

# National Water Model: Geospatial Tool, Services, Inundation Maps

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**NWS / AFSO / Water Resources Services Branch Chief**

**2023 FFaIR Seminar Series - August 8, 2023**

# Outline

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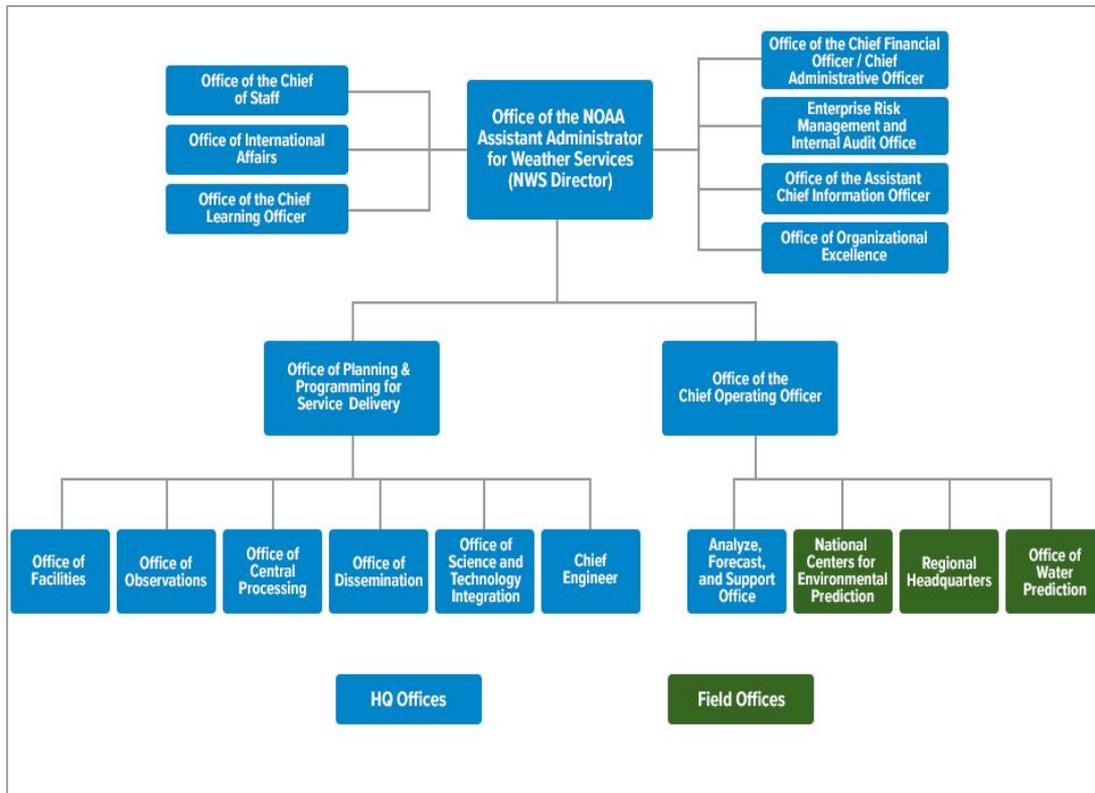
- **National Water Model**
  - Overview and FFaIR Context
- **NWC Map Visualizations (experimental)**
  - Water in the stream
- **NWC Products (experimental)**
  - AHD, FHO, NHD
- **NWC Flood Inundation Mapping (experimental)**
  - RFC and NWM FIM for 10% of country
- **Hazard Services and IDSS**
  - Future service delivery



# Water Services Delivery



National Water Center - Tuscaloosa, AL



## Water Resources Team

### Chief Operating Officer (COO)

- Analyze, Forecast, Support Office (AFSO) Water Resources Services Branch
- Office of Water Prediction (OWP) / National Water Center
- NCEP Weather Prediction Center (WPC)
- River Forecast Centers (RFCs)
- Weather Forecast Offices (WFOs)
- Regional Operations Centers (ROCs)

### Planning, Programming for Service Delivery

- All portfolios

### Collaborators

- IWRSS partners (USACE, USGS, FEMA)
- IDSS partners
- NOAA partners (NOS, OAR, NESDIS)
- Cooperative Institute (CIROH)

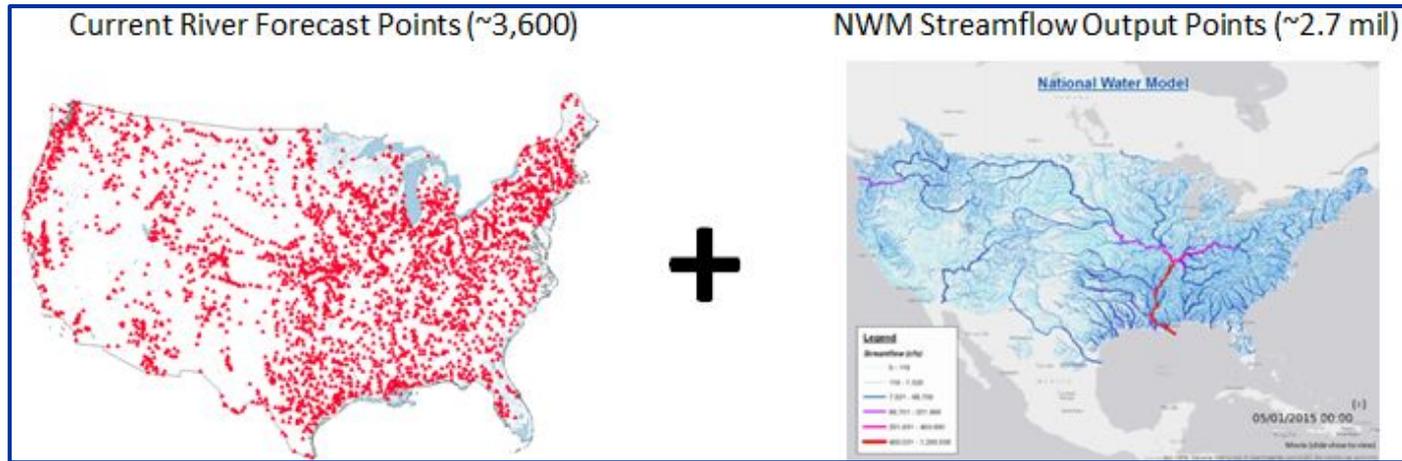


# **National Water Model (NWM)**

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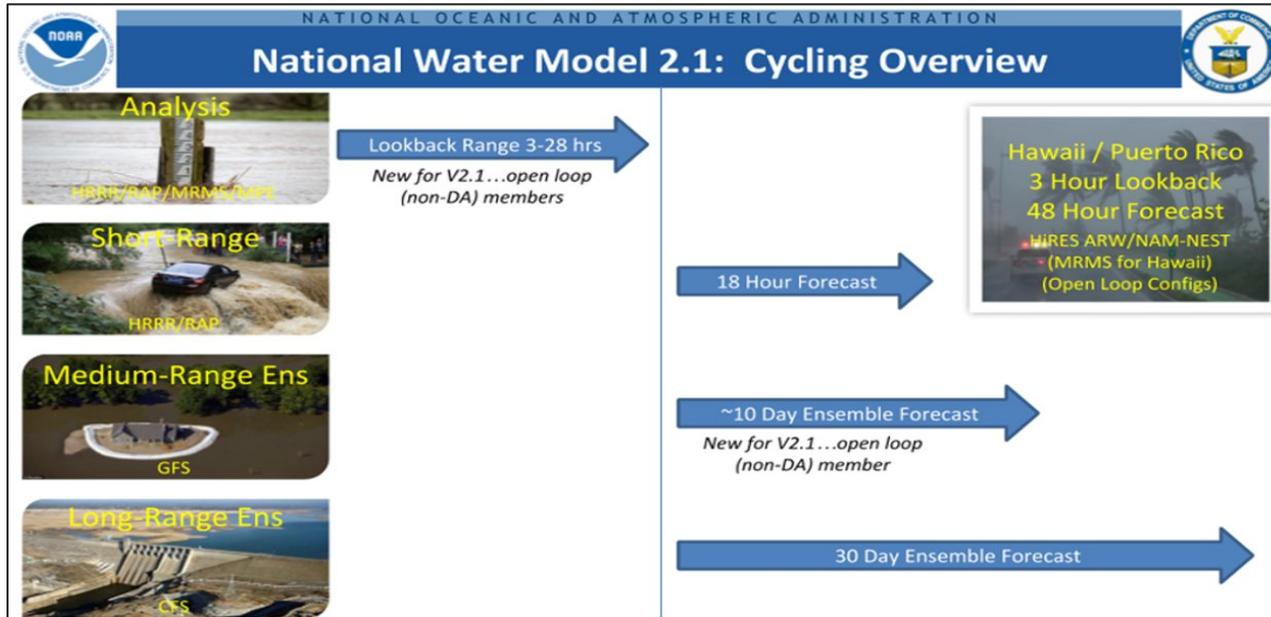
# National Water Model - New Water Prediction Information

- NWM is a hydrologic model that simulates observed and forecast **streamflow**
- *Compliments* official NWS river forecasts at ~3,600 locations
- Models using fine spatial and temporal scale with large spatial coverage
  - 2.7 million river reaches = 3.4 million river miles



# National Water Model - Versions

Model info at: <https://water.noaa.gov/about/nwm>



NWM v3.0 Update in August 2023

**SCN23-76: Updated:**  
Upgrade of National Water Model on NCEP's WCOSS System and its Post-processing Application on the Integrated Dissemination Platform (IDP), Effective **August 16, 2023**

<https://www.weather.gov/notification/>

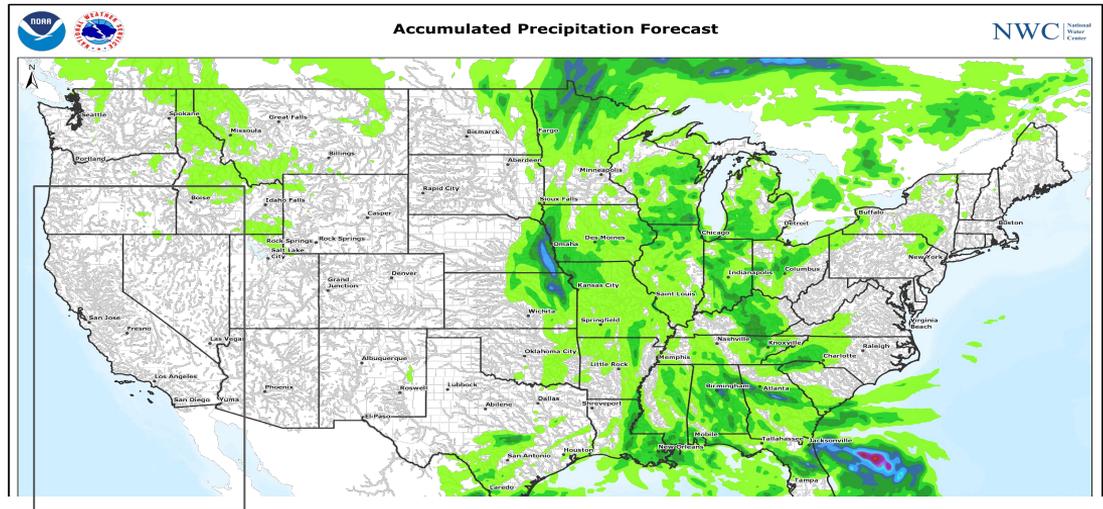
# National Water Model - Forcings

## Precipitation Sources for NWM v3:

- Analysis (Current Conditions): MRMS (RFC StageIV)
- Short Range Forecast (18-hours): HRRR and RAP
- Medium Range Forecast (10-days): GFS and NBM

NWM v3: Using the National Blend of Models (NBM) for:

- CONUS medium-range 10-day forecasts
- Alaska short-range and medium-range forecasts



# NWM Data Delivery - 1 TB/day

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18 time steps x 24 forecasts for the NWM Short Range Forecast per day

**Raw model output available via NCEP web services:**

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm>

<ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nwm>

- How do we extract actionable intelligence from that much data?
- How do we communicate the NWM output to forecasters and decision-makers?

**Answer:**

- Map services for near-real-time visualizations (70+ services)
- Operational products based on latest guidance



# **NWC Visualization Services (Experimental)**

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# Available NWM Visualizations / Map Services

## October 2023 ... Adding public Flood Inundation Mapping (FIM)

- **GIS Viewer**
  - Adding FIM services covering 10% of county (~ TX, PA, NY)
  - In future, adding FIM for 30%, 60%, 100% in FY24, 25, 26



## February/March 2024 ... New web portal for water prediction

- Replacing primary NWS hydrologic web portal for public
  - Currently AHPS (Advanced Hydrologic Prediction Service) at [water.weather.gov](https://water.weather.gov) being retired.
  - Upgrading to NWPS (National Water Prediction Service) at [water.noaa.gov](https://water.noaa.gov)
  - Mobile-friendly with expanded data services and features

# Public NWM Visualizations / Map Services

## River Forecast Center Services

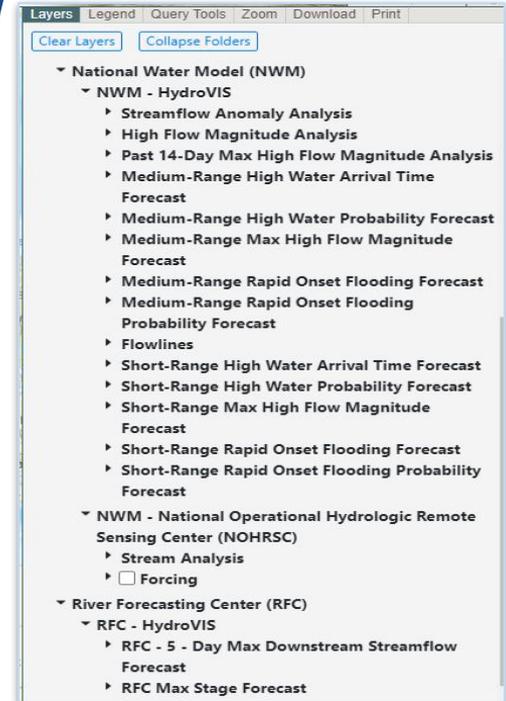
- AHPS Maximum Stage Forecast
- RFC 5-Day Maximum Streamflow Forecast

## National Water Model Services

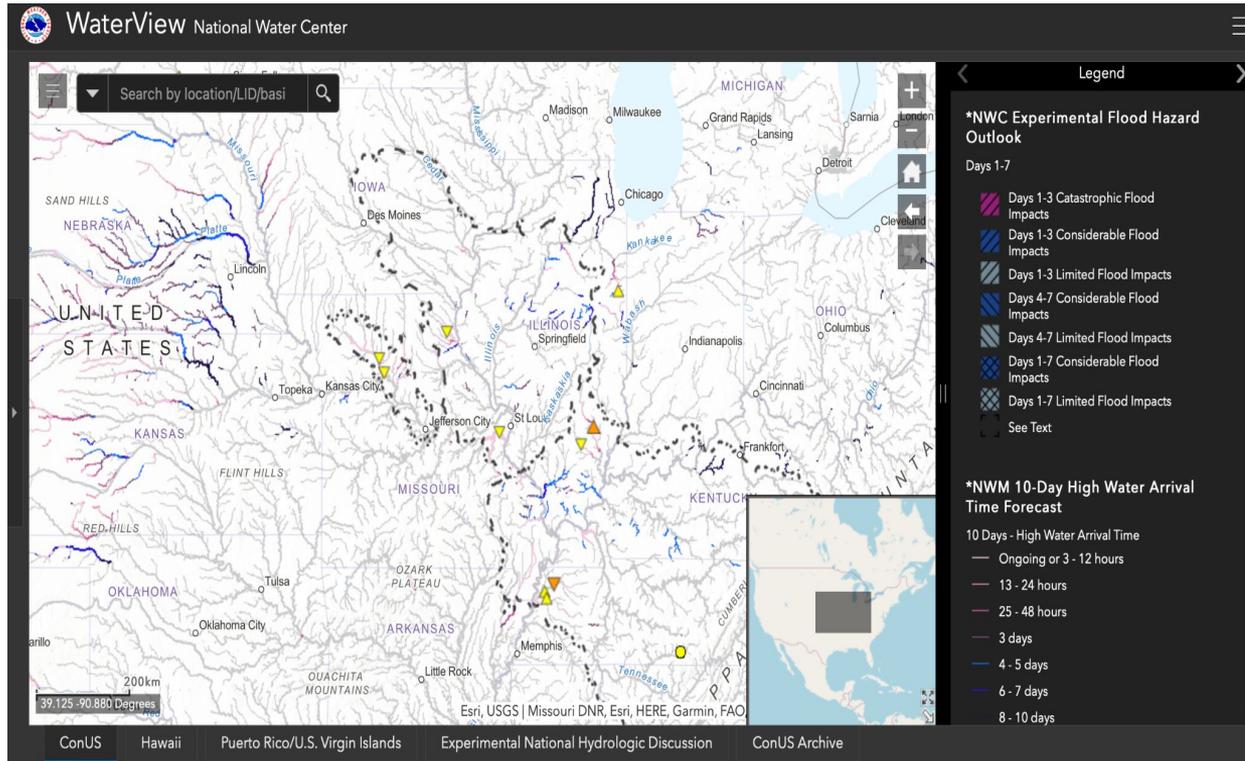
- Current Conditions (Analysis and Assimilation)
  - NWM Streamflow Anomaly
  - NWM High Flow Magnitude
  - NWM Past 14-Day High Flow Magnitude
- Short-Range Forecast
  - NWM 18-Hour Maximum High Flow Magnitude (48 hrs for HI, PR/VI)
  - NWM 18-Hour High Water Arrival Time (48 hrs for HI, PR/VI)
  - NWM 12-Hour High Water Probability
  - NWM 18-Hour Rapid Onset Flooding / Probability
- Medium-Range Forecast
  - NWM 10-Day Maximum High Flow Magnitude
  - NWM 10-Day High Water Arrival Time
  - NWM 5-Day High Water Probability
  - NWM 10-Day Rapid Onset Flooding / Probability

When?  
Arrival Time

How much?  
High Flow  
Magnitude



# WaterView - Access to All Visualizations



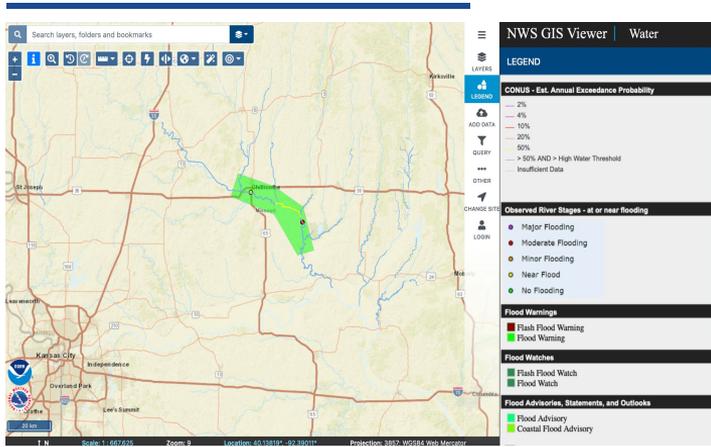
Situational awareness needs synthetic thresholds, given that 99.9% of country is unengaged.

- For “magnitude” displays, river reaches colored by the estimated annual exceedance probability (AEP) of their current flow.
- “High water” thresholds are also used (regionally varied use of AEP flow).
- AEPs were derived using the 40-year NWM v2.1 reanalysis simulation.

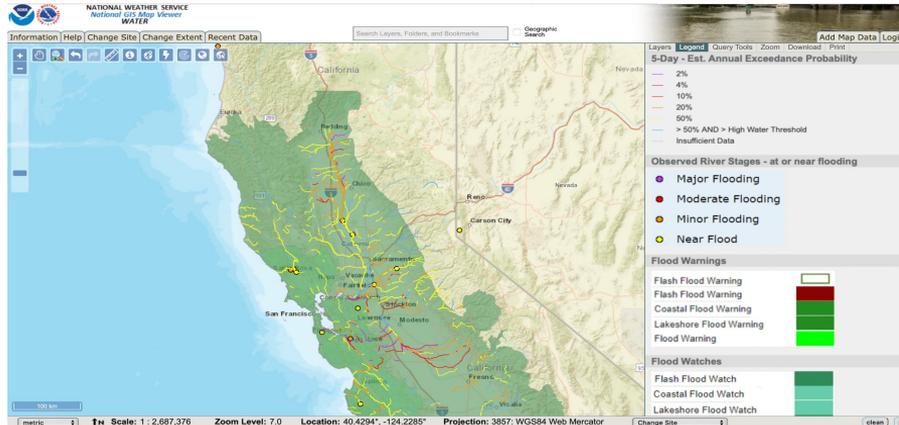
Waterview showing FHO and High Water Arrival Time



# GIS Viewer - Access to Limited Visualizations



GIS Viewer samples showing forecast flows colored by AEP for river reaches and watch/warnings





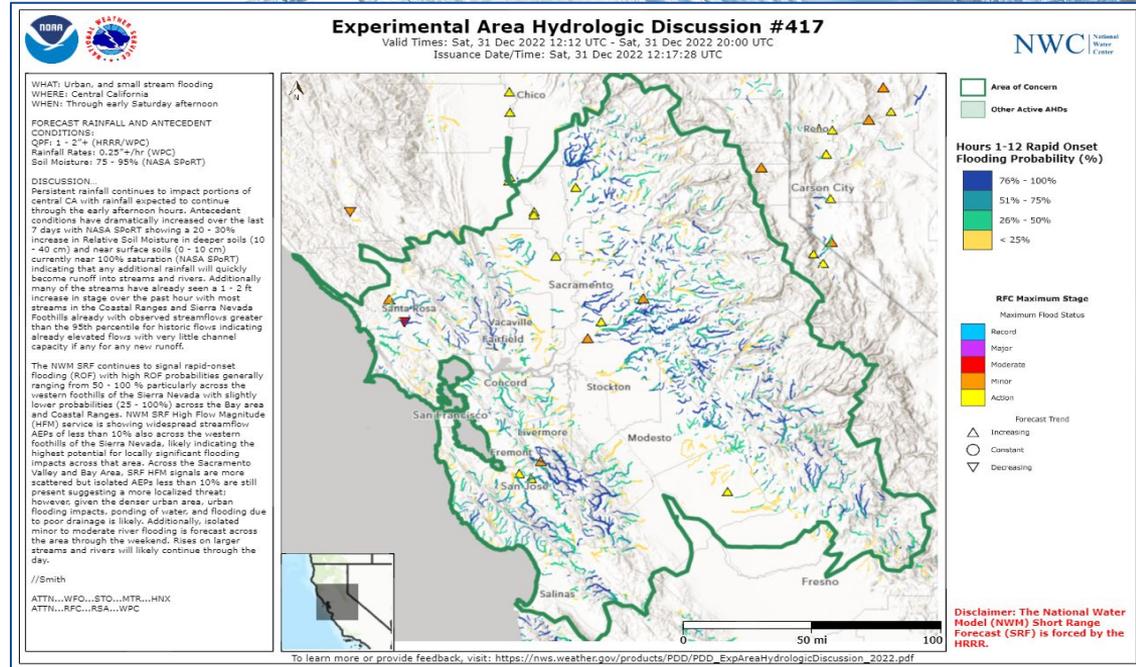
# **NWC Products (Experimental)**

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# Area Hydrologic Discussion (AHD)

- Episodic
- 2-6 hrs
- Rapid-onset Flooding
- Flash
- Urban / Small Stream
- WPC Coordination
- Inform WFO Warning Workflow
- PIL: AHDNWC
- Archive



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

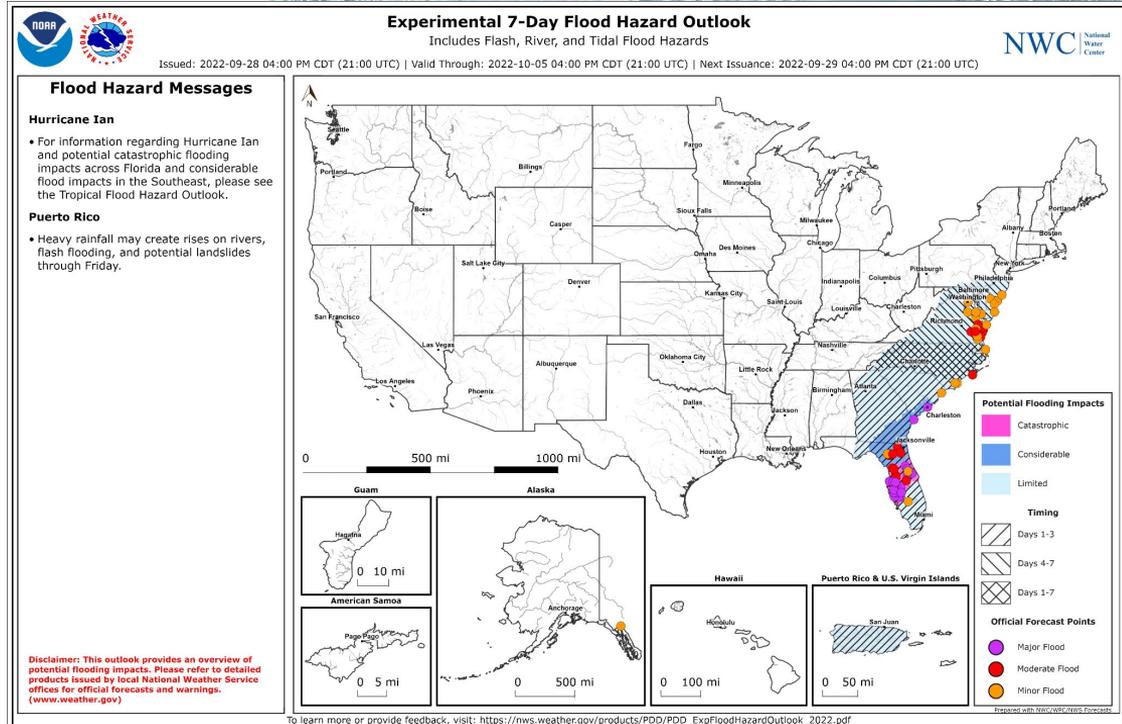
Instructions for adding AHD AWIPS Ingest and Local Alert

[https://www.wpc.ncep.noaa.gov/hmt/hmt\\_webpages/seminars/2023/June12023\\_HowtoReceiveAlertsforAreaHydrologicalDiscussionsforyourSite\\_NWC.pdf](https://www.wpc.ncep.noaa.gov/hmt/hmt_webpages/seminars/2023/June12023_HowtoReceiveAlertsforAreaHydrologicalDiscussionsforyourSite_NWC.pdf)



# Flood Hazard Outlook (FHO)

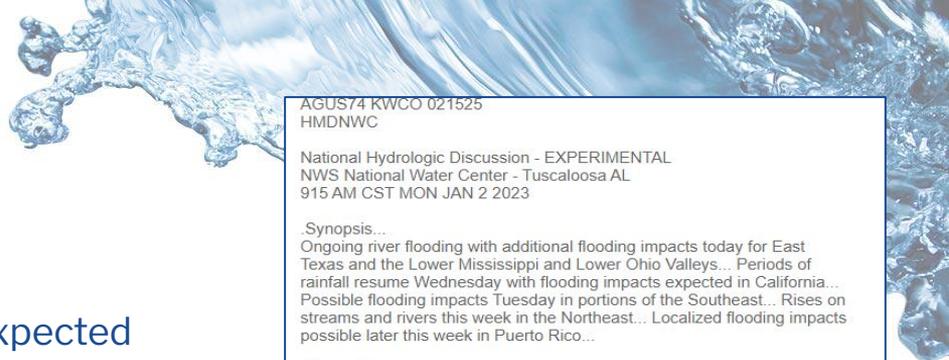
- High Level
- Heads-up
- 7-Day Outlook
- Comprehensive
- 3 Categories
- 3 Timing Bins
- 1xday\* @2100Z
- Static Map
- Map Service



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

Future Consideration: Incorporate Significant River Flood Outlook ([SRFO](#)) from RFCs into an enhanced FHO.

# National Hydrologic Discussion (NHD)



- **What:** Discussion for observed, modeled, and expected hydrologic conditions for the United States days 1-10
  - NOT just a National Water Model (NWM) diagnostic discussion
  - Uses all available resources and forecaster knowledge
- **Audience:** Internal & external surface water information users
- **Issuance:**
  - 1530Z
  - PIL: HMDNWC
  - <https://www.weather.gov/owp/operations-nhd>

AGUS74 KWCO 021525  
HMDNWC

National Hydrologic Discussion - EXPERIMENTAL  
NWS National Water Center - Tuscaloosa AL  
915 AM CST MON JAN 2 2023

.Synopsis...

Ongoing river flooding with additional flooding impacts today for East Texas and the Lower Mississippi and Lower Ohio Valleys... Periods of rainfall resume Wednesday with flooding impacts expected in California... Possible flooding impacts Tuesday in portions of the Southeast... Rises on streams and rivers this week in the Northeast... Localized flooding impacts possible later this week in Puerto Rico...

.Discussion...

.East Texas and the Lower Mississippi and Lower Ohio Valleys... Moderate to locally heavy rainfall is expected to affect these regions today, bringing a threat for isolated flash, urban, small stream, and riverine flooding impacts. The latest WPC QPF indicates widespread 1 - 3" of rainfall from extreme East TX through northern LA and AR and into southeast MO, southern IL, and western TN/KY, with the highest amounts expected in eastern AR and western TN. Antecedent conditions are wettest in east TX, northern LA, and eastern AR, where riverine flooding is ongoing and forecast from recent rainfall, and soils are primed for flooding impacts from additional rainfall. Top and mid-layer soils are in the 40 - 50% relative soil moisture (RSM) range in southeast MO into the Lower OH Valley, but are dry below those layers (NASA SPoRT). The NWM Short Range Forecast (SRF) indicates rapid-onset flooding (ROF) probabilities of less than 50% from southwest AR into northeast AR; expect these signals to gradually increase in coverage as the day progresses. The NWM MRF also continues to indicate ROF probabilities of generally less than 50% in northern LA, AR, western TN/KY, and southeast MO and southern IL. Overall, with the highest rainfall amounts not overlapping with the most vulnerable areas in the region based on antecedent conditions, widespread flooding impacts are not anticipated; however, isolated lower AEPs on smaller streams in northeast AR and southern IL, depicted in the NWM SRF High Flow Magnitude Forecast, suggest some potential for locally significant flooding impacts in these areas. In addition, new and renewed minor riverine flooding is forecast in East TX, LA, and eastern AR, along with forecasts of in-bank rises in these same areas.

.California...

Periods of moderate to heavy rainfall and mountain snow will again impact much of the state through day 7 (Sun), providing a threat for additional urban, small stream, and riverine flooding impacts. Light to moderate rainfall through day 2 (Tue) is not expected to produce flooding impacts, and it will not likely allow the entire wet soil column to make room ahead of multiple rounds of heavier rainfall beginning on day 3 (Wed), when the threat for more significant flooding impacts increases. SNODAS and the National Water Model (NWM) continue to indicate that there is very little, if any, snow water equivalent (SWE) left to melt in the lower elevations of northern and central CA; as a result, snowmelt should not be a significant



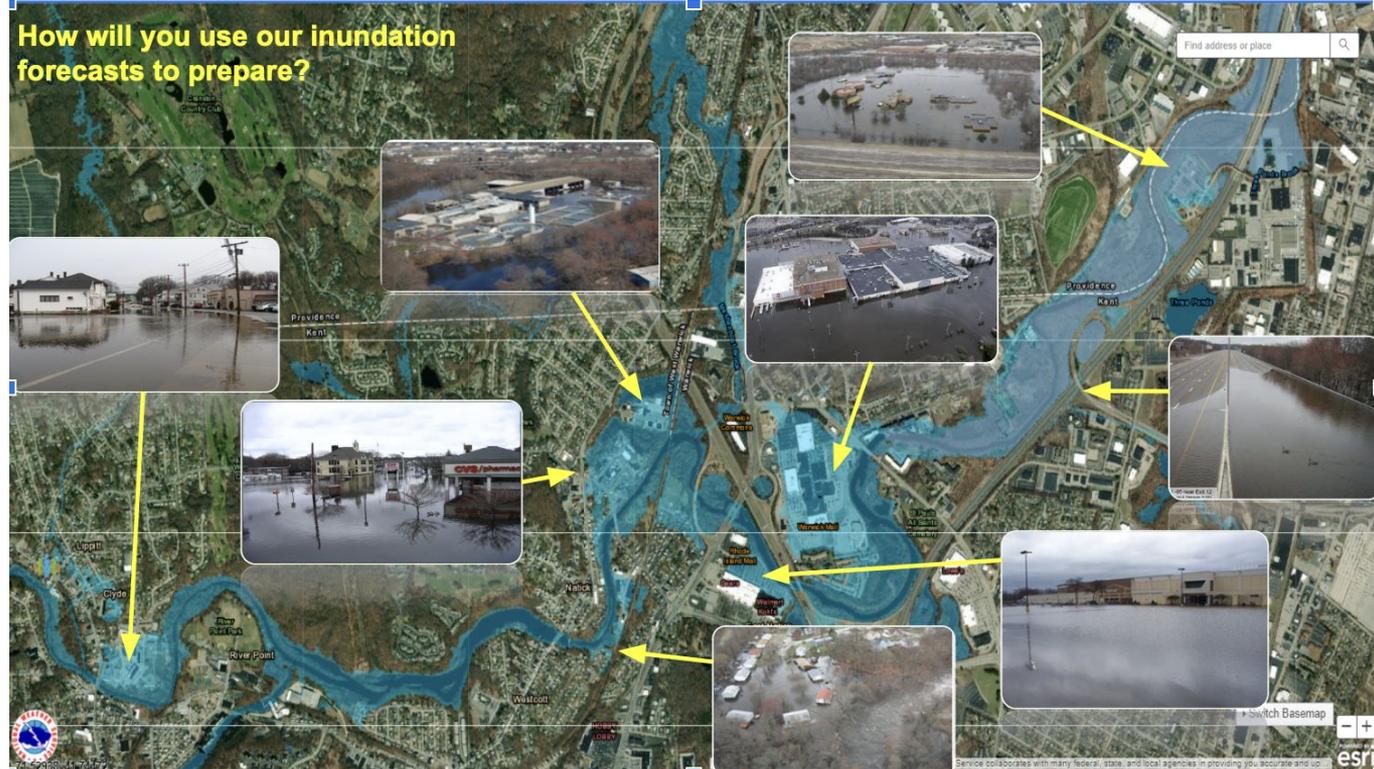


# **NWC Flood Inundation Mapping**

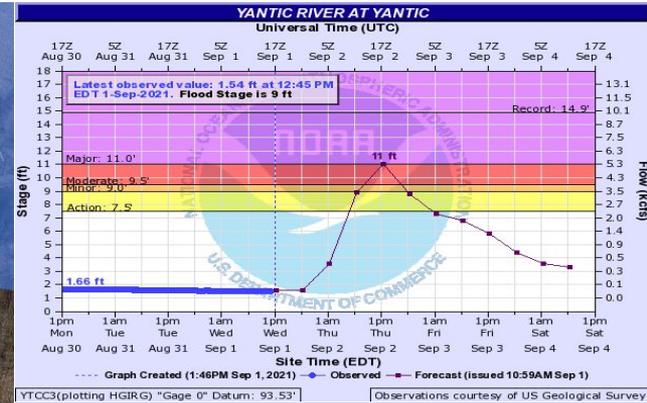
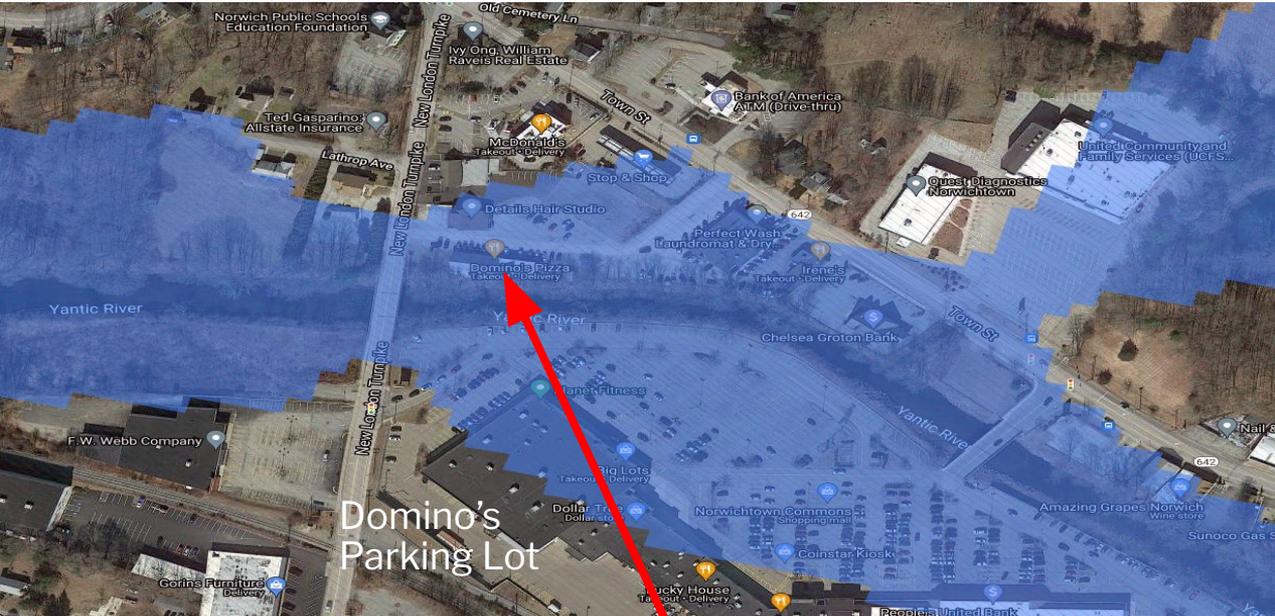
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# Flood Inundation Mapping - Service Delivery

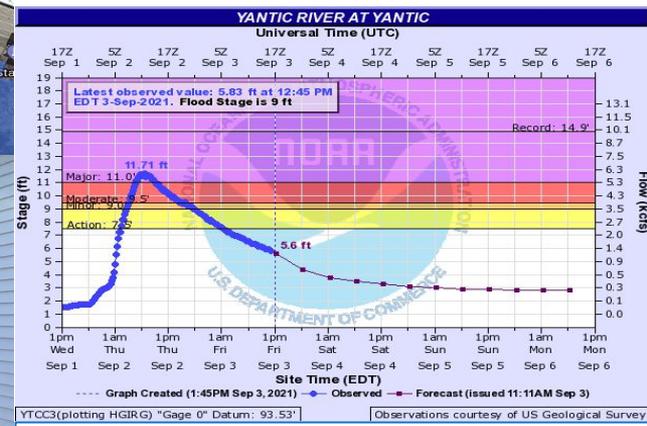
- IDSS and FIM services
- New generation of high-resolution geospatial information
- Must ALWAYS represent uncertainty



# Visualizing FIM: Remnants of Ida in Connecticut



Official NERFC forecast issued on September 1<sup>st</sup>, 2021



Observed crest above Major on September 2<sup>nd</sup>, 2021

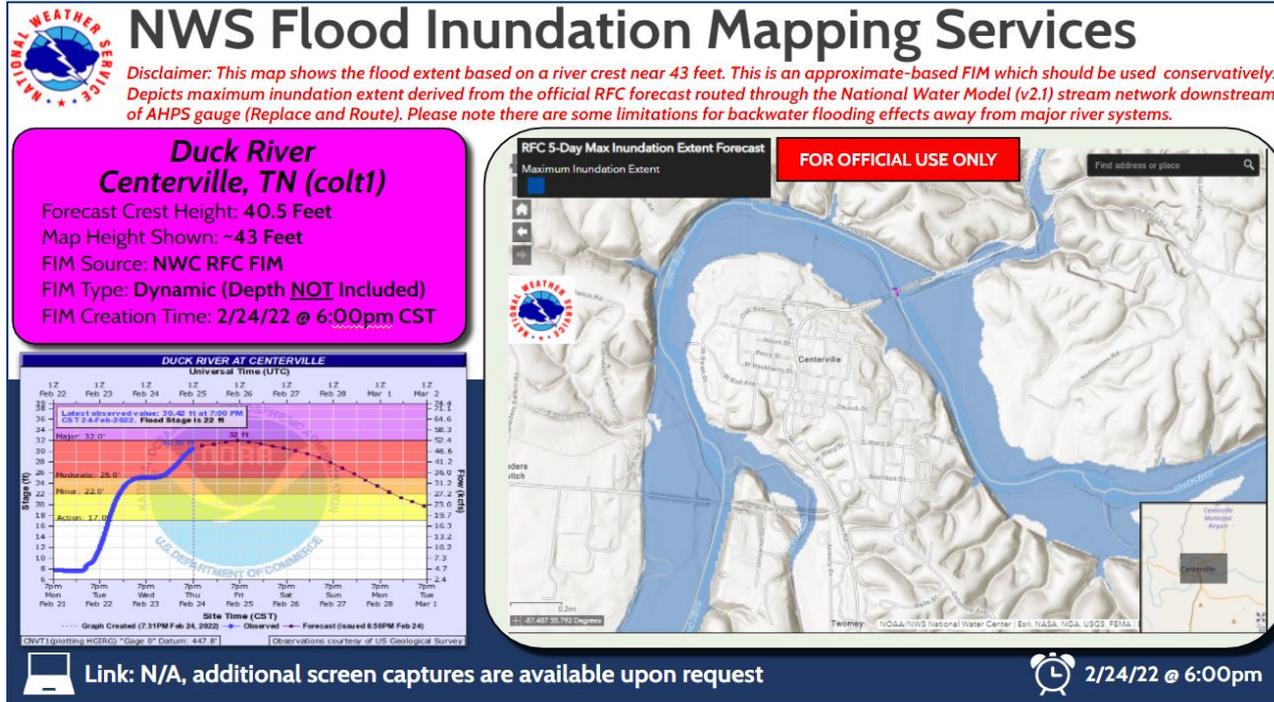
Image above is the RFC FIM based on the late morning forecast from NERFC for the Yantic River at Yantic on September 1<sup>st</sup>, 2021.

Image to the right depicts the Yantic river the morning of September 2nd, 2021 with inundation in and around Domino's Pizza in Norwich, CT. This photo was taken several hours after the river had crested.



Photo credit: Trevor Ballantyne  
Norwich Bulletin

# Flood Inundation Mapping

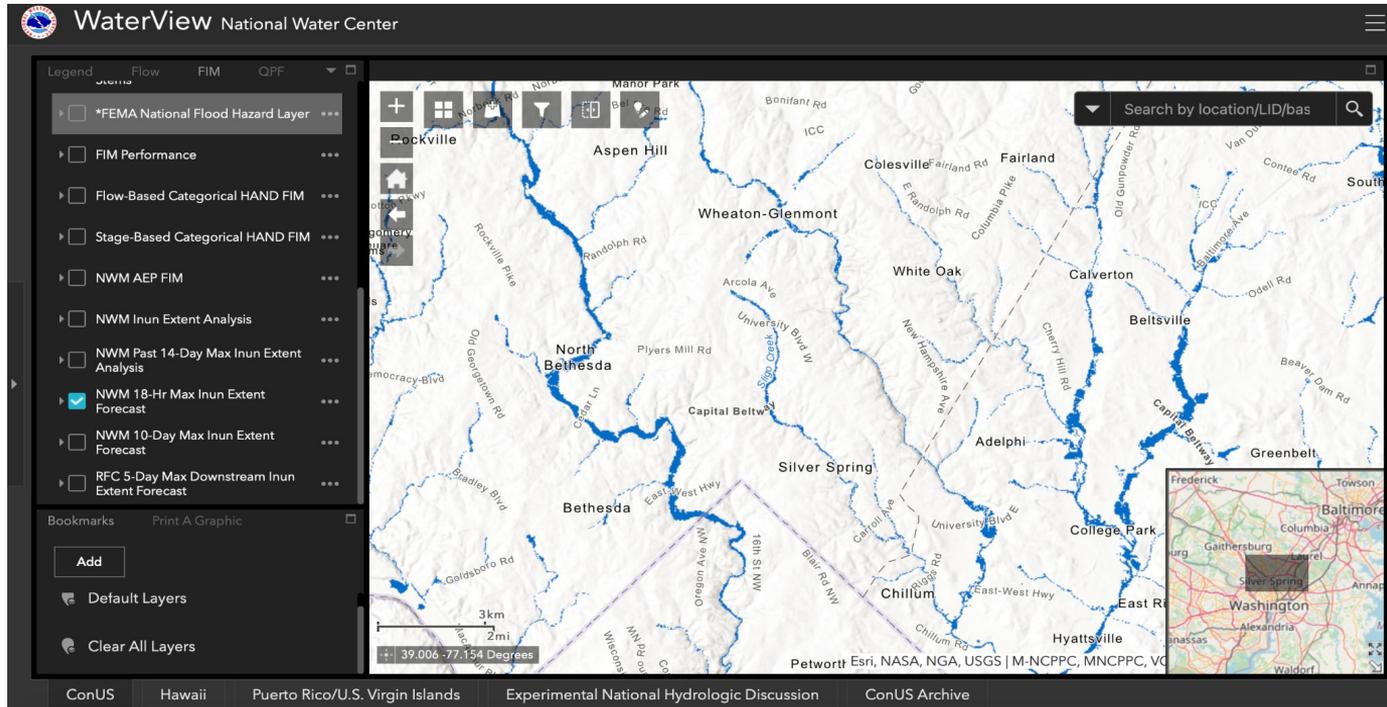


- Prototype DSS information at existing forecast point



# Flood Inundation Mapping

- Near-real-time FIM is available now for CONUS
- Viewable through WaterView application for NOAA users

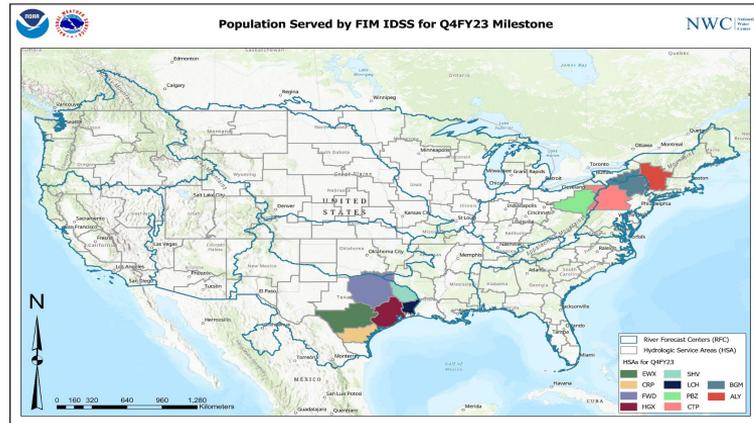


# FIM - Public Deployment

## Delivering in Phases Over 4-Years

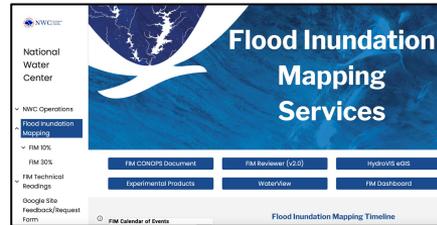
- FY23 10%
- FY24 30%
- FY25 60%
- FY26 100%

Public Services Fall 2023: population served 10.8%

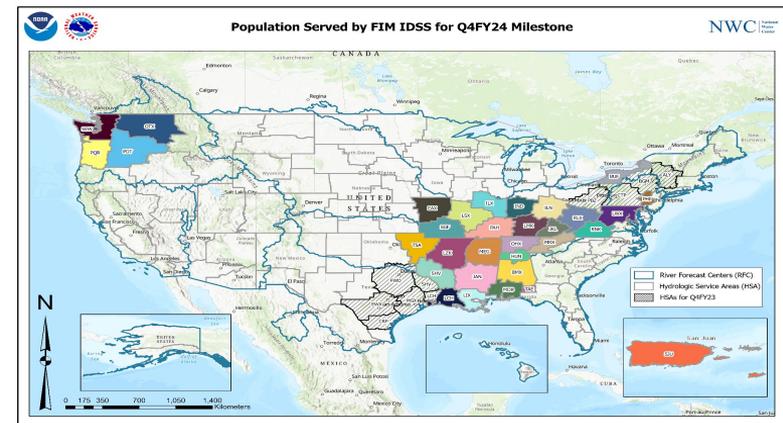


## FIM Google Site:

<https://sites.google.com/noaa.gov/nws-nwc/flood-inundation-mapping?pli=1>



Public Services Fall 2024: population served 36.9%





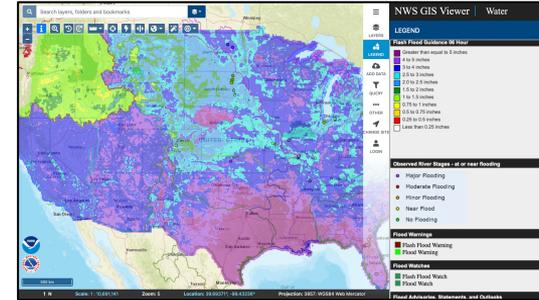
# **Hazard Services and IDSS - Flood**

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# Hazard Services and IDSS

## Future approach to service delivery?

- Hazard Services
  - Polygons (Ken10 Team)
  - Provide NWC map services in AWIPS
- Hazard Simplification
  - Removal of Advisory
- Integration of Information
  - ERO - future of FFG?
  - FLASH - linkage with NWM information
  - MPD -
  - Linkage btw inland and coastal flooding
- IDSS
  - Emergency managers
  - Federal partners



FFG: August 7, 2023 04Z

## Practices / Policy Evolution

- NWC Field Service and Evaluation Board (FSEB)
- Social Science
- NWS Directives updates

# Thank you!

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Can reach NWC Operations (WPOD) at:

**(205) 347 - 1500**

**[nws.nwc.ops@noaa.gov](mailto:nws.nwc.ops@noaa.gov)**

**Nwcchat**

**5 AM - 8:30 PM CT, 7 days/week**



FFaIR 2023 Seminar Series Archive:

[https://www.wpc.ncep.noaa.gov/hmt/hmt\\_webpages/seminars/2023/](https://www.wpc.ncep.noaa.gov/hmt/hmt_webpages/seminars/2023/)