Mark Peterson - Host:

I'm Mark Peterson, and this is "Before, during, and after: a podcast from FEMA."

Floods are the most common natural disaster in the United States, causing an average of more than $150 billion per year, over the past five years, according to the National Oceanic and Atmospheric Administration or NOAA. To address this threat, NOAA created the National Water Center to provide a state-of-the-art facility to promote collaboration between federal agencies and the scientific community to address floods nationwide. On this episode of the FEMA podcast, we are joined by Whitney Flynn, FEMA's liaison to the National Water Center, to discuss why the partnership is so critical in helping communities deal with flooding events before, during, and after they occur.

Alright so, we're trying something a little bit different on this episode. Instead of one host, we get two. So, we had Troy Christensen - Troy, thanks for helping me out with this one.

Troy Christensen:

Great to be here this morning, Mark.

Mark Peterson - Host:

So, you know, for anybody who doesn't know Troy, he's hosted a few episodes on the podcast - does great job. But, more than that, he's also got a great history with FEMA. He's responded to a number of different events, including floods, but has also served on our Incident Management Assistance Teams within FEMA Region Five. But, even more than that, he's also a meteorologist. So, anytime we are gonna talk about science and the effects of, you know, potential weather - and here, we're gonna talk about hydrology and flooding, it's great to have Troy on the show.

Troy Christensen:

Well, it's good to be here. And you know what, talking about flooding, I think is so important because at FEMA, that's one of the things that we respond to, especially in the Midwest, is all about flooding. So, it's great to be here on this episode and talking to an expert in flooding and water in general.

Mark Peterson - Host:

So, speaking of that, on this episode, we're gonna be talking with Whitney Flynn, who is FEMA's liaison to the National Water Center. Whitney, great to have you here.

Whitney Flynn:

Hey, good morning. Thanks for having me. I'm really excited to be here and talk to you guys a little bit about this new role and the National Water Center and just this whole, you know, developing evolving program.

Mark Peterson - Host:

Yeah. So, let's just start off so, tell us about the National Water Center and, sort of, its mission.

Whitney Flynn:

So, a little over 10 years ago, congressional leaders responded to this growing need for water resources intelligence by having NOAA Build a National Water Center right here in Tuscaloosa, Alabama. The center is this cornerstone facility of the Office of Water Prediction, our OWP within NOAA's National Weather Service. And they're charged with developing and providing this new generation of water prediction services for the entire nation. These services help to inform essential emergency management and water resource decisions from all time scales, including flooding and drought, low flow risks and information for routine and long-range water management and planning. In addition to collaboration with academia and the private sector, the water center works very closely with over 30 federal agencies - from US Geological Survey, US Army Corps of Engineers, of course, FEMA, to all address the nation's growing water challenges. So, like I said, they're very new in the weather service space but they've come a long way in their development of experimental products and services over the last few years. And this means, they've begun to deliver products to an external audience and this includes core partners in the emergency management community. And, to streamline that process of service delivery and partner engagement, Congress directed FEMA to co-locate personnel at the water center to ensure coordination with the water center and help to familiarize FEMA with water center products and services. So, really exciting stuff.

Troy Christensen:

Absolutely. Whitney, you mentioned that this has been a collaboration that FEMA's been a part of for a couple of years. Tell us a little bit about your background and, kind of, how you came into the position of being a liaison to the National Water Center, but also a FEMA employee.

Whitney Flynn:

So, something that I've always appreciated about emergency management as the discipline continues to evolve over the past, you know, few decades, is its interdisciplinary nature. And that continues to evolve, right? You see people from all walks of life, all backgrounds - from military, criminal justice, medical fields, geography, meteorology, all kinds- can find themselves in emergency management. And, that's kind of how it worked out for me. Growing up, I always had a passion for weather. I had in my head at around five or six years old that I was gonna be a meteorologist. That's what I was gonna do. Nobody was gonna get in my way. And, I started out in geography in GIS from Jacksonville State University, where I got my bachelor's, and I was ready to make that jump into meteorology masters when I learned about JSU's Emergency Management Program.

And this was, sort of, an all-hazards field and what came together by pure happenstance, being in the right place at the right time, I ended up landing an internship at the county EMA and totally fell in love with it. And I decided to pursue my masters in emergency management there, while continuing the internship. And about a year into the program, the director, at the time, of the county EMA, he knew I was interested in weather. And on the side, I did a lot of volunteer work and water quality through Alabama Water Watch. He sent me this application for this National Water Center Summer Institute. It's the seven-week program that they hold every year in partnership with the academic sector to bring in grads and post-grads from all over the country in hydrology to work on their research at this new center, this new NOAA center. So, I looked at my director and I said, "You've lost your mind. This is not for me. This is for some high-level graduates in hydrology and physics, and I'm just, I'm not any of these, I'm not in any of these categories." And he just said, "You know, well, it can't hurt to apply." Plus, one of the themes that year had to do with emergency response. So, I went for it. I applied and I actually was accepted, and I asked one of the leads for the summer institute, I asked, "You know, why did you pick me?" And ultimately, they said, "It's because the emergency management community is one of the weather service's deep core partners, and if we can't effectively deliver products and services to our partners, we're not doing our job." And they needed someone with that perspective in this program.

And so, I ended up spending the next seven weeks working on an app - well, a proof of concept for an app that would inform emergency responders of flooding in their area and helping to translate hydrologic forecasts, somewhat complex hydro-forecast to actionable messages for emergency managers. And, I think it was really well received. I remember being invited back to present my research at this NOAA Science Advisory Board and the NOAA administrator was there at the time, Dr. Catherine Sullivan, and I was a big fan girl. You know, I didn't know if my presentation would even phase her since, you know, she was the first American woman to walk in space. So I was like, you know, here's what I've got. But, it went over really well and she emphasized that the job doesn't end with the forecast. You have to communicate it effectively to decision makers for it to have any value.

Mark Peterson - Host:

You know Whitney, just on that value piece there, the role that you have at the National Water Center. On the podcast here, we've interviewed some of our liaisons to the hurricane center. So, is the role at the National Water Center similar in terms of that outreach to local emergency managers?

Whitney Flynn:

Somewhat, yes. So, continuing to build out that contact list for state and local emergency managers. Right now it's more at the state level, because as of just last year or, last summer, actually, the water center just rolled out their experimental suite of public products that are now out there in the world. And so, prior to last July, a lot of the products were prototyped and so they were internal, sort of, being built within the weather service. And so, we only had a little bit of leeway to provide access to federal partners. And so, now that we have products to share to the world, we're trying to expand that to state and local partners. And a lot of that is being started out by, you know, do they have a hand in any kind of like hydrology programs? One that comes to mind is North Carolina's NC Fiman program, their flood inundation mapping and alert network. That's something that we've been coordinating with them on but continuing to grow in that field, for sure.

Troy Christensen:

And Whitney, give us a little bit of an idea of what your job looks like on a day-to-day basis. It sounds super interesting, but you know, when you come to work in the morning, you know, on a regular day that there are not a lot of, I guess, not a lot of meaningful weather events happening across the country, what does it look like and how does that change when you're expecting, you know, some type of heavy rain or flooding event to develop?

Whitney Flynn:

Yeah, I'm part of that cadre of FEMA liaisons to the weather service. There's four of us, like you mentioned. There's two FEMA LNOs to the Hurricane Center, one to the Storm Prediction Center, and then myself at the water center, here in Tuscaloosa, and we're all organized under the FEMA National Watch under the Office of Response and Recovery within FEMA headquarters. And, my role focuses on developing and fostering a collaboration between FEMA, National Water Center and the broader emergency management and hydro-communities for effective water resource support across all directors. And many think this is just about flooding, but it's all dimensions of water, be it too much, too little, everything in between. On a day-to-day basis, I'm usually developing and conducting training on water center products and services, or just general hydro-elements, you know, like what types of flooding are we dealing with, what types of flooding are we gonna continue to be concerned with in the next year, 30 years.

And then, you know, working to enhance a communication of information between the water center and FEMA for decision making, while also taking in any feedback on experimental products that would help make the product or service more actionable or usable to FEMA. And then taking that feedback, back to the water center. So, with the water center being so new, a lot of my job right now just revolves around familiarizing FEMA with, you know, what is the water center? What is a water center? What kinds of products are they developing, and how can they help inform, you know, their reporting, especially ahead of major flooding incidents. So, each day I'll send out, you know, routine hydro-products from the water center, depending on what that region's reporting thresholds are, you know, what they care about. So, I'll only send out information that they might care about or need to know that's pertinent to their region.

And each morning I'll coordinate with the NOAA LNO to FEMA and the National Watch Center to provide those updates. Now during major flooding incidents, you know, reporting occurrences definitely ramp up. So, I'll usually send more frequent updates to the regions in HQ National Watch while also providing updates on the daily operations briefing for higher end excessive rainfall or flash flooding incidents. Usually if we're looking at a big event like what we saw in eastern Kentucky this past July, or during Hurricane Ian, right, I'll coordinate with the impacted regions and pass along any request for information or data. And usually, this is flood inundation mapping. So, I'll work with the water center to try and define those requests and get the best available information data delivered as efficiently as possible.

Troy Christensen:

I think that's so interesting, Whitney, that it's not only, you know, obviously too much water, but also the lack of water. So, you probably, you know, do a lot with droughts and other types of situations where, you know, rivers are low and other things like that. Is that right?

Whitney Flynn:

Absolutely. So right now, the current suite of products are focused more on the high flow side of things, but in the coming years, the water center is continuing to develop a whole suite of low flow products and services including, you know, soil moisture, low flow anomaly, the whole gambit of things. So, that's definitely on the horizon, for sure.

Mark Peterson - Host:

I'm just curious, going back, you know, I know that we have put liaisons into these specialized weather centers and it's been a huge success, but sort of going back to how you indicated that Congress, kind of, instructed NOAA to set up this center. Was there, I mean, there has been so many historic events, right, that I think we can all look back on the Midwest floods in 93, 97. Was there a particular event that really, you know, drove interest in setting up a center like this? And then also, was the national watch aware of a need to put a FEMA liaison in there?

Whitney Flynn:

I can't think of any, I don't think there was so much a specific event that precipitated the position as much as the growing occurrence of extreme precipitation and flooding events, like what you had mentioned. Like, we're seeing a growing demand for water resource information, like low flow is continuing and drought is continuing to get worse and worse in the west. We're seeing more and more extreme precipitation events. I can count six or seven, you know, extreme precipitation thousand-year rainfall events just in the past six months, you see, like, you know, Death Valley, St. Louis, Jackson, Eastern Kentucky- those were just all in the past six months, this year, all thousand-year rainfall events. And they're just gonna continue to grow. And I think it goes back to a need for more, you know, a new generation of water resource information stream flow information beyond just our, you know, our day-to-day stream flow forecast. You know, what does that mean? What does 14,000 CFS mean for the North Fork Kentucky River at Whitesburg?

Mark Peterson - Host:

What does it mean?

Whitney Flynn:

Yeah, what does that look like? And with the Water Center sort of hitting this milestone of being able to provide these real time hydro-forecast at a national scale, we've gotta get this information out there, you know, and I think that's what led to the development of this position. You've got this brand new center, you know, that's essentially this nexus for water resources information for the country. They've got a new generation of products that will - are, changing the game of hydro-forecasting and observation, and they really are helping make this nation a water ready nation.

Mark Peterson - Host:

It seems, at least from a layman like myself, some of that information sounds a little overwhelming. And I'm just thinking about some of the emergency managers out there who are trying to prepare their, you know, elected officials for communicating with the public or just like, providing safety messaging to their community. Maybe, tell me about some of the tools that you're producing and then how do you make it actionable for them and people like myself.

Whitney Flynn:

Yeah, so, one of the biggest products that has changed the game of water predictive capabilities is the national water model. And, if you think about how traditional river observations and forecasting has been done over the past several years, it's through stream gauges, right, through the USGS and larger water resource communities. They've developed this huge network of over 9,000 stream gauges with observations and over 3,600 locations with forecasts all over the country that are leveraged by the river forecast centers. And that's great, but these will always be discreet locations, only providing information at about a mile or two up and downstream of that one point. So beyond that, we're not, we don't have any information at the smaller streams and tributaries, we don't have any information. So, that's where the water model comes in. So, the first version was released back into operations back in August of 2016. This provided an enhanced hydro-fabric with stream flow observations and forecast for nearly 3.4 million stream flow waterway miles, all across the country, which is mind blowing to think about. And then, you know, you say that 3.4 million waterway miles, that's great, you know, and that helps complete that hydro-picture, but how do you make all of that data actionable? Because if you think about all the different configurations of the water model running through all of those different, you know, waterway miles, that ends up being like billions of data points every day. So, yeah. How do you derive actionable intelligence out of that without, you know, drowning in the deluge? It's sort of been the question for the past several years, and I think that goes back to the series of data services that the water center has been working on the past several years to boil down those data points into just the information that they care about.

And so, and that's been defined by core partners from the emergency management water resource communities, like what are those thresholds? Is bankfull your threshold? Is, you know, major river flooding your threshold? And then, how can we take the major river flood threshold and translate that to the 3.4 million waterway miles, right? Because, we can't define flood stage at the other areas that don't have, you know, a gauge. So, we kind of have to use what's called recurrence intervals or annual exceedance probability. So, using a little bit of math there, but trying to make it as actionable as possible to where, once it hits a certain thresh point, once that stream flow hits a certain threshold, then it alerts that user saying, "Hey, you know, over the next 10 days we can expect a peak stream flow that could meet or exceed, you know, this annual exceedance probability that could amount to moderate river flooding or major river flooding." And based on, you know, where your plans stand, you may wanna take some mitigative, you know, mitigation action or whatever it is across, you know, more vulnerable areas, be it sandbagging or whatever it is. But this just gives us a more complete picture beyond just the gauges that we've been relying on for the past several years.

Troy Christensen:

And just a few moments ago, Whitney, you mentioned also on the low water side that you may have some different products that are gonna be coming out in the future as well. What new things are coming out from the National Water Center, you know, in 2023 and beyond?

Whitney Flynn:

Yeah, so with the water model - water model has been coming a really long way. Right now, we're sitting at version 2.2, so it's gone beyond just CONUS. It's now providing streamflow observations in forecast for Hawaii, Puerto Rico, US Virgin Islands, and even the Great Lake basins. Looking ahead to 2023. We'll also have the provision of first time total water level guidance for coastal areas of the continental United States. And that includes Puerto Rico, US Virgin Islands, and Hawaii. As of this current version, we're sitting at current - we're sitting at version 2.2 right now. The model focuses solely on inland flooding and inland processes. So, we're leaving out the nearly 40% of the population that lives on or near a coastline that, you know, deals with coastal or tidal processes. With version 3.0, which will be coming next year in 2023, this will simulate and forecast the additive impacts of things like storm search tides, freshwater flow, and providing guidance on compound flooding for coastal regions that are homes to millions of people and will hopefully complement existing regional systems. Also, upgrading operations to version 3.0 will help enable first time coverage of Alaska. You know, that's huge. Never had coverage up in Alaska before. Several aspects of the model will be optimized to take on this new region. There's a lot of differences when it comes to hydrology in Alaska. You know, you've gotten - you know, once we get into the core of winter in Alaska, all of their rivers freeze, and then they get into an area where all of those frozen rivers break up, and that becomes a hazard of itself. So, optimized to take on to that new region, coupling to a glacier model, and then the ability to ingest the Alaska Pacific River Forecast Center's glacial lake outburst flood forecast. And then looking even further ahead from that, the water model will undergo this big transition to their next generation water resources modeling framework. Or, just NextGen. The NextGen framework will provide a community-based hydrologic modeling infrastructure. This is sort of designed to just speed the operations to research pathway in water prediction. So, this is aimed for 2025. And then on top of all the water model production, there will also be, you know, suites of low flow and water resources products and services and development as well, because there will be more confidence in water model output.

Troy Christensen:

It's amazing to hear about all of the things that go into these models. When you were talking about Alaska, you know, a lot of people probably think it's all about the rainfall, but there are so many other variables when it comes to glaciers, when it comes to freezing and thawing here in the upper Midwest, Red River of the North is very, very - it is one of those situations where it's all about, not only how much snow, but also how quickly that snow melts and all of the other variables. So, it's great to see all of these different things coming together.

Whitney Flynn:

I can't think about the Red River of the north flooding without thinking about what you guys went through in March of 2019, the strength, the spring flooding of 2019, that was, I mean, of course, the historical spring flooding for several basins, but the Red River of the North basin really took a brunt of it, along with, you know, a lot of the Missouri and the upper Mississippi. It was, that was pretty bad. And a lot of it did come down to, you know, how much snow was left on the ground and how long it sat along the upper tier for so long, and then, you know, suddenly melted so much later than expected in the season.

Mark Peterson - Host:

Well, and fortunately, you know, I think that's been a persistent flooding for decades, obviously, well, longer than decades, and a lot of the communities have really taken some aggressive steps in mitigation, which certainly helps the impact. And I, you know, as I hear you talk about the products, a lot of what I think we're talking about, at least from my perspective, is about where water goes, but not necessarily what water affects, what tools are you, is the water center maybe looking at or, you know, I know there are some tools out there that FEMA has, like Hazus, where you can, kind of, look at, you know, where the hazard will affect infrastructure and things like that. Are you looking at inundation maps so that, you know, an emergency manager might be able to say, "Oh, well, I know what kind of infrastructure might be impacted by this, where this water is going?"

Whitney Flynn:

Yes. And that is sort of the water center's bread and butter right now. And that is sort of their, one of their, big agency priorities is the development of flood inundation mapping and not just that, real time, continental scale flood inundation mapping. So, of course, you know, I think they're understanding that one of the most critical and sought after pieces of information by the emergency management community and even water resource communities before, during, and after flooding incidents are flood maps that depict both the spatial extend and the depth of flood waters. And the water center wants to get there. Ever since the water model went operational back in 2016, the water center has been developing its flood inundation mapping capabilities. And the spatial and temporal resolution capabilities of the water model allow the weather service to provide freshwater flood inundation extent mapping capabilities at a neighborhood level in a consistent, timely, and equitable way.

And now, I said extent. I didn't say depth, not yet anyways, but it is in development. I think they're trying to get the extent right for the entire country and then go back and get the depth grids right. But, right now they're demonstrating prototype inundation extent for the entire continental United States, leveraging the official River Forecast Center forecast along the main stem reaches and the National Water Model nowcast and forecasts runs for parts of the United States. And this features full resolution, inundation extent, not just the main stems for the water model. And they're continuing to expand on this capability, but right now it's being run for the West Gulf, Northeast, Mid-Atlantic, and Southeast river forecast domain. So basically, the West Gulf area, and then all along the East coast, that's where they're demonstrating the water model for resolution, and they're gonna continue to expand on that. But you think about those 3.4 million waterway miles having to run inundation on that, it's a lot of bandwidth. So, trying to expand that to a continental scale they're hoping to get there by 2026. Huge feat, but they are starting with the first 10% of the United States publicly available flood inundation maps this coming year. And this would be inundation mapping as a service. So like, you know, a GIS service that a dynamic live layer that partners could plug into their maps, apps and dashboards that could house other layers, so maybe hazard layers of critical infrastructure or population information. So, we can intersect, you know, all that and get an idea of how many homes or businesses are potentially impacted, or how many people over the age of 65 are impacted. This is where collaboration with FEMA and other geospatial response offices, and even risk management offices, are so important from a response and recovery perspective FEMA regions GIS and HQ response geospatial offices, they typically will use the flood inundation layers combined with tools like the USA structures or social vulnerability index to derive potential exposure to the risk to flood hazards.

And from a mitigation perspective, using the flood inundation information can be used to help reduce flood risk by looking at simulated inundation through tools like Open Hazus. So, trying to find opportunities for collaboration to share that flood inundation mapping information - be it analysis of what's going on right now, looking ahead 18 hours or even all the way out to five, even 10 days to FEMA from a response perspective or a mitigation perspective. And just trying to find, you know, where we can intersect, where we can collaborate and they can plug it into the data sets and tools that they already have.

Troy Christensen:

And it sounds like it's all about making the data actionable for emergency managers, which is great. We are recording this podcast in the middle of the winter, which is not typically, at least for a large portion of the country what we think of as, you know, a prime flood season. Do you have any seasonal products that you can share with us or that local emergency manager would need to be aware of that you produce?

Whitney Flynn:

Yes, so, I'm always really excited to talk about the seasonal products from the water center and overall the Office of Water Prediction. Many folks may already be familiar with this product, the NOAA Spring Outlook. This is released around the third Thursday of March, each year. This provides an outlook for drought, temperature precipitation, and flood risk from April to June. And the water center leads the flooding portion of this outlook through its national hydrologic assessment, which is part of the overall outlook. Sometimes it's just called the spring flood outlook for bigger flood years, like in 2019. Many might be familiar with the spring flood outlook map. This is just a general overview. It shows you all the basins with an increased risk of seeing minor, moderate, or major river flooding at some point over the next three months.

But the national hydrologic assessment - the text, this offers a really solid in-depth analysis of flood risk and water supply, even for Alaska for spring based on a number of factors from snowpack to stream flow, ice breakup and is tightly collaborated with all the NOAA's network of forecast offices. So, it's a really solid product that comes out annually. I think the water center wants to get down to more frequent than that. So, of course they'll still have a spring outlook and it'll be, it'll have the most detail to it. But I think they wanna do, you know, a winter outlook. They wanna do, sort of a, some more frequent outlooks every few months, rather than just having one seasonal outlook and that's it. That's all you get - maybe doing a winter one, like some portions of NOAA does.

Mark Peterson - Host:

Whitney, when I had previously spoken with the liaisons at the hurricane center, I was just really struck by the customer service - the amount of information that is flowing out to people that really need to know it so they can inform the public, but also being able to ask questions of the liaisons. Now you are in a unique position where there's just one of you with the center and there are a lot of flooding events going on around the country. Obviously, it's the number one natural hazard in the United States. So, what are the touchpoints for emergency managers to connect with you, connect with the water center, and connect with the products that are being, being pushed out?

Whitney Flynn:

So, of course, I'm continuing to build that contact list. So, right now, just trying to reach out to anybody that I can and trying to provide any kind of training that I can, familiarization to the regions, and then have the regions connect me with their states, and then the states connect me with, you know, the locals - at least the ones that may need, you know, any additional, you know, supplemental information with hydrology information or just need like an extra tool or two in their hydro-toolbox to reach out to me. And because, now that the water center has those experimental products and services that are out, you know, on their website that they can access, I think it's just a matter of showing them - here's where they are, here's where you can access them and interact with them and here I am, if you have any questions or just need me to walk through or do a quick demo or deep dive or whatever they need. I think it's just, yeah, about, you know, making contact right now and initial familiarization. But yeah, always around, always happy to answer any questions. But yeah, I think right now it's still about familiarizing, familiarizing everyone about, you know, who is a water center, what is a water center, what are they up to, and what's coming next?

Troy Christensen:

That's fantastic. Whitney, is there anything you'd like to add?

Whitney Flynn:

You know, I always like to end every message like this with a very necessary public safety message on flooding. You know, each year more deaths occur due to flooding than any other thunderstorm related hazard. The CDC, you know, reports that over half of all flood related drownings occur when a vehicle is driven into hazardous floodwaters. A lot of people think they know that, but then, you know, they, they drive into it anyways. The next highest percentage of flood related desk is walking into or near floodwaters. You know, people underestimate the force and the power of water. Many of these deaths occur in cars swept downstream, and many of these drownings are completely preventable. You know, a mere six inches of fast-moving water can knock over adult and it takes just 12 inches of rushing water to carry away most cars. And just two feet of rushing water to carry away an SUV. Never safe to drive or walk near floodwaters. And utilizing the experimental flood inundation or other guidance, in collaboration with the NOAA Field offices and other federal water agencies, you know, the water center continues to better address and grow their water resource information by collaboratively advancing and providing that water prediction service, which will hopefully support that provision of enhanced IDSS, or impact based decision support services necessary, to build that weather and water ready nation. And as the old saying goes, just turn around, don't drown. That's all I got.

Mark Peterson - Host:

Thanks for listening to this episode of "Before, during, and after: a podcast from FEMA." If you'd like to learn more about this episode or other topics, or have ideas for future episodes, visit us at fema.gov/podcast.