

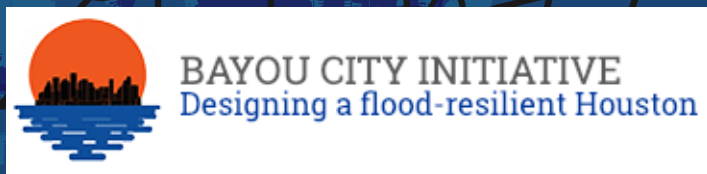
A Proposal for Equitable Flooding Solutions in Northeast Houston

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For interactive map visit

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I. Purpose of this Report and Summary

Bayou City Initiative (BCI) was asked by Northeast Super Neighborhoods United to help them address a long-running problem of inequitable flood protection in the northeast quadrant of Houston-Harris County. To help document and analyze this situation, BCI solicited the help of Sustainable Planning and Design, LLC which assisted in this work without charge. The coalition of Super Neighborhoods has read this report and agrees with both the analysis and the recommendations.

It should be noted that this report is not being generated to either finger-point or allocate blame for the current situation. At this point, these actions would be counterproductive. Instead, this report is about trying to find ways to move forward – to fix these problems. This is a report about the current situation, regardless of how we got here, and sets out ideas for moving forward. It does, however, provide background information to support the assertion that an equity crisis exists in the Northeast.

This study concludes that a major flooding problem exists in the Northeast part of Houston, and that frame-breaking concepts and unprecedented action are needed to generate required improvements. Both serious and nuisance flooding routinely occur in the Pleasantville area, portions of the 5th Ward and within the watersheds of Greens, Halls, and Hunting Bayous. All of these areas are lower income areas of Houston and Harris County that are predominantly home to Hispanic and African American residents. Within the Northeast community, there is a common perception among residents that they are treated as votes for bond issues but are neglected afterwards. The events following the passage of the 2018 flood bond issue have only acted to harden this perception.

This document discusses the current issues and several concepts that, if implemented collectively, could vastly improve these flooding problems. The equity problem identified in this document did not occur overnight and did not occur from any single event. Actions or inaction at the federal, state, county and city level over the years have all contributed to this situation. It is unrealistic to think that there is any single magic bullet to solve these problems. On the other hand, there are actions that can be taken cohesively as a community that can begin to reverse this historical absence of equity. If Houston and Harris County are to succeed into the future, the flooding problem in the Northeast sector must be solved. It is a key to Houston's and Harris County's long-term transition to a resilient community that takes care of all residents.

II. Introduction to the Northeast Community

Before discussing specific concepts, it is useful to consider some basic facts about the Northeast Houston community (hereafter the Northeast). Generally speaking, the Northeast can most easily be conceptualized as the area between I-45 on the west, Buffalo Bayou and the Houston Ship Channel on the South, and Beltway 8 on the east and north sides. Portions of this area are within the City of Houston and are part of the [Super Neighborhood](#) structure (City of Houston, 2021a).¹ Portions of the northern and eastern section outside of the City's boundaries still lie within Harris County; the residents living in this unincorporated area of Harris County outside of municipal utility districts (MUDs) generally lack the social safety net for garbage, water, sewer, and drainage that most Houstonians enjoy, although the county goes beyond the norm to try to offer some assistance (*Municipal utility district taxpayers*, 2016). The boundaries of the Northeast for purposes of this study are shown in Figure 1. This area is comprised of about 142,000 acres, of which 76,000 acres are in the City of Houston and about 66,000 lie in unincorporated Harris County. Of the 66,000 acres in Harris County, about 19,000 are within Municipal Utility Districts which provide water, sewer, drainage, and flood protection. This leaves about 49,000 acres in unincorporated area without a safety net of similar utilities.

¹ "Houston has been divided into 88 Super Neighborhoods where residents of neighboring communities are encouraged to work together to identify, plan, and set priorities to address the needs and concerns of their community. The Super Neighborhood Council serves as a forum where residents and stakeholders can discuss issues, establish priority projects for the area and develop a Super Neighborhood Action Plan to help them meet their goals. In some cases, more than one of the Super Neighborhoods have joined together to create a stronger, more active Council" (City of Houston, 2021b).

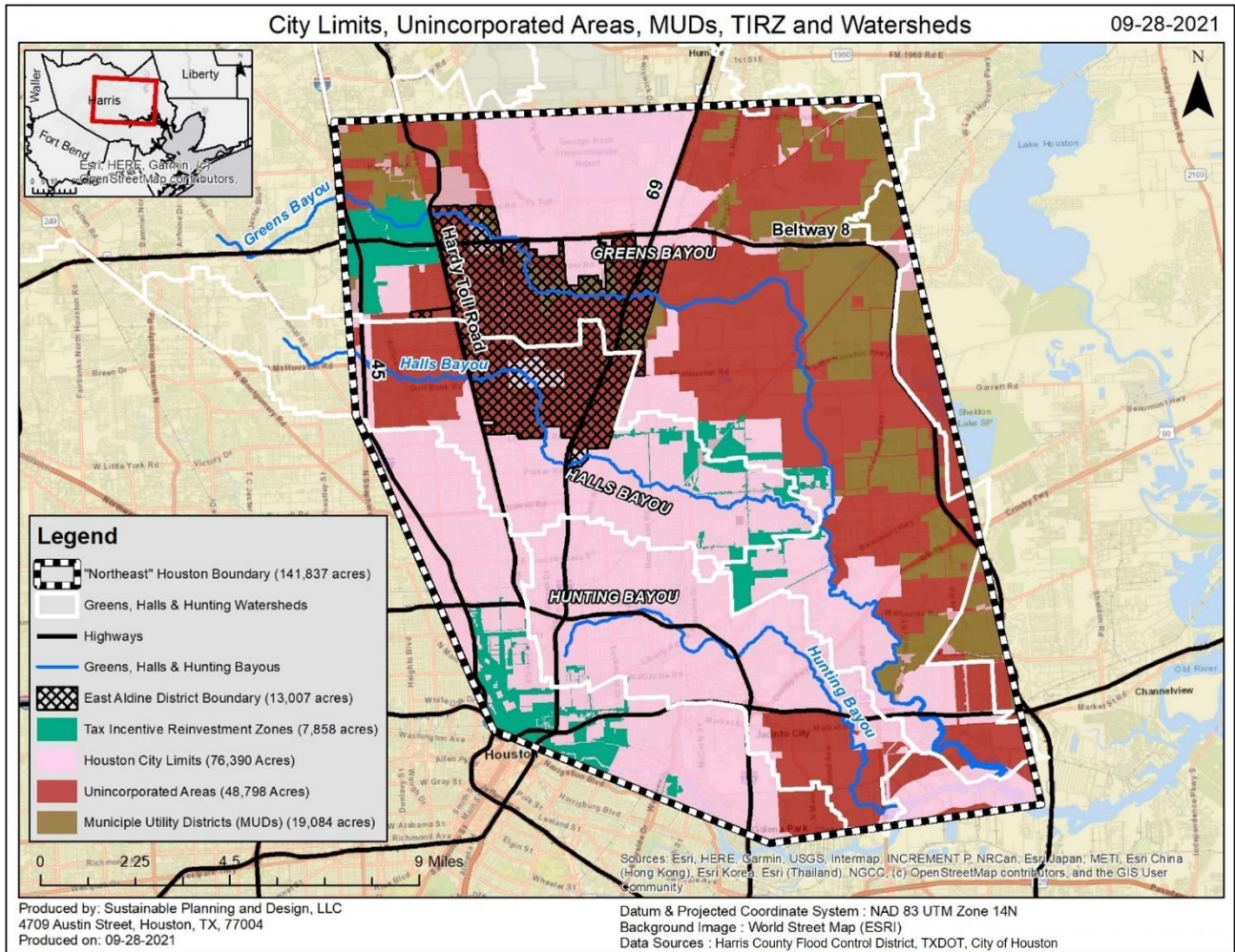


Figure 1. The area discussed in this paper – the Northeast Community – is roughly outlined by the black and white dashed line. The major bayous within the area are shown with their watersheds (City of Houston, 2021c; HCFCD, personal communication, September 9, 2021). The image shows Houston City limits (City of Houston, 2021d), unincorporated areas, major highways (TxDOT, 2020), Municipal Utility Districts (City of Houston, 2021e), Tax Incentive Reinvestment Zones (City of Houston, 2021f), and the East Aldine District Boundary (East Aldine District, personal communications, August 27, 2021). The area, in acres, of each boundary within the Northeast boundary is shown in the legend. Map created by Jace Hodder and Sustainable Planning and Design.

A. Current Planning Structure

The City, County, and municipal districts split responsibilities for flood protection for residents in this area. The City maintains streets, sewers and drainage within the City boundaries and occasionally partners with Harris County Flood Control District (HCFCD) on larger infrastructure projects. The County oversees HCFCD which plans larger projects and

seeks federal partnership funding on behalf of the County. HCFCFCD is also responsible for the regular maintenance of county-owned flood channels (see Figure 11).

Harris County

Harris County Flood Control District was created in 1937 by the Texas legislature to serve as a local partner for major projects with the Army Corps of Engineers. HCFCFCD is governed by Harris County Commissioners Court and currently has the mission to "[p]rovide flood damage reduction projects that work, with appropriate regard for community and natural values" (HCFCFCD, 2021a). The Executive Director of HCFCFCD is appointed by the Commissioners Court and runs the District. Alan Black is currently the Interim Executive Director with Matt Zeve as Deputy Executive Director. The Flood Control District's current and planned projects are described in more detail in the appendix of this report. The Flood Control District is the County's main entity for solving flooding issues, however the Harris County Community Flood Resilience Task Force including the Infrastructure Resilience Team is on track to have an increasingly important role in the future of Harris County's flooding solutions.

In August of 2020, the Harris County Flood Control District Task Force was reconstituted as the Harris County Community Flood Resilience Task Force (CFRTF). According to the CFRTF bylaws the purpose of this task force is to

[S]erve in an advisory capacity to the Harris County Infrastructure Resilience Team (IRT) and, as applicable, Commissioners Court, to promote collaboration among stakeholders and encourage equitable resilience planning efforts and flood resilience projects that:

- Support holistic, innovative, and nature-based solutions to building flood resilience and mitigating flood risks;
- Achieve multiple short- and long-term benefits for as many Harris County communities as possible;
- Take into account the needs and priorities of the community and promote equitable community-level outcomes in the face of flooding; and
- Protect communities, homes, and businesses across Harris County from flood-related hazards (Harris County, 2020).

The Infrastructure Resilience Team (IRT) is made up of representatives from the Harris County Engineering Department, Harris County Flood Control District, Harris County Community Services Department, Harris County Toll Road Authority, and the Harris County Office of Emergency Management and Homeland Security (Harris County, 2020). The court letter requesting the creation of the IRT by the Harris County Commissioners Court includes a three-phase timeline which ultimately leads to the creation of the "2050 Flood

Resilience Plan" which aims to strengthen flood resilience in Harris County over the next thirty years (Blount et al., 2020). The CFRTF will advise the IRT in the development of this plan.

City of Houston

Most of the work done by the City of Houston on flood protection is done by Houston Public Works (HPW). The public works department is administered by the mayor and is responsible for streets, drainage, and collecting and treating wastewater among other things. HPW responds to 311 calls made by residents. In addition to regular drainage maintenance, HPW also acts as a local partner for larger flood protection projects within the City. The Storm Water Action Team and Build Houston Forward are programs under HPW which address flooding in Houston (City of Houston, n.d.-a)². More information on specific plans by HPW to mitigate flooding can be found in the appendix.

The City of Houston began the Storm Water Action Team (SWAT) program in 2017. The program is allocated \$20 million annually to fund drainage projects including repair and replacement of storm sewer lines, re-establishment of roadside ditches, and rehabilitation of off-road ditches and detention ponds. Projects are chosen based on community input, city council input, 311 calls, and other flood data (City of Houston, n.d.-b).

Build Houston Forward is a City program meant to improve streets and drainage systems without accruing debt by relying on property taxes, third party funds, and drainage fees. The City of Houston's Build Houston Forward site shows planned, active and completed projects including repair, street and drainage rehabilitation, and reconstruction (City of Houston, n.d.-c).

Municipal Utility Districts (MUDs)

MUDs are political subdivisions of the State authorized either by the State Legislature or TCEQ created to provide services such as water and storm drainage where city services are unavailable or lacking. In the Northeast area MUDs function to provide water, sewer, drainage, and other utilities to areas outside of the City of Houston. MUDs are overseen by a Board of Directors which are elected by property owners within the MUD (*Harris County Municipal Utility District 278*, n.d.).

² In APA citation style, for multiple sources with the same author and date the date is followed by a letter to indicate the source to which it refers. In the case where no date is provided n.d. stands for no date. When multiple sources from the same author have no date, they are labeled (Author, n.d.-a.), (Author, n.d.-b.), etc. Not to be confused with NDA meaning non-disclosure agreement.

Municipal Management Districts (MMDs)

MMDs are political subdivisions of the State created to supplement County and City improvements and services. MMDs are very similar to MUDs with the addition of projects aimed at beautifying or otherwise improving areas for businesses and residents. Four MMDs exist in the Northeast area: East Aldine Management District, Greater Northside, North Houston District and Airline Improvement District. The East Aldine Management District pictured above in Figure 1 has already conducted studies and worked with HCFCD to find solutions to flooding in this neighborhood (East Aldine District, 2021).

B. The Super Neighborhoods of the Northeast Community

The Northeast community can be further broken down by its various Super Neighborhoods, some of which formed the Northeast Super Neighborhood Alliance and requested this paper from Bayou City Initiative. Those Super Neighborhoods include Eastex Jensen, Kashmere Gardens, Greater 5th Ward, Denver Harbor – Port of Houston, Pleasantville, Settegast, Trinity Gardens, East Little York – Homestead, East Houston, El Dorado – Oates Prairie, Northshore and Hunterwood (see Table 1). A map of the Super Neighborhoods and MUDs of the Northeast Community is shown on Figure 2. Super Neighborhoods are categorized as active and inactive; inactive Super Neighborhoods do not currently have active members or meetings although civic clubs may exist within those Super Neighborhoods. Although there are some utility districts within the county unincorporated area, they do not exist at the density found on the northwest, west and southwest side of town, meaning that many residents lack the same level of governmental services enjoyed by most of us living in the Houston region.

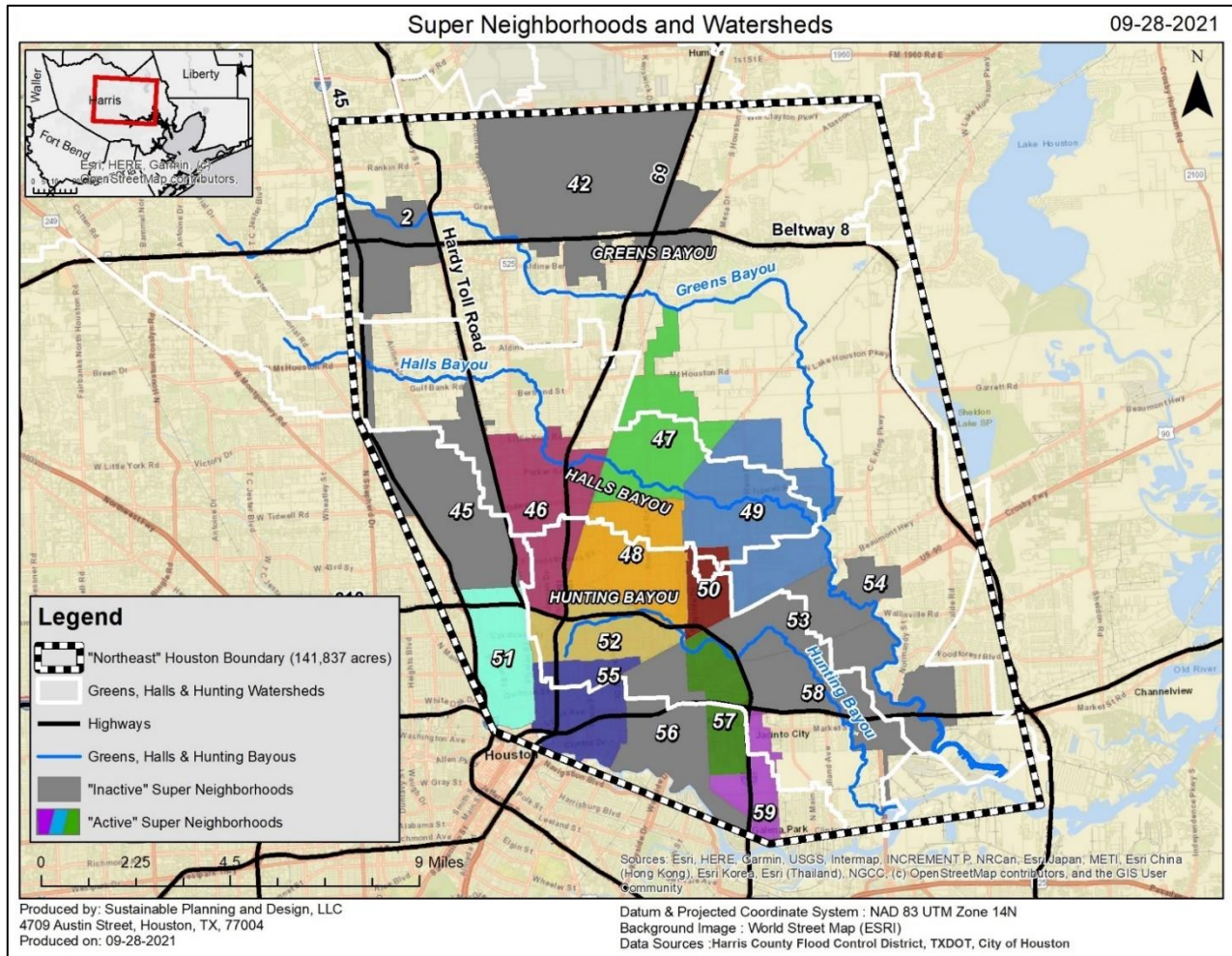


Figure 2. The location of Super Neighborhoods in the Northeast with bayous, watershed boundaries, and highways (City of Houston, 2021c; City of Houston, 2021d; HCFC, personal communication, September 9, 2021; TxDOT, 2020). Graphic by Jace Hodder for Sustainable Planning and Design.

Table 1. Super Neighborhoods and their numerical code.

SN #	Super Neighborhood	SN #	Super Neighborhood
2	GREATER GREENSPOINT (inactive)	52	KASHMERE GARDENS
42	IAH / AIRPORT AREA (inactive)	53	EL DORADO / OATES PRAIRIE (inactive)
45	NORTHSIDE/NORTHLINE (inactive)	54	HUNTERWOOD (inactive)
46	EASTEX - JENSEN AREA	55	GREATER FIFTH WARD
47	EAST LITTLE YORK / HOMESTEAD	56	DENVER HARBOR / PORT HOUSTON (inactive)
48	TRINITY / HOUSTON GARDENS	57	PLEASANTVILLE AREA
49	EAST HOUSTON	58	NORTHSHORE (inactive)
50	SETTEGAST	59	CLINTON PARK TRI-COMMUNITY
51	NEAR NORTHSIDE	65	HARRISBURG / MANCHESTER (inactive)

C. Demographics

The Greens Bayou watershed, including Halls Bayou, is home to about 529,000 persons (HCFCD, 2021c), second only to Brays Bayou's 717,000 persons (HCFCD, 2021d). Halls Bayou alone has about 160,000 residents. About 76,000 residents live in the Hunting Bayou watershed (HCFCD, 2021e). Residents of the Northeast Houston area are predominantly Hispanic or Latinx (65%) and Black or African American (25%). Figure 3 and Table 2 show ethnicity and race data for households within the Northeast boundary from 2019 census estimates. Recovery poses a harsh challenge for the many residents in this area living below the poverty threshold. From an income standpoint, the Greens Bayou and Hunting Bayou watersheds have among the highest proportion of lower income residents in the county, joining Sims Bayou in that distinction as shown in Figure 4. Table 3 shows that 24% of families live in poverty within Northeast Houston compared to 14% in all of Harris County. When discussing the disparities in flooding infrastructure in this area, it is important to note that the Northeast community is mostly home to low- and middle-income people of color.

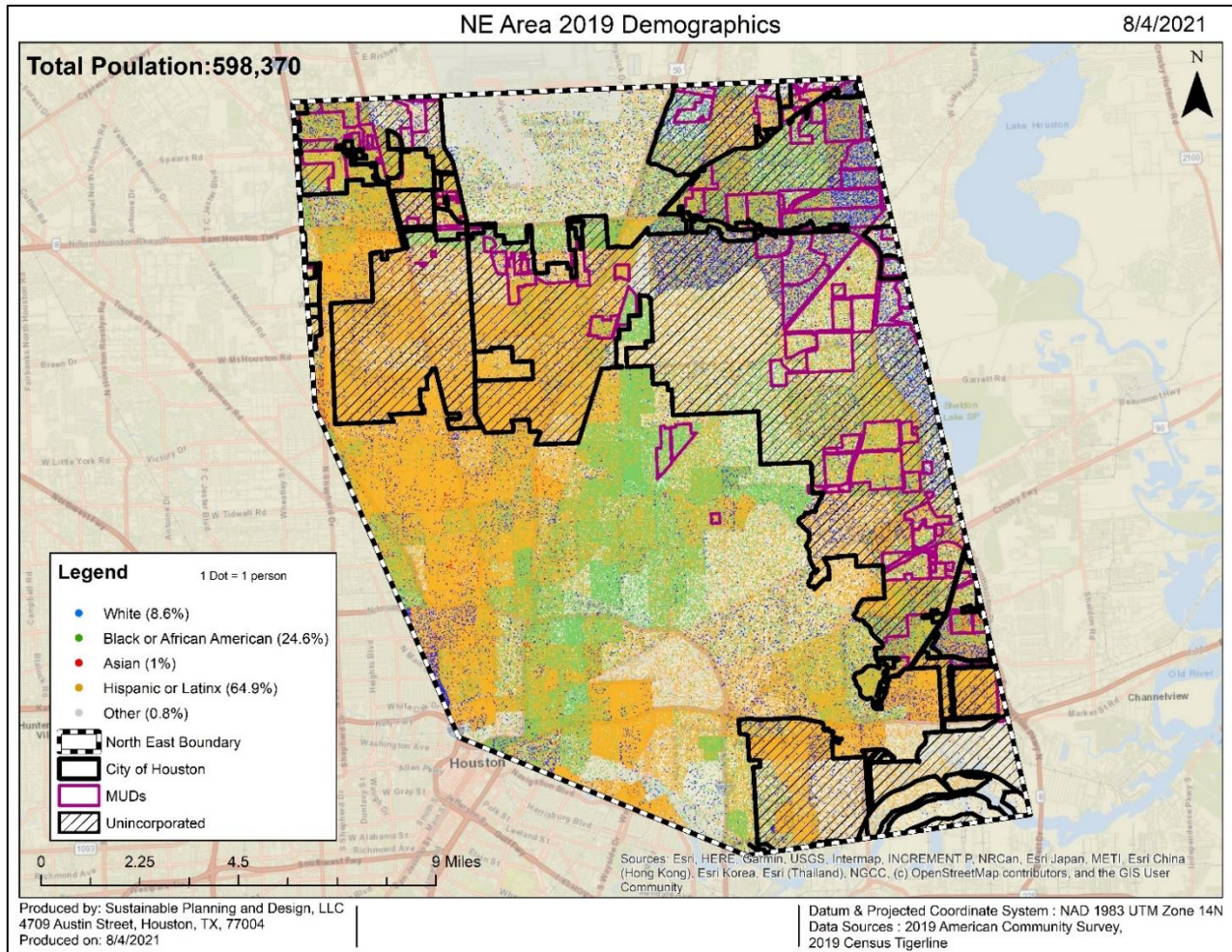


Figure 3. Racial and ethnic data for the Northeast Houston area with City and MUD boundaries. Data gathered by block group (U.S. Census Bureau, 2019a; U.S. Census Bureau, 2019b; City of Houston, 2021d; City of Houston, 2021e). One dot represents one person. Map created by Emily Fucile for Sustainable Planning and Design.

Table 2. Racial and ethnic breakdown of population within Harris County, the Northeast community, the Northeast community living within Houston City limits, The Northeast community living in MUDs outside of City limits, and the Northeast community living in the unincorporated area. Data compiled by Emily Fucile for Sustainable Planning and Design using 2019 Census data on race and ethnicity from the 2019 community survey (U.S. Census Bureau, 2019a; U.S. Census Bureau, 2019b).

Population by Race and Ethnicity for Harris County and the Northeast Area Based on 2019 Estimates						
Boundary	Total Population	White Population	Black or African American Population	Asian Population	Hispanic or LatinX	Other Population
All of Harris County	4,646,630	1,374,905 (30%)	863,044 (19%)	321,392 (7%)	1,995,115 (43%)	92,174 (2%)
Northeast Boundary	598,370	51,724 (9%)	147,422 (25%)	6,125 (1%)	388,090 (65%)	4673 (1%)
City of Houston in NE Boundary	340,646	20,795 (6%)	93,518 (27%)	2,118 (1%)	221,736 (65%)	2,476 (1%)
MUD inside NE Boundary	88,424	14,256 (16%)	28,378 (32%)	2,137 (2%)	42,497 (48%)	1,155 (1%)
Unincorporated in NE Boundary	181,309	17,865 (10%)	30,136 (17%)	2,044 (1%)	129,760 (72%)	1,502 (1%)

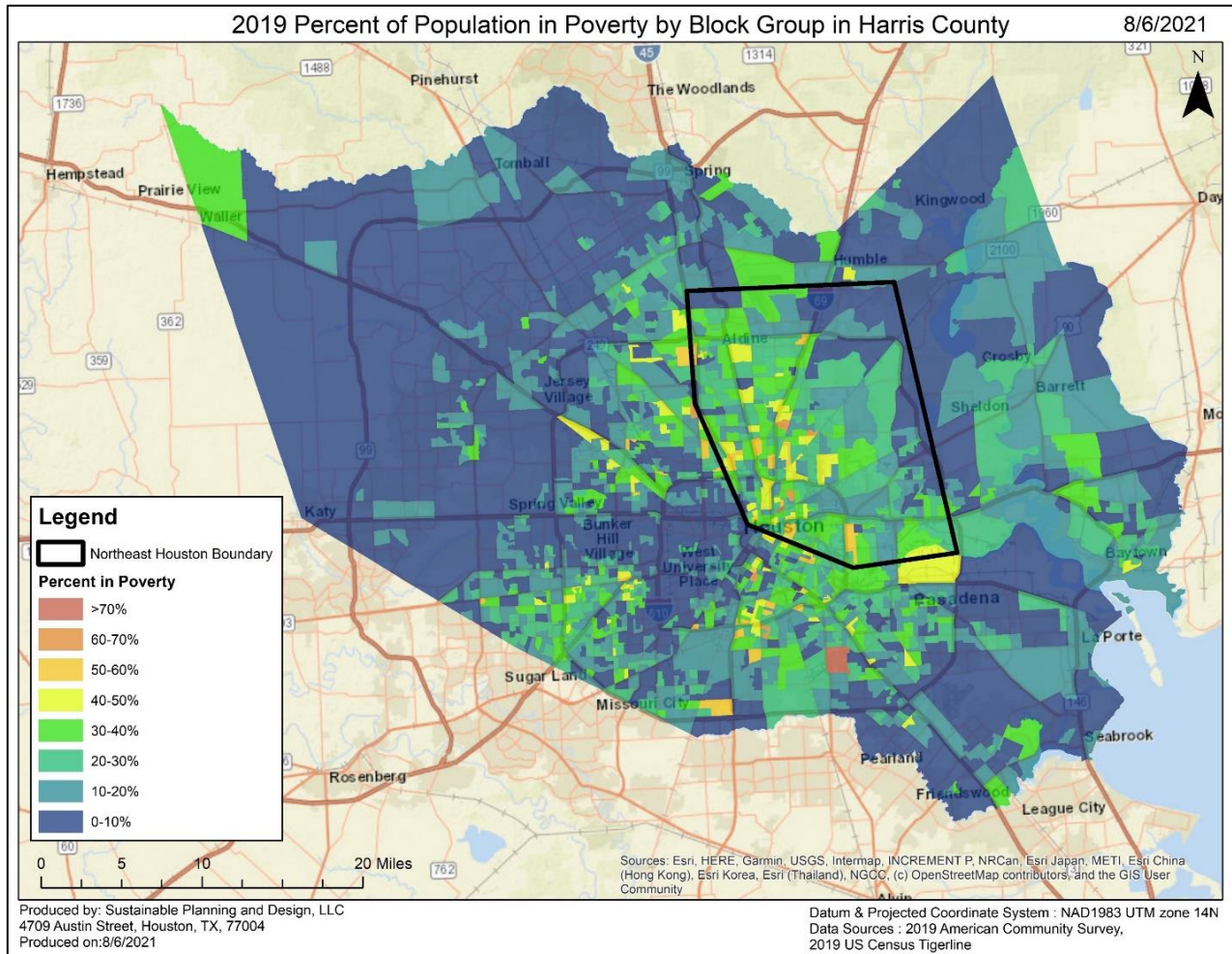


Figure 4. Percent of Households in poverty throughout Harris County (U.S. Census Bureau, 2019a; U.S. Census Bureau, 2019b). Graphic by Emily Fucile for Sustainable Planning and Design.

Table 3. Percentage of families living in poverty withing Harris County and within the Northeast community based on 2019 Census data (U.S. Census Bureau, 2019a; U.S. Census Bureau, 2019b). Emily Fucile for Sustainable Planning and Design.

Count of Households in Poverty in Harris County and the Northeast Area (2019 Estimate)			
Boundary	Total Number of Households	Count of Families in Poverty	Percentage of Families in Poverty
All of Harris County	1,605,368	229,518	14%
Northeast Boundary	181,785	43,790	24%

D. Representation

Northeast Houston has representatives on the City, County, and national scale who have been grappling with these issues. The following maps show the different government representation districts in Northeast Houston. City Council Members Karla Cisneros (District H) and Tarsha Jackson (District B) represent a large number of Northeast residents, while Robert Gallegos (District I) and Dave Martin (District E) represent smaller portions of the area (see figure 5). On the City level, of course, Mayor Turner also holds a very large amount of power to address the situation. For the County, most of Northeast Houston falls into Precinct 1, represented by Commissioner Rodney Ellis, and Precinct 2, represented by Commissioner Adrian Garcia. A small portion lies within Precinct 4, which is represented by Commissioner Jack Cagle (see figure 6). Judge Lina Hidalgo also has power to make change in this situation. On a federal level Senators Ted Cruz and John Cornyn of course represent all of Texas, including Northeast Houston. In the House of Representatives, Congresswoman Sheila Jackson Lee (District 18) and Congresswoman Sylvia Garcia (District 29) represent most of the Northeast sector along with Dan Crenshaw (District 2) and Brian Babin (District 36) who represents a small portion (see figure 7). All of these individuals should take the responsibility they are given by their elected office to find and pursue equitable solutions to the major flooding issues in Northeast Houston.

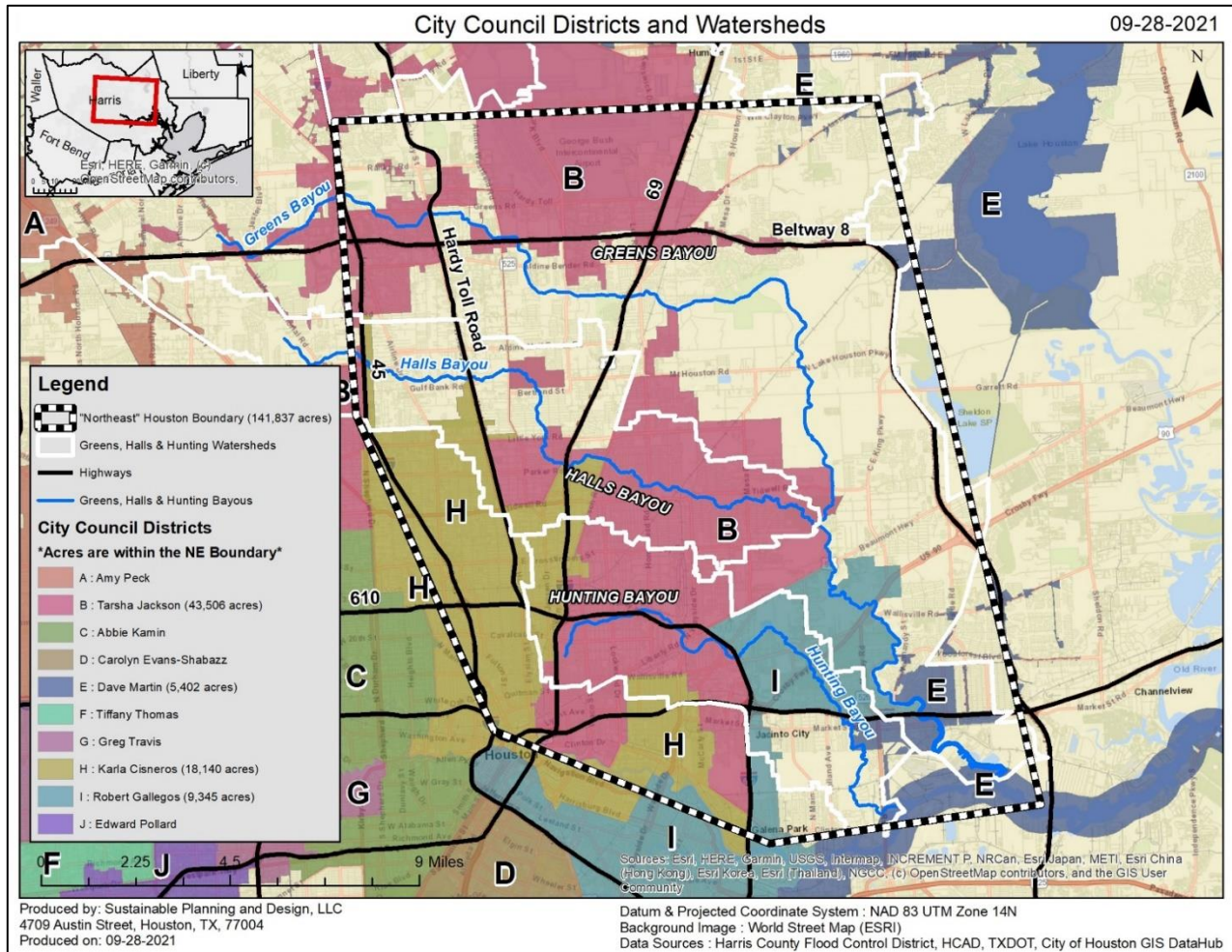


Figure 5. City Council Districts in Northeast Houston (City of Houston, 2021g) with bayous, watersheds, and highways (City of Houston, 2021c; City of Houston, 2021d; HCFCD, personal communication, September 9, 2021; TxDOT, 2020). The area, in acres, of each City Council district located within the Northeast boundary is shown in the legend. Map made by Jace Hodder for Sustainable Planning and Design.

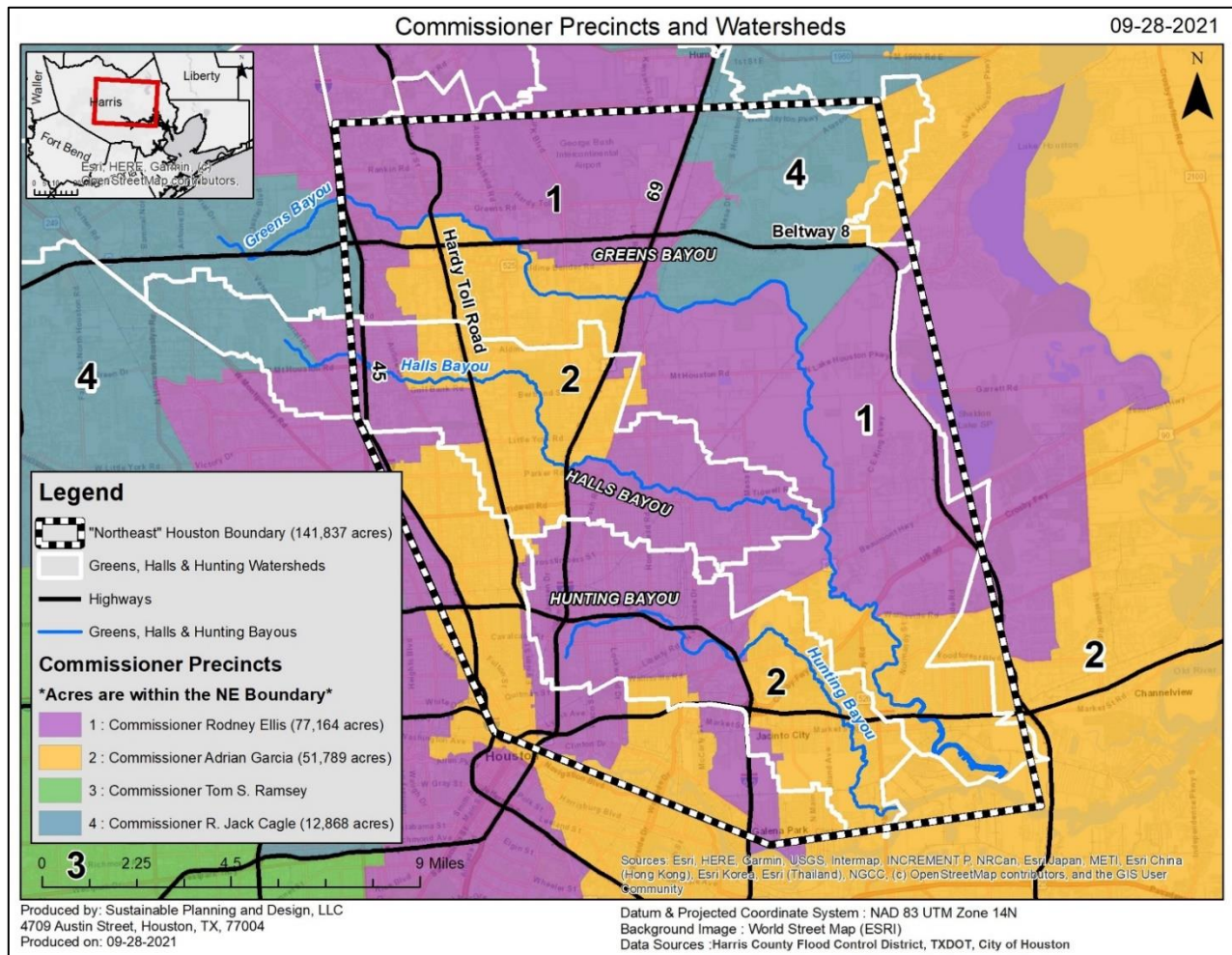


Figure 6. Harris County Commissioner Precincts in Northeast Houston (City of Houston, 2021h) with bayous, watersheds, and highways (City of Houston, 2021c; City of Houston, 2021d; HCFC, personal communication, September 9, 2021; TxDOT, 2020). The area, in acres, of each Commissioner Precinct located within the Northeast boundary is shown in the legend. Map made by Jace Hodder for Sustainable Planning and Design.

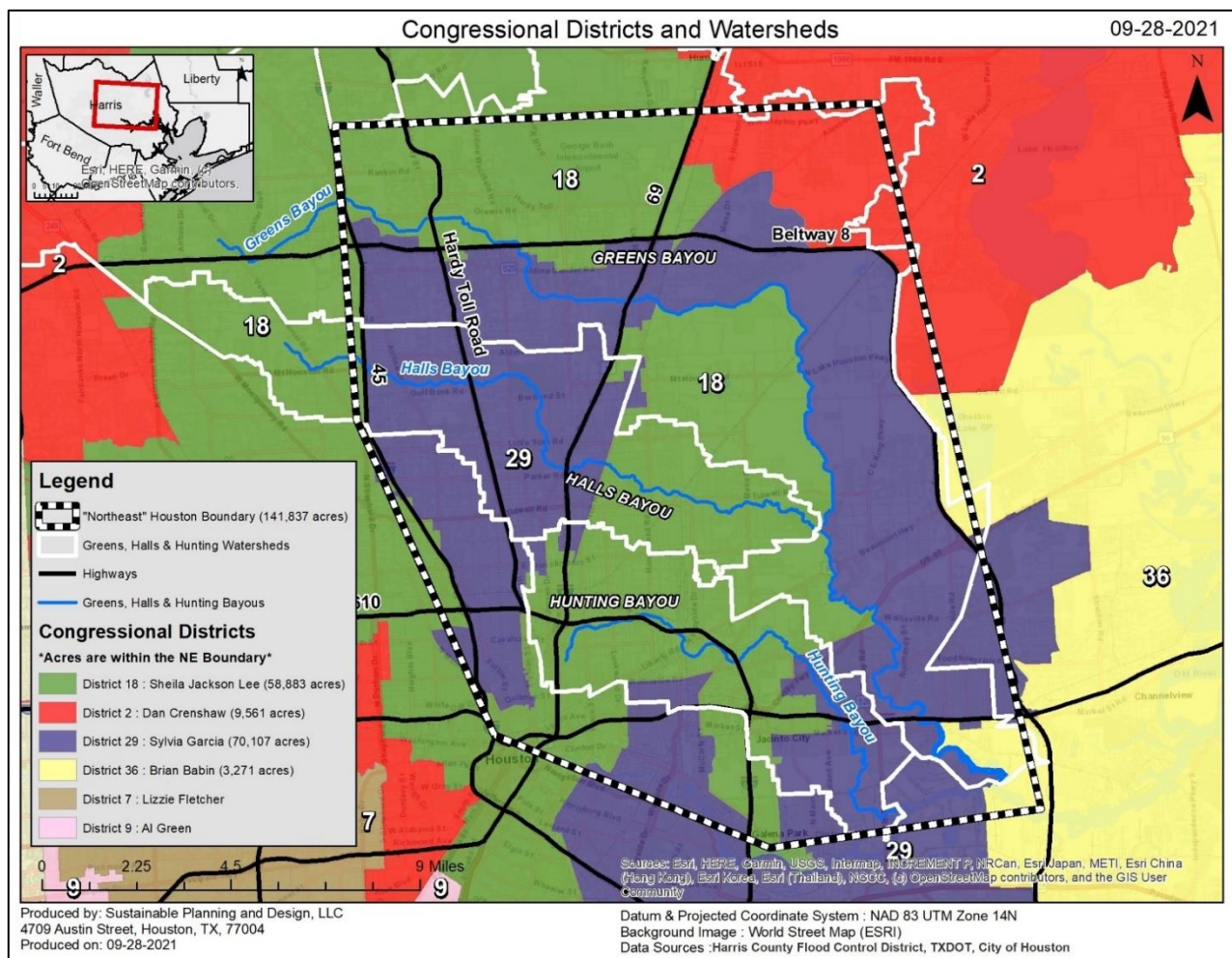


Figure 7. House Congressional Districts in Northeast Houston (City of Houston, 2021i) with bayous, watersheds, and highways (City of Houston, 2021c; HCFCD, personal communication, September 9, 2021; TxDOT, 2020). The area, in acres, of each Congressional District located within the Northeast boundary is shown in the legend. Map made by Jace Hodder for Sustainable Planning and Design.

III. Flooding in Northeast Houston

Like many other low-income and minority communities in the United States, the Northeast community suffers with poor infrastructure resulting from historical underinvestment. Studies in Environmental Justice have clearly documented patterns of poor infrastructure and access to resources in such communities resulting from systemic racism and policies which disadvantage low-income neighborhoods (Bullard, 1994; Hendricks, 2021; Fothergill, 1999). These patterns show why equity must be central in the discussion of flooding solutions in Houston. This section describes the flooding issues in the Northeast and their causes. Outdated infrastructure, poor development practices and

chronic lack of maintenance combined with natural flooding geography has led to flooding issues in Northeast Houston well beyond what is experienced in most other Houston neighborhoods.

A. Flooding Geography and History of Storm Damage

On the watershed map of Harris County (Figure 8), most of the Northeast falls within the Greens Bayou watershed. Halls Bayou, which is a tributary of Greens Bayou, often does not show up in official documents because it is considered part of the Greens Bayou watershed by Harris County.^{3,4} Hunting Bayou is a separate watershed and most of the Fifth Ward and Pleasantville are located with the San Jacinto River watershed, e.g. the Houston Ship Channel. It is interesting to note that while Halls Bayou is not considered a separate watershed, Little Cypress Creek, a tributary of Cypress Creek, is considered a separate watershed (HCFCD, 2021b), and Willow Creek, a tributary of Spring Creek, is also a separate watershed (HCFCD, 2021f). This issue will be discussed later in this paper.

³ “Another notable Harris County subwatershed is Halls Bayou, which is a major tributary of Greens Bayou, designated by the letter ‘P.’ ... Halls shares the ‘P’ watershed letter with Greens” (HCFCD, 2021g).

⁴ “The Halls Bayou watershed, as a sub-watershed of Greens Bayou, is not counted as one of Harris County’s 22 official watersheds” (HCFCD, 2021b).

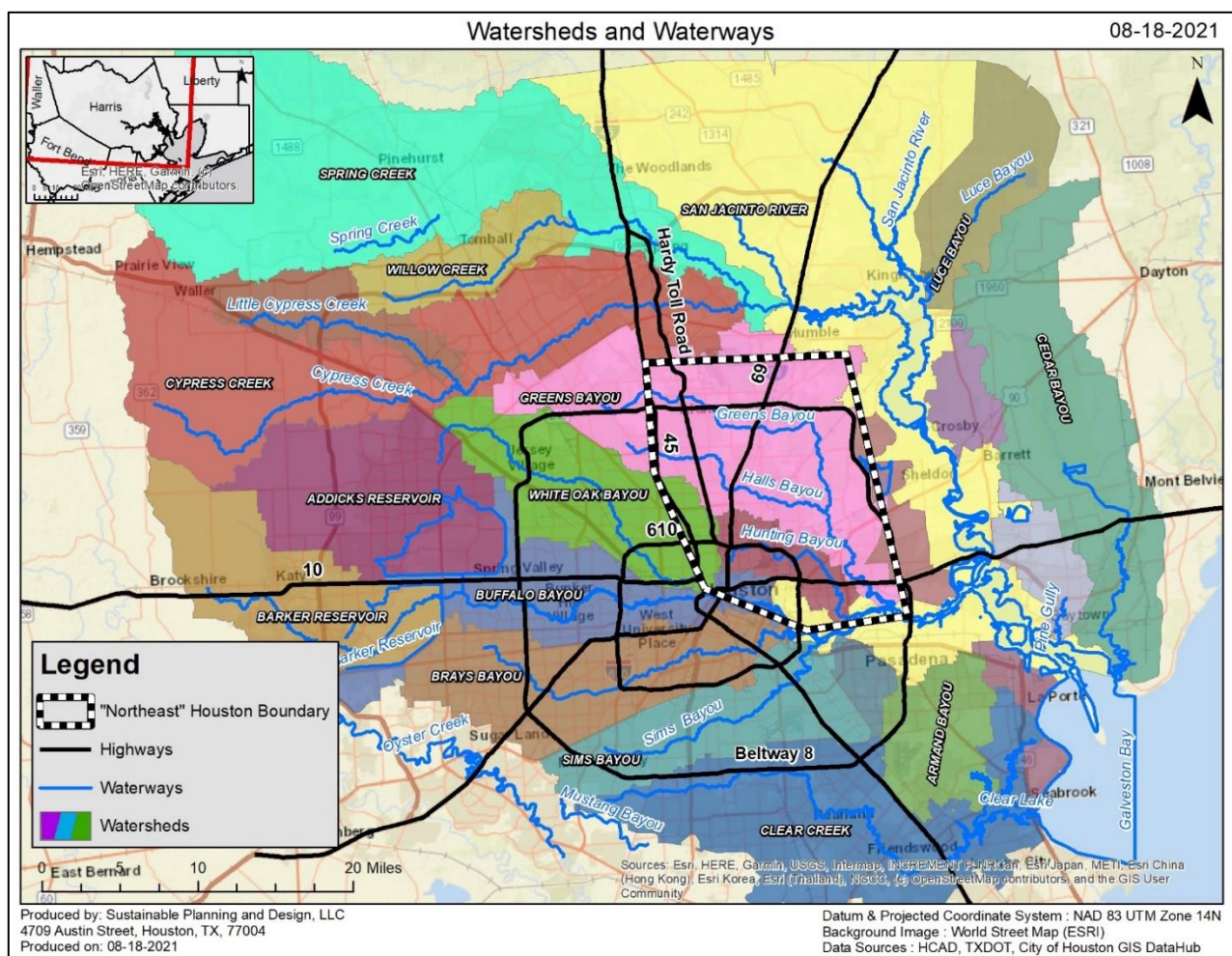


Figure 8. Harris County Watersheds with waterways and highways (HCFCD, 2021h; City of Houston, 2021c; TxDOT, 2020). The Greens Bayou Watershed including Halls Bayou is shown in pink, with Hunting just to the south in dark red. The Northeast boundary includes portions of White Oak, Buffalo, San Jacinto, and Carpenters watersheds. Map made by Jace Hodder for Sustainable Planning and Design.

The Northeast is crossed by highways, railroads, and bayous. Figure 9 shows these bayous' floodplains along with key roads and railroads. According to this map, 23,804 acres are in the 100-year floodplain and 41,790 are in the 500-year floodplain. While the floodplains shown in this map are current, they are also out-of-date. A new floodplain map being developed by Harris County Flood Control District uses more up-to-date rainfall information and a different computer modeling process. This is expected to be release but was not available to the authors of this report.

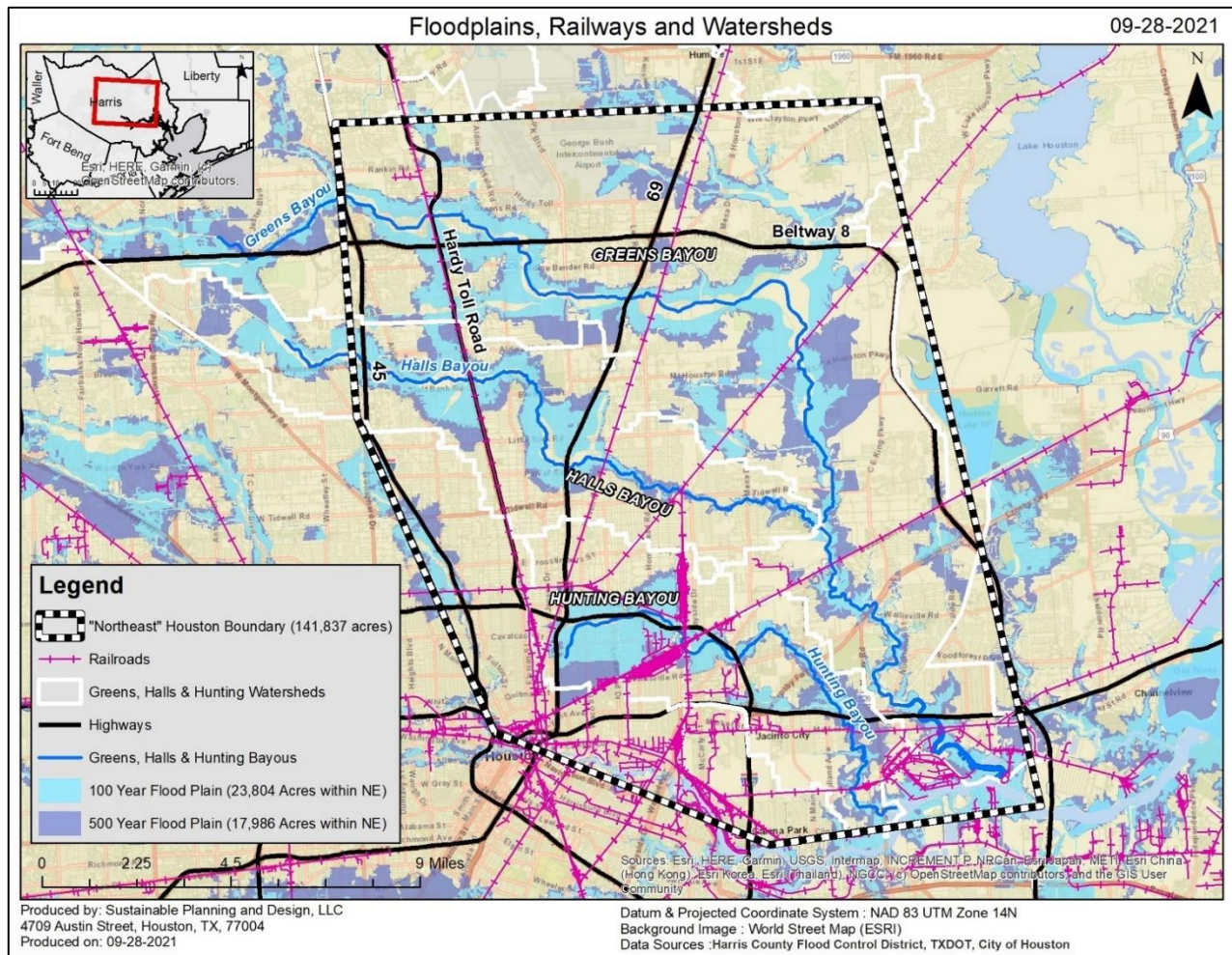


Figure 9. FEMA 100-year and 500-year floodplains in Northeast Houston with railroads, bayous, watershed boundaries, and highways (FEMA, 2021a; FEMA 2021b; TxDOT, 2016; City of Houston, 2021c; HCFCD, personal communication, September 9, 2021; TxDOT, 2020). Map created by Jace Hodder for Sustainable Planning and Design.

During Hurricane Harvey, Greens and Halls Bayou had about 25,000 flooded homes combined, the most in Harris County after Brays Bayou, where 26,750 homes were flooded. In Hunting Bayou about 7,400 homes flooded, which is a higher proportion of flooded homes to population than any watershed in Harris County, with Greens Bayou not far behind (HCFCD, 2018a, p. 14). Looking at the Flood Report from Imelda, it is clear that the Northeast neighborhoods were once again hit disproportionately hard, with 775 homes flooded in Halls Bayou, 310 flooded in Greens Bayou, 165 in Lower San Jacinto, and 35 in Hunting Bayou. This can be compared to 30 homes flooded in Brays Bayou or 165 homes flooded in Buffalo Bayou in the same storm (HCFCD, 2019, p. 10). In Allison, over 28,000 residences flooded within Greens and Halls watersheds (HCFCD, 2001, p. 14).

Hunting Bayou experienced flooding of over 8,000 residences. Comparatively, around 6,000 residences flooded in Brays Bayou or 2,500 in the Buffalo Bayou during Allison (HCFCD, 2001, pp. 14-16).

Table 4. Homes flooded in Northeast Houston during Imelda, Harvey, and Allison. Data compiled by Sarah Swackhamer for Sustainable Planning and Design using information from HCFCD flood reports following major storms (HCFCD 2019; HCFCD 2018a; HCFCD 2001).

Watershed	Imelda	Harvey	Allison
Greens Bayou	310	12,900	15,000
Halls Bayou	775	11,830	13,000
Hunting Bayou	35	7,420	8,000

In other words, the Northeast community was hit disproportionately hard during Harvey and then again in Imelda as well as earlier during Allison, and several times in between that are not documented here. Yet, this watershed has never qualified for a major federal flood protection project. This fact is hard to understand – the Greens Bayou watershed (including Halls) routinely leads Harris County in number of homes flooded in larger events, yet it has never qualified for a major federal project.

B. Flooding Patterns and Structural Flaws

Floodplains are generally only associated with major watercourses and often do not reflect the localized drainage problems that are abundant in the Northeast. Localized drainage problems are persistent in the Northeast due at least in part to a poorly maintained, open ditch drainage system as well as numerous blockages by roads and railroads, some of which are visible in Figure 9 as they affect major watercourses. More sophisticated modeling such as HEC-RAS, which is currently being implemented by Harris County Flood Control District to produce the new 100-year floodplain maps, can show flooding in neighborhoods as well as along the major watercourses. A HEC-RAS analysis of flooding in a portion of this area during Harvey prepared by Rice University’s SSPEED Center is shown in Figure 10, indicating the severity of the flooding problem within the Northeast.



Figure 10. HEC-RAS modeling of flooding in the Northeast during Hurricane Harvey when over 25,000 homes flooded in the Greens Bayou Watershed. In this image, Greens Bayou is flowing across the upper part of the diagram, crossing the Hardy Toll Road before going under Beltway 8 and then flowing east under the Eastex Freeway. Halls Bayou is shown crossing the middle portion of the image under IH 45, the Hardy Toll Road and the Eastex Freeway. Image courtesy of Dr. Phil Bedient, SSPEED Center, Rice University.

It is important to note that climate change is substantially affecting the size of rainfall events hitting the Houston region. Many studies show that climate change is causing stronger hurricanes to occur more frequently (Knutson et al., 2020; Masson-Delmotte et al., 2021; Knutson et al., 2021; Lui et al., 2019). From a planning standpoint, cities and counties across the United States use the 100-year and the 500-year flood events because these metrics were set up by the federal government's flood insurance program. The 100-year floodplain is the area that is flooded by a storm that has a recurrence frequency of once every 100 years and the 500-year is once every 500 years, representing the storm that has a 1% (100-year) or 0.2% (500-year) chance of occurring in any year. These rainfall amounts are determined by statistical methods that rely on past rainfall patterns. Unfortunately, climate change is increasing our rainfall amounts, meaning that we cannot solely rely on past rainfall as the best indicator of future rainfall occurrence frequencies.

Harris County is revising its floodplain maps due to an increase in the size of the 100-year flood from about 12.5 inches in 24 hours to 17-18 inches in 24 hours according to the National Oceanic and Atmospheric Administration’s NOAA Atlas 14 (NOAA, 2017, p. 261). More recent analyses of the increasing intensity of storms indicates that while Hurricane Harvey would have been considered to be a 10,000-year event a decade ago, it may now be considered a 35- to 75-year event due to the increase in large storm events in the recent past (P. Bedient, personal communication, 2021). This rainfall data indicates that flooding problems in the Northeast will only get worse over time. Immediate action must be taken to solve those problems that can be more easily addressed while work continues on the larger-scale issues over time. A comparison of the rainfall estimates for 100- and 500-year floods from FEMA floodplain data and the new NOAA Atlas 14 data is shown in Table 4 along with rainfall data from some of the regions more recent storms.

Table 5. Comparison of the “current” FEMA 100-year and 500-year rainfall by time period as well as the NOAA Atlas 14 “new” 100-year and 500-year rainfall and five recent storm events. It is important to note that the Northeast has been impacted by at least two storms – Harvey and Allison – that were larger than the “new” 500-year rainfall. Table created by Camille Chenevert for Sustainable Planning and Design, based in part on data from Jeff Lindner of Harris County Flood Control District and NOAA Atlas 14 Point Precipitation Frequency Estimates for Houston WB City (79-0056) station (NOAA, 2017).

Duration	Precipitation Depth (Inches)								
	Current FEMA 100-Year	Current FEMA 500-Year	NOAA Atlas 14 100-Year	NOAA Atlas 14 500-Year	Imelda Sept. 2019	Harvey Aug. 2017	Tax Day April 2016	Allison June 2001	October 1994
1-hr	4.3	5.5	4.9	6.4	6.4	6.8	4.7	5.7	3.7
2-hr	5.7	7.6	7.0	9.8	9.2	11.9	7.3	9.9	4.7
3-hr	6.7	9.2	8.6	12.4	10.9	14.8	8.3	13.5	5.3
6-hr	8.9	12.8	11.4	17.0	14.3	18.9	13.9	21.2	7.2
12-hr	10.8	15.5	14.1	21.2	17.9	20.9	16.7	28.3	12.0
24-hr	13.2	18.9	17.0	25.5	21.1	25.6	17.4	28.4	20.9
2 days	14.5	20.0	20.6	30.0	29.1	35.2	17.5	28.5	23.1
4 days	15.9	21.1	23.2	32.9	29.7	47.7	N/A	38.5	28.9

While it is understandable that significant flooding may arise from these huge storms, the Northeast also suffers regular flooding in certain areas from much smaller storm events. At least in part, this problem is related to the open ditch drainage system that is prevalent throughout the Northeast sector as is shown in Figure 11. This drainage

situation unfolded over many decades as the city developed but was worsened in the early 2000s when the decision was made to place maintenance responsibility for culverts beneath private driveways on residents rather than upon the city. This has led to major maintenance and flow problems.

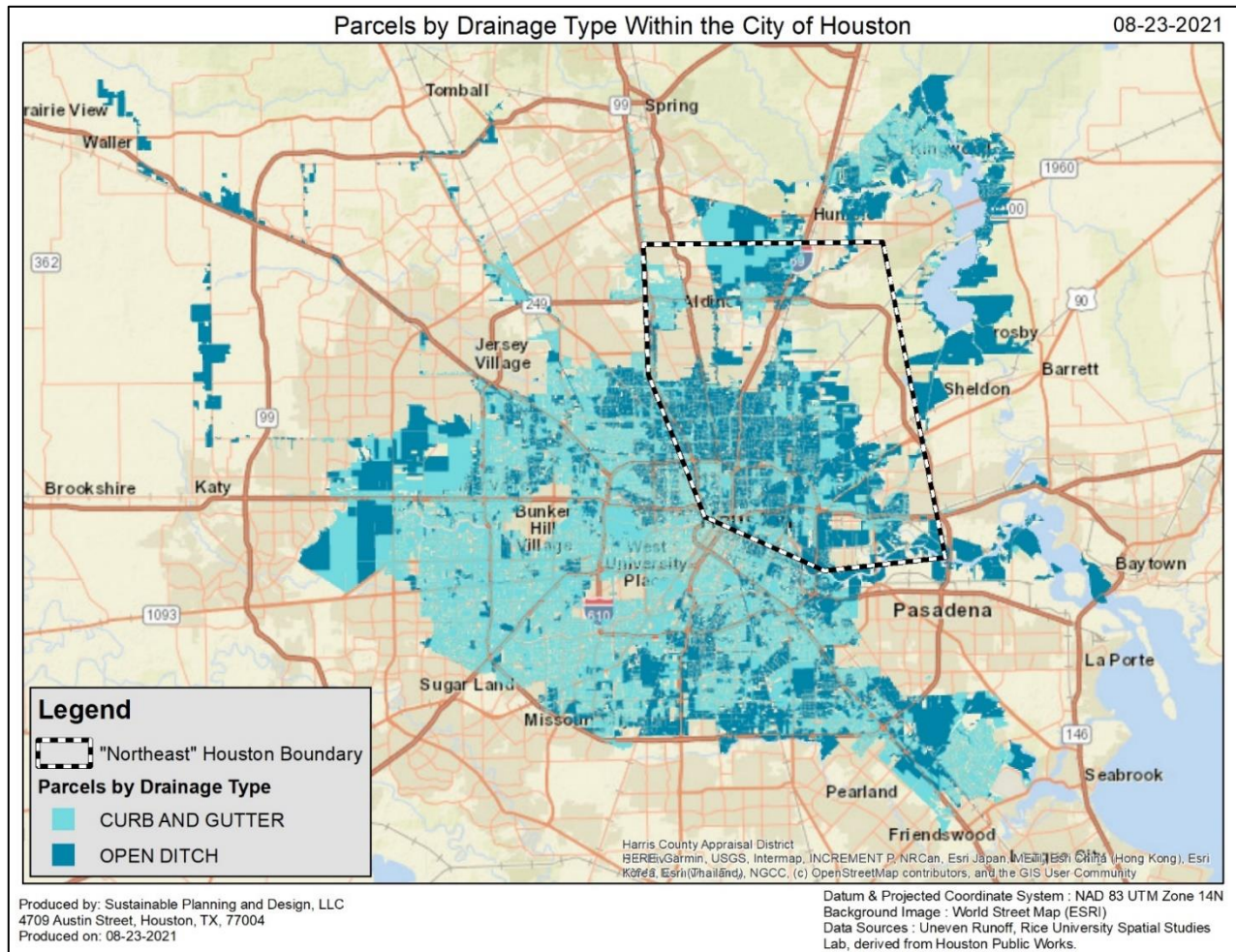


Figure 11. Map showing distribution of open ditch drainage system by parcel throughout the City of Houston. Shapefiles created by Rae Atkinson from data provided by the Houston Public Works (Ng et al., 2021).

Although open ditch drainage is not inequitable *per se*, this transfer of maintenance responsibility has led to the widespread presence of ditches with blocked culverts that prevent flow, making many sites of open ditches more vulnerable to flooding. Because of this lack of maintenance, open ditch drainage can represent an equity issue. Figure 12 and 13 shows such open ditches and the obstructions that often occur. A further change in City policies occurred when maintenance of ditches (other than private culverts) and other storm sewer maintenance became scheduled by 311 calls rather than by a regular maintenance schedule. Residents interviewed about this issue complain that this system is

not working to get problems solved in their neighborhoods. They say that the regular maintenance of all ditches, not just ditches for which someone makes 311 calls, is necessary to keep the flooding under control. There is no doubt that frustration exists with the 311 system of maintenance resource allocation.



Figure 12. Picture of open drainage ditch in Northeast Houston with culvert non-functional. Photo by Sarah Swackhamer.



Figure 13. Picture of open drainage ditch in Northeast Houston with culvert non-functional. Photo by Camille Chenevert.

In collaboration with the Northeast Super Neighborhoods United, Councilwoman Tarsha Jackson, Councilwoman Karla Cisneros, Congresswoman Sylvia Garcia, Congresswoman Sheila Jackson Lee, and Commissioner Adrian Garcia, Sustainable Planning and Design has initiated a survey of residents to find the location of more persistent flooding issues regardless of whether they flooded in bigger storms, smaller ones, or both. Figure 14 shows the locations identified in the surveys returned to date as well as SWAT (Storm Water Action Team) Projects which are being prioritized by Council Members Tarsha Jackson and Rober Gallegos and areas of concern sent by Karla Cisneros. Due to time and financial constraints, we were not able to solicit responses from every neighborhood, so the data here is far from complete. However, patterns did emerge from the responses we received, allowing us to identify major areas of flooding beyond those presented by official maps and floodplains. The map below includes responses from IAH/Airport Area (SN 42), Eastex - Jensen Area (SN 46), East Little York/Homestead (SN 47), Trinity/Houston Gardens (SN 48), East Houston (SN 49), Near Northside (SN 51), Kashmere Gardens (SN 52), Greater Fifth Ward (SN 55), Denver Harbor/Port of Houston (SN 56), and Northshore (SN 58).

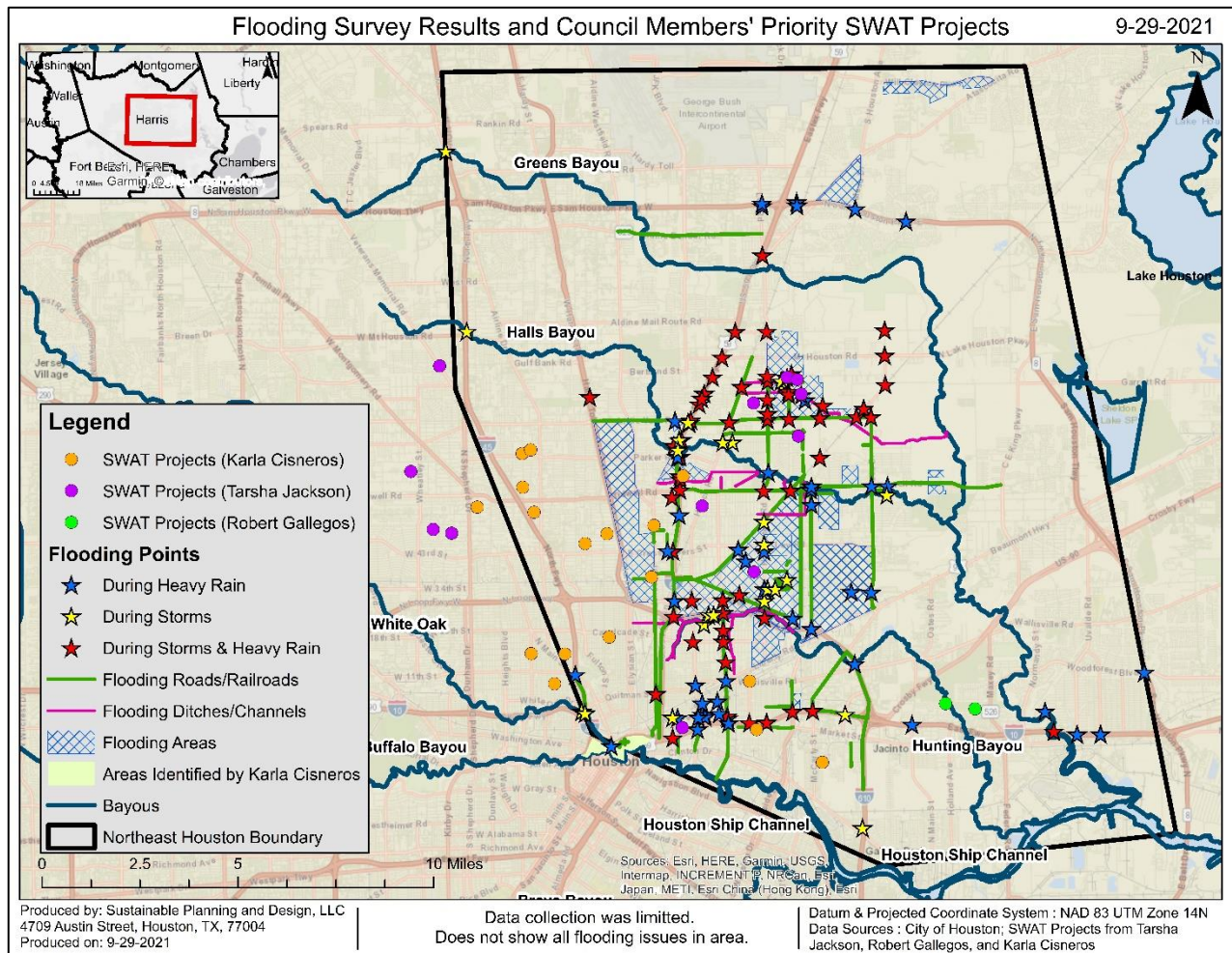


Figure 14. Map compiled showing locations identified as suffering from persistent flooding issues in Northeast Houston according to a survey conducted of residents and Super Neighborhood leaders. Priority SWAT projects from Council Members Karla Cisneros, Tarsha Jackson, and Robert Gallegos are also included. Bayous are also shown (City of Houston, 2021c). This map is still under development and will be expanded as more responses come from various parts of the community. Map by Camille Chenevert for Sustainable Planning and Design.

On the survey, multiple responses showed persistent flooding issues along sections of integral streets including Little York Rd., Lockwood Dr., Jensen Dr., Hirsch Rd., and McCarty St. Residents attribute flooding on smaller residential streets to poor road design in which elevation differences cause pooling of water in certain places along with the lack of maintenance on open drainage ditches including an issue with illegal heavy trash dumping in ditches. This map also shows several of Councilwoman Jackson's priority projects are in areas which residents identified as persistently flooding.

Poor or absent maintenance of open county drainage ditches, like Harris County ditch P125 and H112, were mentioned by residents. Figure 15 shows all Harris County drainage ditches which are substantial in this quadrant. Recalling Figure 10, the obstruction and flooding represented by IH 45 and IH 69 as well as the Hardy Toll Road and various rail lines can be seen. Flooding also is persistent along highway service roads and railroad intersections. This means major entry points to neighborhoods become impassable during moderate to heavy rain events, trapping residents both inside and outside their neighborhoods. Interviewed residents said that it was often impossible to get from their workplace to their homes, just a few streets apart, during flood events.

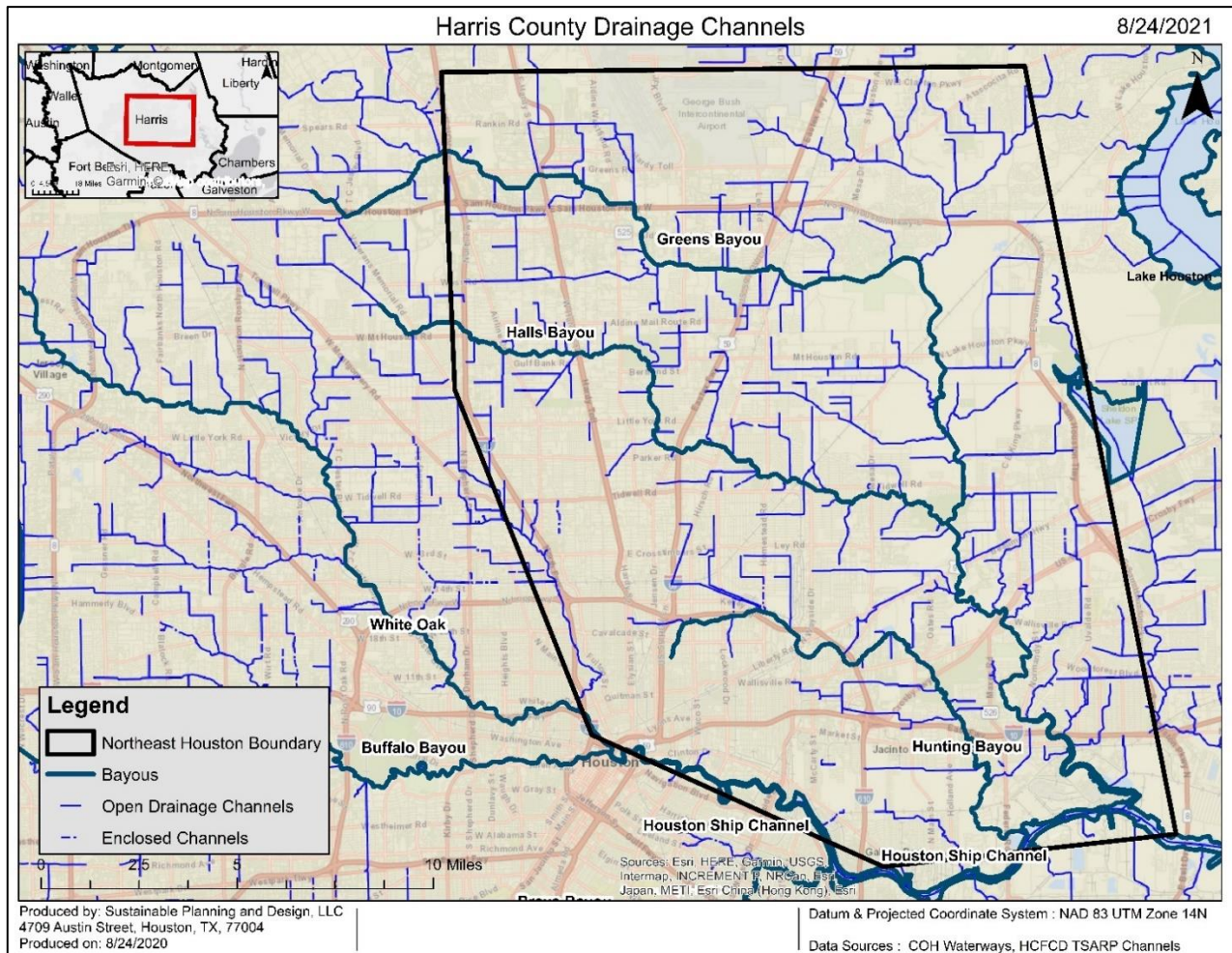


Figure 15. Harris County drainage ditch network and bayous (HCFCO, 2015; City of Houston, 2021c). Map by Camille Chenevert for Sustainable Planning and Design. See [HCFCO's Flood Education Mapping Tool](#) to see labels of ditches (HCFCO, n.d.-a).

According to the residents interviewed for this report, flooding within neighborhoods seems to be attributable to several sources: lack of maintenance of open

drainage ditches, lack of maintenance on County drainage ditches, lack of storm drainage inlets, uneven roads, illegal dumping, and impoundments created by highways and railroads. The information below comes from discussions with the residents. The authors have not conducted separate investigations during flood events of the validity of all these concerns, but the authors have made spot checks and verified that some of the conditions related to ditch condition, lack of maintenance, culvert blockage and trash deposition identified by residents are valid concerns.

Open Drainage Ditches: As discussed above, the open drainage ditches along neighborhood streets are frequently stopped by debris and over silting causing backup in storm water throughout neighborhoods. If one culvert is not maintained, the whole street's drainage is disrupted. Many circumstances can show the flaws of the City's current maintenance policies. For instance, if a house is uninhabited, the culvert under that driveway will go unmaintained and cause flooding for all the neighbors. Further, the policy puts unreasonable burden on low-income and elderly residents. Another issue observed with the open drains is that trash, both heavy and light, builds up in the drain. Figure 16 is a photograph of trash build up in an open drain in front of a house in Northwood Manor. Uninhabited properties are often sites of illegal dumping, adding to the debris in the drainage system. Residents say that when they report heavy trash on uninhabited properties to 311, Public Works employees say it is against HPW policy to pick up trash on uninhabited property. There must be a way for residents to get this trash cleared.



Figure 16. Open drainage ditch in Northwood Manor with trash piling up and obstructing drainage. Picture by Camille Chenevert.

County Drainage Ditches: County drainage ditches often are poorly maintained and possibly poorly designed to transport water. Water remains stagnant in the ditches and does not flow into Bayous. According to residents, the County maintains their ditches on a quarterly basis. The maintenance consists of cutting grass and sometimes removing trees from within the ditch. When a County employee walked the P125 with Super Neighborhood leaders, the employee noted that some inlets passing under roads were too small. However, despite massive sediment buildup, no excavation has been done to widen or deepen the channels. HCFCD did desilt the channel in 2020, but as can be seen in the photos below sediment buildup remains an issue. In some places, changes in the depth of the drains seem to hinder the movement of water towards the bayous. Illegal dumping is also a major problem in these drains. Residents have reported dead livestock, boats, tires, and other large debris left in the drains. They feel those complaints are not responded to other than in some rare cases where there is extreme persistence from the residents. Residents also report that during scheduled maintenance of the ditches, debris is often not removed, and even when trash is removed, it is placed on the side of ditches and not removed. Figures 17 and 18 are pictures taken of P125 showing the buildup of trash, stagnant water, and inadequate inlets. All these problems lead to flooding for resident living adjacent to these ditches. Major investments should be made to improve and maintain the County drainage ditches.



Figure 17. Tires in the Harris County P125 drainage ditch. Picture from Camille Chenevert.



Figure 18. Inlets of the Harris County P125 drainage ditch. Pictures from Camille Chenevert.

Storm Drainage Inlets: In parts of the Northeast which are serviced by storm drainage inlets rather than open drainage ditches, the inlets do not provide for sufficient drainage. Residents say maintenance on these inlets is an issue as debris will build up and clog them. In older sections of the neighborhood, there are not enough inlets on streets and the inlets which are there are too small to drain the street. In many cases, a residential street may have only two small inlet drains on one end of the street. This means drainage is slow even in the best of circumstances. However, the inlets often also see a buildup of trash or overgrowth further compounding street flooding as seen in Figure 19. Figure 20 shows a storm drain from the old section of Northwood Manor which services a block of around eighteen houses on the right, on the left is a storm drain located in a recently developed neighborhood in Northwood Manor. These newer neighborhoods are built with many more drainage inlets, all of which are twice the size of those in older parts of town. The infrastructure in these older parts of town should be improved to accommodate the current needs of residents.



Figure 19. A drainage inlet on an uninhabited property in Northwood Manor which is almost completely covered by overgrown plants and debris. Picture by Sarah Swackhamer.



Figure 20. On the left, a drainage inlet in the old section of Northwood Manor. On the right, a drainage inlet in a newly developed neighborhood of Northwood Manor. Pictures by Camille Chenevert.

Uneven roads: Many roads within the Northeast slant downward causing pooling at certain parts of the street. In many cul-de-sacs, the dead-end side of the road is higher, causing ponding on the other end. In addition, serious cracks in the streets often allow water to rise from the ground after floodwaters have begun to recede. A survey should be done to determine where this is a major cause of flooding.

Impoundments from Highways and Railroads: Flooding along railroad crossings and highway exits were reported as occurring during rainfall events and hurricanes. This is supported by the HEC-RAS modeling. Railroads are raised higher than surrounding areas and water cannot flow under the tracks causing ponding on both sides (see Figure 21).

Highways and service roads cause similar issues as they may be raised above the landscape but lack adequate drains from one side to the other, obstructing flow. This can be seen both in HEC-RAS modeling and [HCFCD's Flood Education Mapping Tool's](#) ponding map (HCFCD, n.d.-a).



Figure 21. The Union Pacific railroad at the intersection of Little York Rd. and Hirsch Rd. Photo by Camille Chenevert.

Another issue reported by residents which coincides with flooding is outdated and under-maintained sewage infrastructure. Residents report that the linings of old sewer pipes in their neighborhood often crumble, leading to blockages that prevent residents from using their facilities. In storm events, this becomes an even larger problem, as residents are trapped in their houses, often without functional plumbing. In neighborhoods like Northwood Manor where many residents are elderly and/or disabled, this is especially difficult. Some residents have purchased portable toilets for their homes because of this problem. When HPW arrives to fix these problems, their efforts to relieve pressure in sewer pipes often lead once again to sewage buildup/accumulation in the facilities of residents.

C. Historic Federal Project Assistance

Historically, the United States Army Corps of Engineers has been a major source of flood protection in Houston and Harris County. The Harris County Flood Control District (hereinafter the District) was formed in 1937, after major flooding of downtown Houston

in the late 1920s and mid-1930s (HCFCD, n.d.-b). The initial responsibility of the District was to be the local sponsor for federal projects such as Addicks and Barker Reservoirs, which were constructed in the late 1940s and early 1950s in the Buffalo Bayou watershed (HCFCD, 2021i).

Over the years, major federal projects have occurred on several of Houston's watersheds with at least two major watersheds – Brays and White Oak – receiving funding for two major projects (Project Brays, 2019; HCFCD, 2018b).⁵ On the other hand, major federal projects have not occurred at all in several other watersheds, including Greens and Halls Bayous, although a relatively small federal project was constructed in the far western segment of Greens Bayou. Even though many homes would be protected by flood control projects in Greens and Halls Bayou watersheds, major bayou-related improvements in low-income communities often do not qualify for federal money because the dollar benefits of the flood protection do not exceed the costs of constructing the project. Because the Corps of Engineers uses dollar benefits⁶ as the primary criteria for project selection, wealthier areas with higher home values qualify more easily for federal projects, a fact that raises important equity issues concerning the federal process for flood relief (U.S. Water Resources Council, 1983; Durden & Fredericks, 2009; Greeley-Polhemus Group, 1991).

Several watersheds were proposed to receive federal funding for flooding projects based upon appropriation decisions in early 2018 after Harvey. Those bayous slated for Corps of Engineers federal flood protection support included Brays, White Oak, Clear Creek, and Hunting Bayous. The watersheds that have received historic federal assistance or are currently approved for federal flooding assistance are shown on Figure 22. Viewed in the context of Figure 6 and Table 3, this map demonstrates the importance of income levels and home price as part of the Corps' and the Office of Management and Budget's approach to federal project approval using the benefit cost analysis framework which is discussed later in this report.

⁵ In HCFCD's 2018 Federal Funding Report, they note several projects within Brays, White Oak, and Hunting Bayous receiving funding and support from the USACE (HCFCD, 2018b, pp. 60, 68, 75). A project in Greens Bayou also features involvement from USACE, but in contrast to the others, the role of the Corps here is to "manage[,] design[,] and build[] the project," with no noted role in funding it (HCFCD, 2018b, p 97).

⁶ The National Economic Development (NED) account is the only evaluation framework that is required by the Army Corps of Engineers when deciding whether or not to pursue a new project (U.S. Water Resources Council, 1983, p.18). This account evaluates a project according to its economic costs and benefits, and encourages selection of the project with the greatest net economic benefit or return. Evaluation criteria for NED in the context of urban flood damage include changes in income and economic activity in the area, including rents, and the value corresponding to "damages or total loss of buildings or parts of buildings" (U.S. Water Resources Council, 1983, p 32). Market values of the land in an area are important aspects of these calculations (U.S. WRC, 1983, p. 38).

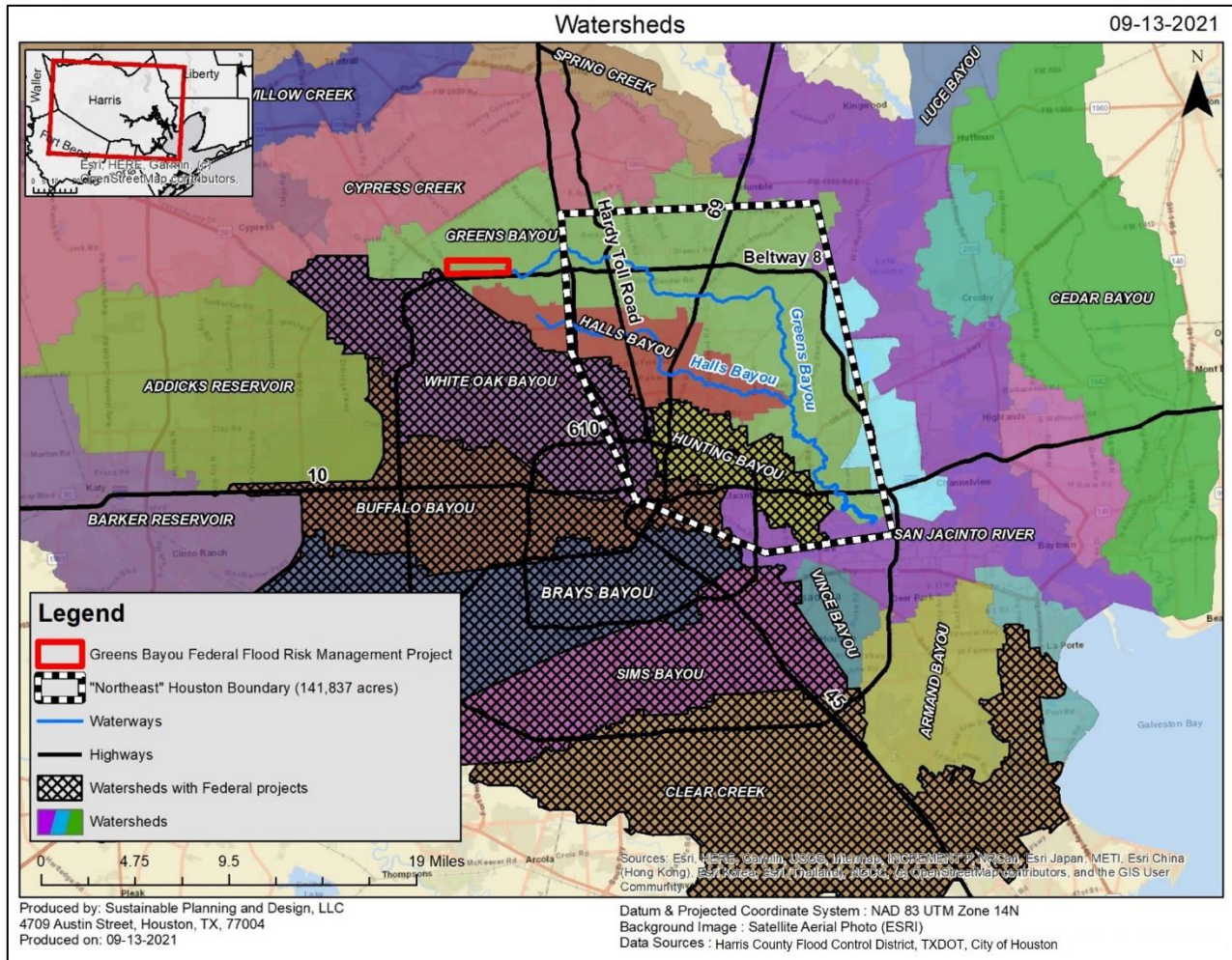


Figure 22. Harris County watersheds with and without major federally funded projects completed or in planning, and Halls and Greens Bayous (HCFCD, 2021h; City of Houston, 2021c). Greens Bayou Federal Flood Risk Management Project marked separately as it is considered a minor project (HCFCD, n.d.-c).

There are some innovative concepts that may be used under the federal guidelines, but they have not been widely used. As will be discussed in the solutions section of this report, there are options available that may make the Corps of Engineers flood abatement process more able to address the needs of the northeast.

IV. The 2018 Flood Bond Issue

A. Allocation of Funds in the 2018 Flood Bond

In 2018, Harris County passed a [bond issue](#) that included projects in every watershed along with a promise of equity in the provision of bond funding to all areas of the County (HCFCD, 2021j; Despart, 2018). The language of the Bond states:

Since flooding issues do not respect political or jurisdictional boundaries, the Commissioners Court shall provide a process for the equitable expenditure of funds, recognizing that project selection may have been affected in the past and may continue to be affected by eligibility requirements for matching federal, state and other local government funds (HCFCD, 2018c, p. 8).

At the time of the bond issue, Hunting Bayou was slated for a federal project, and that is moving forward with bond assistance. However, Greens and Halls have never qualified for a major Corps of Engineers project because the homes in this region are of relatively low dollar value.

After passage of the bond issue, a decision had to be made as to how to allocate the bond money. Various watershed projects had been promised by County Judge Ed Emmett and the Flood Control District in public meetings leading up to the bond election. These allocation decisions were made after the bond election but before the change of leadership within Harris County whereby current County Judge Lina Hidalgo and Commissioner Adrian Garcia were sworn in in early 2019. At this time, all promised projects were evaluated as to how much bond money should be allocated along with other sources of money. Areas that qualified for federal flood projects by the Corps of Engineers would get less bond money because the federal project would help address flood abatement needs. Other sources of matching funds also were relied upon along with the bond money. The overall allocation of matching funds versus bond funds and partner funds is shown in Figure 23. Figure 24 isolates the funding allocations for Greens and Halls Bayous. Overall, funding for Halls and Greens Bayou projects is made up of a much, much larger percentage of partner funding than projects in other watersheds. However, this partner funding is not guaranteed, as Corps money for federal projects will be, meaning

that the actual funding of Greens Bayou projects is more unreliable than the figure reveals.

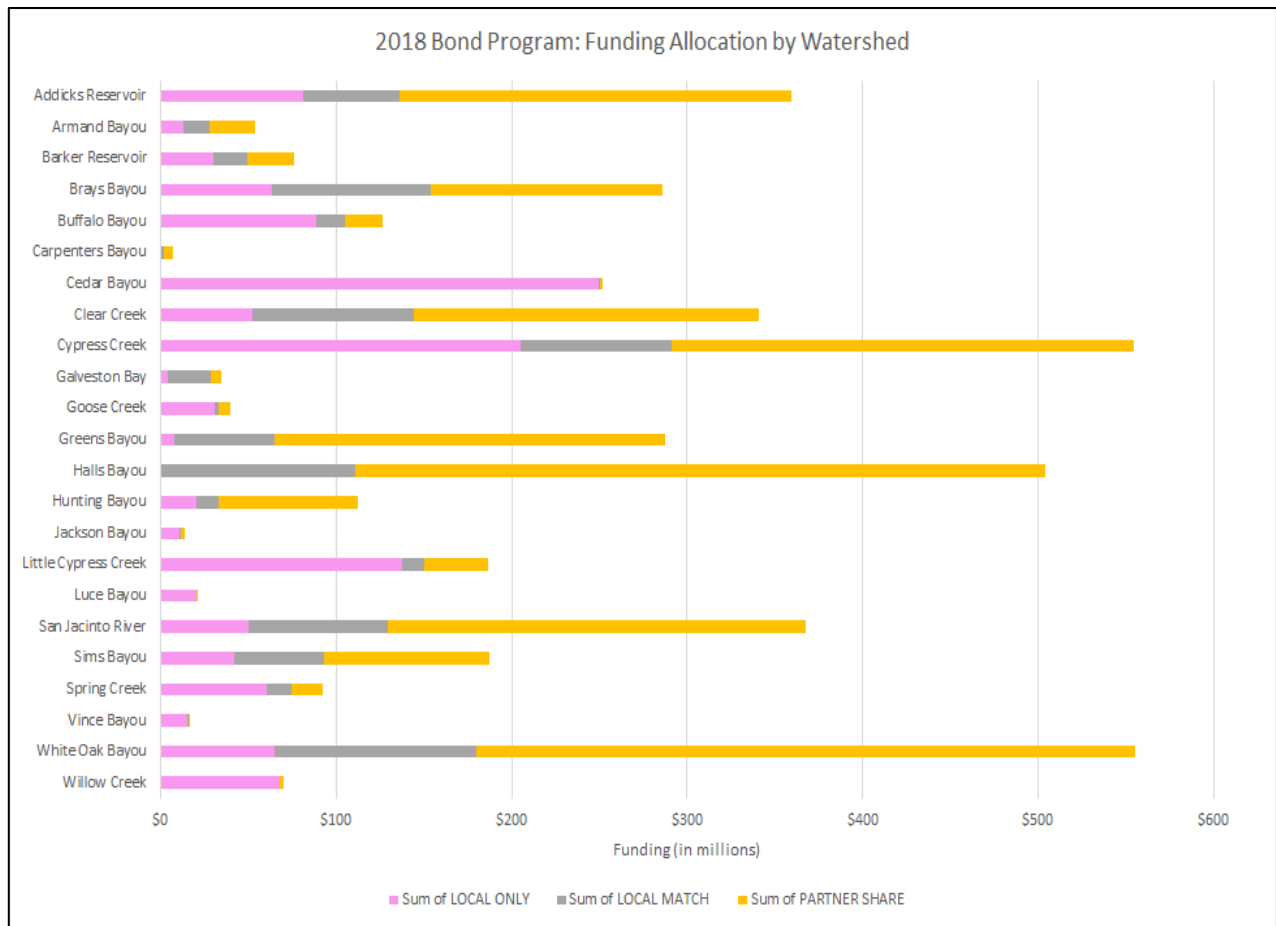


Figure 23. The allocation of local, local match, and partner share funding for the 2018 Bond Project (HCFCD, 2018d). For ease of viewing, graphic excludes countywide projects, which account for a large portion of total funds. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District. Local funds come from Harris County via the \$2.5 billion allocated to the Bond Program. Partner funds come from various governmental entities and organizations beyond Harris County and HCFCD. Certain partner organizations require a percentage of their funds to be matched locally, hence the category of local match. Local match funds are still drawn from Harris County and the Bond Program. Figure 25 describes the relationship between the different funding types (HCFCD, 2021k).

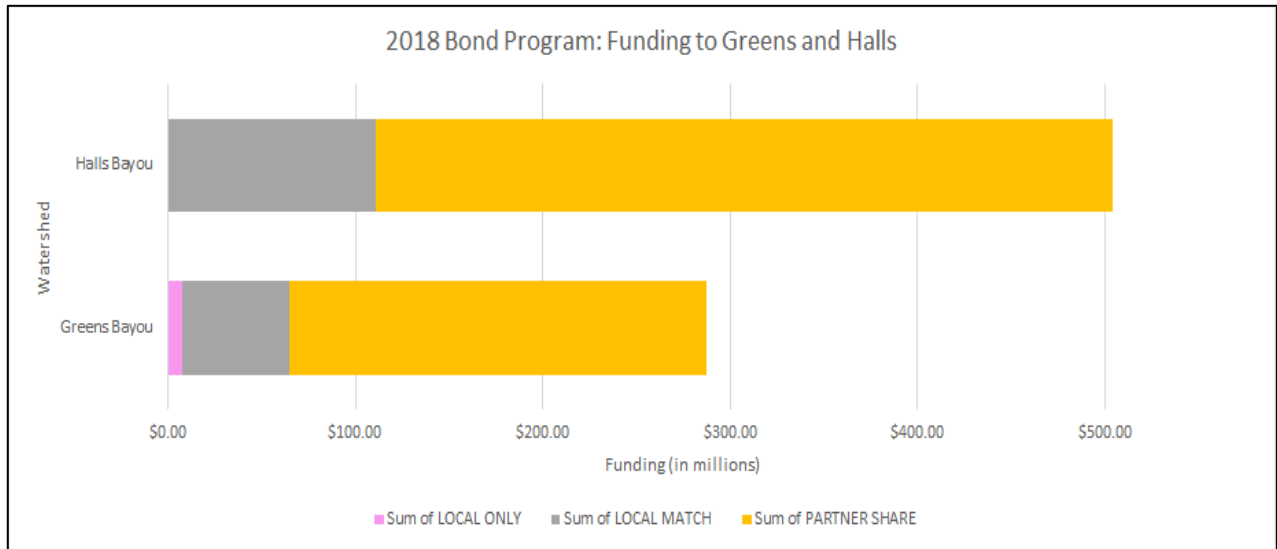


Figure 24. Funding allocation to Greens and Halls Bayous. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District (HCFCD, 2018d).

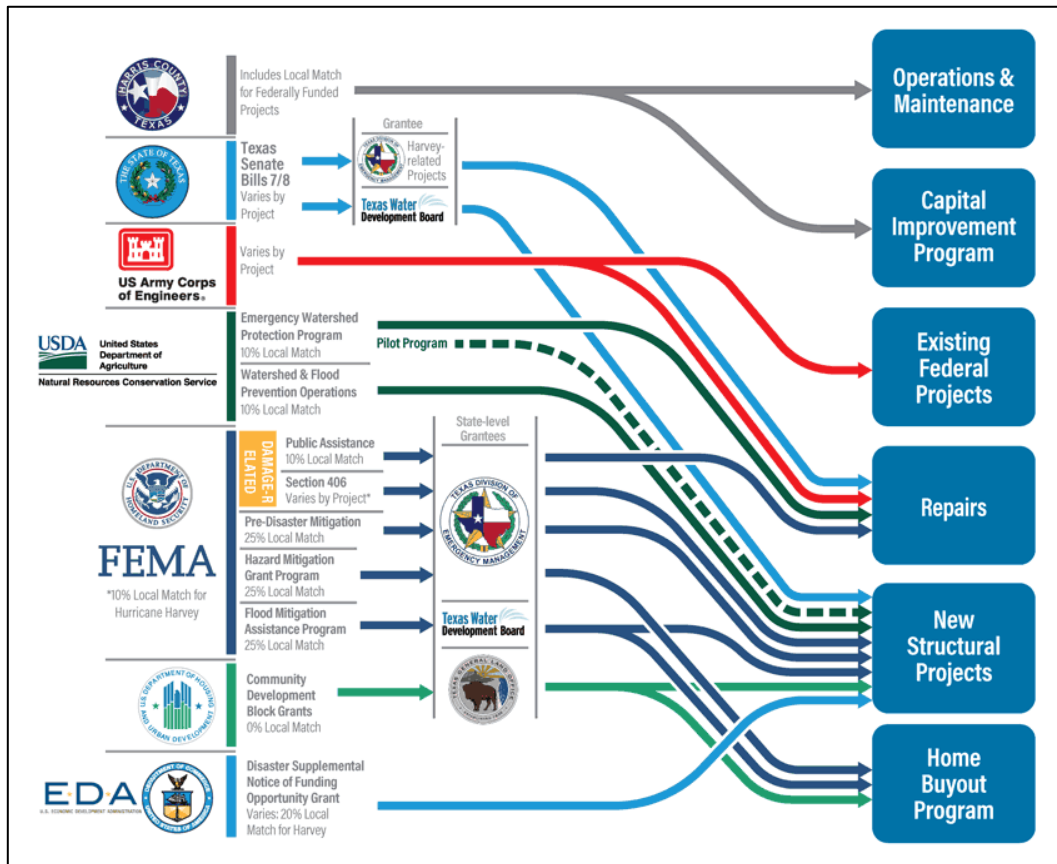


Figure 25. Graphic from Harris County Flood Control District shows the flow of various partner funds and their unique requirements of local match (HCFCD, 2021k).

In the case of Greens Bayou (including Halls Bayou), the plan did not work. Originally, it was proposed that of the approximate \$800 million required for projects in this watershed, only about \$10 million would come from bond proceeds and over \$600 million in federal money was to come from the Community Development Block Grant (CDBG) program mitigation funds that were approved by Congress for Harris County (Texas GLO, n.d.-a). However, these CDBG funds first went to the General Land Office of the State of Texas, which developed a formula for awarding these funds.⁷ After serious argument, these funds were not allocated to Harris County by the GLO as initially anticipated in the spending plan for the bond proceeds developed by Harris County.⁸ The county had depended upon a huge match for Greens and Halls Bayou that was coming from the federal government through the General Land Office, and that money simply did not come. On the other hand, a larger percentage of the bond issue money went to watersheds in which neighborhoods were either wealthier, had fewer racial minorities, or both. Watersheds located in the wealthy area of West Houston received substantial allocations of “local only” money (16% of the total local only money went to Cypress Creek, for example). At the same time, Greens and Halls Bayous received almost none of the “local only” funds. In fact, the vast majority of the “local” funds allocated to these watersheds instead came from the category of “local match,” which describes funds that originate from the Bond Program but are contingent upon partnership with a funding organization. Only with “partner funds” available to match can “local match” funding be used.

It is clear that this action by the Texas GLO had a disproportionate impact on the low income and minority community of the City of Houston and Harris County. It certainly raises environmental equity concerns about this state-controlled process of allocation of federal money. Despite the language in the bond election resolution which acknowledges the historical disparities in the distribution of funds and creates a requirement of an equitable process, the County relied upon undesignated partner money to fund projects in the Northeast rather than distributing the bond funds equally. For reference purposes, the actual per capita allocation of bond proceeds per watershed is shown on Figure 26 and 27.

⁷ Through multiple appropriations from Congress, the U.S. Department of Housing and Urban Development has allocated more than \$5.676 billion in Community Development Block Grants for Disaster Recovery funds to the State of Texas for long-term disaster recovery. The GLO will administer these funds for housing, infrastructure and planning through state and local programs (Texas GLO, n.d.-b.).

⁸ A press release from Harris County Flood Control district dated May 21, 2021 reads, “[t]oday, the Texas General Land Office (GLO) announced the recipients of Community Development Block Grant for Mitigation (CDBG-MIT) funds through the Hurricane Harvey State Mitigation Competition. The Harris County Flood Control District was not included in the list of recipients, although Houston & Harris County account for more than 50 percent of the estimated 300,000 structures flooded during Hurricane Harvey – more than any other region in Texas” (HCFCD, 2021, May 21).

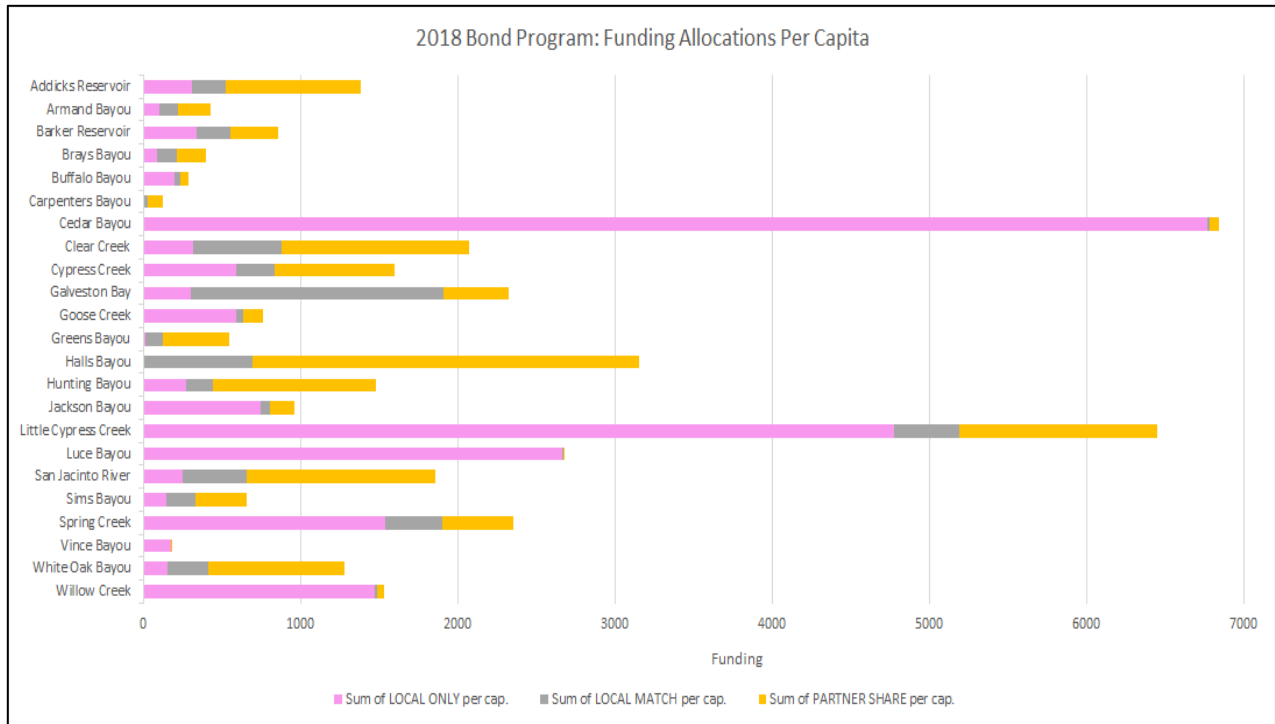


Figure 26. Harris County 2018 bond allocation per capita over watersheds. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District (HCFCD, 2018d).

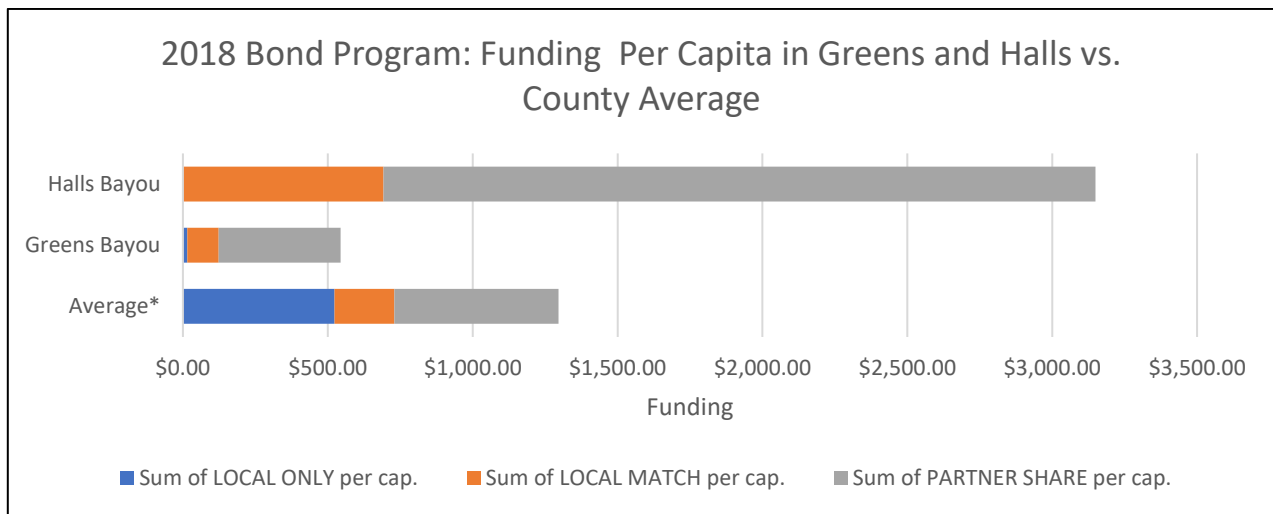


Figure 27. Harris County 2018 bond allocation per capita in Halls and Greens Bayous versus the County average. *Average calculated by dividing the total funding from each source (local, match, partner) by the total population of Harris County. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District (HCFCD, 2018d).

B. Funding Gathered Since GLO Distribution of Funds

To address this funding disaster on Greens and Halls Bayous, several actions have been taken by the County. On June 29, 2021, the Harris County Commissioners court approved a plan establishing the Flood Resilience Trust (HCFCD, 2021, June 30). The Flood Resilience Trust was designed to be a source of County-controlled funds for floods. To create the fund, the annual mobility transfer from the Harris County Toll Road Authority (HCTRA) will be increased by 25% or \$40 million beginning in Fiscal Year 2023 in addition to a lump sum of \$230 million will be added to the Trust from HCTRA. In addition, \$315 million dollars which was approved by the Commissioners Court in April 2021, \$166 million in expected reimbursements to the District, and \$8 million in existing Bond contingency funding will be allocated to the Flood Resilience Trust. The money will be allocated to bond projects which require additional funding to move forward using the Prioritization Framework adopted by the Commissioner's Court in 2019 (Harris County Budget Management Department, 2021). This leaves a budget shortfall of \$951 million (Harris County, 2021, June 29). If no more partner funding is received, the Budget Office estimates that the Flood Resilience Trust can keep projects funded until about 2026. County Officials believe this fund will ensure that all Bond projects will stay funded and therefore they will uphold the promise of equity from the 2018 Bond Program (Despart, 2021). In addition to the creation of the Flood Resilience Trust, the Commissioners also agreed to continue pursuing partner funding and continue a push to ensure the GLO delivers the \$750 million of funding from the CBDG-MIT funds as promised by George P. Bush (Harris County, 2021, June 29).

In addition to finding additional funding sources, HCFCD has made changes to the original Bond Program projects and funding expectations. The original (2018) Bond Program contained a contingency line item of more than \$600 million, funding which at the time of the Program's launch was unavailable (HCFCD, 2021I). This surplus of local money was included in the hopes that the program would gain additional financial means along the way of their projects.⁹ As that has not happened, HCFCD felt it necessary to publish some revisions to their original plan. The [2020 Bond Program update](#) reduces the number of local funds to \$2.5 billion, the promised number of the bond program (HCFCD, 2021I; HCFCD, 2020). The revisions also consolidate several projects that had previously been outlined on a watershed basis into countywide initiatives. Finally, the republished list of

⁹ Harris County Flood Control District states that “[a]t the time the Program was proposed, there was public acknowledgement that we had about a \$620M shortfall, with the hope that as the Program progressed, additional funding sources would become available to help address this shortfall.” However, because of “a significant shortage of partnership funds, [HCFCD is] reducing the \$500M of funding shown in the contingency line item from the Program” (HCFCD, 2021I).

Bond Projects re-classifies the three sources through which projects may be funded. In the original Program, funds were classified as local only, local match, and partner funds. The former two sources drew from a combination of the \$2.5 billion Bond and the \$600M contingency fund, but local match money was only guaranteed if partner organizations required it. In the 2020 revisions, these categories are clarified into 2018 bond funds (BF), district funds (DF), and partner funds (PF). District Funds (DF) are defined as “Flood Control District funds not derived from the 2018 Bond that may be used to supplement program financials” (HCFCD, 2021). The updated allocation of funding by watershed are shown below in Figures 28 and 29.

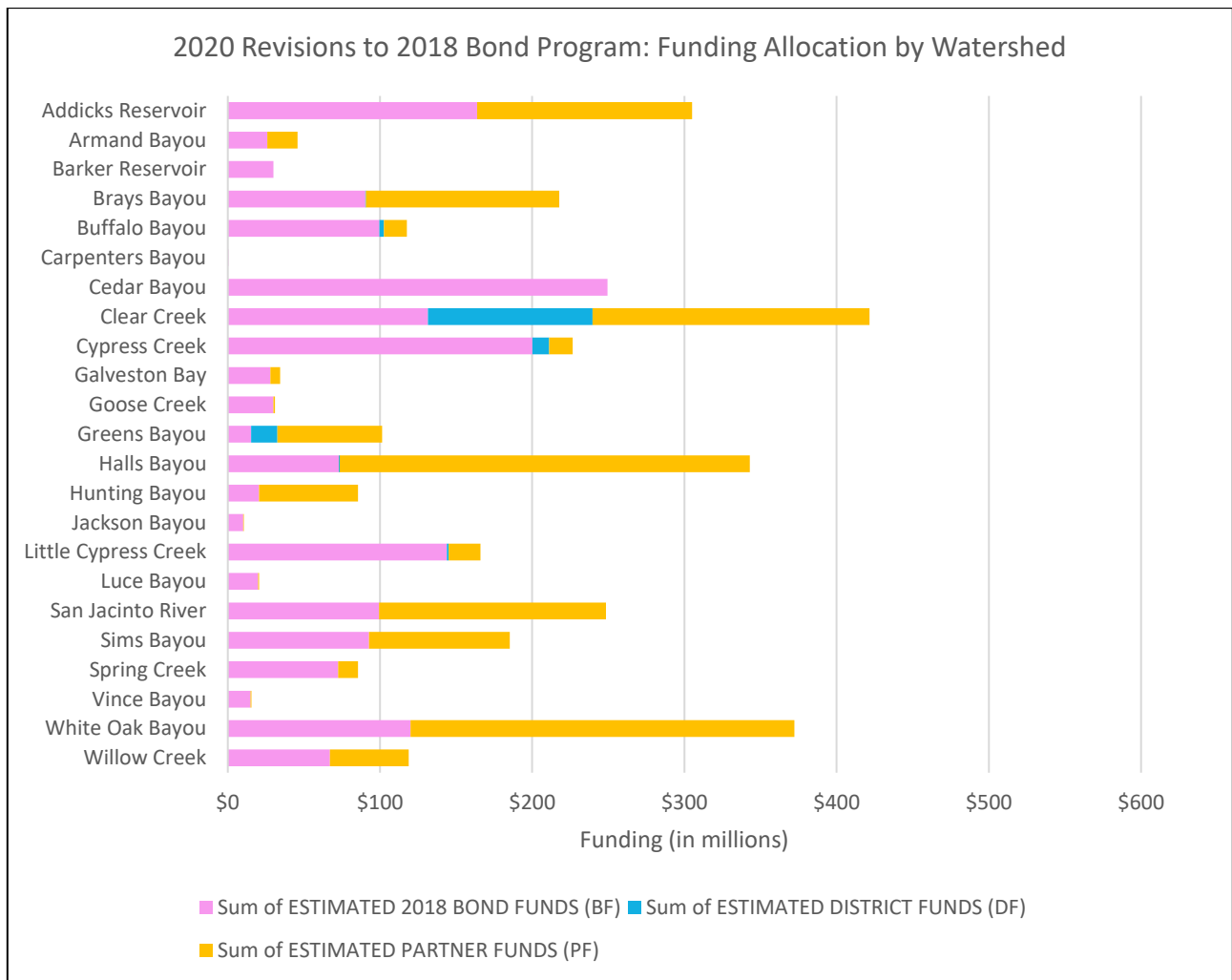


Figure 28. 2020 revised funding allocation by watershed. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District (HCFCD, 2020).

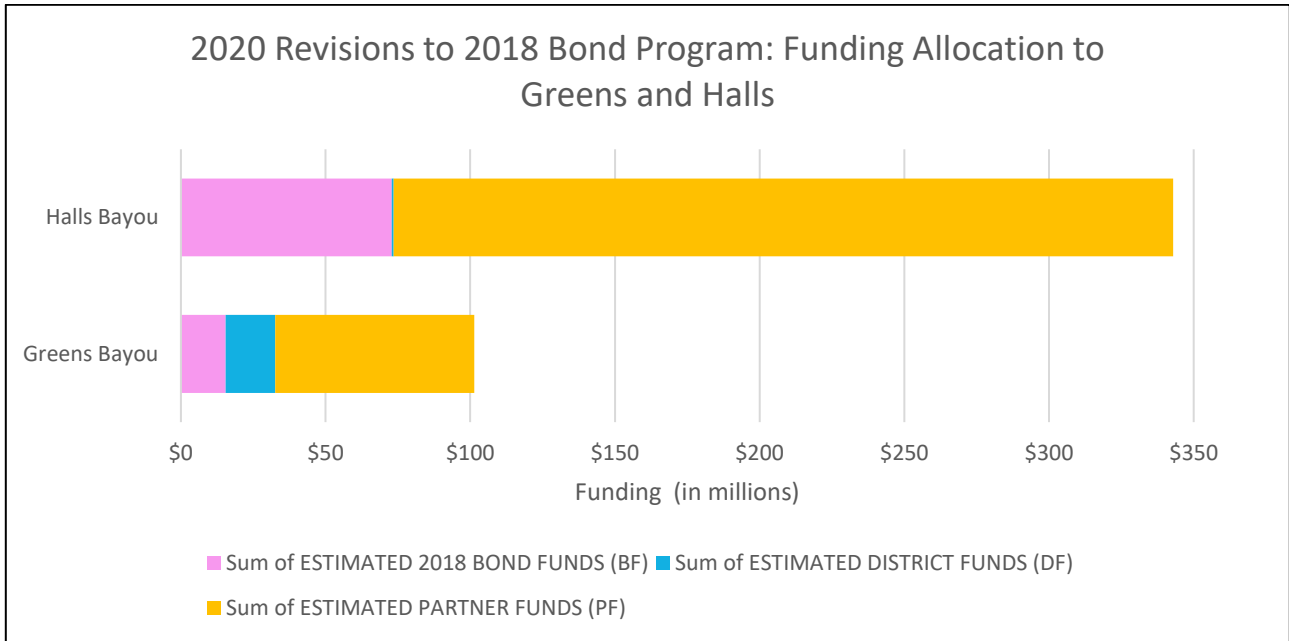


Figure 29. 2020 revised funding allocation for Greens and Halls Bayous. Graphic by Sarah Swackhamer for Sustainable Planning and Design based on data from Harris County Flood Control District (HCFCD 2020).

V. Frame Breaking To Create Change - Just Do It

Equity in flood funding is difficult. There is no doubt that the General Land Office really fouled up the Harris County plan. The adjustments that have been made are a beginning, but there is much more to be done to achieve equity in the bond issue funding and equity in the provision of flood protection throughout Harris County.

Greens and Halls Bayou watersheds and other areas within the Northeast have a major flooding problem that has existed for decades. At least in part, new and different thinking about the issues and challenges of the Northeast is necessary. We cannot keep doing what we have done in the past. We need to change our approach. We need to move this discussion forward in a positive manner while understanding that we did not get in this situation overnight.

In this section of the report, several “frame-breaking” ideas are set out that might be useful to begin to address these issues in a different manner. All of us see issues from within a frame – a point of view – a perception of reality. That frame confines and limits us. It prevents us from acting in certain ways because those ways are outside the frame. Dr. Henk Mooiweer is a great facilitator who leads exercises on how to think in a manner

that breaks down these frames and allows us to find solutions that are different from what we have seen in the past. Frame breaking and out-of-the-box thinking are two different ways of expressing a similar thought.

The bond issue promised an equitable process for the delivery of flood projects and protection. However, little time or attention has gone into a public discussion of that requirement, which was a key to getting the lower income sections of the county to vote for the bond issue. Equity is more than equality. Equity is about recognizing the different circumstances of each community and is necessary to reach an equal outcome. Figure 30 is a simplistic diagram that illustrates the difference between equality, equity, and justice. Three people are attempting to watch a soccer game from behind a gate. Simply giving everyone a box to stand on does not work for everyone. This represents equality where everyone is given the same thing. Equity is about providing assistance that works for all based on people's specific needs. In this image the shortest person is given two boxes allowing them to see the game while the tallest person has no boxes because they were already able to see the game without support. With equity, everyone is able to see the game. Finally, a just solution is provided which is removing the barrier which was creating the inequity—the gate. Justice results in an equitable outcome in which a community no longer needs additional resources to overcome inequity because the systemic causes of inequity have been addressed (MobilizeGreen, n.d.). We must push for solutions which eliminate the structural disparities between communities along with solutions which can quickly lift the burdens of past inequity.

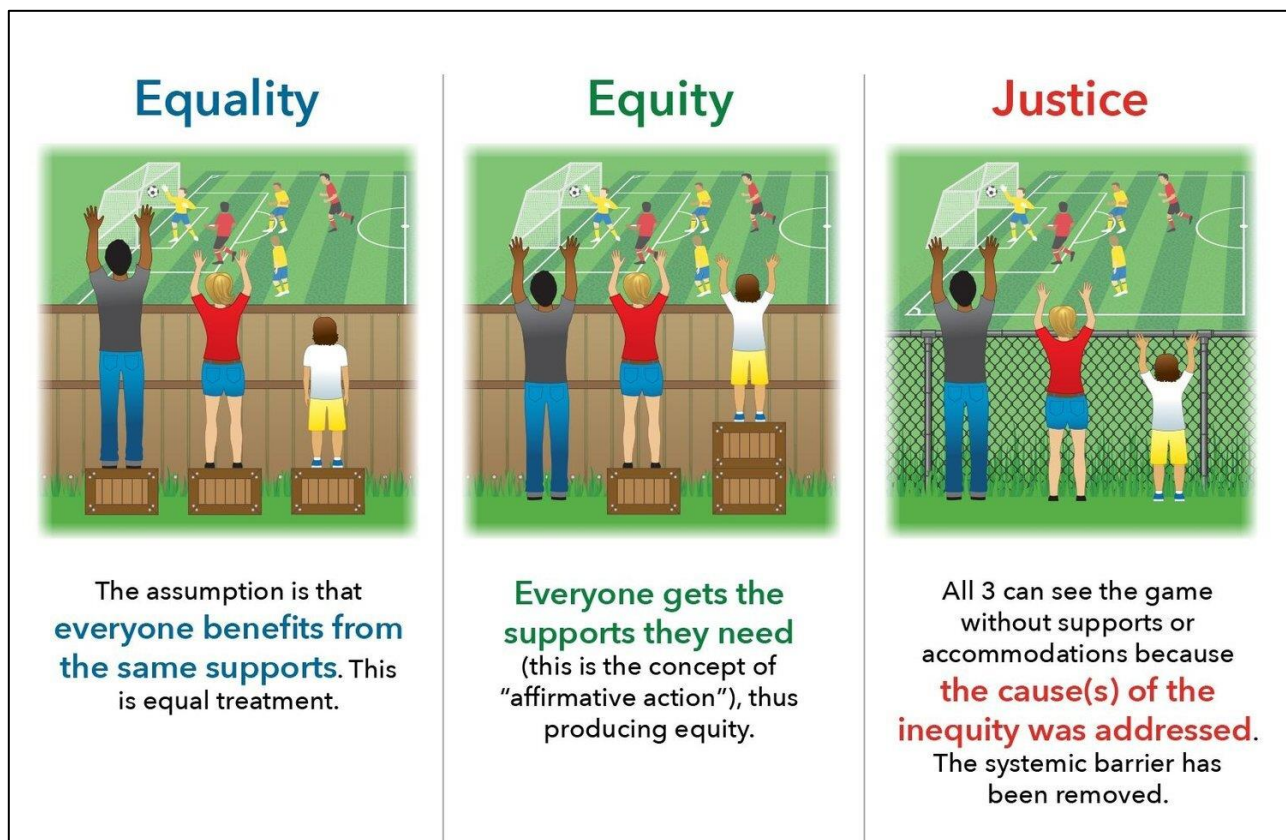


Figure 30. Diagram showing the difference between equality, equity, and justice (MobilizeGreen, n.d.).

The most essential change in approach needed is that officials must be more transparent in this process and take responsibility for the changes they are able to make. These two concepts are discussed more below. This equity crisis cannot be solved without transparency on every level in which decisions are being made. Many residents have for years taken time out of their lives to work on solving the flooding issues in this area. This contribution shows a great sense of civil and community responsibility on the part of these residents. The information they need to engage and to remain safe should be made easily available to them. While it is admirable that members of the community show so much passion and commitment to solving these issues, it ultimately is not supposed to be their responsibility. These are tax paying citizens who deserve flood protection from the government. Those government officials who are supposed to represent the community's interest or provide this essential protection have too often abdicated responsibility for the issues that exist and to make changes which could solve them. This needs to change. Officials must see themselves as having a responsibility to serve the residents in this area in partnership with those residents who are fighting for improvements.

Transparency

A key element of equity is transparency. Lack of transparency in decision making restricts the ability of the community to engage in the process. Because equity relies on the contextualization of circumstances creating inequality, participation of those community members who understand the circumstances best is essential in making equitable decisions and must be encouraged. The community should be involved in how decisions are made and have access to any information that affects their ability to live safely.

One final recommendation involves the Harris County Flood Control District. As part of this equity effort, HCFCD should make computer modeling results which show patterns of flooding throughout the community, and the expected efficacy of proposed projects, available to the public so that residents have the knowledge to engage with these topics. The community deserves to know the extent to which these projects will mitigate flooding and when they can expect to see the results.

Another aspect of transparency is acknowledging historic injustices and taking responsibility for mistakes. We need to be clear that the need exists for special programs and community focus on the Northeast if we are going to correct the errors and omissions of the past. Getting past denial may be the most “out of the box” idea suggested in this paper, but it is a key.

Responsibility

Ultimately, this paper is about responsibility. Although the City and the County, the state and the federal governments all have responsibility to act with us to gain forward momentum, the community itself is best positioned to make informed decisions about its future. This is why governmental entities must prioritize community participation in their planning. We all must take responsibility. The Northeast must focus on both short- and long-term goals and needs. Those living outside of the Northeast need to roll up our sleeves and help, whether it be by donating services or by donating time. This will not be an easy task, but it can be done by working together.

This paper is not intended to be a final document but is instead intended to start a dialogue. There are likely errors and omissions in this report. There are many topics to be added and expanded. There are possibly better ideas out there. The important point is that we must begin this process of addressing this inequity which has been ongoing for too long.

A. Northeast Community Vision and Equity Entity

In this paper, an area has been drawn on a map and called the Northeast District. What seems to be needed is both a vision of what future flood control should include and a means for achieving that vision within this geographic area. One way to achieve this is through the creation of an entity or coalition in the Northeast that would be formed and managed with extensive, representative resident input. This could be a special governmental district of some type or a subgroup of an existing non-profit that could receive funds and manage flood protection oversight in the Northeast. Such an entity would need the full support and respect of the City of Houston and Harris County and the Harris County Flood Control District if it is to succeed. Support can be pledged, but respect will come with performance. The leaders of this Equity Entity must act equitably within this organization to create plans and argue for implementation in a manner which brings in the necessary partners to solve the flooding crisis in the area.

The proposed Northeast Equity Entity would then lead the way in creating an action plan and vision for the future. As is discussed further in this section, there are larger-scale visions and smaller-scale visions. Some of these ideas may take a year or two or more to become implemented. Other actions could be implemented in a much shorter time frame. Although no specific agreement as to what plans to pursue has been made, the following sections will discuss the following long-term and shorter-term solutions:

- 1. Get a federal project – build a tunnel;**
- 2. Separate Greens and Halls Bayous Administratively;**
- 3. City of Houston Takes Responsibility for Culvert Maintenance;**
- 4. Talk Honestly About the Magnitude of the Problem and the Need to Provide More Room For These Big Storms;**
- 5. Create Metrics For Determining Success in Flood Control Efforts**
- 6. Support Additional Hurricane Surge Flooding Protection;**
- 7. Increase the Scope of Local Participation**

As the investigation into these alternatives progresses, one thing seems clear and that is that there needs to be concerted citizen action in addition to the work being done by the governmental entities. To get an idea of how such action might unfold, it is useful to look at another part of the county to understand how they have one about helping themselves relative to flooding.

On the west side of Houston, [Houston Stronger](#)¹⁰ has put forth a plan for addressing the flooding problem that exists surrounding Addicks and Barker Reservoir due to flooding from Harvey. Here, the Corps of Engineers undertook a study that led to few positive ideas that the community liked. But rather than stopping there, Houston Stronger helped organize a “self-help” study that has identified four major actions to address the flooding of 10,000 homes behind the reservoirs. To this end, they have proposed the map in Figure 31 which shows four projects: (1) building a tunnel from the reservoirs to the San Jacinto River, (2) deepening the flood pools of Addicks and Barker, (3) putting detention storage on the Katy Prairie, and (4) putting detention storage to provide overflow from the Cypress Creek watershed.

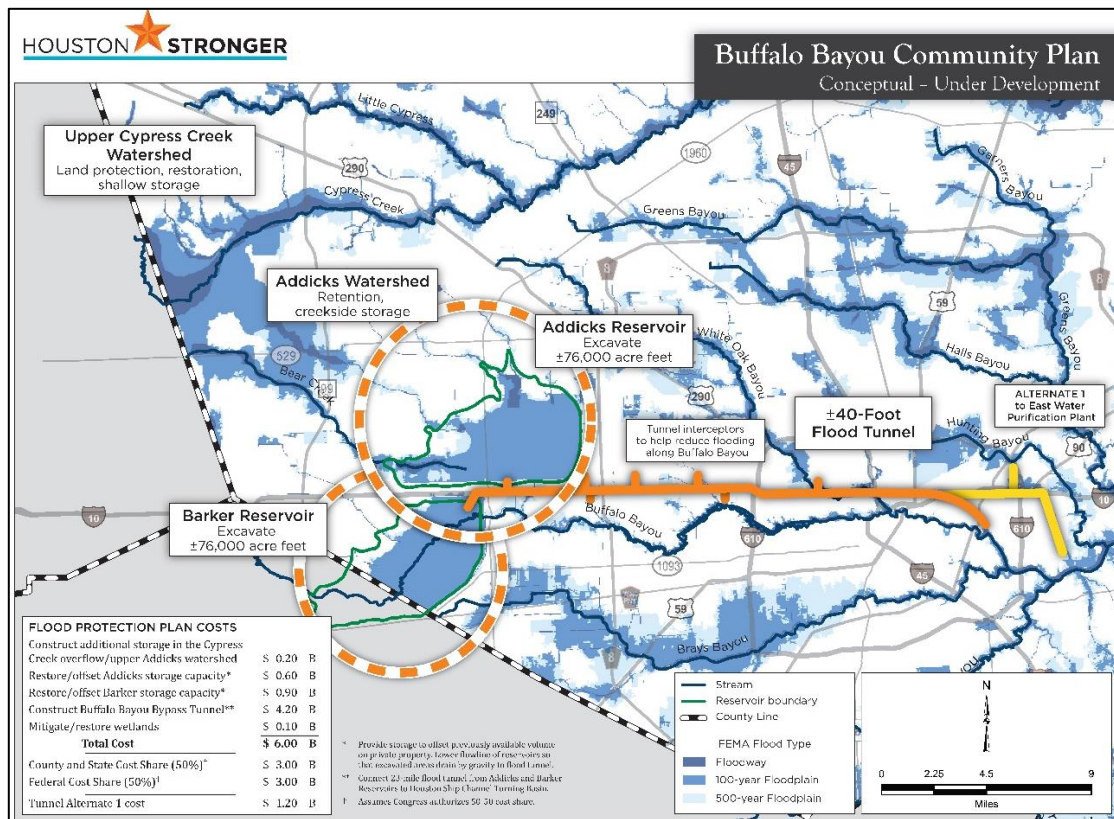


Figure 31. Private sector action plan for the Addicks and Barker Reservoir area developed by Houston Stronger, a private sector organization. Image by Houston Stronger (Houston Stronger, 2020, April 6).

¹⁰ Houston Stronger is "a coalition of civic groups, business associations and active citizens from throughout the Texas Gulf Coast region dedicated to working with local, state and federal officials to implement a comprehensive regional flood control plan that safeguards our citizens and property" (Houston Stronger, n.d.). Although they have created a Regional Plan ([Houston Stronger, 2021](#)) that broadly proposes to improve drainage “across the Houston area,” they say on their home page that “Houston Stronger is currently working on the Buffalo Bayou Community Plan,” shown in Figure 28, which focuses on Addicks and Barker (Houston Stronger, 2020).

Without doubt, residents in West Houston have more resources to put into planning on this scale than residents of the Northeast community. However, despite limited resources, many residents in the Northeast have already donated time to solving this issue. The key concept here is that the solutions are community based, meaning they were developed by the residents to address their perceptions of the needs of the community. The Equity Entity should be led by members of the community and when possible supported by staff experienced in planning and policy. It should uplift and respond to voices from the community.

Similar to the plan laid out for West Houston, a Northeast Action Plan is needed for the “entity” that is proposed above. At the least, it must involve some improvement to drainage down or beneath Greens Bayou, Halls Bayou and Hunting Bayou. The scope of this initial study has not included engineering evaluation of various stream modification alternatives, but the need for improved flow from west to east and then south is clear. Although some degree of funding will be essential for this Northeast District, it is worth noting that volunteers were relied upon by Houston Stronger. The possibility exists that one or more engineering firms may be willing to volunteer to help develop a plan for the Northeast. Similarly, it may be possible for one or more contractors to work within different Super Neighborhoods and similar areas to help maintain culverts and ditches. Previously, the Northeast community has lacked the resources and political power to advocate for projects at the scale of the Houston Stronger project. This proposed entity would leverage donations, community power and knowledge, and organizational strength to create a path out of this equity crisis. The point here is that by creating an “action” entity, the potential exists to elevate the problems and solutions for the Northeast to a level not previously realized.

B. Build One or More Tunnels with Federal Funding

One serious alternative worth considerable time and study is the possible construction of one or more tunnels from the Northeast to the San Jacinto River. Major blockages exist on Greens, Halls and Hunting Bayous as can be seen in Figure 10. One or several of these blockages might be able to be addressed by one or more syphons or tunnels that would move the stormwater past the blockages. Syphons are essentially small tunnels which can pump water small distances such as under a railroad. If syphons or tunnels are used, there must be adequate capacity to receive that water on the downstream side of the obstruction. If a tunnel were proposed for construction, then it would have to have an outlet where adequate receiving capacity existed such as the San Jacinto River.

There are major flood problems associated with rail lines and freeways throughout the Northeast. This can be seen in the FEMA floodplain maps (see Figure 9), the HEC-RAS Modeling (see Figure 10), and the community survey (see Figure 14). Hunting Bayou has a huge floodplain that is impounded behind two major rail yards. Major flooding exists where IH-45, the Hardy Toll Road, and U.S. 59 cross Halls Bayou and also where IH-45 and a rail line cross Greens Bayou. Flooding also occurs along I-10 between U.S. 59 and I-610. Here there are several points. The Hardy Toll Road, the interstate highway system and Union Pacific rail lines and storage yards all appear to contribute if not solely cause these obstructions to flow. However, if these obstructions were immediately removed, insufficient capacity would exist immediately downstream of the obstructed areas to handle the increased flow. In other words, an initial concern is that there is currently nowhere for this impounded water to go without causing additional damage.

Halls Bayou has never qualified for a major Corps of Engineers flood mitigation project and Greens Bayou has only received a relatively small federal project in the western part of the watershed mainly because of issues concerning the benefit/cost methodology used to determine if a project is “feasible.” This benefit/cost ratio has for years acted to limit the eligibility of lower income communities where home value is lower, instead favoring wealthier flood-prone areas. Eliminating this policy is an example of a just solution. The cost/benefit methodology has long been a cause of inequity in flood protection and removing this barrier for low- and medium-income communities will create a more just and equitable system. This methodology could be challenged in court, but there is perhaps a better option. Section 118 of the recent [Water Resources and Development Act \(WRDA\)](#) ordered the Corps of Engineers to undertake demonstration equity evaluations for ten areas in the United States.¹¹ A priority for Greens and Halls Bayous is to obtain one of these projects for the Northeast sector if at all possible.

There will be strong competition for a Section 118 project. Rep. Vela from the Rio Grande Valley already has spoken up very strongly for a section 118 project in his district and the odds are against two of ten demonstration projects being from the same Corps District. However, there may be another pathway for the Northeast if we can find authorization for a Corps project that may still be “live”. It turns out that there are several pathways for potentially qualifying a project in an area that meets the socio-economic characteristics of the Northeast area.

¹¹ “[T]he Secretary shall establish and implement a pilot program to carry out feasibility studies, in accordance with this subsection, for flood risk management and hurricane and storm damage risk reduction projects for economically disadvantaged communities.” The Secretary shall review the proposals it receives and “select 10 feasibility studies for such projects to be carried out by the Secretary, in coordination with the non-Federal interest, under this pilot program” (Water Resources Development Act, 2020, pp. 37-38).

The U.S. Army Corps of Engineers is obligated to adhere to federal policy for project evaluation dating back to the Flood Control Act of 1936, which states that "the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs." Mandated to use a benefit cost analysis, the Corps currently observes the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, often referred to as the [Principles and Guidelines \(P&G\)](#) adopted in 1983 as proper procedure for project evaluation.

The P&G outlines four accounts for analysis:

1. National Economic Development (NED) – changes in the value of the national output of goods and services, expressed in monetary units
2. Regional Economic Development (RED) – changes in the distribution of regional economic activity (regional income and regional employment)
3. Environmental Quality (EQ) – effects on ecological, cultural, and aesthetic resources that cannot be measured in monetary terms
4. Other Societal Effects (OSE) – effects on social aspects such as urban and community impacts, life, health and safety factors, and displacement (U.S. WRC, 1983)

The important point is that in addition to NED considerations, there are other criteria by which a project can be approved as set out above. Additionally, the [National Environmental Policy Act](#) applies to every Corps project and it offers a great number of pathways that have never been fully utilized by the Corps. And then, on top of all of that, President Biden has passed two recent executive orders that address environmental justice and environmental equity. These are:

[E.O. 13985](#) - **Advancing Racial Equity and Support for Underserved Communities Through the Federal Government**, is the first [executive order](#) signed by U.S. President [Joe Biden](#) on January 20, 2021. Its goal is to advance racial equity and support for underserved communities through the federal government. This EO applies to all agencies of the federal government (Exec. Order No. 13985, 2021).

[E.O. 14008](#) – **Tackling the Climate Crisis at Home and Abroad** is perhaps a bit less directly focused upon the Northeast but Part II orders all federal agencies to consider adaptation to climate change and environmental justice as part of its mandate. This would apply to all Corps of Engineers flood damage reduction studies (Exec. Order No. 14005, 2021).

The bottom line is that now is the time to have a federal project of any type approved for study in the Greens and Halls Bayou watersheds. There are many possibilities here. But we must get a federal flooding study underway as soon as possible.

C. Dividing the Greens and Halls Bayou Watersheds

Greens and Halls Bayou have been considered a single watershed by Harris County Flood Control District for many decades, and it is time to seriously consider whether breaking these bayous into two separate watersheds administratively would make sense. At the least, it seems as if each watershed being apart might provide for more administrative resources and focus. This could also make community involvement easier for residents. Currently a resident in the Halls Bayou watershed would go to community meetings for Greens Bayou watershed and receive a lot of information related to Greens Bayou which is not relevant to their needs. Splitting the watersheds would streamline communications with residents allowing them to participate in the discussions that will most likely affect them more easily. Little Cypress Creek, although a tributary of Cypress Creek, is a separate watershed as is Willow Creek which is a tributary of Spring Creek and Armand Bayou which is a tributary of Clear Creek. Evidently, there seems to be nothing universal about the designation of watersheds, and a separate designation should lead to more focus and attention on these two watersheds, by separating their needs and separating their funding. It is interesting to note that the reporting on the bond issue expenditure broke Halls away from Greens.

Acknowledging that these two watersheds are separate entities will reveal the need for separate solutions and additional funding which reflects the needs of residents in each of the watersheds.

D. City of Houston Takes Responsibility for Culvert Maintenance

Local drainage is a mess throughout much of Northeast Houston. Open ditch drainage, while not innately inferior, is inferior when not properly maintained, and the Northeast by far has the highest density of open ditch drainage in the city as shown in Figure 11. As stated earlier, in the early 2000s, the City of Houston placed responsibility for maintenance of the culverts beneath private driveways crossing the open ditches on the private homeowner (City of Houston, n.d.-d). This policy should be reversed. The City of Houston maintains the full drainage system in almost all parts of the City but not here. That must change. Although equity demands more than equality, equality of service provision is an absolute requirement at the very least. Equal service is not being provided relative to open ditch drainage in the Northeast sector. Similarly, the maintenance schedule should be changed back to a regular rotation basis rather than responding to 311 calls.

On the one hand, this ask of the City of Houston doesn't sound like a frame-breaking concept; in fact, it sounds easy. In reality, it is not. This issue has been discussed off and on for several years. In fact, this is a hard request for the City to agree with because it

involves resetting budgets that are always difficult to balance. As a legacy issue, this would be a great one for Mayor Turner. In fact, it would be great if the City would take the lead here and take care of its Super Neighborhoods, allowing the focus to turn to the unincorporated areas of Harris County which have open ditch street drainage but lack any governmental entity with responsibility. Maintenance in these areas is technically not a county responsibility although the precincts attempt to help on these issues. The point here is that if the City would take the lead within its jurisdictional areas, that would allow the Northeast District to focus upon the unincorporated areas which pose a potentially more difficult problem to address.

E. Talk Honestly About the Magnitude of the Problem and the Need to Provide More Room For These Big Storms

The more that one studies the problems of the Northeast as well as Houston more generally, the more one becomes concerned about the magnitude of the storms that we will be facing in the future. Our climate is changing, and it is changing more rapidly than previously understood. Dr. Bedient, Director of the Severe Storm Prediction, Education, & Evacuation from Disasters (SSPEED) Center at Rice University, has projected that a storm like Harvey may be expected to recur every 35 to 70 years rather than every 10,000 years as earlier believed. Our drainage system cannot handle big storms such as Harvey, Allison, Imelda, or the Tax Day Floods. We need to talk honestly about this fact, and our government agencies need to talk honestly about these facts. As was shown in Figure 10, the extent of Harvey flooding was truly historic, and it will be seen again.

The bottom line is that many residences immediately adjacent to Greens and Halls and Hunting Bayous may not ever be protected from these very large storm events, and the people that live in the northeast need to be told the truth about the size of the storms of the future and the extent of the flooding that they will generate. In the opinion of the authors of this report, the extent of this flooding – and our inability to “control” this flooding – frightens local elected officials. Many believe that the public cannot “handle” the truth and will not re-elect them if they are honest about the scope of our flooding.

A major implication of the scope of this flooding is that the water will flow from higher ground to lower ground until it reaches the bay. That fact we know. And we also know that there are many homes that will be flooded when that happens. Sooner or later, many homes will have to be bought out near Greens and Halls and Hunting Bayous. Many residents – even those flooded multiple times – do not want to be bought out. They like their neighborhood. They have a community in the Northeast. They have a “place” within a harsh urban environment. And if they are lower income, they face the prospect that there may not be affordable replacement housing.

It is clear that government agencies will and should have buy-out money available right after the flood occurs and not a year or two later after repairs have been made and out-of-pocket money spent. But buy-outs must be supported by a reasonable replacement housing approach. A high priority is for the flood control planners and the housing planners to work together to address the question of buy-out. We know buy-outs will occur. Let's be honest about the extent of the problem and the likely extent of the buy-outs and develop a replacement housing program to go with this honest approach to the size of the flood events.

F. Create Metrics For Determining Success in Flood Control Efforts

In reviewing material for this paper, the researchers searched for metrics used to evaluate success in flood protection or ways to evaluate equity in flood protection. As shown from the attention to bond funding and money spent per watershed, that is one metric that could be used to compare one watershed to another. However, what is not clear is what degree of flood protection is afforded in the Brays Bayou watershed when compared to the level of protection provided in the Greens or Halls Bayou watershed. We know that in larger storm events, both watersheds have major flood damages. We know that in Harvey, Greens Bayou (including Halls Bayou) had more homes flooded yet had significantly less population than did the Brays watershed. But in reviewing various web sites and information, no basis appears to exist publicly to evaluate the success of past and proposed future flood protection efforts.

On the one hand, it is difficult to believe that we have been providing flood protection for over 50 years and have never developed quantitative methods for evaluating flood protection success. For example, if all bond program improvements were funded in every watershed, would they all reach a certain level of protection – protection from the 5-year storm? 10-year storm? 25-year storm? Although this could be determined for any watershed through computer modeling, such information is not readily available and arguably should be. From an equity standpoint, the level of protection in all of our bayou systems should be similar or at least relatively comparable. But metrics do not exist publicly to make such an assessment.

This issue raises a larger issue of transparency and the relationship of our flood and drainage authorities to the public. The public needs more information than they are receiving. This is true in terms of local maintenance. This is true in terms of which entity is responsible for which ditch. This is true in honesty about the extent of the flooding. And it is true with regard to level of protection provided. This can be addressed if the will exists to address it.

G. Support Additional Hurricane Surge Flooding Protection

There are portions of the Northeast community that are subject to hurricane surge flooding. These are the subdivisions along the Houston Ship Channel such as Manchester and Pleasantville as well as those along the lower portions of Greens, Hunting and Carpenters Bayous near their outfall into the Houston Ship Channel. Hurricane surge flooding comes in from the Gulf as larger hurricanes come ashore. Recent climate change data indicates that hurricanes are getting larger, with more Category 4 and 5 storms expected in the future than occurred historically (Masson-Delmotte et al., 2021, p. SPM-20).

With regard to surge flooding, the Corps of Engineers has proposed construction of the “coastal spine” that would be constructed on the west end of Galveston Island and on the Bolivar Peninsula as well as across the pass between the island and the peninsula. However, this coastal spine will not protect upper Galveston Bay and the Houston Ship Channel from the surge from a category 4 or 5 storm. The lower income and racially diverse population of the upper reaches of the ship channel is subject to inundation from these large storms that will likely rupture storage tanks and spread oil and hazardous substances into these neighborhoods as well as back onto the bay (SSPEED Center et al., 2020). This would potentially be among the worst environmental disasters in United States history, and residents within the northeast district would be seriously impacted if such an event were to occur.

The good news is that a solution has been proposed to address this inequity in the level of protection being provided by coastal spine. A second project known as the Galveston Bay Park Plan is proposed to be constructed along the Houston Ship Channel in Galveston Bay. This project would be built from clay dug up from widening the Houston Ship Channel, an action that will make channel navigation safer. This barrier would extend from the Texas City levee in Galveston County up the bay to end in Chambers County just east of Cedar Bayou, thereby keeping category 5 storm surge out of the Northeast sector of the City and County. The Galveston Bay Park Plan is currently up for additional funding by the City of Houston, Harris County and the Port of Houston along with Joe Swinbank, a landowner on the Houston Ship Channel. This project should be supported by Northeast residents to help those living along the southern portion of district.

H. Increase the Scope of Local Participation

This project began as an effort organized by Super Neighborhoods within the City of Houston. The hope is that this core will be expanded by adding groups from throughout the Northeast area which includes most of Greens and Halls Bayous as well as Hunting Bayou. And the further hope is that this group can establish a process that will allow the

view of the community to be brought to the elected officials and the public employees that are charged with implementing this difficult job of trying to protect us from flooding.

No one thinks that protecting the public from flooding is easy. We did not develop this flooding problems overnight and it will not be solved overnight. But in order to succeed, better communication and trust must be established between those working on these problems and those suffering from the flooding. Some of the earlier suggestions have addressed this issue but it is worth repeating that honest communications with the public is essential. The truth may hurt, but it is the only way to remove the scars from past actions and move us forward toward healing as a community.

I. Just Do It

On top of these frame-breaking issues are the direct asks by those with responsibility and the tasks that simply must be done. We have the county bond projects that have been promised: they must be delivered. We have the SWAT list by Council Members Jackson, Cisneros, and Gallegos: they must be delivered. We have the continuing supervision of the Harris County Flood Control District by the County Commissioners: that must be delivered honestly and equitably. All of these tasks must be completed even as we attempt to raise the bar and break out of our traditional way of thinking and looking at things. Appendix A sets out a full list of solutions which have already been proposed by the City and County.

VI. Concluding Comments

By any criteria, the Northeast is experiencing an equity crisis. It is not from mal intent but rather from decades of action and inaction. The inequity is pervasive relative to flooding in the Northeast, and it is time for collective action to address this problem.

In performing this study, we realized that information and data related to this issue is decentralized and sometimes difficult to obtain. This information, if made accessible, can empower residents to push for change. In an effort to make some of this information more accessible we have created an interactive map with all the spatial data used in this report. With this map residents can overlay layers such as watersheds, bond projects, and administrative boundaries in ways that are meaningful to them. This map is hosted on the Bayou City Initiative website. See the acknowledgement page at the beginning of this report for the link.

To solve this crisis, we must think creatively, break out of our frames, do something special. Equity is not only about equality. It means going that extra length to help a disadvantaged community succeed. By creating and supporting a Northeast equity entity

of some type and taking these other frame-breaking actions as well as those that any citizen has a right to expect, we have a chance to break out of our frame that has brought past failure and create a better, more equitable future where we all will learn to live with flood water rather than control it.

VII. Appendix A: Proposed Solutions by Harris County and the City of Houston

Several projects have been proposed by Harris County and the City of Houston to solve the issues of flooding in the neighborhood. This section will discuss some of the proposed solutions.

A. Harris County Projects

HCFCFCD includes [eighteen projects](#) in the Halls Bayou watershed among the 2018 Bond Projects as of 2020. Figures A1 and A2 show the locations of most of these projects and a full list of these projects with details can be found in Table A1 below. The majority of the funding for these projects is still coming from partner funding. Most of the projects are in the preliminary engineering phase while C-01 and C-25 are in the construction phase. The Little York and Hopper Stormwater Detention Basins project (C-35) was just completed in August of 2021 making it the first completed bond project in the Northeast (HCFCFCD, 2021, August 12). Both C-35 and C-01 are storm water detention basin projects which HCFCFCD claim together reduce the flood risk of 380 structures in the area. C-25 is a channel conveyance improvement project which includes the construction of a detention basin (HCFCFCD, 2021 July 23). In total the HCFCFCD plans to complete four storm water detention projects, one study in coordination with the Corps of Engineers, nine channel conveyance improvement projects, a subdivision drainage improvements project, the Bond implementation Management (BIM) of the right-of-way acquisition, design and construction, a federal grant-funded volunteer home buyout program, and one storm repair project in the Halls Bayou watershed. The buyout programs will be discussed in more detail in the next section.

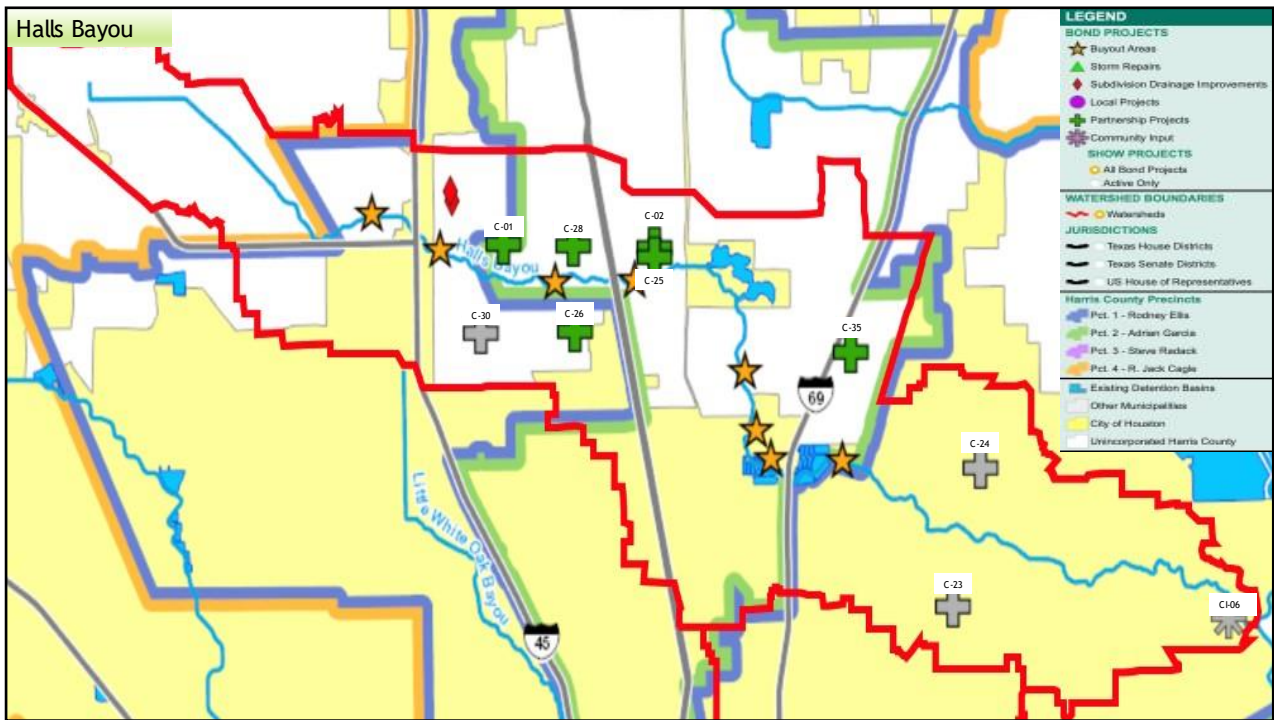


Figure A1. HCFCF projects in Halls Bayou Watershed.. Map adapted from HCFCF Bond Projects interactive map (2021n).

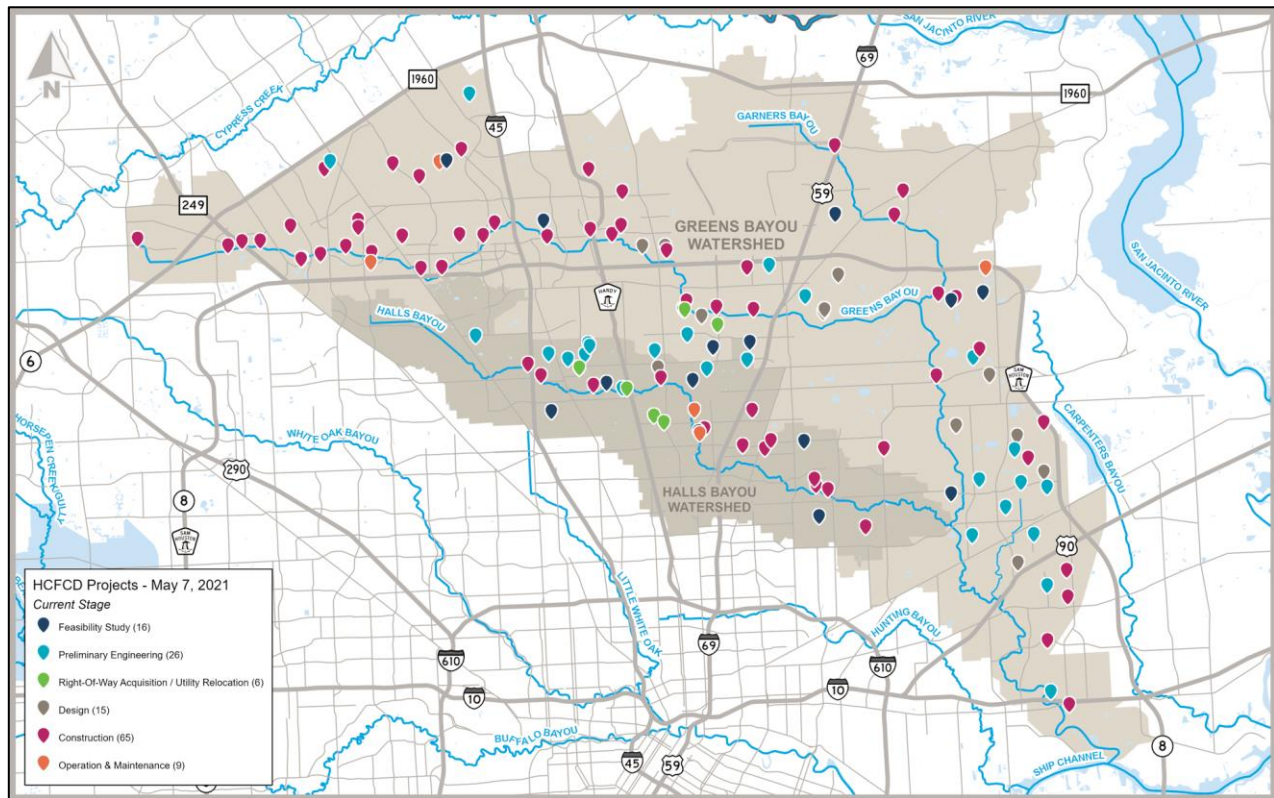


Figure A2. Projects in Halls Bayou Watershed. Map from HCFCF (HCFCF, 2021g).

Table A1. Halls Bayou HCFCD bond project details. Table adapted from 2020 update of 2018 Bond Project List (HCFCD, 2020). Project statuses from project details found on HCFCD website (HCFCD, 2021g).

TITLE	TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL (BF+PF+DF)	DESCRIPTION OF BENEFITS / NOTES
Construction of P518-26 Stormwater Detention Basin	Partnership	C-01	P518-26-00	Construction	-	\$ 975,853	\$ 56,229	\$ 1,032,082	When complete with future funding, this project could reduce the risk of flooding for more than 230 structures and could reduce the 1% floodplain for over 100 acres as part of the Halls Ahead Bond Implementation Program.
CDBG-DR (2016) - Aldine Westfield Stormwater Detention Basin and Channel	Partnership	C-02	P518-00-00	Consolidated into countywide project in 2020	-	-	-	-	Project consolidated with C-25 to match ongoing project management as a single project.
Local Cost Share for Corps of Engineers Halls Bayou Study	Partnership	C-21	P118-00-00	Consolidated into countywide project in 2020	-	-	-	-	Project consolidated with C-41 as the project did not receive funding from the Corps of Engineers. District Funding consolidated with C-41.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-08-00	Partnership	C-23	P118-08-00	Preliminary Engineering	\$ 2,500,000	\$ 22,500,000	-	\$ 25,000,000	This project could reduce the risk of flooding for over 210 structures and could reduce the 1% floodplain for over 170 acres as part of the Halls Ahead Bond Implementation Program.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-09-00	Partnership	C-24	P118-09-00	Preliminary Engineering	\$ 1,200,000	\$ 10,800,000	-	\$ 12,000,000	This project could reduce the risk of flooding for over 200 structures in the pre-Atlas 14 1% AEP (100-year) floodplain and could reduce that floodplain by more than 160 acres as part of the Halls Ahead Bond Implementation Program.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-21-00	Partnership	C-25	P118-21-00	Construction	\$ 5,400,000	\$ 14,636,050	-	\$ 20,036,050	This project could reduce the risk of flooding for over 140 structures in the pre-Atlas 14 1% AEP (100-year) floodplain and could reduce that floodplain by more than 100 acres as part of the Halls Ahead Bond Implementation Program.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-23-00 and P118-23-02	Partnership	C-26	P118-23-00	Preliminary Engineering	\$ 2,800,000	\$ 25,200,000	-	\$ 28,000,000	This project could reduce the risk of flooding for more than 380 structures in the pre-Atlas 14 1% AEP (100-year) floodplain and could reduce that floodplain by more than 430 acres as part of the Halls Ahead Bond Implementation Program.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-23-02	Partnership	C-27	P118-23-02	Consolidated with C-26 in 2020	-	-	-	-	Project consolidated with C-26 to match ongoing project management as a single project.

TITLE	TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL (BF+PF+DF)	DESCRIPTION OF BENEFITS / NOTES
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-25-00 & P118-25-01	Partnership	C-28	P118-25-00	Preliminary Engineering	\$ 2,400,000	\$ 21,600,000	-	\$ 24,000,000	This project could reduce the risk of flooding for more than 600 structures in the pre-Atlas 14 1% AEP (100-year) floodplain and could reduce that floodplain by more than 200 acres as part of the Halls Ahead Bond Implementation Program.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-25-01	Partnership	C-29	P118-25-01	Consolidated with C-28 in 2020	-	-	-	-	Project consolidated with C-28 to match ongoing project management as a single project.
Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-27-00	Partnership	C-30	P118-27-00	Preliminary Engineering	\$ 1,200,000	\$ 10,800,000	-	\$ 12,000,000	This project could reduce the risk of flooding for over 140 structures in the pre-Atlas 14 1% AEP (100-year) floodplain and could reduce that floodplain by more than 200 acres as part of the Halls Ahead Bond Implementation Program.
Design and Construction of Stormwater Detention Basin and Associated Channel Improvements	Partnership	C-35	P518-10-00	Completed	\$ 800,000	\$ 6,384,960	\$ 623,207	\$ 7,808,167	This project removes the Atlas 14 1% AEP (100-year) floodplain from more than 150 structures and reduces the risk of flooding for more than 300 other structures as part of the Halls Ahead Bond Implementation Program.
Planning, Right-Of-Way, Design and Construction of Halls Bayou Flood Risk Management Project	Partnership	C-41	P118-00-00	Alternatives Analysis phase of Preliminary Engineering	\$ 3,460,000	\$151,500,000	-	\$154,960,000	This project could reduce the risk of flooding for over 2,800 structures in the 1% floodplain as part of the Halls Ahead Bond Implementation Program.
Design and Construction of a Stormwater Detention Basin in Brock Park	Community Input	CI-006	P118-00-00	Unspecified	\$ 5,000,000	\$ 5,000,000	-	\$ 10,000,000	Provides additional stormwater detention in support of flood damage reduction as part of the Halls Ahead Bond Implementation Program. The project will be a partnership with the City of Houston.
Halls Bayou Subdivision Drainage Improvements	Subdivision Drainage Improvement	E-11	P118-00-00	Consolidated into countywide project in 2020	-	-	-	-	Sixteen (16) subdivision drainage improvement projects are consolidated into one Bond ID assigned for countywide subdivision drainage improvement labeled Z-SubDiv. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation and grant amendments.
Bond implementation Management (BIM) of the Right-of-Way Acquisition, Design and Construction in Halls Bayou Watershed	Local	F-122	P118-00-00	Unspecified	\$ 48,040,000	-	-	\$ 48,040,000	Bond implementation Management (BIM) of Halls Ahead Program could reduce the risk of flooding along Halls Bayou for over 2,800 structures in the pre-Atlas 14 1% AEP (100-year) floodplain.

TITLE	TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL (BF+PF+DF)	DESCRIPTION OF BENEFITS / NOTES
Federal Grant-Funded Volunteer Home Buyouts	Buyout		P118-00-00	Consolidated into countywide project in 2020	-	-	-	-	Seventeen (17) buyout projects are consolidated into one Bond ID assigned for countywide buyout, labeled Z-Buyout. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation. Funding amounts were not changed and only aggregated into one Program ID
Storm Repairs in Halls Bayou Watershed	Storm Repair		P118-00-00	Consolidated into countywide project in 2020	-	-	-	-	Twenty (20) storm repair projects are consolidated into one Bond ID assigned for countywide storm repair labeled Z-StormRep. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation and grant amendments.

In the Greens Bayou watershed the HCFCF includes [eleven projects](#) in the 2018 Bond Projects as of 2020. Figures A2 and A3 show the locations of most of these projects and a full list of these projects with details can be found in Table A2 below. Again, the majority of the funding for these projects is coming from partner funding. Two stormwater detention projects are now in phase two and another is in construction. The remainder of the projects are in preliminary engineering, design, or undergoing feasibility studies. In total the HCFCF plans to complete five storm water detention projects, two channel conveyance improvement projects, one channel diversion project, one subdivision drainage improvements project, a federal grant-funded volunteer home buyout program, and one storm repair project in the Greens Bayou watershed.

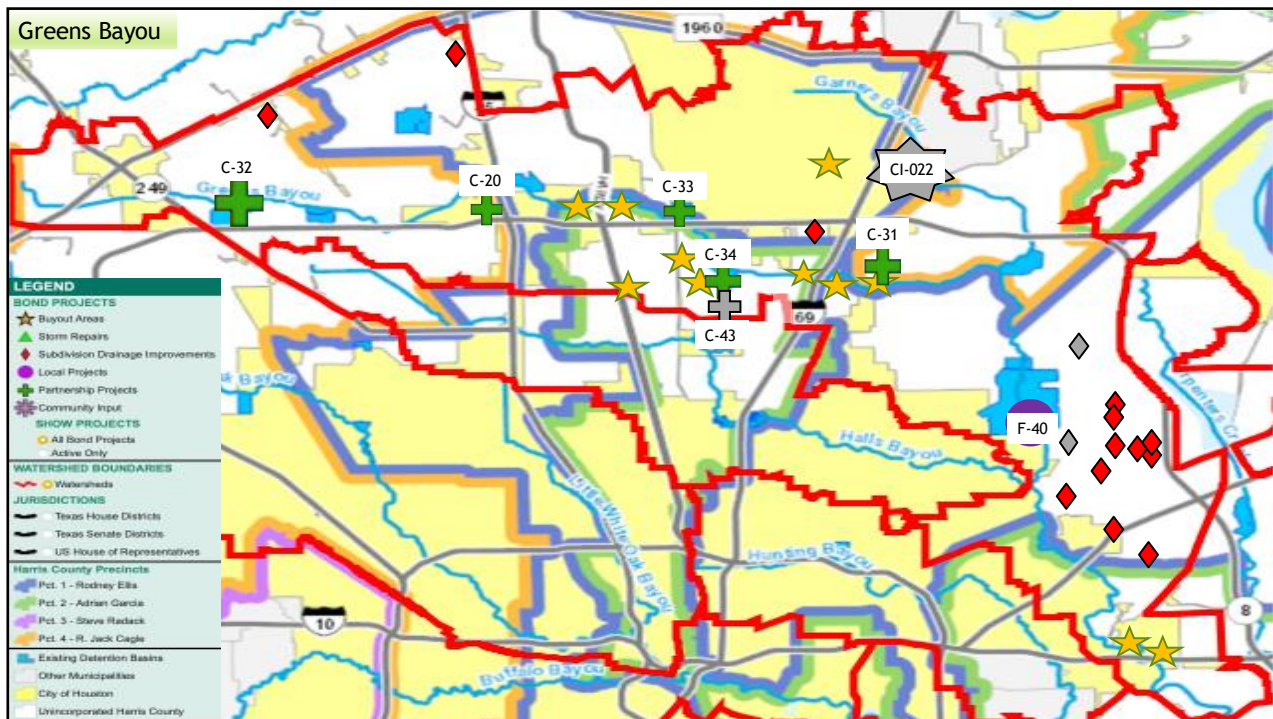


Figure A3. HCFCF projects in Greens Bayou Watershed. Map adapted from HCFCF Bond Projects interactive map (2021n).

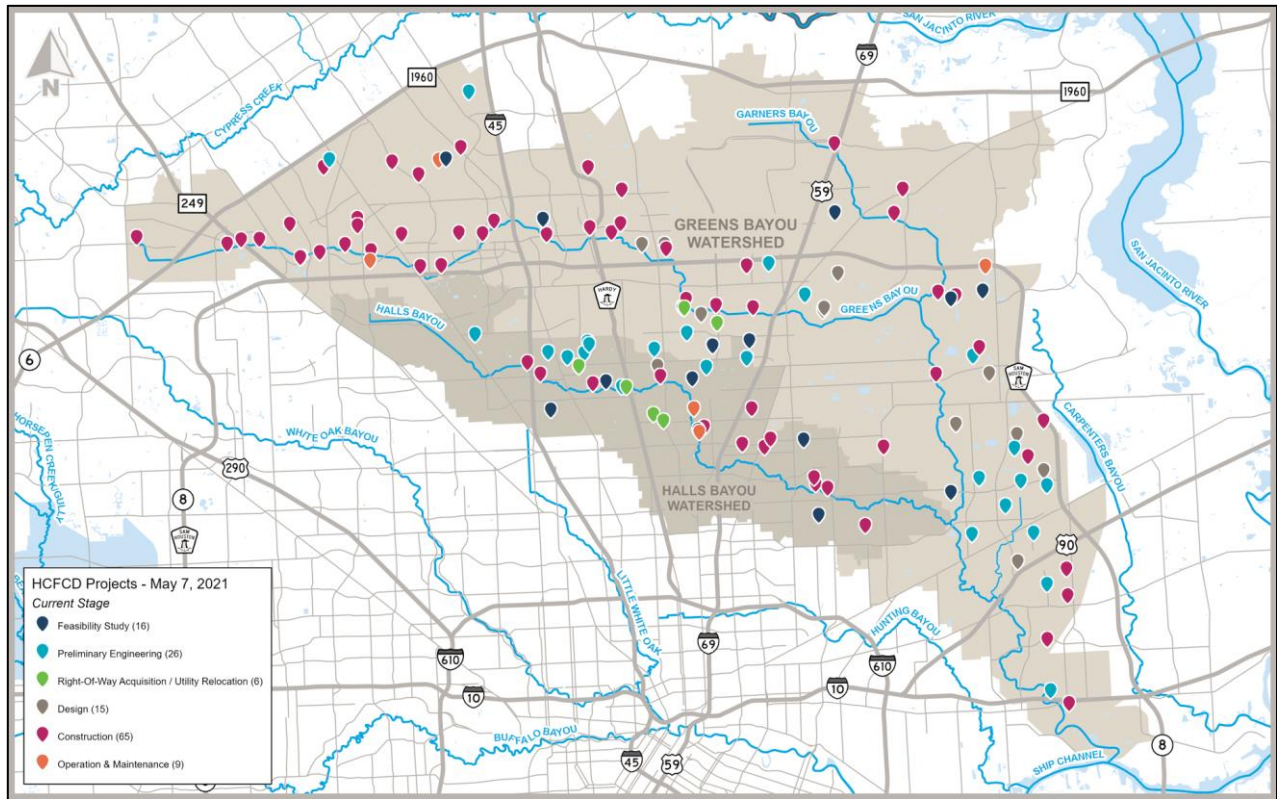


Figure A4. Projects in Greens Bayou Watershed (HCFCF, 2021c).

Table A2. Greens Bayou HCFCD bond project details. Table adapted from 2020 update of 2018 Bond Project List (HCFCD, 2020). Project statuses from project details found on HCFCD website (HCFCD, 2021c).

TITLE	PROJECT TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL (BF+PF+DF)	DESCRIPTION OF BENEFITS / NOTES
Mid-Reach Greens Bayou Project - Design and Construction of Channel Conveyance Improvements along Greens Bayou	Partnership	C-20	P100-00-00	Preliminary Engineering	\$2,000,000	\$18,000,000	-	\$ 20,000,000	This project is one of Greens Bayou Mid Reach Project that will reduce the risk of flooding for 4,500 structures in the Atlas 14 1% AEP (100-year) floodplain.
Design and Construction of the Smith Road Channel Diversion	Partnership	C-31	P133-00-00	Design	\$ 800,000	\$ 7,200,000	-	\$ 8,000,000	This project could reduce the risk of flooding for over 70 structures during the 10% AEP (10-year) event along P133-00-00 and secondary benefits could include reduced erosion.
Design and Construction of the Cutten Road Stormwater Detention Basin Improvements	Local	C-32	P500-02-00	Construction	\$1,500,000	-	\$15,500,000	\$ 17,000,000	This project is a component of the Greens Bayou Mid Reach Project that will reduce the risk of flooding for 4,500 structures in the Atlas 14 1% AEP (100-year) floodplain.
Design and Construction of Aldine-Westfield Stormwater Detention Basin Improvements	Partnership	C-33	P500-04-00	Phase I is Complete, Phase II in Design	\$1,510,000	\$13,590,000	\$ 1,700,000	\$ 16,800,000	This project is a component of the Greens Bayou Mid Reach Project that will reduce the risk of flooding for 4,500 structures in the Atlas 14 1% AEP (100-year) floodplain.
Design and Construction of Lauder Stormwater Detention Basin Improvements	Partnership	C-34	P500-06-00	Phase I in Construction, Phase II in Design	\$1,600,000	\$25,000,000	-	\$26,600,000	This project is a component of the Greens Bayou Mid Reach Project that will reduce the risk of flooding for 4,500 structures in the Atlas 14 1% AEP (100-year) floodplain.
Planning, Right-of-Way Acquisition, Design and Construction of Channel Conveyance Improvements along P138-01-01	Partnership	C-43	P138-01-01	Feasibility Study	-	\$5,000,000	-	\$5,000,000	Potential federal funded project, the risk of flooding could be reduced for approximately 100 structures in the pre-Atlas 14 1% AEP (100-year) floodplain.
ROW, Design, and Construction of Stormwater Detention Basin Near P130-05	Community Input	CI-022	P130-05-01	Feasibility Study	\$3,000,000	-	-	\$3,000,000	Project could reduce the risk of flooding for structures near P130-05-01
Greens Bayou Subdivision Drainage Improvements	Subdivision Drainage Improvement	E-09	P100-00-00	Consolidated into countywide project in 2020	-	-	-	-	Sixteen (16) subdivision drainage improvement projects are consolidated into one Bond ID assigned for countywide subdivision drainage improvement labeled Z-SubDiv. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation and grant amendments.

TITLE	PROJECT TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL (BF+PF+DF)	DESCRIPTION OF BENEFITS / NOTES
Repairs and Enhancements to the Lower Greens Bayou Regional Detention Embankment and Control Structure	Local	F-40	P500-01-00	Unspecified	\$5,000,000	-	-	\$5,000,000	Major maintenance of existing detention facilities in Lower Greens Bayou.
Federal Grant-Funded Volunteer Home Buyouts	Buyout		P100-00-00	Consolidated into countywide project in 2020	-	-	-	-	Seventeen (17) buyout projects are consolidated into one Bond ID assigned for countywide buyout, labeled Z-Buyout. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation. Funding amounts were not changed and only aggregated into one Program ID
Storm Repairs in Greens Bayou Watershed	Storm Repair		P100-00-00	Consolidated into countywide project in 2020	-	-	-	-	Twenty (20) storm repair projects are consolidated into one Bond ID assigned for countywide storm repair labeled Z-StormRep. Program ID, project title, precinct, project funding and description of benefits updated to reflect the consolidation and grant amendments.

HCFCFCD includes [four projects](#) in the Hunting Bayou watershed among the 2018 Bond Projects as of 2020. Figure A5 shows the locations of most of these projects, and a full list of these projects with details can be found in Table A3 below. Unlike for Halls and Greens Bayous, Hunting Bayou’s page on the HCFCFCD website contains no map of current projects.

Two projects are in the feasibility study phase, one is in the design and construction phases, and another has been initiated. C-18 is a Corps of Engineers project with several elements, including excavation of a stormwater detention basin near the northeast corner of Homestead Road and 610; widening and deepening 4 miles of Hunting Bayou; and replacing or modifying approximately 20 bridges (HCFCFCD, 2021o). This is the only project in Hunting Bayou watershed slated to receive partner funds; the rest of the projects are funded through the bond issue.

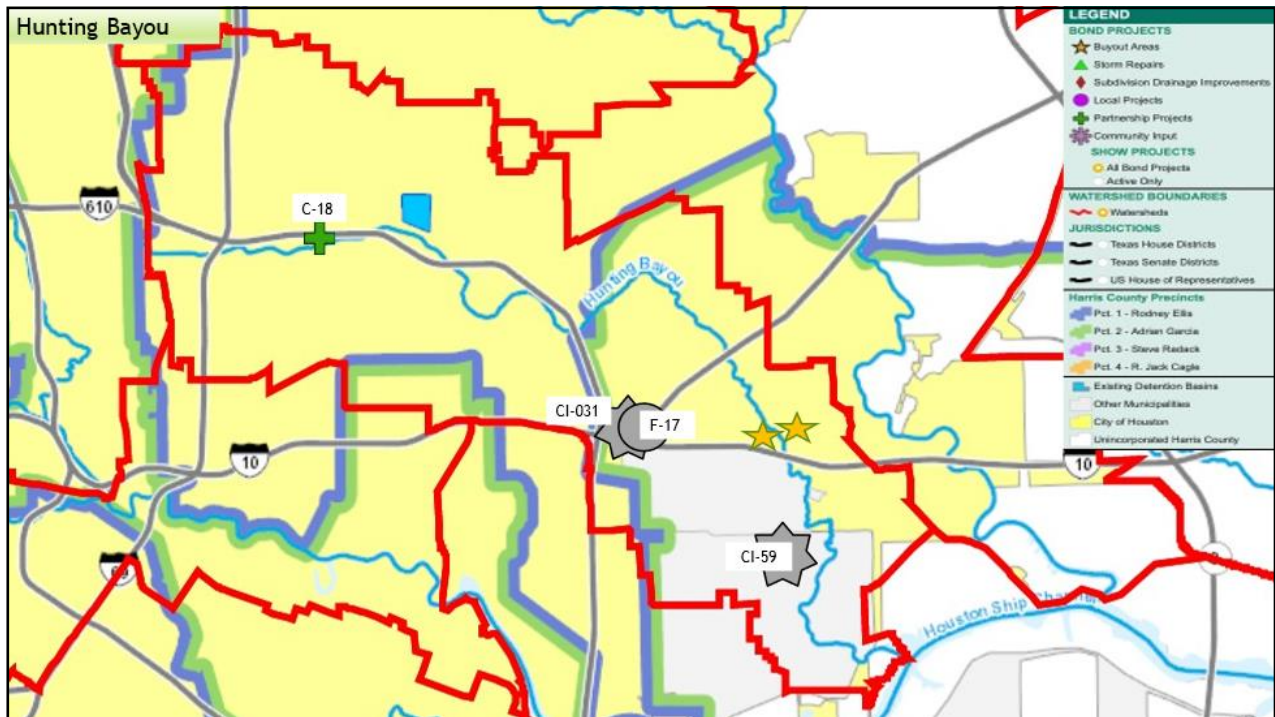


Figure A5. HCFCFCD projects in Hunting Bayou Watershed. Map adapted from HCFCFCD Bond Projects interactive map (2021n).

Table A3. Hunting Bayou HCFCD bond project details. Table adapted from 2020 update of 2018 Bond Project List (HCFCD, 2020). Project statuses from project details found on HCFCD website (HCFCD, 2021e). Gray row indicates a project in the 4th quartile.

TITLE	TYPE	BOND ID	UNIT ID	STATUS	ESTIMATED 2018 BOND FUNDS (BF)	ESTIMATED PARTNER FUNDS (PF)	ESTIMATED DISTRICT FUNDS (DF)	TOTAL(BF+P F+DF)	DESCRIPTION OF BENEFITS / NOTES
Design and Construction of Corps of Engineers Hunting Bayou, Section 211(f) Project	Partnership	C-18	H100-00-00	Segment 104 and 107 in Construction; Segment 105 in Design	-	\$65,000,000	-	\$65,000,000	The pre-Atlas 14 1% AEP (100-year) floodplain will be removed from up to 4,450 structures as part of the federal project.
District Cost Share of Study with the City of Houston on Wallisville Outfall	Community Input	CI-031	H103-00-00	Feasibility Study	\$500,000	-	-	\$500,000	Study will investigate flooding problems and identify potential solutions along the H103-00-00 channel. Project will be coordinated with City of Houston.
Planning, Right-Of-Way, Design and Construction of a Diversion Channel from H102-00-00 to H100-00-00 through Galena Park	Community Input	CI-59	H102-00-00	Initiated	\$10,000,000	-	-	\$10,000,000	Specific benefits will be established when the project is initiated in the 4th quartile.
Right-Of-Way Acquisition, Design and Construction of Wallisville Outfall	Local	F-17	H103-00-00	Feasibility Study	\$10,000,000	-	-	\$10,000,000	The project could reduce the risk of flooding for over 140 structures in the pre-Atlas 14 1% AEP (100-year) floodplain.

One other HCFCD project of note in the Northeast area is the North Canal partnership project which is planned in coordination with the City of Houston. Councilwoman Cisneros has been an advocate for the North Canal. This project includes an overflow channel east of downtown which is designed to mitigate flooding in the Warehouse District (HCFCD, n.d.-d).

Buyouts

Buyouts are an option for areas where homes and businesses are too far into the floodplain for flooding projects to protect them. However, buyouts pose a major equity challenge. Buyouts can either be done through Voluntary Acquisition or Project Right-of-Way Acquisition. If a buyout uses Right-of-Way Acquisition this means the project is deemed a public necessity and the property owner must sell the house (HCFCD, n.d.-e; HCFCD, n.d.-f). Residents could make good money from a buyout of their home, but they often wish to remain in their community. If there is no guarantee of available and affordable housing within the homeowner's community, a buyout effectively displaces homeowners from their community. To perform buyouts equitably, property should be bought at above a fair price to ease relocation, and money should also be invested to ensure affordable housing is available in the community. A good example of this type of investment is Fort Bend's buyout program following the 2016 events which included a Method of Distribution for housing and infrastructure projects which attributes 55% of CDBG-DR funds received to housing projects with a focus on low-income homeowners (Patterson, 2018, p. 9). Guidelines on the voluntary buyout programs from Harris County sets a goal which is essential to the equity of the process: "[t]he goals established in other Harris County Disaster Recovery programs will seek to provide an equal or greater amount of new or rehabilitated housing units to offset the number of homes removed from the County's housing stock as a result of the buyout program," (Community Services Department, 2018, p. 49). The County must ensure that they provide housing within the Northeast neighborhoods to replace the houses lost through buyouts in that same neighborhood.

Another major issue with the buyout program is the speed of the process. HCFCD is clear that buyout programs cannot proceed without full funding; this is a good requirement because it ensures all homeowners qualifying for the program will be able to participate. However, because HCFCD relied on CDBG-MIT and CDBG-DR funding for the buyouts in the Greens and Halls Watersheds and that funding did not come through, there has been a huge delay in the buyout programs in this area. This means four years after Harvey residents in the Northeast area are still living in damaged homes within the floodplain with no assistance for relocation or are paying for repairs on homes that will inevitably flood again. To fulfill their commitment to equity, HCFCD should move to

complete home buyout programs in the Northeast as soon as possible. Relocating and repairing homes is particularly challenging for low-income and minority residents, so they should be prioritized in the buyout process over residents who can relocate or repair their homes more easily due to their wealth and race.

Currently, both HCFCD and the City of Houston have buyout programs. The City program does not currently have any buyout projects in Northeast Houston (City of Houston, 2021, February 25). HCFCD has buyout projects included in the 2018 flood bond project list. In the list updated in 2020, buyout projects from all watersheds were consolidated into one project, making it difficult to determine costs and properties affected (HCFCD, 2020). In the original 2018 list, the projects are separated out and costs included. This list shows that approximately 830 buildings in Halls Bayou Watershed will be affected by buyouts and the total cost is estimated at \$137,500,000 (\$103,125,000 partner share and \$34,375,000 local match). In Greens Bayou watershed 810 buildings were included in the buyout plans with a total cost of \$97,900,000 made up of \$73,425,000 partner share funds and \$24,475,000 local match funds (HCFCD, 2018d). These buyouts are funded by federal grants, either from FEMA Flood Mitigation Grant Program, FEMA Hazard Mitigation Grant Program or HUD Community Block Development Grants (Patterson, 2018, p. 9). FigureA3 shows a map adapted from the HCFCD's map of buyouts which shows the funding sources. This map shows that HCFCD intends to fund many of the projects in this area with HUD Community Block Development Grants. These are CBDG-MIT or CBDG-DR funds. It is important to note that these funds are required to be used in low-income areas.

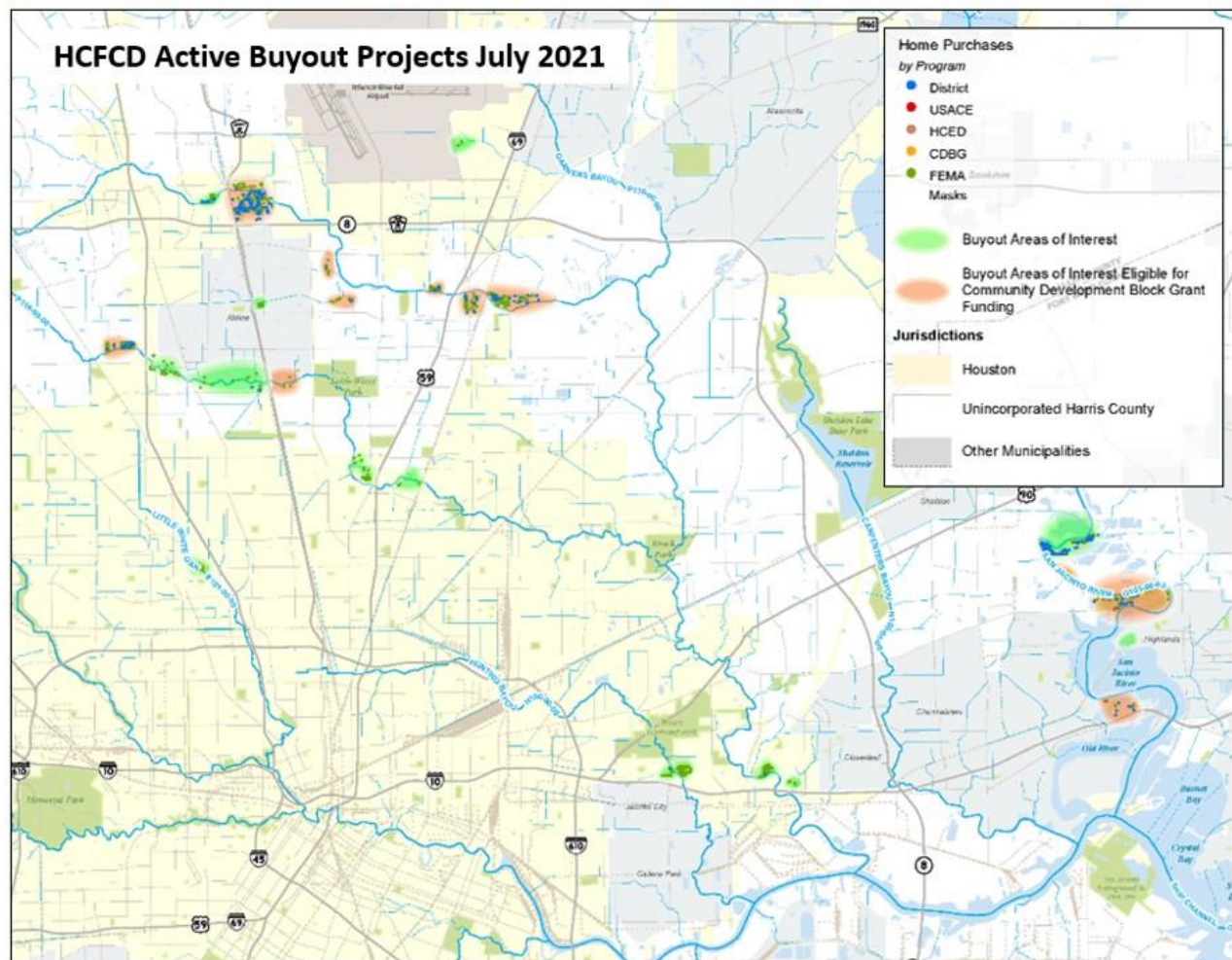


Figure A6. HCFC Active Buyout Projects map (July 2021) adapted to fit area (HCFC, 2021m).

In the program guidelines on disaster recovery voluntary buyouts, Harris County outlines several provisions which will enhance the equity of the buyout program including case management as a service to homeowners in the application process and incentives such as the replacement housing incentive, social vulnerability incentive, rehabilitation incentive, down payment assistance, and equity incentive (Community Services Department, 2018, pp. 21-23). The document defines case management as, "Working with individual survivors and their families to understand the program's housing options, resulting in clear and transparent determination of eligibility. Case Managers must take into account all special circumstances of the survivor's needs to decrease their barriers to participate in the program where possible" (Community Services Department, 2018, p. 5). These case management services include relocation advisory services which are extremely important services for low- and moderate-income households (Community Services Department, 2018, p. 11). These provisions are commendable and important for

implementing the program equitably. Comments on the buyout program guidelines written by Madison Sloan on behalf of Texas Appleseed, a public interest justice center, provides insight into several equity issues that could arise from the program and offers solutions. A major need identified in the comments and clearly required for an equitable process is community participation in the formulation of guidelines for the program. Sloan writes that "[I]nability to show clear title because of heirs' property ownership is a barrier to choosing to move to a safer location, particularly for African-American homeowners because of the prevalence of heirs property in African-American communities" (Sloan, 2018, p. 3). For this reason, she concludes that legal assistance is essential to an equitable buyout program. In their guidelines Harris County writes that their Advisory Services will provide referrals to local legal aid organization to households which need this service. Sloan argues that the County has a responsibility to ensure that those organizations have the funding to take on the cases related to the buyout programs and points to the State funded title-clearing project following Hurricane Ike as a model to provide these services. The Texas Appleseed comments also call for clarity in the guidelines on the Certification of Residency and the details of the appeals and grievances process (Sloan, 2018). The authors of this report concur with these recommendations.

On a final note, it is the policy of Harris County to pursue buyout programs in areas within the floodplain. Flooding caused by ditches, ponding, and sheet flow are typically not considered for buyouts by Harris County (Patterson, 2018, p. 10). However, much of the flooding in the Northeast is attributable to overflowing ditches and sheet flow and occurs outside of the floodplain. That these houses flood as frequently as those within the floodplain but do not qualify for buyouts underscores the urgent need for structural and maintenance improvements in the neighborhoods.

B. City of Houston Projects

[Build Houston Forward](#) is a City program meant to improve streets and drainage systems without accruing debt by relying on property taxes, third party funds, and drainage fees. The City of Houston's Build Houston Forward site shows planned, active and completed projects including repair, street and drainage rehabilitation, and reconstruction. Figure A7 is a map adapted from the Build Houston Forward site showing active and planned rehabilitation and reconstruction projects in districts B, E, H, and I. The yellow dots show projects meant to improve drainage.

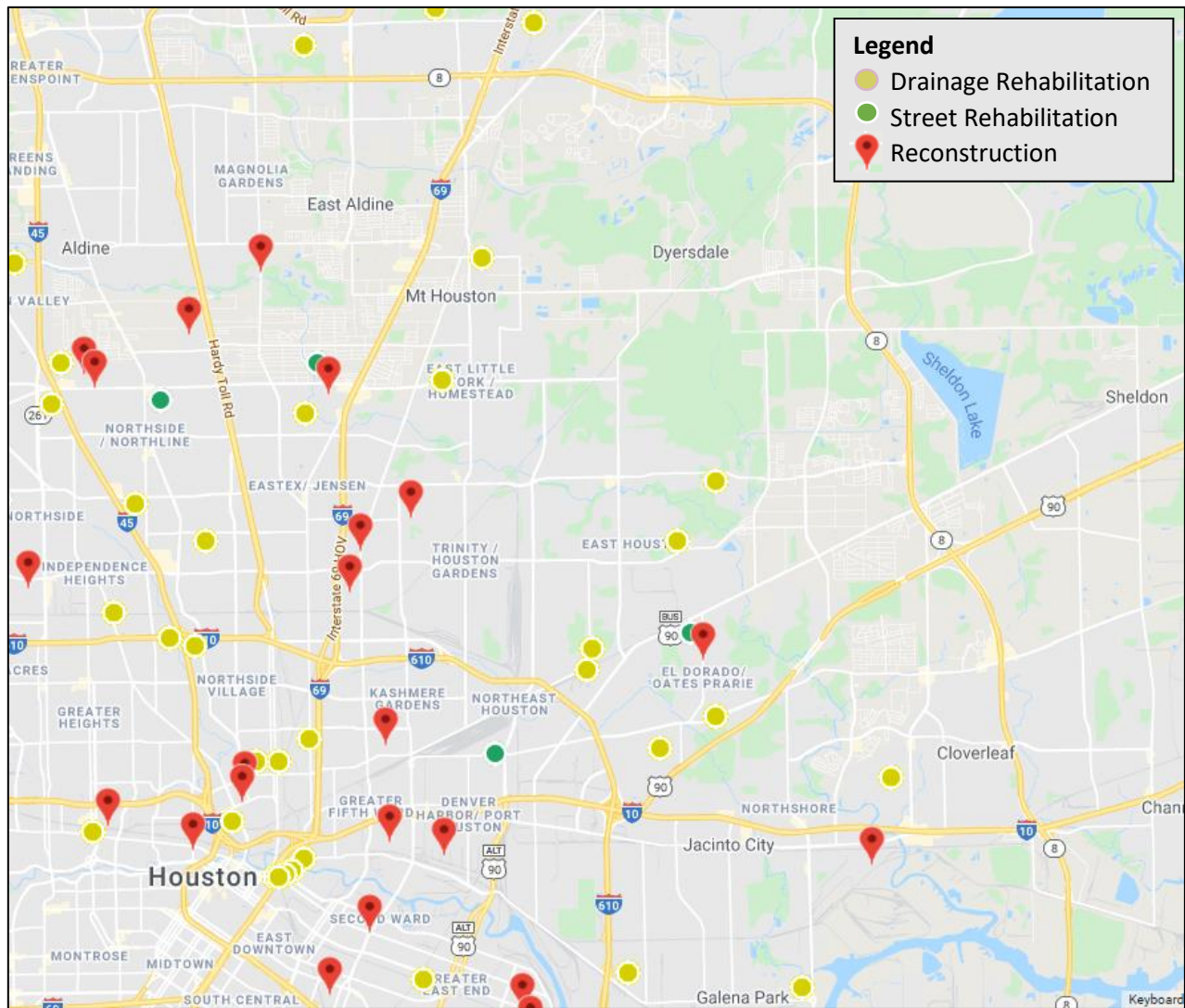


Figure A7. Active and Planned drainage and street rehabilitation and reconstruction projects in districts B, E, H, and I shown on the Build Houston Forward site (City of Houston, n.d.-c).

The City of Houston began the Storm Water Action Team (SWAT) program in 2017. The program is allocated \$20 million annually to fund drainages projects including repair and replacement of storm sewer lines, re-establishment of roadside ditches, and rehabilitation of off-road ditches and detention ponds. Projects are chosen based on community input, city council input, 311 calls, and other flood data (City of Houston, n.d.-b). Councilwoman Karla Cisneros, Councilwoman Tarsha Jackson, and Councilman Robert Gallegos have provided the authors with a list of locations and details of SWAT projects they are advocating for which are shown in Figure A8 and listed below.

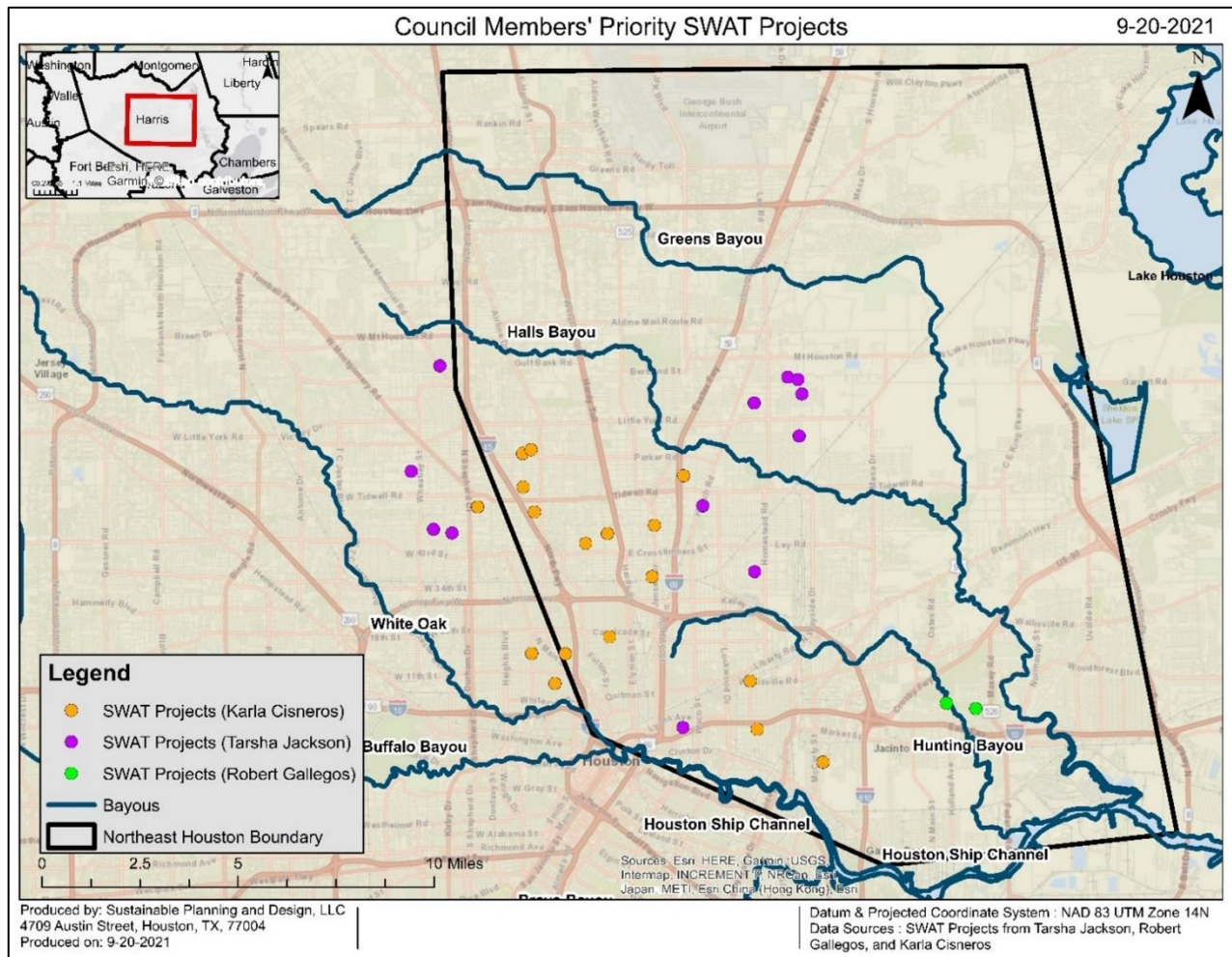


Figure A8. SWAT Projects in the Northeast area provided by Council Members Tarsha Jackson, Robert Gallegos, and Karla Cisneros with bayous (City of Houston, 2021c). Map by Camille Chenevert for Sustainable Planning and Design.

Councilwoman Karla Cisneros' Priority SWAT Projects

1. Denver Harbor New Addition (Sec 2)—Recommend H&H analysis to determine proposed improvements within the neighborhood.
2. E Burrese St (Airline Dr to N Fwy)—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
3. 8259 Munn St. (H102-00-00-B)—Clearing and Grubbing of ditch and re-establish proper grade.
4. Northside/Northline Area 5 (Phase I Improvements)—Installing 24-in to 72-in RCP storm sewers throughout the entire subdivision - has to be completed in phases
5. Enid Street (Between Patton St & N main St)—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
6. 6717 Nordling—Evaluate upgrade of inlets & upsizing of storm sewer
7. 539 Foxglove Ln—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.

8. 3700 Hage—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
9. 2700 Spence—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
10. 8000 Nellie (Irvington; Hardy Toll; Northam St)—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line. Project qualifies for SWAT but may qualify for HCD Storm funding.
11. Eastex-Jensen—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line. Project qualifies for SWAT but may qualify for HCD Storm funding.
12. Northside/ Northline Area (Roadside Ditch Project 3)—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
13. Wallisville Rd. - SubProject A (Lockwood to N. Wayside)—Evaluate storm sewer and inlets. Project doesn't qualify due to CIP project N-000626-0001 along Wallisville Rd.
14. Norhill Storm Drain (Studewood & E 14th St)—Add a storm drain on the northeast corner to alleviate chronic pooling after rain events. Project doesn't qualify for SWAT due to the lack of flooding and ponding issues. It appears that there has been
15. minimal impact from the shallow ponding on the street.
16. Woodland Heights (700 Bayland)—Issue: A dip in the street is site of accumulation of water during rain events big and small. Request: Asphalt overlay to correct the dip. Due to lack of flooding issues, ponding issues, this area does not qualify for SWAT. This is more of a mobility issue, and asphalt overlay project.
17. Delman Heights (6810 Luna St.)—Issue is the drainage ditch at the corner of Riverwood and Luna St. Project doesn't qualify for SWAT since this is being addressed by LDP: M-420126-0098-3 (WO #13)
18. 601 W Donovan Rd. (E101-17-00)—Clearing and Grubbing of ditch and re-establish proper grade. Ditch owned by HCFCD. Does not qualify for SWAT as the channel owned by the HCFCD
19. Irvington Park Roadside Ditches—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line. Project doesn't qualify for SWAT due to the lack of flooding reports, and there is minimal ponding in the area.
20. First Ward—Storm drains tends to get clogged. Storm drains need to be reconstructed. Very large area, needs H&H study prior to any recommendation. This is a very large project area with an intricate storm sewer system. Recommend an H&H study and CIP to propose different alternatives on how to address structural flooding and repetitive loss issues. Project would cost considerably over one million dollars. Ponding map does not show heavy ponding in most of the project area, but significant ponding is shown in the southeast corner.
21. Independence Heights (Part 1)—Rebuild existing open ditch system into vegetated swales with possible infiltration beds for inline detention. Very large area, needs H&H study prior to any recommendation. This is a very large project area with an intricate storm sewer system that falls mostly in the 100-yr floodplain. Recommend an H&H study and CIP to propose different alternatives on how to address structural flooding and repetitive loss issues. Project would cost considerably over one million dollars. This project does not fall under SWAT. Consider a joint

project with ID 574 – Independence Heights (Part 2), where council member requests to regrade roadside ditches so that water will flow.

22. Independence Heights (Part 2)—Regrade ditch so that water will flow. Very large area, needs H&H study prior to any recommendation. This is a very large project area with an intricate storm sewer system that falls mostly in the 100-yr floodplain. Recommend an H&H study and CIP to propose different alternatives on how to address structural flooding and repetitive loss issues. Project would cost considerably over one million dollars. This project does not fall under SWAT. Consider a joint project with ID 573 – Independence Heights, where council member suggests to rebuild existing open ditch system into vegetated swales with possible infiltration beds for inline detention.

Councilwoman Tarsha Jackson's Priority SWAT Projects

1. Scenic Woods (7703 Spinnet)—Recommend H&H analysis to determine proposed improvements within the neighborhood.
2. 4414 Fitch St.—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line
3. 3799 Market St. (G122-00-00-B)—Clearing and Grubbing of ditch and re-establish proper grade.
4. 6928 Apache St—Re-establish proper grade (de-silt). Replace culverts (i.e. undersized, collapsed) not set to proper flow line.
5. Northwood Manor Sec 6 (11111 Tamworth Dr)—Upsize existing 18-inch leads to 24-inch, and replace B inlets with BB inlets. (Partially in floodplain)
6. Northwood Manor Sec 2 (6400 Hartwick & 11318 Spottswood)—Recommend H&H analysis to determine proposed improvements within the neighborhood
7. 11022 White Thorn—Re-establish proper grade (de-silt) of the ditch. Replace culverts (i.e. undersized, collapsed) not set to proper flow line.

Councilmen Robert Gallegos' Priority SWAT Projects in Northeast Houston

1. 503 Donnacorey Street – Remove existing outfall and replace with 66-inch corrugate metal pipe.
2. 701 Coolwood Dr. (H126-00-00) – Clearing and grubbing of ditch and re-establish proper grade.

In addition to these projects the City also applied for funding from the Texas GLO Community Development Block Grant Mitigation Program (CDBG-MIT) for three projects in Northeast Houston in 2020. The City did not receive the funds requested but stated before the selection occurred that, "Houston Public Works will continue the project development process with local funds. Local funds are committed in the City's Capital Improvement Plan for the next 5 years so the schedule for design and construction will be longer," (Houston Public Works, n.d.). The first of these proposed projects includes a storm line improvement and detention basin located in Pleasantville and Harbor Street Lily Pad; details for this project can be seen in Figure A9 which is a slide from Houston Public Works

(HPW) Public Meeting Presentation on the CDBG-MIT Proposed projects. Another project located in Fifth Ward focuses on improvements to the drainage trunk system as shown in Figure A10. Lastly, a project located in Kashmere Gardens includes new storm lines and detention basins as shown in Figure A11 (Crocker, 2020). These projects address key areas of flooding found in the community survey and should move forward as soon as possible.

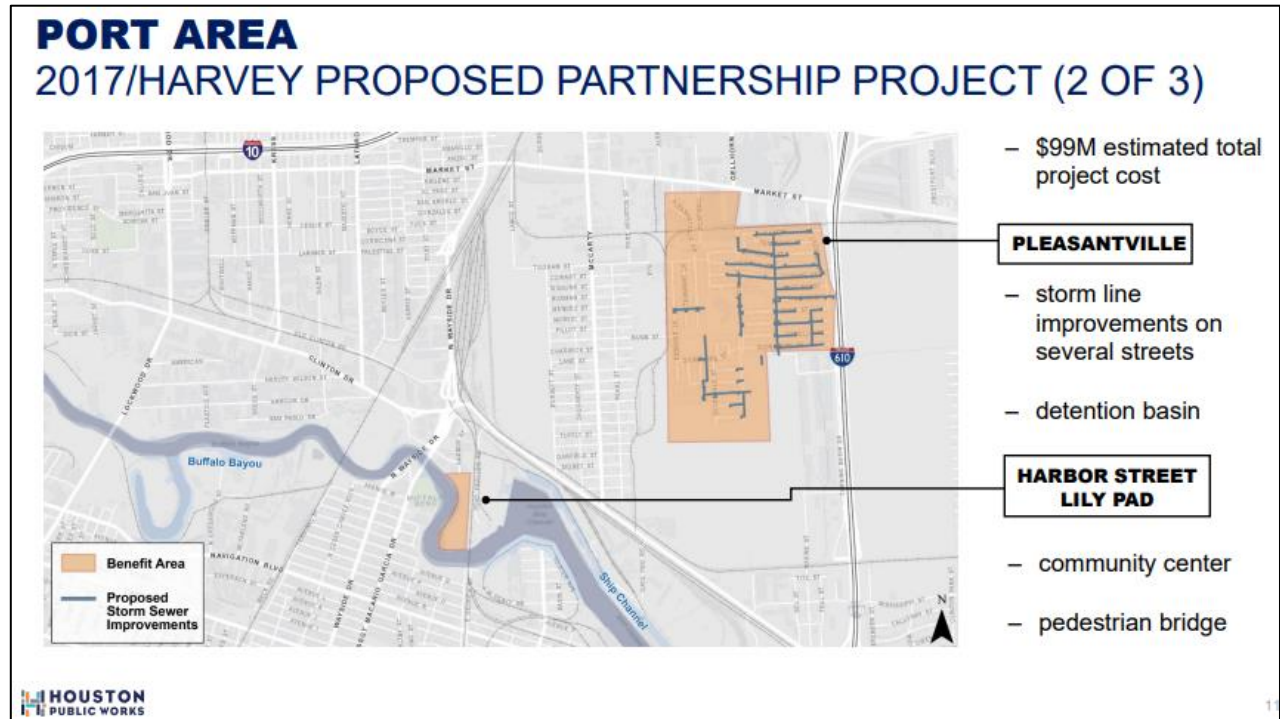
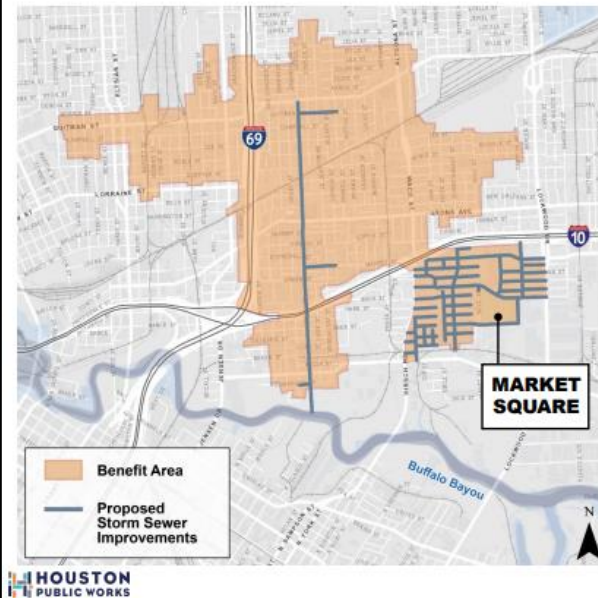


Figure A9. Slide on proposed Port Area project from HPW public meeting presentation on the City's application for CBGD-MIT funds from Texas GLO (Crocker, 2020, p. 11).

FIFTH WARD AREA 2017/HARVEY PROJECT

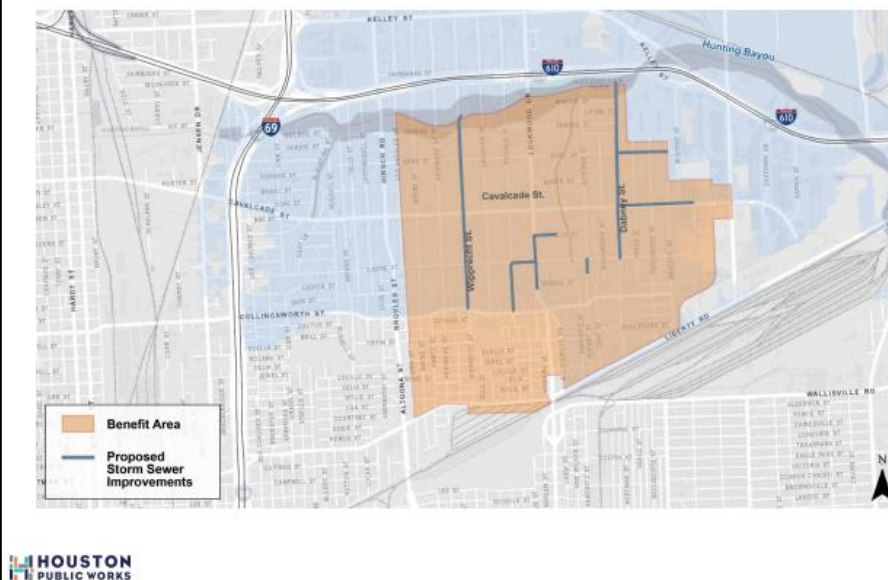


- \$115M estimated project cost
- 1.5-mile drainage trunk system on Gregg Street from Liberty to Buffalo Bayou
- Upgraded trunk system on Buck Street, Schweikhardt Street and Coke Street
- New 3 x 108-inch trunk system to Japhet Creek

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Figure A10. Slide on proposed Fifth Ward Area project from HPW public meeting presentation on the City's application for CBGD-MIT funds from Texas GLO (Crocker, 2020, p. 13).

KASHMERE GARDENS AREA 2017/HARVEY PROJECT



- \$94.8M estimated project cost
- new storm lines on several streets
- detention basins with pedestrian trails & amenities

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Figure A11. Slide on proposed Kashmere Gardens Area project from HPW public meeting presentation on the City's application for CBGD-MIT funds from Texas GLO (Crocker, 2020, p. 14).

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A Proposal for Equitable Flooding Solutions in Northeast Houston

Members of the Northeast Houston Super Neighborhoods United have organized to seek solutions for persistent flooding issues which afflict the Northeast neighborhoods. They have solicited the assistance of Bayou City Initiative and Sustainable Planning and Design, LLC to examine the root of these issues and possible solutions. This report summarizes our research on the causes of persistent flooding issues in Northeast Houston and potential solutions. We hope that collecting the information in this report helps community members and officials solve the equity crisis of flooding in Northeast Houston.

Why must we act now?

"Flooding in Northeast Houston must be solved because of the consistent chance of more flooding each year. This is a place of home for 200,000 residents and no one should be forced out of their home because of lack of responsibility by our city and county flood mitigation agencies."

—Ivory Mayhorn, President of Super Neighborhood 47 (East Little York/Homestead)

"There are several neighborhoods in this area that are hit time and time again. We are a working-class neighborhood and cannot afford to continue to rebuild every year. This is a serious problem that must be addressed."

—Sonia López, Resident of Super Neighborhood 46 (Eastex/Jensen)

"The flooding issue in Northeast Houston is an equity issue because we can trace a disproportionate amount of this flooding to the lack of infrastructure maintenance and the lack of real aggressive projects to address the changing landscape to meet the expanding needs. This speaks further to the fact that this community has been ignored for generations."

—Huey German Wilson, President of Super Neighborhood 48 (Houston/Trinity Gardens)

"We deserve to live in a healthy, safe, and dry neighborhood."

—Genette Smith, Resident of Super Neighborhood 47 (East Little York/Homestead)

"Communities that did not have a history of flooding, now regularly flood due to combinations of freeway proximity, inadequate storm sewer drainage infrastructure, watershed neglect and the impacts of climate change. As long as allocation of funds for mitigation are based on wealth or cost/benefit analysis, underfunded/underserved communities will continue to be victims of disasters."

—Bridgette Murray, President of Super Neighborhood 57 (Pleasantville)

