

# Can we use historical claims to predict flood hazard?

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TEXAS A&M UNIVERSITY  
GALVESTON CAMPUS.

**CTBS**  
The Center for Texas Beaches and Shores

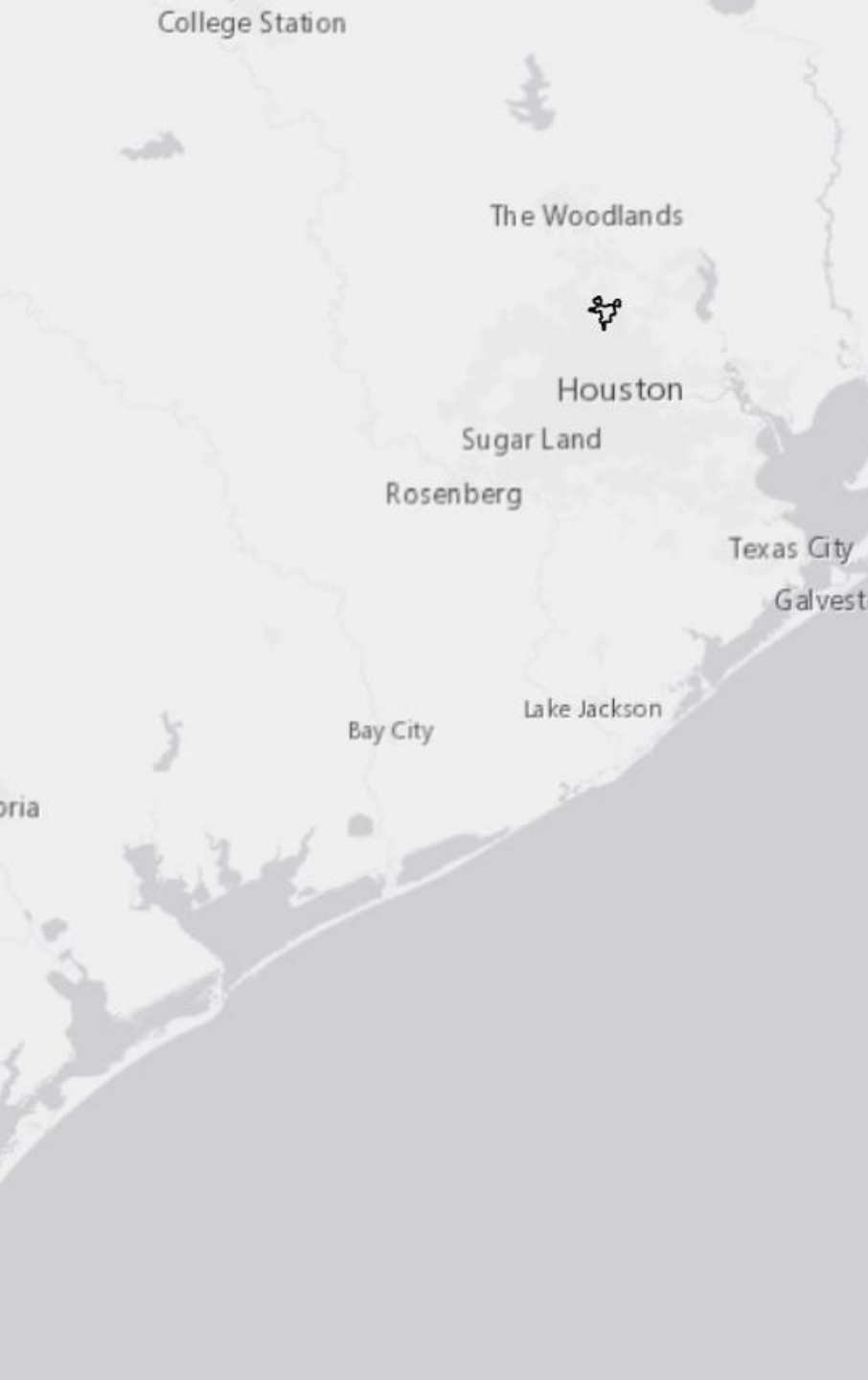
# Why the floodplain does not work

- 100-year floodplain is a poor predictor of actual flood losses
  - $\frac{1}{4}$  of all insured flood damages are outside the floodplain
- Floodplain maps are old
  - 15 years old or more
  - Fail to account for Land Use change
- NFIP claims fail to represent a large proportion of a community



# Identifying Hazard with Historic Claims

Source: [CNN \(2017\)](#)



# Study area: Greenspoint, Tx

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## Claims: 1013

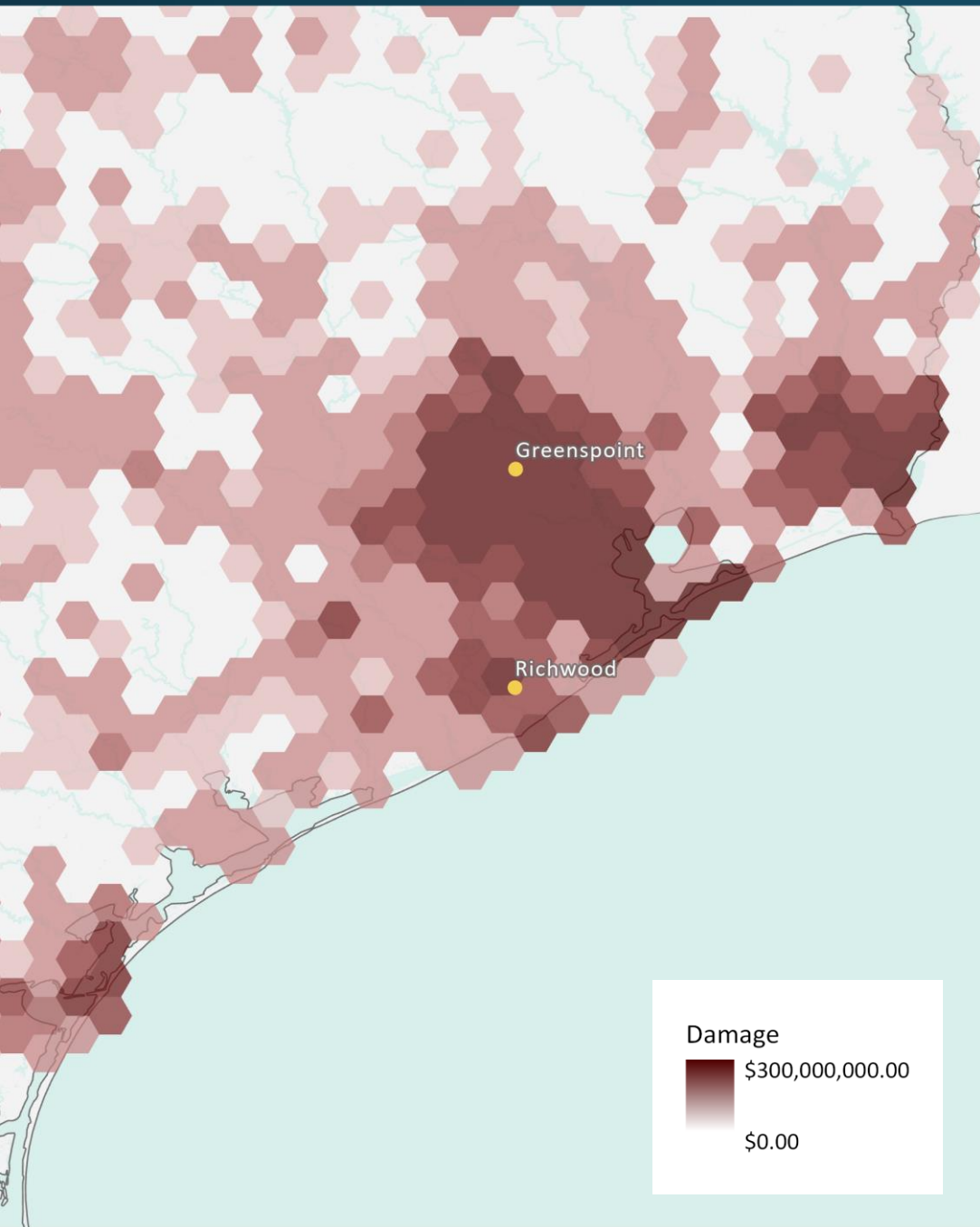
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## Losses:

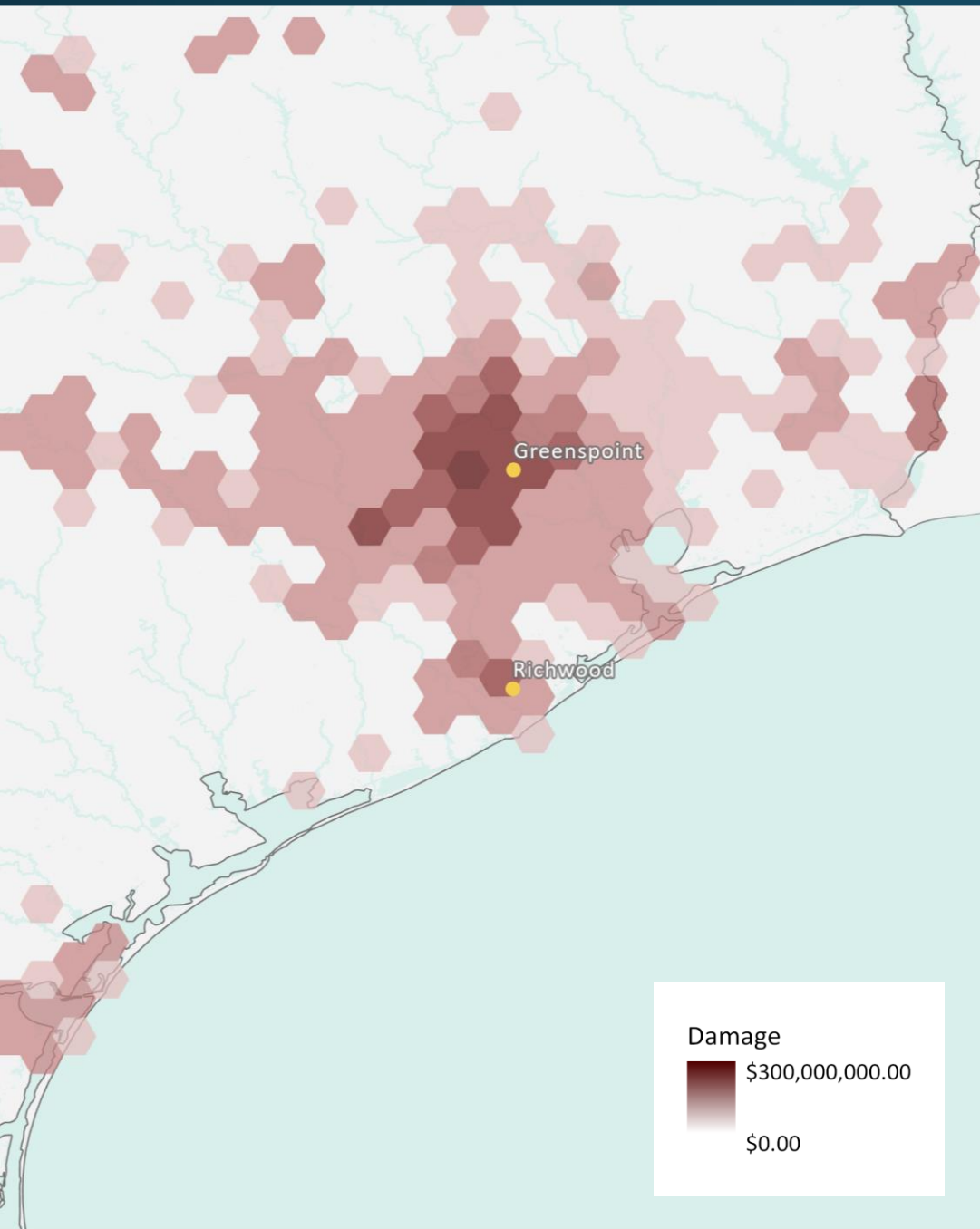
## \$129 Million

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# Flood Claims



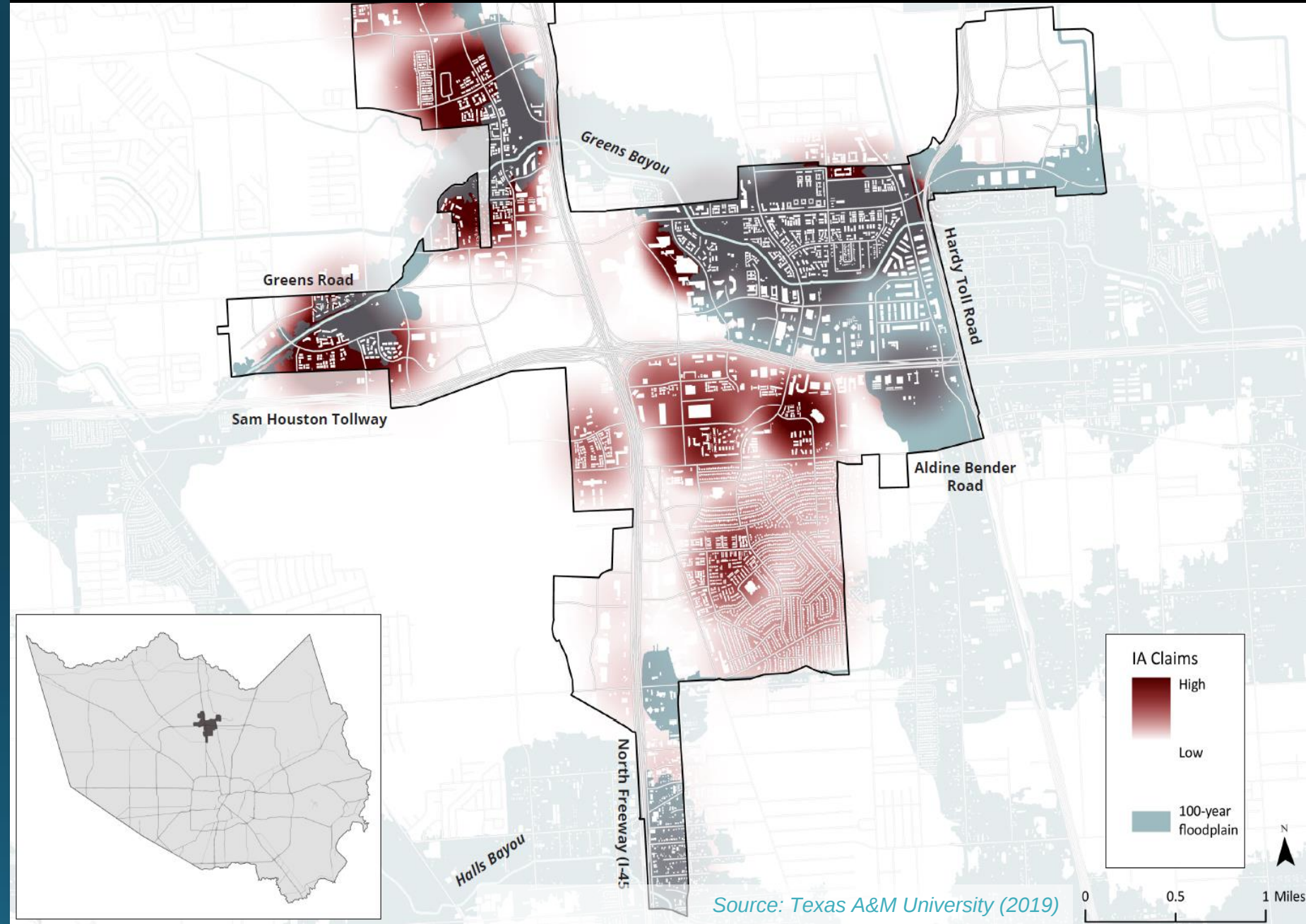
# 2016 Claims



# Hotspot Map

- Quick Assessment
- Displays Spatial Distributions
- No Hydrologic or driving variables

## Hurricane Harvey Uninsured Loss Hotspots Greenspoint, Texas



# Model: Random Forest



Uses Flood Claims

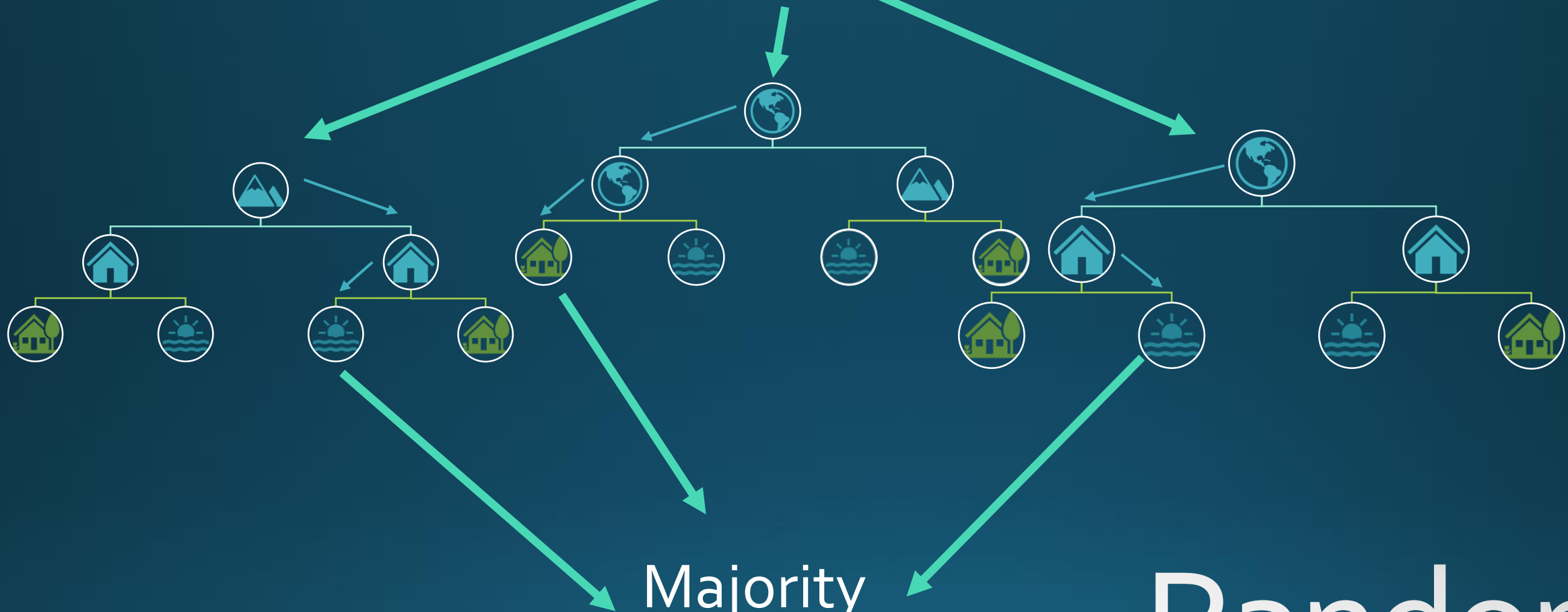


Underlying drivers



Outputs continuous Flood Hazard  
Map

# Trees



Majority  
Decision

Random  
Forest

# Underlying Drivers



## Topographic

Elevation

Height Above Nearest Drainage

Topographic Wetness Index



## Spatial Hydrology

Distance to Stream

Distance to Coast

Flow Accumulation

Soils KSAT

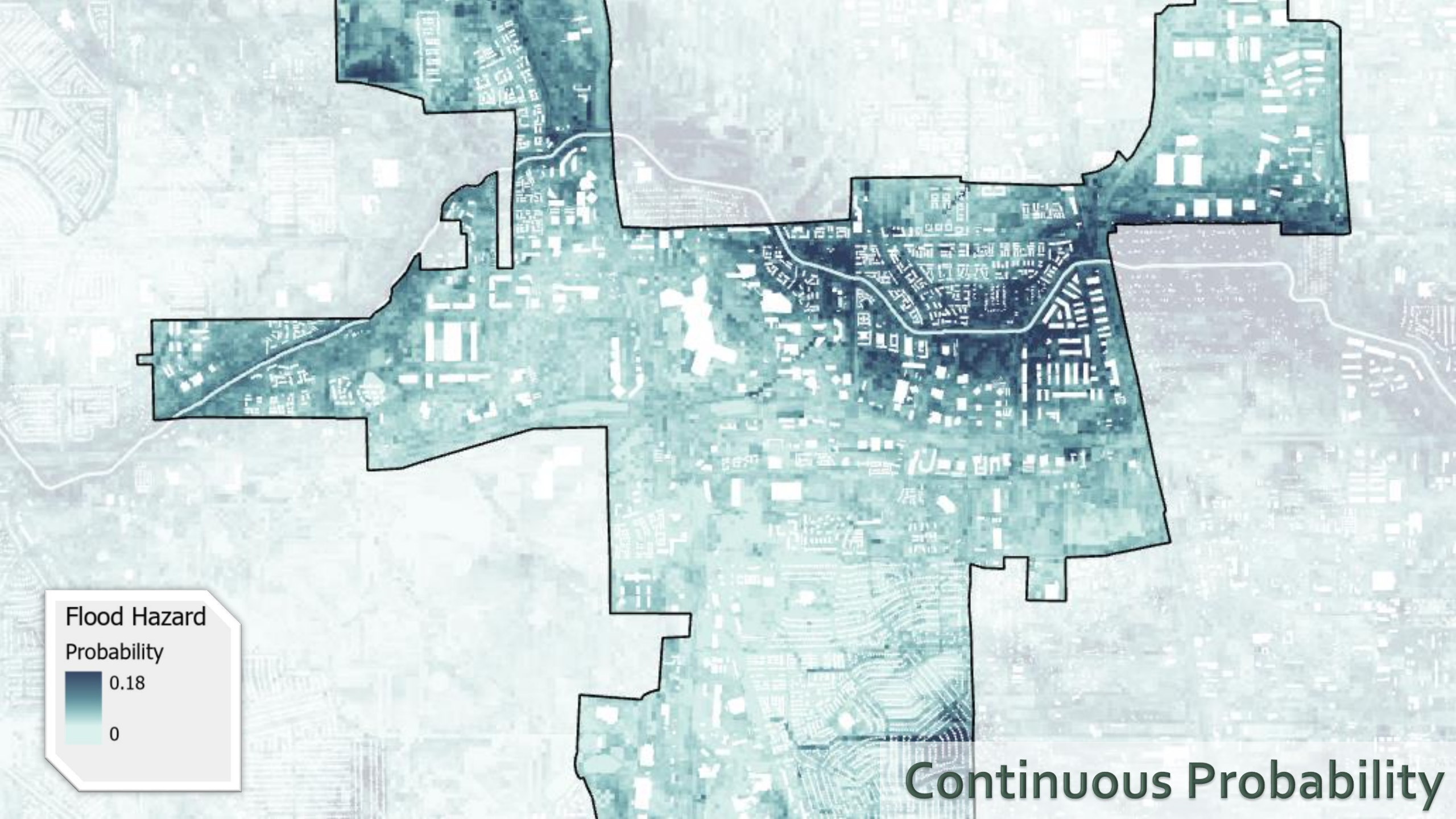
Roughness



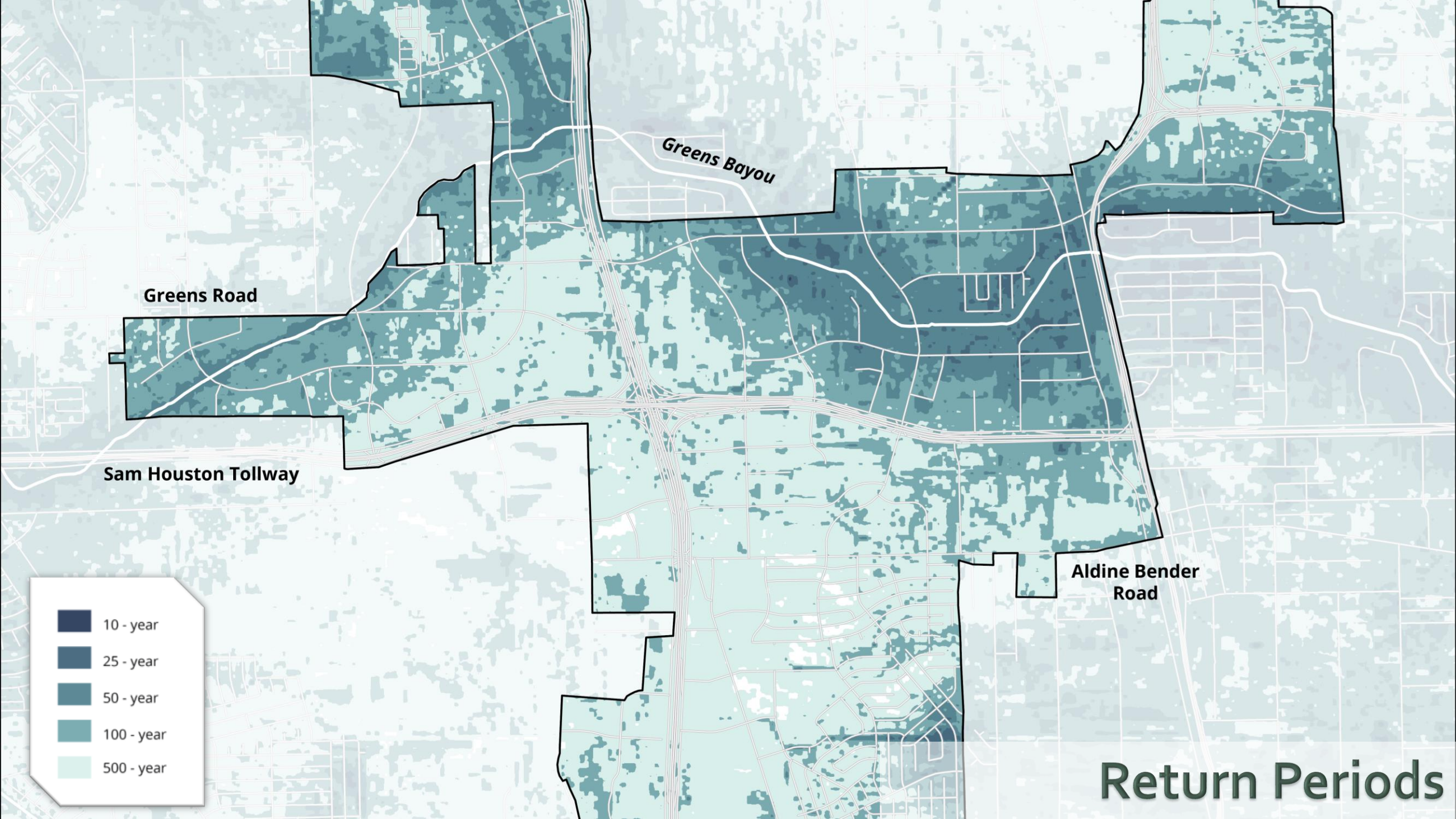
## Development

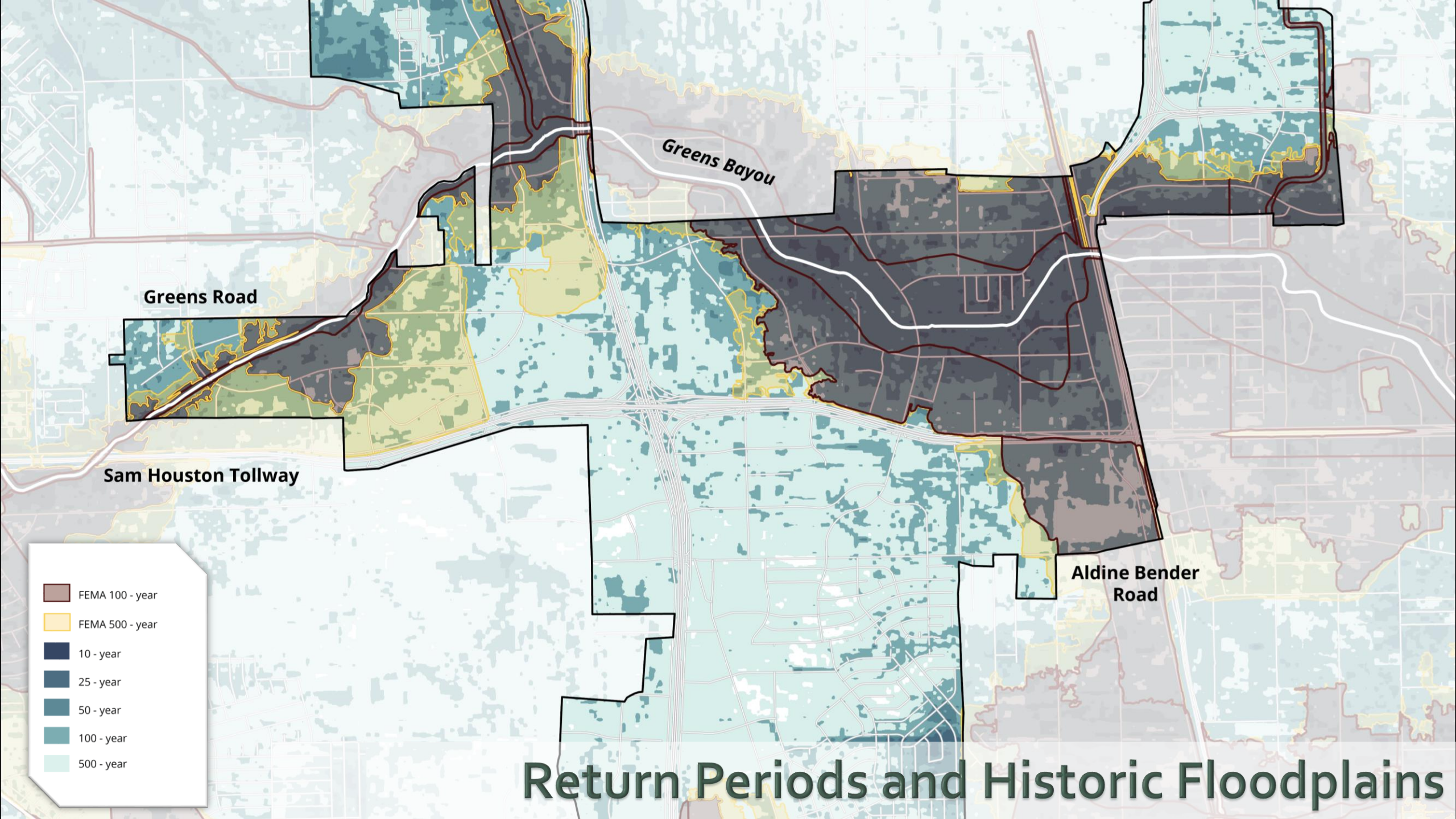
Imperviousness

Accumulated Imperviousness



Continuous Probability





- FEMA 100 - year
- FEMA 500 - year
- 10 - year
- 25 - year
- 50 - year
- 100 - year
- 500 - year

# Return Periods and Historic Floodplains

Not intended to replace the  
100-year floodplain

# Informative outputs



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Continuous Probability

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Zones probability

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Normalized flood score

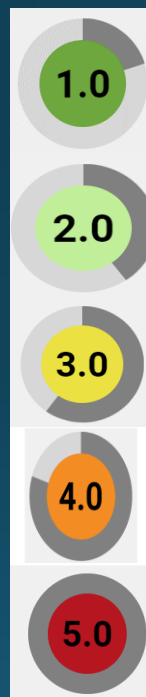
# Example Alternative Explanations

| SPACE CITY WEATHER FLOOD SCALE                                                                                                                                                            |                                                                                                                                              |                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                           | EXPECTED IMPACT                                                                                                                              | HISTORIC EXAMPLES                                                                                                                                                 |
| Stage 1                                                                                                                                                                                   | <b>Nuisance street flooding</b> , frontage road flooding, some minor impacts in a few locations.                                             | <ul style="list-style-type: none"><li>• Jan. 2017 street flooding</li><li>• May 2018 flooding in Harris, southern Montgomery counties</li></ul>                   |
| Stage 2                                                                                                                                                                                   | <b>Flash flooding</b> with mostly localized impacts (i.e. just Sugar Land, or Katy, or The Woodlands).                                       | <ul style="list-style-type: none"><li>• 2015 Halloween floods</li><li>• May 2019 floods in Sugar Land and Kingwood</li></ul>                                      |
| Stage 3                                                                                                                                                                                   | <b>Significant flash flooding</b> ; 100s of homes flooded; high impact timing (rush hour) or longer-duration flooding (Brazos, San Jacinto). | <ul style="list-style-type: none"><li>• 2016 Memorial Weekend floods</li><li>• 2009 April W. Houston flooding</li><li>• Tropical Storm Imelda (Houston)</li></ul> |
| Stage 4                                                                                                                                                                                   | <b>Significant urban and suburban flooding</b> with widespread effects; thousands of homes flooded, may shut city down for day.              | <ul style="list-style-type: none"><li>• 2015 Memorial Day floods</li><li>• 2016 Tax Day floods</li><li>• 1994 mid-October floods</li></ul>                        |
| Stage 5                                                                                                                                                                                   | <b>Major urban and suburban flooding</b> ; tens to hundreds of thousands of homes flooded, likely shuts city down for multiple days.         | <ul style="list-style-type: none"><li>• Hurricane Harvey</li><li>• Tropical Storm Allison</li><li>• T.S. Imelda (Beaumont)</li></ul>                              |
| Note: This scale seeks to generalize regional effects. If you did not flood during a previous Stage 4 or 5 event, you may still flood in future Stage 4 or 5 events, or even lesser ones. |                                                                                                                                              |                                                                                                                                                                   |

# Space City Weather Stages: Tax Day Flood

Event Classification

Hazard Classification

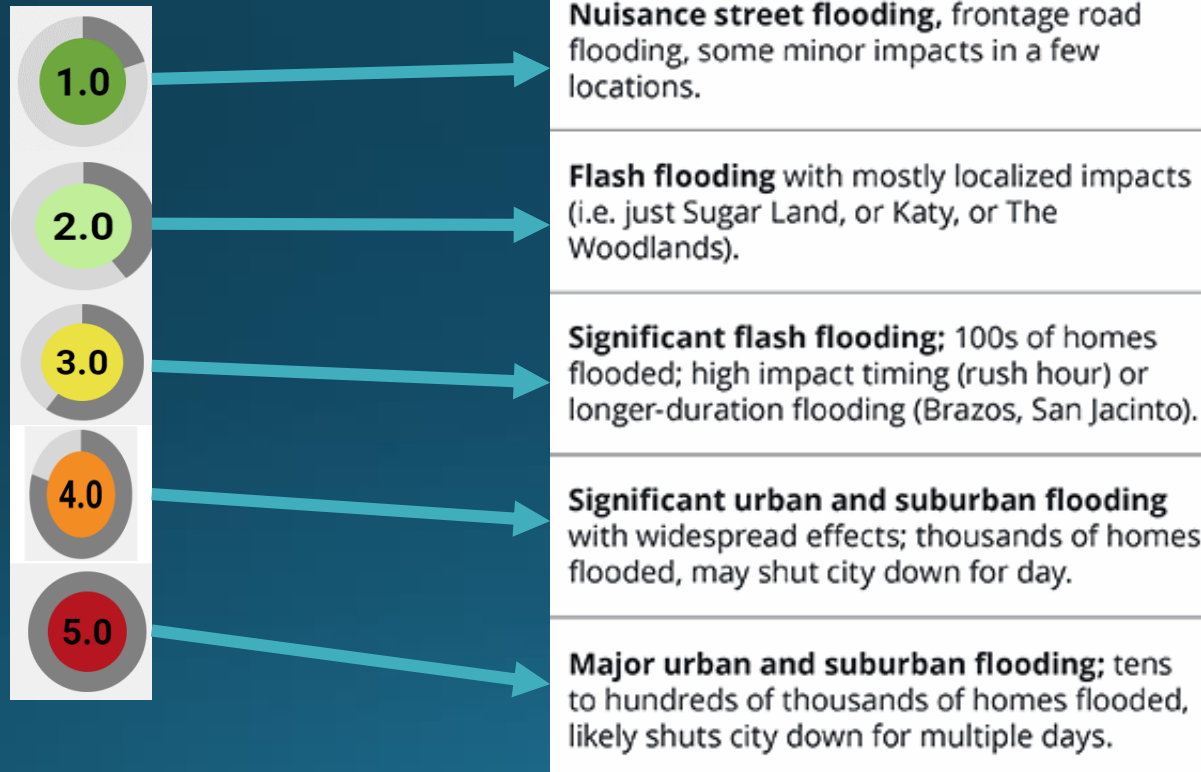
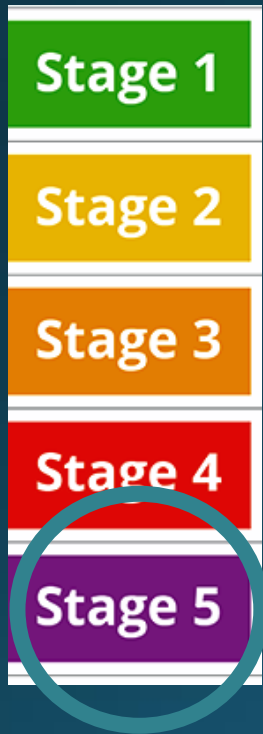


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|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Nuisance street flooding</b> , frontage road flooding, some minor impacts in a few locations.                                             |
| <b>Flash flooding</b> with mostly localized impacts (i.e. just Sugar Land, or Katy, or The Woodlands).                                       |
| <b>Significant flash flooding</b> ; 100s of homes flooded; high impact timing (rush hour) or longer-duration flooding (Brazos, San Jacinto). |
| <b>Significant urban and suburban flooding</b> with widespread effects; thousands of homes flooded, may shut city down for day.              |
| <b>Major urban and suburban flooding</b> ; tens to hundreds of thousands of homes flooded, likely shuts city down for multiple days.         |

# Space City Weather Stages: Harvey

Event Classification

Hazard Classification





How much damage can we expect?

# Future: Estimating Exposure

# Acknowledgements



National  
Academy of  
Sciences



FEMA