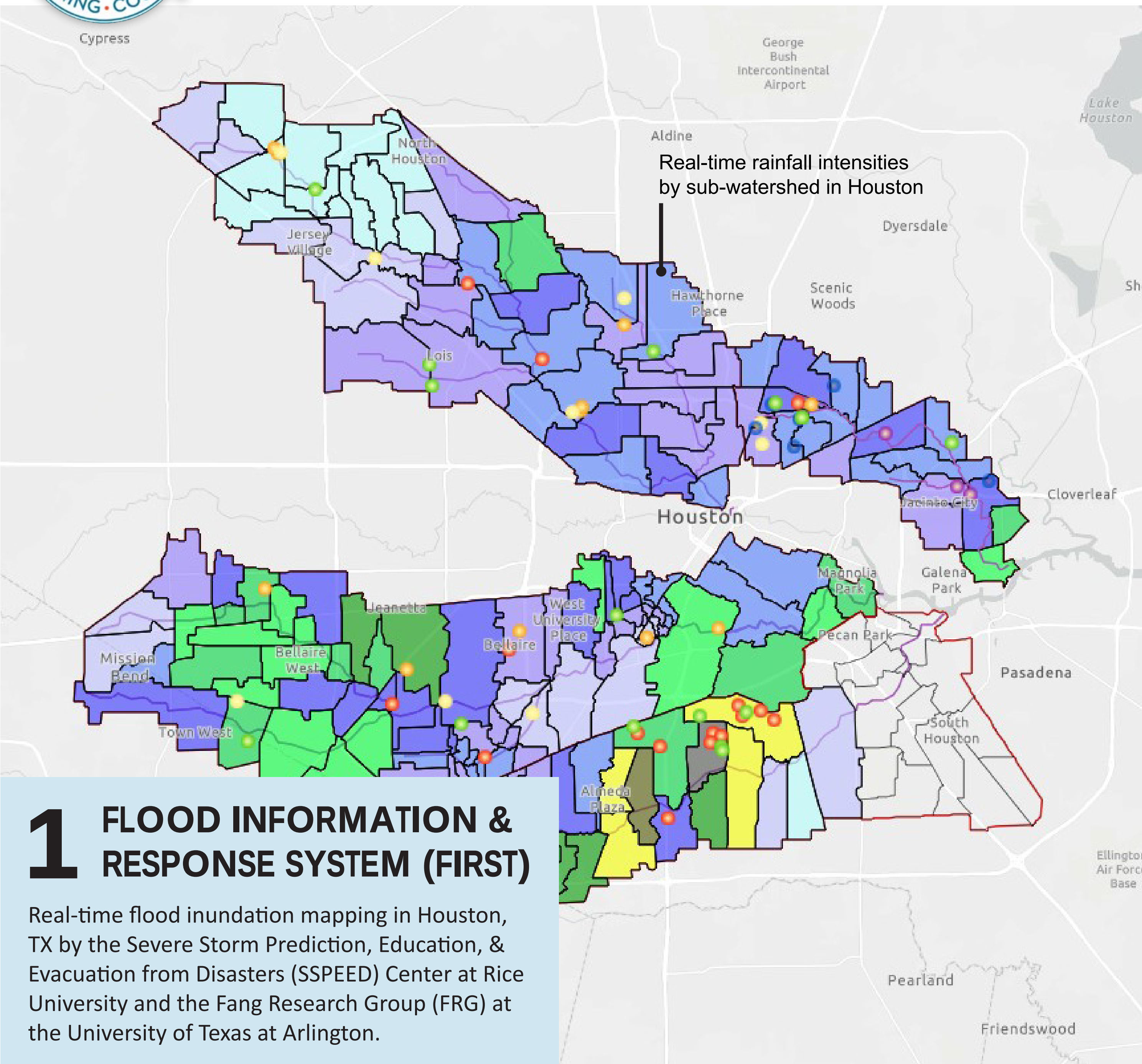
NHWC Transmission

Fall 2021



1 FLOOD INFORMATION & RESPONSE SYSTEM (FIRST)

Real-time flood inundation mapping in Houston, TX by the Severe Storm Prediction, Education, & Evacuation from Disasters (SSPEED) Center at Rice University and the Fang Research Group (FRG) at the University of Texas at Arlington.

9 INTERVIEW: QUEENSLAND RECONSTRUCTION AUTHORITY

NHWC reaches far and wide to learn about Australian state-wide efforts to implement best-practice flood warning systems in Queensland.

17 NEWS, WEATHER AND EVENTS

The NHWC Training and Professional Development Committee webinar series wraps up 2021 and the Texas Workshop date is set. Historic tornado outbreak occurs across six states with paths up to 160+ miles.

FIRST: REAL-TIME FLOOD INUNDATION MAPPING

by True Furrh[1], Mia Peeples[2], Dongfeng Li[3], Zheng Nick Z. Fang[4], and Philip Bedient[5]

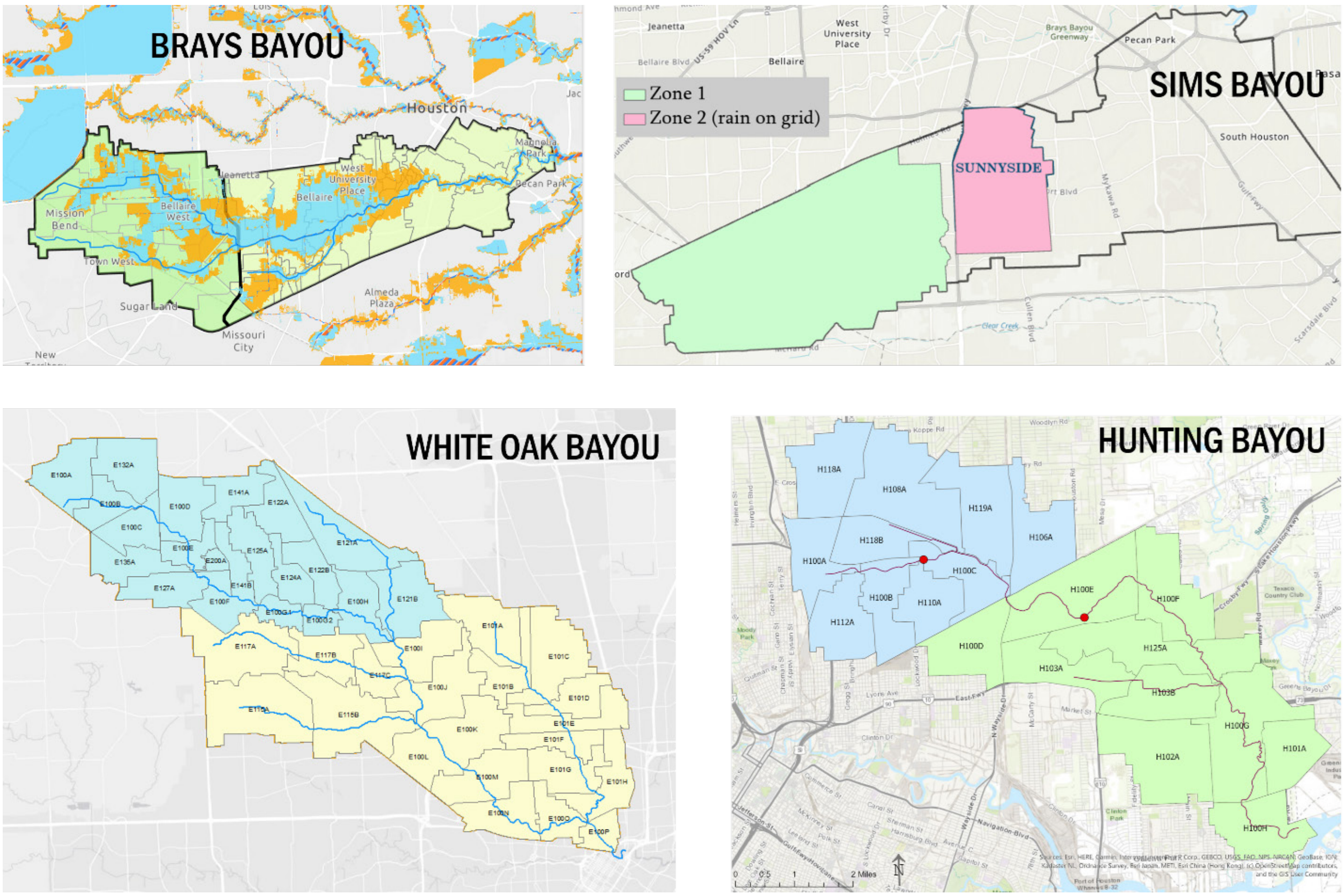


Figure 1 - FIRST watersheds. Note that Sims Bayou includes a 2-Dimensional, rain-on-grid model for a neighborhood identified as an area of interest by the COH.

A joint research team from the Severe Storm Prediction, Education, & Evacuation from Disasters (SSPEED) Center at Rice University and the Fang Research Group (FRG) at the University of Texas at Arlington developed the Flood Information & Response System (FIRST) for the City of Houston (COH). The research team's goal was to develop and implement an end-to-end radar-based flood assessment and mapping tool for critical infrastructure within the COH. The FIRST currently covers four major watersheds in COH: Brays Bayou, Hunting Bayou, Sims Bayou Sunnyside, and White Oak Bayou, all displayed in **Figure 1**. The FIRST is currently hosted at Amazon Web Services (https://firstcoh.org/) and uses ArcMap Online to display the floodplain inundation maps, provide real-time rainfall visualization, and monitor flood risks and warnings. Additionally, the team identified critical facilities (e.g., hospitals, fire stations, wastewater treatment plants, etc.) using the Homeland Infrastructure Foundation Level Data Geographic Information System (GIS) portal, displaying them alongside inundation and rainfall data on the FIRST dashboard.

While flash flooding is not new to Houston, rapid urbanization of the region has exacerbated the local flood vulnerability (Gori et al. 2019; Sebastian et al. 2019), especially in recent years (e.g., 2010, 2015, 2016, 2017, and 2019). The devastating flooding caused by Tropical Storm Harvey (2017) raised concerns from both the City and public. While improvements to existing, structural measures are necessary to mitigate future flood risks, non-structural solutions such as real-time flood information and mapping systems are helpful to provide timely data for facility operators, emergency personnel, and the general public during severe storms. The FIRST helps fill this gap, with a state-of-the-art dashboard that can (a) display rainfall intensity for all the sub-catchments of the four watersheds in real time, and (b) display the flood inundation maps over the watersheds based on NEXRAD radar rainfall data provided by Vieux & Associates, Inc. (VAI).

Hydrologic & Hydraulic Analyses: Brays Bayou

To determine the floodplain associated with different rainfall scenarios, hydrologic and hydraulic analyses were conducted using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's (HEC) suite of computer modeling software. The Hydrologic Modeling System (HEC-HMS) was used for rainfall-to-runoff conversion while the River Analysis System (HEC-RAS) was used for hydraulic inundation and floodplain mapping. Both models are commonly used for hydrologic and hydraulic analyses (Bedient, Huber, and Vieux 2019).

In 2007, Harris County adopted the HEC-HMS and HEC-RAS models, developed for the entirety of Harris County as a part of the Tropical Storm Allison Recovery Project (TSARP) in the early 2000s. The county makes these models publicly available in the Harris County Flood Control District (HCFCD) Model and Map Management (M3) library and the SSPEED Center used them in the FIRST project.

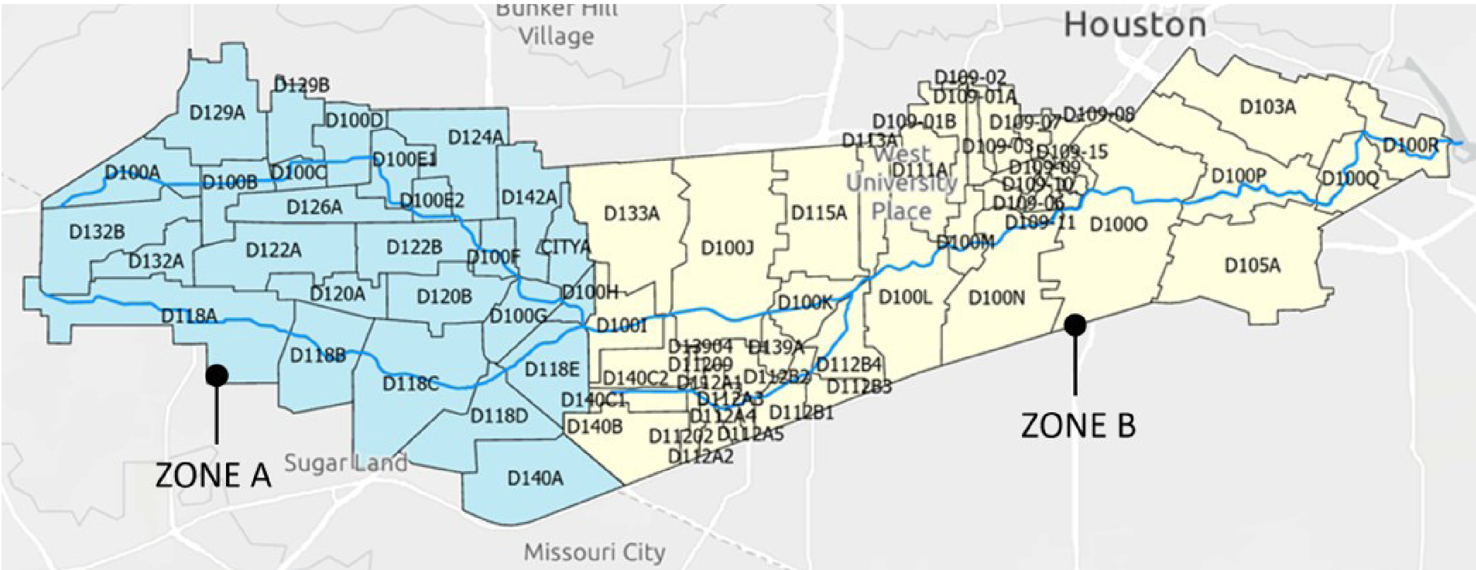


Figure 2 - Zones A (upstream) and B (downstream) in Brays Bayou.

Brays Bayou is presented as an example to detail the modeling process and as it is representative of all four bayous modeled in the FIRST project. Brays Bayou is a major tributary to Buffalo Bayou, running from the southwest side of the City to the east. Its watershed is long and narrow, and heavily developed, covering about 130 square miles. Meyerland, in central Brays Bayou watershed, is one of the most flood-prone neighborhoods in Houston (Juan, Gori, and Sebastian 2020) and was a neighborhood of interest for the COH.

Project Brays, a 480-million-dollar regional flood mitigation project in the Brays Bayou watershed began in 2006 (www.projectbrays.org). As part of Project Brays, the bayou channel in the downstream section was widened, and bridges were expanded to improve channel conveyance during a flood event. So that the FIRST models accurately reflect the current state of the bayou and can more accurately predict flood levels now and in the future, the team incorporated these changes into the HEC-RAS model of Brays Bayou.

To validate the accuracy of these models, the research team compared flow and water elevation outputs to values from historic storms (Tropical Storm Harvey, 2017; Tropical Storm Imelda, 2019; and Tropical Storm Beta, 2020). Rainfall data were loaded into the HEC-HMS model and the resultant flow hydrographs were compared to observed U.S. Geological Survey (USGS) stream gage data. The team then loaded the peak flows from HEC-HMS into HEC-RAS, comparing the simulated water surface elevation profiles to observed water surface elevation data from HCFCD stream gages. The average difference was around 1 foot, which may, in part, be due to the inclusion of Project Brays features in the model. Omitting one erroneous gage (HCFCD Gage 465 @ Beltway 8) due to the construction of local detention basins after the HEC-HMS models were created, the average difference between actual and modelled depth was 0.21 feet, a reasonable level of error.

Floodplain Map Library (FPML)

The team divided each watershed in the project into upstream and downstream areas to better represent spatially varied rainfall during the application of the FPML. Approximately 50 maps were created for each watershed to represent combinations of rainfall ranging from 5 to 17 inches in 2-inch increments spread over the upper and lower portions. These amounts were carefully selected to reflect the range of large events for Houston, covering flooding scenarios between the 10 and 100-year frequencies.

Figure 2 shows the division of FPML zones for the Brays Bayou watershed. The upstream portion, Zone A, covers approximately 50 mi^2, and includes the contributing drainage areas from Upper Brays and Keegans Bayou. The downstream portion, Zone B, covers approximately 70 mi^2, and includes the drainage areas from Lower Brays and the University of Houston campus. The team entered each design

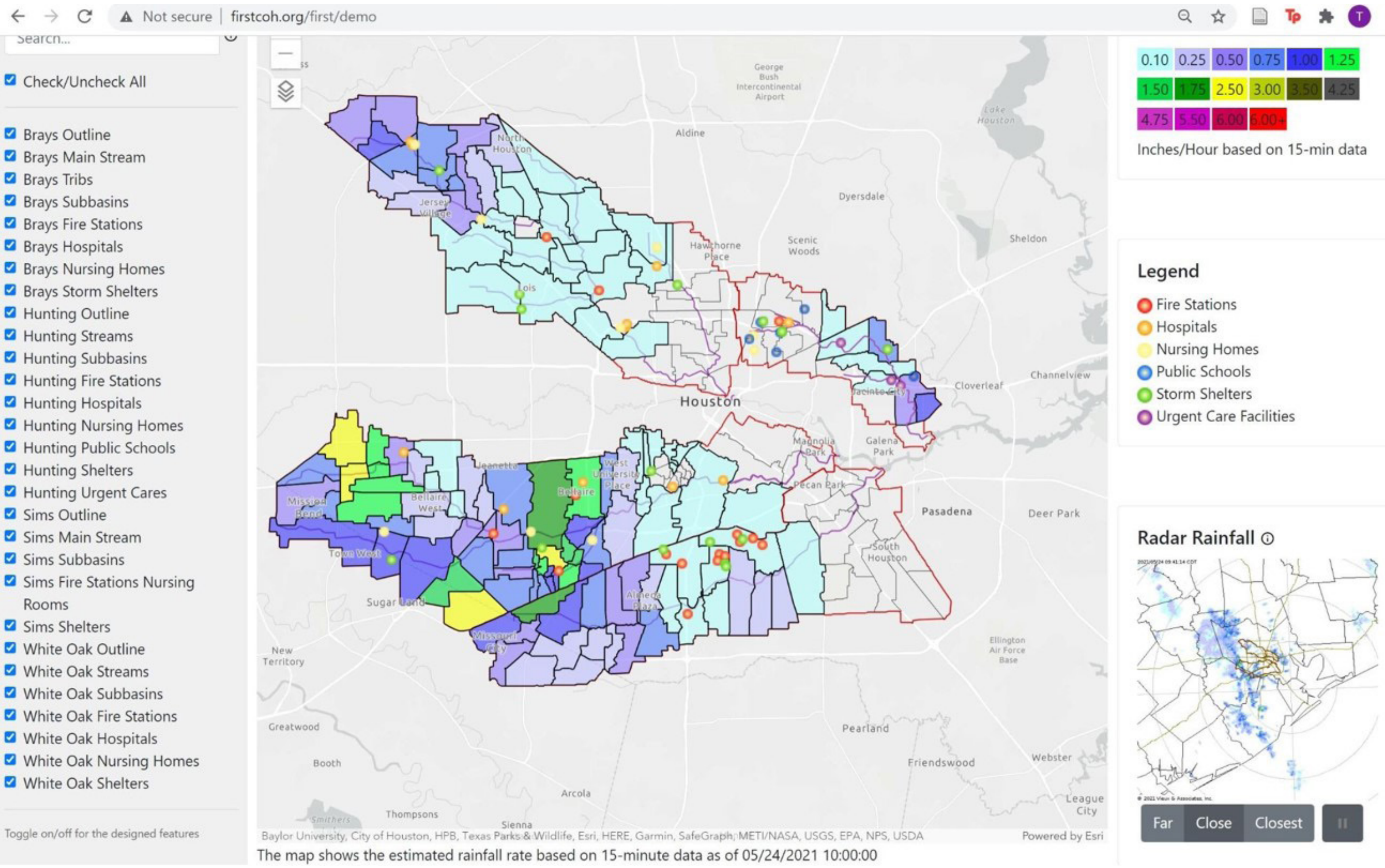


Figure 3 - The FIRST dashboard during a rainfall event on May 24, 2021. Note that critical facilities are marked in each watershed.

rainfall scenario into HEC-HMS using one design gage to represent Zone A, and one for Zone B, each having a hyetograph with a total cumulative rainfall equal to the chosen rainfall depth for that scenario. The team used the Soil Conservation Service (SCS), now National Resources Conservation Service (NRCS)), Type III distribution to create these synthetic hyetographs. The resulting hydrograph peaks for 50 combinations were then entered into HEC-RAS to create the floodplain map library for each watershed.

Real-Time Web-Based Flood Information System

The FIRST receives real-time radar rainfall data from VAI. VAI provides the near real-time (NRT) Gauge Adjusted Radar Rainfall (GARR) data for this project based on their radar rainfall processing system using the local NWS NEXRAD, KHGX, an S-band weather radars. The Houston area has used NEXRAD radar rainfall data since the late 1990s (Bedient et al. 2000). The Flood Alert System (FAS) developed by Dr. Phil Bedient and Rice University has used NEXRAD radar rainfall and GIS technology to predict flooding in the Texas Medical Center since 1998 (Bedient et al. 2003). FIRST radar rainfall data are provided by VAI directly to the COH for its use in real-time.

When rainfall occurs in one watershed, the FIRST algorithm determines corresponding colors for its subbasins according to a rainfall estimate every 15 minutes. The algorithm updates rainfall estimates when the FIRST server receives new data. Showing colored rainfall information in ArcMap Online helps emergency personnel better understand weather conditions during any events. The FIRST system (the website) uses the same algorithm to display rainfall intensity for each sub-catchment as the one used in Flood Alert System 5 for Brays Bayou. The rainfall information is updated every 15 minutes. **Figure 3** shows what the dashboard looks like during a rainfall event.

Map Selection Algorithm

To meet the demand for mapped inundation information by emergency personnel, Fang et al. (2008) originally introduced a hydraulic prediction tool — Floodplain Map Library (FPML) that provides visual images of flooding conditions as storms progress. The FPML system consists of the maps that were pre-delineated based on various rainfall totals incorporating frequencies, durations, and spatial variations. These maps allow emergency personnel to know at a glance where flooding will be most severe and which roads are most likely to be inundated. This prediction feature is useful to critical transportation infrastructure because it enables emergency personnel to understand inundation conditions and start appropriate evacuation strategies at many levels to deal with emerging issues. The FPML system has proven successful in upgrades to the FAS in the Texas Medical Center (Fang, Bedient, and Buzcu-Guven 2011).

FIRST includes a new FPML dataset for all four major watersheds. Corresponding flood inundation maps can be called out based on 15-minute rainfall estimates. The team scripted a robust selection algorithm in C#. Using Brays Bayou as an example, it works in the following logic:

1. The 15-minute radar rainfall information is consolidated into two mean areal precipitation (MAP) values in real time for the upstream and downstream sections of Brays Bayou (U for upstream and D for downstream);
2. The consolidated rainfall information MAP is accumulated into three past durations: 6, 12, and 24 hours;
3. The algorithm compares the cumulative MAP values for the upstream and downstream sections against three threshold values: 5, 7, 9, 11, 13, 15, and 18 inches;
4. Once any threshold value is reached for the upstream and downstream sections, an appropriate floodplain map is called up from the pre-delineated FPML and displayed on the ArcMap Online platform;

The algorithm dynamically links the most appropriate floodplain map to the rainfall patterns as a storm progresses based on actual rainfall measurements. The FPML system can zoom in on hotspots and major transportation routes with a history of flooding, and demonstrates flood risks at critical facilities, as the symbol color changes from blue to yellow to indicate potential flooding. FPML with a hydrologic prediction feature on the interactive website will provide end users with a comprehensive understanding of dynamic flood response, allowing emergency personnel to promptly determine likelihood of road inundations and begin flood preparations with as much leadtime as possible. **Figures 4** and **5** on the following page show inundation extents in Brays Bayou from 7-inch and 13-inch design storms with a 6-hour duration. **Figure 6** on page 7 displays the inundation extent for a 13-inch 24-hour design storm in Hunting Bayou, a low-income area of East Houston which is subject to repeated flooding similar to Brays Bayou. This system also provides inundation data at critical facilities to allow the COH to better understand and access important real-time flood data.

Conclusion

The SSPEED Center at Rice University and FRG at the University of Texas at Arlington developed FIRST. It allows for early warning of potential flooding through real-time visualizations of critical facilities and inundated areas during storm events. The system will assist the COH in addressing emergency operations, including emergency closures, evacuations, and rescue operations. It uses the results of calibrated hydrologic and hydraulic models, the local rain gage network, NEXRAD radar precipitation data in real time, and the existing flood warning framework developed for FAS at Texas Medical Center in 2002. The FIRST is unique in that it visualizes flood inundation maps and proximity to critical facilities within watersheds, including hospitals, storm shelters, fire stations, and nursing homes. The flood inundation in terms of water depth and water surface elevation can appear on the map along with the selected critical facilities. The successful implementation of this flood information system serves as a template for later expansion to other flood-prone locations in the COH. Next year, the system will be linked to road inundation models on a real-time basis.

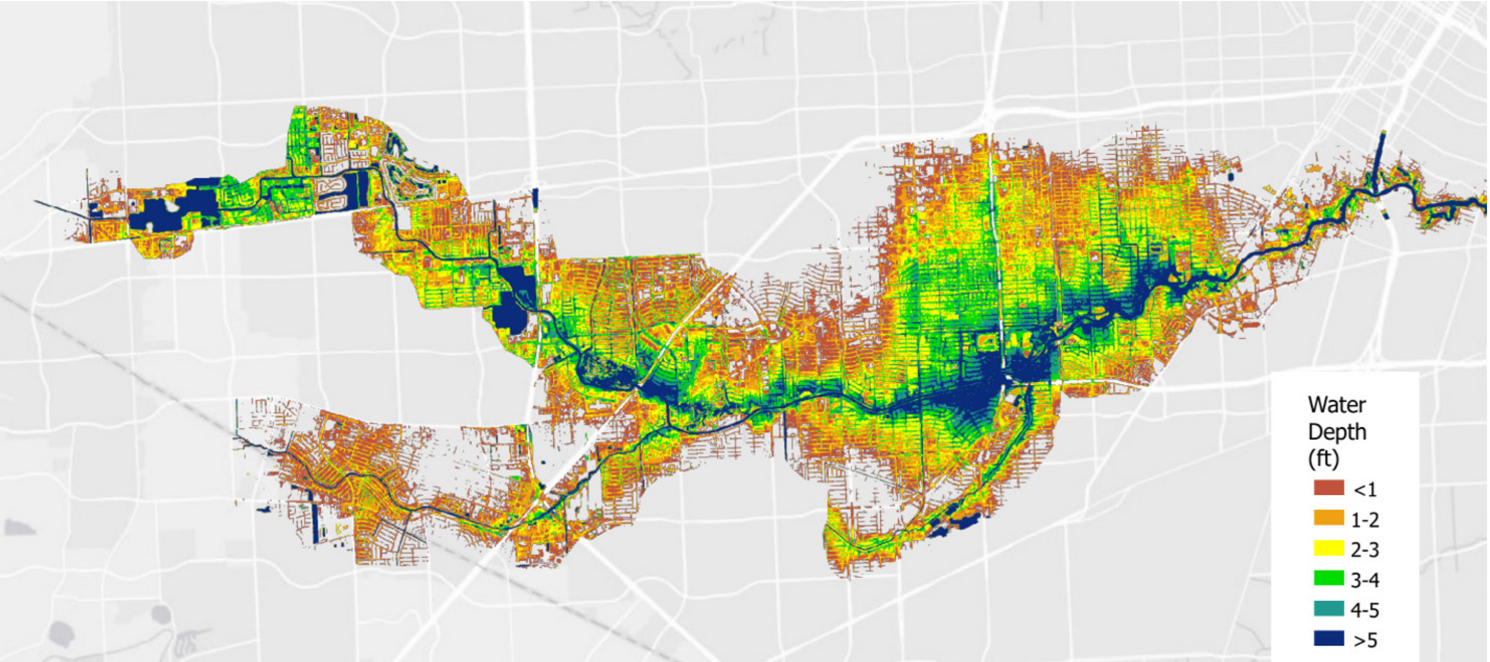


Figure 4 - Inundation extent from 7 inches of rainfall over 6 hours in Brays Bayou.

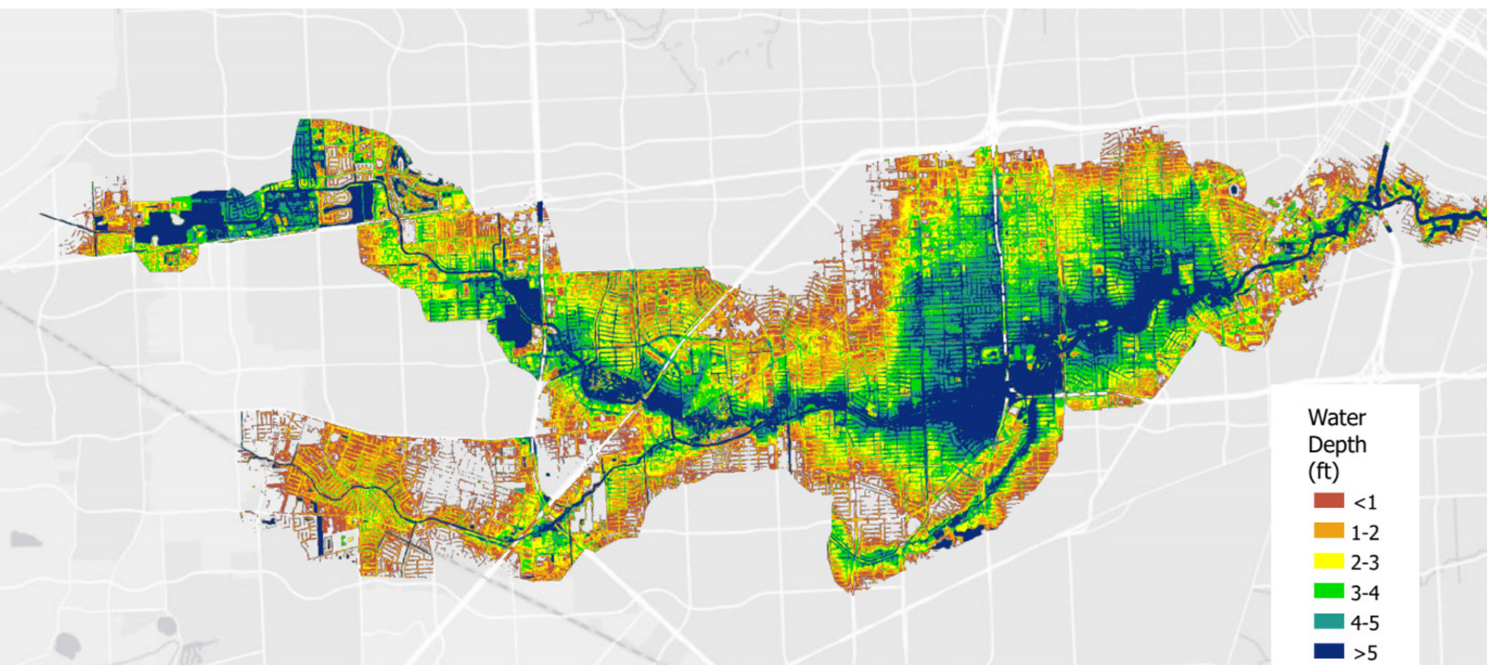


Figure 5 - Inundation extent from 13 inches of rainfall over 6 hours in Brays Bayou.

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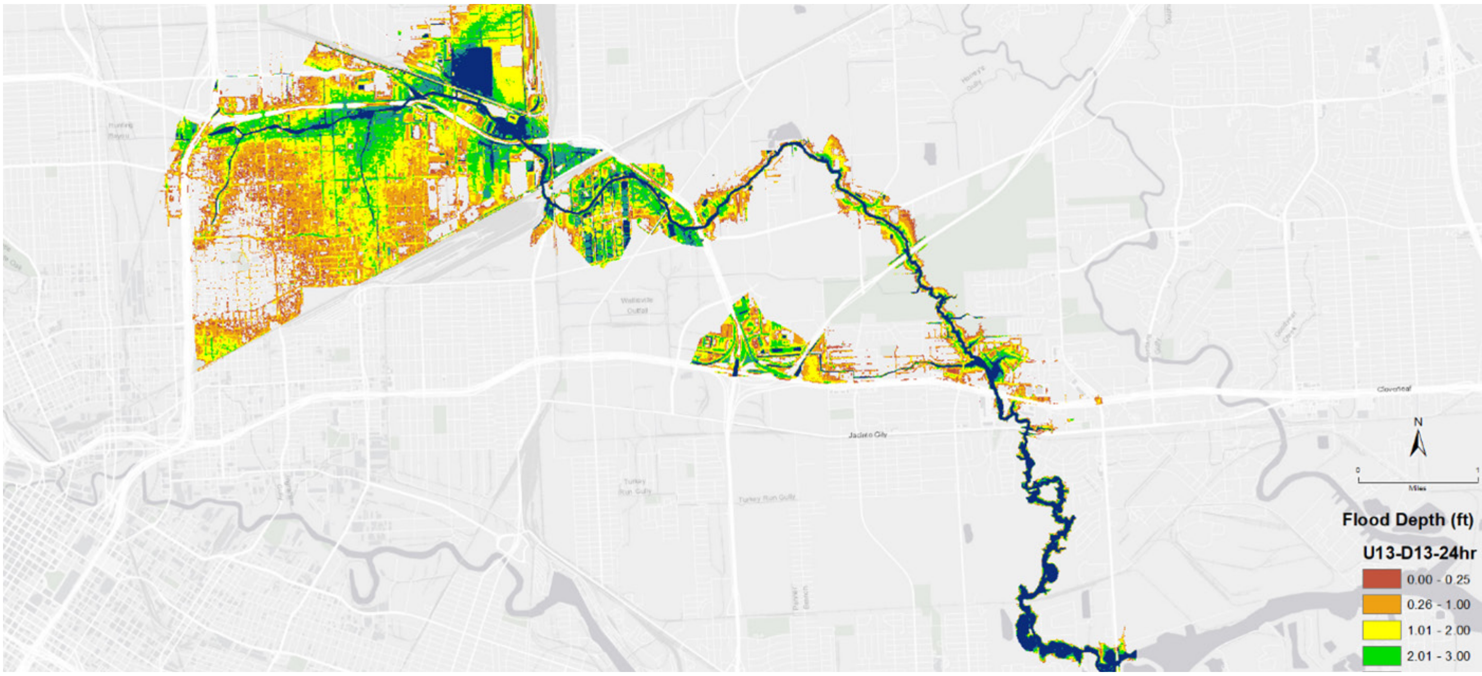

Figure 6 - Inundation extent from 13 inches of rainfall over 24 hours in Hunting Bayou.

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INTERVIEW: QUEENSLAND RECONSTRUCTION AUTHORITY

with Jimmy Scott and Greg Scroope / Queensland Reconstruction Authority

by Lee von Gynz-Guethle, P.E., CFM / NHWC Transmission Co-Editor / WEST Consultants

The following interview was conducted in June 2021 with the Queensland Reconstruction Authority (QRA), which oversees the implementation of flood warning system assets in the Australian state of Queensland. Queensland is roughly 715,300 square miles and has a population of 5.12 million. Compared to Texas, with a population of 29 million and area of 268,597 square miles, Queensland is sparsely populated. Residents are primarily based in urban coastal communities linked via the Bruce Highway, a 1,034 mi north-south highway from Brisbane to Cairns. Rural population centers, farms and mining facilities exist inland with limited transportation networks. These dynamics present challenges to implementing and maintaining flood warning systems that QRA is working to overcome.

Can you provide an overview of QRA and Queensland's flood warning system?

Queensland has four drainage basins and 64 catchments. The Australian Government's Bureau of Meteorology (BOM) receives data from over 3,200 rainfall and river height gauges. The BOM and local governments own approximately 1,200 gauges each, with other agencies such as dam owners and natural resources groups make up the balance (see **Figure 1** on the following page). In total, 60 asset owners contribute data to the BOM's flood warning service. 98 per cent of council gauges are automatic, while a significant proportion of the BOM gauges are manually read and reported by volunteers and ranch owners during events. We are finding that as family ranches are being slowly bought out by corporations, the gauges at these locations but are falling silent with no one to read them.

Jimmy Scott is the General Manager of Resilience and Recovery at the QRA. He oversees recovery of communities impacted by natural disasters and coordinates implementation of the Queensland Strategy for Disaster Resilience, which is focused on empowering communities to build their resilience to disasters. He leads a team working across all levels of government and state agencies to coordinate a collaborative approach to policy, information management, project delivery and stakeholder engagement.

Greg Scroope is the Technical Lead for the Flood Warning Infrastructure Program at the QRA. Greg has worked with QRA since 2013 and is well known across Queensland for his valuable work on flood warning infrastructure mapping and the development of the Queensland Strategic Flood Warning Infrastructure Plan. During his time at QRA, Greg has developed Flood Warning Gauge Network Investment Plans for 60 councils and coordinated the design and implementation of more than 180 flood warning assets.

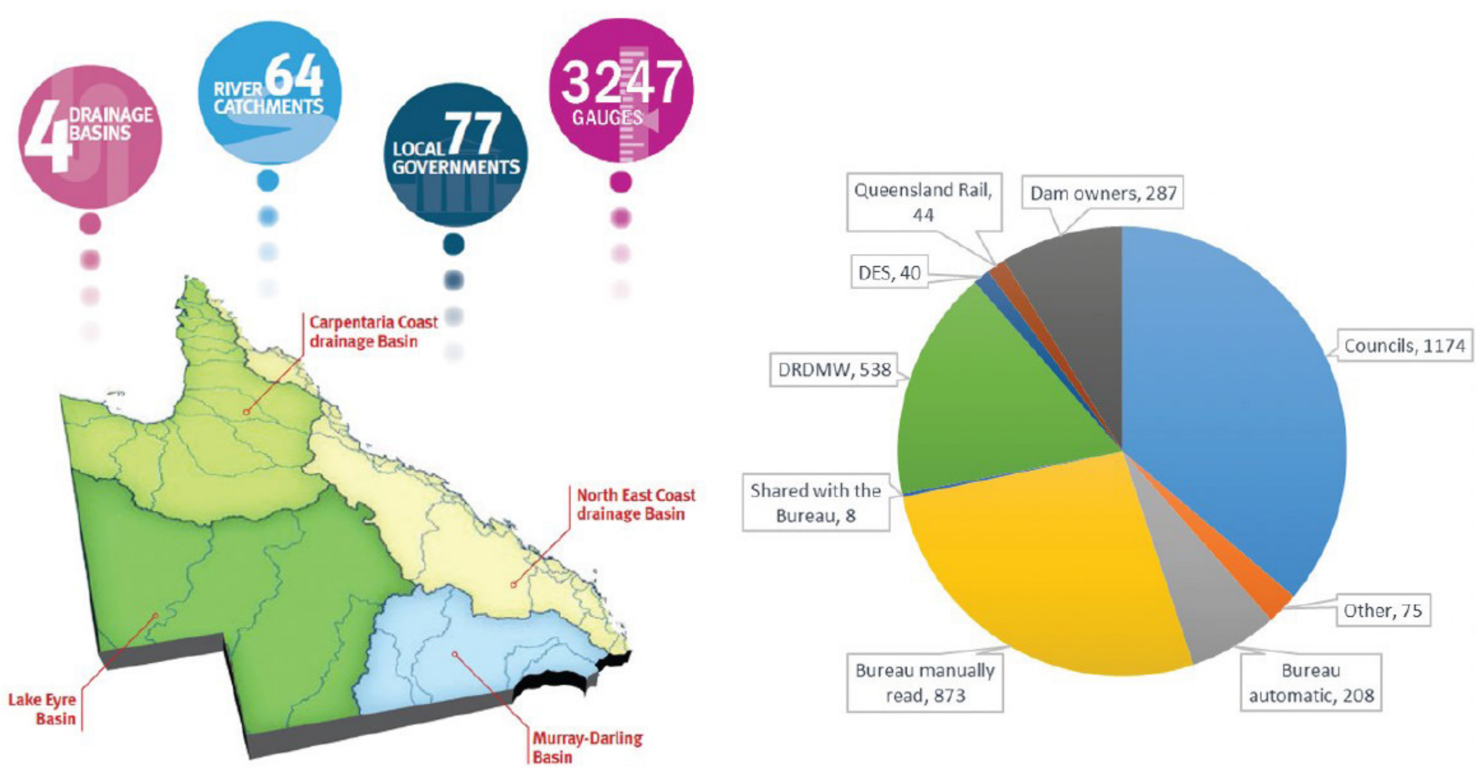


Figure 1 - Flood Warning Gauge Network in numbers (2020) (left); Gauge ownership (Queensland Service Level Specification - November 2020) (right) (Directly sourced from Queensland Strategic Flood Warning Infrastructure Plan, Draft, March 2021)

QRA has a legislative responsibility to coordinate development of a flood warning infrastructure network that complies with best practice (see **Figures 2** and **3** on the following page). We fulfill our responsibility by coordinating and working with local authorities to facilitate the development of this network. Ultimately, it is our aim to improve the situational awareness of responding agencies and the community.

A fully effective flood warning service is multi-faceted in nature and its development and operation involves input from several agencies each with specialized roles to play. It is vital that all agencies involved work in close cooperation.

The BOM has established governance to oversee the performance of the observation network. The Queensland Flood Warning Consultative Committee (QFWCC) is a state-level committee chaired by the BOM that QRA sits on. The QFWCC coordinates network development and ensures it meets BOM's requirements.

How did QRA get started down this path?

In 2015, QRA recognized that the flood warning gauge network did not always report in a timely manner to BOM. So, we engaged 62 councils, state agencies and other stakeholders to produce 44 Network Investment Plans (NIPs) to identify where there were gaps in the network and where there were opportunities to improve network efficiency. The recommendations from the NIPs were used by councils to support grant programs to secure funding for asset upgrades and new gauges in agreed locations.

After the 2019 monsoon flood event, $8 million was approved by the Australian and Queensland governments to upgrade and install flood warning infrastructure for 39 councils. Using the NIPs to inform investment, the $8 million is be used for installation of around 180 assets across 28 councils in northern half of the state. This will result in the implementation of the recommendations from the NIPs and the automation of the top half of the state.

At the commencement of the project, we met with all the impacted stakeholders, including councils, to get a better understanding of what happened in 2019 and what's missing from their NIPs. We workshopped 'big map' exercises where we produced 36ft by 36ft cloth maps and invited stakeholders to 'walk the map' and identify problem areas. With our boots off, we walked over the map and laid down sticky notes where the problems were. The big map scale meant that people could pick out their properties and then see the flood extents that we overlaid from satellite imagery. We got amazing feedback in these sessions, and then collaboratively modified the NIPs with the data collected. We sent them out to state and local governments, generational landowners, the BOM, and also had them independently peer reviewed.

"A fully effective flood warning service is multi-faceted in nature and its development and operation involves input from several agencies each with specialized roles to play. It is vital that all agencies involved work in close cooperation."

Jimmy Scott & Greg Scroope,
Queensland Reconstruction Authority

We also looked at how to go beyond best practice to further improve situational awareness. For example, we expanded the need for additional rainfall and river height gauges to also include cameras and electronic signage with sensors.

We knew we wouldn't have enough funding for the entirety of each NIP, so we prioritized assets as a basis for moving forward.

Queensland's Flood Warning Gauge Network:	
1.	supports the Bureau of Meteorology's Total Flood Warning System
2.	meets the national standard for flood warning infrastructure
3.	provides real-time situational awareness and suitable data for flood forecasting models and timely early warnings
4.	is reliable, accurate and fit for purpose
5.	is continuously improved through ongoing review, endorsed governance structures and investment in upgrades
6.	is managed collaboratively for shared benefits and cost effectiveness

Figure 2 - Key principles adopted by Queensland to deliver best practice flood warning infrastructure (Directly sourced from Queensland Strategic Flood Warning Infrastructure Plan, Draft, March 2021).

Pathways	Approaches	Key outcomes and links to principles
Enduring network governance	Established governance mechanisms and partnerships. Commit to collaboration for asset standards, operations, data sharing and flood risk management. Collect and share data, in suitable formats, for mutual benefit.	Linkages to components of the Total Flood Warning System are maintained (Principle 1). Data is suitable and visible to asset owners and stakeholders (Principle 3). Situational awareness is consistent, to enable decision making and response (Principle 3).
Asset planning, operations and maintenance	Catchment-based approach. Optimise asset types and locations, based on risk assessment, catchment knowledge and identified synergies. Align with other infrastructure upgrade programs for efficiency and cost gains. Coordinate maintenance for time and cost savings (where appropriate) with other asset owners in the catchment.	Assets and infrastructure comply with best practice standards (Principle 2). Network is fit for purpose (Principle 4). Integrated maintenance programs are cost effective and efficient for asset owners (Principle 6). Data capture and transmission is accurate, consistent and shared (Principle 3).
Proactive funding	Proactively plan for funding for network efficiency including assets, supporting infrastructure and activities, software etc. Collaborate on regional priorities for funding.	Funding opportunities are realised (Principle 5). Investment in upgrades is achieved (Principle 5).
Sustained action	Systems-based approach which complies with best practice guidelines. Clear program of action. Apply learnings from work to date. Enable proactive up-skilling and knowledge transfer.	Network is reliable and resilient (Principle 4). Continuity of service is delivered (Principle 4). Continuous improvement is achieved (Principle 5).

Figure 3 - Strategic pathways that underpin a best practice flood gauge network and enable the operationalisation of a collaborative and catchment scale approach to the flood warning network (Directly sourced from Queensland Strategic Flood Warning Infrastructure Plan, Draft, March 2021).

Through the NIPs, you seem to have created a process that ensures post-disaster and long-term funding are synchronized to increase long-term value.

We all face the challenge of these ad-hoc, post-disaster requests for infrastructure across resilience and preparedness activities. Following the 2019 flood, we were lucky to get the support of the federal and state governments to fund a package of flood warning upgrades. We were well prepared to point to the NIPs and it made it easy for the government to buy in. In some cases, updates were needed but it was all off the back of fresh information. The big maps are a great way of opening a discussion about how flood water moves through the landscape.

There is sometimes a disconnect between engineers and emergency managers. How do you bridge that potential disconnect during this collaborative process?

Sometimes certain professions can attract introverted personalities who are very good at what they do but not always predisposed to being effective collaborators and communicators. In our experience, we need a team that can bring people together. Their discipline doesn't always matter. By way of example, I have experience as a landscape architect, carpenter, plant operator, asset manager in councils, and I ran disaster management for 10 years in the country's largest city. We try to choose personalities that are there to collaborate and to coordinate and to see success in others. We tend to be behind the scenes, like a coach standing in the wings with the councils and other local stakeholders placed front and center on stage. We are lucky to be an organization that can influence outcomes and deliver funding and initiatives to benefit the people dealing with problems they could never be able to resolve or afford in their work.

We also invest heavily in face-to-face contact with our 77 councils. Because Queensland is such a large state, there is a view of being ruled by George Street policy, (where all the government offices are in Brisbane – Queensland's capital city). Regional communities tend to prefer where possible a local solution that reflects a statewide policy. The people we are working with have specific challenges, and you appreciate that by visiting the community and walking a mile in their shoes.

Ultimately their success is your success. Let those local community leaders be the champions.

Exactly. That's the approach we take. We try to lift the councils up. Everyone benefits. Success has many fathers.

You mentioned an aim of QRA is to improve situational awareness versus simply installing assets. How have communities improved situational awareness?

For example, the state's Department of Transport and Main Roads and councils will sometimes send officers up to 90 minutes to assess a river crossing just to report it back to their offices. We've also had situations where they become isolated because water has risen in a waterway, they have previously crossed. These automatic networks are all linked via satellite or cellular to provide instant situational awareness to avoid those situations.

We've ensured the standards and qualities of cameras meet Main Road's standards so they can be ingested into the websites for all responding agencies and communities at risk. We're trying to ensure that we don't have multiple service providers providing different levels of technology that isn't shareable that also costs each asset owner annual service fees to host the platform.

> ***"Assessment of long-term costs and councils' ability to afford that cost was part of the exercise. We asked councils to confirm they could support the NIP. "***
>
> ***Jimmy Scott & Greg Scroope, Queensland Reconstruction Authority***

How are you tackling long-term sustainability in communities with a limited funding base?

We've tried to ease the load on councils who in some cases live hand to mouth from a financial perspective. A lot of the councils are not well funded because their base population is small, and their area is large. For the 28 councils in the $8 million asset upgrade program, we created 'areas of operation' and led a bulk procurement process using funded project managers on behalf of the councils. So rather than 28 councils going to market, we consolidated. Councils own the assets, but we coordinated procurement and project management on their behalf. As a result, we saved up to 25 per cent of our costs and out of the $8 million, we propose to place more assets into the network.

What about operations and maintenance costs?

You've hit upon one of the big challenges. When we deal with 60+ owners, if you don't coordinate the maintenance, you're going to have 60 organizations going to market to establish maintenance contracts. With the hand to mouth existence of some of our councils, many of our councils are inherently unsustainable financially without external support. So, assessment of long-term costs and councils' ability to afford that cost was part of the exercise. We asked councils to confirm they could support the NIP. We can't forcibly give an asset to council that they don't want. So, there were instances where councils had to prioritize where the gauges were going in due to available funding for operations and maintenance.

Training is also a common challenge. NHWC is trying to provide basic training material and is considering developing a certification program. Have you considered this aspect?

We are trying to facilitate and fund a regional approach to training through regional organizations, which are either legal or informal collaborations of a group of councils. We try to include anyone with water monitoring assets. For example, in the Fitzroy catchment we have six councils, dam owners, and state agencies responsible for main roads, resources and mines. In the Fitzroy, there are also 57 operating commercial mines, which have a combined 440 water monitoring assets. So, the total assets in the Fitzroy are around 1,240. If we can establish partnerships with these groups, then we can move towards effective and integrated data sharing and asset management.

We are looking at developing an accredited course, probably led by the BOM in partnership with a professional organization. Then we may require that any tender related to management of these assets needs to be undertaken by an accredited contractor. We should have something up and running within the next three years.

In additional to the regional organizations mentioned, we've been working to stand up working groups at the catchment level that include the key gauge owners. These groups will be fit for purpose. We look at any existing governance structures. For example, in northwestern and central Queensland we'll probably approach existing roads groups because they have staff in the area, and we might be able to add gauge maintenance to their list of responsibilities. But that might not work in another region due to geography or organizational structures. We're planning for 10 or so working groups around the state. And of course, we're trying to figure out how we get them long-term funding to improve efficiencies and to work collaboratively.

We're also reassessing ownership structure. We're working with the BOM and the Local Government Association of Queensland to determine whether councils should individually own gauges, or would it be more effective for ownership to be consolidated by, for example, the BOM. To do that though, we need cost sharing arrangements and, as you can imagine, there's a lot of moving parts.

Presumably, ownership and maintenance could change over time? For example, if a council says they can handle it now but in two years they're not handling it, they could put their hand up and arrange with BOM to transfer the asset?

Absolutely. As a reminder, we engaged 62 councils as part of the NIPs. $8 million went to the north and northwest. The bottom half of Queensland still has needs identified in their NIPs. We just put in a funding request to the national government for those councils and we were not successful. So, it's an on-going process.

So, funding is an on-going challenge but one you all are ready to tackle.

Yes, it's a challenge for everyone in the industry. At some point though, we will have complete automation of the state. And the only other things that will go in will be cameras and signage and new technologies, such as drones. We will eventually get there.

For More Information Visit: www.qra.qld.gov.au/

QRA QUEENSLAND RECONSTRUCTION AUTHORITY

NEWS & EVENTS

2022 Texas Workshop

The Texas workshop is currently set for February 9-10, 2022 in San Marcos, Texas. Given that our annual conference was canceled this year, we hope to see a large turnout in Texas.

NHWC Transmission - Articles Needed!

We need members to contribute articles and spread the word to make the newsletter a success. The newsletter is a great way to offer value to existing members and to attract new members, but it won't work without consistent, informative content. Our goal is two articles and one interview per issue. Please help us get there!

Board Elected

The Board was elected at the annual meeting, held virtually this year. Lots of familiar faces plus a few new folks joined the Board. Thanks to all of the Board members for their efforts and a special thanks to the new members for getting involved.

Calendar

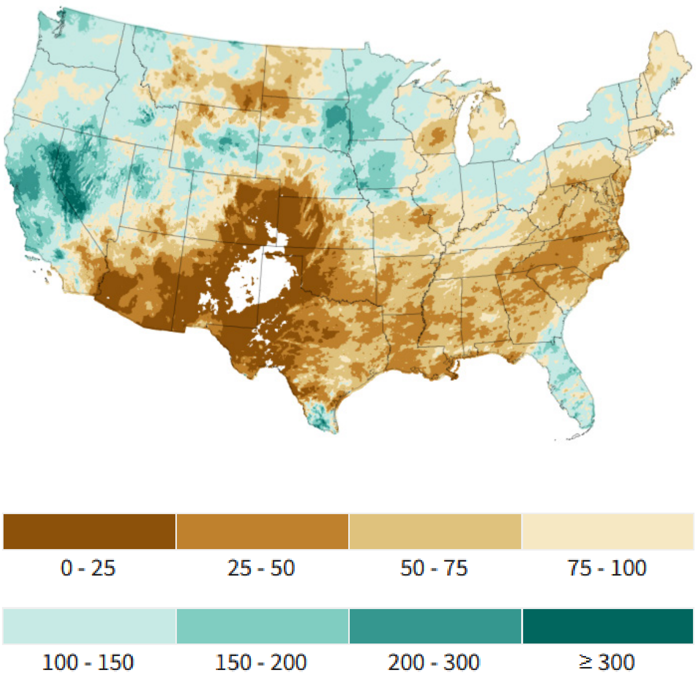
January 23-27, 2022	American Meteorological Society Annual Meeting
January 27-28, 2022	Rice University SSPEED Center Conference
February 9-10, 2022	Texas Workshop, San Marcos, Texas
March 8-11, 2022	Texas Floodplain Management Association Annual Meeting
May 3-6, 2022	ALERT Users Group Training Conference & Exposition

SUBSCRIBE

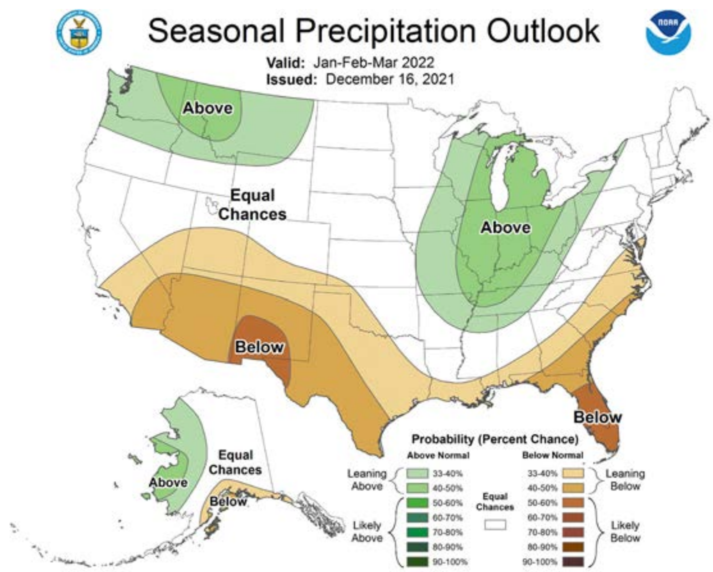
Subscribe to the Transmission today and consider recommending the Transmission to your colleagues. Non-members can access the latest issue and receive it in their inbox! Members receive access to all past issues.

HYDROLOGIC CONDITIONS

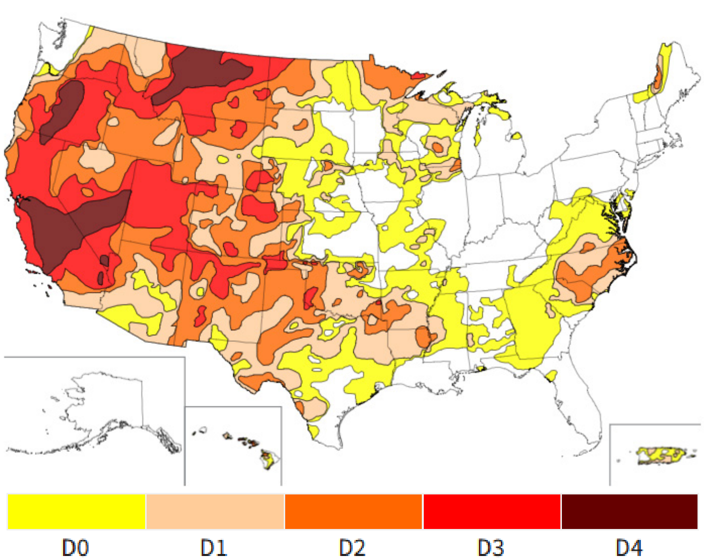
60-day % of Normal Precipitation
Last Updated 12/16/21



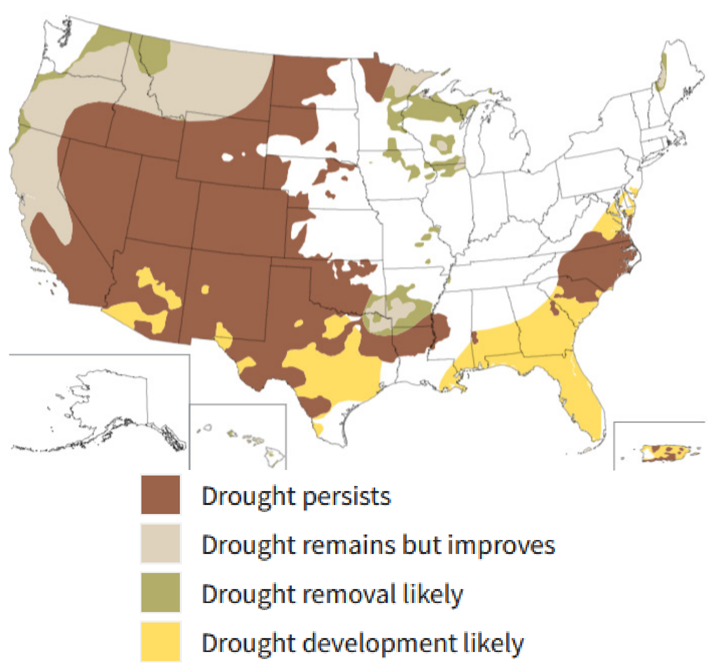
3-mo Precipitation Outlook
Last Updated 12/16/21



Current Drought Conditions
Last Updated 12/14/21



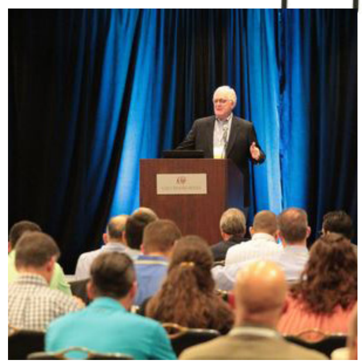
3-mo Drought Outlook
Last Updated 12/16/21



Sources: https://www.drought.gov/forecasts
https://www.drought.gov/current-conditions
https://www.cpc.ncep.noaa.gov/

TEXAS WORKSHOP

FEBRUARY 9-10, 2022 / EMBASSY SUITES / San Marcos, Texas



CONFERENCE TOPICS

- Field Maintenance and Procedures
- Lessons Learned from Flood Events
- ALERT, ALERT2, Radio & Satellite Telemetry
- Advances in Hydrologic Technology
- Modeling and Flood Forecasting
- Inundation Mapping
- Communication Before, During, and After Weather Events
- Dam Safety

Call for Abstracts

The National Hydrologic Warning Council invites engineers, meteorologists, and hydrologic staff to submit abstracts for presentation at our 2022 Texas workshop in San Marcos, TX. This workshop will feature a range of exciting talks, discussions, and networking opportunities with experts, vendors, and up-and-coming leaders to assist managers and operators of hydrologic warning systems. The workshop is not limited to Texas folks! Out-of-state members are encouraged to attend!

> *“I recognized a surge of energy ... in the jam-packed technical agenda, the networking, the conversations in the hallway, ... and the enthusiasm of attendees. Our conference ... provided all attendees ample opportunity to learn and grow as professionals.”*
>
> *Ben Pratt / NHWC Treasurer*
>
> *2019 National Conference Committee Member*

Conference Abstract Submission

Presentations are 30 minutes, including a Q&A period. All submissions are welcome!

More information here

TRAINING AND PROFESSIONAL DEVELOPMENT COMMITTEE

WEBINAR TOPICS

- Overview of Flood Warning Systems
- Basic Hydrology
- Collecting Rainfall
- Collecting Stage
- Other Data Collection
- Batteries and Solar Panels
- Transmitting Data
- Data Evaluation
- Upgrades & Installation
- Flood Modeling & Forecasting
- Communicating Data

The Training & Professional Development Committee is hosting a monthly webinar series to provide an overview of Flood Warning Systems and the topics that are fundamental to planning, operating, and maintaining those systems. The Committee is also planning for potential workshops, training courses, and a Flood Warning System certification program.

Interested in Volunteering?

We need volunteers! If you are interested in the topics mentioned above, regardless of your experience, contact Mark Moore, Training and Professional Development Committee Chair at: mark.moore@distinctiveafwsdesigns.com. Consider sending around a request for volunteers within your organization as well.

Flood Warning System Webinar Series

2021 was a huge success for our virtual webinar series! Attendance ranged from 50 to 100 viewers. **All webinars are FREE!** Past webinars are also available on our website here. Our goal is to offer a library of videos covering flood warning systems and make these available to the industry. Of course, we hope viewers will become members, volunteers, and conference attendees!

Interested in Speaking?

We are currently planning the 2022 webinar schedule, so contact the Committee Chair if you are interested in speaking at our webinar series.

More information on the webinar schedule and registration is here.

PARTING SHOT

OCTOBER 24, 2021 / **Folsom Dam, Folsom, CA / 38.69° , -121.13° / 350 MSL**

by David Curtis / Senior Vice President / WEST Consultants, Inc.

David Curtis of WEST Consultants, Inc. took this photo on Sunday evening, October 24, 2021 after Folsom, California's epic rainstorm (6.4 inches in 24 hours). This is the National Weather Service gauge at Folsom Dam - Folsom Point (Dyke 8).

Send us your best shot!
Editor@HydrologicWarning.com

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