EVALUATING NEIGHBORHOOD-SCALE FLOOD HAZARD FOR GREENS BAYOU WATERSHED

OCTOBER 21, 2019

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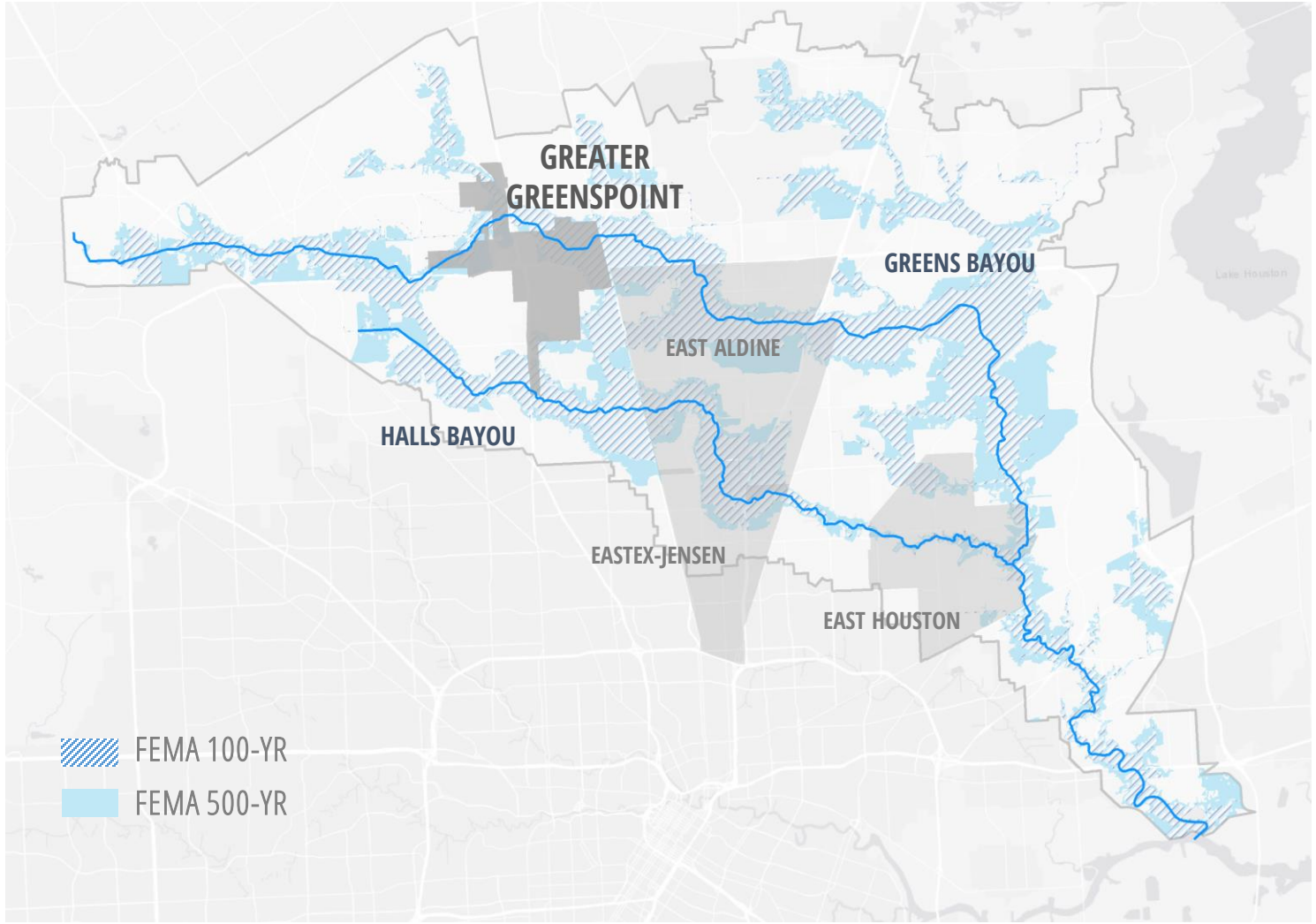
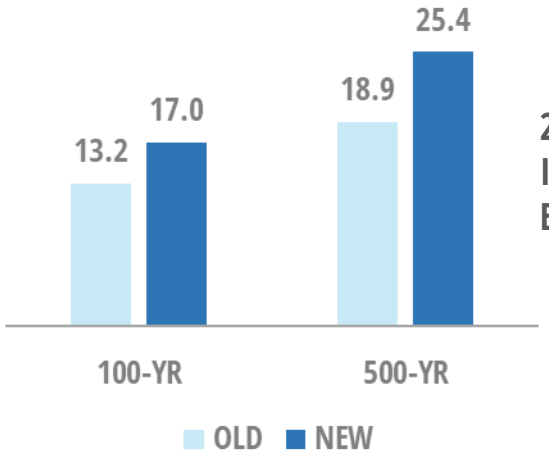
Severe Storm Prediction,
Education, & Evacuation from Disasters

GREENS BAYOU WATERSHED & GREATER GREENSPOINT



- Approx. 7 square miles (Greenspoint)
- Gradual disinvestments since the 1980s (high vacancy rates in area office buildings and retail spaces)
- Low income communities in multi-family housing
- Major flood losses in recent storms



24-HR RAINFALL (IN INCHES) FOR GREENS BAYOU WATERSHED

GREATER GREENSPOINT

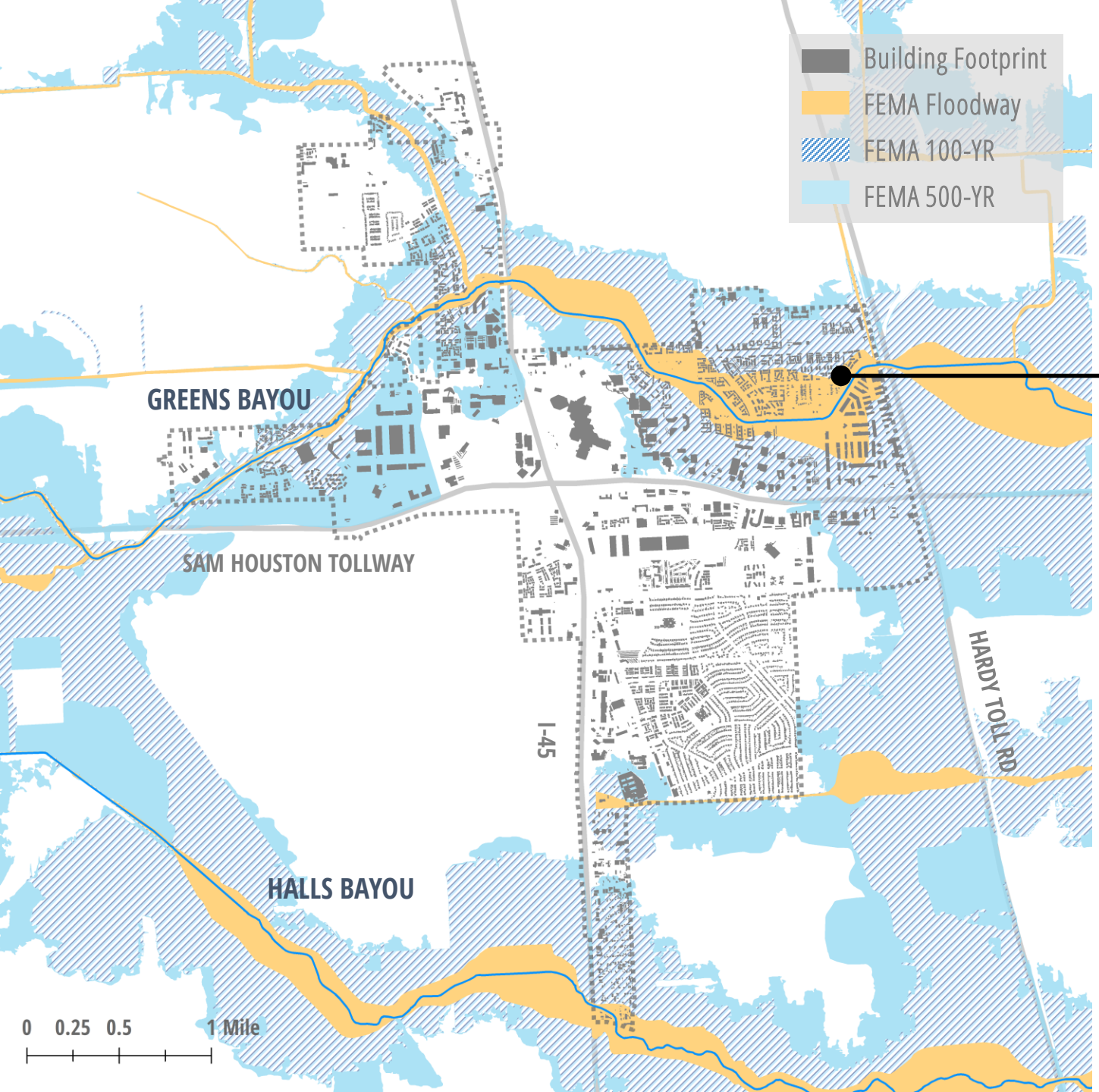


Image source: Houston Chron

METHODOLOGY

INPUT

- Rainfall: gauge
- Topography: LIDAR 2018
- Land use: HGAC 2018
- Reference models: HCFCD M3 system

HYDRAULIC MODELING

- Hydraulic model: HEC-RAS 2D
- Model validation: gage records and high water marks for Harvey (2017)

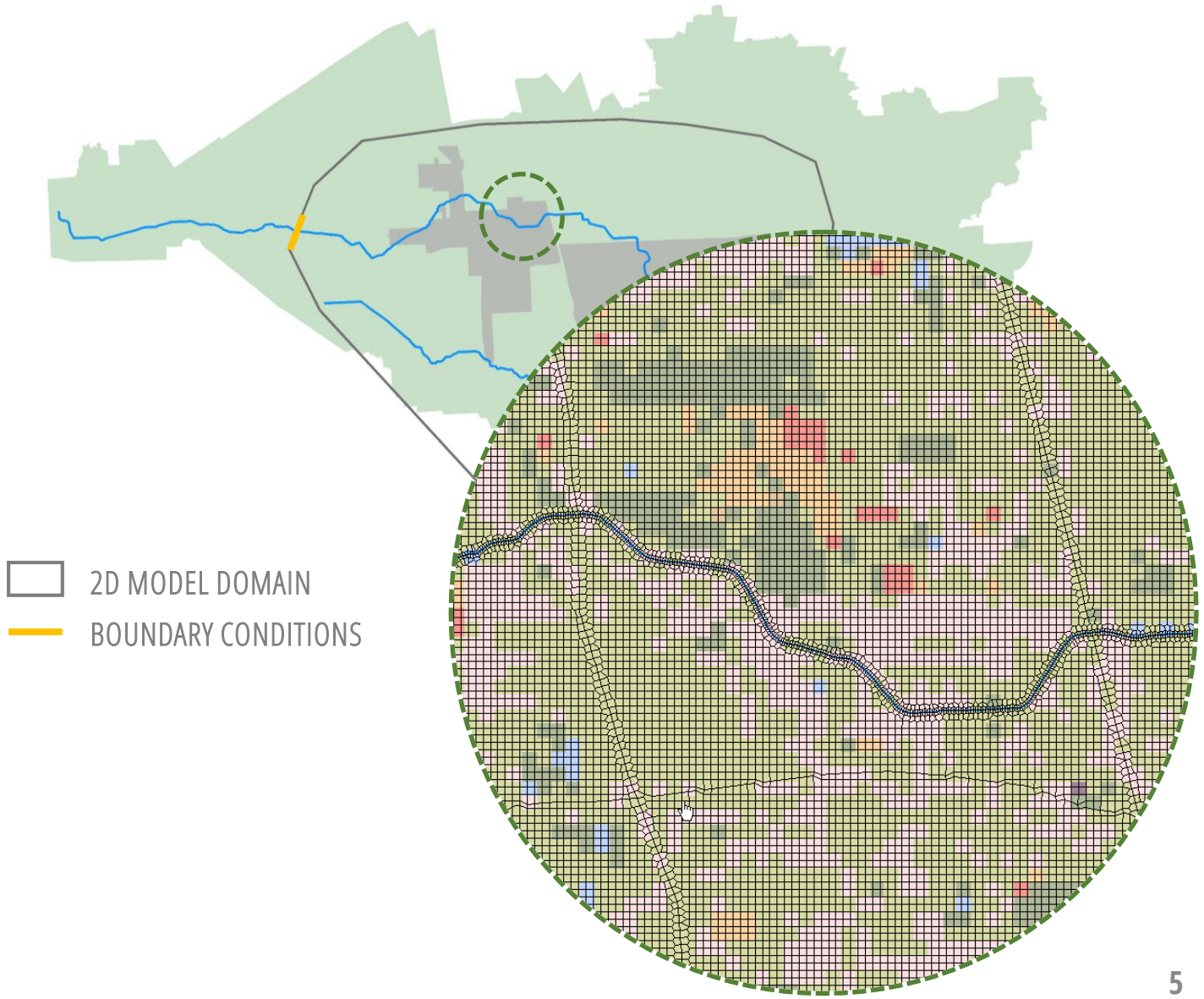
OUTPUT

- Metrics: WSE, flood depth, discharge, flow velocity
- Flood hazard scenarios: 2, 5, 10, 25, 50, 100, and 500-yr (HCFCD and NOAA Atlas 14)

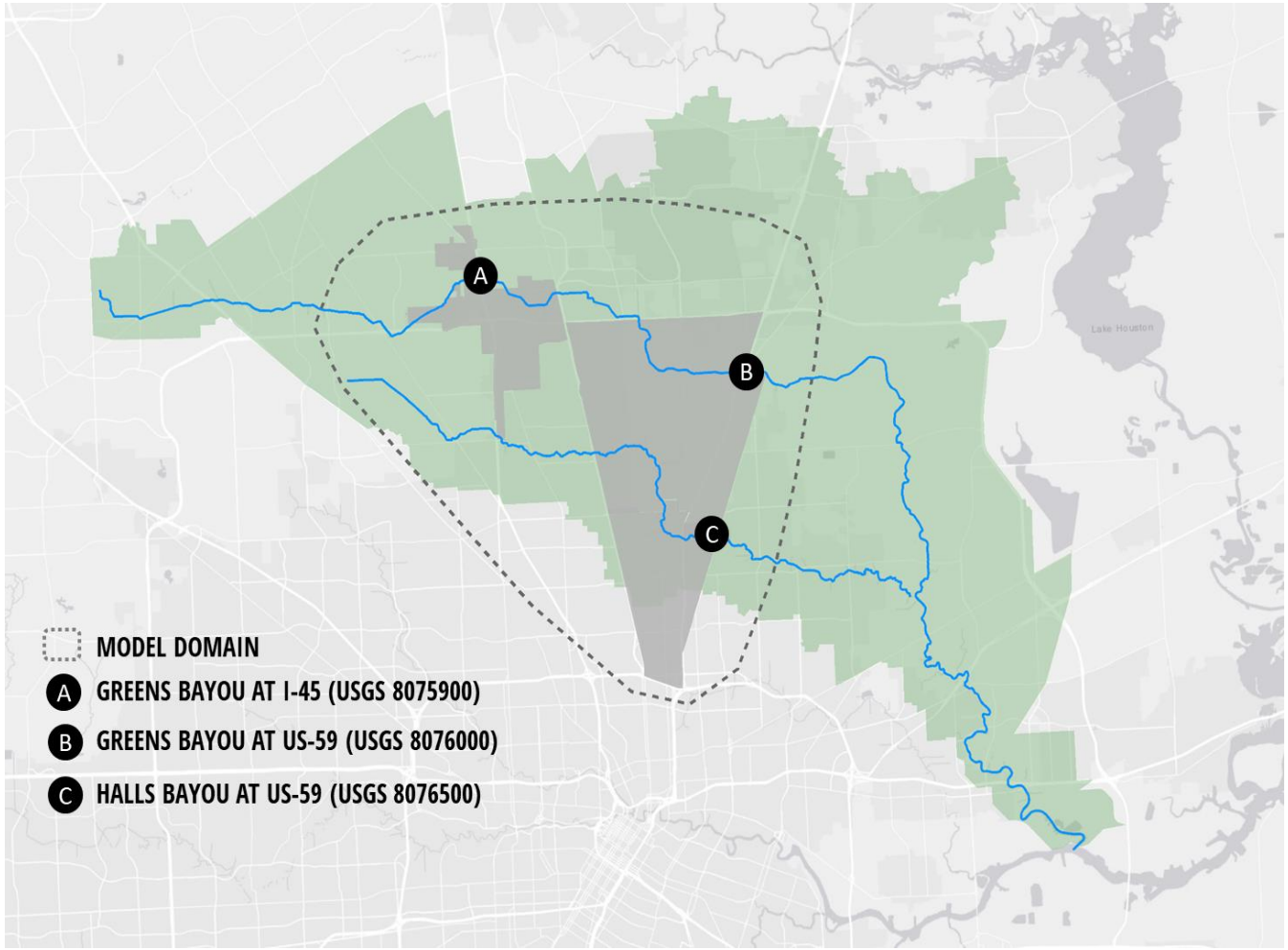
HEC-RAS 2D MODEL SETUP

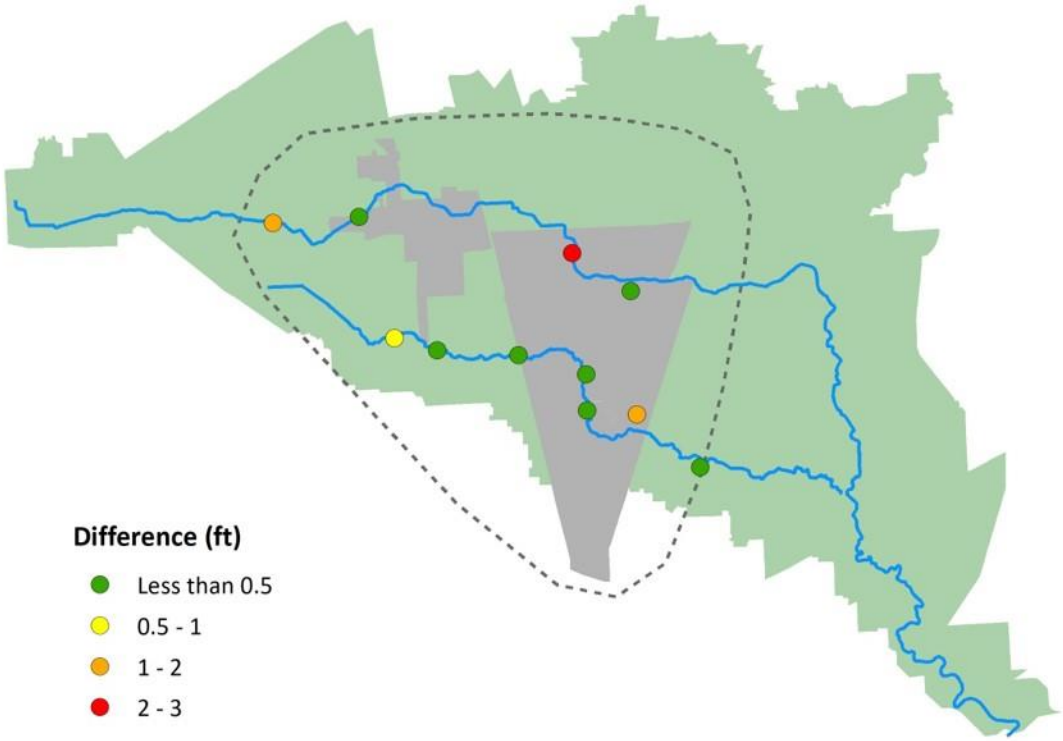
Model parameters:

- **Domain**: 150 ft grid resolution, breaklines on channels and major highways
- **Roughness**: channel (0.045), overland (variable based on LULC)
- **Precipitation**: HCFCD or NOAA Atlas 14
- **Boundary conditions**: flow hydrograph (USGS or HEC-HMS M3) and normal depth

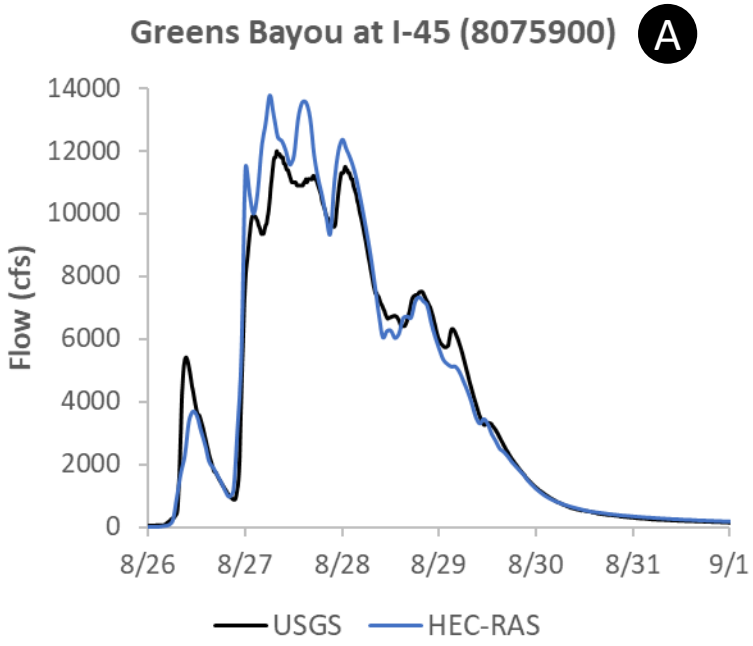


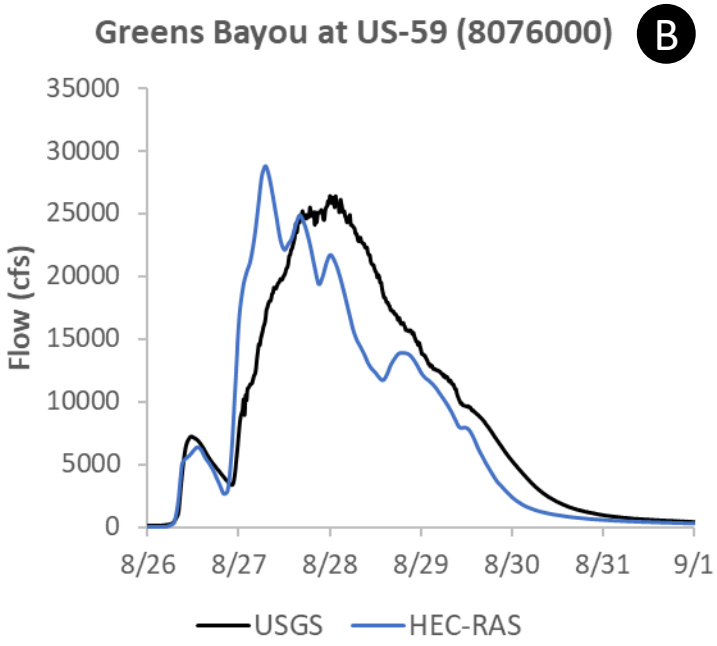
MODEL VALIDATION (HARVEY 2017)

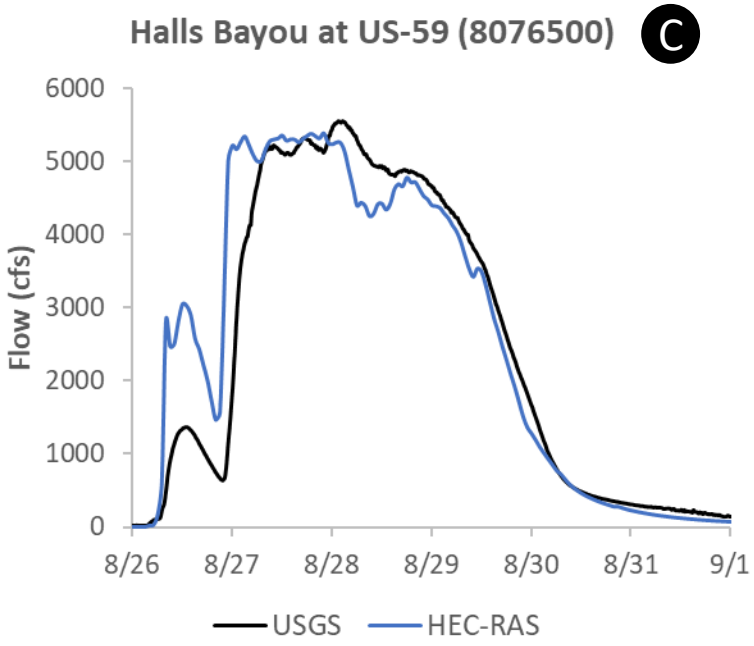


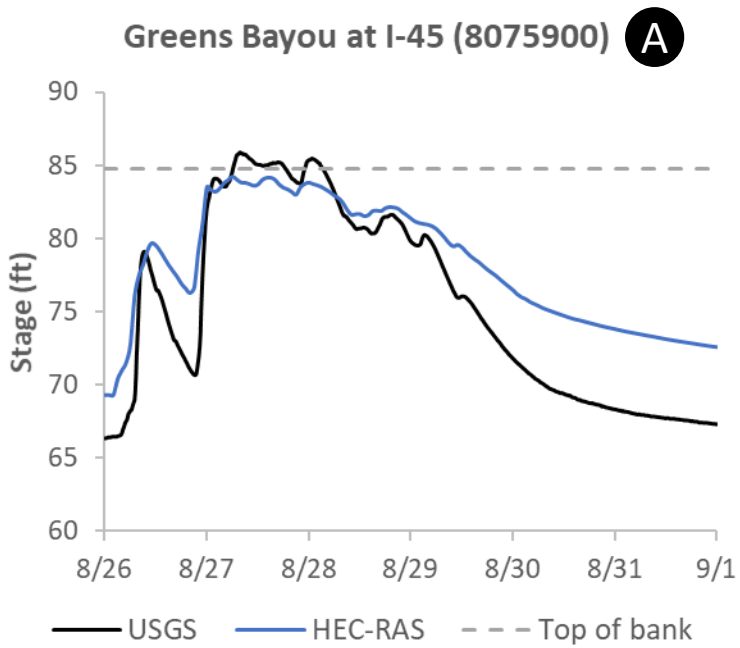


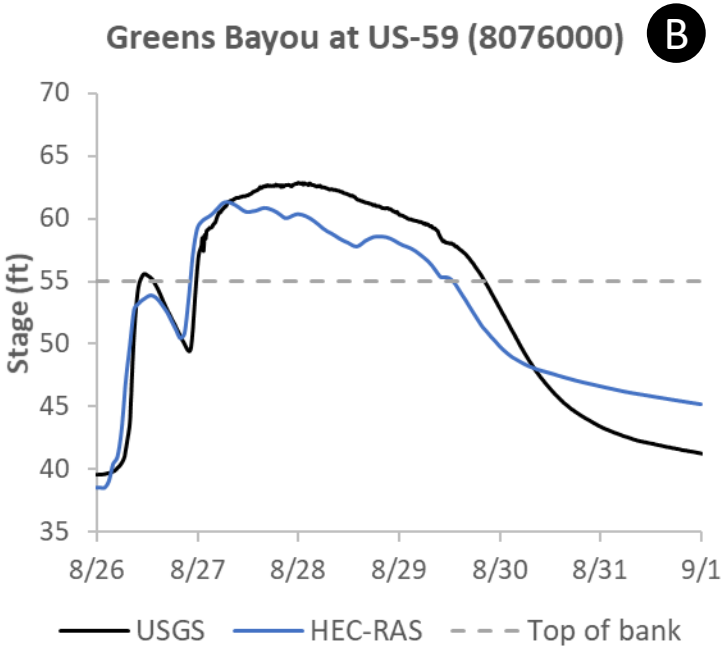
Difference in modeled vs recorded flood depths at available USGS high water marks

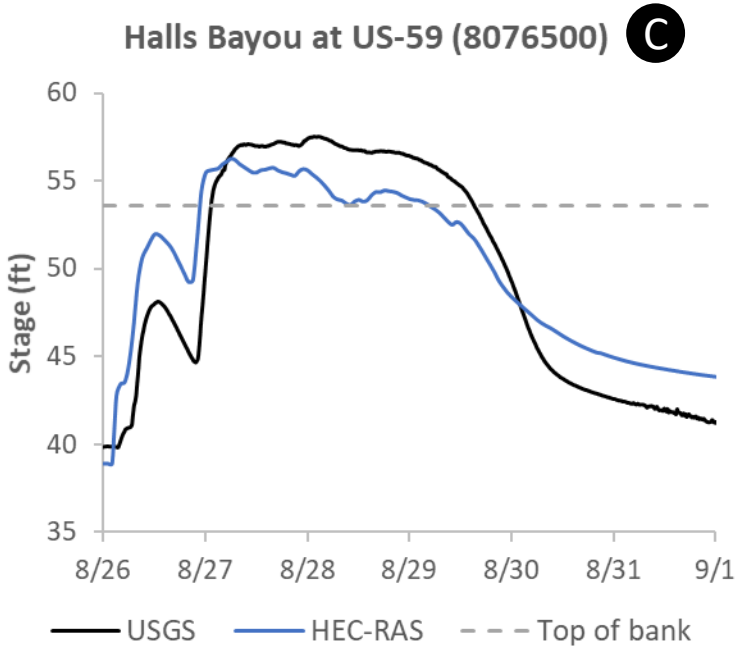

Greens Bayou at I-45 (8075900)
A
Flow (cfs)
14000
12000
10000
8000
6000
4000
2000
0
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS


Greens Bayou at US-59 (8076000)
B
Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS

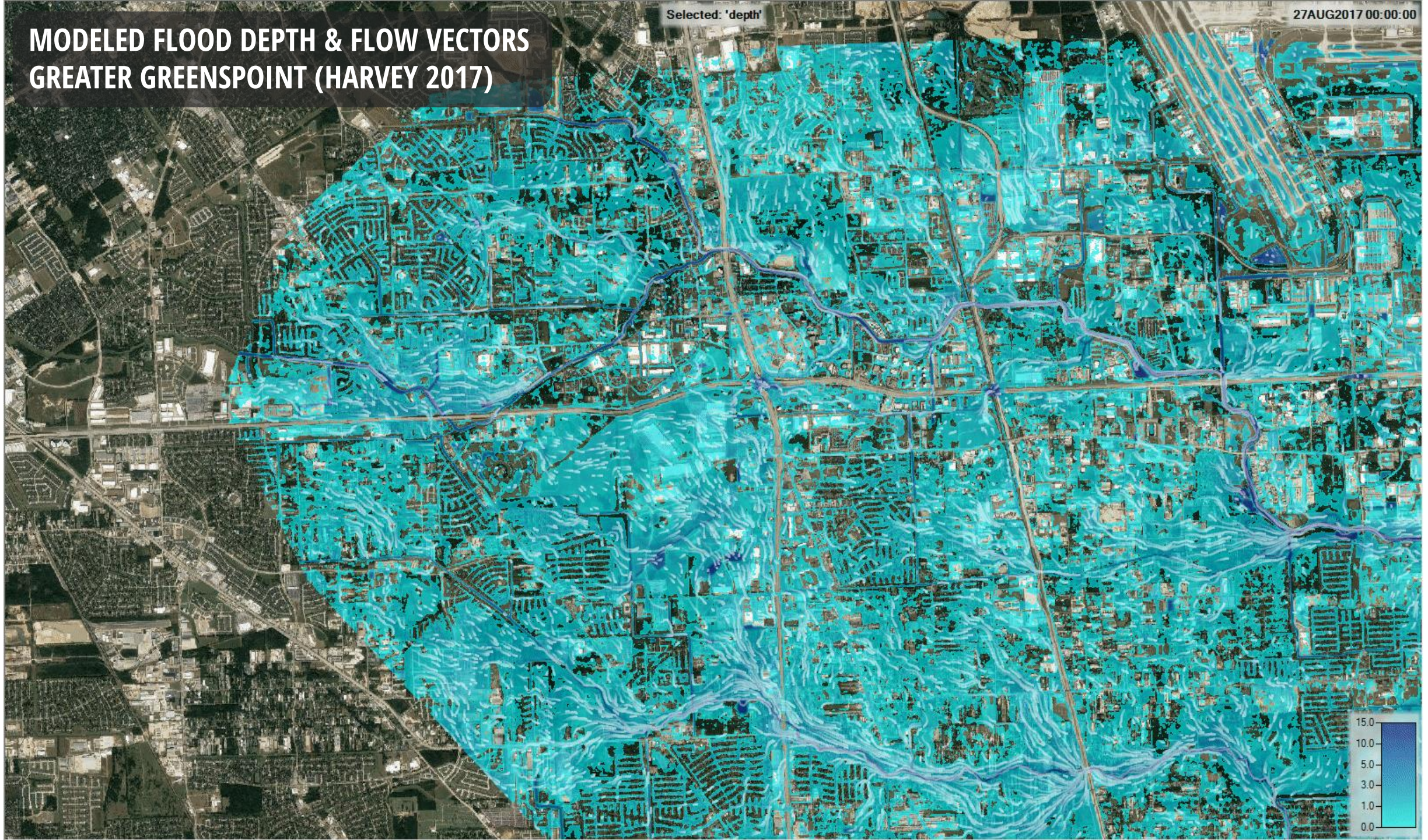

Halls Bayou at US-59 (8076500)
C
Flow (cfs)
6000
5000
4000
3000
2000
1000
0
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS


Greens Bayou at I-45 (8075900)
A
Stage (ft)
90
85
80
75
70
65
60
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS
Top of bank


Greens Bayou at US-59 (8076000)
B
Stage (ft)
70
65
60
55
50
45
40
35
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS
Top of bank

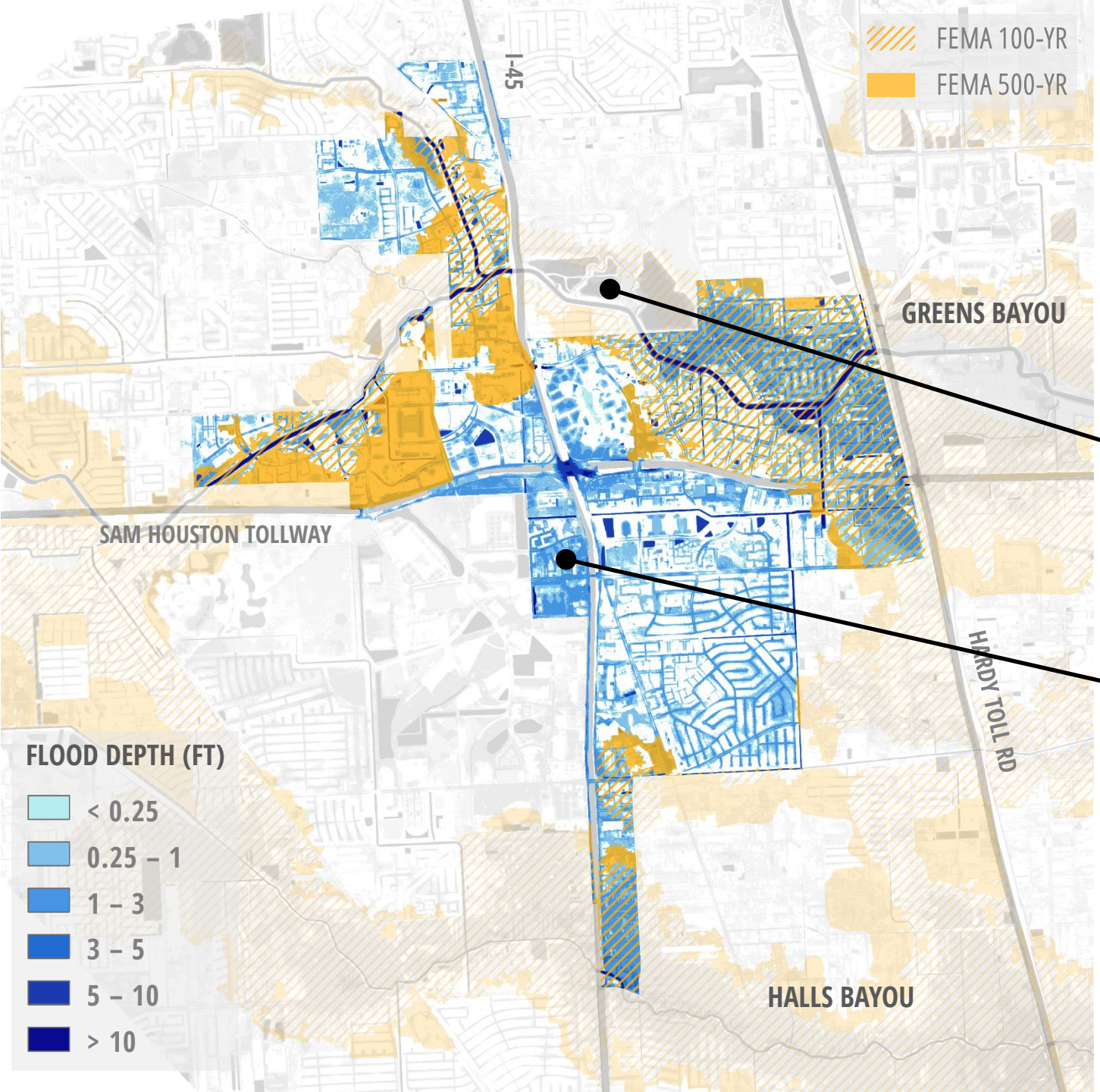

Halls Bayou at US-59 (8076500)
C
Stage (ft)
60
55
50
45
40
35
8/26
8/27
8/28
8/29
8/30
8/31
9/1
USGS
HEC-RAS
Top of bank

MODELED FLOOD DEPTH & FLOW VECTORS
GREATER GREENSPOINT (HARVEY 2017)



NEW 100YR FLOOD HAZARD

GREATER GREENSPOINT



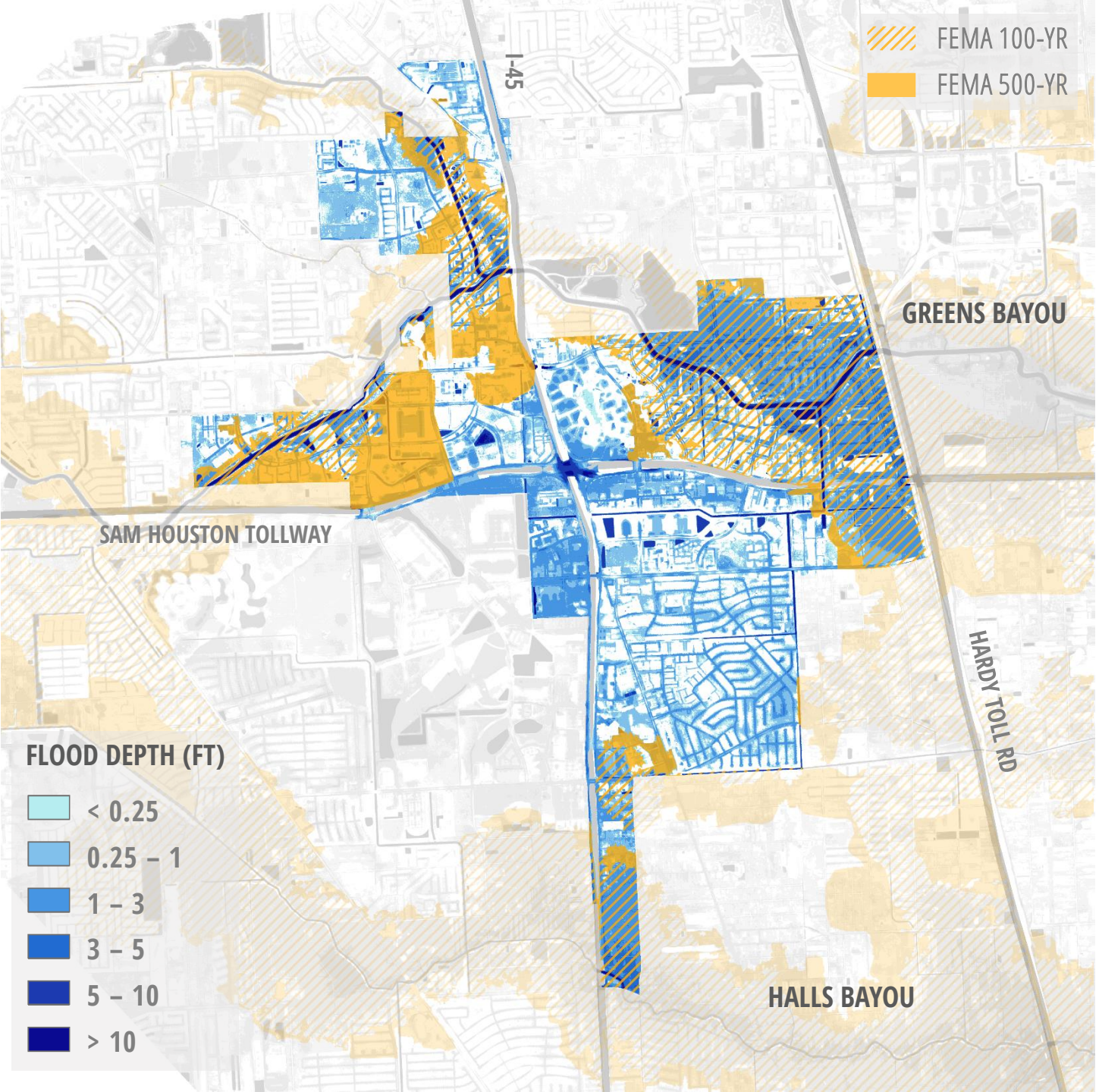
- Riverine (**fluvial**) flooding observed along Greens Bayou and Halls Bayou

  Recently completed HCFCD detention basins on Greens Bayou near I-45 (e.g., Glen Forest basin) appear to reduce downstream floodplain extent

- Local (**pluvial**) flooding hotspot south of Sam Houston Tollway

NEW 500YR FLOOD HAZARD

GREATER GREENSPOINT



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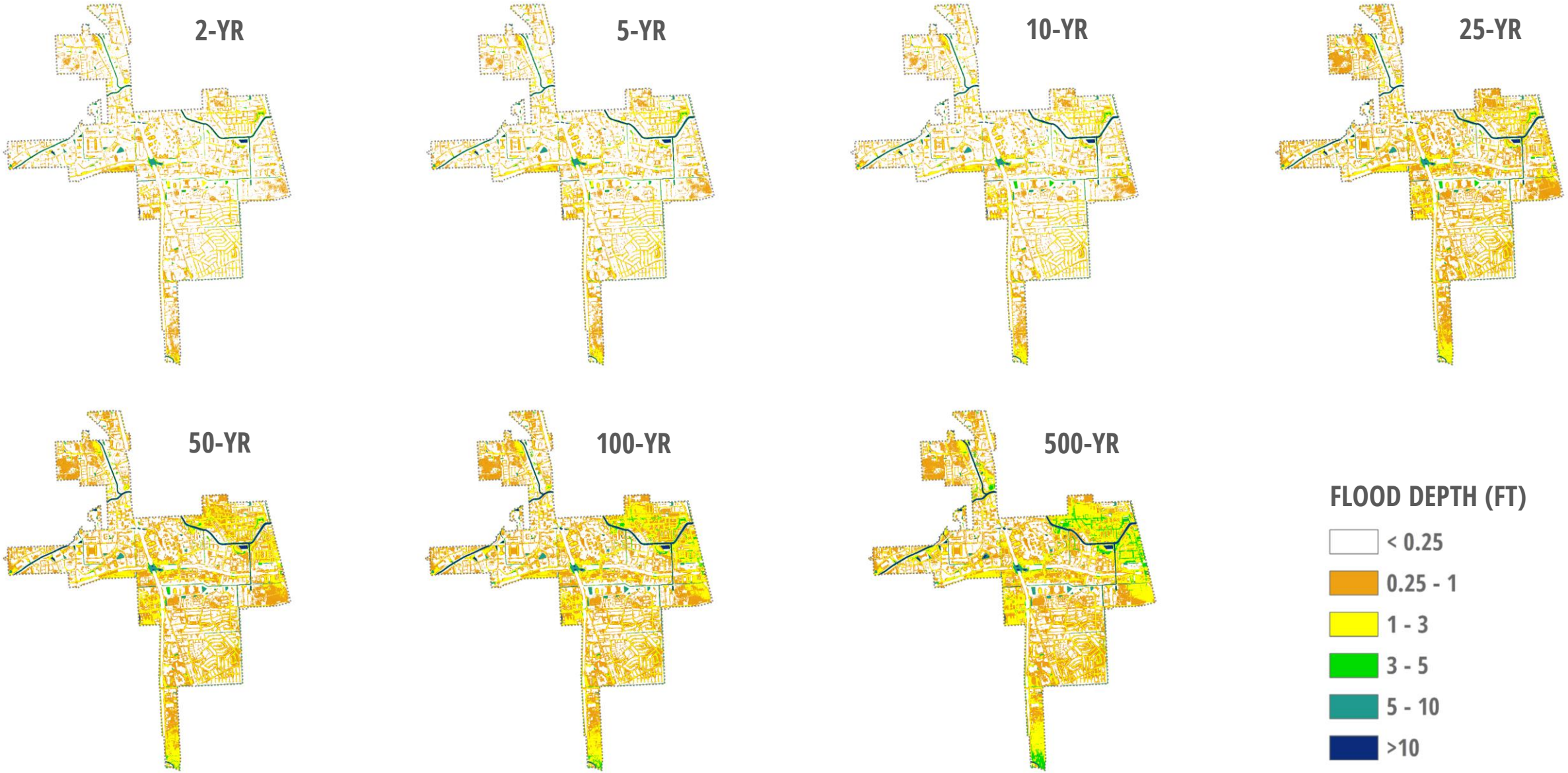
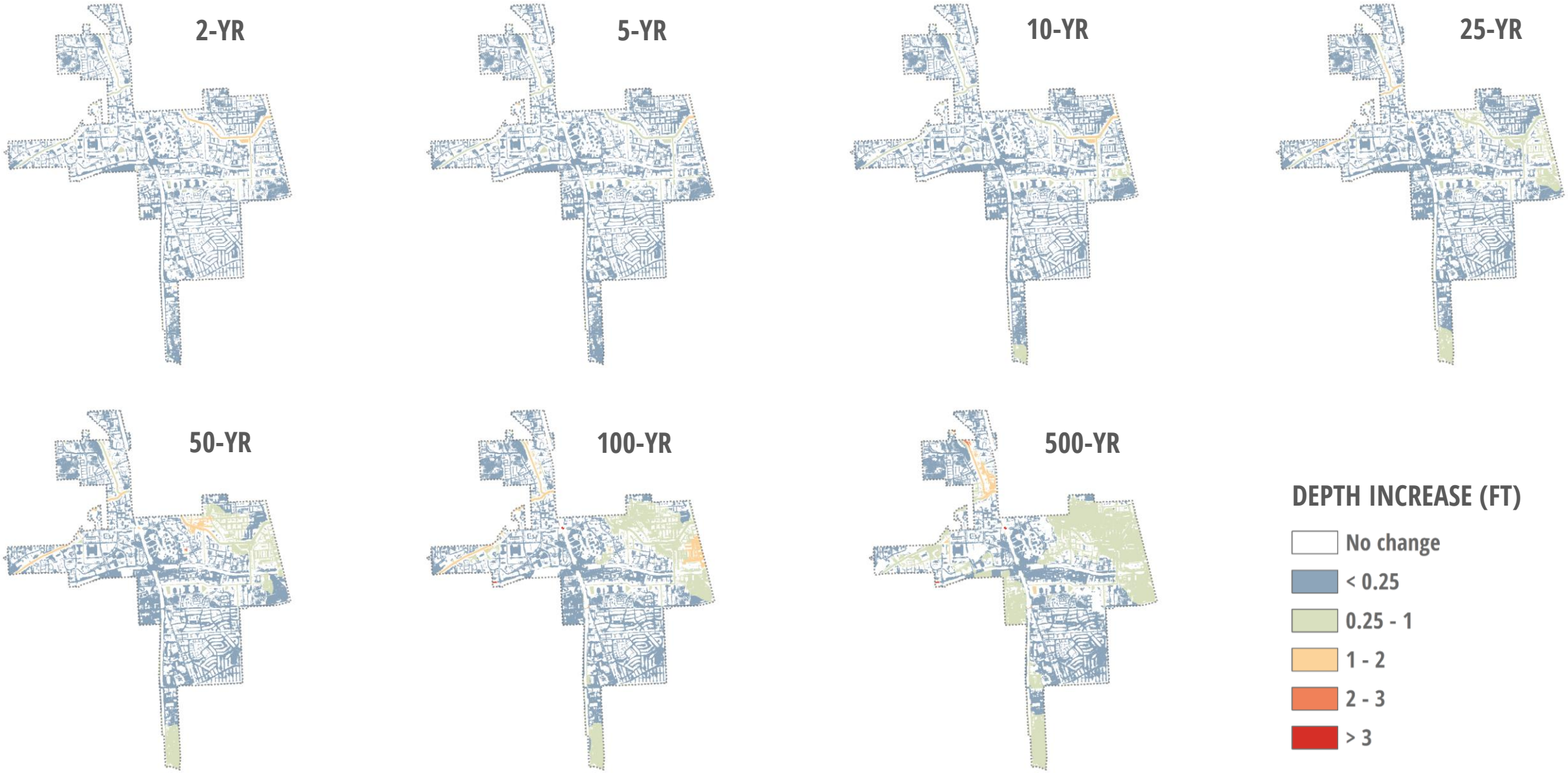
- Local (**pluvial**) flooding hotspot south of Sam Houston Tollway

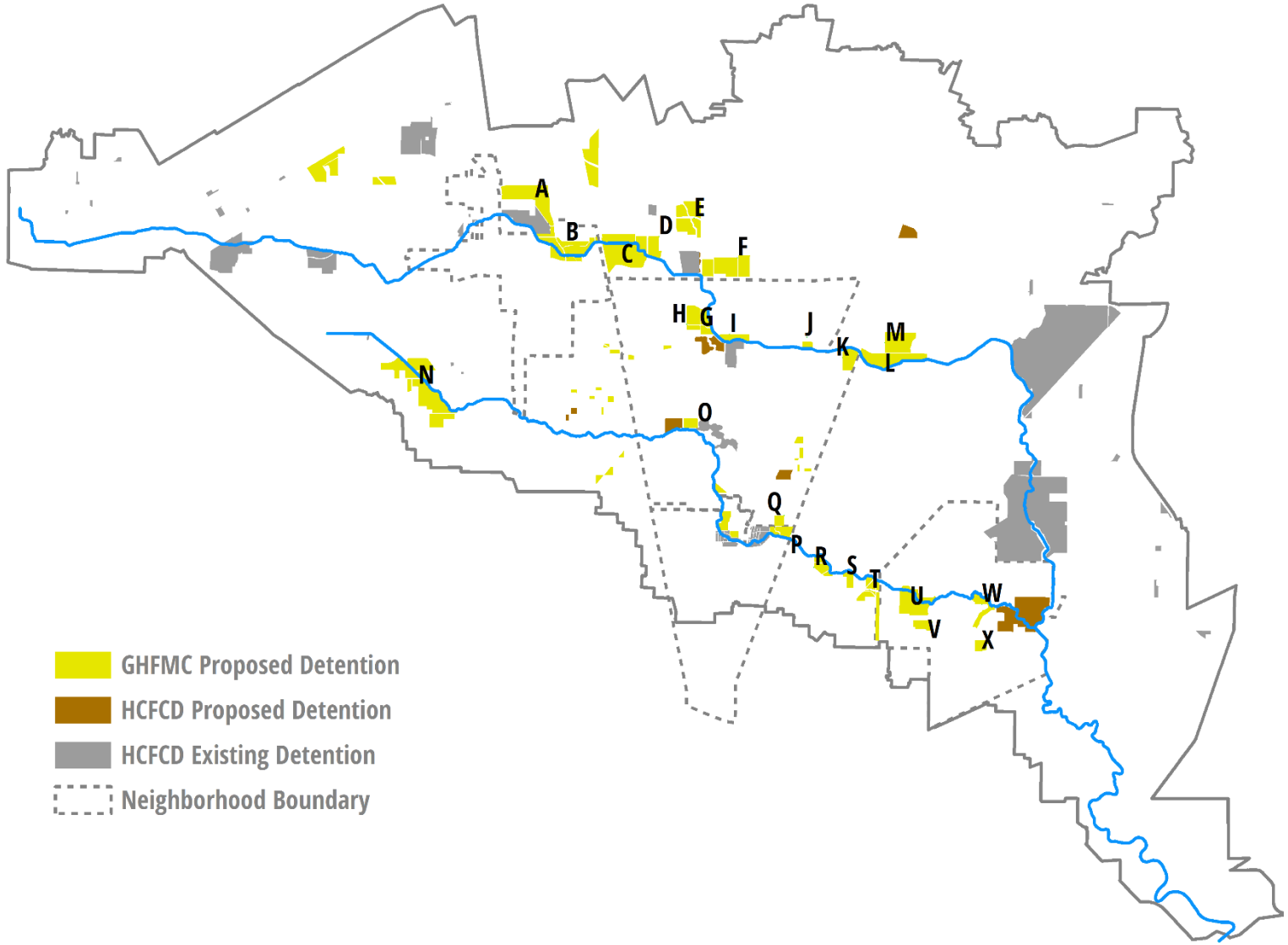
NOAA ATLAS 14 (2018) FLOOD HAZARD



MODELED FLOOD HAZARD INCREASE (NEW – OLD)



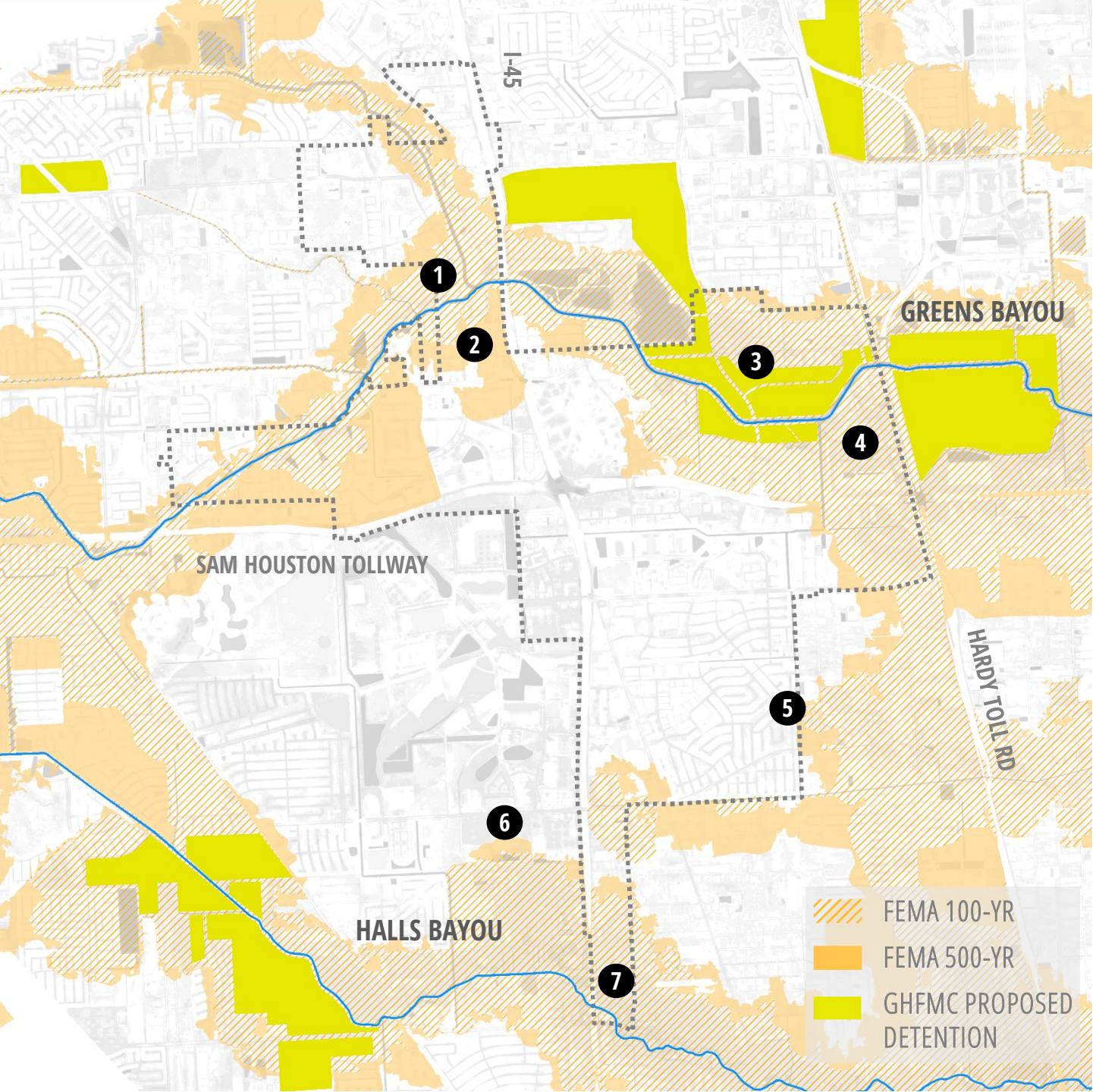
POTENTIAL APPLICATION: FLOOD MITIGATION ASSESSMENT



- Evaluated detention scenarios to reduce riverine flooding
- GHFMC proposed detention (15 - 429 acres) includes potential buyouts based on community input
- All modeled basins assume 15 ft depth and gravity outfall

DETENTION ANALYSIS

GREATER GREENSPOINT



ID	New 100-yr flood depth (ft)	Post-mitigation flood depth (ft)	Flood depth reduction (ft)
1	1.01	1.01	-
2	0.97	0.97	-
3	2.15	0.86	1.29
4	1.08	0.00	1.08
5	0.69	0.69	-
6	2.61	2.61	-
7	2.77	2.23	0.54

MODEL LIMITATIONS

- No infiltration loss
  - Apply abstraction (net rainfall)
- No spatially-distributed rainfall
  - Area-weighted gauge average or use multiple meshes
- Limited structure options within HEC-RAS 2D
  - Terrain data modification

CONCLUSIONS & FUTURE WORK

- Flood hazard analysis identified the presence of riverine (fluvial) and local (pluvial) flooding in Greater Greenspoint
- Modeled riverine floodplains generally show good agreement with existing FEMA floodplains
- The change in flood hazard for smaller storms (10-yr or less) is relatively minor in Greenspoint, but more significant in larger storms (25-yr or more)
- Future work should consider using both 1D and 2D models or a hybrid 1D/2D approach to better represent riverine and local flood hazards
- Potential applications: flood risk analysis, mitigation planning, accessibility / mobility studies