LOUISIANA WATERSHED INITIATIVE
working together for sustainability and resilience

DATA WORKSHOP SUMMARY

FOR DISCUSSION AND RESEARCH PURPOSES ONLY

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STREAM AND RAIN GAGE DATA

Measurements of stream flow, river water elevations, and precipitation

Stream and rain gage data are critical datasets in understanding flooding and flood risk. They help to understand the relationship between precipitation and flood elevations, which determine the extent of flooding. Stream gages may measure flow or may measure stage (an indicator of depth). An understanding of the relationship between depth and flow is needed to determine flow from a stage measurement.

What Can I Do with the Data?

Not only are these datasets used to understand flooding from current and historical events, these critical data are used in modeling efforts to help understand potential future flooding based on changes that may occur throughout the state. Real-time data are also critical in decision making for flood response, allowing public officials to make decisions about operations of flood control structures and recommend evacuations.

Where Can I Access the Data?

Both the United States Geological Survey (USGS) and the United States Army Corps of Engineers (USACE) collect, maintain, and distribute stream gage data. They also collect limited rainfall information. These data may be accessed at the following locations:

- Real-time and historical stream gage records for Louisiana – https://la.water.usgs.gov/
- Real-time stream gage levels searchable by USACE district and river basin – http://rivergages.mvr.usace.army.mil/WaterControl/new/layout.cfm
- Historical USGS river gage records nationwide – https://waterdata.usgs.gov/nwis

The main source of publicly available rainfall data is the National Oceanic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information. NOAA's rainfall data may be accessed at the following websites:

- Overview and general access to datasets available through NOAA – https://www.ncdc.noaa.gov/data-access
- Rain gage data – https://www.ncdc.noaa.gov/cdo-web/

- Next Generation Weather Radar (NEXRAD) data as well as links to Terminal Doppler Weather Radar, maintained by the Federal Aviation Administration (FAA) are found at the following sites:
    - Radar-only rainfall products for NEXRAD – https://www.ncdc.noaa.gov/data-access/radar-data/nexrad-products
    - Terminal Doppler Weather Radar, maintained by the FAA – https://www.ncdc.noaa.gov/data-access/radar-data/tdwr/tdwr-products
    - Gage-adjusted radar rainfall products – http://www.emc.ncep.noaa.gov/mmb/ylin/pcpanl/stage4/

USGS Gages

Stream Gages – USGS stream gages in Louisiana are shown on the map to the right (Figure 1). Approximately 70 gages measure discharge (black triangles), and approximately 200 gages measure stage only (red dots). The locations of these gages are driven by the funding sources, with 60% receiving federal funding and 40% placed through cooperative agreements with state and local partners.

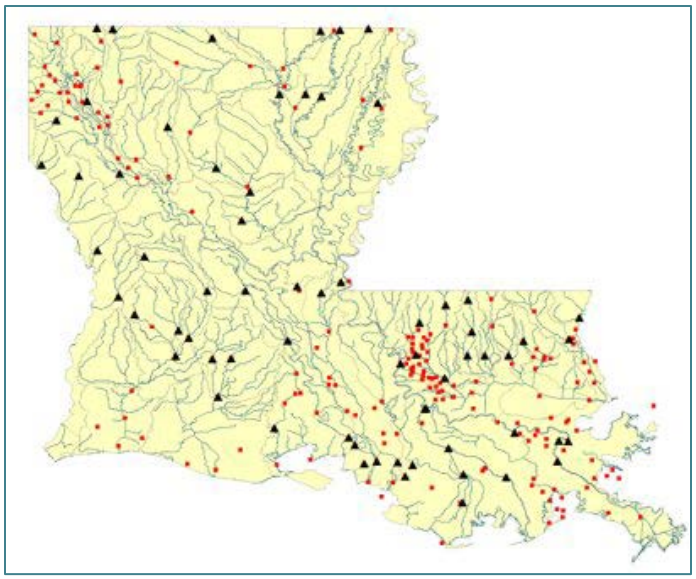

Figure 1: USGS stream gages (discharge and stage)

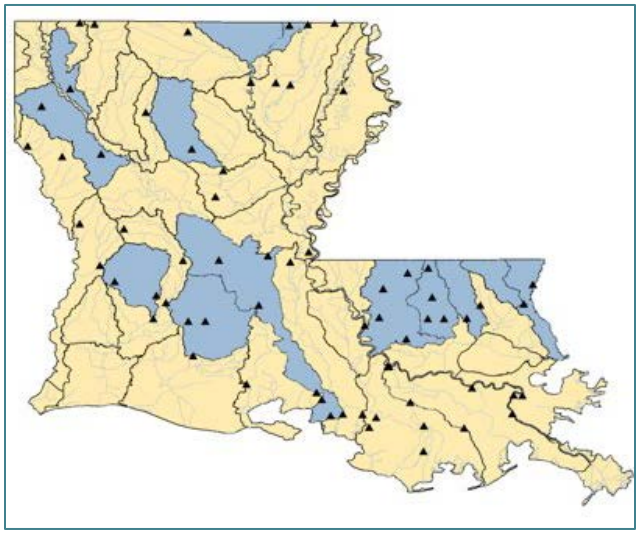

Figure 2: Watersheds and USGS discharge gages

A preliminary evaluation of Louisiana's watersheds, based solely on the location of USGS stream gages, indicates that a minority of them (13 of 59, shown in blue shading in Figure 2) have adequate gages to fully characterize how water moves through the watershed. The number of watersheds with adequate gages may increase, however, when considering other sources of gage data, such as USACE's gage data.

Rain Gages – About 70 USGS stream gages have collocated rain gages. These rainfall gages are located primarily in the southern portion of the state; several previously located rain gages in the northern part of the state were removed, as these gages were not set up primarily to measure rainfall, but to accompany the streamflow data, they did not receive the same level of quality control as the streamflow data. Based on funding issues and quality control concerns these northern rain gages were removed.

USACE Gages

USACE maintains 120 real-time gages, most of which measure stage.[1] Additionally, USACE maintains 150 high-water staff gages that are used only during high-water and flood events. Many of these gages are concentrated in the New Orleans area to support the Hurricane & Storm Damage Risk Reduction System (HSDRRS) as well as around the Mississippi and Atchafalaya Rivers to maintain navigation and support river forecasting. Placement of these gages is done in close coordination with the National Weather Service. USACE gages are shown in Figure 3.

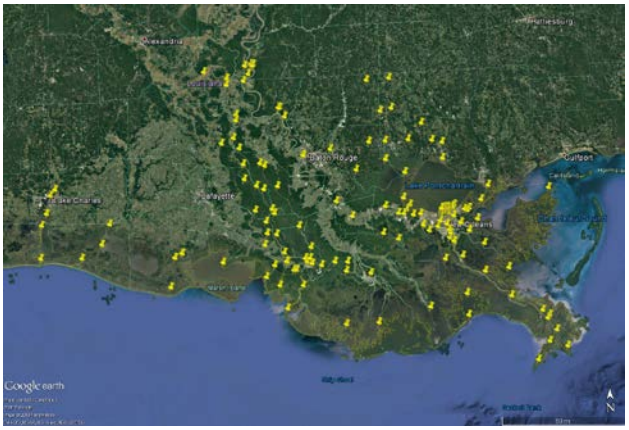

Figure 3: USACE gages

Rain Gages

NOAA rain gages are scattered throughout the state. Data are collected on 15-minute, hourly, or daily intervals. More than 100 sites record daily data, with fewer sites for 15-minute and hourly data (shown in Figure 4). Radar data covers the entire state, as the typical range of most radar products is 230 kilometers (km) from the radar site. For hydrologic application, the usable range of data is approximately 150 km. There are four Doppler radar sites located in Louisiana, with data from neighboring states also providing coverage of the state[2]. While gage data are a more traditional way of representing rainfall, radar rainfall products provide more information on how rainfall patterns vary across an area. Radar-based rainfall data are available as radar-only products and also as gage-adjusted radar products.

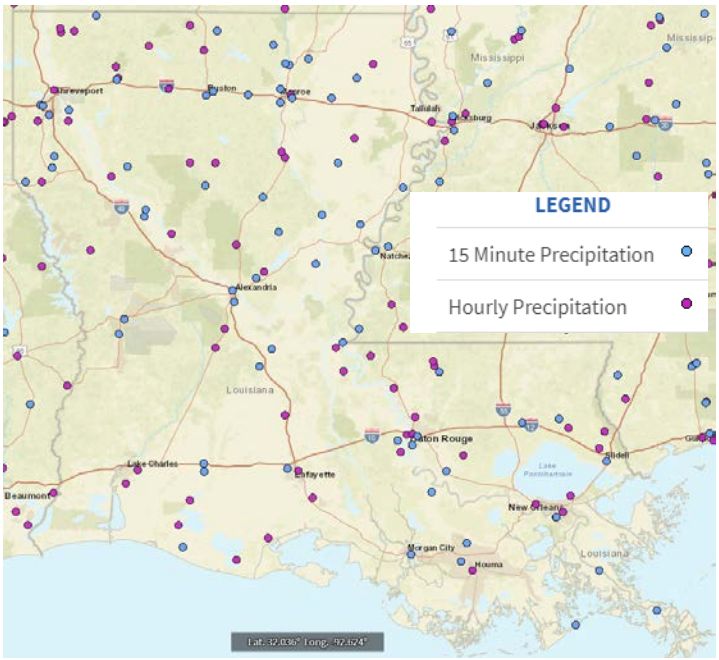

Figure 4: Rain gages

[1] USACE contracts USGS to maintain some of its gages. These gages may be included in both the USGS and USACE gage counts.

[2] NOAA. 2018. National Weather Service Enhanced Radar Images. Available at https://radar.weather.gov/. Retrieved January 9, 2019.

What Areas Do the Data Cover?

The stream and rain gages are scattered throughout the state. While USGS stream gages are generally scattered statewide, there are a cluster of stage-only gages in the Baton Rouge area. USACE gages primarily focus on the areas around New Orleans and the Mississippi and Atchafalaya Rivers. Other rivers with major stream gaging sites include the Red, Ouachita, and Bouef-Tensas Rivers. USACE also has a few gages in coastal areas. The location of existing gages as well as modeling needs should be considered when adding or improving gages.

How Current Are the Data?

The time period that each gage station has records for varies from site to site. All 270 USGS sites are active (currently taking readings). Both USGS and USACE have additional inactive sites throughout the state, with some data not available digitally.

What Is the Future of the Datasets?

The following suggestions were made on potential improvements to the gage network, primarily related to stream gages:

- Re-establish previously existing gages, particularly those with a long period of record. Further analysis is needed to determine if the current locations are the optimum ones to meet the needs of the Louisiana Watershed Initiative (LWI).
- Add gages in watersheds with no gages at all.
- Add wave gages, particularly at inshore or near shore locations, to improve the validation of coastal models.
- Use an adaptive/iterative process in placing gages to optimize and prioritize recommended locations.
- Consider modeling needs during gage location selection.
- Consider forecasting in urbanized areas during gage location selection.
- Upgrade existing stage-only gages.
- Consider the National Weather Service Forecast Center's needs when suggesting new gage locations.
- Standardize data collection by conducting the following:
    - Adjust gages to use a consistent datum (base elevation reference) and epoch (time stamp for the datum, which helps account for how land in Louisiana settles over time, particularly in southern Louisiana).
    - Adjust all gages to use a gravity-based datum, currently under development by the National Geodetic Survey (NGS), once the datum is released.
    - Share best practices and standards, such as https://pubs.usgs.gov/tm/03/a24/tm3a24.pdf for high-water marks.
- Provide user-friendly options for public access to data.
- Modernize to use gages with better communications capabilities (e.g., use the Iridium Satellite System rather than the Geostationary Satellite Constellation, and/or connect more gages through the cellular network).

- Digitize the remaining historical paper gage records.
- Consider using new sensor technologies for flow and stage measurement (e.g., acoustic doppler, radar, and ultrasonic devices).

Additionally, the following suggestions were made to coordinate work between agencies and interested parties:

- USGS will work with and share what they know how to do (e.g., share high-water marks standards, staff gage/crest gages).
- Work with current partners to expand the network and determine how to best support the LWI effort with federally funded gages.
- Share knowledge on data storage and distribution. For example, USGS has a framework for bringing data in from the field, storing it, and distributing it to the public.

How Can I Contribute?

Local officials can collaborate with LWI, USGS, and USACE to identify priority locations and opportunities associated with ongoing projects where additional gage data would be beneficial. Local officials can also work with these partners to identify appropriate standards for data collection. Once agreed on, all parties should work to ensure that any data collected meets the appropriate standards.