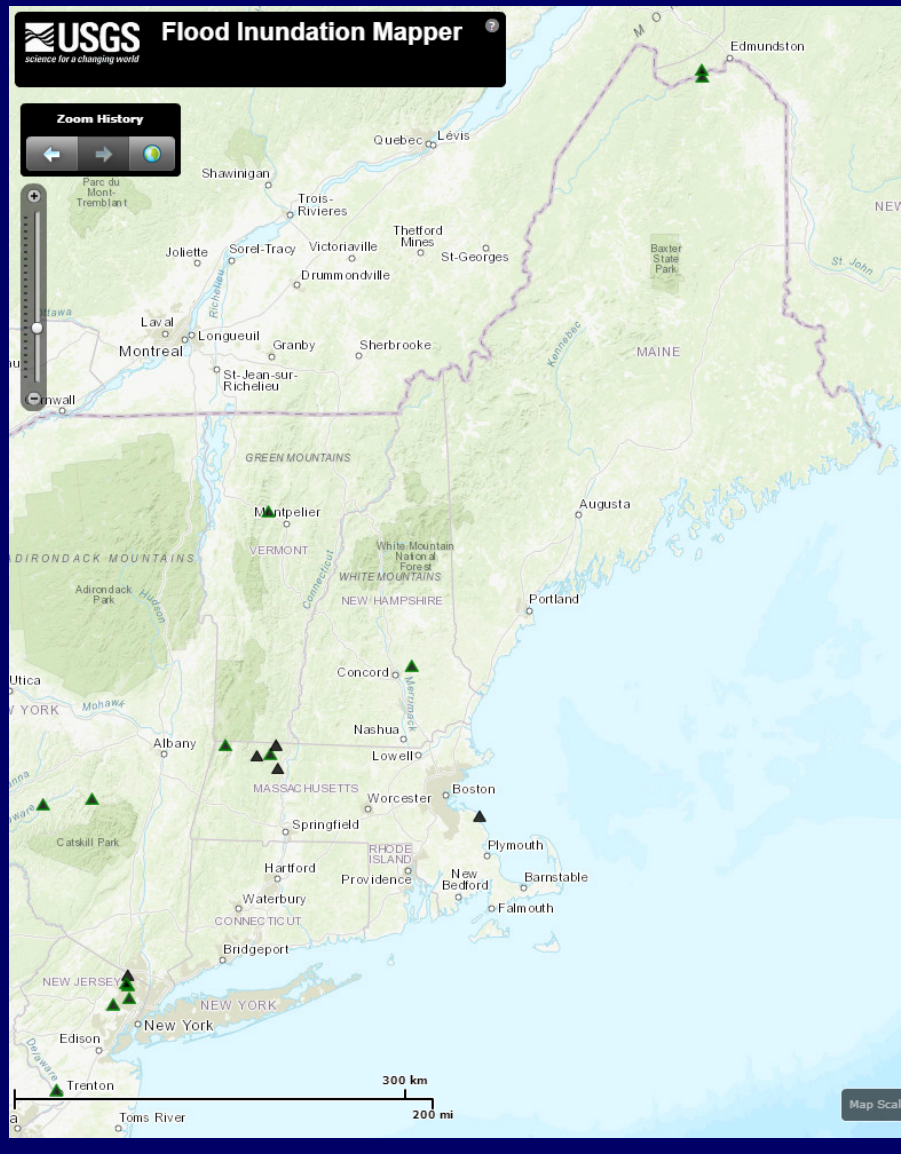
FIMs Studies in New England

On USGS FIM mapper

- Maine: Fish and St. John's Rivers
- Massachusetts: Deerfield (2), Green, Hoosic, North Rivers, and Scituate Harbor area
- New Hampshire: Suncook River
- Vermont: Winooski River

Ongoing FIM studies

- Rhode Island: Pawtuxet and Pawcatuck Rivers
- Vermont: Lake Champlain (most)

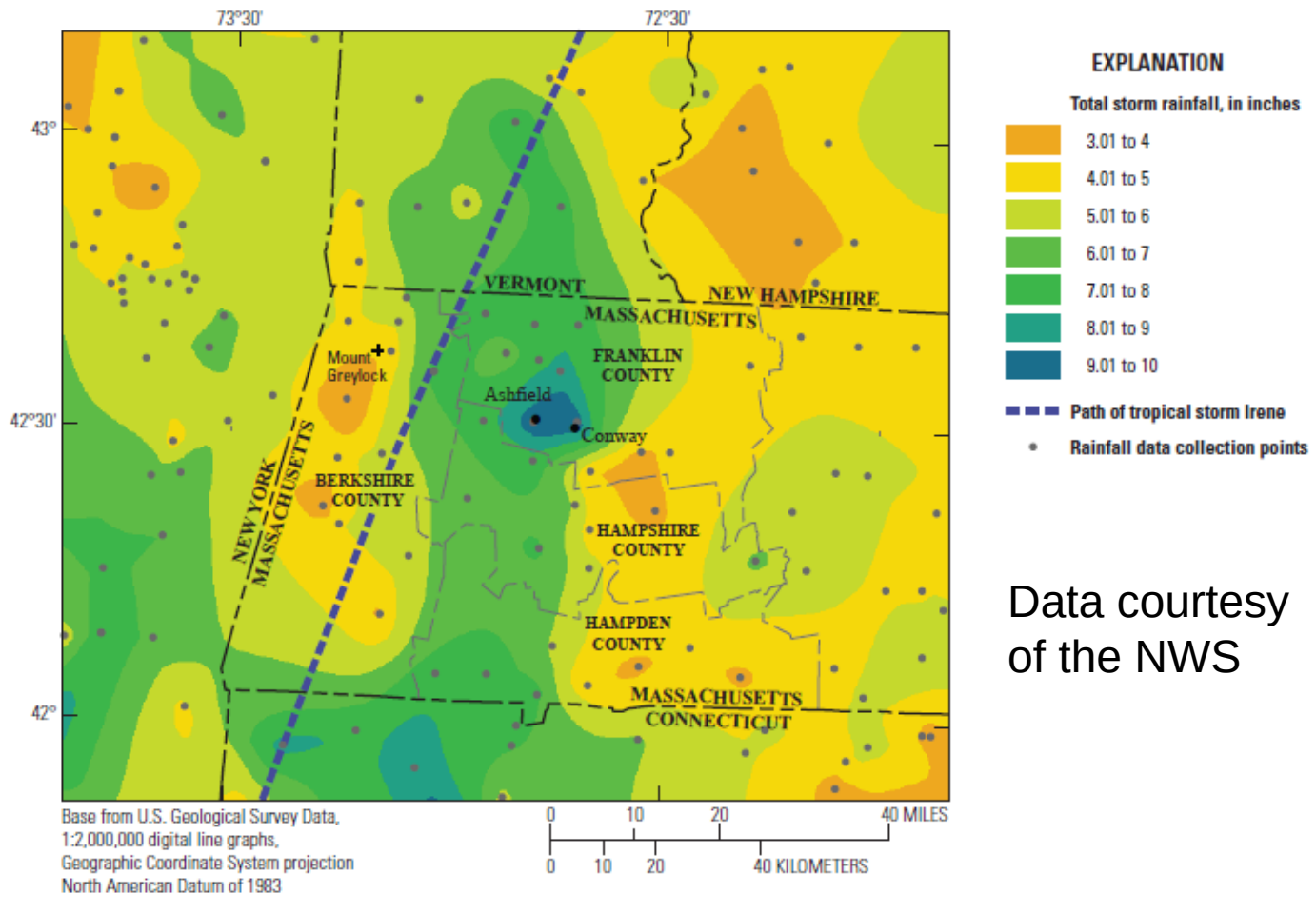


FIM Benefits

- Helps with preparedness, response, recovery, and mitigation and planning
- Interactive tools give users a better understanding of flood risk areas
- Data can be shared by many users simultaneously to make decisions to reduce flood loses *(before, during, and after)*
- Help assess cost and damages of floods *(HAZUS)*
- USGS report documenting flood flows, hydraulic model, calibration, lidar, mapping, and map libraries
- Potentially helps communities with their NFIP community rating system (CRS) - lowering flood insurance premiums

Example: Tropical Storm Irene

- Most of western MA received about 3 – 10 inches of rainfall in about 12 hours



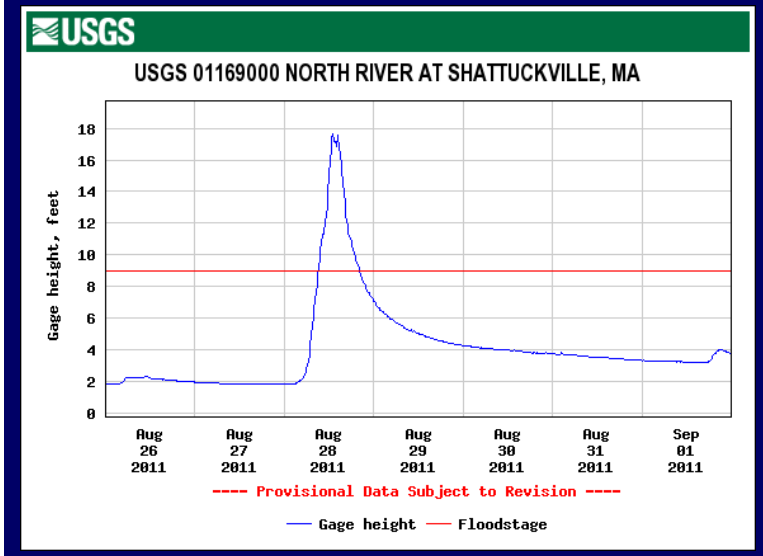
Data courtesy of the NWS

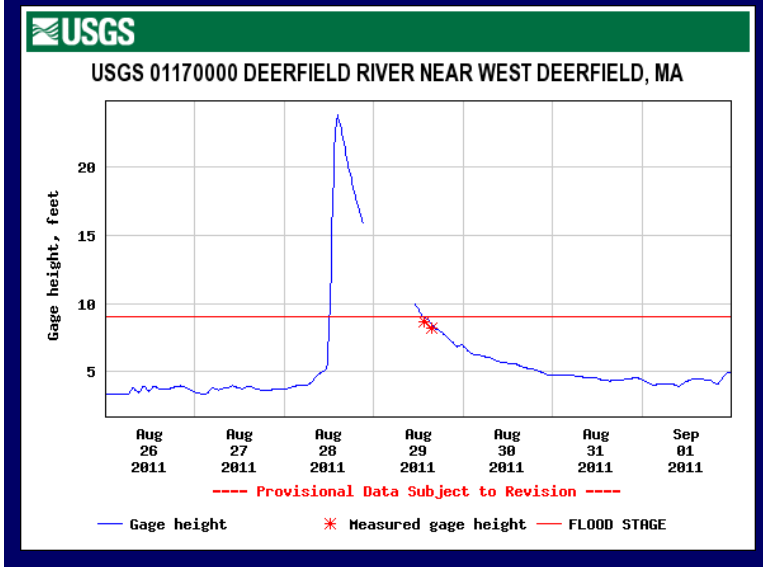
IRENE STREAMFLOWS

Deerfield River at Shelburne Falls
Dam #3, Rt. 2A, and
Bridge of Flowers

Photos Courtesy of
John Elder Robison

RIVER STAGE HYDROGRAPHS





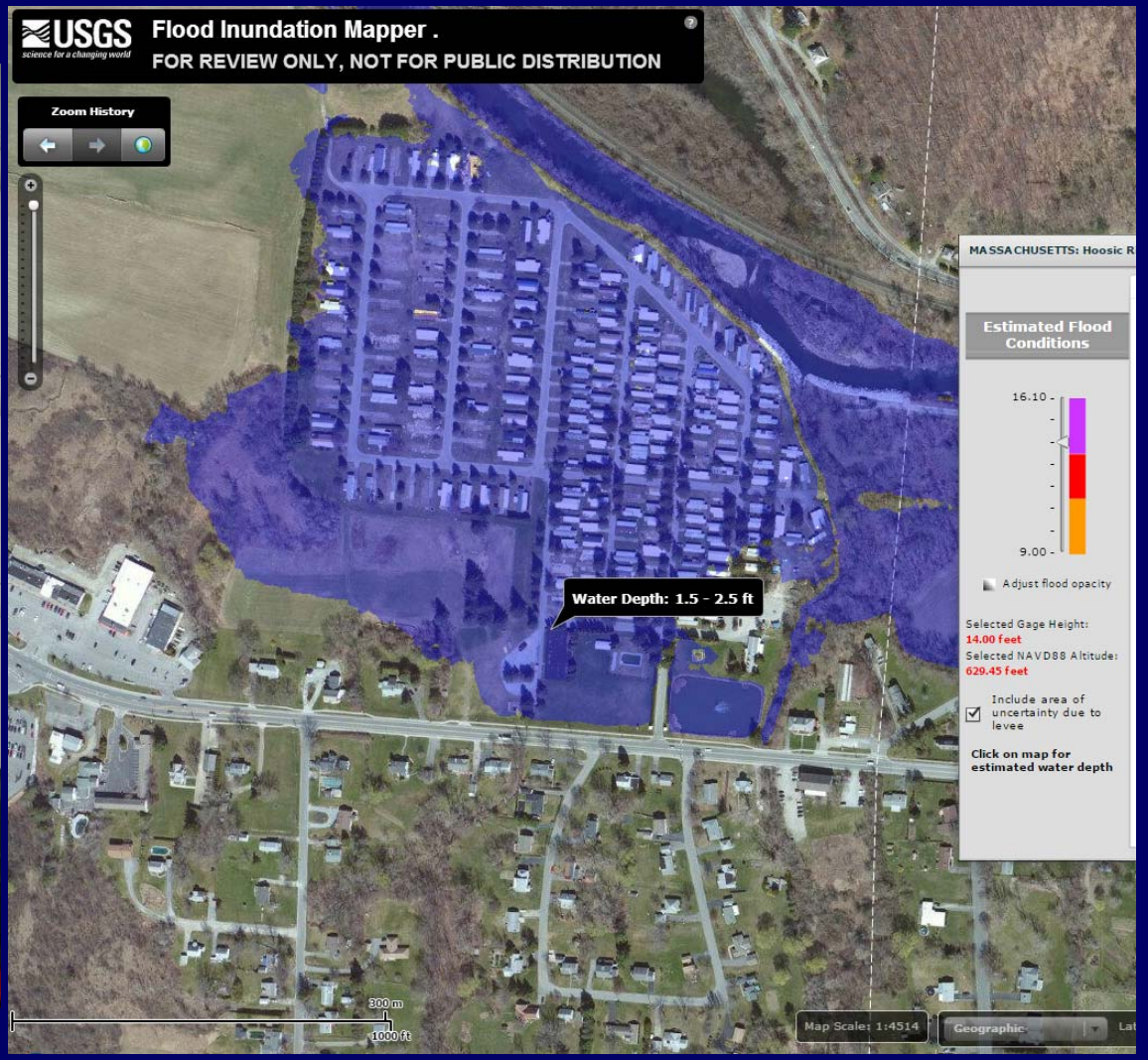
River stage changes in ~ 9-12 hrs after 0300 am

- Deerfield R. at Charlemont 16.2 ft
- North R. at Shattuckville **16.3 ft**
- South R. near Conway 11.1 ft
- Deerfield R. near W. Deerfield **19.7 ft**
- Green R. near Colrain 12.2 ft

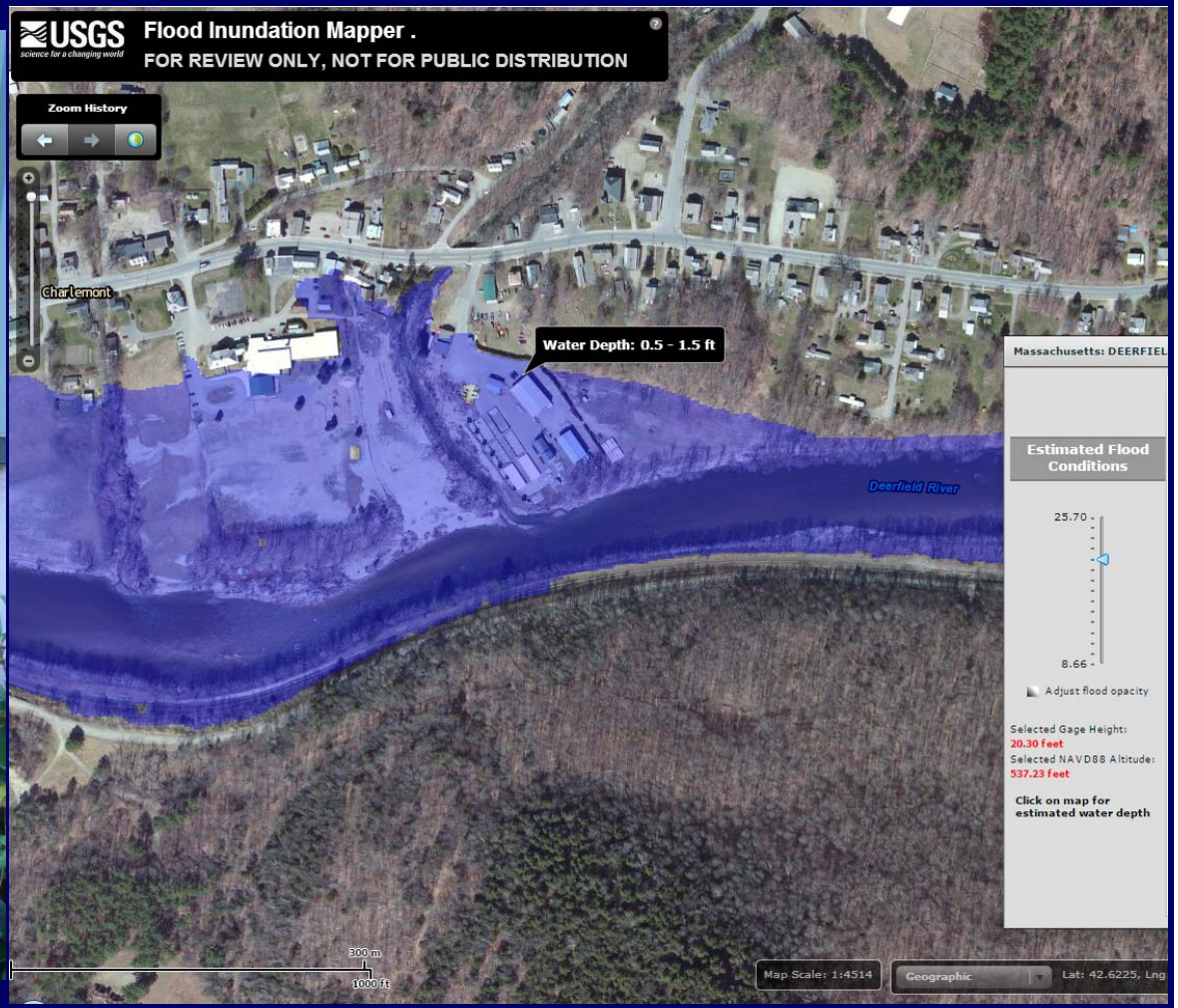
Maximum river stage change in a 15-min periods were 1.3, 1.1, 0.8, 2.4, and 1.1 ft, respectively

- Hoosic R. at Adams 3.4 ft
- Hoosic R. near Williamstown 9.0 ft
- Green R. at Williamstown 5.1 ft
- Connecticut R. at Montague City 23.2 ft

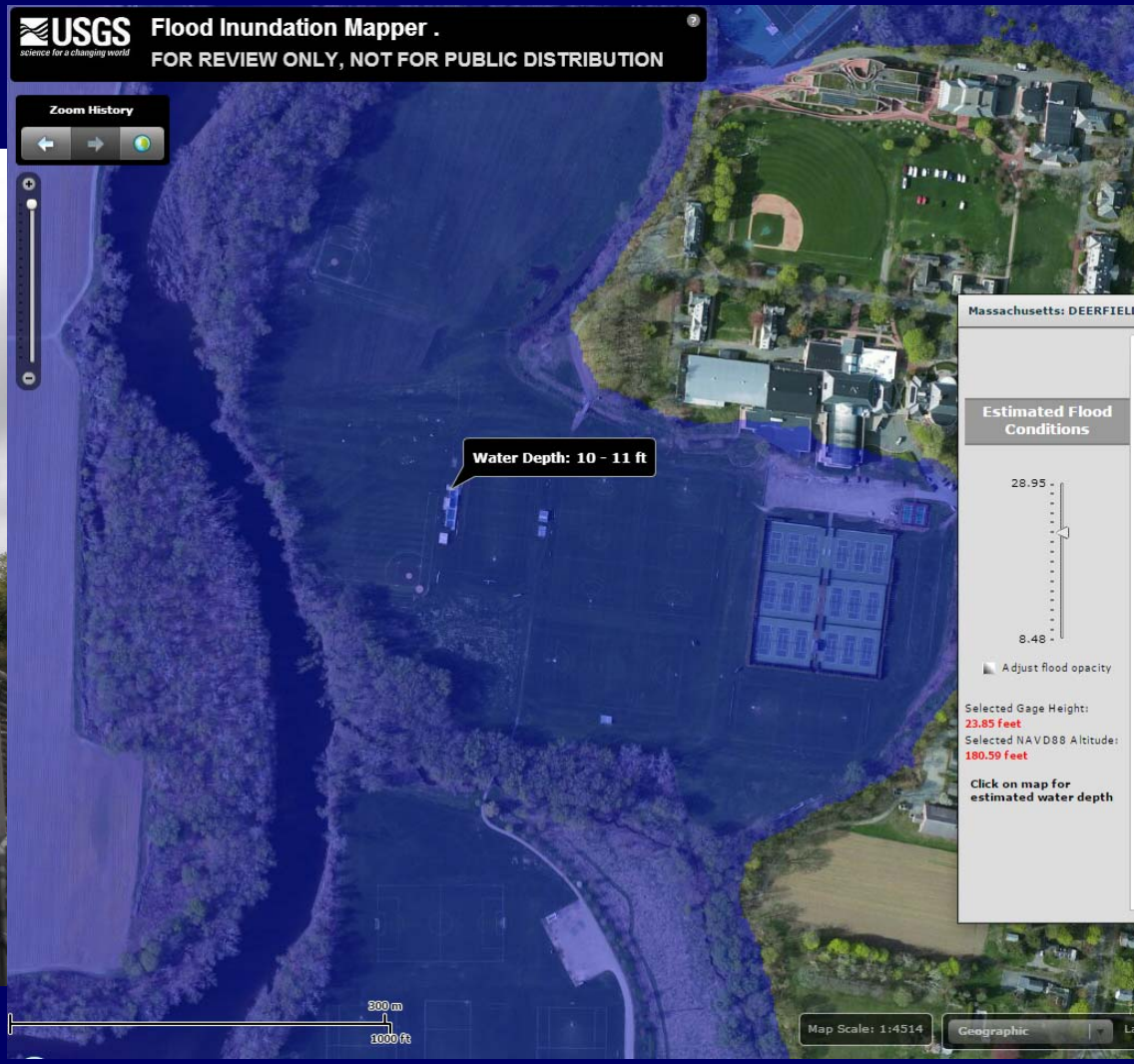
Hoosic River at Spruces



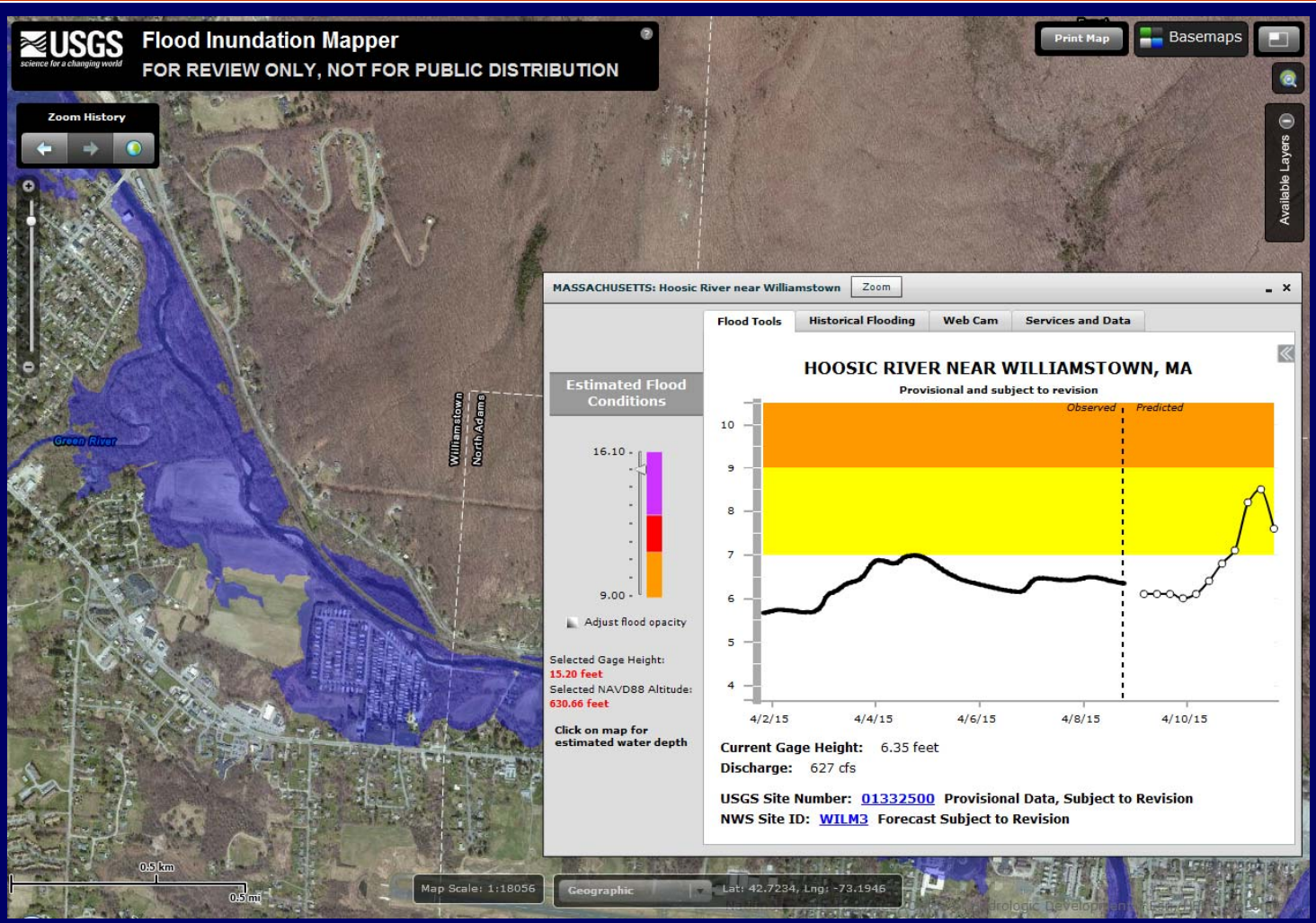
Deerfield at Charlemont Police



Deerfield at Deerfield Academy



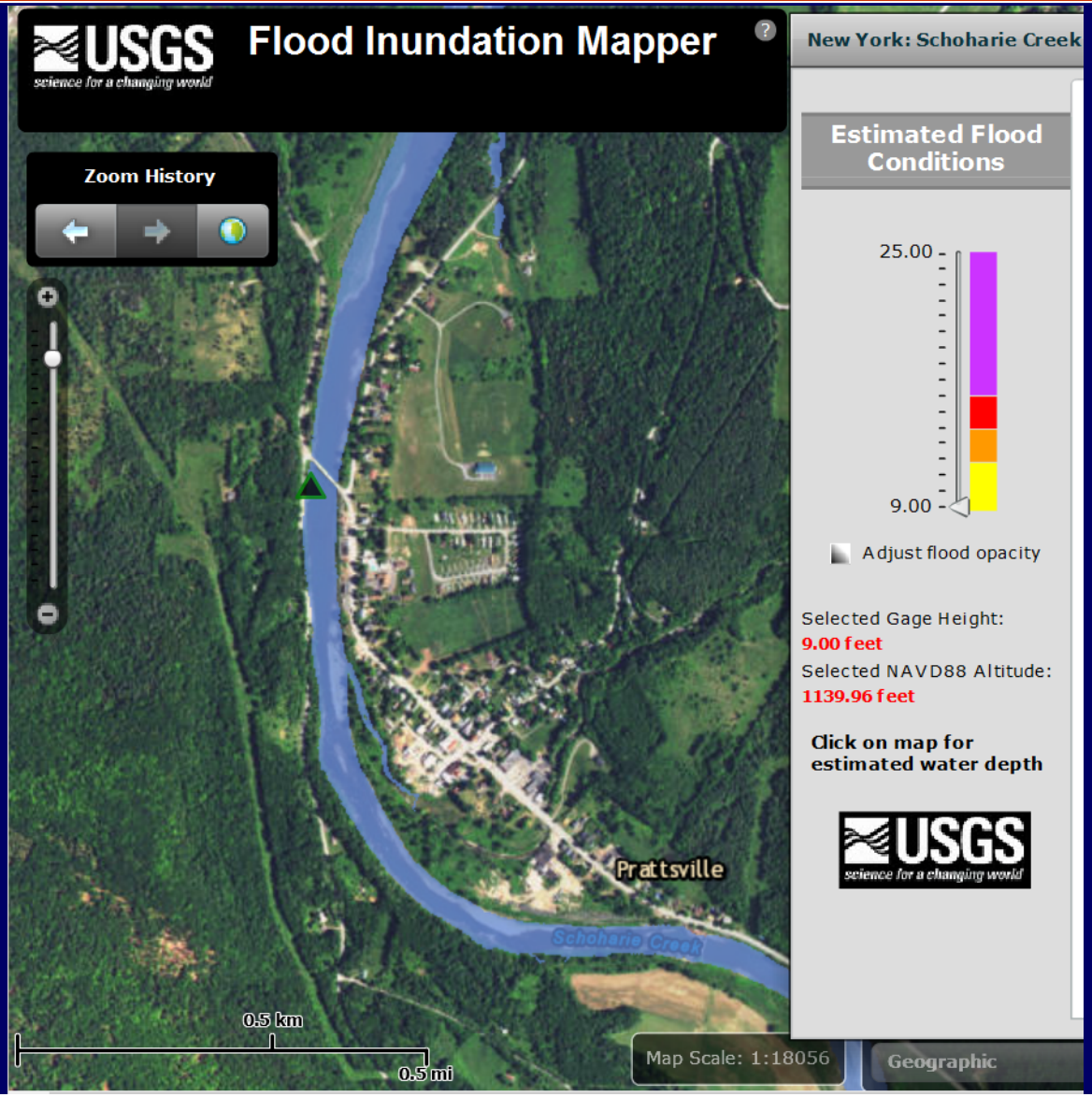
FIM Web Mapping Application



http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html

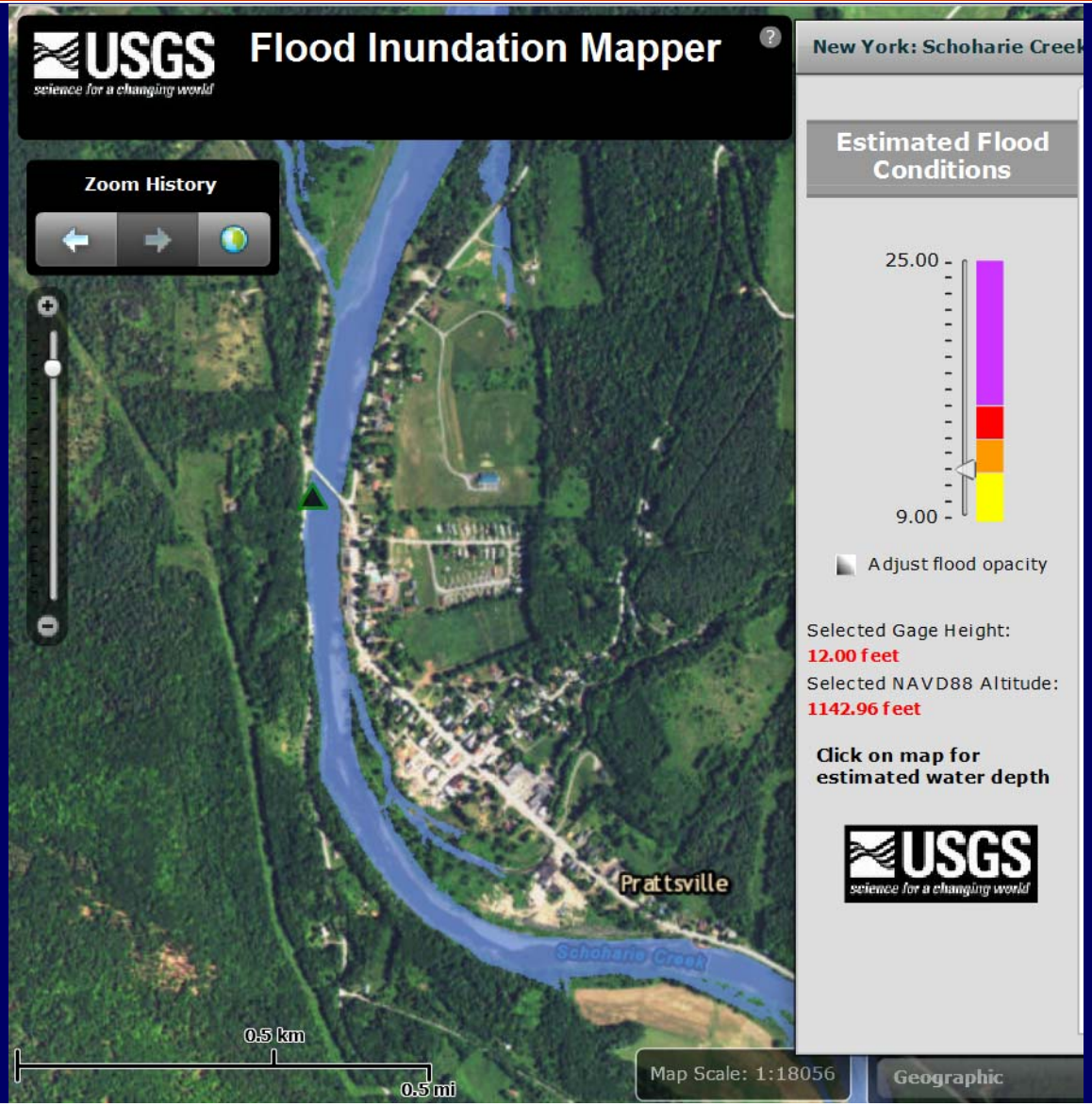
Example of Flood Inundation Mapping

Stage = 9.00 ft



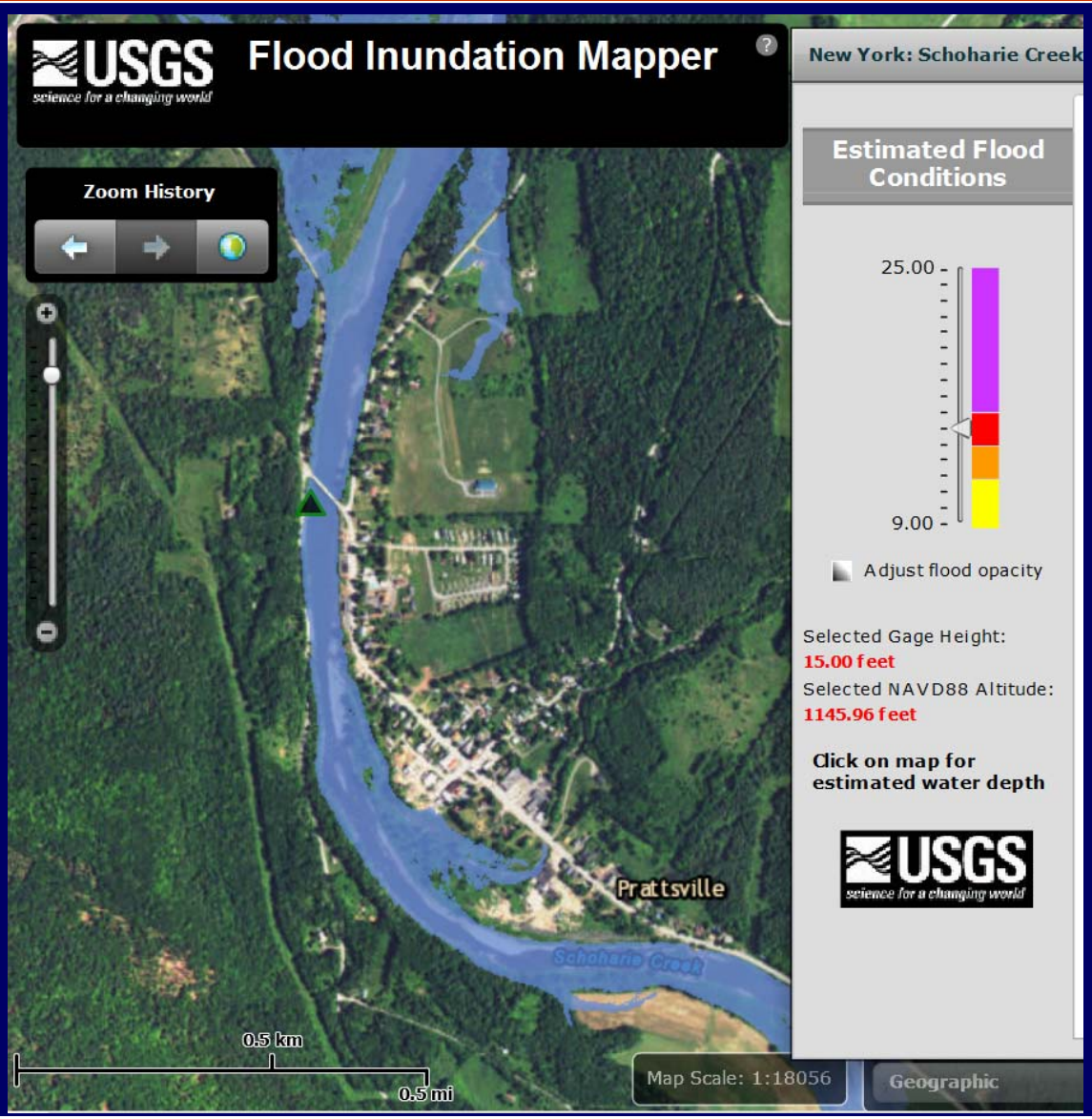
Example of Flood Inundation Mapping

Stage = 12.00 ft



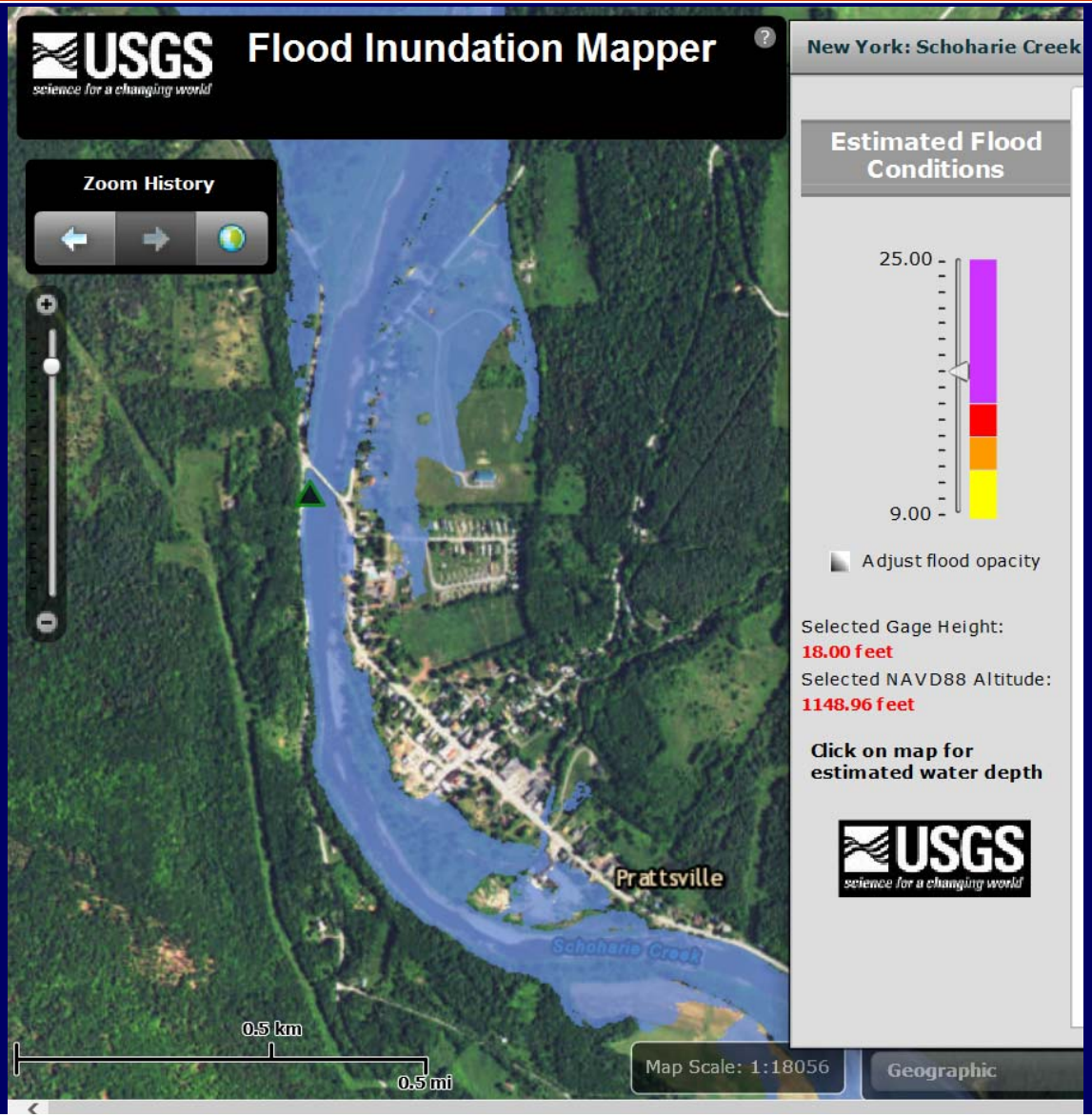
Example of Flood Inundation Mapping

Stage = 15.00 ft



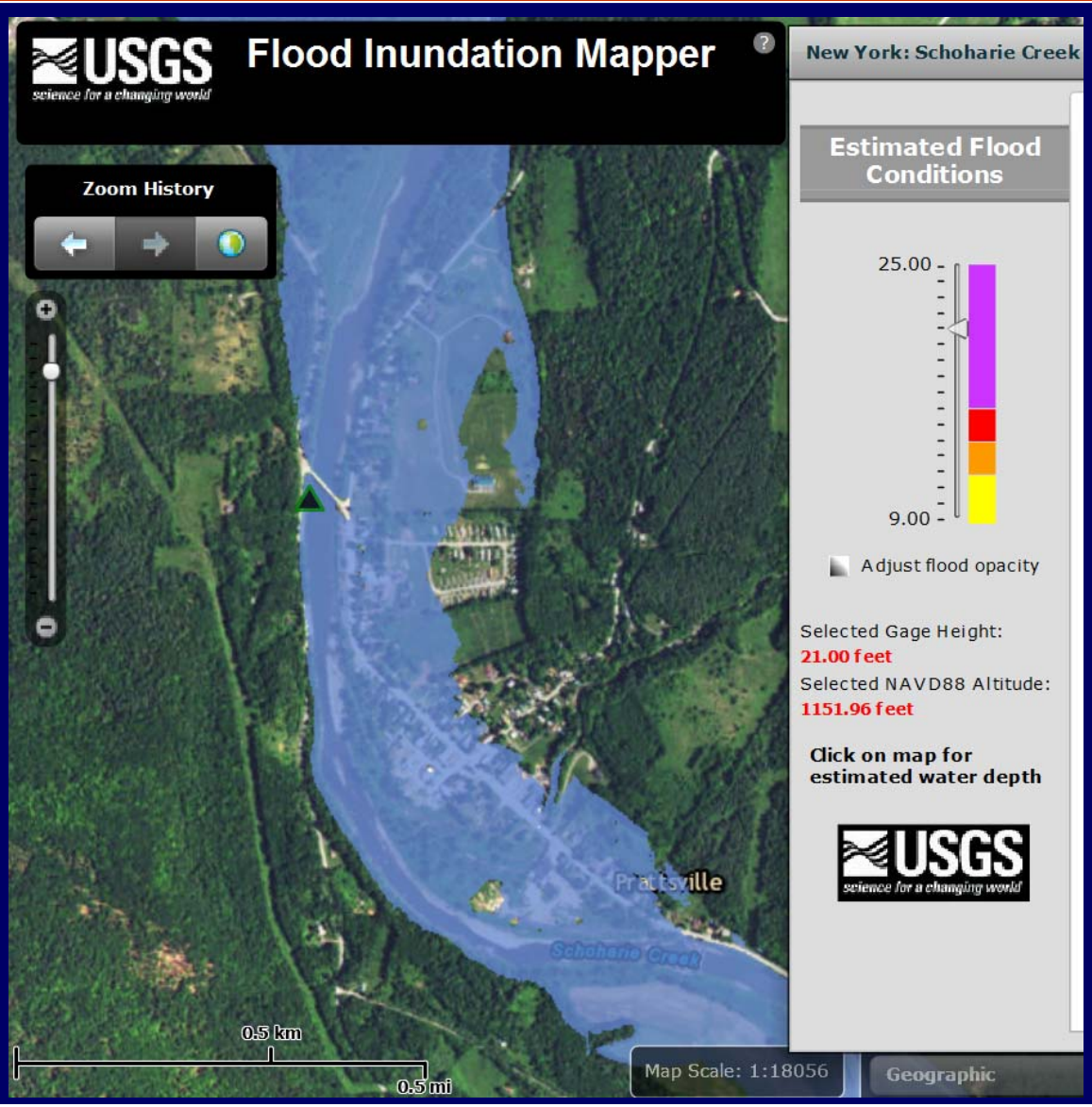
Example of Flood Inundation Mapping

Stage = 18.00 ft



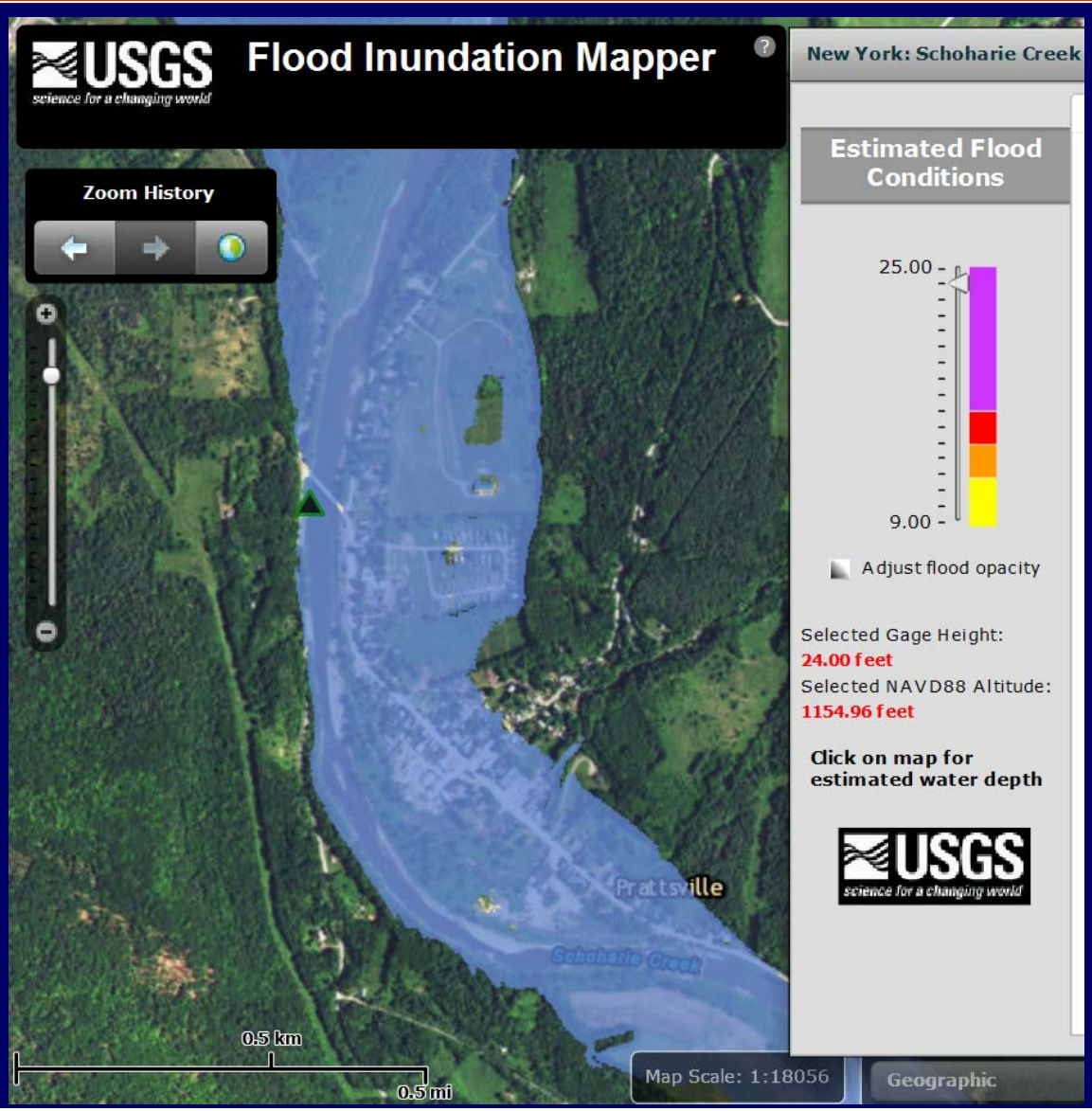
Example of Flood Inundation Mapping

Stage = 21.00 ft



Example of Flood Inundation Mapping

Stage = 24.00 ft



Contacts

- Liz Ahearn, eaahearn@usgs.gov or 860-291-6745
- Gardner Bent, gbent@usgs.gov or 508-490-5041

Pawcatuck River
Westerly, RI and
Stonington, CT