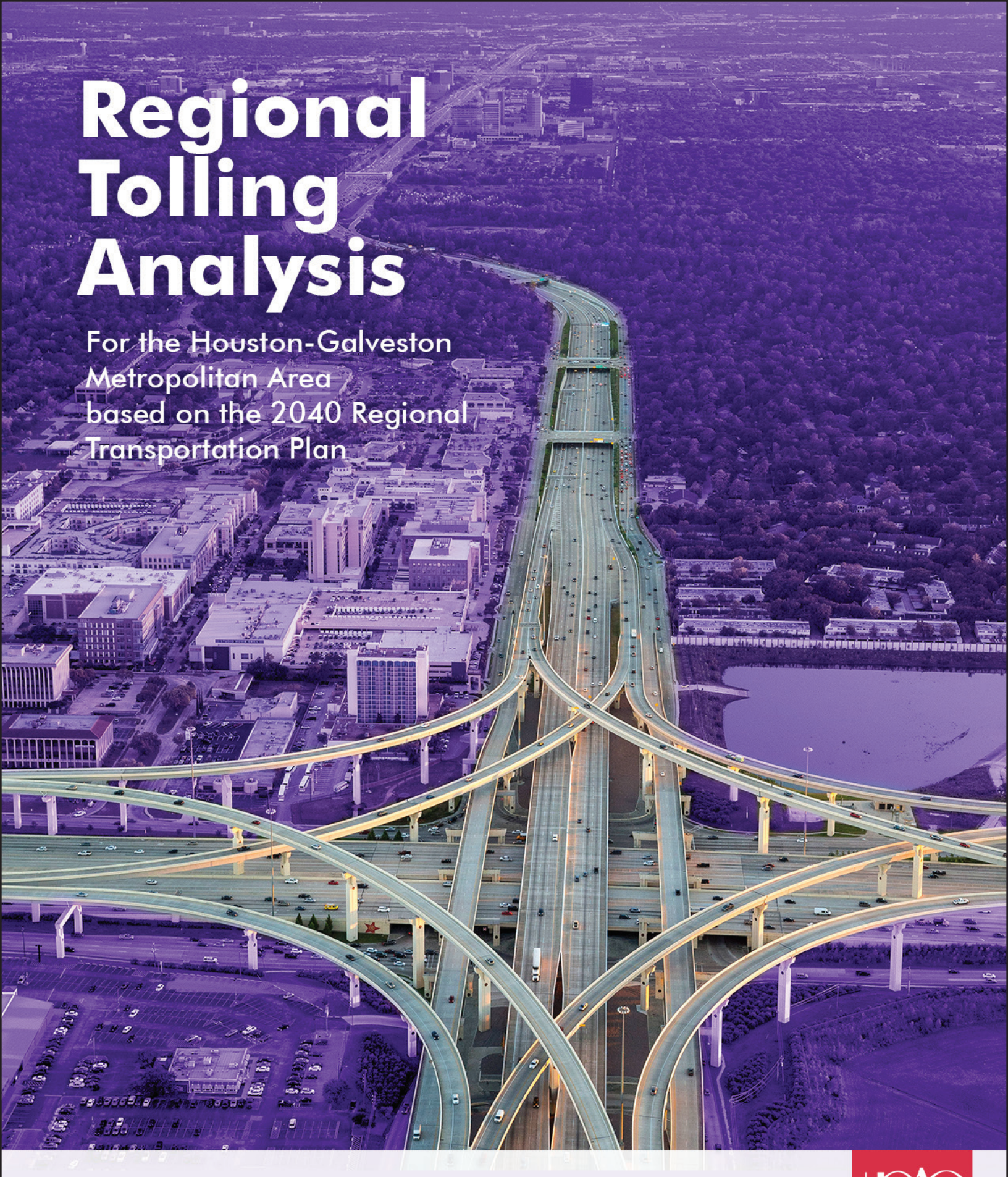
Regional Tolling Analysis

For the Houston-Galveston Metropolitan Area based on the 2040 Regional Transportation Plan



July 2017 – Houston-Galveston Area Council

METROPOLITAN PLANNING ORGANIZATION

REGIONAL TOLLING ANALYSIS

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1.0 INTRODUCTION

The tolling of roadways has become an increasingly favored mechanism for funding the construction, maintenance, and improvement of road facilities as State and Local Government entities explore alternative financing options in the face of budget shortfalls and shrinking transportation revenue streams. Tolling was the hallmark of turnpike developments from as far back as the 18th century, but faded with the growth of the modern public Interstate Highway system which was funded mostly by tax assessments. Beyond its providing an alternative source of revenue for surface transportation projects, the re-emerging interest in road pricing strategies follows the use of tolls as a transportation demand management tool to encourage greater efficiency in the use of the roadways, relieve traffic congestion, increase trip reliability, and help to improve air quality.

Policy guidelines articulated through the recent transportation funding and authorization Acts indicate growing federal interest in the use of tolling strategies to meet the fiscal needs for maintaining the nation's transportation infrastructure.[1] Although federal law prohibits charging tolls on highways constructed with federal funds,[2] Congress has carved out some exceptions that authorize the U.S. Department of Transportation (DOT) to permit tolling in limited circumstances. Current federal participation includes organizing pilot tolling programs and encouraging public-private partnership agreements (P3s) to attract private investment for the construction of transportation facilities.

Despite the perceived benefits of road pricing, the tolling of roads raise equity concerns because of the potential to disproportionately impact members of racial minority communities and individuals with low-incomes - collectively referred to as the Environmental Justice population. Title VI of the Civil Rights Act of 1964, Presidential Executive Order 12898, and the U.S. Department of Transportation (DOT) Order 5610.2(a) require transportation agencies to ensure that their programs, policies, and investment activities do not disproportionately impact environmental justice communities, or deny this protected population the benefits of regional planning efforts. It is the policy at H-GAC to ensure that the needs and opinions of the entire regional community are obtained in the planning process, embracing the fundamental principle that the greater and more inclusive the public engagement, the better and more successful would be the planning outcomes.

The purpose of this document is to examine the effects that an expansion of the network of priced facilities as recommended in the 2040 Regional Transportation Plan would have on the environmental justice population and natural resources within the Houston-Galveston Area Council (H-GAC) planning region.

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[1] See for example the "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)"; "Moving Ahead for Progress in the 21st Century Act (MAP-21); Fixing America's Surface Transportation Act (FAST Act).
[2] 23 U.S. Code § 301.

2.0 WHAT IS ENVIRONMENTAL JUSTICE?

Presidential Executive Order 12898 signed by President Bill Clinton in 1994 introduced environmental justice to the national discourse by directing every federal agency to identify and address the effects of all their programs, policies, and activities on the minority and low-income populations. The requirements of the Executive Order extend broadly to every recipient or beneficiary of Federal financial assistance. Environmental justice operates functionally under the umbrella of the Title VI Program. Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color, or national origin.

Environmental Justice is a fundamental element of the transportation planning process with legal foundations in the equal protection principles of the United States Constitution. The DOT defines environmental justice as:

> "… The fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations and policies…"

"Fair treatment" specifies that no group of people should be made to bear a disproportionate share of negative health or environmental consequences resulting from any Federal, State, Local, or Tribal Government programs just because of their socio-economic dis-empowerment. "Meaningful involvement" on the other hand requires that all people, particularly the disadvantaged and traditionally underserved, are adequately informed and are enabled to participate in transportation project decisions that could affect their environment, health, and quality of life, or that may influence their access to benefits from federally funded development activity.

The protected class for environmental justice review are minority populations and low-income populations. Minority status is defined as persons who are Black, Hispanic, Asian American, American Indian or Native Alaskan, and Native Hawaiian or Pacific Islander. Low-Income status is typically defined by a household income that is at or below the U.S. Department of Health and Human Services (HHS) poverty guidelines. Within the context of an environmental justice analysis, the target community consists of any readily identifiable group of minority persons or low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient person who would be similarly affected by a proposed federal program, policy, or activity.[3]

2.1 ENVIRONMENTAL JUSTICE AND TRANSPORTATION

In 1997, the Department of Transportation issued its *Order to Address Environmental Justice in Minority Populations and Low-Income Populations* - Order 5610.2(a), which distilled environmental justice into three key principles:

a. Avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations;

[3] Federal Highway Administration Order 6640.23A.

b. Ensure full and fair participation by all potentially affected communities in the transportation decision-making process; and
c. Prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

These three principles express the core objectives of environmental justice and describe a process for implementing the vision of EO 12898. In summary, environmental justice requires government agencies to evaluate the community impacts of their planning efforts to ensure that these activities do not result in disproportionate harm to the minority and low-income communities. Environmental justice also requires that the protected population is permitted to contribute their opinions regarding a proposed action, and identify the options and choices they believe would best suit their needs. Environmental Justice considerations must accompany every stage of the transportation project development process.

3.0 TRANSPORTATION PLANNING IN THE GULF COAST REGION

The Houston-Galveston Area Council (H-GAC) serves as the Metropolitan Planning Organization (MPO) for the eight-county Gulf Coast Planning Region which consists of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery and Waller Counties (Map 1). The MPO is a federally funded transportation policy-making organization and is responsible for planning and programming all the transportation investments in the region in a coordinated manner.

Investment priorities utilizing federal transportation funds are defined in the Regional Transportation Plan (RTP) – a comprehensive statement of long and short range actions proposed to be implemented over a 25-year horizon. The RTP identifies goals and strategies anticipated to produce a multi-modal transportation system sufficient to meet the present and projected needs for a safe and efficient movement of people and freight within the region.

The MPO is also responsible for preparing the Transportation Improvement Program (TIP), a listing of multi-modal transportation infrastructure projects and service improvements approved for implementation within a four-year window. TIP projects are drawn from the RTP and are accurately defined and more importantly, fiscally constrained. These projects are recognized as the highest priorities for the region, and are adopted by the Transportation Policy Council (TPC) after a public hearing. Upon adoption, the TIP is incorporated into the Statewide Transportation Program (STIP), which is approved by the Texas Transportation Commission.

3.1. REGIONAL DEMOGRAPHY

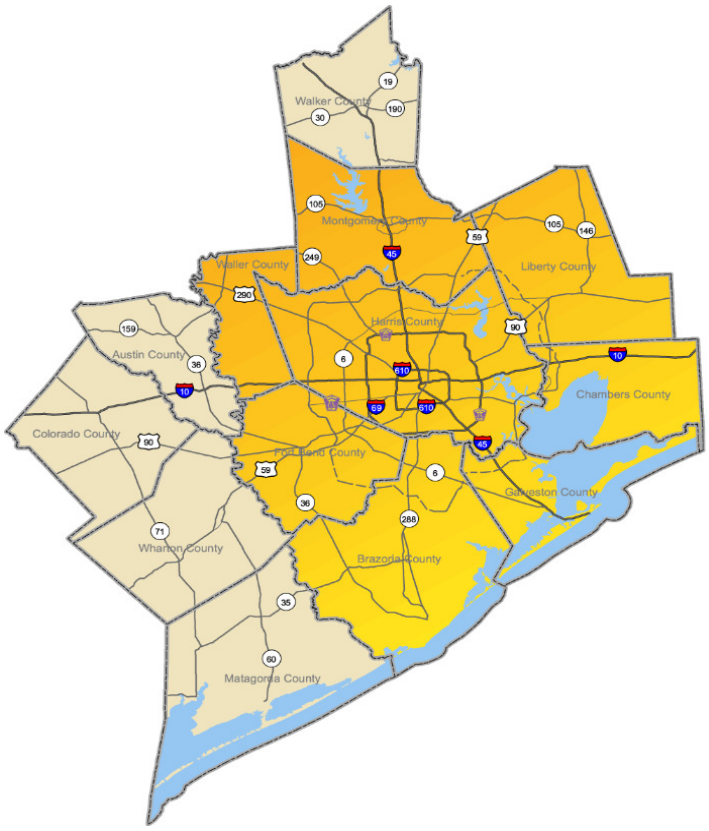
Greater Houston is the fifth-largest metropolitan area in the United States and the second largest in the State of Texas, after the Dallas-Fort Worth-Arlington Metroplex. The Houston metropolitan region is also a rapidly-growing area and between 2014 and 2015, led the nation with the greatest population increase in terms of the total number of people added to the region.[4] Again, the City of Conroe, the county seat of Montgomery County, was the fastest growing city in the nation by percentage growth

[4] United States Census Bureau, 2015.

between 2015 and 2016.[5] Census Bureau estimates for 2015 indicated that the population of the eight county Houston-Galveston Transportation Management Area (TMA) was 6,626,384 residents (Table 1). Socio-economic growth forecasts also project that the TMA region will be home to over 10 million residents by the year 2040.[6] Within the same time-line, employment in the region is expected to grow by 1.3 million new jobs. Geographically, most of the anticipated population growth is expected to occur in the unincorporated suburbs beyond the Beltway, while the expansion in employment will be concentrated in the regional employment centers at Downtown Houston, the Uptown-Galleria area, and the Energy Corridor. Due to this growth, it is anticipated that there will be many more vehicles on the road, and consequently, more traffic congestion.

The suburban trend of population growth coupled with the expansion of employment in the central city will probably mean that in the future, area residents will experience longer trips to work and there will be an urgent need to expand transportation resources to accommodate the rising traffic volumes. The continuous growth of the region will impose a significant strain on the transportation network and have critical implications for congestion management, air quality, and maintaining an acceptable level of mobility within the region.

MAP 1: The 13-County H-GAC Region with TMA Counties



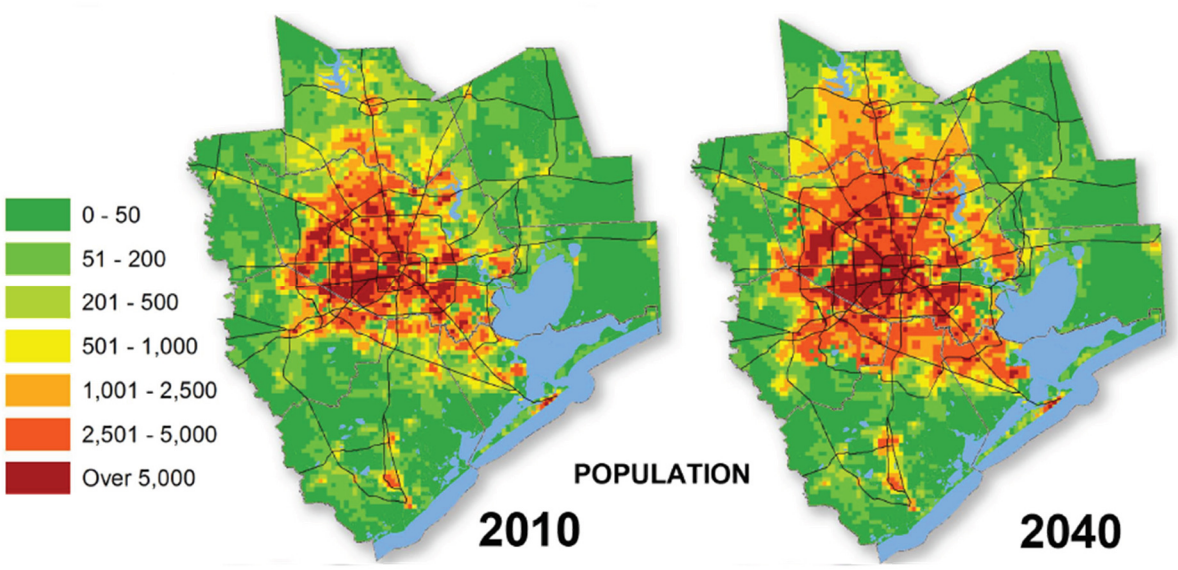
[5] United States Census Bureau, 2015.
[6] H-GAC Socio-Economic Forecast (2016).

Table 1: Population Size (in 000s)

	1980	1990	2000	2010	2015	2040
8-County MPO % Change	3,082	3,681 19%	4,596 25%	5,814 27%	6,626 14%	10,019 51%
State of Texas % Change	14,229	16,987 19%	20,852 23%	25,146 21%	27,469 9%	36,551 33%
USA % Change	226,546	248,710 10%	281,422 13%	308,755 10%	316,515 3%	380,220 18%

Source: US Census Bureau; H-GAC Socio-Economic Forecast (2016).

Figure 1: Regional Population Growth – 2010 to 2040



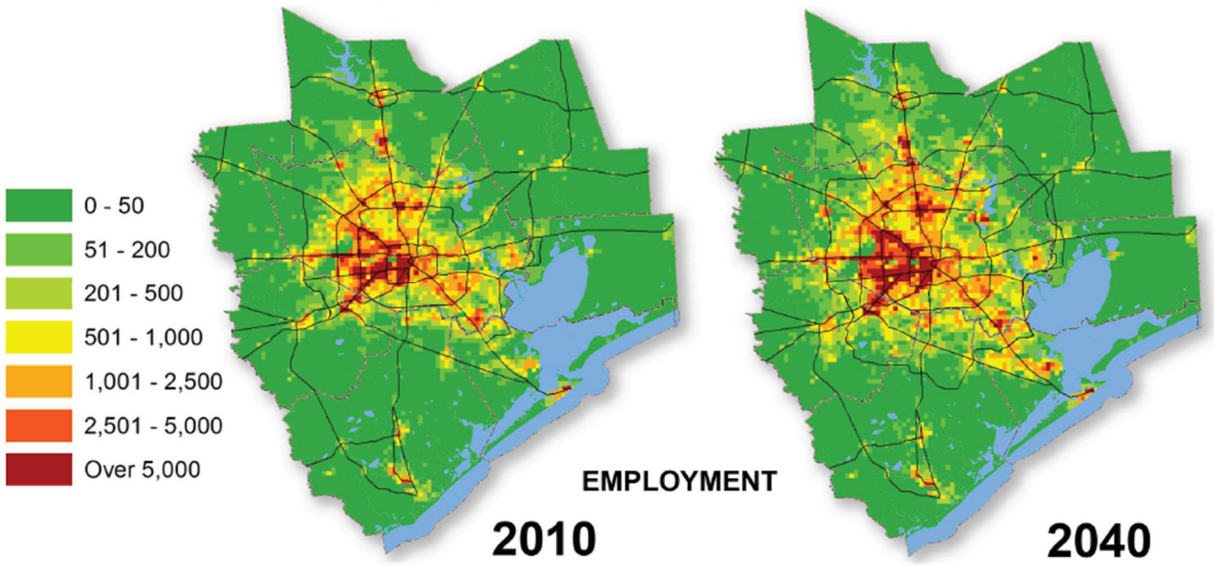
Source: Houston-Galveston Area Council Socio-Economic Forecast, 2016.

Table 2: Employment Characteristics (in 000s)

	1980	1990	2000	2010	2015	2040
8-County MPO % Change	1,613	1,811 12%	2,329 29%	2,742 18%	3,112 13%	4,465 43%
State of Texas % Change	5,851	7,101 21%	9,432 33%	10,353 10%	11,700 9%	N/A
USA % Change	90,528	109,487 21%	131,785 20%	129,819 -1%	140,000 5%	N/A

Source: US Census Bureau; H-GAC Socio-Economic Forecast (2016)

Figure 2: Regional Employment Growth – 2010 to 2040

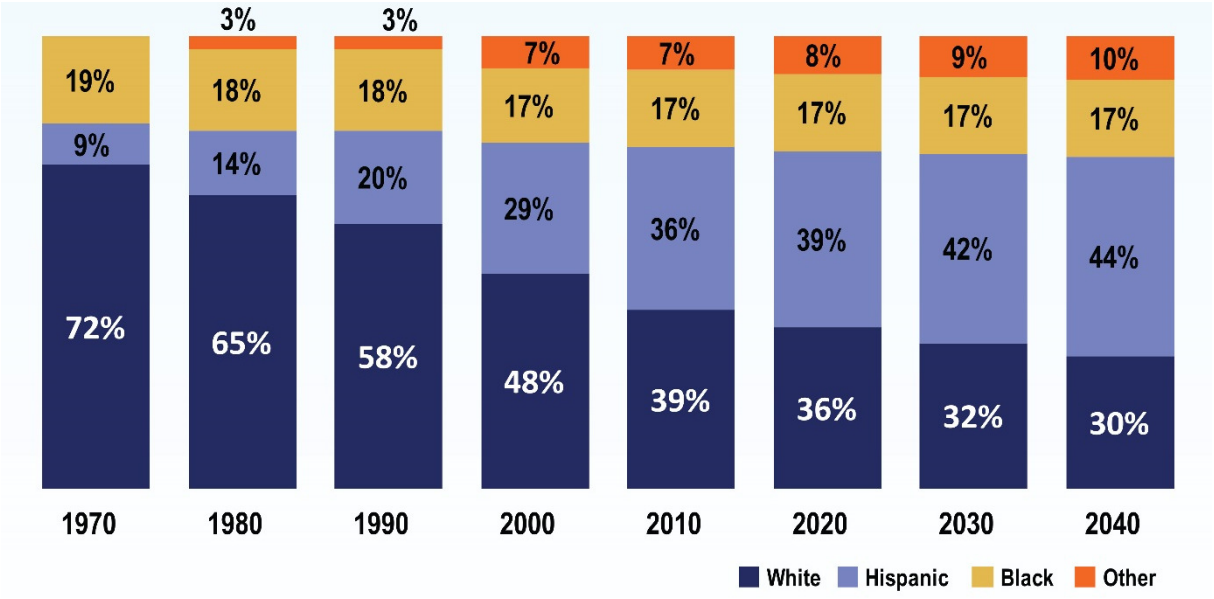


Source: Houston-Galveston Area Council Socio-Economic Forecast, 2016.

3.2. POPULATION DIVERSITY AND AGE

A notable characteristic of the Houston-Galveston region is the ethnic diversity of its population. The Houston metropolitan area is presently a majority-minority region and is the single most ethnically diverse urban region in the United States.[7] While the non-Hispanic White residents composed a 72% majority in 1970, the proportion of this racial group in the regional population dropped to 39% by 2010. Demographic forecasts indicate that the non-Hispanic White residents will amount to only 30% of the population by the year 2040. Although the proportion of black residents has held relatively steady at about 17% of the region's population, the numbers of residents of Hispanic/Latino origin has risen dramatically, and is expected to surpass the size of the non-Hispanic White population by the year 2020.

Figure 3: Regional Change in Ethnic Composition



Demographic statistics also show that the population in the region is gradually aging. In 2010, about 8% of the population were 65 years and over. Census statistics for the year 2015 indicate that individuals in that age group currently make up nearly 10% of the population.[8] Regional forecasts suggest that by 2040, the proportion of the individuals 65 years and over in the region could be as high as 20% of the total population within the region. As they age, individuals tend to decrease their use of personal vehicles and rely more on public transit for their transportation needs. In addition, the older an individual gets, the greater the probability of their having a form of disability that imposes challenges to their mobility. As many as 226,488 adults aged 65 years and over self-reported having some form of disability. This amounts to about 36% of population of that age group in the region.

[7] The Kinder Institute for Urban Research Houston Area Survey, 2017.
[8] U.S. Census Bureau, 2011–2015 American Community Survey Estimates from American Fact Finder, last accessed February 2017.

TABLE 3: Demographic Profile of the Gulf Coast Planning Region

Region	Total Population	Minority Population	Median HH Income	Persons in Poverty	LEP Population	Population 65 and Over	Disabilities (under 65)
Texas	26,538,614	56.2%	$53,207	15.9%	14.0%	11.7%	8.1%
Gulf Coast Region	6,626,384	62.0%	$60,047	14.75%	13.8%	9.8%	7.1%
Brazoria County	331,741	49.4%	$69,749	10.6%	5.7%	11.1%	6.4%
Chambers County	37,251	31.6%	$70,544	9.6%	6.5%	10.9%	10.2%
Fort Bend County	658,331	64.8%	$89,152	7.0%	8.3%	9.9%	5.5%
Galveston County	308,163	41.8%	$62,313	14.0%	4.6%	13.1%	9.5%
Harris County	4,356,362	68.3%	$54,457	16.6%	17.3%	9.4%	6.6%
Liberty County	77,486	32.8%	$48,729	15.8%	5.0%	12.9%	12.8%
Montgomery County	502,586	30.9%	$68,838	10.1%	7.2%	12.3%	7.3%
Waller County	45,847	57.0%	$51,348	16.8%	9.2%	11.7%	9.3%

Source: US Census Bureau, 2011-2015 American Community Survey Estimates from American Fact Finder.

3.3. REGIONAL EMPLOYMENT

Historically, the energy sector has been the main driver of employment in the Houston regional economy. As much as 84% of the area gross domestic product (GDP) was dependent on oil and gas. The collapse in the price of oil that occurred in 1982 resulted in a sizable loss of energy sector jobs. The recession spread from the energy sector to the entire economy and the unemployment rate more than doubled - dropping from 4.7 to 10.1 percent.[9] By 1987, one in every seven jobs that existed five years earlier had disappeared. It took several years for the region to recover from the economic downturn cycle.

While periodic downturns continue to impact the oil and gas sector, its effect on the regional economy is not as severe as it was decades ago largely because the economy has become more diversified. The healthcare, construction, manufacturing, transportation, government, hospitality, and education sectors continue to provide some stability to the job market. Non-farm employment in the region stood at just over 3 million at the end of the first quarter of 2017, up by 1.4 percent from one year earlier.[10]

As the regional population increases, employment is projected to continue to grow. An estimate of 1.4 million new jobs are expected to be added to the region between 2015 and 2040. Concentrations of employment will continue to exist in the major activity centers Downtown Houston, the Texas Medical Center, Uptown-Galleria, Greenway Plaza, the Sugarland and Woodlands Town Centers, and Downtown

[9] Kinder Institute for Urban Research. Thirty-Five Years of the Kinder Houston Area Survey: Tracking Responses to a Changing America. Rice University, 2016. p. 7.
[10] U.S. Bureau of Labor Statistics, Southwest Information Office (2017).

Galveston. New employment centers are expected to develop along major transportation corridors that include I-45 North at Greenspoint, US 290 at Northwest Point, IH 10 West, IH 69 South, and along FM 1960 (Figure 2).

3.3. THE REGIONAL ROADWAY SYSTEM

The Houston-Galveston Region transportation network consists of almost 27,000 total lane-miles of roadway[11], and supports over 186 million total trip miles each day (Table 4). The 186 million total daily trip miles represents a 3.9% increase from the 179 million trip miles reported for 2015. Arterial streets make up more than half of the regional road network (54.2 %), and account for about 31.8% of the daily vehicle miles travelled. Freeways on the other hand, represent 12.8% of the entire network but convey as much as 34.5% of the daily vehicle miles travelled. Local roads, or collectors, comprise about 18.7% of the regional road network but are responsible for only about 7% of the daily vehicle miles travelled - most of which occur at trip origins and destinations. The Freeways and arterial roads represent the most utilized segments of roadway system and together convey about two-thirds of the daily traffic for the entire region. Overall, the non-priced roadway facilities embody 95.7% of the total lane miles.

The H-GAC region currently has approximately 966 lane-miles of tollways and 193 lane-miles of Express\Managed Lanes. These priced facilities together amount to 4.3% of the 2016 transportation network. The anticipated transportation network for the year 2040 will grow to over 30,000 total lane-miles. This will include 3,773 lane-miles of freeways or 12.4% of the grand total lane-miles in the 2040 network. The proportion of Arterials in the network would also fall to 52.1%. By the year 2040 however, the non-priced roadway will occupy 93.1% of the total network, slightly lower than the present size of 95.7%. On the other hand, the proportion of priced roads and managed lanes will grow to 6.9% of the entire regional transportation network.

Table 4: Description of the Roadway System

Roadway Classification	Lane-Miles			Percent Change	Percentage of Total Lane Miles	
	2017	2040	Difference		2017	2040
Freeways	3,460	3,773	313	9.0%	12.8%	12.4%
Major Arterials	3,854	4,010	156	4.0%	14.3%	13.2%
Minor Arterials	10,765	11,820	1,055	9.8%	39.9%	38.9%
Collectors	5,041	5,404	363	7.2%	18.7%	17.8%
Access Ramps	-	-	-	-	-	-
Frontage Roads	2,481	2,829	348	14.0%	9.2%	9.3%
Express/HOV	193	413	220	114.0%	0.7%	1.4%
Total Non-Priced Lanes	**25,794**	**28,249**	**2,455**	**9.5%**	**95.7%**	**93.1%**
Tollway/Managed Lanes	966	1,692	726	75.1%	83.3%	80.4%
~~Tolled Managed Lanes~~	~~193~~	~~413~~	~~220~~	~~114.0%~~	~~16.7%~~	~~19.6%~~
Total Priced Lanes	**1,159**	**2,105**	**946**	**81.6%**	**4.3%**	**6.9%**
Grand Total	**26,953**	**30,354**	**3,401**	**12.6%**	**100%**	**100%**

Source: H-GAC Travel Demand Model, 2016.

[11] H-GAC 2016 Travel Model Estimate.

3.3. THE TOLL ROAD SYSTEM

The Houston-Galveston region is a national leader in the use of road pricing as a strategy to raise transportation financing and improve mobility. In 2013, the Harris County Toll Road Authority (HCTRA) ranked in the top ten nationally in terms of toll revenue.[12] There are currently nine priced facilities in operation within the H-GAC planning region - Fort Bend Parkway, Grand Parkway, Westpark, Hardy, Sam Houston Parkway, Tomball Tollway, Katy Freeway Managed Lanes, SH 242, and the system of METRO HOV\HOT lanes (Table 5). The network of tolled facilities will be expanded from the 2017 level of 966 lane miles to approximately 1,692 lane miles by 2040.

A statewide interoperability program allows users with electronic toll tags issued by any of the program participants to operate their vehicles on any toll road within the State of Texas. Members of the program include (1) Harris County Toll Road Authority (EZ TAG), (2) North Texas Turnpike Authority (TollTag), (3) Texas Department of Transportation (TxTAG), and (4) the Metropolitan Transit Authority of Harris County (METRO HOT Lane Toll Tag). An Inter-State interoperability agreement allows vehicles with Texas toll tags to operate on toll roads in the Kansas Turnpike system. Plans are underway for similar interoperability agreements with toll authorities in Oklahoma, Florida, Georgia, North Carolina, and South Carolina.

For vehicles with electronic transponders, toll charges are automatically deducted from a prepaid account when a priced facility is used. A fee is assessed upfront for the purchase of an electronic transponder tag. The driver is subsequently required to maintain sufficient funds in the account to cover incurred toll charges. Prepaid accounts are replenished automatically by credit/debit card, or a bank account, to maintain a pre-defined minimum balance. Cash payments are received only at select toll booths along the Sam Houston Parkway. Overall, cash customers pay a higher rate than electronic tag users. To accommodate the differing needs of patrons, HCTRA introduced two new toll user account types. "EZ TAG Express" is a smart phone App which replaces the windshield transponder and offers a slightly lower sign-up cost than the EZ TAG. A credit/debit card is however still needed to replenish the account and to maintain the required minimum balance. The other option, the "BancPass EZ TAG" may be purchased at participating retail stores and offers a lower sign-up cost than the EZ TAG. BancPass EZ TAG users do not have to maintain a minimum balance and can make cash payments to replenish their toll fare accounts in area retail stores.

Pursuant to the Texas Transportation Code, Section 372.053, Texas tolling authorities offer free or discounted tolls to eligible veterans. The applicable vehicle must be registered with the State of Texas and display a qualified specialty license plate as a disabled veteran, a recipient of the Purple Heart, or the Congressional Medal of Honor.

[12] IBTTA, 2013.

Table 5: Toll Roads and Managed Lanes in the Houston Region

Priced Facility	Designation	Operator(s)	Toll Range	Access Options
Fort Bend Parkway	Tollway	FBCTRA [a]	$0.60 - $3.00	Electronic Toll Tag Only
Grand Parkway	Tollway	TxDOT [b] FBCTRA	$0.35 - $3.25	Electronic Toll Tag Only
Westpark	Tollway	HCTRA FBCTRA	$0.65 - $3.25	Electronic Toll Tag Only
Hardy	Tollway	HCTRA [c]	$0.90 - $8.75	Electronic Toll Tag Only
Sam Houston Parkway	Tollway	HCTRA	$0.50 - $8.75	Electronic Toll Tag / Cash
Tomball Tollway	Tollway	HCTRA	$0.90 - $8.75	Electronic Toll Tag Only
SH 242	Direct Connector Ramp Tollway	HCTRA MCTRA [d]	$0.25 - $1.50	Electronic Toll Tag Only
Katy Freeway	Managed Lanes	HCTRA	Free HOV 2+ / $0.30 - $7.00	Electronic Toll Tag / Free HOV
I-45 N | I-45 S | US 59 N | US 59 S | US 290 NW	HOV / HOT Lanes (Express Lanes)	METRO [e]	Free HOV 2+ / $1.00 - $6.50 (Dynamic Tolling)	Electronic Toll Tag / Free HOV

[a] Fort Bend County Toll Road Authority; [b] Texas Department of Transportation; [c] Harris County Toll Road Authority; [d] Montgomery County Toll Road Authority; [e] Metropolitan Transit Authority of Harris County.

Beginning in 2014, Metro converted the existing HOV lane system to Managed Lanes, creating the dual functionality of the free HOV lanes which provide travel priority for transit buses, carpools, and van pools, and the High Occupancy Toll (HOT) lane for fee paying solo drivers. Texas law prohibits existing general purpose freeway lanes being converted to priced lanes unless the public has a reasonable alternative non-tolled alternative route.[13] Toll rates on the Katy Managed Lanes vary by time of day, in response to the daily fluctuations in traffic volume. The managed lanes are however closed to HOT traffic during the morning and evening rush hours to ensure unimpeded access and unconstrained highway speed to transit and HOV traffic. Plans are underway to implement real-time monitoring of the freeway traffic to support a system of dynamic tolling that is directly related to the level of congestion.

Overall, congestion pricing strategies encourage a more efficient use of highway capacity. HOT lane applications permit single occupancy vehicles to use the underused capacity of carpool lanes for a fee which varies with the time of day. Price discounts are offered during off-peak periods to encourage greater use of the facility during off-peak hours. Map 2 show the toll roads and managed lane system contained in the fiscally constrained Regional Transportation Plan (RTP) for the year 2040.

[13] Texas Transportation Code Ann. § 370.035(2), Vernon 1999.

MAP 2: Toll Roads, HOVs and Managed Lanes

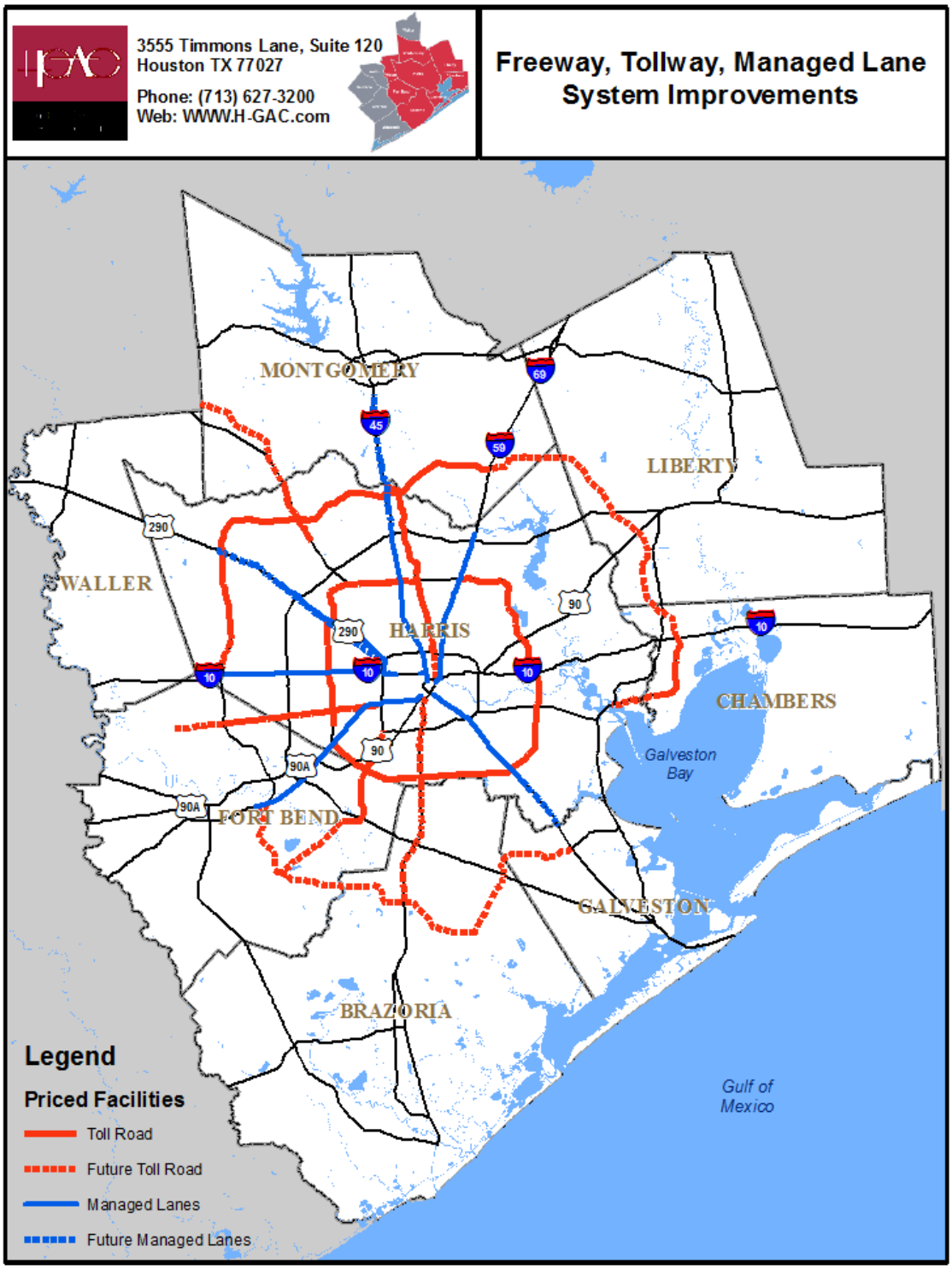


Table 6 shows that toll road usage in the planning region has grown steadily since 2009, with the largest increase occurring in the years 2015 and 2016. The trend of an increase in toll road usage in the region is expected to continue.

Table 6: Toll Road Usage and Percentage Change (Vehicles per Year)

2009	2010	2011	2012	2013	2014	2015	2016
353,948,710	371,245,774	380,664,408	408,307,389	428,226,811	443,256,890	485,444,170	523,949,934
-	4.9%	2.5%	7.3%	4.9%	3.5%	9.5%	7.9%

Source: Harris County Toll Road Authority (HCTRA).

3.4. PUBLIC TRANSPORTATION

A continuous program to expand the capacity of the road network is not the panacea to the present traffic congestion neither is it a practical approach to address the region's future transportation needs. An intermodal strategy is necessary because no single mode can address the traffic problems on its own. Public transportation provides an option that facilitates the more efficient use of the existing roadway by a less expensive means. High capacity transit options can move more passengers per hour, per road lane, than most other urban modes.[14] As the region continues to grow, an expansion of the public transportation system will be invaluable to maintaining and enhancing the level of mobility and accessibility the residents.

The regional transit system is comprised of about ten main public transportation providers with service areas that cover seven counties. Transit service consists of local bus service, park and ride/commuter service, demand response service, and light rail (LRT). The number of people using public transportation is increasing after previous years of declining ridership. Park and ride service provides trips from sub-urban locations to links in business centers like Downtown Houston, Greenway Plaza, and the Texas Medical Center. Transit dependent communities are segments of the population who use the public transit services as their primary source of mobility. They are primarily located close to the core areas of the urban counties. New communities of transit dependent individuals are identified in the more rural areas in the planning region, and are a concern of a regional coordinated effort to increase transit service coverage and efficiency. While light rail is fairly new to the Houston region, the system is enjoying increasing ridership on the existing lines. Plans underway to extend the light rail service in the region (Table 7). Transportation planning authorities are also exploring the possibility of introducing commuter rail service as a strategy to relieve the congestion on area roadways.

[14] Congestion Cost and Benefit Analysis II – Victoria Transport Policy Institute (2017).

Table 7: Daily Transit Miles Traveled

Mode	Transit Miles			% Change
	2017 Network	2040 Build Network	2040 No-Build Network	
Local Bus	2,973	2,712	2,712	-8.8%
Express Bus	502	258	258	-48.6%
Commuter Bus	2,045	1,910	1,910	-6.6%
Light Rail	107	175	175	63.6%
Commuter Rail	0	97	97	100%

Source: H-GAC Travel Demand Model, 2017.

The Metropolitan Transit Authority of Harris County (METRO) is the largest public transit service provider in the region, and operates bus, light rail, bus rapid transit, and paratransit service within a 1,303-square mile area that includes the City of Houston and portions of unincorporated Harris, Fort Bend, and Montgomery counties; serving a population of approximately 3.6 million people. Prior to the introduction of its rail service in 2004, METRO operated the largest all-bus fleet in the nation.

METRO bus service is the most used bus system in the State of Texas and conveys an average of about 275,000 riders every day.[15] In fiscal year 2015, METRO buses operated over 71 million miles and delivered over 86 million passenger trips. Passenger facilities include 8,899 active bus stops, 20 transit centers and 29 Park and Ride lots. The light rail service operates three lines that run a length of about 22.75 miles, centered on the central city and reaching out to communities on the East end and Northside, and the Medical Center and NRG Stadium to the South. For financial year 2016, METRO's light rail service recorded an estimated 16.8 million boardings. While METRO manages its bus and light rail services directly, the agency contracts out its paratransit operations. METROLift operates a fleet of 155 federally funded, lift-equipped vans, while Yellow Cab and three other taxi cab companies provide on-demand services to its patrons.

Nine smaller agencies provide additional transportation services to residents in the planning region.

- Harris County Transit provides fixed route service to municipalities in eastern Harris county (outside the METRO service area). Shuttle service connects La Porte and Baytown, while Park and Ride Service takes workers to Houston's central business district. Harris County Transit also provides a no-charge shared ride to seniors and disabled clients for medical purposes only.
- Brazos Transit District provides demand-response service within Walker, Liberty and Montgomery Counties. The Woodlands Express provides commuter bus service connecting locations in the Woodlands with downtown Houston, the Texas Medical Center, and Greenway Plaza. Trolley service and ADA paratransit service is also provided around the Woodlands.

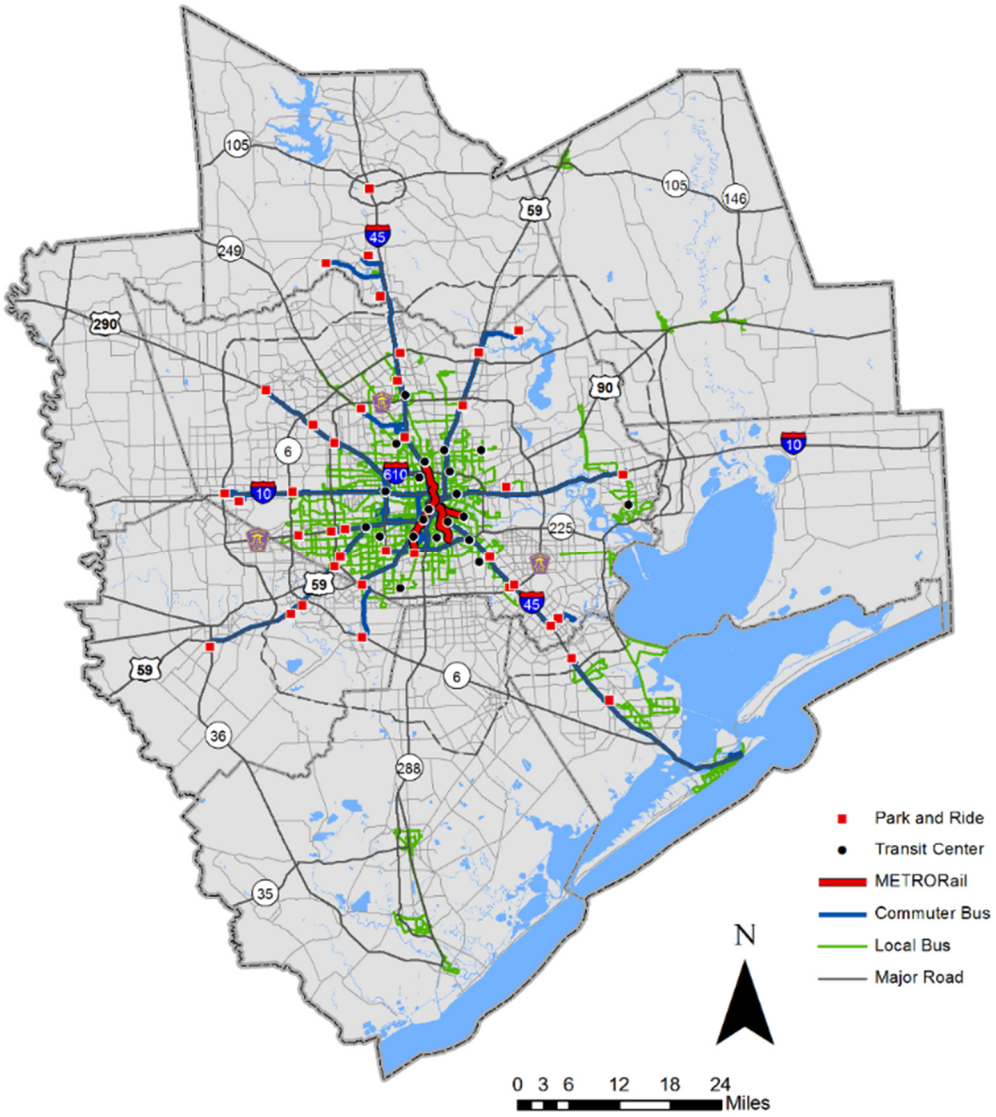
[15] H-GAC - Gulf Coast Regionally Coordinated Transportation Plan Update (2016).

- Colorado Valley Transit is a rural transit operator and provides demand-response service within Wharton, Colorado, Waller, and Austin Counties. Colorado Valley Transit also runs a deviated-fixed route LOOP service within the city limits of Bellville, Sealy, El Campo, and Wharton.
- Fort Bend County Transit provides demand-response service throughout the county, and point-deviation route service within the city limits of Richmond and Rosenberg. Fort Bend Transit also operates Park and Ride commuter service to Greenway Plaza, Galleria, and the Texas Medical Center.
- Connect Transit operates demand-response service in rural Brazoria County, fixed-route service in Southern Brazoria County, and ADA paratransit service within the city limits of Angleton, Clute, Freeport, and Lake Jackson.
- Island Transit operates fixed-route bus and ADA paratransit services for Galveston Island. Island Transit and Connect Transit jointly deliver Park and Ride commuter services known as Island Connect for riders travelling between Galveston Island, Texas City and League City.
- R Transit provides public transportation services to rural residents. The organization is classified as a social service/welfare agency and provides shuttle service for the elderly and persons with disabilities, including wheelchair access. Children under 12 ride free.
- Conroe Connection provides fixed-route service within the City of Conroe. Conroe Connection also provides ADA complementary paratransit, a shared ride, curb-to-curb service to ADA eligible passengers. This service is provided in a 3/4-mile radius of the fixed-route bus system throughout the city.

- The Woodlands Express provides Park and Ride service and free trolley service to area residents. The Woodlands Town Center Trolleys connect the Woodlands Mall and Cynthia Wood Mitchell Pavilion with other town center businesses and residences. Demand/Response service is also provided for seniors and people with disabilities.

  Table 8 gives a picture of the relative importance of these transportation agencies to supporting mobility in the region. Center

Map 3: The Regional Transit Service Network



Numerous community organizations, private non-profit, and human service agencies from around the Gulf Coast region provide client focused transportation services to their patrons. A large proportion of these trips are for medical purposes to healthcare facilities, trips to shopping, for personal business, and recreation.[16] H-GAC facilitates the Regionally Coordinated Transportation Plan (RCTP), a comprehensive effort to provide greater coverage, and a better and more efficient transportation service to the region's elderly, disabled, youth, veteran, disadvantaged population through strategic planning, coordination of services, and regional cooperation.

[16] H-AC – Gulf Coast Regionally Coordinated Transportation Plan (2016).

Table 8: Transit Boardings by Transportation Agency – 2008 - 2014

	METRO	Connect Transit	Brazos Transit District	Fort Bend Transit	Harris County Transit	Island Transit	Total
2008	100,277,342	50,912	N/A	165,386	N/A	N/A	**100,493,640**
2009	88,510,712	71,478	N/A	193,095	29,852	499,920	**89,305,057**
2010	81,151,205	123,855	N/A	180,409	90,557	610,058	**82,158,084**
2011	81,085,192	189,068	N/A	247,324	122,704	684,844	**82,320,132**
2012	80,891,292	223,202	N/A	320,542	168,545	708,870	**82,329,132**
2013	84,235,798	266,735	729,285	373,597	210,479	774,629	**86,590,523**
2014	85,369,587	334,195	695,295	389,272	172,862	862,355	**87,823,546**

Source: Regional Transit Framework Study, 2016 (Draft).

3.5. TRANSPORTATION SYSTEM PERFORMANCE

Traffic congestion is a common feature of the large urban environment and occurs when a high volume of traffic is imposed on a roadway with limited capacity. Congestion is a key factor in evaluating the performance of a transportation system. As road usage approaches capacity, every additional vehicle entering the system imposes marginal costs on other road users in terms of increases in travel time, arrival unreliability, added fuel consumption, pollution emissions, and driver stress.[17] Because traffic congestion is a non-linear function, a small addition of vehicles to a roadway at capacity can cause disproportionately larger changes in congestion delay.[18]

Congestion may be exacerbated by conditions and incidents that impair the efficiency of roadway use or reduce effective roadway capacity. These include vehicles travelling at uneven speeds, bottlenecks at freeway interchanges, road construction sites, traffic accidents, and disabled vehicles. Furthermore, sometimes on roads without congestion, drivers may experience delay as a result of uncoordinated traffic signal controls. Table 9 lists a selection of indicators of congestion for the Houston metropolitan region, taken from the 2015 edition of *Urban Mobility Report*, published by the Texas A&M Transportation Institute (TTI). The report shows that congestion within the Houston region has grown steadily over time. The following section highlights a few indicators of congestion and what they mean to the performance of the regional transportation system.

3.5.1 Travel Time Index

The travel time index is a primary measure of congestion, calculated as the ratio of average travel time in the peak period to average travel time in free-flow conditions. The travel time index of 1.33 identified for

[17] Congestion Cost and Benefit Analysis II – Victoria Transport Policy Institute (2017)
[18] Ibid.

the Houston region means that a 20-minute trip under free-flow conditions would take 26.6 minutes during peak periods. Based on this index, the TTI Urban Mobility Report concluded that the Houston region was the tenth most congested metropolitan region in the nation in 2014.

3.5.2 Planning Time Index

The Planning Time Index (PTI) is a measure of the reliability of the roadway system and indicates how much time should be planned for a trip based on the roadway conditions. PTI differs from the travel time index in that it is based on a percentile of a compilation of actual travel time data rather than on an average, and compares a near-worst case travel time to free-flow conditions.[19] From empirical knowledge, the PTI score at the 80th percentile indicates the amount of time that should be planned for a trip to limit the probability of being late to only one day a week.[20] The 80th percentile score for the Houston metropolitan region PTI is 1.58,[21] which means a trip that would normally take 30 minutes in free flow conditions would require 17 additional minutes to be completed in a timely manner. The higher the PTI, the less reliable the travel network for scheduling arrival time.

Table 9: Houston Metropolitan Region Traffic Performance Summary

Performance Measure	1990	1995	2000	2005	2010	2014
Population (in 000s)	2,700	3,150	3,800	4,325	4,750	5,000
Daily Vehicle Miles of Travel (in 000s) [Freeways & Arterials]	52,480	64,285	82,085	91,955	93,887	90,884
Congestion Cost ($million) in 2014 Dollars	3,079	3,227	3,705	4,518	4,413	4,924
Annual Person-Hours Spent in Delay (in 000s)	70,147	85,720	111,210	153,810	165,230	203,173
Travel Time Index	1.22	1.22	1.23	1.28	1.28	1.33
Annual Excess Fuel Consumed (in 000 gallons)	32,558	39,785	51,616	71,389	76,689	94,300

Source: 2015 Urban Mobility Report, Texas A&M Transportation Institute (TTI).

3.5.3 Congestion Costs

A variety of methods have been used to calculate the cost of surface transportation congestion. The TTI Urban Mobility Report bases its congestion cost determinations on two direct factors: the value of the extra time spent on a trip plus the cost of the fuel that is wasted during congested travel. Some other approaches consider additional cost factors such as safety, increased emissions and environmental damage, depreciation\vehicle operating costs, reduced business productivity, and congestion impacts on

[19] NCHRP Report 618, *Cost-Effective Performance Measures for Travel Time Delay, Variation, and Reliability* (2008).
[20] Ibid.
[21] Ibid.

freight movement. Most of these indirect costs are hard to estimate which makes them disfavored for conventional use.

Congestion on the urban road network in the United States is estimated to cost the nation about $85 billion per year assessed on the basis of longer and less reliable journey times, reduced mobility, increased vehicle operating costs, and environmental degradation.[22] The TTI Urban Mobility Report estimated the surface transportation cost of congestion for the Houston metropolitan region at almost $5 million dollars for the year 2014. Based on this value, the report ranked the Houston metropolitan region as fourth worst in the nation. Annual excess fuel usage for the year 2014 was estimated at 94.3 million gallons, almost triple the amount recorded for 1990. Based on this value, TTI also ranked the Houston region fourth worst in the nation.

A copy of TTI's 2015 Urban Mobility Report is available in Appendix A.

3.9 VEHICLE MILES TRAVELLED (VMT)

Table 10 provides a record of the daily vehicles miles travelled (VMT) on each functional roadway classification, modelled for the following transportation networks:

- The 2017 network – containing all the present network facilities.
- The 2040 RTP Build network – containing all programmed RTP facilities including the priced facilities, and
- The 2040 RTP No-Build network – containing all programmed RTP facilities except the priced elements scheduled to be built after 2017.

Several estimates of the daily VMT for the region have been provided by various programs interested in assessing the traffic system performance for the region. Some of these estimates are based on more conservative assumptions than others.[23] The common observation from the different studies is that VMT numbers in the region are on a continuous rise. The number of vehicles on the road are expected to increase with every passing year. H-GAC's travel demand model shows approximately 186.5 million vehicle miles travelled per day for the year 2017 network. Most of these trips occur on the area freeways, which account for over one third of the total regional vehicular traffic.

[22]

[23] See for example the TxDOT VMT estimate produced by the Highway Performance Monitoring System (HPMS).

Table 10: Daily Vehicle Miles Traveled (VMT)

Roadway Classification	2017 Network		2040 Priced Facility Build Network		2040 No Build Network	
	Daily VMT	% of Network	Daily VMT	% of Network	Daily VMT	% of Network
Freeways	64,356,012	34.5%	89,828,433	31.7%	90,788,761	32.3%
Toll Roads	20,559,949	11.0%	33,083,841	11.7%	30,765,578	10.9%
Major Arterials	21,423,153	11.5%	30,539,219	10.8%	30,734,723	10.9%
Minor Arterials	37,796,800	20.3%	58,872,132	20.8%	59,488,469	21.1%
Collectors	9,971,903	5.03%	18,417,614	6.5%	18,461,047	6.6%
Access Ramps	4,851,092	2.6%	6,892,269	2.4%	6,579,181	2.3%
Frontage Roads	8,984,369	4.8%	13,899,541	4.9%	13,680,073	4.9%
HOV	647,707	0.3%	1,086,192	0.4%	1,097,111	0.4%
Express/HOV & Managed Lanes	1,481,941	0.8%	4,000,058	1.4%	3,176,554	1.1%
Local (Centroid)	16,439,743	8.8%	26,621,555	9.4%	26,627,303	9.5%
Daily Total Trips	**186,512,668**	100%	**283,240,854**	100%	**281,398,801**	100%

Source: H-GAC Travel Demand Model, 2017.

The traffic demand model VMT projections indicate that by the year 2040 on the build network, the number of daily vehicle miles travelled in the region will increase by over 50% to as high as 283.0 million vehicle miles daily. In 2040, freeways will continue to be the heaviest travelled class of roadway for both the build and the no-build networks but the proportion of the total trips carried by each class of roadway will remain fairly the same. VMT numbers are important because large VMT values are often associated with high emissions of air pollutants and greenhouse gases, as well as with greater incidences of congestion. The level of vehicle emissions and conditions of congestion are critical to the Houston-Galveston-Brazoria metropolitan region because of the region's non-attainment status with respect to federal NAAQS air quality standards.

Table 11: H-GAC Daily Vehicle Miles Traveled (HPMS)

	Total Non-Toll VMT	Total Toll VMT	Regional Total VMT	Regional Population	VMT/ Population
Year 2007	140,293,998	6,879,587	147,173,585	5,546,228	26.54
Year 2008	132,678,193	6,392,416	139,070,609	5,674,837	24.51
Year 2009	130,558,602	6,592,815	137,151,417	5,815,339	23.58
Year 2010	134,267,513	8,111,295	142,378,808	5,891,999	24.16
Year 2011	135,781,924	8,117,408	143,899,332	6,032,069	23.86
Year 2012	134,605,666	8,052,443	142,658,109	6,158,301	23.17
Year 2013	135,503,380	1,130,443	136,633,823	136,633,823	21.67
Year 2014	124,569,976	6,022,575	130,592,551	6,461,066	20.21
Year 2015	137,081,405	11,268,336	148,349,741	6,611,066	22.44

Source: TXDOT Highway Performance Monitoring System, 2016.

3.10 TRANSPORTATION SYSTEM LEVEL OF SERVICE

Examining the daily vehicle miles traveled in conjunction with the predicted level of service (LOS) on the roadways provide helpful insights on transportation system performance. The LOS performance metric expresses a ratio of traffic volume to roadway capacity, and describes roadway conditions that range from the free vehicular flow through a standstill traffic jam. The LOS for the transportation system on each roadway classification was modelled for the three transportation networks:

- The 2017 network – containing all the network facilities that exist in the year 2017.
- The 2040 RTP Build network – containing all programmed RTP facilities, including the proposed priced facilities scheduled to be built by 2040.
- The 2040 RTP No-Build network – containing all programmed RTP facilities except the priced facilities scheduled to be built after 2017.

Table 12 presents a picture of the congestion levels for morning peak hours for the three transportation networks mentioned above. The morning peak traffic best captures daily travel conditions for trips between home and work, and may be considered more representative of mandatory regional travel than the evening peak which may include discretionary and leisure trips.

Table 12: Level of Service – Morning Peak Period (6am – 9am)

Roadway Classification	Year 2017		2040 Build Network		2040 No-Build Network	
	LOS	% by Class	LOS	% by Class	LOS	% by Class
Freeways	A-B-C	93.1%	A-B-C	76.5%	A-B-C	75.0%
	D-E	5.2%	D-E	10.4%	D-E	10.1%
	F	1.7%	F	13.1%	F	14.9%
Toll Roads	A-B-C	80.7%	A-B-C	77.2%	A-B-C	70.2%
	D-E	15.7%	D-E	8.2%	D-E	12.4%
	F	3.6%	F	14.6%	F	17.4%
Principal Arterials	A-B-C	95.6%	A-B-C	85.8%	A-B-C	85.7%
	D-E	3.1%	D-E	7.8%	D-E	7.6%
	F	1.3%	F	6.4%	F	6.7%
Other Arterials	A-B-C	97.7%	A-B-C	90.0%	A-B-C	90.2%
	D-E	1.8%	D-E	5.3%	D-E	4.9%
	F	0.5%	F	4.7%	F A-B-C	4.9%
Collectors	A-B-C	97.1%	A-B-C	88.9%	A-B-C	88.7%
	D-E	1.3%	D-E	4.7%	D-E	4.5%
	F	1.6%	F	6.4%	F	6.8%
Ramps	A-B-C	92.5%	A-B-C	90.6%	A-B-C	90.9%
	D-E	3.3%	D-E	3.8%	D-E	3.5%
	F	4.2%	F	5.6%	F	5.6%
Frontage Roads	A-B-C	95.5%	A-B-C	87.8%	A-B-C	87.3%
	D-E	2.8%	D-E	5.6%	D-E	5.1%
	F	1.7%	F	6.6%	F	7.6%
HOV	A-B-C	96.2%	A-B-C	69.5%	A-B-C	69.5%
	D-E	3.8%	D-E	5.2%	D-E	1.0%
	F	0.0%	F	25.3%	F	30.5%
HOT	A-B-C	98.9%	A-B-C	80.4%	A-B-C	77.2%
	D-E	1.1%	D-E	11.4%	D-E	11.5%
	F	0.0%	F	8.2%	F	11.3%

Source: H-GAC Travel Demand Model, 2017.

A notable observation is the fact that compared to the 2017 network, there will be a lower percentage of lane miles at LOS A, B, and C for all roadway classifications in both the 2040 build and no-build networks (Table 12). The difference in LOS will be most pronounced for the Freeways, HOV lanes, and the Toll roads. Toll road use in the region is on the rise and expected to continue to grow, which will put more pressure on the tolled facilities. Some of the traffic delays on the toll roads may be associated with backups at toll booths for the cash paying customers. These toll booth backups are a reason some toll road authorities are discontinuing cash payments and moving to a fully electronic toll collection system. The anticipated LOS F on the HOV may influence policy decisions regarding HOV use and the operation of the managed lanes.

Implementing all the transportation system improvements programmed for the 2040 build network, including the priced facilities, will probably not accommodate the increased travel demand that will be created by the expected growth in the regional population without a degradation of the LOS throughout the network, compared to the 2017 network. Generally, however, the overall proportion of road-miles at LOS F levels will be lower for the 2040 build network than they will be under the 2040 no-build network.

3.6. THE 2040 REGIONAL TRANSPORTATION PLAN (RTP)

The H-GAC 2040 Regional Transportation Plan (RTP) is described as the "blueprint" for a transportation system designed to meet the region's mobility needs over a 25-year planning horizon. The plan expresses a regional vision of a multi-modal transportation system that can sustain the growth of the economy, accommodate the upsurge in population and vehicular traffic, and support a desirable quality of life with increased safety, access, and mobility. RTP 2040 incorporates select strategies for implementing a blend of roadway, transit, freight, and pedestrian/bicycle projects that contribute to the vision. Several performance measures are stipulated as indicators of how the well the goals of the plan are being achieved. The H-GAC Regional Transportation Plan is updated every four years.

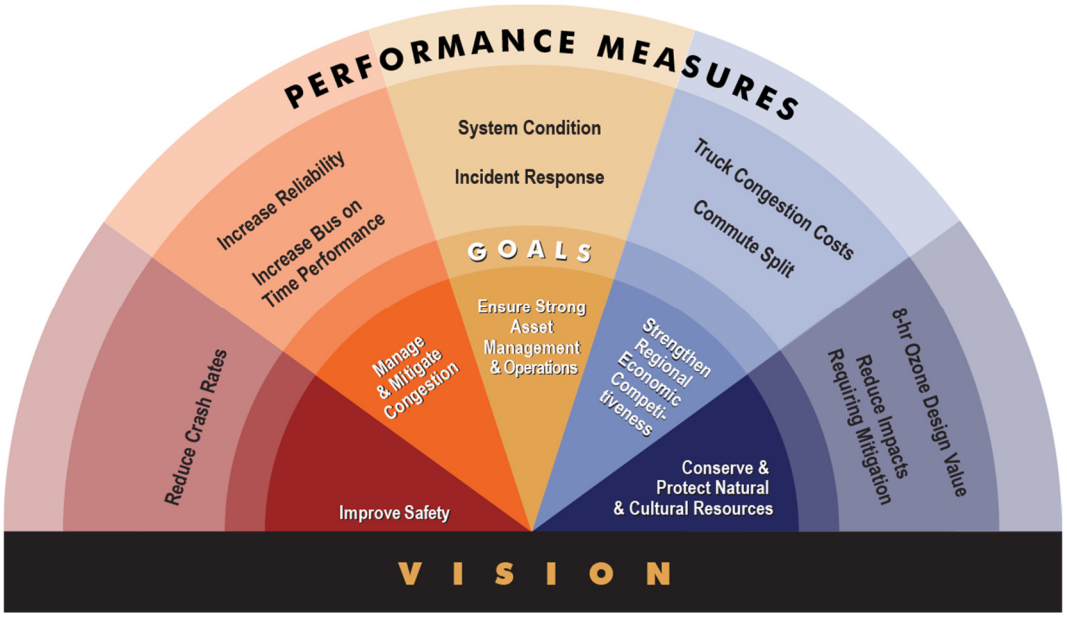
Federal regulations require the RTP to be fiscally constrained, consequently only projects that can be constructed under reasonable funding assumptions may be included in the multi-year plan. Also, because the U.S. Environmental Protection Agency (EPA) has designated the eight-county Houston-Galveston-Brazoria area as a non-attainment area for ground-level Ozone, the Regional Transportation Plan and Transit Improvement Program (TIP) are required to conform to emission limits established by the Texas Commission on Environmental Quality (TCEQ) and approved in the State Implementation Plan (SIP). Furthermore, with a population over 200,000, the Houston metropolitan region is classified as a Transportation Management Area (TMA). Because of this classification, the RTP update must include a Congestion Management Process (CMP). The H-GAC 2040 Regional Transportation Plan can be viewed at http://www.h-gac.com/taq/plan/2040/default.aspx.

The 2040 RTP is guided by five goals:

1. Improve Safety;
2. Manage and Mitigate Congestion;
3. Ensure Strong Asset Management and Operations;
4. Strengthen Regional Economic Competitiveness; and
5. Conserve and Protect Natural and Cultural Resources.

To ensure region-wide validation, the RTP was developed in coordination with the public, local governments, transit authorities, TxDOT, the Federal Highway Administration (FHWA), and the Federal Transit Authority (FTA). Final approval and the formal adoption of the plan came from H-GAC's Transportation Policy Council (TPC). The Technical Advisory Committee (TAC) on the other hand, served as the Regional Transportation Plan Sub-committee and was responsible for guiding plan development and giving direction to its content.

Figure 4: The 2040 Regional Transportation Plan – Performance Measures



Source: H-GAC 2040 Regional Transportation Plan Update

Programmed investments in the RTP total approximately $88.4 billion dollars (valued in 2015 dollars), and include more than 1,450 individual projects that were sponsored by over 60 local government entities in the region.[24] The investment priorities in the plan are based on a conservative estimate of the revenue expected to be available over the 25 horizon years. One of four strategies adopted to implement the plan is the expansion of the multimodal network. This strategy accounts for nearly one quarter of total 2040 RTP expenditure and supports the goals of congestion relief and economic competitiveness.[25] RTP projects that will add to roadway capacity are shown in Map 4. Target projects include:

- Extending current light rail service to the regional airports, and constructing new commuter rail lines to northwest and southwest suburban centers;
- Local roadway expansions by cities, counties, and private developers;
- Extension of the bicycle and pedestrian circulation network; and
- Additional travel lanes, extensions, and construction of new toll road corridors.

Specifically, the 2040 RTP recommends the expansion in capacity of the Sam Houston Parkway (South and East Segments), and extensions to the Westpark Toll Road, Fort Bend Parkway, and the Hardy Toll Road (Table 13). The RTP also recommends the completion or construction of new priced facilities: US 290 (toll road/managed lanes), Hempstead Toll Road, SH 249 Toll Road, SH 35 Toll Road, and the remaining segments of SH 99 (the Grand Parkway).

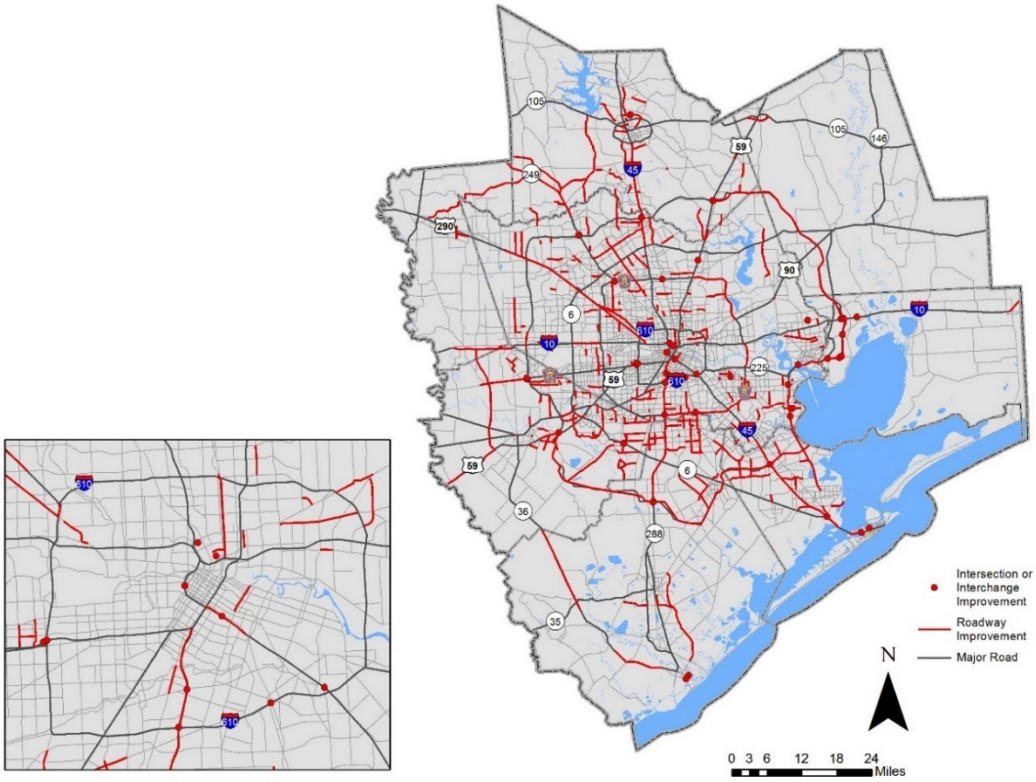
[24] H-GAC 2040 Regional Transportation Plan Update.
[25] Ibid.

Table 13: Proposed Expansion of the Toll Road System

AGENCY	2016 SYSTEM (Centerline Miles)	2040 SYSTEM (Centerline Miles)
Harris County Toll Road Authority	106 Miles	112 Miles
Brazoria County Toll Road Authority	N/A	25 Miles
Fort Bend County Toll Road Authority	12.2 Miles	27 Miles
Montgomery County Toll Road Authority	N/A	15 Miles
TxDOT	66 Miles	89 Miles

Source: H-GAC 2040 Regional Transportation Plan Update/

Map 4: 2040 RTP Projects that Add Roadway Capacity



3.7. FUNDING

Funding considerations are critical in the development of the RTP because the MPO must adhere to the requirement of fiscal constraint. The transportation plan must achieve a balance between the choice of a potentially beneficial project and a reasonable expectation that revenue will be available to fund it. Because of this obligation, the Transportation Policy Council (TPC) routinely updates the RTP list and timing of projects; to reflect changes in the assumptions of funding availability. Multiple sources of revenue and funding mechanisms are available for transportation projects, however, restrictions on the permissible uses of the funds may limit the projects they can be used for. Moreover, some funding sources require a local match which sometimes prove prohibitive to the less wealthy governmental entities. Responsibility for funding the surface transportation network is shared by the Federal, State, and Local Governments (Table 14).

3.7.1 Funding Sources

Federal Funding Sources:

Federal funds for surface transportation come primarily out of the Highway Trust Fund (HTF) which was created to support the federal-aid highway, intermodal, and transit programs. The highway trust fund is a user-supported program that is maintained by taxes on motor fuels, tires, truck and trailer sales, and certain road user fines\penalties. Because it is designed as a re-imbursement system, States which look to receive funding must first receive clearance to incur obligations and afterwards seek reimbursement for costs they have incurred. However, no payments may be made out of the HTF fund without congressional authorization. The current funding and authorization bill that governs federal surface transportation spending is the "Fixing America's Surface Transportation (FAST) Act" which was signed into law in 2015 and provides 5 years of predictable formula funding.

The federal "gas tax" dedicated to maintaining the HTF fund is currently 18.4 cents per gallon of gasoline, and 24.4 cents per gallon of diesel fuel. The revenue collected is distributed to the States following a highway\transit-based sharing formula. Because of the rising demand for transportation funds and the declining value of the revenue collected stemming from inflation trends in the economy, the variable price of oil, and the increased fuel-efficiency of automobile engines, the HTF is supplemented with federal general funds. Texas traditionally contributes more funds in federal fuel taxes than it receives in return apportionments. In 2017, the State will recoup 95 cents for every dollar of federal tax paid and stands to take a net loss of $738 million.[26]

State Funding Sources:
The State Highway Fund (SHF), also referred to as "Fund 6," is TxDOT's primary transportation funding source. The SHF receives revenue from several sources, including a State motor fuels tax (set at 20 cents per gallon); vehicle registration fees; taxes on lubricant sales; permit fees for special vehicles; and reimbursements from federal highway funds and from other agencies. The Texas legislature enabled constitutional amendments that permitted additional sources of revenue for State transportation projects

[26] TxDOT 2016-2017, Transportation Funding in Texas.

through Proposition I funding, (which appropriates oil and gas severance tax funds for use on publicly owned non-tolled roadways); and Proposition 7, (which appropriates a percentage of sales and motor vehicle rental\purchase tax to the SHF, also restricted to publicly owned, non-tolled roadways). The SHF also has sub-accounts for Proposition 14 bond proceeds, State Infrastructure Bank (SIB) loan repayments, and surplus toll revenue from comprehensive development agreements (CDAs).

Local Funding Sources:
In addition to grant funds from Federal and State sources, transit service is funded by fare-box revenue and local sales tax that is collected within the transit agency's service area. METRO is the largest public transit service provider in the Houston metropolitan region and collects a one cent dedicated sales tax within its 1,303-square mile service area. Other local funds available for transportation include receipts from HOT lane applications and toll roads.

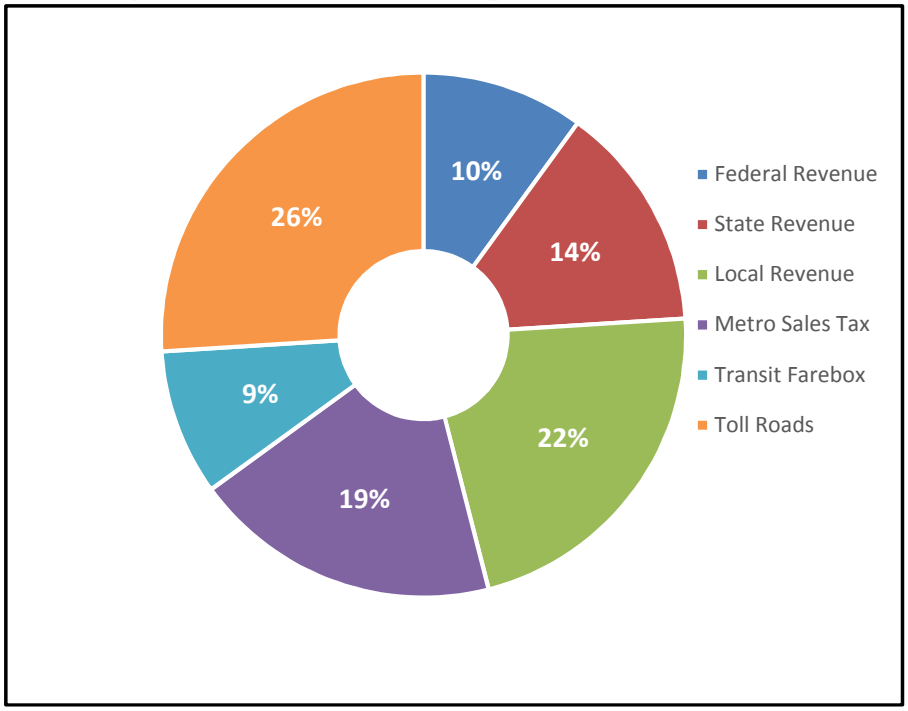
Table 14: Transportation Revenue Sources

FEDERAL FUNDS	- Motor Fuel Tax - Transfers from General Fund
STATE FUNDS	- Federal Reimbursements - Motor Fuel Tax - Lubricant Tax - Title Fees - Commercial Transportation Fees - Oversize/Overweight Permit Fees
LOCAL FUNDS	- METRO Farebox - METRO Sales Tax - HOT Lanes - Local Government Investment Income - Bond Interest - Transfers - Property Taxes - Toll Receipts

Source: H-GAC 2040 Regional Transportation Plan Update

From the panoply of federal, state, and local funding sources available, approximately $124 billion worth of revenue was estimated to be available for the 2040 RTP (Figure 9). The estimate was based on projections of growth in the main factors that drive revenue such as population, GDP, interest rates, and the consumption of gasoline. The projections were then applied to financial reports from the different project-sponsoring municipalities, counties, transit agencies, and toll road authorities to give a realistic estimate of total revenue based on the anticipated economic scenario.

Figure 4: The 2040 RTP Anticipated Revenue by Source



Source: H-GAC 2040 Regional Transportation Plan Update

In addition to estimating available revenue, the RTP also made projections of expenditure representing the cost of implementing all the projects recommended in the plan. The estimate of $88.4 billion included assumptions regarding the level operating and operations cost for existing and the proposed facilities. Overall, approximately 75% of the estimated expenditure is dedicated to preserving and enhancing efficiency of the existing transportation facilities. Following the strategies identified to implement the goals of the RTP, only about 35 cents of every investment dollar will be assigned to projects that add capacity to the network.[27] Road tolls are projected to constitute over one-quarter of the anticipated revenue supporting the plan.

3.8. PUBLIC INVOLVEMENT

Public involvement is a core component of the transportation planning process and played a large and important role in the preparation of the 2040 RTP. Outreach to the community was guided by the H-GAC Public Participation Plan (PPP) and included three rounds of public meetings targeted at (1) elected and appointed officials; (2) business associations, chambers of commerce, and transportation organizations; and (3) the public, including members of the underserved and disadvantaged population. Outreach events consisted mainly of public meetings, open houses, and focus groups. Publicity and notifications about public meetings was spread by telephone contact, US mail service, email blasts, flyers, agency website

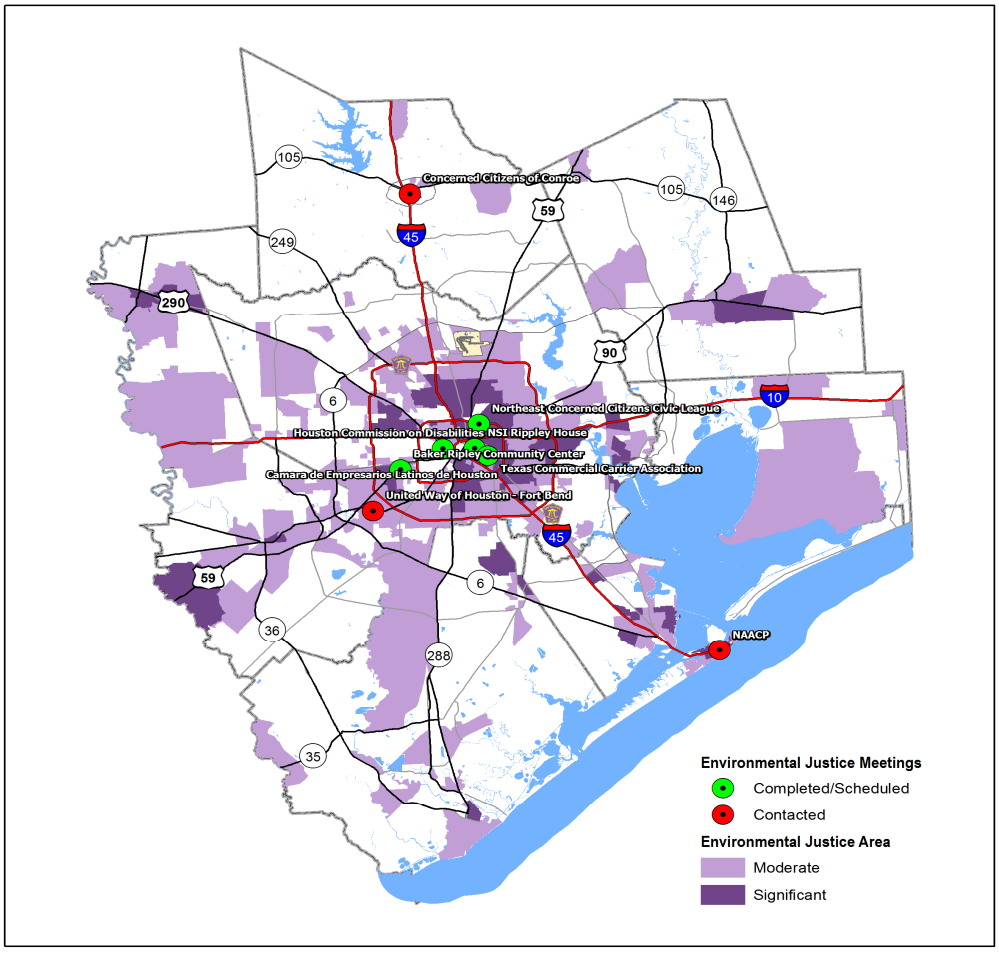
[27] H-GAC 2040 Regional Transportation Plan Update.

postings, radio public service announcements and press releases in newspapers of local and general circulation.

Every meeting session included a question and answer period. Comments about plan elements were encouraged and were taken directly at the public meetings or through a telephone hotline that was set up for that purpose. Comments could also be left on the H-GAC website, where citizens could also fill an online survey to answer specific questions regarding community preferences.

Special attention was paid to reaching the underserved and disadvantaged population. Community leaders and organizations that advocated for these communities were represented in the outreach programs. Several public meetings were held within an environmental justice community and conducted at an time believed to be conducive to the greatest participation. The turnout for the 2040 RTP hearings by citizens from the underserved communities was reportedly one of the largest recorded, exceeding 400 participants.

Map 15. Location of Environmental Justice Outreach Meetings



4.0. IMPACT OF THE REGIONAL TOLL SYSTEM

The focus of this document is to determine the impact of the toll road system - whether the proposed regional toll road additions recommended in the H-GAC 2040 RTP Update would equitably benefit all residents of the planning region, or whether the toll roads would disparately harm the environmental justice communities compared with the non-protected population. It considers the identification, measurement, and the indications and options for the mitigation of disproportionately high or adverse environmental justice impacts associated with the toll road investments. To conduct a disproportionate impact analysis, it is necessary to define a system of metrics that can objectively describe both the positive as well as the negative project impacts, and can apportion the associated benefits and costs to the environmental justice as well as the non-environmental justice neighborhoods. The Texas Department of Transportation (TxDOT) has proffered a list of potential impacts and measurable outcomes that may be used as points of focus to evaluate toll road projects for their environmental justice implications (Table 14).

Table 14: Potential Impact of Toll Roads

Impacts	Outcomes
Air Quality	If traffic is diverted through neighborhoods adjacent to toll roads, then these neighborhoods may experience higher levels of pollution
Mobility	Because of significant travel speed improvements, significant time savings accrue to commuters who can afford the toll.
Accessibility	Toll roads improve the access of upper-income commuters. For lower-income commuters, the extra cost imposed by the toll may result in less access to services and opportunities.
Route and Trip Time Shifting	Low-income commuters may be forced to change their trip times to avoid congestion on non-toll roads, or low-income shoppers may have to go to another shopping center to avoid paying a toll.
Safety	Diverted traffic through neighborhoods adjacent to toll roads may pose a higher safety risk to residents, pedestrians, cyclists, and local drivers in these neighborhoods
Property Values/Land Use	Higher prices of housing units near toll nodes because of increased access to services and opportunities. Industries and businesses that value mobility and reliability tend to locate at nodes and along connectors, which in turn attract high-income developments and leisure businesses.
Social	For low-income individuals, tolls are an additional expense and therefore they may be forced to live and work close to non-toll roads. Since property values tend to be higher at toll road nodes, these areas may become unaffordable for low-income individuals to live in. Toll roads thus have the potential to encourage segregation of population groups by income level.
Economic	Potential positive effects in terms of business relocations, increases in employment, and increased tax revenues.

Source: Prozzi et. al., (2006). Guidebook for Identifying, Measuring and Mitigating Environmental Justice Impacts of Toll Roads.

Whether a toll road has a disproportionate impact on the protected population is a function of how many low-income drivers use the toll facility, how many of them are discouraged or prevented from using the toll facility, the quality of available alternative transportation options, and how toll revenues are used.[28] Emerging best practices have brought to focus the subject of indirect and cumulative impacts as they relate to environmental justice analysis. The consideration of indirect and cumulative impacts is a requirement of the NEPA review process and has generally looked at project impacts associated with natural systems. Less attention has been devoted to indirect and cumulative impacts as they relate to minority or low-income communities. This issue is becoming more topical with the aging of the national interstate highway infrastructure as mounting efforts to rebuild them revive the environmental justice complaints that attended their initial construction.

4.1. ENVIRONMENTAL JUSTICE METHODOLOGY

Environmental Justice sensitive areas in the H-GAC planning region were identified using information taken from the U.S. Census Bureau 2011-2015 American Community Survey (ACS) estimates and mapped in GIS to the geography of census block-groups. The large size of the minority population in the region made it necessary to apply more stringent thresholds in order to derive meaningful environmental justice area delineations. This is deemed most appropriate for a region-wide analysis. Minority census block-groups were defined as those block groups where persons of all races and ethnicities except the non-Hispanic White exceeded the threshold value of the regional average plus one standard deviation.[29] Low-income sensitive census block-groups were defined as those block-groups that exceeded the regional average plus one standard deviation of the poverty level as numerated by the US Census Bureau. Over 60% of the population in the planning region qualify as environmental justice populations (Table 15). To facilitate the application of the travel demand model, the H-GAC planning region is divided into 5,217 Traffic Analysis Zones (TAZs). GIS layer attributes relevant to environmental justice were transferred from the census block-groups to their corresponding TAZ. Of the 5,217 TAZs in the region, a total of 2,285 or 43.8 % are identified as environmental justice zones. About 2,212 qualify based on minority status alone, while 676 qualify based on low-income alone.

Table 15: Distribution of EJ communities in H-GAC Region

Region	Total Population	EJ Population	% of Region	Minority Population	% of Region	Low-Income Households	% of Region
H-GAC MPO	6,313,767	3,914,328	62.0%	3,914,328	62.0%	302,740	14.0%

Source: US Census Bureau, 2011-2015 American Community Survey Estimates from American Fact Finder.

[28] Prozzi et. al., (2006). Guidebook for Identifying, Measuring and Mitigating Environmental Justice Impacts of Toll Roads.

[29] The standard deviation was waived for minority status determinations because of the high regional average.

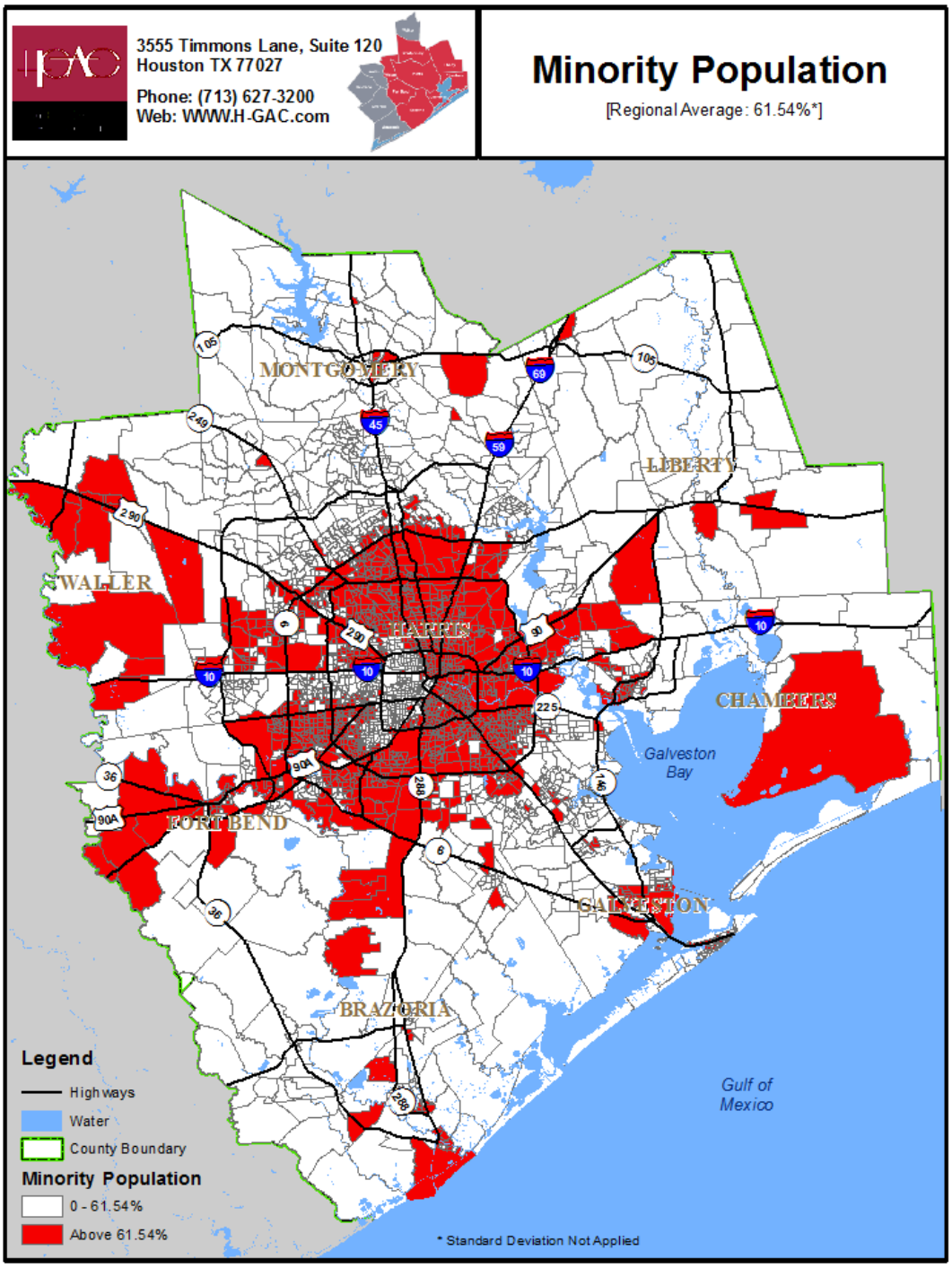
Executive Order 13166 directs all federal agencies and recipients of federal funds to provide special accommodations to persons with limited proficiency in the English language, often referred to as the "LEP" population. This Executive Order stems from the realization that the limited ability to read, speak, write, or understand English can be a barrier to meaningful participation in the planning process. The LEP condition is usually concurrent with minority and/or low-income status, and is an indicator of socio-economic disadvantage and therefore, environmental justice standing. Understanding the fact that there are other residents in the regional community who may be just as vulnerable as the racial minority and low-income individuals, H-GAC recognizes several additional demographic characteristics for its environmental justice analysis. These secondary indicators include:

- Elderly Persons − Population 65 years and over;
- Limited English Proficiency – Individuals 5 years and over who speak English "not well;"
- Zero Automobile Households – Households without an automobile;
- Female Headed Household – Households with a female head; and
- Limited Educational Attainment – Persons 25 years and over with no high school diploma.

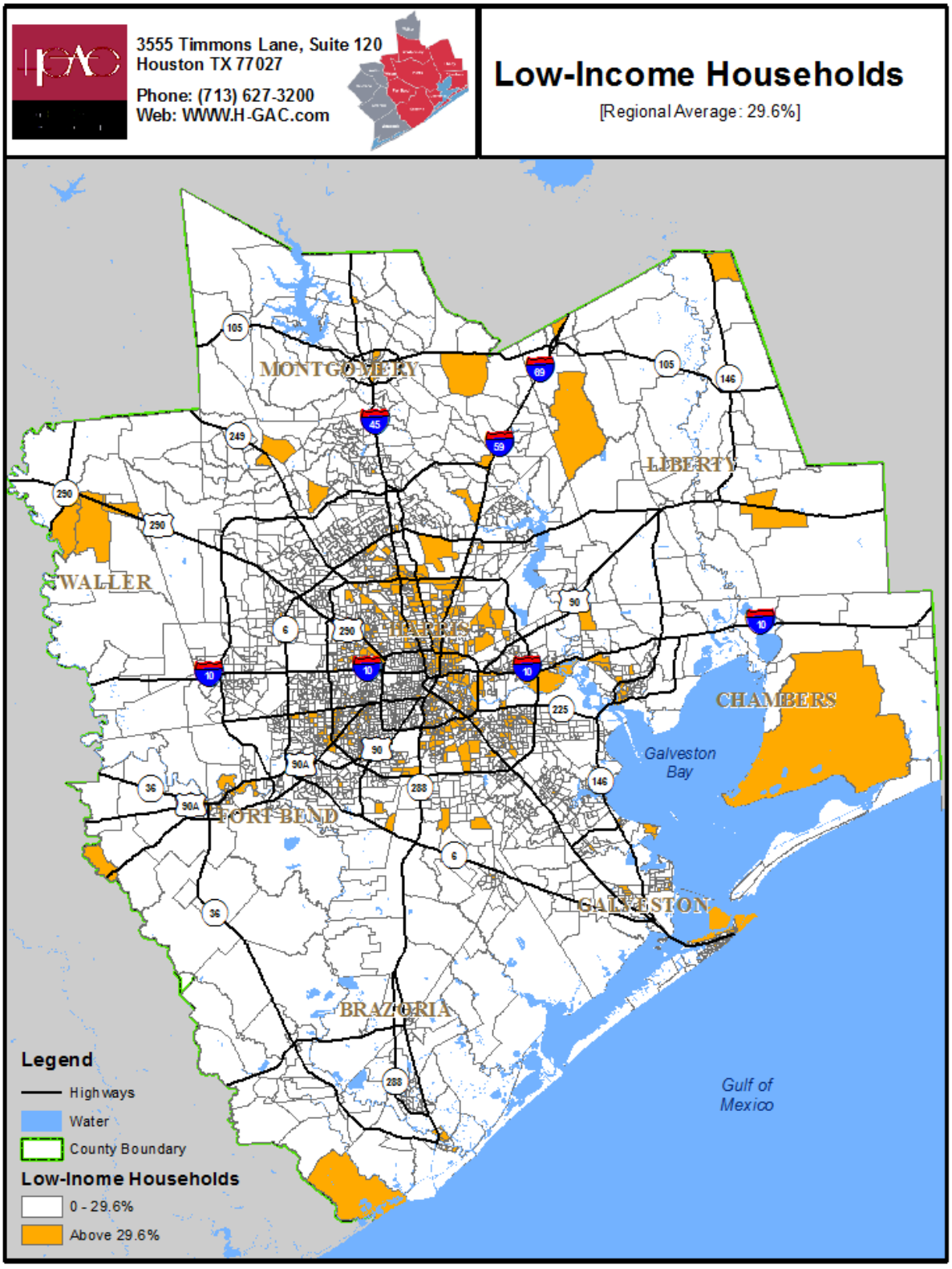
To map the secondary environmental justice indicators, a census block-group is identified as disadvantaged where the number of citizens in the applicable demographic category exceed the regional average for that category, adjusted by one standard deviation. All these environmental justice indicators considered together create a composite map of "disadvantage" within the planning region . It should be noted that because either racial minority status *or* low-income status qualifies an individual for environmental justice recognition, both count as one indicator where either or both exist in qualifying proportions in the Census Block-Group/TAZ.

A novel but potentially informative picture of the probable severity of a project on the environmental justice population may be obtained by examining a map of the concentrations of disadvantage. A concentration of disadvantage exists in a census block-group/TAZ where one or more of the secondary indicators of disadvantage listed above apply – *in addition* to minority and/or low-income status (Map 7). The greater the number of indicators of disadvantage attributed to a census tract/TAZ, the higher the concentration of disadvantage. Arguably, a community that is saddled with a series of socio-economic handicaps would be more vulnerable to, and less able to recover from the adverse effects of development.

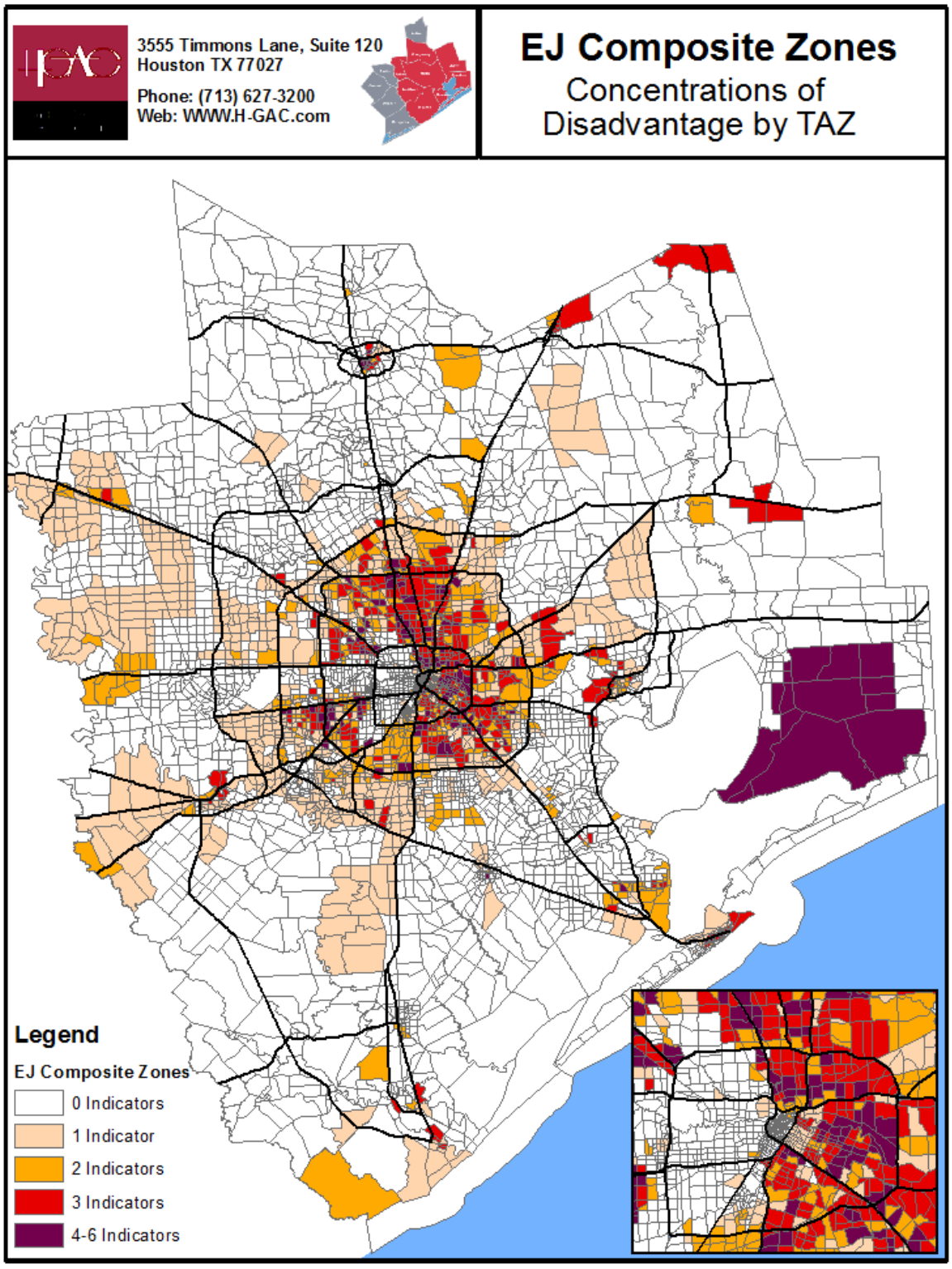
Map 5: Minority Population Concentrations by Census Block-Group



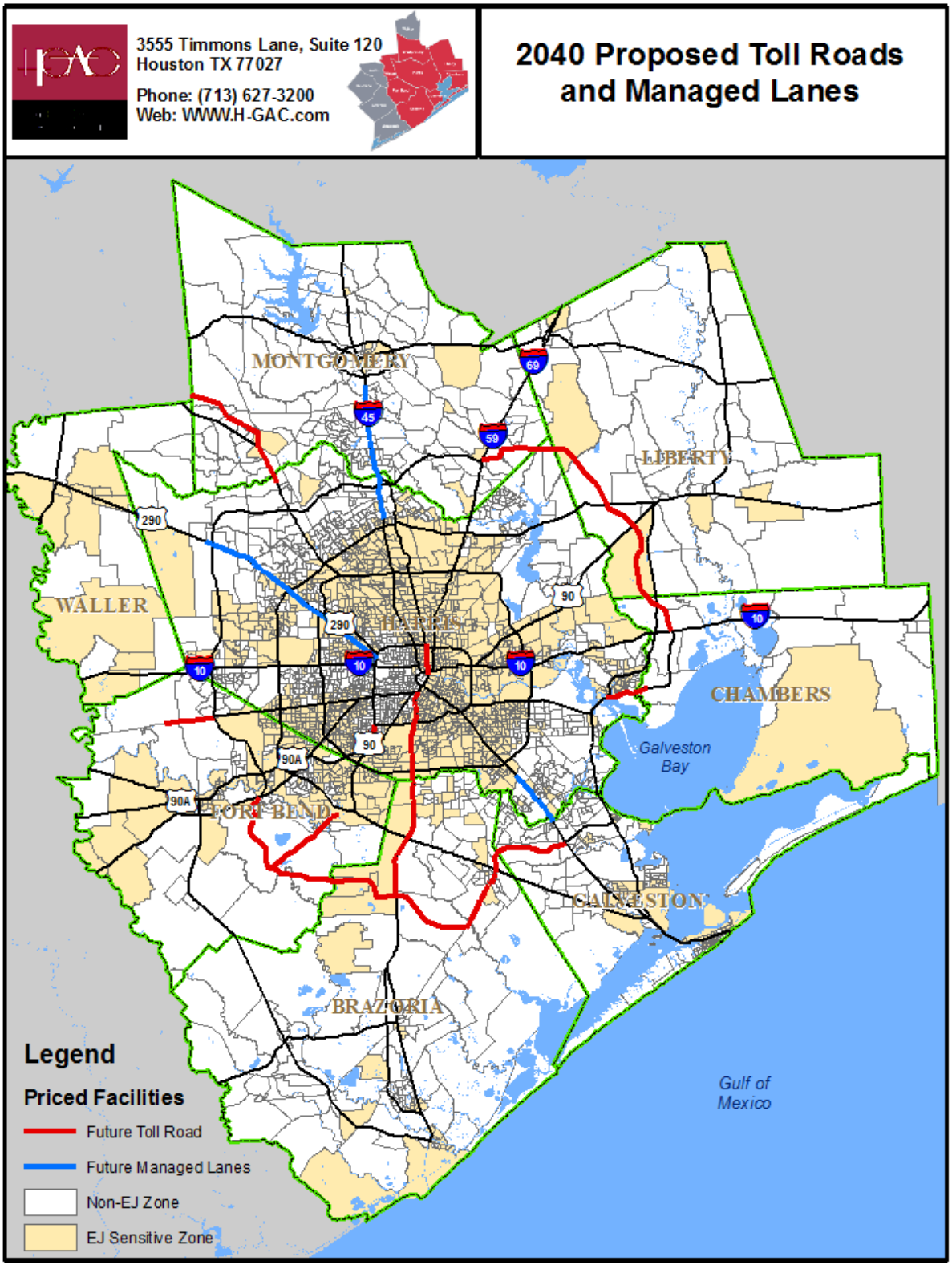
Map 6: Low-Income Population Concentrations by Census Block-Group



Map 7: Concentrations of Disadvantage by Traffic Analysis Zones



Map 8: Proposed 2040 Expansion of the Toll Road and Managed Lane Network



4.2. ASSESSING THE ENVIRONMENTAL JUSTICE IMPACT OF TOLL ROADS

Several different measures, methodologies, and analytical technics have been proffered for assessing the environmental justice impacts of toll roads, many of which lend themselves more to project level analysis than to a system-wide review.[30] The primary environmental justice concern regarding toll road projects is tied to equity: whether expanding the tolled network will affect the low-income and minority populations differently from the non-protected population. Pointed questions that must be answered will include:

1. Whether the non-protected communities will benefit from improved access, faster trips, and congestion relief while the minority or low-income community receive fewer or no benefits;
2. How the new toll roads affect the travel behavior of the environmental justice community;
3. If there are reasonable alternative non-tolled transportation routes available to those who cannot afford to pay the toll; and
4. How toll revenues are used.

"Mobility" and "Accessibility" are quantitative measures which describe travel related benefits that may be obtained from enhancements to the road network and lend themselves to a region-wide assessment. Mobility measures the ability to travel from one location to the other - expressed in travel time. A mobility analysis compares the travel time that would be experienced by persons who reside in environmental justice zones with travel time for residents of the non-environmental justice zones. Accessibility on the other hand assesses the level of connectivity within the transportation network, and expresses how well the transportation network enables the traveler access to specific desired destinations and "opportunities." Mobility and accessibility have a direct impact on the quality of life of the community. It is assumed that the introduction of a new tolled facility would result in savings in travel time for those persons who chose to use a priced facility. It is also expected that the diversion of traffic from the general-purpose lanes to a new toll facility would reduce congestion on those roadways from which tollway traffic was diverted or redistributed. These assumptions must however be tested, to verify that the benefits of the toll road construction accrue equitably to the general population.

4.3. TRAVEL DEMAND ANALYSIS – METHODOLOGY AND ASSUMPTIONS

To conduct a mobility/accessibility analysis to determine the effects of priced facilities on environmental justice populations, a traffic demand model analysis was applied to the following transportation networks:

- The 2017 network – containing all the network facilities that exist in the year 2017.
- The 2040 RTP Build network – containing all programmed RTP facilities, including the proposed priced facilities scheduled to be built by 2040.
- The 2040 RTP No-Build network – containing all programmed RTP facilities except the priced facilities scheduled to be built after 2017.

The travel demand model simulates trips between TAZs, applying a "mode choice" analysis. The mode choice analysis implies that certain assumptions are made about the travel behavior of individuals and

[30] Prozzi et. al., (2006). Guidebook for Identifying, Measuring and Mitigating Environmental Justice Impacts of Toll Roads.

about the choice of transportation mode they make for each proposed trip. The system-wide mobility analysis models trips from home to work (HBW) and trips from home to non-work destinations (HBNW), producing estimates of the time it would take to travel between each origin and destination zone. Two travel time estimates are computed: (1) average trip length using tolled links, referred to as the "toll path" travel time, and (2) average trip length using the network without toll links, referred to as the "free path" travel time. Where travel time can be saved by using a toll path rather than a free path, the toll link is considered a "candidate" for the trip length analysis. If the toll path does not offer a shorter travel time than the free path, the toll path is a non-candidate path for the trip length analysis. The impact of the new toll facilities on mobility is determined by comparing average travel time for trips on the toll paths versus the free path - for both the build and the no-build alternatives.

4.4. MOBILITY ANALYSIS - HOME-BASED WORK TRIPS

Table 16 presents the number of home to work trips for the year 2040 and the predicted average trip lengths for both the free and tolled path options under the Build and the No-Build alternatives. The trip lengths are based upon the morning peak congested travel period. Some pertinent observations may be made from the data:

Of the total 4,241,724 HBW trips forecasted, 2,625,543 (61.9%) were produced by EJ zones while 1,616,181 (38.1%) were produced by non-EJ zones. However, of the trips that originated from an EJ zone, only 23.3% were identified as candidate trips (trips for which travel time could be saved by using the new toll facilities). In comparison, 33.8% of the trips that originated from a non-EJ zone were identified as candidate trips. Again, there were almost twice as many non-candidate trips originating from the EJ zones (2,013,900) as those originating from the non-EJ Zones (1,069,997). The EJ zones have a smaller proportion of candidate trips than would be expected based on their share in the population and the total number of trips they generate. This under-representation of the EJ candidate trips is likely to be a factor of the geographic location of the toll road network relative to the non-protected population.

For both the 2040 build and the no-build networks, the average trip length of the candidate trips is greater than those of the non-candidate trips. This couples with the fact that the average trip length for trips originating from the non-EJ zones is significantly larger than those that come from the EJ zones. Several conclusions may be drawn from these observations. Toll roads are designed to support rapid movement to and from the suburbs, consequently fewer inner-city trips will have optimal routes that could benefit from time saving via a tolled pathway. This buttresses the argument that the toll roads in the region appear to be geographically situated to meet the travel needs for the sub-urban destinations more than the travel needs of protected population, who generally tend to be situated closer to the inner city.

Other inferences may however be made from a comparison of average travel time savings between the trips from the EJ zones and the non-EJ zones. Overall, the addition of toll facilities in the 2040 build network would result in reductions in average travel time for both the EJ zones and the non-EJ zones (Table 17). For the 611,343 candidate trips originating from an EJ zone, choosing the toll path on the build network would save an average of almost one minute over toll path trips on the no-build network, and as much as 3.6 minutes over trips along the free path. Similarly, for the 546,184 candidate trips that

originate from a non-EJ zone, trips using the toll path in the build network would save an average of 2.3 minutes over toll path trips on the no-build network, and as much 4.9 minutes when compared with trips along the free path.

Table 16: 2040 HBW Person Trips – AM Peak Average Trip Lengths in Minutes

Production Zones	Segmentation of 2040 HBW Person Trips by potential time savings	Number of 2040 HBW Person Trips		2040 Build Network		2040 No-Build Network	
				ATL using a Toll Path (Minutes)	ATL using a Free path (Minutes)	ATL using a Toll Path (Minutes)	ATL using a Free Path (Minutes)
EJ Zones	Trips that can save 0+ minutes using a new toll facility	611,643	14.4%	33.3	36.9	34.2	37.3
	Trips that cannot save 0+ minutes using a new toll facility	2,013,900	47.5%	19.7	20.7	19.8	20.8
Non-EJ Zones	Trips that can save 0+ minutes using a new toll facility	546,184	12.9%	44.5	49.4	46.8	51.0
	Trips that cannot save 0+ minutes using a new toll facility	1,069,997	25.2%	24.4	25.4	24.7	25.9

AM Peak Average Trip Length (ATL) in minutes for Free Path and Tolled Path options under the Build and the No-Build networks

Table 17: Differences in Average Trip Lengths for 2040 HBW Person Trips

Production Zones	Segment of 2040 HBW Person Trips by potential time saving	Number of 2040 HBW Persons Trips	Differences in ATL for Toll Path Options (No-Build ATL – Build ATL)	Differences in ATL for Free Path Options (No-Build ATL – Build ATL)
EJ Zones	Trips that can save 0+ minutes using a new toll facility	611,643	0.9 Minutes	0.4 Minutes
	Trips that cannot save 0+ minutes using a new toll facility	2,013,900	0.1 Minutes	0.1 Minutes
Non-EJ Zones	Trips that can save 0+ minutes using a new toll facility	546,184	2.3 Minutes	1.6 Minutes

	Trips that cannot save 0+ minutes using a new toll facility	1,069,997	0.3 Minutes	0.5 Minutes

Difference in 24 Hour Average Trip Lengths for 2040 HBW Person Trips

The difference in average travel time savings for trips originating in the EJ zones and the non-EJ zones probably reflects the urban nature and consequently shorter trips for the protected population as opposed to the suburban trip origins and longer average distances travelled by the non-protected population.

4.5. MOBILITY ANALYSIS - HOME-BASED NON-WORK TRIPS

Home-based non-work (HBNW) trips include discretionary or non-mandatory trips that may not typically occur during peak traffic periods. The HBNW travel times are therefore based on 24-hour off-peak speeds. Like the home-based work trip analysis, the HBNW analysis models the 2017 network, the 2040 build network, and the 2040 RTP No-Build network. The analysis predicts average trip lengths for candidate and the non-candidate trips on both the free and tolled path options. Table 16 presents the home-based trips to non-work destinations. Certain observations may be made from the data:

Of the 18,151,002 HBNW trips predicted, 11,074,791 (61.0%) originated from an EJ community, while 7,076,211 (39.0%) were produced by the non-EJ zones. These proportions are very similar to the HBW trips discussed earlier. The analysis of HBNW trips however showed that a smaller proportion of the trips that originated from an EJ zone (6.8%) were identified as candidate trips for a toll path than those that originated from a non-EJ zone (12.2%). Furthermore, there are about 40% more non-candidate trips that originate from an EJ zone (10,320,885) as those that originate from the non-EJ Zones (6,212,945).

These observations again lend support to the argument that the suburban travel focus of the toll facilities geographically tends to benefit the non-EJ population at a higher rate than it does the protected population, who are more likely to have an inner-city location which are not situated for an extensive use of tolled facilities.

Table 18 compares the differences in the average trip lengths by toll paths and by free path options for the HBNW trips. Under the build network, candidate HBNW trips originating from an EJ zone using a toll path rather than the free path would enjoy an average travel time saving of 3.7 minutes. This is compared with the 5.2 minutes in average travel time savings that would accrue to non-EJ zone trips which use a toll path rather than a free path. Generally, there are more opportunities for travel time savings using toll facilities under the build alternative than under the no-build alternative. It should however be noted that for the non-candidate trips that originate from either of the EJ zones or the non-EJ zones, there is virtually no difference in average travel time savings using a tolled or non-tolled path in both the build and the non-build networks (Table 19). This suggests that system-wide, there may be only marginal congestion relief for the non-tolled roadway deriving from the shift of some traffic from the general purpose lanes to a toll path.

Overall, the travel demand model results suggest that both the EJ zone trips and the non-EJ zone trips would benefit almost equally from the addition of priced facilities in the build network, and the EJ community would not be disproportionately impacted by mobility restraints.

Table 18: 2040 HBNW Person Trips – 24 Hour Average Trip Lengths in Minutes

Production Zones	Segmentation of HBNW Person Trips by potential time saving	Number of 2040 HBNW Persons Trips		2040 Build Network		2040 No-Build Network	
				ATL using a Toll Path (Minutes)	ATL using a Free Path (Minutes)	ATL using a Toll Path (Minutes)	ATL using a Free Path (Minutes)
EJ Zones	Trips that can save 0+ minutes using a new toll facility	753,906	4.1%	22.5	26.2	23.4	26.4
	Trips that cannot save 0+ minutes using a new toll facility	10,320,885	56.9%	11.3	11.7	11.3	11.7
Non-EJ Zones	Trips that can save 0+ minutes using a new toll facility	863,266	4.8%	32.8	38.0	35.1	38.7
	Trips that cannot save 0+ minutes using a new toll facility	6,212,945	34.2%	13.6	13.9	13.6	14.0

24 Hour Average Trip Length (ATL) in minutes for Free Path and Tolled Path options under the Build and the No-Build networks.
Difference in AM Pear Average Trip Lengths (ATL) in Minutes.

Table 19: Differences in Average Trip Lengths for 2040 HBNW Person Trips

Production Zones	Segmentation of HBNW Person Trips by potential time saving	Number of 2040 HBNW Persons Trips	Differences in ATL for Toll Path Options (No-Build ATL – Build ATL)	Differences in ATL for Free Path Options (No-Build ATL – Build ATL)
EJ Zones	Trips that can save 0+ minutes using a new toll facility	753,906	0.9 Minutes	0.2 Minutes
	Trips that cannot save 0+ minutes using a new toll facility	10,320,885	0.0 Minutes	0.0 Minutes
Non-EJ Zones	Trips that can save 0+ minutes using a new toll facility	863,266	2.3 Minutes	0.7 Minutes

	Trips that cannot save 0+ minutes using a new toll facility	6,212,945	0.0 Minutes	0.1 Minutes

Difference in 24 Hour Average Trip Lengths for 2040 HBNW Person Trips.

4.6. ACCESSIBILITY ANALYSIS

"Accessibility" measures the number of activity centers or "opportunities" that may be reached by residents of a TAZ within a defined travel distance, travel time, or travel cost, and is an indicator of the quality of life for a community. The chosen metric for accessibility analysis is travel time. The analysis predicts the number of jobs that would be accessible to defined communities within 30 minutes when travelling by automobile, and within 60 minutes by transit. To analyze the effects of priced facilities on environmental justice populations, the traffic demand analysis was applied to three transportation networks:

- The 2017 network – containing all the network facilities that exist in the year 2017.
- The 2040 RTP Build network – containing all programmed RTP facilities, including the proposed priced facilities scheduled to be built by 2040.
- The 2040 RTP No-Build network – containing all programmed RTP facilities except the priced facilities scheduled to be built after 2017.

Table 20 shows the results of the region-wide analysis of accessibility to jobs, assessed for (1) the non-EJ neighborhoods, (2) the EJ neighborhoods, and (3) the EJ neighborhoods with high disadvantage. The analysis includes a focus on most vulnerable environmental justice communities, defined as communities which have the greatest concentration of indicators of hardship, to determine if they are disparately impacted compared with other communities.

Results of the analysis show that the 2040 build alternative would provide the protected population with 4.4% more jobs accessible within 30 minutes by automobile, and 17.3% more jobs accessible within 60 minutes by transit than was the case under 2017 conditions. Furthermore, the model predicts that under the 2040 build alternative, the EJ communities with high disadvantage would have as much as 17.3% more jobs accessible within 30 minutes by automobile, and 26.9% more jobs accessible within 60 minutes by transit than was the case with the 2017 network. Positive job access opportunities will also be available to the EJ communities under the no-build alternative for the transit users. This includes a 3.6% increase in the number of jobs accessible within 30 minutes by automobile and 16.8% within 60 minutes compared to the 2017 network for the EJ population. The EJ communities with high disadvantage can expect even higher job access numbers (16.5% within 30 minutes by automobile and 26.8% within 60 minutes by transit) than the EJ community at large.

Table 20: Accessibility to Jobs by Automobile and Transit Modes

	Number of Jobs Accessible within 30 Minutes by Automobile			Number of Jobs Accessible within 60 Minutes by Transit		
	2017 Network	**2040 Build Network**	**2040 No-Build Network**	**2017 Network**	**2040 Build Network**	**2040 No-Build Network**
Non-EJ Zones	937,833	844,709	839,970	2,031,672	1,965,868	1,937,073
Percent change from 2017 Network	-	-9.9%	-10.4%	-	-3.2%	-4.7%
EJ Zones	1,557,675	1,626,627	1,614,313	2,561,247	3,005,174	2,991,916
Percent change from 2017 Network	-	4.4%	3.6%	-	17.3%	16.8%
EJ Zones (With 4 or more Indicators of Disadvantage)	2,059,634	2,415,254	2,399,440	2,753,607	3,494,401	3,491,334
Percent change from 2017 Network	-	17.3%	16.5%	-	26.9%	26.8%

Source: H-GAC Travel Demand Model, 2017.

The predicted job accessibility numbers for the EJ community contrasts with the non-EJ communities which under the 2040 build alternative are projected to *lose* up to 9.9% of the jobs accessible within 30 minutes by automobile and *lose* 3.2% jobs accessible within 60 minutes by transit when measured against the 2017 network. Again, under the 2040 no-build alternative, the non-protected population is expected to lose access to even more job opportunities (10.4% by automobile and 4.7% by transit use), if the proposed toll facilities are not built. The diminished access to job opportunities for the non-EJ population may relate in part to the location pattern of future employment in the urban core areas coupled with the sub-urban extension of residences for the non-EJ population.

In summation, for both automobile and transit travel options, the protected population will have access to more jobs than the non-protected population. The difference in job access numbers is more pronounced for the transit mode, which is probably tied to three factors: (1) the convergence of most transit service in the urban core, (2) the location of most job opportunities in the central city, and (3) the tendency for the EJ communities, (especially those with high disadvantage), to be situated nearer the inner city. These observations have important implications for the choices of mitigation strategies for EJ communities impacted by development proposals. Relocating the community further away from the urban core would more than likely impact their access to jobs, and their overall quality of life.

4.7 TRANSPORTATION SYSTEM PERFORMANCE

Another set of metrics that can provide a comparative assessment of the potential impact of priced facilities on the environmental justice population in the region is the performance of the transportation network. A transportation equity enquiry looks at whether environmental justice communities will have similar benefits in travel conditions and congestion relief as the non-environmental justice communities in the region. The following analyses utilize the 2017 Network, the 2040 build network, and the 2040 no-build network and models morning peak conditions for automobile users and for transit trips.

Table 20 compares the average vehicle trip time, trip length, and trip speed for the metropolitan planning region as a whole, the non-environmental justice areas, the EJ communities, and the EJ communities with high disadvantage. The analysis includes a focus on the most vulnerable environmental justice communities, defined as communities which have the greatest concentration of socio-economic indicators that imply hardship, to determine if they are disparately impacted when compared with other communities in the region.

Table 21: Trip Characteristics (Roadway Users) - Morning Peak Period (6 am – 9 am)

	All TAZ Zones	Non-EJ Zones	EJ Zones	EJ Zones with High Disadvantage
	Average Vehicle Trip Time (Minutes)			
2017 Network	20.2	22.2	18.6	15.7
2040 Build Network	24.8	28.6	21.1	17.2
2040 No-Build Network	24.9	28.6	21.1	17.2
	Average Vehicle Trip Length (Miles)			
2017 Network	14.6	16.6	13.0	11.1
2040 Build Network	15.7	18.2	13.2	10.8
2040 No-Build Network	15.6	18.1	13.1	10.8
	Average Vehicle Trip Speed (Miles/Hour)			
2017 Network	43.5	44.8	42.1	42.2
2040 Build Network	38.0	38.2	37.6	37.8
2040 No-Build Network	37.6	37.7	37.4	37.6

Source: H-GAC Travel Demand Model, 2017.

Average vehicle trip time and trip speed is expected to degrade across the planning region due to the increase in the regional population, and the associated growth in the number of cars on the roadway. However, for all the travel networks, average vehicle trip time and vehicle speed performance for the EJ communities exceed the regional average and the non-EJ communities. The better road network performance and shorter trip lengths for the EJ communities may derive from their being situated closer to the urban core than the bulk of the non-EJ community.

Table 22 details the system performance for transit users, showing the total transit trips, average travel time, trip length, and trip speed in the morning peak period. In all the three travel networks, most transit trips are associated with the EJ community, which receive 65.7% of the total trips in the 2017 network. The proportion of total regional transit trips serving the EJ community will rise to 67.3% in the 2040 build network. Comparing the 2017 network and the build network, EJ zones with high disadvantage are expected to have the greatest percentage of increased service of all the communities studied.

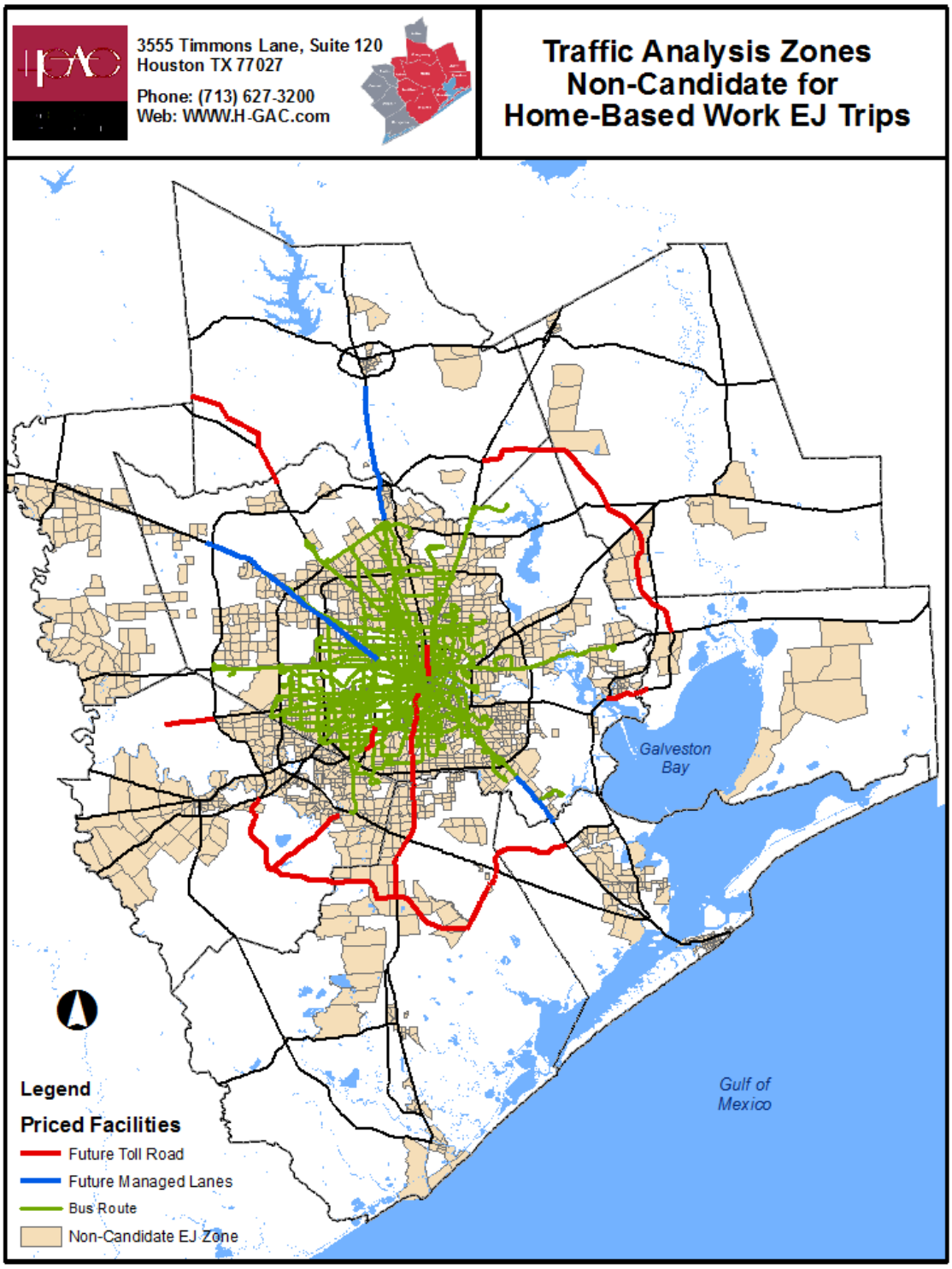
As with automobile traffic, average transit trip time and trip speed is expected to degrade across the planning region due to the increase in the regional population, and the associated growth in the number of vehicles on the roadway. For all the travel networks, average transit trip time and transit speed performance for the EJ communities exceed the regional average and the non-EJ communities. The larger proportion of transit trips, better system performance, and shorter transit trip lengths for the EJ communities may derive from their being situated closer to the urban core than the non-EJ community, and may reflect planned expansion and focus on transit planning efforts to meeting the need of the transit dependent population, who mostly come from among the minority and the low-income population.

Table 22: Trip Characteristics (Transit Users) - Morning Peak Period (6 am – 9 am)

	All TAZ Zones	Non-EJ Zones	EJ Zones	EJ Zones with High Disadvantage
	Average Vehicle Trip Time (Minutes)			
2017 Network	16.3	17.8	15.4	12.3
2040 Build Network	18.9	22.5	17.2	13.6
2040 No-Build Network	19.1	22.7	17.3	13.6
	Average Vehicle Trip Length (Miles)			
2017 Network	11.4	13.2	10.5	8.2
2040 Build Network	12.3	15.0	10.9	8.4
2040 No-Build Network	12.3	15.0	10.9	8.3
	Average Vehicle Trip Speed (Miles/Hour)			
2017 Network	42.2	44.4	40.9	40.2
2040 Build Network	38.9	40.0	38.2	37.0
2040 No-Build Network	38.9	39.6	37.9	36.8
	Number of Transit Trips			
2017 Network	164,354	56,402	107,952	21,565
2040 Build Network	234,997	76,918	158,080	33,854
2040 No-Build Network	237,792	78,429	159,363	33,985

Source: H-GAC Travel Demand Model, 2017.

Map 9: Non-Candidate Zones for EJ Home Based Work Trips and Transit Service



5.0 SOCIO-ECONOMIC PROFILE OF PRICED FACILITY USERS

H-GAC conducted a baseline study of Houston area toll facilities to characterize toll road usage and to understand the factors that influenced customer use of priced facilities.[31] The survey, which was administered in English and Spanish, solicited information on the frequency of use of HCTRA tolled facilities, trip purpose, origins and destinations, and customer opinions regarding the toll price schedules and general toll road operations. The study distinguished between electronic tag (EZ TAG) users and cash paying customers on the premise that this would reveal any differences in their socio-economic characteristics and expose any underlying environmental justice questions. Because the study looked at existing priced facilities, it does not directly address the issue of expanding the toll facility network. However, by describing who is using the toll roads, it informs on who is *not* using the priced facilities, and permits inferences that may facilitate efforts to measure the potential impacts of new toll facilities.

Survey responses cited three HCRTA toll facilities: Hardy, Sam Houston Parkway, and Westpark toll roads. The Westpark Toll road is restricted to electronic toll collection consequently no cash paying customer information was reported for that corridor.[32] Results of the study are summarized by Trip Characteristics, Demography, and Household Attributes.

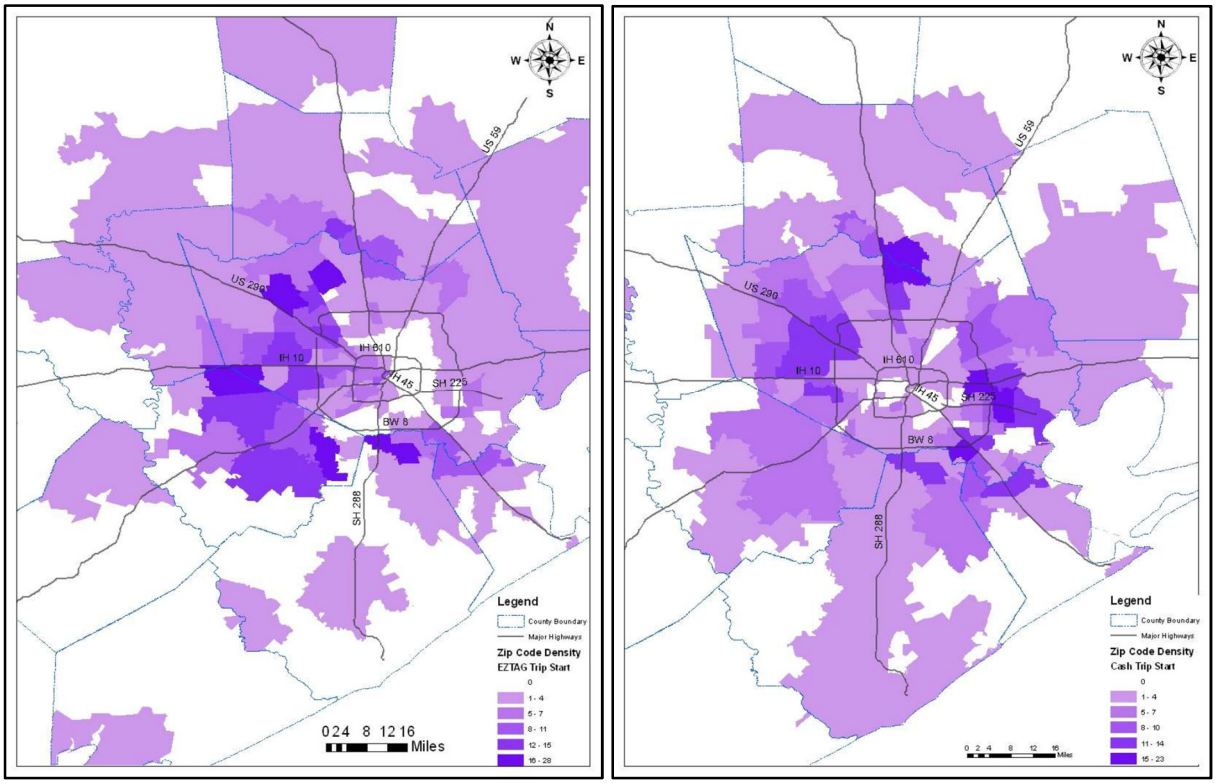
5.1. TRIP CHARACTERISTICS

The primary trip purpose for the majority of the EZ TAG patrons (54%) and especially the cash paying toll road customers (63%) was travel to work or for some work-related purpose, however, the frequency of toll road use varied within each group. While most customers used a toll road daily or weekly, some reported using a tolled facility only monthly or else "rarely." These could be persons who visited the Houston area from outside the region, or else local residents for whom paying a toll was reserved for those critical occasions when it was considered worth the price to save travel time. A greater proportion of cash paying customers (48%) reported using a tolled facility on a daily basis compared with patrons with electronic tags (35%), even though electronic tags were the more economical option of the two. In absolute numbers, most toll traffic occurred on the Sam Houston Parkway.

The largest concentration of trip origins for electronic tag users was suburban (outside the beltway), coming mostly from the far west, south, and northwest of the metropolitan area. These trip origins basically correspond with the analysis zones with no environmental justice concerns (Map 10). The most common trip destinations for this group of respondents included downtown Houston, the Westchase district, and the Greenspoint area. Trip origins for most cash paying toll road customers were also concentrated in suburban Zip Codes. However, an enclave of cash paying toll road users located in the far East of the City of Houston included EJ neighborhoods with a concentration of disadvantage. Destinations for the cash paying toll road users were concentrated in the downtown region, and at different activity centers along the beltway.

[31] Houston Toll Road User Survey, Texas Transportation Institute, 2009.
[32] Westpark Toll Road was the first in the nation to become completely electronic. The Hardy Toll Road has been turned into an all-electronic toll collection roadway since the survey was conducted.

Map 10: Trip Origins of EZ TAG and Cash Paying Toll Road Customers by Zip code



Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

5.2. DEMOGRAPHY

The racial composition of the toll road users reported by the study did not reflect the diversity in the region. Overall, Caucasians were the predominant users of the electronic tags (Table 23). Hardy Toll Road, a north-south thoroughfare which connects central Houston to Montgomery County, showed the greatest difference in the proportion of the White and the non-White toll road patrons. The numbers emphasize the under-representation of the minority residents among the EZ TAG toll road users, a fact which may have policy implications for the future implementation of toll road program. The Sam Houston Parkway was cited as the most frequently used toll road facility of all the EZ TAG options.

Table 23: Classification of EZ TAG Users by Race

Race	Hardy Toll Road	Percentage	Sam Houston Parkway	Percentage	Westpark Toll Road	Percentage	All	Percentage
WHITE	144	90%	616	79%	164	79%	924	81%
NON-WHITE	16	10%	160	21%	44	21%	220	19%
TOTAL	160	100%	776	100%	208	100%	1,144	100%

Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

Cash paying toll road respondents on the other hand were evenly split between the racial minority and the non-Hispanic White population (Table 24). Racial minority status is implicitly regarded as a surrogate for low-income status and further, low-income status is typically associated with a cash-based economy. Finding a higher proportion of minority respondents among the cash paying toll road patrons than among the EZ TAG customers follows the general expectation for the diverse region. The Sam Houston Parkway was shown to be the most used toll road of the cash payment options. It should be noted that the Sam Houston Parkway is currently the only tolled facility in the Houston regional network that still accepts cash payments.

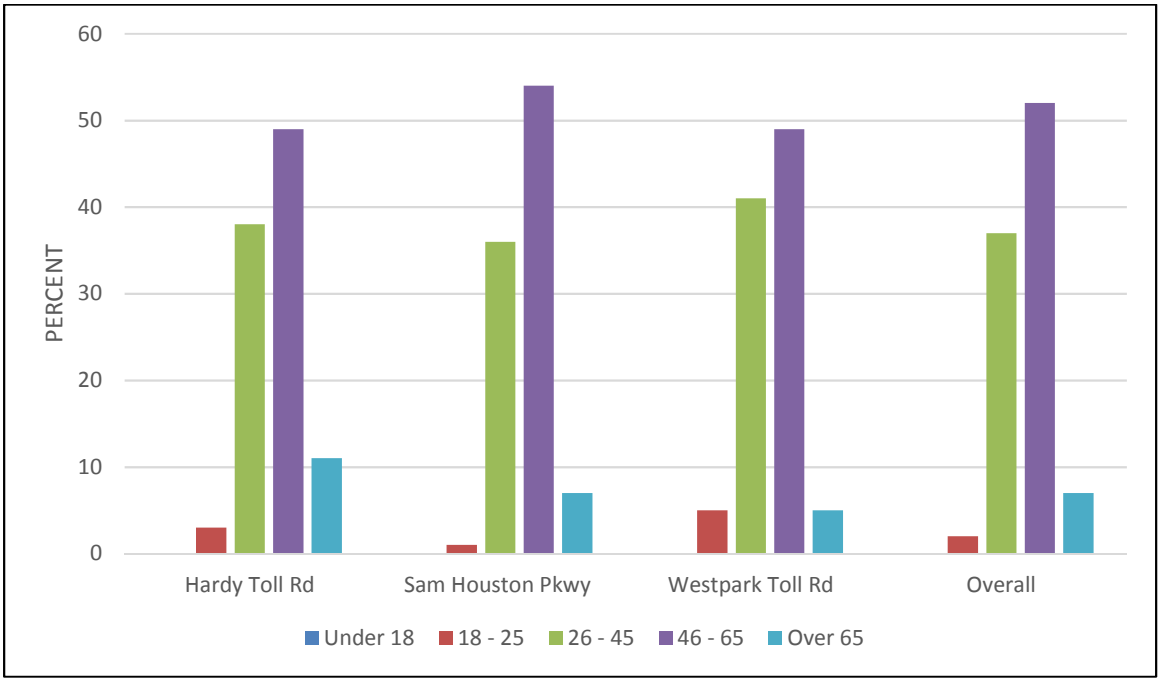
Table 24: Classification of Cash Paying Users by Ethnicity

Ethnicity	Hardy Toll Road	Percentage	Sam Houston Parkway	Percentage	All	Percentage
WHITE	112	56%	372	49%	484	50%
NON-WHITE	89	44%	395	51%	484	50%
TOTAL	201	100%	767	100%	968	100%

Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

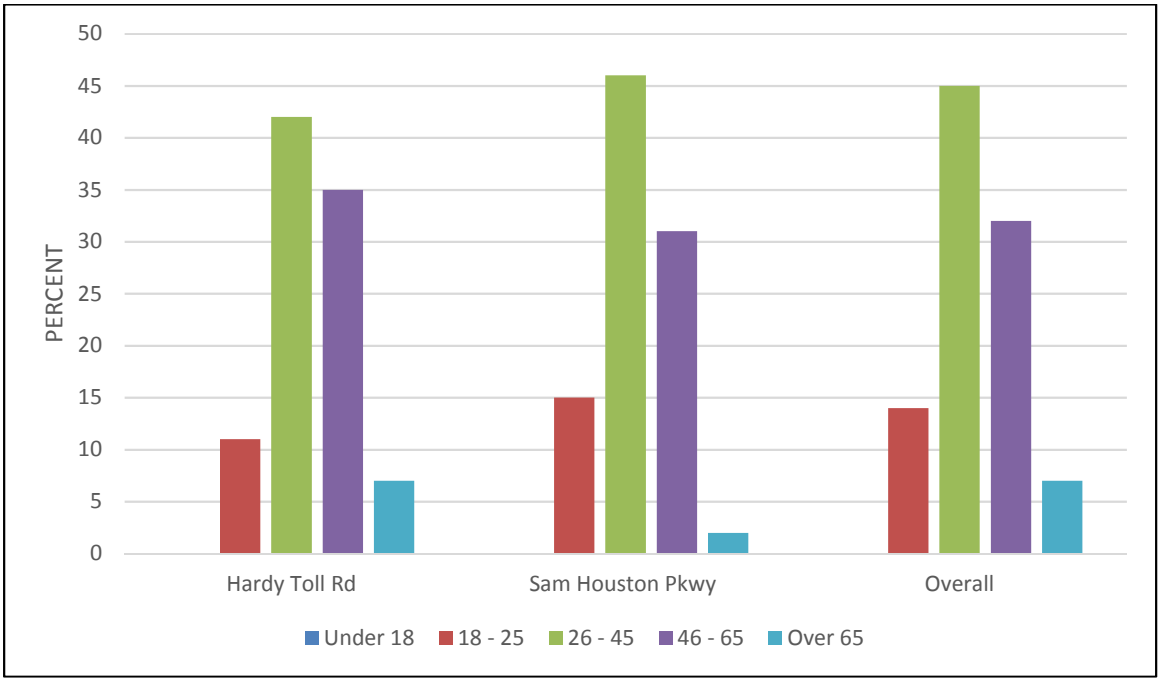
Age may sometimes be related to the economic or professional status of the respondent. None of the EZ TAG users or the cash paying respondents were under the age of 18. The survey however found that cash paying customers were generally younger than the electronic tag users. Most toll road users from both groups declared English to be their primary language.

Figure 5: EZ TAG Toll Road Users by Age



Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

Figure 6: Cash Paying Toll Road Users by Age



Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

5.3 HOUSEHOLD ATTRIBUTES

For the low-income population, road tolls can impose a severe burden on household finances - especially where it is impossible to avoid using a priced facility because there are no reasonable non-tolled alternatives available. The survey requested information about household income for both the electronic tag owners and the cash paying customers. Establishing the context, the median household income for the State of Texas when the survey was administered was $55,090 and the poverty level for a family of four set by the Department of Health and Human Services (HHS) was $22,050.

Overall, the electronic tag customers reported a higher household income than the cash paying customers (Table 25). About 73% of the electronic tag users had a household income over $63,000, and 30% of them reported a household income over $125,000. This contrasts with the cash paying respondents of whom 46% had a household income above $63,000, over half earned below or close to the State median household income, and up to 8% lived below or close to the poverty line.

Among other pertinent statistics, EZ TAG users had a higher education level than the cash paying toll road users. On the other hand, the cash paying customers reported having a slightly larger household size (2.86 compared to 2.4 for EZ TAG users), as well as a greater number of vehicles in the household (2.4 compared to 2.35) than the EZ TAG users.

Table 25: Classification of Respondents by Household Income

HOUSEHOLD INCOME (in Dollars)	EZ TAG USERS	CASH PAYING CUSTOMERS
$0 - $9,999	0%	2%
$10,000 – $23,000	0%	6%
$23,001 – $41,000	4%	20%
$41,001 – $63,000	12%	24%
$63,001 – $102,000	27%	27%
$102,001 – $125,000	16%	9%
Over $125,000	30%	10%
Unreported	11%	3%

Source: Houston Toll Road User Survey, Texas Transportation Institute, 2009.

5.4 LESSONS FROM THE TOLL ROAD USE STUDY

A key finding of the study on the socio-economic profile of toll road users was the under-representation of the environmental justice population - especially the low-income residents. This supports the known fact that road tolls can be a significant burden on household finances for the low-income family. Persons who cannot afford to pay the road toll are constructively excluded from using the priced facility. It must nevertheless be acknowledged that not all low-income individuals own an automobile, and furthermore, many trips that originate from an environmental justice neighborhood may not be situated geographically to be able to benefit from a tolled facility. Additional information that is unavailable but would be useful to have for this analysis include what proportion of household income is spent on road tolls, and what value of time (VOT) decisions underlie the choice to use a priced roadway or to take a non-tolled alternative.

The Toll Road Use survey also found that members of the environmental justice population who used a priced facility were more likely to pay their toll by cash rather than electronically. This was notwithstanding the fact that EZ TAG users payed a lower rate than those who paid by cash. A reason suggested for this finding was that the low-income population probably lacked the credit history necessary to establish their credit worthiness and therefore had a low incidence of credit card use. A credit card was however required to sign up for electronic billing.[33] Recognizing the different financial needs of potential users, HCTRA has since introduced the BancPass tag program which does not require a credit card and has a modest initiation fee and no minimum balance requirement. Moreover, the user account may be replenished by making a cash payment at a neighborhood store.

[33] Houston Toll Road User Survey, Texas Transportation Institute, 2009.

Lastly, most of the respondents reported that their trips on the priced facilities had origins in a "suburban" location, where suburban is defined as outside the Beltway. The toll roads facilitate suburban travel by virtue of their geographic location. This leads to the general conclusion that toll roads improve the access of upper-income commuters. Toll road use has increased by over 32% since the toll road user survey was completed (Table 6).

Merging the findings of the survey with the results of the mobility/accessibility analyses discussed earlier, the lower income commuters will not benefit from the expansion of the priced facilities network in a similar manner as the non-environmental justice population will. Practically, for lower-income commuters, the tolling the road may result in less access to services and opportunities, and their use of the priced facilities will likely remain restricted.

6.0 MITIGATION AND THE BALANCE OF EQUITY

The purpose of an environmental justice analysis is to achieve equity for the vulnerable and disadvantaged members of society. Environmental justice principles instruct that an enquiry into whether a project impact disproportionately burdens the minority or low-income population must be evaluated under the "totality of the circumstances." This means the dis-benefits of a project may be offset by other project benefits that accrue to the protected population, or by actions taken to mitigate the adverse consequences associated with the project. As mentioned earlier, the equity of a toll road investment may be examined by addressing certain directed questions. These include:

1. Whether the non-protected communities will benefit from improved access, faster trips, and congestion relief while the minority or low-income community receive fewer or no benefits;
2. How the new toll roads affect the travel behavior of the environmental justice community;
3. If there are reasonable alternative non-tolled transportation routes available to those who cannot afford to pay the toll; and
4. How toll revenues are used.

6.1 MOBILITY AND ACCESSIBILITY

The travel demand model analyses of regional mobility and accessibility indicate that the environmental justice communities would benefit from improved access, faster trips, and less congestion if the proposed priced facility network in the 2040 RTP is built. Like the non-environmental justice communities, trips that originate from environmental justice neighborhoods would experience savings in travel time if they used a toll road option for their morning peak travel time mandatory trips. Similar travel time savings would also be obtained for discretionary trips originating from the environmental justice communities when they used a toll path. In addition, with the implementation of the build network, roadway performance is expected to be slightly better in the EJ zones than it would be at the non-EJ zones. The travel demand model analyses and the Toll Road User Survey however also inform that there will be a segment of the population who cannot afford to use a priced facility. For them, the toll path is not a practical option even if there would be a savings in travel time. Furthermore, over 2 million or about 47.5% of all the HBW trips predicted by the travel demand model were non-candidate trips, and came from an environmental justice zone from which no trips could save travel time by using a priced facility (Table 16).

A mitigating circumstance is the availability of the non-tolled alternative. Virtually all the existing priced facilities in the Houston metropolitan region have general purpose freeway lanes or frontage roads throughout most of their length,[34] except some of the recently completed sections SH 99 Toll Road which has several miles of tolled lanes without a free alternate. Along those stretches of lane miles without a frontage road, the user of this facility would have no option but to pay the toll. For that facility, this would embody an EJ concern.

Another mitigating circumstance is the availability of transit service to the environmental justice neighborhoods. A map of the regional transit network was superimposed on the non-candidate EJ zones,

[34] Counting the N. Hardy Road as the non-tolled alternate to the Hardy Toll road.

which are TAZ zones from which none of the trips could save any travel time through using a priced facility (MAP 9). The dense network of bus routes serving these areas could ameliorate the lack of connectivity to the toll road system by ensuring a reasonable level of mobility through another vital travel mode. This is especially important considering that the travel demand model analysis estimated that the protected populations, especially those with high disadvantage, would have access to a significantly greater number of jobs when travelling by public transportation, than would be available to the non-EJ population (Table 20).

Transit service will play a key role in providing for the future mobility and accessibility of the EJ population. The travel demand model estimates that under the build network scenario, as much as 67.3% of all transit trips will occur within an EJ community (Table 22). A key drawback of transit service is the waiting and the long travel time associated with this travel mode. The expansion and more frequent transit service would enhance access to job opportunities and overall quality of life for the EJ population much more than service to the suburban regions. To mitigate for the general lack of access to the toll road investments by the low-income population, an equitable response would be to invest a portion of the toll road revenue in improving the transit system – which can be a benefit to all.

7.0 LAND USE

Transportation and land use are inextricably linked and inexorably connected. Transportation projects that bring new or expanded access to a neighborhood raise its potential for development. On the other hand, urban development and population growth generates additional travel and creates a demand for expanded transportation facilities. This section considers the potential for the new toll roads and managed lane facilities recommended in H-GAC's 2040 Long Range Plan to induce growth within the region and adversely impact the environmental justice community. The review is conducted at a system-wide level rather than on a project-by-project basis.

7.1 INDUCED GROWTH EFFECTS

The Center of Environmental Quality (CEQ) defines indirect effects as impacts caused by an action that are "later in time or farther removed in distance, but are still reasonably foreseeable."[35] These impacts may include changes in the pattern of land use, increases in the population density or the growth rate in the area of influence, and the associated impacts of this growth on the natural environment. Indirect effects will generally occur outside the right-of-way (ROW) of a project. Several factors have been identified as being conducive to inducing growth. These include the availability of land for development; added capacity from a proposed project action; substantial increase in access and mobility in the project area; and an existing population and economic growth in the project area.[36] These factors are present within the current study region. This high-level review is supported using GIS\Cartographic technology and the application of planning judgment.

The core area of the City of Houston is heavily built-up and there is little potential for additional development. The proposed priced facilities that extend existing toll roads into the sub-urban counties stretch towards or pass through rural areas consisting of prairie grassland, woodlands, farm land, and urbanized areas. Judging, among other things, from the experience of completed segments along these corridors, building the proposed priced roadways could potentially attract development to take advantage of anticipated improved mobility. The general direction of growth of the Houston metropolitan region is towards the suburbs to the West, South, and Southwest. Increasing opportunities for faster access to the urban core will probably attract more development to these areas further away from the metropolitan region. Considered at a high level, there are no major natural barriers to development identified.

7.2 ENVIRONMENTAL JUSTICE CONCERNS

Several environmental justice concerns are associated with transportation projects that increase capacity and access, the most prominent of which is probably the displacement impact. Displacement occurs from the extension of the ROW to accommodate a new or expanded facility. Displacement is also attributable to gentrification, where a residence or business owned by a minority or low-income individual is "priced out" of the real estate market due to changes in the value of land in proximity to the transportation development. Recent studies suggest that nationally and in the Houston region, poverty is creeping

[35] 40 C.F.R. §1508.8.
[36] Indirect Impacts Analysis Guidance, TxDOT (September 2015).

towards the suburbs because of the gentrification of the inner city. The potential for the displacement of the disadvantaged population may be better analyzed at the project level.

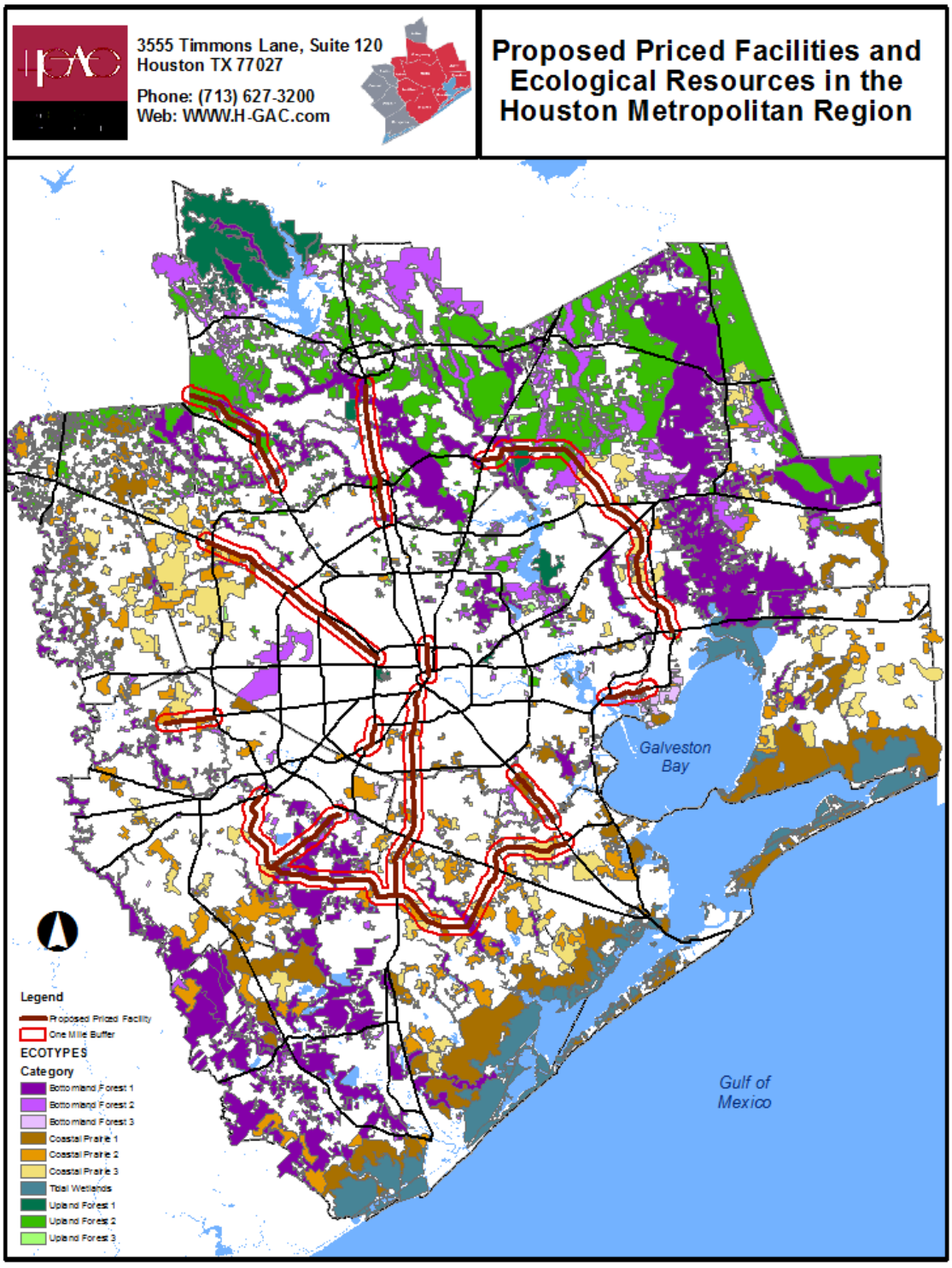
8.0 VEGETATION\ECOLOGICAL RESOURCES

The construction of the toll and managed lane facilities recommended in the 2040 RTP Update will likely have an impact on the vegetation, ecological resources and wildlife habitats in the region. The Houston-Galveston Area Council identified, classified, and mapped the most valuable ecosystem resources within its planning region through the Eco-Logical initiative: a program advocated and funded in part by the FHWA (Map 9). The "Ecotypes" identified include Prairie Grasslands, Bottomland Forests, Upland Forests, and Wetlands. These ecological resources help to control erosion, improve air quality, moderate temperature, provide flood control, sustain the bio-diversity in the region, maintain water quality and provide habitat to the wildlife.

Because much of the City of Houston is intensely built-up, most of these natural ecosystem resources have already been removed and been replaced with urban development. Within the urban core, the expansion of the priced facilities is not likely to have a significant impact on any remaining ecological resources. However, a great proportion of the large and contiguous stands of high quality ecological resources that remain in the region are located in the suburban and rural areas of the planning region, outside the beltway. In these areas, the preparation of the ROW and construction of the new priced facilities will involve the disturbance or removal of grassland, forest and wetland habitats. In addition, the improvements in access provided by the roadway facilities will likely attract further development to the region, which will result in the additional loss of these vegetation and habitat stands.

Impacts to the vegetation and ecological resources may be minimized through the use of best management practices that curtail project impact during construction, and avoid the disturbance or removal of ecological resources where unnecessary.

Map 11: Proposed Priced Facilities and the Eco-Logical Landscape



8.0 AIR QUALITY

The EPA has designated the Houston-Galveston-Brazoria area as a non-attainment area for ground-level Ozone under the National Ambient Air Quality Standard (NAAQS) therefore, pursuant to the Clean Air Act Amendments of 1990 (CAAA), all transportation plans, programs, and projects funded by the Federal Highway Administration (FHWA) or Federal Transit Authority (FTA) must conform to the State Implementation Plan (SIP). This is to ensure that these activities do not create conditions that worsen the existing air quality violations or delay the timely attainment of the National Ambient Air Quality Standards.

The proposed additions to the toll road and managed lanes network recommended in the 2040 RTP have undergone a conformity determination to verify that vehicle emissions of nitrogen oxides and volatile organic compounds (VOCs) resulting from the implementation of these projects will not exceed the emission budgets established in the SIP for these Ozone precursors. Additionally, building the regional priced facility system would provide additional travel capacity to the regional transportation network and facilitate a higher LOS and improved throughput of traffic in the region than the no-build scenario. Decreasing the number of cars travelling at lower speeds or under idling conditions will reduce their harmful emissions and help to improve air quality.

During the construction phase, there may be increases in the particulate matter (PM) and in the Mobile Source Air Toxics (MSAT) emissions because of the construction activities. These will be temporary and may be minimized by the application of best practices that control these emissions at the construction site.

8.1 ENVIRONMENTAL JUSTICE CONCERNS

TxDOT's toll road guidance suggests that environmental justice concerns may arise where traffic is diverted through the neighborhoods adjacent to toll roads, causing higher levels of pollution in the local environment.[37] This diversion is experienced in the Baytown region where freight truck traffic travel on to SH 146 to avoid paying the toll on the Southeastern section of the SH 99 (Grand Parkway) toll road. Because these freight trucks idle at traffic lights, their emissions contribute to the pollution of the ambient air. The diverted truck traffic also poses a safety risk to the residents of the neighborhood, the local traffic, cyclists, and pedestrians. These issues are being studied in the SH 146 Subregional Study. The official findings will probably help to shape the measures recommended to address the problem.

[37] TxDOT, cited in Prozzi et. al., (2006). Guidebook for Identifying, Measuring and Mitigating Environmental Justice Impacts of Toll Roads

9.0 CONCLUSION

Based on the environmental justice analysis discussed above, building the priced facilities recommended in the 2040 Regional Transportation Plan Update will provide some benefit to the environmental justice population within the H-GAC planning region, and will probably not cause a disproportionately high and adverse impact to this protected population. Some mitigation actions are recommended to ensure that the toll road program comports with the standard of equity.

The Houston-Galveston Area Council in preparing the 2040 RTP Update included several levels of participation by members of the environmental justice communities, to exclude discrimination in the planning process. Given the benefits that will accrue to protected population from the building the priced facilities, the 2040 Regional Transportation Plan is consistent with Title VI of the Civil Rights Act of 1964 and Executive Order 12898 for environmental justice.

APPENDIX A

TRANSPORTATION SYSTEM PERFORMANCE MEASURE SUMMARY HOUSTON TEXAS 2015

Performance Measure Summary - Houston TX

There are several inventory and performance measures listed in the pages of this Urban Area Report for the years from 1982 to 2014. There is no single performance measure that experts agree "says it all." A few key points should be recognized by users of the Urban Mobility Scorecard data.

Use the trends – The multi-year performance measures are better indicators, in most cases, than any single year. Examining a few measures over many years reduces the chance that data variations or the estimating procedures may have caused a "spike" in any single year. (*5 years is 5 times better than 1 year*).

Use several measures – Each performance measure illustrates a different element of congestion. (*The view is more interesting from atop several measures*).

Compare to similar regions – Congestion analyses that compare areas with similar characteristics (for example, population, growth rate, road and public transportation system design) are usually more insightful than comparisons of different regions. (*Los Angeles is not Peoria*).

Compare ranking changes and **performance measure values** – In some performance measures a small change in the value may cause a significant change in rank from one year to the next. This is the case when there are several regions with nearly the same value. (*15 hours is only 1 hour more than 14 hours*).

Consider the scope of improvement options – Any improvement project in a corridor within most of the regions will only have a modest effect on the regional congestion level. (*To have an effect on areawide congestion, there must be significant change in the system or service*).

Performance Measures and Definition of Terms

Travel Time Index – A measure of congestion that focuses on each trip and each mile of travel. It is calculated as the ratio of travel time in the peak period to travel time in free-flow. A value of 1.30 indicates that a 20-minute free-flow trip takes 26 minutes in the peak.

Planning Time Index – A travel time reliability measure that represents the total travel time that should be planned for a trip. Computed with the 95th percentile travel time it represents the amount of time that should be planned for a commute trip to be late for only 1 day a month. If it is computed with the 80th percentile travel time it represents the amount of time that should be planned for a trip to be late for only 1 day a week. A PTI of 2.00 means that for a 20-minute trip in light traffic, 40 minutes should be planned.

Peak Commuters – Number of travelers who begin a trip during the morning or evening peak travel periods (6 to 10 a.m. and 3 to 7 p.m.). "Commuters" are private vehicle users unless specifically noted.

Annual Delay per Commuter – A yearly sum of all the per-trip delays for those persons who travel in the peak period (6 to 10 a.m. and 3 to 7 p.m.). This measure illustrates the effect of traffic slowdowns as well as the length of each trip.

Total Delay – The overall size of the congestion problem. Measured by the total travel time above that needed to complete a trip at free-flow speeds. The ranking of total delay usually follows the population ranking (larger regions usually have more delay).

Free-Flow Speeds – These values are derived from overnight speeds in the INRIX speed database. They are used as the national comparison thresholds. Other speed thresholds may be appropriate for urban project evaluations or sub-region studies.

Excess Fuel Consumed – Increased fuel consumption due to travel in congested conditions rather than free- flow conditions.

Congestion Cost – Value of travel delay for 2014 (estimated at $17.67 per hour of person travel and $94.04 per hour of truck time) and excess fuel consumption estimated using state average cost per gallon.

Urban Area – The developed area (population density more than 1,000 persons per square mile) within a metropolitan region. The urban area boundaries change frequently (every year for most growing areas), so increases include both new growth and development that was previously in areas designated as rural.

Number of Rush Hours – Time when the road system might have congestion.