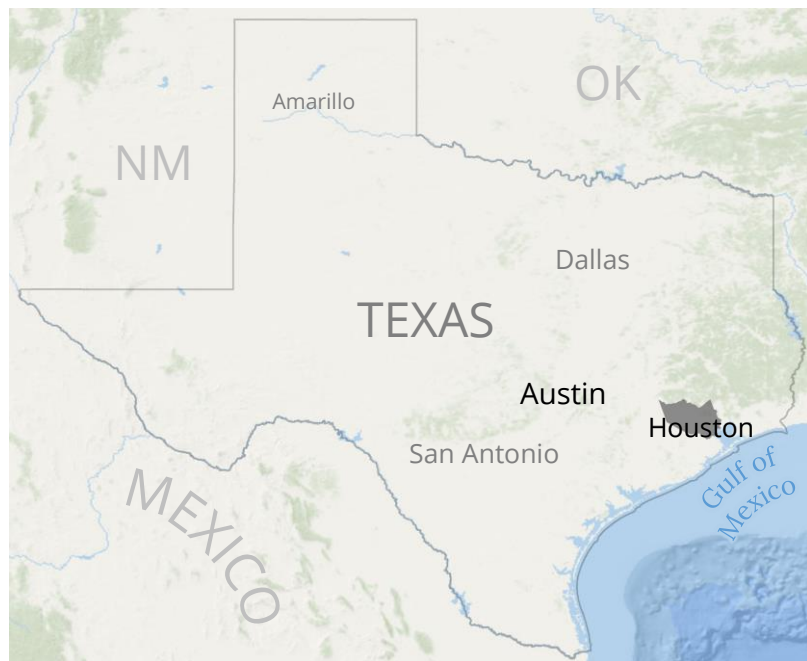
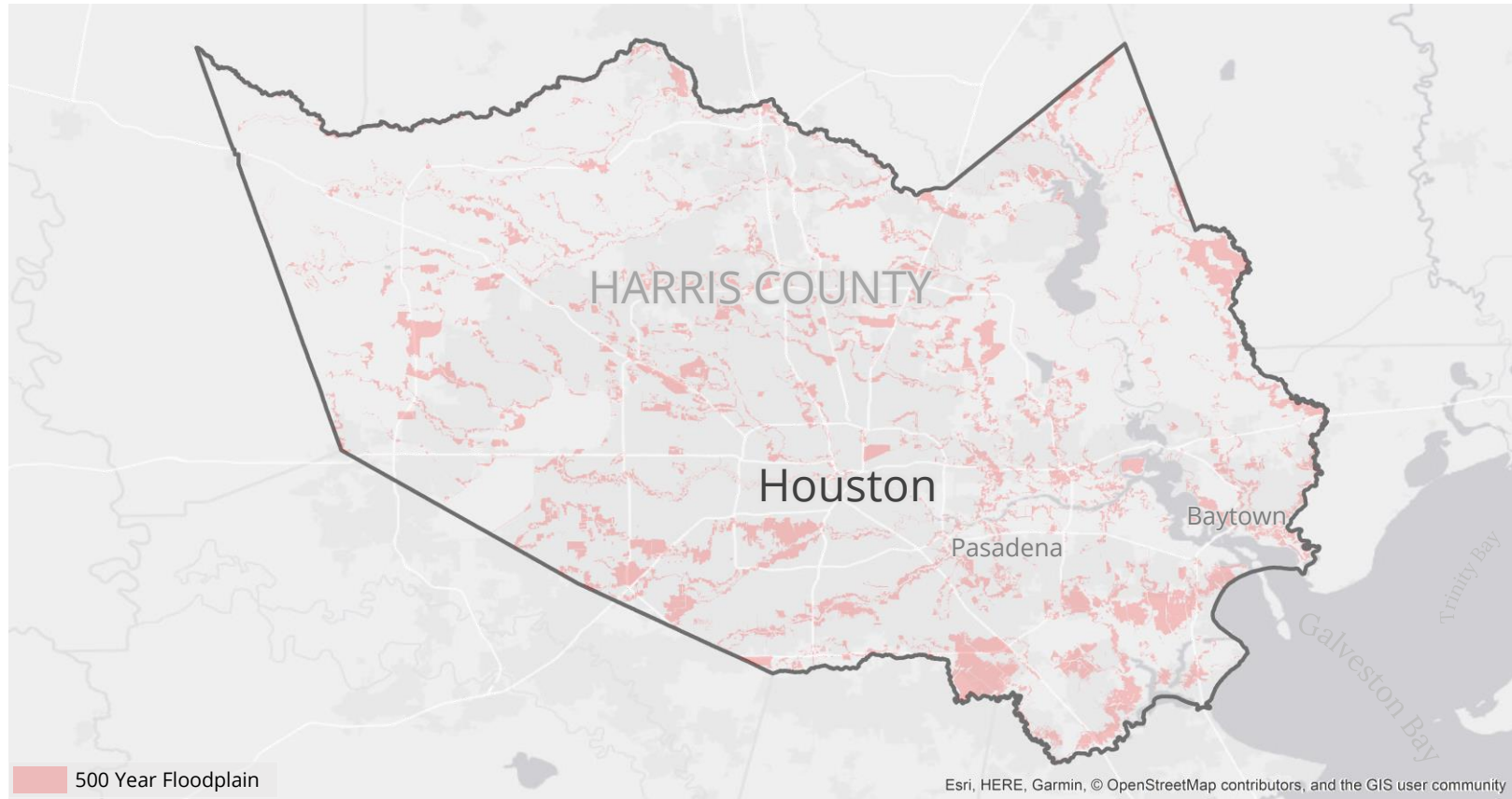


500 YEAR FLOOD MAP OF GREATER HOUSTON

Areas within Harris County, Texas with a one in 500 chance of flooding in any given year



Report and Maps Prepared by:

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Data:

- US Census Bureau
- Texas Natural Resources
- Harris County
- City of Houston



Extreme Flooding

On April 15th, 2016, Houston experienced one of the most destructive floods in the city's 180-year history. However, flooding, even extreme floods, are not unusual for Houston and Harris County. In fact, the Greater Houston area experiences, on average, five days of flooding per annum. This report will look at critical infrastructure, flood risks (hazards/vulnerabilities), and flood preparedness for Harris County and the city of Houston. Due to the frequency of flooding seen in Harris County, only those areas and facilities affected by a 500-year flood event, like that of the Tax Day flood of 2016, will be shown.

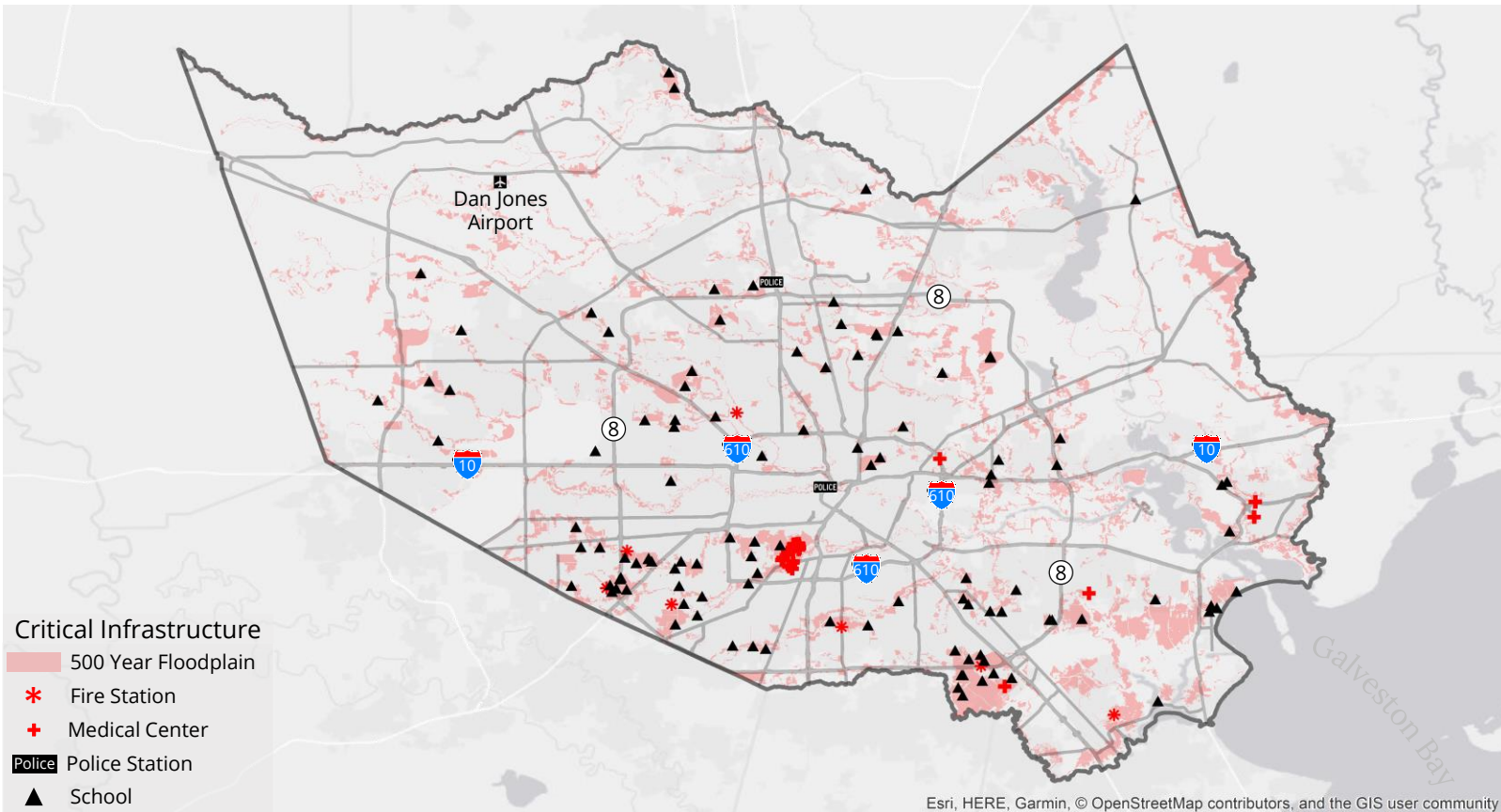


Figure 1 Critical infrastructure located within the 500-year floodplain

500-year Floods and Infrastructure

FEMA defines 500-year floodplains as those that have a 1 in 500 (0.2%) annual chance of flooding. In Houston, these 500-year events are happening more frequently, three have occurred successively: 2015 (Memorial Day), 2016 (Tax Day), and 2017 (Hurricane Harvey). With another 500-year flood occurring in 2001 (Tropical Storm Allison). Critical infrastructure (figure 1), such as fire/police stations, schools, and hospitals need to be prepared for more regular extreme flooding. Data retrieved from the US Census, Texas, Harris County, and the city of Houston clearly shows that there are numerous facilities that would be impacted by a 500-year flood event. Houston is the most populated city in the state of Texas and the fourth most in the United States with a population of over 2.3 million people. Information gathered from the US Census and Texas, show that many of those living in Harris County and Greater Houston would be affected negatively by extreme flooding (figure 2).

Flood Hazards and Vulnerabilities

Floods are among the most frequent and costly natural disasters. Flood hazard within Harris County is not just related to flash flooding. Flood hazard refers to the risk associated with flood-prone areas, areas of poor drainage, localized street flooding, and other related flood risk areas.

Houston's flat terrain, large amounts of impervious cover (concrete and asphalt), slow-absorbing soil, and potential for thunderstorms, tropical storms, and hurricanes all combine to form ideal conditions for flooding. Located in humid-subtropical climate and with its proximity to the coast, Harris County is susceptible to a large amount of rainfall that is often too great for its infrastructure and bayous to handle. Once the regions ditch and stormwater networks are inundated with runoff, streets then become secondary drainage facilities.

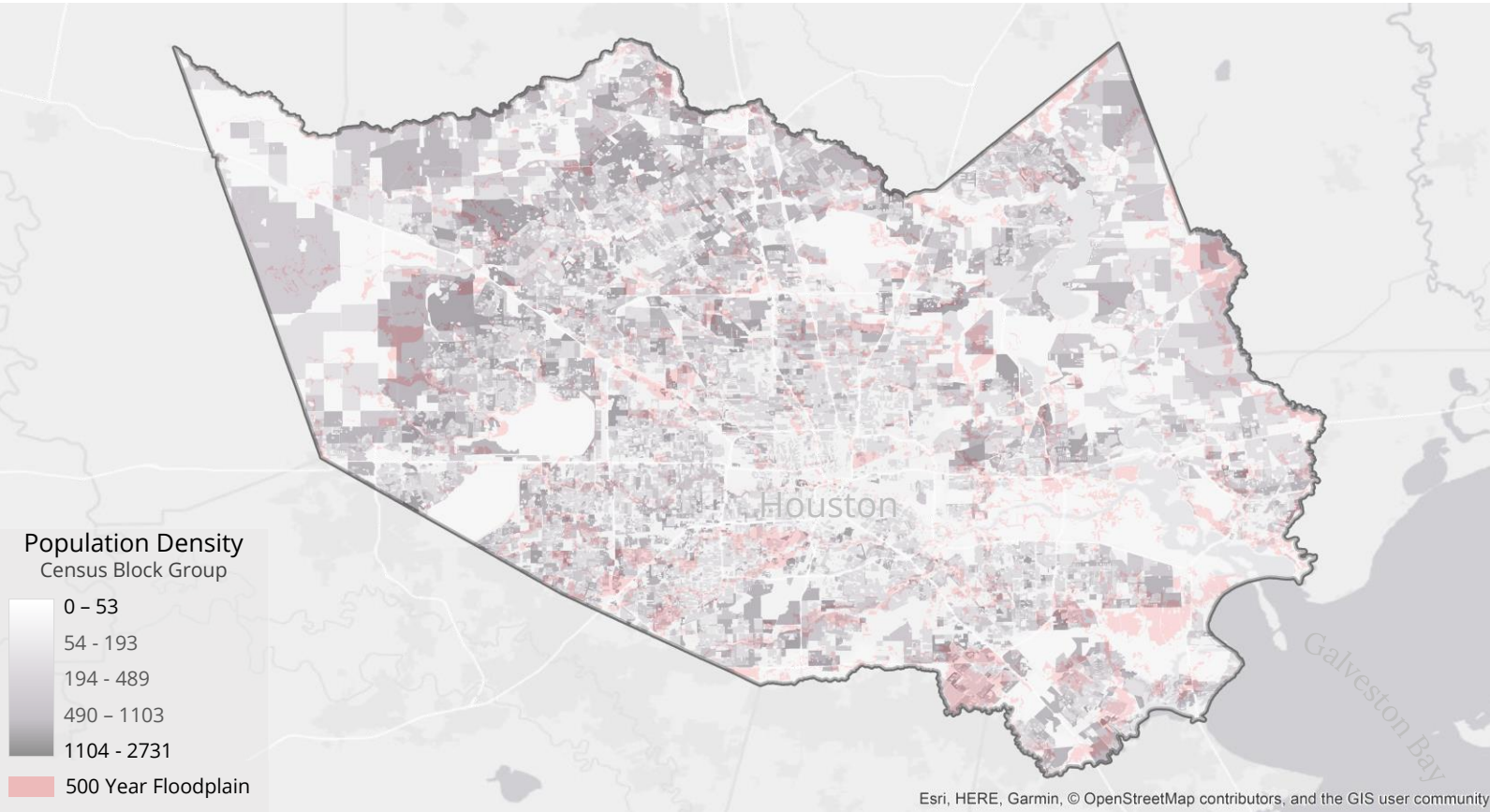


Figure 2 Population density of Harris County

As of 2010, the US Census classifies 39% of the census tracts in Harris County as high-poverty, with at least 20 percent of households living at or below the poverty line. Thousands of Harris County's most-vulnerable populations live within the 500-year floodplain. These populations would be hit hardest by a natural disaster such as flooding. Most of Harris County's affordable housing is in areas that are more flood-prone, they are cheaply constructed and poorly maintained, resulting in housing stock that would easily succumb to flood waters. Also, the most underprivileged populations are less likely to have access to the information and resources needed to adequately prepare and respond to anticipated threats, such as flood events.

There are numerous critical infrastructures that would also be at risk during a major flood event, many of these serving vulnerable populations. Only a few fire and police stations are in a 500-year floodplain,

however, many roads surrounding them would be impacted, greatly reducing their accessible service area. Dozens of schools have the potential to flood during a major flood. Many of these would normally serve as temporary shelters to residents most at risk in times of lesser floods. Medical centers (hospitals and urgent

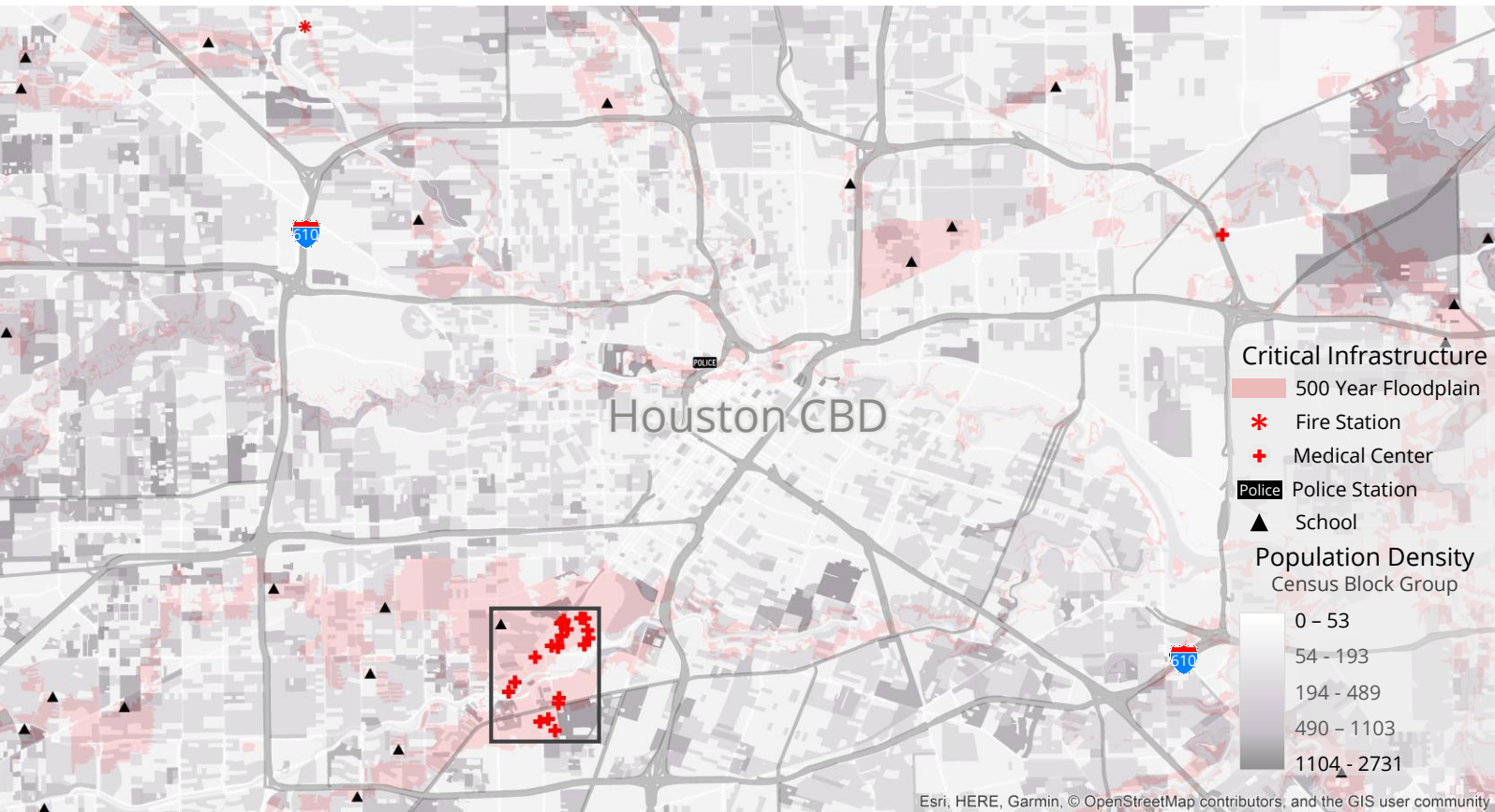


Figure 3 Critical infrastructure and population density for Houston’s CBD (See Figure 4 for enlarged map of outlined area)



Figure 4 Southwest region of Houston’s CBD with numerous medical facilities at risk of flooding during a 500-year flood event

cares) represent infrastructure at the greatest susceptibility to significant floods. Roughly two dozen are located within 500-year floodplains, with a substantial number serving those communities already vulnerable to natural disasters. In an area southwest of Houston’s central business district (CBD) there is over a dozen medical centers (figures 3 & 4) that provide services to some of the poorest neighborhoods in Harris County. If any one of these critical facilities is impacted during major a major flood, it would have devastating effects on the population that is already at its most vulnerable.

Community Preparedness

One of the best ways to prepare for a flood is to know if you are at risk for one, whether it be a flash flood, 100-year, or 500-year. Communities should have outreach programs to inform those in areas at high-risk that 1) they

are at risk of flooding and what type, 2) how to monitor for potential signs of flooding, and 3) evacuation routes and shelter plans, including alternative ones. Emergency services need to have alternative routes planned out in the event that roadways ways become flooded. In addition to protecting back-up generators and lower level entrances from flood waters, medical centers also need to coordinate with surrounding facilities that are not prone to flooding. This coordination is not only for patient care but also for much need supplies such as platelets and medicine. Medical centers also need to have a singular triage plan for incoming patients and distribute that plan throughout the surrounding area so residents know which medical facility will attend to there level of injury.

Communities at risk of flood events need to work holistically to ensure that every resident is attended to before, during, and after the natural disaster. Special attention needs to be given to those populations identified as being the most vulnerable.

Sources

US Census Bureau - <https://www.census.gov/>

Federal Emergency Management Agency - <https://www.fema.gov/>

Texas Natural Resources Information System - <https://tnris.org/data-download/#!/statewide>

Harris County Open Data - <http://geo-harriscounty.opendata.arcgis.com/>

Harris County - <http://www.harriscountytexas.gov/>

City of Houston GIS Open Data Portal - <https://cohgis-mycity.opendata.arcgis.com/>

City of Houston - <https://www.houstontexas.gov/>