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

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

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

Remote Sensor Sites

Data Relay

Base Station

Backup

Warning Devices (Optional)

Media

Public

FWS Operators

Emergency Managers, Other Agencies, & NWS

Remote Sensor Sites

Data Relay

Base Station

Backup

Warning Devices (Optional)

Media

Public

FWS Operators

Emergency Managers, Other Agencies, & NWS
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

<table>
<thead>
<tr>
<th>2017 Manual</th>
<th>Max Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTR (Flood Threat Recognition)*</td>
<td>75</td>
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<tr>
<td>EWD (Early Warning Dissemination)*</td>
<td>75</td>
</tr>
<tr>
<td>FRO (Flood Response Operations)*</td>
<td>115</td>
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<tr>
<td>CFP (Critical Facilities Planning)*</td>
<td>75</td>
</tr>
<tr>
<td>SRC (StormReady Community)</td>
<td>25</td>
</tr>
<tr>
<td>TRC (TsunamiReady Community)</td>
<td>30</td>
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<tr>
<td><strong>2017 Max</strong></td>
<td><strong>395</strong></td>
</tr>
</tbody>
</table>
Hickenlooper declares Manitou Springs flooding 'a disaster'

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

http://hydrologicwarning.org
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
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
The NHWC Transmission
October 2017

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

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 Flood Warning System 2016 Tax Day Flood Test – Passed! The analysis from Harvey shows how successful 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 – equating to 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 meter 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 Ven 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 procedure.

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.

![Image of flood gages](image1.png)

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 path ways 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 29th, 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 29th, 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 29th (+4.5 hours after our backup site failed), OneRain completed setup of a cloud server 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 County’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 has been utilized during the event.

Over 1 million unique visitors visited the website during Harvey, with over 0.3 million different page views (6% higher than any previous event). This load on the website caused the entire page to crash several times during the event even with preventative measures. A review of the statistics from the FWS website revealed a few 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.
3. Most users went to the website directly or from a google search (70%), but other websites such as news agencies (20%) and...
Leadership

NHWC Board Member’s Locations
<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
</tr>
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<tbody>
<tr>
<td>Steve Fitzgerald, President</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>Josh McSwain, Vice-President</td>
<td>Charlotte, NC</td>
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<tr>
<td>Ben Pratt, Treasurer</td>
<td>Lancaster, PA</td>
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<tr>
<td>Brad Heilwagen, Secretary</td>
<td>Nashville, TN</td>
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<tr>
<td>Bruce Rindahl, AUG Rep.</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>Kevin Stewart</td>
<td>Denver, CO</td>
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<tr>
<td>Andy Rooke</td>
<td>Austin, TX</td>
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<tr>
<td>Fritz Law</td>
<td>Longmont, CO</td>
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<tr>
<td>Jimmy Stuart</td>
<td>Queensland, Australia</td>
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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

www.hydrologicwarning.org