

**Windham Regional Emergency Management Committee**  
**Informational Session Minutes**  
**August 8, 2023 at 5:00pm In-person**  
**Wilmington Fire Department**  
40 Beaver Street, Wilmington

**Guest Speakers:**

- Stephen DiRienzo, Warning Coordination Meteorologist - National Weather Service, Albany forecast office
- Britt Westergard, Warning Coordination Meteorologist - National Weather Service, Albany forecast office

Attendees: Paul Fraser - Interim REMC Chair; Tom Goddard – Putney EMD and FC; Scott Moore – Wilmington EMD and FC; Greg Lakis – Jamaica EMD; Jon Abel – East Dover FC; Bill Kearns – Grafton EMD; Jeffrey Martell – interested Grafton resident; Mike Holmes – Grafton EM Radio operator; Dara Zink – BCRC Regional Planner and REMC Staff; Taiga Christie – VEM Southern Reg Coordinator; Alyssa Sabetto, WRC Senior Planner and REMC Staff

**Meeting:**

1. Welcome from Alyssa Sabetto, and group introductions

2. Call for any business items to add to the agenda

3. **National Weather Service (NWS) presentation**

Britt discussed the services that NWS provides and the tools they use to provide them. They are now breaking out their flood warnings into three levels – base, considerable and catastrophic, so that there is a more precise understanding of risk. They are always working to make forecasts as precise as technologically possible.

NWS flood inundation mapping services are beginning to roll out. The initial rollout covers about 10% of the United States, and NWS Albany is a test site, so flood inundation mapping (FIM) will be possible later this year for Bennington and Windham Counties in Vermont. This will be event driven FIM based on rainfall forecasts and river forecasts from the National Water Model and the Northeast River Forecast Center. Initially it will just be extent mapping without depth, but depth is planned for the future. The NWS flood maps are not connected to FEMA's Flood Insurance Rate Mapping in any way.

This initial training introduced NWS FIM and its capabilities and limitations. In November of this year at the next REMC gathering, NWS will introduce the flood inundation mapping on a public facing web page. Please direct any questions or topics you'd like addressed to Alyssa and she can ensure that NWS is made aware of that in preparation for November.

4. Updates:

- Taiga – Update from Vermont Emergency Management
  - SEOC still active from the July rain events
- Alyssa – Update from WRC
  - There will be a lithium-ion battery fire 2.5 hour 'train the trainer' event held on August 30-31 at the VT Fire Academy. Registration is open. Following this there will be courses offered through regional fire academies.
  - Alyssa took nominees for REMC representative on the statewide LEPC. Paul Fraser is potentially interested and will be in touch with Alyssa after the meeting about this.

5. General discussion and Q&A

6. Reminders and other items:

- Topic suggestions/requests for future meetings/events/trainings – none received

- The latest Vermont Emergency Management newsletter: <https://vem.vermont.gov/contact-us/newsletter>
- REMC business – none

The next REMC informational session will be a virtual one on November 14th when the NWS mapping is expected to be provided on a public facing web page.

Thank you for attending!

# Flood Inundation Mapping [FIM] Summary Sheet for Partner Training and Outreach

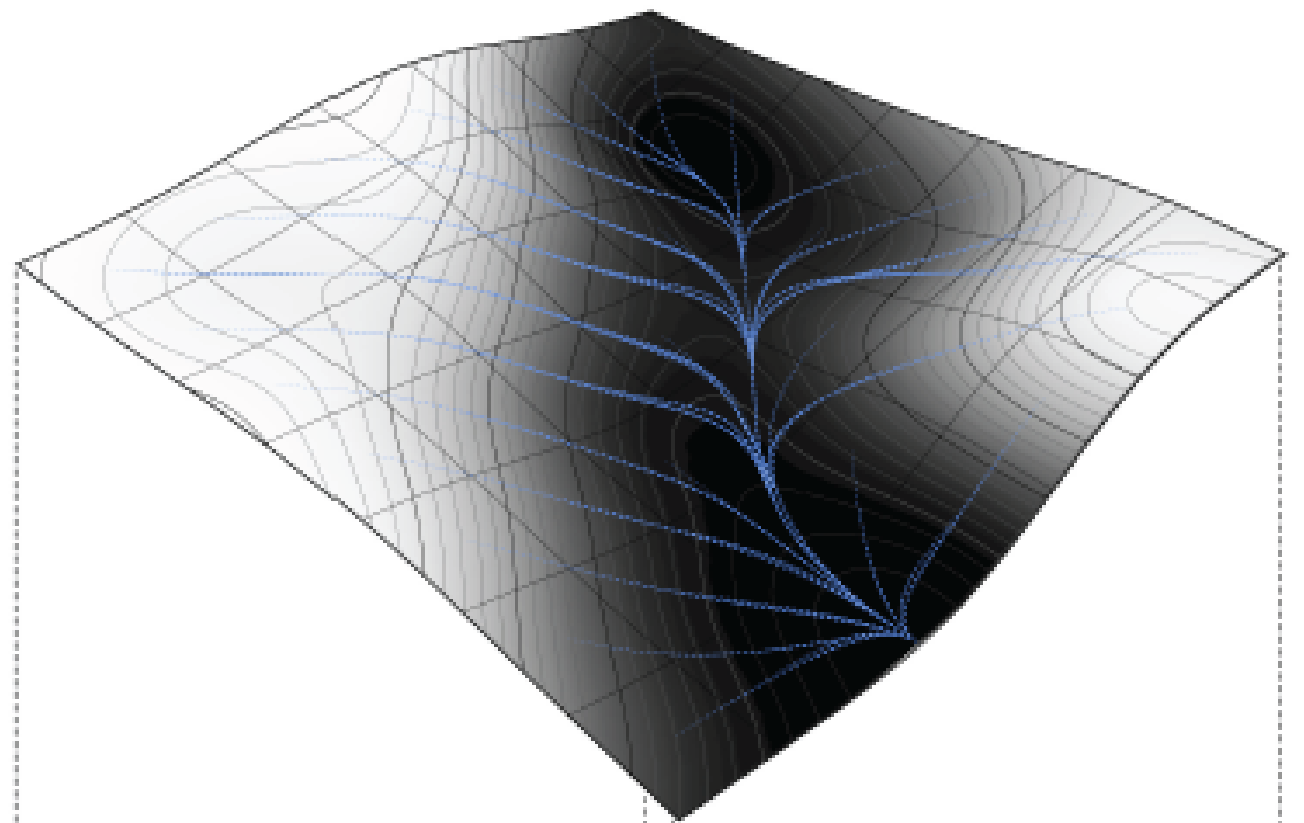
This document complements FIM Partner Training and Outreach efforts provided by local offices. It serves as a reference for partners to understand the strengths and limitations of available FIM services and how to access additional resources and assistance.

## Height Above Nearest Drainage [HAND] Model Schematic

The Height Above Nearest Drainage [HAND] method is a low-complexity, terrain-based approach for inundation mapping. It uses a 10m Digital Elevation Model [DEM] produced by the US Geological Survey's [USGS] 3D Elevation Program [3DEP] and the NHDPlus Hydrography [stream network] dataset produced by the USGS to create a "hydrofabric." The hydrofabric represents the land surface elevations at the 10m resolution, consistent with the location of the stream and river channel network represented as vectors or lines. As the name implies, the HAND method approximates the vertical distance between each 10m cell and the nearest stream outlet for water flowing from each cell. In other words, the HAND model normalizes the topography with respect to the drainage network. The HAND method converts DEM elevation values referenced to mean sea level [MSL] into a Relative Elevation Model [REM] that no longer references MSL. To generate the forecasts of 5-day max inundation extents, forecast flows from the NWM and the River Forecast Center [RFC] are routed through the NWM, respectively, and passed through the HAND technique to generate these forecast services.

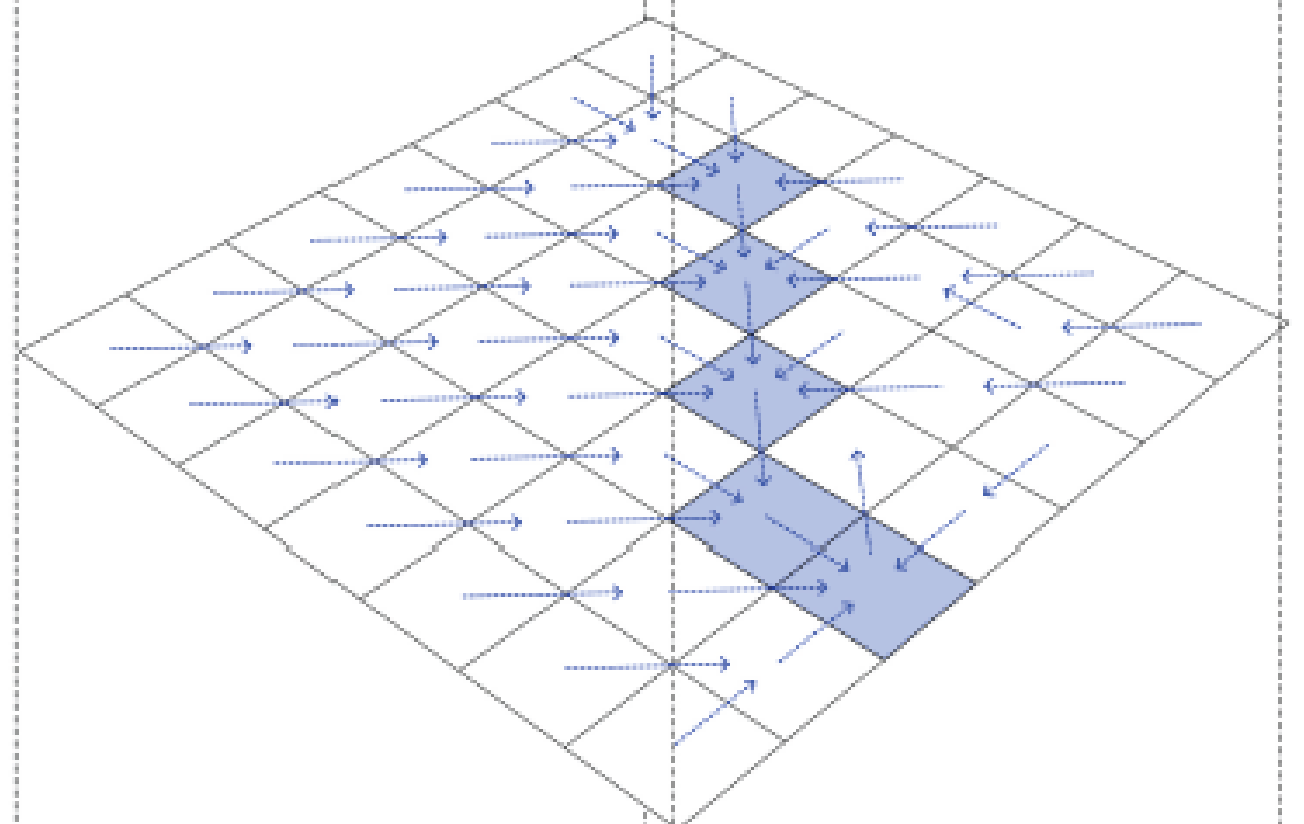
## 01.

The HAND method begins with a DEM produced by USGS. Currently, DEMs used to generate the HAND model have a 10m resolution



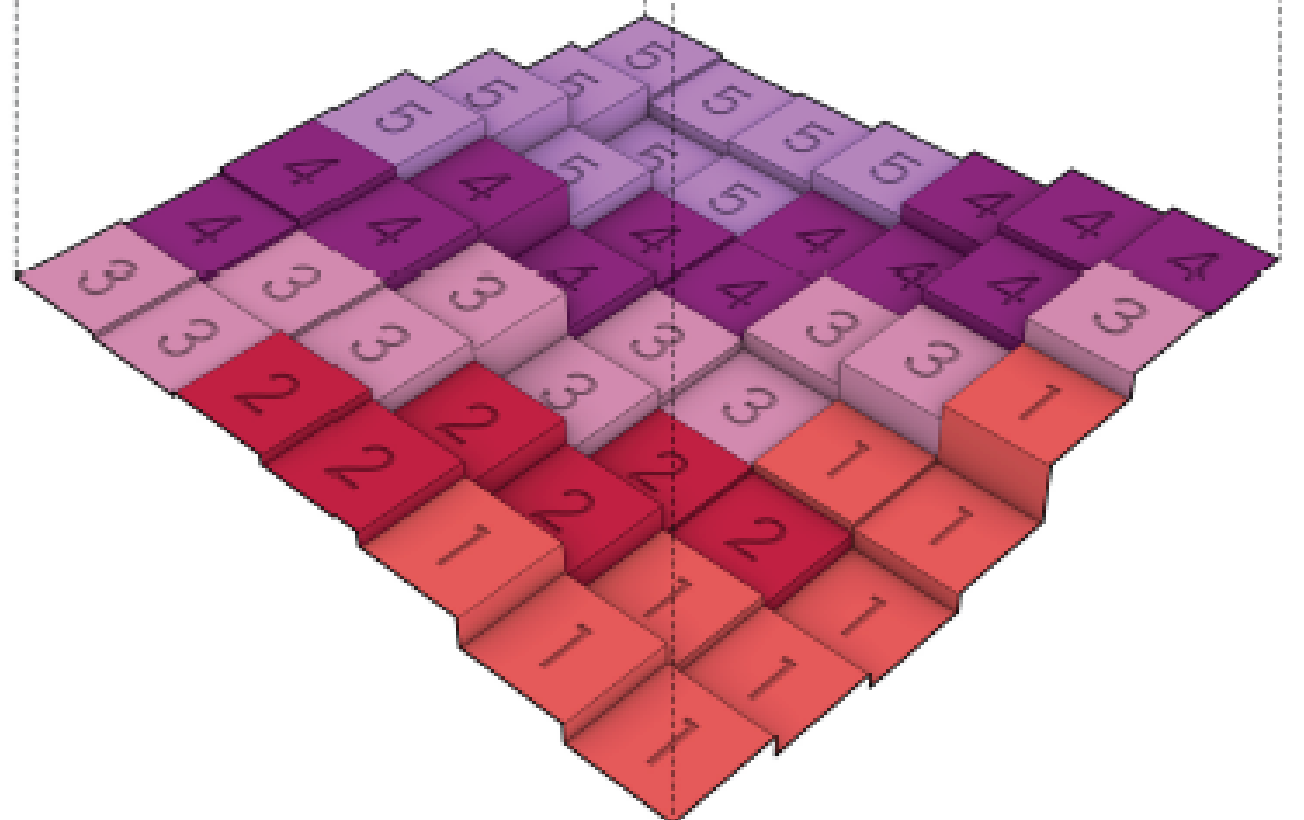
## 02.

The DEM then undergoes geoprocessing techniques also known as hydroconditioning, which helps identify drainage cells and surface waterflow



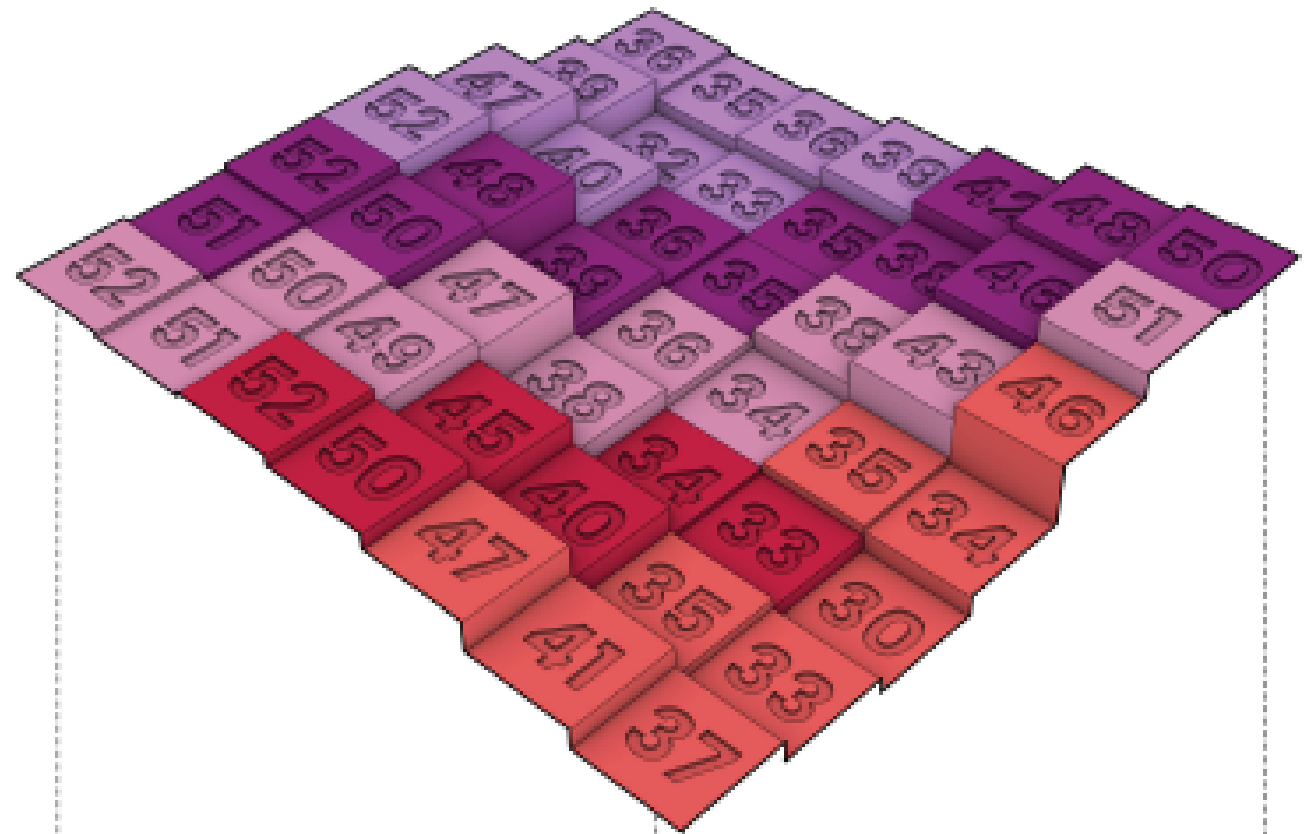
## 03.

Cells in this 10m grid matrix are grouped according to their nearest drainage cell forming a drainage network



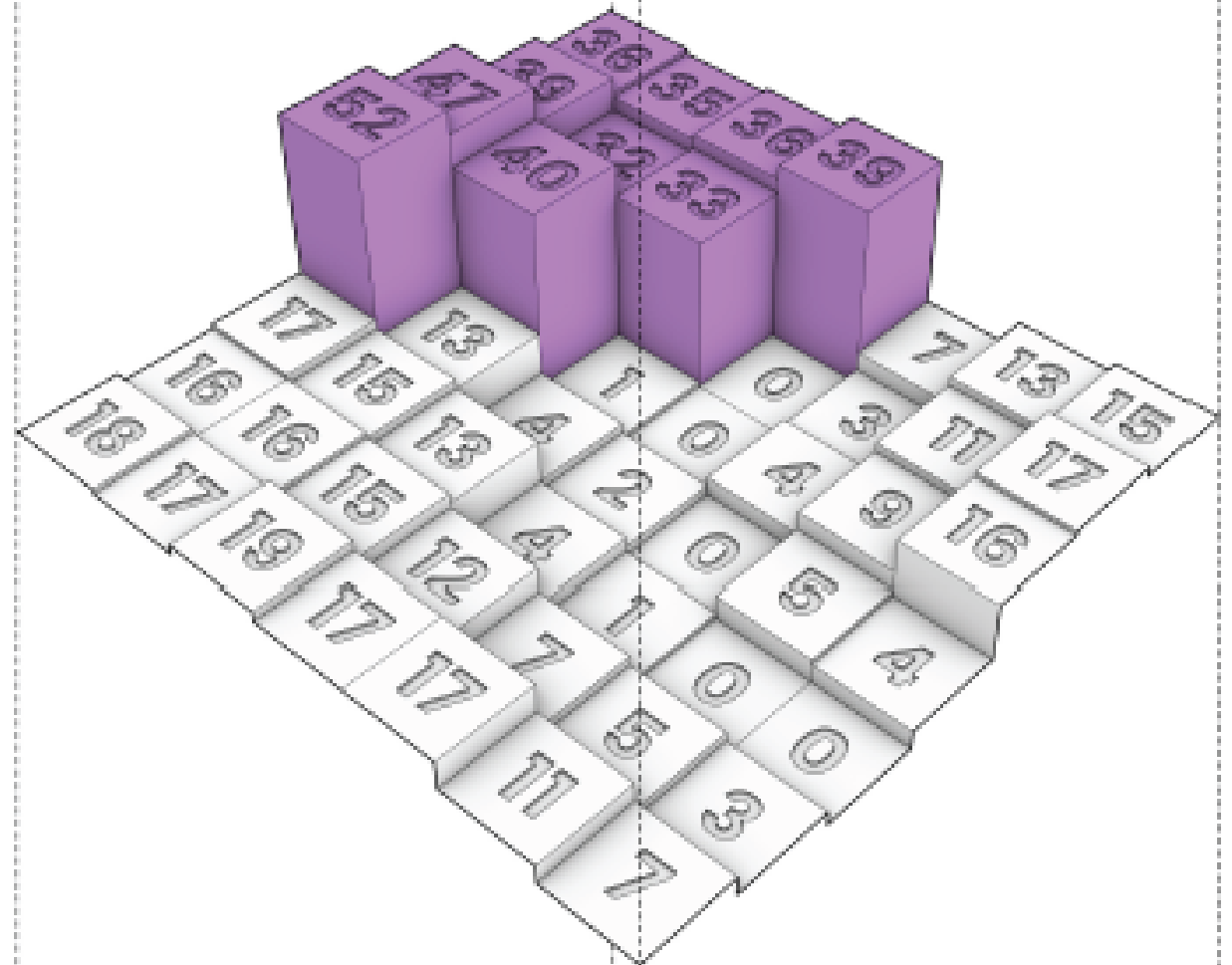
## 04.

The elevation values of the drainage cells are normalized to a 0 value



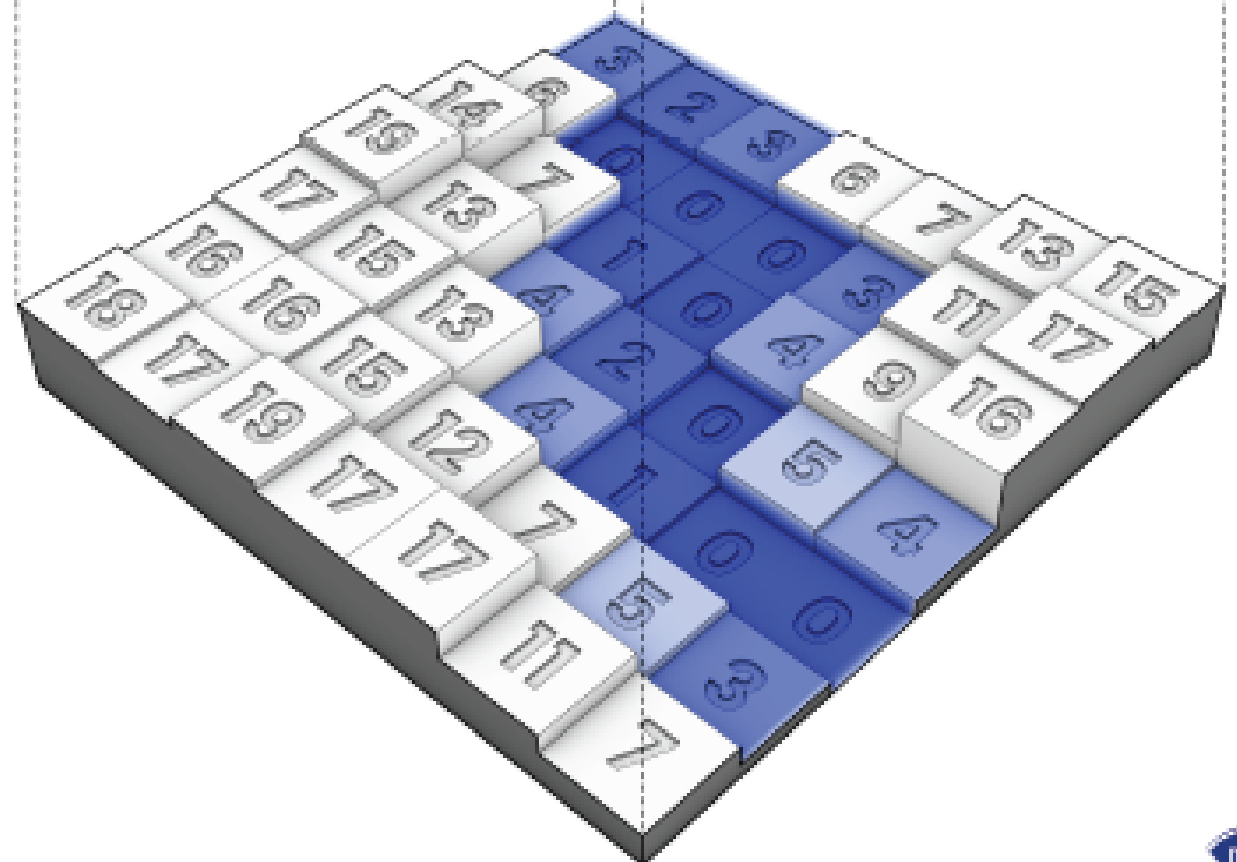
## 05.

The topography is then normalized with respect to the drainage network by converting elevations above MSL into relative elevations [vertical difference of each cell in the terrain relative to its nearest draining cell]



## 06.

The HAND method converts DEM data into a Relative Elevation Model [REM] or HAND grid used to create FIM



## Three Dynamic FIM Services

Currently, three dynamic FIM services are available

01. NWM Analysis and Assimilation Flood Inundation Mapping [NWM ANA FIM]
02. River Forecast Center 5-Day Maximum Flood Inundation Mapping [RFC 5-Day Max FIM]
03. National Water Model 5-Day Maximum Flood Inundation Mapping [NWM 5-Day Max FIM]

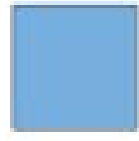
While NWM ANA FIM reflects an analysis of observed conditions, RFC 5-Day Max FIM and NWM 5-Day Max FIM provide forecast information.

### National Water Model Analysis and Assimilation [NWM ANA FIM] Service

The NWM Analysis and Assimilation [ANA] FIM service depicts the inundation extent of the National Water Model [NWM] streamflow analysis where the NWM is signaling high water. High water is a term used by the Office of Water Prediction [OWP] as an indicator of elevated flows for a given NWM reach or stream. Its name refers to how this service uses observed data and assimilates it into modeled streamflow conditions which are then presented as the most recent FIM in delayed real-time. NWM ANA FIM uses observed rainfall data as a base for modeling runoff for the continental U.S. Using real-time gage data, FIM is created to reflect and approximate what is currently occurring.

NWM ANA is not a forecast service and is therefore limited by the precision of its observed source data [Multi-Radar/Multi-Sensor System [MRMS] and the river gage network]. NWM ANA will be more reliable where there are more gages and less reliable farther away from river gages and where rainfall data [gage, radar, and satellite] are less accurate. It should be used when forecast information is not desired.

NWM  
ANA FIM



RFC  
5-Day  
Max FIM



NWM  
5-Day  
Max FIM

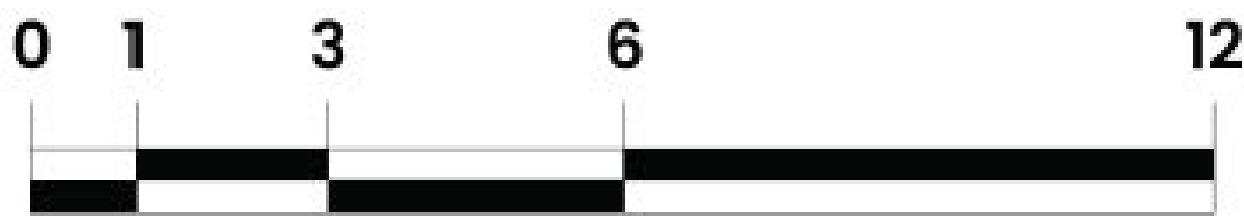
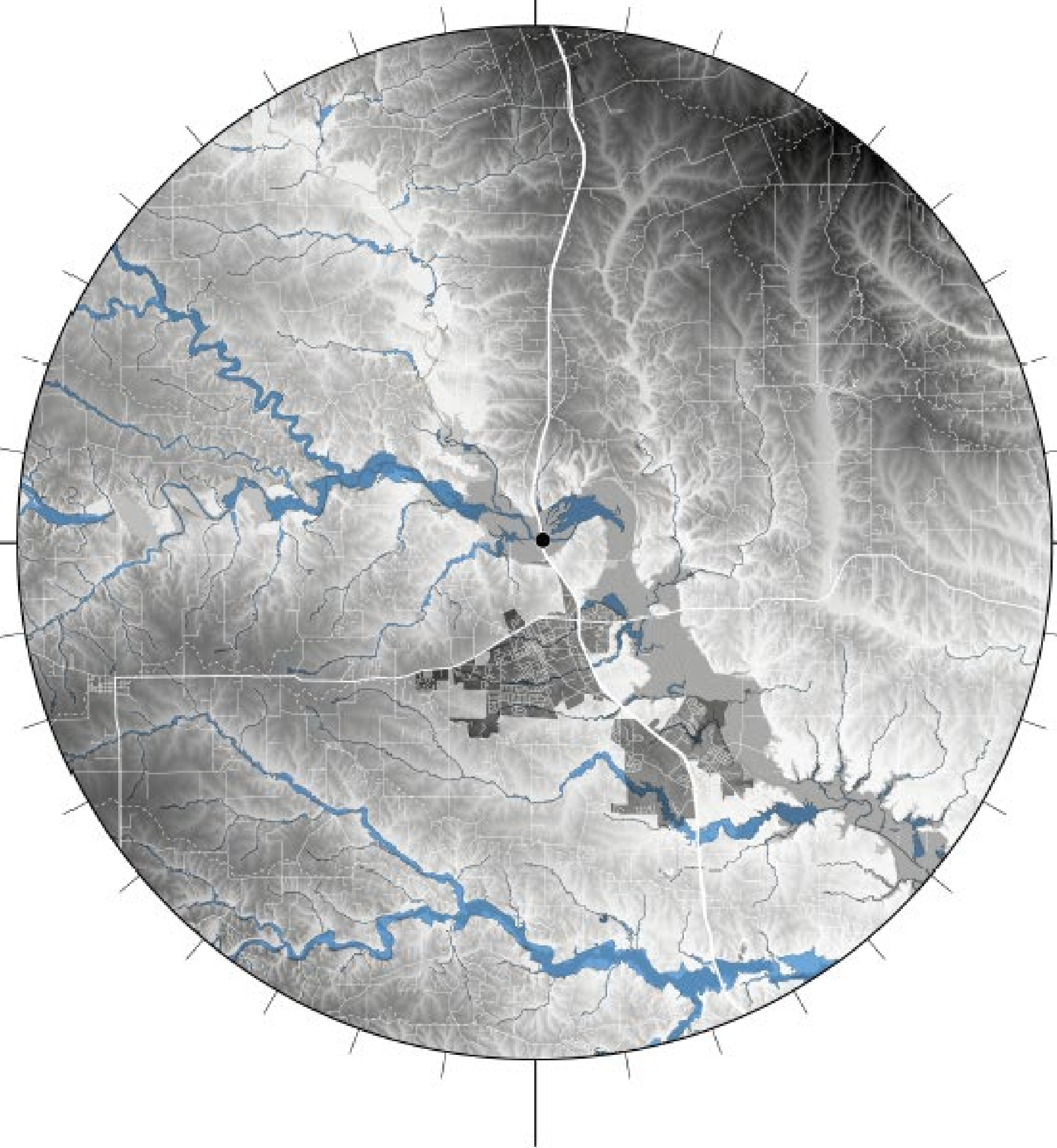


N



W

E



miles



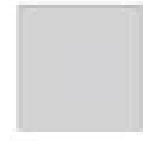
# River Forecast Center [RFC 5-Day Max FIM] Forecast Service

RFC 5-Day Max FIM Forecast depicts the maximum inundation extent over the next five days, derived from the official River Forecast Center [RFC] forecast routed downstream of a forecast gage location through the National Water Model [NWM] stream network. Forecasters at each RFC generate a Quantitative Precipitation Forecast [QPF] forecast several times daily. This QPF serves as the precipitation forcing in the Community Hydrologic Prediction System [CHPS], the modeling system used to produce the RFC streamflow forecasts for forecast points. The forecast flow from the RFC at a gage location is subsequently used to generate the 5-day Max FIM Forecast by routing the flow downstream through the National Water Model [NWM] stream network. In total, this provides inundation services along approximately 110,000 river miles downstream of the about 3,600 RFC forecast points.

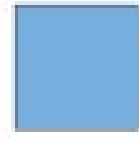
RFC 5-Day Max FIM Forecast is only available downstream of AHPS forecast points. Because the RFF CHPS models are highly calibrated for the specific location, and the forecaster reviews the resulting forecasts, there is generally higher confidence in the flows used to produce RFC FIM than the NWM FIM. Therefore, use the RFC 5-Day FIM Forecast instead of the NWM FIM where it is available.



NWM  
ANA FIM



RFC  
5-Day  
Max FIM



NWM  
5-Day  
Max FIM

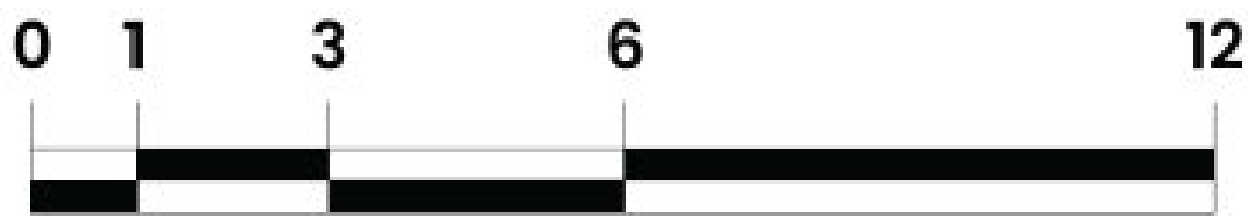
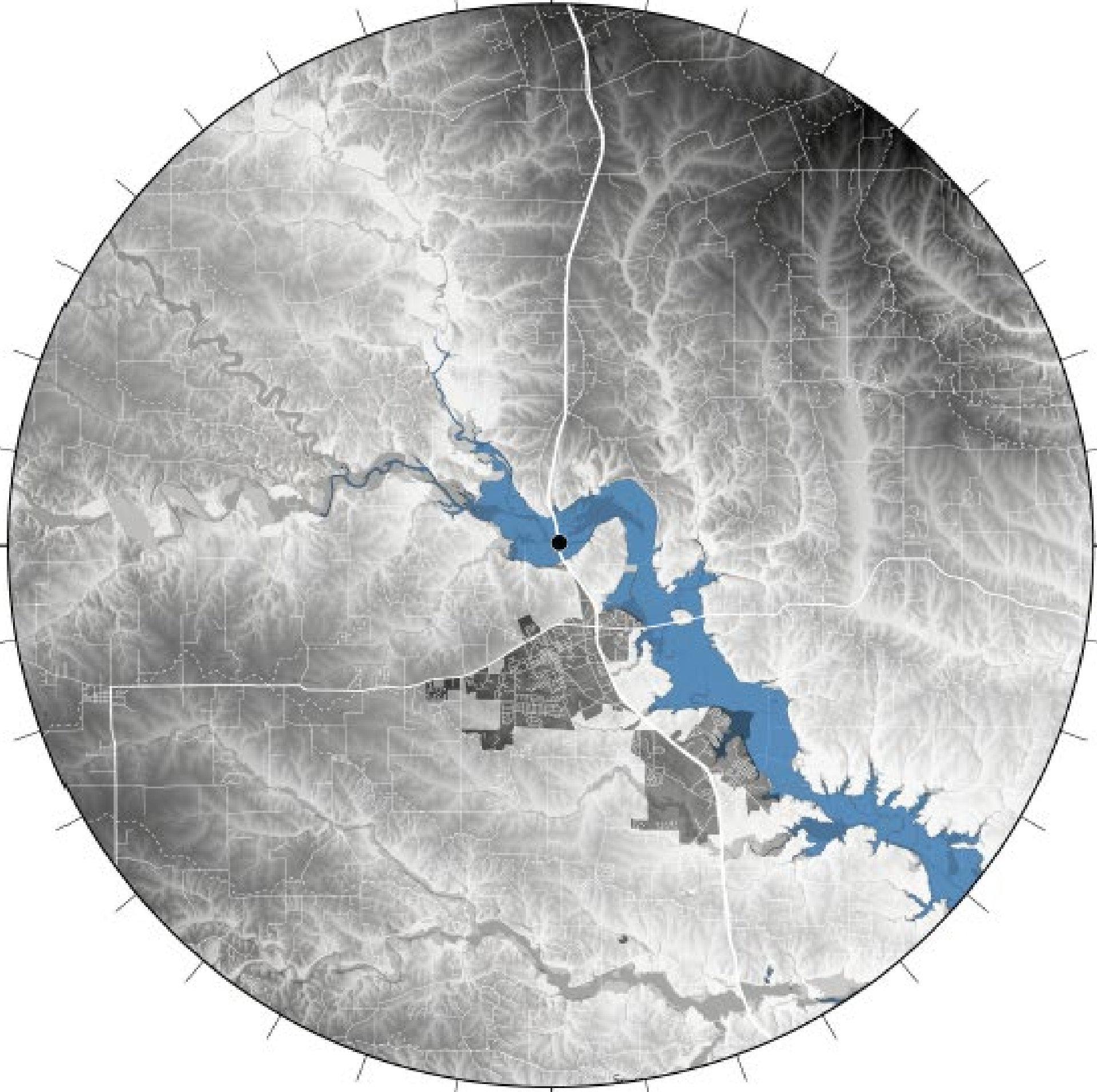


N



W

E



miles



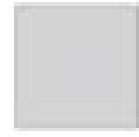
# National Water Model [NWM 5-Day Max FIM]

## Forecast Service

NWM 5-Day Max FIM Forecast depicts the maximum inundation extent over the next five days derived from the National Water Model streamflow forecast. This FIM is only generated where and when the NWM is forecasting flows that meet or exceed the high water threshold for a given river reach. This service is derived from the medium-range configuration of the NWM over the contiguous U.S. NWM 5-Day Max FIM Forecast uses the NWM Analysis and Assimilation FIM configuration as its initial conditions. It ingests meteorological forcing data from the Global Forecast System [GFS] model, taking forecast rainfall from the GFS for the upcoming five days and running it through a rainfall-runoff simulation to create a flood forecast. The FIM depicted by this service represents the maximum extent of inundation during these five days.

Because a forecaster is not involved in the decision-making process regarding the forecast, a Quality Control [QC] limitation exists. Therefore, the RFC FIM Forecast is recommended where available downstream of AHPS forecast points. Use NWM 5-Day Max Forecast for areas not covered by other services and have confidence in the GFS forcing.

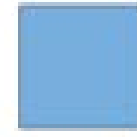
NWM  
ANA FIM



RFC  
5-Day  
Max FIM



NWM  
5-Day  
Max FIM

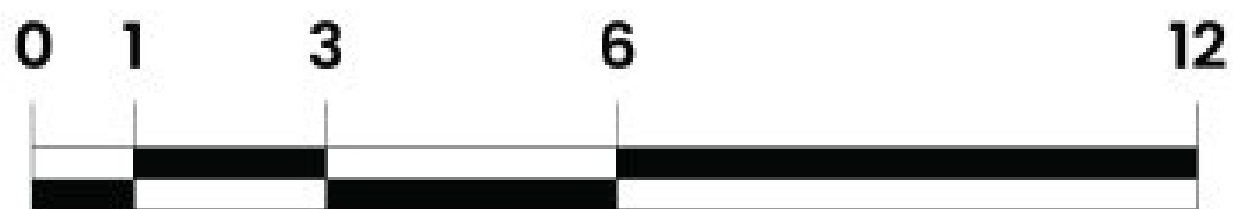
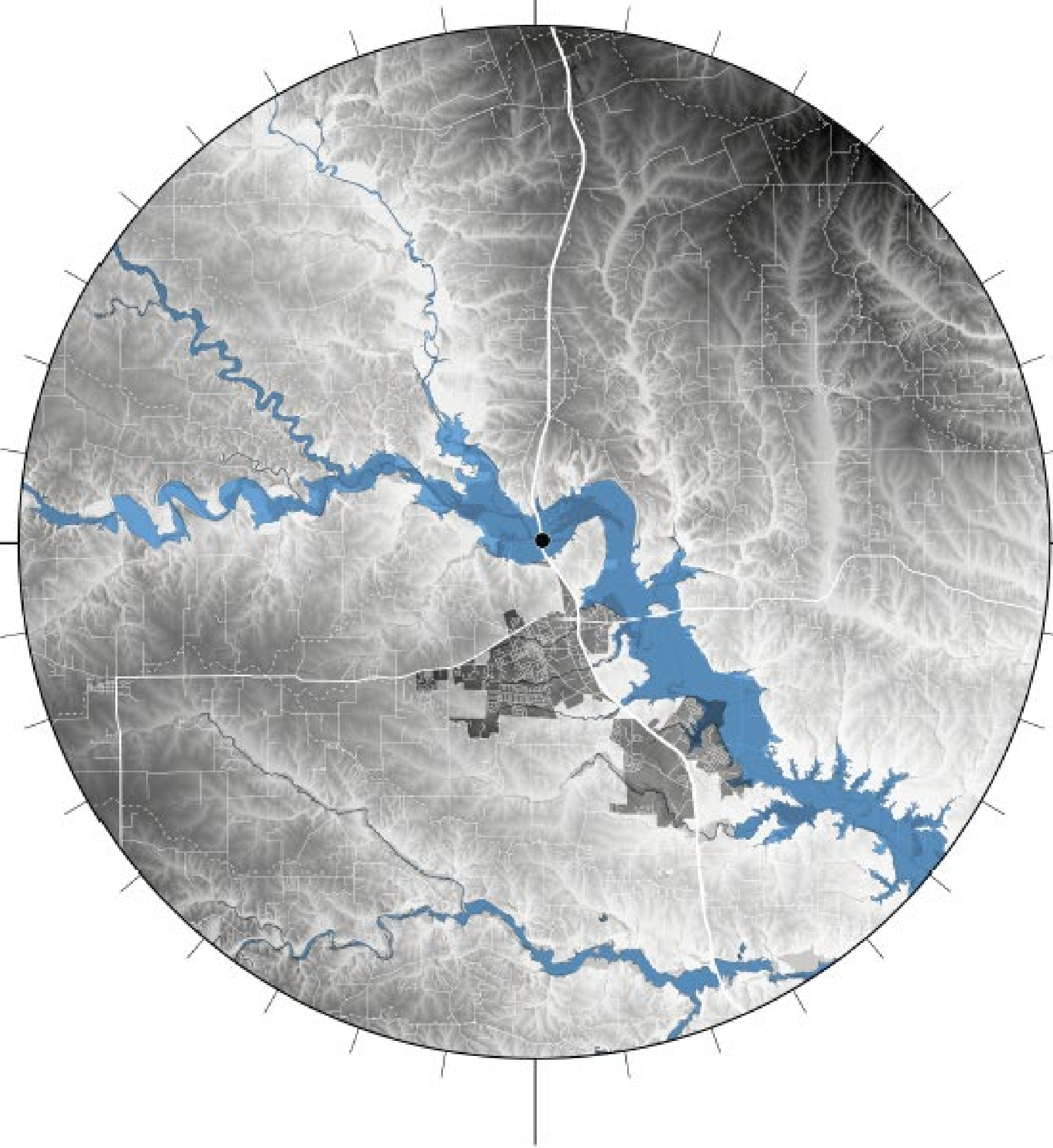


N



W

E



miles



# Three Dynamic FIM Services Comparison Table

## 1.0

	<b>NWM ANA FIM</b>	<b>RFC 5-Day Max FIM</b>	<b>NWM 5-Day Max FIM</b>
<b>Data Type</b>	Observation-based simulations [precipitation estimate and assimilated with USGS gage observations]	Forecast [5-day RFC forecasts]	Forecast [5-day GFS]
<b>Latency/Duration</b>	Real time streamflow with 1 hr 20 min latency time	1 hr 55 min latency max extent for 5-days	6 hr 30 min latency max extent for 5-days
<b>Update Frequency</b>	Hourly	Hourly [if new forecasts are available]	Every 6 hours
<b>Availability</b>	Entire NWM domain [CONUS, HI, PR, US Virgin Islands]	Downstream of AHPS forecast points	Entire NWM domain [CONUS, HI, PR, US Virgin Islands]
<b>When to Use</b>	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

# NEIGHBORHOOD LEVEL FLOOD INUNDATION MAPS:

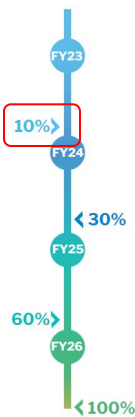
Transforming NWS Water Prediction Across the U.S.



# FLOOD INUNDATION MAPPING

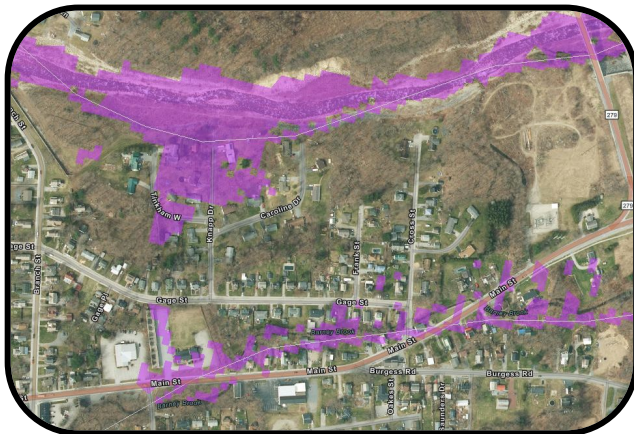
Prepared for Bennington County by NWS Albany, NY

The National Weather Service (NWS) has begun a multi-year effort to introduce high resolution flood extent mapping on a community scale across the country. This new suite of Flood Inundation Mapping (FIM) products is based on the agency's National Water Model (NWM) framework and will be evaluated in the years to come by the NWS and our partners. We need your help!



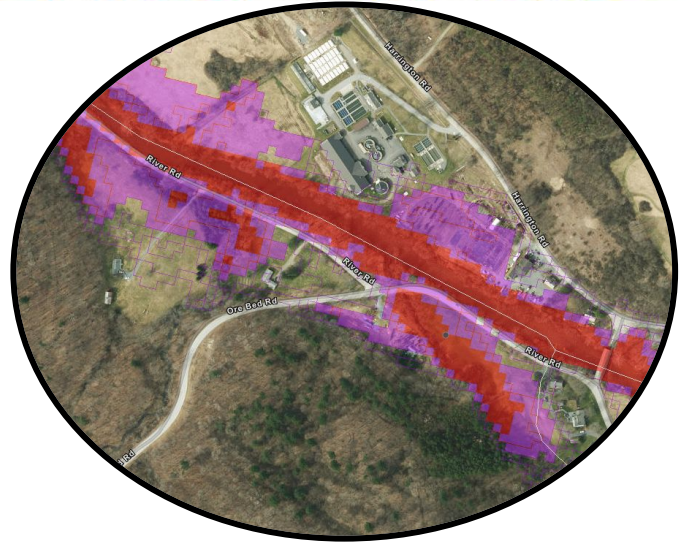
The roll out of flood inundation mapping services will occur in phases over the next 4 years based on location.

Communities in Eastern New York and Western New England served by the NWS in Albany, NY will be in the first 10% of the U.S. population to receive these map services by **October 1, 2023**.



The above image shows the National Water Model (NWM) 2% Annual Exceedance Probability (AEP), or 50-year Major Flooding Threshold, flow through the Roaring Branch Walloomsac Brook and Barney Brook, focused east of the center of Bennington. These NOAA AEP inundation maps represent a model simulation and do not have any regulatory authority. Local impacts resulting from flooding of this magnitude include flooding of parts of Main Street along Barney Brook and adjacent properties; flooding of homes on Tinkham Way and Knapp Drive.

**Look for a tabletop exercise coming this fall!**



The above image shows the Moderate and Major Stage-Based Categorical Flood Extent for the Walloomsac River Near North Bennington, focused along River Road where it joins Ore Bed Road. Local impacts resulting from flooding of these extents include flood waters covering Ore Bed Road and flooding of Paper Mill Village.

Three new FIM products will be available via web services allowing for panning, zooming and viewing multiple layers:

**FIM Inundation Extent Analysis** Depicts the current flood extent using observed rainfall and stream data. **Only available** for locations exceeding the high water threshold. Updated hourly.

**NWM 5-Day Maximum Inundation Extent Forecast** Depicts the inundation extent of the peak National Water Model (NWM) streamflow forecast over the next 5 days. **Only available** where the NWM flows exceed the high water threshold; based on rainfall from a single computer model. Updated every 6 hours.

**RFC 5-Day Maximum Inundation Extent Forecast** Depicts the maximum inundation extent over the next 5 days based on the official River Forecast Center (RFC) forecast. **Only available** for forecasts above action stage and downstream of current river forecast points. Updated within about an hour of RFC forecast updates.