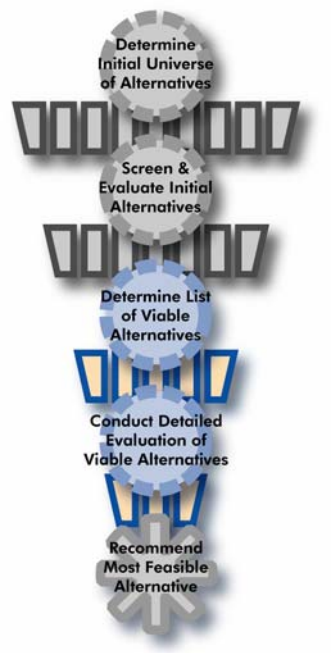
Viable Alternatives



The development and detailed evaluation of "Viable Alternatives" represents the final major steps in the process of selecting a Most Feasible Alternative that includes recommended transportation improvements along the SH 288 corridor. The development and screening evaluation of the Initial Alternatives summarized in *Chapter Four, Initial Alternatives* and discussed in more detail in *Technical Memorandum Number 4*, considered various traffic, environmental, socioeconomic, engineering and cost impacts, as well as public comment. Based upon this screening evaluation, the nine initial alternatives were narrowed to six "Viable Alternatives" for further consideration.

This *Chapter 5, Viable Alternatives*, describes the six alternatives that were considered candidates for the Most Feasible Alternative, as well as the in-depth analysis used to determine the transportation recommendations most appropriate for the study corridor. The development and evaluation of Viable Alternatives is discussed in detail in *Technical Memorandum Number 5*.

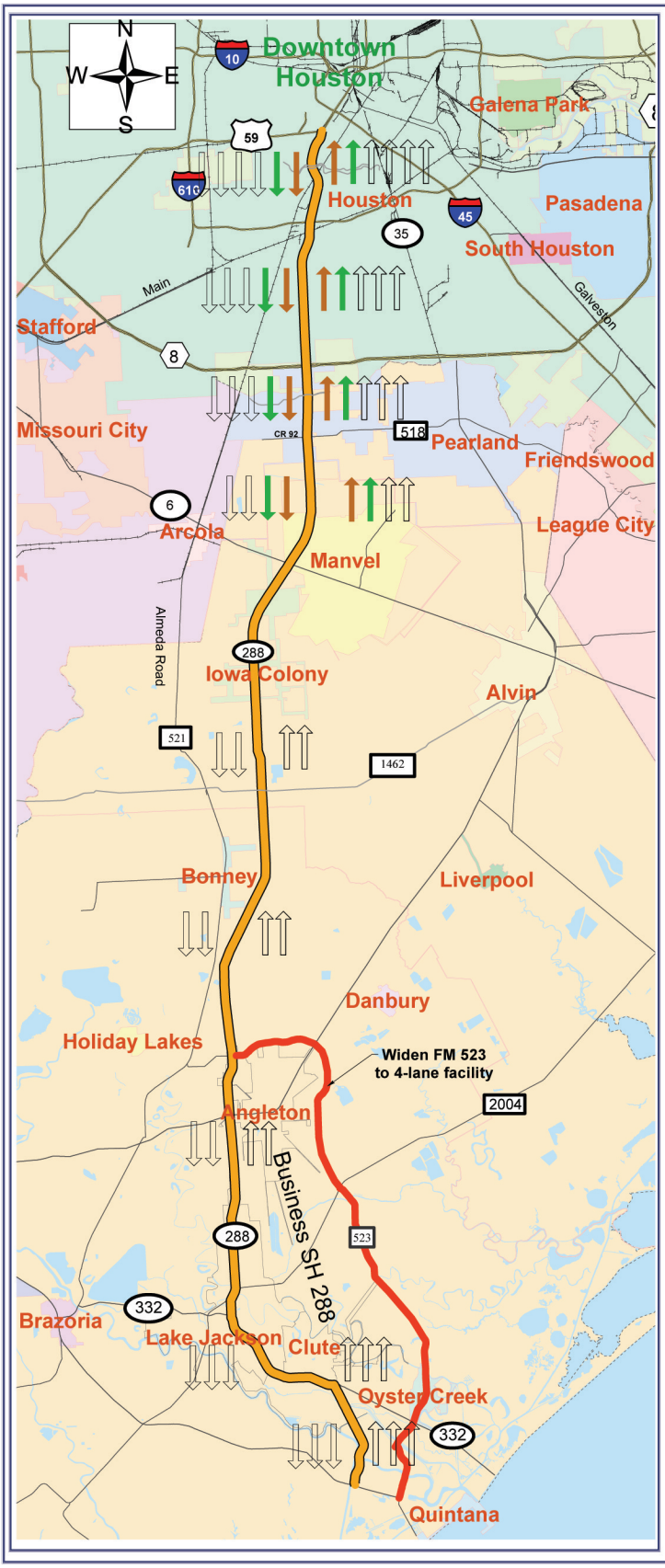
Description of Viable Alternatives

Six alternatives were selected as "Viable" candidates for the SH 288 corridor based on the screening of Initial Alternatives. Of the six Viable Alternatives selected for detailed evaluation, four add highway travel lanes along SH 288 while two consider rail improvements along the FM 521 (Almeda Road) corridor. All six Viable Alternatives included improvements discussed in the initial No Build alternative (Alternative 1) and the TSM/TDM/ITS Alternative (Alternative 2).

The Viable Alternatives are presented in **Figures 5-1** through **5-6** and **Tables 5-1** and **5-2**, and include the following:

- Alternative A: Single Occupancy Vehicle (SOV) & High Occupancy Vehicle (HOV) Lanes along SH 288
- Alternative B: High Occupancy Vehicle (HOV) Lanes along SH 288
- Alternative C: Managed Lanes along SH 288
- Alternative D: Express Toll Lanes along SH 288
- Alternative E: Light Rail Transit along the FM 521 (Almeda Road)/UP corridor
- Alternative F: Commuter Rail Transit along the FM 521 (Almeda Road)/UP corridor

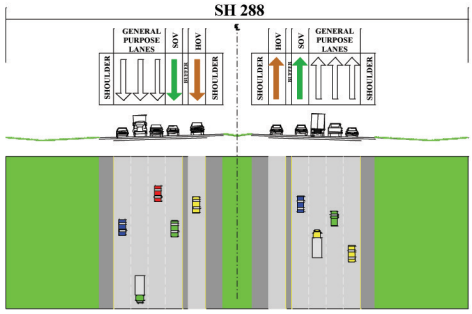
It should be noted that the limits and alignments for the Light and Commuter Rail Alternatives (E and F) are different than those assumed for the Initial Alternatives based on the results of the screening evaluation and further study in this detailed evaluation phase. Both of these rail alternatives are assumed to follow the FM 521 (Almeda Road)/UP rail corridor from the existing METRO Fannin South rail station to SH 6.



ALTERNATIVE A - SOV & HOV LANES
(SINGLE & HIGH OCCUPANCY VEHICLE)

- Add one SOV lane and one HOV lane in each direction between US 59 and SH 6.
- Eliminate at-grade intersections along SH 288 from US 59 to Main Street in Clute.
- Upgrade main lanes of entire corridor to current design standards.
- Expand or construct new Park & Pool Lots at Airport Rd, FM 2234, FM 518, CR 101, SH 6.
- Implement recommended TSM/TDM/ITS improvements along entire corridor.
- Widen FM 523 from two to four lanes from SH 288 to FM 1495.

ALTERNATIVE A - SOV & HOV LANES



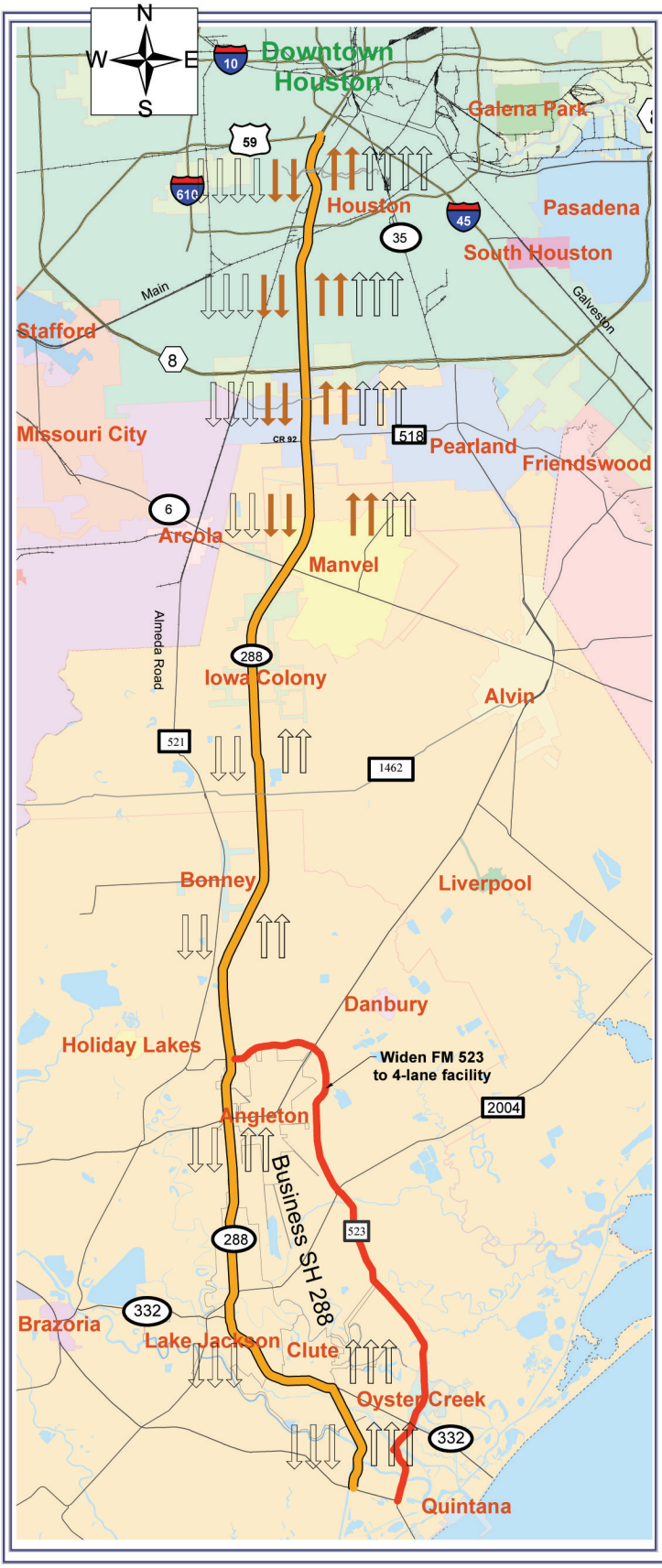
Legend

- Existing lanes
- Additional SOV (Single Occupancy Vehicle) lanes
- Additional HOV (High Occupancy Vehicle) lanes
- SH 288 Corridor
- FM 523 widening from 2 lanes to 4 lanes

Note: No additional lanes will be added south of SH 6.

5 2.5 0 5 Miles

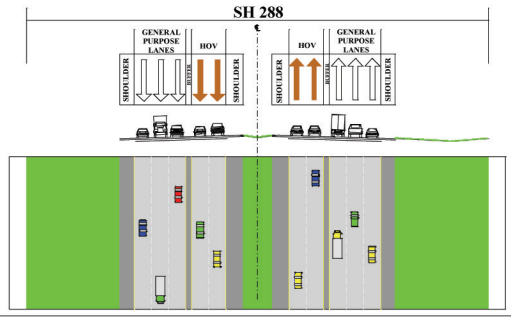
Figure 5-1
Alternative A
SOV & HOV Lanes



ALTERNATIVE B - HOV LANES (HIGH OCCUPANCY VEHICLE)

- Add two HOV lanes in each direction between US 59 and SH 6.
- Eliminate at-grade intersections along SH 288 from US 59 to Main Street in Clute.
- Upgrade main lanes of entire corridor to current design standards.
- Expand or construct new Park & Pool Lots at Airport Rd, FM 2234, FM 518, CR 101, SH 6.
- Implement recommended TSM/TDM/ITS improvements along entire corridor.
- Widen FM 523 from two to four lanes from SH 288 to FM 1495.

ALTERNATIVE B - HOV LANES



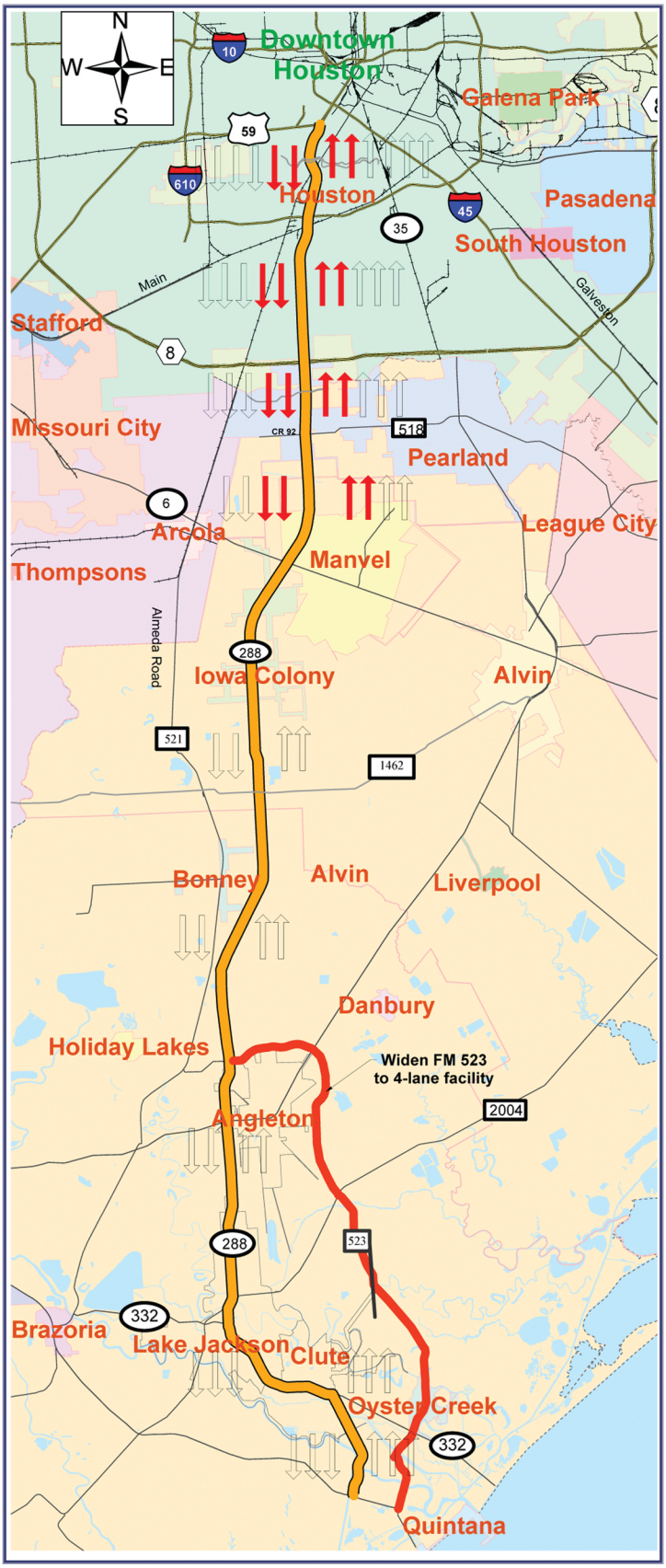
Legend

- Existing lanes
- Additional HOV (High Occupancy Vehicle) lanes
- SH 288 Corridor
- FM 523 widening from 2 lanes to 4 lanes

Note: No additional lanes will be added south of SH 6.

5 2.5 0 5 Miles

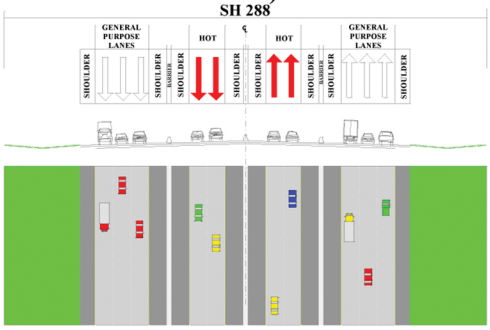
Figure 5-2
Alternative B
HOV Lanes



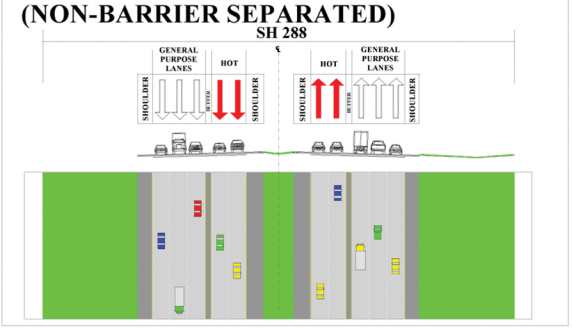
ALTERNATIVE C - MANAGED LANES

- Add two managed lanes in each direction between US 59 and SH 6.
- Consider barrier on non-barrier separated.
- Eliminate at-grade intersections along SH 288 from US 59 to Main Street in Clute.
- Upgrade main lanes of entire corridor to current design standards.
- Expand or construct new Park & Pool Lots at Airport Rd, FM 2234, FM 518, CR 101, SH 6.
- Implement recommended TSM/TDM/ITS improvements along entire corridor.
- Widen FM 523 from two to four lanes from SH 288 to FM 1495.

ALTERNATIVE C - MANAGED LANES (BARRIER SEPARATED)



ALTERNATIVE C - MANAGED LANES (NON-BARRIER SEPARATED)

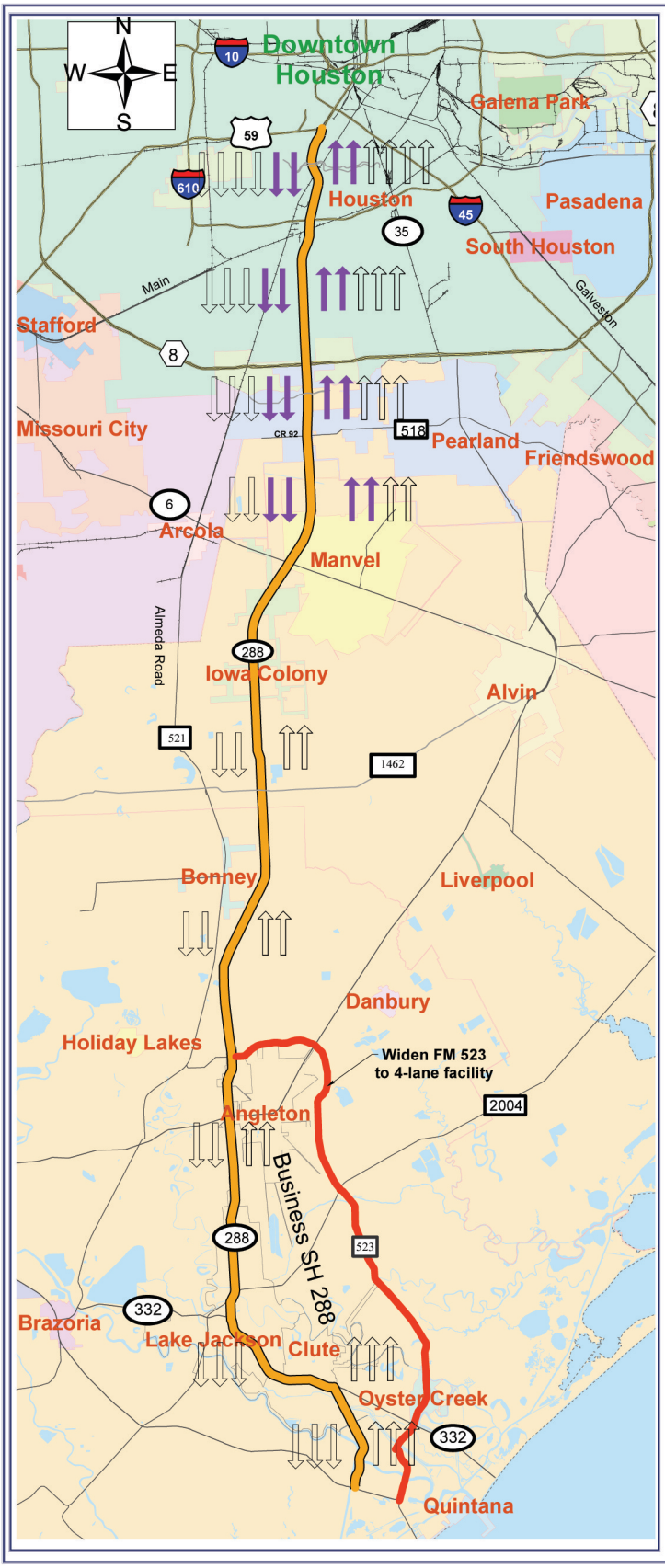


Legend

- Existing lanes
- Additional managed lanes
- SH 288 Corridor
- FM 523 widening from 2 lanes to 4 lanes

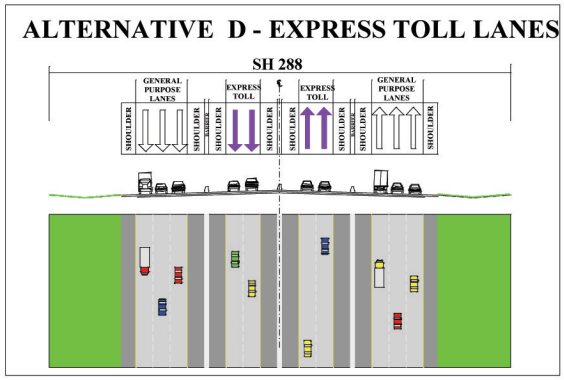
5 2.5 0 5 Miles

Figure 5-3
Alternative C
Managed Lanes



ALTERNATIVE D - EXPRESS TOLL LANES

- Add two Express Toll lanes (barrier separated) in each direction between US 59 and SH 6.
- Eliminate at-grade intersections along SH 288 from US 59 to Main Street in Clute.
- Upgrade main lanes of entire corridor to current design standards.
- Implement recommended TSM/TDM/ITS improvements along entire corridor.
- Widen FM 523 from two to four lanes from SH 288 to FM 1495.

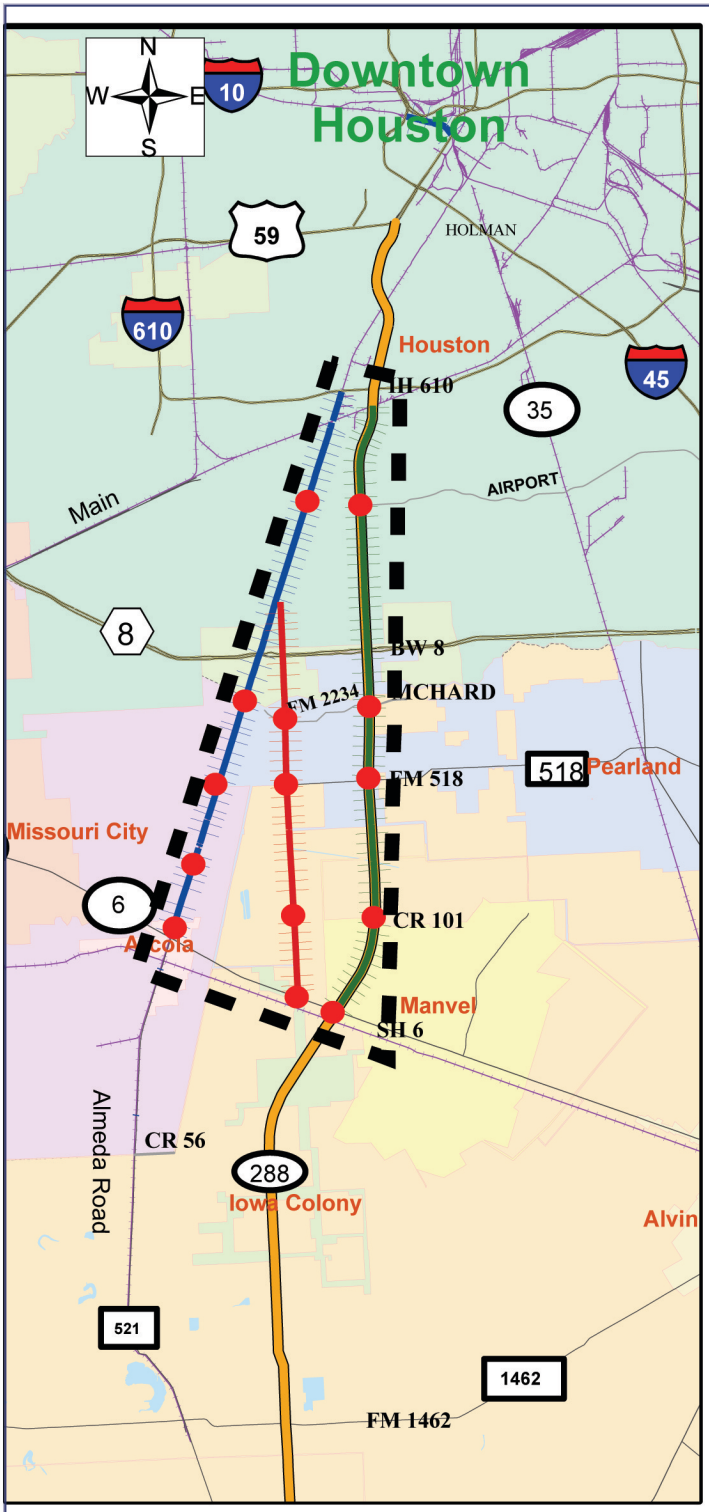


Legend

- Existing lanes
- Express toll lanes
- SH 288 Corridor
- FM 523 widening from 2 lanes to 4 lanes

5 2.5 0 5 Miles

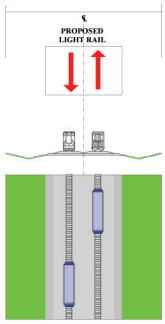
Figure 5-4
Alternative D
Express Toll Lanes



ALTERNATIVE E - LIGHT RAIL TRANSIT

- Light rail alternative will be studied in the detailed evaluation phase in conjunction with alternatives A through D.
- Light rail will also be considered in other locations between FM 521 and SH 288.

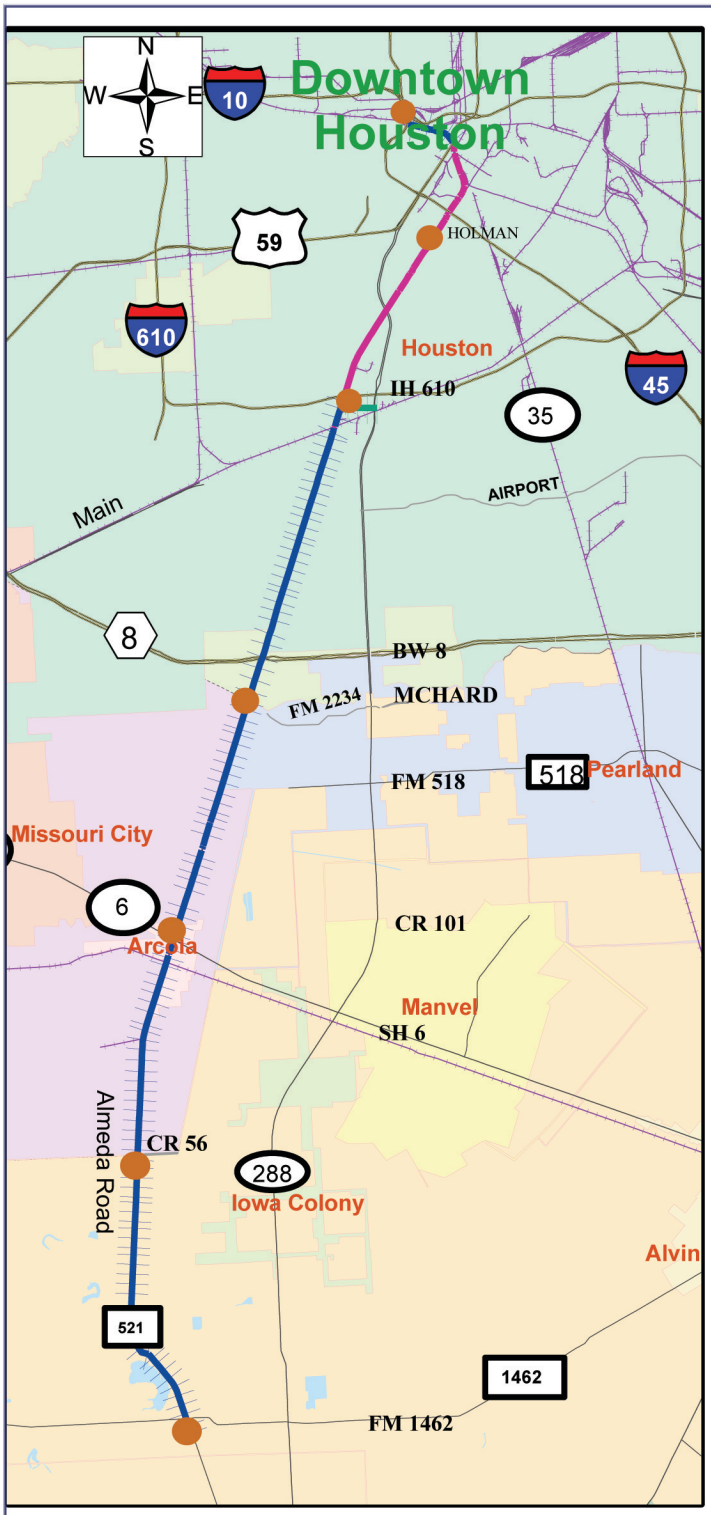
ALTERNATIVE E - LIGHT RAIL TRANSIT ALONG EXISTING CORRIDORS OR NEW LOCATION BETWEEN FM 521 AND SH 288



Legend

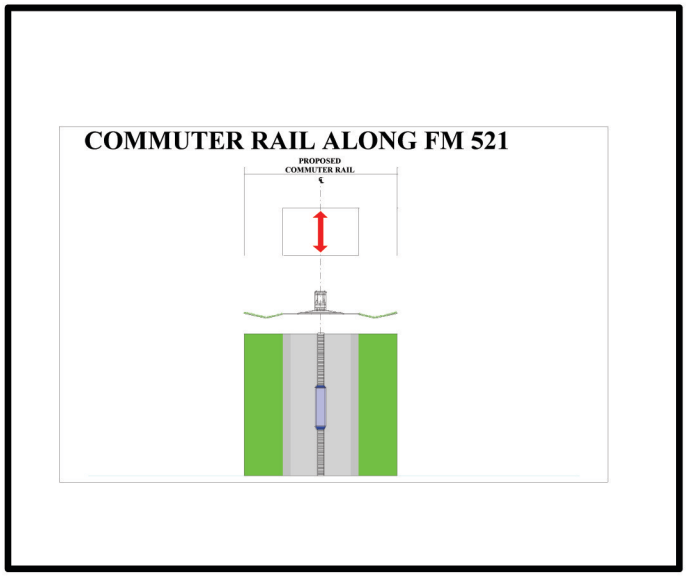
- Light rail transit within SH 288 median
- Light rail transit along FM 521 (Almeda Road)
- Light rail transit along Almeda School Road
- SH 288 Corridor
- Proposed light rail transit station
- Area where light rail is to be considered between FM 521 and SH 288.

Figure 5-5
Alternative E
Light Rail Transit



ALTERNATIVE F - COMMUTER RAIL

- Commuter rail alternative will be studied in the detailed evaluation phase in conjunction with alternatives A through D.



Legend

- Commuter rail along FM 521 (Almeda Road)
- Commuter rail option to Downtown Houston
- Proposed commuter rail station

Figure 5-6
Alternative F
Commuter Rail Transit

Viable Alternatives

Table 5-1
Characteristics of Viable Alternatives A, B, C & D

	Alternative			
	A	B	C	D
Overall Improvements				
Additional lanes are added, existing pavement is reconstructed, and design deficiencies are corrected where feasible from US 59 to SH 6	●	●	●	●
Existing pavement is reconstructed and design deficiencies are corrected where feasible from SH 6 to Main Street	●	●	●	●
Upgrade to freeway from FM 518 to Main Street in Clute	●	●	●	●
Existing pavement is reconstructed from Main Street to SH 36	●	●	●	●
Salvage existing bridge structures and widen when possible	●	●	●	●
Additional Lanes				
One SOV and one HOV lane in each direction from US 59 to SH 6	●			
Two HOV lanes in each direction from US 59 to SH 6		●		
Two Managed or Express Toll lanes in each direction from US 59 to SH 6			●	●
Location of Lanes				
Median of SH 288	●	●	●	●
Separation Type				
4 foot buffer zone (not barrier separated)	●	●		
Concrete barrier separated between SOV and Managed/Express Toll lanes			●	●
Lane Type and Restrictions				
Access identified by break in striping along buffer zone.	●	●		
Single person to pay a fee/ HOV potentially use lanes for free.			●	
All users pay a fee				●
Access Points				
Between: US 59 and MacGregor; MacGregor and Old Spanish Trail; Old Spanish Trail and IH 610; IH 610 and Reed Road; Reed Road and Airport; Airport and Almeda-Genoa; Almeda-Genoa and BW 8; BW 8 and McHard; McHard and FM 518; FM 518 and CR 59; CR 59 and CR 58; CR 58 and SH 6	●	●		
SH 288 Northbound Access to Managed or Express Toll lane from main lanes is north of SH 6, FM 518, BW 8, Airport Boulevard, IH 610			●	●
SH 288 Northbound Access from Managed or Express Toll lane to main lanes is south of BW 8, IH 610, Old Spanish Trail, director connectors to US 59 northbound and to SH 288 northbound/IH 45			●	●
SH 288 Southbound Access to Managed or Express Toll lane from main lanes is south of US 59, Old Spanish Trail, IH 610, BW 8			●	●
SH 288 Southbound Access from Managed or Express Toll lane to main lanes is north of IH 610, Airport Boulevard, BW 8, FM 518, SH 6			●	●

Table 5-1 (continued)
Characteristics of Viable Alternatives A, B, C & D

	Alternative			
	A	B	C	D
"T" ramps at park and ride lots at Airport, FM 518, SH 6	●	●	●	
Direct connectors at Beltway 8	●	●	●	●
Northern Terminus Configuration				
Access to HOV lane via SH 288 mainlanes	●	●		
Toll Collection				
None	●	●		
All electronic (no manned toll plazas)			●	●
Congestion Pricing				
None	●	●		●
Varied Toll based on time of day, HOV usage and available capacity remaining for SOVs			●	
Toll Plaza Locations				
None	●	●		
Between: FM 518 and BW8, Airport and IH 610, MacGregor and U.S. 59			●	●
Park and Ride/Park and Pool Facilities				
Expand Existing Locations: FM 518, SH 6, CR 45, SH 35	●	●	●	
Proposed New Locations: Airport (in METRO plan), FM 1462	●	●	●	
Widen FM 523 from two to four lanes between SH 288 and SH 332	●	●	●	●
Extend and widen CR 92/Broadway between SH 288 and FM 521	●	●	●	●
Other Street Improvements				
Add frontage roads between MacGregor and Holcombe	●	●	●	●
Add northbound and southbound frontage roads and revise ramps between Bellfort and Reed Road	●	●	●	●
Add 3rd lane on Reed Road (between SH 288 and last P&R lot entrance) westbound from SH 288 to last P & R lot entrance	●	●	●	●
Add additional lane on Reed Road eastbound to provide storage for exclusive double left turn lane	●	●	●	●
Intersection Geometric/Operational Improvements				
FM 521 (Almeda Road) intersections between US 59 and Holcombe, and at Holly Hall, Reed, Airport, Orem, Almeda-Genoa, FM 2234, FM 518, and SH 6	●	●	●	●

Table 5-1 (continued)
Characteristics of Viable Alternatives A, B, C & D

	Alternative			
	A	B	C	D
Closed Circuit Television Cameras				
Existing Locations: US 59, Blodgett, Southmore, MacGregor, Holcombe, Holly Hall, Holmes, Bellfort, Reed, Airport, Orem, Almeda-Genoa, BW8	●	●	●	●
Proposed New Locations – Short Term: McHard, FM 518, CR 58, SH 6	●	●	●	●
Proposed New Locations – Long Term: Juliff-Manual, CR 64, CR 60, FM 1462, CR 51, Bus 288, Henderson, SH 35, CR 220B, Bastrop Bayou, FM 2004, South Yaupon, Flag Lake, SH 332, Gulf Blvd., SH 36	●	●	●	●
Dynamic Message Signs				
Existing Locations: Southmore, Yellowstone, Holly Hall, Almeda-Genoa	●	●	●	●
Proposed Locations – Short Term:				
US 59, IH 610, Beltway 8	●	●	●	●
Between US 59 and South MacGregor; South of OST; Between Airport and IH 610; Between Beltway 8 and FM 518			●	●
Airport			2	2
FM 518, SH 6	1	1	2	2
Proposed Locations – Long Term: SH 35	●	●	●	●
Ramp Meters				
North of North MacGregor (NB), north of Holcombe (NB), south of Yellowstone (SB), north of Bellfort (SB), north of Reed (NB), north of McHard (NB), north of FM 518 (NB)	●	●	●	●
Highway Advisory Radio				
Existing Locations: IH 610, SH 6	●	●	●	●
Proposed Locations: FM 1462, SH 35, SH 332	●	●	●	●
Motorist Assistant Patrol				
Existing Locations: Between US 59 and BW8	●	●	●	●
Proposed Locations: Between BW8 and SH 6 (County's decision)	●	●	●	●
FM 521 (Almeda Road) Improvements				
Add or improve shoulders where nonexistent or substandard	●	●	●	●
Re-stripe pavement markings from US 59 to SH 6 as needed	●	●	●	●
Optimize signal timing from US 59 to SH 6	●	●	●	●

Table 5-2
Characteristics of Viable Alternatives E & F

	Alternative	
	E	**F**
Limits	Extends existing METRO light rail system from Fannin South Station to SH 6	Fannin South Station to SH 6
Alignment (N to S)	♦ Fannin South to UP branch line right-of-way on east side of FM 521 (Almeda Road) ♦ Flyover needed to cross over UP mainline from Fannin South Station ♦ Runs between the east side of FM 521 and the west side of UP Branch Line ♦ Runs on the east side of the UP branch line and the west side of FM 521 from McHard Road to SH 6 ♦ Shifting from west side to east side of branch line will require a flyover of branch line at McHard Road	♦ From a proposed light rail Transfer Station at Reed Road to SH 6 using existing UP branch line track parallel to FM 521 ♦ METRORail to be extended from Fannin South Station to Reed Road Transfer Station ♦ Light rail trains cross Reed Road and FM 521 at grade ♦ One grade separation needed at intersection of Holmes Rd/UP mainline/Fannin
Stations	Fannin South, Airport Road, W. Fuqua/Almeda Genoa, FM 2234/McHard, Palmetto/Trammel-Fresno, SH 6	Transfer Station Reed Road, FM 518, SH 6
Tracks	Double Track	New single track from proposed Reed Road transfer station to SH 6
Rolling Stock	11 train sets (2 cars per train set), for 15% spare ratio add additional 2 train sets	Six train sets – each has 1 locomotive, 2 coaches, and 1 cab car – total of 18 cars and 6 locomotives
Car Capacity	"crush load" - 180 per car; seated capacity - 74 per car	Seated capacity – 140 per car
Peak Frequency	12 minutes, Off Peak Frequency - 30 minutes	18 minutes, Off Peak Frequency - 60 minutes
Approximate Speed	30 mph	45 mph
Grade Separations	Holmes Rd/UP mainline, Reed Rd, Airport Blvd, W. Fuqua/Almeda-Genoa, Freight Rail Track/FM 521/FM 2234/Shadow Creek Pkwy	LRT grade separation at Holmes Rd/UP mainline/Fannin
TSM/TDM/ITS	Includes all TSM/TDM/ITS measures identified in the highway alternatives.	Includes all TSM/TDM/ITS measures identified in the highway alternatives.

Detailed Evaluation of Viable Alternatives

The detailed evaluation criteria used to analyze the Viable Alternatives are listed in **Table 5-3**. General evaluation categories included traffic/mobility impacts, economic feasibility, social/environmental impacts, engineering/costs, and public input. As in the initial evaluation discussed in *Chapter 4, Initial Screening*, the Viable Alternatives were measured against the No Build alternative to provide a "baseline" for comparison.

It was recognized after the initial screening process that the rail alternatives (Alternative E, Light Rail Transit and Alternative F, Commuter Rail Transit) should not be carried forward as stand-alone improvements. Implementation of only commuter or light rail along the SH 288/FM 521 (Almeda Road) corridor is not projected to significantly reduce congestion and result in acceptable traffic flow conditions on SH 288. Additional travel lanes will be needed on SH 288 to accommodate the projected travel demands along the corridor. Therefore, the rail alternatives were considered complimentary alternatives that could provide significant benefits and play a major role in addressing area mobility issues, but could not directly compete with the Viable Highway Alternatives as a Most Feasible Alternative. For this reason, evaluation of the rail options (Alternatives E & F) is discussed separately from the rigorous analysis of the SH 288 highway options (Alternatives A to D).

Table 5-3
Evaluation Criteria for Viable Alternatives

Traffic/Mobility	
Travel Demand	Vehicle Miles Traveled (VMT)
Travel Efficiency (LOS)	LOS by Percent VMT
Travel Mobility	Average Travel Time (Minutes) and Average Travel Speed (Miles Per Hour)
Multimodal Efficiency	Average Vehicle Occupancy
Traffic Utilization	Optimum Capacity Utilization (volume to capacity ratio)
Conformance with Area Transportation Plans	Does Alternative Facilitate and Coincide with Area Transportation Plans
Economics	
Economic Impacts	Benefit/Cost Ratio Travel Time Savings Accident Cost Savings Vehicle Operating Cost Savings
Social and Environmental Impacts	
Land Acquisitions and Displacements	Number of Homes Per Mile to be Displaced Number of Businesses Per Mile to be Displaced Percentage of County's Prime Farmland to be Displaced
Noise Impacts	Number of Homes with Audible Noise Changes Number of Homes with Noise Impacts over FHWA Criteria Number of Businesses with Audible Noise Changes Number of Business with Noise Impacts over FHWA Criteria
Social and Economic Impacts	Are Communities Bisected
	Are Community Cohesions Affected
	Are Community Facilities Displaced
	Are Minority/Low Income Communities Disproportionately Affected

Table 5-3
Evaluation Criteria for Viable Alternatives (continued)

Social and Environmental Impacts (continued)	
Air Quality Impacts	Number of Homes with Air Quality Changes Number of Homes with Air Quality Impacts over NAAQS Number of Businesses with Air Quality Changes Number of Businesses with Air Quality Impacts over NAAQS
Habitat Impacts	Area of Bottomland Hardwood and Riparian Forest Affected Area of Mature Bottomland Hardwood and Riparian Forest Affected Area of Remnant Prairie Habitat Affected
Wetland Impacts	Area of Wetland Impacts Area of High-Quality Wetland Impacts
Water Quality Impacts	Changes in Pollutant Loads to Surface Water Bodies Expected Due to the Project
Hazardous Materials	Number of Potential Hazardous Material Sites in Standard Radius from the Proposed Project Right-of-Way Number of Hazardous Material Sites within the Right-of-Way
Engineering/Costs	
Right-of-Way	Number of Acres of Right-of-Way to Acquire Type of Land Use
Constructability	Complexity of Construction Duration of Construction
Cost	Construction and Right-of-Way Cost Operation and Maintenance Cost
Safety	Improve Corridor as an Emergency Evacuation Route Conformity with Design Criteria Reduce Number of At-Grade Crossings Alternative Route Provided for Hazardous Cargo

Table 5-3
Evaluation Criteria for Viable Alternatives (continued)

Engineering/Costs Continued	
Utilities	Impacts to Existing Utilities
Drainage	Conformity with Drainage Design Criteria Provide for Efficient Emergency Evacuation
Public Acceptance	
Public Involvement	Improvements are Supported by the Public

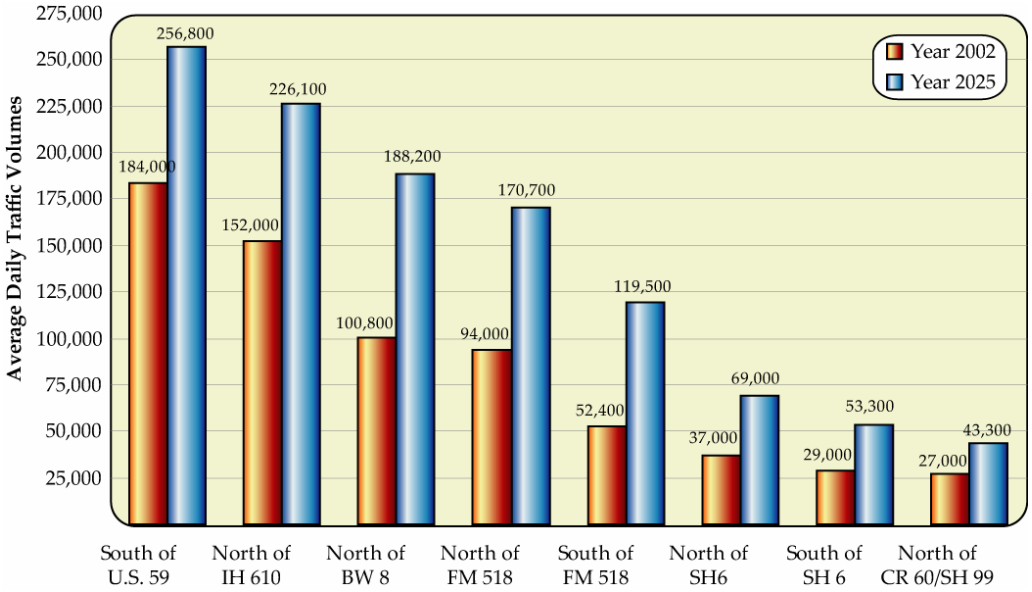
Traffic and Mobility Impacts

As discussed in *Chapter 3, Existing Conditions*, traffic volume is steadily increasing within the SH 288 corridor as significant development growth continues in the area. Existing traffic and mobility improvement needs combined with increasing travel demands in the SH 288 corridor make the ability of the various Viable Alternatives to improve area traffic and mobility conditions particularly important in determining a Most Feasible Alternative.

Level-of-Service (LOS)

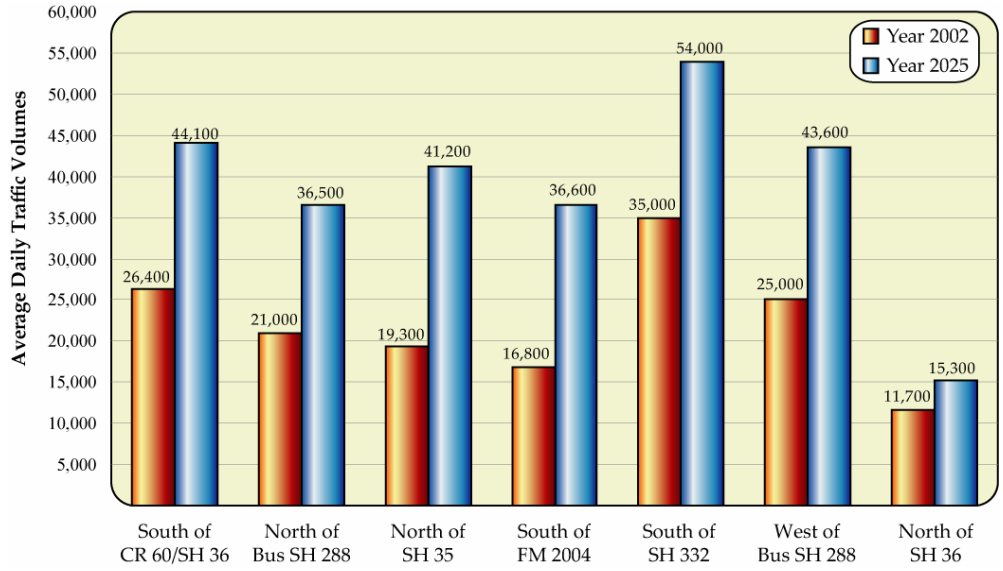
Projected increases in daily traffic volumes are shown in **Figures 5-7 and 5-8**. Existing daily traffic volumes are projected to double by Year 2025 along several sections of SH 288. Traffic volumes are projected to increase by 1.5 percent to 3.6 percent per year.

Figure 5-7
Average Daily Traffic Volumes on SH 288 (US 59 to Grand Parkway)



Source: Year 2002 Traffic Volume Counts (TxDOT), and Year 2025 Regional Travel Demand Model (H-GAC).

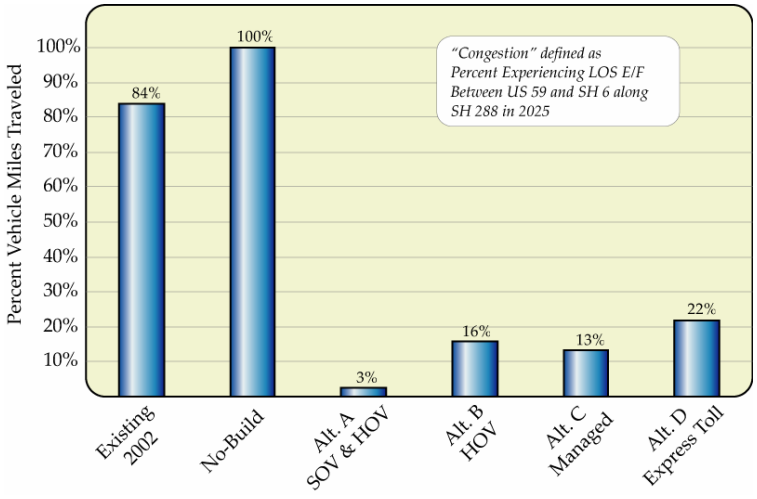
Figure 5-8
Average Daily Traffic Volumes on SH 288 (Grand Parkway to SH 36)



Source: Year 2002 Traffic Volume Counts (TxDOT), and Year 2025 Regional Travel Demand Model (H-GAC).

Currently, the section of SH 288 from US 59 to FM 518 is experiencing severe congestion (LOS E/F) during peak periods, which includes almost 84 percent of the total Vehicle Miles Traveled (VMT) from US 59 to SH 6. The entire section of SH 288 between US 59 and SH 6 is projected to operate at LOS E/F by Year 2025 without any transportation improvements. Each of the Viable Alternatives provides significant reductions in the percent of traffic that is projected to experience LOS E/F operations over the No Build alternative. As shown in **Figure 5-9**, Alternative A (SOV/HOV Lanes) has the largest impact in reducing congestion over the No Build alternative, followed closely by Alternatives B (HOV Lanes) and C (Managed Lanes).

Figure 5-9
Percent of SH 288 Traffic Experiencing Congestion in Year 2025 (US 59 to SH 6)



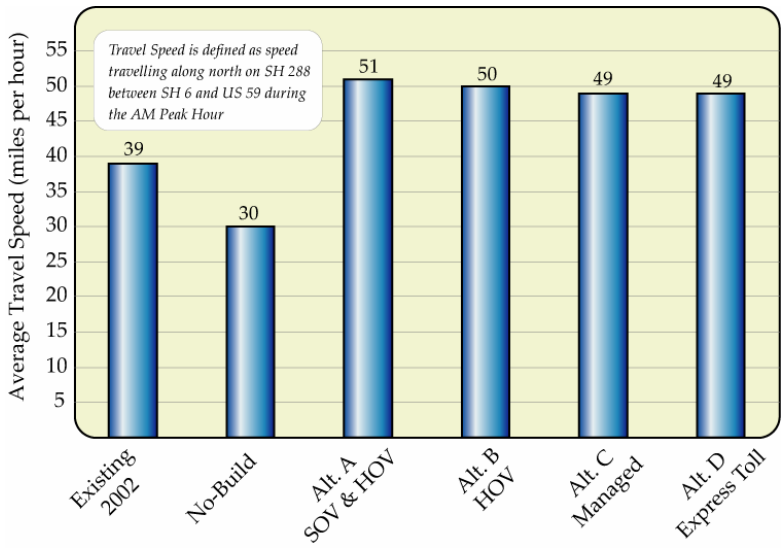
The difference in the traffic operating performances between alternatives can be attributed to the elements of management and user-cost of additional capacity. Managed and express toll lanes limit users to maintain adequate capacity and efficient traffic flows on these restricted lanes. The managed and express lane restrictions force a greater share of traffic to the existing general purpose lanes, which in turn decreases the LOS provided in these existing lanes.

Average Travel Speed

The rate of speed at which a driver is able to travel on a roadway is influenced by the level of congestion experienced on the facility. Reducing travel demands or increasing capacity (i.e. additional lanes) on a roadway can make a significant difference in the average travel speed on that roadway. The average travel speed calculated for each alternative takes into consideration the travel time on both the existing general purpose lanes and the additional lanes proposed in each alternative. The alternative which has less congestion typically results in faster average travel speeds.

As shown in **Figure 5-10**, all the Viable Highway Alternatives improve the average travel speed over the No Build condition. The projected average travel speeds for all the Viable Alternatives in the northbound direction during the AM peak hour is around 50 mph (compared to the current AM peak period travel speed of 39 mph and future No Build speed of 30 mph).

Figure 5-10
Year 2025 Average Travel Speed Along on SH 288 (US 59 to SH 6)



Average Travel Time

Like speed, travel time is influenced by the level of congestion experienced during travel. Reducing travel demand or increasing capacity on a roadway can make a difference in the average travel time on that roadway. Today, the average travel time in the AM peak period (northbound direction) between US 59 and SH 6, is approximately 28 minutes and is expected to increase to approximately 36

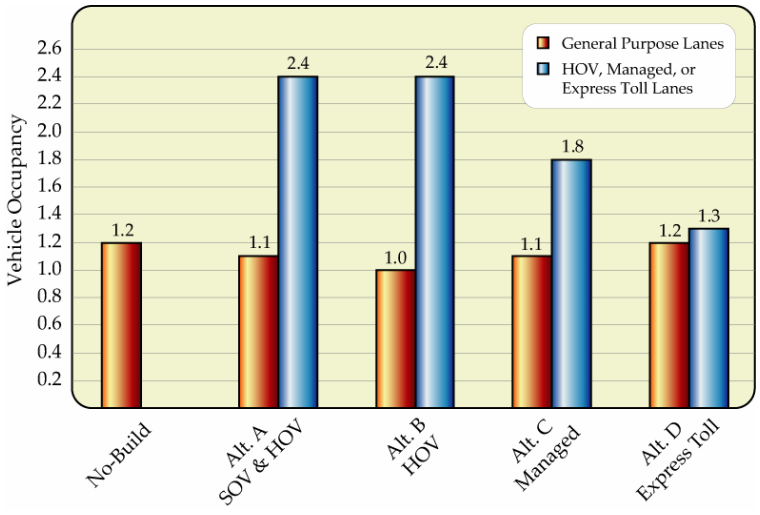
minutes by the Year 2025 for the No Build Alternative. Implementation of any of the Viable Highway Alternatives A to D reduces average travel time to between 21 and 22 minutes - a significant decrease in average vehicle travel time compared to No Build conditions.

Multimodal Efficiency

Carpools, vanpools, and commuter buses offer alternative transportation mode choices and remove vehicles from the roadway. Alternatives A (SOV/HOV), B (HOV) and C (Managed Lanes) benefits high occupancy vehicles (2+ persons per vehicle) by providing exclusive lanes for their travel, which results in improved travel times and speeds for the occupants. Managed lanes allow single occupant vehicles to also use the restricted lanes for a toll. Express Toll (Alternative D) provides no preference for high occupancy vehicles as all vehicles are charged a fee.

As indicated in **Figure 5-11**, average vehicle occupancy rates for the existing SH 288 lanes (general purpose lanes) in each of the Viable Alternatives are the same or slightly lower than No Build conditions. The vehicle occupancy rate in the new lanes of the Managed Lane Alternative (C) are lower than the SOV/HOV and HOV alternatives (A and B, respectively) as single occupant vehicles are allowed to share the lane with other higher occupancy vehicles. The Express Toll alternative does little to increase vehicle occupancy in the corridor.

Figure 5-11
Year 2025 Average Vehicle Occupancy on SH 288 by Lane Type (US 59 to SH 6)

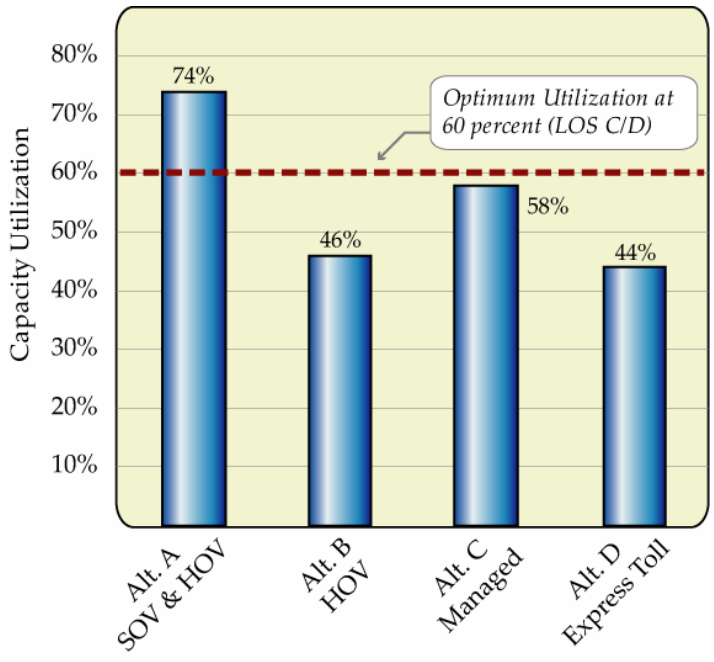


Traffic Utilization

Each of the Viable Alternatives requires a significant investment for the provision of additional capacity. Use of the additional travel lanes provides a measure of the return on the investment required of each alternative. Optimal utilization balances capacity (supply) and demand with the desired LOS (in this case, LOS C/D). Optimal lane utilization to achieve a LOS C/D is approximately 60 percent of the available capacity.

As shown in **Figure 5-12**, Alternative C (Managed Lanes) best maximizes capacity while operating at an acceptable LOS C/D. The additional capacity provided in the SOV/HOV alternative (a single SOV and HOV lane in each direction) is not sufficient to achieve a LOS C/D based on the anticipated demands for these lanes. On the other hand, the additional capacity provided in the HOV and Express Toll alternatives (two additional lanes in each direction) is under utilized. In the case of the HOV alternative which provides two HOV lanes, the single occupant vehicle is a large percentage of the total demand but is prohibited from the additional capacity. In the case of the Express Toll alternative, free travel is prohibited and high occupancy vehicles are not given the preferences received in the other alternatives. The HOV and Express Toll alternatives limit the travel options and mode choice provided by the SOV/HOV and Managed Lane alternatives.

Figure 5-12
Year 2025 Utilization of Added Lanes (US 59 to SH 6)



Vehicle Miles of Travel

Vehicle miles of travel (VMT) is a measure of the total vehicle miles traveled on a segment computed by multiplying the number of vehicles on a roadway segment by the length of that segment. As the number of vehicles on a segment approach the capacity of that segment congestion occurs and travel times on that segment begin to increase. Congestion results when a facility can no longer accommodate the total demand for that facility.

Each of the Viable Alternatives generate an increase in VMT on traffic along SH 288 over the No Build scenario, with differences between alternatives attributed to the way additional capacity is managed. The SOV/HOV alternative has the highest percent increase (approximately nine percent) in VMT because it provides an additional general purpose lane without any restrictions on its usage. The other Viable Alternatives (all of which place some restrictions to their use) are projected to attract an additional six percent traffic to SH 288 over the No Build Alternative.

Summary

Results of the traffic/mobility evaluation are presented in **Table 5-4**. All of the alternatives, with the exception of the No Build, scored an overall ranking of "favorable" for this category, primarily due to their ability to significantly improve traffic and mobility conditions in the SH 288 corridor.

Table 5-4
Traffic/Mobility Ratings for Viable Alternatives

Alternatives	MEASURE OF EFFECTIVENESS: Travel Demand	Travel Efficiency	Travel Time/Speed	Multimodal Efficiency	Traffic Utilization	Conformance with Transportation Plans	Overall Ranking
No Build	⦿	○	○	○	○	○	○
A. SOV/HOV	●●	●●	●	●●	⦿	●	●
B. HOV	●	●	●	●●	⦿	⦿	●
C. Managed	●	●	●	●	●●	●●	●
D. Express Toll	●	⦿	●	⦿	⦿	●●	●

●● - Most Favorable, ● - Favorable, ⦿ - Neutral,
○ - Unfavorable, ○○ - Most Unfavorable

Economic Impacts

The significant investment required to improve the SH 288 corridor requires substantial public funding so the improvements must make economic sense. Each alternative was evaluated based on its cost effectiveness to ensure the best use of public funding. Measuring the impacts of the four Viable Alternatives requires an understanding of the transportation benefits as well as the implementation costs – and how they can be measured monetarily.

Travel Efficiency Benefits

The economic benefits derived from a major transportation improvement can be classified in two ways:

- Direct benefits to those that travel within the improved SH 288 corridor, including cost savings from reduced travel time, vehicle operating cost savings, and reduction in accidents; and,
- Indirect benefits of economic development that takes advantage of an improved corridor, including an increase in industrial employment and production in the region served by the proposed improvement.

This economic feasibility analysis focuses on the travel efficiencies associated with the Viable Alternatives. The travel benefits are converted to constant dollars using accepted and current monetary values for elements related to travel time, vehicle operating costs, and accidents.

Vehicle Operating Cost Savings

Vehicle operating costs include daily upkeep and operation costs such as gas, maintenance and tires. Roadway characteristic attributes, including distance, running speeds, grades, horizontal curves, roadway surface, and speed change cycles, can impact operating costs. Vehicle operating cost savings are generated by:

- Reducing the distance that vehicles travel;
- Reducing stops, starts and delay associated with congested areas; and,

- Improving the general operational efficiency of roadways by improving curvature and gradient changes and reducing the number of speed changes that occur with braking, acceleration, and deceleration.

Analysis of vehicle operating costs, as shown in **Table 5-5**, indicates annual savings for each of the alternatives in Year 2025. Costs for both automobiles and trucks were projected to be lower with each of the Viable Alternatives than with the existing roadway system, resulting in a benefit to the users.

Table 5-5
Annual Vehicle Operating Cost Savings

Alternative	Year 2025 Savings		
	Autos	Trucks	Total
Alternative A	$30,803,000	$14,182,000	$44,985,000
Alternative B	$31,184,000	$13,918,000	$45,102,000
Alternative C	$33,387,000	$14,837,000	$48,224,000
Alternative D	$29,455,000	$13,240,000	$42,695,000

Note: Costs are in Year 2004 dollars

Travel Time Savings

Travel time savings is created by increasing the speed of travel and by reducing the delay effects of traffic congestion. The monetary value of time varies by person and type of trip. By providing faster and more direct access to and around the SH 288 corridor, each of the Viable Alternatives will save travel time for both local and tourists-related travel. A summary of the anticipated travel time savings for Year 2025, provided in **Table 5-6,** indicate that Alternatives A (SOV/HOV Lanes) and C (Managed Lanes) offer the greatest annual travel time savings.

Table 5-6
Annual Travel Time Savings

Alternative	Year 2025 Savings		
	Autos	Trucks	Total
Alternative A	$129,139,000	$24,311,000	$153,450,000
Alternative B	$122,969,000	$23,150,000	$146,119,000
Alternative C	$125,602,000	$23,645,000	$149,247,000
Alternative D	$116,058,000	$21,849,000	$137,907,000

Note: Costs are in Year 2004 dollars

Accident Cost Savings

Improved design standards and increased safety features can reduce accident risks in and around the SH 288 corridor. Accident "savings" are based on a reduction in average accident rates per hundred million vehicle-miles of travel in

comparison to the No Build scenario. The accident cost savings associated with the Viable Alternatives is provided in **Table 5-7**. As with travel time savings, Alternatives A (SOV/HOV Lanes) and C (Managed Lanes) offer the greatest accident cost savings when projecting to Year 2025. Alternative D (Express Toll) is projected the lowest amount of accident cost savings among the four Viable Highway Alternatives.

Table 5-7
Accident Cost Savings

Alternative	Year 2025 Savings
Alternative A	$ 13,621,000
Alternative B	$ 12,276,000
Alternative C	$ 12,857,000
Alternative D	$ 11,905,000

Note: All savings are in Year 2004 dollars

Total Travel Efficiency Benefits

In total, the economic benefits gained through travel efficiency are significant for each of the four Viable Highway Alternatives. As indicated in **Table 5-8**, by Year 2025, Alternatives A (SOV/HOV Lanes) and C (Managed Lanes) are projected to provide the greatest total annual travel efficiency benefits to the traveling public, with approximately $210 million in savings. Alternative D (Express Toll) is projected to provide the least total annual travel efficiency benefits in Year 2025, with almost $193 million in savings.

Table 5-8
Total Travel Efficiency Benefits

Alternative	Year 2025 Savings
Alternative A	$212,056,000
Alternative B	$203,497,000
Alternative C	$210,328,000
Alternative D	$192,507,000

Note: Costs are in Year 2004 dollars

Transportation Investment Costs

The total implementation costs associated with highway improvements are greater than just the cost of construction. If necessary, land for right-of-way must be acquired, improvements must be designed and additional studies may be needed. Once in place, improvements such as lanes and toll facilities must be managed, operated, and maintained. Costs can be divided into:

- Net "capital costs" of improving and constructing any of the alternatives, including right-of-way acquisition, planning, design, and construction; and,

- Continuing upkeep and improvement including annual net change in administration, operation, and maintenance costs.

Capital costs and annual operations and maintenance costs for the Viable Alternatives are discussed in the "Engineering and Cost" section of this chapter. **Table 5-9** provides a summary of the additional or net operations and maintenance costs associated with the Viable Alternatives. The operations and maintenance costs estimates for Alternatives C (Managed Lanes) and D (Express Toll) are considerably higher than those for the alternatives that are comprised of only improvements for single and high occupancy vehicles. This is primarily due to the toll related costs with these alternatives.

Table 5-9
Average Additional Annual Operation and Maintenance Costs

Alternatives	Additional Annual Maintenance Costs
Alternative A	$3,855,000
Alternative B	$5,679,000
Alternative C	$16,775,000
Alternative D	$12,463,000

Note: Costs are in Year 2004 dollars

Cost Effectiveness

To determine whether investment in the four Viable Highway Alternatives is economically feasible, costs were compared with the benefits estimated for these options. Thorough analysis of costs and benefits requires a "life cycle" approach that anticipates the year in which a cost or benefit takes place. Comparison of costs and benefits provides three indicators of "economic feasibility" for each of the alternatives.

- **Net Present Value** - The net present value is the best indicator of whether or not the alternative is economically feasible because it takes into account

Measuring Benefits to Cost

A feasible project offers:

- A positive Net Present Value (NPV);
- An Internal Rate of Return (IRR) that is higher than the opportunity cost of money, which is assumed to be 5.5 percent; and
- A benefit-cost (B/C) ratio of 1.0 or higher.

The most feasible project has the highest NPV, IRR, and B/C ratio.

the *magnitude* of the costs and benefits. All costs and benefits in future years are discounted back to the base year using a 5.5 percent real (constant dollar) discount rate. If the sum of the discounted benefits is greater than the sum of the discounted costs, the "net present value" is positive and the Viable Alternative is deemed to be "economically feasible."

- **Discounted Benefit/Cost Ratio** - After future costs and benefits are discounted, the sum of the discounted benefits are divided by the sum of the discounted costs. When the result is 1.0 or greater, the highway is considered to be "economically feasible."
- **Internal Rate of Return** - The internal rate of return determines the discount rate that would result in the net present value difference between costs and benefits being zero. If the rate of return, expressed as a percentage, is equal to or greater than 5.5 percent, then the investment is deemed to be "economically feasible."

As shown in **Table 5-10**, all four alternatives are very economically feasible or cost effective projects with the benefit/cost ratios ranging from 4.8 for Alternative C (Managed Lanes) to 7.9 for Alternative A (SOV/HOV Lanes). Given the high level of cost effectiveness, all four alternatives would continue to be economically feasible with various sensitivity tests, including the assumption of 10 percent higher costs, 10 percent lower benefits, or a higher discount rate.

Table 5-10
Summary of Cost Effectiveness

Alternatives	B/C Ratio	NPV ($)	IRR (%)
Alternative A	7.86	1,795,557,000	34.53%
Alternative B	7.23	1,700,684,000	33.62%
Alternative C	4.84	1,615,416,000	29.75%
Alternative D	5.02	1,494,979,000	29.20%

Note: Dollar Values are shown as Year 2004 dollars

Potential Revenue/Bond Coverage

The Viable Highway Alternatives consisting of a toll component were ranked from a revenue/bond coverage perspective based on a very preliminary analysis. Based on general estimates and assumptions regarding traffic and revenue, tolls from Alternative C (Managed Lanes with HOV 3+ use free) are projected to generate revenues to cover or fund between 60 percent and 90 percent of the total project cost – sufficient for a favorable rating. Alternative D (Express Toll) toll revenues are projected to cover between 80 percent and 90 percent of the total project cost – the most favorable of the Viable Alternatives. It should be emphasized that this analysis should not be used for financing purposes and more detailed toll feasibility studies would be required prior to making any transportation improvement decisions. Alternatives A (SOV/HOV Lanes) and B (HOV Lanes) received "most unfavorable ratings" because they do not generate revenue.

Summary

Table 5-11 provides a summary of the overall economic impacts of each of the Viable Highway Alternatives. All of the Viable Alternatives received a "positive ranking" with Alternatives A and B having a "favorable" rating and Alternatives C and D having a "most favorable" rating.

Table 5-11
Economic Ratings for Viable Alternatives

Alternatives	MEASURE OF EFFECTIVENESS: Benefit Cost Ratio	Travel Time Savings	Accident Cost Savings	Vehicle Operating Cost Savings	Revenue/Bond Coverage	Overall
No Build	○	○	○	○	○	○
A. SOV/HOV	●●	●●	●●	●●	○	●
B. HOV	●●	●●	●●	●●	○	●
C. Managed	●●	●●	●●	●●	●	●●
D. Express Toll	●●	●●	●●	●●	●●	●●

●● - Most Favorable, ● - Favorable, ⦿ - Neutral,
○ - Unfavorable, ○○ - Most Unfavorable

Social and Environmental Impacts

The environmental evaluation of Viable Highway Alternatives identifies impacts in the following social and environmental categories:

- Land Acquisition and Displacements
- Noise
- Social and Economic Conditions
- Air Quality
- Vegetation and Wildlife Habitat
- Wetlands
- Water Quality
- Hazardous Materials

Land Acquisition and Displacements

Acquiring land for roadway improvements unfortunately can sometimes require displacement of homes, businesses, buildings or prime farmland. In the case of the four Viable Highway Alternatives, very few buildings or farms will be removed. All four alternatives would require additional land for right-of-way needed as part of the proposed widening of FM 523 from SH 288 in Angleton to SH 332 in Freeport and for expanded and proposed Park and Ride lots. In addition, CR 92 (Broadway) would be widened from SH 288 to Almeda School Road and extended from Almeda School Road to FM 521 (Almeda Road).

As shown in **Table 5- 12**, Alternatives A (SOV/HOV Lanes) through D (Express Toll) would displace some homes and businesses with the proposed widening of FM 523 between SH 288 and SH 332. If FM 523 were widened to the east, three homes and ten businesses would be displaced. Widening FM 523 to the west would displace eleven homes and four businesses, or 0.42 homes per mile, and 0.15 businesses per mile.

Table 5-12
Socioeconomic Impacts

Category	No Build	Alternative A (FM 523 east/west)	Alternative B (FM 523 east/west)	Alternative C (FM 523 east/west)	Alternative D (FM 523 east/west)
Homes Displaced per Mile	0	0.12/0.42	0.12/0.42	0.12/0.42	0.12/0.42
Businesses Displaced per Mile	0	0.38/0.15	0.38/0.15	0.38/0.15	0.38/0.15
Harris County Prime Farmland Soils Displaced by Percentage	0	Less than 1 percent	Less than 1 percent	Less than 1 percent	0
Brazoria County Prime Farmland Soils Displaced by Percentage	0	Less than 1 percent	Less than 1 percent	Less than 1 percent	Less than 1 percent
Value	0	-	-	-	-

- - Significant negative impacts, - Impacts exist, but they are minor or easily mitigated, 0 No impact, + Some positive impact, ++ Significant positive impacts

Prime farmland would be impacted by the proposed Park and Ride lots for all four alternatives, widening FM 523 from two to four lanes and widening CR 92/Broadway from SH 288 to Almeda School Road and extending it to FM 521 (Almeda Road). In total, the loss of prime farmland soils in Brazoria County would consist of 61 acres, or 0.01 percent of Brazoria County's prime farmland soils. In Harris County, the loss of prime farmland soils would be only four acres impacted by Alternatives A (SOV/HOV Lanes), B (HOV Lanes) and C (Managed Lanes) which is a nominal amount of Harris County's prime farmland soils.

Alternative D will not affect Harris County prime farmland soils. Because the impacts are measurable, but less than 10 percent, they are considered very minor.

Noise Impacts

Noise impacts are expected throughout the SH 288 corridor regardless of the alternative selected, although in several places, mitigation measures such as noise walls could be installed. The No Build scenario anticipates that the increase in traffic by 2025 would increase noise to more than 66 decibels (dB) in limited areas such as a few homes along SH 288 between US 59 and Holcombe, as well as along FM 523 in Oyster Creek. In other cases, noise may increase 3 to 10 dB, but will not exceed the 66 dB threshold. The impacts of the four Viable Alternatives roughly reflect those of the No Build scenario. Alternatives A (SOV/HOV Lanes) and D (Express Toll) would increase noise between US 59 and Holcombe by less than 3 dB, but some of the residences in this area would still be receiving more than 66 dB. Alternative B (HOV Lanes) would slightly *decrease* noise between US 59 and Holcombe while Alternative C (Managed Lanes) would have a similar impact on the east side of the roadway in the same area.

Social and Economic Impacts

Social and economic issues include "environmental justice" – a situation that disproportionately impacts low income or minority areas, significantly displaces community facilities, or affects access to services - a "fatal flaw" for a transportation improvement alternative. For example, if an alternative would bisect only low-income or minority communities, disproportionate impacts would occur and that alternative would be excluded. Fortunately, in all four alternatives, the proposed expansion of SH 288 within the median would not bisect communities or displace homes, businesses, or community facilities. It would also maintain access to communities and community facilities. Similarly, the proposed expansion of CR 92 (Broadway) between SH 288 and FM 521 would not create environmental justice issues. As previously discussed in the "Land Acquisition and Displacements" section, the proposed widening of FM 523 from two to four lanes would displace a limited number of homes and businesses.

Air Quality Impacts

None of the alternatives results in 10 percent increase or decrease of the CO level compared to the national eight-hour and one-hour CO standards. Therefore, none of the alternatives were considered to have a real impact on air quality.

Non-Wetland Habitat

Adding lanes in the median of SH 288 for Alternatives A (SOV/HOV Lanes) through D (Express Toll) would affect only maintained right-of-way and would not affect bottomland hardwood, riparian forest, or native prairie habitat. The proposed Park and Ride lots along the SH 288 right-of-way would affect only fallow farmland or pasture, with young scattered Chinese tallow and other hardwood trees. Similarly, widening FM 523 would affect only maintained right-of-way, farmland, pasture, areas of scattered Chinese tallow, yaupon, and other hardwood trees. Only 0.7 acres of young, bottomland hardwood would be affected north of Oyster Creek, west of the existing FM 523 right-of-way.

Wetlands

Adding lanes in the median of SH 288 for Alternatives A (SOV/HOV Lanes) through D (Express Toll) between US 59 and SH 6 would affect wetlands at crossings over Mustang Bayou, Sims Bayou, and Clear Creek. Widening FM 523 would affect wetlands along the banks of additional waterways. As shown in **Table 5-13**, one of the crossings would affect at least 0.5 acre of wetlands, resulting in a slight impact created by each of the four Viable Alternatives. The wetlands that would be affected are along the banks of open water crossings and are not critical wildlife habitat, watershed filters, or floodwater retention, and are not high quality. The dominant plant species in the fringe wetlands include sedge (*Cyperus* sp.), curly dock (*Rumex crispus*), and cattail (*Typha latifolia*).

Table 5-13
Wetlands

Category	No Build	Alternative A	Alternative B	Alternative C	Alternative D
Impacts to Wetlands	No	Yes	Yes	Yes	Yes
Impacts to 0.5 acre/crossing	No	No	No	No	No
Impacts to High Quality Wetlands	No	No	No	No	No
Impacts to High Quality Wetlands ≥0.1 acre	N/A	N/A	N/A	N/A	N/A
Value	0	-	-	-	-

- - Significant negative impacts, - Impacts exist, but they are minor or easily mitigated, 0 No impact, + Some positive impact, ++ Significant positive impacts

Water Quality Impacts

The analysis of water quality impacts is an estimate of suspended solids, hydrocarbons, oxygen-demanding substances and heavy metals added to surface waters by each alternative. The increases in highway pollutant loads to surface water bodies resulting from Alternatives A (SOV/HOV Lanes) through D (Express Toll) range from 56 to 100 percent. However, the Texas Commission on Environmental Quality indicates that because nonpoint source pollution comes from many sources, it is difficult to regulate and identify single factors affecting surface water quality. Therefore, it is unlikely that the additional lanes proposed for SH 288 and FM 523 would result in a 50 percent increase in suspended solids, hydrocarbons, oxygen-demanding substances, and heavy metals to the watersheds. Regardless, all four Viable Highway Alternatives will have some impact on water quality without mitigating measures.

Hazardous Materials

Hazardous materials located in or near proposed right-of-way could be an issue if it is determined that the site may pose a potential threat (adjacent to the right-of-way) or imminent threat (within the proposed right-of-way) to soil and groundwater that would be disturbed by construction activities. Many hazardous materials sites are along the SH 288 corridor from US 59 south to SH 6; however, based on distances of at least 250 feet from the median of SH 288, these sites are not anticipated to affect proposed lane additions for any of the four Viable Highway Alternatives. The widening of FM 523 would potentially disturb soil and groundwater affected by two TCEQ LUST facilities, one TCEQ SWF facility, one TCEQ VCP facility, and one EPA RCRA TSD facility. In total, Alternatives A through D would potentially be affected by less than 10 potential hazardous materials sites and no imminent hazardous materials sites.

Summary

All four Viable Alternatives will impact the social and environmental fabric of the SH 288 to a limited and largely similar extent. The proposed improvements to FM 523, CR 92 (Broadway), and Park and Ride lots are the primary cause of disruptions. As exhibited in **Table 5-14**, the result is an "unfavorable" rating for each in regards to environmental impacts, compared to a "neutral" rating for the No Build scenario.

Table 5-14
Environmental Ratings for Viable Alternatives

Alternatives	MEASURE OF EFFECTIVENESS								
	Land Acquisition	Noise Impacts	Social/Economic	Air Quality	Vegetation/ Wildlife Habitat	Wetlands	Water Quality	Hazardous Material	Overall Ranking
No Build	⦿	○○	⦿	⦿	⦿	⦿	⦿	⦿	⦿
A. SOV/HOV	○	○○	⦿	⦿	○	○	○	○	○
B. HOV	○	○○	⦿	⦿	○	○	○	○	○
C. Managed	○	○○	⦿	⦿	○	○	○	○	○
D. Express Toll	○	○○	⦿	⦿	○	○	○	○	○

●● - Most Favorable, ● - Favorable, ⦿ - Neutral,
○ - Unfavorable, ○○ - Most Unfavorable

Engineering and Costs

Each of the four Viable Highway Alternatives requires changes to the SH 288 corridor that will require engineering and design, construction and funding. However, the amount and type of design and construction is different for each alternative, particularly in comparison between the concepts of "free" versus "restricted" lanes.

Regardless of the scenario selected as the Most Feasible Alternative, several corridor issues affect the potential for improvements on SH 288 and will likely present design challenges:

- A detailed drainage study is recommended to determine improvements needed along SH 288 and resolve drainage problems in the area between US 59 and IH 610.
- Bridges may have to be brought to standards currently used by TxDOT. Bridge reconstruction should be considered if the vertical clearance is less than 15 feet, the vertical and/or horizontal alignment of the bridge does not meet a design speed of 70 mph, or age warrants replacement.
- To improve access to the Texas Medical Center from SH 288, MacGregor and Holcombe should be connected and the ramping scheme on SH 288 in the area should be reevaluated.
- Between West Bellfort and Reed Road, substandard ramp geometry in both the southbound and northbound directions should be examined and addressed. The short distance between Bellfort and Reed Road may require elimination of one ramp in each direction to resolve any issues.

Six "measures of effectiveness" including right-of-way, constructability, cost, safety, utilities, and drainage assist in determining a Most Feasible Alternative, particularly in relationship to Engineering and Cost. **Table 5-15**, provides a synopsis of considerations taken in evaluating the engineering and cost elements for each of the four Viable Highway Alternatives.

Table 5-15
Engineering Rating Definitions

Measure of Effectiveness	RATINGS *		
	Most Favorable	Neutral	Most Unfavorable
Right-of-Way	No or minimal right-of-way required	Moderate right-of-way required majority on undeveloped land	Significant right-of-way required, majority on developed land
Constructability	Low construction duration, complexity, and disposable construction costs	Moderate construction duration, complexity and disposable construction costs	High construction duration, complexity, and disposable construction costs
Costs	Low Net Cost (less than $390 Million)	Moderate Net Cost ($562 to 735 Million)	High Net Cost (greater than $907 Million)
Safety	Design standards met, number of at-grade intersections reduced, emergency evacuation route improved, provides alternative route for hazardous cargo	Design standards met for most of the alignment, number of at-grade intersections remained the same, emergency evacuation route not improved, does not provide alternative route for hazardous cargo	Design standards not met for most of the alignment, number of at-grade intersections increased, emergency evacuation route not improved, does not provide alternative route for hazardous cargo
Utilities	Minimal impacts to existing utilities	Moderate impacts to existing utilities	Significant impacts to existing utilities
Drainage	Conveyance system upgraded, addressed drainage issues for emergency evacuation scenario	Some improvements to conveyance system & addressed some drainage issues for emergency evacuation scenario	Conveyance system not upgraded, didn't address drainage issues for emergency evacuation scenario

Note: Definitions for "Favorable" and "Unfavorable" are not specifically described here, but are used when an alternative's rating falls between those shown above.

Right-of-Way

In general, the SH 288 corridor has sufficient right-of-way to accommodate the proposed capacity improvements. Right-of-way acquisition is required for Park and Ride or Park and Pool lots, the widening of FM 523, and the widening and extension of CR 92 (Broadway). Additional right-of-way needs may be identified during schematic design in order to accommodate ramp configuration revisions and the connections of cross streets. Alternatives A (SOV/HOV Lanes), B (HOV Lanes), C (Managed Lanes), and D (Express Toll) require right-of-way that is concentrated in small areas in comparison to the overall length of the SH 288 corridor. **Table 5-16** provides a summary of the new right-of-way needed for the Viable Alternatives.

Table 5-16
Right-of-Way Requirements for Viable Alternatives

Alternative	Right-of-Way	Quantity	Total
No Build	None	0	**0 Acres**
A, B, C	FM 523	58	**100.7 Acres**
	CR 92	31.2	
	Park & Ride Lots	11.5	
D	FM 523	58	**92.0 Acres**
	CR 92	31.2	
	Park & Pool Lots	2.8	

Alternatives A (SOV/HOV Lanes), B (HOV Lanes), C (Managed Lanes), and D (Express Toll) were rated as favorable because they require some right-of-way for roadway improvements and Park and Ride or Pool lots, most of which are on rural or undeveloped land. The amount of right-of-way required for the Viable Highway Alternatives is relatively small considering the number of proposed improvements over the 58-mile corridor length.

Constructability

The term "constructability" is a combination of three factors: complexity of construction, duration of construction, and the cost of temporary detour pavement. Complexity of construction represents the degree of difficulty in constructing the proposed improvements. Considerations include the number of

lanes proposed, the number of bridges removed and constructed, and the amount of construction "phasing" involved.

The second factor, duration of construction, is an estimation of the number of months necessary to construct each segment. Duration of construction assumes that projects exceeding $55 million in construction increased by one month for every $3 million increment increase in construction cost.

The third factor, cost of temporary detour pavement includes the cost of providing temporary pavement during construction, as well as pavement needed during reconstruction efforts along the SH 288 corridor -based on the assumption was made that the existing pavement would be replaced within the next 20 years, and therefore should be included in the analysis for all the alternatives. Temporary detour pavement is disposed of upon completion of construction, adding no value to the capital improvement.

Table 5-17 presents the overall constructability cost for each alternative and demonstrates how the construction phasing cost and temporary detour pavement cost are combined to produce the overall constructability cost. To provide added information, the corridor is divided into four segments:

- Segment I: US 59 to IH 610;
- Segment II: IH 610 to Harris County Line;
- Segment III: Harris County Line to SH 6; and,
- Segment IV: SH 6 to SH 36.

Costs

Costs consist of three components which provide an approximation of the net agency cost for each alternative: capital costs, operations and maintenance (O&M) costs, and toll revenue. The purpose of evaluating costs is to be able to compare the order of magnitude of costs for each alternative. The alternatives are similar to each other, differing primarily in the type of lanes that are being added, which then affects other design aspects. An Opinion of Probable Construction Costs (OPCC) was developed in order to approximate the capital costs for constructing each alternative. Capital costs include construction and right-of-way acquisition.

Table 5-17
Overall Constructability Costs for Viable Alternatives

Alternative	Segment	Complexity of Construction		Duration of Construction *(in months)*	Construction Phasing Cost *(complexity x months)*	Temporary Detour Pavement Cost *(rounded to the nearest 1,000)*	Overall Constructability Cost
No Build	I	Mod.	$6,000	32	$192,000		
	II	Low/Mod.	$4,000	35	$140,000		
	III	Low/Mod.	$4,000	35	$140,000		
	IV	Low	$2,000	71	$142,000		
	Total		***$16,000***	***173***	***$614,000***	***$31,323,000***	***$31,947,000***
Alternative A	I	High	$10,000	65	$650,000		
	II	Mod.	$6,000	73	$432,000		
	III	Mod.	$6,000	59	$354,000		
	IV	Low/Mod.	$4,000	134	$536,000		
	Total		***$26,000***	***331***	***$1,972,000***	***$19,422,000***	***$21,400,000***
Alternative B	I	Mod./High	$8,000	61	$488,000		
	II	Mod.	$6,000	75	$450,000		
	III	Mod.	$6,000	59	$354,000		
	IV	Low/Mod.	$4,000	134	$536,000		
	Total		***$24,000***	***329***	***$1,828,000***	***$19,422,000***	***$21,250,000***
Alternative C	I	Mod./High	$8,000	64	$512,000		
	II	Mod.	$6,000	82	$492,000		
	III	Mod.	$6,000	68	$408,000		
	IV	Low/Mod.	$4,000	134	$536,000		
	Total		***$24,000***	***348***	***$1,948,000***	***$19,422,000***	***$21,370,000***
Alternative D	I	Mod./High	$8,000	64	$512,000		
	II	Mod.	$6,000	81	$486,000		
	III	Mod.	$6,000	63	$378,000		
	IV	Low/Mod.	$4,000	131	$524,000		
	Total		***$24,000***	***339***	***$1,900,000***	***$19,422,000***	***$21,322,000***

Operations and maintenance (O&M) costs include the continued annual expenditures required by agencies to operate and maintain the roadway facility. Generally speaking, the cost of O&M per lane mile is similar for the No Build Alternative and the SOV lanes in all of the build alternatives. The operations cost per lane mile for HOV lanes takes into account that HOV lanes require police enforcement, wrecker services, engineering support, materials, and other services. Maintenance cost for HOV lanes is approximately 1.5 times higher than the average for SOV lanes because of the additional buffers, shoulders, and barriers that may be associated with these types of lanes. Managed lane operations cost is higher than the Express Toll lane because managed lanes require additional police and camera enforcement to determine the number of riders in the vehicle as well as additional administrative support associated with high occupancy vehicles. The cost for HOV users is higher due to the additional mechanism needed to allow registered and non-registered HOV users to use the managed lanes without being tolled or incorrectly identified as a violator. The revenue generated from tolls in Alternatives C (Managed Lanes) and D (Express Toll) can be used to assist agencies in paying for construction bonds or paying annual O&M costs.

Net cost includes the present value of each alternative's cash outflows (capital and O&M costs) minus cash inflows (toll revenues). **Table 5-18** indicates that Alternative D provides the best overall net cost among the four Viable Highway Alternatives, primarily due to the revenue generated by the express toll lanes. Alternative C (Managed Lanes) was anticipated to include the largest cash outflow; however, Alternative B (HOV Lanes) had the highest net cost as a result of offering no toll mechanism to raise revenue.

Table 5-18
Net Cost Summary for Viable Alternatives

Alternative	Capital Construction Cost	30-year O&M Cost	30 year Toll Revenue	Net Cost
No Build	$232,143,563	$71,826,469	$0	**$303,970,032**
A	$692,610,567	$246,263,215	$0	**$938,873,782**
B	$690,505,438	$302,807,401	$0	**$993,312,839**
C	$745,174,229	$362,201,600	$197,061,635	**$910,314,194**
D	$716,643,455	$294,921,369	$390,523,168	**$621,041,657**

Safety

Along the SH 288 corridor, safety has several meanings. Certainly, removing opportunities for accidents is critical so consideration is given to issues such as roadway design speed (70 mph) and reduction of at-grade intersections. However, since SH 288 is an evacuation route for an incident such as hurricanes, safety also includes ensuring sufficient roadway capacity to move people from the coastal region when needed. Finally, safety means making alternative arrangements for traffic carrying hazardous materials so that the risk to developed areas is minimized.

Each of the four highway alternatives improves safety along the SH 288 corridor, including recommendations to:

- Incorporate TSM/TDM/ITS improvements such as re-striping, signal modifications, adding auxiliary lanes, upgrading shoulder widths, and adding turn lanes which improve safety in the corridor;
- Evaluate the existing SH 288 highway facility using a 70 mph design speed from US 59 to Main Street in Clute;
- Reconstruct bridges with a vertical clearance of less than 15 feet, or those in which the vertical and/or horizontal alignment of the bridge did not meet a design speed of 70 mph.
- Construct median closures or new overpasses to replace existing at-grade intersections on SH 288 for full control of access;
- Improve emergency evacuation by including two additional lanes in each direction from SH 6 to US 59; and,
- Widen FM 523 to provide an alternate route for trucks and hazardous cargo outside of developed areas of Angleton, Lake Jackson, and Clute.

Constraints such as existing developments and existing cross-streets may impact the ability to correct some design deficiencies. Regardless, improvements in all cases were sufficient to be considered favorable to existing conditions and the No Build scenario.

Utilities

Each of the four Viable Highway Alternatives will likely conflict, to a limited extent, with the location of existing petrochemical pipelines and overhead utility

lines. Existing utilities crossing SH 288 have been identified and are currently deep enough to accommodate construction of proposed added lanes in the SH 288 median. Proposed Park and Ride lots are small enough in area that they can be repositioned in order to avoid major utility conflicts. However, enhancements to FM 523 will require relocation of numerous petrochemical pipelines. Both proposed improvements along FM 521 (Almeda Road) and CR 92/Broadway require additional right-of-way to widen and extend these roadways, which increases the possibility of additional major utility impacts.

Drainage

Similar to discussion of utilities, the impact of the four Viable Highway Alternatives upon the drainage system is similar and proposed to resolve a number of current issues. Each alternative proposes upgrading the drainage system to accommodate reconstruction of the existing lanes and construction of new lanes include the stormwater collection and conveyance system, floodplain mitigation, stormwater detention facilities, and stormwater quality treatment facilities. Pump stations and detention facilities are likely needed for the depressed sections of SH 288 north of IH 610, as well as new or improved ditch systems along the remainder of the corridor to SH 36. Further steps are recommended, if necessary, to eliminate flooding issues during high intensity rain events.

Table 5-19
Engineering Ratings for Viable Alternatives

Alternatives	MEASURE OF EFFECTIVENESS						
	Right-of-Way	Constructability	Costs	Safety	Utilities	Drainage	Overall Ranking
No Build	●●	○	●●	○○	●●	○○	⦿
A. SOV/HOV	●	⦿	○○	●	⦿	●	⦿
B. HOV	●	⦿	○○	●	⦿	●	⦿
C. Managed	●	⦿	○○	●	⦿	●	⦿
D. Express Toll	●	⦿	⦿	●	⦿	●	●

●● - Most Favorable, ● - Favorable, ⦿ - Neutral,
○ - Unfavorable, ○○ - Most Unfavorable

Summary

As indicated in **Table 5-19**, Alternative D (Express Toll) was considered slightly superior to the other Viable Alternatives with a "favorable" rating, largely due to its reduced overall cost when considering the

substantial revenues generated by the toll lanes. The other alternatives received a "neutral" rating.

Rail Alternatives

Two rail alternatives – light rail transit and commuter rail transit - offer the opportunity to compliment corridor highway improvements. While rail offers a number of benefits, initial screening indicated that neither rail option could stand alone as a Viable Alternative. After evaluating potential alignments for the Light Rail Alternative, it was determined that the light rail line, like the Commuter Rail Alternative, would be most appropriate along FM 521 (Almeda Road). Although this location would result in several at grade intersections, the alignment offers:

- an existing UP railroad track along this corridor;
- sufficient right-of-way already available;
- closer proximity to proposed residential developments; and,
- no significant socioeconomic issues.

Both light rail and commuter rail would run from the existing Fannin South METRORail station to FM 521 (Almeda Road), continue in a southerly direction along the FM 521 corridor and terminate at SH 6, a distance of nearly 12 miles. The commuter rail alternative required an extension of METRORail from the Fannin South station to a commuter rail transfer station approximately one mile to the south at intersection of FM 521 and Reed Road. Both rail modes would take advantage of the existing Union Pacific (UP) rail right-of-way along FM 521 (Almeda Road) between Reed Road and SH 6.

There is a potential for either of these rail lines to generate "transit-oriented development" (TOD) surrounding one or more of their stations. TOD's typically develop around stations where a high ridership currently exists, predominantly in an urban/suburban area. Some TODs are established in undeveloped areas and generate much of the transit ridership. Examples of TOD development include service businesses (i.e. dry cleaning, shoe repair) as well as amenities such as restaurants and convenience stores that cater to transit users. TODs are most successful when residential development emerges near stations, attracting both ridership and commercial investment.

Ridership

As shown in **Figure 5-13**, projected daily ridership on the light rail from US 59 to SH 6 is approximately 9,300 passengers as compared to 4,900 passengers for the commuter rail. Peak period ridership for the light rail is projected at 5,600 passengers and commuter rail peak period ridership is projected to be 3,900 passengers.

Extending commuter rail further south to FM 1462 and into Downtown Houston would significantly increase the ridership. A preliminary analysis was performed and projections are anticipated to increase readership by approximately 2,570 passengers per day for a total of approximately 7,500.

Figure 5-13
Year 2025 Daily and Peak Period Ridership

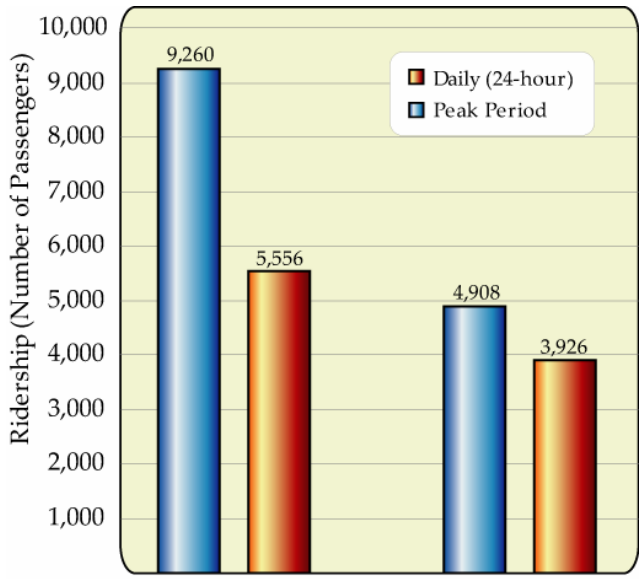
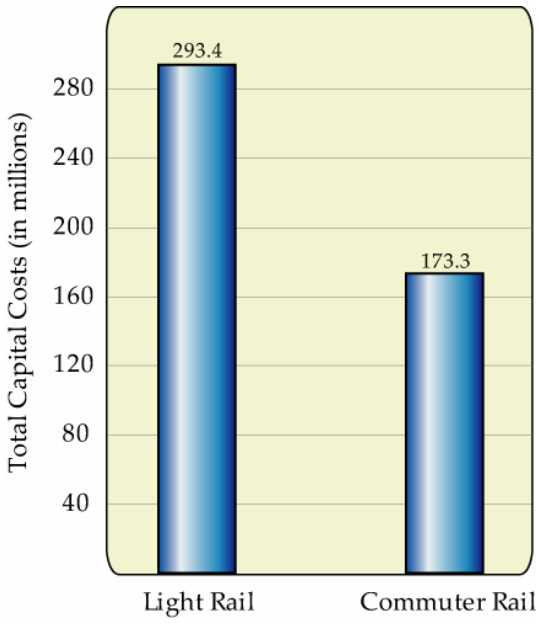


Figure 5-14
Total Capital Costs for Rail Alternatives



Costs

As shown in **Figure 5-14**, capital costs vary for both light rail and commuter rail as a result of the changes in ridership, different travel lengths, and, in commuter rail's case, with the assumption of different rolling stock. Light rail is expected to produce costs for new riders at $17 per rider while commuter rail will cost $19 per rider. Still, on a capital cost-per-mile basis, commuter rail is less expensive to implement, as there are no electrical systems or separate double tracks are

required. While the commuter rail alternative would require rebuilding of the existing freight track and adding a new commuter track, commuter rail can share track with UP trains, a capability that eliminates the need for double track exclusively for commuter rail use.

Environmental/Land Use Impacts

The light rail alternative would add one rail line and improve the existing rail line parallel to FM 521 (Almeda Road) from the Fannin Street Station south to SH 6. This alternative would affect wetlands at crossings over Sims Bayou, Clear Creek, and Mustang Bayou of less than one-tenth of an acre each.

Both rail alternatives have the potential to impact fifteen potential hazardous materials sites along the existing rail right-of-way. The potential sites identified include TCEQ LUST facilities, TCEQ Industrial Hazardous Waste facilities, TCEQ VCP facilities, EPA RCRA Treatment Storage and Disposal facilities, EPA RCRA Large Quantity Generator Industrial facilities, and EPA CERCLIS No Further Remedial Action Planned facilities. In addition, two unmapped EPA Emergency Response Notification System facilities are on the existing railroad corridor and one RCRA TSD facility, which includes a pipeline that distributes hazardous materials to a railroad tanker fill port located above the rail line. These facilities are imminent hazardous materials sites. The light rail alternative would be affected by more than ten potential hazardous materials sites and three imminent hazardous materials sites. This alternative would not cause displacements or impacts to noise, social and economic conditions, air quality, vegetation, wildlife habitat or water quality.

The commuter rail alternative would also expand MetroRail Fannin South Station northeast of Holmes Road along Fannin Street, and add proposed stations at the southwest quadrant of FM 2234 (McHard Road) and FM 521 (Almeda Road), and the northwest quadrant of SH 6 and FM 521 (Almeda Road). The displacements and impacts for commuter rail are the same as those discussed previously for light rail.

Summary

These preliminary findings indicate significant ridership for both the commuter and light rail alternatives in the SH 288 corridor. Depending on the scenario, ridership would be in a range between approximately 4,900 and 9,300 passenger trips per weekday. At this point, it is difficult to determine which rail alternative would be best for the corridor. That really depends on two factors. One is future development in the corridor. For example, if housing and commercial development occurs faster than expected south of SH 6, then a commuter rail alternative extending to FM 1462 would likely become more attractive than this analysis determined. The other factor will be the implementation and success of other regional rail initiatives and improvements by Metro and other agencies. For example, if commuter rail is implemented in corridors to the north and northwest of Downtown Houston, there may be ridership and operational advantages to be gained in linking these lines with a future US 90A commuter line and a future FM 521 (Almeda Road) commuter line through Downtown Houston.

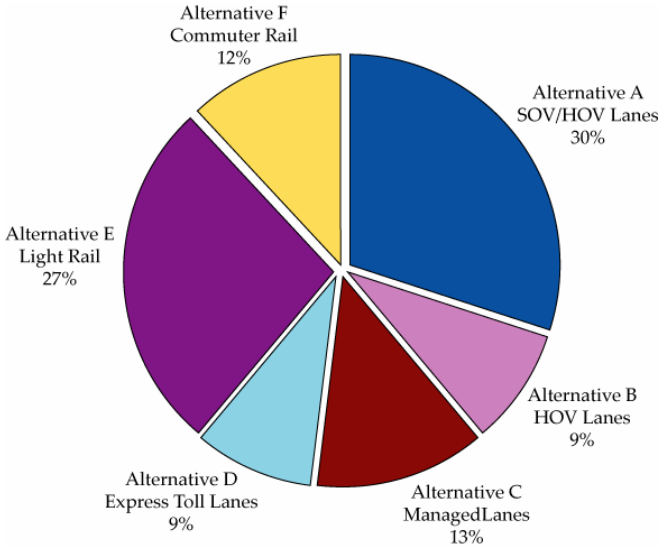
It is clear that rail could efficiently serve thousands of people a day in the future, and for that reason the appropriate transportation authorities should take steps to preserve the FM 521 (Almeda) corridor for future high capacity transit service. The final selection and implementation schedule of the most appropriate and feasible form of high capacity transit such as commuter or light rail should be determined as part of future regional transportation planning activities and the actual system of passenger rail improvements that will ultimately be constructed throughout the Houston-Galveston metropolitan area.

Public Acceptance

The public involvement process for the SH 288 Corridor Feasibility Study was discussed in *Chapter 2, Public Involvement* as a critical component of gathering information and making informed decisions. As mentioned, public involvement included three series of public meetings, three Steering Committee meetings, three project newsletters, a total of 15 meetings with area stakeholders along the corridor, and a project website.

During the second series of public meetings, held May 4-6, 2004 in Lake Jackson, Pearland, and Houston, a total of 155 people were presented the results of the initial evaluation and asked to provide input on the proposed Viable Alternatives. The indicated Viable Alternative preferences are shown in **Figure 5-15**.

Figure 5-15
Public Preference of Viable Alternatives



Based on comments received, the public was open to all modes of transportation including SOV/HOV lanes, light rail, commuter rail, and managed lanes. Other suggestions included the significant need for transportation improvements along SH 288 from US 59 to SH 6. Specific locations identified as needing improvements along SH 288 included FM 518, Beltway 8, and IH 610.

Based on public comments on the Viable Highway Alternatives, Alternative A (SOV/HOV Lanes) received a "most favorable" rating, followed by Alternative C with a "favorable" rating. Both the rail alternatives received strong public support. The No Build scenario was considered most unfavorable.

Summary of Detailed Evaluation Results

The results of the detailed evaluation of Viable Alternatives by major category and overall are presented in **Table 5-20.** The detailed evaluation ranking does not give any of the criteria a higher "weight" (i.e. all criteria have the same importance). As shown, Alternatives A (SOV/HOV Lanes) and C (Managed Lanes) rated "favorable" compared to the "neutral" rating for the remaining alternatives.

Table 5-20
Summary of Detailed Evaluation

Alternatives	Traffic/Mobility	Economics	Social/ Environmental	Engineering/ Costs	Public Acceptance	Overall
No Build	○○	○○	◉	◉	○○	○
A. SOV/HOV	●	●	○	◉	●●	●
B. HOV	●	●	○	◉	◉	◉
C. Managed	●	●●	○	◉	●	●
D. Express Toll	●	●●	○	●	◉	◉

●● - Most Favorable, ● - Favorable, ◉ - Neutral,
○ - Unfavorable, ○○ - Most Unfavorable