



## Agency Priority Goal Action Plan

# Mitigate Flood Impacts by Demonstrating Improved Decision Support Services to Emergency Managers

### **Goal Leader:**

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# Overview

**Goal Statement:** By September 30, 2019, NOAA National Weather Service will improve decision support services by demonstrating a new flood inundation mapping capability serving 25 million people (approximately 8%\* of the continental U.S. population) residing in flood-vulnerable freshwater basins, and delivering an enhanced excessive rainfall outlook product that extends the lead time of high risk predictions from two days to three days.

Emergency Managers will use this information to more effectively mitigate flood impacts by prepositioning resources, ensuring critical infrastructure (e.g., hospitals, evacuation routes, etc.) are viable, and ordering evacuations<sup>1</sup>.

\*Future out-year goal is to incrementally expand flood inundation mapping to near 100% of the continental U.S. population residing in flood-vulnerable freshwater basins.

## Challenge:

- Flood and other water emergencies increasingly are associated with property damage and threats to safety. For example, in 2016, just four flooding events led to \$16.6 billion in damages and 49 deaths.\*\* Losses associated with flooding events in 2017, which are still being tabulated, are expected to exceed 2016.
- Emergency managers lack detailed information during flood emergencies to efficiently allocate resources to save lives and property.

## Opportunity:

- NOAA can use advances from the state-of-the-art National Water Model (NWM) to demonstrate improved decision-support products to emergency managers.
- Provide emergency managers and the public a longer lead time out to Day 3 for “High Risk” of Excessive Rainfall. Excessive rainfall expresses the probability of rainfall exceeding flash flood guidance.

\*\* <https://www.ncdc.noaa.gov/billions/events/US/1980-2017>

<sup>1</sup> Execution of the APG is subject to availability of staff resources, especially at the Weather Prediction Center, River Forecast Centers, and the National Water Center which could be affected by implementation of the Analyze, Forecast, and Support reduction.

# Long-Range Vision for Flood Inundation Mapping

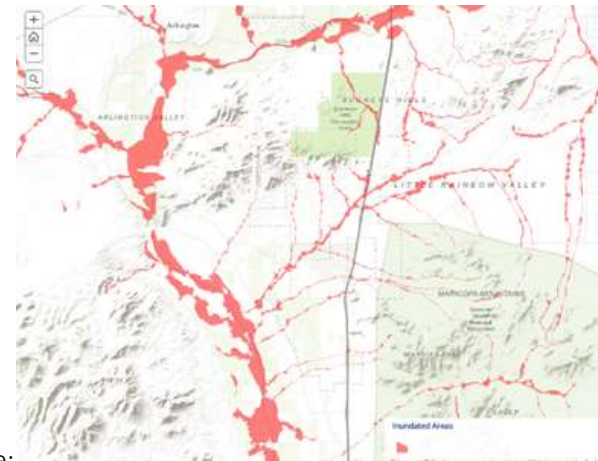
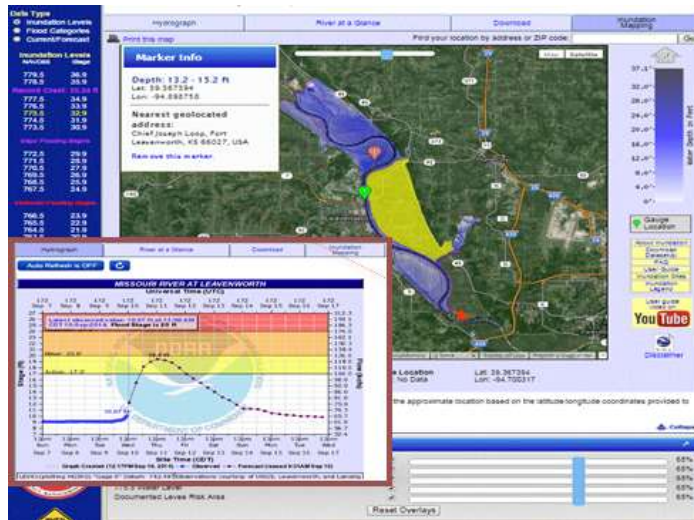
**Flood Inundation Maps:** Maps depicting the spatial extent and depth of flood waters so Emergency Managers can better mitigate impacts of flooding and build more resilient communities.

**Current Capability:** Static Inundation Map libraries at ~150 river locations across the United States.

- Provides the spatial extent and depth of flood waters
- Displays inundation maps for levels from minor flooding through flood of record
- Limited spatial coverage, resource intensive, only at small number of USGS streamgage locations

**Next Steps -- NWM enabled capability:** The high spatial and temporal resolution capabilities of the National Water Model coupled with high resolution hydrography datasets will allow us to provide real-time flood inundation mapping capabilities at neighborhood-level in a more consistent and timely way.

- Provides spatial extent of flood waters
- Technique can be driven by official streamflow forecasts or NWM guidance (to be demonstrated in this APG for the WGRFC domain)
- Incrementally expand flood inundation mapping to 2.7 million stream reaches nationwide



**Future Planned Enhancements:** Build on and enhance the NWM enabled capability to include:

- Flood Inundation maps informed by the (to be developed) NWM hyper-resolution capabilities to provide improved resolution of maps and better depict the urban built environment
- Flood Inundation maps informed by the (to be developed) NWM coupled with estuarine and coastal processes, and groundwater models

# Summary of Progress – FY 18 Q4

- Milestones Completed:
  - Q4FY18: Internal validation of flood inundation mapping (using official forecast) with the Office of Water Prediction and West Gulf River Forecast Center
  - Q4FY18: Execute Flash Flood and Intense Rainfall Experiment and assess Day 3 rainfall tool
  - Q4FY18: Test machine-learning first guess field for Excessive Rainfall Risk areas
- Why these milestones are important
  - The internal validation of flood inundation mapping (FIM) milestone further advances the protection of life and property -- across a broader geography covering more Americans -- by increasing the confidence Emergency Managers (EM) have in NWS FIM services. EMs use this information to more effectively mitigate flood impacts by prepositioning resources, ensuring critical infrastructure are viable (e.g., hospitals, evacuation routes, etc.), and ensuring effective evacuations.
  - The other two milestones established advances that help focus forecasters' attention to areas of high level heavy rainfall threats and provide EMs earlier awareness, leading to increased public safety. Forecaster feedback from the experiment was provided back to model developers to help improve the tool. The first guess field test has established that a first-guess field is feasible.
  - Building this capacity as an APG has already shown improvement of NWS Decision Support Services during this year's Hurricane Florence. A 'High' excessive rainfall outlook was issued on Day 3 before Hurricane Florence which provided EMs earlier awareness, leading to increased public safety. FIM provided during Hurricane Florence was used to identify high risk transportation corridors, manage asset relocation to higher ground, and assess potential impact to shelter locations.
- **APG On Track** for completion Q4 FY19.

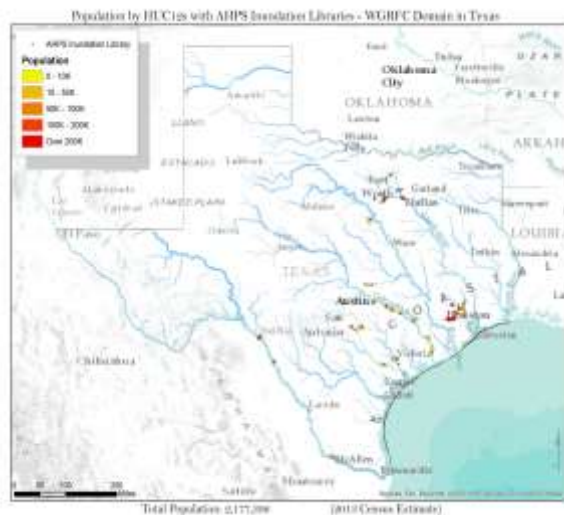
# Key Milestones (Flood Inundation Mapping)

Milestone Summary				
Key Milestone	Milestone Due Date	Milestone Status	Change from last quarter	Anticipated Barriers or other Issues Related to Milestone Completion
Initiate flood inundation mapping (FIM) techniques using the River Forecast Center (RFC) official forecast for West Gulf River Forecast Center (WGRFC) domain	FY18 Q3	Complete (FY18 Q3)	n/a	
Internal validation of FIM (using official forecast) with OWP and WGRFC	FY18 Q4	Complete (FY18 Q4)	Completed	
Initiate flood inundation mapping techniques using the National Water Model (NWM) guidance for WGRFC domain	FY18 Q4	Complete (FY18 Q3)	n/a	
Internal validation of FIM (using NWM guidance) with OWP and WGRFC	FY19 Q1			
NWM version 2.0 released	FY19 Q2			
Complete tabletop exercise planning	FY19 Q2			
Execute tabletop exercises with demonstration area Emergency Managers	FY19 Q3			
Incorporate feedback from tabletop exercises. Complete FIM demonstration.	FY19 Q4			

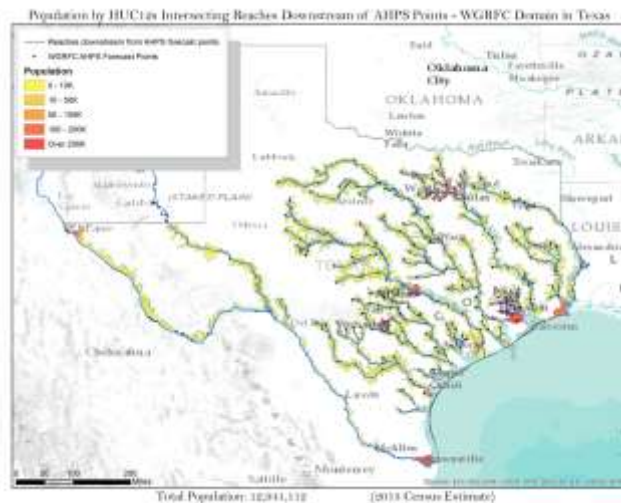
# Key Indicators (Flood Inundation Mapping)

Population served by inundation information, considering areas within NWS West Gulf Forecast Center service area in Texas.\*

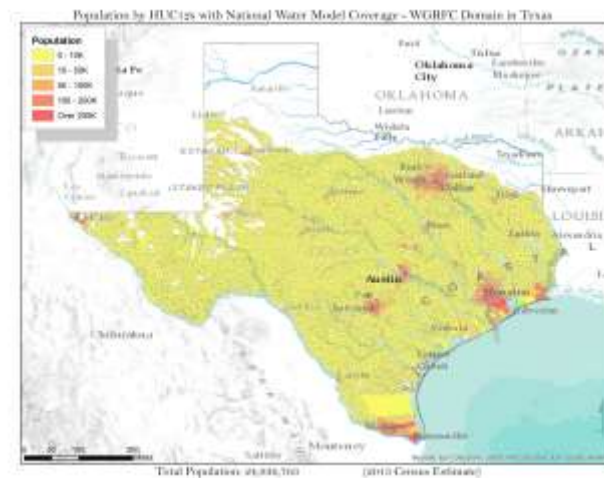
- Baseline: < 1% of population (2.2M) served by current Advanced Hydrologic Prediction Service (AHPS) static inundation maps near specific river locations
- FY18 Q3: Initiate demonstration on 4% of population (12.9M) served with NWM hydrography and Height Above Nearest Drainage (HAND) technique near NWS official forecast locations.
- FY18 Q4: Initiate demonstration on 8% of population (24.9M) served with NWM guidance and HAND technique along full river/stream network.
- FY19 Q4: Complete demonstration on 8% of population and incorporate emergency manager feedback.
- Out-year: ~100% of CONUS population (317M) served by NWM model and HAND technique



Baseline



FY18 Q3



FY18 Q4

\*Population totals based on 2013 population in adjacent hydrologic areas, defined by Hydrologic Unit Code (HUC) 12 delineations.

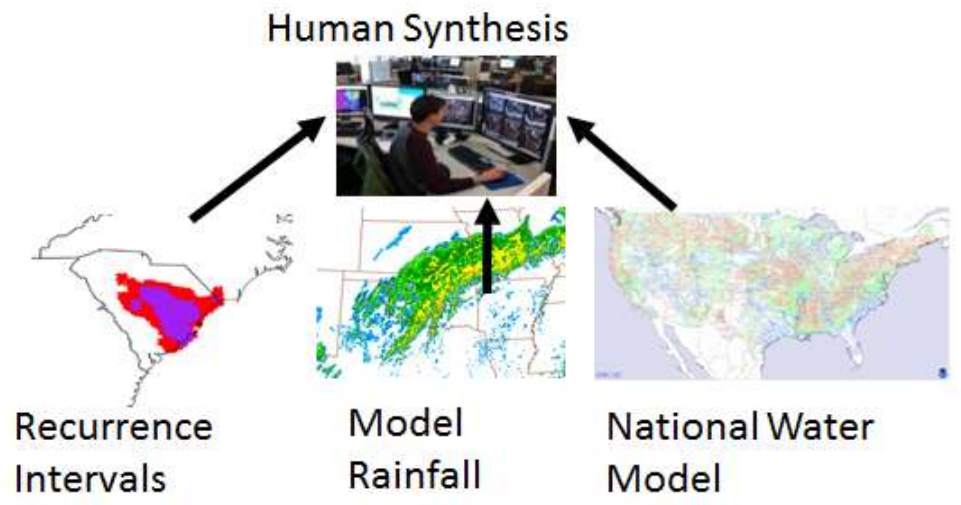
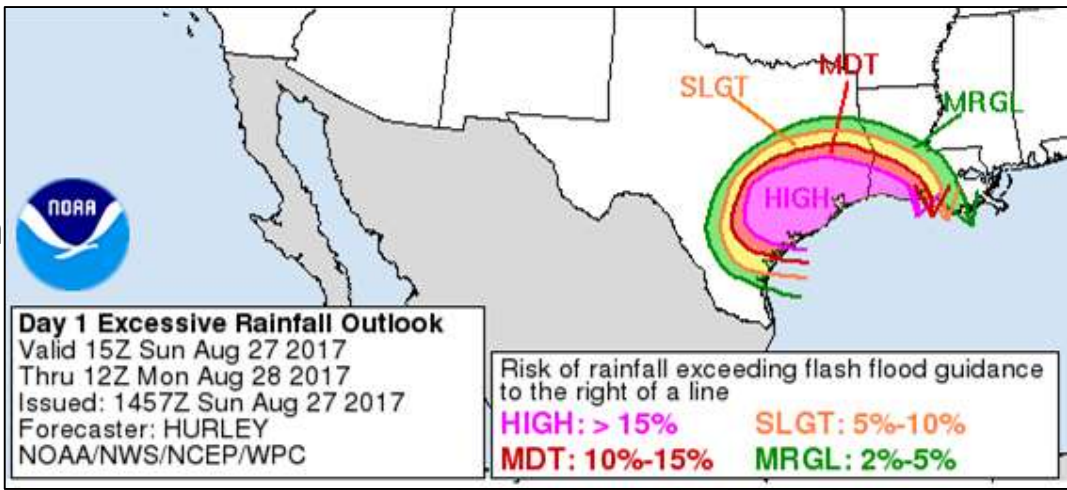
# Excessive Rainfall Outlook

The Excessive Rainfall Outlook (ERO) provides a national summary of rainfall threat by expressing the probability of rainfall exceeding flash flood guidance.

The ERO raises situational awareness that conditions are favorable for impactful rainfall.

The risk of excessive rainfall is expressed both probabilistically and categorically (e.g., Marginal 5-10%, Slight 10-20%, Moderate 20-50%, and High >50%).

“High” risk forecast days have been correlated to events with fatalities and large damages. Currently “High Risk” is only used in Day 1 and Day 2 products.



# Key Milestones (Excessive Rainfall Outlook)

Milestone Summary				
Key Milestone	Milestone Due Date	Milestone Status	Change from last quarter	Anticipated Barriers or other Issues Related to Milestone Completion
Enhance excessive rainfall outlook to include improved definition and calibration	FY18 Q1	Complete (FY18 Q1)	n/a	
Execute Flash Flood and Intense Rainfall Experiment and assess Day 3 rainfall tools	FY18 Q4	Complete (FY18 Q4)	Completed	
Test machine-learning first guess field for Excessive Rainfall Risk areas	FY18Q4	Complete (FY18 Q4)	Completed	
Internal issuance of test 'high' risk areas on Day 3	FY19 Q1			
Add excessive rainfall outlook to National Hurricane Center webpage for landfalling tropical cyclones.	FY19 Q3			
Execute tabletop exercises with Emergency Managers	FY19 Q3			
Enhance operational excessive rainfall outlook to add High Risk category out to 3 days.	FY19 Q4			

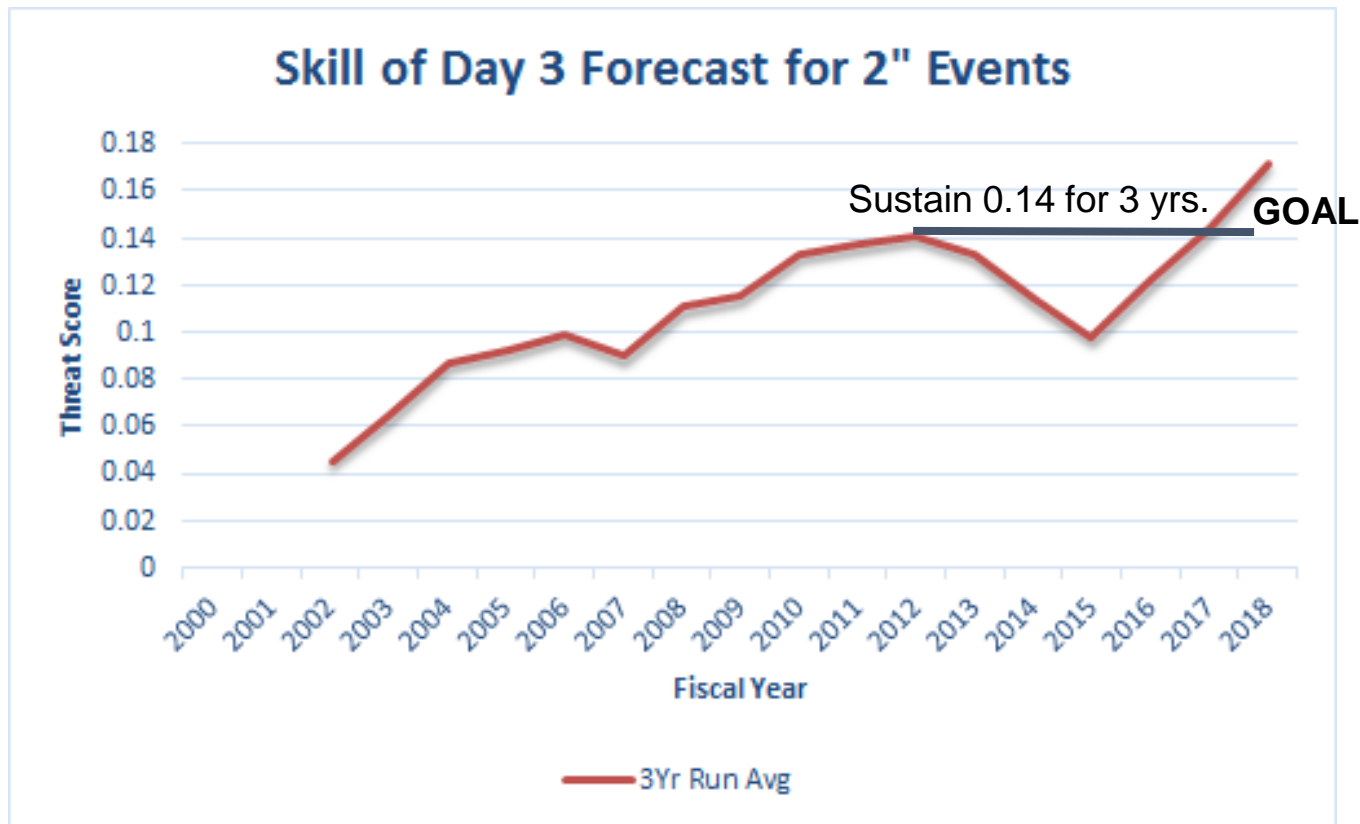


# Key Indicators (Excessive Rainfall Outlook)

Threat score of two inch rainfall events forecast 3 days in advance  
(3 FY running average)

**3-year running average goal = 0.14**

Sustaining a 0.14 Threat Score gives confidence to provide 'high risk' excessive rainfall outlook category on Day 3



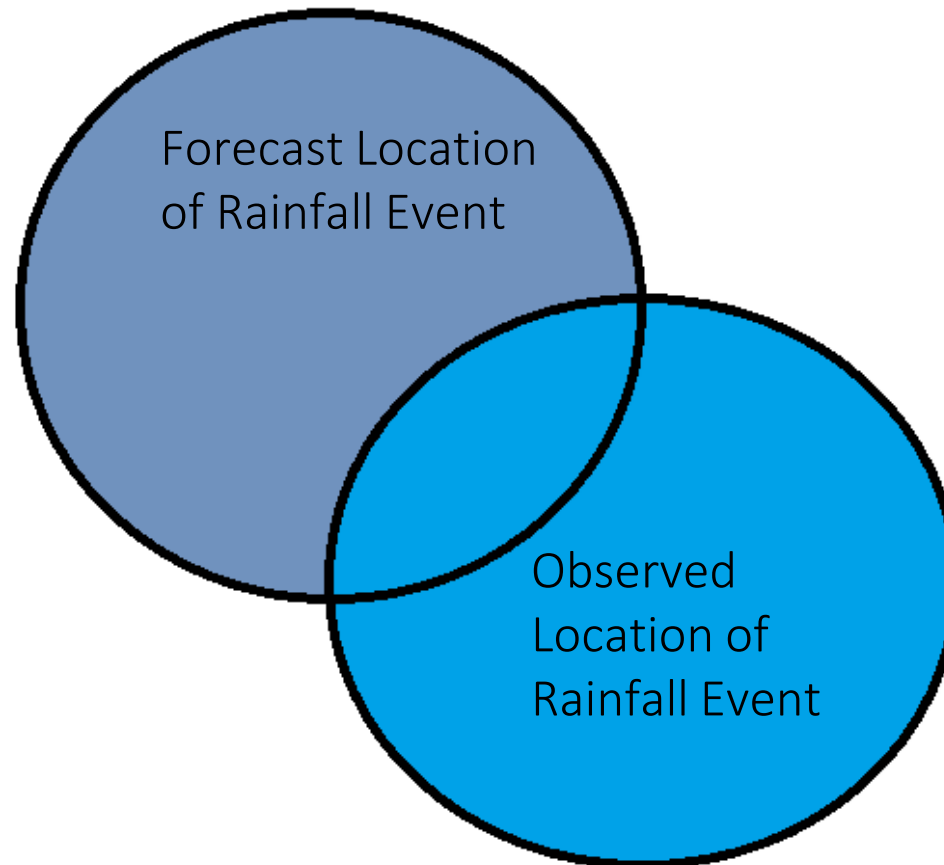
# What does a 0.14 Threat Score Mean?

**Threat Score of 0** = NO overlap between forecast & observed location.

**Threat Score of 1** = COMPLETE overlap between forecast & observed location.

**Threat Score of 0.14** = Index score which represents 25% overlap between forecast and observed location

Note: Predictions with some variation are still highly useful to planning for and responding to extreme weather.



# Additional Information

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## Contributing Programs

Organizations:

- OMB, DOC, NOAA -- Oversight
- NWS -- Implementing Organization for APG

Program Activities:

- Office of Water Prediction -- Demonstrate Flood Inundation Map
- National Centers for Environmental Prediction -- Deliver Enhanced Excessive Rainfall Outlook

Regulations:

- N/A

Tax Expenditures:

- N/A

Policies:

- None

Other Federal Activities:

- None

## Stakeholder Consultations

The APG advances decision support, which is authorized in the Weather Research and Forecasting Innovation Act of 2017.