

Appendix B: Recommendations

Chapter 1: Regional Transportation Needs Assessment..... 2

Chapter 2: Operations Management 29

Chapter 3: Freight and Goods Movement 35

Chapter 4: Bicycle and Pedestrian Plan..... 60

Chapter 1

Regional Transportation Needs Assessment

H-GAC staff initiated a Regional Transportation Needs Assessment (RTNA) process to augment the standard call for projects from stakeholder agencies in the region. During the call for projects transportation agencies and their jurisdictions submitted projects for inclusion in the regional plan, and the MPO staff prioritized those projects for funding. Three additional sources of information were used to help identify the regional transportation needs for the 2025 Regional Transportation Plan (RTP):

- Public comments from meetings, focus groups, interviews and survey results;
- Roadway System Deficiency Analyses; and
- Transit System Service Analyses

It is important to note that the public involvement process that led to the 2025 RTP spanned several years beginning in the late 1990s, and continued into 2004. There was an interruption in the process due to legal actions related to the air quality conformity determination of the 2022 Metropolitan Transportation Plan (MTP) and 2022 MTP Update. However the comments and suggestions from the earlier public involvement efforts have been incorporated into this 2025 plan, along with more recent input. Some of the summary information and specific recommendations from a systematic 1999 transportation survey are noted below.¹

Public Input Summary

Based upon the 1999 survey results, the following conclusions can be drawn.

1. There appears to be a public desire for more of a balance in transportation priorities with an increased emphasis in the areas of public transportation, traffic safety, and congestion reduction.
2. “Quality of Life” factors (environmental related, congestion reduction, and neighborhood preservation) are the public’s most important concerns to be considered when developing solutions to our transportation needs.
3. A significant percentage of the respondents (37%) felt there was inadequate funding to meet our transportation needs within the next 10 years.
4. The most preferred strategies for meeting our future funding shortfalls were changing existing priorities, seeking more private sector contributions, and to a lesser extent, considering new tolls and parking fees.
5. The most effective strategies to change existing commuting habits are more flexibility in work hours and days followed by a guaranteed ride home program and improved transit service coverage.
6. Whereas a majority of the public appears to want to continue driving, a significant percentage (28%) of drivers want to change. The options they are willing to try are transit (bus and rail) and carpools and vanpools.

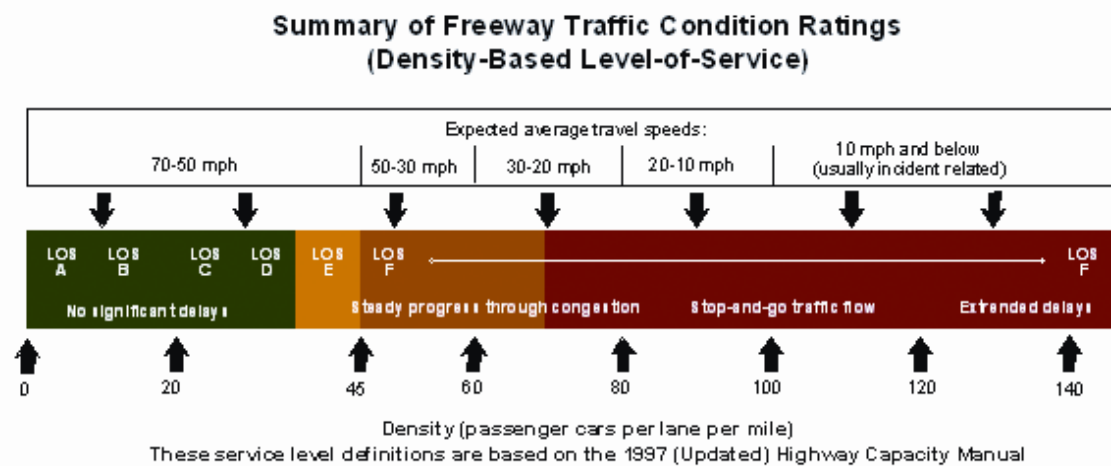
¹ Transportation Issues Public Opinion Survey, March 1999, Opinions Unlimited, Inc.

The 2025 RTP includes specific recommendations for projects, programs, and strategies that address the recommendations noted above. A summary of the extensive public involvement process and the comments received is provided in Appendix L.

Roadway System Deficiencies

The roadway system deficiency analyses are based on projected 2025 travel demand on the planned 2022 MTP roadway facilities. This analysis considered the regional freeway and arterial roadway systems with serious and severe levels of congestion measured by the Level of Mobility (LOM). The LOM was developed to graphically illustrate the degree of congestion on roadways within the region. The LOM is comparable to the standard engineering Level of Service (LOS) measure which is based on volume-to-capacity (V/C) ratios. The LOM incorporates local adjustments to account for facilities that carry higher volumes than they were designed to carry.

Level of Mobility	V/C Ratio	Level of Service (LOS)
Tolerable	V/C less than 0.85	A,B
Moderate	V/C between 0.85 and 1.00	C
Serious	V/C between 1.00 and 1.25	D
Severe	V/C greater than 1.25	E, F



This analysis resulted in the identification of 20% more roadway capacity needed than was estimated in the 2022 MTP. (Table 1). That result is mostly attributed to the more aggressive regional growth forecast of population and employment in the region. (See Appendix B-Regional Growth Forecast for more details). The viability of those improvements was determined based on a review of the major thoroughfares and the planned rights of way.

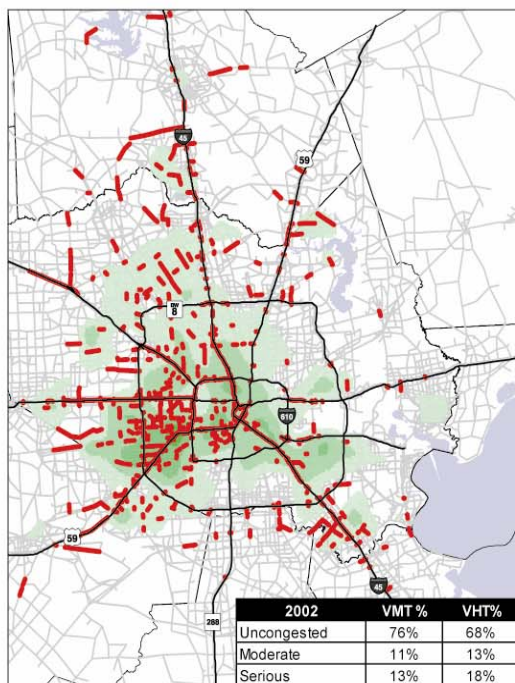
Table 1: Regional Roadway Deficiency Analysis

	Existing Lane Miles 2002	Planned Lane miles 2022	Proposed Lane miles 2025	% change 2002-2025	% change 2022-2025
Freeways/Tollways					
Freeways	3,200	4,700	4,100	28%	-13%
Tollways	400	700	2,100	425%	200%
HOV/HOT Lanes	100	300	300	200%	0%
Subtotal	3,700	5,700	6,600	78%	16%
Frontage Roads					
	2,200	2,700	2,700	23%	0%
Arterials					
Principal	3,600	4,400	1,200	-67%	-73%
Other	12,900	15,200	15,300	19%	1%
Smart Streets	0	0	8,800	n.a.	n.a.
Subtotal	16,500	19,600	24,200	68%	81%
TOTAL	22,400	28,000	34,600	55%	23%

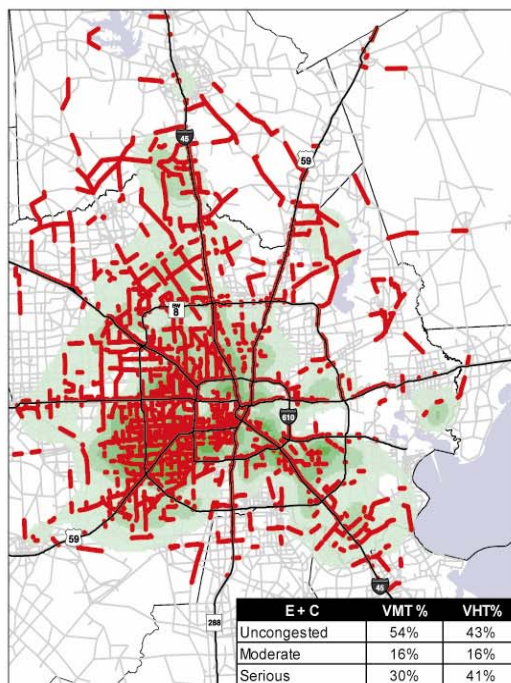
The series of maps below show the locations of the serious and severely congested roadway segments over time beginning with the current system, a no-build scenario, and the implementation of the 2025 RTP projects.

These maps show that even with the improvements proposed in the 2025 RTP, high levels of congestion will remain on several regionally significant roadway corridors. The corridors include Westpark, I-10 West (Katy Freeway), FM 1960, SH 6, I-45 North, SH 105 and several other principal roadways in northwestern and southwestern Harris County. The increases in the expected level of congestion, with the planned roadway improvements, highlight the importance of developing multimodal travel options in the region.

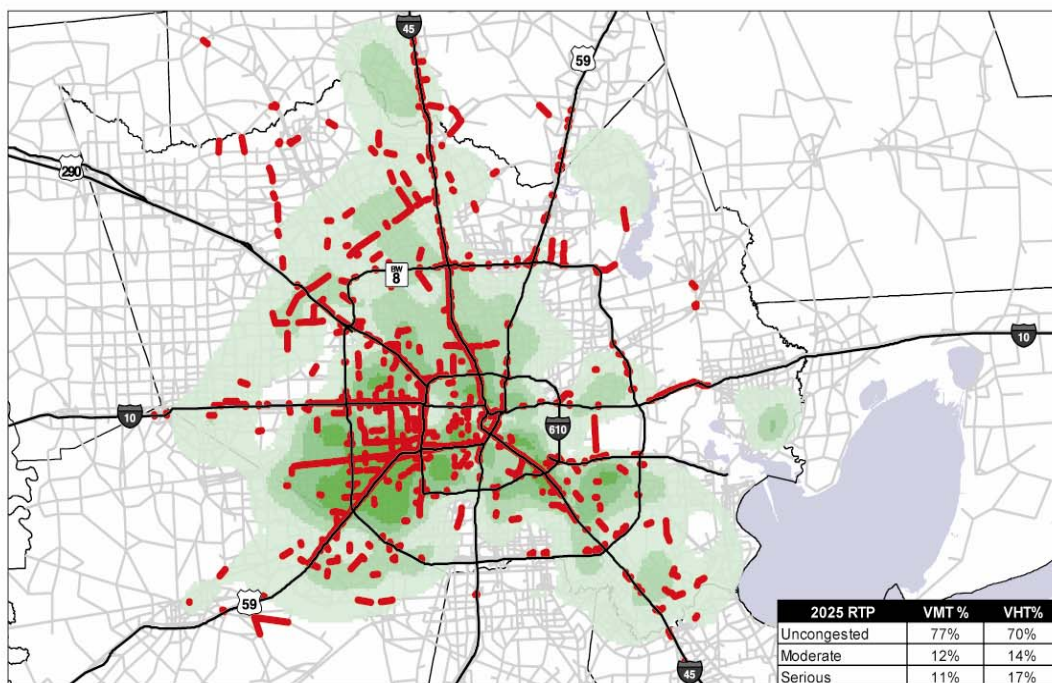
A second roadway deficiency analysis was based on historical speed profiles from the Transtar Web site for major freeway segments during peak travel periods in 2002. That data indicates the 10 worst or most deficient locations based on the slowest average speeds during the peak periods. (See Table 2).



2002 Congestion



2025 Existing + Committed Projects

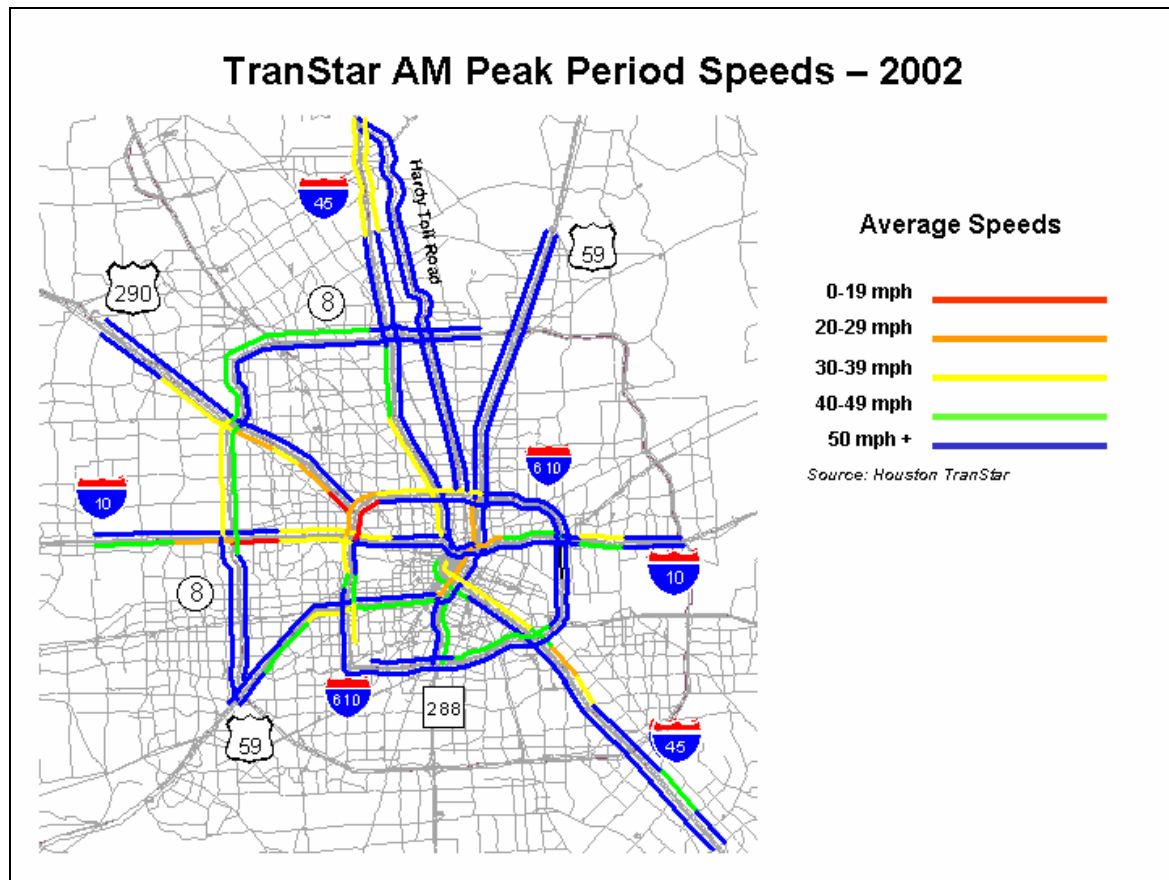


2025 Financially Constrained Plan

Table 2: Ten Most Deficient Freeway Segments for AM & PM Peak Periods – 2002
(sorted by slowest average speeds)

Freeway	Freeway Segment	AM Peak Hour	Avg. Travel Time	Avg. Speed
U.S. 59 Eastex Inbound	I-610 Loop to Downtown (4.45 mi.)	7:15-8:15	12.3	21.8
I-10 Katy Inbound	Barker-Cypress to I-610 Loop (13.90 mi.)	7:00-8:00	35.9	23.3
I-10 East Inbound	I-610 Loop to Downtown (4.10 mi.)	7:15-8:15	10.5	23.6
I-45 North Inbound	I-610 Loop to Downtown (4.80 mi.)	7:45-8:45	11.5	25.2
U.S. 290 Northwest Inbound	Barker-Cypress to I-610 Loop (17.15 mi.)	7:00-8:00	37.1	27.8
I-45 Gulf Inbound	I-610 Loop to Downtown (6.05 mi.)	7:15-8:15	11.6	31.5
I-610 West Loop Southbound	Ella to South Post Oak (9.50 mi.)	7:45-8:45	17.3	33.0
U.S. 59 Southwest Outbound	Downtown to I-610 Loop (7.40 mi.)	7:30-8:30	12.5	35.7
I-610 North Westbound	North Wayside to Ella (9.40 mi.)	7:15-8:15	15.6	36.2
I-45 Gulf Inbound	NASA Road 1 to I-610 Loop (15.55 mi.)	7:00-8:00	25.0	37.4
Freeway	Freeway Segment	PM Peak Hour	Avg. Travel Time	Avg. Speed
I-10 Katy Outbound	I-610 Loop to Barker-Cypress (13.95 mi.)	5:00-6:00	39.2	21.4
U.S. 59 Southwest Inbound	I-610 Loop to Downtown (7.40 mi.)	4:45-5:45	19.2	23.3
U.S. 59 Southwest Outbound	Downtown to I-610 Loop (7.40 mi.)	5:00-6:00	16.3	27.3
I-610 West Loop Southbound	Ella to South Post Oak (9.50 mi.)	5:00-6:00	20.7	27.6
U.S. 290 Northwest Outbound	I-610 Loop to Barker-Cypress (17.15 mi.)	5:00-6:00	37.2	27.8
SH 288 Outbound	Downtown to I-610 Loop (3.30 mi.)	5:00-6:00	7.0	28.4
I-10 Katy Inbound	Barker-Cypress to I-610 Loop (13.90 mi.)	5:15-6:15	29.0	28.8
I-610 West Loop Northbound	Stella Link to Ella (12.10 mi.)	4:00-5:00	23.9	30.4
I-45 North Outbound	Downtown to I-610 Loop (4.80 mi.)	4:15-5:15	9.4	30.6
I-45 North Inbound	I-610 Loop to Downtown (4.80 mi.)	4:45-5:45	9.4	30.7

Source: Houston TranStar (<http://traffic.tamu.edu/hist/traveltimes.html>)



Many of the deficient roadway segments noted above are associated with projects that are included in the financially constrained RTP, for example improvements to the Katy Freeway and the I-610 West Loop. Some of the projects identified above are not slated for improvements in the RTP at this time. Those will be highlighted and added to the unfunded needs list.

Further analyses of projected roadway system congestion levels have also identified more added capacity roadway projects that are warranted based on the travel demand estimates but may have right of way conflicts or would be very expensive. Those are included in the Unfunded Needs list (see Appendix P). Another step in the analyses identified additional thoroughfares that would be required to accommodate forecasted population densities in high growth areas. Needed thoroughfares were assumed to be either the construction of new two-lane roads or the widening of existing roads with additional lanes. Also under this analysis, conceptual facility spacing criteria were used to determine potential locations for a series of smart express streets and other roadway operational upgrades to improve traffic flow (Unfunded Needs-Appendix.P).

Transit Systems Service and Needs Analysis

The public transportation system deficiency analyses included the following steps:

1. A review of the geographic distribution of transit routes overlaid with the locations of forecasted high density population clusters. Those locations were examined for the potential for fixed-route bus transit in areas with population densities greater than 2,500 persons per square mile. The potential bus routes in the highest density areas were modeled to estimate potential ridership and costs.
2. Examination of those locations with concentrations of mobility limited persons including the low income and elderly in terms of the availability of demand response (dial-a-ride) para-transit services.

3. Development of a Transit Need Index for each county to point out those locations that have a combination of factors that result in a higher potential need for public transportation.
4. The examination of potential light rail extensions to the METRO Solutions 2025 plan and commuter rail operations in other corridors outside of the METRO Service Area. The results of those analyses are reported below.

The purpose of this transit analysis is to assess regional transit needs and to recommend viable options that address the identified needs. The analysis combines demographic factors, observed travel characteristics, and public transportation projections into a long-range, comprehensive plan. This document describes existing transit service and deficiencies, identifies current and future system needs, presents an analysis of the long-term potential for rail or additional service to outlying areas, and makes recommendations that will likely result in the achievement of tangible benefits such as decreased vehicle miles traveled (VMT), improved transit availability and access, and increased travel options.

Existing Public Transportation Service

Several transit agencies or social service providers currently serve the Houston-Galveston Transportation Management Area (TMA). Notably, all of the eight counties in the TMA have a degree of transit service. Table 3 summarizes the existing service providers.

Table 3: Public Transportation Service

Provider	Acronym	County of Service	Fixed-route	Type of Service	
				Paratransit	Commuter
Metropolitan Transit Authority	METRO	Harris	Yes	Yes, ADA	Yes
Brazos Transit System	BTS	Montgomery, Liberty	Yes	No	Yes
Island Transit	None	Galveston	Yes	Yes	No
Colorado Valley Transit	CVT	Waller	Yes	Yes	No
Gulf Coast Center/Connect Transportation	GCC	Galveston, Fort Bend, Brazoria	No	Yes	No
TREK EXPRESS	TREK	Fort Bend, Harris	Yes	No	Yes
Greater Greenspoint Mgmt District	GGMD	Harris	Yes	No	Yes
Senior Citizens Transportation of Chambers County	None	Chambers	No	Yes	No

Existing METRO Service

METRO, the largest transit provider in the region, serves most of Harris County and small portions of Fort Bend and Montgomery counties. METRO's service area encompasses approximately 1,300 square miles. The agency has 100 miles of barrier-separated high-occupancy vehicle (HOV) lanes operating on six freeways that carry 73,000 carpool and vanpool passengers daily. In January 2004, METRO began operating the Downtown to Reliant Park light rail line with 16 stations, including one new park and ride lot, two transit centers and a new light rail maintenance and storage facility.

Proposed Services

METRO Solutions Transit System Plan

On November 4, 2003, voters authorized METRO to proceed with a Transit System Plan that includes 72 additional miles of rail, the expansion of current bus services, issuance of up to \$640

million in bonds without raising taxes, and an extension of funding for street improvements through 2014.

The METRO Solutions Transit System Plan was developed based on the findings of several corridor planning studies, technical analyses and public input. METRO worked with the community for more than 18 months to develop the draft plan. Community input regarding the draft transit system plan was solicited at hundreds of meetings and from thousands of interested people. The METRO Solutions Transit System Plan adopted by the Board of Directors reflects the input received from the community and the corresponding additional technical analyses conducted in response to public comments.

The following is a summary of the various transit improvements included in the METRO Solutions Transit System Plan:

- Light rail transit (64.8 proposed new miles);
- Commuter rail transit (8 miles within METRO service area, 17 miles outside METRO service area extended to Richmond/Rosenberg, the extension to be funded by others);
- Nine new transit center;
- Upgrades to existing transit centers and park and rides;
- Nine new park and ride lots ;
- More than 250 miles of two-directional park and ride service;
- A 50 percent increase in bus service, including 1,038 new route miles, longer hours of service, and approximately 44 new bus routes, including five new Signature Express Cross-town routes which offer high-frequency, and limited-stop service in areas of high transit demand;
- New bus operating facility; and
- 1,000 passenger shelters, other amenities and lighting.

Other Proposed Services

Additional corridors throughout the region have a demonstrated potential for rail service. H-GAC had already begun a series of studies to assess the feasibility of commuter rail operations in existing freight corridors such as those along U.S. 290 (44 miles), U.S. 90A (6.5 miles), and SH 249 (38.5 miles). H-GAC intends to fully incorporate all elements of METRO Solutions and the additional proposed rail lines (if feasible) into the Regional Transit Plan.

Transit Need

Public transportation systems for urban, rural, and regional travel include fixed-route transit or paratransit services. While METRO has been the primary transit provider for the more densely populated areas in western Harris County, travel demands are continually increasing in eastern Harris County and less densely populated urban and rural corridors. Smaller transit or paratransit providers often provide limited service coverage to these markets.

Service Coverage

Service coverage area indicates how well a transit system reaches its market. Urban transit service coverage is defined by the distribution of stops or stations, the distance that people are willing to walk to reach a transit line, and individual spacing of transit lines or routes. Population density parameters are typically used to justify the need for a new transit route. Suggested transit service planning guidelines from the Institute of Transportation Engineers (ITE), based on U.S. and Canadian practice, recommend one-quarter mile coverage when population density exceeds 4,000 persons per square mile and one-half mile coverage when population density ranges from 2,000 to 4,000 persons per square mile.² Population density and route spacing parameters are used in this analysis to identify the potential for additional service coverage.

² Edwards, John D. Edwards Jr. Institute of Transportation Engineers Transportation Planning Handbook, Prentice Hall, Englewood Cliffs, New Jersey, 1992.

Population density and distance parameters are identified using a geographic information referencing system. Demographic data from the 2000 census is taken to develop current year estimates and future projections. Table 4 gives a summary of the referenced density and spacing parameters.

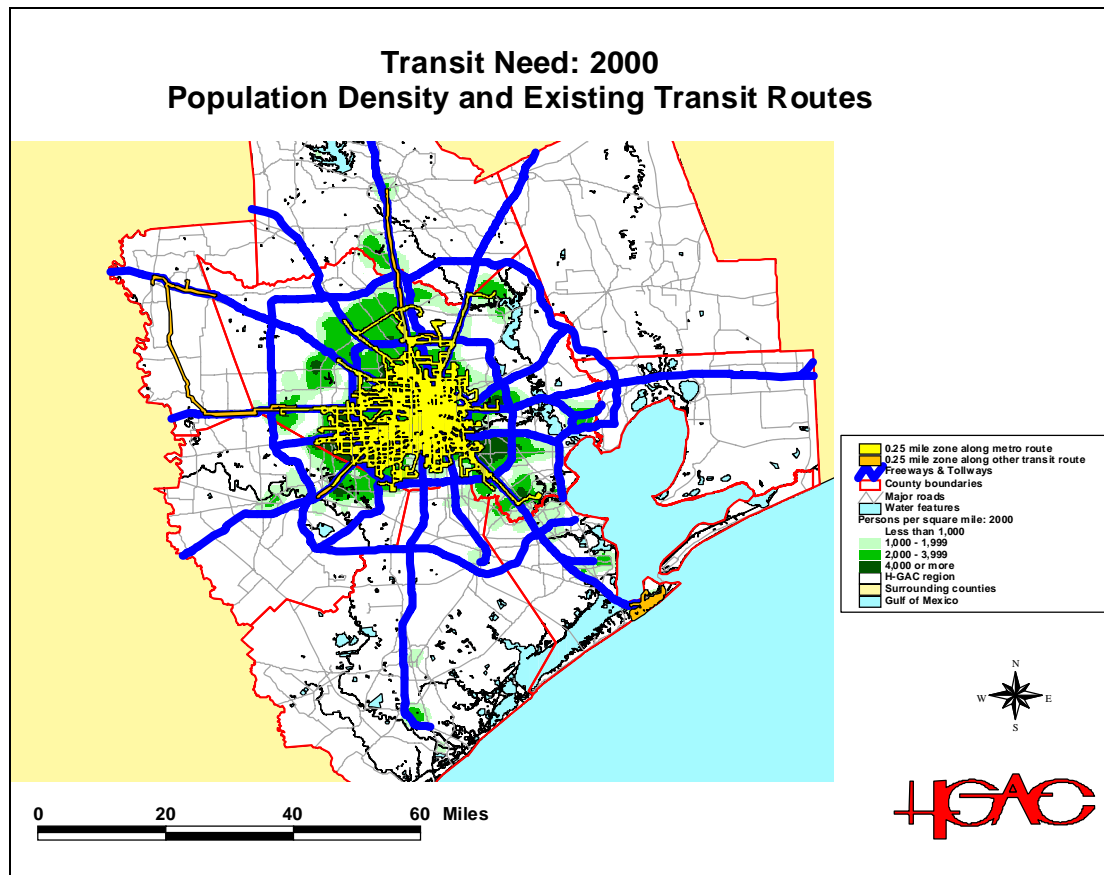
Table 4: Pop. Density & Route Spacing > 0.25 miles

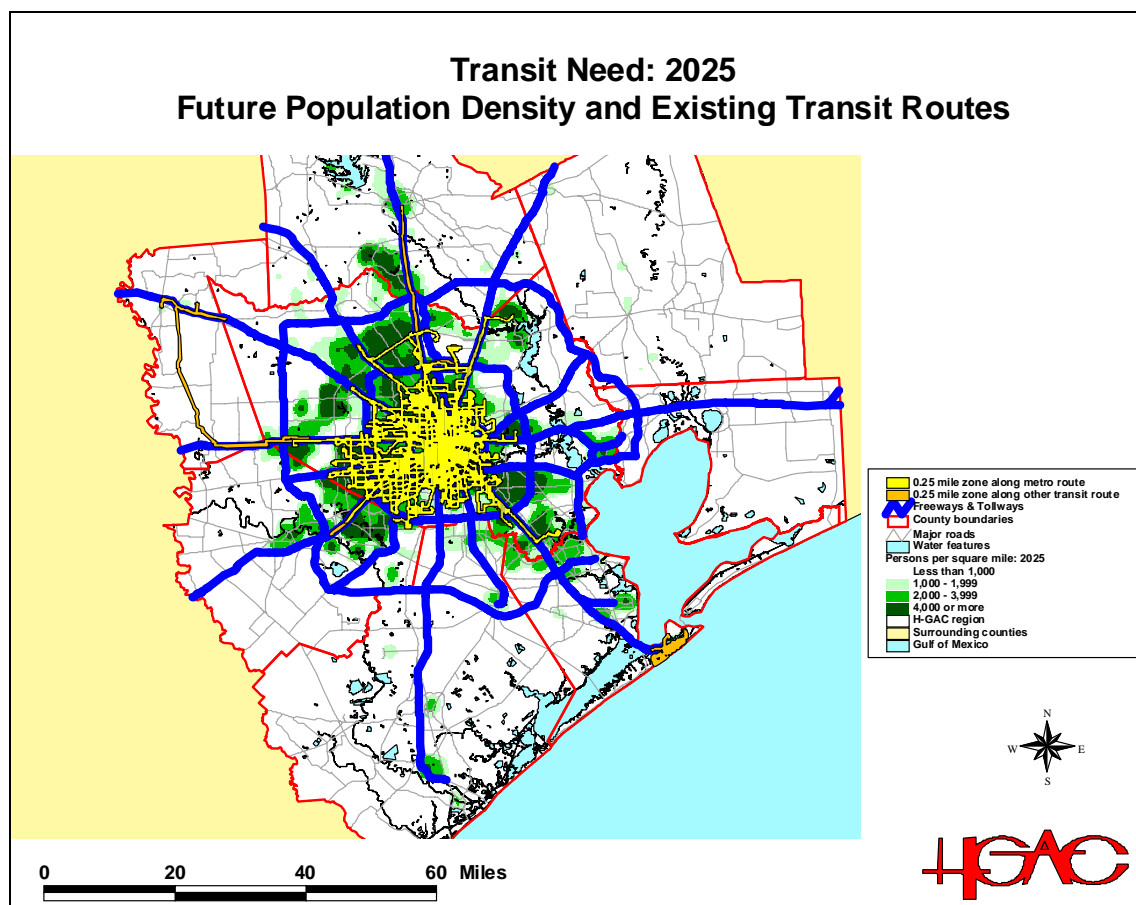
Pop. Density*	Year 2000	% of Tot al	Year 2025	% of Tot al
< 2,000	3,210,957	69	4,820,780	63
2,000– 3,999	1,067,881	23	1,309,891	17
> 4,000	390,789	8	1,530,900	20
Regional Total	4,669,627	100	7,661,571	100

*Persons per square mile

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The following maps provide a graphical representation of current and future service coverage by superimposing current and future population densities on the existing transit layout. It is clear that several areas are currently without transit, or have insufficient transit service coverage based on ITE density criteria.





Although there are several areas within the core of Harris County (inside I-610) without sufficient service coverage, the most densely populated areas inside BW 8 and I-610 have the highest levels of service coverage. The exceptions to this observation are portions of southwest, southeast and northwest Harris County. These high-density areas have minimal service coverage. Less dense areas (outside BW 8) in the surrounding transitioning (rural to urban) and rural counties, have a notable gap in service coverage. By 2025, a more starkly contrasting picture emerges. Population densities are expected to increase dramatically throughout the region, particularly in the outer northwest and southwest regions. As horizon year densities increase without an associated change in service coverage, larger segments of the population will face inadequate service coverage.

Fixed or Variable Service

Individuals living in households without access to an automobile (zero-auto households) tend to be dependent on public transportation, either fixed- or variable-route service. Previous research conducted by H-GAC suggests that a single variable—namely, zero-auto households—correlates with fixed-transit need in areas where transit is available. Based on 2000 census data, approximately 8 percent of households in the region do not own an automobile. While the highest concentrations of households without access to an automobile are within the City of Houston, a number of zero-auto households are located outside METRO’s service area. The figure on the next page provides insight on the location of zero-auto household clusters in the region and their proximity to transit. Table 5 shows specific areas of transit need based on the variable, zero-auto households.

Table 5: Unmet Special Transit Needs

	Increased Service	Paratransit		
Community	Zero-Auto	Poverty	Disability	Seniors
Angleton	•			•
Barrett Station	•	•	•	•
Baytown	•	•	•	•
Brookshire	•			
Cleveland	•	•	•	•
Conroe	•	•	•	•
Cut & Shoot	•	•	•	•
Freeport	•	•	•	•
Hempstead	•	•	•	
Katy	•			•
Kingwood				•
Liberty/Dayton	•	•	•	•
Magnolia	•	•	•	•
Manvel	•	•	•	•
Needville	•			
Pearland	•	•	•	•
Richmond/Rosenberg	•	•	•	•
Splendora	•	•	•	•
Texas City	•			•
The Woodlands				•
Waller	•	•	•	
Willis	•	•	•	
Winfree	•			•

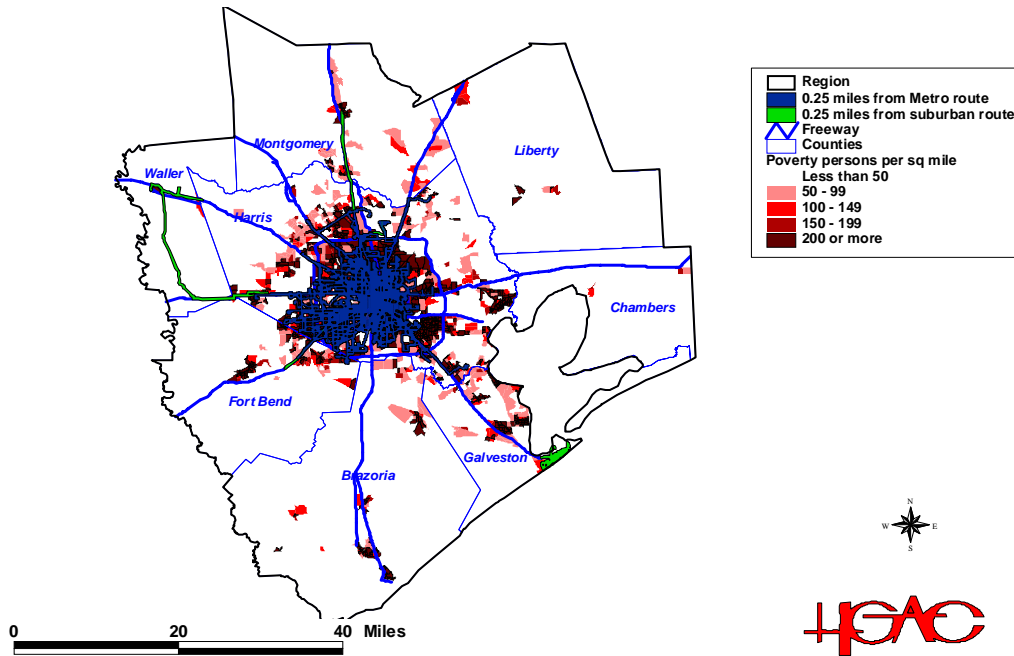
• = Significant Need Present

Source: U.S. Census Bureau, Census 2000.

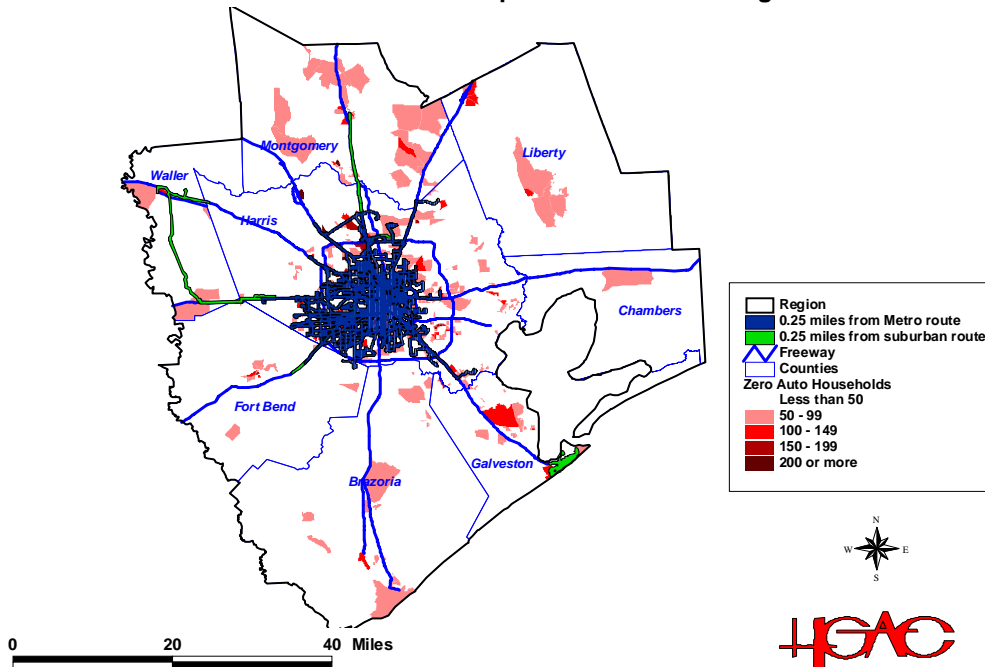
Specialized Service

An analysis of households that included those living in poverty, age 65 and over, or with physically or mentally challenged individuals is used to determine the need for paratransit or other specialized forms of transit service. The figures below and on the next page provide insight about areas with high concentrations of households, and their proximity to transit: below the poverty line, with some form of physical or mental disability, and seniors age 65 and over. Table 3 lists specific areas of transit need based on the poverty, age and disability.

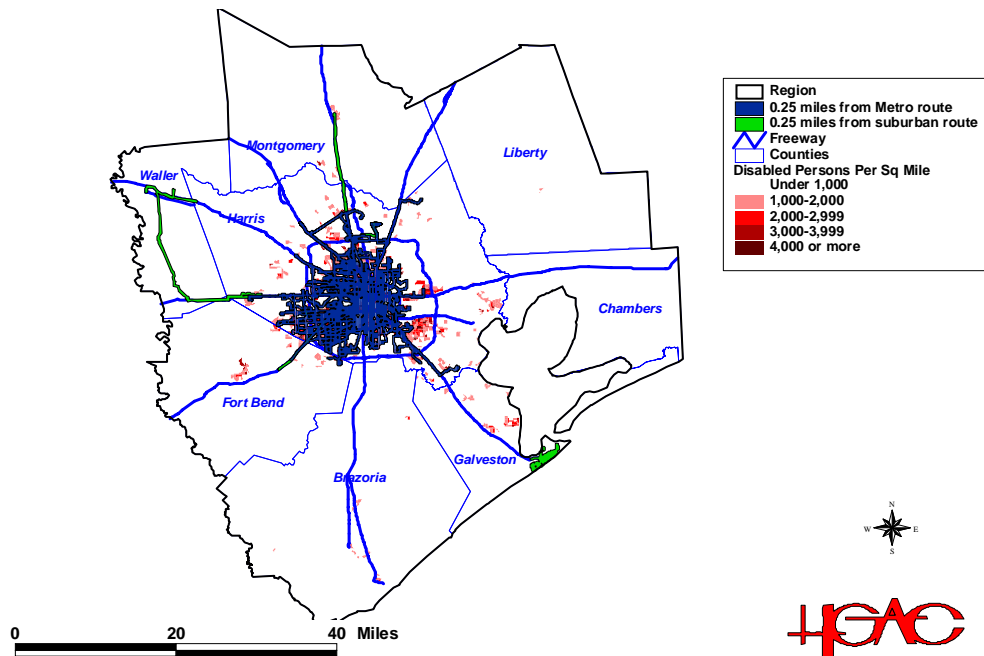
Transit-dependent Population: 2000
Number of Persons Below Poverty Level Per Square Mile and Existing Transit Routes



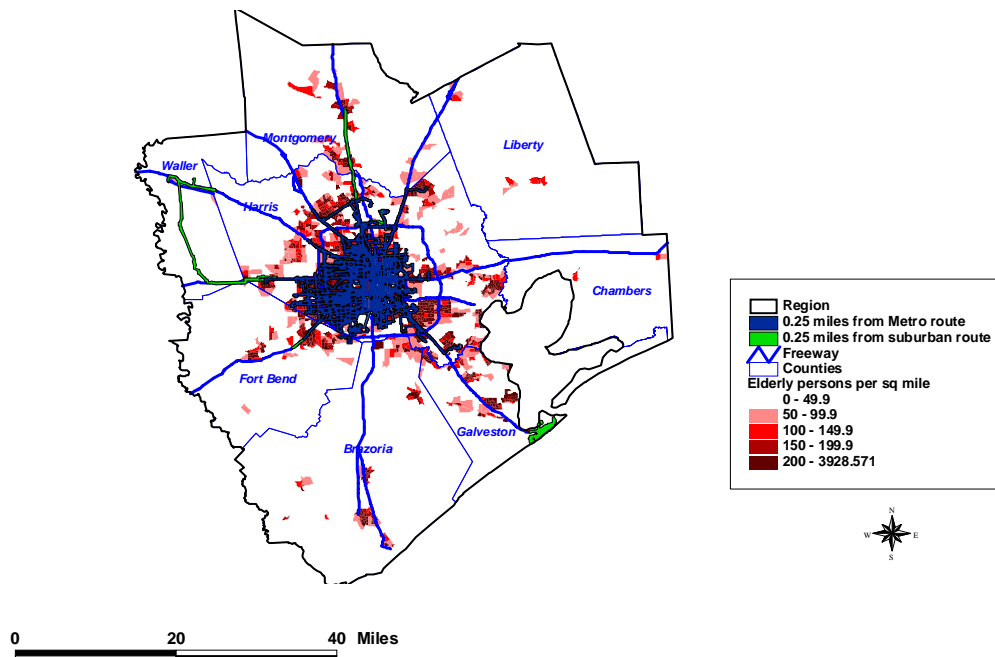
Transit-dependent Population: 2000
Households Without Vehicles Per Square Mile and Existing Transit Routes



Transit-dependent Population: 2000
Disabled Persons (Age 5 or Older) Per Square Mile and Existing Transit Routes



Transit-dependent Population: 2000
Number of Persons, Age 65 or Older, Per Square Mile and Existing Transit Routes



2025 All Transit Boardings and Volumes



The figure above shows the relative levels (by the width of the lines) of transit system ridership (bus and light rail) in the 2025 RTP. It also highlights the highest boarding locations (red dots). Also shown are the comparative volumes of Park and Ride and express bus users in the non-rail corridors such as US 290, I-45 North and others.

Preliminary Service Plan and Transportation Expansion Outside METRO Service Area

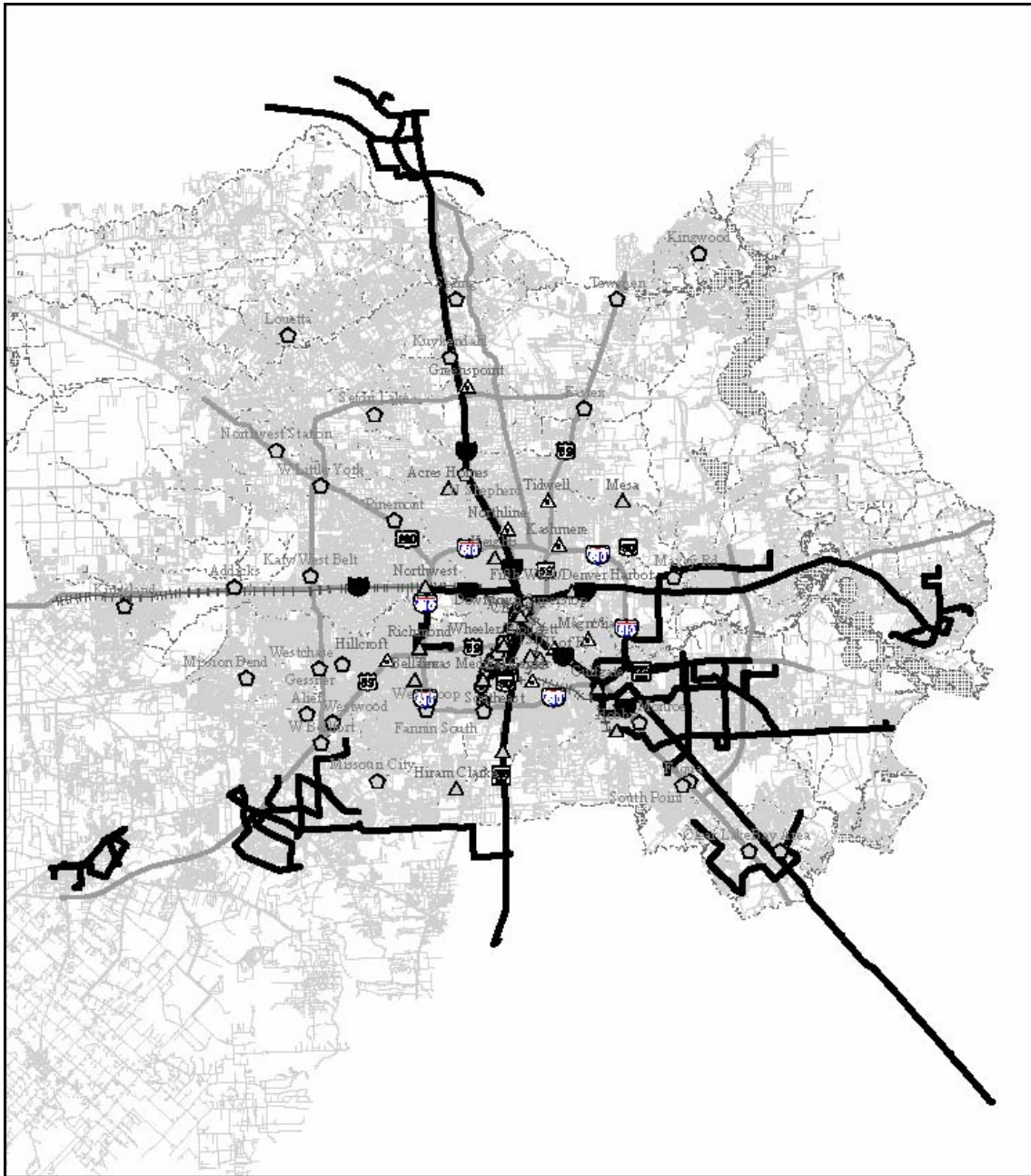
A number of projects and plans have been proposed to expand transit service and facilities in an attempt to meet the transit needs of our region. H-GAC staff worked with METRO to develop a preliminary service plan for high-density corridors currently being underserved by transit. The target markets were areas located outside METRO's service area. A conceptual diagram of the proposed preliminary routes is provided in the map on the following page. A brief listing of specific projects in the preliminary service plan with cost estimates (Table 6) and detailed performance analyses (Addendum A) is also provided.

Table 6: Preliminary Service Routes and Recommended Service

Route	Service Type	Daily Ridership	Daily Costs	Annual O&M Costs	Cost per Rider
Fort Bend County					
Sugar Land Route 'D'	Circulator	1,028	3,068	920,489	2.98
Bear Creek/Willowbrook	Circulator	3,300	9,437	2,831,061	2.86
Total		4,328	\$12,505	\$3,751,550	\$2.89
Montgomery County					
Grogan's Mill	Local Fixed	1,074	4,702	1,410,485	4.38
Total		1,074	\$4,702	\$1,410,485	\$4.38
Galveston County					
Gulfgate/Bay Area/Texas City	Local Fixed	5,018	\$6,600	\$1,979,972	\$1.32
Total		5,018	\$6,600	\$1,979,972	\$1.32
<i>Harris County</i>					
Galena Park-Channelview	Local Fixed	1,927	4,778	1,433,371	2.48
Gulfgate-Redbluff	Crosstown	2,176	4,999	1,499,904	2.30
Shaver Crosstown	Crosstown	1,163	3,329	998,734	2.86
Fairmont Parkway Ltd.	Crosstown	2,721	6,045	1,813,626	2.22
Southmore	Crosstown	3,984	4,937	1,481,003	1.24
Deer Park Commuter	Commuter Park & Ride	2,708	\$9,156	\$2,334,883	3.38
Total		14,679	\$33,244	\$9,561,521	\$2.26
Total Circulator		4,328	\$12,505	\$3,751,550	\$2.89
Total Fixed Route		8,019	\$16,080	\$4,823,828	\$2.01
Total Crosstown		10,044	\$19,310	\$5,793,267	\$1.92
Total Commuter Park & Ride		2,708	\$9,156	\$2,334,883	\$3.38
All Routes Total		25,099	\$57,051	\$16,703,528	\$2.27

Note: Number of days used for annualization factor: 300 days for local service, 265 days for express routes and 255 days for commuter routes. Used \$87.87 cost per revenue hour in 2003 constant dollars.

**Conceptual Diagram: Preliminary Modeled Transit Routes
Outside METRO Service Area**



Operational Cost Comparison

A cost comparison analysis was conducted to evaluate the operational efficiency of the recommended routes in relation to the type of service using data provided by METRO and other sources. Table 7 summarizes cost per rider for the full spectrum of recommended service types. As expected, initial costs per rider are much higher for outlying transit service when compared to current cost for similar (METRO) service types operating in higher density areas.

Table 7

Average Cost per Rider

METRO SERVICE PLAN - FY 2004		OUTSIDE METRO SERVICE AREA	
Type of Service	Cost/Rider	Type of Service	Cost/Rider
Circulator	\$6.89	Circulator	\$13.08
Crosstown	\$3.14	Crosstown	\$3.72
Local Fixed	\$2.88	Local Fixed Routes	\$6.94
Park & Ride	\$8.31	Park & Ride	\$11.87

Source: FY 2004 METRO Transit Service Plan

Non-urbanized Transit System	\$7.56
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Source: 2001 Texas Transit Statistics for Non-urbanized Systems - Section 5311 Report
Average for 41 Systems

	Local Express	Rural	ADA Paratransit
WMATA	\$2.31	\$9.64	\$36.97

Source: 2002 NTD for Washington Area Transit Authority (WMATA) for local express and ADA Paratransit

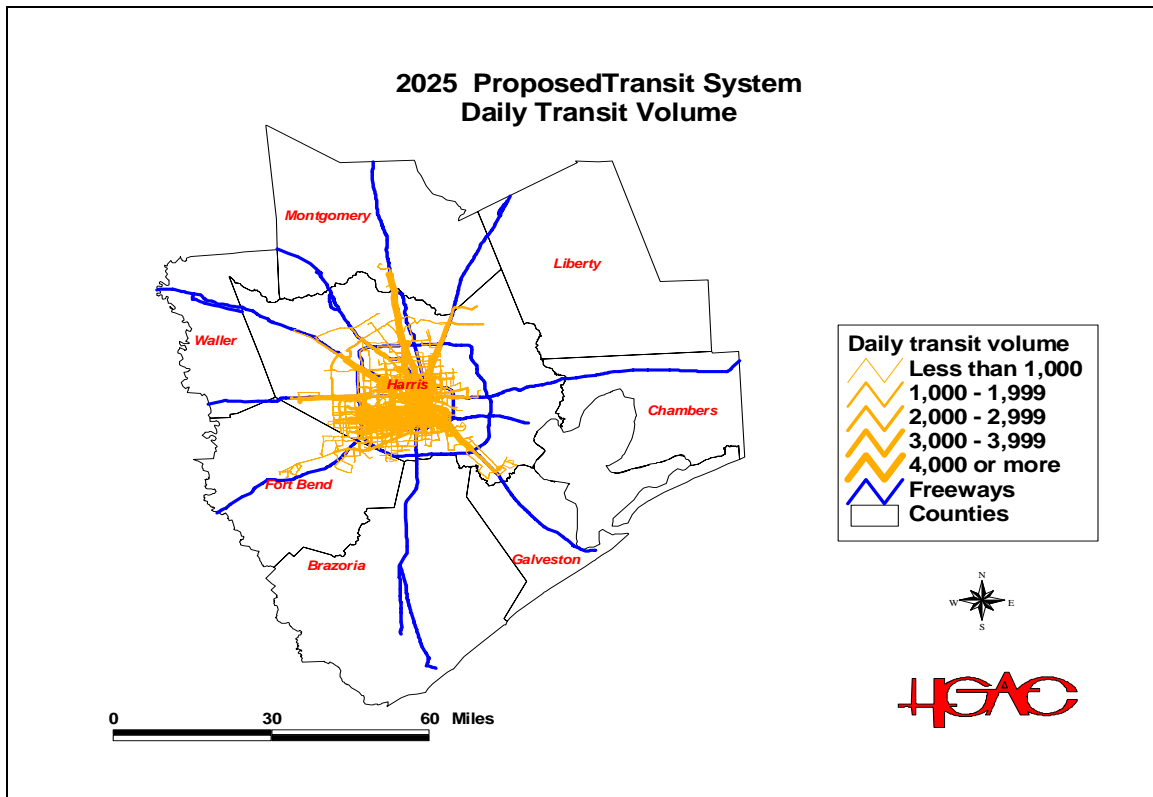
2025 Transit Plan

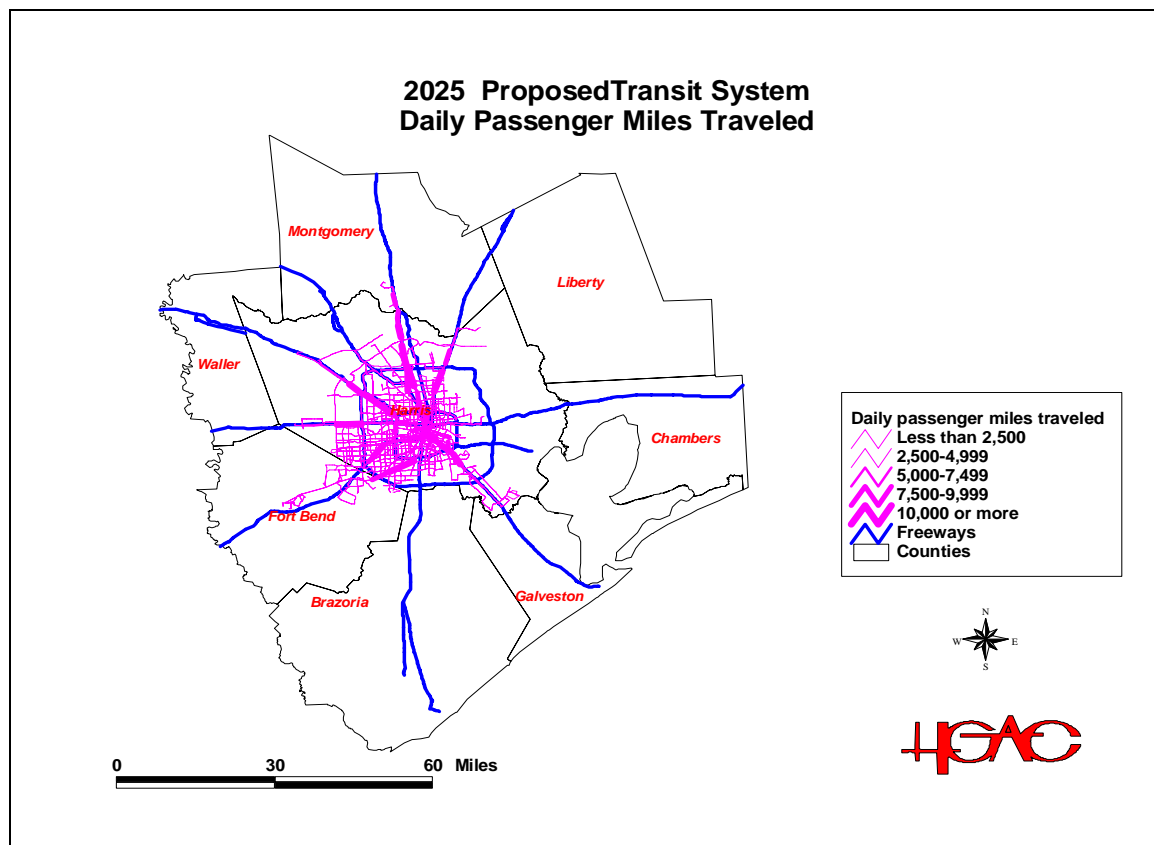
The 2025 transit plan consists of the Metro Solutions transit plan in combination with additional lines outside the Metro service area. In order to analyze the potential demand from such a system, H-GAC staff analyzed the transit passenger volumes and transit passenger miles traveled for the region as a whole and for eight separate transit corridor. A corridor was defined as an area two miles on each side of a proposed or possible rail line and would include both bus and rail transit.

Table 8 below shows the passenger miles traveled (PMT) along each of the corridors and the percentage share of total vehicle miles traveled that the PMT represents. This latter measure is a measure of *transit shift*, the number of vehicle miles traveled (VMT) that occur by transit relative to the total VMT. For the region as a whole, the 2025 transit plan will account for about 1.7% of the vehicle miles traveled for the region as whole. This is for all trip purposes. Since most transit use is concentrated for home-to-work (commute) trips, it will account for a higher percentage. The proposed system will cover some corridors better than others. Of note are the SH 288 corridor (where 3.9% of all vehicle miles are covered by transit), the US 59 East corridor (3.6%), the IH 10 West 'Katy' corridor (3.5%) and the US 45 North corridor (3.2%). The other corridors will have 2% or less of their vehicle miles covered by transit in 2025. The two figures below show the total transit passenger volume in each corridor as well as the PMT.

Table 8
2025 Transit Plan
Transit Shift for Selected Corridors

Two-mile Corridor	Vehicle Miles (VMT)	Passenger Mile (PMT)	PMT as % of VMT
SH 225-SH 146	9,598,424	77,230	0.8%
US 59 E	20,674,156	751,459	3.6%
US 45 N	29,648,753	960,464	3.2%
IH 10 W	21,449,564	758,617	3.5%
SH 288	12,917,657	507,520	3.9%
US 290	15,928,751	316,187	2.0%
US 249	9,866,134	152,957	1.6%
US 90A	11,830,342	230,493	1.9%
Region	205,578,094	3,485,972	1.7%





Possible Comprehensive Regional Rail System

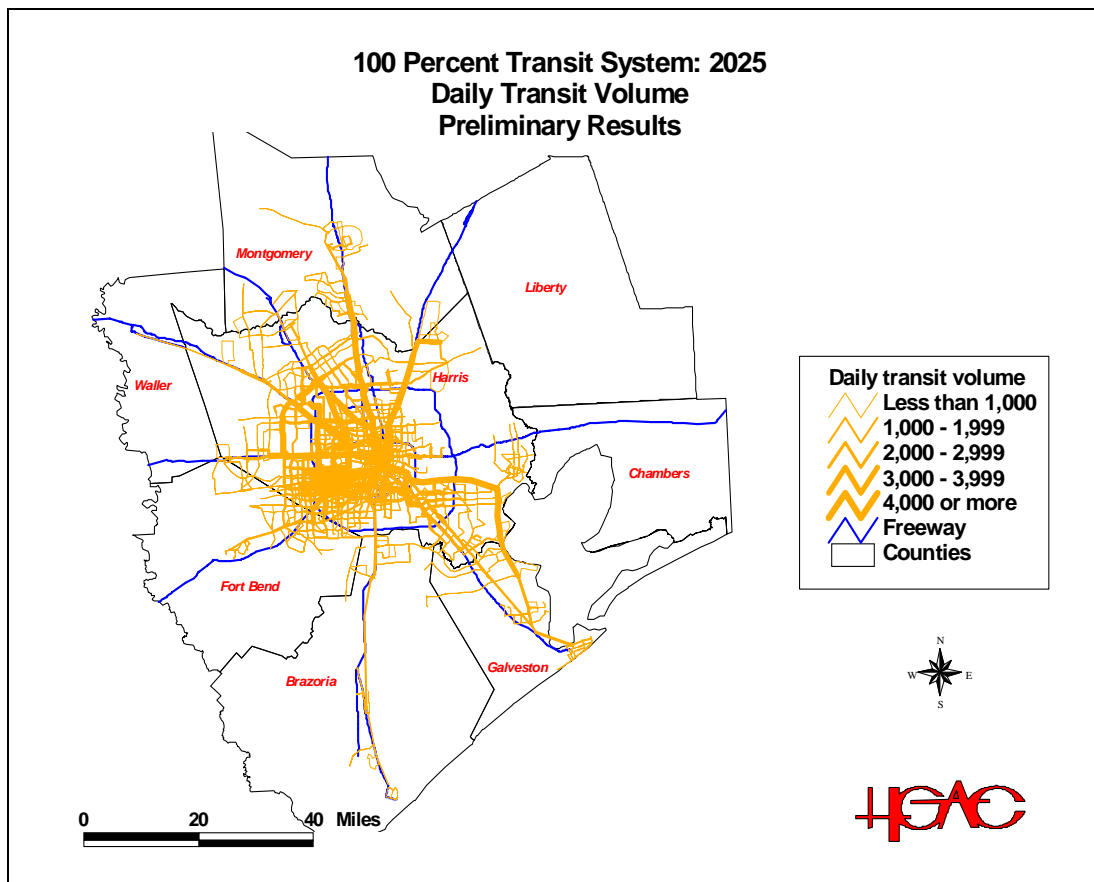
In addition to the METRO Solutions Plan and the corridor studies along US 290, US 249 and US 90A, H-GAC is starting to model an enhanced regional rail transit plan in order to estimate future transit demand on an extended system. The possible regional rail transit plan explores the impact on the transportation system of extending rail lines beyond METRO Solutions, particularly along the major corridors. Financial considerations are ignored in this scenario, a clearly unrealistic situation. However, H-GAC staff felt it is important to understand the potential demand throughout the region, assuming financing could be obtained in the future. Among the additional rail transit corridors that are being examined are a SH 225-SH 146 (“Harbor”) line, a US 59 E (“Kingwood”) line, and an SH 288 (“Lake Jackson”) line. The maps below show the preliminary results for the lines that are being modeled. The first map is that of passenger volume while the second map is that of passenger miles traveled. Several commuter lines appear to offer the potential for sizeable transit volume, among which are an SH 225-SH 146 (“Harbor”) line, an US 59 E (“Kingwood”) line, an IH 45 N (“North”) line, and an IH 10 W (“Katy”) line.

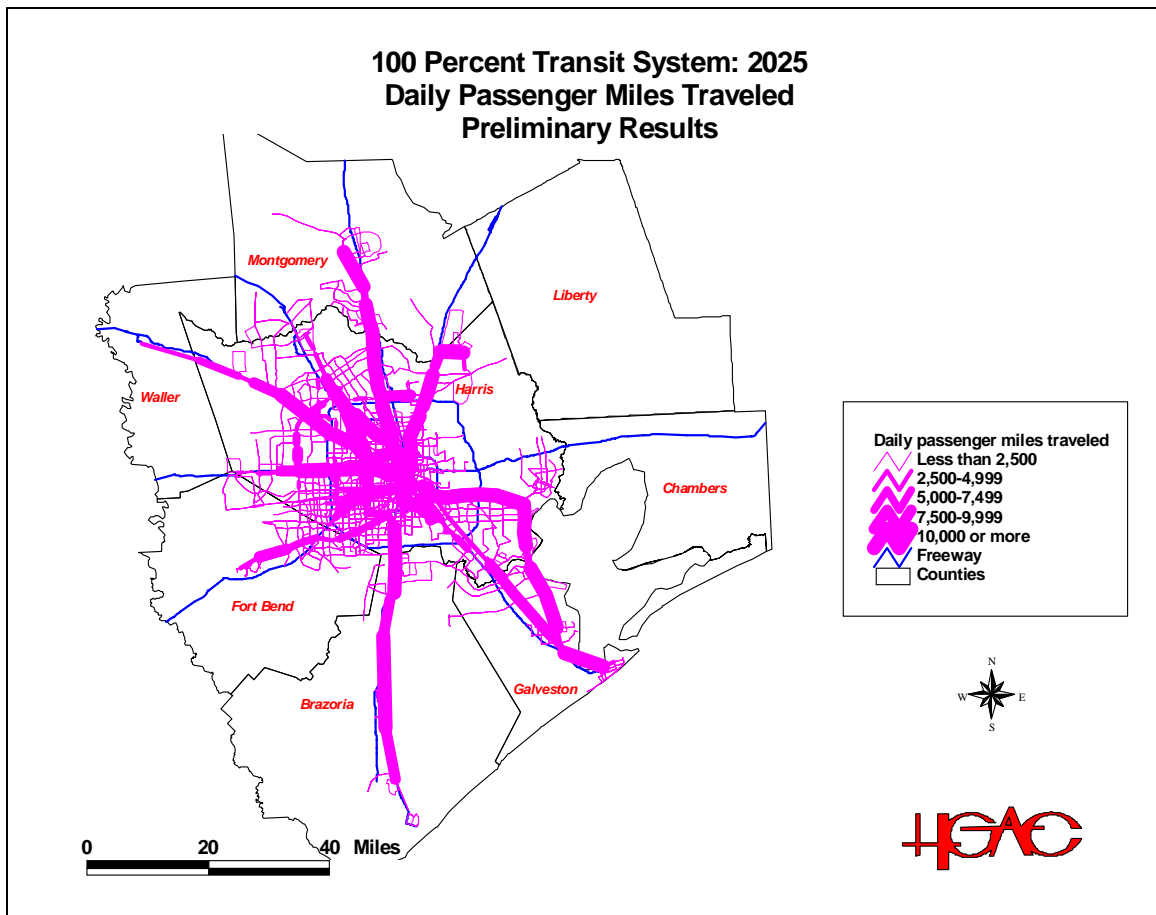
Several of these lines appear to have the potential for shifting a sizeable number of VMT to transit, as Table 9 shows. In other words, expanding the transit system (bus and rail) beyond the current Metro Solutions Plan has the potential for absorbing a sizeable share of VMT along particular corridors. For the region as a whole, the possible regional rail plan accounts for 4.5% of vehicle miles traveled as represented in the percent of forecasted passenger miles traveled.

Table 9
Possible Regional Rail System
Transit Shift for Selected Corridors

Two-mile Corridor	Vehicle Miles (VMT)	Passenger Miles (PMT)	PMT as % of VMT
SH 225-SH 146	9,598,424	590,480	6.2%
US 59 E	20,674,156	1,603,625	7.8%
US 45 N	29,648,753	2,250,061	7.6%
IH 10 W	21,449,564	1,645,575	7.7%
SH 288	12,917,657	1,101,223	8.5%
US 290	15,928,751	820,958	5.2%
US 249	9,866,134	594,873	6.0%
US 90A	11,830,342	499,107	4.2%
Region	205,578,094	9,251,819	4.5%

The work is still in a very early stage of analysis so that recommendations are premature. Construction for commuter rail typically costs \$10-70 million per mile (at current rates in the U.S.) so that 300 additional miles of rail would be quite expensive (with a total cost varying between \$3-\$21 billion). Operating costs would be in addition to the construction costs. However, H-GAC recommends conducting additional feasibility studies to explore adding new high capacity transit services beyond the Metro Solutions Plan. In future long-range plan, H-GAC will present this analysis with possible recommendations for expansion.





Conclusion, Recommendations and Areas for Additional Research

Public transportation plays a unique role in improving regional mobility. Current transit service providers have limited influence on regional mobility largely because of the characteristics of the region's environment within which public transportation operates. Today's environment is a metropolis of suburbs, expanding rural communities, a dispersal of shopping and employment centers, numerous segments of seniors, individuals with mental and physical disabilities, and large poverty households all of which require an ever-increasing radius of commuter travel. The net results are more trips in more vehicles that cover longer distances.

The research and analyses conducted in the first-phase of the Regional Transit Plan are in response to overall regional transit deficiencies. The transit component of the RTP provides an objective measure of the extent to which specific transportation and transit applications can potentially aid in the achievement of RTP goals. This plan emphasizes a multimodal approach to current and future system users, and offers a variety of travel options. The ultimate aim is for transit to increase its viability and become an increasingly significant transportation alternative in the region.

Recommendations for Regional Transit

The Regional Transportation Needs Assessment (RTNA) process led to numerous recommendations for improvements:

- Develop a system of higher capacity (parallel) arterial roadways to accommodate future growth and emerging suburban travel patterns.

- Implement a regional (eight-county) inter-connected public transportation system to meet basic mobility needs.
- Promote the development of a regional higher speed mass transit system with linkages to future higher speed inter-city rail lines.
- Secure more funding and promote infrastructure improvements to support the increased development of non-motorized transportation including sidewalks, bicycle pathways, pedestrian bridges and compatible open spaces.
- Provide more funding for incentives to commuters to shift their travel modes from single-auto driver to transit, carpool, vanpool, or to telework (e-commute) and utilize variable work hours.

Funding constraints limit the recommended projects that can be included in the 2025 RTP. The list of unfunded recommendations is included in Appendix O: Unfunded Needs.

Based on overall indicators and results generated by the aforementioned analyses, H-GAC proposes the following policy options for consideration by regional officials.

- **Develop new service plans.** H-GAC encourages the development of transit service plans for outlying areas and other local jurisdictions as a means to justify or implement additional transit or paratransit services. Each local jurisdiction or municipality should establish an individualized transit service plan and capital improvement program that identifies proposed local investment in transit, based on localized needs. H-GAC staff is to work closely with each local jurisdiction to insure consistency between local and regional plans and the application of uniform criteria.
- **Check to see if FTA minimums are met.** Local governments outside of the METRO service area that do not currently qualify for FTA formula funding may become eligible as their populations increase. A completed transit plan enables those local governments to initiate service most efficiently and effectively, as either direct service providers or through a transit contractor.
- **Extend METRO service area.** Local officials should evaluate the potential of expanding the METRO service area. In addition to voter approval, this would require local governments to enact local sales taxes or utilize other innovative funding options, such as future toll revenues.
- **Expand current providers' services.** An initial step towards increasing regional transit service could be accomplished through expansion of current services by existing providers. Connect Transportation, Brazos Transit, and Colorado Valley provide transit service in sectors outside of the METRO service area. With additional funding, services could be provided to a broader geographic area. The majority of these existing services are funded through Federal Transit Administration Section 5307 and Section 5311 grants that are awarded based on population. As outlying areas grow, the service providers can qualify for additional funding, and should be prepared to remediate service deficiencies.
- **Establish Regional Mobility Authority.** Legislation enacted by the Texas Legislature during its most recent session enhanced the ability of local officials to establish Regional Mobility Authorities (RMA) and to use surplus RMA revenues on transportation projects in the geographic area of the RMA. These projects can include rail. Counties within the Houston-Galveston region should consider the possible benefits to transit that the establishment of a Regional Mobility Authority could bring.

- **Establish Regional Transit Authority.** Other large urban areas have established regional transit authorities to expand transit service beyond the service area of an established metropolitan transit authority. The Houston-Galveston region could examine the costs and benefits associated with creation of a regional transit authority. The authority would serve to define and develop a regional growth and development strategy. Service provisions could include high-speed rail, several hundred miles of HOV lanes, significant bus fleet expansions, additional park and ride spaces, and major transportation demand management (TDM) and transportation system management (TSM) programs. In addition to extensive coordination between local jurisdictions, this option requires state authorization.
- **Approve Local Option Transportation Tax measures.** The Texas Legislature has proposed amending the state constitution to enable local governments to levy a Local Option Transportation Tax (LOTT). With voter approval, a LOTT could be collected and used to fund transportation projects (including transit). This revenue option could be evaluated from a regional perspective. State legislators require information regarding the costs and benefits of a LOTT to the region.
- **Coordinate existing services.** In a related effort, H-GAC can continue to work with transit and social service agencies whose services overlap. Coordination of service delivery enables more efficient use of funds, and should result in service increases at current funding levels. H-GAC is working with agencies in Harris County to coordinate the provision of transit services. The agency will investigate the need for a regionwide transit coordination program with the potential to establish programs to coordinate and improve the efficiency of the transit services of smaller/social service agencies.

Future Research

- **Concurrent Land Use and Transit Development.** Increasing transit capacity alone is not sufficient enough to alter travel behavior to the point where motorists will, with little hesitation, decrease SOV mileage. Changes also need to be made in the overall environment and perception within which transit operates and competes with other travel modes. Without significant coordination between land use and transportation planning, no amount of resources can bring about a truly transit-oriented transportation network that promotes a local balance of jobs and housing, walk and bike access to transit, and an intense mix of commercial, office, and multifamily development.
- **Quantify Benefits and Costs.** A significant capital investment is be required to implement recommendations for additional transit services. Additional research is needed to determine total operation, maintenance and capital costs, as well as regional benefits.
- **Regional Guidelines.** Minimum threshold indices and guidelines need to be developed for transit-dependent individuals, such as seniors, disabled and poverty households. Such indices and guidelines are not well documented in the prevailing literature.
- **Transit Need Index.** Establish a regional transit need index based on population density parameters and newly developed senior, disabled, and poverty threshold parameters. Incorporate the newly created transit need index into the performance based prioritization methodology.
- **Nonwork Trips.** A large share of current transit service is based on the transportation network's travel demands associated with work trips. Investigate the proportion of total vehicle miles traveled attributed to nonwork trips to determine if the potential exists for nonwork and off-peak expansions.

ADDENDUM A
Table 7: Route Performance and Cost Estimate – Transit Outside METRO Service Area

Route Name	Total Daily VMT	Total Daily VHT	Total Daily Boardings	Boardings/ Veh. Miles	Boardings/ Veh. Hrs.	Daily O&M Cost	Cost/Rider	Annual O&M
Pearland/Angleton Commuter								
Angleton – CBD P&R HOV	2,200.00	74.4	235	0.1	3.2	\$6,538	\$27.82	\$1,667,202
Pearland – CBD P&R HOV	2,461.24	93.5	355	0.1	3.8	\$8,213	\$23.14	\$2,094,250
Commuter Services Brazoria County	4,661.24	167.9	590	0.1	3.5	\$14,751	\$25.00	\$3,761,451
Gulfgate/Bay Area/Texas City	2,441.34	75.1	5,018	2.1	66.8	\$6,600	\$1.32	\$1,979,972
Harris County								
Baytown								
San Jacinto Route 1	386.10	22.2	97	0.3	4.4	\$1,950	\$20.10	\$585,080
San Jacinto Route 2	628.98	35.8	450	0.7	12.6	\$3,147	\$6.99	\$944,182
San Jacinto Route 4	382.80	12.4	789	2.1	63.6	\$1,090	\$1.38	\$327,026
U of H – San Jacinto Crosstown	565.92	29.7	608	1.1	20.5	\$2,608	\$4.29	\$782,497
Galena Park-Channelview Crosstown	1,043.46	54.4	1,927	1.8	35.4	\$4,778	\$2.48	\$1,433,371
Total Local Service	3,007.26	154.48	3,871	1.3	25.1	\$13,574	\$3.51	\$4,072,157
Baytown P&R	3,105.04	73.1	955	0.3	13.1	\$6,4278	\$6.73	\$1,639,029
Total Local & Commuter Services	6,112.30	227.63	4,826	0.8	21.2	\$20,001	\$4.14	\$5,711,187
Pasadena								
Gulfgate-Redbluff	987.36	56.9	2,176	2.2	38.2	\$4,999	\$2.30	\$1,499,904
Shaver Crosstown	685.52	37.9	1,163	1.7	30.7	\$3,329	\$2.86	\$998,734
Fairmont Parkway Ltd	1,531.20	68.8	2,721	1.8	39.5	\$6,045	\$2.22	\$1,813,626
Southmore Crosstown	956.01	56.2	3,984	4.2	70.9	\$4,937	\$1.24	\$1,481,003
Preston Crosstown	473.22	25.7	727	1.5	28.3	\$2,256	\$3.10	\$676,914
Total Local	4,633.31	245.4	10,771	2.3	43.9	\$21,567	\$2.00	\$6,470,181
Deer Park P&R	2,592.96	104.2	2,708	1.0	26.0	\$9,156	\$3.38	\$2,334,883
Total Local	7,226.27	349.65	13,479	1.9	38.6	\$30,723	\$2.77	\$8,805,064
Subtotal Harris County	13,338.57	577.27	18,305	1.4	31.7	\$50,722	\$3.80	\$14,516,251
Grand Total	45,634.61	1,788.40	38,837	1.4	31.7	\$157,150	\$4.05	\$44,227,911

Note: Used \$87.87 cost per revenue hour in 2003 constant dollars. Number of days used for annualization factor; 300 for local service, 265 for express and 255 for commuter routes. The costs figures are rough estimates and can only be used as such.

Examples of Transit Types

Automated Guideway Transit (AGT; also called **people mover):**

An electric railway (single or multi-car trains) of guided transit vehicles operating without an onboard crew. Typically moving small groups of people, AGTs have a high level of electronic intelligence so that vehicles are operated by computers over



exclusive guideways. Examples include

Detroit's People Mover (pictured left), Jacksonville, Florida's Skyway, Miami, Florida's Metromover (pictured right) and others. AGTs are more common in non-transit settings such as airports and hospital campuses.



Bus Rapid Transit (BRT):

A rubber-tired transit mode that, in concept, provides the speed and utility associated with light rail transit. It can operate anywhere there is pavement from shared roadways to exclusive rights-of-way such as in street medians or on a separate facility (busway).

When operating on specially-prepared

busways, the operation of BRT can be totally automated. BRT is typically associated with state-of-the-art buses (pictured left) and appealing stations with amenities similar to light rail. Technology advances have led to dual powered busses (hybrid electric) that help reduce emissions. BRT offers the flexibility to operate in an on-street environment similar to traditional bus service to provide greater service coverage at either end of the service. BRT is growing in popularity across the US as a cheaper alternative to LRT. The example pictured right is in Curitiba, Brazil.



Commuter Rail (CR; also called **metropolitan rail, regional rail, or suburban rail):**

A type of heavy-rail transit. CR is an electric or diesel propelled railway for urban passenger train service typically using existing freight rail line. Offering travel operating between a central city and adjacent suburbs, it provides service during peak periods in the peak direction. Suburban stations are typically oriented toward park-&-ride access. Examples include Los Angeles' Metrolink, Chicago's Metro, and New York's Long Island Railroad.



Demand Response (also called paratransit or dial-a-ride):

Specialized, door-to-door passenger car, van, or small bus service usually restricted to serving persons with disabilities and elderly individuals who are unable to use regular transit options. Operating in response to calls from passengers or their agents, transit operators dispatch vehicles to pick up passengers and transport them to their destinations, and do not operate over a fixed route or on fixed schedules. Many of these services are provided by private companies or other social service agencies. Examples include services offered by METRO and Senior Citizens Transportation of Chambers County.



Heavy Rail Transit (HRT; also called metro, subway, rapid transit, or rapid rail):

A transit mode that is an electric or diesel railway with the capability for a heavy volume of traffic. It is characterized by high speed and rapid acceleration



on fixed rails; separate rights-of-way from which all other vehicular and foot traffic are excluded; sophisticated signaling, and high platform loading.



High-Speed Transit (HST):

An electrically propelled, grade-separated transit mode operating at speeds greater than 150 mph on exclusive right of way. HST is typically built in corridors with very high traffic demands. The technology offers very fast, high-capacity, reliable service. Examples include Tokyo's Bullet trains



(pictured right) and France's TGV. One type of HST technology is magnetic levitation, or maglev, that can support travel speeds in excess of 250 mph. Shanghai, China's maglev train is the first operational example of a high-speed maglev train (pictured left).

Jitney (JT):

A type of paratransit comprised of passenger cars or vans operating on fixed routes (sometimes with minor deviations) as demand warrants without fixed schedules or fixed stops. Currently, there are no official jitney services offered in the United States.



Light Rail Transit (LRT; also called streetcar, tramway, or trolley):

An electrically-driven, self-propelled train on



shared, semi-exclusive, or exclusive rights of way. LRT technology provides frequent

service during peak periods with intermediate passenger capacity. Houston's METRO Rail (pictured right) is an example of modern light rail transit, and New Orleans's Trolley (pictured left) is a vintage trolley car.



Monorail (MO):

An electric railway of guided transit vehicles suspend from or straddle a fully-separated aerial guideway formed by a single beam, rail, or tube. Typically used as a circulator or shuttle. Examples include, Seattle



(pictured right), and Las Vegas. If the trains do not have an onboard crew, they are considered automated

guideways. Their most common use is in the non-transit settings of amusement parks, such as Disneyworld (pictured left).



Publico:

A transit mode comprised of passenger vans or buses operating with fixed routes but no fixed schedules. Publicos are a privately owned and operated transit service which is market oriented and unsubsidized, but regulated through a public service commission, state or local government. Publicos are operated under franchise agreements, fares are regulated by route, and there are special insurance requirements. In the United States, publicos are used only in Puerto Rico.



Chapter 2

Operations Management

Introduction

Transportation System Management (TSM) strategies are designed to enable efficient use of multi-modal facilities and to help ensure safe, coordinated flow thereby reducing traffic delays and reducing congestion. The overall objective of TSM is to improve the efficiency and effectiveness of the existing transportation system. To facilitate and enhance efficiency of the regional transportation system, H-GAC has initiated an Operations Task Force to determine regional goals for traffic operations. The Task Force will determine regional traffic operations goals, as well as develop guidelines defining project readiness and project ranking for traffic management and operations projects submitted as candidates for federal funding.

The primary TSM strategies utilized in the region are Intelligent Transportation Systems (ITS) and Access Management.

Intelligent Transportation Systems (ITS)

ITS is a system of advanced technologies designed to make the movement of goods and people along the transportation system safer, more effective, and more efficient. With extensive infrastructure in place along with constrained funding plans and environmental concerns, it is logical that improved operations receive high priority as the next step in improving and managing existing transportation facilities. ITS systems provide comprehensive, integrated tools for managing transportation facilities including the following:

1. Incident Detection & Response Programs
2. Courtesy Patrol, Motorist Assistant Program
3. Changeable Message Sign (CMS)
4. Traffic Operation Centers
5. Traffic Signal Timing & Coordination Improvements
6. Automated Traffic Management System
7. Computerized Traffic Management System

The Houston Region ITS Strategic Plan (May 2003) addresses and guides the region's stakeholders to plan, program, and implement key ITS strategies based on the region's needs and issues. The mission statement of the ITS Strategic Plan for the Houston Region is "to enhance transportation services for the eight-county region by effectively and efficiently deploying advanced technologies and techniques for:

1. Travel and traffic management
2. Public transportation management
3. Traveler information systems
4. Travel payment
5. Commercial vehicle operations
6. Railroad at-grade crossings
7. Emergency and incident management
8. Advanced vehicle safety systems."

The cornerstone of ITS deployment in the region is Houston TranStar. Houston TranStar provides traffic management, traveler information, emergency management, and transit management services within the greater Houston area. The traffic management center is jointly operated by four agencies that include the Texas Department of Transportation (TxDOT), Metropolitan Transit Authority of Harris County (METRO), Harris County, and the City of Houston. These agencies are responsible for operation and management services on freeways, arterial streets, high occupancy vehicle lanes (HOV), and the transit system. Agencies at TranStar manage a number of programs including:

1. Freeway management system, 200 centerline miles out of a projected 300 miles
2. Freeway and arterial incident management
3. Ramp metering at 128 ramps
4. 316 closed circuit television cameras
5. 154 dynamic message signs
6. 94.4 miles of barrier separated reversible HOV lanes, with an additional 6.6 miles of diamond lanes on IH-10 freeway
7. Regional computerized traffic signal system (RCTSS) of 2800 planned signals
8. Emergency management operations
9. Motorist assistance patrol
10. Heavy wrecker contract for commercial vehicle removal
11. Flood alert systems/Roadway weather information systems
12. Highway advisory radio (12 fixed sites and 1 portable site)³

The following table provides specific information on the many existing and proposed TranStar programs.

Table 1: Overview of ITS Systems Operated by TranStar in the Houston Region

Application Area	System	Subsystem	Status
Traffic Management	Transportation/Traffic Management Center	<i>TranStar</i>	Existing
	Detection and Surveillance Technologies	CCTV (Closed Circuit Television Cameras)	Existing
		Loop Detectors	Existing
		Automatic Vehicle Identification (AVI)	Existing
		Video Imaging and Vehicle Detection Systems (VIVIDS)	Existing
		Flood and Weather Warning Systems	Existing
	Control Strategies	High Occupancy Vehicle (HOV) Lanes	Existing
		Ramp Metering	Existing
		Dynamic Message Signs (DMS)	Existing
		Signal Network	Existing
		Changeable Lane Assignment Signs (CLAS)	Existing
		Lane Control Signals	Existing
		Motorist Assistance Patrol (MAP) Program	Existing
		Heavy Duty Wreckers	Existing
		Emergency Vehicle Preemption	Existing

³ *Houston Region ITS Strategic Plan, May 2003*

Traveler Information	Pre-trip and En-route Planning	TranStar Web Page	Existing
		Texas Travel Information System	Existing
		METRO Line	Existing
Electronic Payment	Electronic Toll Collection	E-Z Pass Toll Program	Existing
	Quick Ride Program	High Occupancy Toll Lane (HOT Lane)	Existing
	City of Houston	Airport Parking	Existing
Transit Management	Advanced Radio Communication System	Onboard System	Existing
		Communication Center Subsystem	Existing
		Communication Subsystem	Existing
	Computerized Telephone Information System (CTIS)	Interactive Voice Response System	Existing
		Personalized Bus Itinerary Service	Existing
	Integrated Vehicle Operation Management System (IVOMS)	Variety of Advanced Transit Applications	Planned
Emergency Management	METROLift	Personal Public Transit Service offered to persons with disabilities	Existing
	City of Houston Emergency Management Division	Provides Emergency Services to 29 Cities in Harris County	Existing
	Harris County Office of Emergency Management	Provides emergency service before, during, and after natural or manmade disasters	Existing
Commercial Vehicle Operations	City of Sugarland	Rail Detection System	Existing
	Truck Rollover Warning System (TRWS)	Vehicle Classification, Speed Detection and Warning Mechanisms	Existing
	Commercial Vehicle Travel Advisory System (CVTAS)	Dynamic Message Signs (DMS)	Existing
Communications		Highway Advisory Radio (HAR)	Existing
	Fiber Optic Communication Network	Not Applicable	Existing
	Cellular Digital Packet Data (CDPD)	Not Applicable	Existing
	Harris County Radio System (HCRS)	Not Applicable	Existing

Source: *Houston Region ITS Strategic Plan*, May 2003.

While the existing systems in Houston provide travelers in the region some relief with traffic congestion, critical requirements to enhance the system have been identified in the Houston Region ITS Strategic Plan :

Traffic Management

- Alleviating Congestion
- Improving Capacity
- Enhance Incident Management
- Optimize Signal Control
- Implement Arterial Management
- Demand Management
- Highway Rail Intersection Management
- Interagency Coordination and Expansion

Traveler Information

- Better Content and Delivery of Traveler Information through a variety of dissemination techniques

Public Transportation

- Improve Mobility and Access
- Develop Public Transit Management Strategies
- Implement Advanced Transit Vehicle Systems
- Improve Transit Traveler Information

Emergency Management

- Enhance Interagency Coordination
- Improve Traffic Coordination
- Faster Emergency Notification
- Expand Flood Monitoring

Electronic Payment

- Expansion of Current Toll System
- Multi-Modal Integration
- Improve Toll Plaza Monitoring and Enforcement
- Electronic Passenger Fare Collection

Commercial Vehicle Management

- Improve Safety
- Improve Commercial Vehicle Management

Emissions Management

- Improve sensor testing and operational policies for emissions management and testing

Archived Data Management

- Expansion of current data warehousing efforts

Safety and Security

- Safety of Rail-road Intersections
- Safety for Pedestrians and Bicyclists
- Applications for Homeland Security

Maintenance and Construction

- Smart Work Zone Strategies

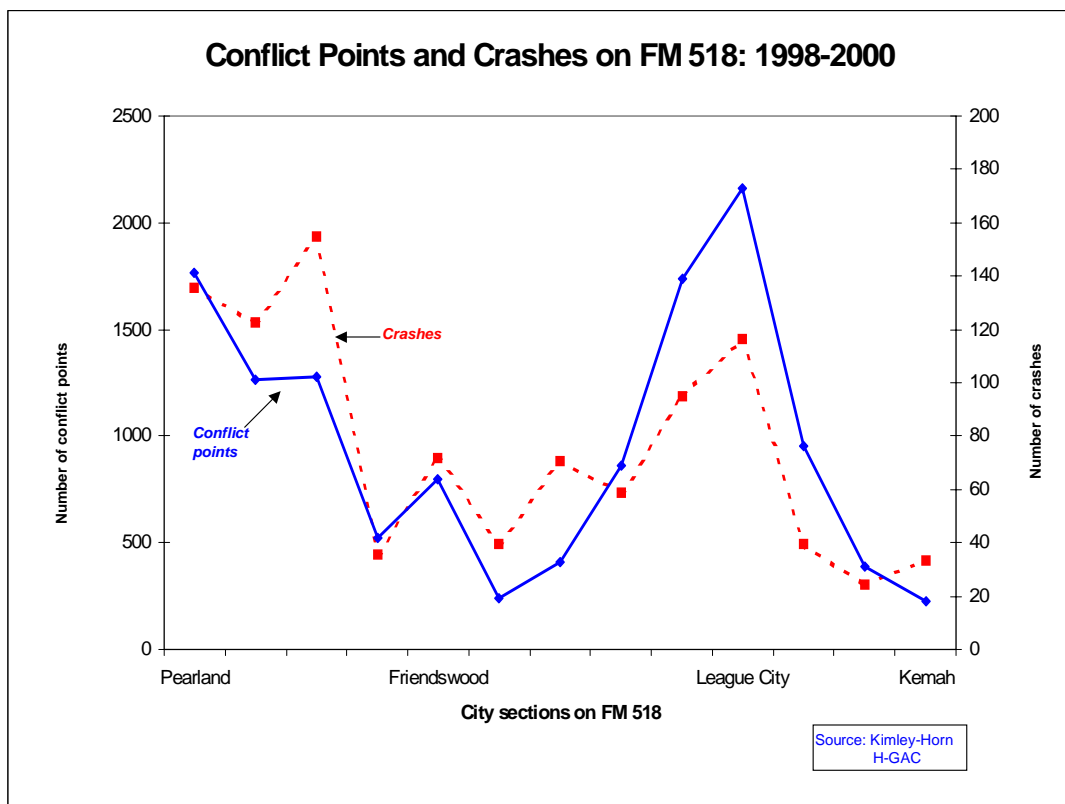
Other

- Improve Agency Coordination
- Develop strategies for Public Involvement and Education

Access Management

Access Management is a set of techniques that can be used to control access to highways, major arterials, and other roadways. Access management includes several techniques that are designed to increase the capacity of roads, manage congestion, and reduce crashes⁴ including:

- Increasing spacing between signals and interchanges;
- Driveway location, spacing, and design;
- Use of exclusive turning lanes;
- Median treatments, including two-way left turn lanes (TWLTL) that allow turn movements in multiple directions from a center lane and raised medians that prevent movements across a roadway;
- Use of service and frontage roads; and
- Land-use policies that limit right of way access to highways.



There is, unfortunately, a strong relationship between the number of conflict points (the number of lanes in which two vehicles could collide) and the number of crashes. One of the central goals in access management is to reduce the number of conflict points by restricting continuous left turns, consolidating driveways, and improving turning movements. Express streets, also, reduce conflict points by separating through traffic from local traffic.

Access Management Studies

⁴ <http://www.accessmanagement.com>

H-GAC has initiated Access Management studies in the region to assess the needs for improvements along certain corridors. Possible recommended improvements could include shared driveways, driveway consolidation/closure, improved signal synchronization, added raised median left turn bays, construction of landscaped medians, better connectivity through supporting streets, more u-turns, install raised medians in key areas, reduction of conflict points, creation of right turn bays, aesthetically buffered parking, and better circulation between parking lots. The regional Access Management studies include:

1. **Westheimer Corridor Study** – a 14-month study commencing in March 2001 to identify short range and long-range transportation improvements along the Westheimer Corridor in order to improve traffic flow and to enhance the physical character of the corridor. Short range and long- range recommendations are outlined in detail in the official document, Westheimer Corridor Study, April 2002.
2. **FM 518 Corridor Study** - a year-long study beginning in July 2003 to identify short range and long- range transportation improvements along the FM 518 corridor. At the time of this publication, there are no preliminary findings.
3. **FM 1960 Corridor Study** – a year-long study beginning in September 2003 to identify short range and long-range transportation improvements along FM 1960. At the time of this publication, there are no preliminary findings.

Chapter 3

Freight and Goods Movement

In 1998, the region's airports, seaports, roadways and railways moved 81 billion tons of freight to, from and within the Houston-Galveston area. The prospects for attracting more freight activity to the Houston-Galveston area are strong.

- IAH ranks fourth nationally in terms of passenger volume and is the 12th largest international cargo gateway in the United States. Growth forecasts for IAH indicate a 6 percent annual growth rate.
- The ports of Houston, Freeport, Galveston and Texas City handled 286 million tons of cargo in 2001, which is more than any other single port in the nation.
- According to the statewide transportation plan, the percentage of trucks on major roadways in and around Houston in 2000 was 11.3 percent of total traffic, on average. By 2025, the percentage of trucks on major roadways in and around Houston will increase to 13.6 percent, on average, with some roads carrying as many as 36 percent trucks.
- Inbound and outbound rail freight handled by Texas Gulf Coast Ports is forecasted to increase from 106 million tons in 1998 to more than 144 million tons by 2025. Houston is expected to continue to account for the largest volume of rail freight tonnage in Texas, forecast to increase by almost 49 percent from 70 million tons in 1998 to 104 million tons by 2025.

The 2025 RTP includes several areas to address in freight-related planning efforts.

- Participation with coalitions promoting high-speed rail corridors through Texas.
- Representation on the I-69 and Trans Texas Corridor steering committees.
- Consider establishing a freight-related Transportation Improvement Program
- Consider implementing a Freight Steering Committee
- Expand upon the findings of the Harris County Rail Study, once completed
- Explore opportunities to consolidate rail facilities
- Follow up on the Quick Response Initiative by developing medium- and long-range recommendations

This chapter includes information presented in the following sections:

- Description of the major freight facilities in the Houston-Galveston area including: seaports, airports, railroads
- Description of freight flows in the Houston-Galveston area

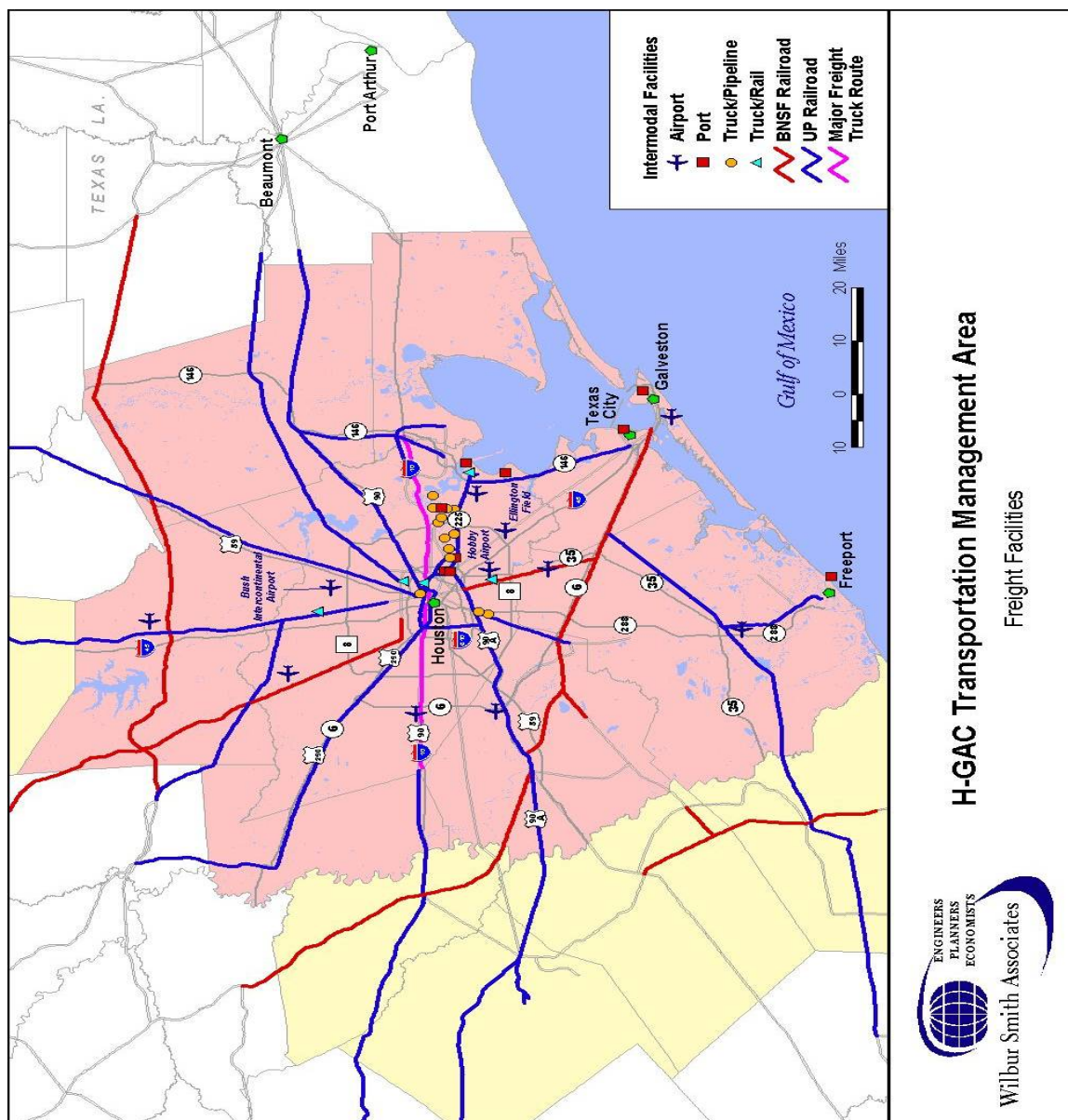
- Discussion of truck traffic in the Houston-Galveston area
- Strategies to address increased truck trips on area roadways
- Regional freight related initiatives
- List of additional areas to address in subsequent freight related research/planning efforts

MAJOR FREIGHT FACILITIES IN THE HOUSTON-GALVESTON AREA

Port Facilities

The ports in the Houston-Galveston area comprise some of the busiest ports in the nation. The Port of Houston represents one of the busiest ports in the country, while the ports of Freeport and Texas City are also nationally significant. Maritime traffic is a stimulus for growth in railroad and highway freight movement, and a primary cause for the increase in growth of freight movement in the Houston-Galveston area over the last decade. The table following the map below shows the growth experienced by selected Texas ports in terms of tonnage handled between 1990 and 2000.

Tonnage Handled by Texas Ports, 1990-2000				
Port	1990	2000	% Change	Change
Houston	126,178,000	191,419,000	34%	65,241,000
Corpus Christi	60,165,000	82,973,000	27%	22,808,000
Texas City	48,052,000	61,586,000	22%	13,534,000
Beaumont	26,729,000	82,653,000	68%	55,924,000
Port Arthur	30,681,000	21,387,000	-43%	(9,294,000)
Freeport	14,526,000	30,985,000	53%	16,459,000
Galveston	9,620,000	10,643,000	10%	1,023,000
Brownsville	1,372,000	3,268,000	58%	1,896,000
Port Lavaca	5,097,000	10,552,000	52%	5,455,000
Source: U.S. Army Corps of Engineers				



The Houston region is served by four deep-draft port facilities, including the ports of Freeport, Galveston, Houston and Texas City. The role of each port has evolved to meet regional and international market demands, concurrent with landside access and freight mobility. Each strategic port facility has a specific role in terms of the global trade network. These roles are identified below:

Port Name	Port Role
Port of Freeport	Container Port
Port of Galveston	General Purpose Cargo, Cruise
Port of Houston	International Gateway; General Purpose Cargo including Container and Bulk Cargo and Cruise
Port of Texas City	International Gateway Bulk Cargo Port

Source: Latin American Trade Transportation Study Phase II

The four ports' individual rankings in various categories of trade, clarify each facility's role and relative volume of trade by cargo and vessel type.

U.S. Waterborne Foreign Trade 2000, Port Rankings	Port of Freeport	Port of Galveston	Port of Houston	Port of Texas City
Volume of Cargo Total	18	40	1	10
Volume of cargo carried by Ocean Liner. (Container and breakbulk cargo)	34	25	5	44
Volume of cargo carried by Tanker. (Bulk Liquid cargo such as crude oil)	12	28	1	6
Volume of cargo carried by Tramp. (Dry cargo such coal, grain and fertilizers)	66	34	5	46
U.S. Port Rankings by Cargo Volume, Total Trade 2001	24	56	2	9
North American Container Traffic 2002, Port Rankings by TEU's (Only Top 40 Ranked)	36	N/A	12	N/A

Source: American Association of Port Authorities

The impact of the region's deep water ports on the surrounding road and rail networks varies based on the roles they play, as port facility type, and the cargos handled. Container cargo tends to be of a higher value and more time sensitive, thereby creating greater numbers of landside vehicular traffic impacts on the surrounding highway and local road network. Bulk cargo is less time sensitive and is typically transported by railroad, which impacts delivery times and safety issues inherent with rail transport and local road crossing conflicts.

Port of Houston

The Port of Houston is a general purpose, deep-water cargo port that is the world's sixth largest port and has historically ranked first in the nation for volume of foreign tonnage and second in the nation for total tonnage. The Port of Houston handles 40 percent of all freight moving through Texas ports and more than 90 percent of all container cargo moving through the Houston-Galveston region. The port consists of both public and privately controlled facilities. The Port of Houston Authority is the public agency at the Port of Houston. Cargo handled through the public complex accounts for approximately 15 percent of cargo in terms of tons and value. Private operators handle nearly 85 percent of cargo in terms of tons and value. The main private operator at the Port of Houston is Shell Oil.

Public and private dock facilities and industrial parks at the Port of Houston extend for 25 miles along the Houston Ship Channel, which is maintained by the Army Corp of Engineers. The Houston Ship Channel, including its tributaries and basins, is a 50-mile-long waterway that reaches from the head of Galveston Bay at Morgan's Point to the turning basin within the city limits of Houston. A shallow-draft channel extends up Buffalo Bayou from the turning basin to the Main Street bridge. Additional facilities of the port are located along the upper west side of Galveston Bay at Bayport near Red Bluff. Major facilities/terminals include:

Facility/Terminal	Function
The Turning Basin Terminal	Navigational head wharves, transit shed, warehouses
Wharf 32	Project and heavy cargo
Barbours Cut Terminal	Container terminal (9th largest in U.S.)
Woodhouse Terminal	Roll-on/roll-off ramp, general cargo, public grain elevator
Care Terminal	Wharves, 45,000 sqft. warehouse, 13-acre marshalling yard
Jacintoport Terminal	82,500 sqft. transit shed, 7.5 acre marshalling yard
Bayport Terminal	Container terminal
PHA Bulk Materials Handling Plan	Bulk material

Source: Port of Houston

Port of Houston Forecasted Growth

From 2001 to 2002 the Port of Houston had nearly an 8 percent growth in import/export total container volume, as expressed in 20-foot equivalent units (TEUs).⁵ Bulk material handled at the port increased by 22 percent over the same period. The Port Import/Export Reporting Service (PIERS) data projected an average six percent annual increase in container volumes over the next three years for the Port of Houston project.

Port of Houston Expansion Plans

The Port of Houston Authority plans to continue development of a major marine terminal complex on about 1,050 acres along the south side of the Bayport ship channel called the Bayport Terminal Project. Full buildout is not anticipated until 2030. The terminal complex will include docking, loading, unloading and storage container facilities. In addition to facilities for cruise ships, the terminal will contain an intermodal yard, warehousing facilities and properties available for light industrial development. The project also contains a four-part system to collect and treat storm water runoff that would otherwise enter Galveston Bay. The economic benefit of this project is estimated to be more than 15,000 jobs by 2015 and nearly \$800 million in business revenue. By 2030, the economic benefit is estimated to be 32,000 new jobs and \$2.4 billion in business revenue. The cost of the project is anticipated to be \$1.2 billion and developed in a market driven timeline.

The Port of Houston proposed more than 25 enhancements for the port, including rail and roadway improvements. Major projects, anticipated to cost more than \$10 million each, are:

- Extending PTR A track mainline rail from Strang Yard to Bayport
- Paving 2 miles of roads and industrial park – east
- Extending PTR A track from mainline to the intermodal yard
- Grade separated crossing at State Highway 146 and PTR A lead track

⁵ PIERS' Port Horizons, Imports and Exports in TEUs (2001 – 2005) Supplement to PIERS' Horizons, U.S. Container Forecasts, The Journal of Commerce/PIERS

TEU = "Twenty-Foot Equivalent Unit" a standard linear measurement used in quantifying container traffic flows. One 20-foot long container equals one TEU while one 40-foot containers equals two TEUs.

- Paving 72 acres of storage yards in industrial park – west
- Widening of Port Road east of SH 146 (6-lane with raised median)
- Paving of 23 acres at Jacintoport

Port of Galveston

The Port of Galveston was established in 1825 and is Texas' oldest commercial port enterprise. The Port of Galveston provides direct access to the Gulf of Mexico, and the majority of its cargo volume is bulk grains. Other major commodity types include sugar, liquid bulk, bananas and other fruit.

The Port of Galveston owns and operates public wharves, transit sheds, open and covered storage facilities, warehouses and freight handling facilities. The Port leases land and facilities to others, including a bulk export grain elevator leased to Farmland Industries Inc., a bulk import sugar terminal leased to Imperial-Holly Corporation, a bulk liquid dock leased to Galveston Terminal Inc., a shipyard repair facility leased to PMB/Bechtel Corp., and an area leased to The Woodlands Corporation for tourist development.

Port of Galveston Forecasted Growth

In 2002, the Port of Galveston experienced gains in the volume of fresh fruit and general cargo. Activity between 2001 and 2002 has seen dramatic increases in the number of cruise ship vessels and passengers passing through the Port of Galveston. During the same period, tonnage passing through the port decreased by 27 percent. The port is projecting an increase of cruise passengers through the port of as many as one million passengers in 2004.

PORT OF GALVESTON			
	2001	2002	% Change
Total Tonnage	4,270,734	3,356,568	-27.24%
Number of Passengers	148,701	266,830	44.27%
<i>Number of Vessels</i>			
Cargo/Lay Ships	625	557	-12.21%
Barges	265	336	21.13%
Cruise Ship Calls	94	152	38.16%

Source: Port of Galveston

Port of Galveston Expansion Plans

Current expansion plans for the Port of Galveston reflect the recent increase in cruise ship passengers at the port. The port expects to spend \$15 million revamping cruise ship terminal 2 in 2004, and is looking at additional modifications to cruise ship terminal 3, estimated at \$20 million.

Another impact of the increased cruise ship business is increased traffic on Harborside Drive. The port is looking at proposing improvements to this roadway, in order to accommodate cruise-related truck and passenger traffic.

For the cargo side of the port, officials are preparing to implement a mixed-use west end development that will include a roll-on/roll-off container ramp, warehousing space and additional cranes.

Port of Freeport

Port of Freeport is a publicly owned port that began operating more than 100 years ago when the first jetty system was built in Freeport, Texas. Since that time, the Port has become one of the fastest growing ports on the entire Gulf Coast. The port is currently ranked as the 16th largest port in the United States in terms of tonnage handled, according to the American Association of Port Authorities.

The Port of Freeport handles a variety of agricultural products, such as rice, bananas and other fruits. More than 90 percent of the port's tonnage consists of agricultural products. Dole Fruit Company Inc. is one of the top 25 container carriers in the world and a major carrier at the port. General cargo and dry bulk freight are also handled through the Port of Freeport. The Port of Freeport operates four terminals, including the Brazosport Turning Basin, Brazos River Turning Basin, Upper Turning Basin and the Stauffer Turning Basin.

Port of Freeport Growth Forecasts

The Port of Freeport was ranked the 12th largest container terminal in the U.S. in 2002, which was largely due to a nearly 25 percent increase in containerized traffic experienced at the port between 2001 and 2002. Container traffic is expected to continue to increase through 2005, although at a more moderate rate of about 5 percent per year.

Port of Freeport Expansion Plans

Major expansion of cargo handling capabilities at the Port of Freeport will be unimpeded by physical capacity, since the port possesses more than 8,000 acres of land available for development. Of this amount, 1,400 acres are environmentally mitigated, and all parcels are accessible by water, highway and railroad.

The port is currently engaged in Phase II of its expansion, which calls for widening the existing channel from 400 feet to 800-900 feet, and deepening the channel from 40 to 60 feet. This expansion will allow greater access for multiple ships. Other expansion plans call for increased lag and crude oil handling facilities at the port. A 60,000 square foot cold storage facility is also in the design phase at the port.

Port of Texas City

The Port of Texas City is a privately owned for-profit port that serves as property owner and landlord to the facility operators. The Port of Texas City almost exclusively handles bulk liquid products, which include chemical and crude oil products. The Port of Texas City ranked ninth in the nation in terms of tons handled in 2001. In 2001, the port handled more than 62 million tons of cargo. It is estimated that 40 million tons of crude oil entered the port, of which approximately 30 million tons is processed in Texas City. The remaining 10 million tons of crude oil is typically transported by pipeline to Oklahoma.

Port of Texas City Growth Forecasts

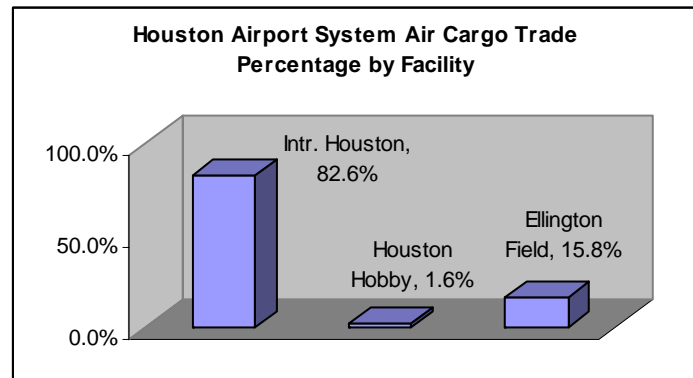
Growth forecasts for the Port of Texas City are tied directly to the oil business growth. If oil business increases, then Port of Texas City activity historically increases.

Port of Texas City Expansion Plans

The Port of Texas City is not restricted from increasing intake of additional chemicals or crude oil. Port officials estimate they could increase trade by at least 40 percent without constructing new facilities. Therefore, the Port of Texas City has no expansion plans in the foreseeable future.

Houston Airport System

The Houston Airport System (HAS), comprised of George Bush Intercontinental Airport/Houston (IAH), William P. Hobby Airport (HOU) and Ellington Field (EFD), ranks fourth nationally and sixth worldwide in terms of passenger volume. Bush Intercontinental Airport/Houston (IAH) is one of the fastest growing international airfreight hubs in the United States. IAH is ranked as the 12th largest international air cargo gateway in the United States, and remains in the top 25 nationally for total air cargo volume.



Air cargo handled through the Houston Airport System increased in 2002 by four percent over 2001, finishing the year with 330,000 tons of cargo handled. IAH handles the vast majority of air cargo for the Houston Airport System, with nearly 83 percent of all air cargo. Belly cargo operations accounted for 53.7 percent of cargo volume at IAH in 2002, and grew 4.6 percent with 161,000 tons of shipments. Freight-only cargo volume, including scheduled and chartered cargo, rose 6.1 percent in 2002. In total IAH cargo volume in 2002 increased by 5.3 percent over 2001 totals. Hobby Airport handled nearly two percent of the air cargo in Houston, while Ellington Field handled nearly 16 percent of all air cargo. Ellington handled 52,000 tons of cargo in 2002, down 1.6 percent from 2001. This distribution of air cargo within the HAS will change in 2003 because United Parcel Service (UPS), the major air cargo carrier at Ellington Field, has relocated to IAH's new air cargo complex.

Houston Airport System Passenger, Cargo and Aircraft Operations - 2002

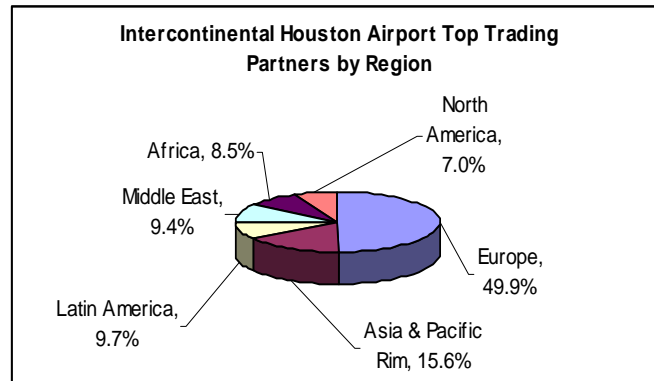
Airport	Passengers	Cargo Tons	Aircraft Operations
Bush Intercontinental	33,904,847	273,078	456,831
Houston Hobby	8,035,727	5,338	246,230
Ellington Field	76,035	52,285	102,016
Total	42,016,609	330,701	805,077

Source: Houston Airport System

Houston Intercontinental Airport Air Cargo Growth Forecasts

International air cargo traffic through IAH has increased 10 percent in the past five years, and with the addition of a new air cargo complex at IAH, the trend is expected to continue. An annual 6 percent growth rate is forecasted for IAH based on historical trends and anticipated new market growth.

Half of the international air cargo trade with IAH is currently from Europe. IAH has targeted increasing trade with Latin America because of the expected threefold increase of trade with Latin America over the next 20 years. For manufactured goods, which are more likely to travel via air, trade is expected to increase six times over in the next 20 years.⁶ A strategic advantage that IAH has over traditional trading partners with Latin America, such as Miami, is its geographic location in the center of the country. Houston is located within 36 hours by road or rail from any point in the country. New facilities designed to handle perishable goods from Latin America will also increase trade opportunities at IAH.



Houston Intercontinental Airport Air Cargo Expansion Activity

The Houston Airport System has completed Phase I of a major expansion of air cargo handling facilities at Bush Intercontinental Airport. When fully completed, the complex will encompass 120 acres on the northeast side of the airport, providing easy access to the proposed I-69 NAFTA Superhighway. Phase I of the development included ramp space for parking up to 20 wide body aircraft simultaneously, and provides more than 550,000 square feet of cargo building space. Cargo aircraft now have direct access to Runway 8-26, the future Runway 8L-26R, and, once the midfield taxiway is constructed, Runway 9-27. All three runways are located on the north side of the passenger terminal.

IAH cargo capacity is projected to triple once the air cargo complex is completed. In addition to increased capacity, airlines and shippers will have the ability to distribute air cargo faster and more efficiently throughout the U.S. and internationally. A stand-alone facility will house federal inspection services, including the U.S. Immigration and Naturalization Service (INS), U.S. Customs Service, U.S. Department of Agriculture, and U.S. Health Inspection Services, providing easy one-stop service to customs brokers, air cargo carriers and all other cargo customers. The IAH air cargo distribution complex can easily be expanded in the future as air cargo develops.

William P. Hobby Airport

The City of Houston's first public airport, William P. Hobby, was acquired in 1937. Today, HOU primarily serves domestic regional and national commercial carriers for the Houston Airport System. In 2002, the airport served more than eight million passengers and offered service from 13 carriers. Southwest Airlines is the largest carrier at Hobby Airport, serving nearly 85 percent of Hobby's passengers.

⁶ LATTS, Latin American Trade and Transportation Study, 2001

Hobby Airport handles less than 2 percent of air cargo in the Houston area. All air cargo handled at Hobby Airport is transported in the cargo section of passenger planes, and 92 percent was handled by Southwest Airlines in 2002.

Increases in air cargo at Hobby Airport will likely mirror increases in passenger activity for the foreseeable future. Although nearly \$250 million is being spent modernizing Hobby's terminal building and other airport facilities, there are no expansion plans for air cargo facilities at Hobby Airport.

Ellington Field

Ellington Field, formally an air force base, still has a strong military presence. Ellington was passed into civilian hands in 1984 under the City of Houston's jurisdiction. However, NASA and the Texas Air National Guard (TXANG) still conduct flight operations at Ellington. Ellington is a base of operations for corporate and commercial cargo and private aviation operations, and served more than 76,000 passengers in 2002, an increase of 26 percent over 2001. With the move of UPS in February 2003 to IAH, air cargo likely will be dramatically reduced at Ellington Field. Future expansion of air cargo handling facilities at Ellington Field is not envisioned in the future.

Rail Freight Movement in Texas and the Houston-Galveston Area

The rail network in Houston is dominated by two major Class I railroads, Union Pacific (UP) and Burlington Northern Santa Fe (BNSF). Terminal companies Houston Belt and Terminal (HBT) and Port Terminal Railroad Association (PRTA) are terminal switching companies in Houston that have now been acquired by UP and BNSF. The acquisition of Southern Pacific (SP) by UP provided additional infrastructure on which UP could operate, and the railroad has worked to integrate these facilities into its larger network. With increasing freight movements from the ports along the Gulf Coast, all existing track has been viewed by UP management as necessary.⁷

Rail Freight Movement in Texas

In the 1990s, there was a 40 percent increase in tons of rail freight transported in the state of Texas. In 1991, 230 million tons of rail freight was transported in Texas. By 1999, this figure had increased to approximately 323 million tons – an increase of almost 40 percent. The figure on the following page depicts commodity flows by rail throughout the state.

Statewide Rail Commodity Flows

During the same period, the number of railcars handled in Texas grew even more quickly than the rise in tonnage, increasing from 4.1 million cars in 1991 to 7.2 million cars in 1999. The expansion of trade, especially with Mexico in the years following passage of the North American Free Trade Agreement (NAFTA), the growth of manufacturing, and a rapidly growing population all contributed to increases in rail freight shipped around the state.

Rail Freight Movement in Houston-Galveston Area

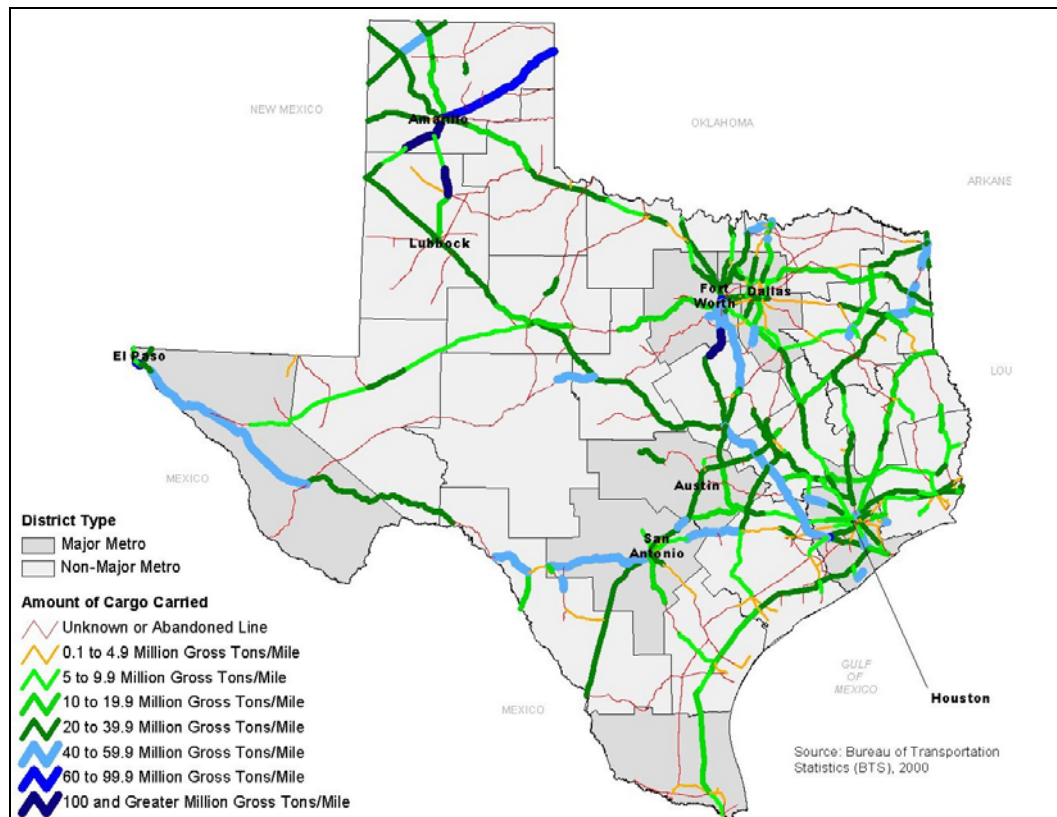
⁷ Inventory of Railroad Operating Conditions in the East End of Houston, Texas Transportation Institute, Texas A&M University System, February, 2003

Houston accounted for the largest volume of rail freight originating in Texas, as well as the greatest amount of freight destined for other parts of Texas. The Houston Rail District is responsible for generating nearly 30 percent (28.7 million tons) of the total freight from Texas, and nearly 45 percent (46 million tons) of freight coming into Texas. The Dallas and Fort Worth districts combined, were responsible for 13 percent of the rail freight tonnage destined for points in Texas. The graphic on the following page shows how the Houston area accommodates higher rail freight volumes than other areas in Texas.

The transport of chemicals represents almost 64 percent of all rail commodities originating in the Gulf Coast port districts, and is the largest rail commodity originating in the Houston area. As the nation's leading center for chemicals manufacturing, the Houston district accounts for a large share of the entire tonnage destined for other major metropolitan areas.

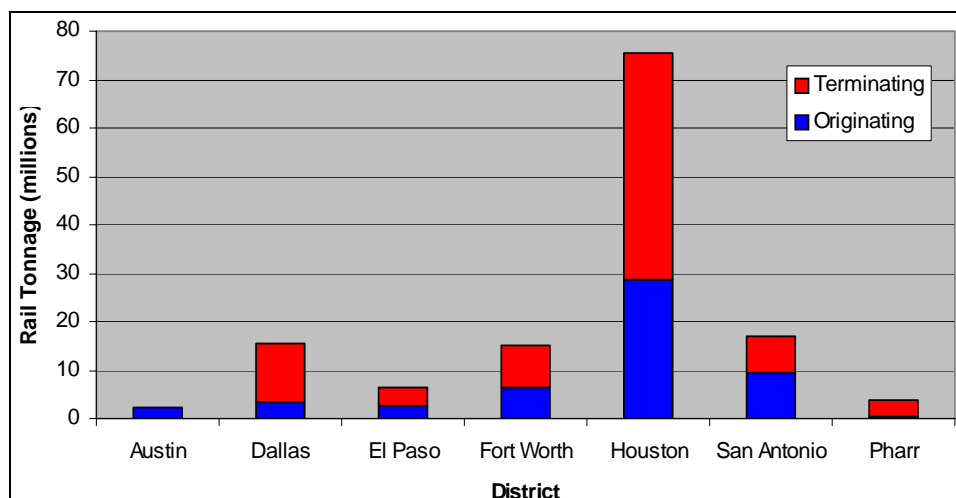
The second largest rail commodity originating in major metropolitan districts in Texas in 1998 was non-metallic ores (almost 26 percent). Used by the construction industry, non-metallic ores (including aggregate rock) are among the top commodities brought into the Houston district by rail. Coal is the most important commodity carried by rail destined for major metropolitan districts in Texas. Coal accounts for 20 percent of the rail tonnage destined for major metropolitan districts and approximately 27 percent of the rail freight destined for Gulf Coast port districts in Texas. Often hauled from Wyoming's Powder River Basin, coal is used to generate electricity at coal burning power plants throughout Texas, and is the largest volume inbound commodity to the Houston district.

Commodity Flows by Rail in Texas



Source: Texas Department of Transportation, Transportation Planning and Programming Division

1998 Rail Tonnage Handled by Major Metropolitan District

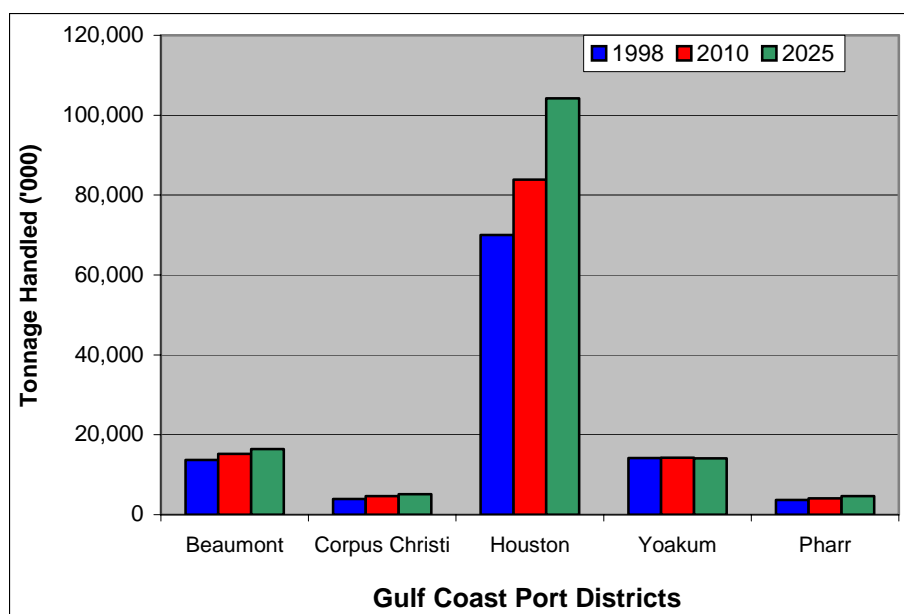


Source: Reebie Associates

Forecasted Rail Freight Trends

Inbound and outbound rail freight handled by Texas Gulf Coast Ports is forecasted to increase from 106 million tons in 1998 to more than 144 million tons by 2025. Houston is expected to continue to account for the largest volume of rail freight tonnage in Texas, forecast to increase by almost 49 percent from 70 million tons in 1998 to 104 million tons by 2025. The following figure compares rail tonnage handled by Texas ports in 1998 with the tonnage forecasted for 2010 and 2025.

Forecast Rail Tonnage Handled by Texas' Gulf Coast Port Districts



Source: DRI-WEFA

Port of Houston

Texas' busiest and largest port in terms of tonnage and commercial value is the Port of Houston. Reduced charges for containers at the Port of Houston have made rail an attractive mode at this port. The Port Terminal Railroad Association (PRTA) revised the formula for determining the cost of transport and effectively reduced the cost of handling containers. The result of this methodology change is a decrease in the average cost per container from \$50 to \$10. The reduction in costs for handling containers will likely further stimulate the growth of rail traffic at the port and contribute to increases in the amount of marine tonnage handled.

The Port of Houston provides more than 170 miles of railroad tracks and heavy equipment for moving freight, including container lift machines, cranes, rail ramps, forklifts, and heavy lift docks. Approximately 130 different trucking companies also transport cargo in and out of the port. The main commodities include grain, iron and steel, and container shipments.

U.S. Army Corps of Engineers statistics show a constant increase in total tonnage handled by the Port of Houston, from 109 million tons (1980) to 191 million tons (2000). This increase in tonnage is expected to continue, creating enormous challenges for highway and rail infrastructure.

Rail Related Expansion Plans

Expansion of rail capacity is primarily focused on improvements and expansion of port rail terminal facilities. The following rail related improvements were identified in the Draft State Rail Plan:

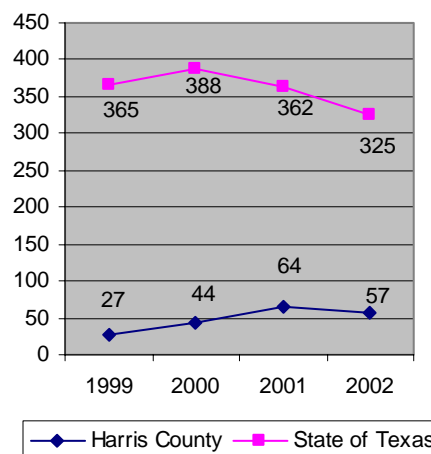
- The Port of Houston is in the process of extending the lead track at Barbours Cut to the west. This project will increase the capacity of the three-mile single-track section used by both UP and PTR. The project is currently in the design stage.
- The Port of Houston Authority is also planning to develop a new intermodal facility at Bayport in southeast Harris County, which will include access by highway, rail and waterways.

At-Grade Rail Crossings

A major concern among residents and rail operators in the Houston-Galveston area are the safety issues surrounding public at-grade crossings in centers of population and commerce. There are 1,009 such public at-grade crossings in Harris County alone. As many as 32 trains on one rail line may be routed through the east side of Houston on any given day. Issues identified as major areas of concerns related to rail crossings include:

- access to local schools over rail corridors;
- access for emergency vehicles;
- noise impacts;

Highway-Rail Incidents at Public Private Crossings in Harris County and State of Texas 1999-2002



- pedestrian safety issues; and
- crossing blockage causing delays of commerce.

According to the Federal Railroad Administration, the number of highway-rail incidents at public private crossings in the State of Texas has remained relatively stable form 1999 to 2002, and declined slightly from 365 in 1999 to 325 in 2002. At the same time, incidents in Harris County have increased rapidly from 27 in 1999 to 64 in 2001. Incidents decreased slightly in 2002 down to 57 incidents during the course of the year.

HIGHWAY-RAIL INCIDENTS AT PUBLIC AND PRIVATE CROSSINGS STATE OF TEXAS

Year Totals 1999, 2000, 2001, 2002

Counties	Total		Total Year Counts			YTD Counts Jan - Dec		% Change Over Time		
	Accs	% of Total	1999	2000	2001	2001	2002	1999 to 2001	2000 to 2001	2001 to Dec 2002
GRAND TOTAL....	1,440	100.0	365	388	362	362	325	-0.8	-6.7	-10.2
Automobile	574	39.9	158	153	142	142	121	-10.1	-7.2	-14.8
Pickup truck	343	23.8	88	96	82	82	77	-6.8	-14.6	-6.1
Truck-trailer	251	17.4	54	66	70	70	61	29.6	6.1	-12.9
Truck	157	10.9	33	39	37	37	48	12.1	-5.1	29.7
Van	57	4.0	17	17	12	12	11	-29.4	-29.4	-8.3
Other	29	2.0	7	10	9	9	3	28.6	-10.0	-66.7
Pedestrian	13	0.9	5	2	4	4	2	-20.0	100.0	-50.0
Other motor vehicle	8	0.6	2	2	4	4		100.0	100.0	
Motorcycle	5	0.3	1	2			2			
Bus	2	0.1		1	1	1				
School bus	1	0.1			1	1				

HIGHWAY-RAIL INCIDENTS AT PUBLIC AND PRIVATE CROSSINGS IN HARRIS COUNTY
Year Totals 1999, 2000, 2001, 2002

Counties	Total		Total Year Counts			YTD Counts Jan - Dec		% Change Over Time		
	Accs	% of Total	1999	2000	2001	2001	2002	1999 to 2001	2000 to 2001	2001 to Dec 2002
GRAND TOTAL....	192	100.0	27	44	64	64	57	137.0	45.5	-10.9
Automobile	78	40.6	14	16	26	26	22	85.7	62.5	-15.4
Truck-trailer	40	20.8	3	11	13	13	13	333.3	18.2	
Pickup truck	35	18.2	4	9	10	10	12	150.0	11.1	20.0
Truck	24	12.5	3	5	7	7	9	133.3	40.0	28.6
Van	6	3.1	1	1	4	4		300.0	300.0	
Pedestrian	4	2.1	1	1	1	1	1			
Other	2	1.0	1	1						
Bus	1	0.5			1	1				
School bus	1	0.5			1	1				
Other motor vehicle	1	0.5			1	1				

SECTION 2: FREIGHT FLOWS IN THE HOUSTON-GALVESTON AREA

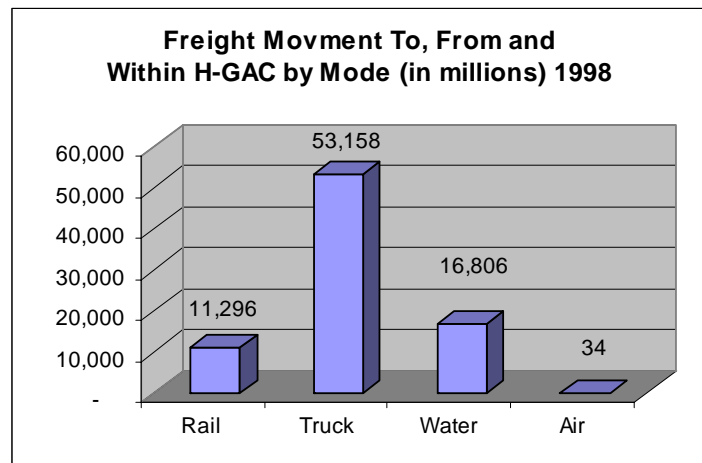
Reebie Associates compiles national freight flow data used by federal and local government agencies to identify how and where freight moves throughout the country. This data is updated every five years. The most recent year for which data is available for the Houston-Galveston area is 1998. Used with special permission from Reebie Associates, this data provides the most complete and current information available to evaluate the flows of freight to, from and within the Houston-Galveston area. In 1998, more than 81 billion tons of freight moved to, from and within the 13-county H-GAC region. The table below shows the breakdown of how much freight moved internationally and domestically, as well as by mode of transport and percent. This table also indicates if the origin or destination point was located in the H-GAC region.

<u>Freight Moved in the Houston-Galveston Area, 1998</u>		
Mode And Type Of Freight Movement	Tons	Percent
INTERNATIONAL RAIL		
Rail Freight Originating in Houston	1,024,839,870	1.26%
Rail Freight Terminating in Houston	1,844,108,637	2.27%
Rail Freight Movement within Houston	2,530,669	0.00%
DOMESTIC RAIL		
Rail Freight Originating in Houston	2,865,869,744	3.53%
Rail Freight Terminating in Houston	5,552,642,858	6.83%
Rail Freight Movement within Houston	5,848,066	0.01%
INTERNATIONAL TRUCK		

Truck Freight Originating in Houston	1,067,000,869	1.31%
Truck Freight Terminating in Houston	1,136,105,120	1.40%
Truck Freight Movement within Houston	1,090,236	0.00%
DOMESTIC TRUCK		
Truck Freight Originating in Houston	25,874,409,552	31.83%
Truck Freight Terminating in Houston	24,987,372,439	30.74%
Truck Freight Movement within Houston	92,312,238	0.11%
INTERNATIONAL WATERBOURNE		
Waterborne Freight Originating in Houston	105,577,251	0.13%
Waterborne Freight Terminating in Houston	176,307,199	0.22%
DOMESTIC WATERBOURNE		
Waterborne Freight Originating in Houston	6,276,834,106	7.72%
Waterborne Freight Terminating in Houston	10,239,013,971	12.59%
Waterborne Freight Movement within Houston	8,324,988	0.01%
INTERNATIONAL AIR CARGO		
Air Cargo Originating in Houston	65,613	0.00%
Air Cargo Terminating in Houston	53,647	0.00%
DOMESTIC AIR CARGO		
Air Cargo Originating in Houston	9,312,898	0.01%
Air Cargo Terminating in Houston	24,701,089	0.03%
Total Tonnage Moved	81,294,321,060	100%

Source: Reebie Associates

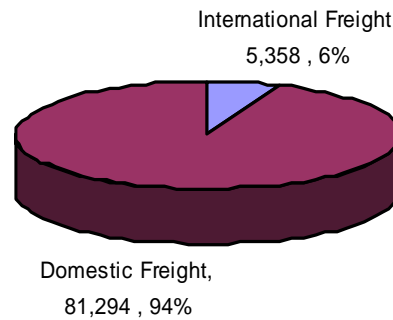
A key finding in the table above is that 65 percent of the tons moved to, from and within the Houston-Galveston area in 1998 were moved by truck. This figure includes both domestic and international freight. As shown in the chart to the right, waterborne freight accounted for 21 percent of the tons moved within the region, totaling 16.8 billion tons. Rail accounted for the movement of 11.3 billion tons of freight, while air cargo accounted for 34 million tons moved. In terms of total value of shipments in the U.S., air cargo ranks second at 12 percent behind truck cargo value at 80 percent. Rail and water cargo account for 7 and 2 percent respectively of the total value of cargo handled in the U.S.⁸



One factor that contributes to the greater share of freight moving by truck versus other modes is that crude oil and chemical products, which are handled in large quantities at the ports in the H-GAC region, are frequently processed at or in close proximity to those ports. The resulting product is then shipped out again, or transported via oil pipeline to destinations such as Oklahoma. If crude oil products and chemicals were moved inland by other means, it would most likely be transported by rail and result in an increase in the share of tons moved by rail.

⁸ Source: The Freight Story, 2002 Freight Analysis Framework, U.S.DOT (FHWA) – 1998 Data

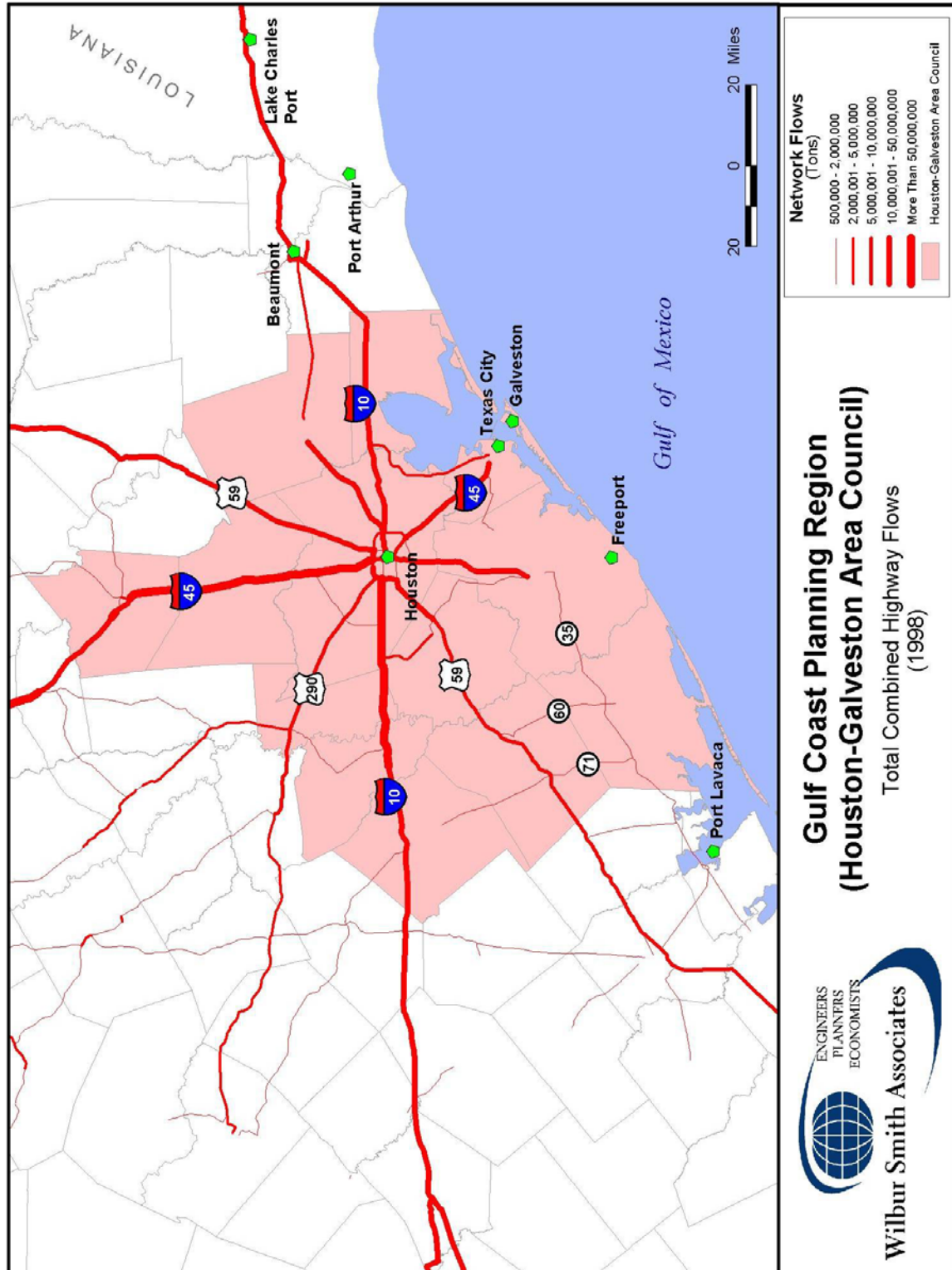
**Freight Movement as Domestic or International,
H-GAC(in millions)1998**

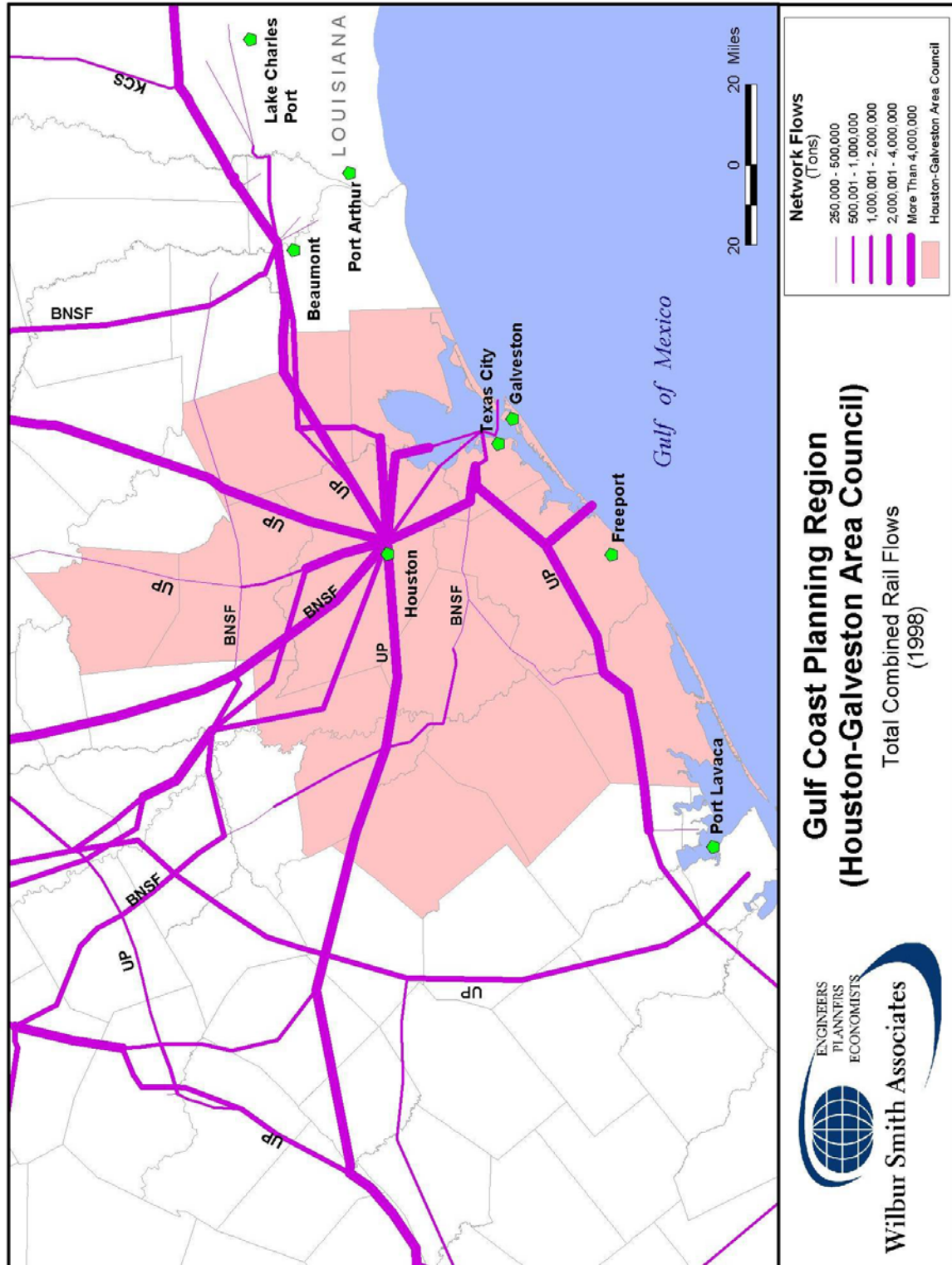


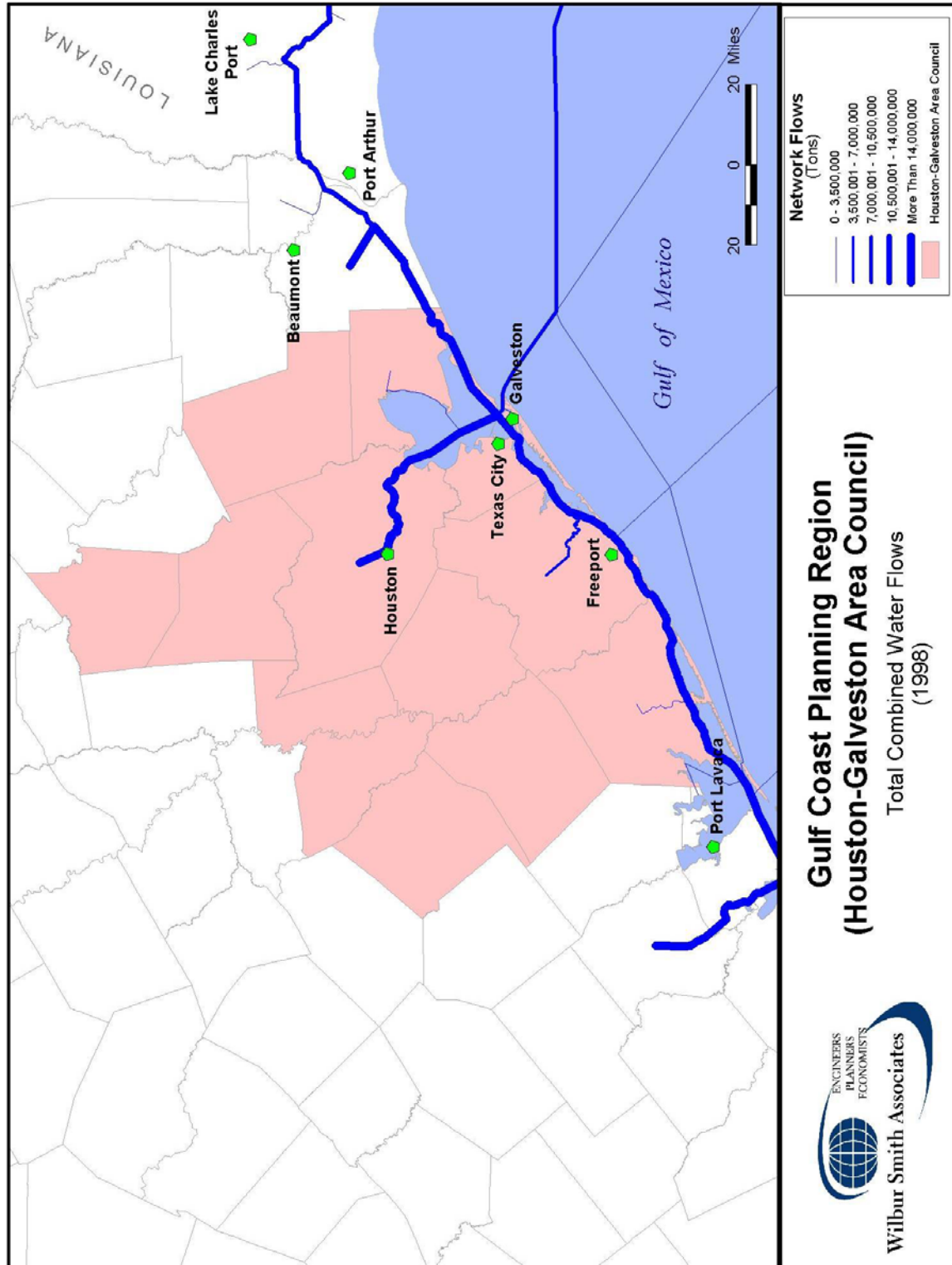
The figure above shows that a majority (94 percent) of the freight movements in 1998 were domestic freight movements. Only 6 percent of freight movements were international movements.

The three maps on the following pages show freight flows assigned to specific highway, railways, and shipping channels. The highway flow map clearly shows that Interstate 10 and Interstate 45 are the primary freight highways of importance in the Houston-Galveston area. Specifically, I-10 west of downtown and I-45 north of Houston are the segments that show flows of more than 50 billion tons annually.

The Houston area rail flow map shows that Houston serves as major rail hub for the region, and that the Union Pacific rail lines transport a majority of the tonnage along the system. The flow data map shows that waterborne flows in the Houston-Galveston area are concentrated at the Port of Houston and along the intercoastal waterway. Inland waterborne transport does not play a significant role in the transport of freight in the Houston region.







SECTION 3: TRUCK TRAFFIC IN THE HOUSTON-GALVESTON AREA

The quality of life of any metropolitan area is enhanced by a strong and vibrant economy. A common byproduct of a strong local economy is the generation of increased truck trips and associated stress on the local transportation system. A manufacturing-based economy, such as Houston's, impacts the transportation system and results in significant truck traffic on area roadways.

The prospects for attracting more freight activity to Houston-Galveston area are strong. Freight facilities in the region will continue to attract growth. IAH ranks fourth nationally in terms of passenger volume and is the 12th largest international cargo gateway in the United States. Growth forecasts for IAH indicate a 6 percent annual growth rate. The ports of Houston, Freeport, Galveston and Texas City handled 286 million tons of cargo in 2001, which is more than any other single port in the nation. In 1998, the region's airports, seaports, roadways and railways moved 81 billion tons of freight to, from and within the Houston-Galveston area. Latin American trade is predicted to increase threefold in the next 20 years, and legislation, such as NAFTA, has made it easier to trade with Mexico and Canada. Now the potential exists to expand economic markets, resulting in increased trade with those countries. Given Texas' close proximity to trade partners, such as Mexico and other Latin American countries, the Houston area should expect the number of trucks to increase on area roadways.

According to the statewide transportation plan, the percentage of trucks on major roadways in and around Houston in 2000 was 11.3 percent of total traffic, on average, with more than 30 percent of truck trips on I-10 east of Houston.⁹

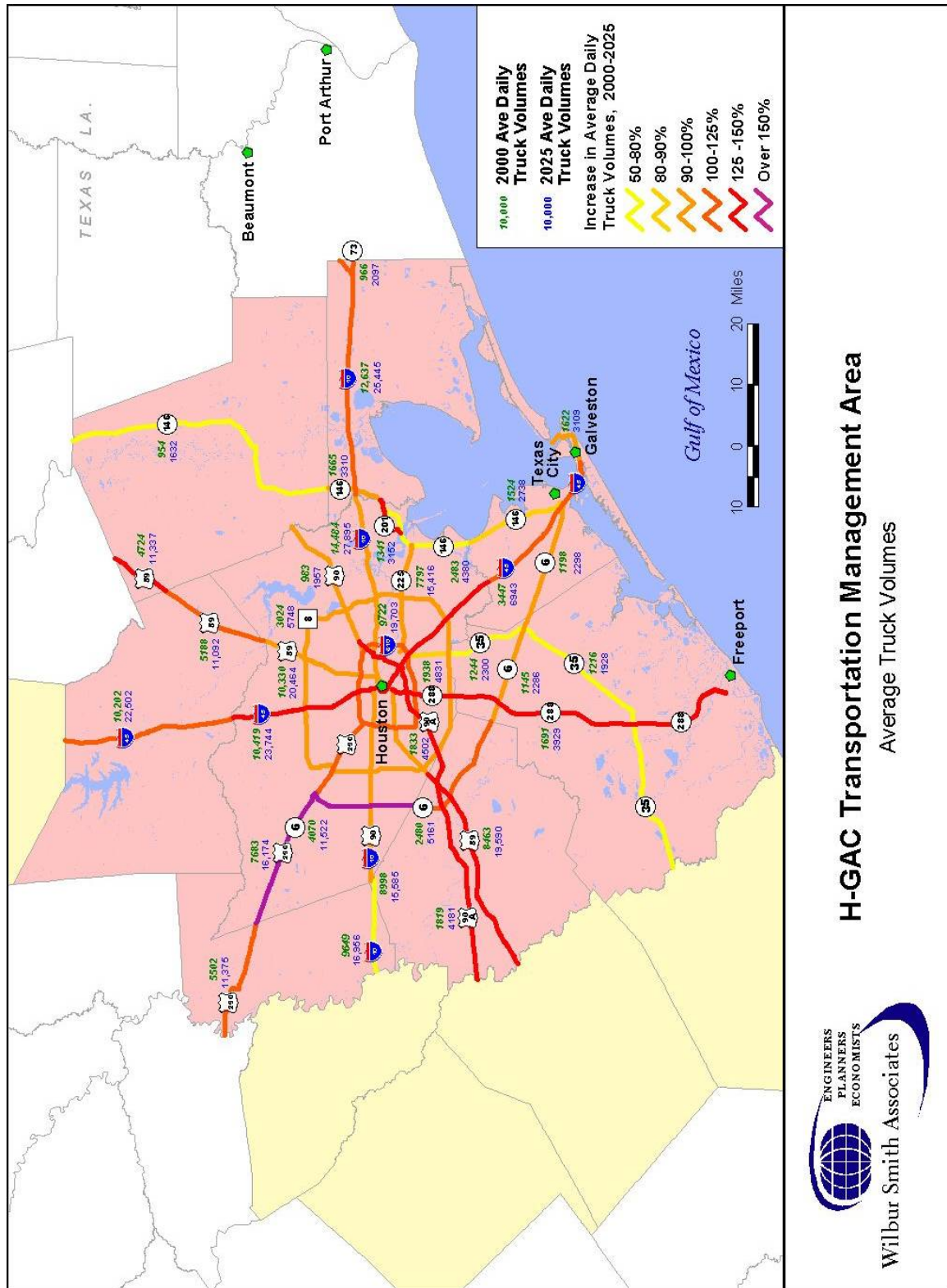
By 2025, the percentage of trucks on major roadways in and around Houston will increase to 13.6 percent, on average, with some roads carrying as many as 36 percent trucks.

Traffic projections indicate that traffic for all types of vehicles will increase by 64 percent by 2025. Those projections, coupled with a modest increase in the average percentage of truck trips by 2025, will result in a dramatic increase in truck trips on the major roadways in the Houston-Galveston area. If alternative solutions are not implemented, the Houston area will see more than double the number of trucks on the major roadways between 2000 and 2025.

The map on the following page shows average truck volumes in 2000 and 2025 for the Houston Galveston area. The roadway segments with the brightest colors (purple and red) indicate the highest percentage of increase in truck volume over the 25-year period. The roadways with greatest increase in actual truck volume over this period are: I-10 in Chambers County, I-45 in Harris and Montgomery counties, and U.S. 59 in Fort Bend and Harris counties.

The map shows no distinct trend in terms of truck traffic growth becoming concentrated in one area of the region. However, it is noteworthy that the roadway forecasted to experience the highest growth in truck percentage, SH 6 north of U.S. 90A, is not close to a major freight facility. Therefore, it is assumed the through trips from generators outside of the region will contribute to the high increase in truck traffic along this segment of roadway.

⁹ Statewide Transportation Plan prepared by Wilbur Smith Associates



SECTION 4: STRATEGIES TO ADDRESS INCREASED TRUCK TRIPS ON AREA ROADWAYS

The time to plan for the safe and efficient movement of freight in the Houston-Galveston area is prior to the time that congestion begins to negatively impact the economy because of excessive delay costs and increased costs of doing business. Strategies that address unique circumstances along with targeted solutions have already been implemented in the Houston area. In a study by the Texas Transportation Institute, researchers evaluated a policy restricting trucks to certain lanes on an 8-mile stretch of I-10 East. After implementing the lane restrictions, the study recorded a dramatic 68 percent reduction in crashes along the test section of the corridor.

Another strategy targeted specifically for the Houston-Galveston area is to assist freight intensive businesses that process raw materials to locate in proximity to freight facilities, such as railroads or port properties. By enhancing the opportunity for these businesses to utilize rail and vessels for transporting freight, the potential that these industries will occupy shrinking space on roadways is greatly diminished.

Strategies that have been implemented in other jurisdictions to address increasing mode share of trucked freight movement should be considered for the Houston region. Such strategies could include many of the following recommendations:

- Designate network roles for freight routes, such as through routes, arterial stem routes, and local connectors. Use these designations to channel investments to the highways that play key network roles for movement of freight.
- Incorporate trucks in the design of the traffic system, such as traffic signalization, intersection design and turning radius design
- Require new development to accommodate freight related concerns, such as the provision of a sufficient turning radius into delivery points (i.e. shopping centers and retail establishments)
- Require freight access for commercial and business establishments (off street delivery bays and loading zones)
- Intelligent Transportation System solutions could be implemented, such as travel management systems and traveling information systems
- Consolidated Freight/Rail Corridors, such as the Alameda Corridor in Los Angeles or the one envisioned for the Trans Texas Corridor.

SECTION 5: REGIONAL FREIGHT RELATED INITIATIVES

Gulf Coast States High Speed Rail Corridor

Texas is a state member (together with Alabama, Mississippi, Louisiana and Florida) of the Southern Rapid Rail Transit Commission. This commission spearheaded the recent official designation of the Gulf Coast corridor that runs between Houston, New Orleans and Mobile, Alabama, and also extends from New Orleans to Birmingham, Alabama.

Designation of the high-speed corridor will make the area eligible to receive federal funds, which will be combined with state and local funds to make grade crossing improvements in the corridor. To eliminate grade crossing hazards, states plan to have a mix of grade separations, warning device enhancements and crossing closures. There are approximately 470 grade crossings in the corridor. The Gulf Coast states and cities along the route are expected to make a commitment to

work with private railroad companies and the federal government to gradually upgrade existing railroad rights of way, so that speeds of 90 miles per hour and greater can be achieved.

Gulf Rivers Intermodal Partnership

The Gulf Rivers Intermodal Partnership (GRIP) is a confederation of eight states, with the mission to advance the maritime mode of transportation as a multimodal, intermodal partner in freight transportation. GRIP recognizes that the United States is reaching the "tipping point" in freight transportation partly because infrastructure demand exceeds available capacity - both existing and planned.

Consequently, state departments of transportation are no longer looking solely at the highway mode of freight transportation. These departments realize that to meet the capacity demands in the 21st century, all available modes of transportation must be developed to their fullest potential. The recommendation is to continue to work through the Gulf Rivers Intermodal Partnership to increase utilization of the inland waterway system and coastal shipping. They now recognize that the maritime mode can serve as an alternative or complement to other modes in meeting freight transport demands.

Quick Response Team

In 1999, H-GAC procured consultants to facilitate a partnership with freight movement industries. The agency issued a Request for Qualifications to develop an Intermodal Congestion Quick Response Team (QRT), and a program to respond to congestion problems identified by the goods movement industry. The main purposes of the QRT program were to demonstrate sensitivity to freight congestion issues by public sector agencies; increase opportunities for public/private partnerships; and provide low-cost, fast solutions. The results of the effort led to the identification of 68 access needs at 27 of the 72 regionally significant intermodal facilities in the H-GAC region. This effort resulted in 6 funded freight-sensitive projects.

Trans Texas Corridor

The Trans Texas Corridor is a conceptual plan for a new type of multi-use, statewide transportation corridor that will incorporate as many as seven different envelopes for vehicular travel, truck travel, high-speed rail, freight rail, commuter rail, pipeline, and utility transmission. The corridor is envisioned as a 4,000-mile, multi-use corridor up to 1,200 feet wide, with 6 separate lanes for passengers, 4 separate truck-only lanes, and 6 rail lines, including lines for high-speed rail, commuter rail and freight rail.

Dedicated truck lanes will provide enhanced freight movement capabilities within Texas. The truck lanes will be built first and passenger vehicles will share the truck facility until such time that the passenger vehicle lanes can be constructed. Four segments of the Trans Texas Corridor have been identified as priority segments, two connect to Houston.

Interstate 69

Interstate 69 is an effort by the federal government and coalition states to construct a road that provides the shortest route between the Northeast/Midwest and South Texas. It will reduce travel time, fuel consumption and costs over existing circuitous routes and serve the largest segments of U.S. trade with Mexico and Canada. Construction/connection of this roadway will certainly increase the potential for trade/freight traffic in the Houston area.

Interstate 69 is the combination of two federally designated High Priority Corridors. Corridor 18 extends from Michigan and Illinois south through Indiana, Kentucky, Tennessee, Mississippi, Arkansas and Louisiana, and terminates at the intersection of U.S. 77 and U.S. 281 in the Rio Grande Valley. Corridor 20 is designated as U.S. 59 from Texarkana through Houston and continuing to Laredo. The I-69 corridor states and the states using I-69 and its border crossing ports account for nearly 63 percent of total U.S. truck-borne trade within North America. No other highway comes close to matching I-69 for trade volume and service efficiency. Other facts include:

- I-69 border crossing ports from Laredo to Brownsville handle 49 percent of total U.S. truck-borne trade with Mexico
- I-69 border crossings in Michigan handle nearly 47 percent of U.S. truck-borne trade with Canada
- I-69 corridor states account for 51 percent of U.S. truck-borne trade with Mexico
- 22 of the nation's top 25 seaports are directly connected to I-69
- 16 of the nation's top air cargo airports are readily accessible by I-69

SECTION 6: ADDITIONAL AREAS TO ADDRESS IN SUBSEQUENT FREIGHT-RELATED RESEARCH/PLANNING EFFORTS

- Expand the study area to include an area larger than the Houston-Galveston region
- Consider establishing a freight-related Transportation Improvement Program
- Consider implementing a Freight Steering Committee
- Glean insights from the Harris County Rail Study, once completed
- Explore opportunities to consolidate rail facilities
- Follow up on the Quick Response Initiative by developing medium- and long-range recommendations

Chapter 4

Bicycle and Pedestrian Plan

Highlights

H-GAC's 1996 *Regional Bikeway Plan* identified 161 miles of existing bikeways within the TMA. Since then, an additional 284 miles of facilities have been built, giving the Transportation Management Area (TMA) a total 445 miles of bikeways. A review of current local bikeway plans and bikeways identified in Major Investment Study (MIS) preferred alternatives since 1996 indicates that a total of 1,243 miles of new bikeways are planned

In recent years, the eight-county Houston-Galveston TMA has averaged more than 1,000 crashes per year involving pedestrians or bicyclists. Additionally, the 2000 U.S. Census reported that more than 7 percent of households in the TMA do not have access to an automobile. The key to successfully integrating pedestrian and bicycle accommodations into roadway projects is to start early in the planning process, especially where new right of way (ROW) must be acquired. To address the issues, H-GAC recommends the following actions:

- H-GAC will encourage local governments to submit current bikeway plans and project information on an annual basis to maintain an up-to-date Regional Bikeway Plan.
- H-GAC will encourage and provide assistance to local governments with the preparation of bikeway plans.
- H-GAC will promote the use of standard terminology as defined in AASHTO's Guide for the Development of Bicycle Facilities, adopted by the Texas Transportation Commission and used by TxDOT.
- A more detailed inventory of existing bikeways will be developed by H-GAC to determine consistency with AASHTO, facility suitability, and any safety and maintenance problems.
- H-GAC, TxDOT and local project sponsors will work together to attempt to identify the most cost-effective approaches to facility design, while maintaining consistency with AASHTO guidelines. H-GAC will continue to develop information resources, provide training opportunities and offer technical assistance to help enhance the level of bikeway design in the TMA.
- Project sponsors should make maintenance a key component of their local planning efforts and outline their long-term maintenance plans for projects submitted to the RTP and TIP.
- H-GAC will continue to develop data resources and tools to project levels of bicycle activity and air quality benefits of bikeway projects.

Purpose and Scope

The purpose of the *Regional Bikeway Plan* element of the RTP is to identify existing and planned facilities within the Transportation Management Area (TMA) where bicycle travel is

encouraged. H-GAC intends that the Regional Bikeway Plan be used to identify future RTP and TIP projects and serve as a guide to coordinate roadway planning and future bikeway projects. Bikeways included in this plan shall be defined as one of the following facility types:

On-Street Bikeways

- **Bike Lanes** – designated portion of roadway with signage and pavement markings for the preferred or exclusive use by bicyclists.
- **Signed Shared Roadways** – roadways with “Bike Route” signage, but no pavement markings, where shared use with motorists is encouraged.
- **Signed Shoulder Bike Routes** – roadways with shoulders and “Bike Route” signage.

Off-Street Bikeways

- **Shared-use Path** – facilities that are separated from the roadway system, often accommodating a variety of non-motorized modes.

The existing bikeways identified in the *Regional Bikeway Plan* are, for the most part, within public rights of way and provide transportation options beyond recreational benefits. The plan does not include the many trail systems that provide circulation within parks or privately developed trails within subdivisions. Facilities shown as proposed include: those identified in local bikeway plans or capital improvement programs; RTP and current TIP projects; projects selected for funding under the Statewide Transportation Enhancements Program (STEP); projects selected for funding under the Congestion Mitigation for Air Quality (CMAQ) program, and bikeways identified as part of the preferred alternative in Major Investment Studies (MIS).

Making Progress

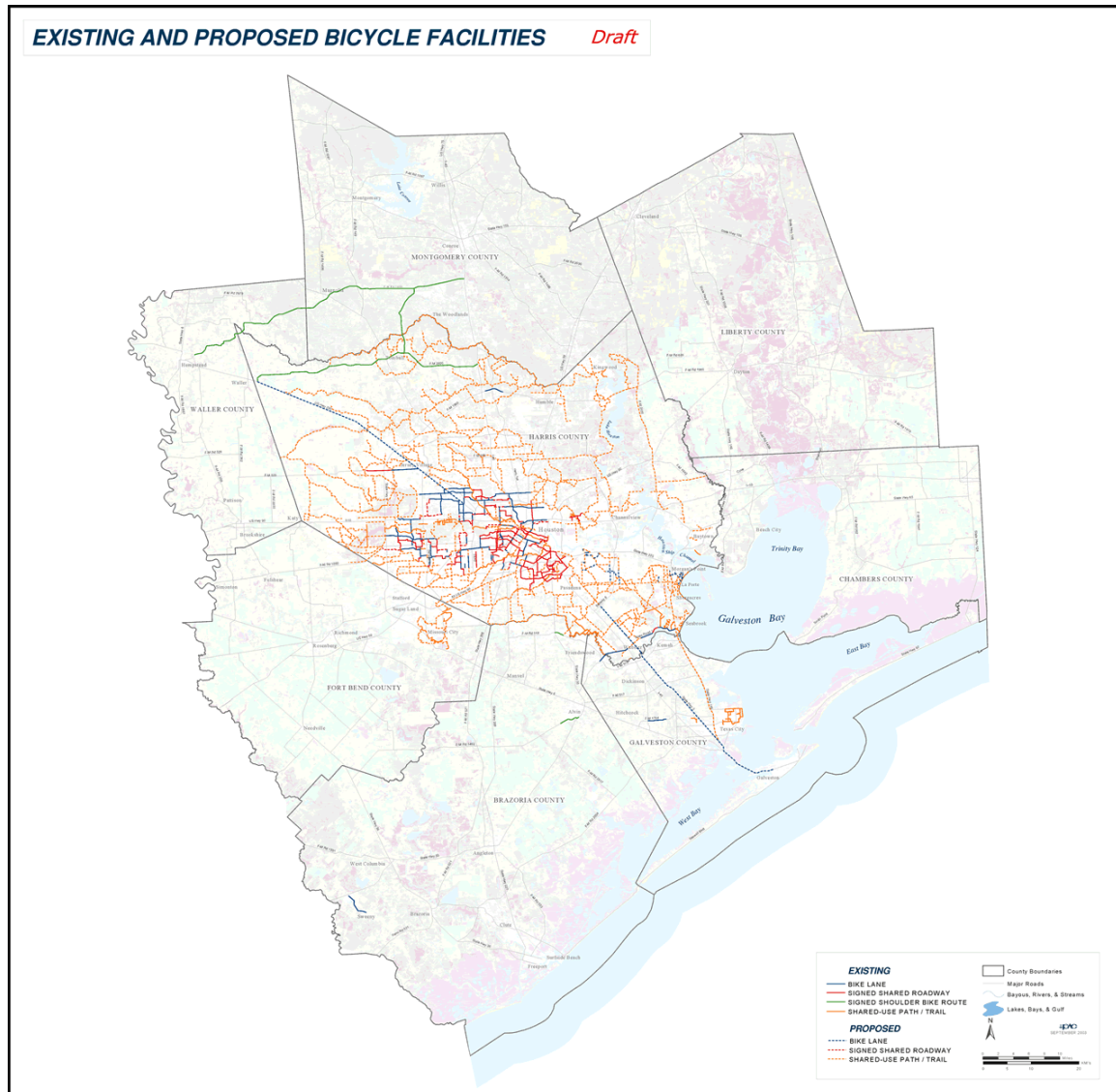
H-GAC’s 1996 *Regional Bikeway Plan* identified 161 miles of existing bikeways within the TMA. Since then, an additional 284 miles of facilities have been built, giving the TMA a total 445 miles of bikeways. These facilities can be categorized as follows:

- | | |
|---------------------------|-----------|
| • Bike Lanes | 125 miles |
| • Signed Shared Roadways | 129 miles |
| • Signed Shoulder Routes | 84 miles |
| • Shared-use Paths/Trails | 108 miles |

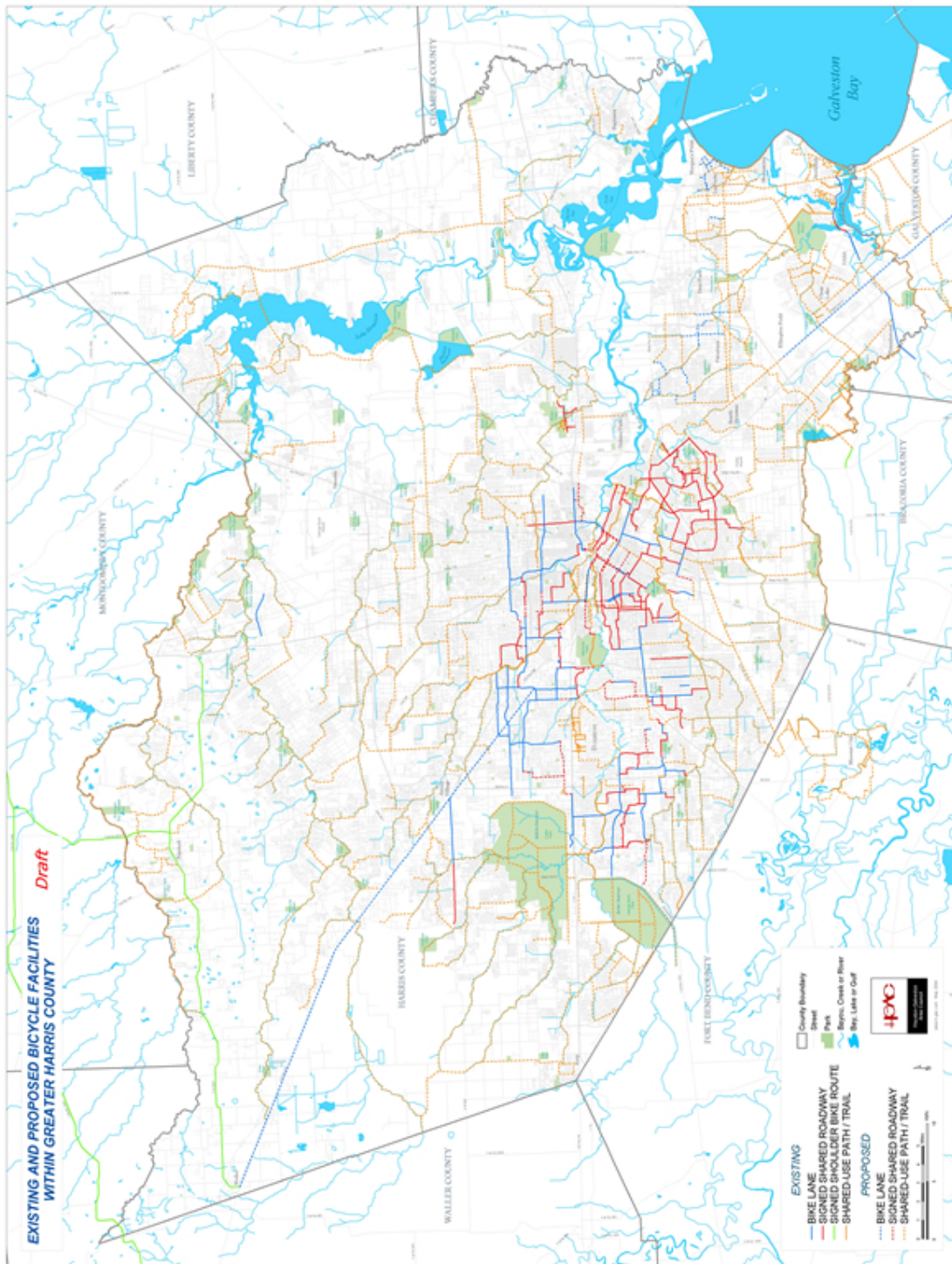
A review of current local bikeway plans and bikeways identified in Major Investment Studies (MIS) “preferred alternatives”(State Highway 3, US 290) was performed. Since 1996, there is an additional 1,243 miles of new bikeways planned. These include the following types of facilities:

- | | |
|---------------------------|----------------|
| • Bike Lanes | 99 miles (MIS) |
| • Signed Shared Roadways | 42 miles |
| • Signed Shoulder Routes | 0 miles |
| • Shared-use Paths/Trails | 1,102 miles |

Map 1: Regional Bikeway Network



Map 2: Harris County Detail



Funding Commitments

H-GAC's current TIP contains 43 pedestrian and bicycle projects, representing an investment of nearly \$85 million. The Draft 2025 RTP, with subsequent amendments, contains an additional 41 pedestrian and bicycle projects with a projected cost of \$117 million. A number of local governments have also made over \$122 million in local funding commitments to bikeway development in their current Capital Improvement Programs.

While a majority of these financial commitments pertain to specific pedestrian and bicycle projects, H-GAC has conducted a Pedestrian and Bicycle Special Districts Study, establishing a basis for developing and evaluating future bicycle and pedestrian improvements within the 8 county region. There were 12 special districts identified, \$18 million within the Draft 2025 RTP is dedicated to strategic investment for improving pedestrian and bicycle travel conditions where these facilities are in great demand.

Local Bikeway Planning and Development

A summary of recent and current bikeway initiatives within the TMA is presented below.

Brazoria County

TxDOT signed shoulders as bicycle routes along several state roadways in Brazoria County.

- ***City of Alvin*** – The City of Alvin is constructing bicycle lanes and signed shoulders to accommodate bicycle through movements through the municipality and is also developing shared-use paths to link residential land uses with schools and parks within the city. Alvin's Mustang Trail System is part of H-GAC's current TIP and has received funding support from the STEP.
- ***City of Lake Jackson*** – Lake Jackson developed a master plan for pedestrian/ bicycle trails projects and is in various stages of development of several facilities. A shared-use path project along Oyster Creek Drive is in the current TIP. Lake Jackson has also received authorization from the Texas Parks and Wildlife Department for the Dow Centennial Trail. The City has also requested that TxDOT consider a bike route along SH 322 as part of their planned expansion of this facility.

Chambers County

Bicycle planning and facility development in Chambers County has been limited to shared-use paths developed within and in conjunction with recreational facilities.

Fort Bend County

All of the master-planned communities in Fort Bend County have internal networks of shared-use path facilities. Existing public bicycle facilities in the county consist of shared-use paths in recreational areas and wide shoulders that have been added as a part of several roadway improvements.

The Fort Bend Mobility Committee is currently evaluating options for developing new facilities that would connect the bicycle and pedestrian networks in the master-planned communities with each other and future municipal networks throughout the county. The committee identified the

need to include a bicycle element in their future plans, but has not yet defined the scope of this effort.

- ***City of Missouri City*** – Missouri City has seven bikeway projects identified in the RTP, including construction of shared-use paths, as well as restriping of roadways to include bike lanes. All projects are slated to start in the 2003-2005 time frame.
- ***City of Sugar Land*** – The City of Sugar Land has developed a shared-use path system that connects park facilities within the city. Sugar Land also has two bicycle and pedestrian bridge projects in the RTP. A bicycle and pedestrian bridge will also be constructed over Oyster Creek and Ditch A to connect existing facilities.

Galveston County

Galveston County's bicycle planning and facility development has been limited to shared-use paths within and in conjunction with recreational facilities.

- ***City of Galveston*** – There are several roadways with bicycle route signage, but the City of Galveston has not officially designated these as signed shared roadways. Shared-use paths have been developed within and in conjunction with park facilities
- ***City of League City*** – League City has a current 2003 TIP project to construct a hike and bike trail along SH 96. The City also has three shared-use path projects included in the RTP that will begin between 2010-2012.
- ***Texas City*** – A system of hike and bike trails connecting schools, parks, activity centers and points of interest was listed in the city's Goals 2000 plan as a need of the community. Since 2000, the City of Texas City has installed over 12 miles of shared-use paths.

Harris County

Harris County, through its parks department, flood control district, and commissioner precinct offices, has developed an extensive shared-use path system. In May 2003, the commissioners court adopted a parks master plan that will vastly expand this system, providing shared-use paths along most bayous, links between recreational facilities, and between existing and proposed facilities of the City of Houston and Fort Bend County. Shared-use paths currently under design include one along South Mayde Creek, an extension of the trails from Terry Hershey Park to the Metro Park & Ride lot, as well as a pedestrian bridge east of Dairy Ashford Road. Harris County has 25 bikeway projects in the RTP and some of them have also received STEP funding commitments from TxDOT.

In addition to bikeway projects sponsored by Harris County, several improvement districts have bikeway projects underway or planned. The Greater Greenspoint Management District has three RTP projects to develop a shared-use path system and supporting amenities. A trail project of the Westchase District also received a STEP funding commitment. TERO has contributed \$8.8 million to the city of Houston for implementation of the city's bikeway plan

- ***City of Baytown*** – The City of Baytown has three shared-use path projects in H-GAC's current TIP. The Goose Creek facility was selected for STEP funding.

- ***City of Bellaire*** – The City of Bellaire has a 2.5-mile shared-use path along Newcastle Street and a half-mile trail along Holly Street. Pedestrian and bike trails/paths were listed as the top need by Bellaire citizens in a 1999 survey and Bellaire is actively pursuing a pedestrian and bike path that would connect all four major quadrants of the city.
- ***Clear Lake Area*** – Several miles of bike lanes and hike and bike trails have been designed and constructed by the various communities in the Clear Lake area. The Bay Area Transportation Partnership (BATP), a coalition of these communities and other organizations, has been working with Harris County and TxDOT officials to take an inventory of these facilities and develop a master plan for bicycle and pedestrian facilities. This inventory, initiated in August 2003, along with the subsequent master plan, will help the BATP set priorities and implementation strategies for improving connectivity of bikeways within southeast Harris County.
- ***City of Houston*** – The City of Houston made significant progress in implementing its bicycle master plan. The city's current network of facilities includes 255 miles of on-street bicycle lanes and signed bicycle routes, and an additional 10 miles of shared-use paths. Changes to the city's master plan include the temporary suspension of the designated bikeway along 20th Street. Bike lanes were removed from West Dallas and replaced with a shared wide outside lane. The bike lanes along West Alabama were removed as part of the traffic mitigation plan for the reconstruction of Route 50/Spur 527; a bicycle route was assigned to Fairview and other local streets as a substitute for the West Alabama facility. Houston also accelerated development of 100 additional miles of shared-use paths. These projects are entering construction and design review and are funded with local and state funds.

The City of Houston has 12 projects in the current TIP and three in the RTP. These projects, which are slated for implementation by the city or in conjunction with TxDOT, include both shared-use path facilities, as well as improvements to the on-street bikeway network. Eleven of the City of Houston projects received STEP funding commitments.

- ***City of La Porte*** – Currently, the only bicycle and pedestrian facilities are within city parks, however, the City of La Porte adopted a bicycle and pedestrian trail implementation plan in June 2003. The goal of the plan is to develop a network of paths, trails, bike lanes and routes that are multipurpose, accessible where possible, convenient and connect to residential neighborhoods, parks, schools, workplaces, shopping and major open spaces, linking into neighboring trail systems within the City of Pasadena and the Clear Lake area. Elements of the LaPorte shared-use path network are included in the RTP.
- ***City of Pasadena*** – The City of Pasadena developed a bikeway plan and incorporated several projects into its Capital Improvement Program (CIP). The projects include construction of shared-use paths and bike and pedestrian bridges, as well as additions to existing trails. The projects are expected to be completed before 2007.

Liberty County

Bicycle planning and facility development in Liberty County has been limited to recreational facilities developed within and in conjunction with park facilities.

Montgomery County

Most of the bikeways in Montgomery County are located in its southern portion. Approximately 60 miles of 8-foot concrete shared-use paths connect residential areas with schools, village centers, churches, parks and other developments. The majority of these facilities are located within The Woodlands, however, there are also facilities in the communities of Chateau Woods, Oak Ridge North and Shenandoah.

Waller County

Bicycle and pedestrian facility development in Waller County has been limited to construction of off-road multipurpose trails that are primarily utilized for recreational purposes.

Guidelines for Bicycle Accommodations

Roadway project sponsors should consult the *Regional Bikeway Plan*, as well as local jurisdiction(s) plan(s), when considering appropriate bikeway accommodations to determine whether their project limits include any designated on-street bikeways and provide appropriate accommodations to ensure system continuity. For safety and mobility, additional consideration should be given to accommodate pedestrians and bicyclists at intersections, over/underpasses, and where existing bikeways and pedestrian paths cross roadways.

Another important consideration is how bicyclists will access the bikeway system from their trip origins and destinations. Providing better accommodations on the overall roadway network will enable bicyclists to safely reach those facilities that have been designed specifically for their use. Project sponsors should consider providing basic bicycle accommodation on all appropriate roadway facilities. Where on-street accommodations are not feasible, Project sponsors should consider providing safe access at reasonable intervals to the nearest parallel bikeway facility.

Project sponsors should consult H-GAC's *Guidelines for Accommodating Pedestrians and Bicyclists* and AASHTO's *Guide for the Development of Bicycle Facilities*, which presents recommendations for on- and off-street accommodations.

Other Bikeway Planning and Implementation Issues

While much has been accomplished since 1996, there are still a number of issues that will need to be addressed to establish an outstanding bikeway network in the TMA.

Consistent Terminology and Mapping

One obstacle to building a coordinated regional system is the lack of consistency in the methods and terminology used by local entities to develop bikeway plans. Resolving inconsistencies in terminology and mapping conventions will allow for greater information sharing and project coordination, particularly when a facility traverses multiple jurisdictions. H-GAC recommends the use of the following standardized terminology, as identified in the AASHTO *Guide for Development of Bicycle Facilities*, for local bikeway planning purposes:

On-Street
Bike Lane

Off-Street
Shared-use Path

Signed Shared Roadway
Signed Shoulder Bike Route

Subsequent updates of the *Regional Bikeway Plan* will also include additional categories of future projects to allow for better tracking of project status and level of commitment.

In addition to using this terminology, H-GAC encourages local governments to adopt standard Geographic Information System (GIS) mapping formats to facilitate electronic data transfer among agencies and local jurisdictions.

Design and Maintenance

Achieving greater consistency in the design and maintenance of local bikeways will be a crucial step increasing usage and improving safety. Many facilities in the TMA have deficiencies in one or both of these areas.

- **Guidelines** – The American Association of State Highway and Transportation Officials (AASHTO) established guidelines for bikeways, last updated in 1999. Federally funded bikeway projects require TxDOT administration and must be designed and constructed to meet the current AASHTO guide. Utilizing federal funds is often a more costly proposition than communities anticipate. The federal process entails additional procedural requirements which can add time and cost to project development. Additionally, federal aid investments are intended to support long-term heavy use facilities, usually entailing higher design, ROW and construction costs. As a result, smaller projects may not be suitable for federal funding and sponsors may wish to consider using local resources which will afford them greater flexibility.

It is important that local project sponsors be aware that the higher costs of building bikeways using AASHTO-guidelines can be offset by reduced maintenance costs over the life of the facility. For example, asphalt trails cost much less build, but will require greater maintenance and have a shorter useful life. It should also be considered that well-designed facilities are safer and will allow higher levels of usage as demand grows.

AASHTO guidelines are flexible, and cost-effective designs are available, especially in areas not subject to flooding or where lower usage is projected. H-GAC's *Guidelines for Accommodating Pedestrians and Bicyclists* provides a range of recommendations for off-road bikeways, based on AASHTO guidelines.

- **Design** – Another common bikeway design problem in the TMA concerns the striping of bike lanes on existing roadways that are not well suited for bicycle travel. Smooth pavement, proper placement of gutter seams, and orientation of storm sewer grates are all key features of safe on-road facilities. If existing roadway conditions are unsuitable, it may be desirable to defer striping of a bike lane until the roadway is scheduled for resurfacing.
- **Maintenance** – Regular maintenance is a critical factor for on- and off-street facilities. Cracked or uneven pavement, debris, low-hanging limbs, missing signs and deteriorated striping can pose greater safety threats to a bicyclist than to a motorist. A program to provide an appropriate level of maintenance should be a component of any project plan, including street sweeping and repairs to cracked pavement.

Funding

Most federal funding support for bikeway projects in the TMA has come from the Congestion Mitigation Air Quality (CMAQ) or STEP programs. However, both of these programs have drawbacks with respect to implementing a regional bikeway network.

- **CMAQ** – A problem with the use of CMAQ funding is the difficulty in calculating air quality benefits from bikeway projects. This deficiency could be addressed by the availability of better data and tools for projecting facility usage. H-GAC has completed the before stage of a before and after study to determine prototypical usage levels for facilities in a variety of settings. Consideration should be given to completing this study or developing other measures for calculating project benefits. Such information would also be helpful in justifying bikeway expenditures and prioritizing projects, regardless of funding source.
- **STEP** – It is also difficult to ensure implementation of regional bikeway initiatives through STEP funding, since these project selection decisions are made by TxDOT in Austin without input from the Metropolitan Planning Organization (MPO). H-GAC will work with TxDOT to enable better local input into the STEP project selection process.
- **Safety Funds** – A previously untapped source of funding for bicycle and pedestrian improvements is federal transportation safety funds. H-GAC has initiated a safety study in the East End of Houston using this funding source and will pursue this funding mechanism in other areas with high incidences of bicycle crashes.
- **Blended Funding** – Opportunities for blended project funding should also be considered. For example, on-street bicycle and pedestrian accommodations could be funded through CMAQ or STEP funds, with STP funds supporting construction of vehicle lanes. Non-transportation funding options, such as the Texas Parks and Wildlife Department (TPWD) trails grant program and local parks and flood control district trails initiatives, should also be pursued.

Project Selection Criteria

Aside from air quality and cost-benefit analysis, H-GAC is currently developing a set of criteria for selecting and prioritizing bikeway projects. Further work needs to be done to define projects that are of regional significance. Additional criteria that could be considered include:

- Linking to major trip origins and destinations;
- Linking to transit stations;
- Connecting existing local bikeway networks and filling gaps in the regional system; and
- Making “spot improvements” to address localized barriers and/or safety problems.

Maintaining Project Commitment

Some project sponsors have had difficulty maintaining commitments for programmed RTP and TIP bikeway projects. Many of these lapsed projects are the result of costs exceeding initial estimates. H-GAC will continue to stress the importance of maintaining bikeway project commitments, especially for projects included in the State Implementation Plan for air quality. However, other avenues of supporting local sponsors toward the completion of these projects

should be explored. Such measures may include technical assistance, allowing a reduction in project scope to match available funding, or providing supplemental funding in future calls for projects.

There are also inconsistencies in the level of commitment that is implied by the inclusion of a bikeway in a local plan. If local bikeways are to be considered in the design of connecting or intersecting facilities, the local government's commitment to developing the facility should be clearly identified in the plan.

Recommended Actions

To address the issues, H-GAC recommends the following actions:

- ***Update the Regional Bikeway Plan frequently.*** H-GAC will encourage local governments to submit current bikeway plans and project information on a frequent basis to maintain an up-to-date regional bikeway plan. Plans and project information should clearly identify the level of local commitment to developing proposed facilities.
- ***Support local planning efforts.*** H-GAC will encourage and provide assistance to local governments with the preparation of bikeway plans.
- ***Promote use of consistent terminology and mapping.*** H-GAC will promote the use of standard terminology and line codes for local bikeway maps.
- ***Develop a bikeway design/conditions inventory.*** A more detailed inventory of existing bikeways should be developed to determine consistency with AASHTO, facility suitability, and any safety and maintenance problems.
- ***Promote appropriate design.*** Agency coordination between H-GAC, TxDOT and local project sponsors, is needed to identify the most cost-effective approaches to facility design, while maintaining consistency with AASHTO guidelines. H-GAC will continue to develop information resources, provide training opportunities and offer technical assistance to help enhance the level of bikeway design in the TMA.
- ***Include long-term maintenance in project planning.*** Project sponsors should make maintenance a key component of their local planning efforts and outline their long-term maintenance plans for projects submitted to the RTP and TIP.
- ***Develop data and projections of bikeway usage.*** H-GAC will continue to develop data resources and tools to project use levels and air quality benefits of bikeway projects.
- ***Provide funding resources.*** H-GAC will pursue funding strategies to support bikeway development, including increased use of CMAQ funding, providing input for STEP project selection, use of transportation safety funding to address problem areas, as well as exploring non-transportation funding resources.
- ***Improve project selection criteria.*** H-GAC will review its selection criteria for RTP and TIP bikeways to better measure the regional significance of a projects.

- **Maintain project commitments.** H-GAC will consider available mechanisms for maintaining project commitments, including reducing project scope when costs exceed initial estimates and/or providing supplemental funding in subsequent calls for projects.

Pedestrian/Bicycle Projects within the Current TIP

Lead Agency	CSJ Number	Project Description	Total Cost	Est. Let Date
CITY OF HOUSTON	0912-71-545	WEST WHITE OAK BAYOU TRAIL EXTENSION	\$3,075,294.00	01-Jul-04
CITY OF HOUSTON	0912-71-544	CONSTRUCT COLUMBIA TAP RAIL TO TRAIL BIKEWAY	\$2,974,110.00	01-Oct-04
CITY OF HOUSTON		CONSTRUCT SIMS BAYOU TRAIL	\$1,296,000.00	01-Mar-04
HARRIS COUNTY PRECINCT 2	0912-71-548	CONSTRUCT HIKE & BIKE TRL	\$944,898.00	01-Jan-05
CITY OF LAKE JACKSON	0912-31-143	CONSTRUCT HIKE & BIKE TRAIL	\$708,960.00	01-Jul-03
CITY OF HOUSTON		BIKE SE HOUSTON ON-STREET BIKEWAY NETWORK (INSIDE LP 610) (TCM SIP COMMITMENT)	\$2,235,000.00	01-Oct-04
CITY OF HOUSTON	0912-71-503	BIKE TRAIL ON BUFFALO BAYOU PARALLEL TO MEMORIAL DR & ALLEN PKWY	\$2,820,050.00	01-Oct-04
CITY OF HOUSTON	0912-71-505	HIKE & BIKE TRAIL (HOUSTON HERITAGE CORRIDOR BAYOU TRAILS WEST, SEGMENT 1)	\$3,421,436.00	01-Sep-05
CITY OF BAYTOWN	0912-71-429	CONSTRUCT HIKE & BIKE TRAIL (PHASE 2)	\$1,526,890.00	01-Sep-04
CITY OF HOUSTON	0912-71-433	ON-STREET BIKEWAY IMPROVEMENTS	\$4,889,000.00	01-Oct-04
THE DISTRICT	0912-37-160	CONSTRUCT PEDESTRIAN BRIDGES @ LAKE ROBBINS & WOODSTEAD	\$2,350,000.00	01-Sep-03
CITY OF BAYTOWN	0912-71-697	CONSTRUCT PEDESTRIAN PATH ALONG GOOSE CREEK	\$1,361,919.00	01-Sep-05
CITY OF LEAGUE CITY	0976-07-006	CONSTRUCT HIKE/BIKE TRAIL ALONG SH 96	\$757,500.00	01-Sep-04
CITY OF ROSENBERG	0188-01-030	CONSTRUCT 5' SIDEWALK TO PROVIDE A CONNECTION BETWEEN US 90A AND SEABOURNE CREEK PARK	\$1,110,398.00	01-Jun-04
CITY OF HOUSTON	0912-71-655	W HOUSTON ON-STREET BIKEWAY PH 2	\$601,000.00	01-Nov-04
CITY OF ALVIN	0912-31-121	CONSTRUCT MUSTANG TRAIL SYSTEM	\$776,160.00	01-Oct-04
CITY OF ANGLETON	0912-31-122	CONSTRUCT PEDESTRIAN WALKWAY IN ANGLETON	\$658,175.00	01-Oct-04
CITY OF GALVESTON	0912-73-082	CONSTRUCT RAILROAD PEDESTRIAN WALKWAY	\$220,000.00	01-Jan-05
CITY OF HOUSTON	0912-71-701	CONSTRUCT BIKE/PEDESTRIAN TIE-IN AT TERRY HERSHEY PARK IN HOUSTON	\$1,205,402.00	01-Nov-04
CITY OF LEAGUE CITY	0912-73-085	CONSTRUCT PED & BIKE TRAIL: PH 2	\$254,956.00	01-Jan-05
HARRIS COUNTY PRECINCT 3	0912-71-702	CONSTRUCT PEDESTRIAN & BICYCLE TRAIL	\$610,969.00	01-Nov-04
METRO	0912-00-215	FY 2000 BIKE RACKS ON METRO BUSES	\$1,500,000.00	01-Aug-04
CITY OF HOUSTON	0912-71-631	CONSTRUCT HIKE & BIKE TRAIL	\$5,027,858.00	01-Nov-04
CITY OF HOUSTON	0912-71-591	BIKE & HIKE TRAIL THRU HERMAN BROWN PARK PHASE 2	\$932,000.00	01-Oct-04
CITY OF HOUSTON	0912-71-647	CONSTRUCT BIKE TRAIL	\$3,144,293.00	01-Nov-04
CITY OF HOUSTON	0912-71-432	CONSTRUCT BIKE TRAIL	\$4,875,822.00	01-Nov-04
CITY OF HOUSTON	0912-71-643	CONSTRUCT BIKE TRAIL	\$705,657.00	01-Nov-04
CITY OF HOUSTON	0912-71-620	HIKE & BIKE TRAIL ALONG HALLS BAYOU	\$7,697,000.00	01-Dec-05
CITY OF BAYTOWN	0912-71-698	CONSTRUCT HIKE/BIKE TRAIL	\$906,250.00	01-Sep-04
CITY OF PASADENA	0912-71-793	VINCE BAYOU PEDESTRIAN AND BICYCLE TRAIL IN PASADENA	\$1,342,998.00	01-Nov-03
GREATER GREENSPPOINT MANAGEMENT DISTRICT (GGMD)	0912-71-797	12' WIDE CONCRETE SHARED USE PATH: GREENS BAYOU TRAIL SYS IN GREATER GREENSPPOINT MGT DISTRICT	\$2,895,038.00	01-Nov-03

Houston-Galveston Area Council
2025 Regional Transportation Plan

City of Houston	0912-71-799	12' WIDE CONCRETE SHARED USE PATH: BUFFALO HERITAGE CORRIDOR SHARED USE TRAIL IN HOUSTON	\$3,761,261.00	01-Nov-03
CITY OF HOUSTON	0912-71-800	12' WIDE CONCRETE SHARED USE PATH: PHASE I SHARED USE PATH - TREES FOR HOUSTON	\$1,140,810.00	01-Aug-04
CITY OF HOUSTON	0912-71-801	12' WIDE CONCRETE SHARED USE PATH: COLUMBIA TAP - UNION STATION TRAIL IN CITY OF HOUSTON	\$883,784.00	01-Nov-04
CITY OF HOUSTON / WESTCHASE MANAGEMENT DISTRICT (WMA)	0912-71-803	12' WIDE CONCRETE SHARED USE PATH: WESTCHASE DISTRICT TRAIL - NORTH-CITY OF HOUSTON & WESTCHASE MGT DISTRICT IN HOUSTON	\$4,901,088.00	01-Mar-04
CITY OF HOUSTON	0912-71-805	8' TO 16' WIDE SHARED USE PATH: HERMANN PARK TRAIL IMPROVE-FRIENDS OF HERMANN PARK	\$2,499,300.00	01-Nov-03
HARRIS COUNTY PRECINCT THREE	0912-71-808	12' WIDE SHARED USE PATH: SOUTH MAYDE CREEK PED/BIKE FACILITY - HARRIS CO PRECINCT 3	\$2,708,036.00	01-Aug-04
LEAGUE CITY	0912-71-811	MEDICAL CENTER GALLERIA PH 3 BIKE TRAIL	\$500,000.00	01-Sep-03
CITY OF HOUSTON	0912-71-822	HIKE AND BIKE TRAIL (HOUSTON HERRITAGE CORRIDOR BAYOU TRAILS EAST, SEGMENT 1)	\$1,826,698.00	01-Sep-05
CITY OF HOUSTON	0912-71-823	HIKE AND BIKE TRAIL (HOUSTON HERRITAGE CORRIDOR BAYOU TRAILS EAST, SEGMENT 2)	\$940,250.00	01-Sep-05
CITY OF HOUSTON	0912-71-824	HIKE AND BIKE TRAIL (HOUSTON HERRITAGE CORRIDOR BAYOU TRAILS EAST, SEGMENT 3)	\$641,828.00	01-Sep-05
		Total Cost of Pedestrian/Bicycle Projects within the current TIP	\$84, 879,186.00	

Pedestrian / Bicycle Projects within the Draft 2025 RTP

Lead Agency	Project ID	Project Description	Total Cost	Est. Let Date
CITY OF LEAGUE CITY	2221	CONSTRUCT HIKE & BIKE	\$324,000.00	01-Jan-10
CITY OF LEAGUE CITY	2222	CONSTRUCT HIKE & BIKE	\$600,000.00	01-Jan-10
CITY OF LEAGUE CITY	2223	CONSTRUCT HIKE & BIKE	\$192,000.00	01-Jan-12
CITY OF MISSOURI CITY	2269	RESTRIPE ROADWAY FOR ON-STREET BIKE LANE	\$20,300.00	01-Sep-05
CITY OF MISSOURI CITY	2273	CONSTRUCT HIKE & BIKE TRAIL	\$2,376,000.00	01-Jan-04
CITY OF MISSOURI CITY	2281	CONSTRUCT HIKE & BIKE TRAIL	\$2,397,600.00	01-Jan-04
CITY OF HOUSTON	2795	PAVE HILLS BAYOU TRAIL	\$3,880,000.00	01-Nov-04
THE DISTRICT	3050	PE/EA, ENGINEERING & CONSTRUCTION OF TRANSITWAY, WATERWAY AND PEDESTRIAN AMENITIES.	\$10,644,200.00	01-Dec-05
CITY OF HOUSTON	5050	BIKE TRAIL/LANE ON ROADS & RR ROW	\$2,136,000.00	01-Jan-04
CITY OF MISSOURI CITY	5054	CONSTRUCT HIKE/BIKE TRAIL (SEG 1)	\$2,795,600.00	01-Jan-04
CITY OF MISSOURI CITY	5055	CONSTRUCT HIKE/BIKE TRAIL (SEG 3)	\$3,004,400.00	01-Nov-04
CITY OF LEAGUE CITY	5057	CONSTRUCT PEDESTRIAN SIDEWALK ALONG FM 518	\$425,000.00	01-Jan-08
CITY OF MISSOURI CITY	6078	MISSOURI CITY BIKE/PEDESTRIAN PROJECTS	\$7,285,000.00	01-Jul-04
GREATER GREENSPRING MANAGEMENT DISTRICT	7127	CONSTRUCT SEG. 2 OF 12' WIDE CONCRETE HIKE & BIKE TRAIL , ASSOCIATED PED BRIDGES, SEATING AND LANDSCAPING.	\$1,450,000.00	01-Jan-04
CITY OF HOUSTON	7544	CONSTRUCT BIKE/HIKE TRAIL	\$850,000.00	01-Jan-23
PORT OF GALVESTON	7576	21ST ST PEDESTRIAN BRIDGE	\$965,000.00	02-Jan-23
CITY OF LA PORTE	7633	COMPREHENSIVE BIKE/PED TRAIL SYSTEM FOR CITY OF LA PORTE	\$1,980,000.00	01-Jan-23
HARRIS COUNTY	7637	CONSTRUCT 4'-WIDE CONCRETE PEDESTRIAN WALKWAY	\$1,320,479.00	01-Jan-23
HARRIS COUNTY	7640	PEDESTRIAN & BICYCLE FACILITY	\$636,426.00	01-Jan-23
HARRIS COUNTY	7641	BICYCLE TIE IN FACILITY	\$1,255,628.00	01-Jan-23

Houston-Galveston Area Council
2025 Regional Transportation Plan

HARRIS COUNTY	7644	PEDESTRIAN WALKWAY	\$207,900.00	01-Jan-23
HARRIS COUNTY	7645	PEDESTRIAN WALKWAY	\$74,040.00	01-Jan-23
HARRIS COUNTY	7646	PEDESTRIAN WALKWAY	\$1,419,000.00	01-Jan-23
GREATER GREENSPPOINT MANAGEMENT DISTRICT	7647	HIKE & BIKE TRAIL SYSTEM PACKAGE OF PROJECTS	\$20,000,000.00	01-Jan-23
HARRIS COUNTY	7768	HIKE & BIKE TRAIL	\$3,348,000.00	01-Jan-23
HARRIS COUNTY	7769	HIKE & BIKE TRAIL	\$2,976,000.00	01-Jan-23
HARRIS COUNTY	7770	HIKE & BIKE TRAIL	\$1,264,800.00	01-Jan-23
HARRIS COUNTY	7771	CONNECTS WOODFOREST & PINE TRAILS SUBDIVISIONS W/ COUNTY COURT, ADMIN FACILITIES & COLLEGE	\$1,302,000.00	01-Jan-23
HARRIS COUNTY	7772	HIKE & BIKE TRAIL	\$1,190,400.00	01-Jan-23
HARRIS COUNTY	7773	HIKE & BIKE TRAIL	\$2,418,000.00	01-Jan-23
HARRIS COUNTY	7774	HIKE & BIKE TRAILS	\$1,488,000.00	01-Jan-23
HARRIS COUNTY	7775	HIKE & BIKE TRAIL	\$2,455,200.00	01-Jan-23
HARRIS COUNTY	7776	DOWNTOWN CONNECTION (2.2 MILES) TWO SECTIONS: 1ST FROM DOWNTOWN AT SESQUICENTENNIAL PARK, ALONG WHITE OAK BAYOU TO HOGAN CONNECTION THE EXISTING SEGMENT OF WHITE OAK BAYOU TRAIL. 2ND: FROM EXISTING TRAIL ALONG BAYOU TO HEIGHTS.	\$1,636,800.00	01-Jan-23
HARRIS COUNTY	7777	HIKE & BIKE TRAIL	\$1,488,000.00	01-Jan-23
HARRIS COUNTY	7779	HIKE & BIKE TRAIL	\$1,488,000.00	01-Jan-23
HARRIS COUNTY	7814	HIKE & BIKE TRAIL	\$1,488,000.00	01-Jan-23
GREATER GREENSPPOINT MANAGEMENT DISTRICT	9355	CONSTRUCT SEG. 1 OF 12' CONCRETE HIKE & BIKE TRAIL W/ ASSOCIATED PED BRIDGES, SEATING AND LANDSCAPING	\$1,450,000.00	01-Jan-04
METRO	11433	BIKE RACKS ON BUSES	\$1,870,000.00	01-Sep-06
H-GAC	11194	STRATEGIC INVESTMENT TO ENHANCE PEDESTRIAN & BICYCLE SAFETY WITHIN HIGH-ACTIVITY AREAS, STRATEGIC PLACEMENT OF SIDEWALKS, CROSSWALKS	\$18,000,000.00	01-Feb-14
H-GAC	11195	STRATEGIC INVESTMENT TO ENHANCE PEDESTRIAN & BICYCLE SAFETY WITHIN HIGH-ACTIVITY AREAS, STRATEGIC PLACEMENT OF SIDEWALKS, CROSSWALKS, ETC.	\$7,000,000.00	01-Feb-14
		Total Estimated Cost of Pedestrian/Bicycle Projects within the Draft 2025 RTP	\$117,101,773.00	

Pedestrian / Bicycle Projects listed in various CIPs within the TMA

Project Number	Project Description	Sponsor	Total Cost	Project Dates
N-0420	Design and construct Hike and Bike Trails throughout the City of Houston	City of Houston	\$91,070,000	2004-2008
N-0420S	Design and construct bikeway trail managed by the US Corps of Engineers in conjunction with the Sims Bayou Improvements	City of OHouston	\$4,300,000	2004-2008
N-0420T	Design and construct Hike and Bike Trail along Buffalo Bayou from Sabine to Bagby.	City of OHouston	\$15,707,000	2004-2008
	South Mayde Creek Hike and Bike-Phase I	Harris County	\$509,000	2001-2005
	South Mayde Creek Hike and Bike-Phase II	Harris County	\$2,157,000	2001-2005
	Terry Hershey Park-Hike and Bike Trail to METRO Park & Ride	Harris County	\$1,255,600	2001-2005

	Terry Hershey Park-Pedestrian Bridge-East of Dairy Ashford	Harris County	\$698,000	2001-2005
R029	Armand Bayou Hike & Bike	City of Pasadena	\$2,200,000	2002-2007
R031	Strawberry to Burke/Crenshaw Hike and Bike Trail	City of Pasadena	\$1,492,000	2002-2007
R033	Holly Bay Spur	City of Pasadena	\$225,000	2002-2007
R034	Village Grove (Armand Bayou) Pedestrian Bridge	City of Pasadena	\$225,000	2002-2007
R035	Vince Bayou Trail	City of Pasadena	\$2,625,000	2002-2007
		Total	\$122,463,600	

Guidelines for Accommodating Pedestrians and Bicyclists

Summary

The Houston-Galveston Area Council (H-GAC) has developed these guidelines (see Table One, page 28) to ensure that pedestrian and bicycle accommodations are considered in the planning and design of future Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) roadway projects, in accordance with federal requirements.

Under these guidelines, H-GAC proposes that consideration of pedestrian and bicyclist factors should occur not later than the preliminary engineering phase of project development. Sponsors should document the considerations and identify any planned pedestrian and bicycle accommodations as part of their submittal of the project as a candidate for the TIP. The guidelines provide recommended accommodations for various types of roadways and off-street facilities.

Purpose and Need

Better accommodation of pedestrians and bicyclists in the region's transportation system is needed to improve the safety of nonmotorized travelers. In recent years, the eight-county Houston-Galveston Transportation Management Area (TMA) has averaged more than 1,000 crashes per year involving pedestrians or bicyclists. Additionally, the 2000 U.S. Census reported that more than 7 percent of households in the TMA do not have access to an automobile. Some of the school, work, transit, shopping and other destinations for these households may be located on major roadways and will be difficult to safely reach on foot or by bicycle if adequate accommodations do not exist.

A roadway system that is safer for pedestrians and bicyclists will benefit those users who have no other choices, as well as those who do. Providing safe accommodations can allow people so inclined to substitute pedestrian or bicycle trips for certain short vehicle trips, providing congestion mitigation and air quality benefits. Improved accommodations within the roadway system will also provide better pedestrian and bicycle connections to trails and recreation facilities, enhancing the region's livability.

The key to successfully integrating pedestrian and bicycle accommodations into roadway projects is to start early in the planning process, especially where new right of way (ROW) must be

acquired. Effective accommodations are more difficult to introduce once a project's ROW and budget are fixed and design flexibility is limited. Retrofits, which are more costly and may result in substandard facilities and/or diminished roadway performance, can also be avoided through early planning.

Pedestrian-Bicycle Considerations

The following factors should be weighed when considering pedestrian and bicyclist accommodations in roadway projects:

- Pedestrian and bicycle demand
- Documented safety problems
- Surrounding land uses, trip generators and transit facilities
- Project impact on existing/planned pedestrian and bicycle facilities
- Facility suitability
- Ability to maintain roadway performance
- Design and ROW constraints
- Budget constraints

Successfully evaluating pedestrian and bicycle transportation needs during the planning process should result in a project design that can cost-effectively serve the needs of motorists and non-motorized users.

Another important consideration is whether the roadway is one where pedestrian and bicycle travel will be permitted (basic accommodations), versus one where it will be encouraged (enhanced accommodation). Basic pedestrian and bicycle accommodations are intended to provide safe access by pedestrians and bicyclists between their trip origins and destination. These basic accommodations also serve as links to bikeways and other facilities designed for heavier pedestrian and bicycle usage. Factors that may warrant an enhanced level of accommodation include the following:

- Project area is densely developed and/or has known pedestrian and bicycle travel demand/high incidence of crashes
- Project is on/provides access to/crosses an existing/planned bicycle facility.
- Project is in a special district where pedestrian and bicycle travel is being actively promoted.
- Project provides access to known generators of pedestrian and bicycle travel, such as schools, parks, and transit facilities.

Choosing Appropriate On-Street Accommodations

Basic Accommodations

In rural or less intensively developed suburban areas, a paved shoulder provides accommodation for stranded motorists and the occasional pedestrian, as well as bicyclists. If the area is expected to eventually urbanize, sufficient ROW should be obtained to provide for the eventual addition of sidewalks. In urban settings, sufficient ROW for a minimum 5-foot sidewalk with 2-foot buffer is recommended, with crosswalks provided at reasonable intervals, as dictated by surrounding land uses and trip generators. Construction of the sidewalk can occur when demand dictates. A wide outside travel lane will accommodate proficient bicyclists.

Enhanced Accommodations

For facilities where there is greater pedestrian and bicyclist demand, or where these modes are encouraged, enhanced accommodation is necessary. For pedestrians, wider sidewalks and buffers, trees/landscaping, and traffic calming measures may be appropriate. Enhanced on-street bicycle accommodations generally fall into one of three types of bikeways:

- **Signed Shoulder Bike Routes** – Roadways with a wide shoulder, striping, and signage indicating bike route. Signed shoulder routes are most appropriate for rural or less developed suburban areas.
- **Signed Shared Roadway (Signed Bike Route)**– Roadways with lower traffic volumes/speeds, good pavement conditions, and delineated by bike route signage but not striping. These facilities are generally best in neighborhood settings.
- **Bike Lane** – On-street bikeways, whereas a segment of roadway has been designated with pavement markings, bike route signage and intersection treatments. Bike lanes provide access to land uses along roadways and allow for longer trips within urbanized areas.

Right of Way Considerations

The lack of sufficient ROW poses the greatest challenge for integrating pedestrian and bicycle facilities into roadway design. For example, expanding a thoroughfare from four to six lanes within a typical 100-foot ROW can limit on-road accommodations for bicyclists and present conflicts between ADA-compliant sidewalks and the placement of utilities.

Under Texas law, counties are allowed to require up to 120 feet of ROW for major thoroughfares, and can exceed this limit if such a requirement is consistent with a transportation plan adopted by the metropolitan planning organization in the region. Municipalities may set their own ROW requirements through their major thoroughfare plans and development ordinances. H-GAC encourages counties and cities to consider whether their ROW policies allow for pedestrian and bicycle accommodation, as well as adequate facility design in general.

Even basic pedestrian and bicycle accommodations may not be feasible on retrofits and other reconstruction projects with limited available ROW. However, the following measures can still improve the safety of pedestrian and bicycle users of these facilities:

Pedestrian Accommodations

- Remove physical obstacles within an existing sidewalk, such as utilities.
- Provide additional or enhanced crosswalk/signal treatment.

Bicycle Accommodations

- Avoid the placement of seams within the outside lane.
- Use bicycle-compatible storm grates and utility covers.
- Provide smooth pavement.

In locations with high pedestrian and bicycle activity or serious safety concerns, some additional measures may be warranted, including reducing the width of the median and/or interior lane(s) to provide for a wide outside lane or a sidewalk.

Choosing Appropriate Off-Street Accommodations

There are situations where off-street accommodations may better serve the needs of pedestrians and bicycles. For example, a major highway may provide the most direct alignment between major trip generators/attractions, but the speed of the roadway and lack of available shoulder may not support bicycle travel. In these situations, a parallel off-road, shared-use path could address travel needs for both pedestrians and bicyclists.

When designing off-street facilities, it is important to minimize the number of conflict points between pedestrians/bicyclists and turning vehicles. Off-road or behind the curb facilities are safest where there are widely spaced intersections and a limited amount of driveways for the shared-use path to cross. Off-road facilities should be designed in compliance with the guidelines developed by the American Association of State Highway and Transportation Officials (AASHTO). Figure 4 summarizes these guidelines.

In cases where it is not feasible to provide off-street accommodations immediately adjacent to the roadway, a nearby parallel on- or off-street facility may provide sufficient accommodation for bicyclists and pedestrians within the corridor. In these instances, it is important that project planners consider how pedestrians and bicyclists will access the land uses on the roadway that does not have direct accommodation.

Use of H-GAC's Guidelines in Project Development

A copy of H-GAC's *Guidelines for Accommodating Pedestrians and Bicyclists* will accompany future calls for RTP and TIP projects, and pedestrian/bicycle training will be provided at H-GAC project development workshops. Sponsors should consult the guidelines when considering pedestrian and bicycle accommodations for RTP/TIP projects, such as new roadways, widening of existing roadways and major roadway reconstruction. Other projects for which pedestrian and bicycle considerations may be appropriate include new roadways, major roadway reconstruction, widening of existing roadways and resurfacing projects.

Ideally, pedestrian and bicyclist considerations should begin during the MIS, if one is required for the project. For projects that do not require an MIS, pedestrian and bicycle considerations should be part of the project's Preliminary Engineering (PE) study. Sponsors should also list the pedestrian and bicycle accommodations that will be included in the final design as part of their submittal of the project as a candidate for the TIP. Figure 1 illustrates this process.

Preliminary Engineering Considerations

Figure 2 is a checklist of factors that should be reviewed as part of the consideration of pedestrian and bicycle accommodations and included in the PE report. H-GAC will provide assistance, upon request, to the sponsor in obtaining this information and may offer comments.

TIP Submittal

H-GAC has initiated a policy requiring sponsors to have conducted their PE and, if possible, their Environmental Analysis (EA) before a project can be considered for inclusion in the TIP. Under these guidelines, sponsors will be asked to include documentation within their PE/EA of the results of their pedestrian and bicycle considerations.

Planned pedestrian and bicycle accommodations should also be described in the TIP submittal, using the checklist shown in Figure 3. Sponsors should refer to the Design Guidelines in Table 1 for recommended on-street or off-street accommodations for different types of facilities. These guidelines are not rigid requirements, but are intended to present project sponsors with a range of suitable accommodations for different facility types and contexts.

During its review of TIP candidate projects, H-GAC staff may offer consultation or provide comments to the project sponsor to help accommodate pedestrian and bicycle travel within the project constraints.

Future Steps

Consideration should be given in future RTP updates to mechanisms that encourage pedestrian and bicycle accommodations on RTP and TIP projects. These could include bonus points for projects that include accommodations or revisions to the benefit-cost calculation so that the cost of the accommodations does not reduce the project's competitiveness.

Opportunities to provide alternative mechanisms for funding pedestrian and bicycle improvements within roadway projects should also be explored. These could include encouraging blended projects, where additional costs of pedestrian and bicycle accommodations are borne by Congestion Mitigation/Air Quality (CMAQ). However, based on the rules of the Statewide Transportation Enhancement Program (STEP), anything with STEP funding must remain as stand alone projects.

Figure 1

H-GAC PEDESTRIAN-BICYCLE CONSIDERATION PROCESS

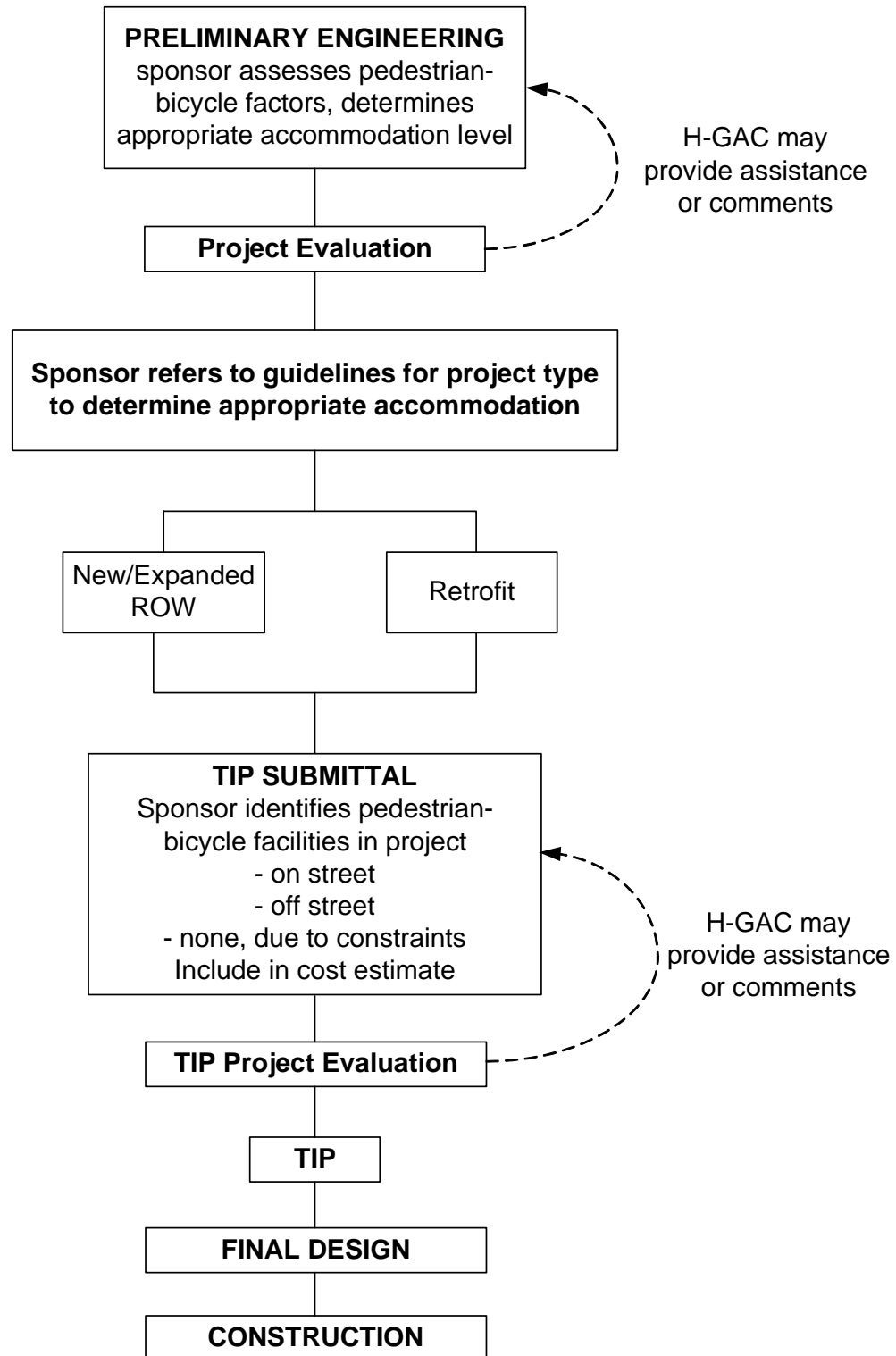


Figure 2

H-GAC

Pedestrian and Bicycle Consideration Checklist

The following checklist outlines the factors project sponsors should evaluate in considering appropriate accommodations for pedestrians and bicyclists in their roadway projects.

Sponsor: _____

Project Name and location: _____

In Urbanized Area? (Y/N) ____

Type of Project: _____

Check one: New/Expanded ROW _____ Retrofit _____

Please include the following information in the description of Project Purpose, Scope and Need:

1. Pedestrian and bicycle travel demand in project area
 - a. Counts or observations (if available) of pedestrian and bicycle activity
 - b. Pedestrian and bicycle crash data (if available)
 - c. Current/projected population and employment
 - d. Number of households without a vehicle (most recent Census)
2. Relationship to existing or planned pedestrian and/or bicycle facilities.
 - a. Regional Bikeway Plan
 - b. Pedestrian-Bicycle District
 - c. Local pedestrian or bicycle plan
 - d. Other relevant local plans
3. Project context
 - a. General land use patterns in project area
 - b. Significant pedestrian and bicycle trip generators accessed by the project
 - i. Schools
 - ii. Parks and recreation facilities
 - iii. Neighborhood retail
 - iv. Transit
 - v. Other

Upon request, H-GAC will assist the project sponsor in compiling this information.

Figure 3

H-GAC Transportation Improvement Program (TIP)
Pedestrian and Bicycle Accommodation Checklist

The following checklist outlines the types of pedestrian and bicycle accommodations that should be address in the PE/EA and included in the project cost estimate.

Sponsor: _____

Project Name and location: _____

In Urbanized Area? (Y/N) ____

Type of Project: _____

Check one: New/Expanded ROW _____ Retrofit _____

1. Please include evaluation of pedestrian and bicycle factors from RTP Project Purpose, Scope and Need (if available) and describe significant changes in any of these conditions within the project area.
2. From the following list, please identify and describe any pedestrian and bicycle facilities being considered in project planning (if applicable or known). Costs for these facilities should also be included in the project cost estimate.

Pedestrian Facilities

Sidewalks/Width

Buffer/Width

Over/underpass accommodations

Bridge accommodations

Intersection/median accommodations (if known)

Off-road or other accommodations (describe)

Bicycle Facilities

Wide outside lane/width

Shoulder or bicycle lane/width

Over/underpass accommodations (if applicable/known)

Bridge accommodations (if applicable/known)

Intersection/median accommodations (if known)

Off-road or other accommodations (describe)

3. Please describe any constraints that restrict or limit the inclusion of pedestrian and bicycle facilities on this project.
4. If available, would additional ROW provide opportunities to provide recommended and desirable levels of pedestrian and bicycle accommodations. (Y/N) _____

Table 1
H-GAC Recommended Accommodations for Pedestrians and Cyclists

Accommodations			Accommodations		
Facility	Pedestrian	Bicycle	Facility	Pedestrian	Bicycle
Secondary Arterial / Major Collector	5' sidewalk, 2' buffer; width of buffer may be decreased if parallel to an on-road designated bicycle lane	14-15' outside lane or 6- 8' shoulder or 5-6' bicycle lane on designated routes	Bridges / Overpasses	6-10' sidewalk along bridge structure, extension of 5' sidewalk, with 2' buffer, linking to existing sidewalk network	14-15' outside lane or 6- 8' shoulder or 5-6' bicycle lane on designated routes
Principal Arterials	5' sidewalk, 2' buffer; width of buffer may be decreased if parallel to an on-road designated bicycle lane	14-15' outside lane or 6- 8' shoulder or 5-6' bicycle lane on designated routes	Underpasses	6-10' sidewalk along bridge structure, extension of 5' sidewalk, with 2' buffer, linking to existing sidewalk network	14-15' outside lane or 6- 8' shoulder or 5-6' bicycle lane on designated routes
Frontage Roads along Interstates and Freeways	ROW for sidewalk adjacent to frontage road or parallel arterial (placement to occur as demand dictates) ADA compliant crosswalks where on/off-ramp intersects existing sidewalks	15' outside lane on frontage road or accommodation on nearby parallel arterial or off-street facility, appropriate crossings at off-ramps, interchanges	Major Intersections	Pedestrian push button activation of the traffic signal, 6-10' ADA compliant crosswalks	Maintain shoulder along approach and departure lanes thru intersection; 5-6' bicycle lane on designated routes
Best Practices	Purchase of ROW for sidewalks (placement will occur as demand dictates)	Use (W11-1) Share The Road sign along designated routes; maintain existing facilities	Exceptions	Use designated local pedestrian/bicycle plan guidelines if in compliance with AASHTO/ADA. Review to identify accommodation possible within project constraints (Limited ROW, Design Constraints or Special Conditions)	

Figure 4

Design Guidelines for Off-Street Shared-use Paths

As defined by AASHTO's 1999 Guide for Accommodating Bicyclists, a shared-use path is "a bikeway that is physically separated from motorized vehicle traffic by an open space or barrier, and can be within the highway right-of-way or within an independent right-of-way" (AASHTO 1999). While these facilities are primarily designed for bicyclists, however, other users include pedestrians, joggers, dog walkers, people pushing baby carriages, persons in wheelchairs, in-line skaters, and skate boarders. While shared-use paths can serve as a transportation system for non-motorized modes, they function best when integrated with a system of on-street facilities such as bike lanes, wide outside lanes, paved shoulders and bike routes.

General design guidelines for shared-use paths include:

- For most conditions, a paved width of 10 feet; if bicycle traffic and general use is expect to be low, 8 feet is sufficient; however, when substantial use is anticipated, a width of 12 feet is desirable.

- A 5 foot-wide buffer between shared-use paths and adjacent roadway is desirable to distinguish the independence of the facility for bicyclists and motorists. If a buffer is not available, a barrier of 3.5 feet is recommended to provide separation.
- A minimum 2 feet of wide graded area (1:6 slope) is recommended for both sides of the path, 3 feet or more is desirable to provide clearance from lateral and vertical obstructions. Vertical clearances of 8 to 10 feet are also recommended.
- Grades on shared-use paths should be kept to a minimum during long inclines, however, these can exceed 5 percent for shorter sections to minimize impacts to adjacent properties and maintain reasonable costs. While ADA recommends grades between 5 percent and 8 percent, some design flexibility may be required to overcome obstacles.
- Reinforced concrete materials are recommended for use in pathway construction for increased strength and durability; for projects that are not within a floodplain, asphalt may be sufficient but may require a greater commitment to maintaining the facility.
- Signage to alert trail users of intersections, steep grades or sharp turns is recommended for all facilities, however, it is best to maintain limited quantities of signage as to preserve the natural environment and visual benefits of shared-use paths.