

The background of the slide is a high-speed photograph of water splashing, creating a dynamic and energetic scene with various droplets and ripples. The color palette is a range of blues, from deep navy to light sky blue.

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PREDICTION

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# Implementation of Forecast Flood Inundation Services To The Nation



*David R. Vallee*

*Director, Service Innovation and Partnership Division  
NOAA/NWS Office of Water Prediction/National Water Center*

# Outline

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- Background on what got us to where we are today
- Progress to Date on our FIM Services Implementation for the Nation
- Examples of our new Experimental Flood Inundation Services
- Where you can access our Experimental National Water Model & Flood Inundation Services
- Some recent examples of our Prototype services for Rhode Island



# Why are we doing this?

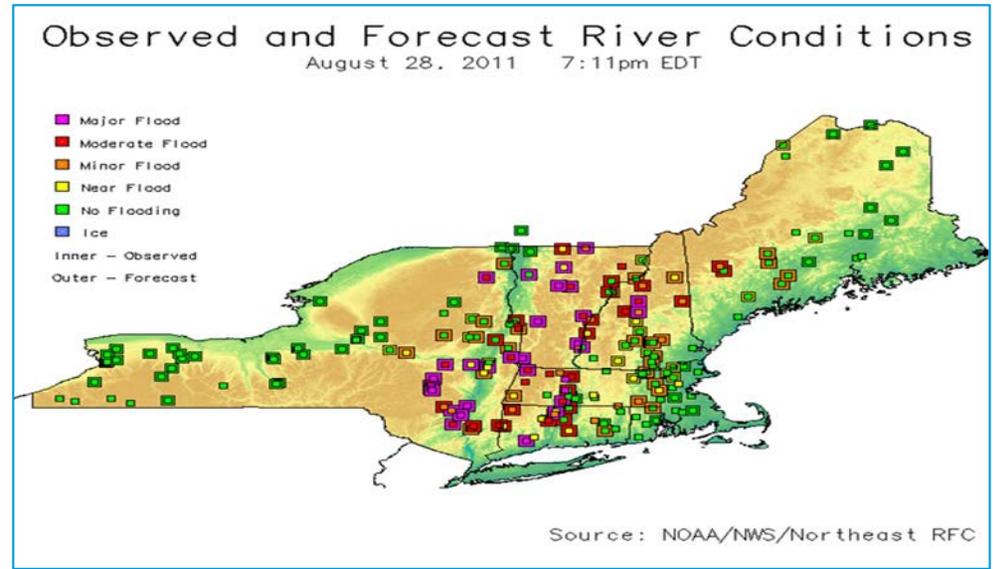
*To fill a significant service gap!*

## Current Flood Services

- Flood and Flash Flood Watches & Warnings
  - Providing general information on timing and impact on small streams
  - Detailed timing and impacts in the vicinity of our river forecast locations
- Impact-based Decision Support Briefings, packages and Webinars

## Partner feedback

- While our current services are tremendously valuable, **warnings lack specificity of location, timing and detailed impacts such as potential extent of inundation & duration of flooding**
- Lead time is critical in preparation
- Knowing what roadways, bridges, etc. could be impacted is invaluable



BULLETIN - EAS ACTIVATION REQUESTED  
FLASH FLOOD WARNING  
NATIONAL WEATHER SERVICE ALBANY NY  
218 AM EDT SUN AUG 28 2011

THE NATIONAL WEATHER SERVICE IN ALBANY HAS ISSUED A

\* FLASH FLOOD WARNING FOR...  
GREENE COUNTY IN EAST CENTRAL NEW YORK...  
THIS INCLUDES THE CITIES OF...HUNTER...CATSKILL...  
ULSTER COUNTY IN EAST CENTRAL NEW YORK...  
THIS INCLUDES THE CITIES OF...SAUGERTIES...NEW PALTZ...KINGSTON...  
ELLENVILLE...

\* UNTIL 815 AM EDT

\* AT 209 AM EDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED  
FLASH FLOODING FROM BANDS OF HEAVY RAIN WITH EMBEDDED  
THUNDERSTORMS ASSOCIATED WITH HURRICANE IRENE.

\* LOCATIONS IN THE WARNING INCLUDE BUT ARE NOT LIMITED TO NORTH-SOUTH  
LAKE CAMPGROUND...NEW BALTIMORE...WINDHAM...PRATTSVILLE...COXSACKIE  
AND ATHENS

PRECAUTIONARY/PREPAREDNESS ACTIONS...

ADDITIONAL RAINFALL AMOUNTS OF 2 TO 4 INCHES ARE POSSIBLE IN THE  
WARNED AREA THROUGH 8 AM.

# Flood Inundation Mapping Timeline



# Tabletop Exercises: Key Findings

1. Partners found the combination of the NWS briefings with the FIM Service was a powerful combination to help them understand the impacts

- **Deliver through web services briefed by a professional forecaster**

2. The capabilities provided by these FIM services would be a “**game changer**” for the emergency management community

- **These geospatial services allowed for the creation of a common operating picture**

3. Services would be most useful in staging and planning activities in the 1-3 day timeframe

- **County EM: “Had I had this tool in 2011, we would have had a larger evacuation area established earlier, would have moved emergency assets out of the flood zone, pre-positioned support resources and been able to provide better information to the residents of the affected area.”**

4. Depth is tremendously important - as it determines the types of resources needed for the flood fight



West Warwick Wastewater Treatment Facility under siege, morning of April 1st, 2010 as the Pawtuxet River began to recede. Photo: RI ANG



Record flooding along Schoharie Creek in the town of Schoharie on the morning of Sunday, August 28<sup>th</sup>, 2011. Source: Kait Wood



# Implementation of NWS Flood Inundation Mapping Services

## Map Legend



Population served by **October 2023.**



Population served by **October 2024.**



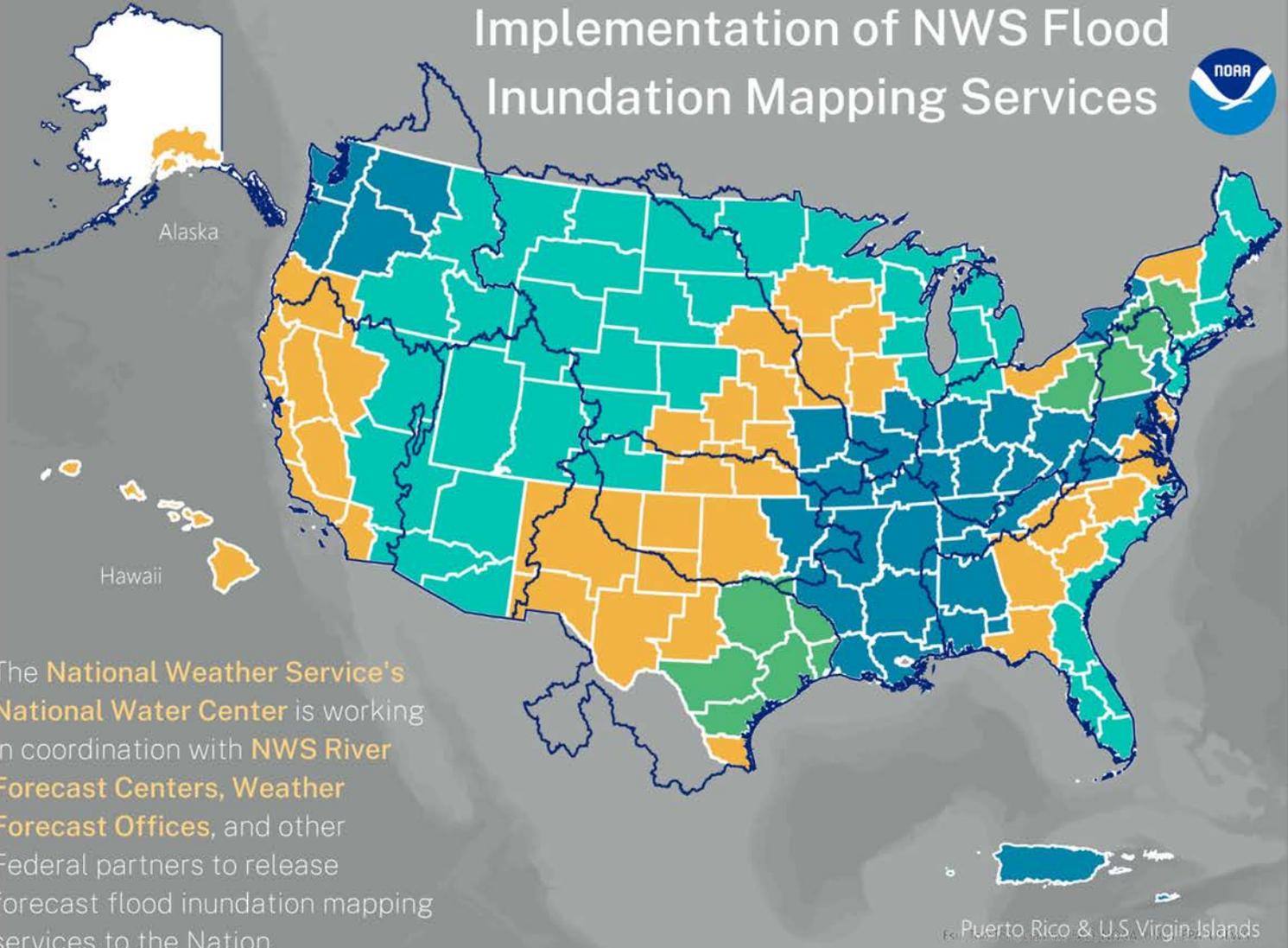
Population served by **October 2025.**



Population served by **October 2026.**

 NWS County Warning Areas

 NWS River Forecast Center Boundaries



The **National Weather Service's National Water Center** is working in coordination with **NWS River Forecast Centers, Weather Forecast Offices**, and other Federal partners to release forecast flood inundation mapping services to the Nation.

\*100% is approximate. Does not include all parts of Alaska, American Samoa, and Guam. Implementation areas are subject to change.

Excl. Puerto Rico & U.S. Virgin Islands

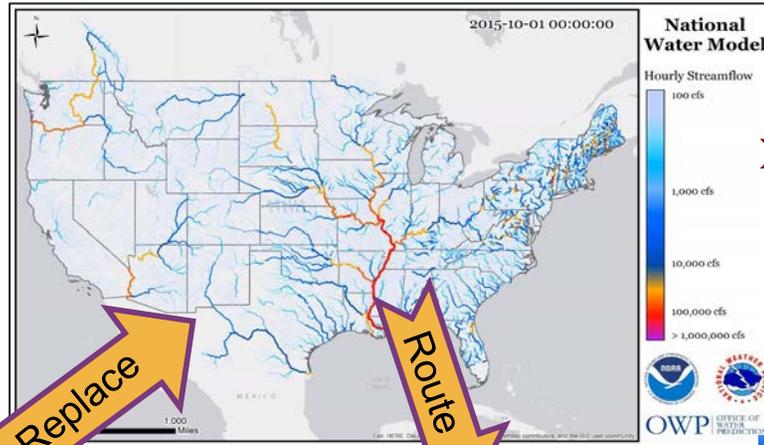
# The Method behind FIM Services: Height Above Nearest Drainage (HAND)

## National Water Model

### Guidance

Completely automated process with no forecaster engagement – but provides complimentary guidance on ~3.4 million stream miles nationwide, including Puerto Rico and the Virgin Islands, Hawaii, and by the fall - portions of Alaska

## Deliver Forecast Flood Inundation Services

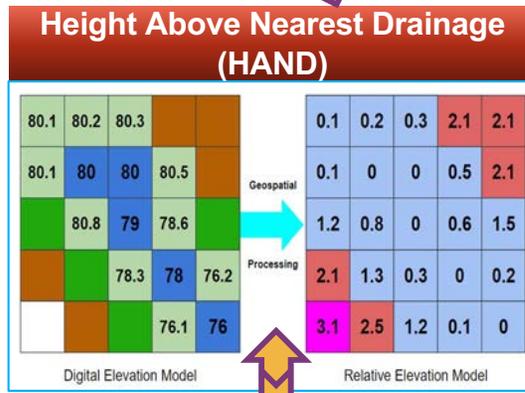
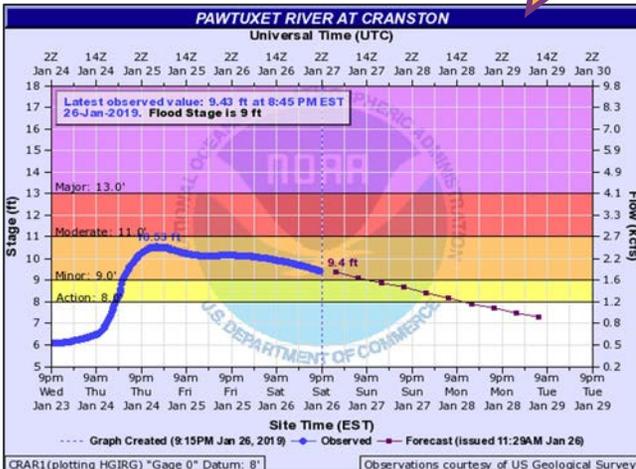


Replace

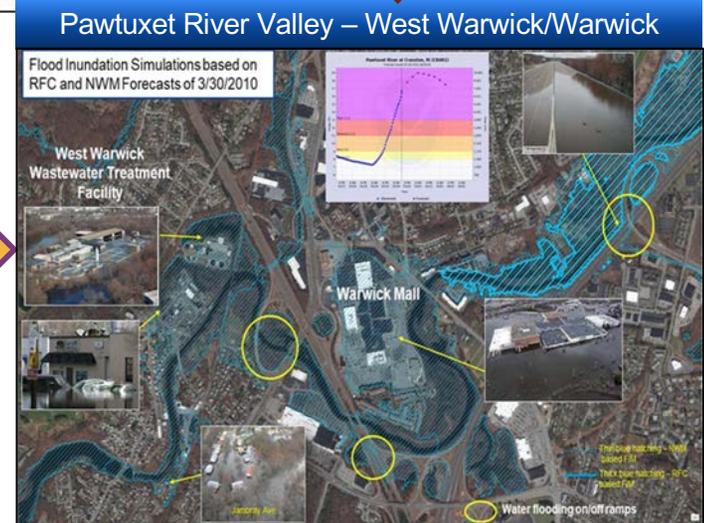
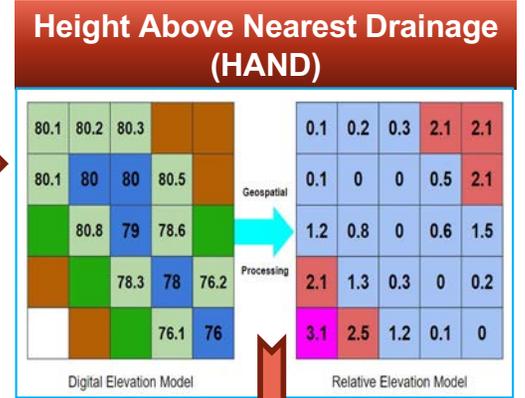
Route

## River Center Forecasts

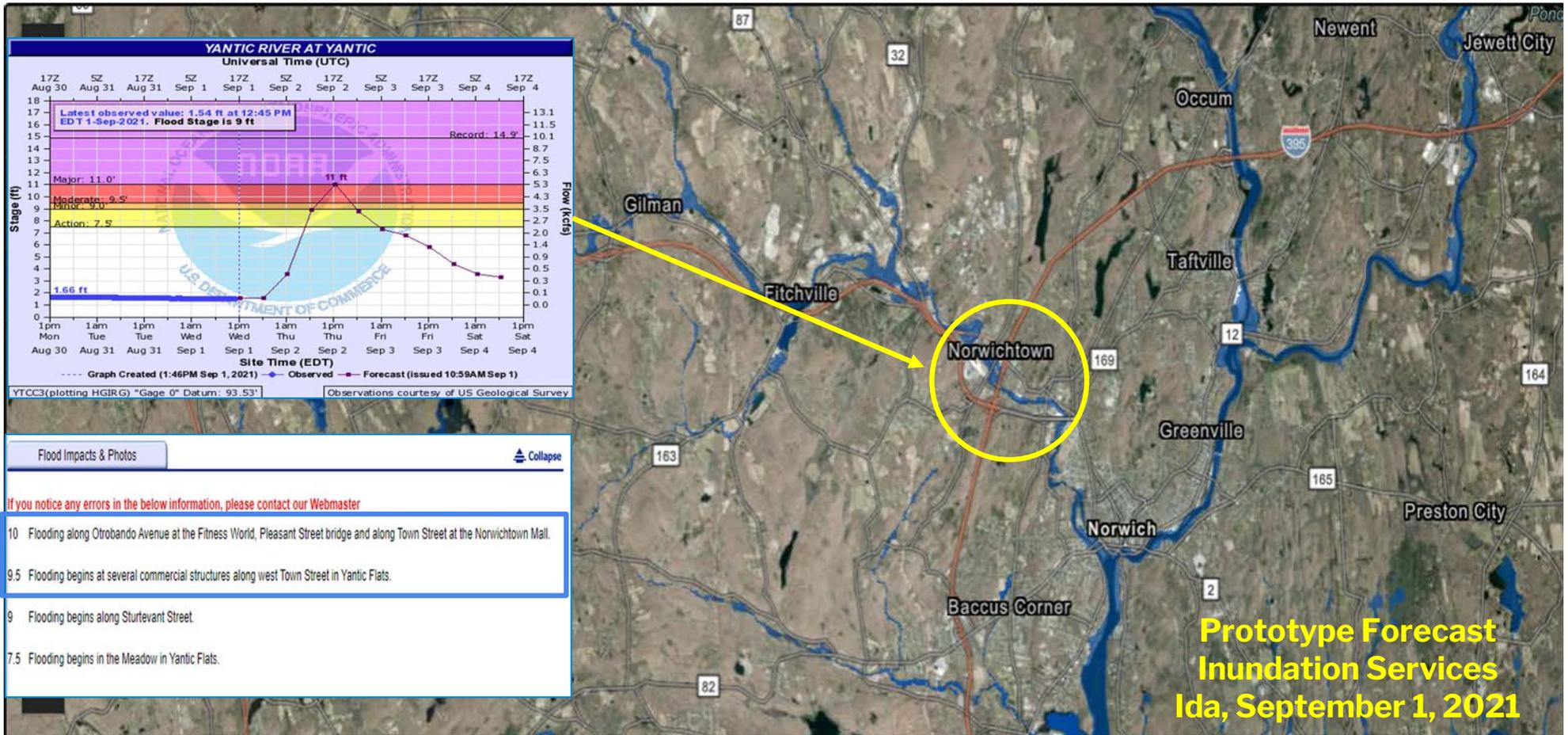
Forecasters heavily engaged in the forecast production



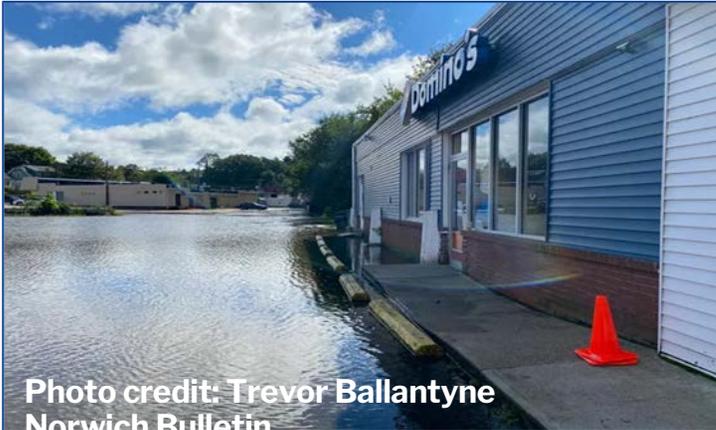
+RASToFIM & RASoREM techniques



# Value of FIM Services - Visualizations to depict impacts



# Value of FIM Services - Visualizations to depict impacts



# Integrating FIM Services into our IDSS

**Disclaimer:** This experimental map represents the NWS's best approximation of inundation based upon modeled river discharge

## Yantic River at Yantic, CT

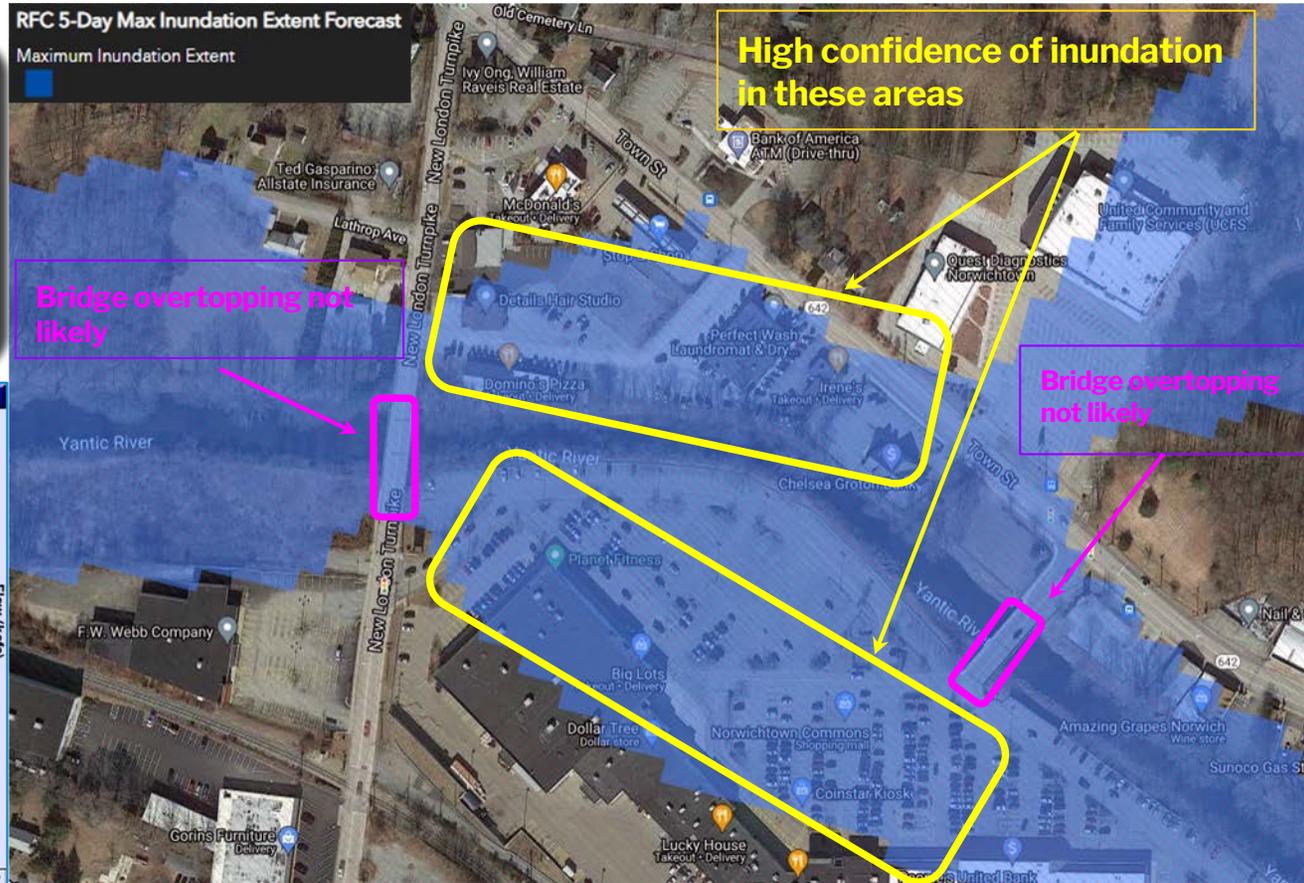
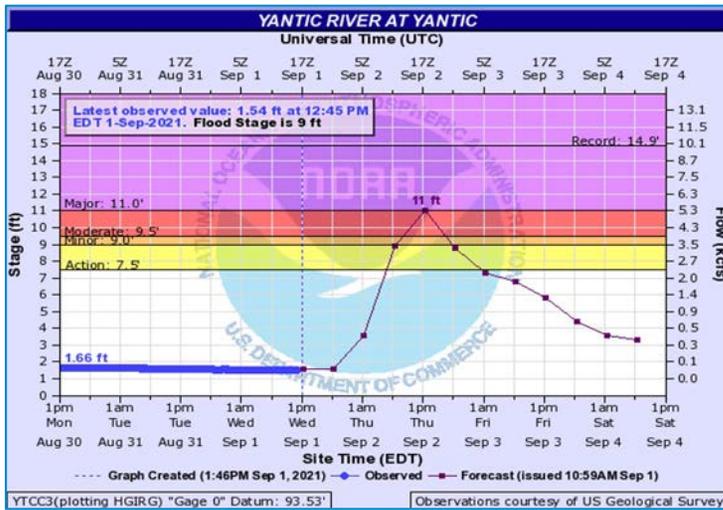
Forecast Crest Height: 11 Feet

Map Height Shown: 11 Feet

FIM Source: RFC FIM 5 Day Max Extent

FIM Type: Dynamic (Depth NOT Included)

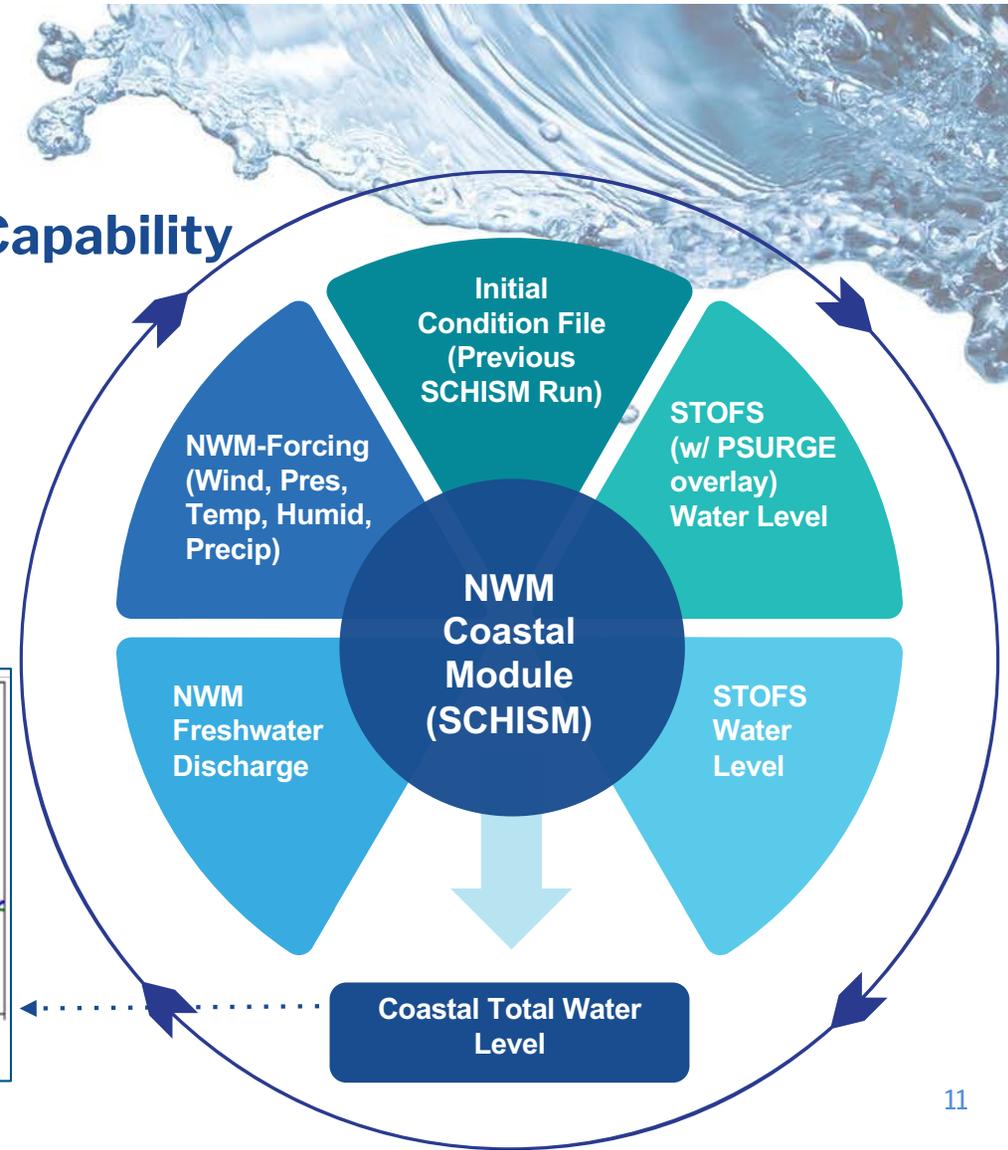
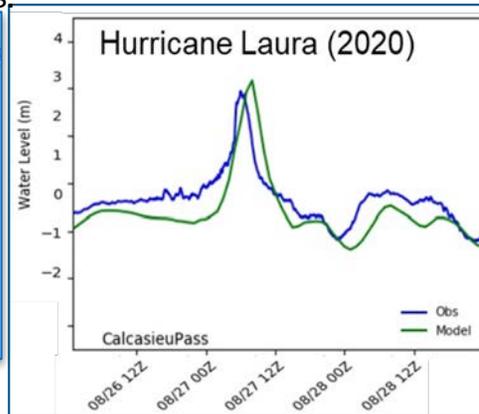
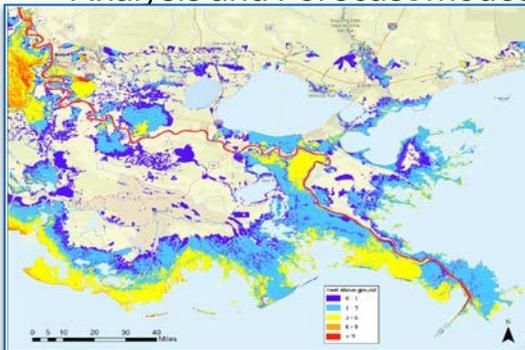
FIM Creation Time: Sept 1st, 1 pm



# NWM v.3.0 (2023): New Total Water Level Forecasting Capability

## Filling the capability gap

- TWL guidance is increasingly critical to the 100 million+ people living near the coast
- National total water level forecasts from the NWM will complement existing regional forecasts with *CONUS-wide, Hawaii, and PR/VI guidance*
- This new freshwater-estuary-ocean coupling will leverage the NWM, SCHISM, STOFS & PSURGE, execute in both Analysis and Forecast modes.



WFO Tampa-SLACK: (12:15 ET)



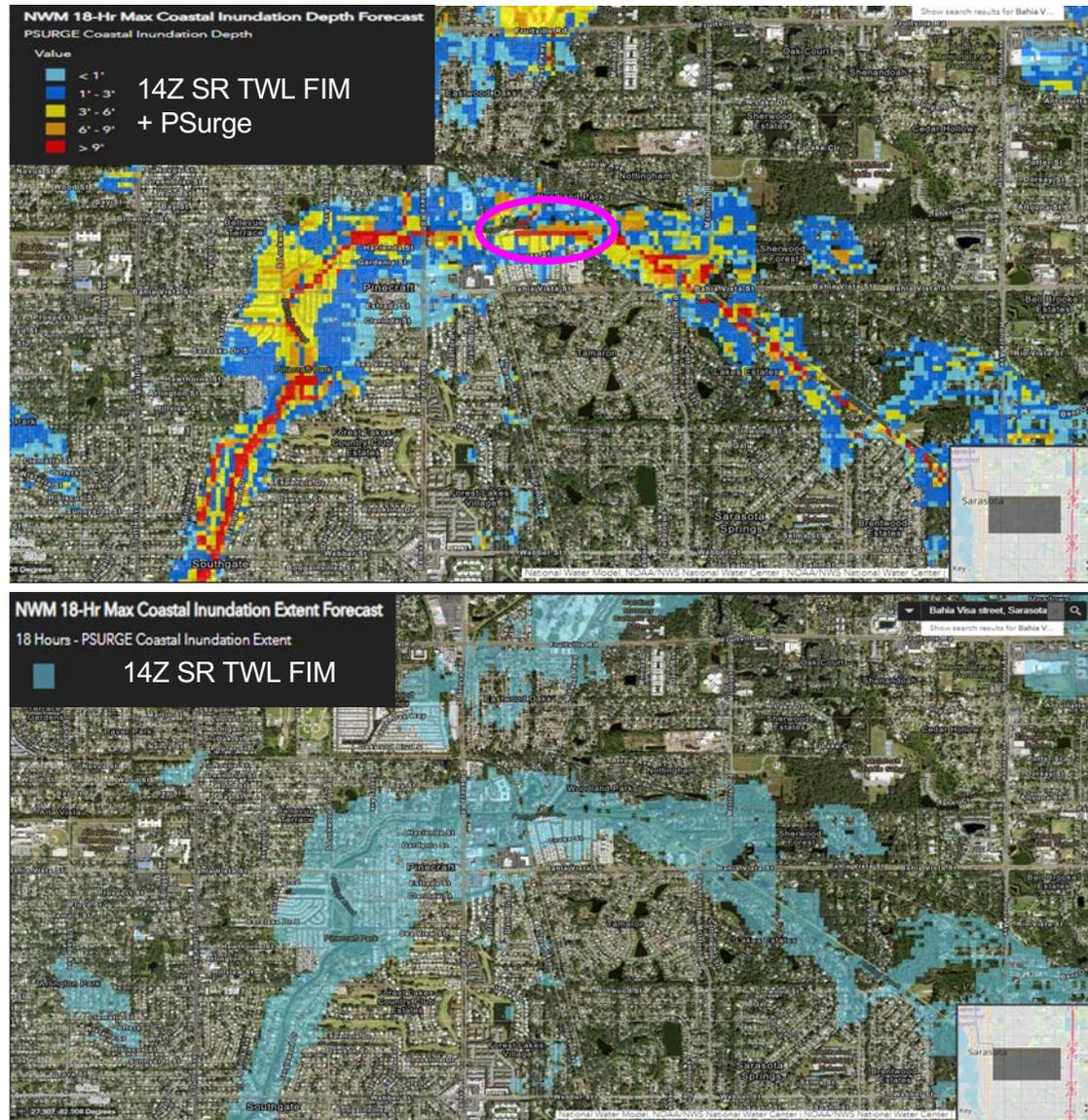
HAM - Pasco County, FL - Joe Tomasone 10:15 AM

Via social media, right now: Bahia Visa St, Sarasota.

image.png ▾



Hard to tell what section of Bahia Visa St. this is on  
Phillippi Creek runs through this and is tidal here



# Initial FIM Rollout - GIS Services

Experimental Services - at 30%

- FIM Services available for 30% of the nation
  - *NWM Latest Analysis FIM*
  - *RFC 5-Day Max Extent FIM*
  - *NWM 5-Day Max Extent FIM*
  - *NWM 18 hr (Short-range) Max Extent FIM to be added to the suite of services next spring*
- FIM Visualizations and GIS Services available on the new National Water Prediction Service (NWPS): <https://water.noaa.gov>
- FIM and NWM services available on our NWS National Viewer
  - (<https://viewer.weather.noaa.gov/water>)
  - *High Water & Peak Flow Arrival Time, Max High Flow Magnitude Forecast, & High Water Probability Forecasts*
  - *Rapid Onset Flooding Probability Forecasts*
  - Services available for ingest into your local GIS systems

National Oceanic and Atmospheric Administration

**Dynamic FIM Services  
Comparison Table [Public Domain]**

FIM Service	NWM Latest Analysis FIM	RFC 5-Day Maximum Forecast FIM	NWM NBM 5-Day Maximum Forecast FIM
Data Type	Observation-Based Simulations [precipitation estimate and assimilated with USGS gage observations]	Forecast [5-day RFC forecasts]	Forecast [5-day NBM QPF]
Total Latency	55 Minutes	45 Minutes	6 Hours 30 Minutes
Update Frequency	Hourly	Hourly [if new forecasts are available]	Every 6 hours
FIM Domain	NWM Domain for FIM 30%	Downstream of NWPS Forecast Points for FIM 30%	NWM Domain for FIM 30%
When to Use	Use as a snapshot of the most recent modeled inundation	Use when RFC forecast is available	Use for rivers and streams not covered by RFC forecast

NOAA

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<https://www.weather.gov/owp/operations>

# NWC Operations Page: <https://www.weather.gov/owp/operations>

## National Water Center Products and Services

### Operational and Experimental

[Weather.gov](#) > [Office of Water Prediction](#) > National Water Center Products and Services

Office of Water Prediction  
National Program

NWC  
National  
Water  
Center

### 2024 National Hydrologic Assessment



#### **!NEW! - National Water Prediction Service (NWPS) - !NEW!**

On March 27, 2024, the National Water Prediction Service (NWPS) website hosted at <https://water.noaa.gov> was launched replacing the legacy Advanced Hydrologic Prediction Service (AHPS) page previously located at <https://water.weather.gov>. Resources and more information are listed below.

Public Notification Statement: November 16, 2023  
Service Change Notice (SCN): January 12, 2024  
SCN: March 6, 2024

NWPS Quick Start Guide  
Accessing Hydrographs on a Mobile Device through NWPS  
NWPS Flyer  
NWPS API Flyer  
NWPS Fact Sheet  
NWPS Overview (Story Map)  
NWPS Product and User Guide  
Recording of NWPS Partner Webinar  
Recording of NWPS API Webinar  
Service Description Document (SDD)

Contact: [nwps.webmaster@noaa.gov](mailto:nwps.webmaster@noaa.gov)



#### **!NEW! - Flood Inundation Mapping (FIM) Services - !NEW!**

**Experimental FIM services** are now available for 30% of the U.S. population including Puerto Rico and the U.S. Virgin Islands. These services will be expanded to nearly 100% of the U.S. population by 2026. **Experimental services** depict the extent of predicted inundation, as derived from River Forecast Center forecasts and National Water Model analyses and forecasts. Services are available via the National Water Prediction Service, the NWS GIS Viewer, or directly via URLs hosted on the Hydrologic Visualization and Information Services (HydroVIS) cloud system. Additional informational resources are available below.

Public Notification Statement (PNS)  
FIM Fact Sheet  
Spanish Translation Dynamic FIM Services  
Stage-based CatFIM Service Summary  
Frequently Asked Questions (FAQs)  
FIM Service Description Document (SDD)  
Viewer Access Instructions  
API Access Instructions  
Viewing FIM in NWPS  
Using CatFIM in NWPS

[CLICK HERE to Provide Feedback](#)



#### **Area Hydrologic Discussion**

Experimental short range, episodic, discussion and graphic which highlights locations across the nation that may be impacted by rapid-onset flooding, using National Water Model and other guidance.

AHD Product Description Document  
[Provide Feedback on AHD](#)  
AHD One-Pager



#### **Flood Hazard Outlook**

High Level graphical depiction and key messages highlighting the potential threat of inland flood hazards (flash, urban, small stream and riverine) and their associated impacts (catastrophic, considerable, and limited) for the next seven days.

FHO Product Description Document  
[Provide Feedback on FHO](#)  
FHO One-Pager



#### **National Hydrologic Discussion**

Experimental discussion of the current and forecast hydrologic conditions across the nation, including a variety of short and medium range (Days 1-10) observed and modeled hydrologic guidance.

NHD Product Description Document  
[Provide Feedback on NHD](#)  
NHD One-Pager



#### **Significant River Flood Outlook**

Operational flood outlook intended to provide a general outlook for significant (moderate and above) river flooding. It is not intended to depict all areas of minor flooding or small-scale events such as localized flooding and/or flash flooding.



#### **NWC Visualization Services**

Experimental geospatial services depicting forecasts from the River Forecast Centers and the National Water Model. Services available via the prototype NWS National Map Viewer, or directly via URLs hosted on the Hydrologic Visualization and Inundation Services (HydroVIS) cloud resource.

Public Services Handbook  
NWC Visualization Services Service Description Document  
[Provide Feedback on NWC Visualization Services](#)

# National Water Model & Flood Inundation Services



<https://viewer.weather.noaa.gov/water>

**NWS GIS Viewer | Water**

**LAYERS**

Clear Layers Collapse Folders

- Watches, Warnings, Hazards, and Advisories
- Quantitative Precipitation Estimates
  - River Forecast Centers (RFC) Quantitative Precipitation Estimates (QPE)
- Radar Products
- Flood Inundation Maps (FIM) (EXPERIMENTAL)**
  - NWM Latest Analysis (Zoom level 18+) <sup>QPE</sup>
  - RFC 5-Day Max Forecast (Zoom level 18+) <sup>QPE</sup>
  - NWM 5-Day Max Forecast (GFS) (Zoom level 18+) <sup>QPE</sup>
  - FIM Coverage Domain <sup>QPE</sup>
    - Opacity: 100%
  - FIM Coastal Exclusion Zone <sup>QPE</sup>
- Flood Products
- River Observations and Forecasts**
  - Advanced Hydrologic Prediction Service (AHPS) River Gauges
  - Land Analysis
    - National Water Model (NWM) Output
      - CONUS Precipitation (inches) <sup>QPE</sup>
      - Hawaii Precipitation (inches) <sup>QPE</sup>
      - Puerto Rico Precipitation (inches) <sup>QPE</sup>
    - Streamflow Anomaly Analysis
      - High Flow Magnitude Analysis
        - Medium-Range High Water Arrival Time Forecast
        - Medium-Range High Water Probability Forecast
        - Medium-Range Max High Flow Magnitude Forecast
        - Medium-Range Rapid Onset Flooding Forecast
        - Medium-Range Rapid Onset Flooding Probability
        - Medium-Range Peak Flow Arrival Time Forecast
      - Flowlines
        - Short-Range High Water Arrival Time Forecast
        - Short-Range High Water Probability Forecast
        - Short-Range Max High Flow Magnitude Forecast
        - Short-Range Rapid Onset Flooding
        - Short-Range Rapid Onset Flooding Probability
    - River Forecast Center (RFC) Output

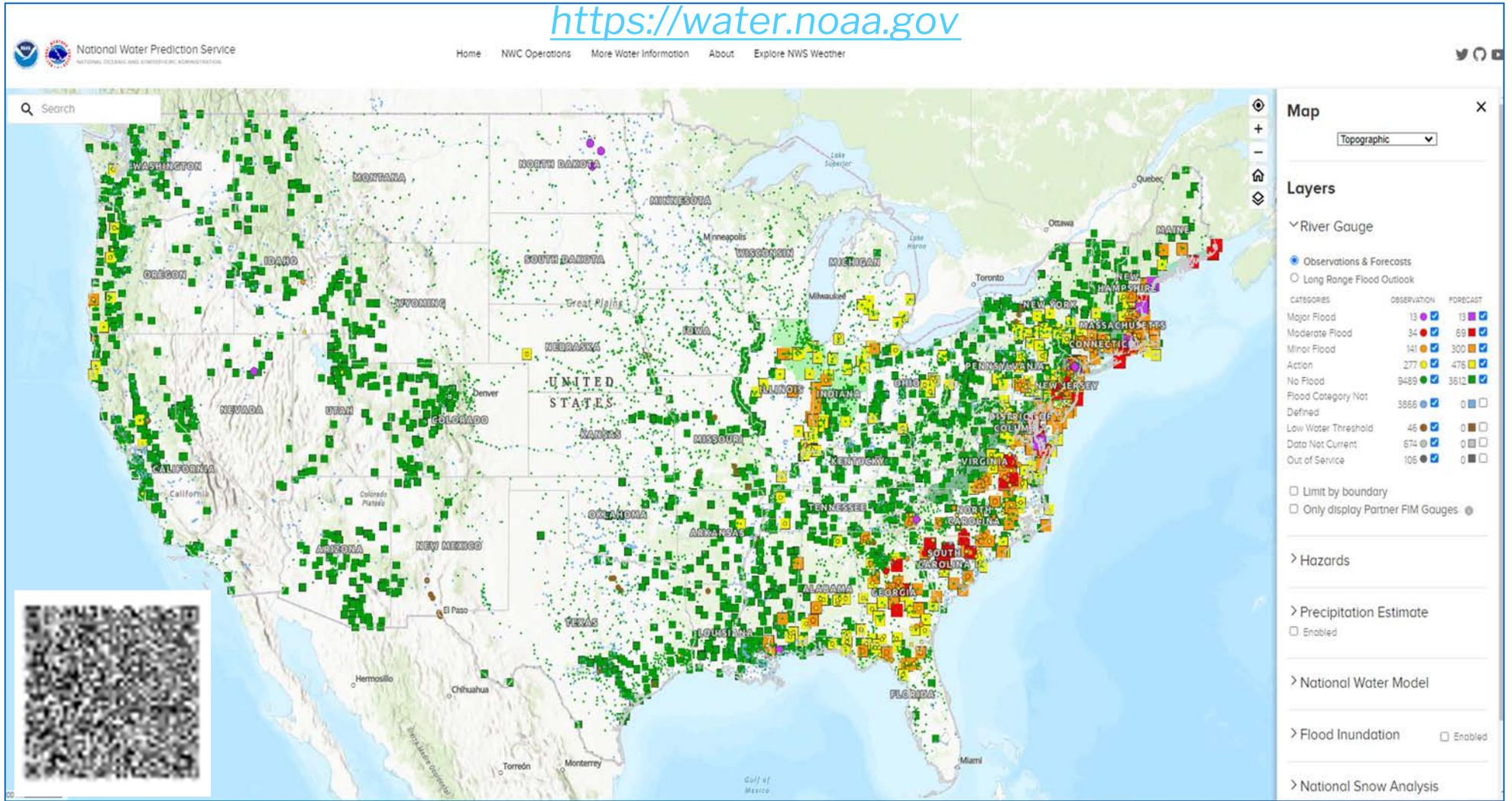
Bookmark Views: >

Scale: 1 : 2,747,837    Zoom: 11.8    Location: 46.07471°, -75.50842°    Projection: 3857: WGS84 Web Mercator

**This experimental map represents the NWS's best approximation of inundation extent based upon modeled river discharge**

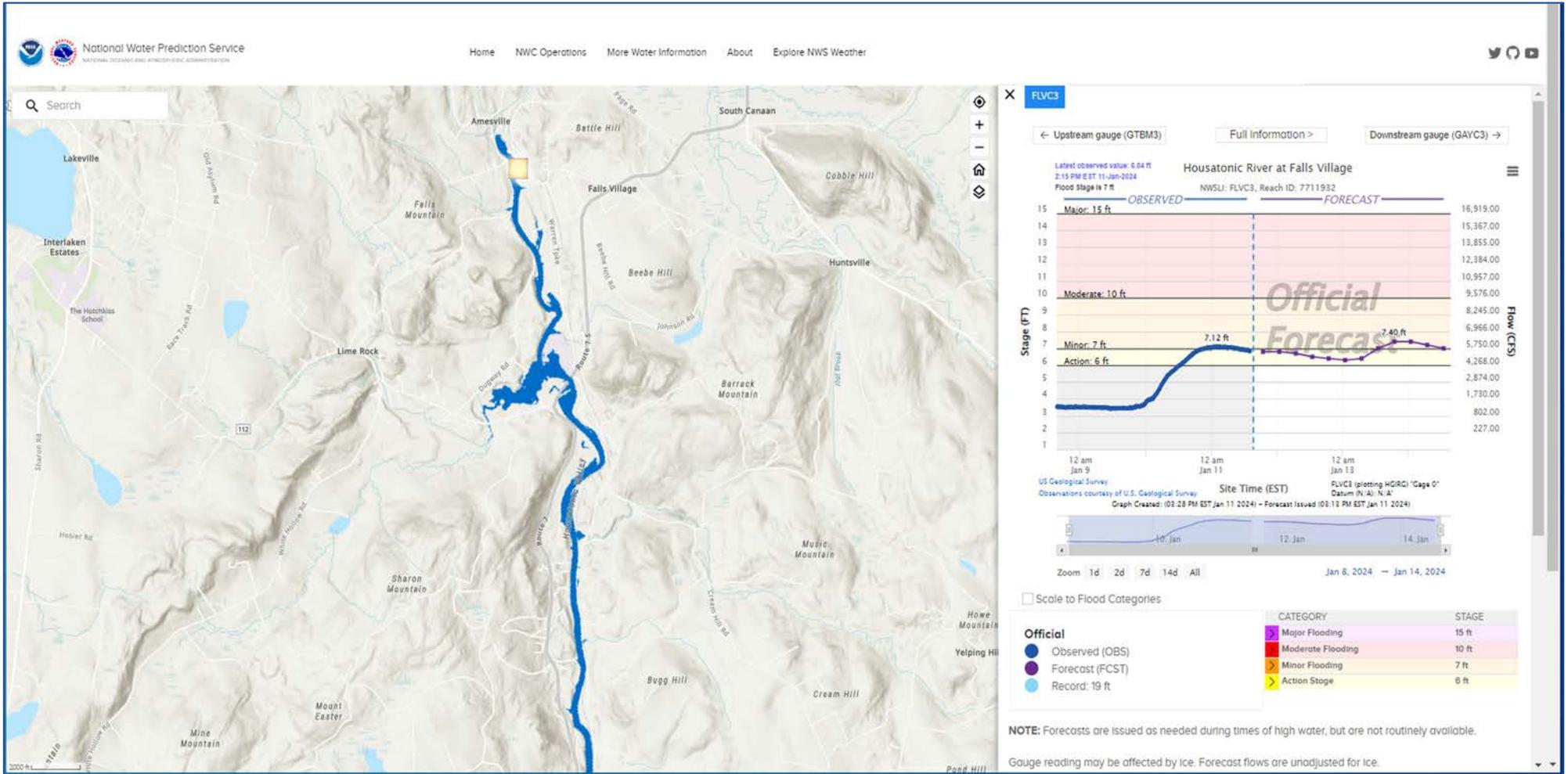
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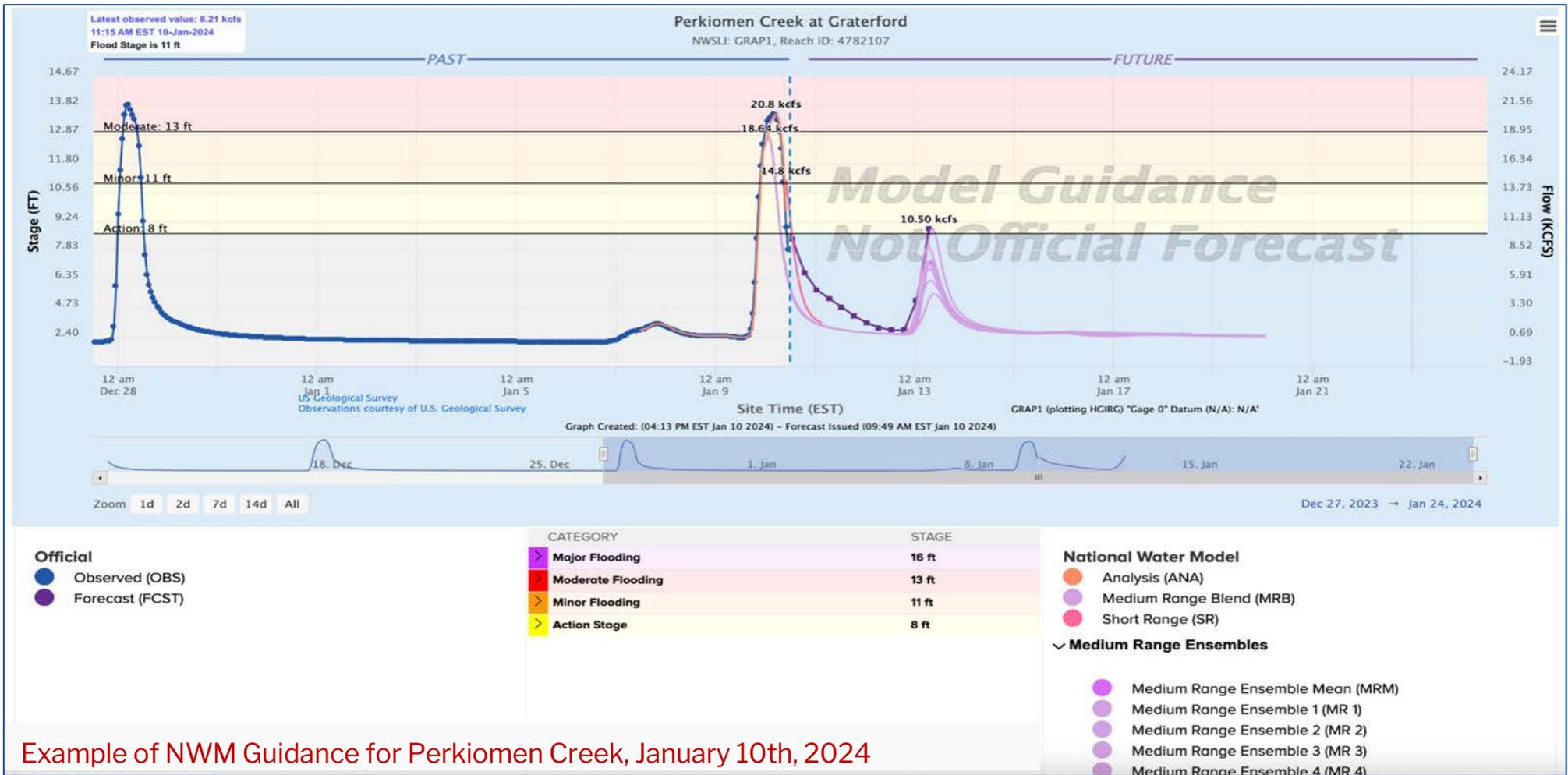
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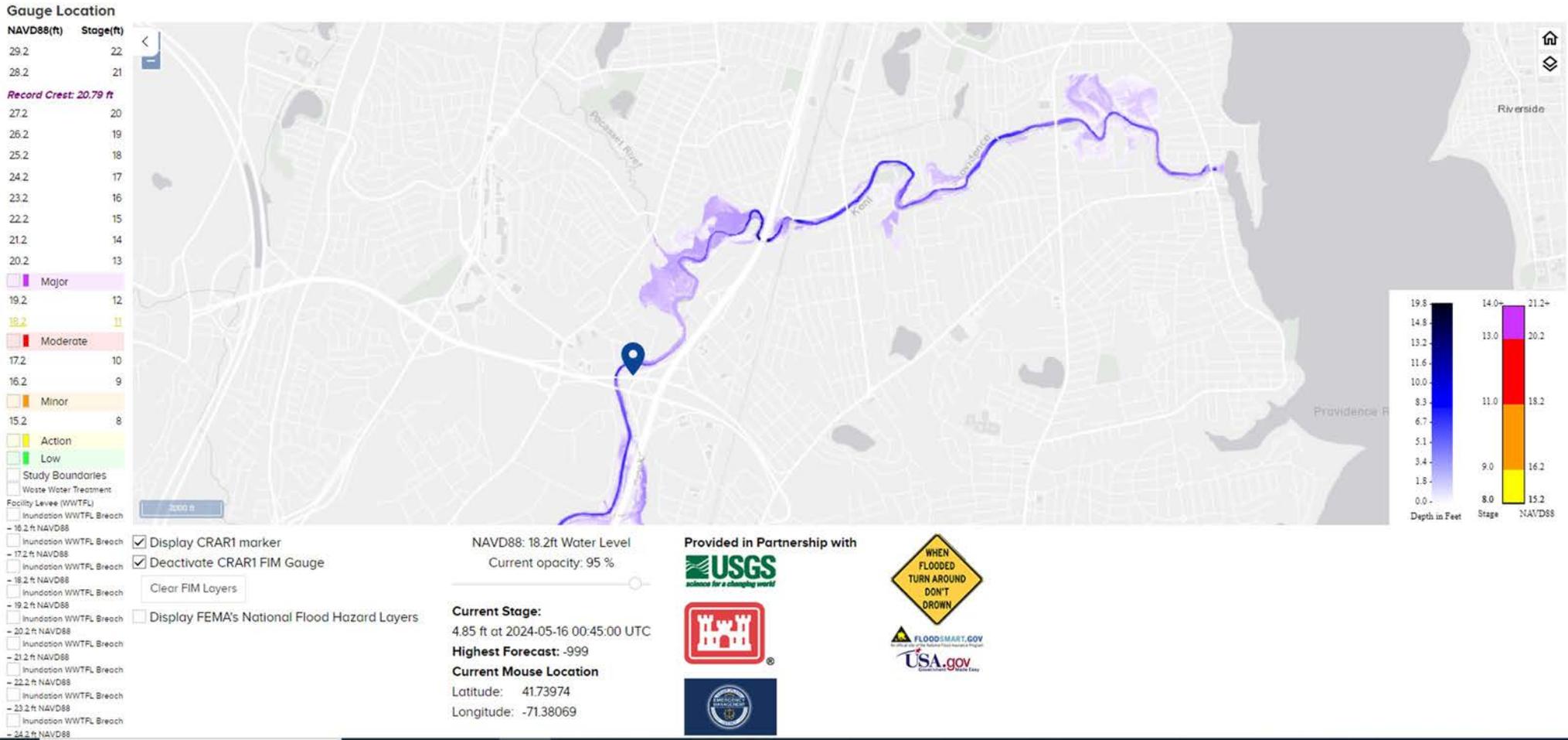
# National Water Prediction Service (NWPS)

<https://water.noaa.gov>



Example of NWM Guidance for Perkiomen Creek, January 10th, 2024

# Partner FIM Libraries (formally called AHPS FIM Libraries)



# Categorical Stage-Based FIM (CATFIM)

### Gauge Location

- Action 1ft Intervals
- Action Threshold
- Minor 1ft Intervals
- Minor Threshold
- Moderate 1ft Intervals
- Moderate Threshold
- Major 1ft Intervals
- Major Threshold
- Major Threshold

- Display PTVN6 marker
- Activate PTVN6 FIM Gauge
- Deactivate PTVN6 CATFIM
- Display FEMA's National Flood Hazard Layers

### Recent Crests

- 13.85 ft on 10-26-2021 (P)
- 17.53 ft on 12-25-2020 (P)
- 13.55 ft on 10-30-2017
- 12.03 ft on 02-25-2016
- 13.71 ft on 09-07-2011

[SHOW ALL CRESTS](#)

### Historic Crests

- 24.38 ft on 08-28-2011
- 19.57 ft on 03-05-1979
- 19.5 ft on 01-26-1978
- 19.39 ft on 01-19-1996
- 19.14 ft on 10-16-1955

[SHOW ALL CRESTS](#)

**Current Stage:** 3.89 ft at 2023-12-01 23:22:05 UTC

**Highest Forecast:** 6.3 ft

**Current Mouse Location**



# NWS Flood Inundation Mapping Services Implementation

## Map Legend



Population served by **October 2023.**



Population served by **October 2024.**

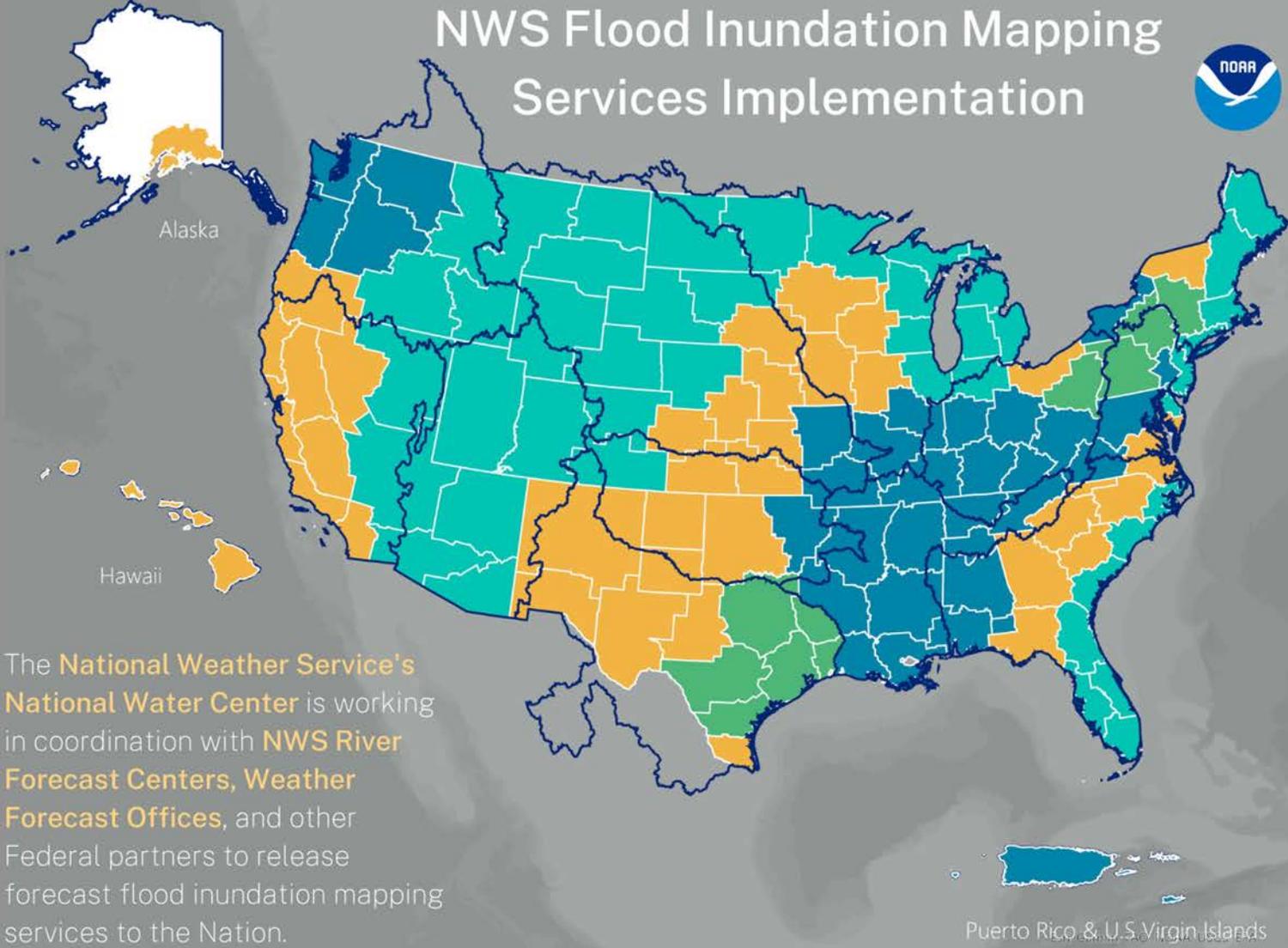


Population served by **October 2025.**



Population served by **October 2026.**

-  NWS County Warning Areas
-  NWS River Forecast Center Boundaries



The **National Weather Service's National Water Center** is working in coordination with **NWS River Forecast Centers, Weather Forecast Offices**, and other Federal partners to release forecast flood inundation mapping services to the Nation.

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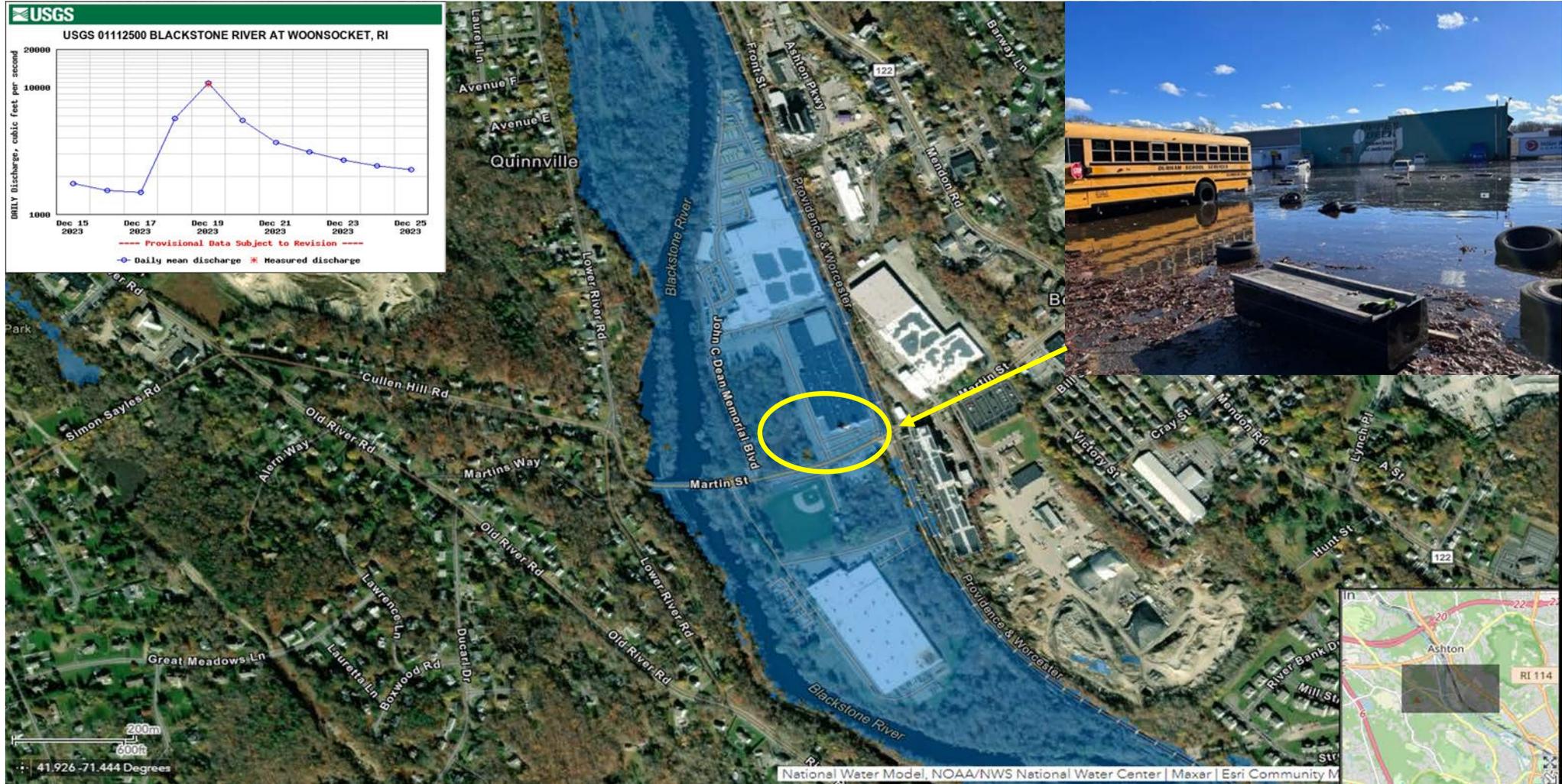
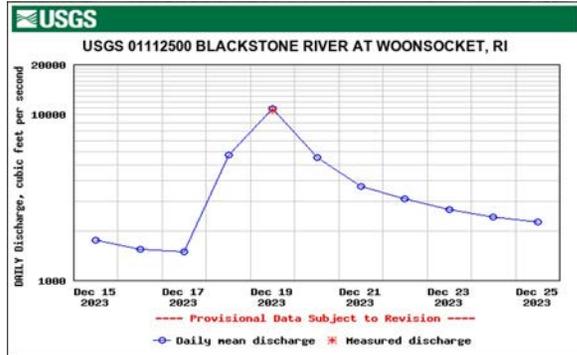
Puerto Rico & U.S. Virgin Islands

# Prototype Services

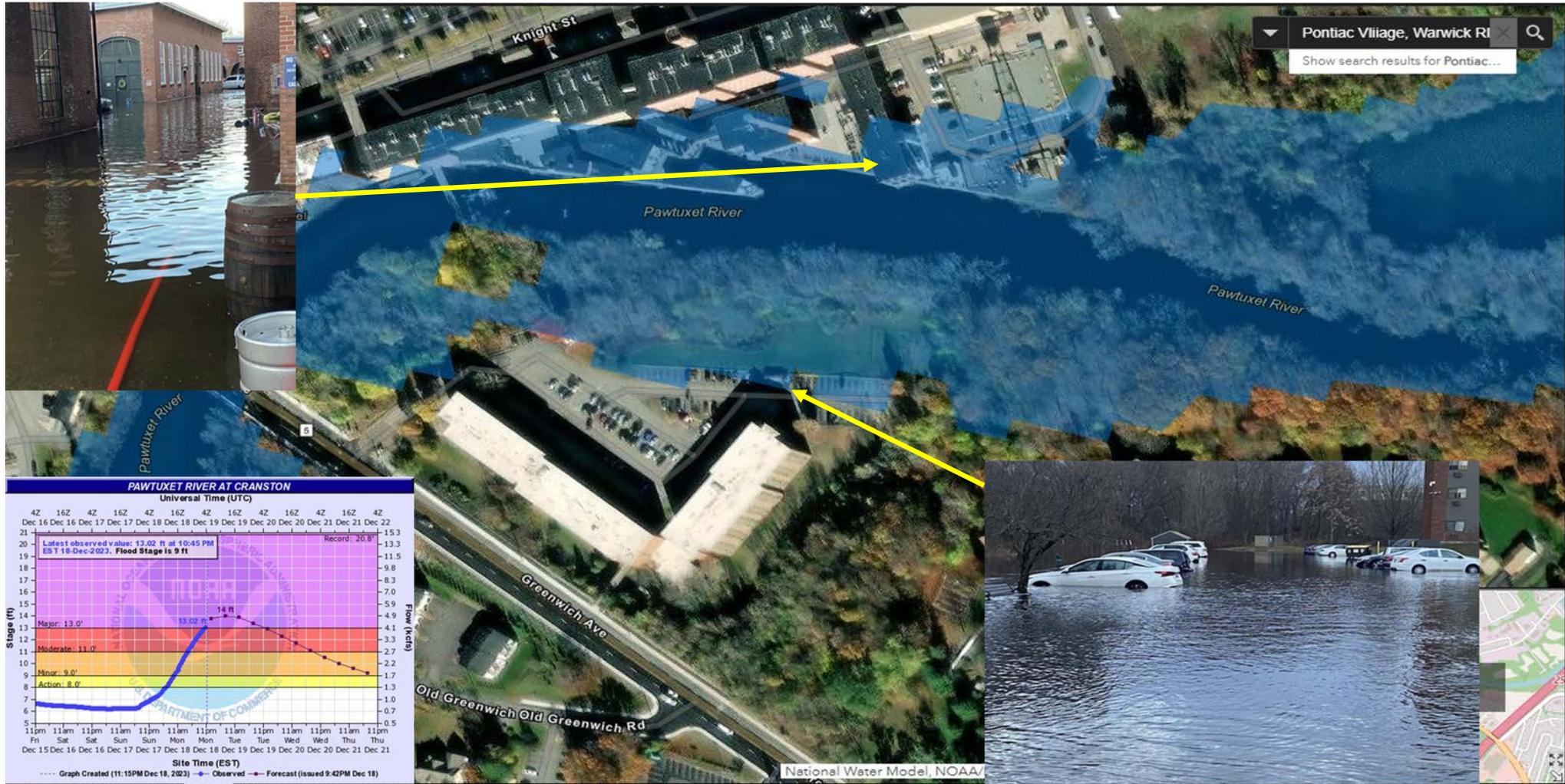
From the December and January Floods



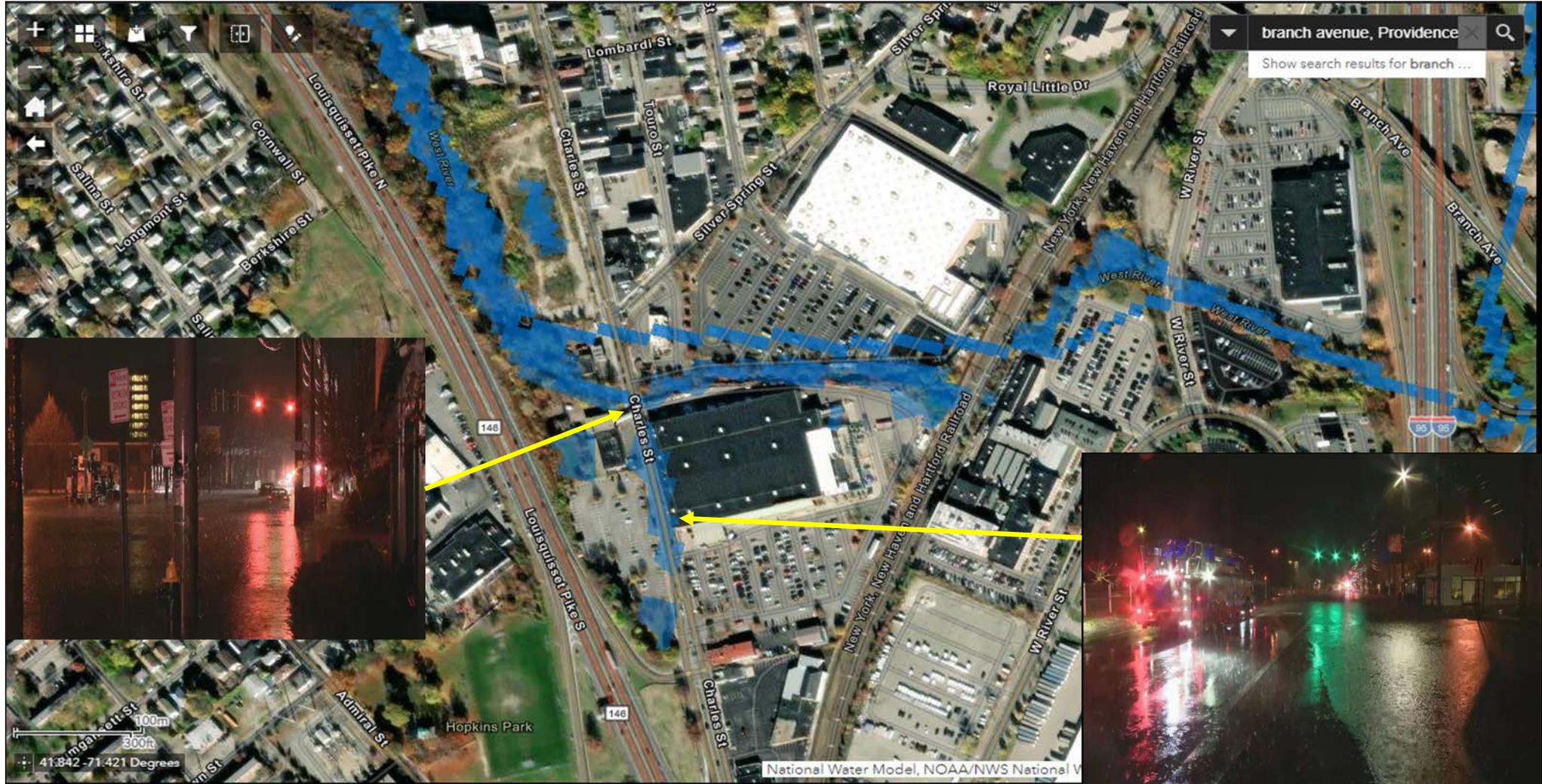
# Blackstone River - Cumberland RI: Two school days lost due to flooded bus yard



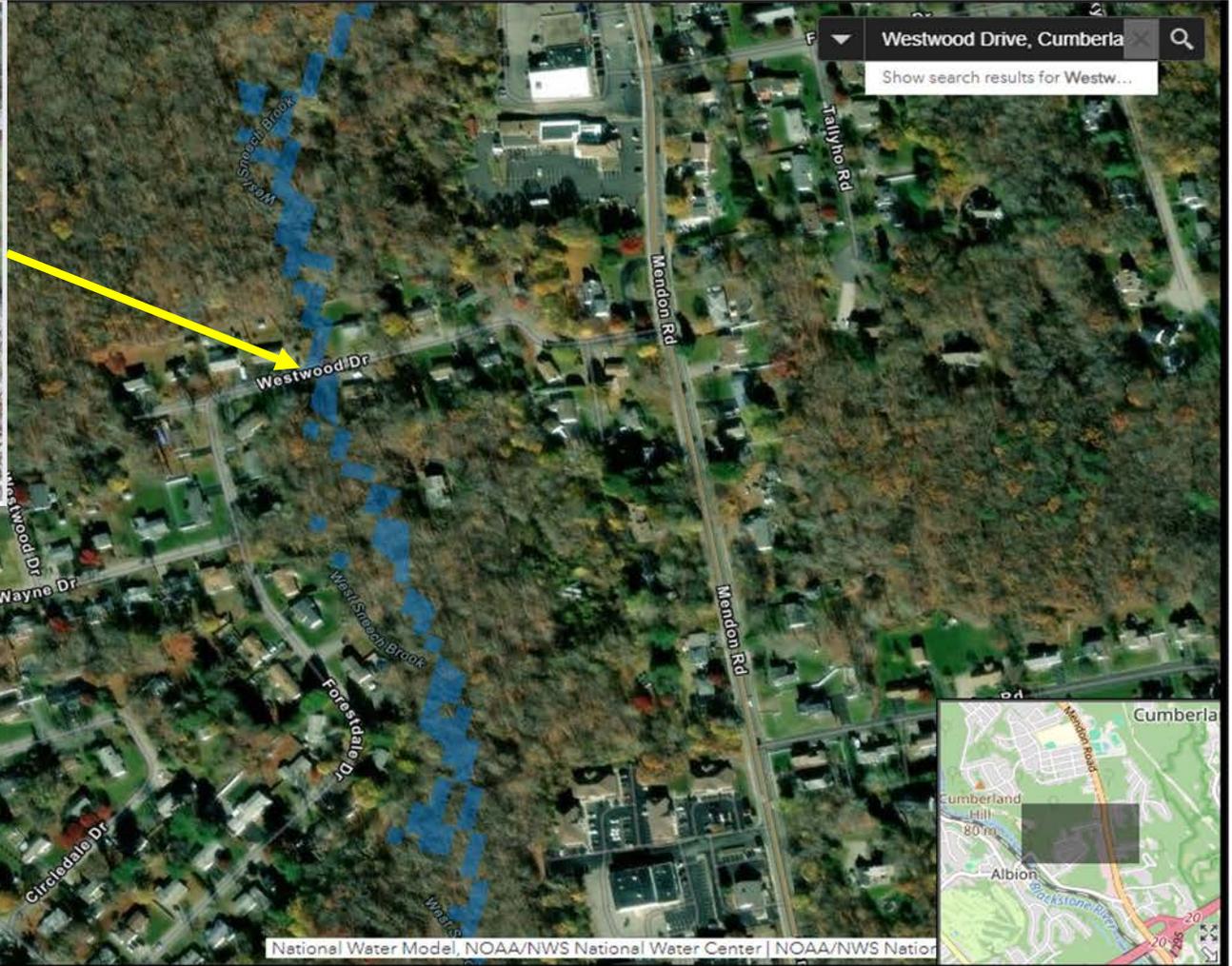
# Pawtuxet River, Warwick RI: Flooding of businesses and apartments



# West River - small stream flowing through Providence, RI



# West Sneech Brook cuts across Westwood Dr., Cumberland RI





# Record Flooding Forecast in Asheville, NC

Friday, September 27, 2024  
12:45 AM EDT

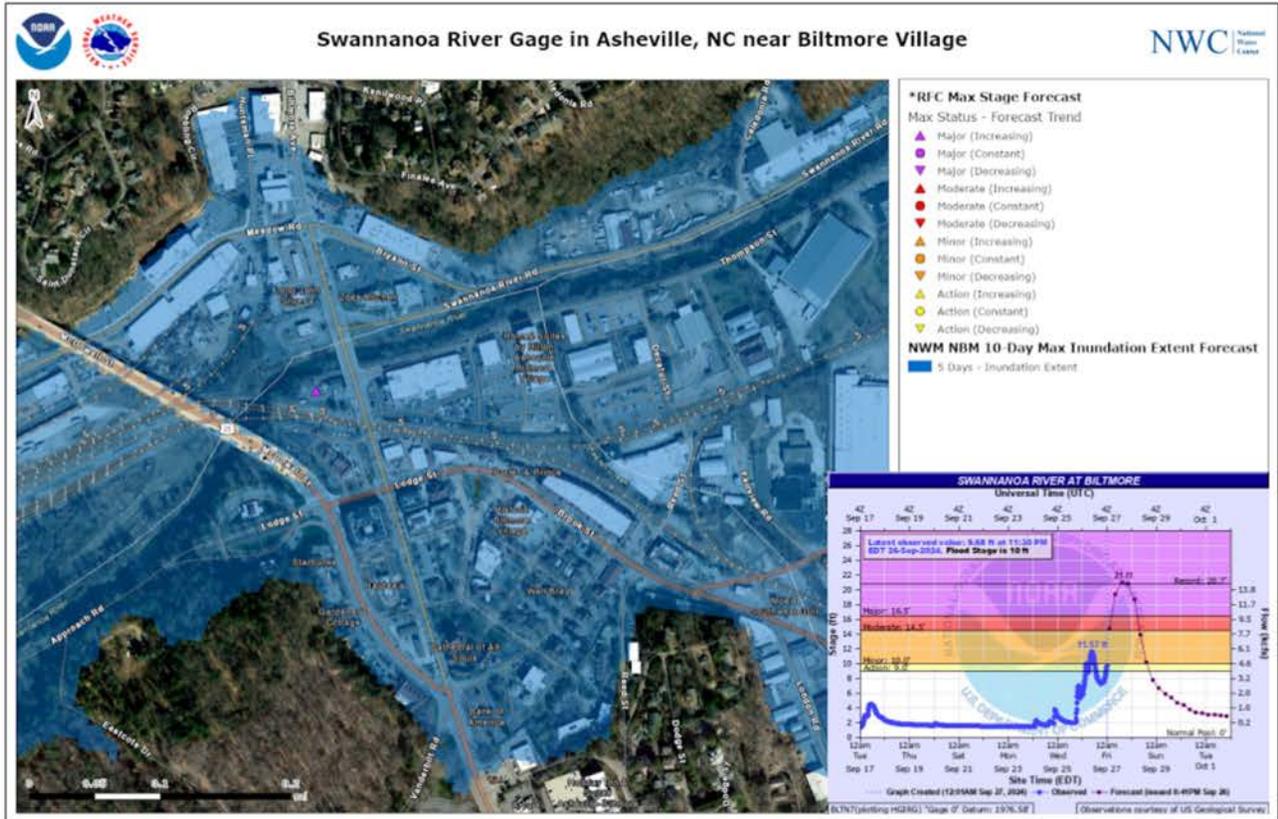
Life Threatening Flooding Possible

## Key Messages

- Record flooding is forecast along the Swannanoa River
- Life threatening flooding may be possible
- Flood inundation mapping suggests widespread flooding in the Biltmore Village area of Asheville (shown in blue in the image on the right)
- To escape rising water, take the shortest path to higher ground.

## Timing

- Flooding is ongoing and expected to crest Friday evening at record stage



National Oceanic and Atmospheric Administration  
U.S. Department of Commerce

National Weather Service  
National Water Center



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