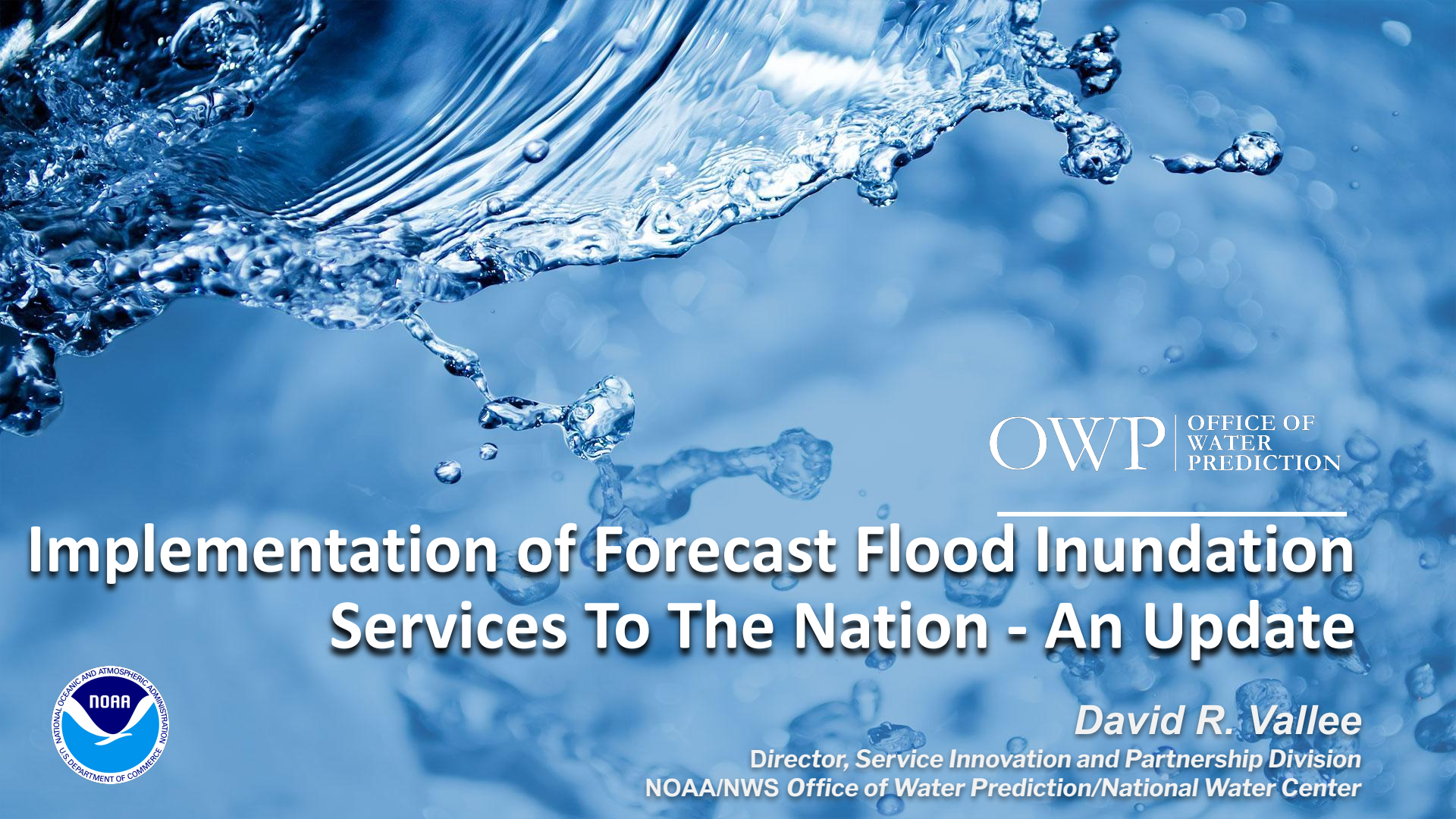


OWP | OFFICE OF WATER PREDICTION

Implementation of Forecast Flood Inundation Services To The Nation - An Update

David R. Vallee

Director, Service Innovation and Partnership Division

NOAA/NWS *Office of Water Prediction/National Water Center*

Outline

- 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
- Field office training

Why are we doing this?

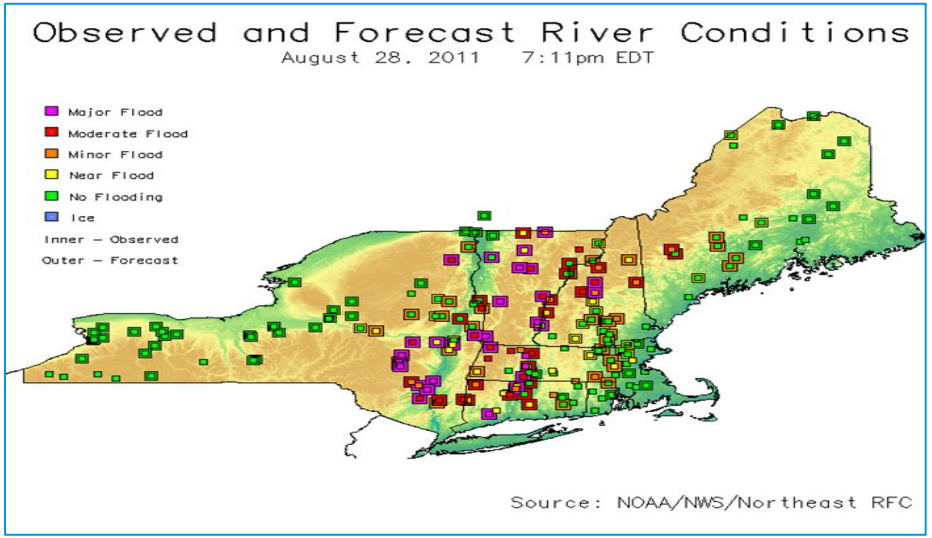
To fill a significant service gap!

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

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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

2017 — NWC Summer Institute

- Demonstrated continental scale FIM capability using the Height Above Nearest Drainage (HAND) method.

2019 — First DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas.
- Completed two tabletop exercises with core stakeholders and emergency responders.

2021 — Second DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas and along the Atlantic Coast.
- Completed two tabletop exercises across the Northeast with core stakeholders and emergency responders.

2023 — Operational FIM for 10% of U.S. Population

- Begin delivery of FIM services and Impact-based Decision Support Services (IDSS).
- Leverage cloud-based solution.

2026 — Operational FIM for nearly 100% of U.S. Population

- Integrated FIM capabilities and services across the U.S.
- Total Water Level FIM forecasts along the coasts.

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 28th, 2011. Source: Kait Wood

NWS Flood Inundation Mapping Services Implementation

Map Legend

10% Population served by **October 2023**.

30% Population served by **October 2024**.

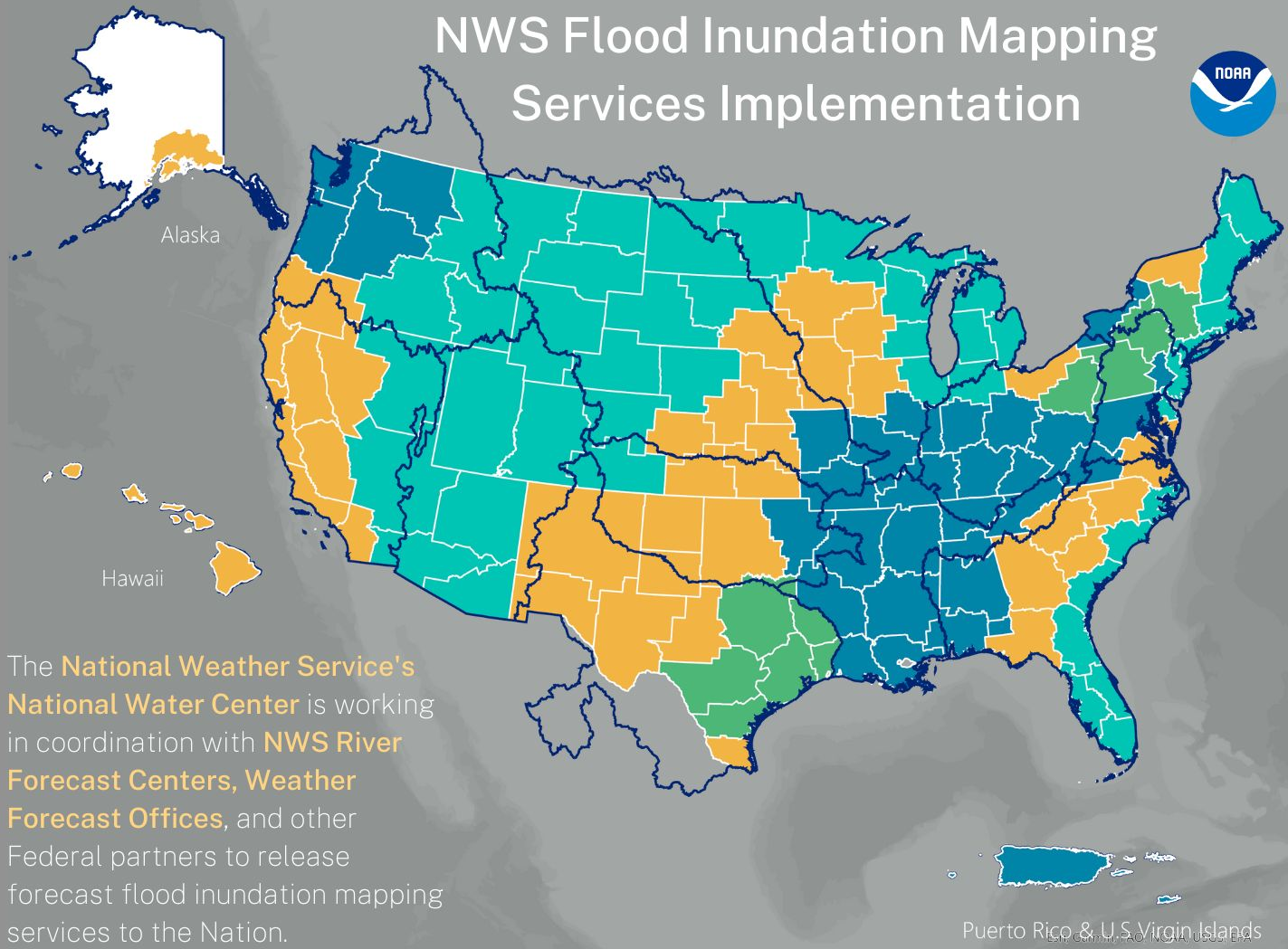
60% Population served by **October 2025**.

100% Population served by **October 2026**.

NWS County Warning Areas

NWS River Forecast Center Boundaries

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



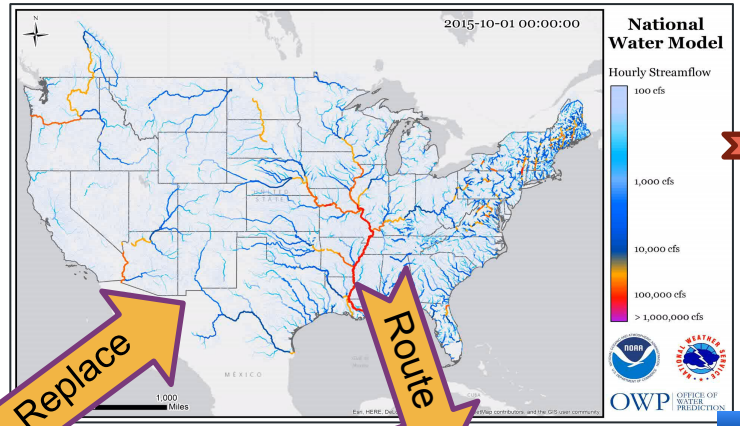
The **National Weather Service's National Water Center** is working in coordination with **NWS River Forecast Centers, Weather Forecast Offices**, and other Federal partners to release forecast flood inundation mapping services to the Nation.

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

Deliver Forecast Flood Inundation Services

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

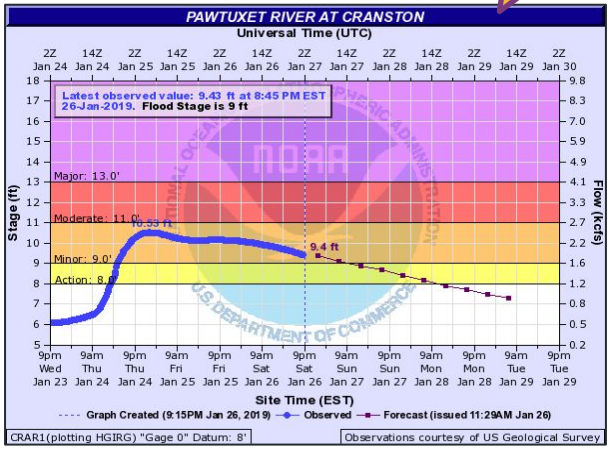


Replace

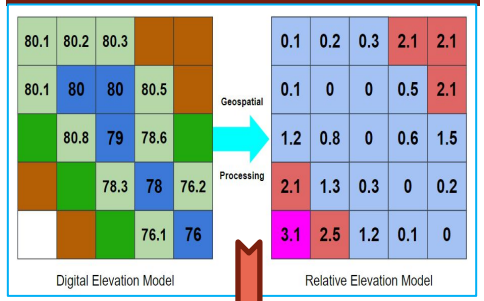
Route

River Center Forecasts

Forecasters heavily engaged in the forecast production



Height Above Nearest Drainage (HAND)



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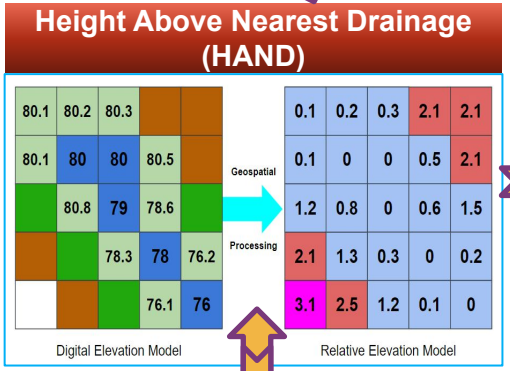
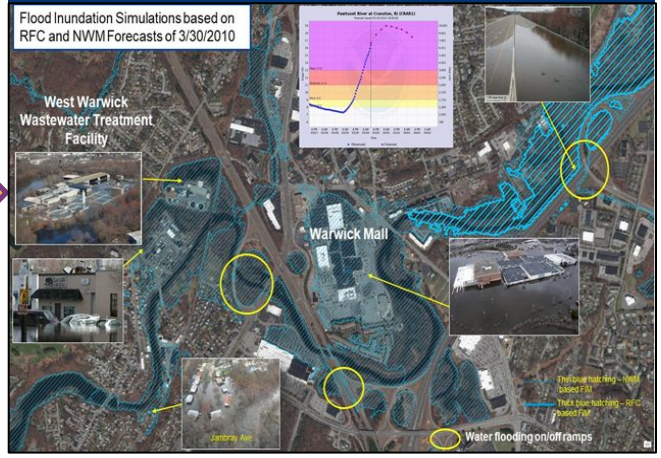
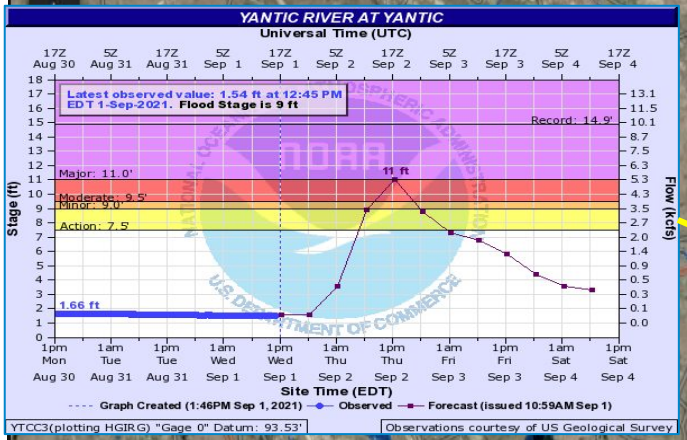


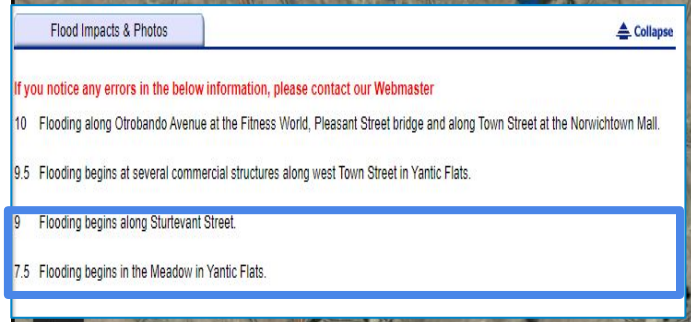
+RAStoFIM & RAStoREM techniques

Pawtuxet River Valley – West Warwick/Warwick



Value of FIM Services - Visualizations to depict impacts





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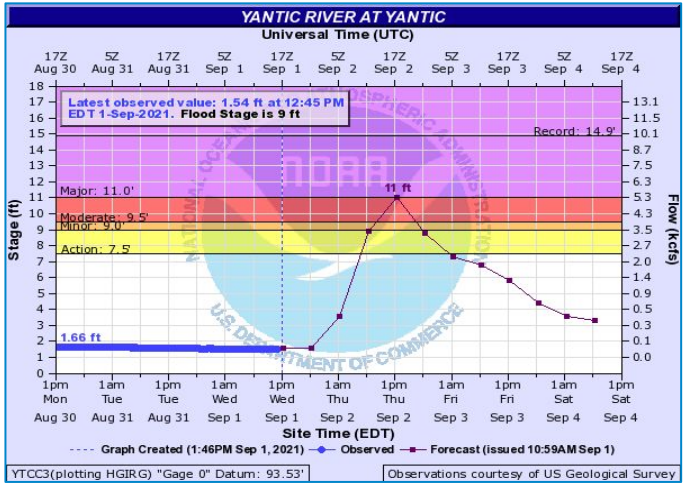
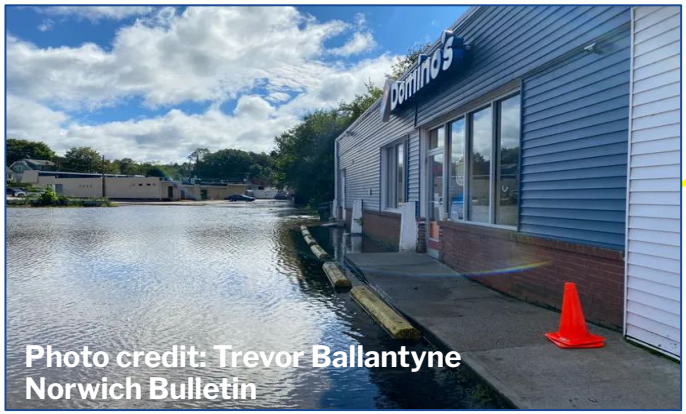
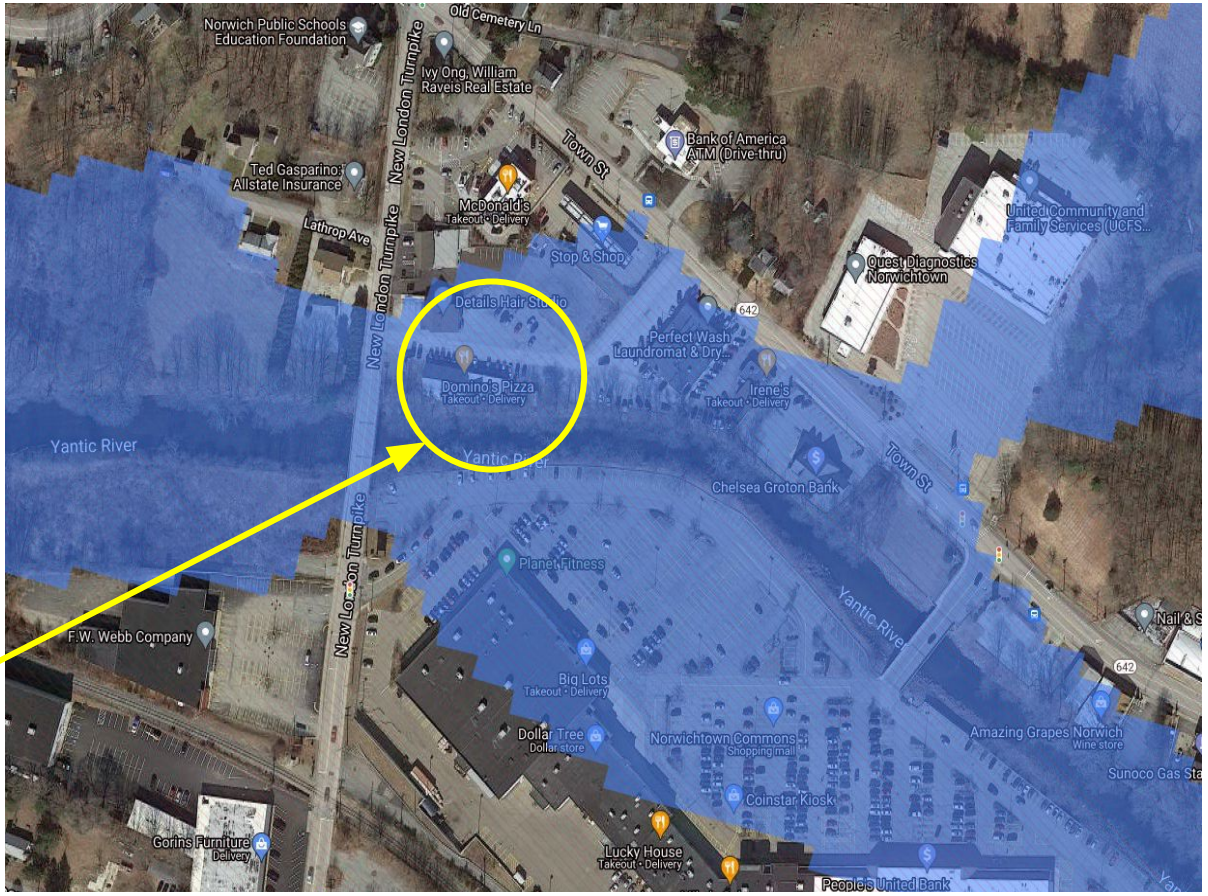






Integrating FIM Services into our IDSS

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

Yantic River at Yantic, CT

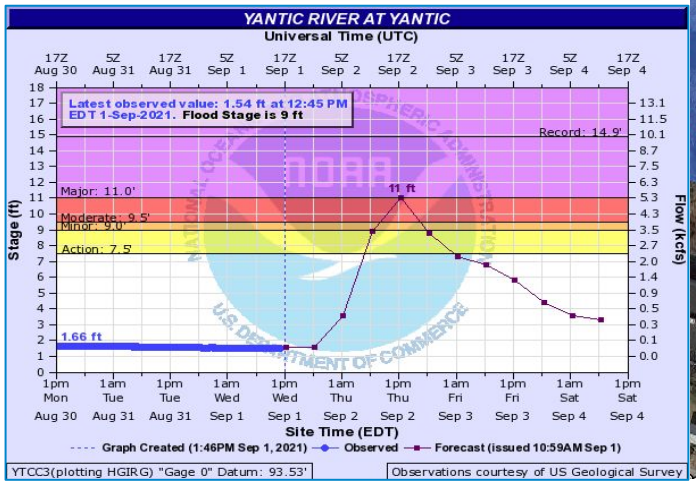
Forecast Crest Height: **11 Feet**

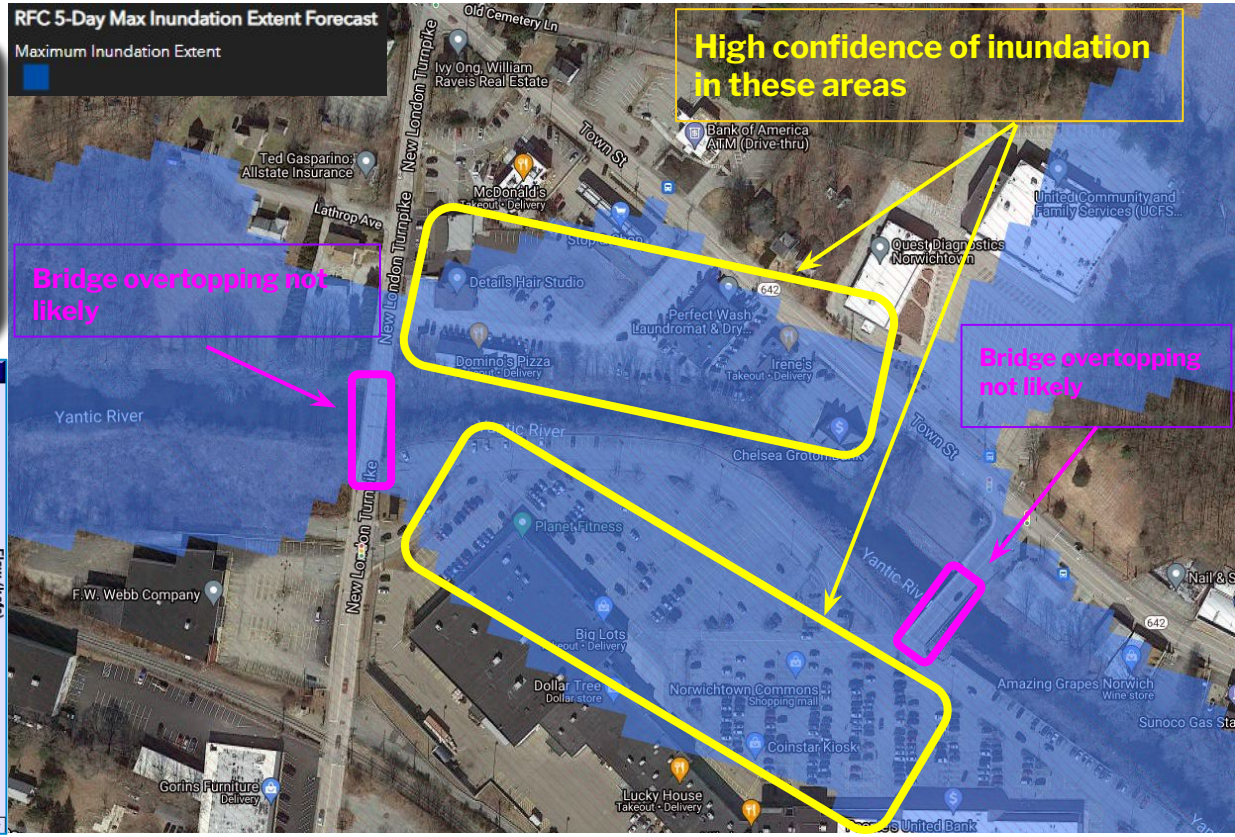
Map Height Shown: **11 Feet**

FIM Source: **RFC FIM 5 Day Max Extent**

FIM Type: **Dynamic (Depth NOT Included)**

FIM Creation Time: **Sept 1st, 1 pm**





Initial FIM Rollout - National Viewer

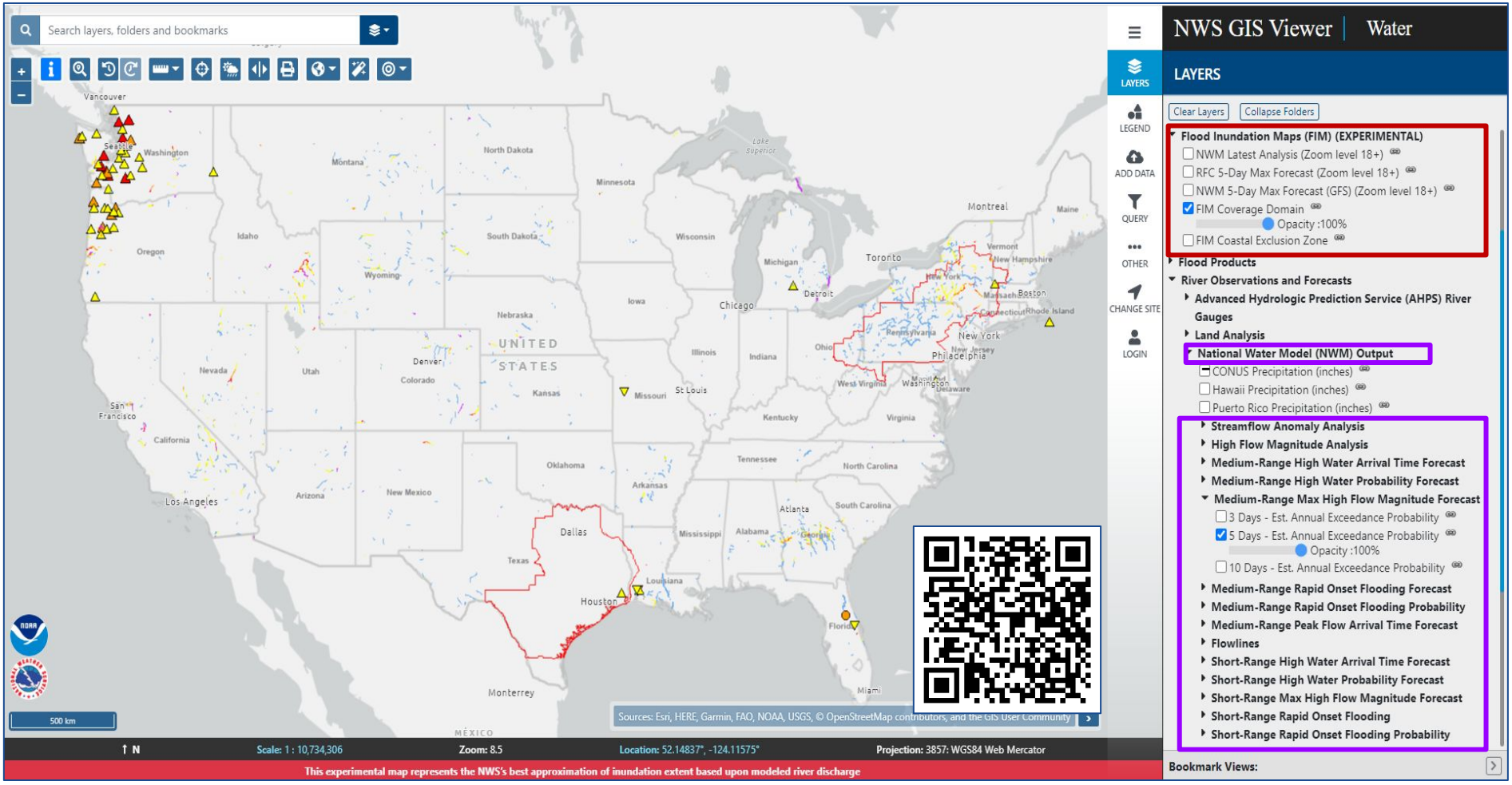
Experimental Services - FIM for 10% of the U.S. population

- Services available on our NWS National Viewer alongside the existing NWM visualizations
  - (https://viewer.weather.noaa.gov/water)
  - High Water Arrival Time, Max High Flow Forecast, & High Water Probability Forecasts
  - Rapid Onset Flooding Forecasts & Probability Forecasts
- Actual services available for ingest into your local GIS systems

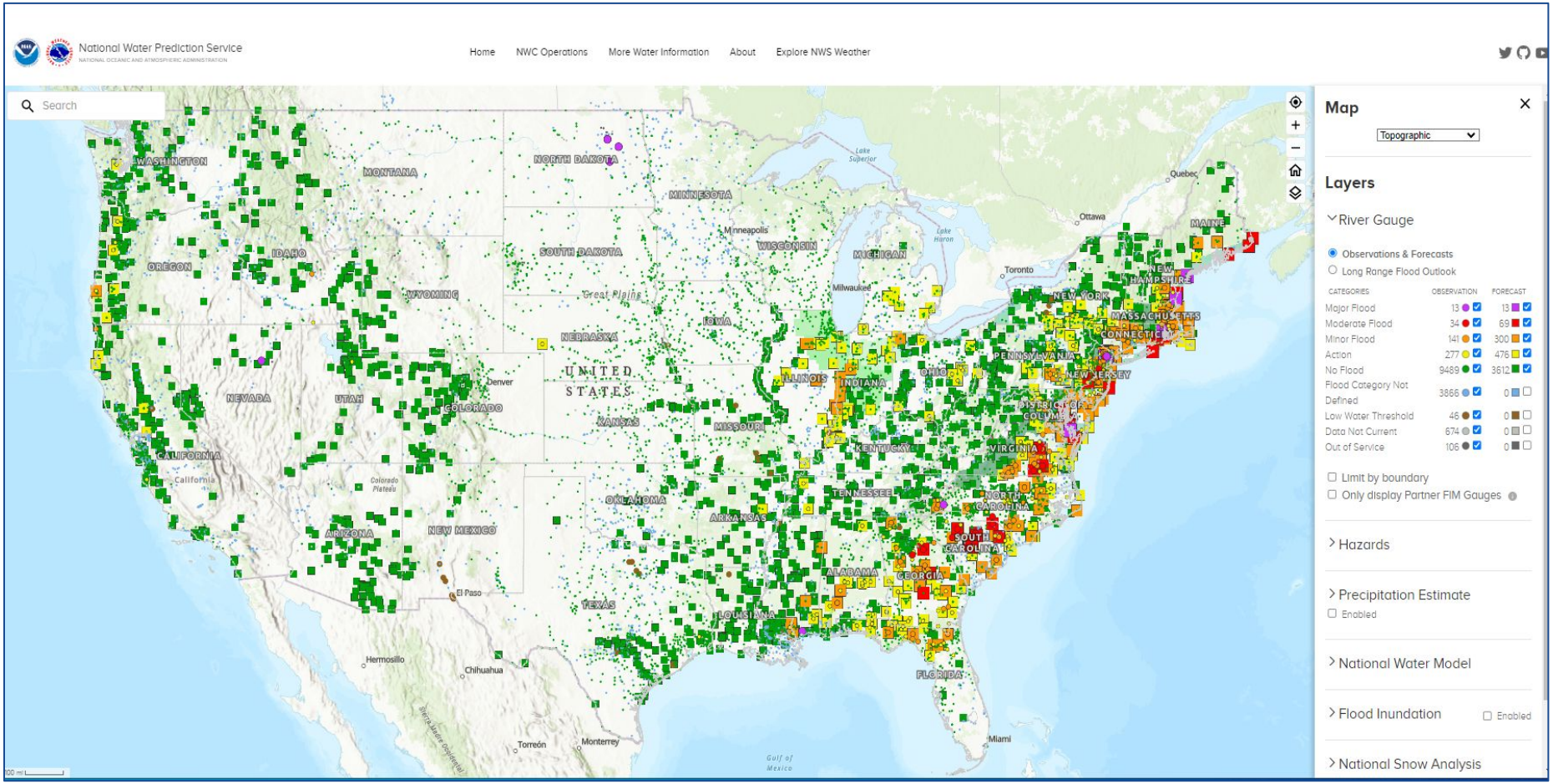
Dynamic FIM Services Comparison Table

FIM Service	NWM Latest Analysis FIM	RFC 5-Day Max FIM	NWM 5-Day Max FIM
Data Type	Observation based simulations [precip. estimates & USGS gage observations]	Forecast [5-day RFC forecasts]	Forecast [5-day GFS]
Total Latency	55 minutes	45 minutes	6 hours 30 minutes
Updates	Hourly	Hourly [if new forecasts available]	Every 6 hours
HAND Inputs	Flow	Flow	Flow
Threshold Source [NWM/RFC]	NWM High Water	RFC	NWM High Water
Error Sources	• RADAR or gage malfunctions • For ungaged reaches, errors associated with NWM & estimated precipitation • HAND errors [10m DEM resolution]	• Rainfall forecast • RFC flow simulations • Routing of flow using NWM physics • HAND errors [10m DEM resolution]	• GFS forecast • NWM flow simulations • HAND errors [10m DEM resolution]
FIM Domain	Entire NWM domain [CONUS, HI, PR, US Virgin Islands]	Downstream of AHPS forecast points	CONUS
Mapping Threshold	Only available for reaches that meet and/or exceed the "High Water" threshold	Only available based on active RFC forecasts at or above "Action Stage"	Only available for reaches that meet and/or exceed the "High Water" threshold
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

NWM and FIM Services - NWS National Viewer



National Hydrologic Prediction System - coming in late March



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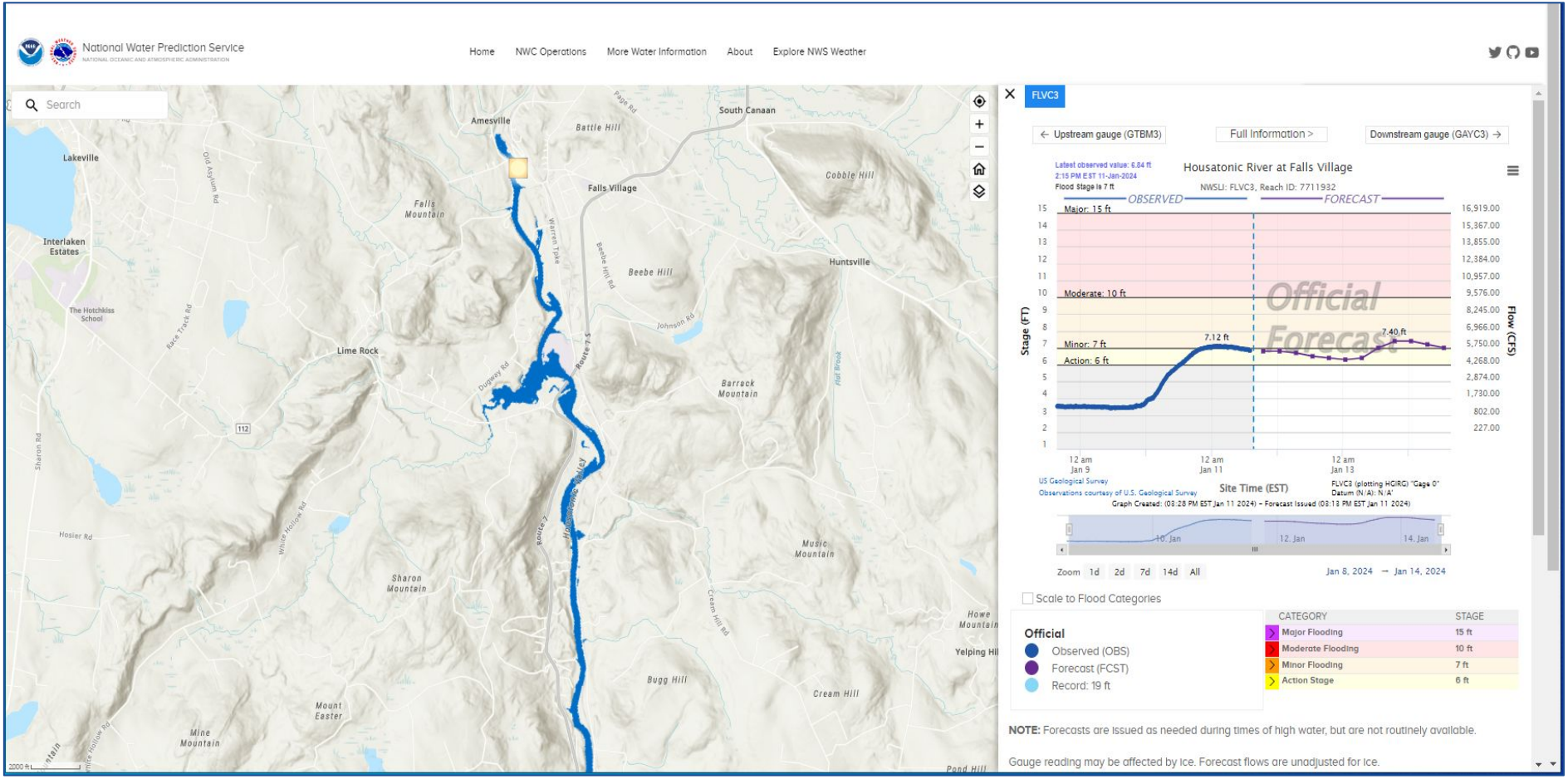

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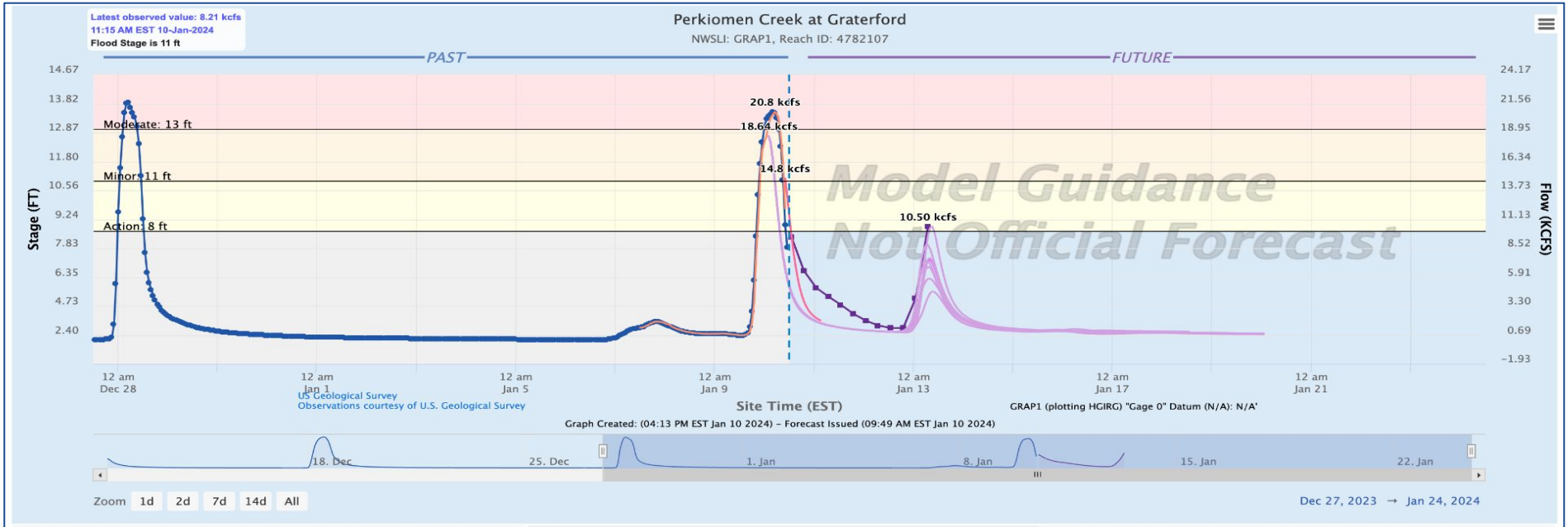


Official
- Observed (OBS)
- Forecast (FCST)

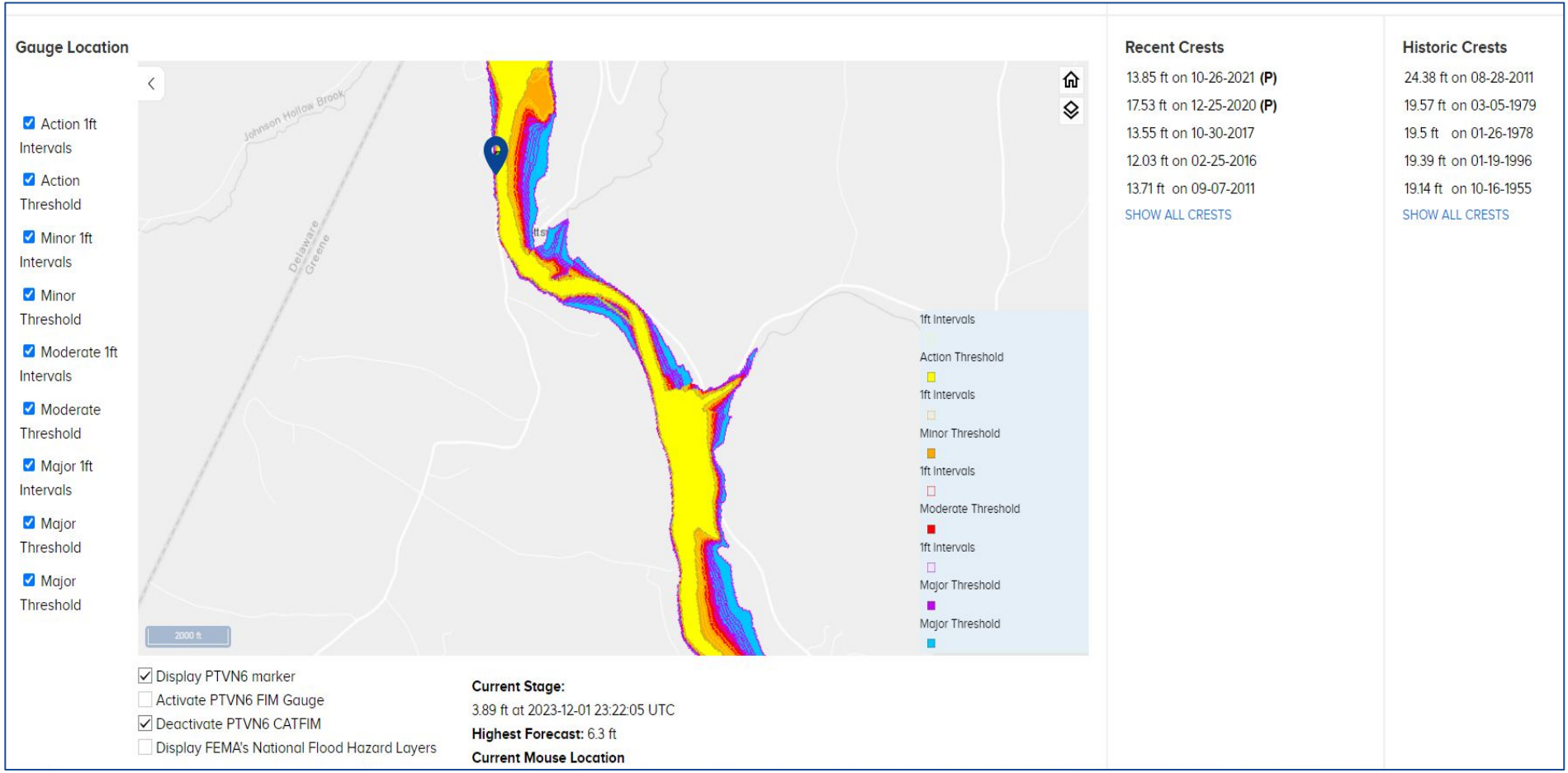
CATEGORY	STAGE
Major Flooding	16 ft
Moderate Flooding	13 ft
Minor Flooding	11 ft
Action Stage	8 ft

National Water Model
- Analysis (ANA)
- Medium Range Blend (MRB)
- Short Range (SR)

Medium Range Ensembles
- Medium Range Ensemble Mean (MRM)
- Medium Range Ensemble 1 (MR 1)
- Medium Range Ensemble 2 (MR 2)
- Medium Range Ensemble 3 (MR 3)
- Medium Range Ensemble 4 (MR 4)

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

National Hydrologic Prediction System: Categorical FIM



NWS Flood Inundation Mapping Services Implementation

Map Legend

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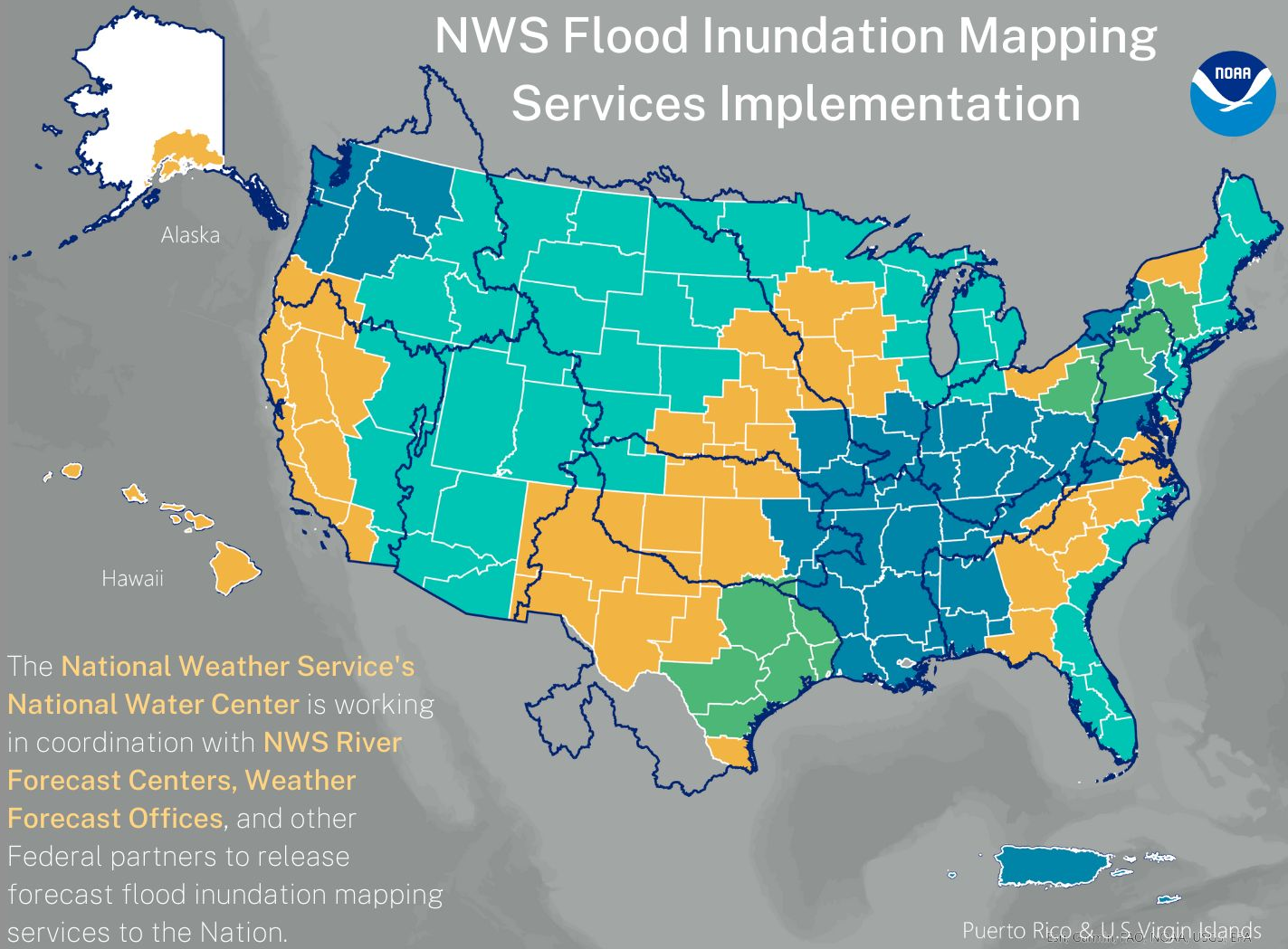

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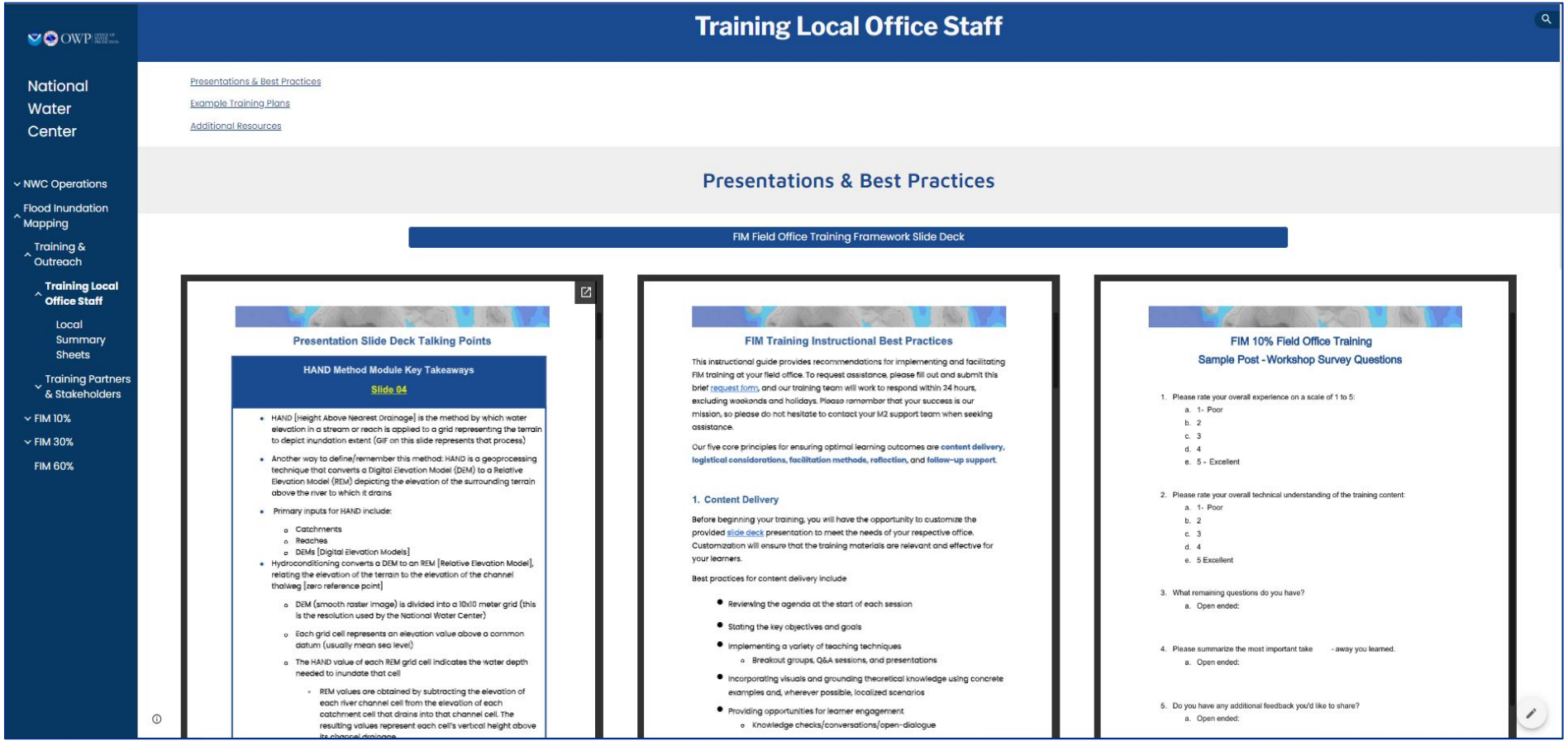
FIM IDSS workshops for field SMEs

- Intensive 3 day workshop
- 2 people per WFO/RFC
- Digging into the Science
- Exercising the tools
- Working actual events and delivering IDSS to partners
- Facilitators included SMEs from the 10% offices!
- Since November of 2022 we've trained:
  - ***~ 133 field staff in 52 offices***
  - ***10 RFCs, 42 WFOs, 4 ROCs, and the NWS NOC!***

Local Office Training Resources



Partner Training Resources

FIM CONOPS Training Roadmap - Field Office Plan

Activities to executing FIM IDSS deliver by Sept 30th, 2024

Develop

Update existing materials for prerequisites to the FIM IDSS Workshops. Complete by June 1, 2023.

In-Person Workshops

Host FIM IDSS Workshops for local FIM SMEs for 30% offices. Complete by December 31, 2023.

Stakeholder Training

Field offices conduct hands-on training sessions and table top exercises for local partners. Complete by August 31, 2024

Rollout

Rollout NWS FIM Services to 30% of the nation by September 30, 2024.

Prerequisites

Office SMEs complete prerequisites by mid September - and attend several webinars leading up to your workshop

**** November 14-16, 2023 or***
**** November 28-30, 2023***

Local Internal Training

Local FIM SMEs conduct local training sessions for staff. Complete by May 31st, 2024

Review

Provide any necessary updates to training via webinars and job sheets. Complete by September 30, 2024.

Disclaimer: Dates for webinars ahead of each workshop TBD - and will be recorded!

Integration into the IMS Prototype

IDSS Management System (IMS)

Purpose

- The IDSS Management System will deliver the database capacity to vastly improve NOAA's understanding of community partnerships and their key vulnerabilities to environmental hazards, especially related to flooding.

Benefits

- It will allow NOAA to consistently provide decision support and communication to our community partners throughout the life cycle of an environmental hazard occurrence.

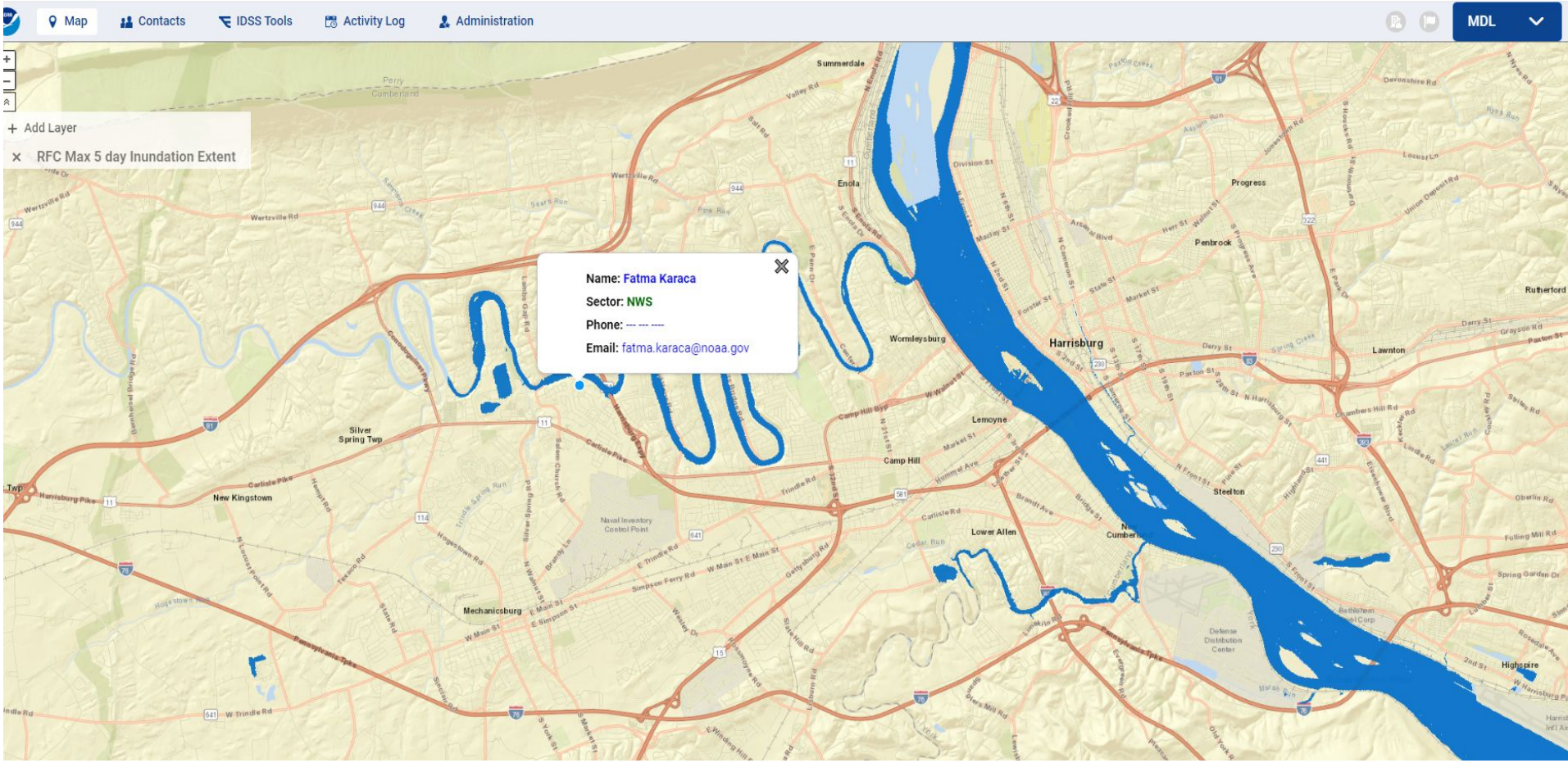
Major Milestones

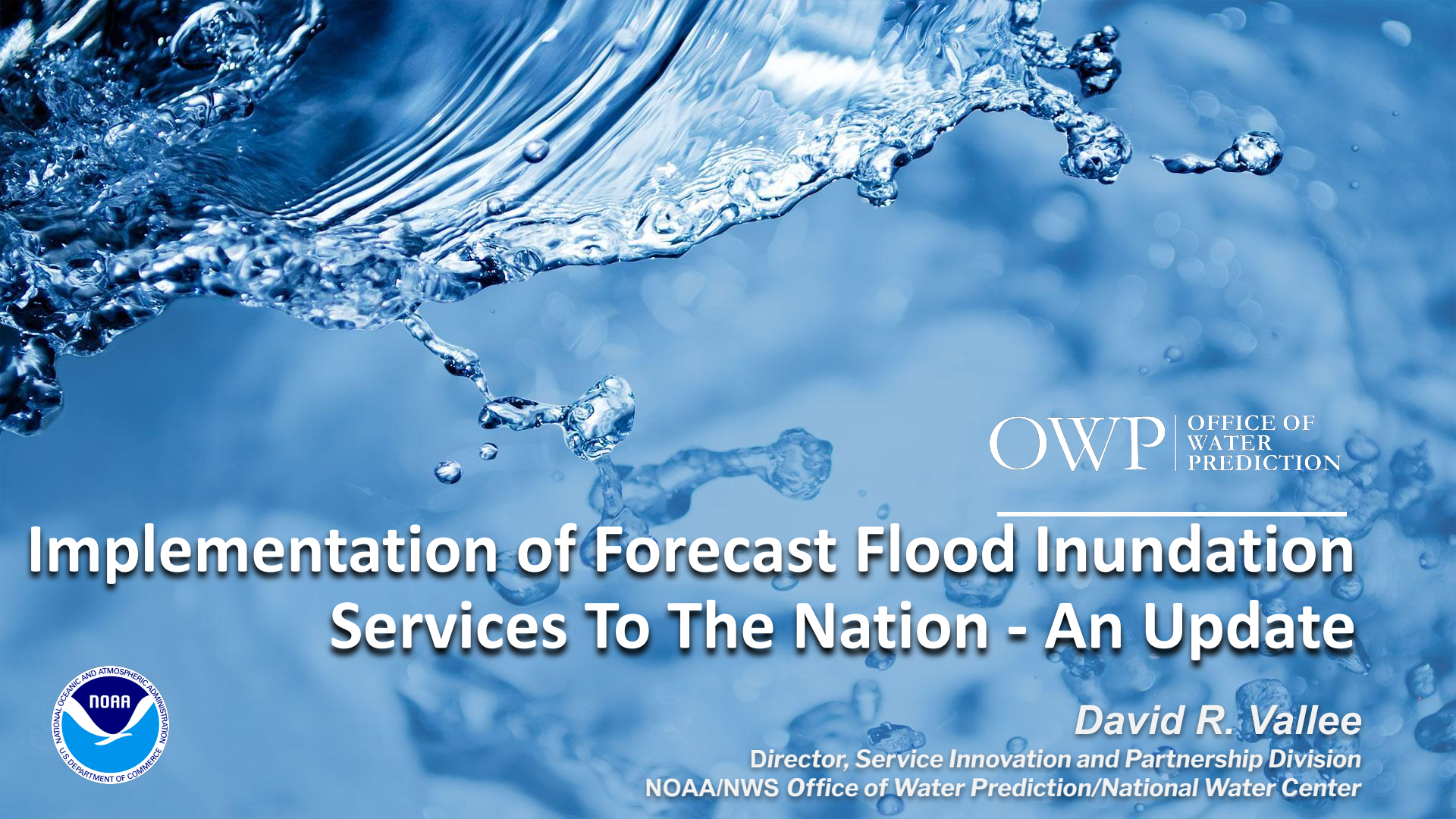
- *Hire 7 Developers - CY23*
- *Set up operational cloud environment 09/23*
- *Add SVI and FIM as layers to prototype 11/23*
- Initial Operating Capability (IOC) (Q3/FY24)
- Agile Development and Deployment of IMS Capabilities Exceeding IOC (FY26)

Accomplishments to Date

- Multiple Developers (Associates and Contractors) have recently started, including our first ever User Experience Designer.
- Field Test and Evaluation (FT&E) with a diverse set of 25 NWS offices started in October 2023. Contact storing/mapping capabilities were the first capabilities released.
- 52 tickets from FT&E have been completed to date, including UI tweaks, bugs, and iterative feature requests.

Prototype integration into IMS





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