

# Flood Mitigation Strategies: Brays vs. Greens Bayou

By

Philip Bedient

Chair, Civil and Environmental  
Engineering

SSPEED Center  
Rice University



SSPEED Center

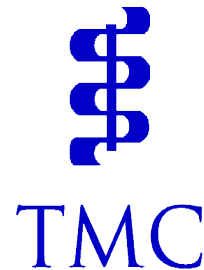
Severe Storm Prediction, Education, & Evacuation from Disasters Center



# SSPEED Center Partners – 2008 Hurricane Ike



Dr. Phil Bedient  
Jim Blackburn  
Larry Dunbar  
Dr. Jamie Padgett  
Dr. Andrew Juan  
Dr. Clint Dawson  
Dr. Nick Fang  
Dr. Sam Brody  
Dr. H.S. Rifai



Rob Rogers  
Tyler Swanson  
Charlie Penland  
Dr. Joe Cibor  
Dr. Jacob Torres

# Brays vs. Greens Bayou Flood Issues

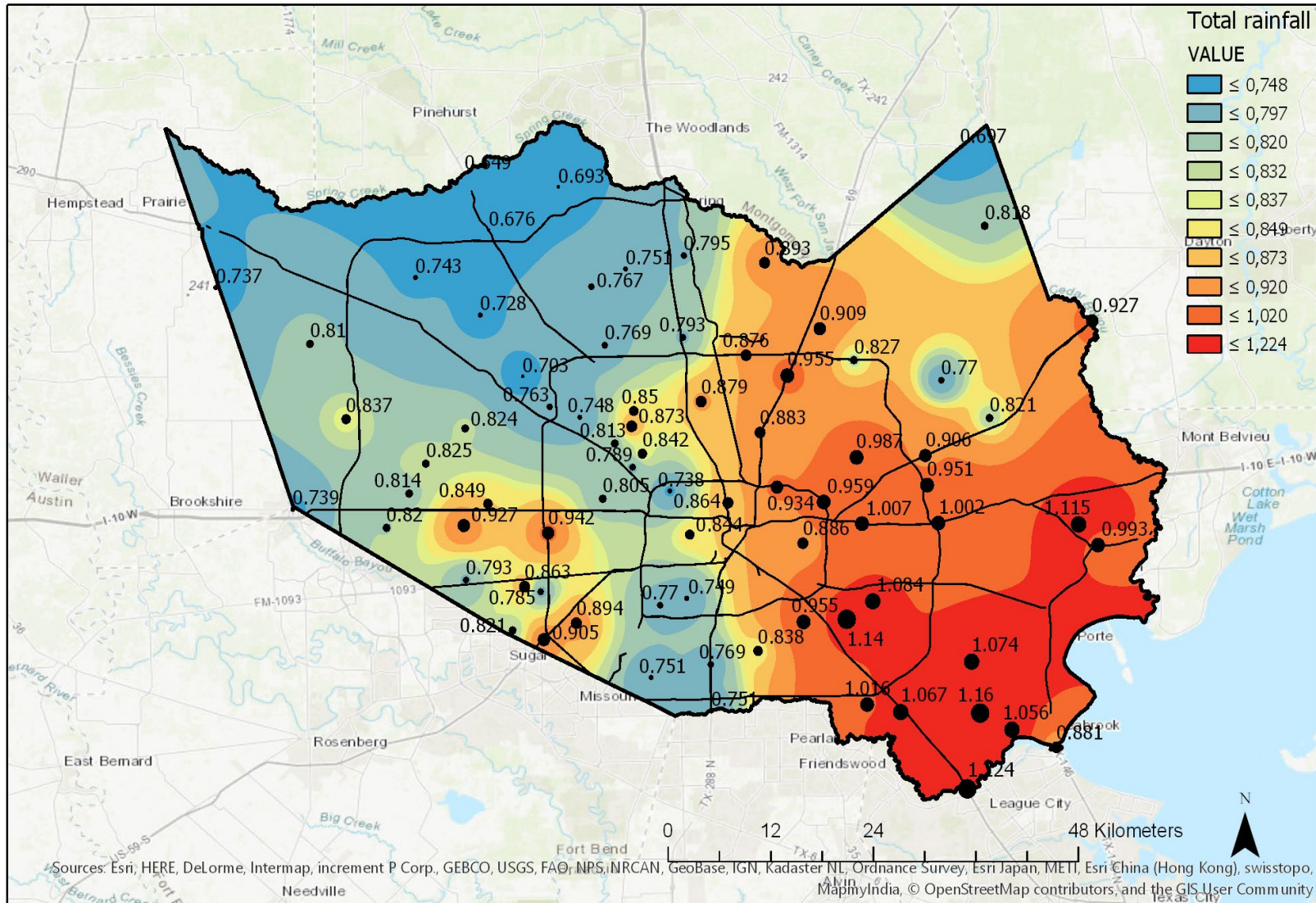


# Comparison of Two Watersheds

- Both were devastated by recent flooding events.
- Both are heavily developed in the floodplain.
- Greens has lower economic status than Brays.
- Brays has has two Federal projects since 1960s.
- Brays recovered much faster than Greens – post events



# Harvey Impacts in 2017



## Harvey Rainfall

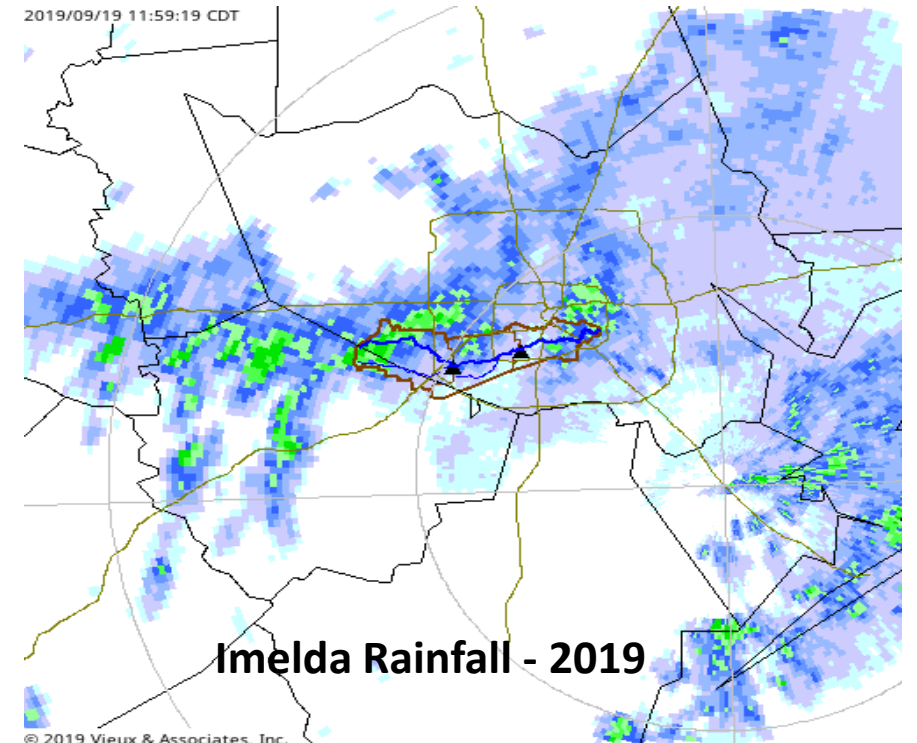
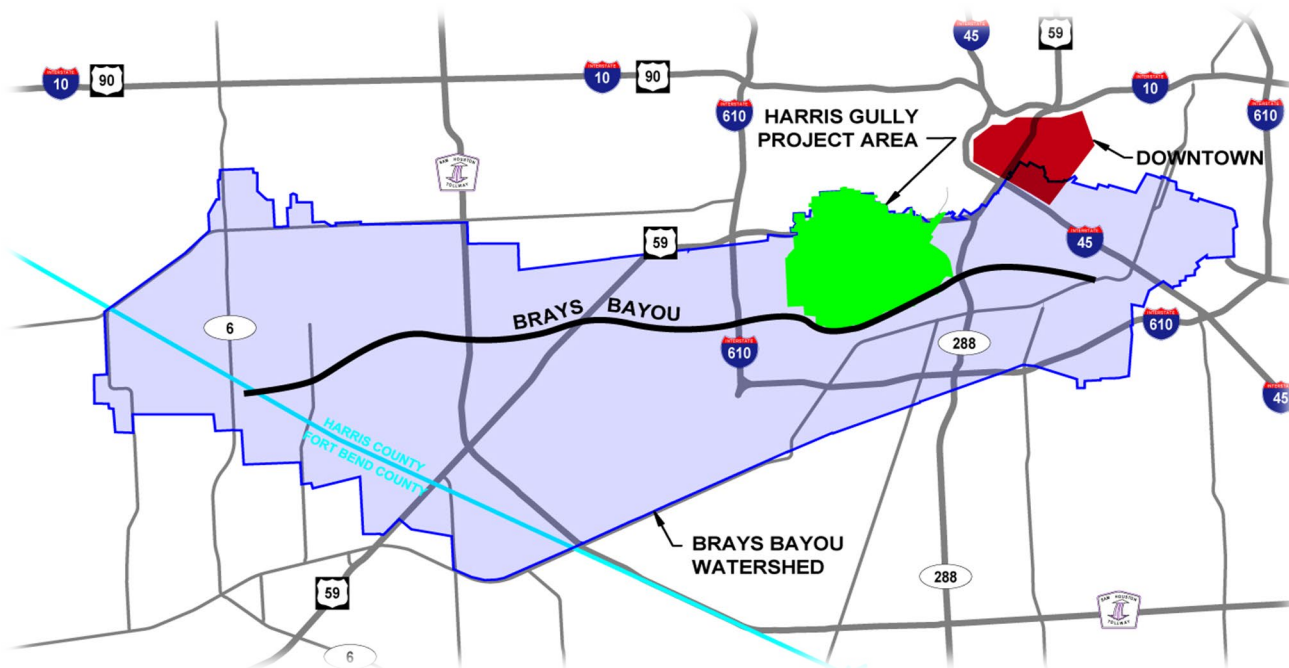
- **25-52 in** - Harris County
- **154,000** homes flooded (68% were outside the 1% floodplain)

## Other Major Floods

- 2001 – T.S. Allison
- 2008 - Hurricane Ike
- 2015 – Memorial Day
- 2016 - Tax Day
- 2017 – Harvey
- 2019 - Imelda

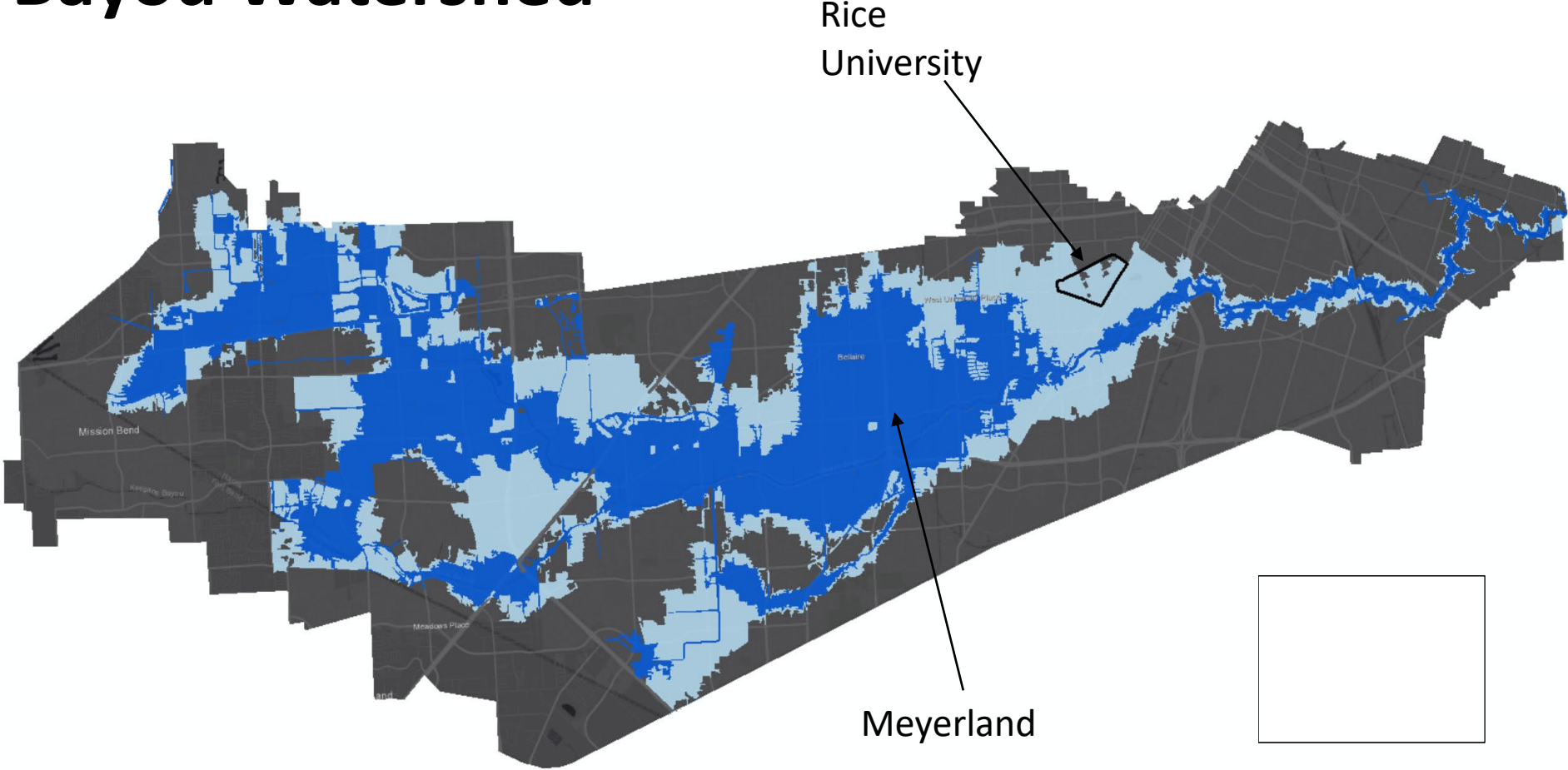
# Brays Bayou Flooding in Houston

- 128 mi<sup>2</sup> drainage area
- 700,000 people, 23,810 houses flooded in Harvey
- 95% developed
- 29% increase in development since 1970





# Brays Bayou Watershed



100 year vs new 100 year  
13 inch vs. 18 inch Rainfall per day



## Existing Mitigation

**Project Brays  
Lowers 100 year level  
By 3 to 5 ft.**

**Brays Channel  
Widening Post Harvey**





# Elevated Houses in Meyerland Area



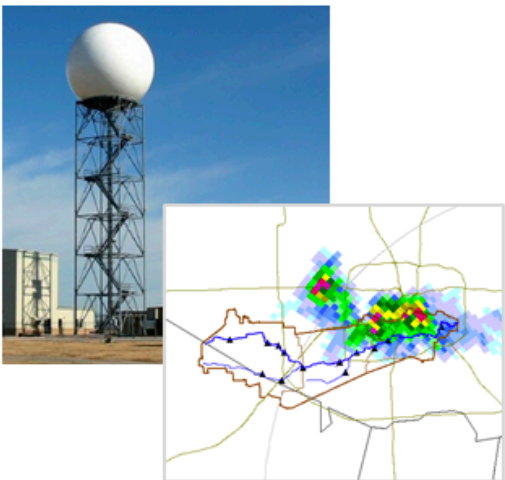
## Abandoned Houses





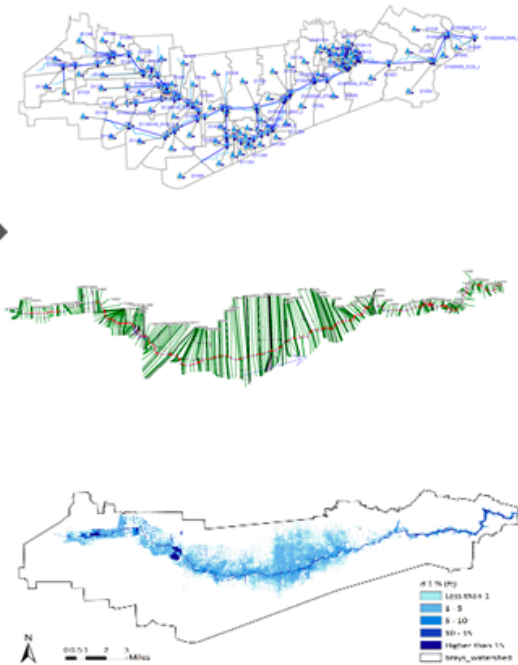
# Radar-Based Flood Alert System

## DATA ACQUISITION



- Radar rainfall (NEXRAD)
- Flow and stage gage data
- Water levels at watch points via bayou cameras

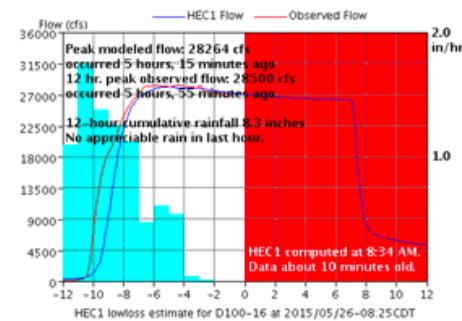
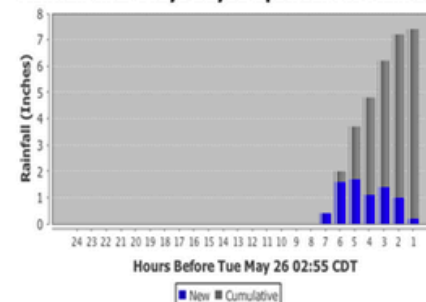
## HYDROLOGIC / HYDRAULIC ANALYSIS



- Hydrologic and hydraulic models (HEC-HMS and HEC-RAS)
- Floodplain mapping

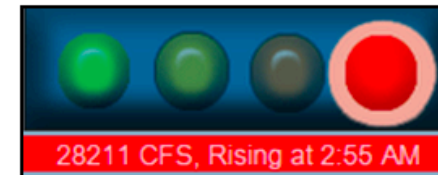
## REAL-TIME FLOOD WARNING INFO

Rainfall over Brays Bayou upstream of Main St.

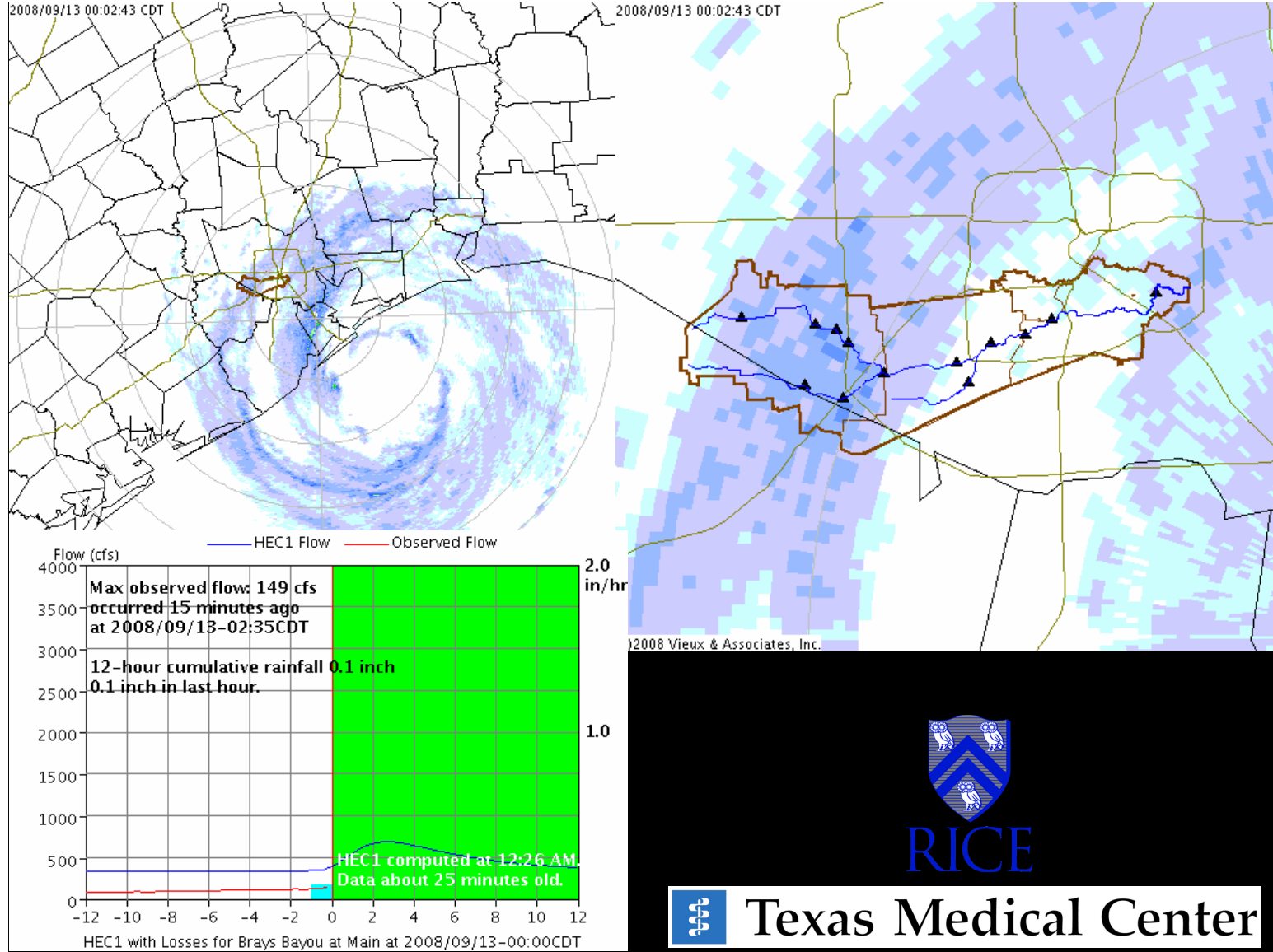


- Real-time rainfall and flow hydrographs at watch points
- Floodplain map library (FPML)

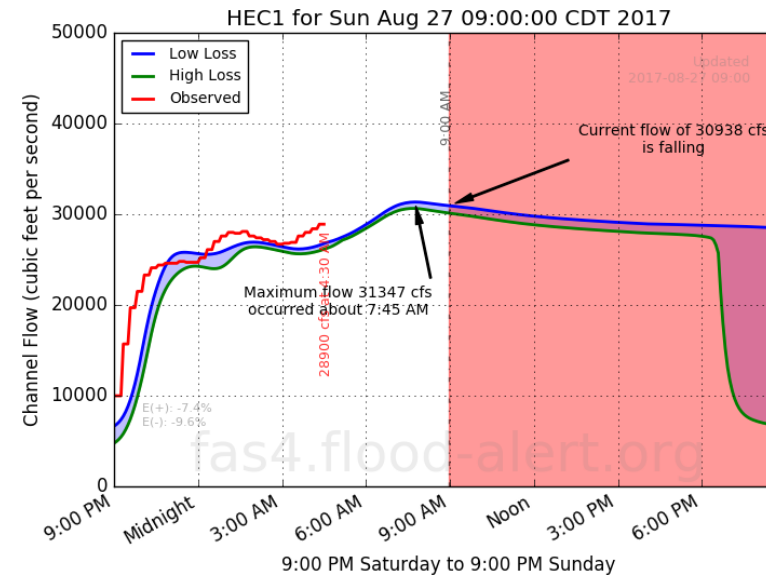
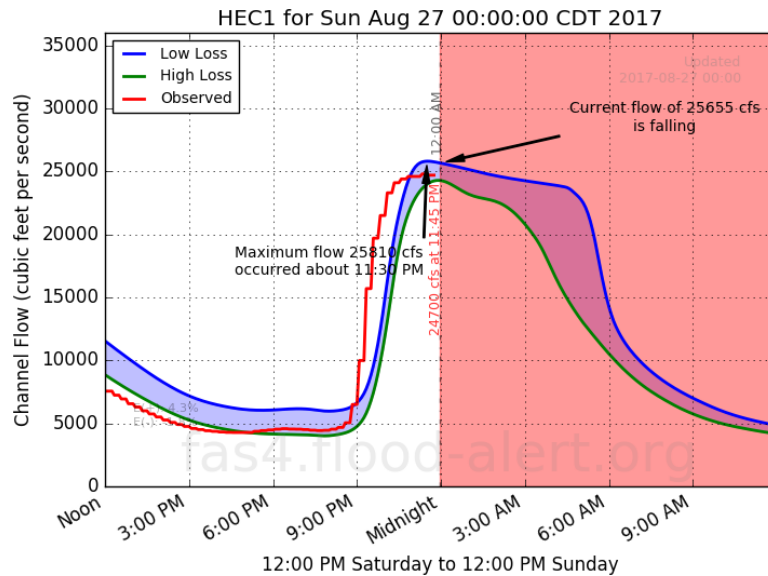
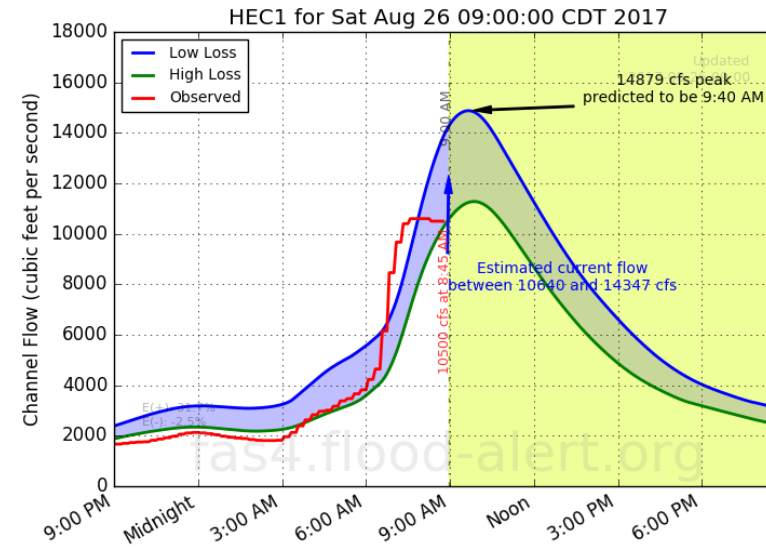
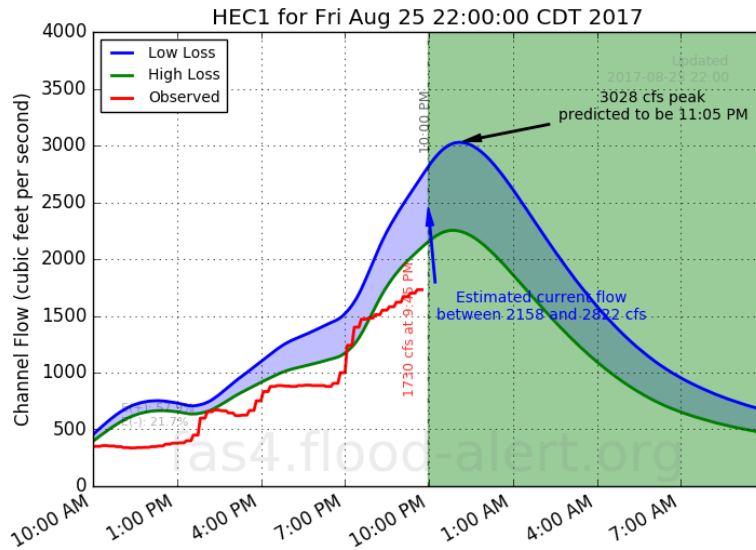
## COMMUNICATION



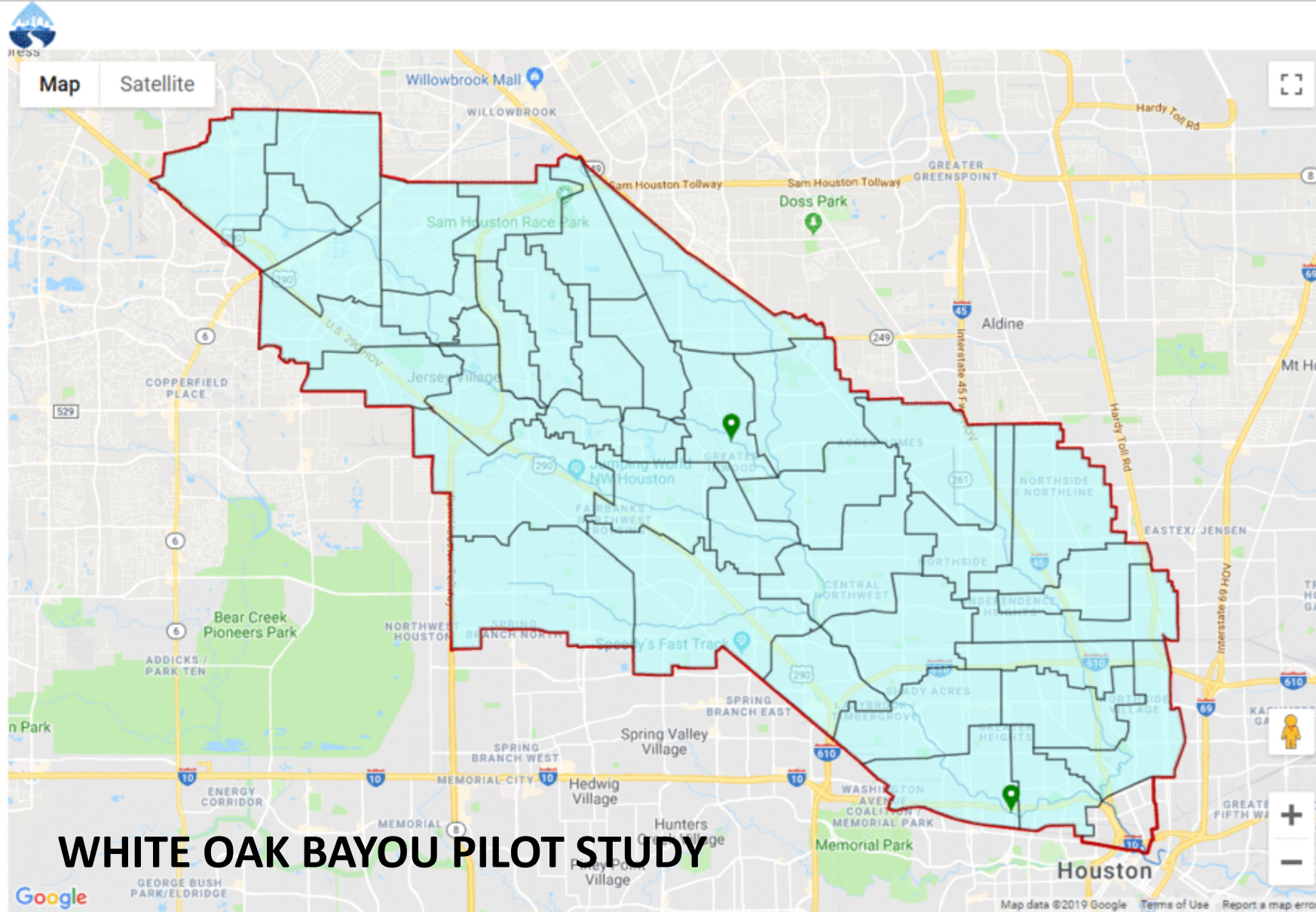
- Establish warning thresholds
- Automatic communication via text, email, and/or FAS website



# FAS PERFORMANCE DURING HARVEY 2017







# WHITE OAK BAYOU PILOT STUDY

**Rainfall Rate (Inches / Hour)**



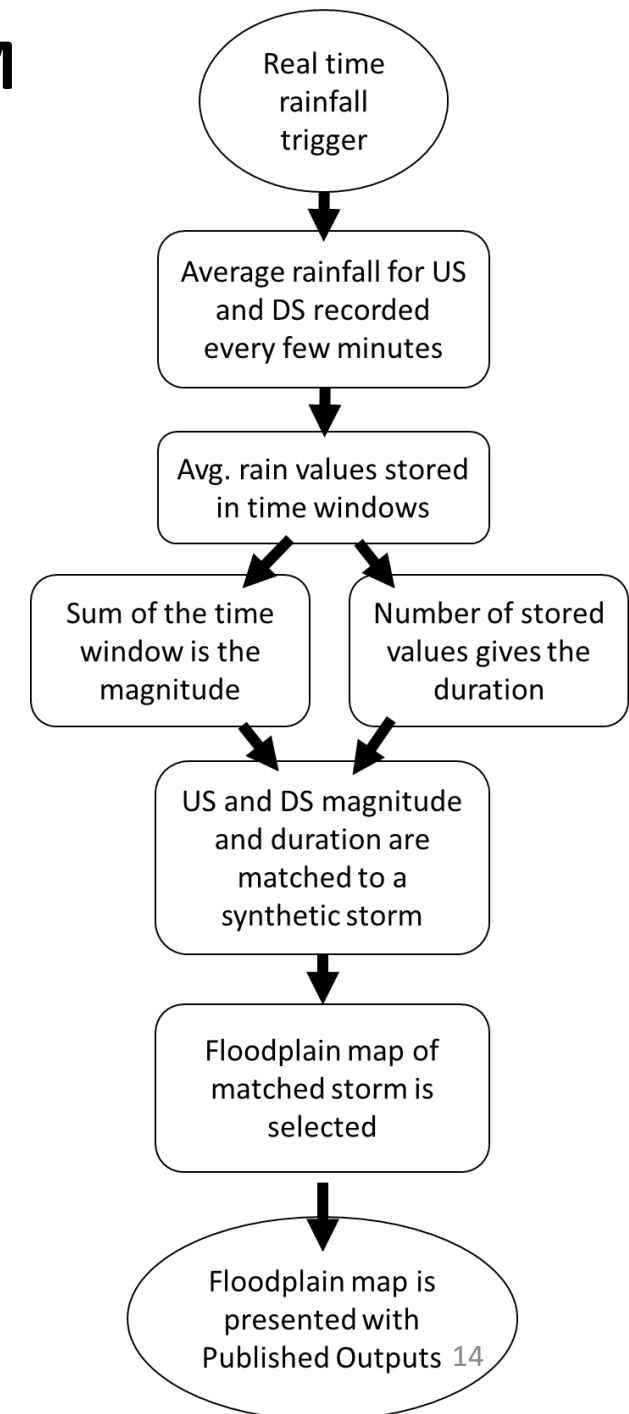
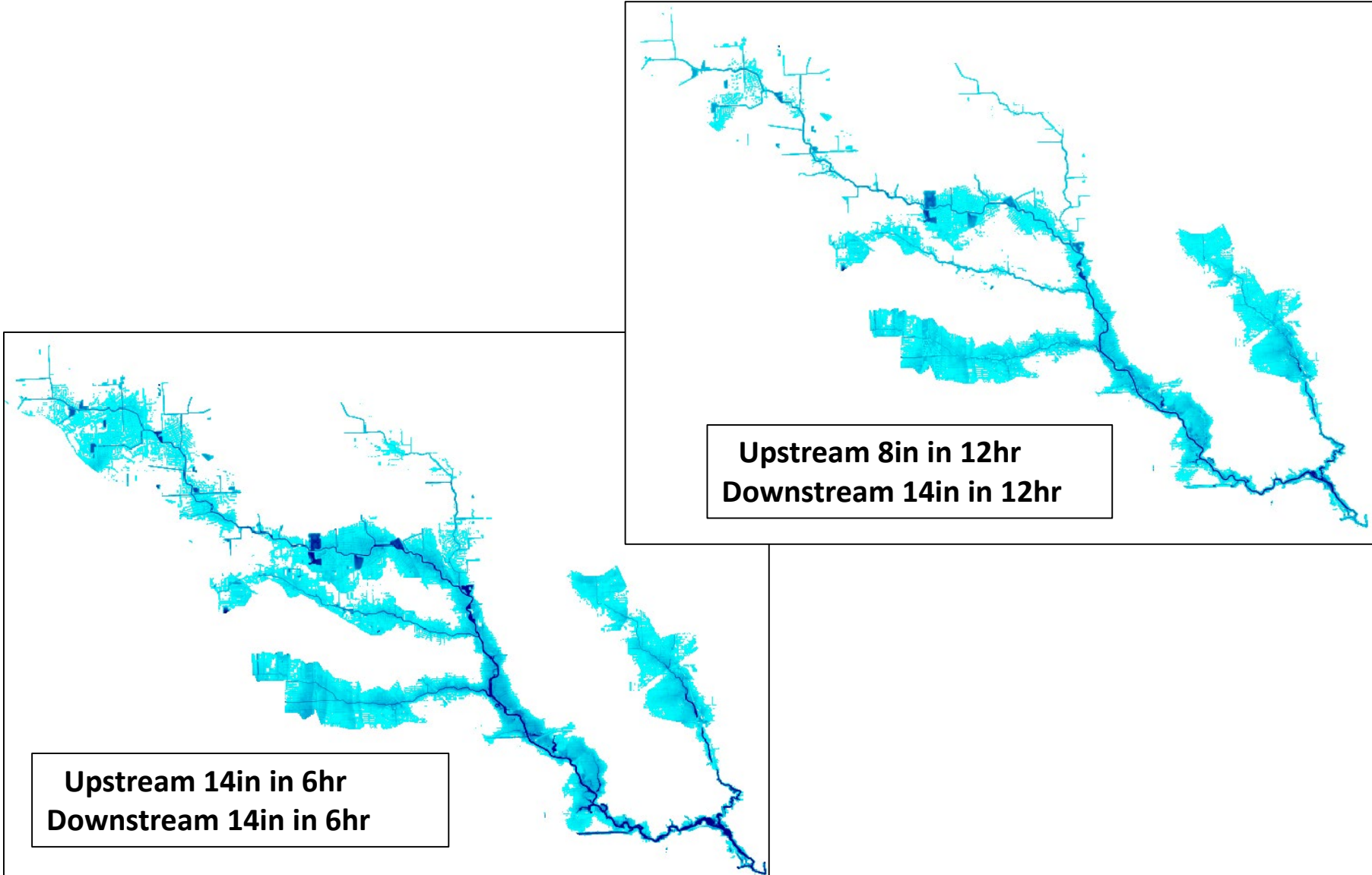
The map shows the estimated hourly rainfall rate based on 15-minute data as of 4/7/19 12:00:00 PM

Stream levels:

SiteNo	Value	Timestamp	Risk
08074020	60	4/7/19 12:00:00 PM -05:00	Low

# FLOODPLAIN MAP LIBRARY & MAP SELECTION ALGORITHM

Allows Access to Critical Facilities in RT – Predict Road Closures

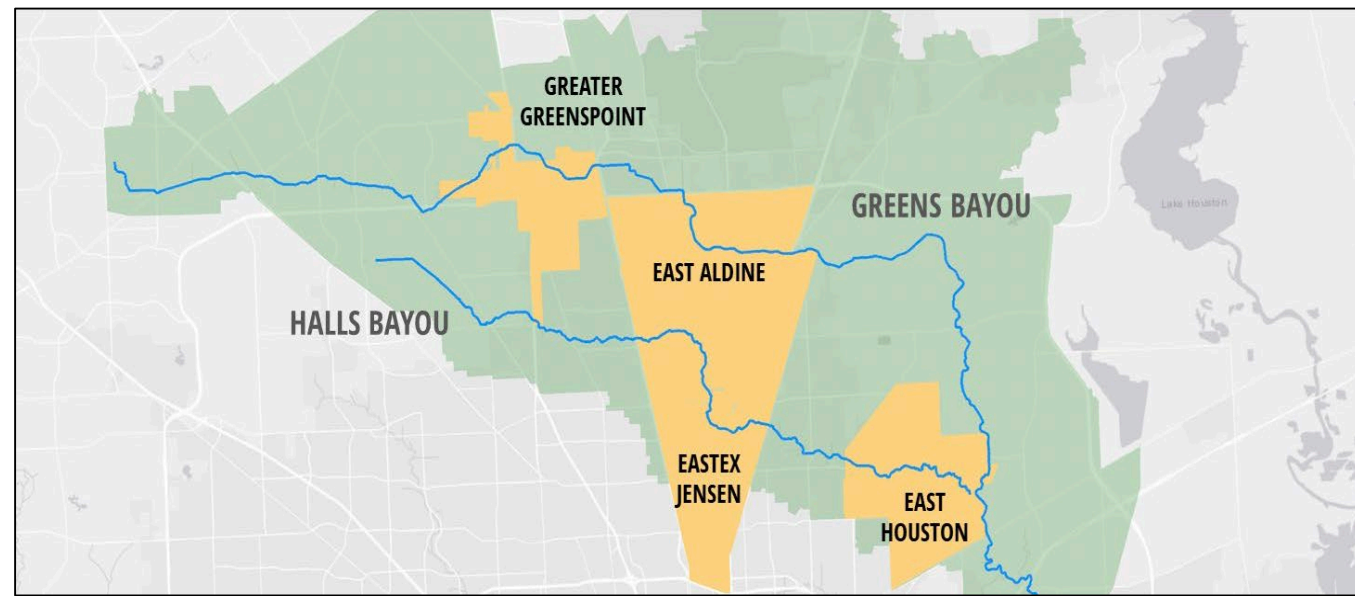




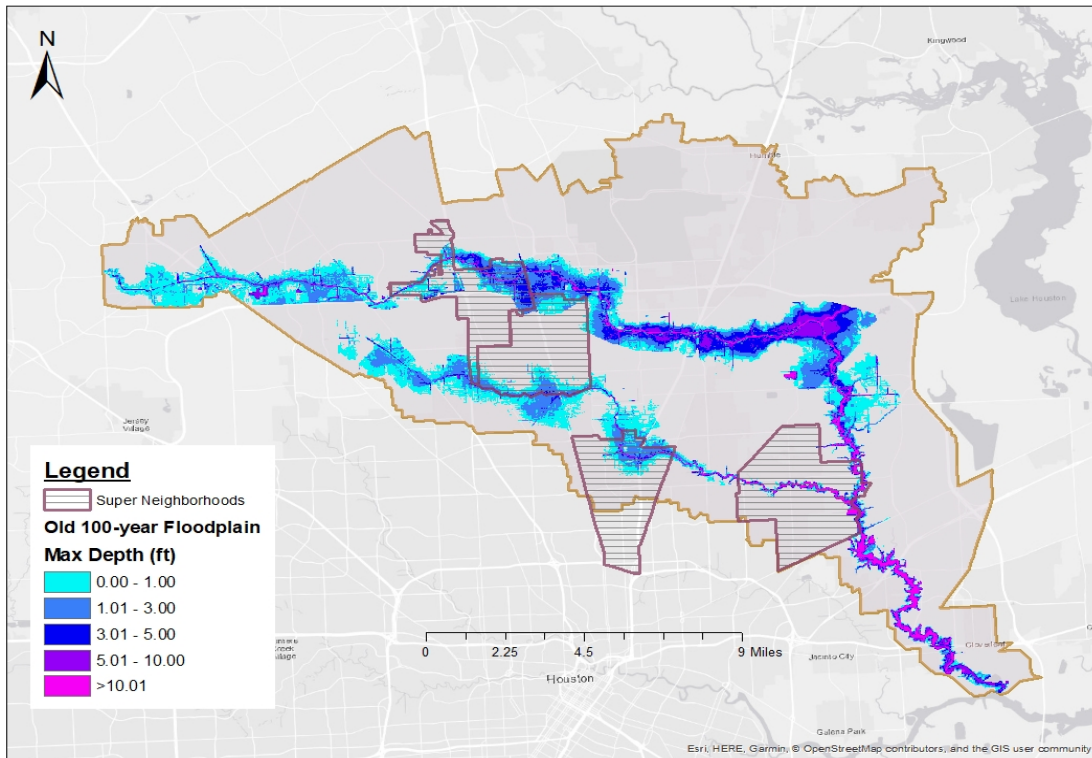
# Greens Bayou Watershed

Funded by GHFMC - 2018

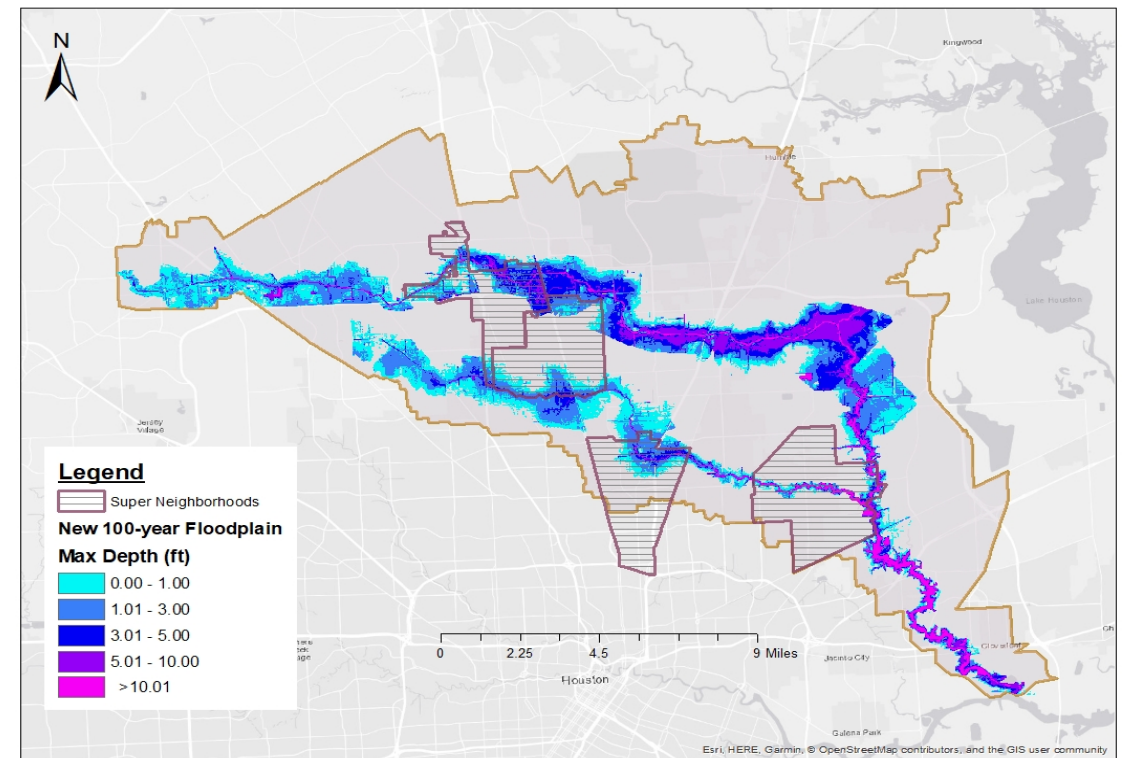
- Perform a flood hazard analysis of the new 100-year and 500-year storms focusing on four neighborhoods: Greater Greenspoint, East Aldine, Eastex/Jensen, & East Houston.
- Evaluate the impacts of selected mitigation options for each neighborhood under the new 100-year and 500-year storms.
- Involve neighborhood community leaders for input on the favorable mitigation strategies.



# FEMA vs. New 100 Yr Floodplains for Greens Bayou



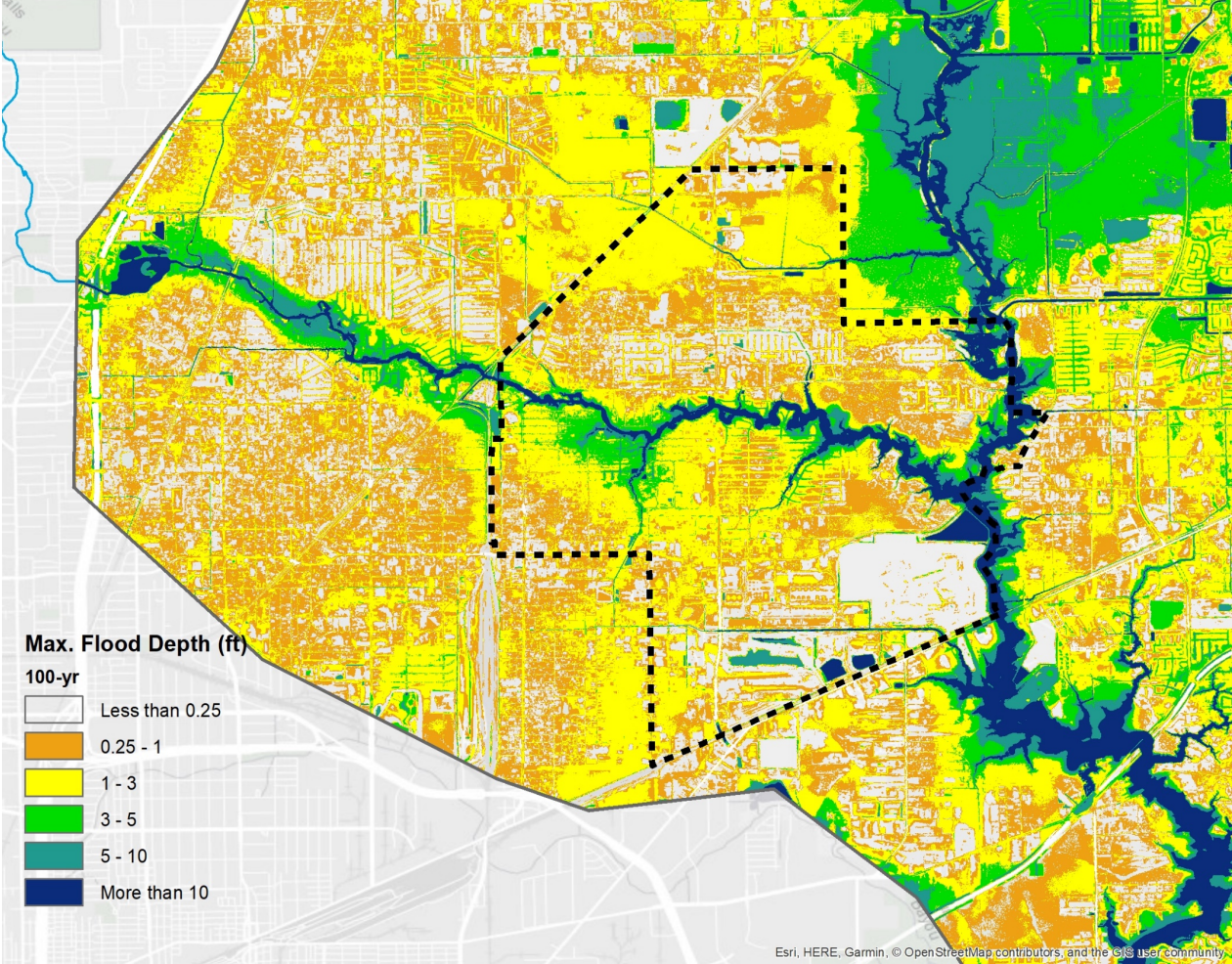
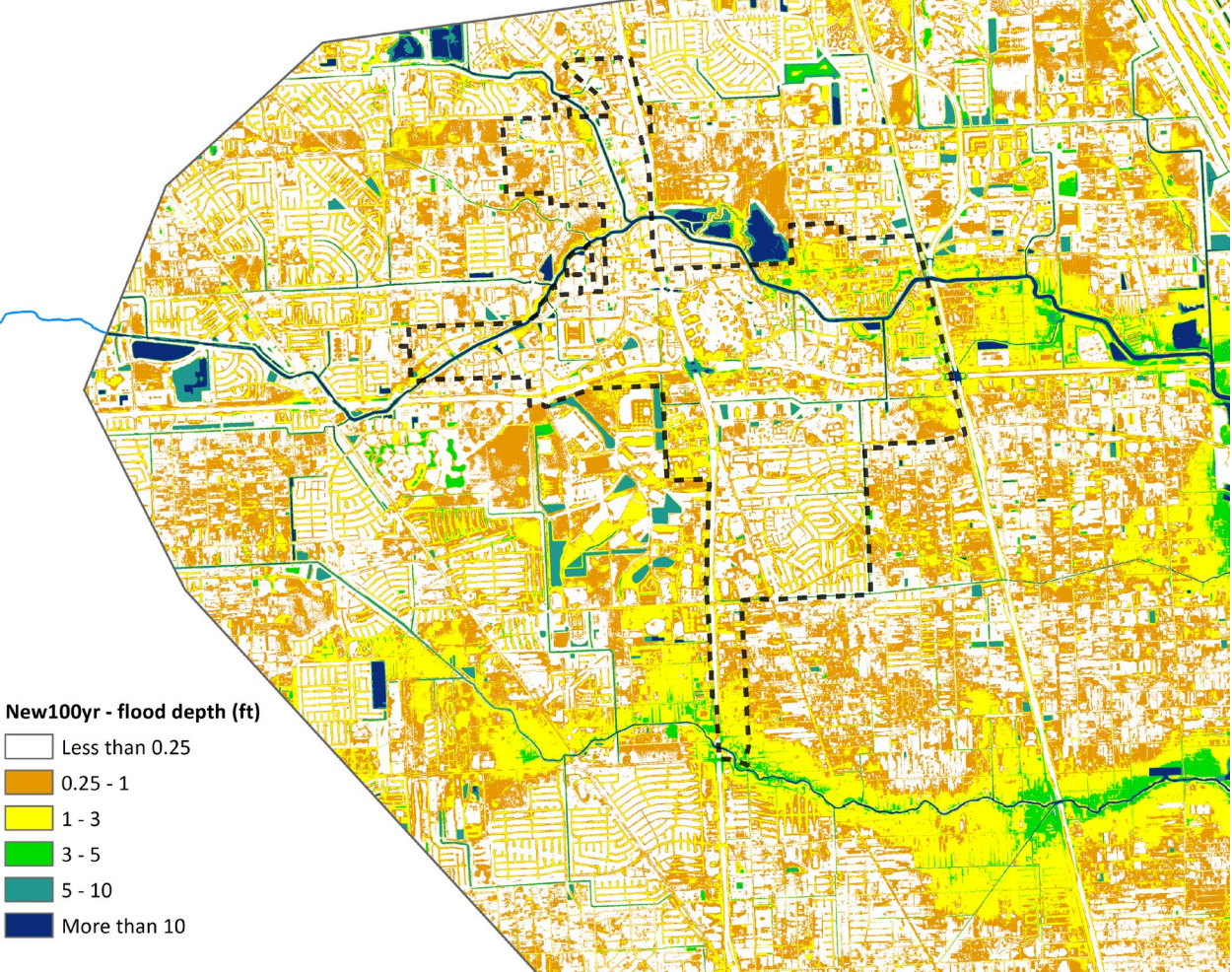
*Old 100-year Floodplain 13 in*



*New 100-year Floodplain 18 in*



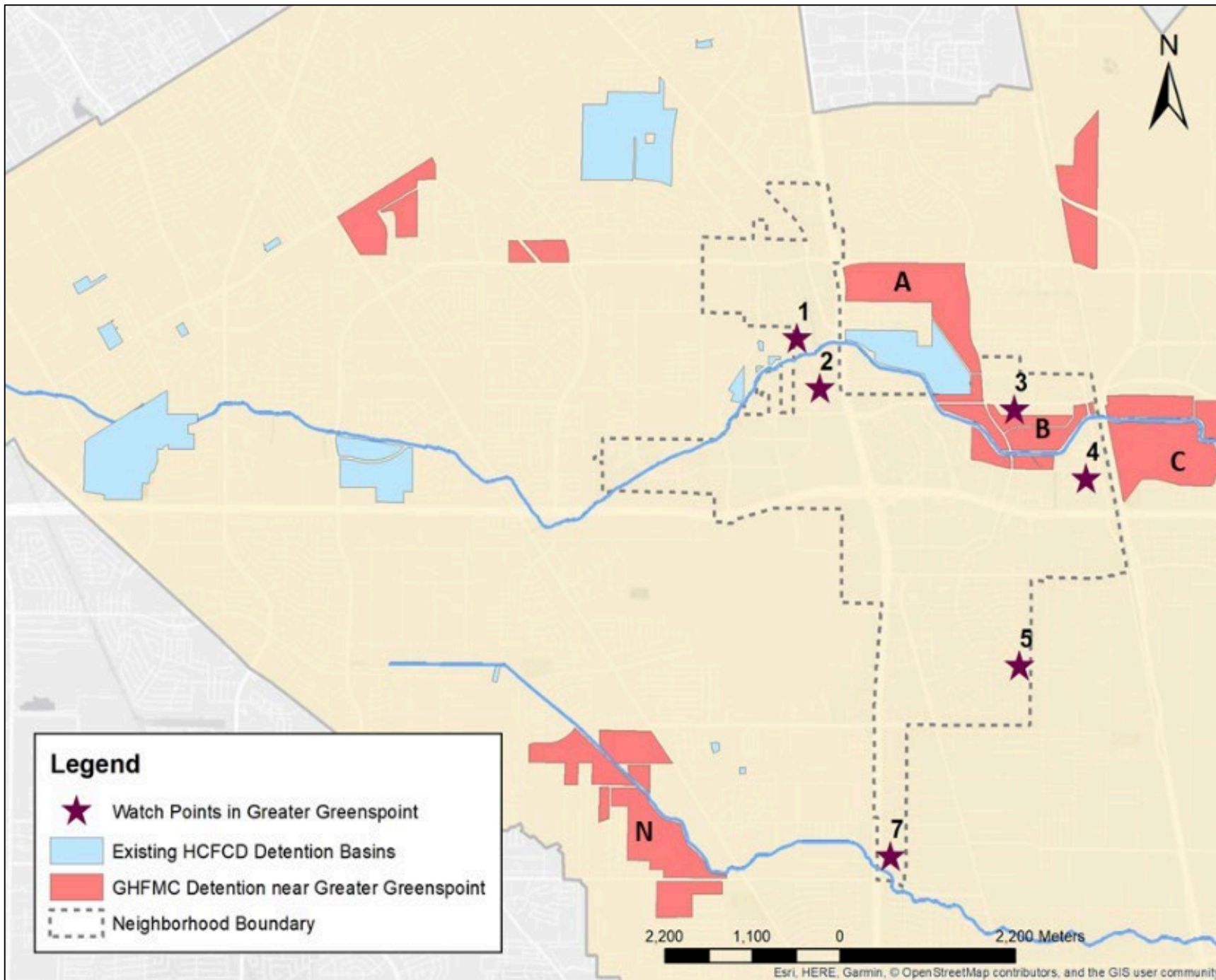
# New 100 year Upper and Lower Greens Bayou (2-D HEC RAS)





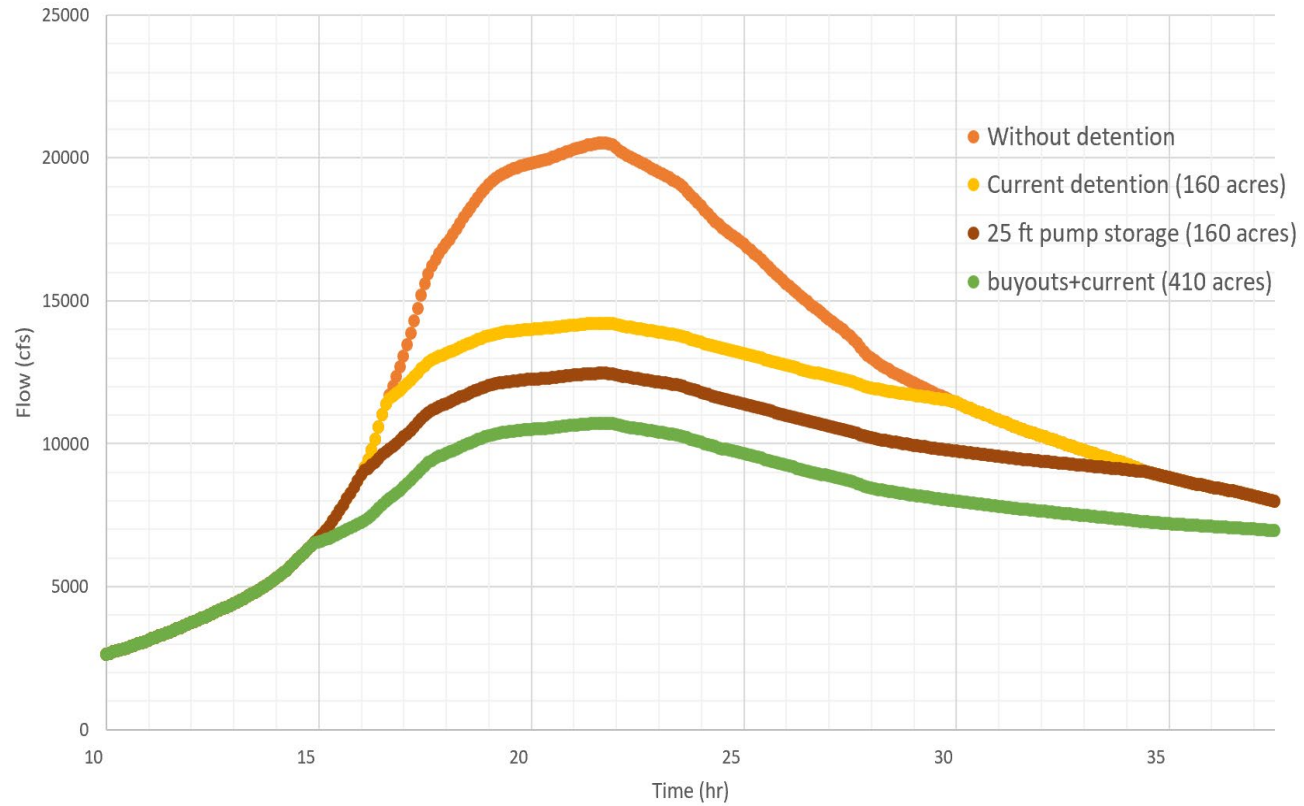
# Greens Point Flooding Mitigation Options

- Small Detention Ponds
- Large Regional Ponds
- Buyouts & Relocation
- Pumped Storage Options
- Channel Bypass Options



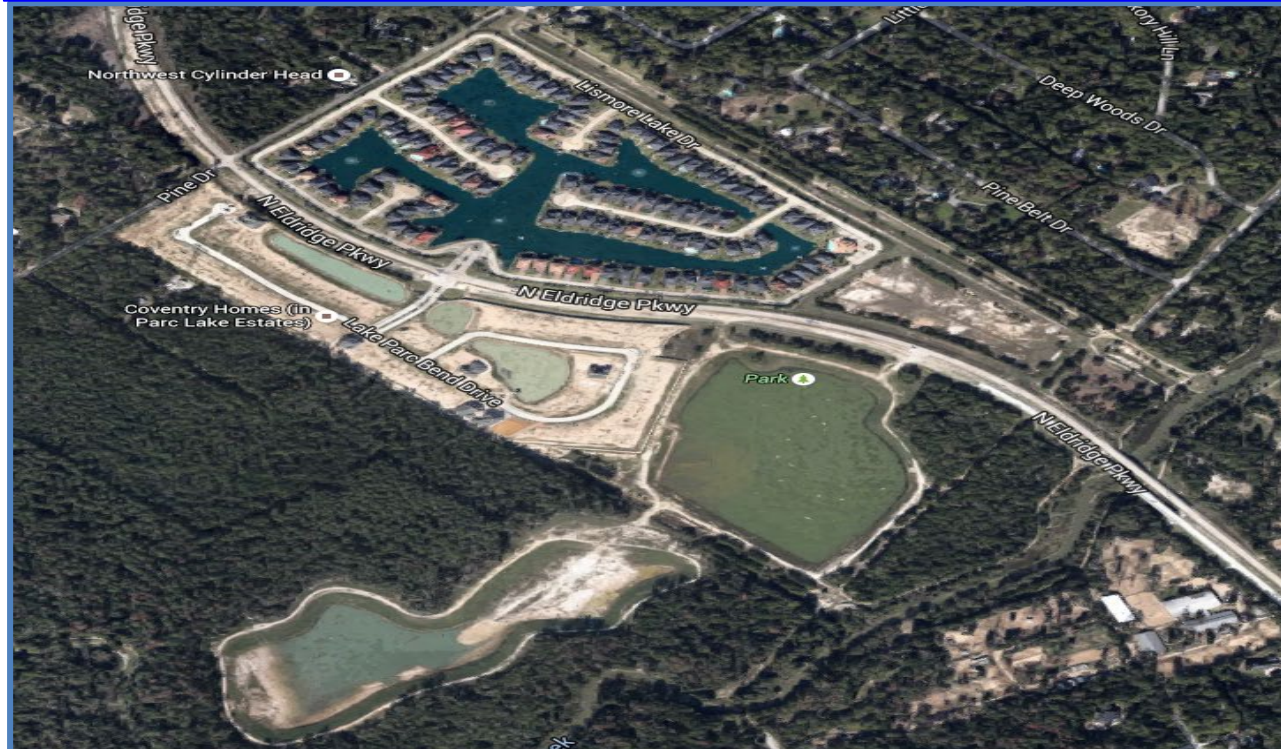
# Future: Detention & Pumped Storage

ATLAS 14 100-yr hydrograph on Greens Bayou near Greenspoint Mall





# Detention & Pumping for Flood Control In Fort Bend County





# Plans for Moving Forward

- Harvey highlighted the need for a more **regional approach** to managing risk
- Recognize that hazard **boundary conditions are changing**; the 100 year has become the 500 year floodplain
- Improve **mapping** of “safe zones”, transitional areas (once flooded), and high-risk areas at multiple scales
- Prioritize home **buyouts** in flood prone areas (repetitive loss properties)
- Expand use of existing and new **flood warning** technologies to the region and customize their use
- Expand **regional and local detention, drainage, & pumping policies** to offset current and future urban development

