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An Examination of Severe Environmental Justice Zones in Houston, Texas

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16. Abstract

Declining federal subsidies are limiting transportation capacity at the regional and local levels. At the same time, federally funded agencies must comply with Executive Order (EO) 12898, which augments Title VI of the Civil Rights Act of 1964. The EO states that agencies are to identify burdens and benefits to vulnerable populations. Prior to the 2010, demographic and socioeconomic data collected from the decennial census, the American Community Survey (ACS) and the United States Department of Health and Human Services were used to classify environmental justice zones. In the 2010 decennial census, the U.S. Census Bureau eliminated the long-form, which reduced the data available to perform adequate environmental justice analyses. Currently, metropolitan planning organizations (MPOs) use the ACS which provides limited data. MPOs must now develop innovative strategies to determine environmental justice zones. In previous work, a methodology for identifying EJZs in the Houston TMA was created for the MPO. This methodology analyzed the level of transportation investment in severe census tracts. The methodology included a three-tier process. First, the EJZs and non-EJZs were identified based on the distribution of variables throughout the census tracts. Of the 1,066 tracts within the Houston transportation management area (TMA), there was usable data for 1,062 tracts. About 356 (34%) were classified as EJ Zones. Among EJ tracts, 209 (20%) were low EJ, 107 (10%) were medium EJ, 32 (3%) were high EJ, and 8 (1%) were extreme EJ tracts. For purposes of this study, only these eight extreme EJ zones are discussed in more detail. The second tier analysis developed community profiles for these extreme EJZs. In the third tier, transportation mobility accessibility options were described for the extreme EJZs, including an automobile versus public transit comparison. The study found that one of the EJ areas had the best travel times and good access to transit and light rail. This was primarily due to its close proximity to the CBD. Study areas located the farthest from the CBD reported higher car ownership.

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An Examination of Severe Environmental Justice Zones: A Houston, Texas Case Study

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EXECUTIVE SUMMARY

Studying the Houston-Galveston Transportation Management Area (TMA), revealed that of the 1062 census tracts, about 356 (34%) tracts were classified as EJ Zones. Among EJ tracts, 209 (20%) were low EJ, 107 (10%) were medium EJ, 32 (3%) were high EJ, and 8 (1%) were extreme EJ tracts. The research team was interested in learning what made eight of the EJ zones fall into the severe category. This study offered an in-depth analysis of these eight most severe environmental justice zones.

The research team developed community profiles for the eight tracts. Data collected included demographic and socioeconomic characteristics, transportation mobility accessibility, and travel times to three select activity centers: the Central Business District (CBD), Texas Medical Center (TMC), and Galleria. In general, as the study areas moved away from the CBD, car ownership increased, with Greenspoint reporting the lowest percentage of households without vehicles. Nonetheless, most study areas had good access to public transportation; however Third Ward had the most access to transit and light rail (LRT). The Third Ward EJ zone is also the closest to the CBD. In most cases, residents in these severe EJ zones could travel to various areas of the city. Travel times to major activity centers varied from one hour to 30 minutes based on proximity. As expected, transit trips proved double to triple the amount of time when compared to the same trip made by automobile. With the exception of Third Ward, the study areas did not have immediate access to LRT.

Further analysis is needed to determine what the implications are for female headed households, persons without access to automobiles, and senior headed households. Additional study should examine the relationship between commute times and percent of money spent on transportation for severe EJ zones.

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1 INTRODUCTION

1.1 Background

Declining revenues from the federal Highway Trust Fund (HTF) limits transportation decisions at the regional and local levels (Eno Center of Transportation, 2012). At the same time, government entities and transit agencies are challenged with the moral value of providing equitable distribution of transportation resources. During the 1960s, advocacy groups actively campaigned for equal rights, contributing to the passing of Title VI of the Civil Rights Act of 1964. This Act prohibits discrimination on the basis of race, color, or national origin under any activity receiving federal funds (Wang, Lu, & Reddy, 2013), and commenced the process of agencies applying for federal funds for transportation projects to consider the minority populations (Yang, 2002). In 1994, President William J. Clinton issued Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Population. The Order augments Title VI, and extends federal environmental and nondiscriminatory protections to low-income populations. Agencies requesting federal funds are to identify and address the effects of all programs, policies, and activities on the protected populations, and to incorporate these groups into the transportation planning process (Ward, 2005). The two legislations set the framework for promoting equitable transportation systems, fair distribution of investments (Flyvbjerg, Skamris, K, & Buhl, 2005).

In terms of regional transportation planning and related regional transportation investments, metropolitan planning organizations (MPO), serve as the policymaking body for regional transportation investments. The MPO provides oversight in regards to how these investments impact the protected populations. Prior to the 2010 U.S. Census, demographic and socioeconomic data were collected from the Census Bureau, including the American Community Survey (ACS) and the U.S. Department of Health and Human Services; these data helped MPOs to determine and categorize environmental justice zones. In 2010, the U.S. Census Bureau eliminated the long-form, reducing the needed decennial data to perform adequate environmental justice analyses. Nonetheless limited data are available from the ACS. This change in data collection means that MPOs needed to develop innovative strategies to determine environmental justice zones.

A preceding study conducted by the Center for Transportation Training and Research at Texas Southern University developed a methodology for identifying environmental justice zones, and analyzed regional transportation investments in the Houston-Galveston Transportation Management Area (TMA). Three major steps were taken to identify the environmental justice communities, and conducting an analysis of the transportation investments. Based on a national comparative analysis, five variables were identified to add to the two federal mandated variables. The additional variables included the aging population, persons 25 years and older with no high school education, households with no automobiles available, female-headed households, and persons who speak English as a second language. The study identified 356 of the 1,062 census tracts as environmental justice zones. Among EJZs, eight were classified as severe tracts, implying that these tracts consist of high concentrations of vulnerable populations.

1.2 Severe Environmental Justice Zones Analysis

In this study, an in-depth analysis of the eight severe environmental justice zones was conducted. The purpose of this research is to better understand Houston's most severe environmental justice zones. Community profiles were developed depicting the demographic and socioeconomic characteristics, transportation mobility accessibility, and travel times to select activity centers. This study can serve as a guide to regional policy makers and planners for identifying the vulnerable populations, assessing transportation accessibility, and most importantly the level of investments.

2 LITERATURE REVIEW

This section presents previous research that describes the importance of conducting environmental justice analyses. The first section offers a history of key legislation and policies that set the framework for environmental justice. The discussion then focuses on the Title VI/ Environmental Justice in the transportation planning process. The literature review section ends with discussing historical methods to classify environmental justice zones.

2.1 The Federal Government's Role in Developing Transportation Policies

The principles of environmental justice originate from the Equal Protection Clause of the Fourteenth Amendment, granting civil rights to all American citizens (Frank, 1950). Bullard and Johnson (1987) argue that the 1955 Montgomery bus boycott ignited the modern civil rights movement. While the primary goal was to fight for equal rights as granted by the constitution, advocacy groups campaigned to guarantee equitable transportation systems. In 1964, Congress passed Title VI of the Civil Rights Act, prohibiting discrimination on the basis of race, color, or national origin under any activity receiving federal funds (Wang, Lu, & Reddy, 2013). In regards to the transportation industry, projects cannot disproportionately affect minority populations. The National Environmental Policy Act (NEPA) of 1969 requires federal agencies to take a "systematic, inter-disciplinary approach" to planning and decision-making when the results may have an impact on the environment (Sanchez, Stolz, & Jacinta, 2003). Steinberg (2000) argues that unlike Title VI, NEPA is a procedural statute that requires the evaluation and consideration of alternatives to assure decision makers make better decisions. There are no requirements to choose the best alternative, which can impose adverse impacts on persons of color.

In 1970, the Federal-Aid Highway Act was passed, requiring states and metropolitan planning organizations (MPOs) to develop long-range plans that consider the "overall social, economic, energy, and environmental effects of transportation decisions" (Cairns, Greig, & Wachs, 2003). The Act specifies that federal money may not fund programs or activities that result in the intentional or unintentional unequal treatment of persons solely based on their race, color, religion, sex, or national origin. Almost 30 years passed before additional legislation was passed to promote equality in transportation investments. In 1994, then-President Clinton issued Executive Order (EO) 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which extends federal environmental and nondiscriminatory protections to low-income people. The EO requires agencies to identify and address disproportionately high and adverse human health or environmental impacts (Clinton, 1994). The Federal Interagency Working Group on Environmental Justice was established to guide, support and enhances federal environmental justice and community-based activities (Cairns, Greig, & Wachs, 2003). The Group classified environmental justice communities as minority populations and low-income populations. Minority groups are identified as African-American, Asian, American Indian and Alaskan Native, Native Hawaiian or other Pacific Islander, and Hispanics. Low-income populations are defined as a person whose household income is at or below the U.S. Department of Health and Human Services poverty level.

In 1997, the Department of Transportation issued the final Environmental Justice Order, directing agencies on strategies to incorporate environmental justice practices into their transportation planning activities (U.S. Envrionmental Protection Agency, 2013). In 1999, the

Federal Highway Administration and the Federal Transit Administration issued a joint memorandum titled "Implementing Title VI Requirements in Metropolitan and Statewide Planning." The federal government mandates that regional planning organizations must comply with Title VI. Consequences for non-compliance will result in withholding federal funds. These federal agencies provided procedures for assuring that states and metropolitan planning organizations complied with Title VI requirements. The guidance requires agencies to complete the following actions:

- Develop demographic profile of the metropolitan planning area that identifies the locations of socio-economic groups.
- Identify the transportation needs of low-income and minority populations.
- Assess the regional benefits and burdens of transportation system investments in the Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) for different socio-economic groups.
- Conduct a public involvement strategy for engaging minority and low-income populations in transportation decision-making.

In 2002, the National Cooperative Highway Research Program published the Technical Methods to Support Analysis of Environmental Justice Issues, outlining methods for state and MPO agencies to perform environmental justice analysis (U.S. Envrionmental Protection Agency, 2013). In 2012, the Interagency Working Group on Environmental Justice revised the US DOT's 1995 Environmental Justice Strategy. The updated report, the 2011 Implementation Report, identified key areas to focus, including public outreach and harmonization across the modes, in particular during the planning and NEPA process. The report provides updated guidance to the eight agencies under the DOT. This memorandum describes revisions for the Federal Highway Administration and Federal Transit Administration.

2.2 Environmental Justice in the Transportation Planning Process

Subsequent to the World War II, cities experienced unprecedented population and employment growth outward from the urban core. Burchell (1998) explains the unplanned, rapid and expansive development of urbanized areas into undeveloped lands beyond the traditional central city as urban sprawl. Researchers proclaim urban sprawl results in environmental, social, spatial, and economic impacts (Johnson, 2001; Nguyen, 2010; Burchell, et al., 1998; and Sanchez, Stolz, & Jacinta, 2003). Providing balanced transportation options is one strategy agencies employ to mitigate the adverse impacts. In addition to passing equity legislation, the federal government approved legislation to expand the transportation network. The Federal-Aid Highway Act of 1944 and 1956 were passed to provide funding for extending and linking the interstate system (U.S. Department of Transportation, 2011). In conjunction, the Federal Housing Administration (FHA) introduced low-interest and low down payments loans (U.S. Department of Housing and Urban Development, 2013). These two policies contributed to rapid suburban development, and promoted disinvestment in the inner city which is predominately minority and low-income communities.

Bullard and Johnson (1987) argue that as regions sprawled, transportation investments were focused in the more affluent suburban communities, neglecting predominantly minority and low-income communities. Sanchez (2003) further argues there were disparities in transportation

investments. The majority of investment focused on funding highway projects connecting the central city with sprawling suburban cities. Minorities and low-income populations, who are traditionally located in the inner city and are more susceptible to no automobile accessibility, must rely on public transportation services. During the 1970's and 1980's, many transit providers focused on aggressively extending their networks. Transit agencies focused on incorporating commuter rail, heavy rail, and light rail into their services. These technologies were used to provide more transportation services to connect the inner city and suburban communities, alleviating adverse impacts emerged during the latter half of the century (Kawabata & Shen, 2007). For the inner city minority and low-income communities, bus was the primary type of transportation.

Today, the US is in the aftermath of the 2008 recession; sales tax revenues are down which is the major contributor into the Highway Trust Fund. This results in reduced available funding for transportation investments. Agencies are still obligated to comply with moral values of providing equitable distribution of transportation services to identified minority and low-income communities (Wang, Lu, & Reddy, 2013).

2.3 Historical Environmental Justice Analysis Methods

Federal policy mandates that funded agencies comply with Title VI/Environmental Justice guidelines. Cairns, Greig, and Wachs (2003) argue there is flexibility to implement activities and programs to identify the protection populations. Forkenbrock and Sheeley (2004) claim the primary objective of incorporating environmental justice practices into the transportation process is to assess the benefits and burdens to protection populations. The term environmental justice is broad, and in addition to lower-level governmental agencies allowed to develop techniques as resulted in true transportation equity. To accurately assess protected populations, transportation agencies need a deep understanding of their communities.

Although the FHWA (2013) suggests a unit of analysis at the census tract level or traffic analysis zone (TAZ), various studies expanded upon this traditional methodology. Wang, Lu, and Reddy (2013) reiterated the methodology by conducting an analysis of New York City's transit service change impacts at the census tract level. In contrast, Forkenbrock and Schweitzer (1999) argue that the unit of analysis should be at the census block level. Traditionally protected population includes minority and low-income populations. In recent years, agencies began collecting data on age, disability, gender, religion, class, limited English proficiency, and national origin (Forkenbrock & Sheeley, 2004). The researchers further argue that a key consideration in environmental justice analyses related to potential transportation projects is how vulnerable populations move about in time and space. Because few people spend the majority of their time at home, it often is not sufficient to determine only where minority and low-income populations live; it also is important to ascertain prevalent daily activity spaces.

To analyze large area census data, Forkenbrock and Sheeley (2004) recommend a threshold analysis. This analysis is good because it can be observed at the census tract level, and then the data can be compared to the region to evaluate transportation equity. Limitations should be recognized from this method. The Census generally undercounts protected populations, in particular because low-income persons are known to move frequently. This adds complexity to

the process of adequately identifying vulnerable populations, and determining if equitable transportation services are provided to the community.

3 DESIGN OF STUDY

This research employs a quantitative approach to analyze the eight severe environmental justice zones (EJZs) within the Houston-Galveston Transportation Management Area (TMA). The goal of this explorative study is to better understand Houston's most severely impoverished neighborhoods. A one-fourth mile buffer from the centroid of the severe zone was calculated, and community profiles were developed for the zone. The community profiles served two purposes, 1) depict the demographic and socioeconomic characteristics of the tracts, and 2) identify the transportation mobility access.

3.1 Severe Environmental Justice Zones Methodology

Microsoft Excel and Geographic Information Systems (GIS) were used to build the model and display the results, respectively. Data were taken from the 2010 American Community Survey (ACS) 5-Year Estimates. Minority population, low- income population and persons 65 years and older data were extracted from the total population tables. For the remaining variables, the data were obtained as follows:

- Persons 25 years and older with no high school degree (or equivalent), extracted from the educational attainment table. The cumulative percentages of two columns were extracted to determine the percentage, 1) persons with less than a 9th grade education, and 2) persons with a 9th to 12th grade education, with no high school diploma.
- Zero automobile ownership, extracted from the tenure by vehicle available table. The cumulative number of households with 1) owner occupied, no vehicles, and 2) renter occupied, no vehicles.
- Female headed households, extracted from the households and families table. Extracted from household and families, female householder, no husband present.
- Language proficiency, place of birth by language spoken at home and ability to speak English in the United States. Cumulative of two columns, 1) Speak Spanish: Speak English less than "very well," and 2) Speak other languages: Speak English less than "very well."

The formula below, which was modeled from the Atlanta Regional Commission (ARC), was used to determine the number of EJ zones. Raw data were downloaded from the ACS tables and uploaded to Microsoft Excel. The distribution of each variable within each census tract was calculated. Variables collected from the population tables were distributed by the total population for the respective census tract. Variables collected from household tables were distributed by the number of households for the respective census tract. Minority demographic data was collected for the five primary ethnic groups to include, African-American, Native American, Asian, Hawaiian, and Hispanic, non-White. To determine the distribution of each minority group within the zone, the total number of the ethnicity divided by total population. The formula is where,

Each Minority Group Population Zone Distribution = [∑(Each Minority Group Pop)/∑(Pop)]*100

The socioeconomic characteristics were then identified for each of the zones. The distribution of the following variables were determined, low-income population, the population 65 years and older, the population 25 years and older with no high school education, the number of households with no automobiles available, female-headed households, and the number of persons who speak English as a Second Language. The formulas for determining these socioeconomic characteristics where,

- Low-Income Population Distribution, where

LiPop = total population within the census tract that is under the poverty line
Pop = total population for the census tract

$$\textbf{LiPop Zone Distribution} = [\sum(\text{LiPop}) / \sum(\text{Pop})] * 100$$

- Senior Population Distribution, where

SP = total population 65 years and older within the census tract
Pop = total population for the census tract

$$\textbf{SP Zone Distribution} = [\sum(\text{SPPop}) / \sum(\text{Pop})] * 100$$

- Educational Attainment Population Distribution, where

EA = total population within the census tract that is 25 years old with no high school degree
Pop = total population within the census tract

$$\textbf{EA Zone Distribution} = [\sum(\text{EAPop}) / \sum(\text{Pop})] * 100$$

- Zero Automobile Ownership Households Distribution, where

ZAO = number of households with no automobile available within the census tract
HH = number of households within the census tract

$$\textbf{ZAO Zone Distribution} = [\sum(\text{ZAOH}) / \sum(\text{HH})] * 100$$

- Female Head of Households Distribution, where

FHH = number of female head of households within the census tract
HH = number of households within the census tract

$$\textbf{FHH Zone Distribution} = [\sum(\text{FHH}) / \sum(\text{HH})] * 100$$

- Non-English Speaking Population Distribution, where

NES = number of foreign persons who speak English as a second language
Pop = total population within the census tract

NES Population Zone Distribution = [∑(NESPop) /∑(HH)]* 100

After all data were compiled, the research team classified the 1,062 census tracts in the Houston-Galveston Transportation Management Area (TMA). About 356 (34%) were classified as EJ Zones. Among EJ tracts, 209 (20%) were low EJ, 107 (10%) were medium EJ, 32 (3%) were high EJ, and 8 (1%) were extreme EJ tracts. For purposes of this study, only these eight extreme EJ zones are discussed in more detail.

3.2 Transportation Mobility Access Methodology

In GIS, a one-mile buffer was applied to the severe EJZs, and transportation mobility accessibility data were collected. Calthorpe (1995) suggest persons are willingly to walk approximately 1/4 mile from their trip origin or destination for transportation. For this study, transportation access within a 1/4-mile radius of the extreme tract was identified using the following items:

- *Roadways.* The number of roadways included highways, major thoroughfares, and collector roads were collected.
- *Transit.* The number of light rail transit (LRT) lines and bus routes that traveled within the capture area. Determined if LRT traveled through an extreme EJZ area, and if there was a stop within a 1/4 mile radius of the zone. For the purpose of this research, data was collected for the number of local bus routes that travel through the EJZ. Local bus routes were identified as routes 1 through 99 by Houston METRO. In cases where express, signature, and park and ride routes traveled through the EJZ, it was determined if the route stopped or if there was a transit center or park and ride lot within the buffer area.

3.3 Travel Time Methodology

A travel time comparison was conducted to determine the difference in public transit and automobile to three activity centers. While Pan (2009) identifies 24 employment centers within the Houston TMA, this research uses the top three centers: (1) central business district (CBD), (2) Texas Medical Center (TMC), and (3) Galleria Uptown. These three activity centers were chosen because there is significant employment, medical, shopping, schools, and entertainment within the district. The public transit travel times were calculated utilizing METRO's trip planner application calculate trip time duration between the intersection nearest to the centroid of extreme EJZ in question to the centroid intersection of each activity center. The automobile travel times were calculated using the same method in Google maps, applying the shortest travel time.

4 RESULTS

The eight extreme zones are Greenspoint, Gulfton, Westwood, Westbury, Third Ward, Sunnyside, and Galveston. Among the eight zones, Gulfton was the only community comprised of two zones. Seven of the EJZs are located within Houston, Texas, and one is located in Galveston, Texas. Of the zones that are located in Houston, one zone (Third Ward) is located within the urban core, and the other six are dispersed throughout the city, but within Beltway 8.

Demographic, environmental justice, and transportation characteristics varied across the zones. Table 1 shows that Hispanics and African-Americans make up the lion share of the population in five and three zones, respectively. The predominately Hispanic communities are located on the north side and west side of town, while the three predominately African-American communities are on located on the south side of the region. The largest Asian populations exist in Gulfton, Westwood, and Westbury, which are all less than 10% of the tract's total population. The American Indian and Hawaiian populations are non-existent in the severe EJ zones.

The environmental justice variables varied in the zones. The low-income populations range from 41 to 67%. Westbury (13%) and Third Ward (12%) have the highest population 65 years and older. All of the Hispanic zones have low educational attainment. In Greenspoint, 68% of the population 25 years and older has no high school education. Sunnyside's educational attainment level is the lowest at the 18%. In all but one zone, more than 25% of all households did not have an automobile available for use. Greenspoint was the only zone in which only 10% of the households had no automobiles available. Female-headed households ranged from 8% to 48%. In the Gulfton zone, only 8% of the households consisted of female-headed, which was the lowest of the zones. In Galveston, nearly half (48%) of the households are female-headed. In all of the Hispanic communities, more than half spoke English as a second language. Notably, the Galveston zone, which is predominately African-American, about 19% of the population spoke English as a Second Language (ESL).

Table 2 provides information for transit accessibility. The zones located closer to the urban core have the most public transit service. Houston has an extensive bus system, complemented with 7.5 miles of light rail transit (LRT) service. In the near future, LRT will travel through only one zone, Third Ward[1]. The new line will provide direct access to the CBD, and decrease travel times to other trip attractors. There are no short-term plans to invest additional technologies within the other zones. Third Ward has the most, with nine bus routes and 62 bus stops. Galveston only has two routes that travel through the zones. Four of the zones are located adjacent to freeways, while the others are within a one-quarter mile radius of major thoroughfares.

[1] LRT service will start in 2014, traveling through the Third Ward community.

Table 1. Environmental Justice Zones Statistics

Community	Galveston	Greenspoint	Gulfton	Gulfton	Sunnyside	Third Ward	Westbury	Westwood
Demographics	92%	99%	89%	88%	97%	100%	93%	97%
Black	**74%**	13%	11%	1%	**94%**	**86%**	18%	31%
American Indi	**0%**	3%	0%	1%	**0%**	**0%**	0%	
Asian	0%	0%	0%	3%	0%	0%	8%	7%
Hawaiian	0%	0%	0%	0%	0%	0%	0%	0%
Hispanic	18%	**83%**	**78%**	**83%**	2%	14%	**67%**	**59%**
EJ Variables								
Low Income	61%	53%	45%	43%	55%	67%	41%	53%
Senior Pop	8%	3%	1%	1%	8%	**12%**	**13%**	1%
Ed Attain	36%	68%	67%	63%	**18%**	43%	66%	50%
Automobile	54%	**10%**	35%	31%	55%	57%	25%	28%
Female Heade	48%	27%	**8%**	18%	37%	28%	15%	24%
ESL	19%	54%	68%	82%	0%	4%	62%	49%

Table 2. Transportation Accessibility

Community	Galveston	Greenspoint	Gulfton	Gulfton	Sunnyside	Third Ward	Westbury	Westwood
Public Transit								
Bus Routes	2	4	7	6	3	9	3	3
Bus Stops	2	19	38	31	38	62	33	31
LRT Lines	0	0	0	0	0	1	0	0
LRT Stops	0	0	0	0	0	3	0	0
Transit Facilit	0	0	1	1	0	0	0	0
Highway	0	1	1	1	0	1	0	1

Galveston

The Galveston EJZ consists primarily of African-Americans (74%) and a smaller population of Hispanics (18%). The neighborhood has a low income population of 61%, along with 8% of the population being 65 years and older. Over half of households do not own a car, and one-third of adults 25 years old and up are without a high school education. The land use characteristics include mostly single family detached homes, some commercial property, minimal industrial uses, and a number of vacant lots. This census tract is about ¾ of a mile away from the Interstate 45, which has a direct connection to the CBD of Houston. Its location on a small island allows this census tract to be near the local activity centers of the Port of Houston and Galveston's CBD; this area is less than a mile from the tourist activity along the Gulf Coast beaches. See Figure 1. This is the only zone that does not fall within Houston METRO's service area. Island Transit offers service to area residents. One of two local bus routes cuts through the census tract and ends at the campus of Texas A & M – Galveston. This trip takes 12 minutes by Island Transit bus compared to 8 minutes by automobile.

Greenspoint

Hispanics (88%) make up the lion share of the population within the extreme Greenspoint EJZ. More than half the population consists of persons who speak English as a second language (54%) and the population over 25 years old has no high school education (68%). Inhabitants have access to highways and public transit. Interstate 45 is within a 1/4-mile radius, which has direct access to the CBD, and connecting highways will take persons to the TMC and Uptown area. There are four local bus routes, in which one has express freeway service to the CBD. See Figure 2. The express route is a top performing route, and is one of a few routes with comparable automobile travel times between Greenspoint area and the CBD. Two of the routes provide direct access to the CBD via major thoroughfares. The travel time between the two points is approximately one-hour compared to 18 minutes via automobile.

Gulfton

In the two Gulfton census tracts, Hispanics comprise the largest share of the population at 78% and 83%, respectively. These zones also report that 45% and 43% of households are considered low income. Among other areas, these zones have the second (67%) and fourth (63%) highest percentages of persons 25 and under without a high school education. In contrast, Gulton ties with Westwood having the lowest percentage of seniors (1%). The area contains primarily large multi-family apartments and pockets of retail development. A look at transportation reveals that Gulfton residents can quickly access US 59/I-69 and I-610 which connect to the Galleria, CBD, and Texas Medical Center. See Figure 3. In terms of transit, a combined total of 13 METRO bus routes traverse the two Gulfton zones. This combined area is the only study area with a transit facility (Hillcroft Transit Center). Routes 163 and 132 provide express services to the CBD from the Hillcroft Transit Center. The 132 takes riders from the Hillcroft Transit Center to Louisiana Street (downtown) in 14 minutes and or to the end of the line at Congress and La Branch (downtown) in 32 minutes. On the 163, riders leave the Hillcroft Transit Center and arrive at the

Wheeler Rail Station in 15 minutes or at the end of the line (Congress and La Branch) in 29 minutes.

Sunnyside

This census tract consists of 94% African American, with virtually none of the residents speaking English as a second language (0%). Approximately 18% of those 25 years and older do not have a high school education, and female headed-households comprise 37% of most households. Although, there is a significant amount of vacant land, this severe Sunnyside EJZ contains 1 and 2-story apartment buildings and duplexes; the area also includes a small commercial area, a government multi-service center, and a high school. Two major highways (Interstate 610 and State Highway 288) are both about 1 mile from the census tract, with both connecting directly to the Galleria and the CBD. See Figure 4. Among the three local routes that pass through the census tract, two have direct access to the Downtown Transit Center, taking about 46 minutes by bus versus 17 minutes by automobile.

Third Ward

The Third Ward neighborhood is an historic African-American neighborhood. Currently, the neighborhood is undergoing gentrification. This zone contains a mixture of mainly lower income residents and some middle income residents. Located approximately four miles from the CBD, the zone consists primarily of single-family housing, with dispersed vacant properties. There are multiple small institutional and commercial uses dispersed throughout the tract as well. See Figure 5. The zone is bordered by Texas Southern University and the University of Houston. The residents gain access to other parts of the city via two major highways: I-45 and US 288. This extreme EJ tract contains 86% African-American, and 14% Hispanic. Approximately 67% of the persons live below the poverty level. The community represents a prime example of a severe EJ community, with one-quarter of the households headed by females, almost half the population over 25 years old with no high school education, and approximately 60% of the households without automobiles.

Although more than half the households do not own a car, sufficient public transit services are available. Within a 1/4-mile radius, nine bus routes travel through the zone directly connecting residents to the CBD. In total, bus service is provided for 20 hours in this zone. Nonetheless, problems accessing transit are apparent as many sidewalks are cracked and disjointed. Third Ward was the only EJZ where additional transit services are planned. In 2014, the Metropolitan Transit Authority of Harris County, Texas (METRO) will begin operating light rail transit service adjacent to the zone. This will provide direct access to the CBD, and decrease travel times to other points of interest.

Westbury

In the severe Westbury EJZ, the majority (67%) of the residents is Hispanic and a much smaller amount (18%) is African-American. The area has a low income population of 41%. About 13%

of the population are 65 years and older. About two-thirds of adults 25 years and older have no high school education, and one-quarter of households do not own a car. Much of the land use is undeveloped or city parkland that contains lakes as the main feature. The rest of the census tract is a collection of single family homes, a few apartment complexes, two public schools, small commercial parcels, and some moderate industrial properties. U.S. Route 90 Alternate forms the southern border of the Westbury neighborhood; this zone can access the TMC and CBD. The express bus to the CBD takes 65 minutes, versus a 21 minute automobile drive. The two local buses that run within that one-quarter mile zone around the census tract take an average of 45 minutes via bus to the Galleria, instead of the mean of about 12 minutes by car. See Figure 6.

Westwood

Hispanics and African-Americans account for 59% and 31% of the population, respectively in the Westwood EJZ. Approximately half the population speaks English as a second language, and the population over 25 years and old has no high school education. The severe Westwood EJZ is less than one-quarter mile from Interstate 59, providing direct access to the CBD and Uptown Galleria. The zone is served by three bus routes, in which two routes provide direct service to the TMC, and one route connects inhabitants to the LRT. The LRT connects to the CBD and TMC. The routes that serve the TMC are comparable with the automobile travel times. During level of service A, the travel time is approximately 21 minutes. Although the buses utilize major arterials, the average travel time to the TMC is 30 minutes. Adding for parking time, this makes the bus comparable. See Figure 7.

Figure 1. Galveston Severe Environmental Justice Zone

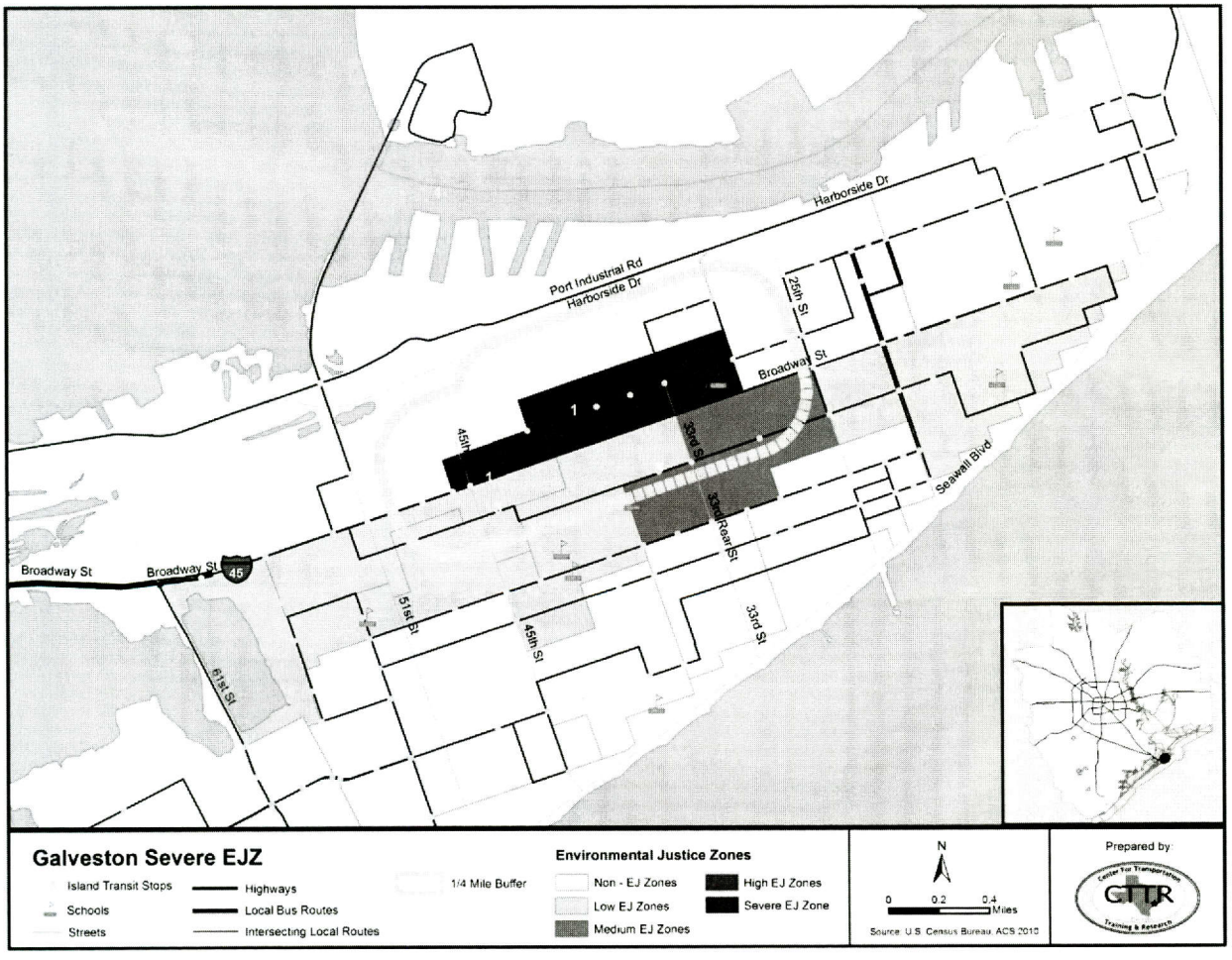


Figure 2. Greenspoint Severe Environmental Justice Zone

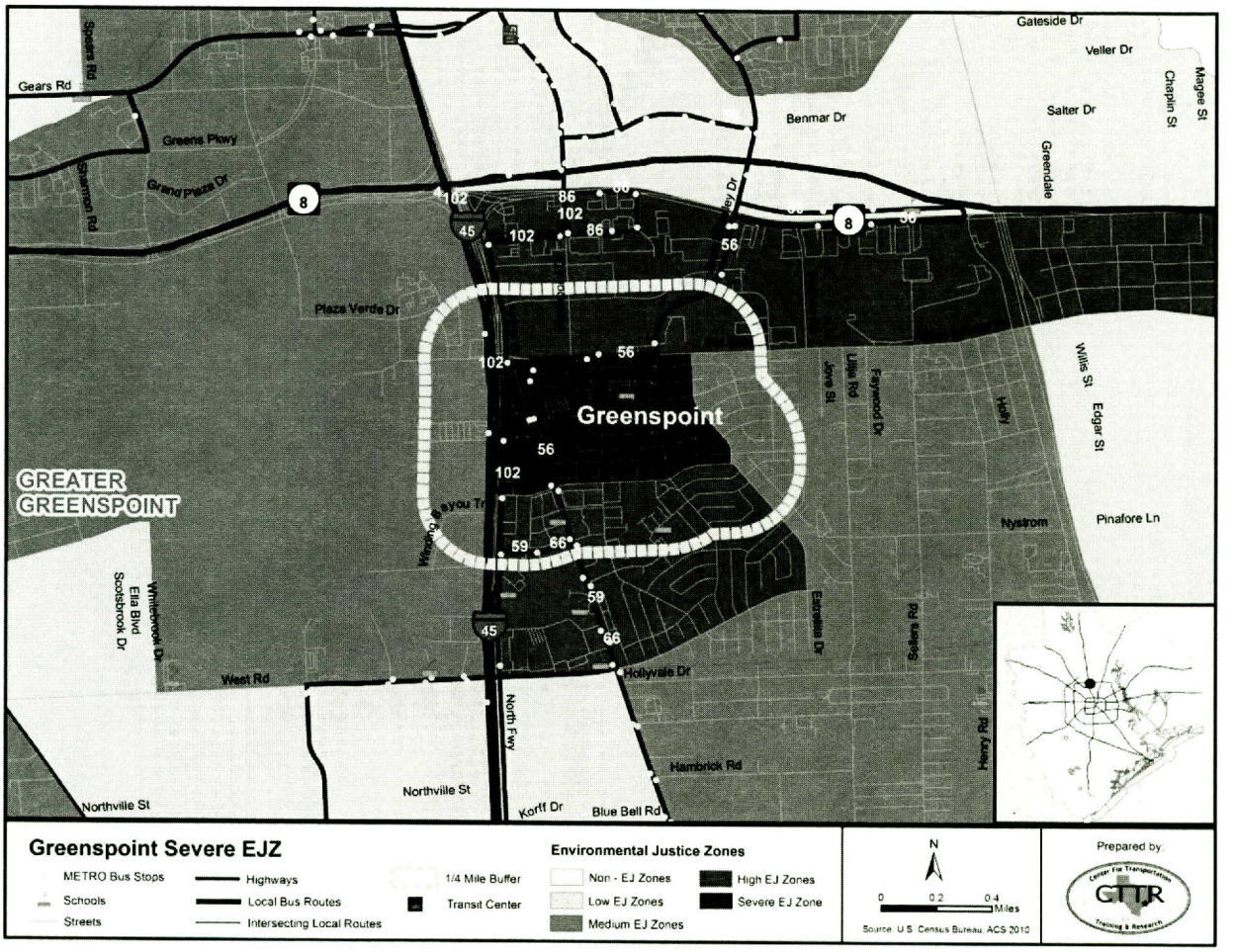


Figure 3. Gulfton Severe Environmental Justice Zones

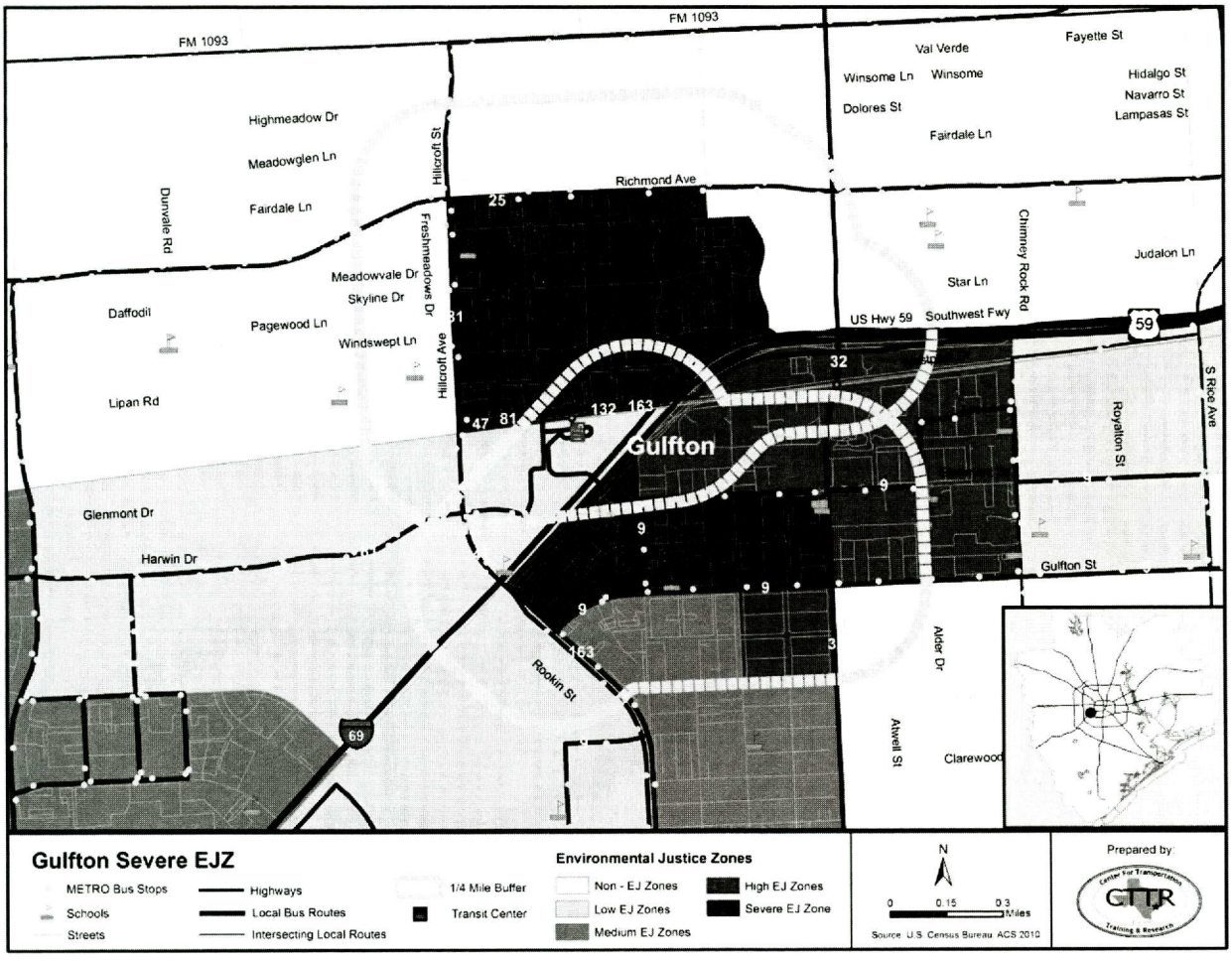


Figure 4. Sunnyside Severe Environmental Justice Zone

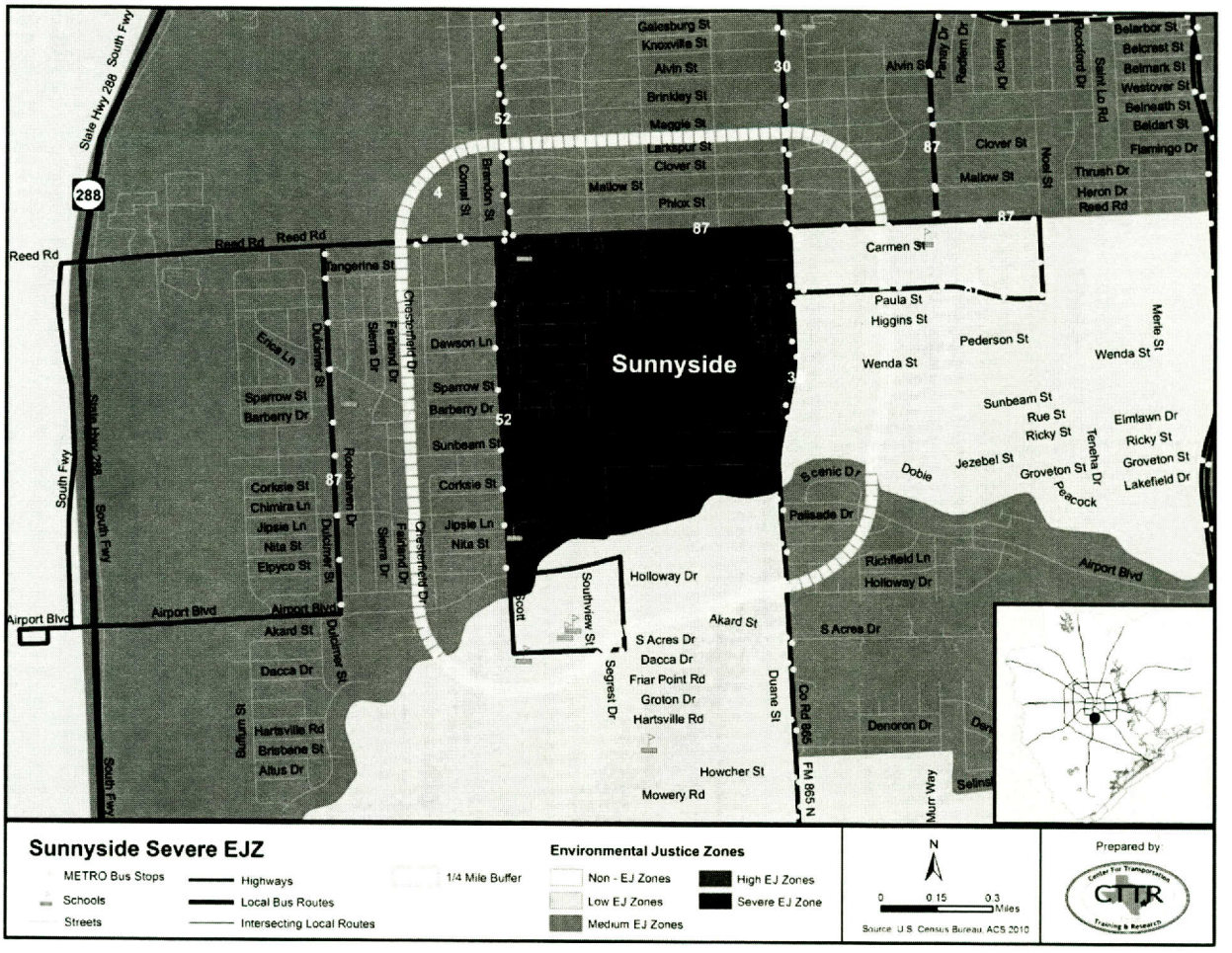


Figure 5. Third Ward Severe Environmental Justice Zone

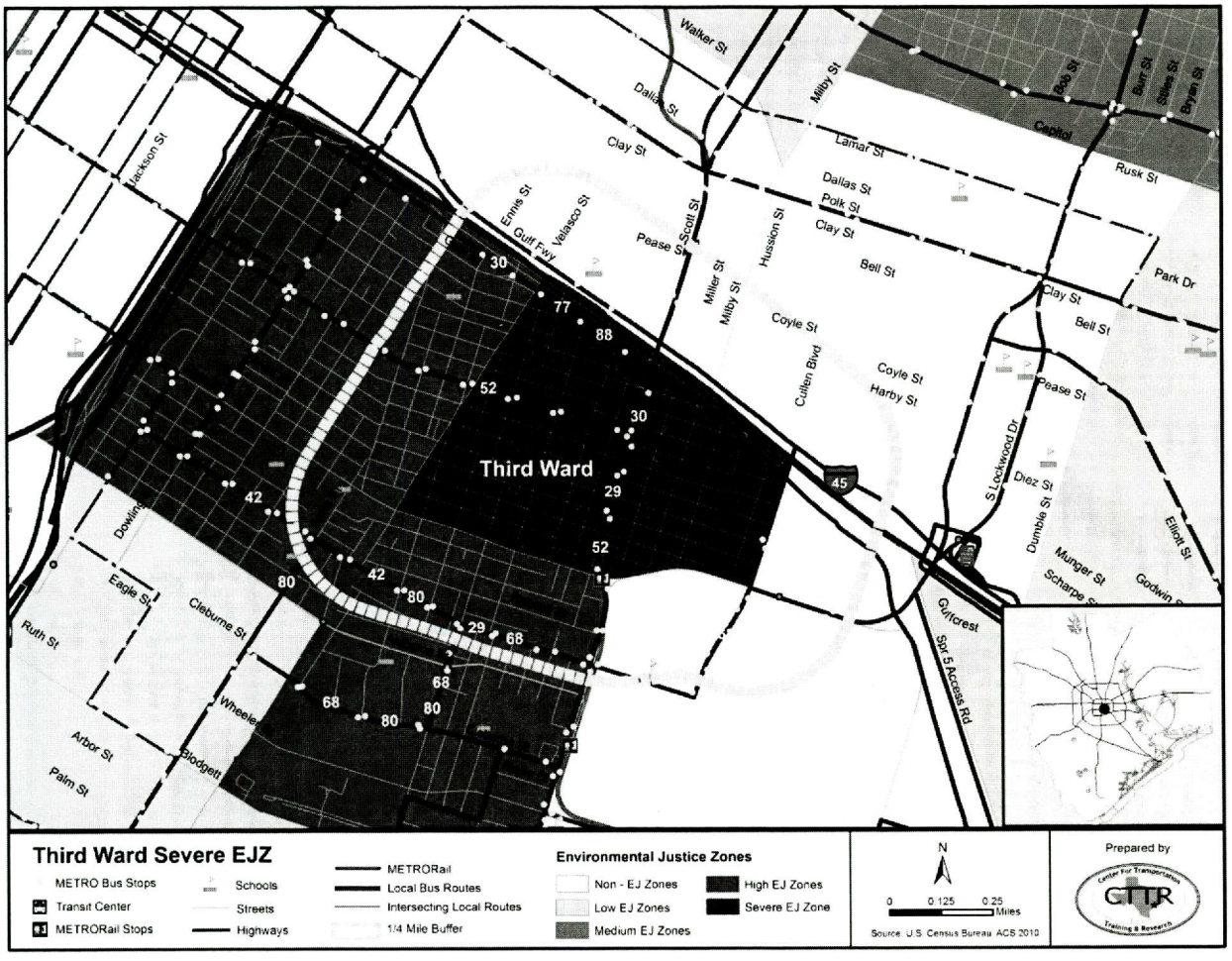


Figure 6. Westbury Severe Environmental Justice Zone

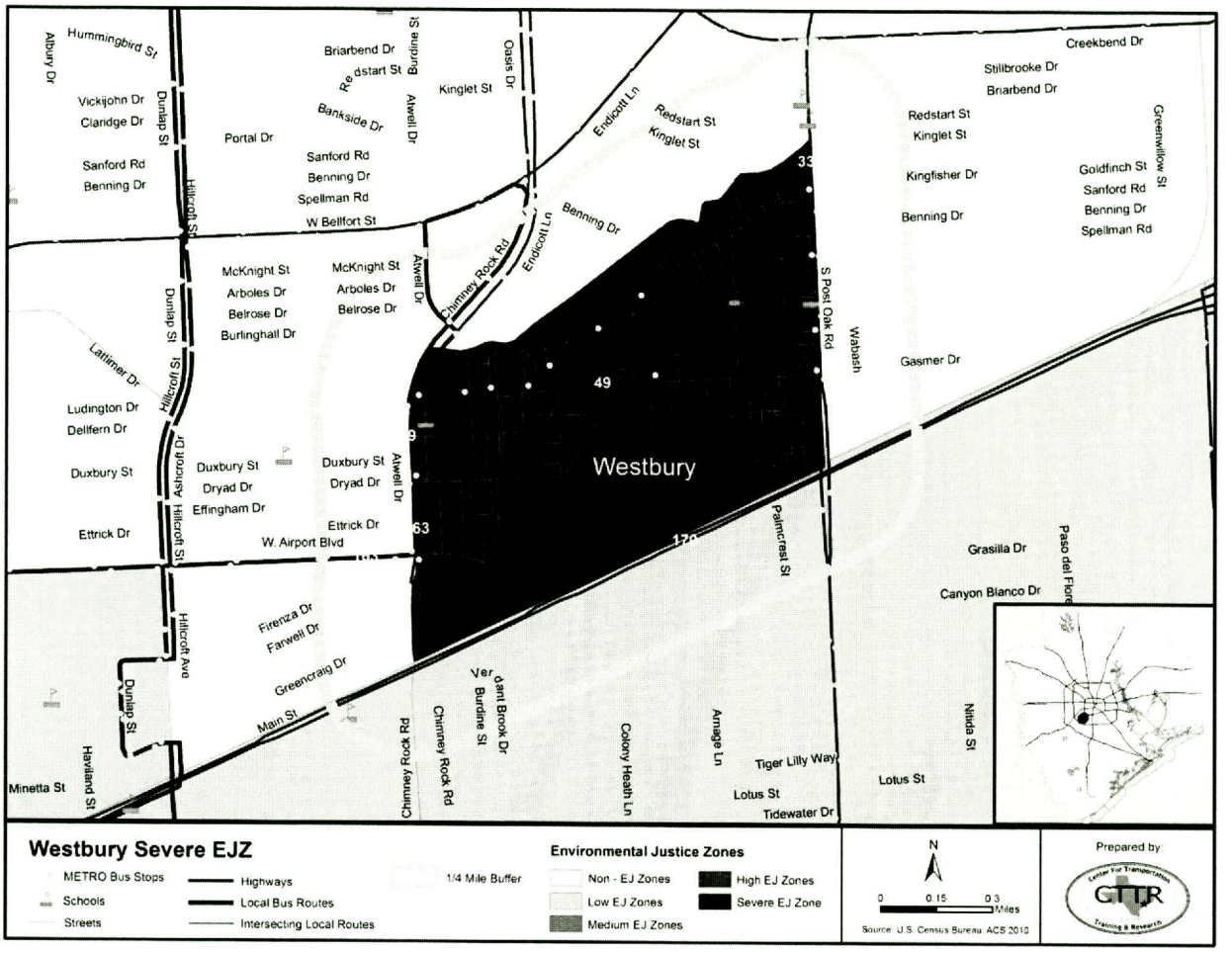
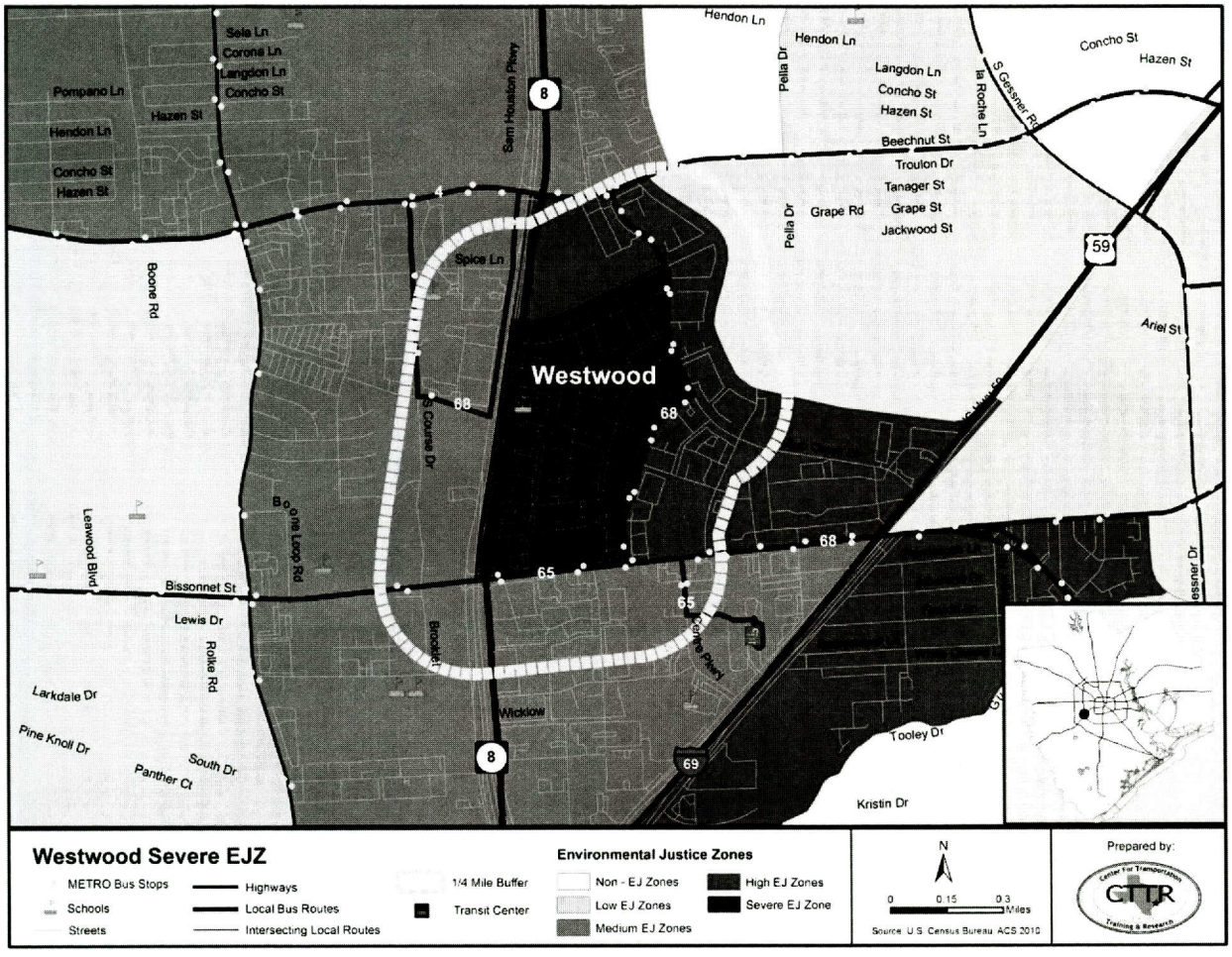


Figure 7. Westwood Severe Environmental Justice Zone



5 CONCLUSION & IMPLICATIONS

This study offered an in-depth analysis of the greater Houston area's eight severest environmental justice zones. For all eight areas, community profiles were developed depicting the demographic and socioeconomic characteristics, transportation mobility accessibility, and travel times to three select activity centers. In general, as the study areas moved away from the CBD, access to automobiles increased, with Greenspoint reporting the lowest percentage of households without vehicles. With this said, most study areas had good access to public transportation; however Third Ward had the most access. In most cases, residents in these severe EJ zones could travel to various areas of the city. Transit travel times to major activity centers varied from one hour to 30 minutes based on proximity. As anticipated these travel times were much higher than travelling by automobile. With the exception of Third Ward, the study areas did not have immediate access to LRT.

Further analysis is needed to determine what the implications are for female headed households, persons without access to automobiles, and senior headed households. Additional study should examine the relationship between commute times and percent of money spent on transportation for severe EJ zones.

Nonetheless, regional and local transportation agencies will continue to make decisions regarding equity. While additional research will help in this decision making process, this study can serve as a guide to regional policy makers and planners for identifying the vulnerable populations and assessing transportation accessibility and equity.

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