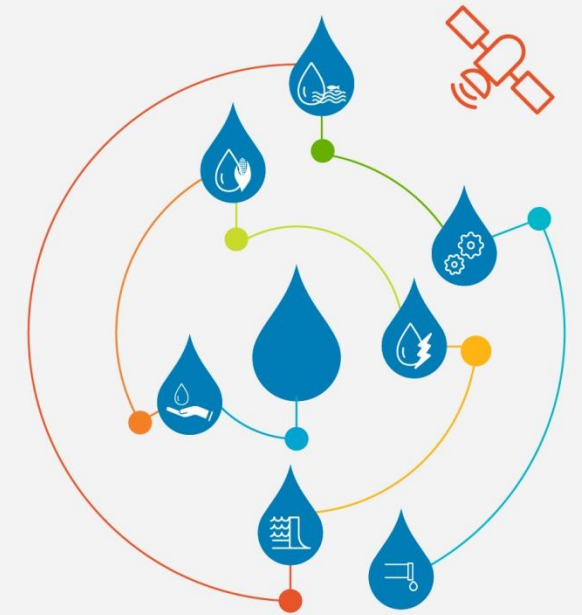


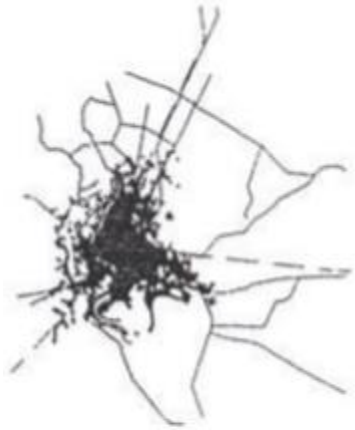
# Decision Support for Watershed-scale Real-time Water-Quality Monitoring to Determine Impacts of Urbanization on Water Treatment



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Geospatial Science + Cyber Innovation Branch  
4 October 2018

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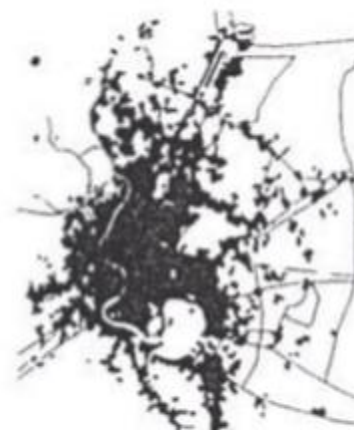
# The Mega-City: Importance of Scale in Scientific Monitoring



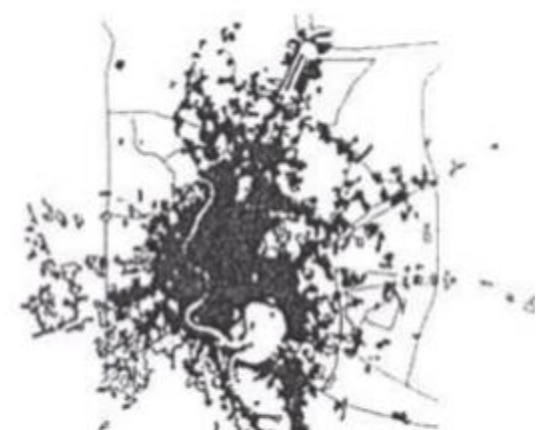
1970



1980



1990



2000

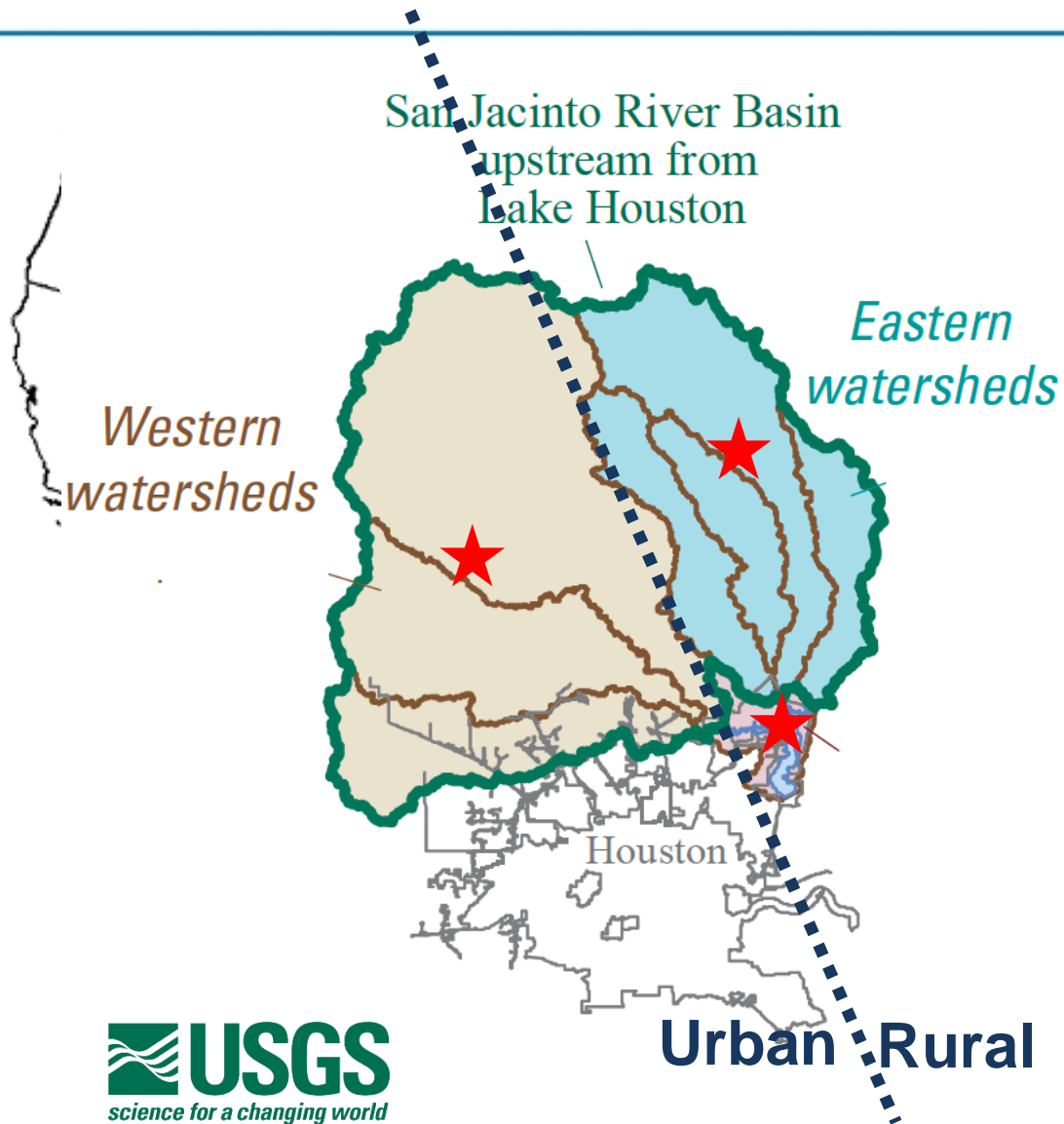
- **Focused and systematic** water supply and treatment planning
- **Community-focused strategy** for essential services
- Drive a management plan for water quality
- Better capacity to **anticipate and respond**

# Water Treatment for Water Security

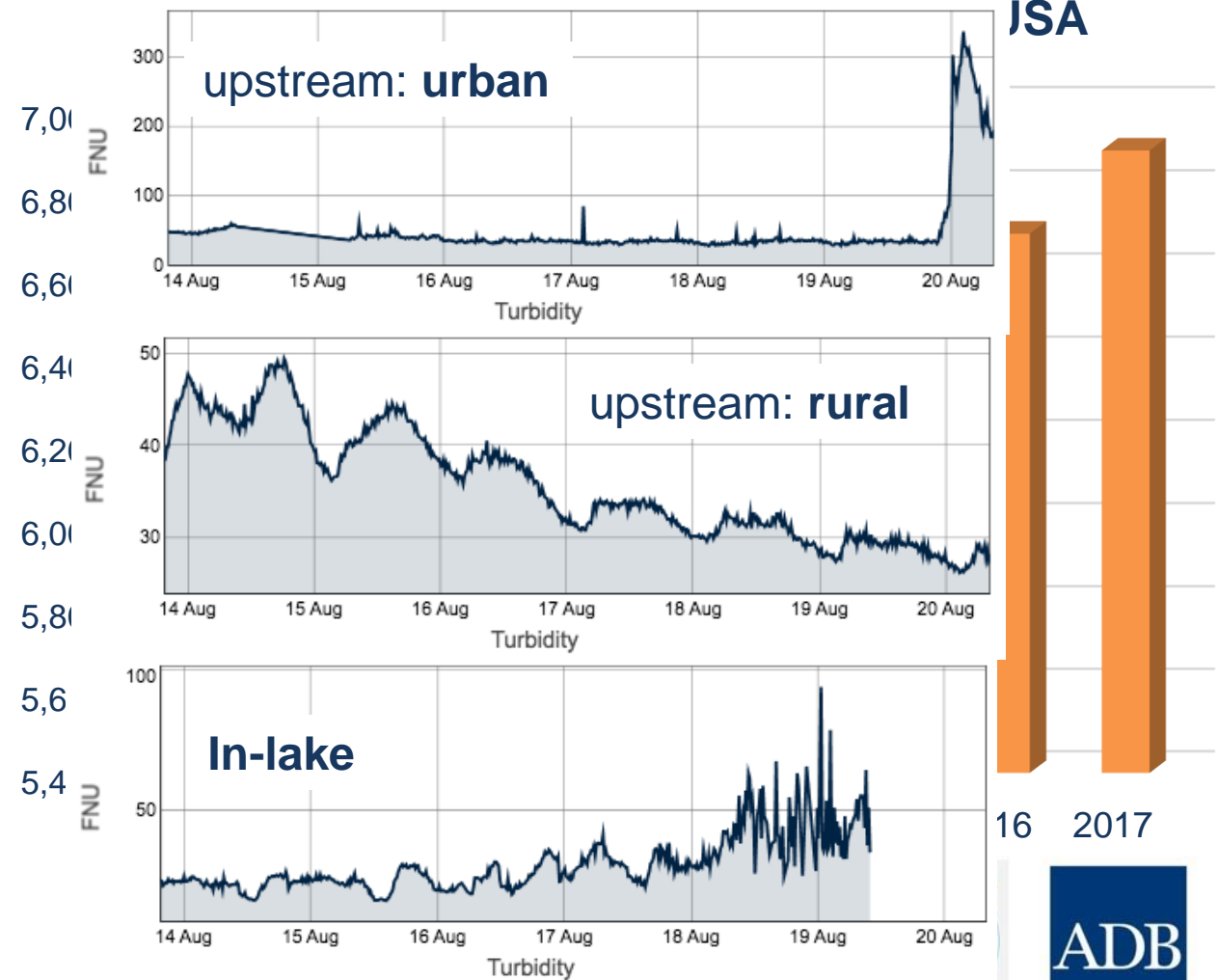
- Water treatment (water quality) → Water Security
- Water supply and sanitation: challenge in megacities
- Juxtaposition of **Urbanization** and **Rural** water quality impacts on treatment

SCALE OF MONITORING

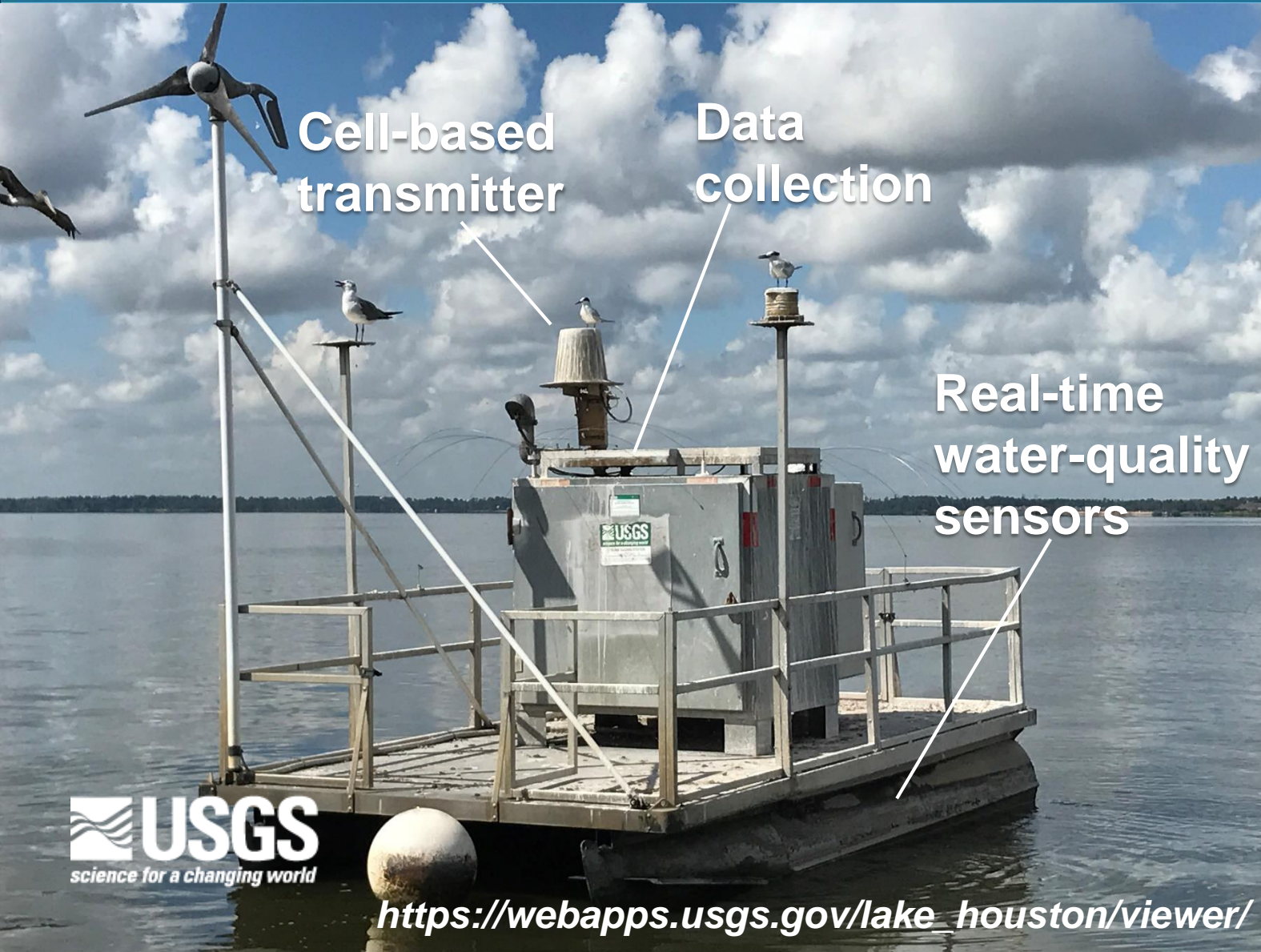
# Water Treatment for Water Security



## TURBIDITY: suspended solid particles



# Technology for Proactive Preparations



Cell-based transmitter

Data collection

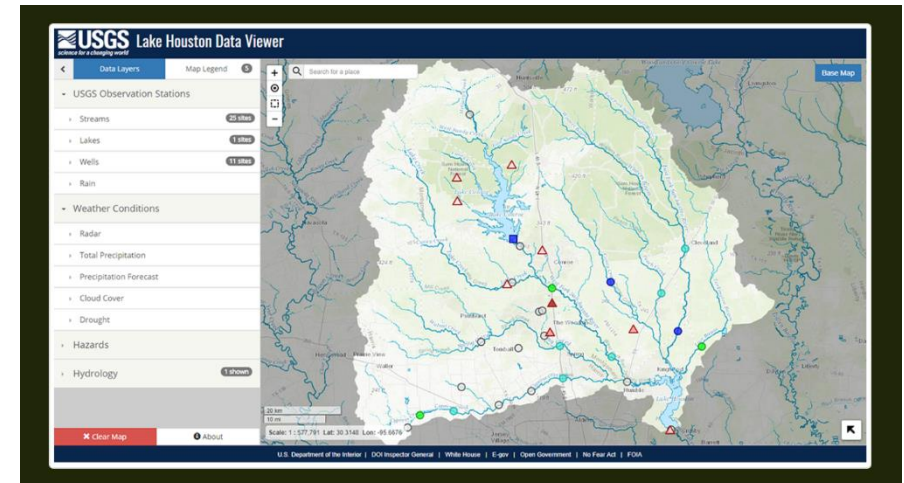
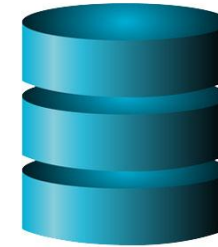
Real-time water-quality sensors



[https://webapps.usgs.gov/lake\\_houston/viewer/](https://webapps.usgs.gov/lake_houston/viewer/)

Turbidity  
Dissolved Oxygen  
Temperature  
Salinity  
pH

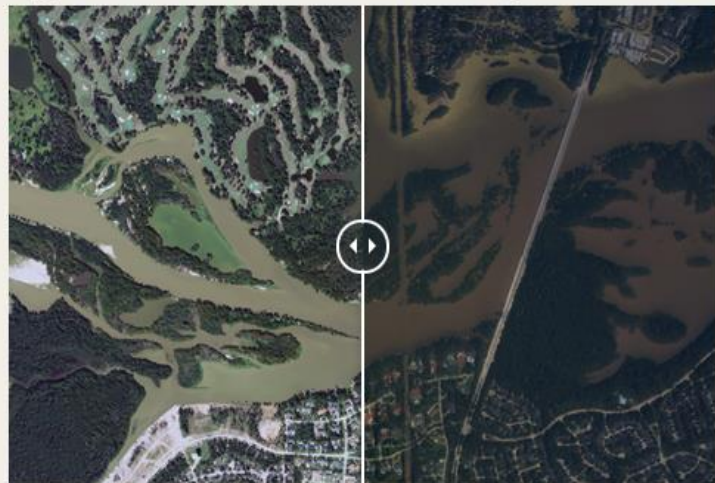
Streamflow  
Stage  
Forecasts  
Hazards  
Lake Elevation



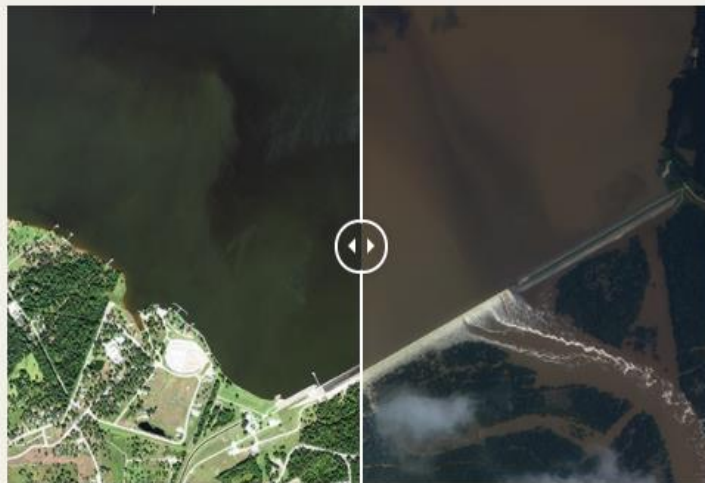
# Urbanization Effects on Water Quality & Treatment



## Typical and Elevated Turbidity

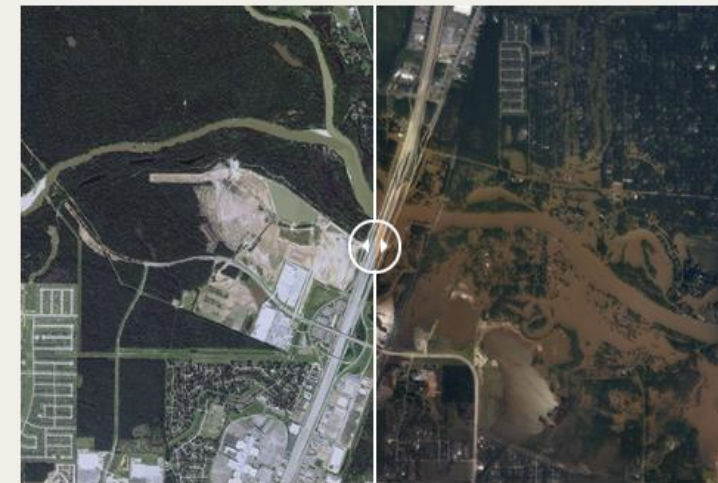


Left image: Typical turbidity at Kingwood, September 2016.



Left image: Typical turbidity at San Jacinto Dam, September 2016.

[https://webapps.usgs.gov/lake\\_houston/viewer/](https://webapps.usgs.gov/lake_houston/viewer/)



Left image: Typical turbidity on the West Fork San Jacinto River, September 2016.

## Explore Water-Quality, Streamflow, and Reservoir Data

Real-time continuous data is collected at 31 gages in the Lake Houston watershed. Reservoir stage and capacity are collected at three reservoirs; discharge and gage height are monitored along the mainstem of the San Jacinto River and tributaries feeding into Lake Houston; and water temperature, specific conductance, pH, dissolved oxygen, and turbidity are monitored at seven gages. Real-time continuous data is augmented and verified with discrete samples collected throughout the Lake Houston watershed.

[Explore the Data](#)

### Looking for the raw data?

Water-quality, streamflow, and reservoir data are available as part of USGS data products.

[Get the Water-Quality Data](#)

[Get the Streamflow Data](#)

[Get the Reservoir Data](#)

[Get the Latest Report](#)

**OPEN DATA:**  
All data is available for download in agnostic format (streamflow, reservoir information, water quality, metadata)

# Drought vs. Storm Management and Capacity

Storms

Drought

Frequency and Intensity

Water-quality  
in watersheds

*Water Quality and Treatment* are  
**WATER SECURITY** issues

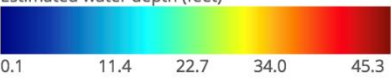
# Flood Inundation Mapper (FIM)

Layers Legend 4

Search for a place

**Flood Inundation Model**

Estimated water depth (feet)



0.1 11.4 22.7 34.0 45.3

Data Source: USGS Texas Water Science Center

Click the flood inundation model layer to show modeled water depth at a location.

**River Measurement Stations** 3 total

Flood Status (marker color)

- Major flooding 0 sites
- Moderate flooding 0 sites
- Minor flooding 0 sites
- Near flood stage 0 sites
- Not flooding 3 sites
- No assigned flood stages 0 sites
- Not flowing (0 ft<sup>3</sup>/sec) 0 sites

Trend (marker symbol)

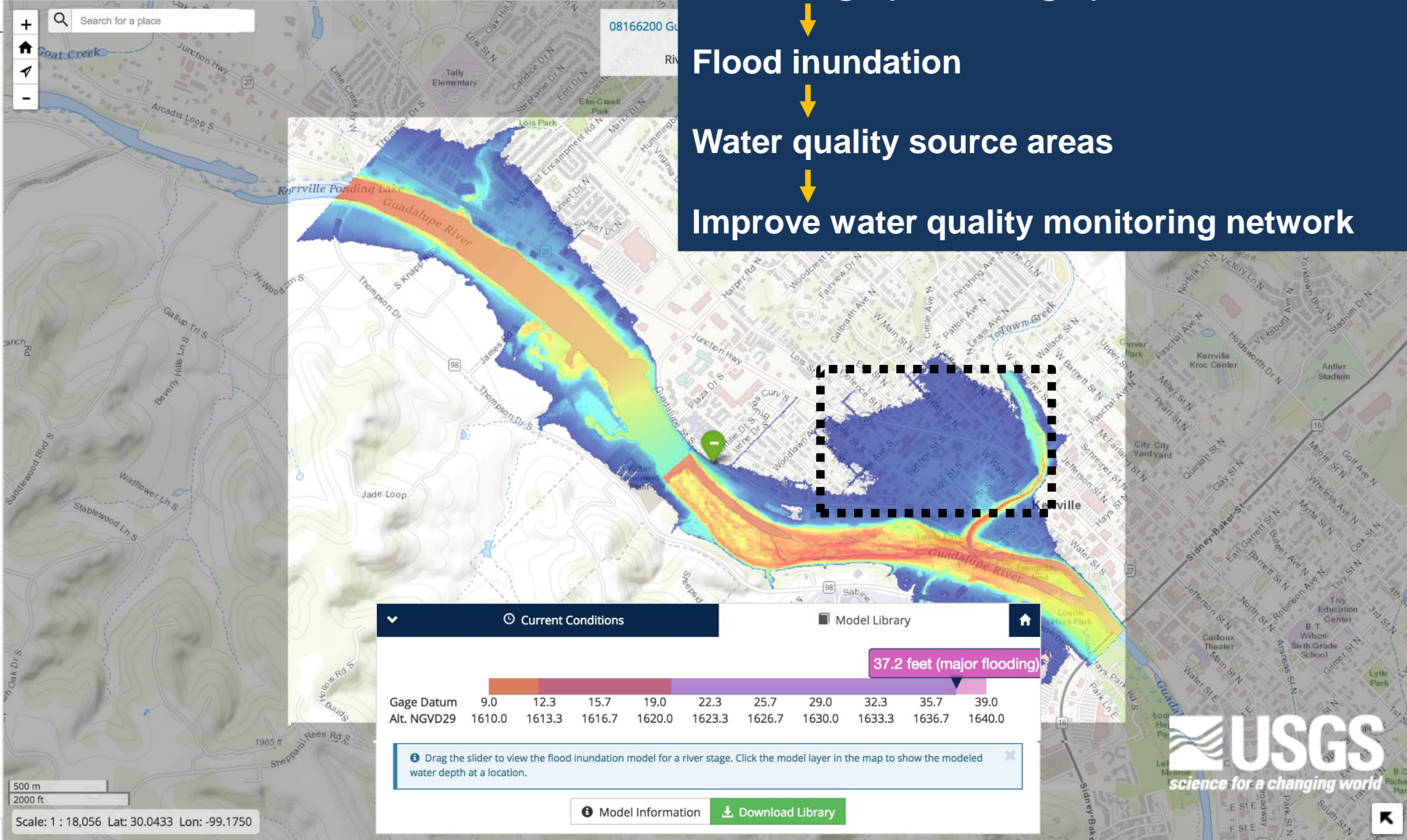
- River rising  $\geq 0.05$  foot/hour 0 sites
- River changing  $< 0.05$  foot/hour 3 sites
- River falling  $\geq 0.05$  foot/hour 0 sites

Comments: The trend rate-of-change is computed by subtracting the two most recent measurements divided by the elapsed time and converting to feet per hour. Data at most stations are collected at 15 minute intervals.

Data Source: Real-time river measurements provided by USGS Water Data for the Nation. Flood stages provided by the National Weather Service (NWS)

Click station markers to view flood inundation

Quick Start About



**Connecting urban flood risk to water quality:**

**River Stage (water height)**

↓

**Flood inundation**

↓

**Water quality source areas**

↓

**Improve water quality monitoring network**



# Watershed Scale Decision Support: Water-Quality Data and Urban Flooding

## IMPACT:

Improved surface water quality and planning for drainage capacity; data granularity

## OUTCOME:

Improved treatment capacity in watersheds (catchments) of interest

## CAPACITY & INSTITUTIONAL STRENGTHENING

Helps the implementing agency for medium-and-long term planning for water-quality impacts due to flooding and provides local people for awareness

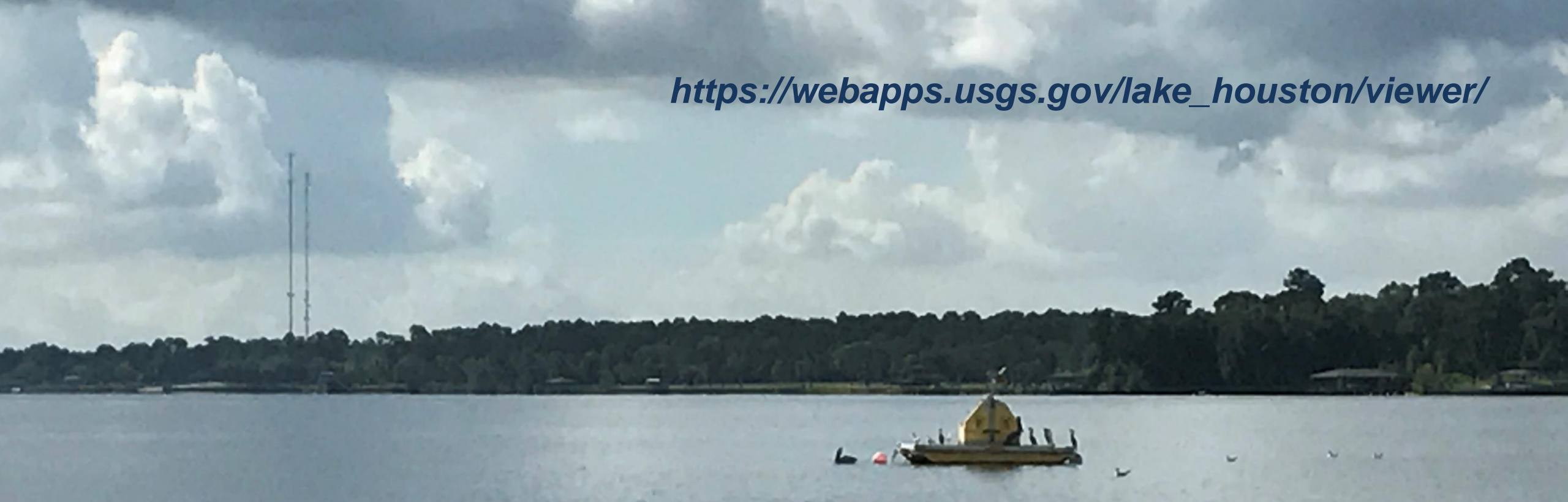
Focused climate resiliency for *urban corridors*

Improve flood risk planning through *data acquisition and management*

Rehabilitate flood infrastructure using *water-quality as a proxy*



[https://webapps.usgs.gov/lake\\_houston/viewer/](https://webapps.usgs.gov/lake_houston/viewer/)



## Explore Water-Quality, Streamflow, and Reservoir Data

Real-time continuous data is collected at 31 gages in the Lake Houston watershed. Reservoir stage and capacity are collected at three reservoirs; discharge and gage height are monitored along the mainstem of the San Jacinto River and tributaries feeding into Lake Houston; and water temperature, specific conductance, pH, dissolved oxygen, and turbidity are monitored at seven gages. Real-time continuous data is augmented and verified with discrete samples collected throughout the Lake Houston watershed.

[Explore the Data](#)

### Looking for the raw data?

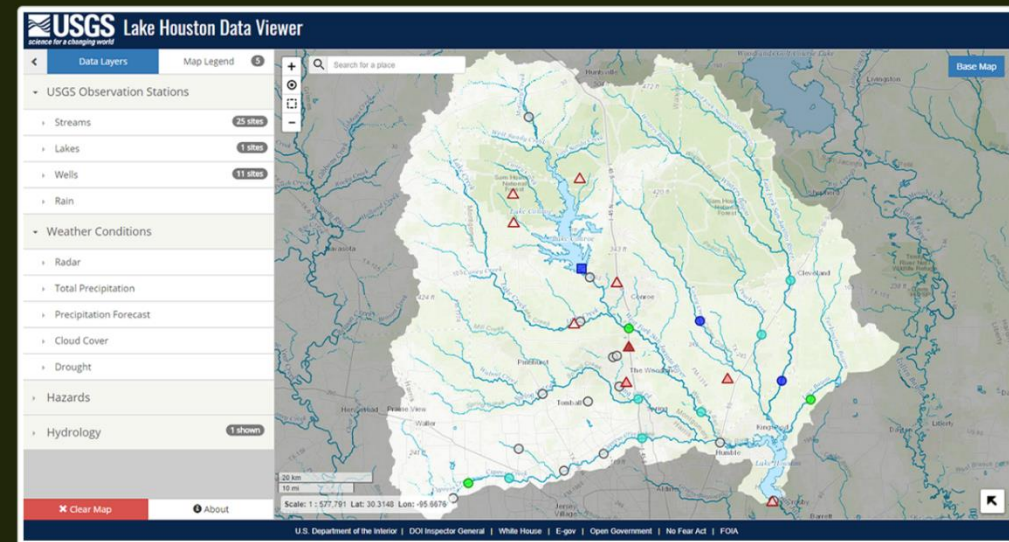
Water-quality, streamflow, and reservoir data are available as part of USGS data products.

[Get the Water-Quality Data](#)

[Get the Streamflow Data](#)

[Get the Reservoir Data](#)

[Get the Latest Report](#)



# Current Conditions in the Watershed

The screenshot displays the USGS Lake Houston Data Viewer interface. At the top left, the USGS logo and the Lake Houston logo are visible. The top right contains navigation links: "Lake Houston", "Water-Quality Monitoring", "Lake Houston Data Viewer", and "Publications". A search bar is located in the top right corner of the map area.

The left sidebar contains a "Data Layers" menu with the following categories and counts:

- USGS Observation Stations
  - Water Quality
  - Streams (28 sites)
  - Lakes (1 sites)
  - Wells
  - Rain
- Weather Conditions
  - Radar
  - Total Precipitation
  - Precipitation Forecast (shown)
  - Cloud Cover
  - Drought
- Hazards
- Hydrology (1 shown)

The main map area shows a topographic map of the Lake Houston watershed. Key features include Lake Conroe, Lake Livingston, and Lake Houston. Numerous observation stations are marked with colored circles and squares across the watershed. A scale bar at the bottom left indicates 20 km and 10 mi, with a scale of 1:577,791. The bottom left corner has buttons for "Clear Map", "Quick Start", and "About".

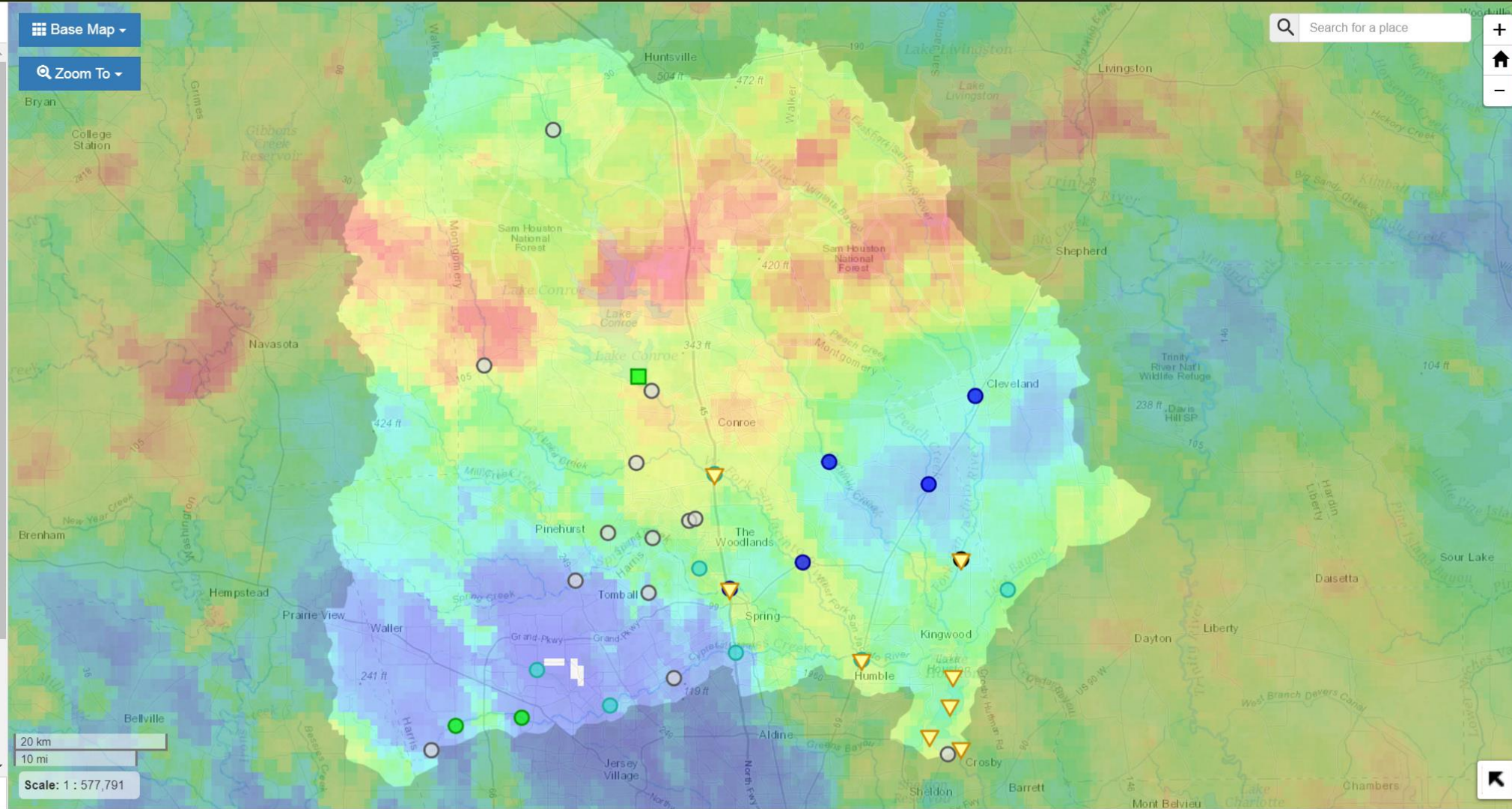
# Total Past Rainfall



**Data Layers** | Map Legend 7

- USGS Observation Stations
  - Water Quality 8 sites
  - Streams 28 sites
  - Lakes 1 sites
  - Wells
  - Rain
- Weather Conditions
  - Radar
  - Total Precipitation** shown
    - On  Off
    - Past 1 hour
    - Past 1 day
    - Past 2 days
    - Past 3 days
    - Opacity: 35%
  - Precipitation Forecast shown
  - Cloud Cover

Clear Map Quick Start About



# Rainfall Forecast



Data Layers | Map Legend 6

Not Ranked See Comments

Comments: Marker color indicates the current lake elevation condition. Categories are based on the percentile of existing lake elevation record on this day-of-the-year. A gage is not ranked when there is insufficient lake elevation record to compute statistics or a current lake elevation measurement is unavailable.

Data Source: USGS Water Data for the Nation

Click points in this layer to access real-time data and station information.

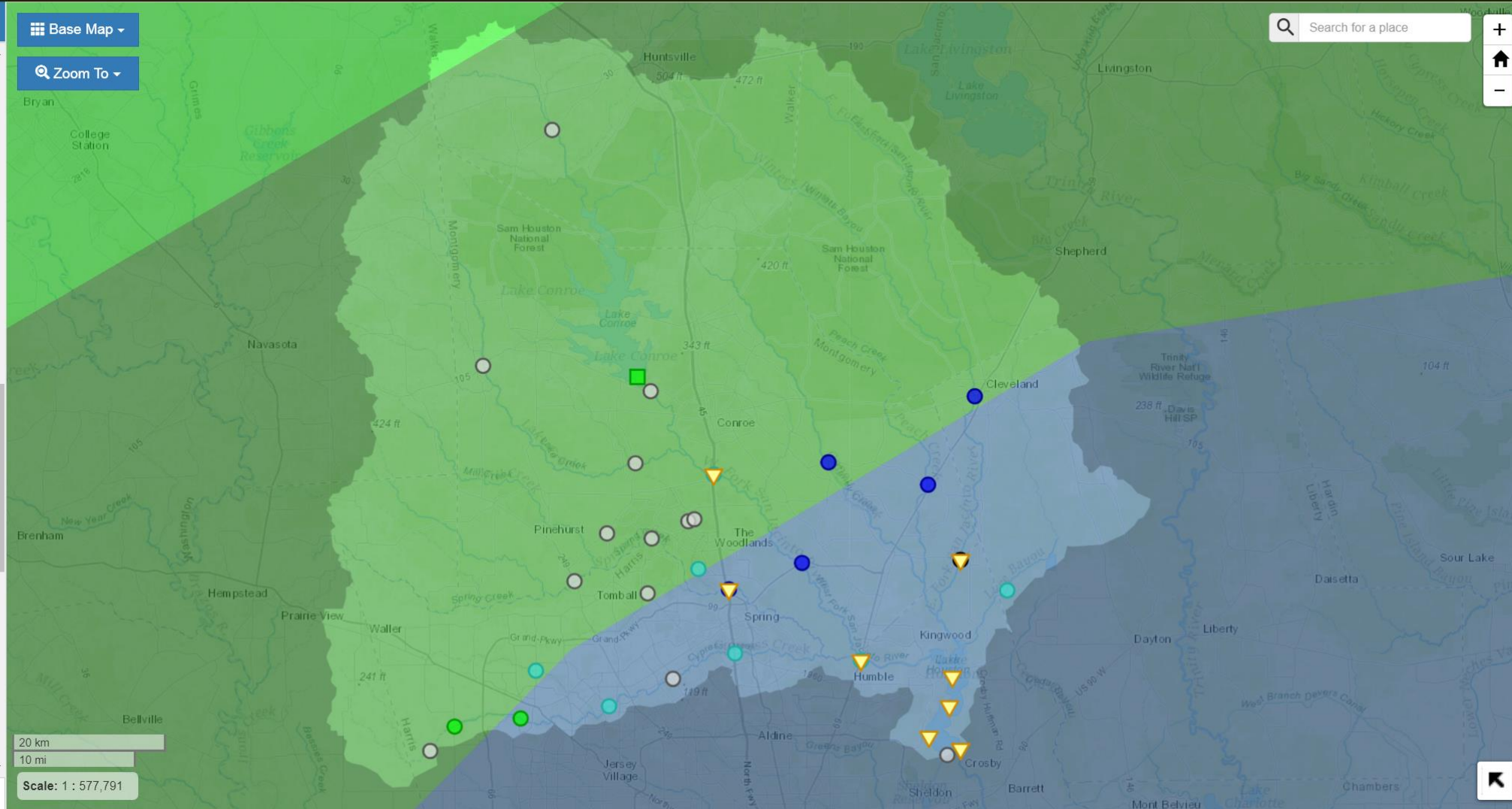
Precipitation Forecast Remove

0.01 inches	2.00 inches
0.10 inches	2.50 inches
0.25 inches	3.00 inches
0.50 inches	4.00 inches
0.75 inches	5.00 inches
1.00 inches	7.00 inches
1.25 inches	10.00 inches
1.50 inches	15.00 inches
1.75 inches	20.00 inches

Comments: Values are Quantitative Precipitation Forecasts (QPFs) defined as the amount of liquid precipitation expected to fall in a defined period of time. QPFs are estimated as areal averages on a 20- by 20-kilometer grid.

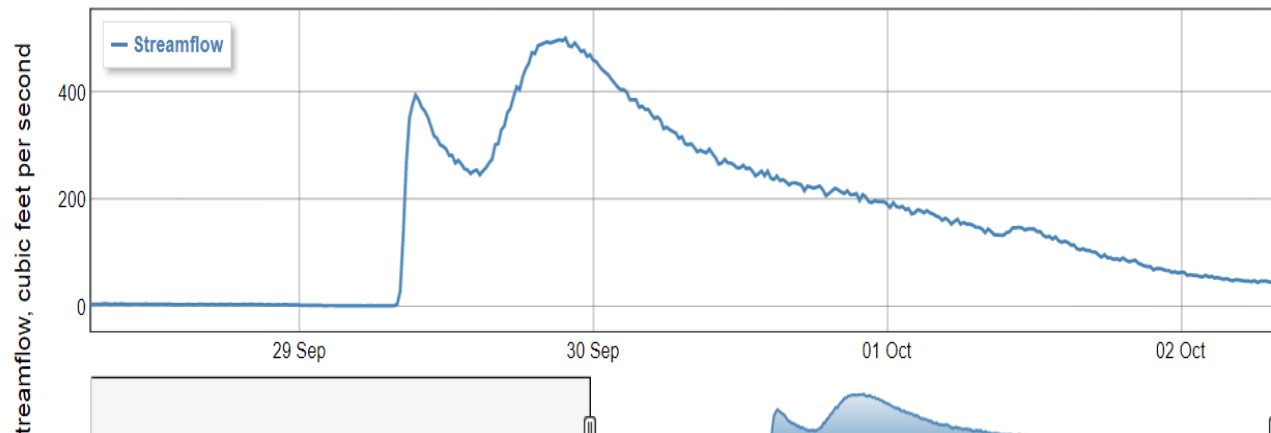
20 km | 10 mi | Scale: 1 : 577,791

Clear Map Quick Start About



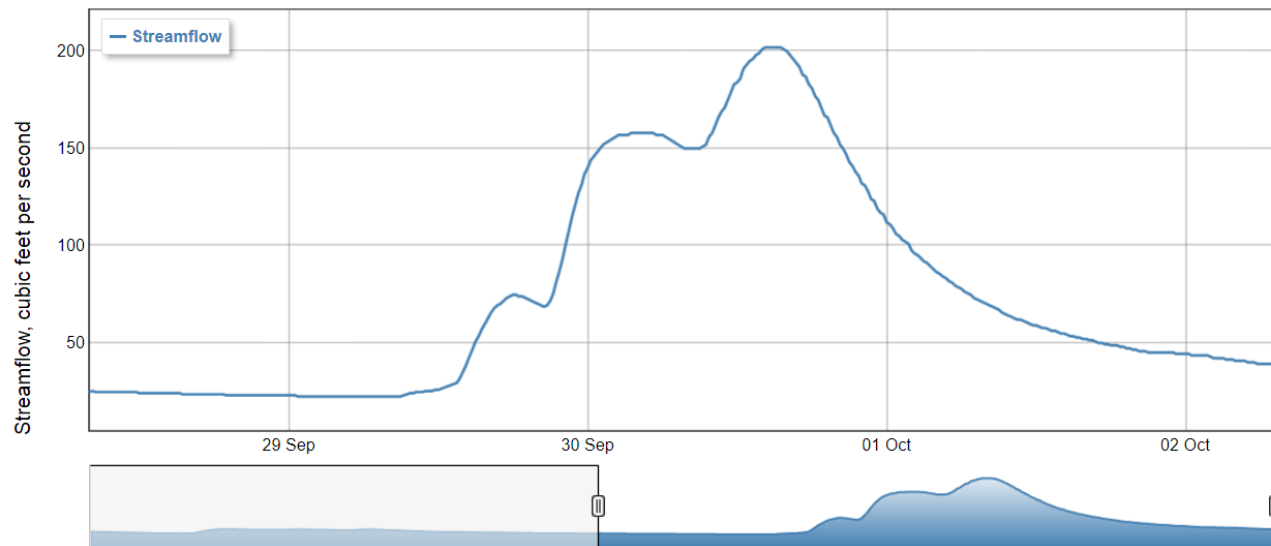
### urban

08068450 Panther Br nr Spring, TX



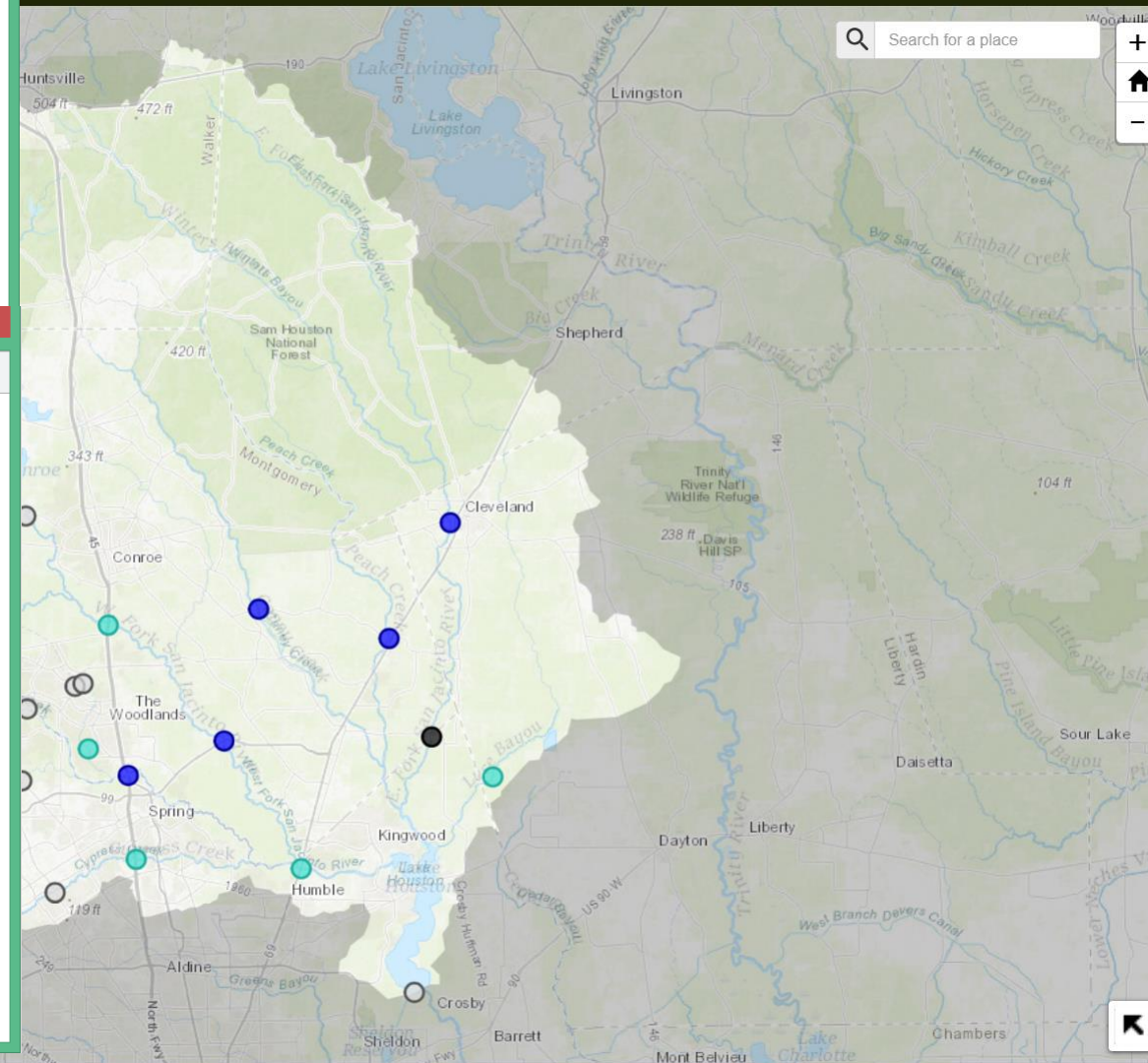
### rural

08070500 Caney Ck nr Splendora, TX

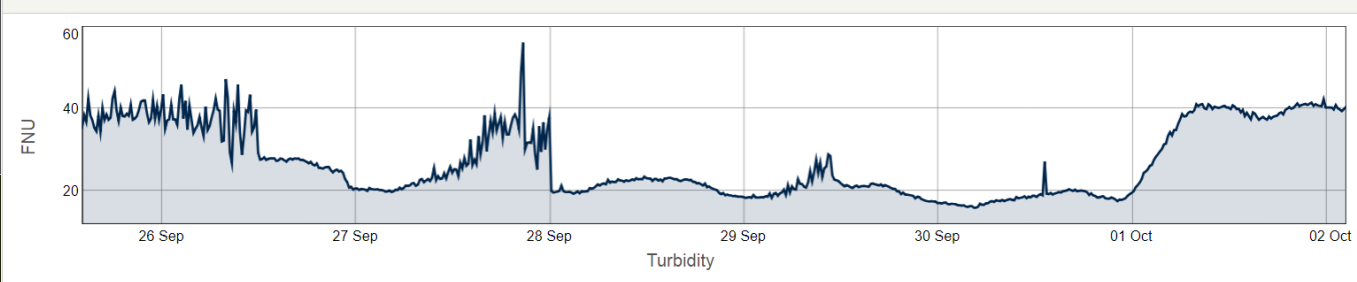


Fixed y-scale
  Y-axis logscale
  Show y=0
  Show x-grid
  Show y-grid

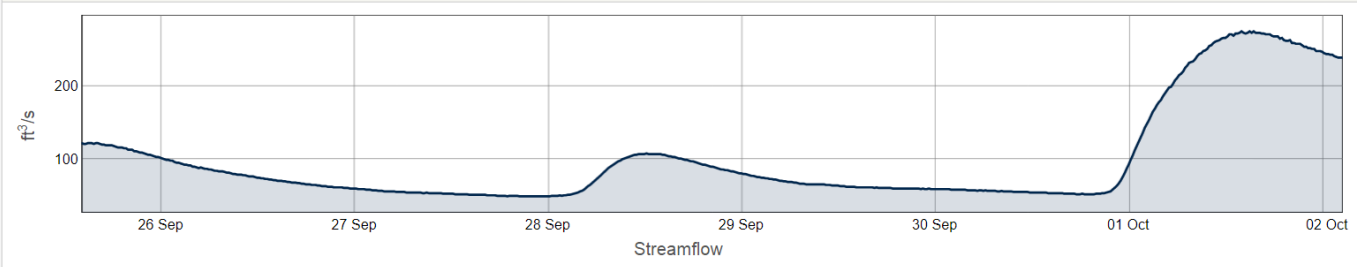
# Conditions



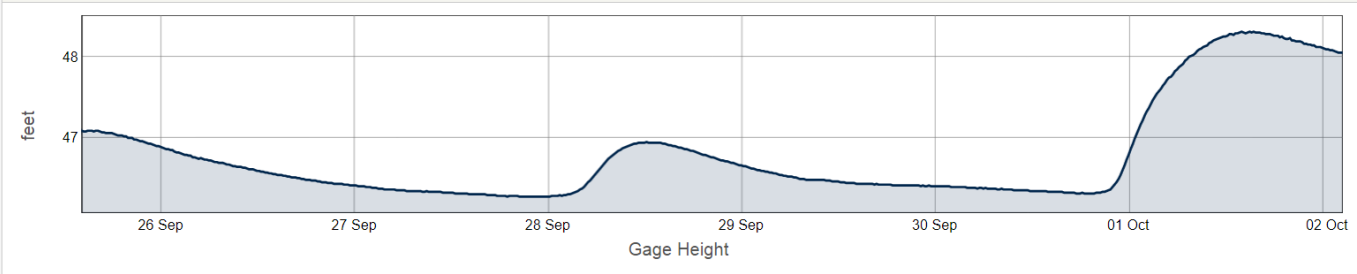
Turbidity, FNU Currently 50.7 @ 8:00 AM



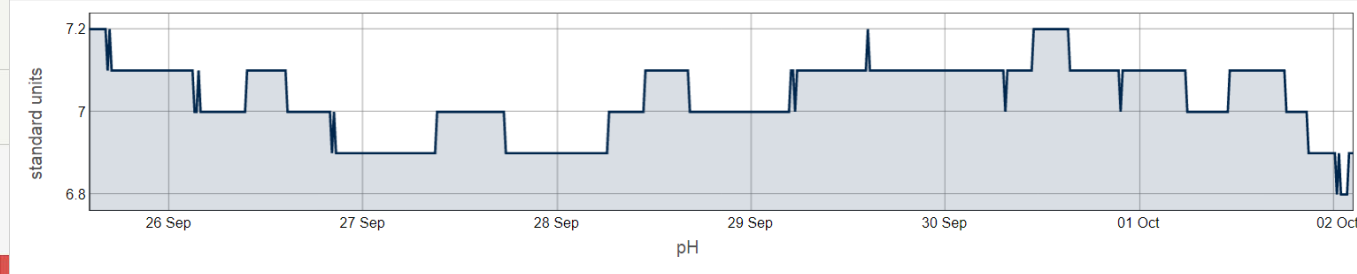
Streamflow, ft<sup>3</sup>/s Currently 226 @ 8:00 AM



Gage Height, feet Currently 47.97 @ 8:00 AM



pH, standard units Currently 6.9 @ 8:00 AM



[https://webapps.usgs.gov/lake\\_houston/viewer/](https://webapps.usgs.gov/lake_houston/viewer/)

Lake Houston Water-Quality Monitoring Lake Houston Data Viewer Publications

