

Hydrologic Warning Systems and the National Hydrologic Warning Council **Bradley Heilwagen** Secretary, Board of Directors National Hydrologic Warning Council



Hydrologic Warning

To warn of imminent danger to life, property, and the environment from hydrologic events through the use of real-time automated remote data collection networks, modeling and analysis, and integrated forecast and warning systems.

Purpose









Goal

- Rainfall or Stage Data
- Accurate Consistent
- Real-Time Basis
- Useful Form
- Decision Support



• Size Varies

Planning - Strategy

Observe

- Develop Vision
- Start Small, Expand Later
- Focus on Warning Process
- Public Education

Respond

Planning

- Existing Flood Hazards
- Community
 Capabilities
- The Human Element
- Emergency Action
 Planning
- Funding







Design



Operations

- Staffing
- Installation
- Maintenance
- Data Management
- Funding
- Communication



Benefits









Benefits – Colorado Floods

- 1976 Flood

 140 Deaths

 2013 Flood

 8 Deaths
- The Difference
 - Flood Control Structures
 - Public Education
 - 230 Rainfall or Water Level Gages



Benefits - CRS

Section 610 – Up to 395 points

2017 Manual	Max Points
FTR (Flood Threat Recognition)*	75
EWD (Early Warning Dissemination)*	75
FRO (Flood Response Operations)*	115
CFP (Critical Facilities Planning)*	75
SRC (StormReady Community)	25
TRC (TsunamiReady Community)	30
2017 Max	395



OMB No. 1660-0022 Expires: March 31, 2020

National Flood Insurance Program Community Rating System

Coordinator's Manual

FIA-15/2017



Hickenlooper declares Manitou Springs flooding 'a disaster'

-HYD

MING.COU

STAFF REPORT | Wed., August 14, 2013 @ 11:20 am

CLIMB *

SAFETY

IN CASE OF A

FLASH FLOOD

5767.0

Historical Flood Hi Water Mark

NAT

2

http://hydrologicwarning.org

G

19-foot flood depth Big Thompson River at Canyon Mouth

July 31, 1976

Vision

For all communities to effectively use hydrologic information and warnings to protect lives, property, and the environment

Mission

To provide education, training, and standards for the generation, delivery, and use of timely reliable hydrologic information

Collaboration & Education

Training & Professional Development

- Biennial Conferences
- Workshops and webinars





NHWC

Technical Areas

- Hydrology
- Data Collection
- Modeling & Analyses
- Standards and Guidance
- Hazard Communication & Public Awareness

Membership

- 88 Companies
- 53 Local/Regional
- 39 Federal Agencies
- 4 State Agencies
- 9 Individuals

NHVC Newsletter Editor: Brian Iserman, Tempe, AZ



The NHWC Transmission

October 2017

CONTENTS

Hurricane Harvey
City of Salem FWS
CoCoRaHS Update
US Hydrologic Conditions
Calendar of Events
November Focus
Parting Shot
Click on hyperlinks located
throughout this newsletter for
more information

NHWC 2017-19 Officers and Directo

Surve Filomenski Freesbant Harris County FCD Joshua MoSWain Vos Pressident Charlohe-Meddersourg Stormwater Services

Secretary Ame: Foster Wheelni

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Directors At-Large Jimmy Stewart SunWater Fritz Law OneRain Incorporated

Andrew Rooke AMR Consults LLC Kevin Stewart Urban Drainage and FCD



The Untold Story of Hydrologic Data Collection for the Harris County Flood Control District during Hurricane Harvey

Mark Moore, Hams Guory Flore Common th

The Harris County Flood Control District (HCFCD) fully converted to ALERT2 in December of 2015, and since then has presented several articles describing the success of the new technology and its implementation. Repeating the same statistics and figures would only provide so much value, so instead we would like to focus on sharing some lessons we have learned from Hurricane Harvey.

ALERT2

For the full story on the HCFCD conversion process to ALERT2, reference Harris County Fload Warning System 2016 Tax Day Fload Test – Passed!* The analysis from Harvey shows similar success for the 154 gages in the system. Over the five days around the event, the ALERT2 network collected 250,000 data points with over 99% of incoming data successfully received. The system sent out over 500 valid alarms indicating intense rainfall rates or flooding conditions.

System Hardware

Over half of Harris County's 22 watersheds experienced record breaking flood levels, and as expected for such an epic event the gage network suffered damage. To put into perspective the magnitude of rainfall that Harvey produced, an average of 33.7 inches of rainfall occurred across Harris County's 1,777 square miles - equaling 1 trillion gallons of water and produced 68% of the annual average rainfall for the City of Houston in a four-day period. Only seven of the 154 gages sustained flood damage. In addition, five other sites had damaged water level sensors and two additional sites reported unreliable rain. All major repairs were completed by September 14th (14 days after rain stopped) due to the hard work of David Haynes, Don Van Wie, and HCFCD Technicians, restoring the system to full functionality to be prepared for the next flood event. Flooding from previous storm events encouraged HCFCD to raise gages to higher locations, and two of the three sites that flooded during Harris County's last storm did not flood during Hurricane Harvey. However, some of the damage may have been prevented with better installation procedures.

Two of the flooded sites are located close to the banks of the San Jacinto River, and have had consistent issues with flooding in past events. Repair work included elevating both stations and installing all equipment as high as possible (Figure 1). Every site that flooded was modified in some way to make the system more flood resilient for future storm events.

¹ M. Moore, S. Fitzgerald, J. Lindner. Harris County Flood Warning System 2016 Tax Day Flood Test – Passed' The NHWC Transmission, October 2016



Figure 1 Flood gage along the banks of the San Jacinto River Storm debrie can be seen all the way to the top of the antenner mast: Repair work involved severing equipment to prevent damage from future minor floods.

HCFCD Servers

The flood gages themselves were not the only part of the network that experienced issues during Harvey's flooding, During the event HCFCD was informed that Harris County IT might be forced to change the network pathways for our primary server location due to flood damage. This would potentially stop the ability to transfer data to the Flood Warning System (FWS) website from the data collection point (Figure 2, Point A). At 10:30 AM August 28th, a conference call was held to ensure that vital processes could be handled by the backup server at a separate location. At 11:05 AM August 28th, 35 minutes later, the backup server failed due to internet connection issues at the unmanned secondary receive site due to storm damage (Figure 2, Point B). This was the only backup for the threatened primary server.

Fearing loss of data connections from the primary and backup servers, we contacted OneRain, HCFCD IT staff, and Harris County IT staff. We proposed a cloud hosted server as a "third" backup location. At 3:32 PM August 28th (~4.5 hours after our backup site failed), OneRain completed setup of a cloud sever that connected to the primary data collector located at the radio tower. All data from other servers was transferred over to the cloud hosted server, and redundancy was successfully restored thanks to the diligent work of OneRain staff.

The Public Website

The HCFCD maintains and operates our FWS website to provide accurate and reliable real-time rainfall, flood stage, and other data. This information is used by the HCFCD and by Harris Courty's Office of Homeland Security and Emergency Management to inform the public of imminent and current flooding conditions along watercourses. The website serves as a direct access point for public users, and was heavily utilized during the event.

Over 1 million unique users visited the website during Harvey, with over 6.3 million different page views (6x higher than any previous event). This load on the website caused the entire page to crash several times during the event even with



Figure 2. Diagram of flood warning data after it has irrived at the radio towers. Concerns were raised about he connection at Point A. Point B failed 35 minutes later.

preventative measures. A review of the statistics from the FWS website revealed a faw key pieces of information that all flood warning system operators should be aware of:

- 1. 65% of users went to the website on a tablet or mobile device.
- 2. 35% of visitors were new users.

2

 Most users went to the website directly or from a google search (70%), but other websites such as news agencies (20%) and __.

1

Leadership





Steve Fitzgerald, President	Houston, TX
Josh McSwain, Vice-President	Charlotte, NC
Ben Pratt, Treasurer	Lancaster, PA
Brad Heilwagen, Secretary	Nashville, TN
Bruce Rindahl, AUG Rep.	Ventura, CA
Kevin Stewart	Denver, CO
Andy Rooke	Austin, TX
Fritz Law	Longmont, CO
Jimmy Stuart	Queensland, Australia

Liaisons

Organizations

- AUG
- ASFPM
- AMS
- ASDOS
- NAFSMA
- CoCoRAHS

Agencies

- NOAA
- NWS
- FEMA
- USGS
- USACE

Benefits

- Collaboration share and learn from each other
- Support each other in time of need (local coordination: operations & maintenance)
- Monitoring & developing technologies
- Collective national position is critical

Conferences & Workshops

- Texas Workshop
 - November 14/15, 2018
 - Menger Hotel
 - San Antonio, TX
- Biennial Conference
 - June 17-20, 2019
 - Galt House
 - Louisville, KY



Questions?

JUNE 17-20, 2019 13TH BIENNIAL TRAINING CONFERENCE & EXPOSITION Observe, Disseminate, Respond: The Triple Crown THE GALT HOUSE HOTEL LOUISVILLE, KENTUCKY



LOUISVILLE - 2019