Final MIS Report

January 2003

Texas Department of Transportation
Houston District

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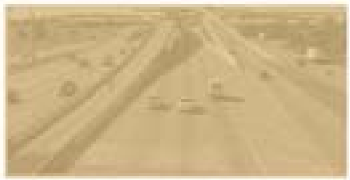
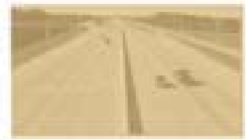
Prepared by:

Kimley-Horn
and Associates, Inc.

In Association with:

Knudson & Associates, Inc. *and* Hicks & Company





TxDOT Houston US 290 Corridor Major Investment Study

Lead Agency: Texas Department of Transportation (TxDOT)
Houston District

Project Manager: Roger M. Gonzalez
Consultant Contracts Department

Steering and Advisory Committees:
TxDOT - Houston
Houston-Galveston Area Council (H-GAC)
Metropolitan Transit Authority (METRO)
City of Houston
Harris County
Federal Transit Administration (FTA)
Federal Highway Administration (FHWA)
Texas Commission on Environmental Quality
(Formerly TNRCC)
Corps of Engineers

Consultant Team: Kimley-Horn and Associates, Inc.
with
Hicks & Company
Knudson & Associates

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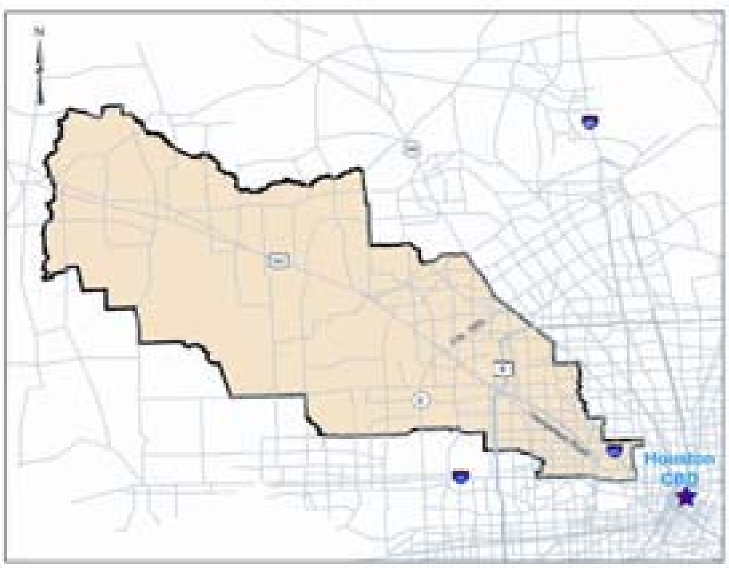
INTRODUCTION

The attached report represents the culmination of an intensive process called a Major Investment Study (MIS). An MIS is commissioned in order to study a federally funded highway or transit improvement of substantial cost that is expected to have a significant impact on capacity, traffic flow, level of service, or mode sharing within a transportation corridor.

In the case of the US 290 Corridor, the MIS was deemed necessary due to the exploding rates of growth in the Houston region. The City of Houston is the fourth largest metropolitan area in the United States and the largest in Texas; with growth-rate predictions at approximately 41% between the years 2000 and 2025 come traffic congestion and transportation-related problems. The regional transportation network will be unable to provide an acceptable level of service on many travel corridors in the study area. In particular, the US 290 Corridor has experienced considerable growth; with the current corridor population at 412,000 and a projected 2025 population of 708,000, this corridor is facing serious transportation issues. The study corridor (which includes Hempstead Highway) is of varying width and is approximately 38 miles long, extending from the interchange area of IH 10 / IH 610 / US 290 northwest to the community of Waller, Texas, at Farm-to-Market 2920.



The study team for the US 290 MIS began work in 1999 and includes the Texas Department of Transportation-Houston District (TxDOT); Kimley-Horn and Associates, Inc.; Knudson & Associates; and Hicks & Company. TxDOT served as the lead agency and was responsible for initiating the MIS and establishing the MIS Steering and Advisory Committees that were responsible for guiding the development of the study. The Steering and Advisory Committees were made up of representatives from various federal, state, and local agencies, as well as elected officials. Kimley-Horn was the prime consultant for the project, responsible for the technical issues and analysis of various transportation alternatives, ultimately arriving at the locally preferred alternative. This process is described in greater detail below. Knudson & Associates led the public involvement effort throughout the project, and Hicks & Company identified and evaluated social, economic, and environmental impacts along the corridor.

The team's objectives and goals were to evaluate alternatives for improvements within the study corridor and to recommend a locally preferred alternative best suited to meet the corridor's transportation needs, while minimizing impacts to the surrounding environment. As a result of an extensive public involvement program and an evaluation of current and projected deficiencies within the corridor, the study team arrived at the following six corridor-specific goals:

- Improve public safety
- Improve and maintain mobility
- Increase opportunities for transit
- Avoid or minimize adverse social, economic, and environmental effects
- Contribute to air quality attainment
- Maximize use of existing right-of-way

These goals, along with incorporated regional goals from the Houston-Galveston Area Council's (H-GAC) *2022 Metropolitan Transportation Plan*, were the driving force behind the evaluation and screening processes that eventually yielded a locally preferred alternative.

In order to fully understand what an MIS is and what it aims to accomplish, one must understand the various components that come into play. These include the following:

- Knowing existing conditions
- Keeping the public involved
- Identifying a full range of alternatives
- Evaluating and screening the alternatives
- Recommending the locally preferred alternative

The following sections give a broad-brushed view of the components above and the various processes involved in the development of the US 290 MIS through the selection of the locally preferred alternative.

EXISTING CONDITIONS

Existing conditions in the US 290 Corridor are comprised of traffic characteristics (with an accompanying analysis) and corridor influences. The former are further broken down into functional classifications (freeways, major thoroughfares, major collectors, local streets, etc.), typical sections, rights-of-way, horizontal and vertical alignments, drainage, interchanges, intersections and traffic signals, lighting, utilities, railroads, transit and high-occupancy-vehicle (HOV) facilities (both operated by the Metropolitan Transit Authority [METRO] of Harris County, Texas), and ITS (intelligent transportation systems).

All of these components were studied and reported upon in the *Existing Conditions Report*, published in June 2001. The following is a summarization of the study area's existing conditions.

Currently, the corridor contains each functional classification, varied right-of-way, and generally slight changes in horizontal / vertical alignments. Interchange types in the corridor include diamond, full directional, and trumpet. There are 37 signalized intersections in the corridor: 20 along US 290, and 17 along Hempstead Highway (which is also referred to as Hempstead Road in certain locations within the study area). Roadway lighting generally consists of high-mast, pressurized sodium or mercury vapor fixtures along US 290. Along Hempstead Highway, lighting generally consists of standard mast-arm fixtures mounted on utility poles and is located predominantly on the north side of the roadway. Utilities within the study area include municipal sewer / water lines, underground electrical and gas lines, buried fiber-optic cable, and overhead electrical lines. Union Pacific Railroad owns, operates, and maintains the rail line in the corridor, which generally parallels Hempstead Highway and US 290. METRO facilities include bus routes, paratransit services, vanpool / carpool programs, transit centers, and park-and-ride lots. METRO also operates an HOV facility, located in the center of US 290. The study area also houses several ITS components, including a computerized transportation management system and an automated vehicle identification system, and is served by Houston TranStar.

An analysis of existing traffic conditions takes into account the levels of service identified along the corridor. Levels of service (LOS) are defined as "A" through "F," with A being least congested and F being the most. An acceptable level of service for the US 290 Corridor is D, which is defined as not congested.

Levels of service currently range in the corridor, varying by location. In some areas, where urbanization is not yet prevalent, the freeway generally operates at level of service C. Traffic levels increase toward downtown Houston. In these areas, the overall level of service is typically E (bordering on F) and, in some cases, reaches F (most congested). Those parts of the corridor that do not currently meet LOS D standards experience congestion that causes delay and contributes to air pollution. In addition to inadequate levels of service, there are substandard shoulders and auxiliary lanes that can have a negative impact on the safety and operations of the corridor.

Corridor influences are another component of the existing conditions within the corridor. For purposes of this study, the corridor influences evaluated include land use and socioeconomics / demographics.

MIS PROCESS

The MIS process implemented for the US 290 Corridor provided a focused analysis and extensive evaluation of mobility needs, identified a set of multimodal options to address problems and needs throughout the corridor, developed measures of benefits, established costs and impacts, and allowed for a comprehensive analysis and evaluation of the selected options. The process used for the US 290 Corridor MIS is shown at left.

The process for the US 290 MIS involved an extensive public involvement campaign throughout. The study team first established a universe of alternatives; this universe comprised all plausible alternatives for the corridor. From the universe of alternatives, conceptual alternatives were developed that included no-build, freeway, managed facility, and transit options. These were then screened in order to arrive at viable alternatives, which are defined as alternatives that are more likely to perform well in light of the study goals and objectives (outlined previously). The viable alternatives were then analyzed in order to determine the locally preferred alternative, which can be defined as the alternative that is most likely to rank high in terms of each goal / objective. The locally preferred alternative (or variation) must be approved and adopted by H-GAC's Transportation Policy Council (TPC).

Public Involvement

The public involvement program for the US 290 MIS was intended to provide information, promote open communication, and gather input regarding corridor needs and transportation preferences. The desired outcome was to achieve consensus on a locally preferred alternative.

Informing and educating the public about the MIS process and the particulars of the US 290 MIS were the first aspects of promoting a cooperative planning process. It was important that citizens felt a part of the MIS, so various tools — many bilingual — were used as part of an outreach program. Newsletters, presentations, a project website, direct mail campaigns, public notices, media coverage, questionnaires designed to garner public opinion, and public meetings all played a role in touching as many project stakeholders as possible. These stakeholders included residents, business owners, employees, commuters, environmental and historic preservation groups, transit riders, trucking and rail representatives, civic and homeowners' associations, community planning groups and city councils, resource agencies, major land owners, and others who are affected by transportation issues in the corridor.

Universe of Alternatives

The approach used in an MIS is to consider many alternatives, evaluating the most promising and selecting the best or most appropriate. This approach is based on understanding the conditions, needs, and goals of the corridor first and foremost. For purposes of the US 290 MIS, a universe of alternatives was established for initial consideration; this included all plausible ideas within the categories of transit, freeway, streets and highway, transportation system management (TSM) strategies, and transportation demand management (TDM) strategies. The following table shows the universe of alternatives used to develop the conceptual alternatives.

Transit		
Rail	**Bus**	**Other**
Light rail	Local service	Personal rapid transit
Commuter rail	Bus rapid transit (BRT)	Carpool / vanpool
Heavy rail	Express with HOV	Park-and-ride
Monorail	Charter or subscription bus service	Transfer facilities
Stations	School buses	
Freeway		
General-purpose lanes	Service roads	Truck lanes
Managed facility	Interchanges	Intelligent transportation systems (ITS)
Express facility	Express lanes	Ramp system modifications
Toll lanes / facility	Non-barrier (Diamond) HOV lanes	Auxiliary lanes
High-occupancy-vehicle lanes (HOV)	Express Hempstead	Dual freeway
Meet current roadway standards		
Streets & Highway		
Arterial network	Signal system (ITS)	Hempstead — 6-lane, 8-lane
Parallel arterial	TSM improvements	Grade separation
Super street		
Transportation System Management (TSM) Strategies		
Arterial widening	Access management	Emergency / special event management
Intersection improvements	Traffic operations and signal system improvements	Intelligent transportation systems (ITS)
Travel Demand Management (TDM) Strategies		
Employee trip reduction programs	Public transportation improvements	Bicycle / pedestrian strategies
Transportation management associations	Traffic restricted zones	Value pricing

Conceptual Alternatives

The universe of alternatives was screened through criteria developed by consensus between the public, the Steering and Advisory Committees, and the study team. Each alternative was screened based on the documented needs and goals of the corridor — improve public safety, improve and maintain mobility, increase opportunities for transit, minimize adverse environmental and social effects, contribute to air quality attainment, and maximize use of existing right-of-way. As a result of this screening, conceptual alternatives in four general categories — no-build, freeway expansion, managed facilities, and transit — were determined. Detailed descriptions of each of the conceptual alternatives can be found in ***Chapter 5*** of the report; however, descriptions of some of the components have been included in this summary.

The baseline (also called no-build) alternative is the description of projected, study-year conditions even if no major transportation improvements are made in the corridor. Typically, the baseline alternative includes all improvements identified in H-GAC's most current *Metropolitan Transportation Plan*, except for those that are proposed in the corridor.

The TSM / TDM alternative incorporates lower-capital components of the region's transportation investment strategy. Both TSM and TDM strategies reduce congestion by implementing strategies on both the supply and demand sides of transportation. Intelligent transportation systems complement and help facilitate both TSM and TDM. Even though TSM / TDM / ITS constitutes its own, standalone conceptual alternative, most of these strategies will be incorporated into the preferred alternative.

A managed facility is a separate facility within the freeway that operates essentially as an expanded, two-way version of the HOV facilities that are in operation today. Managed facilities have limited entry and exit opportunities, serve relatively long trips, and may collect tolls, which could fluctuate by occupancy or levels of congestion.

Advanced high capacity transit (AHCT) is a general term used to address the type of advanced transit system that might be implemented in the corridor. The transit chosen will be high capacity and likely take the form of light rail transit, bus rapid transit, or some yet-undeveloped future transit technology.

The 11 conceptual alternatives (CA) are as follows:

No-build
- CA-1A Baseline (no-build)
- CA-1B TSM / TDM

Freeway expansion
- CA-2A Expand US 290 and extend HOV
- CA-2B Expand US 290 and remove HOV

Managed facilities
- CA-3A Four-lane, two-way, barrier-separated managed facility
- CA-3B Two-lane, reversible HOV, expand US 290
- CA-3C High capacity, partially grade-separated Hempstead Highway

Transit alternatives
- CA-4A Advanced high capacity transit (AHCT) along US 290 and SH 249, expand US 290
- CA-4A-1 AHCT along US 290, expand US 290
- CA-4B AHCT along Hempstead Highway, expand US 290
- CA-4C Express busway, expand US 290

Screening process

Once the conceptual alternatives were established, the project team once again went through a thorough screening process in order to arrive at viable alternatives, which represent the best elements from the conceptual alternatives in regard to those that are most likely to meet the needs of the US 290 Corridor. A system to evaluate and compare the conceptual alternatives was created that ranged from two plus marks (more positive) to two minus marks (more negative). Zero was used to identify those alternatives that had a neutral effect on the defined goals and objectives as compared to the indicated alternative or baseline. Following is a matrix showing a breakdown of the various alternatives and their ratings in regard to the screening criteria:

		No-Build Alternatives		Freeway Alternatives		Managed Facility Alternatives			Transit Alternatives			
		CA-1A	CA-1B	CA-2A	CA-2B	CA-3A	CA-3B	CA-3C	CA-4A	CA-4A-1	CA-4B	CA-4C
	-- More Negative - Negative O Neutral + Positive ++ More Positive	Baseline	TSM/TDM	Expand US 290, Extend HOV	Expand US 290, Remove HOV	Four-Lane, Two-Way, Barrier Separated	Two-Lane, Reversible HOV, Expand US 290	High-Capacity, Partially Grade-Separated Hempstead Rd.	AHCT along US 290 and SH 249	AHCT along US 290	AHCT along Hempstead	Express Busway
Improve Public Safety	Consistency with Design Standards	- -	- -	++	++	++	++	+	++	++	++	++
	Reduce Weaving Volumes	- -	-	+	+	++	+	+	+	+	+	+
	Accident Locations Eliminated	- -	-	+	++	++	+	+	+	+	+	+
Improve Mobility	Congestion	- -	- -	+	-	++	+	++	-	-	-	-
	Person Capacity	- -	-	+	+	++	+	++	O	O	+	+
	User Benefits	O	+	++	- -	++	++	++	-	- -	- -	- -
Increase Transit Opportunities	Transit Ridership	-	-	O	- -	+	+	-	++	++	++	+
	METRO Plan Consistency	-	-	+	-	+	+	+	+	+	+	-
Avoid or Minimize Adverse Social, Economic and Environmental Effects	Social Effects	+	+	-	-	-	-	-	-	-	-	-
	Economic Effects	O	+	-	-	-	-	-	-	-	+	-
	Environmental Effects	++	++	-	-	-	-	-	-	-	-	-
Contribute to Air Quality Attainment	VOC (lbs)	- -	-	O	- -	+	++	-	+	+	+	+
	CO (lbs)	- -	-	O	- -	-	++	+	+	+	-	+
	NOx (lbs)	- -	-	O	- -	+	+	- -	++	++	++	+
Maximize Use of Existing ROW	US 290	O	O	-	-	- -	- -	-	-	-	-	-
	Hempstead/ UP Corridor	O	O	O	O	O	O	++	O	O	++	O

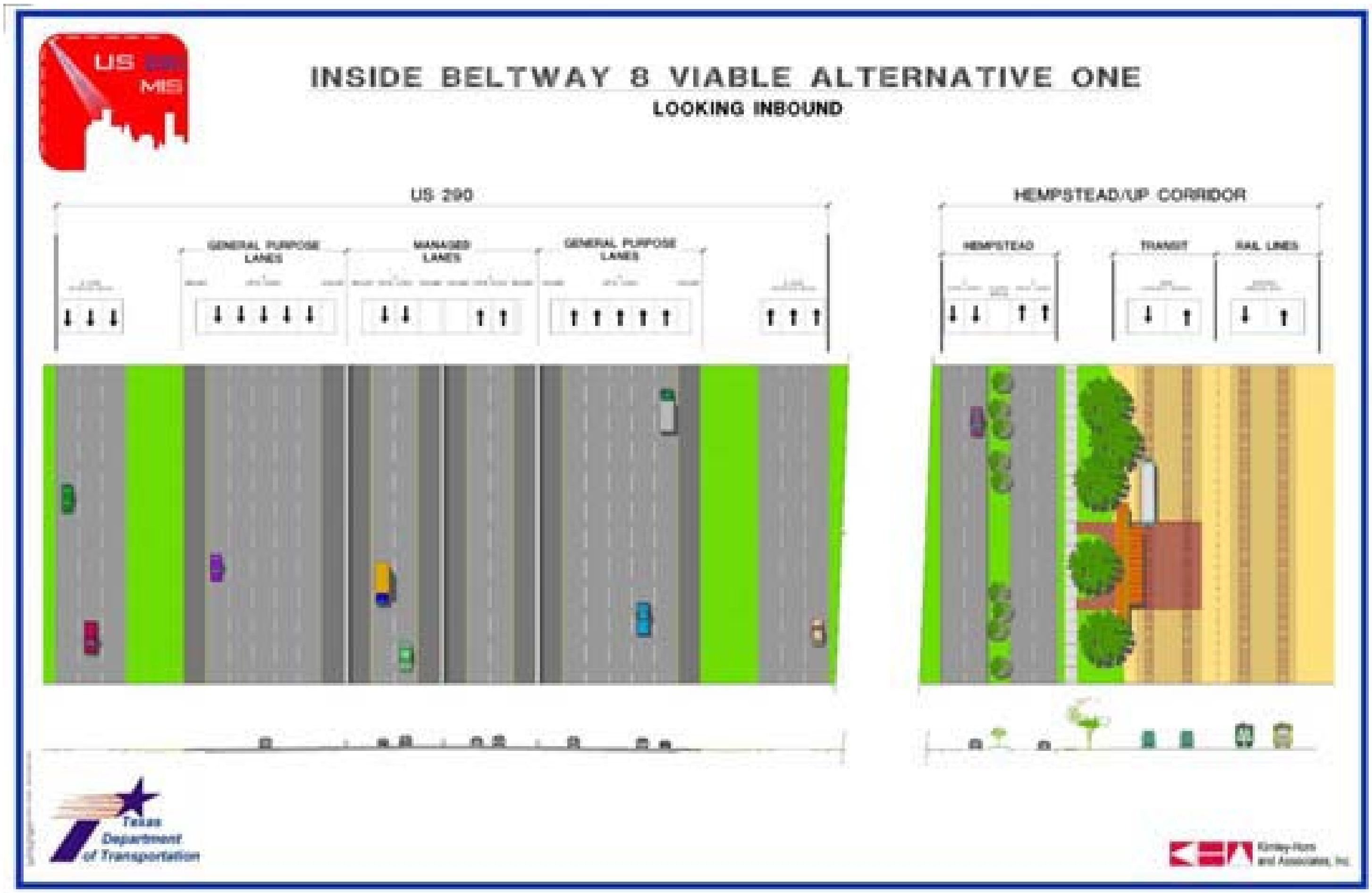
Generally, the findings of the conceptual analysis were as follows: more general-purpose lanes are needed, the HOV lane is being utilized and should not be removed, managed facilities performed well, and AHCT generates additional transit riders.

Viable Alternatives

Six conceptual alternatives or elements from conceptual alternatives were recommended for further screening. Excluding the no-build alternative, the components of these conceptual alternatives were incorporated to produce four viable alternatives that allowed the study team to merge the positive influences that each alternative had on the corridor. The build viable alternatives incorporated general-purpose lanes, managed facilities, and AHCT — **all of which were proven to be necessary components of the locally preferred alternative** through the use of H-GAC's regional travel model, a major tool used in the mobility analyses. The no-build alternative, including the TSM / TDM components, was also considered as a viable alternative.

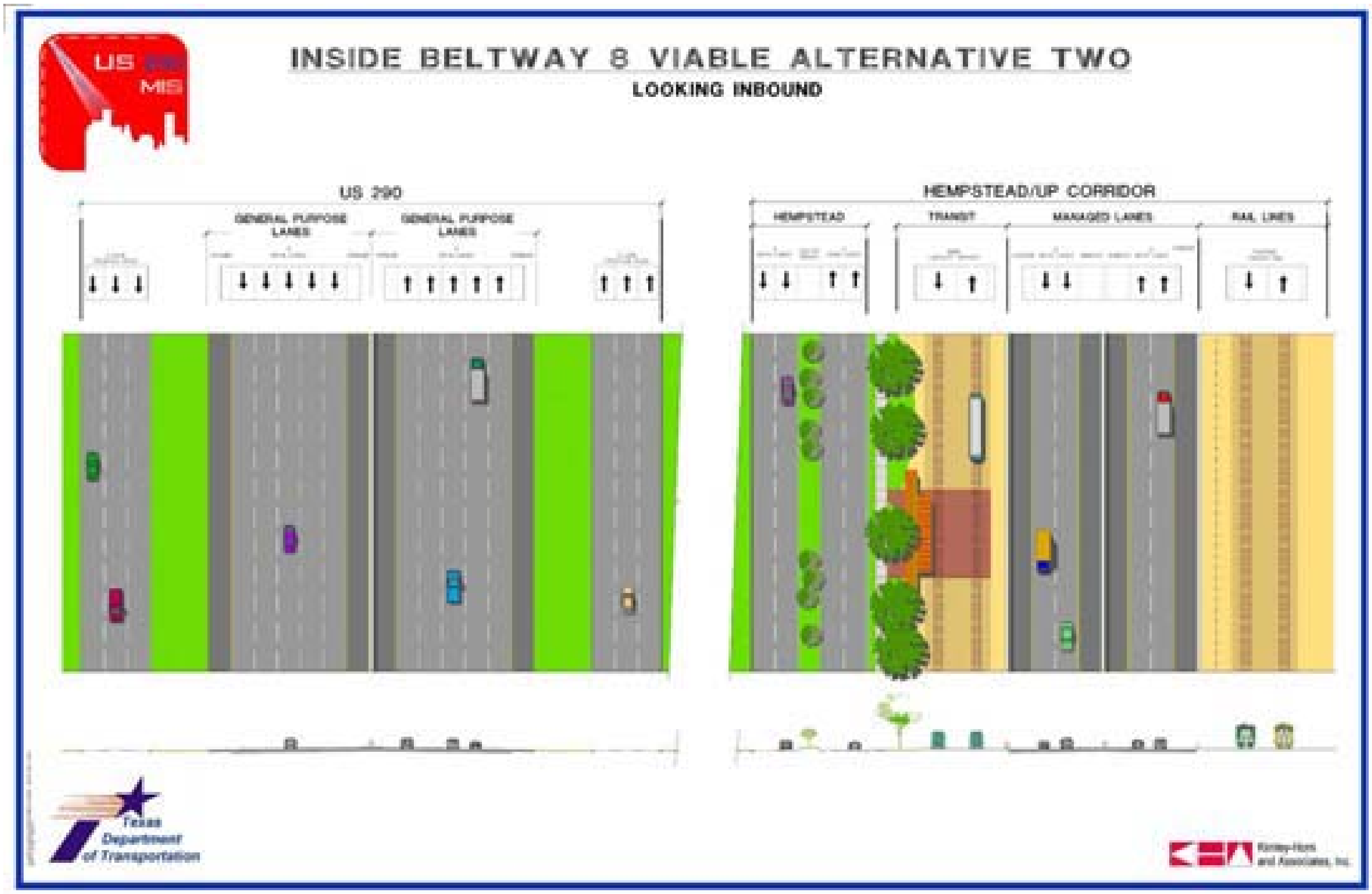
Viable alternative 1 generally involves the following improvements:

- Five general-purpose lanes in each direction from IH 610 to Beltway 8 (excluding auxiliary lanes)
- Four general-purpose lanes in each direction from Beltway 8 to the west study limit (excluding auxiliary lanes)
- Four-lane, two-way managed facility in the middle of US 290 from IH 610 to the future Grand Parkway
- Two general-purpose lanes in each direction along Hempstead Highway
- Advanced high capacity transit envelope along Hempstead Highway Corridor from the Northwest Transit Center to the future Grand Parkway



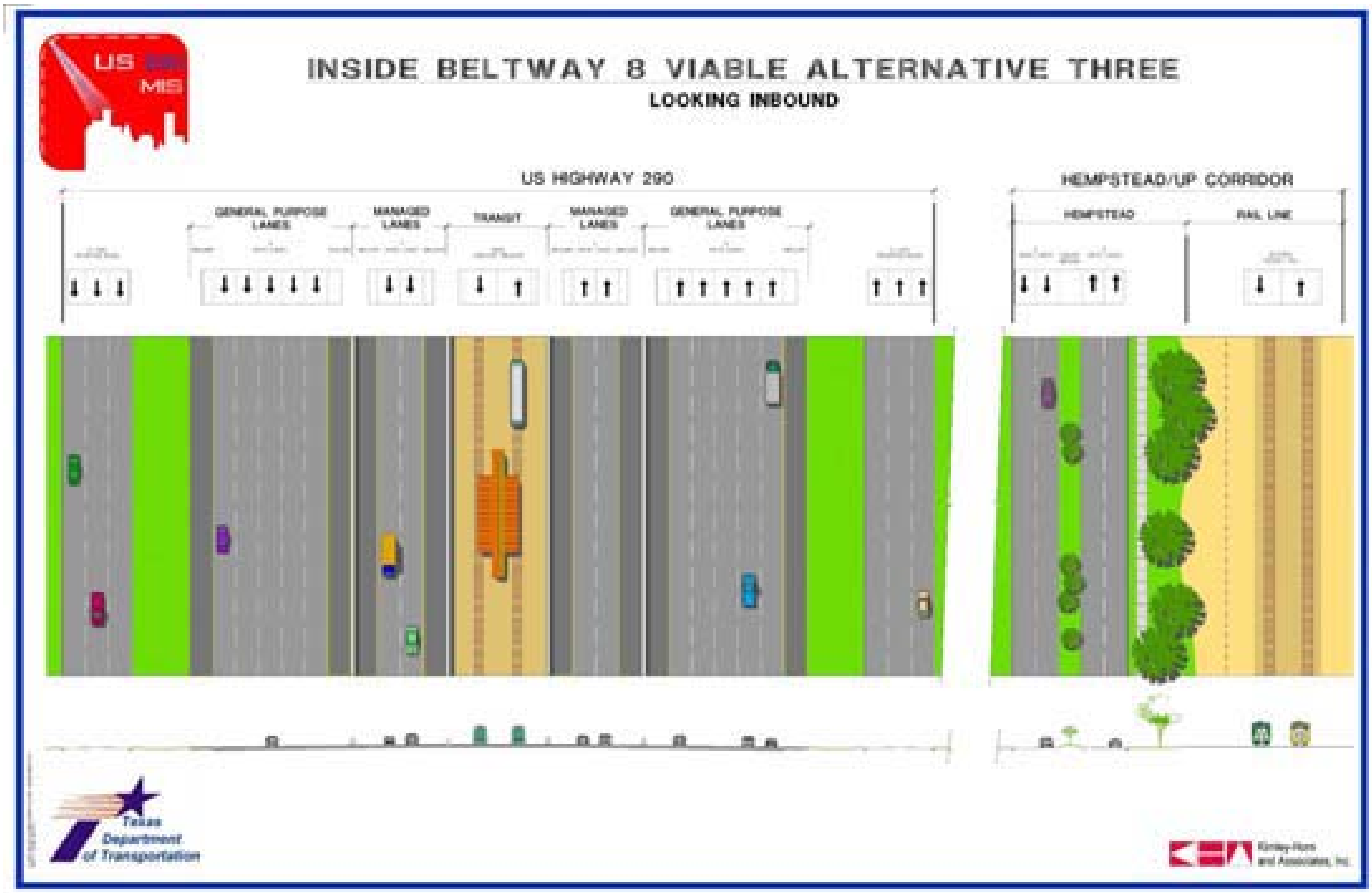
Viable alternative 2 generally involves the following improvements:

- Five general-purpose lanes in each direction from IH 610 to Grand Parkway (excluding auxiliary lanes)
- Four general-purpose lanes in each direction from Grand Parkway to the west study limit (excluding auxiliary lanes)
- Four-lane, two-way managed facility along the Hempstead Highway Corridor from IH 610 to the future Grand Parkway
- Two general-purpose lanes in each direction along Hempstead Highway
- Advanced high capacity transit envelope along Hempstead Highway Corridor from the Northwest Transit Center to the future Grand Parkway



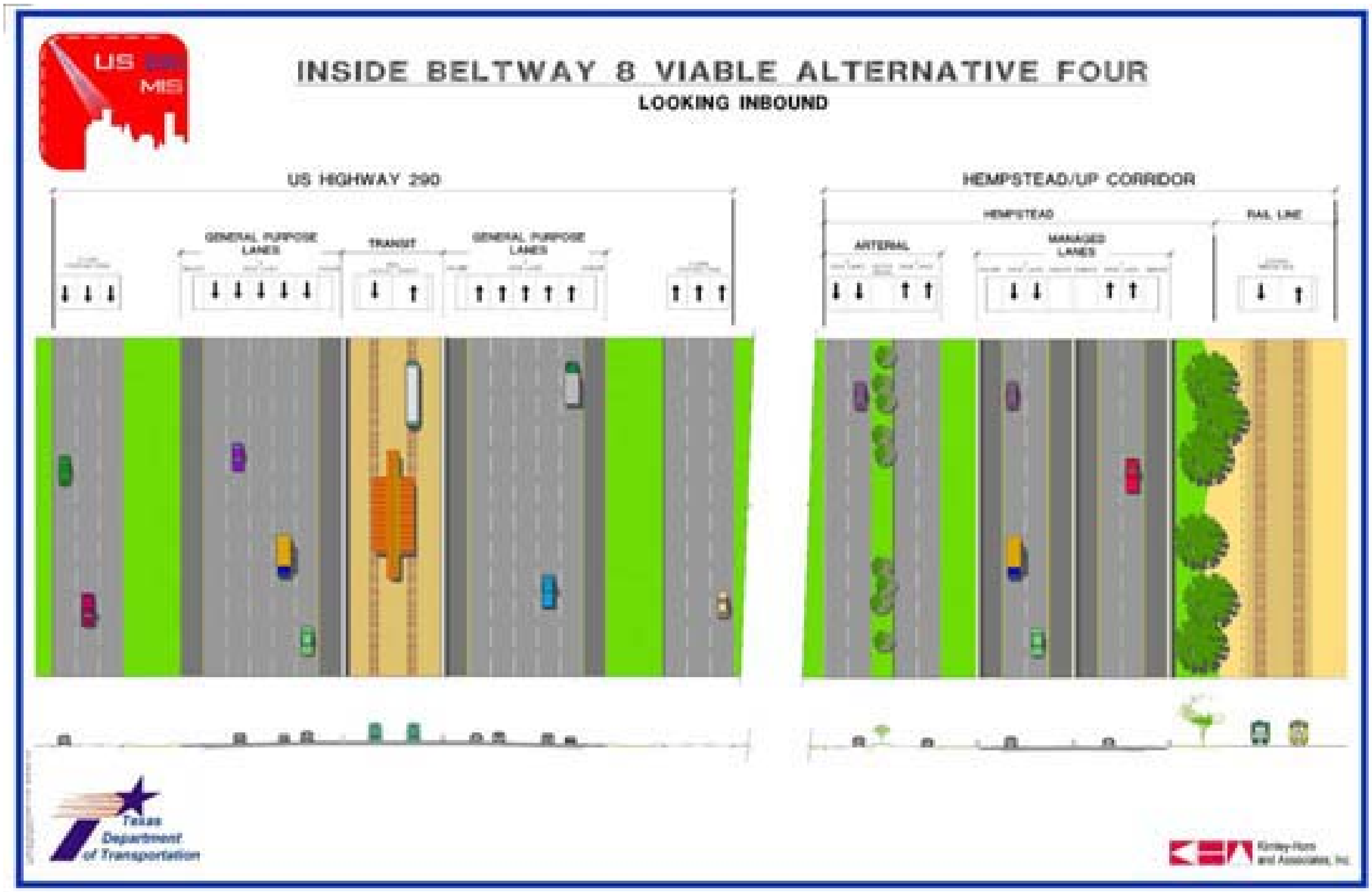
Viable alternative 3 generally involves the following improvements:

- Five general-purpose lanes in each direction from IH 610 to Beltway 8 (excluding auxiliary lanes)
- Four general-purpose lanes in each direction from Beltway 8 to the west study limit (excluding auxiliary lanes)
- Four-lane, two-way managed facility along US 290 from IH 610 to the future Grand Parkway
- Two grade-separated Hempstead general-purpose lanes in each direction
- Advanced high capacity transit envelope along US 290 from the Northwest Transit Center to the future Grand Parkway



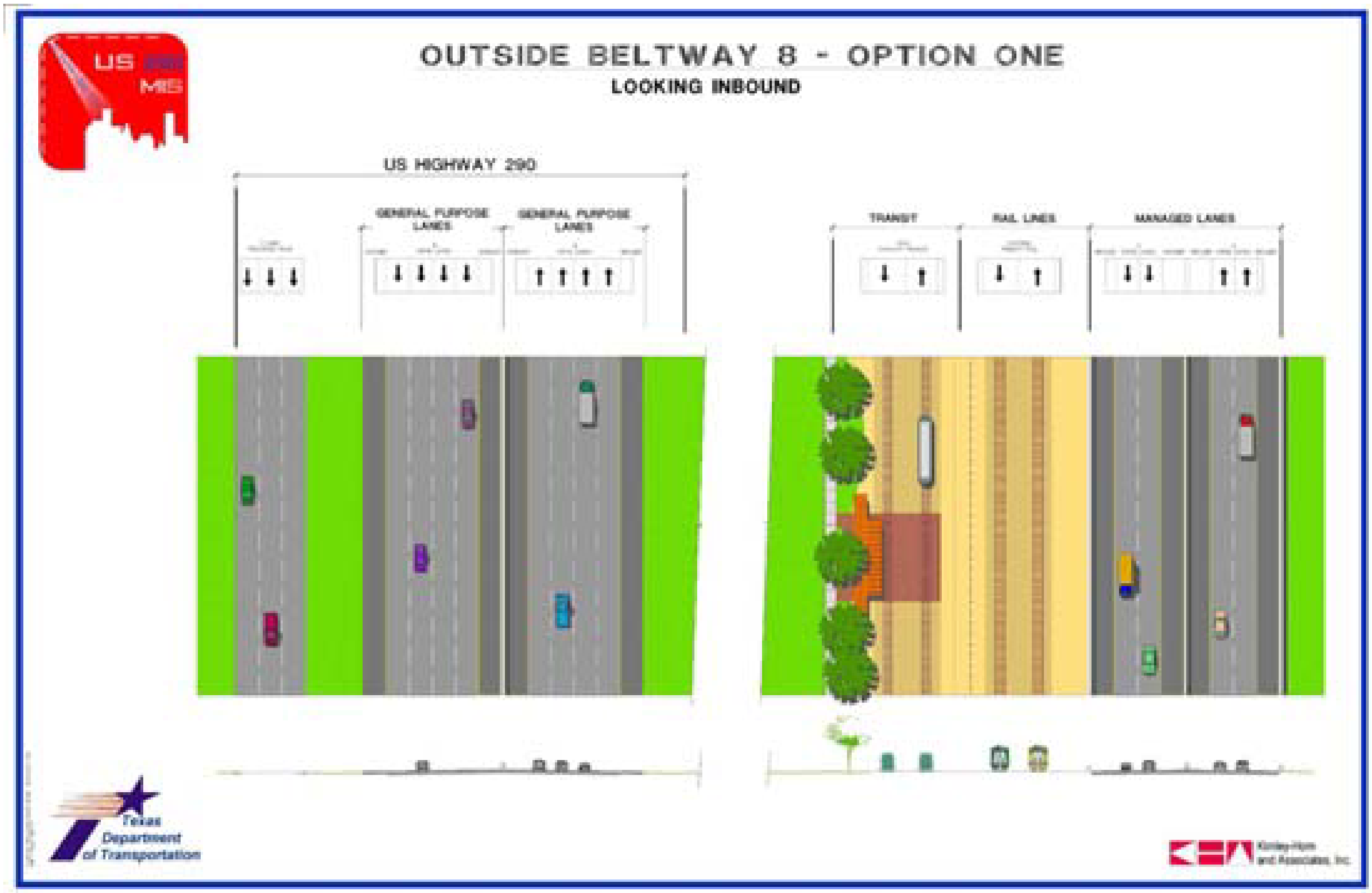
Viable alternative 4 generally involves the following improvements:

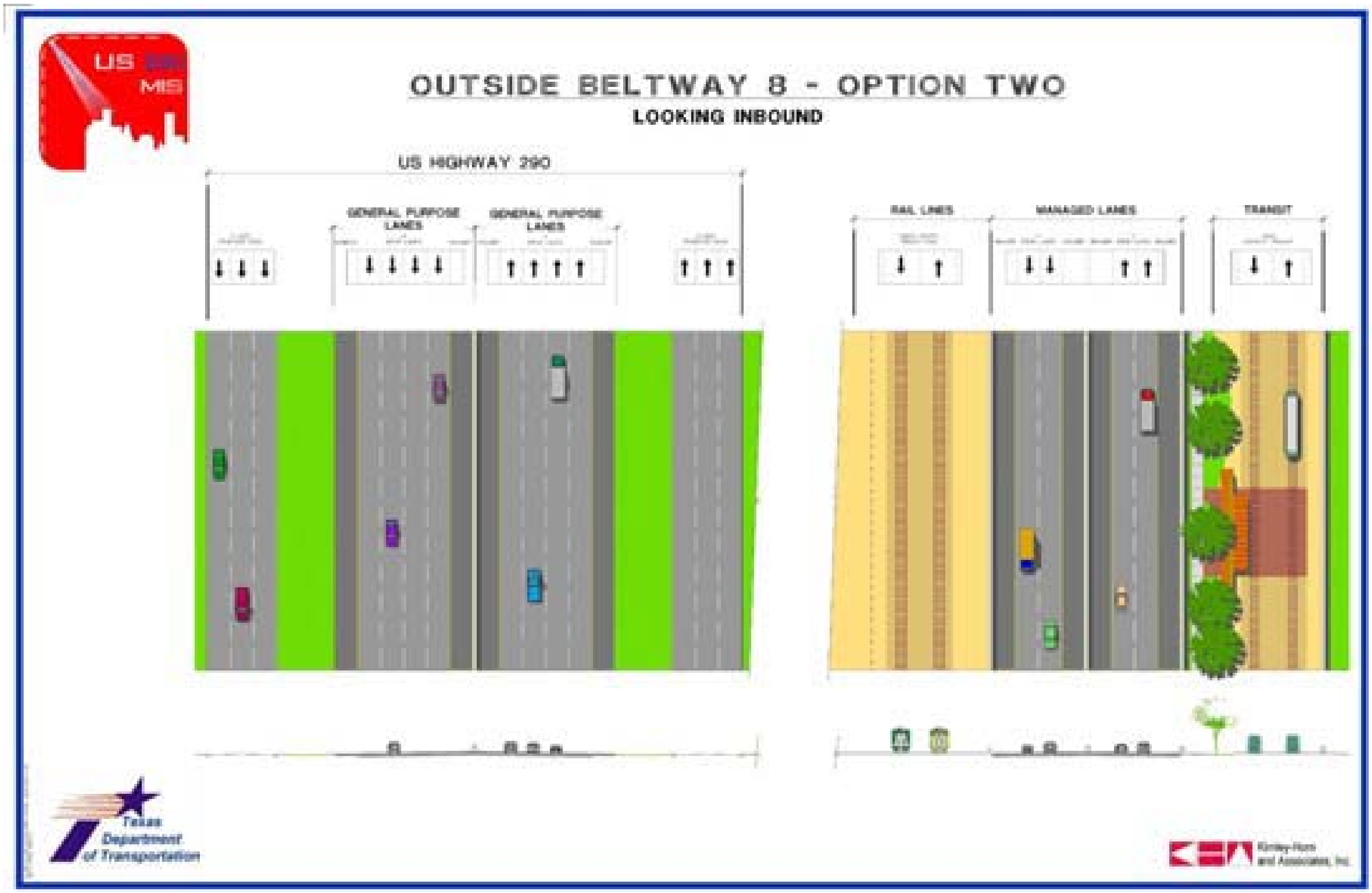
- Five general-purpose lanes in each direction from IH 610 to Grand Parkway (excluding auxiliary lanes)
- Four general-purpose lanes in each direction from Grand Parkway to the west study limit (excluding auxiliary lanes)
- Four-lane, two-way managed facility along the Hempstead Highway Corridor from IH 610 to the future Grand Parkway
- Two grade-separated Hempstead general-purpose lanes in each direction
- Advanced high capacity transit envelope along US 290 from the Northwest Transit Center to the future Grand Parkway

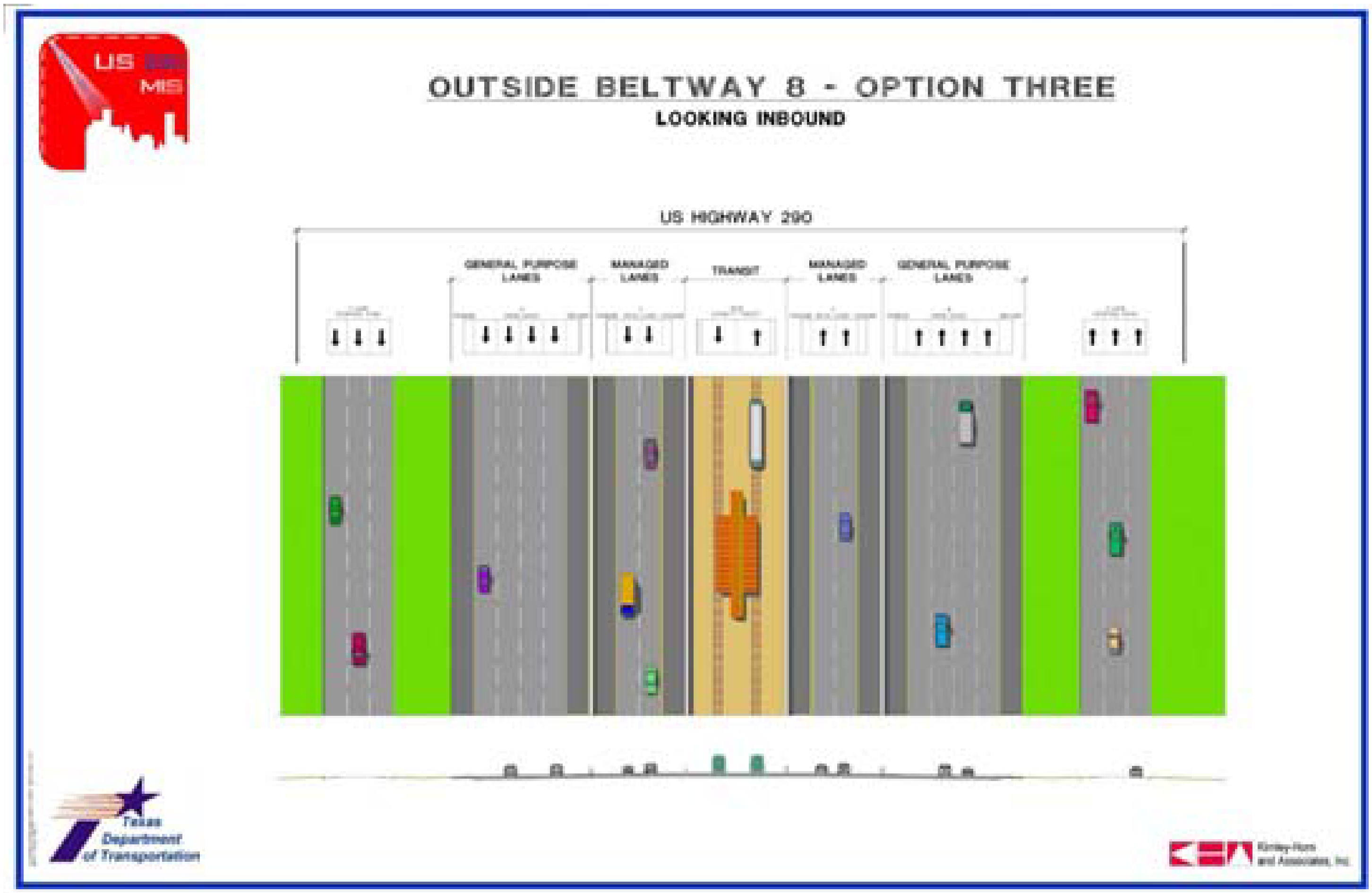


Three alternative options were developed west of Beltway 8 because of the nature of the area and the absence of Hempstead Highway. The options describe alternate placements of the managed facility and AHCT facility.

Due to the underdeveloped nature of the US 290 Corridor west of Beltway 8, any of the three options could be paired with the geometry described on the previous page for viable alternatives 1 through 4 inside Beltway 8. Note that the terminus of both the AHCT and managed facility is near the future Grand Parkway.




OUTSIDE BELTWAY 8 - OPTION TWO
LOOKING INBOUND
US HIGHWAY 290
GENERAL PURPOSE LANES
GENERAL PURPOSE LANES
RAIL LINES
MANAGED LANES
TRANSIT
Texas Department of Transportation
Kimley-Horn and Associates, Inc.



Analysis of Viable Alternatives

In an effort to determine a locally preferred alternative, analysis of the viable alternatives involved screening and evaluating alternatives using a process similar to that used in culling down the conceptual alternatives. However, several slight adjustments were made in order to refine the process and produce a more detailed analysis.

The results of the various viable alternatives' performance against the goals and objectives of the study team are as follows:

Public Safety

- Each build alternative is capable of meeting the public safety goal (through the addition of shoulders, auxiliary lanes, the elimination of weaving sections, new ramps and interchanges, etc.).
- Viable alternatives 2 and 4 allow for the design of a seamless interchange directly from the managed facility to IH 610; other alternatives would create weaving and circulation issues at the US 290 / IH 610 interchange.

Mobility

- Each build alternative demonstrates improvement over the baseline (no-build).
- Viable alternative 2 performs best in regard to congestion, person capacity, and user benefits (fewer hours of delay as compared to the baseline).

Transit

- Each build alternative is consistent with METRO's *2025 Mobility Plan*.
- Transit ridership in the corridor remained fairly consistent with each build alternative.

Social, Economic, and Environmental

- Of the build alternatives, viable alternative 2 offers the least amount of adverse impacts for all land use categories along US 290 inside Beltway 8.
- Of the build alternatives, viable alternative 3 offers the fewest acres of land use displacement inside Beltway 8 along Hempstead Highway; however, it has the greatest impact on land adjacent to US 290 inside Beltway 8.

Air quality

- The viable alternatives all perform similarly to one another in this category except for the baseline, which performs significantly worse than all the other alternatives.
- Due to increases in speeds and vehicle miles of travel (VMT), some pollutant levels drop while others rise; the various pollutants have different degrees of sensitivity and plateaus based on travel speeds and VMT. Air quality conformity will be addressed by H-GAC after the adoption of the locally preferred alternative.

Maximization of existing right-of-way

- Of the build alternatives, viable alternative 2 requires less right-of-way along US 290 inside Beltway 8; however, it requires the most right-of-way along Hempstead Highway inside Beltway 8.
- Of the build alternatives, viable alternative 3 requires the greatest amount of right-of-way along US 290 inside Beltway 8; however, it requires the least right-of-way along Hempstead Highway inside Beltway 8.

Determining Locally Preferred Alternative

After thoroughly reviewing the previously described results, discussing alternatives with the Steering and Advisory Committees, coordinating with TxDOT, and gathering opinions and concerns expressed at public meetings, the study team recommended a locally preferred alternative (generally viable alternative 2 with some modifications) that includes the following improvements:

- Five general-purpose lanes in each direction from IH 610 to just west of Beltway 8, plus auxiliary lanes where appropriate
- Four general-purpose lanes in each direction from just west of Beltway 8 to near the future Grand Parkway / SH 99
- Three general-purpose lanes in each direction from near the future Grand Parkway / SH 99 to the west study limit
- Four-lane, two-way managed facility along Hempstead Highway from IH 610 to some location near the future Grand Parkway / SH 99
- Two general-purpose lanes (possibly three) with curb and gutter in each direction will be reconstructed along Hempstead Highway
- Advanced high capacity transit along Hempstead Highway from IH 610 to near the future Grand Parkway / SH 99
- TSM / TDM / ITS improvements
- Bicycle and pedestrian improvements
- Two- or three-lane frontage roads in each direction (will be determined during schematic design)
- Planning-level cost estimates indicate that the locally preferred alternative will cost $883 million in roadway construction (mobilization, contingency, and traffic control included), $35 million in right-of-way acquisition, and $873 million in AHCT construction

The locally preferred alternative represented the most appropriate choice for the corridor when taking into account cost, constructibility, environmental impacts, and construction staging. The analysis of the alternatives led to the conclusion that all three of the major components studied in this MIS (general-purpose lanes, managed facility, and AHCT) are necessary elements of the locally preferred alternative. The locally preferred alternative provides congestion relief by having an acceptable LOS throughout the corridor; the new design presents a great opportunity to improve public safety in the corridor and it meshes well with METRO's plans for transit in the corridor.

H-GAC's Transportation Policy Council is the policy board ultimately responsible for adopting the locally preferred alternative. The implementation sequence for the locally preferred alternative is as follows:

- Locally preferred alternative adoption by Transportation Policy Council
- Harris County Toll Road Authority toll study for managed facility
- METRO alternative analysis and environmental impact statement (AHCT details)
- TxDOT schematic design and environmental impact statement
- Plans, specifications, and estimates
- Construction

Chapter I
Introduction

The Houston-Galveston Area Council, comprised of the 13 counties surrounding the City of Houston, is the fourth largest metropolitan area in the United States and the largest in the State of Texas. The rate of growth in the Houston region is predicted to be approximately 41% between the years 2000 and 2025. The result of such significant growth will be a regional transportation network that is unable to provide an acceptable level of service in many of the travel corridors. Some of the primary transportation corridors are congested throughout entire days and especially during peak periods. One of these corridors is the northwest corridor of Houston, served primarily by US Highway 290 (US 290). The Texas Department of Transportation (TxDOT) identified the northwest corridor as a candidate for a major investment study (MIS) in order to address the mobility needs within the corridor through the year 2025. To fully understand the beginning point of this project in relationship to the recommended alternative, one should become acquainted with the corridor's history, the study team chosen for the MIS, and the study process.

1.1 STUDY TEAM

The project team listed below, along with certain local and state agency involvement, was responsible for the development and implementation of the US 290 Corridor MIS.

- Texas Department of Transportation–Houston District
- Kimley-Horn and Associates, Inc.
- Knudson & Associates
- Hicks & Company

The TxDOT–Houston District served as the lead agency and was responsible for initiating this MIS. Besides overseeing the completion of the project, TxDOT was responsible for establishing the MIS Steering and Advisory Committees, which were responsible for guiding the development of the study. The specific responsibilities and goals of these committees are discussed in ***Chapter 2***.

Kimley-Horn and Associates, focused on technical issues, served as the prime consultant for the project and was responsible for evaluating the US 290 Corridor, ultimately recommending the locally preferred alternative to the Transportation Planning Council (TPC). Two subconsultants, Knudson &

Associates and Hicks & Company, also contributed to the development of this MIS. Knudson & Associates was responsible for the public involvement effort throughout the project, while Hicks & Company identified and evaluated the social, economic, and environmental impacts along the corridor.

1.2 MIS Study Process

When an MIS is initiated for a corridor such as US 290, it is important to understand the process involved. The MIS is an integral part of a metropolitan area's long range planning process and is defined as a study of a highway or transit improvement of substantial cost that is expected to have a significant effect on capacity, traffic flow, level of service, or mode share within the transportation corridor. It is designed to provide decision-makers with information on the various options available for addressing identified transportation problems. The components that constitute an MIS are as follows:

- Extensive public involvement
- Identification of facts and needs
- Establishment of goals and objectives
- Corridor evaluation
- Identification of multimodal alternatives
- Travel forecasting (mobility)
- Environmental constraints and impacts
- Cost-effectiveness
- Design concept and scope

Figure 1.2-1:
Process for a Major Investment Study

The MIS process implemented for the US 290 Corridor provided a focused analysis and extensive evaluation of mobility needs, identified a set of multimodal options to address problems and needs throughout the corridor, developed measures of benefits, established costs and impacts, and allowed for a comprehensive analysis and evaluation of the selected options. The process used for the US 290 Corridor MIS is shown at left in **Figure 1.2-1**.

After continuous public involvement and engineering planning, a locally preferred alternative was the result of screening a broad range of universal components / conceptual alternatives and analyzing specific, detailed, viable alternatives.

Key steps were established in order to ensure the success of the preferred transportation improvements. These steps included long-range planning, project development, detailed design, and finally, construction of major improvements. This MIS process is an important part of the long-range planning process. As a result of the MIS, a locally preferred alternative is adopted by the MPO policy board and becomes a part of the long-range plan. From here, the schematic design of the locally preferred alternative can begin.

1.3 STUDY AREA AND CORRIDOR HISTORY

The approximately 38-mile-long study area for the US 290 Corridor MIS extends from the IH 10 / IH 610 / US 290 interchange area northwest to the community of Waller, Texas, at Farm-to-Market (FM) 2920. The corridor includes a number of major facilities: US 290, the Union Pacific Railroad, IH 610, Sam Houston Tollway (Beltway 8), future SH 99 (Grand Parkway), and Hempstead Highway, which generally parallels US 290. The predominant transportation facility within the corridor is US 290, providing access to the central business district (CBD) of Houston from the northwest. US 290 in the corridor as it exists today was built in segments, the first having been built in the mid-1970s. Some bridges in the far west region of the corridor are currently being built or will be let within the next year. US 290's interchange with Beltway 8 was built in the late 1980s.

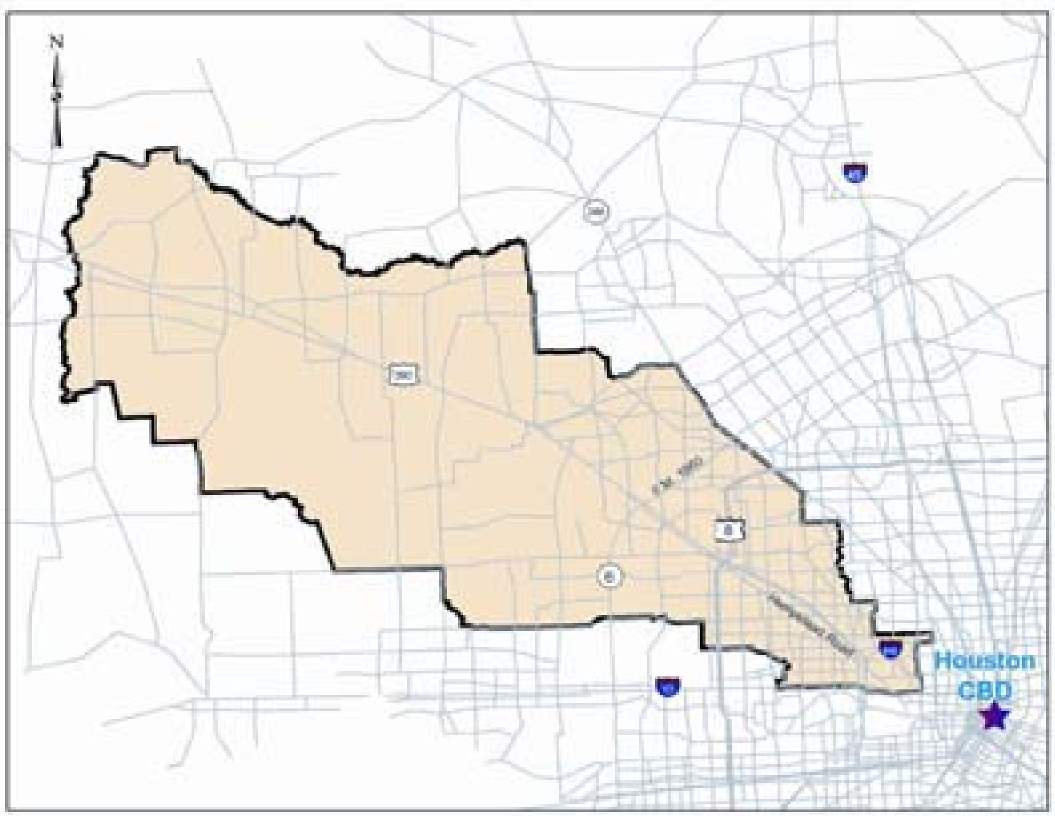
The US 290 Corridor has experienced considerable traffic growth due to various factors, including economic influences throughout the area and residential development towards the northwest region of Houston. In some locations, US 290 is a four-lane divided highway; however, in most locations it is a six-to-eight-lane freeway with frontage roads. The freeway includes an eight-mile, reversible, high-occupancy-vehicle (HOV) lane in the median. The HOV lane was built in the late 1980s and is accessed from either the freeway main lanes at its northwestern terminus or via three transit centers located adjacent to the freeway. The transit centers provide parking, passenger amenities, access to local and commuter bus service, and HOV-lane access for buses, vanpool vehicles, and qualified passenger cars. The corridor transportation system also includes bus transit service with local, commuter, and park-and-ride transit service. The HOV lane and other transit service in the corridor is operated by the Harris County Metropolitan Transit Authority (METRO). Other than sidewalks and crosswalks on most roadways, the US 290 Corridor does not provide pedestrian or bicycle facilities.

Currently, development along the corridor consists primarily of the following: commercial / industrial and residential land uses east of Beltway 8, and undeveloped land west of Beltway 8. However, there are several existing and planned housing developments west of Beltway 8. The corridor has experienced strong social and economic growth over past years, creating a need for corridor improvements. The amount and locations of available, developable land in the corridor are other indications that travel demand will continue to outweigh the corridor's capacity supply. Thus, the US 290 Corridor is a prime candidate for mobility and transit improvements to ultimately increase and strengthen the corridor's efficiency.

With the current corridor population of 366,884 and a predicted 2025 population of 708,000, this corridor is facing serious transportation issues.

The limits of the study area along the US 290 Corridor are illustrated in **Figure 1.3-1.**

Figure 1.3-1: Study Area



Chapter 2
Public Involvement Process

2.1 INTRODUCTION

An important element of the US 290 MIS has been the proactive public involvement program, which provided opportunities for the public and various interest groups to participate in the MIS process and ultimately provided guidance in forming the locally preferred alternative. Since the local responsibility for compliance with federal regulations for public involvement lies with the Houston-Galveston Area Council (H-GAC), the program was designed to comply with the goals of the H-GAC transportation public involvement program, which has a strong emphasis on public education, outreach, and participation. The program provided opportunities for the public and various interest groups to participate in the planning process. US 290 MIS public involvement activities addressed the need to have an ongoing information exchange from the very beginning of the study throughout its end. Arriving at consensus on the locally preferred alternative during the MIS process will enable the next phase, schematic design, to focus on design details rather than bigger-picture modal issues.

This chapter describes the various public involvement activities and techniques that were used during the development of the US 290 MIS.

2.2 PURPOSE OF PUBLIC INVOLVEMENT PROGRAM

The purpose of the public improvement program for the US 290 MIS was to promote open, proactive communication with the public and stakeholders in the corridor in order to develop a meaningful dialogue. As such, the suggested alternative and other decisions made as a part of the MIS may be more widely accepted, although there may not be unanimous agreement. The public involvement program provided access to information about the project, an opportunity for the public to give input on needs and solutions, and a mechanism by which decision-makers can value and seriously consider the public input received. It also served as a means to reflect that the input received was considered in the development of the study recommendations.

The program was enhanced by close adherence to the following guiding principles throughout the study:

- Initiation of citizen participation at the onset of the study and continued throughout the process;
- Intensified efforts to solicit community views prior to major project-decision points;
- Public access to all relevant information;
- Regular reports of study findings to the public in layperson terms;
- Provision of orientation materials to accommodate new participants entering the process;
- Two-way communication between the study team and community participants to exchange information, ideas, and values freely;
- Presentation of transportation options in a objective manner;
- Use of a variety of techniques and approaches to reach a diverse group of persons potentially affected by the proposed project;
- Serious consideration of all suggestions from the community;
- Timely response with answers and information to citizen inquiries;
- Complete documentation of public involvement activities;
- Incorporation of small discussion groups to encourage a casual environment for discussions during public meetings; and
- Evaluation of the public involvement program's effectiveness.

2.3 INFORMATION & EDUCATION

As part of the public involvement program and to support a cooperative planning process, the project team developed an informational and educational campaign. The campaign described regional transportation and related air quality plans and activities in a concise, straightforward manner. The team also developed materials to educate the public on the MIS process and transportation planning issues. In disseminating information to the public, the team used a variety of methods, including the following, which will be discussed in more detail below:

- Newsletters
- Presentation materials
- Website

Newsletters

The project team distributed a total of six newsletters during the project in order to provide educational information as well as update readers on the study progress and key decision points.

The main function of the newsletters was to serve as a source of information for project stakeholders on the study's progress. In addition, newsletters served to announce upcoming public meetings, summarize public meeting results, provide background information on transportation issues, address frequently asked questions, solicit written comments, and report on any policy or technical decisions. Persons who did not receive project newsletters by direct mail were able to obtain copies through TxDOT and from the project website. Newsletters were also distributed upon request for independent use in community or civic association meetings. Extra copies in both English and Spanish were made available as handouts during public meetings.

Presentation Materials

At each round of public meetings, a series of presentation boards was used to provide information about the study and describe the project. The boards included the definition of an MIS, a project schedule, an overview of the corridor, the goals of the study, the purpose and need for the study, environmental issues, a summary of community responses to questionnaires, and the technical results at each stage of the study.

Website

As part of the effort to educate and inform the public about the MIS, the project team worked with TxDOT's Public Affairs department to keep an up-to-date and informative project website. The site, which made available copies of the various newsletters and presentation materials, was advertised in the newsletters and at public meetings.

2.4 OUTREACH

An outreach program to increase awareness of and interest in transportation plans and the transportation planning process, as well as encourage participation in these efforts, was crucial to the project's success. The US 290 Corridor has many stakeholders, including residents, businesses, employees, commuters, environmental and historic preservation groups, transit riders, trucking and freight rail representatives, civic and homeowner organizations, community planning groups and city councils, resource agencies, major land owners, and others who are affected by transportation issues in the corridor.

In addition, TEA-21 (Transportation Equity Act for the 21st century) guidelines on public involvement require that the following groups be provided a reasonable opportunity to participate in the planning process:

- People traditionally underserved by transportation services;
- Special interest groups;
- Governmental officials and agencies;
- Affected land owners;
- Public transit operators;
- Environmental, resource, and permit agencies;
- Community development agencies;
- Major governmental housing agencies;
- Representatives of transportation agency employees; and
- Private providers of transportation.

The following approaches were used to contact and involve project stakeholders in the MIS process:

- Direct mail
- Public notices
- Media coverage
- Public meetings

Direct Mail

To conduct a public involvement process touching as many affected parties as possible, the project team identified and assembled a comprehensive list of area residents, property owners and businesses, public officials, civic organizations, resource agencies, community groups, and media representatives who will likely have interest in this project. The list was updated periodically during the study to include the most recent property owner information available from the Harris County Appraisal District, newly elected public officials, people who had attended public meetings, or those who had otherwise expressed an interest in the study and wished to learn more about the project. Copies of the newsletters (which included the dates and locations of public meetings) were mailed out to all people on the mailing list, which numbered nearly 5,000 people by the final-round series of public meetings.

Public Notices

Timely access to public outreach activities is also achieved via public notices and announcements. To ensure notification of both English- and Spanish-speaking stakeholders, public notices were placed in local, community, and bilingual newspapers, including the *Houston Chronicle*, *The North Freeway Leader*, *La Voz de Houston, Houston Defender,* and *The 1960 Sun.* Public notices were published twice — at 30 days and 10 days prior — for each round of meetings.

Notices of public meetings were also provided prior to meetings on movable message boards along the corridor. In addition, meeting notices were posted on the project website.

Media Coverage

One to three weeks prior to all public meetings, news releases were issued throughout the corridor to English- and non-English-language newspapers, radio stations, and television stations. The purpose of the news releases was to provide a wide range of coverage concerning upcoming public meetings and key decisions of the study. A number of key media contacts were also included on the general mailing list and received notice of all meetings.

Public Meetings

Public meetings are the best opportunity for most people to learn about a project and directly interface with the project team. The meetings, which were open to all interested parties, were conducted primarily in an open-house format so that people could arrive at their convenience and review information at their own paces. There were also occasions where brief presentations were made, and questions and comments from the meeting attendees were encouraged.

At the meetings, poster-sized graphic displays providing information about the study were available for review. Displays were staffed by team members who were knowledgeable about the project so that attendees could have questions answered and provide direct input regarding the project.

The public-meeting component of the outreach effort comprised four series of meetings, each made up of three meetings. These meetings, intended to relay the purpose, process, and progress of the MIS, were held in the evenings at different locations in the corridor; this maximized public convenience and allowed discussions to focus in on subareas as well as whole-corridor issues.

The meetings were very well attended throughout the study, with interest increasing as the MIS progressed. Total attendance at all public meetings combined was more than 1,400 people. Data on the meetings are as follows:

Series and Attendance	Location	Date
One: 120 people	Ault Elementary School	November 15, 1999
	Scarborough High School	November 16, 1999
	Jersey Village High School	November 17, 1999
Two: 311 people	Delmar Stadium Field House	January 29, 2001
	Jersey Village High School	January 30, 2001
	Ault Elementary School	January 31, 2001
Three: 472 people	Delmar Stadium Field House	May 21, 2002
	Ault Elementary School	May 22, 2002
	Jersey Village High School	May 23, 2002
Four: 508 people	Delmar Stadium Field House	September 30, 2002
	Ault Elementary School	October 2, 2002
	Jersey Village High School	October 1, 2002

In addition to the various public meetings, local community and business groups were encouraged to invite MIS project team members to make presentations about the MIS to their respective groups. The following separate meetings were held in the community:

- Cy-Fair Chamber of Commerce
- Rolling Fork Owners Community Meeting
- Lazybrook Baptist Church
- Greater Houston Partnership
- West Houston Chamber of Commerce

Public Input

Members of the public were afforded the following opportunities for providing input into the study:

- Questionnaires with specific questions and open-ended response opportunities;
- Comment forms for general notes, comments, and ideas;
- Flip charts for making general notes, comments and ideas — these were set up at various strategic positions at each public meeting;
- Verbal communication with members of the project team; and
- Letters, e-mails, and phone calls to TxDOT and the project team.

All comments received from the public meetings and in response to the questionnaires were documented and analyzed as input into the study as it progressed.

Questionnaires / Comment Cards

Questionnaires were provided at each series of meetings to seek input for the study, as follows:

- November 1999 comment card
  - Transportation problems in the corridor
  - Most important issues to consider
  - Objectives for the study
  - Possible solutions
- November 1999 questionnaire
  - Comments on the public involvement process
- January 2001 questionnaire
  - Comments on proposed conceptual alternatives
- May 2002 questionnaire
  - Comments on the public involvement process
  - Comments on proposed viable alternatives
- September / October 2002 questionnaire
  - Comments on the public involvement process
  - Comments on proposed locally preferred alternative
  - General comments on the information presented
  - Comments on the public involvement process

Documentation

All input from the public was carefully documented. After each series of public meetings, the project team prepared detailed summaries in order to provide a permanent record of the material covered and the public comments received. Copies of these summaries, which include the following, are available from the project team or TxDOT.

- *US 290 MIS Public Meetings, November 15, 16, 17, 1999*
- *US 290 MIS Public Meetings, January 29, 30, 31, 2001*
- *US 290 MIS Public Meetings, May 21, 22, 23, 2001*
- *US 290 MIS Public Meetings, September 30, October 1, 2, 2001*

Follow Up Procedures

The purpose of timely follow-through by TxDOT was to demonstrate to the public that decision makers seriously consider the public input received. Citizen inquiries were followed up promptly with answers and information.

2.5 AGENCY PARTICIPATION

MIS Steering Committee

TxDOT established the MIS Steering Committee to offer technical and policy decisions and guide the technical development of the study. The committee met at key milestones in the process to receive and assess reports on progress, comment on the schedule, coordinate with their respective agencies, and provide oversight of major activities associated with the MIS. The Steering Committee was comprised of representatives from TxDOT, Houston-Galveston Area Council (H-GAC), the Metropolitan Transit Authority (METRO), the Federal Highway Administration (FHWA), the Federal Transportation Agency (FTA), the Texas Commission on Environmental Quality (TCEQ), the US Fish & Wildlife Service (USFWS), Harris County, and the City of Houston. ***Appendix A*** contains a list of Steering Committee members.

Steering Committee meetings were held on the following dates:

- November 2, 1999
- September 18, 2000
- January 17, 2001
- August 2, 2001
- April 16, 2002
- August 26, 2002

MIS Advisory Committee

An MIS Advisory Committee was established to provide the MIS project team and Steering Committee with corridor-specific concerns and issues for consideration in the study process. The MIS Advisory Committee met to hear reports on progress and discuss issues and concerns. ***Appendix A*** contains a list of Advisory Committee members.

Chapter 3
Study Goals and Objectives

3.1 PURPOSE AND NEED

The first step in the MIS process included identifying the purpose and need and then developing goals for the project, which the various alternatives were to strive toward meeting. The purpose and need were established with input from the US 290 Steering and Advisory Committees as well as the public.

Definition of Level of Service

The need for transportation improvements is established by evaluating the level of service and capacity in order to identify any deficiencies of the existing transportation system. As described in the Transportation Research Board's *Highway Capacity Manual, Special Report 209, Third Edition (updated 1998)*, "A principal objective of capacity analysis is the estimation of the maximum amount of traffic that can be accommodated by a given roadway facility while maintaining prescribed operational qualities." Ranges of operating conditions are defined by levels of service (LOS). The concept of levels of service is defined as a qualitative measure describing operational conditions in a traffic stream and the perception of those operational conditions by motorists and / or passengers. Operational conditions include such factors as speed and travel time, freedom to maneuver, traffic interruption, comfort and convenience, and safety. Six levels of service are defined for each type of roadway facility. They are given letter designations from "A" to "F," with level of service A (LOS A) representing the best operating conditions and level of service F (LOS F) representing the worst. **Figure 3.1-1** shows the levels of service pictorially. The current policy of TxDOT and the Houston-Galveston Metropolitan Planning Organization is to plan and design transportation facilities to operate at no worse than LOS D. Therefore, LOS E or F on an existing facility is a condition that usually merits remedial action, and the planning and design of new facilities is based on achieving at least LOS D.

Figure 3.1-1: Levels of Service

LOS A

LOS B

LOS C

LOS D

LOS E

LOS F

Source: *The Transportation Research Board, Highway Capacity Manual*, Special Report 209, Third Edition

Existing Corridor Traffic Conditions

The northwest corridor and US 290, its primary transportation facility, currently exhibit a range of levels of service, varying by location within the corridor. The western areas (where urbanization is not yet prevalent) are well-served, with the freeway operating generally at LOS C. Traffic levels increase with development densities when moving toward downtown Houston. Currently, traffic congestion is such that peak-hour delays are not uncommon on the freeway near FM 1960; they are routine from Beltway 8 in to IH 610. In these areas, the overall level of service is typically LOS E and is, in many locations, an unacceptable LOS F. From the Hockley community to Cypress Mill Road (where US 290 is a divided highway with grade intersections — some signalized), the highway exhibits high levels of congestion and safety concerns where higher speed vehicles on US 290 interact with cross-street traffic.

Hempstead Highway also currently exhibits a range of levels of service, varying by location within the corridor. Currently, congestion occurs during the peak hours between W. Little York and Gessner, N. Post Oak and Mangum, and W. 34th and Antoine, among others. The overall LOS along Hempstead Highway is typically LOS D in the a.m. peak hour (not congested) and LOS E in the p.m. peak hour (congested).

Projected Corridor Traffic Conditions

The existing conditions in the corridor are not ideal, and there are reasons to believe that conditions will worsen. Population and employment projections prepared by the Houston-Galveston Area Council (H-GAC) indicate that the northwest corridor will grow considerably. From a base population figure of 366,884 in 2000, population is expected to increase 93% to 708,484 by 2025. This population increase will contribute to a comparable service employment increase. Further, the area's economic vitality is secured by a strong basic employment foundation provided by companies that include the Hewlett-Packard Company (formerly Compaq Computers). The employment outlook is for the 2000 employment figure of 241,448 to grow 54% to 370,970 by 2025.

The growth that has occurred in this corridor over the last decade is an indication of how much — and how fast — growth can occur. The amount and locations of available, developable land in the corridor is another indication that travel demand will continue to outweigh transportation supply. There are many negative aspects of an imbalance between transportation supply and demand, including the following:

- More travel-time delays
- Increased fuel consumption

- Higher vehicle-operating costs
- Degradation in air quality
- Decreases in levels of safety

Purpose of the Major Investment Study

This project's purpose is to evaluate alternatives for improvements within the corridor and to recommend a locally preferred alternative that is feasible and best suited to meet the corridor's transportation needs while minimizing impacts to the surrounding environment. Due to high demand levels and the corridor's nature as an urban setting, the alternatives will include a wide range and various combinations of travel modes, as well as possible measures to meet transportation and related goals in the area. These alternatives may include, but are not limited to, combinations of the following universal modal components:

- General-purpose freeway lane increase
- Light rail
- Commuter rail line
- Expand the high-occupancy-vehicle facilities
- HOV (diamond) lanes
- Additional bus lanes
- Additional traffic demand management (TDM) techniques
- Additional traffic systems management (TSM) techniques
- Add toll or special-use lanes
- Add express facility
- Add managed facility
- Add frontage road / cross-street grade separations
- Additional lanes on thoroughfares
- New thoroughfares

Another alternative that was considered is the "do nothing" or "no-build" alternative, also referred to as the baseline alternative. This alternative, which may include lower-cost improvement (transportation system management [TSM] / Transportation Demand Management [TDM]) strategies, also serves as the baseline against which the "build" alternatives are compared. Typically, the no-build alternative will include projects already proposed in the Metropolitan Planning Organization's (MPO) transportation improvement program (TIP). The build alternatives may include any number of combinations of the above-listed options.

Another tenet of the study was appropriate involvement of the public and public agencies. To provide decision-makers with information needed to select the locally preferred alternative, it is important to receive information from and provide information to the public. Public input contributes to an understanding of corridor needs, issues, and the goals which guide alternative analysis and selection. The foundation for smooth implementation of project recommendations is laid upon public input and participation, which was discussed in detail in ***Chapter 2***.

In addition to the general public, the MIS process involves the participation of many cooperating agencies. While TxDOT is the performing agency and will ultimately be responsible for the implementation of many of the recommendations, multiple other agencies may be affected and involved. Of particular note are the participating agencies, such as METRO, the Harris County Toll Road Authority, the City of Houston, and Harris County, that may be called on to implement recommendations of the study. The recommendations from this study are presented to the Houston-Galveston Metropolitan Planning Organization which, upon adoption of any recommendations, will incorporate the findings into the metropolitan transportation plan.

The results of this study are intended to provide the most cost-effective alternative (or combination of alternatives) that meet the project purpose and needs and are consistent with relevant local, state, and federal goals. The principle of cost effectiveness meshes with the need for the recommendation to be financially feasible and consistent with the metropolitan transportation plan. This process is a subset of the long-range planning process. As such, the preferred alternative will ultimately require demonstration of conformity with the metropolitan transportation plan and all of its related components, including TEA-21, the Clean Air Act amendments, and the National Environmental Policy Act.

3.2 CORRIDOR GOALS AND OBJECTIVES

US 290 Corridor Goals

Through an extensive public outreach program and the recognition of the current and projected deficiencies in the corridor, the study team established six corridor goals, which are later discussed in detail, as follows:

- Improve public safety
- Improve and maintain mobility
- Increase opportunities for transit
- Avoid or minimize adverse social, economic, and environmental effects
- Contribute to air quality attainment
- Maximize use of existing right-of-way (ROW)

In addition to the corridor-specific goals, the study team also incorporated regional (H-GAC) goals. Listed below are the H-GAC goals as found in H-GAC's *2022 Metropolitan Transportation Plan*.

H-GAC Goal 1: *Increase number of travel choices for people and freight movement*

- Evaluate transit options, including urban rail, in all travel corridors where major transportation improvements are being considered
- Provide transit options, where feasible, to those who cannot or choose not to drive a car
- Improve ongoing public education programs on alternatives to driving alone
- Develop a variety of transportation solutions that meet the unique needs of each community in the region
- Develop a system of connected bicycle and pedestrian facilities within each community and throughout the region
- Evaluate adding new bicycle and pedestrian facilities in all new roadway construction or major maintenance projects

H-GAC Goal 2: *Adequately maintain current roads and transit services*

- Give priority to maintaining, operating, and managing existing roadways and transit services over expanding these facilities and services

H-GAC Goal 3: *Promote coordinated land use and transportation development*

- Transportation projects should support regional and local land use policies and plans
- Transportation projects should promote community and neighborhood cohesion
- "Smart growth" and compact land use development should be encouraged with appropriate transportation investments

H-GAC Goal 4: *Improve access to and connections within the transportation system*

- Provide convenient transfers between connecting methods of travel necessary to complete a trip
- Design future HOV facilities to provide easy access onto and off facilities
- Improve local streets necessary for shorter-distance trips

H-GAC Goal 5: *Efficient movement of people and goods*

- Consider the needs of freight movement in all aspects of transportation development
- Encourage the active involvement of freight shippers in transportation development
- Improve street and sidewalk access to transit services and encourage land uses that promote transit ridership
- Use new, proven technologies to increase the efficiency of our transportation system

H-GAC Goal 6: *An environmentally responsible system*

- Minimize the negative impacts of transportation projects on the physical and social environment of communities
- Include in transportation project budgets sufficient funding to mitigate a project's environmental impacts to an acceptable level
- Give priority to programs that reduce vehicle emissions and provide incentives to encourage the use of alternatives rather than driving a car alone

H-GAC Goal 7: *A cost-effective and affordable transportation system*

- Foster governmental cooperation to avoid duplication and minimize costs
- Encourage the joint development and operation of transportation facilities to reduce costs and maximize benefits
- Consider life-cycle costs and cost / benefit analyses in transportation project selection

H-GAC Goal 8: *Safe and secure movement of people and commodities*

- Identify and improve roads for evacuation during emergencies and natural disasters; support emergency management programs
- Identify and maintain roads and railroads for the transfer of hazardous materials
- Design and operate transportation facilities and services that are safe and secure
- Where feasible, provide grade separations on major rail corridors
- Identify and eliminate safety hazards

Chapter 4
Existing Corridor

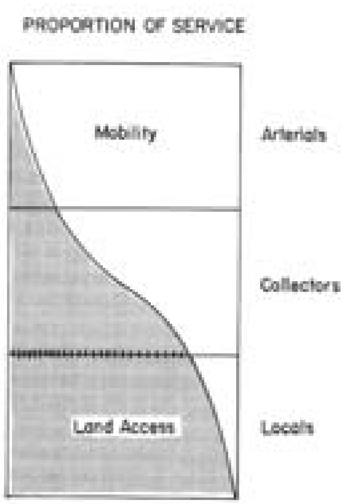
The following sections define existing traffic characteristics, existing traffic analyses, and corridor influences along US 290. Additional information regarding the existing conditions of the corridor may be gained from the *Existing Conditions Report*, released in June of 2001.

4.1 EXISTING TRAFFIC CHARACTERISTICS

Functional Classifications

A complete functional design system provides a series of distinct travel movements. The six recognizable stages in most trips include main movement, transition, distribution, collection, access, and termination.

Figure 4.1-1: Functional Classifications



(Source: AASHTO)

For example, the main movement of vehicles is usually uninterrupted, high speed, longer-trip-length flow. When approaching destinations from the freeway, vehicles reduce speed on the ramps, which act as transition roadways. Vehicles then enter a moderate-speed arterial that brings them nearer to their destination neighborhoods. They next enter collector roads that penetrate the neighborhoods. Finally, the vehicle enters local access roads that provide a direct connection to individual residences or other terminations. Each of the six stages is handled by a separate facility designed specifically for its function. Additionally, functional classifications are generally classified by the surrounding land use form. For example, urban and rural areas have fundamentally different characteristics in regard to density and types of land use, density of street and highway networks, nature of travel patterns, and the way each of these elements is related. **Figure 4.1-1** demonstrates the relationship of facility types to access.

The City of Houston classifies their thoroughfares into four major categories: local streets, major collectors, major thoroughfares, and freeways. For planning purposes, the H-GAC has created separate area types, or land uses, that relate roadway capacity to functional class and area type. The relationship of functional class in different area types provides a more detailed method of estimating the true capacity of the facility.

The US 290 study corridor, starting at its western terminus with FM 2920 in Waller, is a limited-access freeway with discontinuous parallel frontage roads.

Traveling eastward, near Badtke Road, the freeway section transitions into a freeway with some at-grade access points for several miles to Cypress Mill Road, at which point the limited-access freeway section continues to its easternmost terminus with IH 610. However, several grade separations in the western portion of the corridor are under construction or planned to be let in 2002. These grade separations are occurring at Mueschke Road, Mason Road, Becker Road, Roberts Road, and Bauer Road (2003). The grade separations should provide for increased capacity and safety. The major investment study area previously shown (**Figure 1.3-1**) contains several major and minor arterials that intersect with US 290 and provide connections to collectors and local streets serving residences and businesses. Due to the northwest alignment of US 290, many of the arterials bisect the freeway at a skew, which creates geometric and circulation challenges. The network of arterials and collectors throughout the study area have improvements planned by H-GAC, the City of Houston, and Harris County; the MIS team coordinated between agencies and analyzed the roadway network.

Hempstead Highway is classified as a major arterial and parallels the freeway in the western portion of the study area, ending at Badtke Road and beginning again near Beltway 8. It continues past IH 610, terminating at Washington Avenue, which ultimately intersects with IH 10. The discontinuous nature of Hempstead Highway provides an opportunity, if feasible, to establish a connection between the two Hempstead thoroughfares. The improvement of existing arterials and collectors and the recommendation for new arterials are vital components of meeting the future demand in this corridor. Coordination with the City of Houston, Harris County, and TxDOT will be necessary as recommendations and improvements are carried forward.

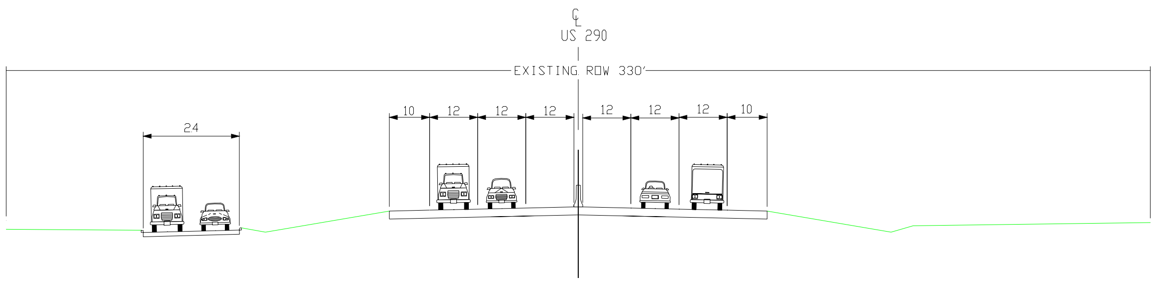
Typical Sections

The safety of the general public relies upon having cross-section elements designed per the minimum requirements of the TxDOT's *Operations and Procedures Manual*. For a freeway, the elements that require particular attention are shoulder and lane widths, horizontal and vertical design, clear zones, median barriers, and interchange proximity or access control.

The arterials and collectors throughout the study area have criteria defined for urban and rural conditions. Urban and rural street design can be differentiated by the land use and density formed around the roadway. Urban roadway sections consist of curb and gutter at the edge of pavement, resulting in a clear zone that terminates at the curb, as opposed to the rural section, which has shoulders and a clear zone that extend out a distance determined by the speed of the roadway. Additional right-of-way differences are associated with the clear zones. Rural sections often require more right-of-way than urban sections.

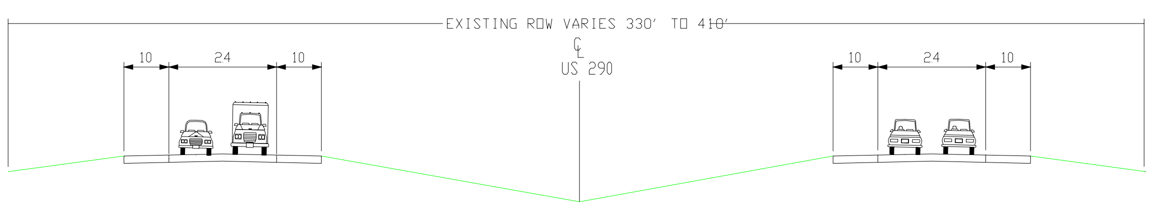
Beginning from the west at FM 2920 in Waller, US 290 consists of a four-lane, barrier-separated freeway section with discontinuous frontage roads. As shown in **Figure 4.1-2**, the outside shoulders are generally 10', with a 12' shoulder on the inside and four general-purpose lanes approximately 12' wide. The right-of-way width in this section is approximately 300'. The rural nature of this section dictates that frontage roads be constructed with shoulders, as opposed to curb and gutter, which is found in some of the urban sections.

Figure 4.1-2: Typical Section



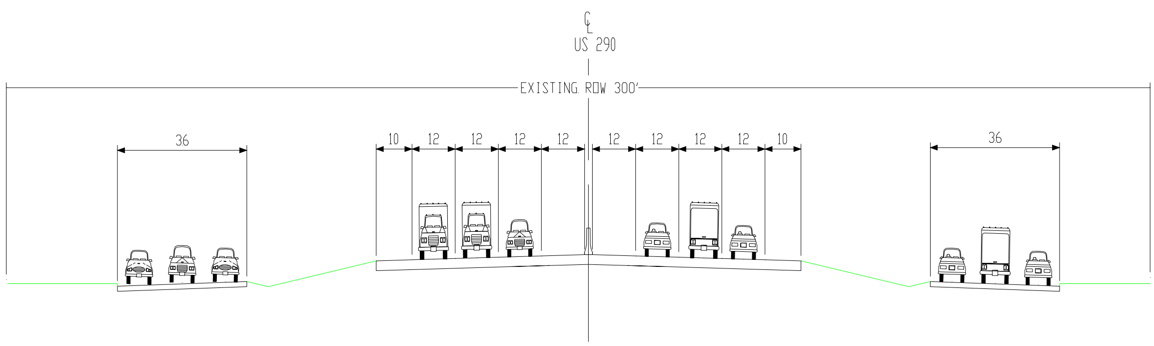
The facility type of US 290 changes from a freeway to a primary arterial with at-grade intersections. Near the intersection with Badtke Road, US 290 diverges to a four-lane divided facility with a wide center median. In **Figure 4.1-3**, the arterial contains 10' paved shoulders inside and outside with open swale ditches. The existing right-of-way ranges from 330' to 410'. This configuration is maintained for several miles, to the intersection at Cypress Mill Road.

Figure 4.1-3: Typical Section



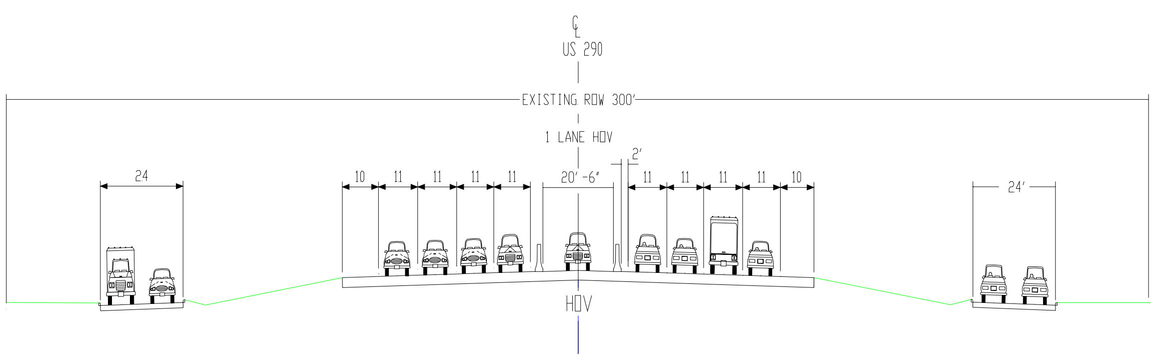
At Cypress Mill Road, the facility again becomes a limited-access freeway and widens to a six-lane section with service roads. In **Figure 4.1-4,** the section shows 10' outside paved shoulders and 12' inside, with a right-of-way width of 300'. This six-lane freeway section is maintained to the intersection of W. 43rd Street. Frontage roads tend to be two lanes between successive on- and off-ramps, with the third lane dropping into on-ramps and beginning with off-ramps. The number of lanes on frontage roads may increase at intersection approaches in order to include turn lanes for U-turns, right turns, or dual left turns.

Figure 4.1-4: Typical Section



At W. 43rd Street, the in-lane section widens to eight lanes, with a reversible HOV lane. This 8-lane section continues to the project terminus at IH 610. From SH 6 to IH 610, the service roads are continuous and vary from two to three through lanes in each direction, with some intersections having as many as five lanes. See **Figure 4.1-5** for a graphical illustration.

Figure 4.1-5: Typical Section



Rights-of-Way

Right-of-way currently varies along US 290.

- IH 610 interchange to northwest of Karbach Street — 350'
- From northwest of Karbach Street to Beltway 8 — 300'
- At Beltway 8 — widens significantly to accommodate interchange
- West of Beltway 8 to Cypress Mill Road — 300'
- Cypress Mill Road to Badtke Road — 330' – 410'
- Badtke Road to FM 2920 interchange — 330'

The general locations of the right-of-way lines with respect to the existing roadways are depicted on the typical sections in ***Appendix B***, **Figures 8 - 11.**

Horizontal Alignment

The entire US 290 Corridor has a general northwest-southeast orientation. There are numerous slight alignment changes to the main lanes, principally to accommodate auxiliary lanes, ramps, elevated HOV viaducts, and other features. Most of these slight alignment changes, typically with small deflection angles, do not require horizontal curves to be incorporated into the alignment change.

Between FM 2920 and Badtke Road, the recently relocated US 290 alignment traverses through four curves, all within current design standards. Between Badtke Road and Cypress Mill Road, there are no centerline curves. Between Cypress Mill Road and Eldridge Parkway, the freeway traverses through two major alignment changes that provide separation from the Union Pacific Railroad Corridor at the Spring-Cypress Road and SH 6 interchanges. From Eldridge Parkway to the IH 610 interchange, the freeway traverses through three minor alignment changes that separate it to the north of the old Hempstead Highway alignment. The entire alignment is depicted in ***Appendix B***, **Figures 1 - 7.**

Vertical Alignment

The general topography of the corridor is such that there is very little change in the natural terrain elevation throughout the area. Since within the study limits the US 290 Corridor is a limited-access facility for most of the route, intersections with arterials are grade-separated. For the majority of these intersections, US 290 is the route that is elevated. There are three intersecting roadways that are elevated over US 290: Pinemont, W. Little York, and Barker-Cypress. Along the entire route, all grades are 3% or less for the main lanes, with the entire corridor at or above grade. The overpass structures for Pinemont, W. Little York, and Barker-Cypress are all

5% grades. Based upon their respective roadway classifications, the existing vertical alignments meet TxDOT's existing design criteria.

Drainage

The US 290 Corridor is drained by two watersheds: Cypress Creek and White Oak Bayou. Within the corridor there are several major drainage channels that intersect with US 290. From west to east, these include Little Cypress Creek, Cypress Creek, White Oak Bayou, South White Oak Bayou, Cole Creek, and Brickhouse Gulley. With the exceptions of Little Cypress and Cypress Creeks, these are all tributaries of White Oak Bayou.

Roadway drainage varies according to the typical sections. On the western portion of the corridor between FM 2920 and Badtke Road, drainage is typically accommodated through the use of roadside ditches. Between Badkte Road and IH 610, most of the drainage is accommodated through the use of subsurface culverts.

Interchanges

Between FM 2920 and IH 610, there are two system-to-system interchanges. These are the IH 610 / US 290 interchange and the US 290 / Beltway 8 interchange. The IH 610 interchange is a four-level interchange, with US 290 terminating as it merges into IH 610. The predominant connection from US 290 connects to IH 610 south, with three out of five lanes in each direction dedicated to that movement.

The interchange at Beltway 8 is a five-level, fully directional interchange with direct connectors. This interchange is skewed at an angle of about 30 degrees from perpendicular. The main lanes on US 290 pass underneath the main lanes for Beltway 8. Beltway 8's current frontage roads through this interchange are discontinuous, with northbound traffic required to make a right turn onto the US 290 eastbound frontage road at Senate Drive, travel about 2,000' east, and then make a left turn onto the northbound Beltway 8 frontage road.

There are numerous system-to-service interchanges of various configurations throughout the corridor. Many of these are accessed through a series of slip ramps located along the length of US 290. Between Beltway 8 and IH 610, the majority of the diamond interchanges provide access to two major intersecting arterials. **Table 4.1-1** provides a summary of the interchanges within the corridor from west to east in descending order.

Table 4.1-1: US 290 Interchanges

Intersecting Arterial Roadway	Interchange Type
FM 2920	Diamond
Binford Road	Diamond
Kickapoo Road	Diamond
Kermier Road	Diamond
Hegar Road	Diamond
Roberts Road / Katy-Hockley Road	Diamond (future)
Becker Road	Diamond (future)
Bauer Road	Diamond (future)
Mason Road	Diamond
Mueschke Road	Diamond
Barker-Cypress Road	Diamond
SH 6 / FM 1960	Diamond
Eldridge Parkway / West Road	Diamond
Jones Road	Diamond
Beltway 8	Full Directional
N. Gessner Road	Diamond
Fairbanks Road – N. Houston Road	Diamond
W. Tidwell Road / Hollister Road	Diamond
Bingle Road / W. 43rd Street	Diamond
Antoine Drive / W. 34th Street	Diamond
Mangum Road / Dacoma Road	Diamond
IH 610	Trumpet

Intersections and Traffic Signals

US 290 has a northwest-southeast orientation, while its major intersecting thoroughfares are arranged in a north-south or east-west grid pattern. Therefore, the large majority of these intersections is skewed at an angle of about 45°. There are 37 signalized intersections within the corridor. Along US 290, as listed from west to east on **Table 4.1-2**, there are 20 signalized intersections, with 17 along Hempstead Highway. The Current Corridor Influences map set ***Appendix B*, Figures 1 - 7** displays the location of each signalized intersection.

Table 4.1-2: Signalized Intersections

US 290	Hempstead
Mason Road	West Little York Road
Mueschke Road	N. Gessner Road
Huffmeister Road	West by NW
SH 6 / FM 1960	W. Tidwell Road
Eldridge Parkway	Fairbanks Road - N. Houston Road
West Road	Pinemont Drive
Jones Road	W. 43rd Street
Spencer Road / FM 529	Bingle Road
Senate Drive	Lang Road
N. Gessner Road	W. 34th Street
Windfern Road	Antoine Drive
Fairbanks Road - N. Houston Road	Longpoint Road
W. Tidwell Road	Mangum Road
Hollister Road	N. Post Oak Road
Bingle Road	IH 610 Frontage Roads
W. 43rd Street	W. 12th Street
Antoine Drive	W. 11th Street
W. 34th Street	
Mangum Road	
Dacoma Road	

Lighting

Roadway lighting is provided along US 290 from IH 610 to Cypress Mill Road. This lighting generally consists of high-mast, pressurized sodium or mercury vapor fixtures. The high-mast poles are generally located on the south side of the freeway. To the west of Cypress Mill Road, no lighting is presently provided.

Roadway lighting along Hempstead Highway generally consists of standard mast-arm fixtures mounted on utility poles adjacent to the roadway. These are predominantly located on the north side of the roadway.

Utilities

There are numerous utility crossings throughout the US 290 Corridor (which includes Hempstead Highway), including municipal sewer and water, electrical and gas distribution lines, major oil and gas pipelines, and overhead electrical lines. The Exxon Satsuma Terminal pipeline facility, located on the south side of US 290 and to the east of SH 6, has several major pipelines originating from that location. Three of these major pipelines cross under US 290. The approximate locations of these and other major pipeline crossings throughout the corridor, as well as major electrical transmission lines, are indicated on the Current Corridor Influences map set.

In addition to the other noted utilities, buried fiber-optic cable is installed adjacent to the Union Pacific railroad tracks.

Railroad

The Union Pacific Railroad owns, operates, and maintains a railroad line in the corridor. From FM 2920 to Beltway 8, the approximately 100-foot right-of-way for this rail line is immediately adjacent to and to the south of the US 290 right-of-way. At Beltway 8, the railroad right-of-way diverges from US 290 and parallels Hempstead Highway on the south throughout the remainder of the corridor to the east. This railroad presently carries an average of eight manifest trains per day. Grade separations for this rail line exist only at Barker-Cypress and SH 6. There are 25 at-grade intersections with this railroad line within the project limits, which are listed below in **Table 4.1-3**:

Table 4.1-3: Union Pacific Railroad At-Grade Intersections Along US 290 Corridor

West of Beltway 8	East of Beltway 8
Mathis Stokes	West Little York Road
Kickapoo Road	N. Gessner Road
Kermier Road	Campbell Road
Hegar Road	W. Tidwell Road
Katy-Hockley Road / Roberts	Fairbanks Road - N. Houston Road
Becker Road	Baythorne Drive
Telge Road	W. 43rd Street
Berwich	Clay Road
Eldridge Parkway	Bingle Road
West Road	W. 34th Street
FM 529/Spencer Road	Antoine Drive
Senate Drive	Long Point Road
	N. Post Oak Road

**Figure 4.1-6:
METRO Route Map**

(Source: METRO)

METRO Facilities

METRO is the primary operating transit agency in Houston area; it has a wide variety of multimodal programs and operates a vast array of services, including fixed-route local, express and commuter bus service, paratransit and special services, vanpool and carpool, transit centers, park-and-ride lots, advanced traffic signalization, and high capacity transit.

Eleven bus routes operate in the northwest corridor, specifically within the US 290 MIS area. The routes provide park-and-ride, local, and cross-town services for its customers. A route map can be seen in **Figure 4.1-6**.

METRO's park-and-ride facilities are located throughout the agency's service areas. Park-and-ride facilities provide a place for patrons to park their cars and board a bus or carpool in a convenient, weather-protected environment. METRO's park-and-ride buses, as well as some express buses and carpool / vanpools, can travel nonstop on HOV lanes to work destinations downtown and other major employment centers. Park-and-ride lots are also served by local, express, and cross-town routes providing convenient transfer opportunities.

The US 290 Corridor MIS has three primary park-and-ride lots located within the study limits: Pinemont, W. Little York, and Northwest Station. See **Figure 4.1-7** for park-and-ride lot locations.

Listed below is a summary of the available spaces, utilization, and total number of routes served by each park-and-ride lot.

	Available Spaces	***Utilization***	***Total Routes***
Pinemont	938	34.9%	2
W. Little York	1,102	32.4%	3
Northwest Station	1,755	114.4%	1

Figure 4.1-7: Park-and-Ride Lot Locations

(Source: METRO)

Two future park-and-ride lots are currently being planned by METRO for the US 290 Corridor: Barker-Cypress and Fairfield. The Barker-Cypress lot is planned to have from 1,000 to 1,500 spaces, with express service to downtown, and is in METRO's Capital Improvement Program (CIP) for construction for fiscal year 2003 / 2005. The Fairfield park-and-ride is a long-range target and will be studied as part of this MIS.

In addition to METRO's three existing park-and-ride lots, Ryder / ATE, Inc., operates the Northwest Bus Operating Facility at 34th Street and US 290 in Deauville Plaza. Ryder / ATE, Inc., is responsible for the maintenance and daily operation of METRO buses originating from the Northwest Bus Operating Facility.

The Pinemont park-and-ride lot services two routes that provide mobility options to the Northwest Transit Center, downtown, and the W. Little York park-and-ride. The W. Little York park-and-ride lot services three routes: two park-and-ride routes and one local. The Northwest Station park-and-ride services one commuter route (214) that provides non-stop service to the Northwest Transit Center throughout most of the day; however, after 7:30 p.m., route 214 stops at the W. Little York and Pinemont park-and-rides. The park-and-ride routes, in peak periods, have roughly five-minute headways; during non-peak periods, the headways gradually increase until they reach up to one hour in the evening.

Local service to the three park-and-rides is limited to one route (36), which serves an area south of US 290 along Hempstead Highway and ultimately to downtown. There are approximately eight local routes and one cross-town route within the US 290 study area. The local routes generally have circular paths servicing most major thoroughfares inside of Beltway 8, with headways ranging from ten to twenty minutes. The Tidwell cross-town route (45) has an east-west path on Tidwell Road from US 290 to Brockpark Road. The cross-town routes are designed to provide connections to other bus routes, the transit center, and activity centers, while at the same time cross-secting the radial freeway network and creating a nexus with the arterial grid system.

HOV Facility

METRO manages a single lane, reversible, high-occupancy-vehicle (HOV) located in the center of US 290, and extending from the Northwest Station park-and-ride to the Northwest Transit Center, which is located at the northwest corner of the IH 10 / IH 610 interchange. During peak-hour operations, a 3+ minimum passenger restriction is enforced, with a 2+ restriction during off-peak hours. Beginning in November of 2000, METRO instituted a managed-facility concept to the US 290 HOV facility, allowing vehicles carrying only two passengers to pay a $2 toll (via electronic toll tag) to gain access to the HOV lane during the peak-hour restriction.

The facility is accessed at six locations within the study area. The first access point is at the beginning of the HOV lane just west of Eldridge Parkway, where non-barrier auxiliary lanes transition into the barrier-separated HOV lane. Heading east, the second point of access is via the tee-ramp from the Northwest Station park-and-ride facility located at West Road on the north side of the freeway. The third access point, from the W. Little York park-and-ride facility located just east of the Beltway 8 interchange on the south side of the freeway, connects to the HOV lane via an elevated tee-ramp. The fourth location at which the HOV lane can be accessed within the corridor is from the tee-ramp connecting to the Pinemont park-and-ride facility located on the north side of the freeway, just east of Pinemont Drive. The HOV facility can also be accessed via an elevated tee-ramp located just west of the IH 610 interchange. These ramps allow for users of the HOV facility to access the service roads and destinations near the easternmost end of the corridor prior to committing to the next exit, which is the Northwest Transit Center. One additional HOV access point is the IH 10 West connection to the Northwest Transit Center.

ITS Capabilities

The US 290 Corridor presently has several intelligent transportation system (ITS) components instrumented within it. These include the following:

- Computerized transportation management system (CTMS)
- Automated vehicle identification (AVI) system
- Elements of the high-occupancy-vehicle (HOV) system
- Elements of the park-and-ride facilities
- Houston TranStar

Approximately 13 miles of freeway main lanes are presently instrumented under the CTMS program. Components of this system include closed circuit television, variable message signs, ramp flow signals, loop detector systems, and associated communications.

In April of 1996, the AVI system on the US 290 freeway became operational. This system collects measure of effectiveness (MOE) performance data by monitoring vehicles that are equipped with Type 2 toll tags, the same tags used on the Harris County toll road system. This MOE data generates real-time status information that is used to monitor the freeway's performance.

The HOV system deployed on the corridor utilizes variable message signs similar to those used with the CTMS system, directional lane-control signals to alert users to the operational status of the HOV lane, and a communication system incorporated into the CTMS communication system. Beginning in November 2000, a toll tag program was initiated on the HOV system, allowing users with only 2 people in a vehicle to "buy" their way on to the system during peak hours, when 3+ persons per vehicle restrictions are in effect.

The existing park-and-ride facilities within the US 290 Corridor also utilize ITS components to control access to and from the HOV system. These include variable message signs, traffic signals, two-state electrical mechanical sign assemblies, and barrier gates. These elements utilize control devices similar to those used in the CTMS system.

Houston TranStar is a 52,000-square-foot central intermodal transportation control facility located near IH 10 and IH 610. This facility is a cooperative effort between TxDOT, METRO, the City of Houston, and Harris County. It serves as the central control facility for all ITS components and houses the central ITS workstations for the entire Houston metropolitan area, key staff from participating management agencies, and dispatching for emergency management services.

4.2 EXISTING TRAFFIC ANALYSIS

Based on geographic location, three levels of capacity have been developed by H-GAC to better reflect travel patterns and roadway design characteristics. These capacities were further differentiated to reflect state standards for four facility types, as is shown in the following table. These "evaluation" capacities include facility adjustments for signal green times, percent trucks, percent left turns, directional factors, etc. The following are 24-hour, per-lane capacities.

Facility Type	Urban	Suburban	Rural
Freeways	23,500	23,500	16,500
Tollways	18,000	18,000	--------
Expressways	11,000	11,000	--------
Arterials	7,500	6,250	5,000

Four levels of mobility (LOM), which are used to define congestion, were developed by the H-GAC Travel Modeling Committee in 1997 and approved by the Technical Advisory Committee (TAC). They are shown as follows:

LOM	Volume / Capacity	LOS
Tolerable	< 0.85	A, B, C, D
Moderate	>= 0.85 < 1.00	E
Serious	>= 1.00 < 1.25	F
Severe	>= 1.25	F

Level of service (LOS) D was assumed to be the minimum acceptable mobility level for the US 290 Corridor. Roadways with LOS of E or F (moderate, serious, severe) were identified as being congested. Roadways with a LOS A through D (tolerable) were identified as not congested.

The existing condition analysis of the US 290 Corridor involved developing levels of service for the freeway main lanes and existing available frontage roads. The section of interest on US 290 extends approximately from IH 610 westward to FM 2920. The freeway main lanes end just southeast of Mueschke Road, continuing as frontage roads to FM 2920.

The corridor includes Hempstead Highway, which extends southeast to northwest and parallels the southeast end of US 290. The section of interest in developing levels of service extends from IH 610 to Beltway 8.

Traffic data used for developing the levels of service on US 290 and Hempstead Highway were provided by the Texas Transportation Institute (TTI - Houston). Peak traffic volumes were observed between the morning hour of 7:00 to 8:00 a.m. and the evening hour of 5:00 to 6:00 p.m.

During these same periods, vehicle turning movement counts were taken at various intersections of frontage roads with crossing streets. Turning movement counts were also collected at the signalized intersections along Hempstead Highway.

Level of Service

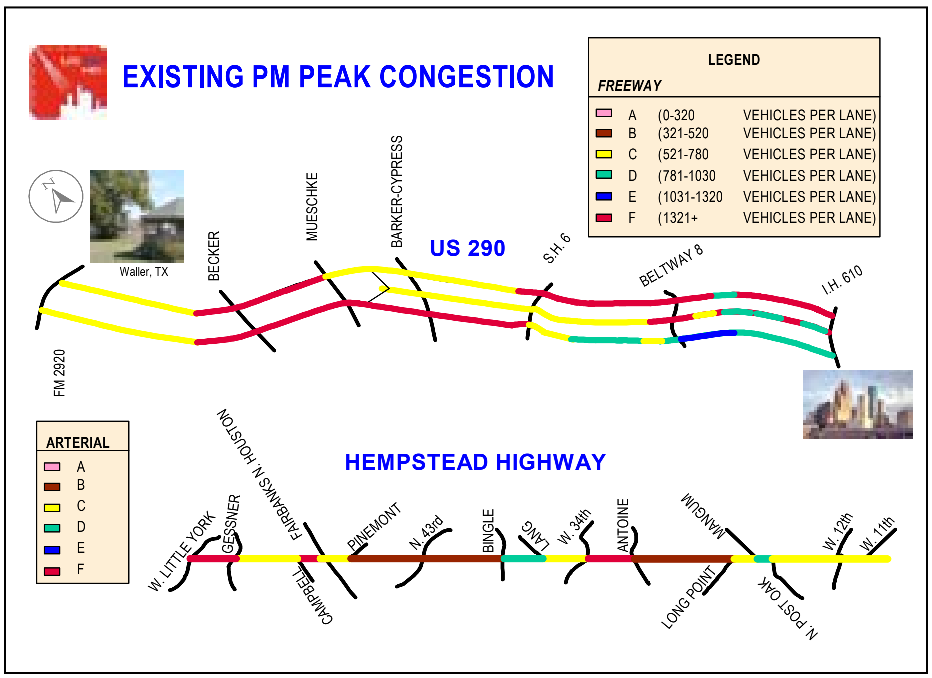
Levels of service were calculated for US 290 (main lane and frontage roads) using TxDOT tables for the recommended average daily traffic (ADT) by facility. Peak traffic hours typically represent 10 percent of the ADT. Using threshold values for level of service E gave a capacity per lane (for the main lanes) of 1,320 vehicles. The capacity per lane for the frontage roads was 500 vehicles.

Level of service was obtained for Hempstead Highway with highway capacity software (HCS). HCS uses intersection level of service to calculate level of service for sections on arterials. The different values for sectional level of service are combined by HCS to give a total level of service for the arterial.

From analysis of the data collected, it was determined that the p.m. peak hour experienced the highest congestion along the corridor. The peak direction during the evening hours is generally expected to be moving outbound and away from the central business district (CBD), which in the case of the corridor, is westbound for both US 290 and Hempstead Highway. Again, the directional main lane volumes were combined to develop an overall level of service for the facility, and the level of service for the frontage roads were developed by direction. **Figure 4.2-1** represents the level of service during the p.m. peak hour along US 290 and Hempstead Highway.

Significant congestion occurs between IH 610 and Beltway 8 for the freeway main lanes as well as the westbound frontage road. The congestion continues to the west along the frontage road to SH 6. Although opposite the peak direction, significant congestion occurs eastbound on the frontage road between Mueschke Road and SH 6. Congestion occurs for each direction on the frontage road between Mueschke Road and Becker Road.

Figure 4.2-1: Existing P.M. Peak Congestion



The expected peak direction for Hempstead Highway in the evening hours is westbound and away from the CBD. Three sections of Hempstead Highway experience significant congestion during the p.m. peak period: between W. 34th and Antoine, between Fairbanks-N. Houston and Campbell, and between W. Little York and Gessner. HCS rated the arterial overall as having a level of service E, or congested, during the p.m. peak hour.

High-Occupancy-Vehicle (HOV) Lane Congestion

US 290 provides an HOV lane for vehicles with two or more (or three or more) persons depending on time of day. It operates from 5:00 a.m. to 11:00 a.m. in the inbound (eastbound) direction and from 2:00 p.m. to 8:00 p.m. in the outbound (westbound) direction. **Table 4.2-1** provides data on HOV usage near Dacoma Road from the year 2000.

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Table 4.2-1: Northwest Freeway (US-290) HOV Lane Operational Summary September 2000

Vehicle Class	a.m. - Inbound Vehicles	a.m. - Inbound Persons	a.m. - Inbound Average Occupancy	p.m. - Outbound Vehicles	p.m. - Outbound Persons	p.m. - Outbound Average Occupancy	Total Vehicles	Total Persons	Total Average Occupancy
Buses (40 Person)									
Peak Hour	0	0	-	0	0	-	0	0	-
Peak Period	0	0	-	0	0	-	0	0	-
Off-Peak	0	0	-	0	0	-	0	0	-
Total	0	0	-	0	0	-	0	0	-
Non-Metro Buses (40 Person)									
Peak Hour	0	0	-	1	20	20.00			
Peak Period	0	0	-	5	140	28.00	5	140	28.00
Off-Peak	0	0	-	0	0	-	0	0	-
Total	0	0	-	5	140	28.00	5	140	28.00
Buses (60 Person)									
Peak Hour	21	1,165	55.48	21	970	46.19			
Peak Period	46	2,485	54.02	48	2,155	44.90	94	4,640	49.36
Off-Peak	0	0	-	0	0	-	0	0	-
Total	46	2,485	54.02	48	2,155	44.90	94	4,640	49.36
Vanpools									
Peak Hour	9	50	5.56	5	28	5.60			
Peak Period	30	170	5.67	29	160	5.52	59	330	5.59
Off-Peak	0	0	-	0	0	-	0	0	-
Total	30	170	5.67	29	160	5.52	59	330	5.59
Carpools									
Peak Hour	912	2,048	2.25	1,183	2,359	1.99			
Peak Period	2,369	5,018	2.12	2,609	5,168	1.98	4,978	10,186	2.05
Off-Peak	193	386	2.00	300	600	2.00	493	986	2.00
Total	2,562	5,404	2.11	2,909	5,768	1.98	5,471	11,172	2.04
Motorcycles									
Peak Hour	20	20	1.00	20	20	1.00			
Peak Period	40	40	1.00	53	53	1.00	93	93	1.00
Off-Peak	0	0	-	0	0	-	0	0	-
Total	40	40	1.00	53	53	1.00	93	93	1.00
Total Vehicle									
Peak Hour	962	3,283	3.41	1,229	3,377	2.75			
Peak Period	2,485	7,713	3.10	2,739	7,536	2.75	5,224	15,249	2.92
Off-Peak	193	386	2.00	300	600	2.00	493	986	2.00
Total	2,678	8,099	3.02	3,039	8,136	2.68	5,717	16,235	2.84

Non-METRO buses are included with 40-person buses.
Data collected at Dacoma.
HOV Lane operates from 5:00 a.m. to 11:00 a.m. inbound and from 2:00 p.m. to 8:00 p.m. outbound; and
All 2+ vehicles are eligible to use the HOV Lane except from 6:45 a.m. to 8:00 a.m. and 5:00 p.m. to 6:00 p.m. when a 3+ requirement is in effect
Source: Texas Transportation Institute

4.3 CORRIDOR INFLUENCES

The US 290 MIS occurs in Harris County, Texas, primarily within the city limits of Houston, although the northwestern portions of the corridor also extend into the smaller cities of Cypress, Hockley, and Waller. The specific geographic areas for this analysis vary according to the type of information being analyzed. For example, land use and cultural resource information is focused on the immediate corridor itself, which is defined as extending 500 feet from both sides of the existing US 290 and Hempstead Highway rights-of-ways within the project limits. (In cultural resource parlance, this area is known as the area of potential affect, or APE[1].) Socioeconomic information is addressed within the geographically larger study area, which, for analysis purposes, is defined by the US Census Tracts that occur in the general vicinity of the corridor.

Existing social, economic, and environmental information was gathered and reported in the June 2001 *Existing Conditions Report*. The following sections address land use and socioeconomic conditions that give rise to travel demand within the corridor. Additional environmental information is contained in Section 8.5.

Land Use

The project corridor consists of a mix of land uses, ranging in character from decidedly urban in the southeastern portion (inside Beltway 8) to more suburban and rural in the northwest (outside Beltway 8). In between, one finds a fairly typical mix of commercial and retail uses along the frontage roads of the highways, with residential neighborhoods occurring adjacent to US 290 at several locations along the corridor. **Plates 1 - 6, Environmental Constraints,** located in ***Appendix C***, show current land uses along the corridor. **Table 4.3-1** summarizes the current land use categories by area.

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[1]The area of potential effect (APE), as designated by the TxDOT Environmental Affairs Division guidelines for historic buildings reconnaissance and documentation, consists of a one-quarter-mile zone on either side of a proposed roadway involving new location right-of-way, and 500 feet on either side of a proposed roadway expansion. TxDOT, in consultation with the Texas Historical Commission, has determined that the APE for archeological sites shall be within existing or proposed rights-of-way and within all areas associated with construction activities.

Table 4.3-1: Land Use Categories

Land Use Category	Area Coverage (Acres)	Percent of Project Corridor
Commercial / Industrial	1,900	31%
Public Facility	79	1%
Residential	457	8%
School	49	<1%
Vacant	3,514	58%
Church	14	<1%
Cemetery	4	<1%
Parks	27	<1%
Total	**6,044**	**100%**

Commercial / Industrial

As previously mentioned, much of the corridor consists of individual businesses, restaurants, strip retail centers, entertainment spots, and convenience stores. There are also a number of major employers located within or adjacent to the project corridor. Listings of these employers are located in **Table 4.3-6** later in this chapter. Commercial and industrial land uses comprise 31% percent of the total project corridor area.

Public Facilities

This category includes government buildings; hospitals; post offices; fire, police, and EMS stations; other publicly owned infrastructure sites (such as lift stations, electric sub-stations, water storage tanks, METRO park-and-ride lots); and community centers. A private airport — Weiser Airport — is located near the interchange of US 290 and Telge.

Residential

Numerous single-family residential neighborhoods occur along the corridor on both sides of US 290 and Hempstead Highway. Multifamily apartments also occur within and adjacent to the project corridor. Residential areas account for eight percent of the total project corridor area.

Schools

Public grade schools and day care facilities are present within the corridor, most notably in the Waller area and at the intersection of US 290 and Telge.

Vacant

About 58% of the total project corridor area is currently vacant or undeveloped. Some of this category includes land being used for agricultural purposes.

Churches

There are two churches within the project corridor; both are located immediately adjacent to the US 290 right-of-way.

Cemeteries

Three known cemeteries occur within the project corridor, two of which are located in the town of Waller.

Parks

Section 4(f) of the Department of Transportation Act of 1966, as amended, affords special protection to public parks. It states that *"The Secretary may approve a transportation program or project requiring use of publicly owned land of a public park, recreation area, or wildlife / waterfowl refuge, or land of a historic site of National, State, or local significance (as determined by the officials having jurisdiction over the park, recreation area, refuge, or site) only if 1) there is no prudent alternative to such use, and 2) the project includes all possible planning to minimize harm…."* Dyer Field and Delmar Stadium, both school facilities and located near the US 290 / IH 610 interchange, appear to be the only park-like facilities within the corridor.

Table 4.3-2 identifies specific land use features within the project corridor that could potentially constrain transportation improvement alternatives (see ***Appendix C***: Environmental Constraints). Efforts will be taken during the alternatives analysis to avoid adversely affecting these features. Any impacts to these places that could occur as a result of proposed alternatives will be further analyzed in subsequent stages of project development, along with measures to minimize or mitigate any adverse impacts.

Table 4.3-2: Land Use Features

Churches	Schools	Parks	Other
Fairfield Baptist Church	Waller High School	Dyer Field and Delmar Stadium	Waller Cemetery
Houston First Church and Day Care	Waller Jr. High School		Lutheran Cemetery
	Waller Elementary		unnamed cemetery
	Cy-Fair High School		
	Arnold Jr. High School		
	Scarborough Jr. High School		
	Wainwright School		

Socioeconomics

Current Study Area Demographics

According to the 2000 US Census, the study area is comprised of 84 Census Tracts that occur in the vicinity of the US 290 and Hempstead Highway corridor. According to the 2000 Census, Whites constitute a majority of the area's population (52%). Hispanics make up the largest ethnic population in the study area, constituting 29% of the total study area population. This proportion of Hispanic residents is less than that found in the City of Houston as a whole, but is well above that for the US population, which is 12.5% Hispanic. **Figure 4.3-1** shows the census tracts in the corridor that have a Hispanic population above the national average. The study area has an African-American population of about 10%, substantially lower than the City of Houston's proportion of 25%. In 2000, elderly residents made up a slightly smaller percentage of study area residents in comparison to the City of Houston. (See ***Appendix C*** for the population characteristics of the study area.)

Poverty rate and household income (***Appendix C***) vary widely within the study area. In the 2000 Census, roughly 10% of the study area households were below the poverty level, compared to about 19% below poverty for all Houston households. **Figure 4.3-2** shows the census tracts in the corridor that have poverty levels above the national average.

Figure 4.3-1: Percent Hispanic Above National Average

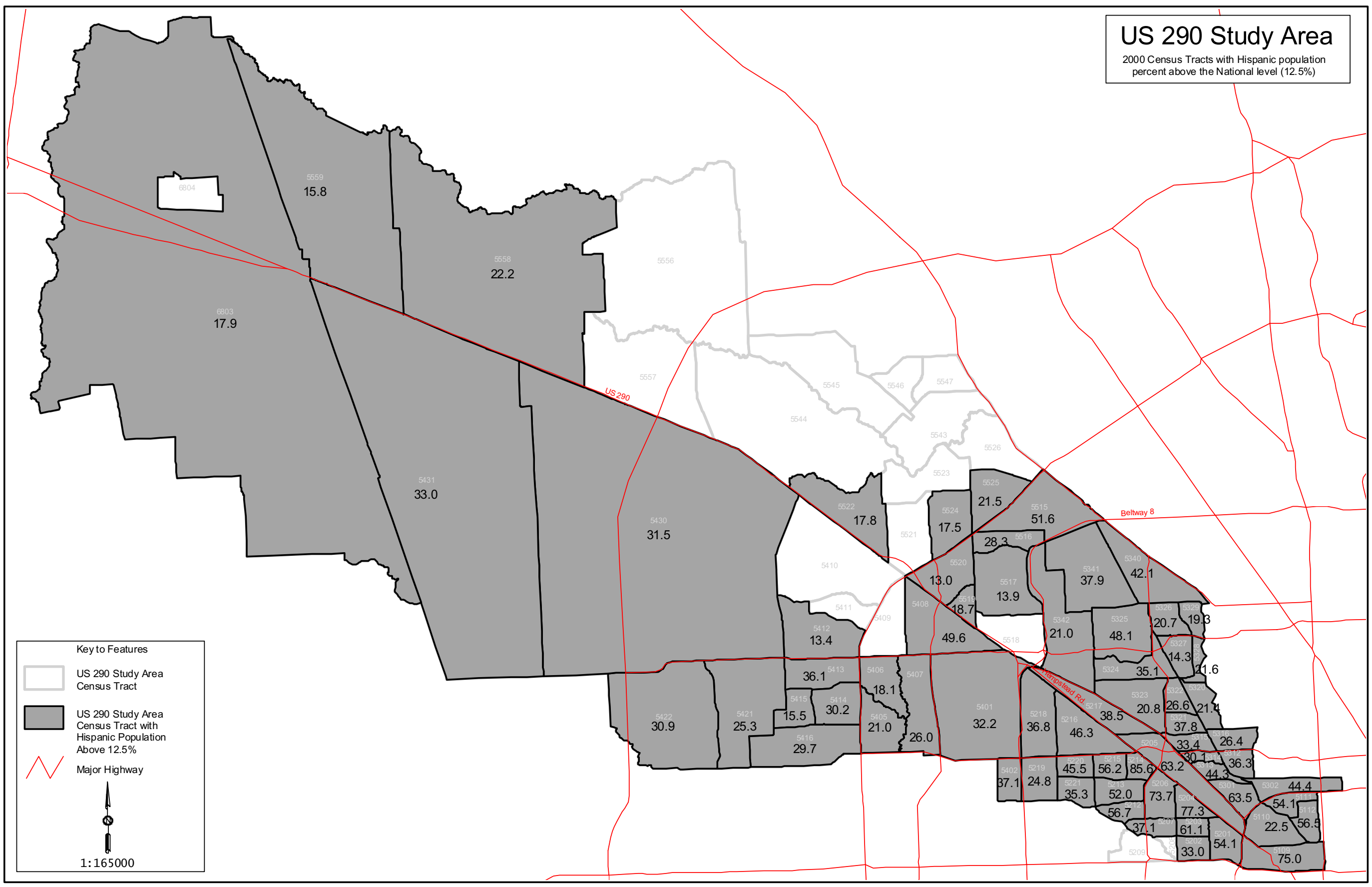
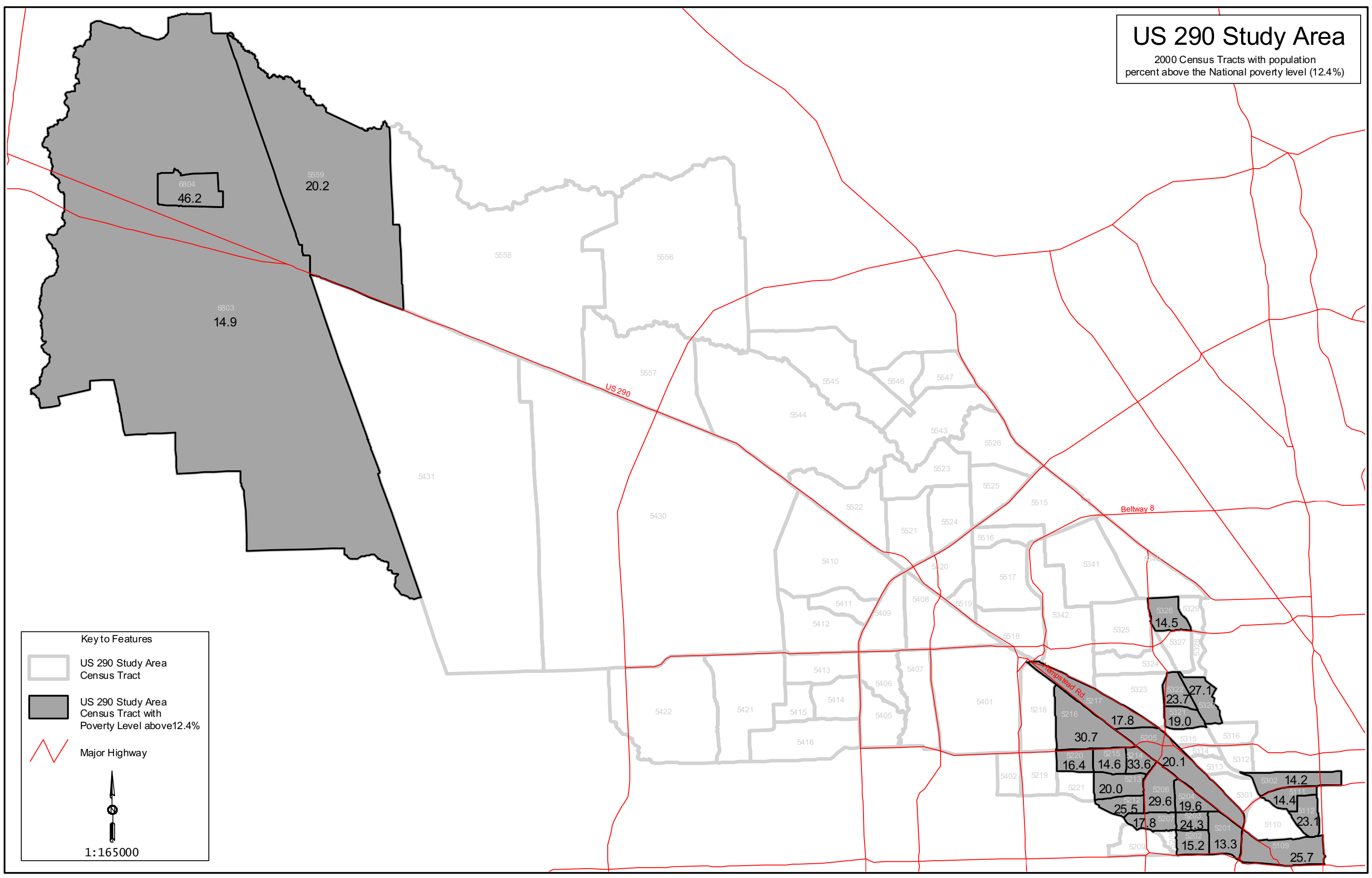


Figure 4.3-2: Percent Poverty Above National Average



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Most of the housing within the study area was owner-occupied (64%) in 2000 (***Appendix C***). The age of homes ranges from the 1950s to the early 1990s. For corridor Census Tracts that occur inside Beltway 8, the median age of house structures is older, reflecting a pattern of residential development that pre-dated construction of the US 290 freeway.

Much of the study area is home to businesses and industries that provide a growing base of employment for both nearby residents and commuters. The major employers within the study area (100 or more employees) are shown in **Table 4.3-6**. These businesses are primarily limited to those found along either US 290 or Hempstead Highway.

Table 4.3-6: Project Corridor Major Employers

Name	Location	Employees
Hewlett-Packard	24500 Highway 290	N/A
Wendy's	13405 Northwest Freeway, Suite 307	1000
Dril-Quip	13550 Hempstead Highway	800
Mustang Tractor & Equipment Company	12800 Northwest Freeway	500
Olsten Temporary Services	13105 Northwest Freeway, Suite 114	500
Ecom-Elite Computer Consultants	10333 Northwest Freeway, Suite 414	250
Vallen Corporation	1333 Northwest Freeway	250
Mustang Power Systems	12800 Northwest Freeway	249
Liberty Mutual Insurance Co.	13201 Northwest Freeway, Suite 400	225
Cherokee Staffing, LLC	14121 Northwest Freeway, Suite B-1	213
IT Corp.	13111 Northwest Freeway, Suite 600	125
Daniel Industries-Electronics Division	19203 Hempstead Highway	100
MEI Engineering & Quality Service	13100 Northwest Freeway, Suite 660	100

Source: Houston Chamber of Commerce, 2000.
Note: List includes primarily those employers with an address on US 290 or Hempstead Highway.

Projected Population and Employment Growth

As stated previously, the study area is comprised of a mix of residential, commercial, and industrial land uses. As a result of this development pattern, increases in both population and employment are expected over the next 25 years. As shown in **Table 4.3-7**, the number of study area employees is projected to increase by 54% between 2000 and 2025, from 241,448 to 370,970. This anticipated employment growth tends to reinforce the increasing importance of business and commerce within the study area. Population is projected to nearly double during the same timeframe, from 366,884 to 708,484.

Table 4.3-7: Change in Study Area Population, Households and Employment, 2000-2025

	2000	Projected 2025	Change 2000-2025	Percent Change 2000-2025
Population	366,884	708,484	341,600	93%
Households	171,646	275,535	103,889	61%
Persons / Household	2.14	2.57	0.43	20%
Employment	241,448	370,970	129,522	54%

Source: 2000 US Census. Year 2025 projection is from the Houston-Galveston Area Council.

Chapter 5
Conceptual Corridor Alternatives

5.1 INTRODUCTION

The existing US 290 Corridor is currently served by a multimodal transportation system. The size and diversity of the US 290 Corridor make it unlikely that one single transportation improvement to the existing system will meet future needs; therefore, this major transportation study of the US 290 Corridor will examine a wide variety of transportation modes and improvements, independently and in practical combinations, that may promise to be part of the long-range transportation solution in the corridor.

The approach used in a major investment study is to consider many alternatives, to evaluate the most promising, and then to select the best and most appropriate. A process is used that, based on an understanding of corridor conditions, needs, and goals, moves from general to detailed evaluation and advances from many alternatives to one recommendation. As the list of options is screened and refined, greater detail is used to evaluate the differences between the alternatives. The process seeks to eliminate the least efficient answers as well as combine techniques and modes that have a synergistic effect to increase mobility.

The alternative development process begins with the consideration of as many modes and strategies as possible. At the onset of the MIS, a universe of alternatives that included all plausible ideas was developed. Initially, no idea was too trivial or grandiose to consider. The universe of alternatives included various ideas and options within the categories of transit, freeway, streets and highways, transportation system management (TSM) strategies, and travel demand management (TDM) strategies. The tactic behind the universe of alternatives is that different combinations of the listed ideas are combined to form conceptual alternatives from which a locally preferred alternative is eventually identified. The identification of a *complete* universe of alternatives may be impossible; however, the attempt leads to a long list of ideas that serve as the starting point for the development of the locally preferred alternative.

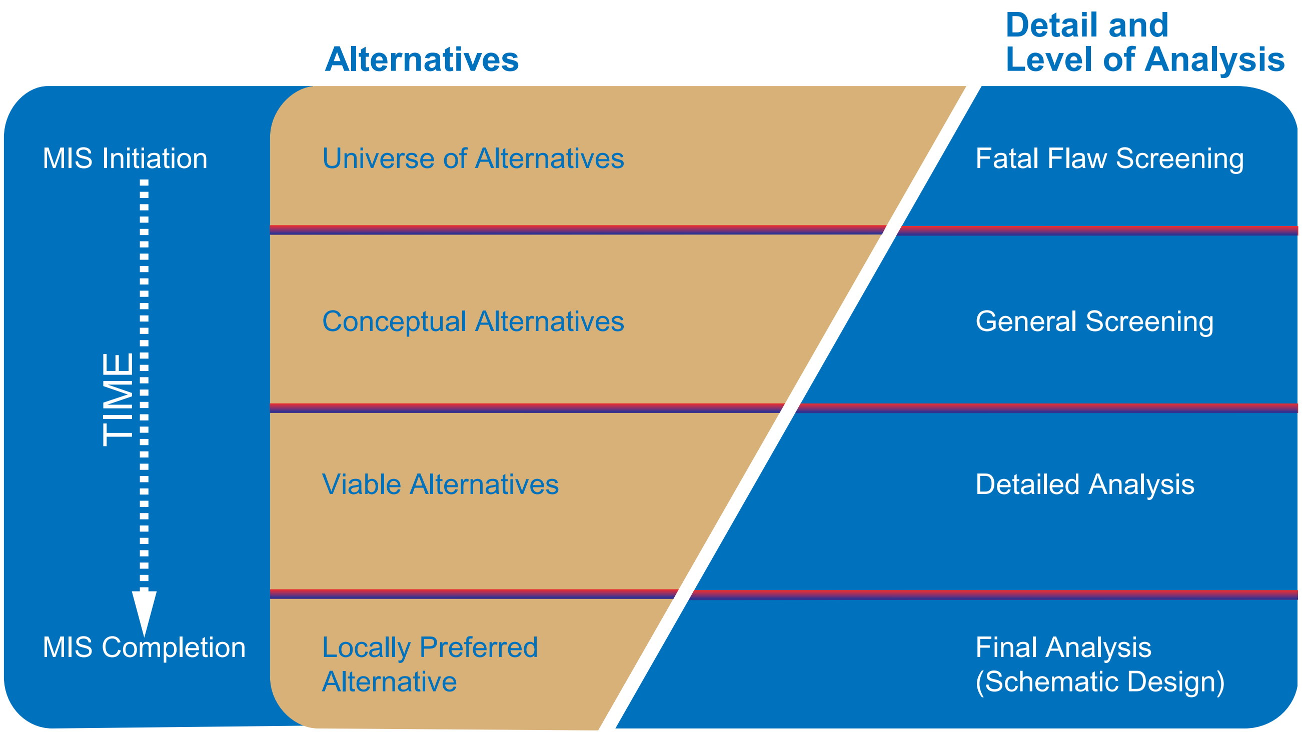
Table 5.1-1 shows the universe of alternatives that was used to develop the initial list of conceptual alternatives. The subsequent sections in this chapter present, within categories, the fundamental components of the alternatives. Each section (except the no-build alternative category) lists a fundamental component and provides a general description. A discussion of the screening process in **Section 5.4** leads to **Section 5.5**, which is a summary listing of the conceptual alternatives.

Table 5.1-1: Universe of Alternatives

Transit		
Rail	**Bus**	**Other**
Light rail	Local service	Personal rapid transit
Commuter rail	Bus rapid transit (BRT)	Carpool / vanpool
Heavy rail	Express with HOV	Park-and-ride
Monorail	Charter or subscription bus service	Transfer facilities
Stations	School buses	
Freeway		
General-purpose lanes	Service (feeder) roads	Truck lanes
Managed facility	Interchanges	Intelligent transportation systems (ITS)
Express facility	Express lanes	Ramp system modifications
Toll lanes / facility	Non-barrier (Diamond) HOV lanes	Auxiliary lanes
High-occupancy-vehicle lanes (HOV)	Express Hempstead	Dual freeway
		Meet current roadway standards
Streets & Highway		
Arterial network	Signal system (ITS)	Hempstead — 6-lane, 8-lane
Parallel arterial	TSM improvements	Grade separation
Super street		
Transportation System Management (TSM) Strategies		
Arterial widening	Access management	Emergency / special event management
Intersection improvements	Traffic operations and signal system improvements	Intelligent transportation systems (ITS)
Travel Demand Management (TDM) Strategies		
Employee trip reduction (ETR) programs	Public transportation improvements	Bicycle / pedestrian strategies
Transportation management associations	Traffic restricted zones	Value pricing

Figure 5.1-1 below depicts the analysis process used to arrive at the locally preferred alternative.

Figure 5.1-1: MIS Process



5.2 BASELINE (NO-BUILD) ALTERNATIVE

An alternative that is always part of any alternatives analysis such as an MIS is the no-build alternative. The no-build alternative is a *de facto* alternative because it is always viable until a decision is made to implement a build alternative. The no-build alternative also serves as a baseline condition, which is the description of projected, study-year conditions even if no major transportation improvements are made in the corridor. Typically, the no-build alternative will include all improvements identified in the *2022 Metropolitan Transportation Plan* (MTP), except those that are proposed in the corridor.

5.3 TRANSIT ALTERNATIVES

Light Rail Transit

(Source: METRO)

Light rail transit (*LRT*) is the most prevalent mode for new high capacity transit systems in the country. It uses a "light" vehicle that may operate in an open right-of-way or within a street in mixed-flow with traffic. This flexibility is possible because overhead wires supply power to the transit vehicle. Where (and if) the vehicles are operated on city streets or roadway medians, light rail resembles a modern version of trolley cars; where it operates in a separate right-of-way (at-grade, elevated, or even in a subway) its comfort and speed resemble heavy rail. Light rail can carry medium-to-high passenger volumes. Stations may be simple stops or more elaborate facilities with significant passenger amenities. Light rail is most efficiently operated as part of an interconnected system.

Potential Application in US 290 Corridor

LRT has the potential to serve the US 290 Corridor because the northwest corridor line would be an integral component of METRO's *Mobility 2025 Transit System Plan*. This plan identifies the Tomball Corridor (SH 249 Corridor) and the US 290 Corridor as candidates for advanced high capacity transit. The plan designation for this corridor is mode neutral, pending the completion of a more detailed analysis (such as this major investment study) that would identify the specific mode and alignment. The Tomball Corridor is mentioned here because the system connection for a US 290 Corridor light rail line would be accomplished identically to the proposed connection for the Tomball Corridor. In both cases, a corridor alignment would connect to the Northwest Transit Center at Old Katy Road and Post Oak. From this location, the line will follow the preferred alignment of the West Loop-Uptown Corridor that connects to the Westpark Corridor and downtown.

Light rail transit would serve the daily commuter trip to work and school; shopping trips; and occasional trips for business, entertainment, or medical purposes. The light rail system plan presents a system that serves the major activity centers in Houston, including downtown, Post Oak, Greenway Plaza, the Texas Medical Center, and many others. In addition, the northwest line would serve the employment centers in the corridor. Light rail stations would serve change-of-mode trips, such as park-and-ride and kiss-and-ride, as well as bus transfers, bicycle, and pedestrian. The service would replace the express and commuter bus service provided by METRO through its transit centers and HOV lanes. By providing large parking lots at some (but not all) stations, the trains serve a large service area with auto and bus access. This allows users to avoid the longer line-haul trip over congested highways and for some, to avoid expensive downtown parking charges. The service can operate at speeds that make it comparable or better than the highway commute.

Heavy Rail Transit

Heavy rail transit is the fastest and most expensive mode because it is always operated in a separate right-of-way (due to the power delivery via a third rail). In dense areas like a downtown, it usually operates in a subway tunnel. Washington, D.C.'s metro system is an example of heavy rail. Stations employ platform loading and are quite elaborate due to the high passenger volumes and the need to separate passengers and other lines from the grade of the track. This mode operates as part of an interconnected system.

(Source: FTA)

Potential Application in US 290 Corridor

Heavy rail transit is not the mode selected by METRO to meet the long-range transportation needs of Houston. This decision is based on several significant factors, such as cost and service characteristics, and is not likely to change within any reasonable planning time frame. The absence of a heavy rail system plan makes the mode unsuitable for a single-corridor application.

Commuter Rail

Commuter rail refers to passenger rail service between a city center and its suburbs. It may use locomotives to pull passenger cars, self-propelled passenger vehicles, or overhead-electric supplied vehicles. As the name implies, it is oriented towards the commuter trip. Passengers may be served at simple stations with or without platforms, and commuter rail lines do not necessarily need to be integrated as a system.

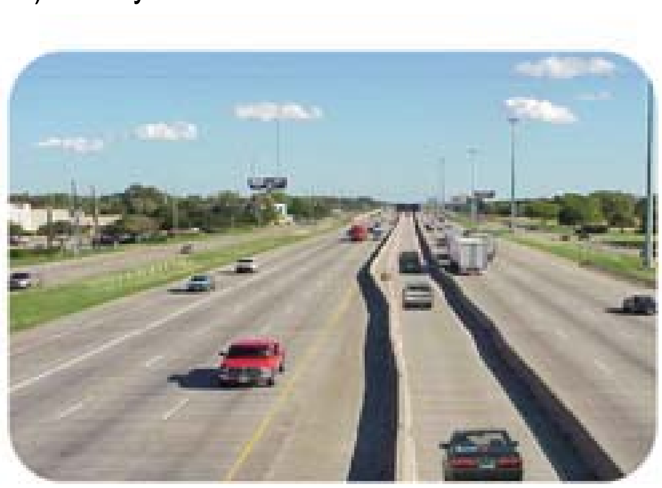
(Source: FTA)

Potential Application in US 290 Corridor

Commuter rail could possibly be implemented in the corridor within the Union Pacific Railroad (UPRR) right-of-way. Service and facilities would have to be integrated into the current freight service operated by the UPRR. The most appropriate service characteristics of this mode favor large commuting volumes between a suburban origin and a center city destination with a limited number of intervening stations. Commuter rail service has the advantage of relatively quick and inexpensive implementation if the UPRR chooses to implement it using existing facilities. While quick implementation is a distinct advantage, this mode is not well-suited to serve long-term intracorridor mobility needs.

High-Occupancy-Vehicle (HOV) Facility

HOV lanes, like those currently used in the US 290 Corridor, are for carpools, vanpools, and buses, and are usually separated from general-purpose lanes by concrete traffic barriers. Access to the lanes may be directly from the freeway or from transit centers, which are facilities that include passenger amenities, parking spaces for bus riders or carpoolers, and stops for local and express bus service.



Potential Application in US 290 Corridor
This mode has met mobility needs in the corridor for many years. Commuters' use of buses and carpools (high-occupancy-vehicles) increases the efficiency of the mobility system and provides air quality benefits as well as reductions in congestion levels. This mode is an integral part of the State Implementation Plan (SIP) that provides for meeting the emission requirements of the Clean Air Act amendments. Since these facilities serve both automobile and transit modes, and there is a considerable existing investment, HOV facilities have a high probability of being part of the future mobility system in the US 290 Corridor.

Bus Service Improvements


(Source: METRO)

As previously noted, METRO is the regional transit authority providing local and express bus service in a service area that includes the northwest corridor. METRO currently provides local bus service in part of the service area, express bus service from transit centers, and operates the HOV lane along US 290. This service was previously illustrated in **Figure 4.1-5**. Bus system improvements would include:

- Addition of bus routes to increase the coverage area
- Increased headways on existing local and express bus routes
- Conversion of HOV facilities to high capacity busways

Potential Application in US 290 Corridor
The projected growth in the northwest corridor assures that the existing bus system needs to be expanded to provide service coverage in newly developed areas. Additionally, the existing route and service structure may be modified over time to meet the changing needs and to maintain system service standards. From a service-supply perspective, the capacity of the bus system to provide line-haul capacity could be increased sufficiently to meet almost any level of projected demand, by operating express buses at greater headways, eventually removing all private vehicles from the HOV facilities. However, there should be more evidence that this high capacity supply option is matched by latent or new demand.

Bus Rapid Transit

(Source: http://www.fta.dot.gov/brt/projects/boston.html)

Bus rapid transit (BRT) combines the ease-of-use of some rail service with the flexibility of a bus system. BRT can operate on ordinary streets, expressways, HOV lanes, or exclusive transitways. BRT incorporates transit priority, intelligent transportation systems (ITS) technology, and integration with land use policy. BRT offers more rapid and convenient fare collection as compared to standard bus systems.

Potential Application in US 290 Corridor

The potential application of BRT is similar to that of LRT. It could be implemented along US 290 or Hempstead Highway. An advantage of BRT is that it operates well on a fixed guideway, but is also capable of leaving the guideway or not using one at all.

Advanced High Capacity Transit

Advanced high capacity transit (AHCT) is a general term used to describe several types of high capacity, line-haul transit modes. AHCT is used to designate a future mode, such as light rail transit, bus rapid transit, or some yet-undeveloped future transit technology to serve the corridor prior to the selection of the specific mode.

5.4 FREEWAY ALTERNATIVES

General-purpose Lanes

General-purpose lanes are regular freeway lanes that are open to all types of vehicles. Adding more freeway lanes would include adding shoulders next to the HOV barriers and widening the existing freeway and / or service roads. Additional right of way may be needed. These alternatives will reduce congestion, but the added capacity for single-occupant-vehicles may not help meet air quality goals.

Potential Application in US 290 Corridor

Existing and projected levels of corridor congestion are evidence that there is a significant need for additional general-purpose lanes in the US 290 Corridor. Further, the goals of safety and the required use of TxDOT design standards require that additional lanes would include the construction of both inside and outside shoulders as part of facility reconstruction. It is likely that the level of demand in the corridor will vary enough to warrant one or two changes in the number of lanes on US 290. The exact location and the manner of the lane transitions is also a significant consideration. The existing “system interchange” with Beltway 8 and another proposed system interchange with the Grand Parkway, are two locations that must be carefully considered with respect to the number of general-purpose lanes.

Diamond Lanes

Diamond lanes are a class of HOV lanes that operate without physical barriers to separate HOV traffic from general traffic. Entry in the lanes may be unrestricted or restricted to certain locations. Since the lanes are separated from general-purpose lanes only by pavement markings, enforcement of occupancy requirements is a consideration, as are the safety issues caused by speed differential where traffic in the diamond lane is traveling faster than the traffic in general-purpose lanes.

Potential Application in US 290 Corridor
Diamond lanes and other forms of special-purpose lanes (bus-only or truck lanes) might be considered operational improvements that could be implemented at any future time when their use is deemed legal, safe, and appropriate. They should be considered in the US 290 Corridor because they provide many of the advantages of separate HOV facilities, with lower implementation expense and more operational flexibility. They may be considered as an alternative to dedicated HOV facilities or as an adjunct to them. Some of the advantages of this approach may be interpreted as disadvantages with respect to transit-oriented goals because they are not permanently dedicated.

Express Service Roads

An *express service road* denotes a case where frontage roads split (or diverge) upon the approach to a crossing street, allowing one or more lanes to bypass the intersecting street intersection by using the freeway-grade-separation structure. Once past the cross street, the express roadway merges back into the frontage road. This technique, when used in conjunction with strategic placement and spacing of freeway entrance and exit ramps, would expedite traffic flow in the main lanes while providing uninterrupted flow on service roads until freeway access is obtained. This facility can also provide an alternative to those travelers using the freeway for short, intermittent trips.

Potential Application in US 290 Corridor
Express service roads are a type of improvement that should be considered, along with ramp configuration and spacing, during the schematic design phase as a design variation, rather than a system planning alternative. The approach may also be considered as part of the transportation system management / transportation demand management alternative.

Managed Facility

The *managed facility* is a separate facility within the freeway that combines several desirable features to optimize capacity, level of service, and air quality benefits. It is basically an expanded, two-way version of the HOV facilities that are in operation today, with a few key differences.

The first feature of these facilities is that they have limited entry and exit opportunities. Stated differently, they serve relatively long trips; the facility is not accessible for short trips. With fewer ramps, there is less disruption caused by vehicle weaving and merging maneuvers.

The second distinguishing characteristic of the managed facilities is the possible collection of tolls as a means of value pricing. This means that the toll charged would vary by time of day to reflect the value of peak-hour trips versus off-peak-hour trips. Charging a greater toll during periods of greatest demand reflects the variable value of travel on the facility and shifts some demand to times when more capacity is available. This market-based pricing approach serves to balance supply and demand in the corridor. Another element of the value pricing concept is to charge variable tolls based on vehicle occupancy. For example, tolls could range from high for single-occupant vehicles, to low for vehicles with three or more occupants, to zero for ten-occupant vans or buses. This value pricing approach rewards vehicles based on the value they contribute toward meeting regional air quality goals. Stated differently, vehicles with higher occupancy increase the person-capacity of the system and cause less pollution per person-mile and therefore "cost" less than vehicles with lower occupancy.

Potential Application in US 290 Corridor

The managed lane concept has good potential in the northwest corridor. The corridor is long enough to generate sufficient demand for long trips that are served by a managed facility. This is true of single occupant vehicle trips as well as multiple occupant vehicle and transit trips. Another favorable condition is the intersection of system facilities such as Grand Parkway, Beltway 8, and IH 610 that serve as logical interchange locations and termini for a managed facility. The potential locations in the corridor include US 290 as well as the Hempstead Highway corridor.

5.5 TSM / TDM / ITS ALTERNATIVES

Transportation system management (TSM) and transportation demand management (TDM) are the lower-capital components of the region's transportation investment strategy. These two approaches reduce congestion by implementing strategies on both the supply (TSM) and demand (TDM) sides of the transportation equation. Together, these strategies and techniques are among the most cost-effective means available to meet the transportation goals of the region. Intelligent transportation systems involve a set of activities and systems that complement and facilitate both TSM and TDM. Since ITS is already identified as a component of US 290, and a system has been identified for implementation, ITS will be identified as a component of this conceptual alternative.

While TSM / TDM / ITS constitutes a standalone conceptual alternative, it should be noted that most of these strategies will be incorporated *into* any preferred alternative that may be selected. This is true for several reasons. The first reason is that the techniques which comprise this category are very cost-effective means of improving regional air quality. Second, they often lend themselves best to implementation on an areawide basis, rather than as corridor improvements. These techniques often call upon other agencies than TxDOT or METRO for implementation. The recognition of TSM, TDM, and ITS as part of the corridor solution also recognizes the fact that the efforts of many different agencies, private interests, civic associations, and neighborhood groups are needed to meet the transportation needs of this corridor.

Transportation Demand Management

Transportation demand management (TDM) refers to techniques that reduce the *demand* for transportation within the corridor or shift that demand to times, modes, or locations that have surplus supply or are more efficient. Employee trip reduction programs that foster carpooling, vanpooling, and transit are the most effective means of managing demand.

Potential Application in US 290 Corridor

Due to their cost effectives, TDM techniques will certainly play a significant role in the future of the northwest corridor. However, the existing levels of corridor congestion, plus the projected growth in the corridor, indicate that the likely benefits of TDM techniques (8%-12% demand reduction) are not sufficient to replace the need for additional corridor supply. This means that, even coupled with transportation systems management techniques, TDM will not be sufficient to meet the purpose and need for the corridor. Instead, TDM techniques will be a identified that can be incorporated in each of the build alternatives.

TDM Strategies

- Traffic constraints
  - Increase generalized cost of travel
    - Value pricing (congestion pricing)
    - Convert through lanes into toll lanes
  - Restrict usage of portions of transportation network using physical restraints
    - Convert some single-occupancy-vehicle (SOV) lanes into barrier-separated HOV lanes
    - Eliminate some entry / exit ramps
    - Convert some SOV lanes into barrier-separated truck-only lanes
    - Prohibit truck traffic on certain roadways
  - Economic restraints / pricing methods
  - Legal restraints / regulatory controls
    - Increased vehicle registration / inspection fees
  - Time penalties
    - Prevent / eliminate left turns during certain periods of the day
    - Prohibit truck traffic during certain periods of the day

- Public transportation improvements
  - New local bus service
  - Improvements to existing local bus service

- Employee trip reduction (ETR) and transportation management associations (TMAs)
  - Ridesharing programs
  - Parking management
  - Alternative work hours
  - Telecommuting
  - Employee transit pass program

- Bicycle / pedestrian strategies
  - Incorporation into roadway and neighborhood designs
  - Regional networks
  - Integration with transit facilities

Transportation Systems Management

Transportation systems management (TSM) deals with the supply side of the transportation supply / demand equation. Available techniques include intersection improvements, traffic signal synchronization, freeway incident management, access management, and other lower-cost strategies.

Potential Application in US 290 Corridor

Like TDM techniques, TSM will be an important component of each alternative. But TSM even when coupled with TDM does not provide enough mobility benefits to meet the long-term needs of the corridor. This fact does not diminish the important role TSM and TDM will play in each of the viable alternatives and the preferred alternative.

TSM Strategies

- Arterial widening

- Intersection improvements
  - Channelization
  - Addition of turn lanes
  - Addition of through lanes
  - Signalization
  - Grade separation

- Traffic operations and signal system improvements
  - Signal coordination and optimization (regional computerized traffic signal system [RCTSS])
  - Signal-warrant program (for signal additions and removals)
  - Traffic operations safety review program

- Access management (TxDOT, Harris County, City of Houston)
  - Driveway design / location / spacing
  - Median openings location / spacing
  - Design criteria
  - Ramp reconfigurations
  - Ramp metering

- Freeway system improvements
  - Auxiliary lanes
  - Ramp closures
  - Re-striping to add lanes and improve weave / merge areas

Intelligent Transportation Systems

Intelligent transportation systems (ITS) is a term that covers a broad range of activities and systems that use advanced technology to increase overall transportation system efficiency. ITS technologies are applied to infrastructure, vehicles, travelers, and the operators of transportation system components. ITS techniques and services might include advanced traveler information system (ATIS), advanced traffic management system (ATMS), or advanced public transportation system (APTS). These and other specific applications suited for the corridor will be proposed.

Potential Application in US 290 Corridor

Currently the US 290 Corridor has a significant ITS in place. Expansion of the computerized transportation management system (CTMS), and Houston's TranStar System will be a part of any alternative. The following strategies can all be implemented and based on the selected alternatives should play a significant role in this mobility solution for the corridor.

ITS Strategies

Travel and transportation management: in-route driver information, route guidance traveler services information, traffic control, incident management, and emissions testing and mitigation

Travel demand management: pre-trip travel information, ride matching and reservation, and demand management

Public transportation operations: public transportation management, in-route transit information, personalized public transit, and public travel security

Electronic payment: electronic payment services (for example, EZ TAG)

Commercial vehicle operations: commercial vehicle electronic clearance, automated roadside safety inspection, onboard safety monitoring, commercial vehicle administrative processes, hazardous materials incident response, and commercial fleet management

Emergency management: emergency notification, personal security, and emergency vehicle management

Advanced vehicle control and safety systems: longitudinal collision avoidance, lateral collision avoidance, intersection collision avoidance, vision enhancement for crash avoidance, safety readiness, pre-crash avoidance, pre-crash restraint deployment, and automated highway systems

5.6 SCREENING OF THE UNIVERSE OF ALTERNATIVES

The screening criteria used in this study resulted from a consensus between the general public, the Steering and Advisory Committees, and the project team. Each alternative was screened with the following questions, which were designed to address the documented needs and goals for the corridor. At the universe of alternatives level, the questions are designed to uncover any fatal flaws. As the alternatives are screened and conceptual alternatives are defined, the evaluation criteria become more objective. The *Screening Tech Memo* was released in August of 2002.

Screening Questions

1. Improve public safety
    a. Does this option attempt to eliminate recurring conflict locations?
    b. Does this option improve the overall design elements of the corridor to current TxDOT standards?
    c. Does this option eliminate dangerous weaving locations?

2. Improve and maintain mobility
    a. Improve level of service
        i. Does this option maintain the appropriate level of service for commuter travelers?
        ii. Does this option reduce travel times for commuters?

    b. Provide multimodal options
        i. Does this option provide an opportunity for additional modes of travel in the future?
        ii. Does this option meet the needs of the local and regional thoroughfare and transit plans?
        iii. Does this option provide increased accessibility to the corridor?

3. Increase opportunities for transit
    a. Does this option meet the travel needs of the public within the corridor?
    b. Does this option encourage transit ridership?
    c. Is this option a part of METRO's regional transportation system plan?

4. Impacts to the human environment
    a. Does the alternative avoid adverse impacts to the human environment?
        i. Residential displacement
        ii. Neighborhood cohesion
        iii. Displacement of recreational resources
        iv. Commercial development
        v. School / church / public facility impacts
        vi. Noise sensitive receivers
        vii. Impacts to minority and low-income communities (environmental justice)
        viii. Cultural resources
        ix. Public safety
        x. Area growth plans and policies
        xi. Secondary land use impacts
        xii. Local economy and property values
        xiii. Air quality
        xiv. Hazardous materials sites
        xv. Aesthetics
    b. If not, what is the relative severity of the impact (low / medium / high) and what can be done to minimize the harm (potential mitigation measures)?

5. Impacts to the natural environment
    a. Does the alternative avoid adverse impacts to the natural environment (yes / no)?
        i. Total land
        ii. Prime farmland
        iii. Ground water resources
        iv. Wetlands
        v. Floodplains
        vi. Vegetation communities / wildlife habitat
        vii. Threatened / endangered species
    b. If not, what is the relative severity of the impact (low / medium / high) and what can be done to minimize the harm (potential mitigation measures)?

6. Contribute to air quality attainment
    a. Does this option have the ability to contribute to air quality attainment?

7. Maximize use of existing right-of-way
    a. Are there adverse right-of-way issues?
    b. Does this option maximize use of the existing public rights-of-way?

Fatal Flaw Screening

The initial screening of alternatives is commonly referred to as the "fatal flaw screening." Fatal flaw screening provides a tool that enables the study team to eliminate alternatives that show problematic signs early in the MIS process. Initially, there is the universe of alternatives, which contains a wide range of alternatives that have the potential of meeting the corridor's purpose and need. Data collection and an existing corridor evaluation were conducted in order to provide the team with a solid technical foundation on which to accurately screen available alternatives. Based upon the corridor goals and questions, alternatives from the universe of alternatives were eliminated during the fatal flaw screening. In **Table 5.6-1,** the universe of alternatives again appears; however, alternatives that have been eliminated through the fatal flaw screening appear with a strike through them. **Table 5.6-2** explains the basis for the fatal flaw screening decisions.

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Table 5.6-1: Fatal Flaw Screening for the Universe of Alternatives

Transit		
Rail	**Bus**	**Other**
Light rail	Local service	~~Personal rapid transit~~
Commuter rail	Express	Carpool / vanpool
~~Heavy rail~~	Express with HOV	Park-and-ride
~~Monorail~~	~~Charter or subscription bus service~~	Transfer facilities
Stations	School buses	
Freeway		
General-purpose lanes	Service roads	~~Truck lanes~~
Managed facility	Interchanges	Intelligent transportation systems (ITS)
Express facility	Express lanes	Ramp system modifications
Toll lanes / facility	Non-barrier (Diamond) HOV lanes	Auxiliary lanes
HOV (# lanes extend)	Express Hempstead	~~Dual freeway~~
		Bring roadway to standards
Streets & Highway		
Arterial network	Signal system (ITS)	Hempstead — 6-lane, 8-lane
Parallel arterial	TSM improvements	Grade separation
Super street		
Transportation System Management (TSM) Strategies		
Arterial widening	Access management	Emergency / special event management
Intersection improvements	Traffic operations and signal system improvements	ITS
Travel Demand Management (TDM) Strategies		
Employee trip reduction (ETR) programs	Public transportation improvements	Bicycle / pedestrian strategies
Transportation management associations	~~Traffic restricted zones~~	

Table 5.6-2 below provides a list of eliminated alternatives and the reasoning behind why certain proposed options were eliminated.

Table 5.6-2: Basis for Fatal Flaw Screening Decisions

Proposed Options	Fatal Flaw Screening Reasoning
Heavy rail	Not consistent with METRO's service plan
Monorail	Not consistent with METRO's service plan
Charter or subscription bus service	Does not address mobility goals
Personal rapid transit	Not consistent with METRO's service plan
Truck lanes	Impossible to enforce, not enough demand
Dual freeway	Operational difficulty
Traffic restricted zones	TxDOT mobility goals are not consistent with this alternative

5.7 CONCEPTUAL ALTERNATIVES

After the fatal flaw screening was completed, the corridor goals and questions were used as a guide to obtain practical combinations of the universe of alternatives, which were then merged together to create eleven conceptual alternatives. This process allowed for the most promising alternatives to move on to a more detailed analysis in order to eventually evaluate and select the best combination of alternatives.

The conceptual alternatives mostly fall into three categories: those that are associated with freeway expansion, managed facilities, or transit. A list of the 11 conceptual alternatives can be seen below. Descriptions of the conceptual alternatives (CA) appear in the following paragraphs.

- CA-1 No-build alternatives
  - CA-1A Baseline (no-build in US 290 Corridor)
  - CA-1B TSM / TDM

- CA-2 Freeway expansion options
  - CA-2A Expand US 290, extend HOV
  - CA-2B Expand US 290, remove HOV

- CA-3 Managed facility options
  - CA-3A Four-lane, two-way, barrier-separated managed facility
  - CA-3B Two-lane, reversible HOV, expand US 290
  - CA-3C High capacity, partially grade-separated Hempstead Highway

- CA-4 Transit Alternatives
  - CA-4A Advanced high capacity transit along US 290 and SH 249
  - CA-4A-1 Advanced high capacity transit US 290
  - CA-4B Advanced high capacity transit along Hempstead Highway
  - CA-4C Express busway

At the end of this chapter there are 11 figures that visually describe each of the conceptual alternatives discussed below.

Conceptual Alternative (CA)-1A: Baseline (No-Build)

CA-1A, the *baseline* (*no-build) alternative*, assumes that all improvements in the *2022 Metropolitan Transportation Plan* (MTP) are implemented except those improvements proposed on US 290. The no-build alternative will not be screened out during the evaluation of the conceptual alternatives; it will be carried through to the viable alternatives. As the screening and refinement process moves forward, the no-build alternative will be refined to include the transportation system management and transportation demand management strategies that improve mobility in the corridor.

CA-1B: Transportation System Management / Transportation Demand Management

In October of 1997, H-GAC adopted the *Congestion Management System (CMS) Plan*, which establishes the requirement for the implementing agency to conduct a congestion mitigation analysis (CMA) for all regionally significant added-capacity roadway projects. As part of that adopted plan, regional policy requires the analysis of cost-effective transportation demand management (TDM) and transportation system management (TSM) measures as an alternative to roadway expansion. The consideration of expanded capacity is justified only if the analysis of TDM and TSM measures demonstrates inability to reduce congestion with a given project limit. Furthermore, regional policy requires implementation of applicable TDM and TSM measures in conjunction with any added capacity if an added-capacity alternative is chosen.

The requirements for meeting the CMS Plan are consistent with the MIS process as documented in *The Texas MIS Process Guidelines*. As part of those guidelines, a TSM alternative is developed as one of the viable alternatives to be considered as part of the alternative evaluation process under the major investment study. The TSM alternative consists of programmatic and typically low-cost construction projects that seek to reduce congestion through demand management or systems-management techniques. If the TSM alternative does not prove to be sufficient to meet the goals and objectives of the MIS (including the primary goal to improve mobility within the corridor), then build alternatives that expand capacity within the corridor may be considered. However, the elements of the regionally significant TSM alternative are inherently incorporated within all alternatives that would seek to add expanded capacity to the corridor. Incorporation of the TSM alternative elements into proposed added-capacity build alternatives is required as part of the CMA policy for securing federal funding assistance.

Development of the TSM / TDM (also ITS) alternative focused initially on the evaluation of the no-build alternative, which consists of the existing (plus committed) projects within the corridor. Committed projects include those that have funding identified in the *2022 Metropolitan Transportation Plan*. Committed projects are likely to be completed prior to any implementation of a recommended alternative. The purpose of the MIS, and hence the development of a preferred alternative, is to determine the best package of improvements to meet the long-range needs of the identified corridor. Once adopted, the recommendation results in a revision to the regional plan.

H-GAC-planned projects identified in the US 290 Corridor are the following:

- Installation of computerized transportation management system (CTMS) along US 290 from Hockley to Waller County line
- Installation of CTMS along US 290 from Harris County line to Washington County line
- Construct park-and-ride on US 290 in Waller County
- Installation of CTMS along US 290 at 0.3 miles east of Mueschke Road to 1.86 miles west of Telge Road
- Installation of CTMS along US 290 at 1.86 miles west of Telge Road to Huffmeister Road
- Installation of integrated corridor transportation management and traveler information system at TranStar, along US 290 at Huffmeister Road to 0.125 miles east of FM 529 and then to IH 610
- Widen to six lanes divided, and install TSM along FM 529 from US 290 to Huffmeister Road
- TSM improvements for US 290 at 34th Street
- Northwest HOV, PNR signalization, traffic, and project management
- Northwest Station PNR expansion

- North Houston on-street bikeway network
- West Houston on-street bikeway network
- Bridge widening for US 290 at Brazos River relief structures
- Construct interim grade separation at US 290 and Roberts Road
- Construct interim grade separation at US 290 and Becker Road
- Construct interim grade separation at US 290 and Bauer Road
- Construct grade separation at US 290 and Mason Road
- Connect main lanes of US 290 at Mueschke Road (0.4 miles south to 0.1 miles south of Mueschke Road)
- Construct interim grade separation at US 290 and Mueschke Road
- Construct four-lane divided rural section of SH 99 from US 290 to SH 249
- Construct four-lane divided rural section of SH 99 from US 290 to Franz

Alternative Elements

The TSM / TDM alternative is defined in sufficient detail for modeling and evaluation purposes. The MIS process is intended to evaluate and address corridorwide mobility issues. The resultant recommended alternative consists of a package of improvements intended to meet corridorwide mobility needs. Congestion mitigation concepts considered in the TSM / TDM alternative are to be incorporated as part of the recommended alternative.

The definition of congestion mitigation concepts and evaluation of their potential congestion-reducing capabilities must be consistent with regional planning efforts in terms of underlying transportation network assumptions. For the US 290 MIS, the travel models used by both METRO and the Houston-Galveston Area Council are incorporated into the evaluation process. Regional modeling techniques, applied to the *2022 Metropolitan Transportation Plan* with regard to TSM and TDM strategies, have been applied to various mobility characteristics within the US 290 Corridor, including roadway capacities, delay functions, and speed assignment procedures.

TSM / TDM improvements documented in the existing transportation improvement plan would be expected to be completed under the TSM / TDM alternative. In addition to documented congestion mitigation projects, the TSM / TDM alternative includes TSM / TDM measures that are recommended to address the regional nature of the mobility issues observed within the corridor. These consist of the following:

- HOV lanes along US 290 terminating at Waller County park-and-ride, express bus service into Houston using the HOV lane, which may require expanded transit service
- Ramp metering on US 290 at high-volume entrance ramps
- Changeable message signs along US 290 from Waller County to Huffmeister Road

- Continuous frontage roads adjacent to US 290, with provision for signal coordination along frontage road
- Increase mobility assistance patrols committed to the US 290 Corridor
- Access management and signal coordination along Hempstead Highway, between North Gessner Road and IH 610
- Access management and signal coordination along FM 529, between SH 99 and US 290
- Access management and signal coordination along Telge Road, between Grant Road and US 290
- Access management and signal coordination along North Eldridge Parkway, between Grant Road and IH 10
- Access management and signal coordination along Cypress-Rosehill Road, between SH 99 and US 290
- Access management and signal coordination along W. Little York Road, between Barker-Cypress Road and West Sam Houston Parkway
- Access management and signal coordination along Clay Road, between SH 99 and West Sam Houston Parkway
- Access management and signal coordination along Addicks Howell Road / FM 1960, between Tomball Parkway and IH 10
- Demand-actuated signals at isolated intersections within the US 290 Corridor
- Contra-flow arterials where strong directional flow occurs in the peak periods
- Promote regional bicycle and pedestrian trail improvements within US 290 Corridor
- Bike lanes along Hempstead Highway
- Bike lanes from each transit station extending at least two miles into adjacent neighborhoods and retail centers (for example, a bike lane is planned from Jersey Village to the W. Little York park-and-ride facility)

CA-2A: Expand US 290, Extend HOV

This alternative is characterized by an increase in general-purpose lanes. The cross-section in this alternative will generally provide for the addition of one general-purpose lane in each direction along the entire corridor. The current one-lane, reversible HOV lane is also extended to a new park-and-ride lot, located near the future Grand Parkway.

CA-2B: Expand US 290, Remove HOV

In this alternative, the one-lane, reversible HOV lane is removed. The US 290 cross-section in this alternative will generally provide for the addition of two general-purpose lanes in each direction along the entire corridor.

CA-3A: Four-Lane, Two-Way, Barrier-Separated Managed Facility

CA-3A is characterized as having a four-lane (two in each direction) managed facility extending from Loop 610 to somewhere near the future Grand Parkway along US 290. The managed facility is barrier separated from the three general-purpose lanes in each direction.

CA-3B: Two-Lane, Reversible HOV, Expand US 290

This alternative includes barrier-separated HOV lanes. The current barrier-separated HOV lane is expanded to allow two-lane, two-way flow. The reversible HOV lane is also extended to a new park-and-ride lot, located near the future Grand Parkway. US 290 is also expanded for the addition of one general-purpose lane in each direction along the entire corridor.

CA-3C: High Capacity, Partially Grade-Separated Hempstead Highway

From Loop 610 to its current end just west of Beltway 8, Hempstead Highway is converted to a six-lane super arterial. Hempstead Highway is grade-separated at some intersections. US 290 is also expanded for the addition of one general-purpose lane in each direction along the entire corridor. The current one-lane, reversible HOV lane is also extended to a new park-and-ride lot, located near the future Grand Parkway.

CA-4A: Advanced High Capacity Transit along US 290 and SH 249

Coordinating closely with METRO, the study team was asked to evaluate complementary and / or competing AHCT investment along both US 290 and SH 249. Due to the existing HOV and transit service along US 290, the current *2025 METRO Mobility Plan* has emphasized AHCT along SH 249. US 290 is expanded for the addition of one general-purpose lane in each direction along the corridor. The HOV lane is removed. Advanced high capacity transit is provided along both US 290 and SH 249. The US 290 Line begins near Fairfield and connects to the Northwest Transit Center, from which it then connects to the Westpark area of Houston. Another route connects to the Northwest Transit Center, at which point it turns east towards downtown and eventually terminates at Hobby Airport. The SH 249 (Tomball) Line begins near Huffsmith Road at its northern end and extends to the Northwest Transit Center, from which it connects to the Westpark area of Houston. A second route much like the US 290 Line takes an eastern turn at the Northwest Transit Center, proceeds to downtown, and ultimately terminates at Hobby Airport.

CA-4A-1: Advanced High Capacity Transit along US 290

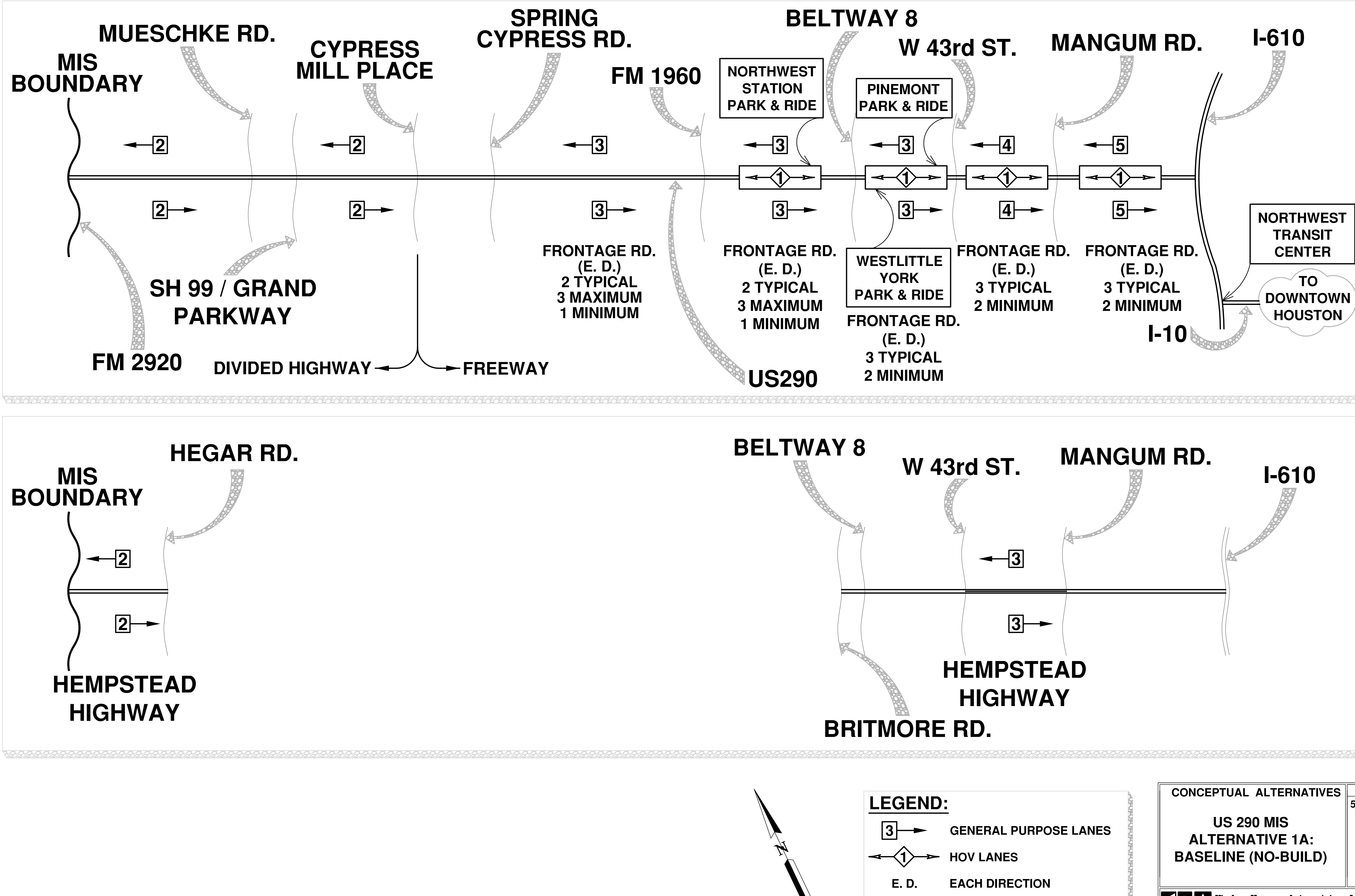
US 290 is expanded for the addition of one general-purpose lane in each direction along the corridor. The HOV lane is removed. Advanced high capacity transit is provided along US 290. The US 290 Line begins near Fairfield and connects to the Northwest Transit Center, from which it then connects to the Westpark area of Houston. Another route connects to the Northwest Transit Center, at which point it turns east towards downtown and eventually terminates at Hobby Airport.

CA-4B: Advanced High Capacity Transit along Hempstead

US 290 is expanded for the addition of one general-purpose lane in each direction along the corridor. The HOV lane is removed. Advanced high capacity transit is provided along Hempstead Highway / Union Pacific Railroad right-of-way. The Hempstead Line begins near Fairfield and connects to the Northwest Transit Center, from which it then connects to the Westpark area of Houston. Another route connects to the Northwest Transit Center, at which point it turns east towards downtown and eventually terminates at Hobby Airport.

CA-4C: Express Busway

The express busway alternative provides the same numbers and types of lanes as CA-2A. However, the traffic carried on the HOV facility will consist entirely of buses. Bus service in the corridor will have expanded routes and increased headways.



CONCEPTUAL ALTERNATIVES

FIG. 5.7-1

US 290 MIS ALTERNATIVE 1A: BASELINE (NO-BUILD)

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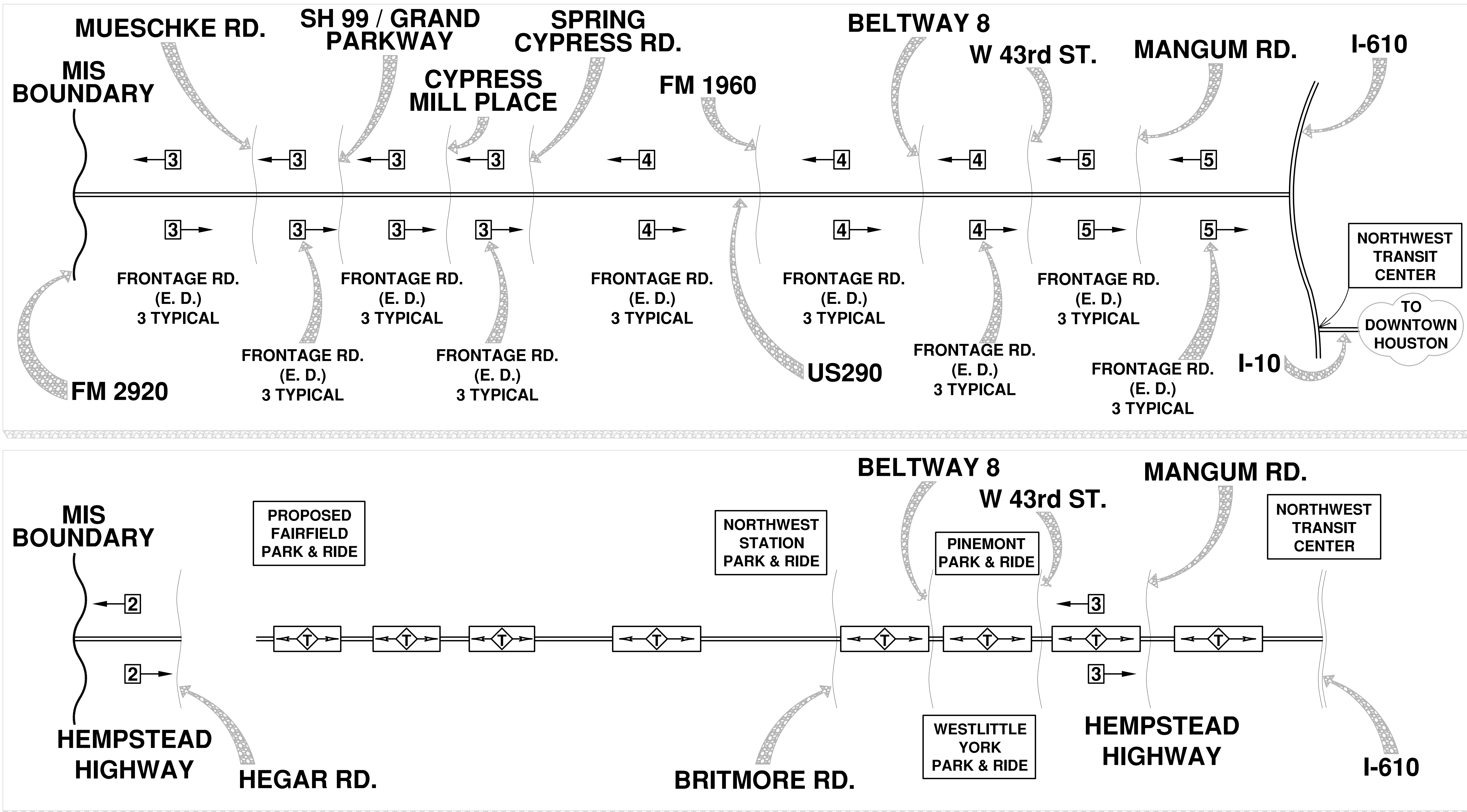

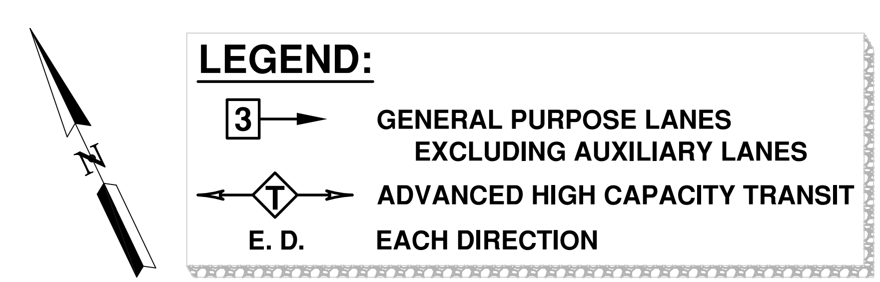

CONCEPTUAL ALTERNATIVES
US 290 MIS
ALTERNATIVE 4B:
ADVANCED HIGH CAPACITY TRANSIT ALONG HEMPSTEAD HWY.

FIG. 5.7-10

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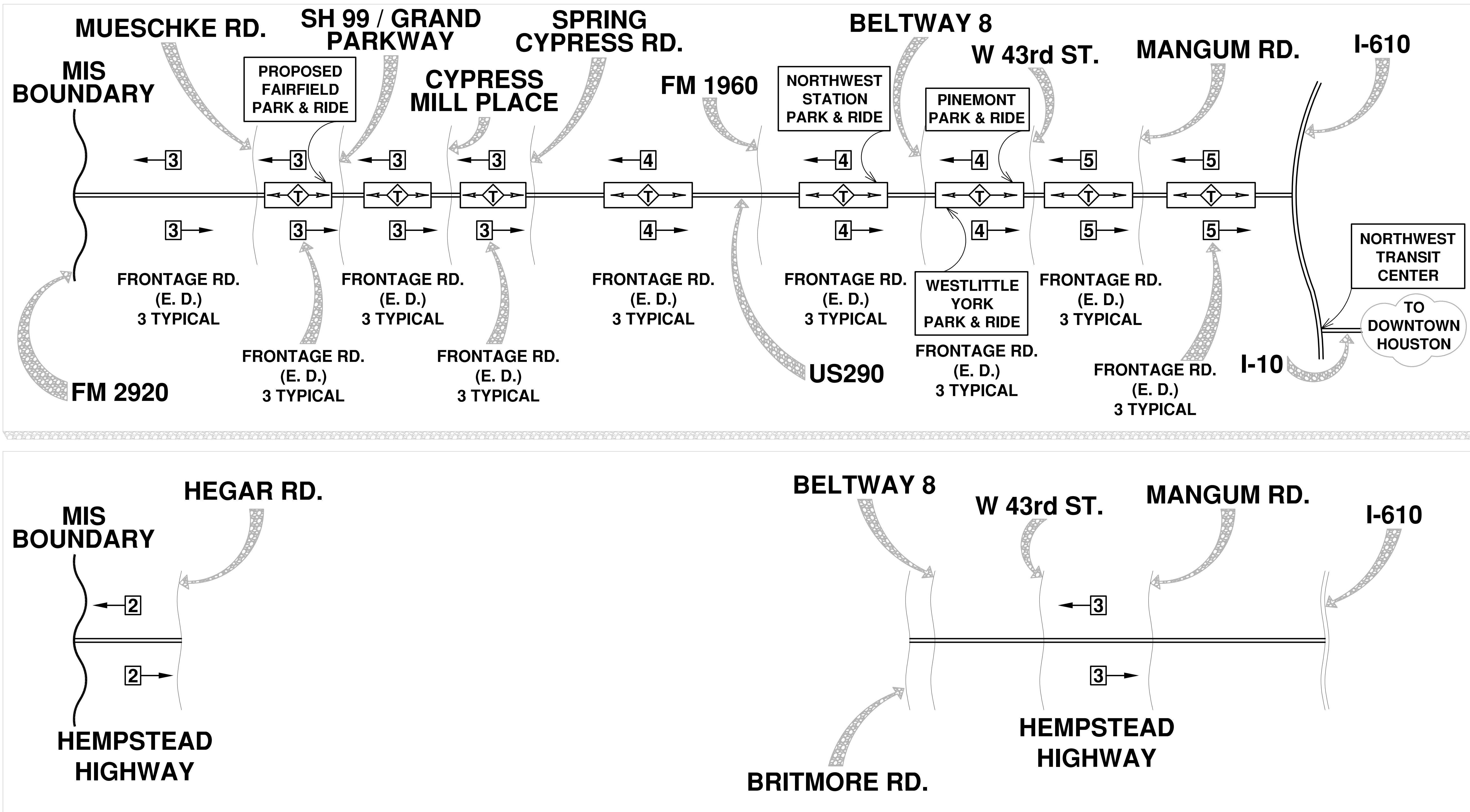

N

LEGEND:

3 → GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES

←◇T→ ADVANCED HIGH CAPACITY TRANSIT

E. D. EACH DIRECTION

CONCEPTUAL ALTERNATIVES
US 290 MIS
ALTERNATIVE 4A-1:
ADVANCED HIGH CAPACITY TRANSIT ALONG US 290

FIG. 5.7-9

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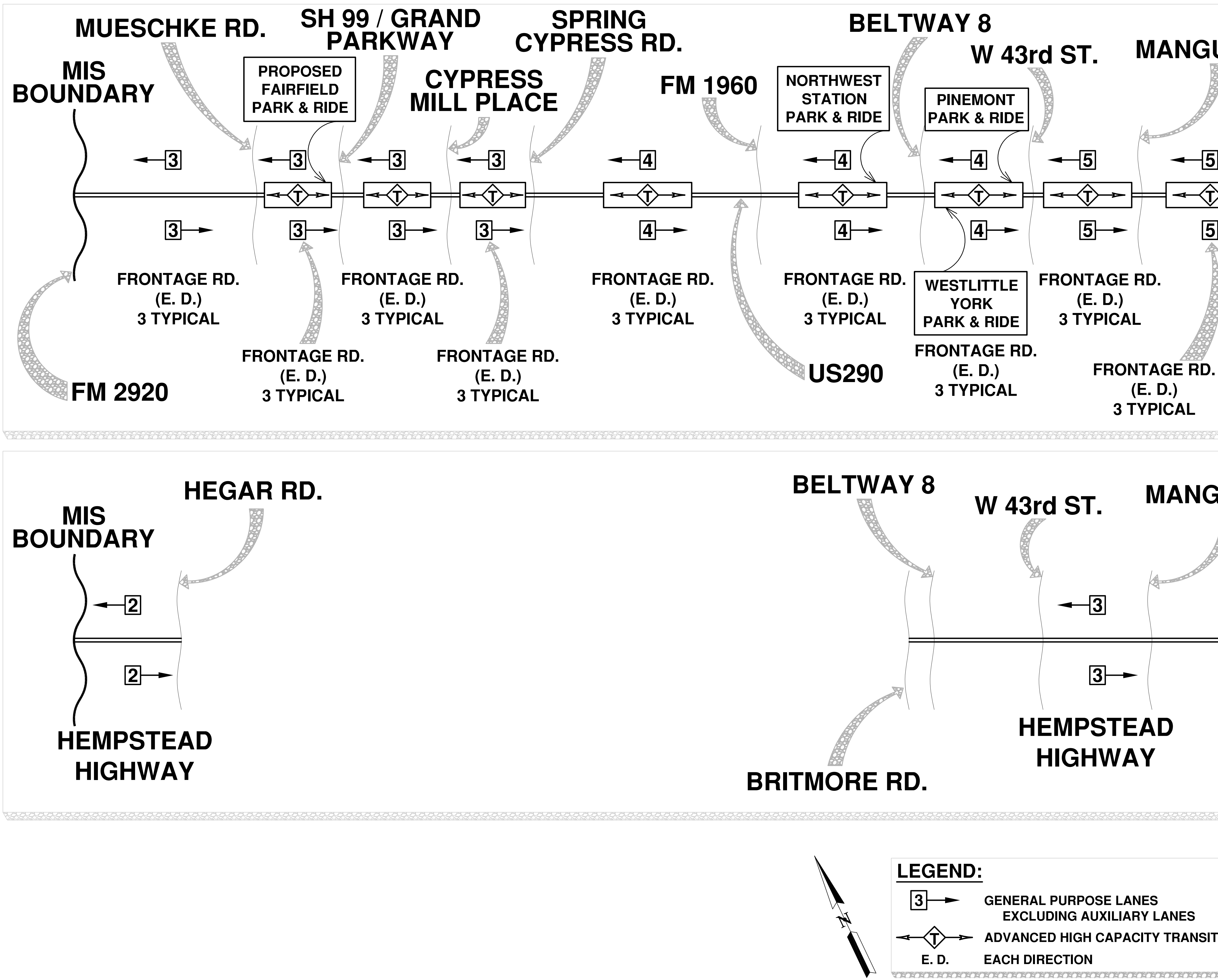

CONCEPTUAL ALTERNATIVES
US 290 MIS
ALTERNATIVE 4A:
ADVANCED HIGH CAPACITY TRANSIT ALONG US 290 AND SH 249

FIG. 5.7-8

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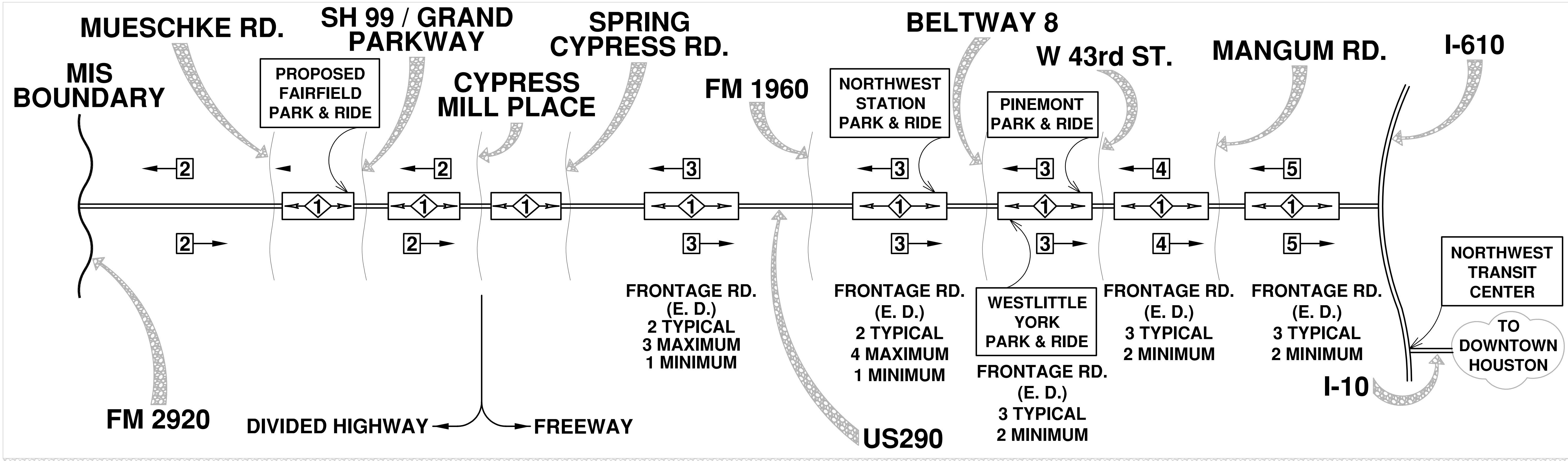

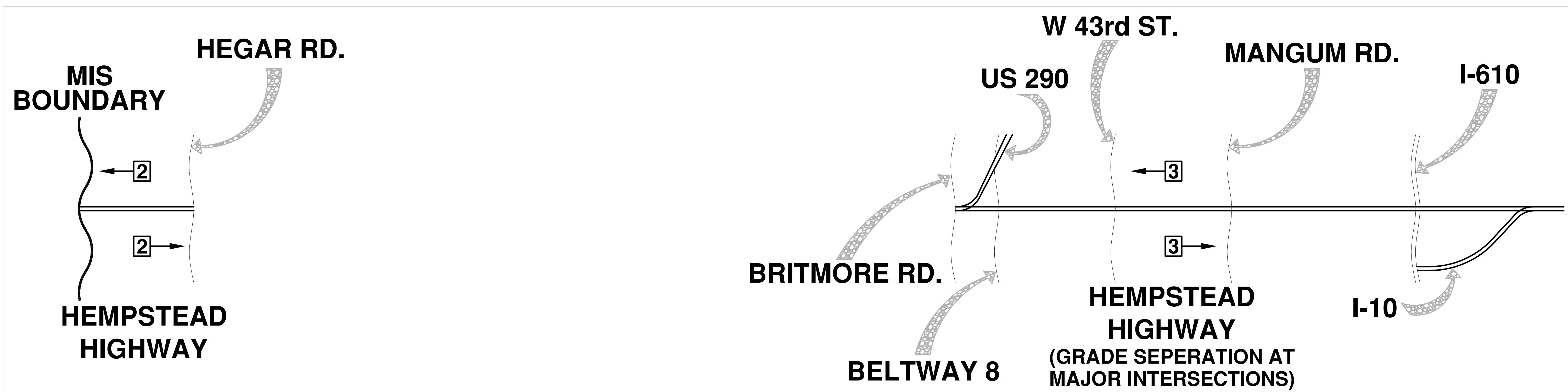

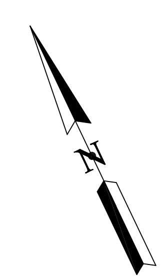

LEGEND:

3 →	GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
←◇1◇→	HOV LANES
E. D.	EACH DIRECTION

CONCEPTUAL ALTERNATIVES

US 290 MIS ALTERNATIVE 3C: HIGH CAPACITY, PARTIALLY GRADE SEPARATED HEMPSTEAD RD.

FIG. 5.7-7

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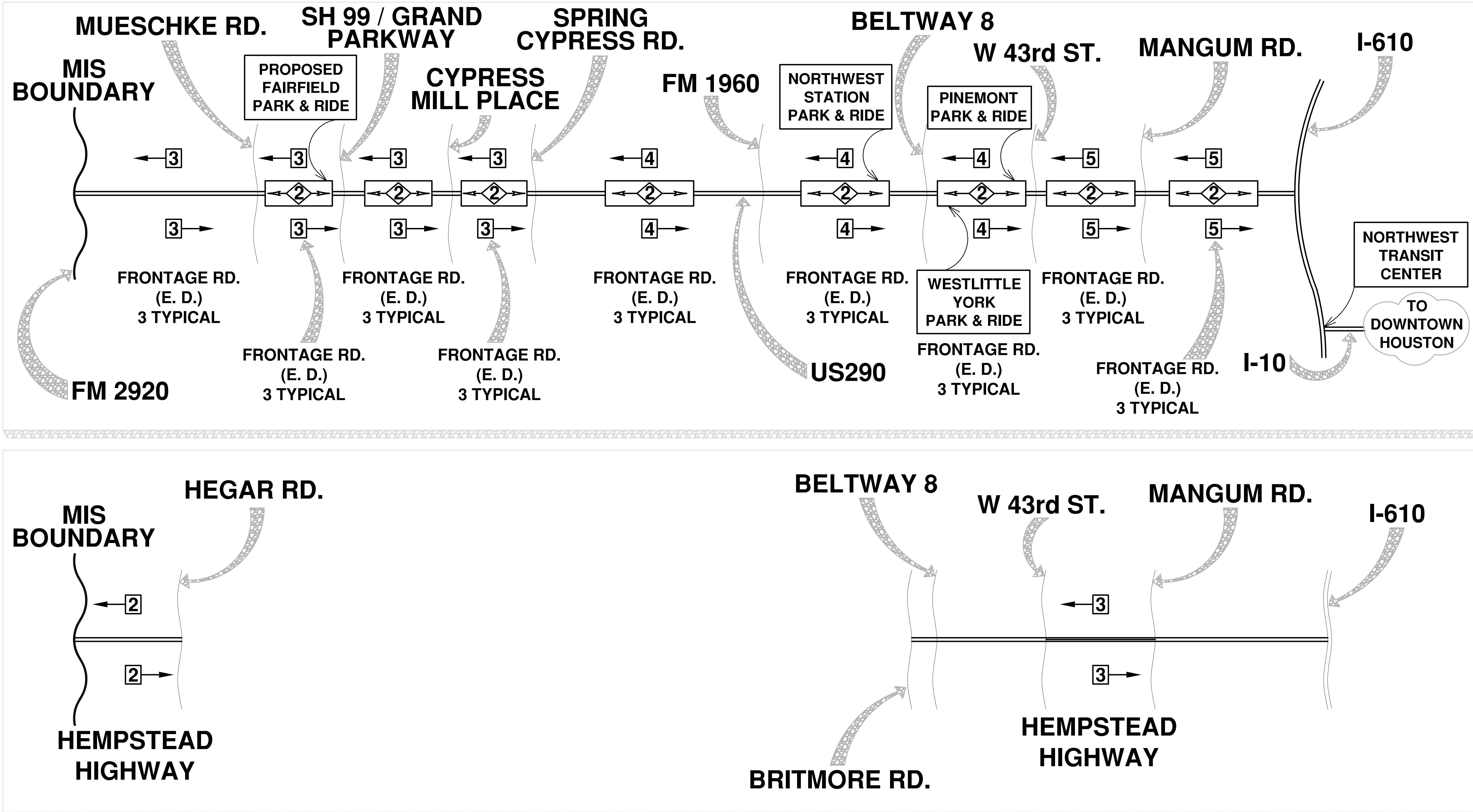

N

LEGEND:

3 →	GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
← 1 →	HOV LANES
E. D.	EACH DIRECTION

CONCEPTUAL ALTERNATIVES

US 290 MIS ALTERNATIVE 3B: TWO-LANE REVERSIBLE HOV, EXPAND US 290

FIG. 5.7-6

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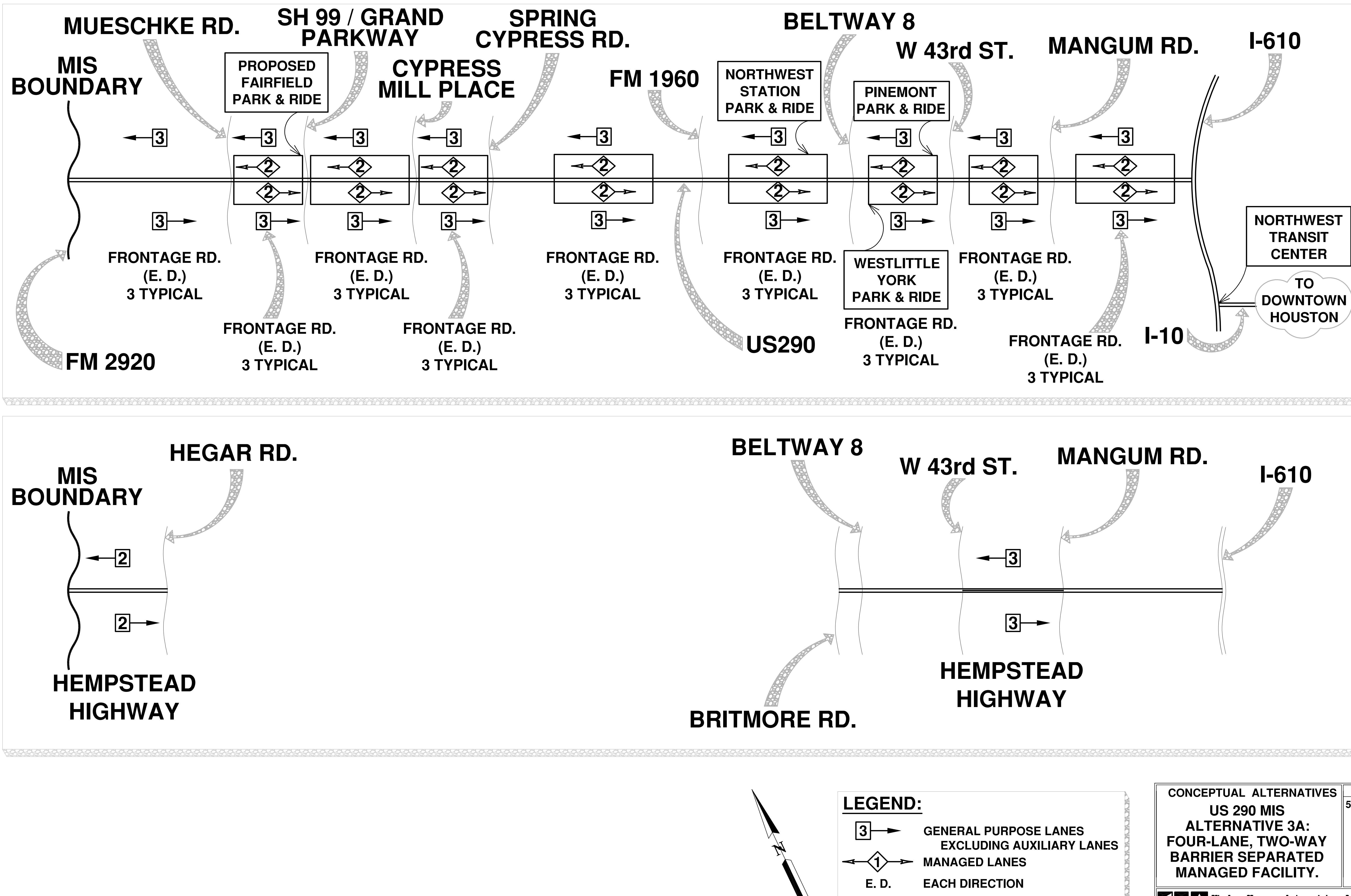

LEGEND:

3 →	GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
← 1 →	MANAGED LANES
E. D.	EACH DIRECTION

CONCEPTUAL ALTERNATIVES

FIG. 5.7-5

US 290 MIS
ALTERNATIVE 3A:
FOUR-LANE, TWO-WAY
BARRIER SEPARATED
MANAGED FACILITY.

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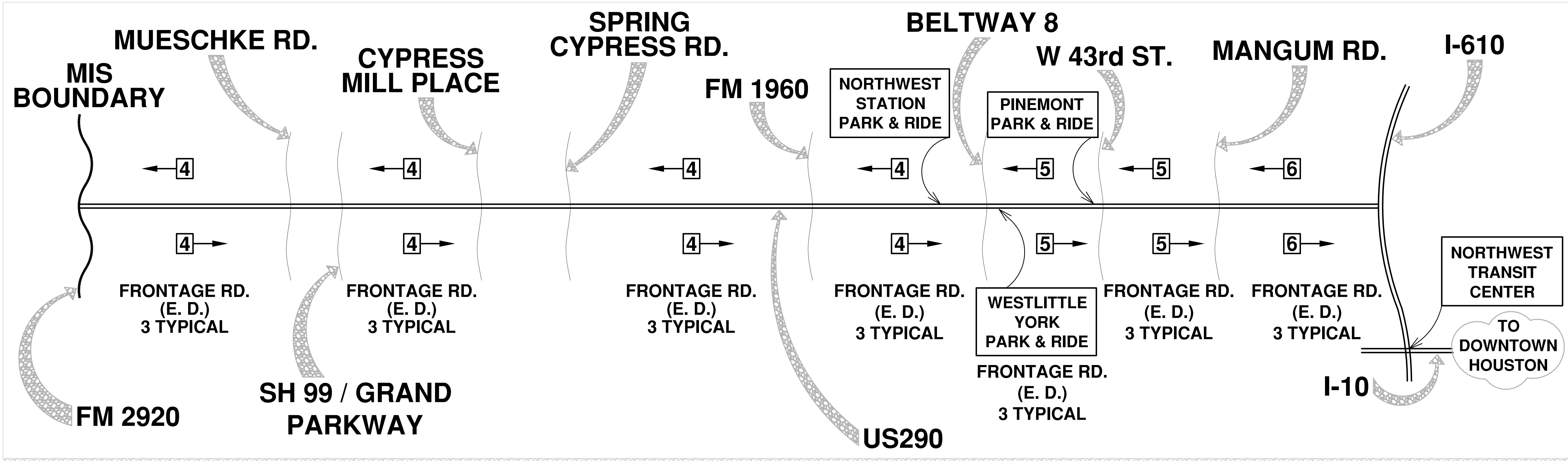

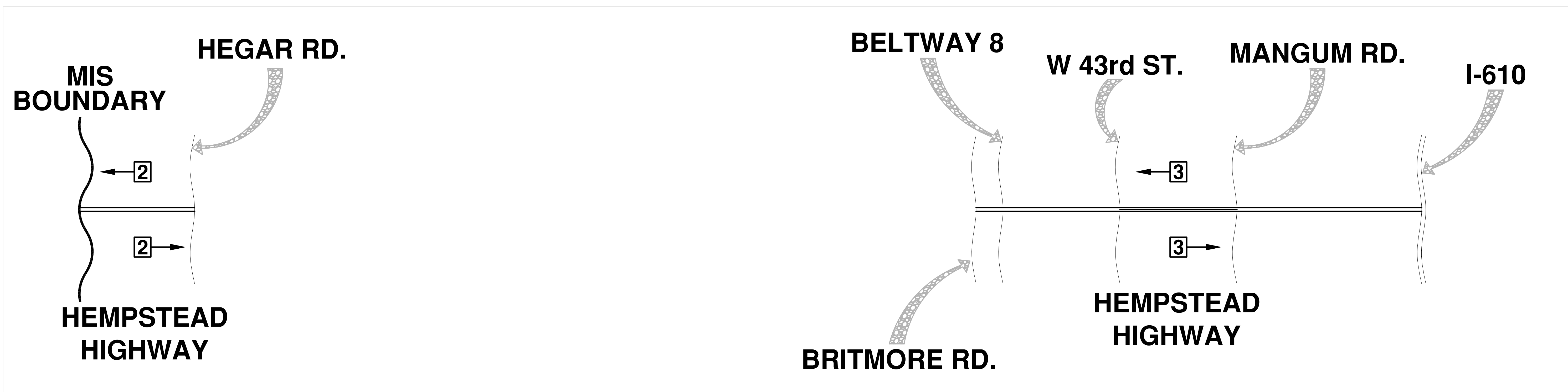

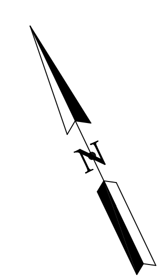

LEGEND:

- 3 → GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
- ←◇1→ HOV LANES
- E. D. EACH DIRECTION

CONCEPTUAL ALTERNATIVES

US 290 MIS
ALTERNATIVE 2B:
EXPAND US 290
REMOVE HOV

FIG. 5.7-4

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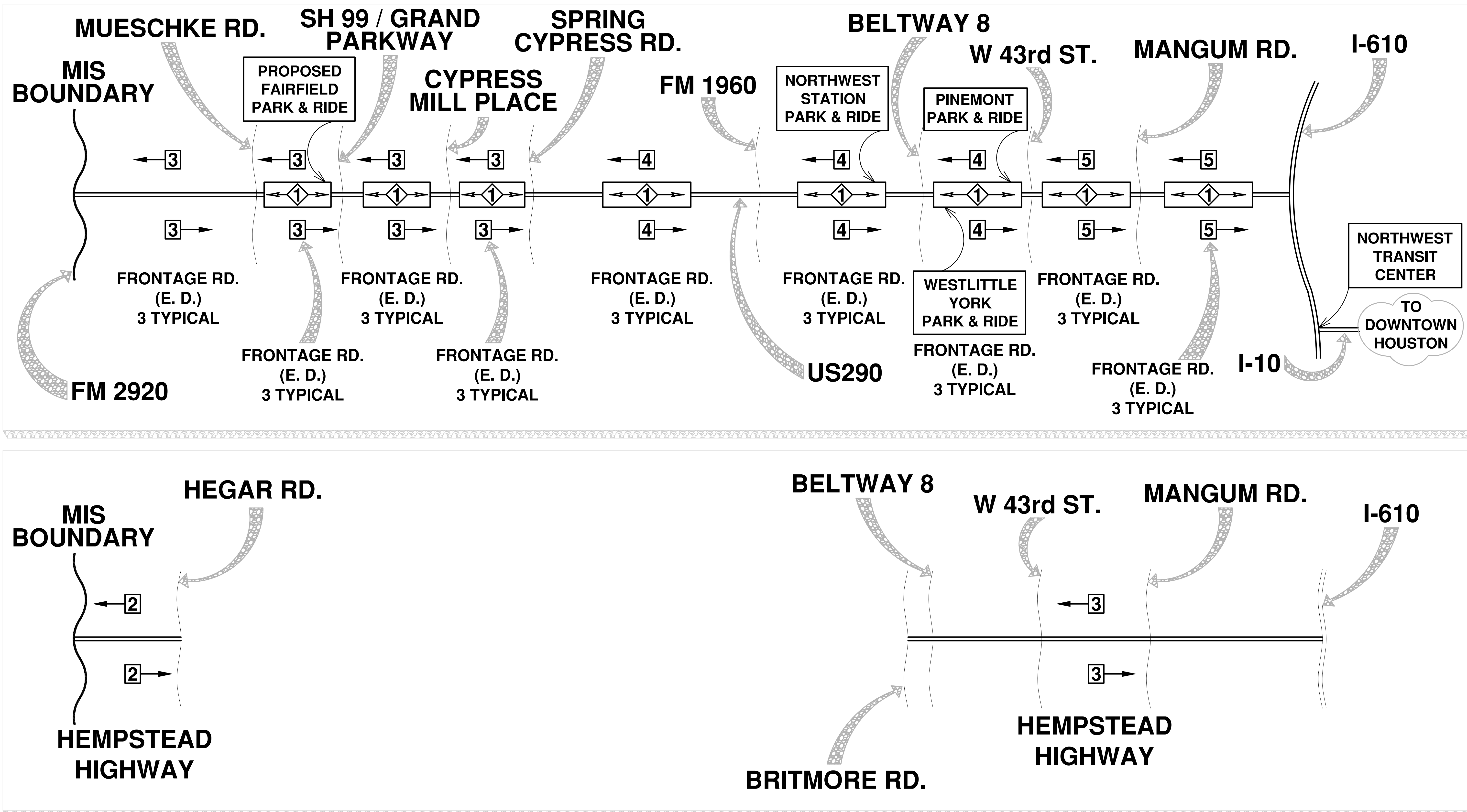

LEGEND:

- 3 → GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
- ←1→ HOV LANES
- E. D. EACH DIRECTION

CONCEPTUAL ALTERNATIVES

US 290 MIS
ALTERNATIVE 2A:
EXPAND US 290
EXTEND HOV

FIG. 5.7-3

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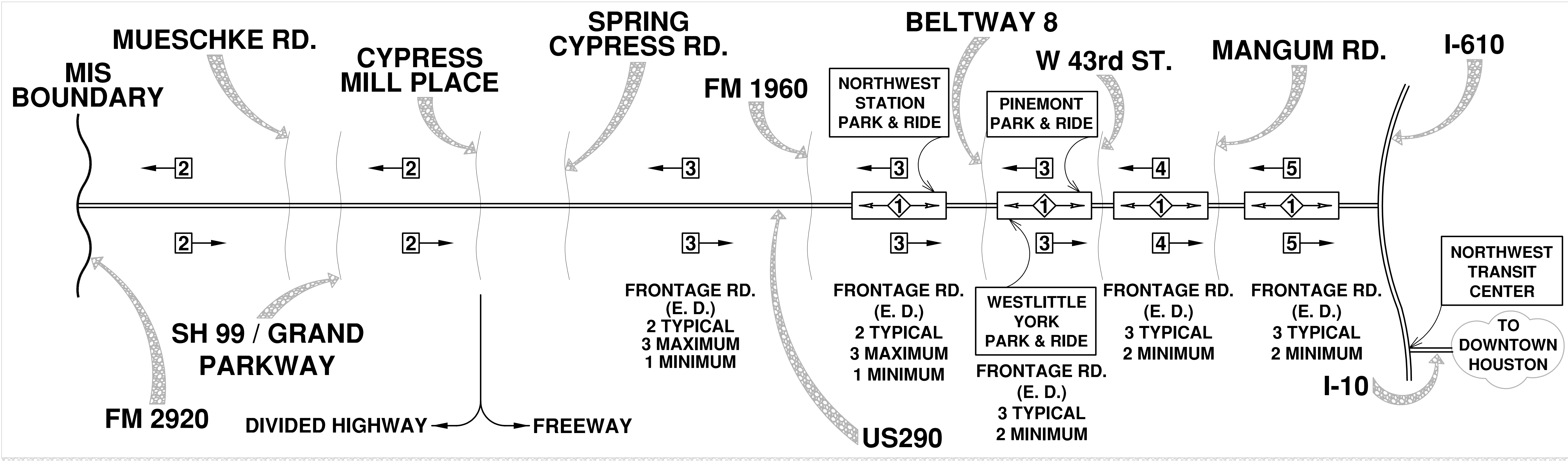
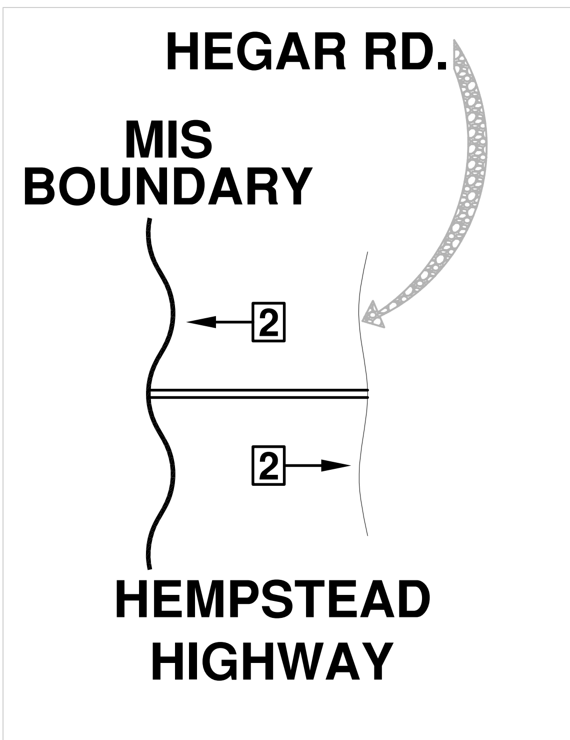




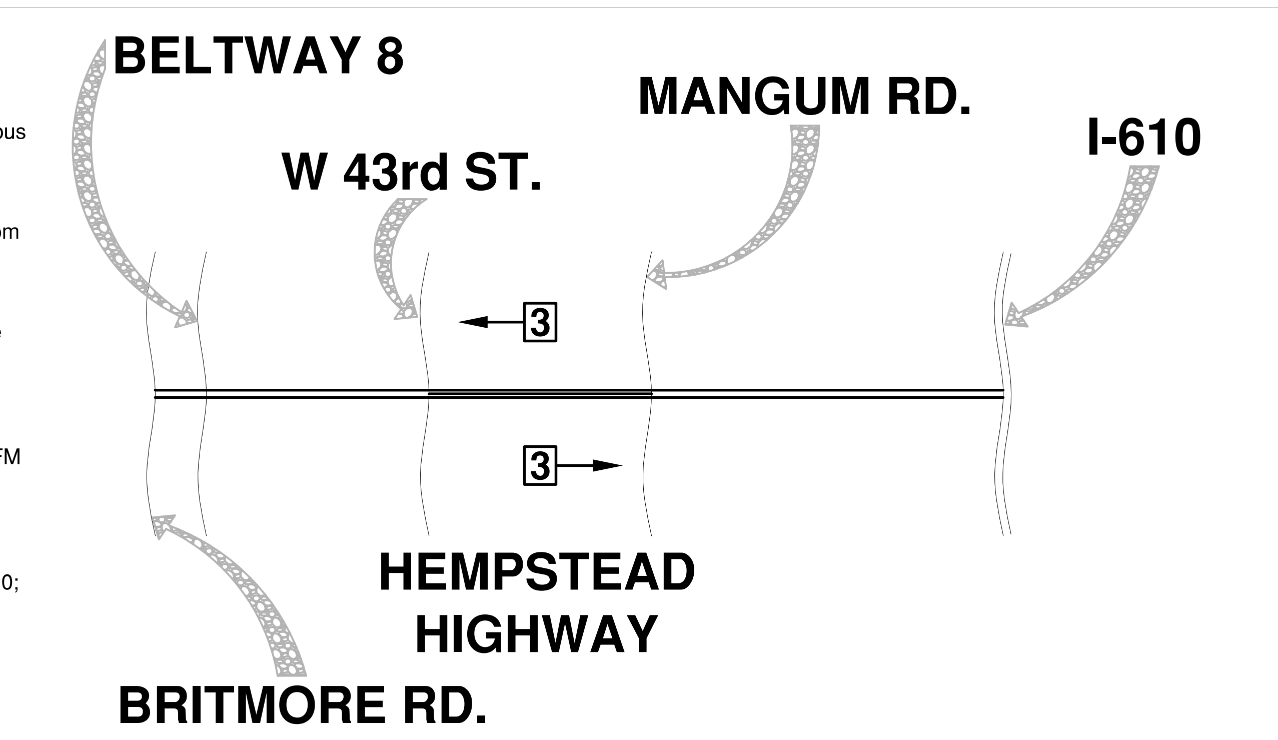
TSM / TDM

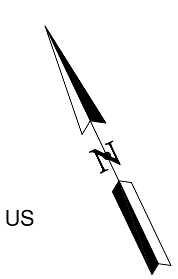
PLANNED IMPROVEMENTS

- Installation of CTMS along US 290 from Hockley to Waller County Line
- Installation of CTMS along US 290 from Harris County Line to Washington County Line
- Construct Park & Ride on US 290 in Waller County
- Installation of CTMS along US 290 at 0.3 mile east of Mueschke to 1.86 mile west of Telge
- Installation of CTMS along US 290 at 1.86 mile west of Telge to Huffmeister
- Installation of Integrated Corridor Transportation Management and Traveler Information System at TranStar along US 290 at Huffmeister to 0.125 mile east of FM 529 and then to IH 610
- Widen to six lanes, divided and install TMS along FM 529 from US 290 to Huffmeister
- TMS Improvements for US 290 at 34th
- Northwest HOV, PNR Signalization, Traffic and Project Management
- Northwest Station PNR Expansion
- North Houston On-Street Bikeway Network
- West Houston On-Street Bikeway Network
- Bridge widening for US 290 at Brazos River Relief Structures
- Construct interim grade separation at US 290 and Roberts
- Construct interim grade separation at US 290 and Becker
- Construct interim grade separation at US 290 and Bauer
- Construct grade separation at US 290 and Mason Road
- Connect mainlanes of US 290 at Mueschke (0.4-mile south to 0.1 mile south of Mueschke)
- Construct interim grade separation at US 290 and Mueschke
- Widen and upgrade to 6-lane freeway US 290 east of Hockley to west of Cypress Bypass
- Construct interim grade separation at US 290 east of Hockley to west of Cypress Bypass
- Construct 4-lane divided rural section of SH 99 from US 290 to SH 2499

RECOMMENDED IMPROVEMENTS

- High Occupancy Vehicle (HOV) lanes along US 290 terminating at Waller County Park and Ride, express bus service into Houston as well which may require expanded transit service;
- Ramp metering on US 290 at high volume entries;
- Changeable Message Signs (CMS) along US 290 from Waller County to Huffmeister
- Continuous frontage roads adjacent to US 290 with provision for signal coordination along frontage road;
- Increase mobility assistance patrols committed to the US 290 Corridor;
- Access Management and signal coordination along Hempstead Road between North Gessner Road to IH 610;
- Access Management and signal coordination along FM 529 between SH 99 and US 290
- Access Management and signal coordination along Telge Road between Grant Road and US 290;
- Access Management and signal coordination along North Eldridge Parkway between Grant Road and IH 10;
- Access Management and signal coordination along Cypress-Rosehill Road between SH 99 and US 290;
- Access Management and signal coordination along West Little York Road between Barker Cypress Road and West Sam Houston Parkway;
- Access Management and signal coordination along Clay Road between SH 99 and West Sam Houston Parkway;
- Access Management and signal coordination along Addicks Howell Road/FM 1960 between Tomball Parkway and IH 10;
- Demand-actuated signals at isolated intersections within the US 290 Corridor;
- Contra-flow arterials where strong directional flow occurs in the peak periods;
- Promote regional bicycle and pedestrian trial improvements within US 290 Corridor.
- Construct 4-lane divided rural section of SH 99 from US 290 to Franz





LEGEND:

3 →	GENERAL PURPOSE LANES
←◇1→	HOV LANES
E. D.	EACH DIRECTION

CONCEPTUAL ALTERNATIVES

FIG. 5.7-2

US 290 MIS ALTERNATIVE 1B: TSM/TDM

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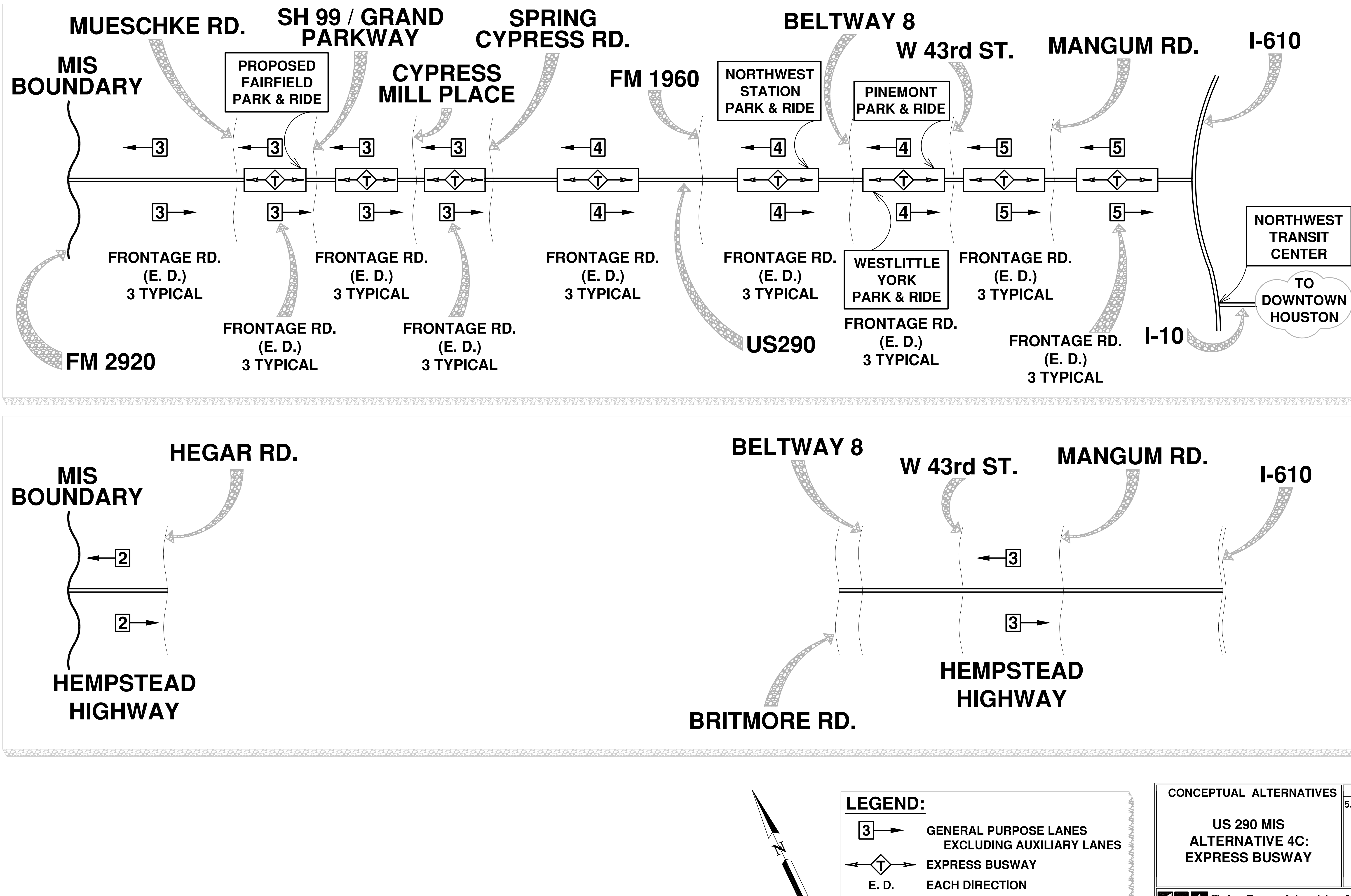

LEGEND:

3 →	GENERAL PURPOSE LANES EXCLUDING AUXILIARY LANES
←T→	EXPRESS BUSWAY
E. D.	EACH DIRECTION

CONCEPTUAL ALTERNATIVES

US 290 MIS
ALTERNATIVE 4C:
EXPRESS BUSWAY

FIG. 5.7-11

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Chapter 6
Development of Viable Alternatives

Once conceptual alternatives were established, the project team implemented a screening and evaluation process in order to refine the conceptual alternatives and craft them into viable alternatives for further analysis. The wide range of conceptual alternatives (identified in the previous chapter) represented the universe of reasonable potential alternatives that might have application within the study and meet corridor goals and needs. These conceptual alternatives were subjected to a preliminary analysis intended to identify those alternatives that were less likely to meet the needs of the US 290 Corridor and to promote the alternatives that performed well. The best elements from the conceptual alternatives were then carried forward as potential components of the ultimate viable alternatives.

6.1 MODELING METHODOLOGY

One of the primary tools used in the evaluation of alternatives is the regional travel demand model. H-GAC maintains an EMME/2™-based multimodal travel demand model. This tool provides statistics that project the demand for, and efficiency of, transit and highway networks in the future. Please see ***Appendix D*** for the regional model set flow chart.

The *Modeling Methodology Report* released in August of 2002 details the existing basis and structure for each of the model components within H-GAC's travel demand model. Required input into the model is made up of two primary sets of data: demographic assumptions and projections and network alternatives. Network coding and the running of models was a combined effort of Kimley-Horn and H-GAC staff.

Trips by mode for each of three categories in the baseline alternative were extracted from the baseline model run and appear on the following page in **Table 6.1-1** for the entire Houston metropolitan region.

Table 6.1-1: Trips by Mode for the Baseline Alternative for the Houston Metropolitan Region

	Home-based non-work	Home-based work	Non-home based
Drive alone free	5,485,952	2,586,875	4,563,425
Drive alone pay	78,699	170,006	127,643
Auto 2 free	1,994,849	593,915	990,659
Auto 2 pay	17,084	20,238	13,100
Auto 3 free	1,132,201	105,160	404,165
Auto 3 pay	16,644	6,135	10,752
Auto 4+ free	1,112,864	72,440	435,779
Auto 4+ pay	20,928	5,313	9,141
Local bus	69,962	109,846	38,929
Commuter bus	5,016	12,605	4,859
Express bus	2,062	3,665	0
Urban rail	12,978	28,735	9,372
Park-and-ride	5,845	32,194	2,512
Kiss-and-ride	2,162	3,844	863
Total	9,957,246	3,750,970	6,611,197

6.2 CORRIDOR APPROACH

For the US 290 MIS, the screening process used for the conceptual alternatives is based on the study's goals and objectives, as well as an associated + / 0 / - system that was created in an effort to help objectively screen the alternatives. The scale ranged from two plus marks (more positive) to two minus marks (more negative). A zero was used to identify conceptual alternatives that had a neutral impact on the defined goals and objectives as compared to the baseline (or other indicated) alternative. Both the matrix used for the screening process and a discussion concerning it can be found in **Table 6.4-1** and in the results and discussion section (***Section 6.4***). Additional in-depth quantitative analysis was performed on each alternative. This analysis included a closer examination of some of the mobility goals, screenline analysis, and transit boardings. The following section defines the criteria used for screening each conceptual alternative.

6.3 SCREENING CRITERIA

The screening process was based on a series of questions or criteria that represented components of the goals and objectives the project team defined for corridor improvements. Detailed descriptions of the goals, objectives, and criteria defining the screening process for the US 290 Corridor are documented in ***Chapter 3***, ***Chapter 5***, and in the *Screening Tech Memo* released in August of 2002. As previously documented, the goals defined for the US 290 MIS are as follows:

Goal 1: Improve public safety

Goal 2: Improve mobility

Goal 3: Increase transit opportunities

Goal 4: Avoid or minimize adverse social, economic, and environmental impacts

Goal 5: Contribute to air quality attainment

Goal 6: Maximize the use of existing right-of-way

Improve Public Safety

An important goal within the US 290 MIS is the ability to improve public safety. In order to evaluate each conceptual alternative's public safety improvement capability, three different measures were selected as criteria. These measures include **design standards, weaving conditions, and recurring conflict / accident locations**. Public safety's evaluation measures are to be evaluated on a qualitative basis on a + / 0 / - scale. New construction using TxDOT's design standards has the ability to not only bring an alternative into compliance, but allows for elimination of weaving sections and recurring accident locations.

Design standards

Design standards refer to the alternative's ability to conform to both state and federal design guidelines, as well as the transportation engineering industry's accepted and suggested practices. TxDOT's *Roadway Design Manual* was last updated in October 2002, and the current American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets* was copyrighted in 2001. These standards provide for safe and comfortable driving conditions, as well as smooth traffic operations. The list of design standards covers virtually every facet of highway design, from entrance and exit ramp spacing and length to superelevation, vertical clearances, slopes, turn radii lane widths, and pavement markings.

Weaving sections

Weaving sections are defined as highway segments where the pattern of traffic entering and leaving at contiguous points of access results in vehicle paths crossing each other. For example, weaving conditions can occur within an interchange or between entrance ramps, followed by exit ramps. Although in relation to the volume of weaving traffic, the distance in which the crossing is accomplished is relatively short, operations within that part of the highway section tend to become congested. The length and number of lanes of the weaving section and the volume of traffic in the various movements affect the operating conditions within the section. Worsened operating conditions, added to improperly designed and spaced weaving sections, can cause hazardous, unsafe, and congested driving conditions for both the weaving and the through traffic movements. The alternative chosen should attempt to eliminate dangerous weaving and merge conditions.

Recurring conflict / accident locations

Finally, recurring conflict / accident locations are just that — intersections and highway sections that continually have safety problems. The alternative chosen should endeavor to eliminate these recurring conflict locations.

The utilization of shoulders throughout the corridor will contribute positively to improving public safety in the corridor.

Improve and Maintain Mobility

When evaluating the conceptual alternatives, the second MIS goal taken into consideration focused in on each alternative's ability to improve and maintain traffic mobility within the corridor. The evaluation measures chosen to appraise this goal include several typical traffic and transportation engineering indicators, which allow for the specific goal of mobility to be evaluated on a quantitative basis. Obviously, mobility is the fundamental purpose of this MIS.

In order to establish each conceptual alternative's impacts and benefits to mobility, travel conditions within the study area corridor were evaluated on a 3-hour a.m. peak period basis for the year 2025. The 3-hour a.m. peak period (6:30-9:30 a.m.) was chosen because it is when travel demands are at their highest. The travel condition estimates were generated using the H-GAC regional travel model.

The transit and vehicle travel statistics for all of the build alternatives were compared against those for the baseline alternative in order to determine a common indication of how each alternative operates under projected 2025 travel demands. The technical evaluation criteria chosen (and associated measure) to evaluate the conceptual alternatives include the following:

- Congestion (volume-to-capacity [V/C] ratio)
- Person capacity
- User benefits (vehicle hours of delay)

Congestion — Volume-to-Capacity (V/C)

Aggregate vehicle miles of travel (VMT) and vehicle miles of capacity (VMC) were calculated for the study area for each alternative. VMT is a tally of the total miles of travel driven by vehicles within the study corridor, while VMC is a tally of the total capacity available in the system. The bi-directional VMT and VMC calculated incorporated general-purpose lanes, HOV lanes, managed lanes, Hempstead Highway, arterials, and collectors as appropriate for each alternative. The VMT calculation consisted of multiplying the volume on each link by the link's length, whereas the VMC calculation was performed by multiplying the link length by the link capacity.

Volume-to-capacity (V/C) ratio is a quantitative computation of capacity sufficiency and can be described as the ratio of observed or predicted vehicular volumes (demand) to the theoretical capacity (supply). A V/C ratio of greater than 1.00 results when forecast demand surpasses the computed capacity of a given roadway segment. When this occurs, it is a clear indication that improvements are necessary; the ratio can also demonstrate how much of a capacity increase a given roadway can withstand. For example, if the V/C ratio is computed to be 0.85 this indicates that the roadway can withstand an increase of only 15% of the capacity in demand before capacity is exceeded.

For this MIS, congestion was measured for each alternative using a V/C ratio calculated by dividing its VMT by its VMC. The goal is to achieve a V/C ratio that corresponds to an acceptable LOS (in the US 290 Corridor, acceptable is a LOS D).

Person Capacity

The real purpose of a transportation system is to move *people,* not vehicles. An alternative must provide more person-moving capacity in order to be able to move more people. Person capacity represents the maximum number of people that can move through the system (as opposed to the maximum number of vehicles); it will be higher for those transportation systems that incorporate high capacity transit and ride sharing options.

For vehicular trips, person capacity was calculated by establishing the percentage of drive-alone, two-person, three-person, four-person-plus, and truck-external trips in the corridor. These percentages were then multiplied by the alternative's vehicle miles of capacity (VMC) and number of occupants in order to estimate the person-moving capacity of the system. This reflects the fact that as more people are able to shift to higher occupancy vehicles, the ability of the transportation system to move people is greatly enhanced. Although the capacity of the average vehicle might be four, the private vehicular "capacity" counted in this methodology is defined as the occupancy. This clearly undercounts the theoretical capacity of the privately owned vehicle fleet, but it provides a realistic sensitivity to policies and networks that increase vehicle occupancy.

For transit, each route in the study area during the study period had its occupant capacity multiplied by the link length in order to establish transit person capacity for the alternative. The transit person capacity is based on the number of seats, although some transit modes have a theoretical capacity in excess of the number of seats. The transit and non-transit person capacity tallies were added together to demonstrate the total person capacity for the alternative in question.

User Benefits (Vehicle Hours of Delay)

Vehicle hours of travel (VHT) is calculated by tallying the total amount of time spent by drivers using the transportation network within the corridor. VHT was determined for each alternative using both the free speeds (average desired speed) and the loaded speed (actual speed). The difference between the two represents the vehicle hours of delay to users of the system.

The ability that a build alternative has over a baseline alternative is a reduction in the vehicle hours spent in delay; it promotes a decline in the amount of time during a typical day that is required for drivers to reach their destinations. These declines in the amount of travel time can be produced by improved mobility conditions in the region, as well as reducing the number of vehicle trips. Reduced numbers of vehicle trips occur when single-occupancy-vehicle (SOV) trips are converted into other trip types, such as transit or HOV trips. Usually, the greater the reduction in vehicle hours spent in delay, the more efficient the build alternative is with respect to the baseline alternative; thus, it is able to offer a more coordinated, balanced transportation system. The reason user benefits are measured is that ultimately the time savings has a monetary value that is part of the justification for spending public money to make the improvement.

Additional Analysis

A screenline is an arbitrary boundary line that bisects a series of parallel roadways. Screenlines allow for the evaluation measures (discussed later) to be applied to all the roadways bisected by the screenline (i.e., general-purpose lanes, high-occupancy-vehicle [HOV] lanes, arterials, and frontage roads). Selected screenlines usually run perpendicular to traffic flows on the roadways they bisect.

Five screenlines were selected to aid in evaluating the various conceptual alternatives for the US 290 MIS. The screenlines were chosen using engineering judgment based upon their physical location, as well as indications of their ability to provide informative data about the corridor. The selected screenlines were:

- West of IH 610
- Bingle Road
- Gessner Road
- Jones Road
- West of SH 6

The different roadway classifications bisected by each screenline include general-purpose lanes, HOV / managed lanes, and Hempstead Highway. The screenlines used in this study appropriately include only those roadways immediately within the freeway envelope. This stems from the fact that US 290 is the primary east-west high capacity facility and thus is the primary east-west travel route in the corridor.

Vehicular Trips (Volumes)

Vehicular trips for the 3-hour a.m. peak period were taken from the model for each of the five screenlines previously listed. This procedure was done for each alternative (as appropriate) for all three facility type categories: general-purpose, HOV / managed, and Hempstead.

Although vehicular trips on their own do not impart any indication of whether or not one alternative is outperforming another, they do suggest, when separated out by lane type (i.e., freeway lanes, managed lanes, HOV lanes, or Hempstead lanes), how various component facilities within each alternative are exploited.

Roadway Capacity

Capacity is defined as the maximum number of vehicles that can be safely accommodated by a particular facility within a specified time period.

The capacities used in the US 290 MIS came from the H-GAC mobility plan. Capacities for freeway lanes are a function of several factors, including the numbers and widths of lanes, geometric conditions, lateral clearances, and traffic characteristics; in contrast, urban arterials' capacities are a function of delay characteristics. These delay characteristics are predominantly determined based upon the spacing and delay attributes of the signals along the arterial.

As with vehicle trips, roadway capacities alone do not provide an indication of whether or not any of the alternatives outperforms another. Estimated capacities at each screenline, however, afford a summary definition of the transportation alternative.

Volume-to-Capacity (V/C) Ratio
As previously described, a V/C ratio will be determined for each screenline using the aforementioned volumes and capacities.

Increase Opportunities for Transit

The third goal of the US 290 MIS is to increase opportunities for transit. When feasible, the alternative chosen should provide transit options to those who cannot (or choose not to) drive a car. The alternative should also provide an opportunity for additional modes of travel in the future and attempt to encourage transit ridership. Evaluating the possibility for meeting this goal for each of the conceptual alternatives was accomplished using two measures. A quantitative measure was examined to determine transit ridership; this was followed by a yes-or-no question: "Is the conceptual alternative consistent with the regional transit plan?" The METRO *2025 Mobility Plan* calls for high capacity transit to be located in the US 290 Corridor. This means that any alternative that does not have high capacity transit in the corridor will receive a "no," and alternatives that recommend high occupancy transit will be given a "yes."

Transit ridership was calculated based on transit boardings. Each mode of transit (buses, rail, vanpools, etc.) shows its ability to move people through the corridor based upon the number of boardings generated within the study time period. A larger number of boardings corresponds to a more efficient transit network. In addition, transit ridership is encouraged to a greater extent if the transit network is efficient, convenient, easy to navigate and understand, and provides several different options to travelers.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects

Identifying potentially negative impacts of proposed transportation improvements is an important function of early project development activities. In keeping with the goal of avoiding or minimizing adverse effects, a variety of qualitative measures were employed for each of the US 290 MIS alternatives. Each alternative was screened against the following specific evaluation measures (**Table 6.3-1**) and later rated as positive, neutral, or negative.

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Table 6.3-1: Environmental Screening Criteria

Measure	Rating Positive +	Neutral O	Negative -
Social Effects			
Land Use Displacement			
What is the likely effect on residences, businesses, schools, churches, public facilities, and parks?	No displacements	Only a few displacements, mostly in the vicinity of interchanges	Displacements would likely occur along entire stretches of US 290, at the interchanges, and in between interchanges
Aesthetics			
What is the likelihood of depreciating the visual quality of the corridor?	No additional elevated sections	Minor amounts of additional elevated sections	Long stretches of additional elevated sections
Minority and Low-Income Communities			
What is the likely effect on these communities?	No potential for disproportionate and adverse effects	Some potential for disproportionate and adverse effects	High potential for disproportionate and adverse effects
Cultural Resources			
What is the likely effect on archeological and historic resources?	No potential for direct impacts on cultural resources	Some potential for direct impacts on cultural resources	High potential for direct impacts on cultural resources
Neighborhoods			
What is the likely effect on neighborhood cohesion?	No potential for increasing or creating a barrier effect	Some potential for increasing or creating a barrier effect	High potential for increasing or creating a barrier effect
Area Growth Plans and Policies			
What is the likely effect on adopted comprehensive plans and policies?	Consistent with public plans and policies	Somewhat consistent with public plans and policies	Inconsistent with public plans and policies
Economic Effects			
Access to Local Businesses			
What is the likely effect on access for adjacent businesses?	Improved access	No change in access	Diminished access

Measure	Rating Positive +	Neutral O	Negative -
Social Effects			
Tax Base			
What is the likely effect on community tax bases?	Potential for enhanced tax base	No foreseeable change in the tax base	Potential for diminished tax base
Environmental Effects			
Air Quality — Separately Evaluated			
Wetlands and Linear Drainages			
What is the likely effect on wetland areas and creeks?	No disturbances	Only minor disturbances, mostly within existing highway right-of-way	Multiple disturbances outside existing highway right-of-way
Vegetation and Wildlife Communities			
What is the likely effect on these communities?	No alteration of wooded areas or other natural habitat	Only minor disturbances to wooded areas or other natural habitat	Large amount of wooded areas or other natural habitat would be converted to highway use
Farmlands			
What is the likely effect on farmlands?	No conversion of farmlands	Only minor amounts of farmland would be converted	Large amounts of farmland would be converted to highway use
Hazardous Materials Sites			
What is the likely effect on known hazardous materials sites?	No additional right-of-way needed in areas with known Hazmat sites	Only minor amounts of additional right-of-way needed	Large amounts of additional right-of-way needed

Contribute to Air Quality Attainment

The fifth goal of the screening of the conceptual alternatives involved the ability of each alternative to contribute to air quality attainment. The Clean Air Act (CAA), enacted by the Environmental Protection Agency (EPA) and last amended in 1990, requires the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants which are considered harmful to public health and the environment. There are two types of NAAQS established by the Clean Air Act: primary and secondary. Primary standards set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including providing protection against decreased visibility and damage to animals, crops, vegetation, and buildings. An attainment area is described as any area that meets the primary or secondary NAAQS for the pollutant, while a nonattainment area is described as an area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the primary or secondary NAAQS for the pollutant. The EPA Office of Air Quality Planning and Standards (OAQPS) has set NAAQS for six principal (criteria) pollutants. The Texas Commission on Environmental Quality (TCEQ), through its legislation and regulations relating to air quality attainment, along with the H-GAC, subscribe and conform to the CAA.

The Houston metropolitan area (in which the US 290 Corridor lies) has been identified as an area with current and potential air quality attainment issues. This is why it is important that modifications and improvements to the corridor are done in a manner that helps alleviate some of these air quality issues; in other words, that they contribute to air quality attainment. The three pollution sources of particular interest in the US 290 Corridor are volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO). Quantitative calculations of each alternative’s levels of the aforementioned pollutants were performed and compared against the *Metropolitan Transportation Plan* (MTP) alternative (CA-1B) because the MTP alternative was set up in such a way that it meets the minimum necessary air quality attainment. Link VMT and loaded speed were multiplied by the appropriate emissions factor for each pollutant and for every alternative to get an idea of where each alternative’s emissions fall relative to the MTP alternative. Air quality conformity of the selected alternative will be addressed by H-GAC after adoption of the locally preferred alternative.

Soot, smoke, liquid droplets, dust, and dirt emitted into the air are air pollutants labeled particulate matter. Particulate matter also includes those particles formed in the atmosphere by condensation or the transformation of emitted gases (such as VOCs). Laboratory studies of humans and animals — and studies of human populations — exposed to high concentrations of particles have shown that high concentrations of particulate matter have adverse effects on human health, including breathing and respiratory symptoms, alteration in the body’s defense systems against foreign materials, aggravation of existing respiratory and cardiovascular disease, carcinogenesis, damage to lung tissue, and premature death. Particulate matter has also been shown to damage soil materials, in addition to being a major cause of visibility impairment. VOCs are emitted from a variety of sources, including automobiles, and they are also a part of air quality issues that relate to ozone (O_3).

When found in the upper atmosphere, O_3 is advantageous to life by shielding the earth from the sun’s detrimental ultraviolet radiation. However, when found in high concentrations at the ground level, O_3 is a large environmental and health concern. O_3 is both a photochemical oxidant and the major component of smog. It is not emitted directly into the air but is actually produced in the presence of sunlight through complex chemical reactions between precursor emissions of VOCs and NOx. Health problems caused by the reactivity of O_3 include damage to lung tissue, reduction in lung function, and sensitivity of lungs to other irritants.

Nitrogen oxides (NOx), is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Although a majority of the nitrogen oxides are odorless and colorless, one pollutant found in all urban areas — nitrogen dioxide (NO_2) — can be described as a brownish, highly reactive gas. NOx is formed when fuel is burned at high temperatures and one of its main emissions sources is transportation. NOx can trigger respiratory problems, contribute to the formation of acid rain, contribute to nutrient overload that deteriorates water quality, and contribute to global warming. NOx is one of the main ingredients involved in the formation of ground-level ozone. Following the pattern of prevailing winds, NOx and the pollutants formed from NOx can be transported over long distances, meaning that problems associated with NOx are not confined to areas where NOx are emitted.

Carbon monoxide is a poisonous, colorless, odorless gas produced by the incomplete burning of carbon in fuels. CO, upon entering the bloodstream, reduces the delivery of oxygen to the body's tissues and organs. Exposure to elevated CO levels can cause impairment of learning ability, performance of complex tasks, visual perception, and manual dexterity. According to the EPA, 77% of the nation's CO emissions come from transportation sources, with the largest contribution coming from highway motor vehicles.[2]

Title 40, Part 50 of the *Code of the Federal Regulations* lists the ambient air quality standards for the aforementioned pollutants.

Maximize Use of Existing Right-of-Way

Finally, the last goal of the US 290 MIS was to maximize the use of existing right-of-way facility. Right-of-way is defined as the total land area acquired for the construction and operation of a facility. Its width should be sufficient to accommodate all the elements of the cross-section, any planned widening, and any public utility facilities. Unfortunately, it is not always possible to construct all of the necessary improvements within the existing right-of-way. It is preferable to preserve and maximize use of the existing right-of-way on cost, social, and environmental basis; the costs associated with acquiring additional right-of-way can be high, and landowners are often unwilling to give up their land for highway construction.

[2] http://www.epa.gov provided background information for this section

Right-of-way currently exists on US 290, Hempstead Highway, and the Union Pacific Railroad. Each of the conceptual alternatives requires use of different quantities and locations of right-of-way, either within the existing limits or with the acquisition of additional right-of-way. The ability of each alternative to minimize the additional right-of-way needed was evaluated on a + / - basis (as compared to the baseline alternative).

6.4 SCREENING RESULTS AND DISCUSSION

As previously stated, the screening process for the US 290 Corridor MIS was conducted on a + / 0 / - system. Each of the conceptual alternatives was evaluated against the screening criteria documented above and in the *Screening Tech Memo*, they were then rated on their ability to positively or negatively affect each specific criterion. Those conceptual alternatives that performed poorly overall were identified and considered for elimination from further analysis.
A summary screening matrix demonstrating the evaluation for each conceptual alternative is provided in **Table 6.4-1**.

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Table 6.4-1: Conceptual Alternative Evaluation Matrix

		No-Build Alternatives		Freeway Alternatives		Managed Facility Alternatives			Transit Alternatives			
		CA-1A	CA-1B	CA-2A	CA-2B	CA-3A	CA-3B	CA-3C	CA-4A	CA-4A-1	CA-4B	CA-4C
	-- More Negative - Negative O Neutral + Positive ++ More Positive	Baseline	TSM/TDM	Expand US 290, Extend HOV	Expand US 290, Remove HOV	Four-Lane, Two-Way, Barrier Separated	Two-Lane, Reversible HOV, Expand US 290	High-Capacity, Partially Grade-Separated Hempstead Rd.	AHCT along US 290 and SH 249	AHCT along US 290	AHCT along Hempstead	Express Busway
Improve Public Safety	Consistency with Design Standards	- -	- -	++	++	++	++	+	++	++	++	++
	Reduce Weaving Volumes	- -	-	+	+	++	+	+	+	+	+	+
	Accident Locations Eliminated	- -	-	+	++	++	+	+	+	+	+	+
Improve Mobility	Congestion	- -	- -	+	-	++	+	++	-	-	-	-
	Person Capacity	- -	-	+	+	++	+	++	O	O	+	+
	User Benefits	O	+	++	- -	++	++	++	-	- -	- -	- -
Increase Transit Opportunities	Transit Ridership	-	-	O	- -	+	+	-	++	++	++	+
	METRO Plan Consistency	-	-	+	-	+	+	+	+	+	+	-
Avoid or Minimize Adverse Social, Economic and Environmental Effects	Social Effects	+	+	-	-	-	-	-	-	-	-	-
	Economic Effects	O	+	-	-	-	-	-	-	-	+	-
	Environmental Effects	++	++	-	-	-	-	-	-	-	-	-
Contribute to Air Quality Attainment	VOC (lbs)	- -	-	O	- -	+	++	-	+	+	+	+
	CO (lbs)	- -	-	O	- -	-	++	+	+	+	-	+
	NOx (lbs)	- -	-	O	- -	+	+	- -	++	++	++	+
Maximize Use of Existing ROW	US 290	O	O	-	-	- -	- -	-	-	-	-	-
	Hempstead/ UP Corridor	O	O	O	O	O	O	++	O	O	++	O

The following section provides a detailed discussion about each alternative, how many points they received, and how the alternative performed relative to the goals. Please refer back to ***Chapter 5*** for detailed descriptions of the 11 conceptual alternatives.

NO-BUILD ALTERNATIVES

No-Build Alternatives

CA-1A Baseline

CA-1B TSM / TDM

Improve Public Safety
The absence of any major improvements along US 290 and in the corridor means that there are no changes to bring US 290 up to design standards, reduce weaving, or eliminate accident locations by virtue of new designs and construction. Therefore, the no-build alternatives received negative ratings with respect to public safety.

CA-1A, the baseline alternative, received all "more negative" ratings for its inability to meet the corridor's public safety goal. CA-1B, the TSM / TDM alternative, provides some operational improvements that serve as improvements over CA-1A. Consequently, CA-1B only received a "more negative" rating in the consistency with design standards category and received a "negative" rating in the reduction of weaving and accident location eliminations category.

Improve Mobility
The absence of any major improvements along US 290 and in the corridor also led the no-build alternatives to not rate well with respect to mobility. Modeling of the alternatives led to the conclusion that the trips generated by the population and employment growth in the corridor through the year 2025 will not be supported by the current transportation network in the corridor. The no-build alternatives create an environment which will operate at level of service F.
For both no-build alternatives, the corridor is over capacity and received a "more negative" rating in the congestion category.

When compared against the results from all of the other alternatives, the respective person capacities of CA-1A and CA-1B were both deficient. CA-1A received a "more negative" rating, while CA-1B received a "negative" rating, performing better due to the TSM / TDM improvements.

All the other alternatives were compared against the baseline alternative to determine their ability to decrease delay for system users. Therefore, the baseline alternative received a "neutral" rating in the user benefits category.

NO-BUILD ALTERNATIVES

Increase Transit Opportunities
The transit ridership of the no-build alternatives, when compared against the transit ridership of other alternatives, performed poorly. In addition, the no-build alternatives are not consistent with METRO's *2025 Transit Service Plan* because they do not include advanced high capacity transit (AHCT) or an extension of the HOV lane.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
No-build alternatives are generally given favorable ratings, primarily because they avoid the need for substantial amounts of additional right-of-way. Although no additional land is required in the baseline alternative, economic conditions in the corridor could worsen over time due to increasing levels of congestion and the resulting gradual deterioration of access to local businesses. The TSM / TDM alternative may require minor amounts of additional right-of-way at intersections and could conceivably improve local access and circulation along the corridor.

Contribute to Air Quality Attainment
The no-build alternatives show increased levels of key pollutants over CA-2A, which is the alternative demonstrated by H-GAC to contain acceptable levels of pollutants in the year 2025. CA-1A's level of pollutants was worse than that of CA-1B; a "more negative" rating was given to CA-1A, and a "negative" rating was given to CA-1B.

Maximize Use of Existing Right-of-Way
The absence of physical changes in the corridor results in "neutral" affects on maximization of existing right-of-way for both no-build alternatives.

Tables 6.4-2 through **6.4-4** show more in depth analysis of CA-1A, including mobility performance measures, screenlines, and transit mode breakdowns. **Tables 6.4-5** through **6.4-7** are equivalent tables, but are for CA-1B. The tables demonstrate that the no-build alternatives are over capacity and experience a high level of delay.

NO-BUILD ALTERNATIVES

Table 6.4-2: CA-1A Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
FREEWAYS	1,141,851	1,504,514	268	17,539	26,122	8,583	32.86%	43.57%
ARTERIALS	2,044,033	4,153,396	1,774	48,511	58,459	9,948	17.02%	16.34%
TOTAL	3,185,884	5,657,910	2,041	66,049	84,580	18,531	21.91%	19.91%

Table 6.4-3: CA-1A Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	30,560	27,327	1.118	21,371	27,327	0.782
	HOV	5,321	4,500	1.182			
Bingle	FREEWAY	25,353	20,940	1.211	17,690	20,940	0.845
	HOV	4,983	4,500	1.107			
Gessner	FREEWAY	26,831	20,940	1.281	14,521	20,940	0.693
	HOV	4,983	4,500	1.107			
Jones	FREEWAY	25,992	20,940	1.241	8,644	20,940	0.413
	HOV	5,325	4,500	1.183			
West of SH 6	FREEWAY	21,187	21,096	1.004	6,533	21,096	0.310
	HOV	n/a	n/a				

NO-BUILD ALTERNATIVES

Table 6.4-4: CA-1A Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	101,435
Commuter Bus	10,121
Express Bus	7,128
TOTAL	118,684

PERSON CAPACITY CA-1A = 9,467,000

Table 6.4-5: CA-1B Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Hour
FREEWAYS	1,141,851	1,579,740	268	17,539	26,174	8,583	32.79%	42.70%
ARTERIALS	2,044,033	4,194,929	1,774	48,511	58,400	9,889	16.93%	16.01%
TOTAL	3,185,884	5,774,669	2,041	66,049	84,574	18,473	21.84%	19.71%

NO-BUILD ALTERNATIVES

Table 6.4-6: CA-IB Sceenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	30,560	27,874	1.096	21,371	27,874	0.767
	HOV	5,321	4,590	1.159			
Bingle	FREEWAY	25,353	21,359	1.187	17,690	21,359	0.828
	HOV	4,983	4,590	1.086			
Gessner	FREEWAY	26,831	21,359	1.256	14,521	21,359	0.680
	HOV	4,983	4,590	1.086			
Jones	FREEWAY	25,992	21,359	1.217	8,644	21,359	0.405
	HOV	5,325	4,590	1.160			
West of SH 6	FREEWAY	21,187	21,518	0.985	6,533	21,518	0.304
	HOV						

Table 6.4-7: CA-IB Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	101,334
Commuter Bus	10,111
Express Bus	7,121
TOTAL	118,565

PERSON-CAPACITY CA-1B = 9,495,401

No-Build Alternatives Conclusion

Lessons learned from evaluation of the no-build alternatives:

- Do not meet the purpose and need for the corridor
- TSM / TDM fails to meet the study's goals, needs, and objectives

The two no-build alternatives received two of the lowest overall ratings of all the alternatives. The baseline and TSM / TDM alternatives will be merged together as one no-build alternative to be carried forward as a viable alternative, despite its inability to satisfy the corridor goals. The new no-build alternative will serve as an alternative on the possibility that none of the build viable alternatives are implemented in the corridor; it will also serve as a comparison base for the build viable alternatives.

FREEWAY ALTERNATIVES

CA-2A Expand US 290, Extend HOV

Improve Public Safety
Expanding US 290 and extending the HOV facility west allows the new design to bring the corridor up to design standards and provides a design that reduces weaving and eliminates accident locations. CA-2A's greatest contribution to public safety is its ability to bring the corridor up to design standards; for this reason, it received a "more positive" rating.

Improve Mobility
CA-2A also had positive impacts with respect to mobility. When compared to the other alternatives, CA-2A was assessed to have "positive" impacts on both congestion and the person capacity available in the corridor. In the area of user benefits, or rather reduction of delay experienced by users, CA-2A received a "more positive" rating when compared to the baseline alternative.

Increase Transit Opportunities
The extension of the HOV lane west is consistent with METRO's plan and therefore received a "positive" rating in the associated category, METRO plan consistency. While the extension of the HOV will generate some new transit riders, when compared to alternatives that include light rail or some sort of high occupancy transit it has significantly lower ridership.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
This freeway alternative requires additional right-of-way due to the expansion of US 290. The resulting land use displacement adjacent to US 290 triggers potentially adverse effects in multiple evaluation categories. This alternative is therefore rated "negative."

Contribute to Air Quality Attainment
CA-2A or the MTP alternative was used by H-GAC to demonstrate air-quality attainment in the Houston metropolitan region. Therefore, CA-2A is the alternative against which all others are compared to gauge air quality effects, resulting in a "neutral" rating for air quality attainment.

FREEWAY ALTERNATIVES

Maximize Use of Existing Right-of-Way
The physical changes to US 290 result in a "negative" rating with regard to right-of-way along US 290, while the absence of any major improvements to Hempstead Highway yields a "neutral" rating in the Hempstead / Union Pacific corridor.

The analysis shows that, while a slight level of service improvement is seen in the corridor, the alternative does not provide enough additional capacity to satisfy future demand. In addition, the one-lane reversible HOV facility is over capacity, and an additional HOV lane is necessary. This is made more evident in the detailed analysis shown in **Tables 6.4-8** through **6.4-9**.

Table 6.4-8: CA-2A Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
FREEWAYS	1,210,045	1,954,210	313	18,262	24,869	6,607	26.57%	31.54%
ARTERIALS	2,100,223	4,207,249	1,798	49,984	61,222	11,238	18.36%	16.74%
TOTAL	3,310,268	6,161,459	2,112	68,246	86,091	17,845	20.73%	18.93%

FREEWAY ALTERNATIVES

Table 6.4-9: CA-2A Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	32,560	33,558	0.970	19,862	33,558	0.592
	HOV	5,144	4,500	1.143			
Bingle	FREEWAY	30,147	27,327	1.103	16,718	27,327	0.612
	HOV	4,342	4,500	0.965			
Gessner	FREEWAY	29,941	27,327	1.096	12,481	27,327	0.457
	HOV	4,342	4,500	0.965			
Jones	FREEWAY	29,717	27,327	1.087	7,644	27,327	0.280
	HOV	4,973	4,500	1.105			
West of SH 6	FREEWAY	22,264	24,927	0.893	5,986	24,927	0.240
	HOV	3,180	4,500	0.707			

Table 6.4-10: CA-2A Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	100,582
Commuter Bus	13,373
Express Bus	7,070
TOTAL	121,025

PERSON-CAPACITY CA-2A = 10,050,019

CA-2B Expand US 290, Remove HOV

Improve Public Safety

Expanding US 290 and removing the HOV facility allows the new design to bring the corridor up to design standards and provides a design that reduces weaving and eliminates accident locations. CA-2B scored similarly to that of CA-2A, except for receiving the higher rating of "more positive" as a result of removing the HOV barrier walls and any associated merging that can take place as cars exit and enter the HOV facility.

FREEWAY ALTERNATIVES

Improve Mobility
CA-2B had mostly negative impacts on mobility. When compared to other alternatives, CA-2B was assessed to have "negative" impacts on congestion, and "positive" impacts on person capacity. However, it received a "more negative" rating in the user benefit category when compared against the baseline alternative. CA-2B's positive impacts can be attributed to the additional freeway capacity, while the negative impacts are linked to the removal of the HOV lane and the likely conversion of HOV commuters to single-occupancy-vehicles (SOV) and the associated increase in travel time for former HOV commuters, as well as the displacement of HOV users to the general-purpose lanes. The HOV commuters may all become single-occupancy-vehicles (SOV), thus lowering the operating speed of the corridor.

Increase Transit Opportunities
This alternative scored worst with respect to transit over all the other alternatives, including the no-build alternatives. With the elimination of the HOV lane, transit ridership is significantly reduced, resulting in a "more negative" rating. In addition, the absence of the HOV lane is not consistent with METRO's *2025 Mobility Plan,* resulting in a "negative" rating.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
As with the other freeway alternative, CA-2B requires additional amounts of right-of-way due to the expansion of US 290. Land use displacements along US 290 would result in potentially adverse effects (negative rating) in all evaluation categories.

Contribute to Air Quality Attainment
CA-2B scored worst, along with the baseline, in the air quality attainment goal. The key pollutant levels were significantly greater than those produced by CA-2A, which is the alternative by which all others are judged.

Maximize Use of Existing Right-of-Way
The physical changes to US 290 result in a "negative rating" with regard to right-of-way along US 290, while the absence of any major improvements to Hempstead Highway yields a "neutral" rating in the Hempstead / Union Pacific corridor.

Tables 6.4-11 through **6.5-13** reinforce alternative CA-2B's mobility and transit insufficiencies, mentioned earlier.

FREEWAY ALTERNATIVES

Table 6.4-11: CA-2B Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,292,848	2,288,469	342	19,613	27,711	8,098	29.22%	30.23%
Arterials	2,014,009	4,153,396	1,773	47,874	58,583	10,708	18.28%	16.94%
TOTAL	3,306,857	6,441,864	2,115	67,487	86,293	18,806	21.79%	19.09%

Table 6.4-12: CA-2B Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	37,250	33,558	1.110	21,567	33,558	0.643
	HOV						
Bingle	FREEWAY	32,696	27,327	1.196	18,378	27,327	0.673
	HOV						
Gessner	FREEWAY	34,600	27,327	1.266	14,643	27,327	0.536
	HOV						
Jones	FREEWAY	34,406	27,327	1.259	8,686	27,327	0.318
	HOV						
West of SH 6	FREEWAY	25,160	24,927	1.009	6,601	24,927	0.265
	HOV						

FREEWAY ALTERNATIVES

Table 6.4-13: CA-2B Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	103,668
Commuter Bus	3,803
Express Bus	6,269
TOTAL	113,740

PERSON-CAPACITY CA-2B = 10,495,316

Freeway Alternatives Conclusion

After evaluating the model results, the following conclusions were drawn:

- More than one HOV lane is necessary (single HOV lane is over capacity)
- More than one additional general-purpose lane in each direction is necessary in some areas
- Transit options are a necessary component in the corridor

Managed Facility Alternatives

MANAGED FACILITY ALTERNATIVES

CA-3A Four-Lane, Two-Way, Barrier Separated Managed Facility

Improve Public Safety
CA-3A, which provides for a four-lane, two-way, barrier-separated, managed facility, along with three general-purpose lanes in each direction (both along US 290), received all "more positive" ratings for the public safety goal. No other alternative received the "more positive" rating in all three categories under the public safety goal. A positive rating was largely due to the managed lanes express component with few interchanges, therefore reducing weaving and accidents.

Improve Mobility
CA-3A also received "more positive" ratings in all of the mobility categories. Providing the managed facility creates an opportunity for more SOV users to consider ridesharing and utilize the managed facility. Although the managed lanes performed well, the three-lane general freeway section suffered from a lack of capacity. Therefore, this alternative can perform even better with some additional capacity.

Increase Transit Opportunities
Transit ridership and METRO plan consistency both received a "positive" rating.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
Additional amounts of right-of-way along US 290 that would be needed for this alternative result in potentially negative effects in all evaluation categories.

Contribute to Air Quality Attainment
When compared against alternative CA-2A, CA-3A positively impacts air quality for two of the key pollutants (VOC and NOx), but received a "negative" rating for CO. Due to the increase in speeds and vehicle miles of travel (VMT), some of the pollutant levels drop, while others rise. The various pollutants have different degrees of sensitivity and plateaus based on travel speeds and VMT.

MANAGED FACILITY ALTERNATIVES

Maximize Use of Existing Right-of-Way
The physical changes to US 290 have a "more negative" impact on right-of-way in the US 290 envelope, but the Hempstead / Union Pacific Corridor's lack of any major changes keeps its right-of-way usage rating at "neutral."

Tables 6.4-14 through **6.4-16** correspond to CA-3A.

Table 6.4-14: CA-3A Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,272,123	2,120,774	342	19,157	26,827	7,670	28.59%	23.37%
Arterials	2,147,952	4,393,847	1,865	51,377	61,351	9,973	16.26%	16.72%
TOTAL	3,420,075	6,514,621	2,207	70,534	88,177	17,644	20.01%	17.75%

Table 6.4-15: CA-3A Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	29,796	26,670	1.117	21,165	26,670	0.794
	MANAGED	7,573	9,000	0.841	273	9,000	0.030
Bingle	FREEWAY	27,716	23,940	1.158	18,188	23,940	0.760
	MANAGED	6,847	9,000	0.761	273	9,000	0.030
Gessner	FREEWAY	29,403	23,940	1.228	14,478	23,940	0.605
	MANAGED	6,847	9,000	0.761	273	9,000	0.030
Jones	FREEWAY	27,503	23,940	1.149	7,234	23,940	0.302
	MANAGED	9,375	9,000	1.042	1,468	9,000	0.163
West of SH 6	FREEWAY	21,246	23,940	0.887	5,267	23,940	0.220
	MANAGED	5,608	9,000	0.623	5,608	9,000	0.623

Table 6.4-16: CA-3A Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	101,171
Commuter Bus	14,62
Express Bus	6,860
TOTAL	122,093

PERSON-CAPACITY CA-3A = 10,620,599

CA-3B Two-Lane, Reversible HOV, Expand US 290

MANAGED FACILITY ALTERNATIVES

Improve Public Safety
CA-3B, which provides an extended two-lane, reversible HOV facility and an additional general-purpose lane in each direction, performs similarly to the one-lane HOV alternative CA-2A with respect to public safety. The new design allows the corridor to be brought up to design standards, and provides a design that reduces weaving and eliminates accident locations. Similar to CA-2A, CA-3B's greatest contribution to public safety is its ability to bring the corridor up to design standards, which is where it received a "more positive" rating.

Improve Mobility
CA-3B also had positive impacts with respect to mobility. When compared to the other alternatives, CA-3B was assessed to have "positive" impacts on both congestion and the person capacity available in the corridor. In the area of user benefits, or rather, reduction of delay experienced by users, CA-3B received a "more positive" rating when compared to the baseline alternative.

Increase Transit Opportunities
Transit ridership and METRO plan consistency both received a "positive" rating.

Avoid or Minimize Adverse Social, Economic and Environmental Effects
Additional amounts of right-of-way along US 290 would be needed for this alternative, resulting in potentially negative effects in all evaluation categories.

Contribute to Air Quality Attainment
CA-3B performed quite well in the air quality evaluation. It received "more positive" ratings for its ability to lower levels of two key pollutants over the alternative currently meeting air quality attainment (CA-2A). In addition, CA-3B received a "positive" rating for its ability to lower levels of the remaining key pollutant.

Maximize Use of Existing Right-of-Way
The physical changes to US 290 have a "more negative" impact on right-of-way in the US 290 envelope, but the Hempstead / Union Pacific Corridor's lack of any major changes keep its right-of-way usage rating at "neutral."

MANAGED FACILITY ALTERNATIVES

Tables 6.4-17 through **6.4-19** correspond to CA-3B.

Table 6.4-17: CA-3B Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,284,197	2,042,322	326	19,080	26,290	7,210	27.42%	26.28%
Arterials	2,023,572	4,213,635	1,802	48,194	58,282	10,088	17.31%	16.93%
TOTAL	3,307,769	6,255,957	2,128	67,274	84,572	17,298	20.45%	18.36%

Table 6.4-18: CA-3B Sceenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	33,314	33,558	0.993	22,044	33,558	0.657
	HOV	7,329	9,000	0.814			
Bingle	FREEWAY	29,802	27,327	1.091	18,749	27,327	0.686
	HOV	6,879	9,000	0.764			
Gessner	FREEWAY	31,114	27,327	1.139	14,835	27,327	0.543
	HOV	6,879	9,000	0.764			
Jones	FREEWAY	30,020	27,327	1.099	8,691	27,327	0.318
	HOV	7,076	9,000	0.786			
West of SH 6	FREEWAY	22,366	34,927	0.640	6,547	34,927	0.187
	HOV	3,599	9,000	0.400			

MANAGED FACILITY ALTERNATIVES

Table 6.4-19: CA-3B Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	106,857
Commuter Bus	12,329
Express Bus	6,862
TOTAL	126,048

PERSON-CAPACITY CA-3B = 10,196,520

CA-3C High-Capacity, Partially Grade-Separated Hempstead Highway:

Improve Public Safety
CA-3C, which provides for a high capacity, partially grade-separated facility along the Hempstead Highway Corridor received all "positive" ratings for the public safety goal. This alternative, while scoring "positive" ratings, does not perform as well as others toward the public safety goal when looking at only the build alternatives. This is due to much of the focus in the corridor being turned to Hempstead Highway and not as much new design and improvements along US 290.

Improve Mobility
CA-3C scored all "more positive" ratings for the mobility goal. CA-3A was the only other alternative to do as well. Improvements to the Hempstead Corridor will enhance the overall mobility of the study area, not just those trips on Hempstead Highway.

Increase Transit Opportunities
CA-3C did not score well with respect to transit. It received a "negative" rating for transit goal, transit ridership, and positive for METRO plan consistency. The reduction in transit ridership can be attributed to the additional available capacity along Hempstead; a conclusion can be made that the reduced vehicle travel times along Hempstead attract transit patrons back to their vehicles.

MANAGED FACILITY ALTERNATIVES

Avoid or Minimize Adverse Social, Economic, or Environmental Effects
Additional amounts of right-of-way along both US 290 and Hempstead Highway would be needed for this alternative, resulting in potentially negative effects in all evaluation categories.

Contribute to Air Quality Attainment
CA-3C received a range of ratings for the air quality goal. Due to the increase in speeds and vehicle miles of travel (VMT), some of the pollutant levels drop while others rise. The various pollutants have different degrees sensitivity and plateaus based on travel speeds and VMT. CA-3C received a "negative," "positive," and "more negative" rating for the three key pollutants — VOC, CO, and NOx respectively.

Maximize Use of Existing Right-of-Way
The physical changes to US 290 have a "negative" impact on right-of-way in the US 290 envelope, but the improvements to the Hempstead / Union Pacific Corridor maximize use of the existing right-of-way along Hempstead Highway. The improvements have the potential for economic revitalization in the aging corridor; therefore, the Hempstead Corridor received a "more positive" rating in the right-of-way category.

Tables 6.4-20 through **6.4-22** correspond to CA-3C.

Table 6.4-20: CA-3C Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,220,257	1,954,212	313	18,372	25,192	6,820	27.07%	36.89%
Arterials	2,243,240	4,626,740	1,866	53,231	63,356	10,125	15.98%	16.65%
Hempstead from IH 610 to Beltway 8	161,913	376,213	61	3,431	3,786	356	9.00%	3.00%
TOTAL	3,463,497	6,580,952	2,179	71,603	88,548	16,945	19.14%	19.55%

Table 6.4-21: CA-3C Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	30,622	33,558	0.912	18,904	33,558	0.563
	HOV	4,209	4,500	0.935			
	HEMPSTEAD	13,757	19,050	0.722	5,078	19,050	0.267
Bingle	FREEWAY	25,842	27,327	0.946	16,056	27,327	0.588
	HOV	3,944	4,500	0.876			
	HEMPSTEAD	12,403	19,050	0.651	3,266	19,050	0.171
Gessner	FREEWAY	27,192	27,327	0.995	13,266	27,327	0.485
	HOV	3,944	4,500	0.876			
	HEMPSTEAD	13,886	19,050	0.729	2,264	19,050	0.119
Jones	FREEWAY	32,500	27,327	1.189	8,722	27,327	0.319
	HOV	4,674	4,500	1.039			
West of SH 6	FREEWAY	24,003	24,927	0.963	6,584	24,927	0.264
	HOV	2,614	4,500	0.581			

Table 6.4-22: CA-3C Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	98,570
Commuter Bus	13,106
Express Bus	6,929
TOTAL	118,605

PERSON-CAPACITY CA-3C = 10,734,257

Conclusions on the Managed Lane Facility Alternatives

Lessons learned from evaluation of the Managed Lane Facility Alternatives

- Managed facilities should be bi-directional at all times due to the future growth west of Beltway 8 and the operational difficulty in reversing the HOV facility
- More than one managed lane in each direction is necessary
- Additional general-purpose lanes are necessary to handle future demand and should be combined with managed lanes

CA-4A AHCT along US 290 and SH 249:

CA-4A-1 AHCT along US 290:

Improve Public Safety
CA-4A and CA-4A-1 are similar alternatives. CA-4A has advanced high capacity transit along US 290 as well as SH 249, while CA-4A-1 has only AHCT along US 290. The alternatives perform the same with respect to public safety, receiving "more positive" ratings in the design standards categories and "positive" ratings in the weaving and accident location categories. The positive rating is a result of the highway improvements planned along US 290.

Improve Mobility
The alternatives also perform similarly with respect to mobility. Both received "negative" ratings with respect to congestion, "neutral" ratings in the person capacity category, and "negative" (CA-4A) and "more negative" (CA-4A-1) in the user benefit category. The negative ratings in the congestion and user benefit categories can be attributed due to AHCT serving as a replacement of the existing HOV facility. In the model, riders utilizing bus services on the existing HOV facility transferred to AHCT; however, a large percentage of the HOV motorists transferred to the general-purpose lanes rather than AHCT, creating more congestion and greater travel times along US 290.

Increase Transit Opportunities
Transit ridership for both alternatives received "more positive" ratings due to the increase in the number of transit passengers and "positive" ratings in the METRO plan consistency because of the addition of AHCT in the corridor.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
Additional amounts of right-of-way along US 290 would be needed for this alternative, resulting in potentially negative effects in all evaluation categories.

Contribute to Air Quality Attainment
Both alternatives received "positive" and "more positive" in regard to their levels of key pollutants as compared to CA-2A.

TRANSIT ALTERNATIVES

Maximize Use of Existing Right-of-Way
The physical changes to US 290 have a "negative" impact on right-of-way in the US 290 envelope, while the absence of any major improvements to Hempstead Highway yields a "neutral" rating in the Hempstead / Union Pacific Corridor.

Focusing on the increase in ridership, it was noticed that having AHCT capabilities on US 290 as well as SH 249 produced a lower ridership number when compared to having transit capabilities solely on US 290. For this reason, placing AHCT on SH 249 was not recommended for further screening but was identified as a possible option or addition to the alternative of AHCT along US 290, a component that was recommended for further screening. **Tables 6.4-23** through **6.4-25** correspond to CA-4A and **Tables 6.4-26** through **6.4-28** correspond to CA-4A-1.

Table 6.4-23: CA-4A Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,236,072	1,825,422	284	18,734	27,191	8,457	31.10%	38.44%
Arterials	2,029,297	4,159,333	1,778	48,328	58,800	10,472	17.81%	18.85%
TOTAL	3,265,369	5,984,754	2,063	67,062	85,991	18,929	22.01%	21.55%

TRANSIT ALTERNATIVES

Table 6.4-24: CA-4A Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	37,250	33,558	1.110	21,567	33,558	0.643
	HOV						
Bingle	FREEWAY	32,696	27,327	1.196	18,378	27,327	0.673
	HOV						
Gessner	FREEWAY	34,600	27,327	1.266	14,643	27,327	0.536
	HOV						
Jones	FREEWAY	34,406	27,327	1.259	8,686	27,327	0.318
	HOV						
West of SH 6	FREEWAY	25,160	24,927	1.009	6,601	24,927	0.265
	HOV						

Table 6.4-25: CA-4A Transit

Transit Mode	Boardings
High Capacity Transit	33,027
Local Bus	98,758
Commuter Bus	4,480
Express Bus	7,083
TOTAL	143,348

PERSON-CAPACITY CA-4A = 9,750,765

Table 6.4-26: CA-4A-1 Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,237,694	1,825,422	284	18,759	27,263	8,504	31.19%	38.44%
Arterials	2,022,411	4,153,396	1,773	48,056	58,768	10,712	18.23%	22.68%
TOTAL	3,260,105	5,978,817	2,057	66,815	86,031	19,216	22.34%	24.86%

Table 6.4-27: CA-4A-1 Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	37,180	33,558	1.108	21,627	33,558	0.644
	HOV						
Bingle	FREEWAY	32,781	27,327	1.200	18,402	27,327	0.673
	HOV						
Gessner	FREEWAY	34,591	27,327	1.266	14,686	27,327	0.537
	HOV						
Jones	FREEWAY	34,436	27,327	1.260	8,695	27,327	0.318
	HOV						
West of SH 6	FREEWAY	25,213	24,927	1.011	6,605	24,927	0.265
	HOV						

TRANSIT ALTERNATIVES

Table 6.4-28: CA-4A-1 Transit

Transit Mode	Boardings
High Capacity Transit	39,370
Local Bus	98,796
Commuter Bus	4,726
Express Bus	6,668
TOTAL	149,560

PERSON-CAPACITY CA-4A-1 = 9,741,124

CA-4B AHCT along Hempstead Highway:

Improve Public Safety
The new design and construction along US 290 and Hempstead allow for both "positive" and "more positive" ratings with respect to public safety.

Improve Mobility
CA-4B performed similarly in regard to mobility as CA-4A and CA-4A-1, with the exception that it received a "positive" rating in the person capacity rating as opposed to a "neutral" rating. The problems concerning congestion and user benefits in CA-4A and CA-4A-1 also plague CA-4B giving it ratings of "negative" (congestion) and "more negative" (user benefits).

Increase Transit Opportunities
CA-4B moved the AHCT to the Hempstead Highway Corridor and received a "more positive" rating in the transit ridership category. CA-4B received a "positive" rating in the METRO plan consistency category due to its inclusion of AHCT within the northwest corridor.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
Additional amounts of right-of-way along both US 290 and Hempstead Highway would be needed for this alternative, resulting in potentially negative effects in the social and environmental evaluation categories. However, economic effects for this AHCT alternative along Hempstead were rated positive due to the land redevelopment potential (transit-oriented development opportunities) afforded by this mode.

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Maximize Use of Existing Right-of-Way
The physical changes to US 290 lead to a "negative" rating when looking at right-of-way effects along US 290; however, providing AHCT along Hempstead Highway has the potential to revitalize the economy surrounding the Hempstead Corridor. For this reason, it yielded a "more positive" rating.

This alternative was recommended for further screening.

Tables 6.4-29 through **6.4-31** correspond to CA-4B.

Table 6.4-29: CA-4B Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,239,425	1,825,422	284	18,787	27,333	8,545	31.26%	38.44%
Arterials	2,159,441	4,393,847	1,865	51,668	62,121	10,453	16.83%	16.67%
TOTAL	3,398,865	6,219,269	2,149	70,455	89,453	18,998	21.24%	19.55%

Table 6.4-30: CA-4B Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	37,305	33,558	1.112	21,786	33,558	0.649
	HOV						
Bingle	FREEWAY	32,810	27,327	1.201	18,540	27,327	0.678
	HOV						
Gessner	FREEWAY	34,746	27,327	1.271	14,730	27,327	0.539
	HOV						
Jones	FREEWAY	34,408	27,327	1.259	8,704	27,327	0.319
	HOV						
West of SH 6	FREEWAY	25,099	24,927	1.007	3,301	24,927	0.132
	HOV						

Table 6.4-31: CA-4B Transit

Transit Mode	Boardings
High Capacity Transit	42,817
Local Bus	98,853
Commuter Bus	4,507
Express Bus	6,719
TOTAL	152,896

PERSON-CAPACITY CA-4B = 10,132,885

CA-4C Express Busway:

Improve Public Safety
Similar to all the other build alternatives, which make the physical changes along US 290 due to new designs, CA-4C improves upon public safety and likewise received “more positive” and “positive” ratings in the public safety categories of the evaluation.

Improve Mobility
The express busway alternative did not perform very well in its effort to improve mobility. The idea behind the express busway was to remove personal vehicles from managed facilities and run express or commuter bus routes there instead. This

TRANSIT ALTERNATIVES

alternative increased congestion along the general-purpose lanes, defeating one of the goals of the study; therefore, CA-4C received a “negative” congestion rating. The alternative did receive a “positive” person capacity rating, but it performed poorly enough in the user benefits category to warrant a “more negative” rating.

Increase Transit Opportunities
A comparison of ridership numbers between AHCT and express busway capabilities revealed that expected express busway ridership numbers were fewer than numbers projected for the AHCT alternatives. AHCT allows for a higher capacity per trip than an express busway trip; however, the transit ridership numbers still showed “positive” impacts when compared with some of the other alternatives. The express busway alternative is not in METRO’s plan for the corridor — although it endeavors to extend the HOV lane, additional buses as they exist today are not what METRO has in mind. Therefore, CA-4C received a “negative” rating in the METRO transit category.

Avoid or Minimize Adverse Social, Economic, and Environmental Effects
The freeway expansion part of this alternative requires additional right-of-way due to the expansion of US 290. The resulting land use displacement adjacent to US 290 triggers potentially adverse effects in the multiple evaluation categories. This alternative’s economic effects are believed to be negative, although some evidence suggests that residential development has been attracted to areas adjacent to park-and-ride lots in the corridor. Environmental effects were rated negative due to the need for establishing additional park-and-ride lots in currently undeveloped (but potentially sensitive) areas outside Beltway 8.

Contribute to Air Quality Attainment
CA-4C experienced “positive” impacts on the levels of all three key pollutants studied in the corridor.

Maximize Use of Existing Right-of-Way
The physical changes to US 290 that this alternative requires make it necessary for a “negative” rating in the US 290 right-of-way category. The absence of any major changes in the Hempstead / Union Pacific Corridor lends a “neutral” right-of-way rating to that particular corridor.

Tables 6.4-32 through **6.4-34** correspond to CA-4C.

Table 6.4-32: CA-4C Mobility

	Performance Measure							
	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F in the Peak Period
Freeways	1,238,121	1,825,422	284	18,766	27,247	8,481	31.13%	38.44%
Arterials	2,153,531	4,393,847	1,865	51,246	61,840	10,593	17.13%	16.71%
TOTAL	3,391,653	6,219,269	2,149	70,012	89,087	19,075	21.41%	19.59%

Table 6.4-33: CA-4C Screenlines

		Inbound			Outbound		
Approximate Location	Lane Type	Volume (vehicles)	Capacity	V/C	Volume (vehicles)	Capacity	V/C
West of 610	FREEWAY	37,103	33,558	1.106	21,733	33,558	0.648
	HOV						
Bingle	FREEWAY	32,670	27,327	1.196	18,548	27,327	0.679
	HOV						
Gessner	FREEWAY	34,612	27,327	1.267	14,788	27,327	0.541
	HOV						
Jones	FREEWAY	34,407	27,327	1.259	8,711	27,327	0.319
	HOV						
West of SH 6	FREEWAY	25,222	24,927	1.012	6,611	24,927	0.265
	HOV						

Table 6.4-34: CA-4C Transit

Transit Mode	Boardings
High Capacity Transit	0
Local Bus	104,368
Commuter Bus	15,996
Express Bus	6,849
TOTAL	127,213

PERSON-CAPACITY CA-4C = 10,133,113

Transit Alternative Conclusions

TRANSIT ALTERNATIVES

Lessons learned from evaluation of the transit alternatives

- AHCT increases transit ridership
- Freeway expansion is still necessary; however, AHCT does not require as much widening
- Removing the HOV lane causes delay

6.5 SUMMARY OF SCREENING RESULTS

The screening analysis provided a preliminary evaluation of eleven conceptual alternatives. Looking at how each alternative positively impacted the US 290 Corridor, six conceptual alternatives (or elements from conceptual alternatives) were recommended for further screening. They are as follows (**Table 6.5-1**):

Table 6.5-1: Conceptual Alternative Screening Reasoning

	Component	Reasoning
1	No-build alternative (with TSM / TDM components)	for baseline comparison
2	Expand US 290, extend HOV	widening is necessary, 1 or 2 lanes in each direction
3	Provide four-lane, two-way, barrier separated managed facility	2, 3, 4+ occupancy, flexible — operate like HOV or with Tolls
4	Provide high capacity, partially grade-separated Hempstead Lanes	more capacity in corridor with little social, economic, and environmental effects
5	AHCT along US 290	transit demand is high
6	AHCT along Hempstead Highway Corridor	transit demand is high, economic benefits

Excluding the no-build alternative, these conceptual alternatives components were merged together to produce four viable alternatives. The reasoning behind creating a multimodal alternative focused on merging the positive influences that each alternative had on the corridor. Analysis of the matrix shows how taking the best of each element of the various conceptual alternatives potentially improves the operational characteristics of the US 290 Corridor. The four viable alternatives (and the no-build alternative) that were carried into the detailed analysis phase of the study are described in detail in the next chapter.

Chapter 7
Viable Alternatives

7.1 INTRODUCTION

The screening process that the project team applied to the conceptual alternatives resulted in the identification of four viable alternatives and one no-build alternative. In addition, three options were developed west of Beltway 8 in order to complement the four viable alternatives. In addition to the general public, the US 290 Corridor MIS Steering and Advisory Committees also provided guidance in the development and evaluation of these alternatives.

As previously stated, these alternatives represent a combination of multimodal conceptual alternatives that had been identified for further screening. By merging freeway, managed facility, and transit alternatives, a resultant viable alternative results. It can have a profound impact on improving the operational characteristics of the US 290 Corridor. Each viable alternative resulting from the conceptual screening process is described in detail below.

7.2 NO-BUILD

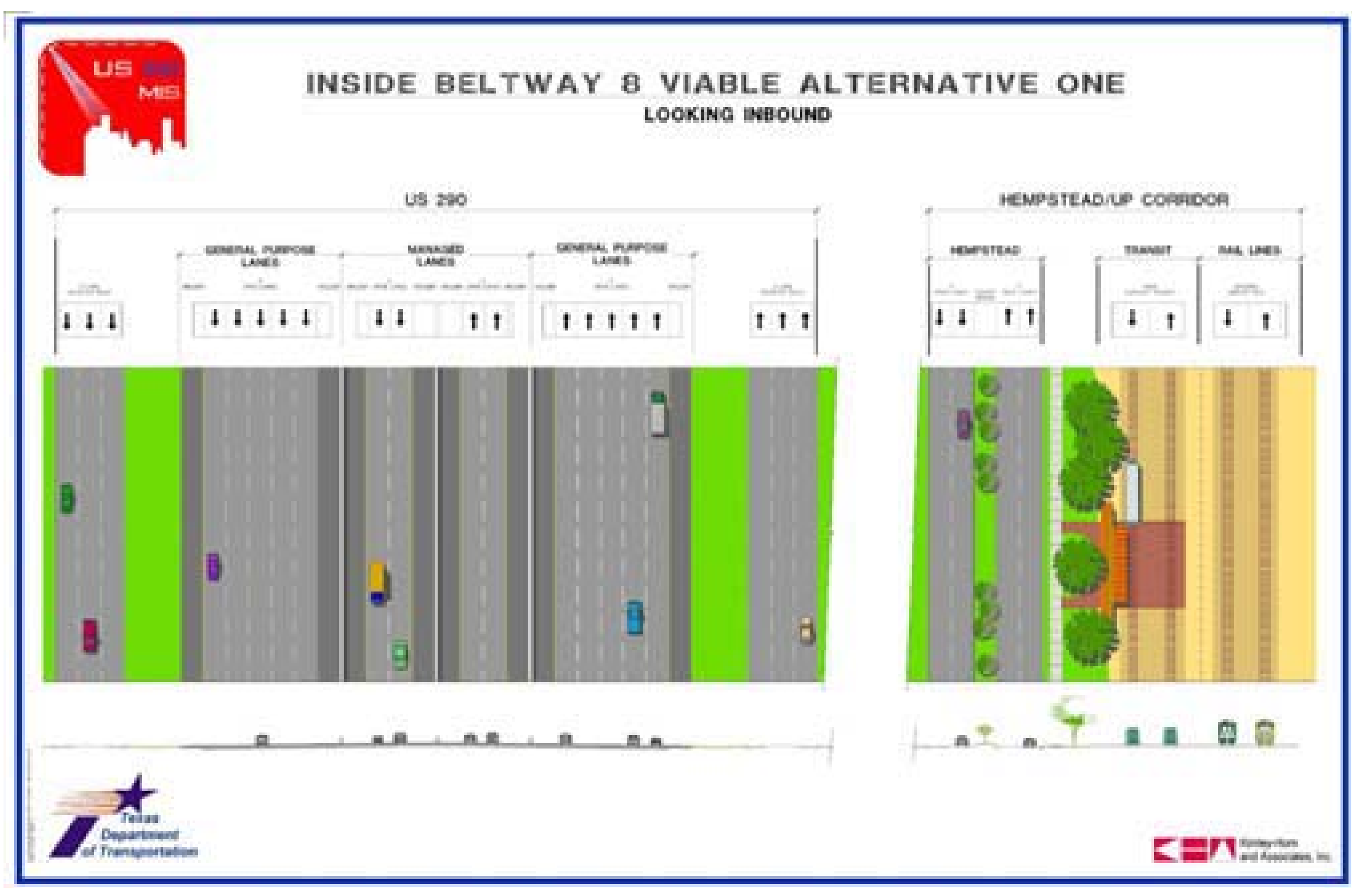
The definition of the no-build alternative consists of existing and regionally significant committed projects within the corridor. Committed projects include those improvements in the *2022 Metropolitan Transportation Plan* that will be implemented, excluding proposed improvements resulting from this MIS. The no-build alternative also includes TSM / TDM strategies that improve upon the stated goals of the MIS. As previously stated, this alternative serves as an "at least" option for the US 290 Corridor.

7.3 VIABLE ALTERNATIVE 1

This alternative allows for the widening of US 290 to five general-purpose lanes in each direction from IH 610 to Beltway 8. This does include auxiliary lanes as needed between entrances and exits onto US 290. Four general-purpose lanes in each direction will stretch from Beltway 8 to the end of the study area (FM 2920). In addition to the widening of US 290, a barrier-separated, managed facility will be provided along the center line of US 290 from IH 610 to Grand Parkway. The managed facility will be four lane two-way, barrier-separated lanes. General-purpose lanes and managed facility lanes will be grade-separated at major and minor streets along US 290 throughout the corridor. Two- or three-lane frontage roads will be provided in each direction throughout the corridor.

Hempstead Highway will consist of two general-purpose lanes in each direction, from IH 610 (Katy Road) through Beltway 8. These lanes will be at-grade, providing access from arterial and collector roadways. Adjacent to the general-purpose lanes along Hempstead Highway, additional right-of-way will be provided for advanced high capacity transit (AHCT) inside Beltway 8. The AHCT will be elevated where appropriate from W. Little York to IH 610, avoiding AHCT crossings at major and minor streets. AHCT will be placed between Hempstead's general-purpose lanes and the Union Pacific Corridor; there will likely be five stations located at W. Little York, Tidwell, Bingle, 34th Street, and Mangum. AHCT is proposed to run adjacent to Post Oak, terminating at the Northwest Transfer Station. Access to these stations will be provided by walk links from Hempstead Highway's general-purpose lanes or other perpendicular arterials. Outside Beltway 8, AHCT will be at-grade. It is likely that five stations will provide access to this facility: Cy-Fair, Spring Cypress, Barker-Cypress, Huffmeister, and Eldridge. These stations will have direct access from the general-purpose lanes along the Hempstead Corridor. **Figure 7.3-1** represents the typical cross-section of viable alternative 1.

Figure 7.3-1: Viable Alternative 1

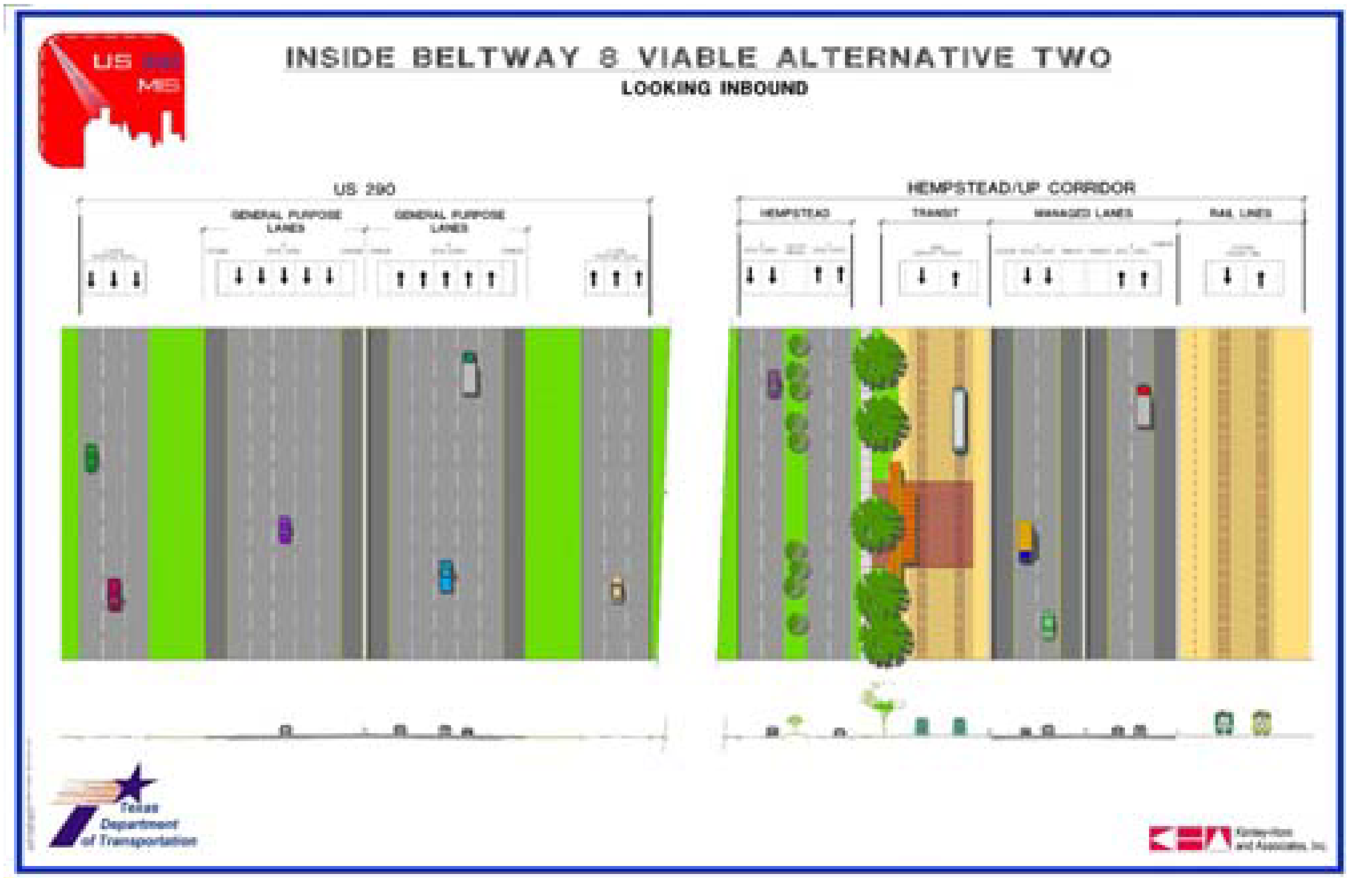


7.4 VIABLE ALTERNATIVE 2

In this alternative, the HOV lanes along US 290 are removed, and managed lanes are placed along Hempstead Highway adjacent to the Union Pacific Corridor. The managed facility will be four lane two-way, barrier-separated managed lanes stretching from IH 610 through Beltway 8 and terminating at Grand Parkway. Inside Beltway 8, the managed facility was modeled as grade-separated the entire length. Outside Beltway 8 to Grand Parkway, the managed facility will generally be at-grade. Two general-purpose lanes (at-grade) will also be provided along Hempstead Highway from IH 610 to Beltway 8 in order to to provide access along Hempstead Highway from arterial and collector roadways. Five general-purpose lanes will be provided along US 290 from IH 610 to Grand Parkway. Four general-purpose lanes will continue along US 290 to the end of the study area (FM 2920). As stated in viable alternative 1, general-purpose lanes did not include auxiliary lanes when modeled. Two- or three-lane frontage roads will be provided in each direction throughout the corridor.

AHCT capabilities will remain along Hempstead Highway, as described in viable alternative 1; they will be placed between the general-purpose lanes and the managed facility. This alternative requires the largest amount of additional right-of-way along Hempstead Highway. Suggestions for alternate placements for the facilities along Hempstead Highway west of Beltway 8 are described below in options 1 and 2. **Figure 7.4-1** represents the typical cross-section of viable alternative 2.

Figure 7.4-1: Viable Alternative 2

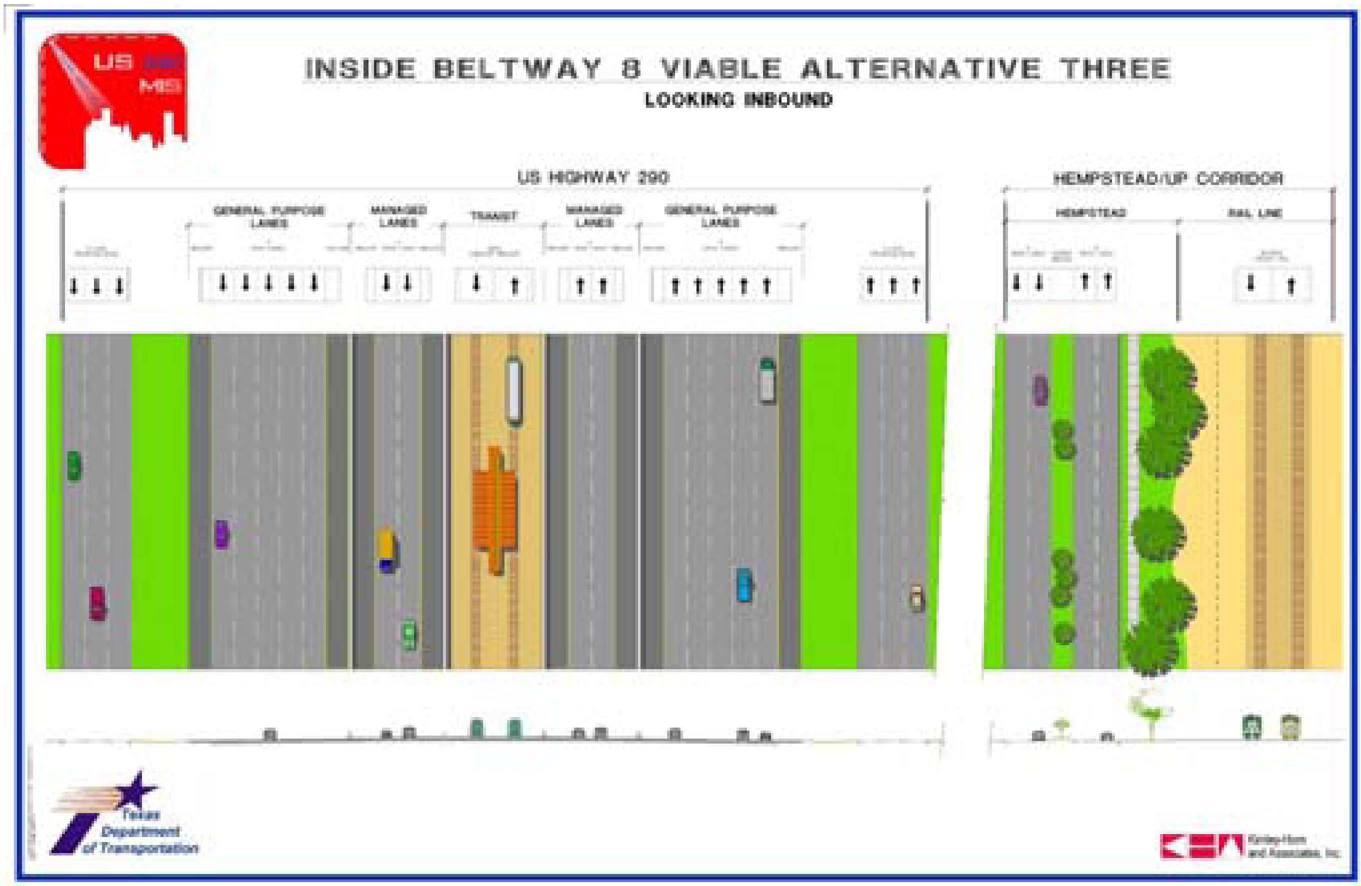


7.5 VIABLE ALTERNATIVE 3

Viable alternative 3 moves the managed facility back onto US 290 and separates it in the middle by AHCT capabilities. Specifically, five general-purpose lanes in each direction will be provided on the outside edges of US 290 from IH 610 to Beltway 8. Between these lanes will be four lane two-way, barrier-separated HOV lanes. Fifty feet will separate these managed lanes in order to provide right-of-way for AHCT. The general-purpose lanes along US 290 will drop to four lanes per direction west of Beltway 8. This geometry will be grade-separated the entire length of the corridor. AHCT stations will remain in the same locations as stated in viable alternative 1 and will be grade-separated. Access to these stations will be provided by walk links from park-and-ride facilities or kiss-and-ride dropoff areas adjacent to the frontage roads along US 290. This alternative requires the greatest need for additional right-of-way along US 290. Two- or three-lane frontage roads in each direction will be provided throughout the corridor.

Along Hempstead Highway, right-of-way will provide for two general-purpose lanes, each direction, from Beltway 8 to IH 610 (Katy Road). These lanes will be grade-separated to reduce travel time and avoid major street crossings. These lanes will be provided north of the Union Pacific Corridor. **Figure 7.5-1** shows the typical cross-section of viable alternative 3.

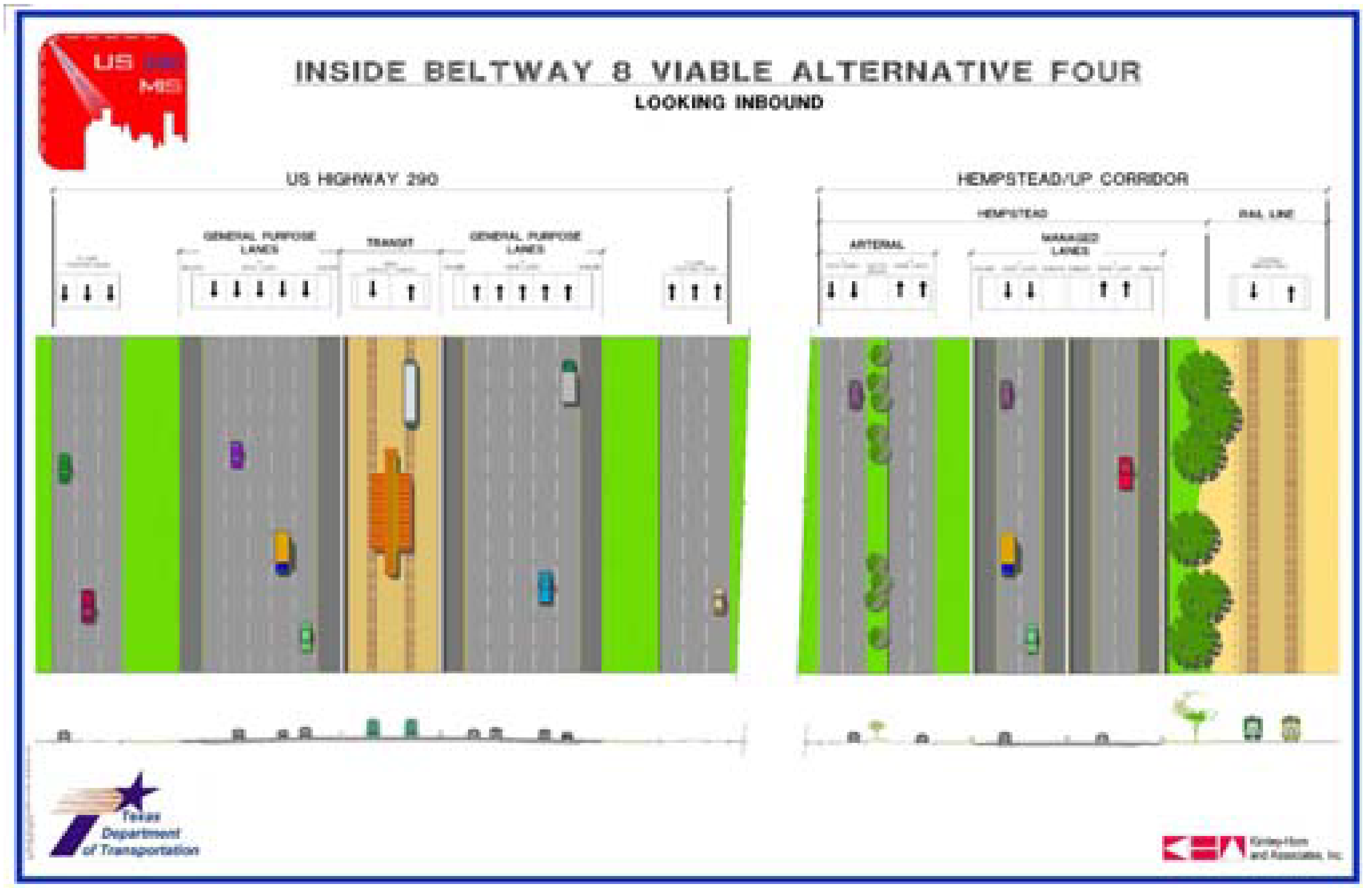
Figure 7.5-1: Viable Alternative 3



7.6 VIABLE ALTERNATIVE 4

In viable alternative 4, AHCT right-of-way will rest between the general-purpose lanes along US 290, as described in viable alternative 3. The geometry for the general-purpose lanes will remain unchanged compared to viable alternative 2. Managed lanes will be provided from IH 610 to Grand Parkway along Hempstead Highway and are described in viable alternative 2. Two general-purpose lanes from IH 610 to Katy Road, will be replaced by two grade-separated lanes in each direction along Hempstead Highway. This was done to minimize major street crossings and decrease travel time along Hempstead Highway. **Figure 7.6-1** represents the typical cross-section of viable alternative 4.

Figure 7.6-1: Viable Alternative 4



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7.7 ALTERNATIVE OPTIONS WEST OF BELTWAY 8

Three alternative options were developed west of Beltway 8 because of the nature of the area and the absence of Hempstead Highway. Options 1 and 2 described alternate placements of the managed facility and AHCT facility for viable alternative 2. Option 3 complemented viable alternative 3, showing all facilities along US 290 west of Beltway 8, with no improvements to Hempstead Highway.

Option 1 has four general-purpose lanes in each direction from Beltway 8 to the end of the study limits at FM 2920. The managed facility will generally be located south of the Union Pacific railroad and will be, for the most part, at-grade. The high occupancy transit envelope will be reserved for north of the Union Pacific Corridor and may possibly even replace the existing frontage road.

Option 2 has five general-purpose lanes in each direction from Beltway 8 to the future Grand Parkway and four general-purpose lanes in each direction from there to the end of the study limits at FM 2920. The managed facility is south of the Union Pacific Corridor as well as the AHCT facility. **Figures 7.7-1** through **7.7-3** present options 1 through 3 respectively.

Due to the undeveloped nature of US 290 west of Beltway 8, any of the three options presented could be paired with the geometry described for viables 1 through 4 inside the Beltway 8. An analysis of the viable alternatives is provided in ***Chapter 8***.

Figure 7.7-1: Option 1

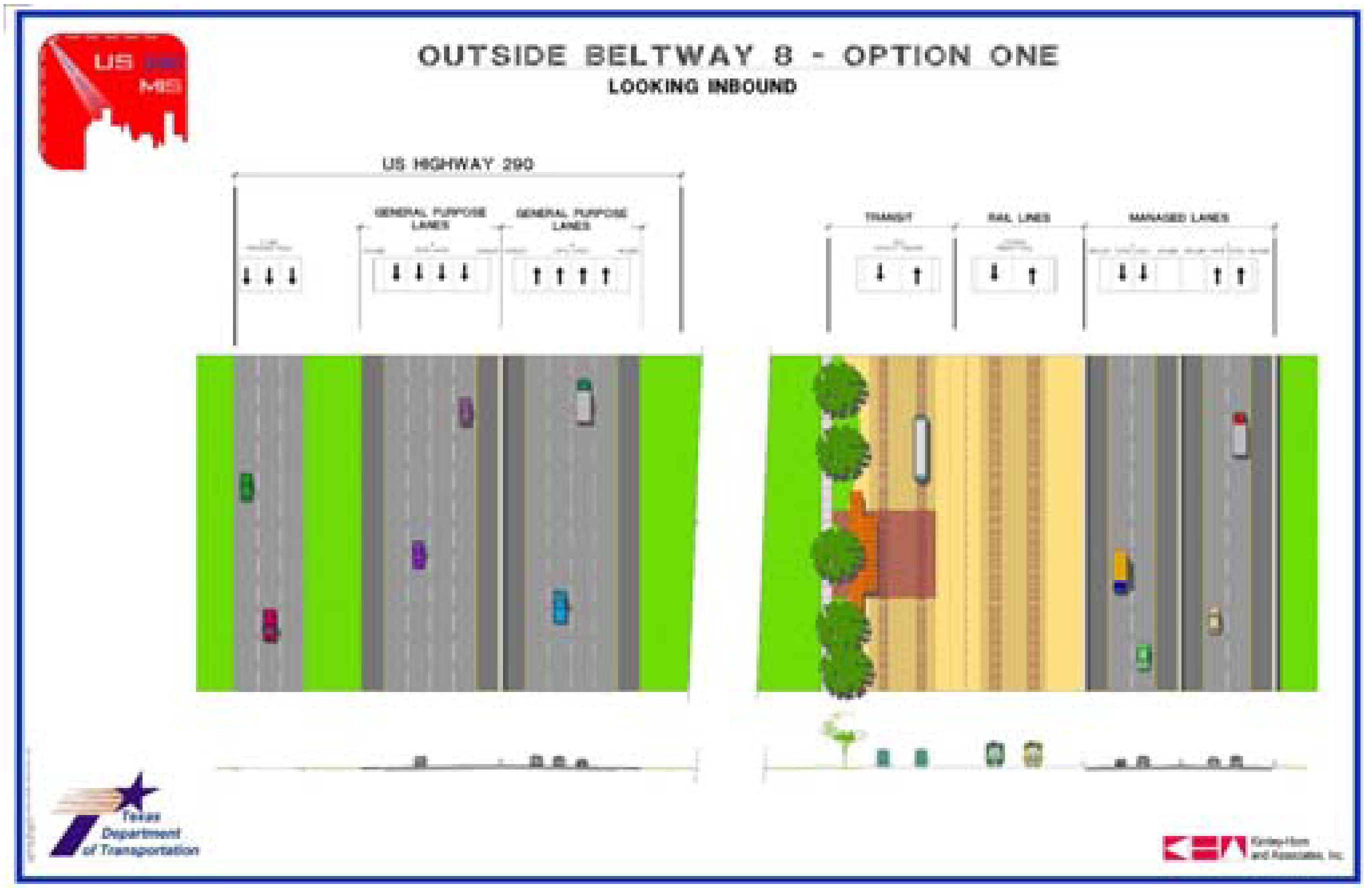

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Figure 7.7-2: Option 2

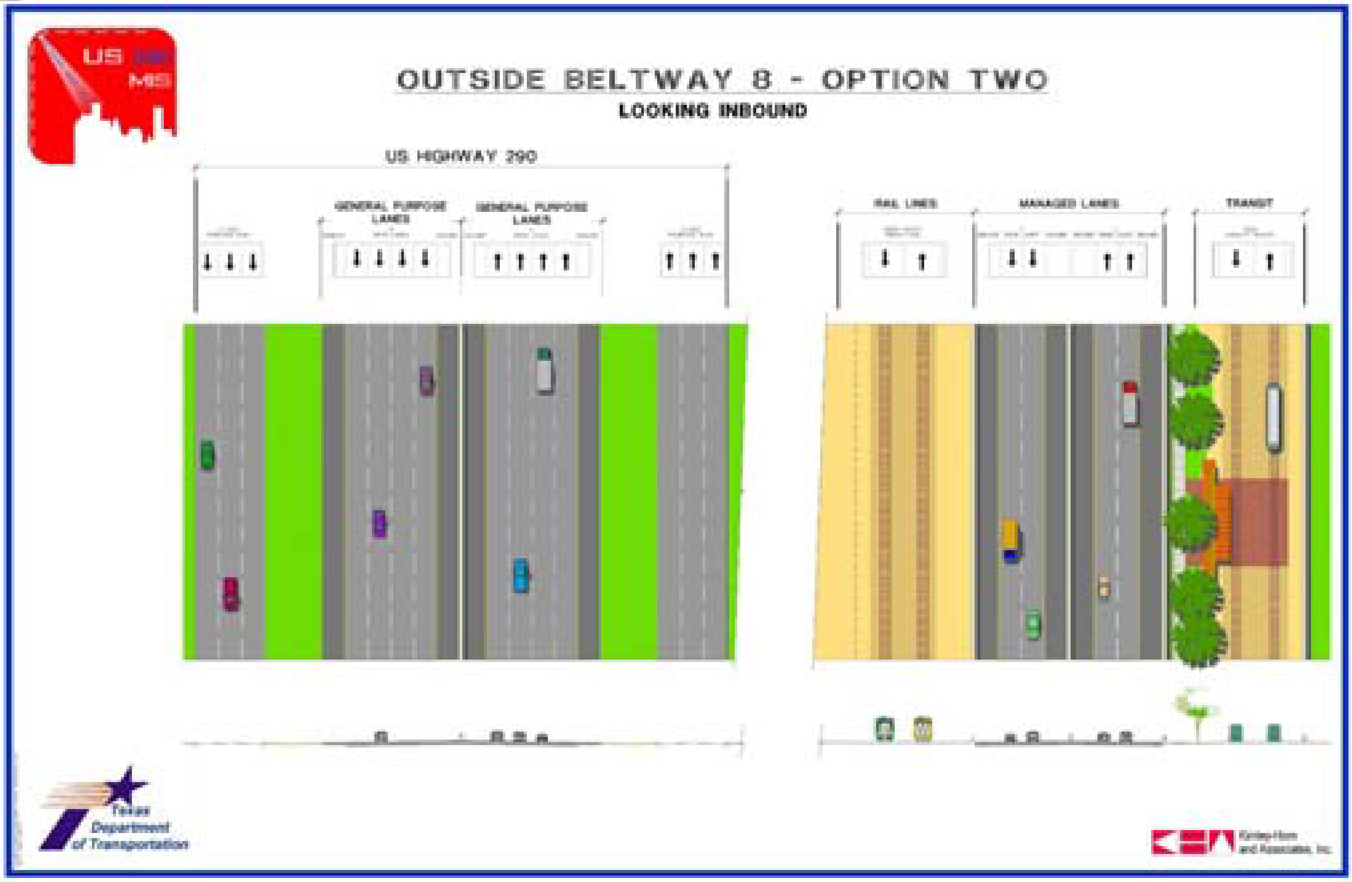
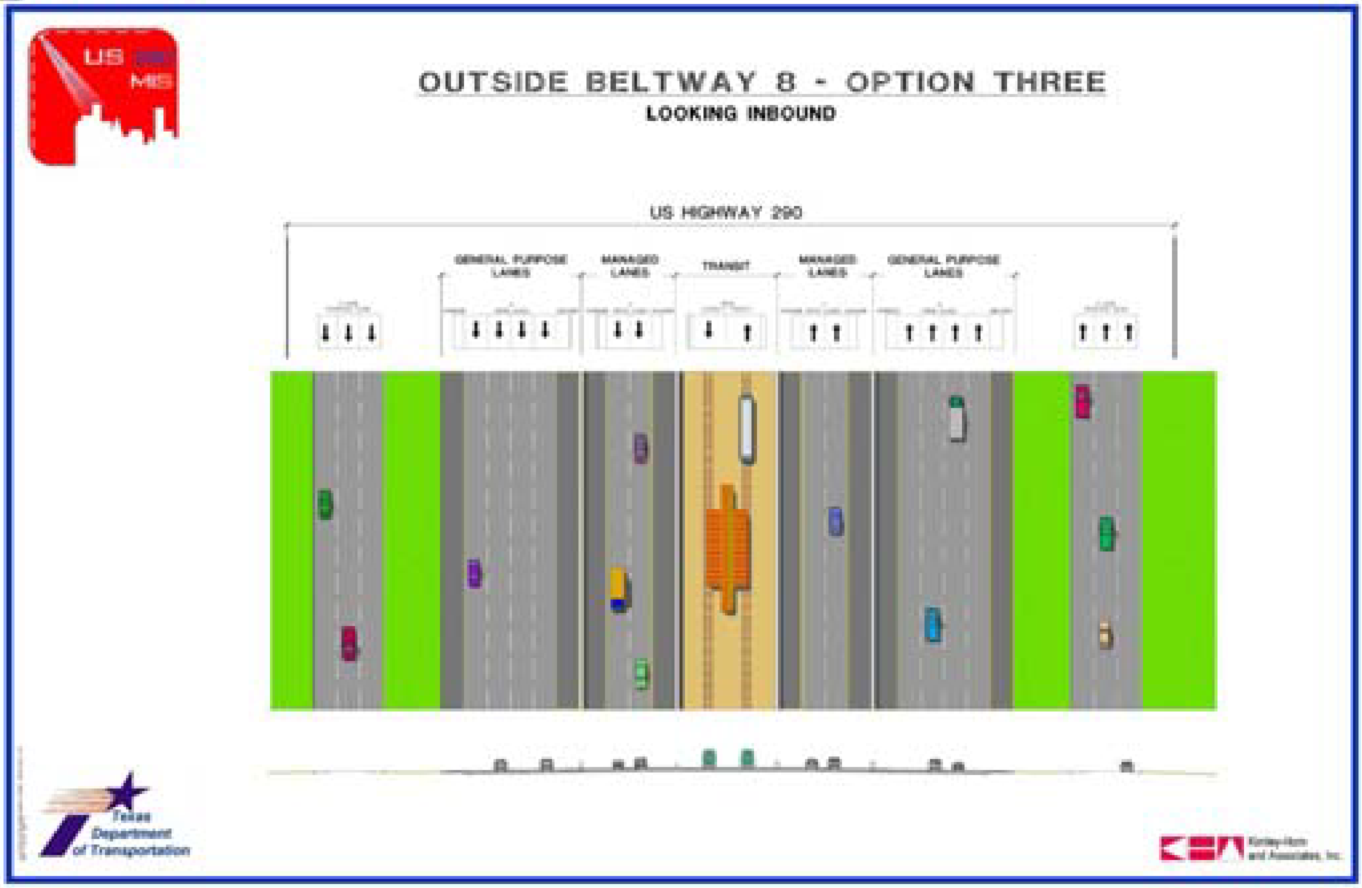


Figure 7.7-3: Option 3



7.8 SUMMARY OF VIABLE ALTERNATIVES

After evaluating 11 conceptual alternatives through a screening process, six conceptual alternatives were recommended for further analysis. The project team then formed a combination of merged alternatives to produce the above-mentioned viable alternatives. These viable alternatives represent positive improvements to the US 290 Corridor and support the goals and objectives established by the project team. The four build viable alternatives and options presented were recommended for further detailed analysis and supported by the Steering and Advisory Committees and TxDOT; in addition, public comments and opinions were documented at public meetings and found to be supportive of the recommended viable alternatives.

Chapter 8
Analysis of Viable Alternatives

The viable alternatives were subjected to a screening and evaluation process in an effort to choose the locally preferred alternative. The four build viable alternatives (described in ***Chapter*** *7*) and the no-build alternative were all analyzed based upon their ability to meet / exceed the needs and goals of the corridor as described in ***Chapter 3*** and the *Screening Tech Memo* released in August of 2002.

8.1 SCREENING AND EVALUATION OF VIABLE ALTERNATIVES

The screening and evaluation of the viable alternatives was nearly identical to that of the conceptual alternatives (***Chapter 6***). Several slight adjustments, outlined below, were made in order to refine the process for a more detailed analysis. Any differences between the screening and evaluation of the conceptual versus the viable alternatives are outlined in the list below; otherwise, please refer to the details in ***Chapter 6*** to learn more about the screening process and evaluation measures.

- 24-hour model runs as opposed to 3-hour a.m. peak model runs.
- Screenlines included the following:
  - West 34th Street
  - Hollister Road
  - Gessner Road
  - Jones Road
  - Telge Road
  - Mueschke Road
- An extensive right-of-way evaluation was conducted in GIS in order to determine certain factors associated with taking land and buildings along the corridor. These factors included what land would be taken, how much would be taken, and the costs of taking land or buildings. The Harris County Appraisal District GIS database was used to determine right-of-way costs and impacts.
- A right-of-way evaluation allowed for a quantitative analysis to estimate more precisely the amount of land adjacent to US 290 and Hempstead Highway that would be converted to a transportation use.
- Only the US 290 freeway, Hempstead Highway, the managed facility, and AHCT were analyzed when evaluating each viable alternative, as opposed to the conceptual alternative evaluation, in which all roadways in the study

corridor were included. This technique allowed the study team to now focus on the US 290 facility and Hempstead Highway.

- A cost estimate was calculated for each alternative and option. The project team made assumptions to combine alternatives with options and then established associated costs.

8.2 PUBLIC SAFETY

During the design phase, each build alternative will conform to design standards and endeavor to reduce weaving and eliminate accident locations. Therefore, all of the viable alternatives, with the exception of the no-build alternative, have the capability of meeting the public safety goal of the US 290 MIS.

The main benefit that viable alternatives 2 and 4 have over the other alternatives is their ability to accommodate a managed lane connection to IH 10 and IH 610. The other alternatives are more likely to have weaving and circulation issues at the US 290 / IH 610 interchange.

8.3 MOBILITY ANALYSIS

The mobility analysis of the viable alternatives used 24-hour model output for the US 290 general-purpose lanes, the managed facility, Hempstead Highway, and the advanced high capacity transit system throughout the study corridor. The congestion, person capacity, and user benefits calculated for each viable alternative can be seen below. As outlined in the *Screening Tech Memo* and ***Chapter 6***, congestion is a vehicular volume-to-capacity ratio measure, while person capacity looks at the total number of people able to move through a system. A slight difference between the conceptual analysis and viable analysis involves the user benefits category. In this analysis, user benefits represents the number of hours of delay experienced by users of the system for each alternative, as opposed to a calculation of additional hours of delay as compared to baseline alternative. The higher the number, the more delay experienced. **Table 8.3-1** shows the results of the mobility analysis.

Table 8.3-1: Improve Mobility

		Baseline	VA-1	VA-2	VA-3	VA-4
Improve Mobility	Congestion	0.939	0.545	0.515	0.548	0.519
	Person Capacity	8,361,238	16,084,976	17,048,566	16,359,219	17,319,270
	User Benefits*	36,414	10,476	9,789	10,842	10,293

*represents the hours of delay

Each of the build alternatives clearly demonstrates its improvement over the baseline. From a mobility standpoint, all four build alternatives have similar operating characteristics. Overall, viable alternative 2 performed best in the mobility analysis. **Figures 8.3-1** through **8.3-3** graphically represent the results of the mobility analysis.

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Figure 8.3-1: Congestion Comparison

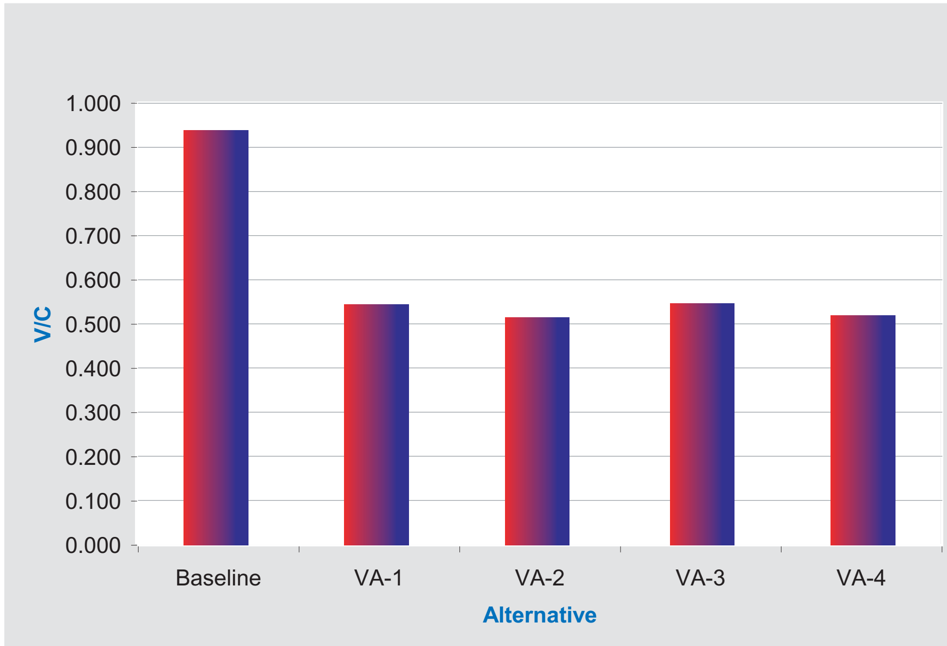


Figure 8.3-2: Person-Capacity Comparison

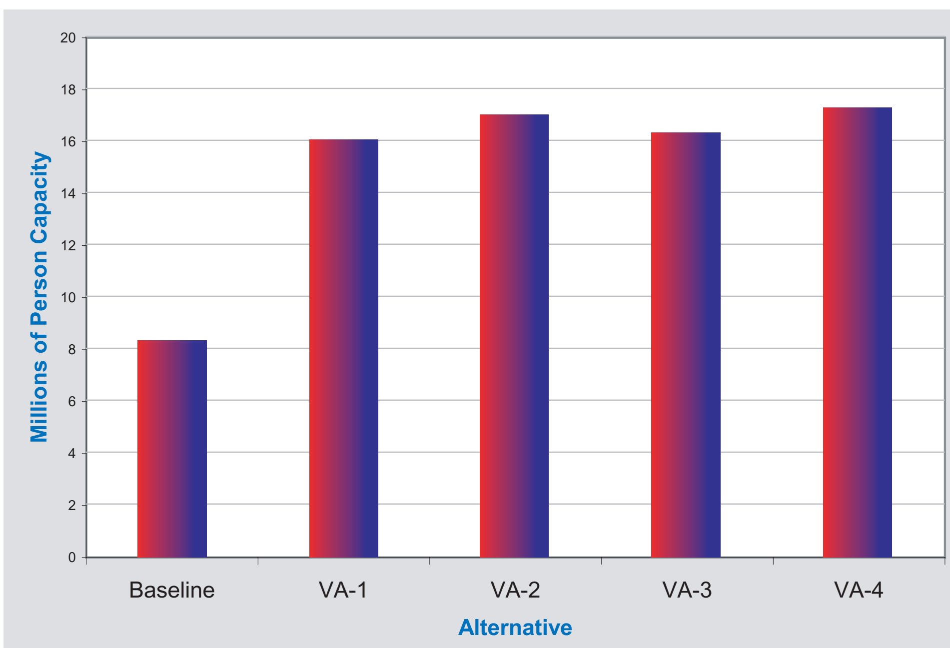
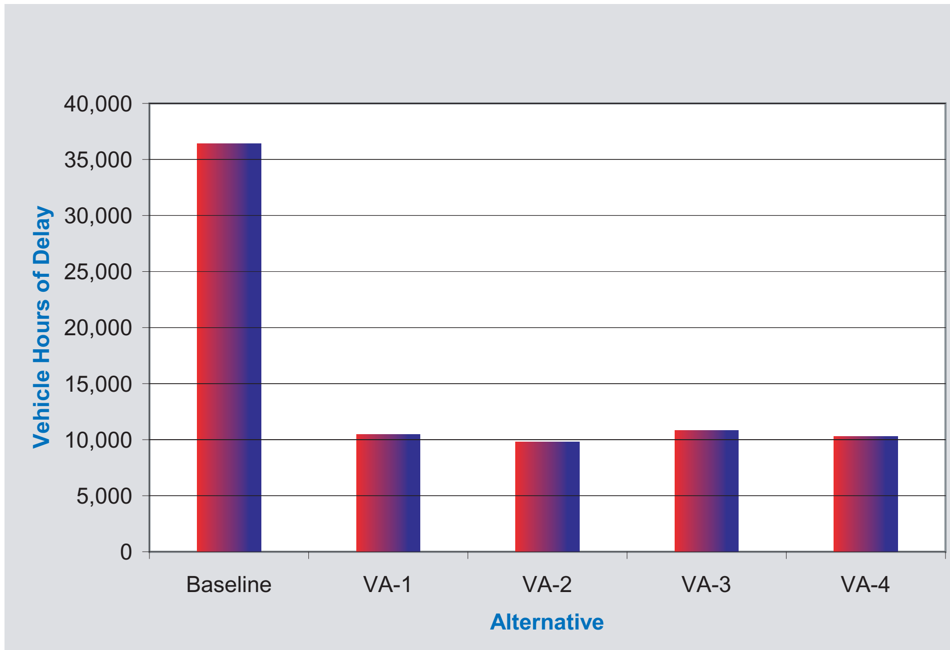


Figure 8.3-3: Vehicle Hours-of-Delay Comparison



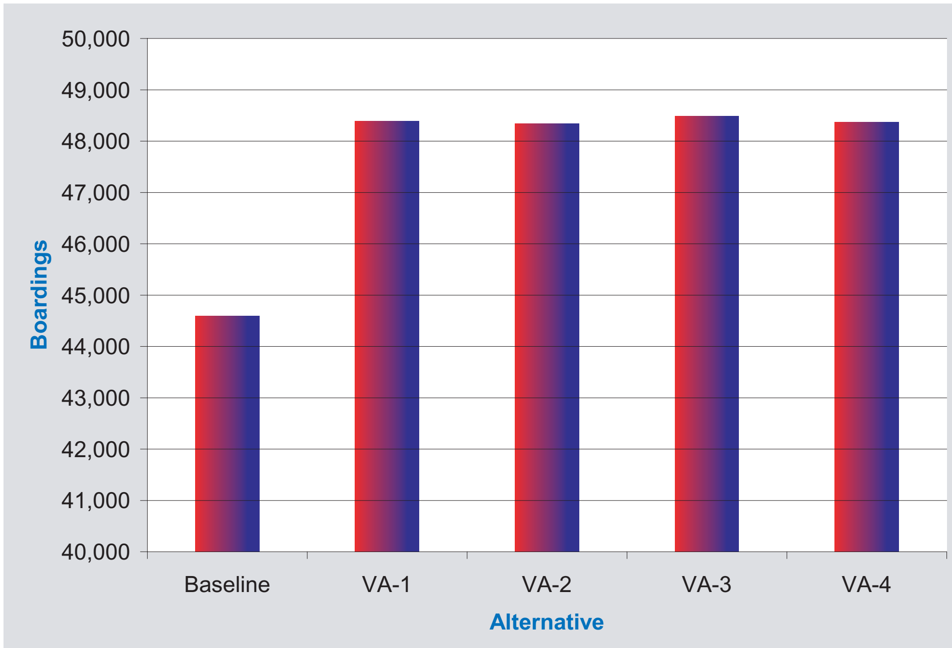
8.4 TRANSIT ANALYSIS

The table below (**Table 8.4-1**) demonstrates that the transit ridership in the corridor for each of the build alternatives remained fairly consistent regardless of the location of the advanced high capacity transit. All of the build alternatives are consistent with METRO's *2025 Mobility Plan*, which calls for some type of future advanced high capacity transit in the corridor. **Figure 8.4-1** represents the table below in graphical format.

Table 8.4-1: Transit Ridership

	Baseline	VA-1	VA-2	VA-3	VA-4
Transit Ridership	44,595	48,392	48,339	48,487	48,368

Figure 8.4-1: Boardings Comparison



8.5 ENVIRONMENTAL IMPACTS

The project team gauged potential impacts of the viable alternatives based on preliminary assumptions about where the additional right-of-way for each alternative would be acquired. The preliminary assumptions for all alternatives can be generally summarized as follows:

- For US 290, additional right-of-way is acquired evenly from both sides of the existing right-of-way
- For Hempstead Highway between Loop 610 and Beltway 8, additional right-of-way is acquired from the north side of Hempstead Highway; west of Beltway 8, the additional right-of-way is acquired from the south side of Hempstead Highway

It should be clearly understood that the goal of avoiding or minimizing adverse effects will apply continuously throughout the life of this project, from the MIS phase to the engineering schematic / environmental impact statement phase, and finally into the final design and construction phases. Over time, as the engineering details for the project become increasingly more defined, the right-of-way needed for any given alternative will become better defined as well. The potential project impacts being presented at this early stage of engineering and right-of-way definition represent areas of concern that warrant careful attention as the project is further developed. In addition, more specific opportunities for avoiding, minimizing, and mitigating adverse social, economic, and environmental impacts are identified.

Potential impacts that can be identified at this early stage of right-of-way definition are shown in the matrix on the following page (see **Table 8.5-1**). The matrix shows acres of potential land use displacement for each of the viable alternatives on US 290, Hempstead Highway, and both inside and outside Beltway 8. An estimate of potential residential structure displacements is also shown. Potential impacts along the two roadways are summarized as follows:

US 290

Inside the Beltway 8, alternative 2 offers the least amount of adverse effects along US 290 for all land use categories examined. Outside the Beltway 8, options 1 and 2 present roughly equivalent amounts of impact, with each being substantially lower than option 3.

Hempstead Highway

Inside the Beltway 8, alternative 3 offers the fewest acres of land use displacement, most notably in the commercial / industrial category. Outside the Beltway 8, option 3 would have no effect on Hempstead Highway, and option 2 would have a somewhat greater impact than Option 1.

Residential displacements, a particularly sensitive issue, are a potential impact along both US 290 and Hempstead Highway under all alternatives. They are minimized along US 290 under alternative 2 (inside the Beltway 8), and under options 1 and 2 (outside the Beltway 8). Along Hempstead Highway, residential structure displacements vary between 11 and 18 for alternatives 1 through 4, although it should be noted that these structures include multifamily apartment buildings, where the total number of displaced residential *units* would be higher.

Regardless of which alternative or option is implemented, other areas of concern should be carefully evaluated as the project is developed and refined. These include the following:

Table 8.5-1: Evaluation of Social, Economic, and Environmental Factors August 2002

# indicates lowest amount of potential land use conversion within that category.

Roadway	Land Use	Acres of Potential Impact and Number of Potential Residential Structure Displacements			
US 290	Inside Beltway 8	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Flood Plains	37	29	42	33
	Wetlands	1	0	2	0
	Vacant or Agricultural	34	12	45	23
	Residential - Acres	13	4	18	9
	Residential - Structures	65	18	69	53
	Public Facilities	0	0	0	0
	Church	1	0	1	1
	Commercial and Industrial	67	22	89	44
	School	0	0	0	0
	Outside Beltway 8	Option 1	Option 2	Option 3	
	Flood Plains	34	35	50	
	Wetlands	3	4	30	
	Vacant or Agricultural	9	13	98	
	Residential - Acres	1	1	8	
	Residential - Structures	1	1	30	
	Public Facilities	0	1	5	
	Church	0	0	1	
	Commercial and Industrial	2	4	47	
	School	0	0	3	
Hempstead Road	Inside Beltway 8	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Flood Plains	10	12	8	12
	Wetlands	0	0	0	0
	Vacant or Agricultural	4	21	2	20
	Residential - Acres	3	4	3	4
	Residential - Structures*	1*	18*	1*	18*
	Public Facilities	1	3	0	3
	Church	0	0	0	0
	Commercial and Industrial	71	123	66	117
	School	0	0	0	0
	Outside Loop	Option 1	Option 2	Option 3	Not Applicable
	Flood Plains	28	30	0	
	Wetlands	8	19	0	
	Vacant or Agricultural	128	160	0	
	Residential - Acres	4	5	0	
	Residential - Structures	0	0	0	
	Public Facilities	5	7	0	
	Church	0	0	0	
	Commercial and Industrial	41	54	0	
	School	0	0	0	

*Note: Residential Structure displacements along Hempstead include multifamily apartment buildings. The total number of residential unit displacements would be larger than the number shown in the table.

Noise Impacts
There are several older, established residential neighborhoods along US 290, especially inside Beltway 8. Sporadic field measurements taken along US 290 led to the conclusion that noise levels from US 290 traffic currently exceed federal noise abatement criteria in areas where residences are in close proximity to US 290 travel lanes. Noise abatement measures (e.g., noise barriers), if found to be reasonable and feasible, should be considered as part of any build alternative. Along Hempstead Highway, the traffic noise environment could be dramatically different under certain alternatives. Although fewer noise-sensitive receptors occur along Hempstead Highway, a full noise analysis for this corridor should also be conducted.

Flood Plains
Dozens of acres of flood plain could potentially be affected along US 290 and Hempstead Highway. Many residents at the MIS public meetings voiced concerns about flooding. The design for improvements should be based on a thorough evaluation of the hydrology characteristics of each drainage crossing, with an aim toward avoiding any increase in flood elevations.

Wetlands
While less of an issue inside the Beltway 8 than outside, many of these features could be impacted by the alternatives, and coordination with the Corps of Engineers (already initiated during the MIS) should continue into subsequent phases of the project. It should be emphasized that the National Wetlands Institute maps (which were used for this preliminary assessment) do not provide a true jurisdictional determination and boundary delineation of wetlands and other Waters of the US with regard to Section 404 of the Clean Water Act. Features in addition to those identified on these maps may (and likely do) exist within the project corridor. Once a preferred alternative is identified, a field survey by qualified wetlands specialists should be conducted to provide a more accurate assessment of project-related impacts to jurisdictional features.

Commercial and Industrial Property
Impacts to existing businesses could be felt along both roadways, especially Hempstead Highway. Under alternative 2, for example, where the north side of Hempstead Highway (inside the Beltway 8) could be converted to transportation uses, an older, established business corridor would be displaced. Notwithstanding the corridor's general appearance of economic decline, efforts should be made to minimize business displacements and to seek opportunities for enhancing or redeveloping the corridor in conjunction with the implementation of transportation improvements.

Other noteworthy but less conclusive findings at this stage of the environmental investigation are listed below:

Environmental Justice
There are several US Census Tracts within the study corridor that have low-income and minority population percentages that are greater than the national average, according to the 2000 Census (see **Figures 4.3-1** and **4.3-2**). This indicates a potential for environmental justice concerns, particularly for those alternatives that rely heavily on additional right-of-way along Hempstead and result in business and residential land use displacements. For those alternatives that utilize Hempstead Highway as a "relief valve" or "reliever route" for US 290, care should be taken to ensure that project impacts do not fall disproportionately and adversely on minority communities along Hempstead Highway. At the very least, efforts should continue to involve these communities in the planning and design of project improvements.

Cultural Resources
No National Register of Historic Places (NRHP) properties, previously recorded archeological sites, State Archeological Landmarks, or Official State Historical Markers exist along the US 290 corridor. Three cemeteries are located along Hempstead Highway. Numerous archeological surveys overlap portions of the project corridors, resulting in the recording of seven archeological sites. Preliminary field observations indicate that the largest concentration of potentially historic-age structures (more than 50 years old) are located along Hempstead Highway and in the town of Waller. Along the Old Hempstead Highway, there is evidence of small town and community development clustered along the railroad. Property types include bungalows, farmsteads, churches, cemeteries, commercial buildings, grain elevators, and railroad-related buildings. There are fewer historic structures along US 290, with only two potentially historic farmsteads identified. In all, roughly 35 potentially historic properties are located along US 290 or Hempstead Highway, including one school, seven farmsteads, 10 residences, seven grain elevators, three cemeteries, four roadside stands, and three commercial buildings.

It is important to note that much of the project corridor has not been surveyed.
The project corridor crosses a number of drainages, and because there is a strong likelihood that prehistoric sites may be encountered in undeveloped portions of the project corridor, those areas exhibiting high potential traits for prehistoric sites within the project corridor should be examined through a pedestrian archeological survey supplemented with subsurface testing and mechanical testing. In addition, all cemeteries lying within or in close proximity to the corridor should be examined.
A reconnaissance survey will be required to identify and evaluate all historic-age sites within the areas of potential effect; the survey should consist of locating, examining, and photographing structures of potential historic importance and on occasion gathering supplemental information through informal interviews with interested parties.
Based on the *Secretary of Interior's Standards and Guidelines for the Evaluation of*

Historic Properties, the historical significance and architectural integrity of the buildings should be evaluated for their potential eligibility to the NRHP.

Threatened and Endangered Species
A search of site-specific record information maintained by the Wildlife Diversity Program (WDP) of the Texas Parks and Wildlife Department (TPWD) shows the reported occurrence of several federal- or state-listed endangered or threatened species within the project corridor. Record information shows two reported occurrences of the Houston Toad, a federal- and state-listed endangered amphibian that is now reportedly extinct, in Harris County, in the vicinity of the Hempstead Highway corridor near Fairbanks. An occurrence of Texas Prairie Dawn, a federal- and state-listed endangered small herbaceous plant, is reported approximately one mile to the north of the existing US 290 Corridor near White Oak Bayou. In addition to these listed species, several species of concern (not currently protected but that could be considered for future listing) have also been reported to occur along or in the vicinity of the study corridors, including Houston Machaeranthera, Texas Windmill-grass, Alligator Snapping Turtle, and Plains Spotted Skunk. Although this information is based upon the best available data regarding rare or sensitive species and communities, it does not provide a definitive statement as to the presence or absence of such organisms or features. An on-site evaluation of the corridor by qualified biologists should be performed after project alternatives are further developed and refined.

Hazardous Materials Sites
A review of environmental regulatory databases was performed in order to locate and document hazardous waste sites within the project corridor. The regulatory databases reviewed were prepared by Environmental Data Resources, Inc. in October of 1999. The purpose of the database review was to determine if sites located within the project corridor are listed as having a past or present record of actual or potential environmental impact, or are under investigation for noncompliance with a hazardous material regulation. The search was conducted within a ¼- to ½-mile corridor along US 290 and Hempstead Highway. Several businesses within the corridor handle regulated materials such as petroleum products, waste oils, lubricating oils, hydraulic fluids, dry cleaning solvents, or acidic compounds. A total of 657 sites (from various databases) were reported, although some sites are duplicated; several sites have multiple listings on multiple databases. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) is a list of reported superfund sites. The survey did not reveal any superfund sites within the study corridor, although nine sites showed up in the CERCLIS-NFRAP (no further remedial action planned) database, indicating no further remedial action planned for those locations. As project alternatives are refined, additional record information regarding hazardous materials sites should be developed and field verified. A Phase One Environmental Site Assessment should be conducted once a preferred alternative is identified.

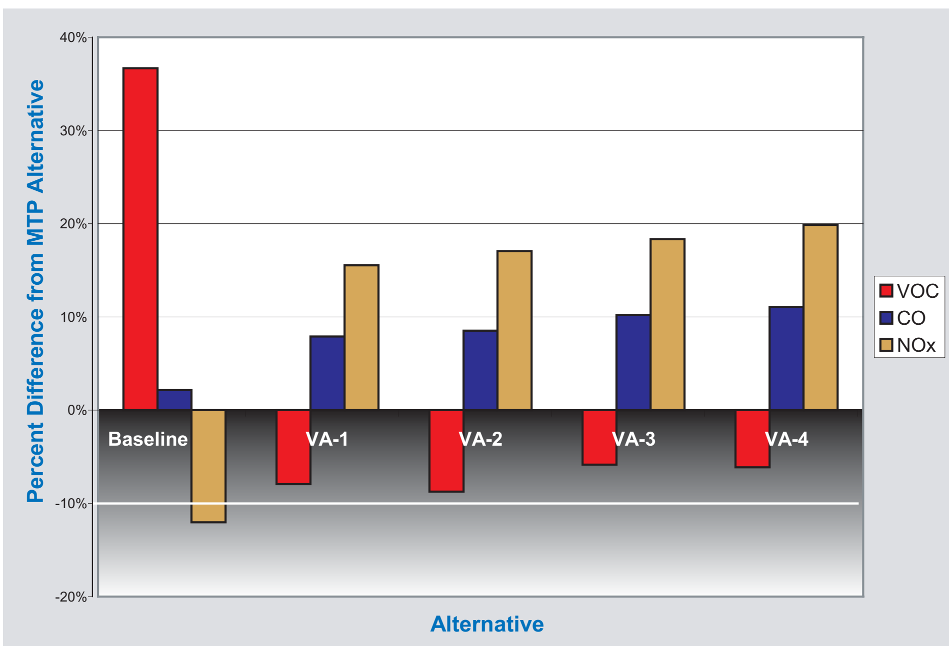
8.6 AIR QUALITY ANALYSIS

Each viable alternative's pollutant levels were compared against the MTP conceptual alternative (CA-2A) because the MTP alternative meets air quality conformity levels for H-GAC and the region. Pollutant levels for each alternative are shown in **Table 8.6-1** below; **Figure 8.6-1** demonstrates each alternative's percent difference from the MTP conceptual alternative (CA-2A). Due to increases in speeds and vehicle miles of travel (VMT), some of the pollutant levels drop while others rise — the various pollutants have different degrees of sensitivity and plateaus based on travel speeds and VMT. Air quality conformity will be addressed by H-GAC after the adoption of the locally preferred alternative.

Table 8.6-1: Air Quality

		Baseline	VA-1	VA-2	VA-3	VA-4	MTP
Contribute to Air Quality Attainment	VOC (lbs.)	788	531	526	543	541	577
	CO (lbs.)	26,896	28,415	28,578	29,026	29,250	26,334
	NOx (lbs.)	6,598	8,666	8,780	8,876	8,992	7,501

Figure 8.6-1: Percent Difference from MTP Alternative Comparison (Air Quality)



8.7 RIGHT-OF-WAY

The project team conducted a preliminary right-of-way evaluation in order to determine where additional right-of-way would be necessary, how much right-of-way would be necessary, and the cost associated with right-of-way acquisition along the corridor. Two analyses were conducted — one for the viable alternatives inside Beltway 8 and the other for the three options outside Beltway 8. The tables below list the additional acres that will need to be acquired. The cost of the additional right-of-way was included in the cost estimates described in the next section.

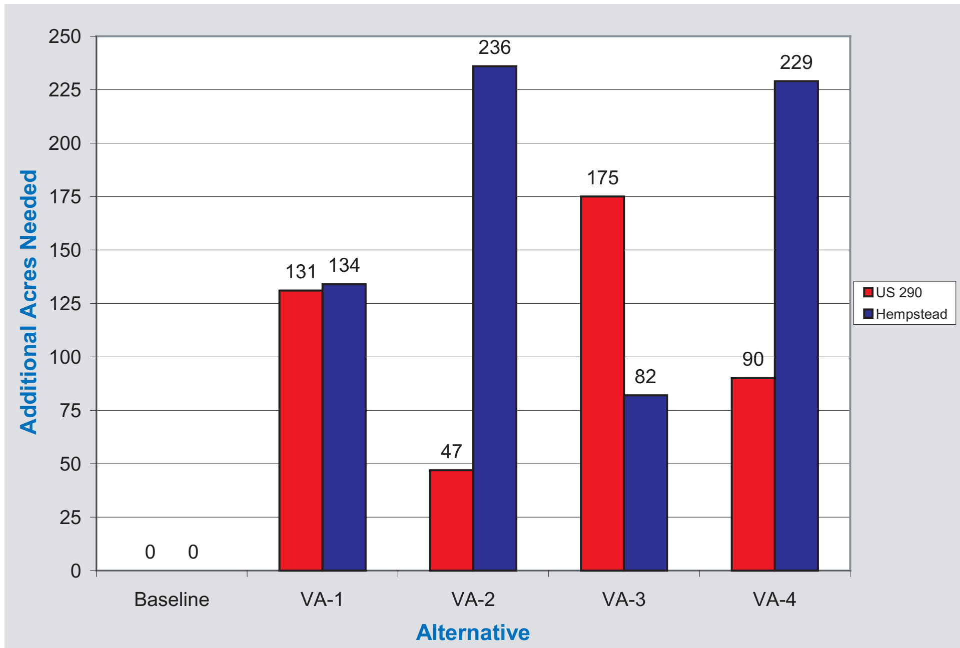
The additional right-of-way needed along US 290 inside the Beltway 8 is significantly lower for viable alternative 2 than for the other viable alternatives; however, viable alternative 2 requires the greatest amount of right-of-way inside the Beltway 8 along Hempstead Highway. Conversely, viable alternative 3 requires the greatest amount of additional right-of-way along US 290 inside the Beltway 8 and the least amount of additional right-of-way along Hempstead Highway. The intensity and cost associated (see next section) with each alternative was weighed, and it was determined that VA-2 has the least impact and the least cost. **Table 8.7-1** and **Figure 8.7-1** address right-of-way issues east of Beltway 8.

Table 8.7-1: Right-of-Way Impacts

		Baseline	VA-1	VA-2	VA-3	VA-4
Maximize Use of Existing right-of-way*	US 290	0	131	47	175	90
	Hempstead	0	134	236	82	229

*additional acres needed

Figure 8.7-1: Right-of-Way Comparison



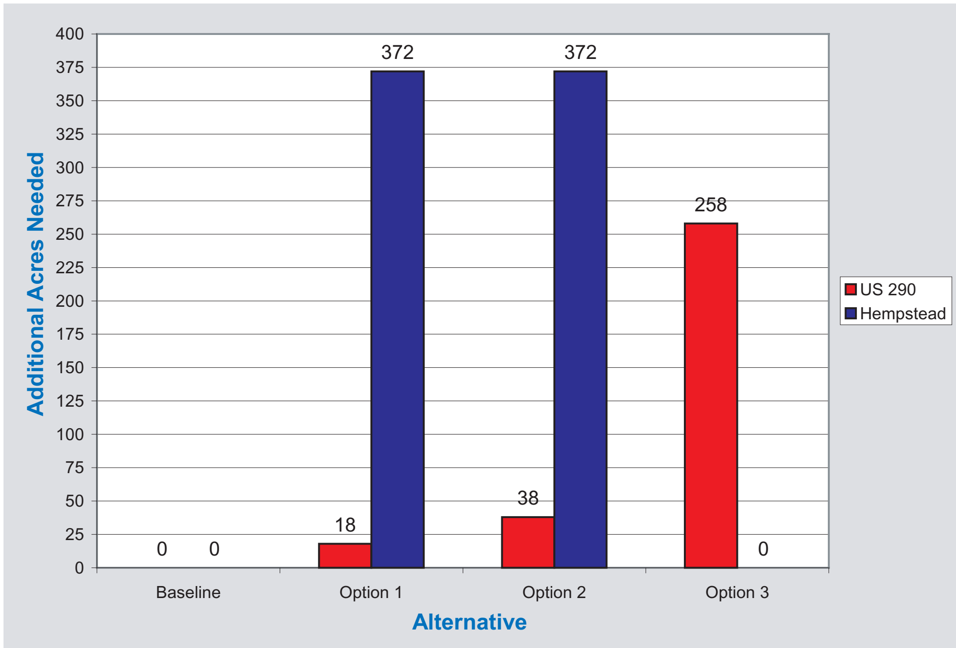
The outside the Beltway 8 option 3 requires significantly more additional right-of-way along US 290 than option 1 or 2, but requires no additional right-of-way along Hempstead outside the Beltway 8 while options 1 and 2 require approximately 372 additional acres of right-of-way each. **Table 8.7-2** and **Figure 8.7-2** address right-of-way issues west of Beltway 8.

Table 8.7-2: Right-of-Way Comparison

		Baseline	Option 1	Option 2	Option 3
Maximize Use of Existing right-of-way*	US 290	0	18	38	258
	Hempstead	0	372	372	0

*additional acres needed

Figure 8.7-2: Right-of-Way Comparison (outside Beltway 8)



8.8 COST ESTIMATES

Planning-level cost estimates were developed for each of the viable alternatives. They were used to judge the relative cost magnitudes between each of the viable alternatives. See ***Appendix E*** for more detailed cost estimate information.

Major contributing costs associated with each alternative involve the construction of interchanges, additional lanes, shoulders, and traffic barrier walls as well as the purchase of additional right-of-way along US 290. Costs were established based on the design and construction of potential improvements.

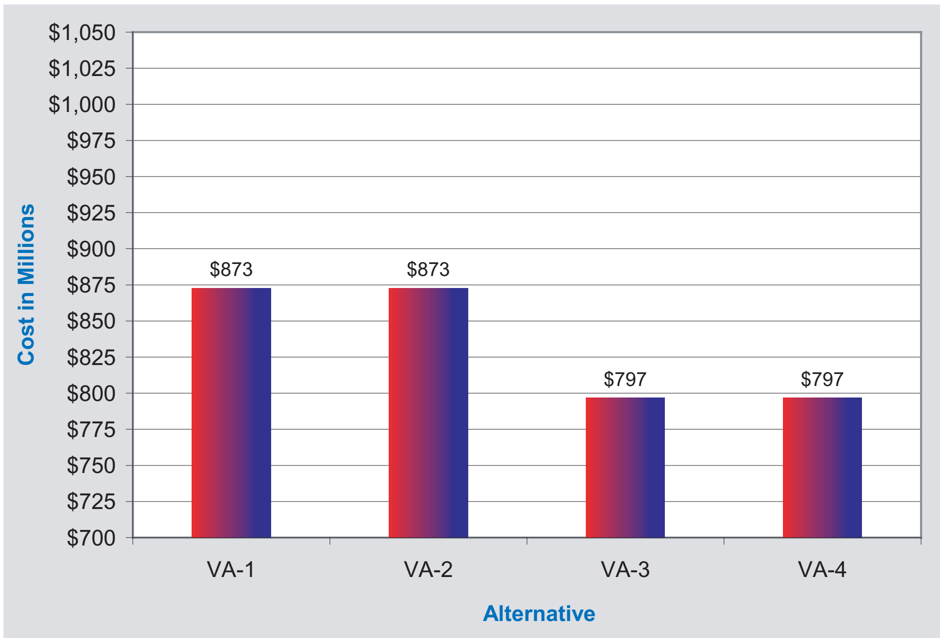
Planning-level costs associated with each alternative are presented graphically in **Figure 8.8-1** (roadway [including mobilization, contingency, and traffic control plans] and right-of-way costs) and **Figure 8.8-2** (AHCT). As shown in **Figure 8.8-1**, viable alternative 3 has the highest capital cost, due to managed lanes and advanced high capacity transit being placed along US 290. This causes the alternative to require the largest amount of additional right-of-way. The lowest capital cost was associated with viable alternative 2, in which the managed and

AHCT facilities are located on Hempstead Highway, greatly reducing the amount of right-of-way required, as well as building relocations on US 290.

Figure 8.8-1: Roadway and Right-of-Way Cost Estimates

Figure 8.8-2 shows the capital costs associated from the construction of advanced high capacity transit along US 290 and Hempstead Highway. Providing transit capabilities along Hempstead Highway requires a higher capital cost. This is due to a larger number of corridor influences, such as major intersection crossings that require transit to be grade-separated between IH 610 and Beltway 8.

Figure 8.8-2: Advanced High Capacity Transit Cost Estimates



8.9 ADDITIONAL MOBILITY ANALYSIS

Table 8.9-1 on the following page represents a detailed analysis of each viable alternative. The calculations of each measure were based upon the general-purpose and managed lanes along US 290 and Hempstead Highway located in the study corridor. Some of the information below, such as the vehicle hours of delay, are repetitive in regard to results presented earlier in ***Chapter 8***, but are presented here because of their influence and roles in calculating other measures.

Table 8.9-1: Mobility

	PERFORMANCE MEASURE							
General Purpose Lanes, Managed Lanes (290 and Hempstead)	Vehicle Miles of Travel (VMT)	Vehicle Miles of Capacity (VMC)	Lane Miles	Vehicle Hours of Travel (VHT) at Free Speed	Vehicle Hours of Travel (VHT) at Loaded Speed	Vehicle Hours of Delay	Percent Vehicle Hours Spent in Delay	Percent Lane Miles at LOS E or LOS F
Baseline	4,811,663	5,126,300	317	72,710	109,124	36,414	33.37%	50.44%
VA-1	5,375,121	9,868,052	507	92,030	102,506	10,476	10.22%	6.30%
VA-2	5,385,577	10,458,442	539	92,224	102,013	9,789	9.60%	4.22%
VA-3	5,494,484	10,033,736	507	94,097	104,939	10,842	10.33%	2.80%
VA-4	5,516,935	10,624,656	539	94,448	104,741	10,293	9.83%	4.24%

VA-2 and VA-4 provide the most lane miles and capacity. These two alternatives also have a slightly lower percentage of vehicle hours spent in delay. VA-3 appears to have fewer lane miles at level of service E and F than the other build alternatives. Each of the build alternatives nearly doubles the capacity of the no-build alternative.

Figures 8.9-1 through **8.9-5** demonstrate H-GAC's LOM (*Section 4.2*) analysis in the corridor on US 290 and Hempstead Highway for all of the viable alternatives; including the baseline alternative. Also included are volume-to-capacity ratios for the screenlines. The aforementioned figures demonstrate that the no-build alternative is over capacity many places throughout the corridor along US 290 and that there is demand for additional HOV lanes. The build viable alternatives all tend to operate similarly — indicating the need for additional capacity on US 290 near its interchange with Beltway 8, and perhaps additional capacity on Hempstead Highway near its intersection with IH 610 (inside the loop).

Figure 8.9-1: Baseline (No-Build) LOM and Screenline Analysis

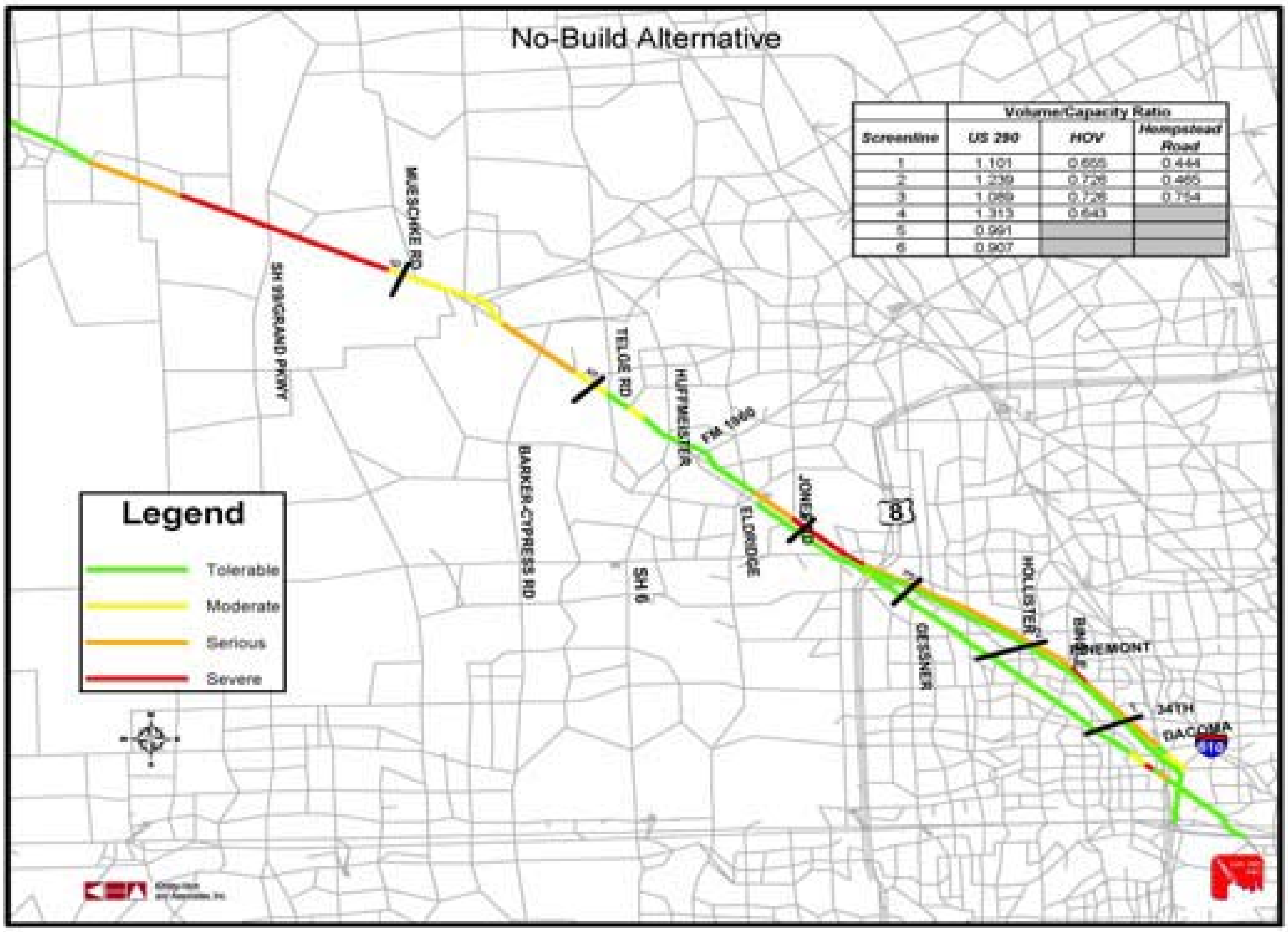
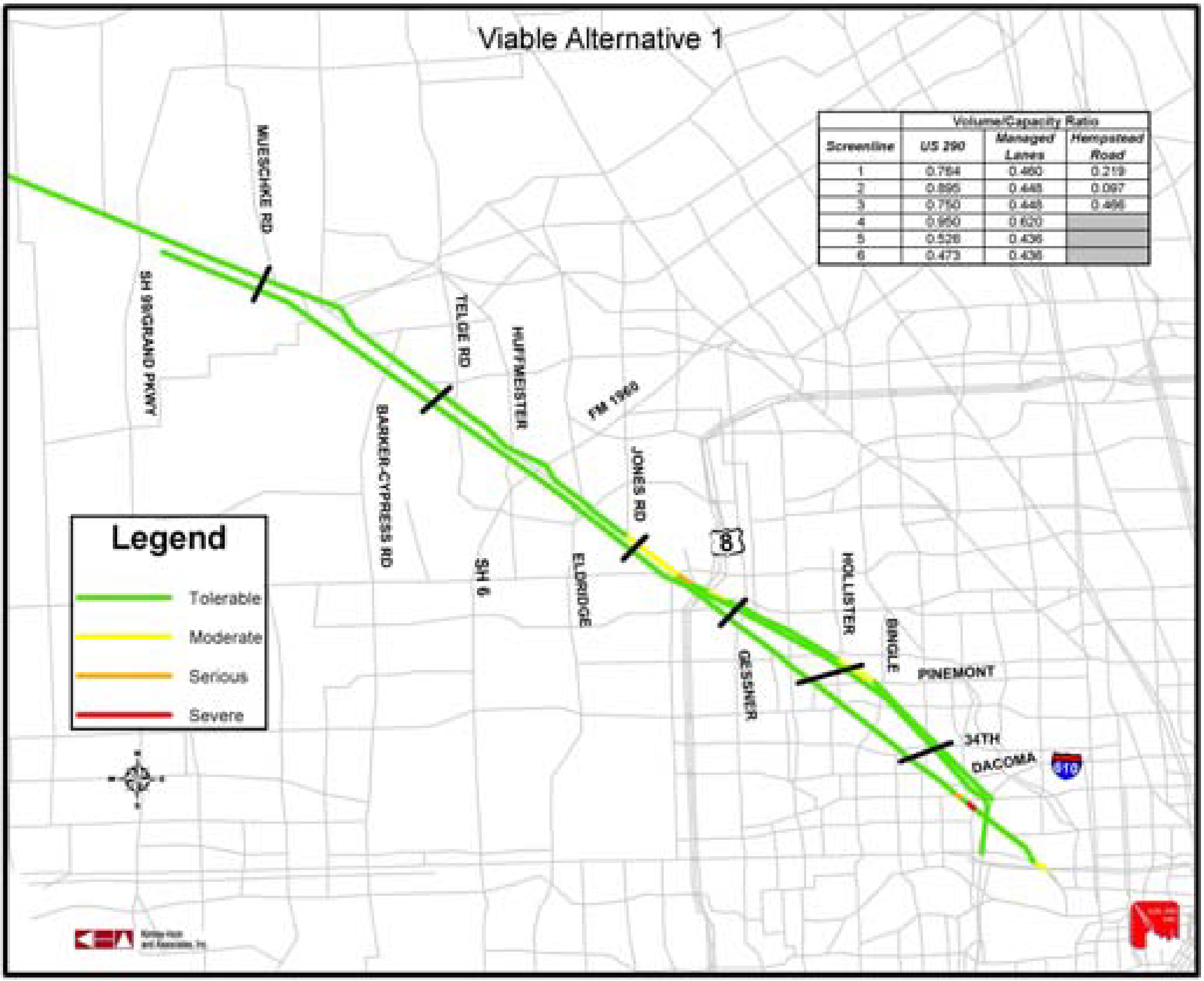
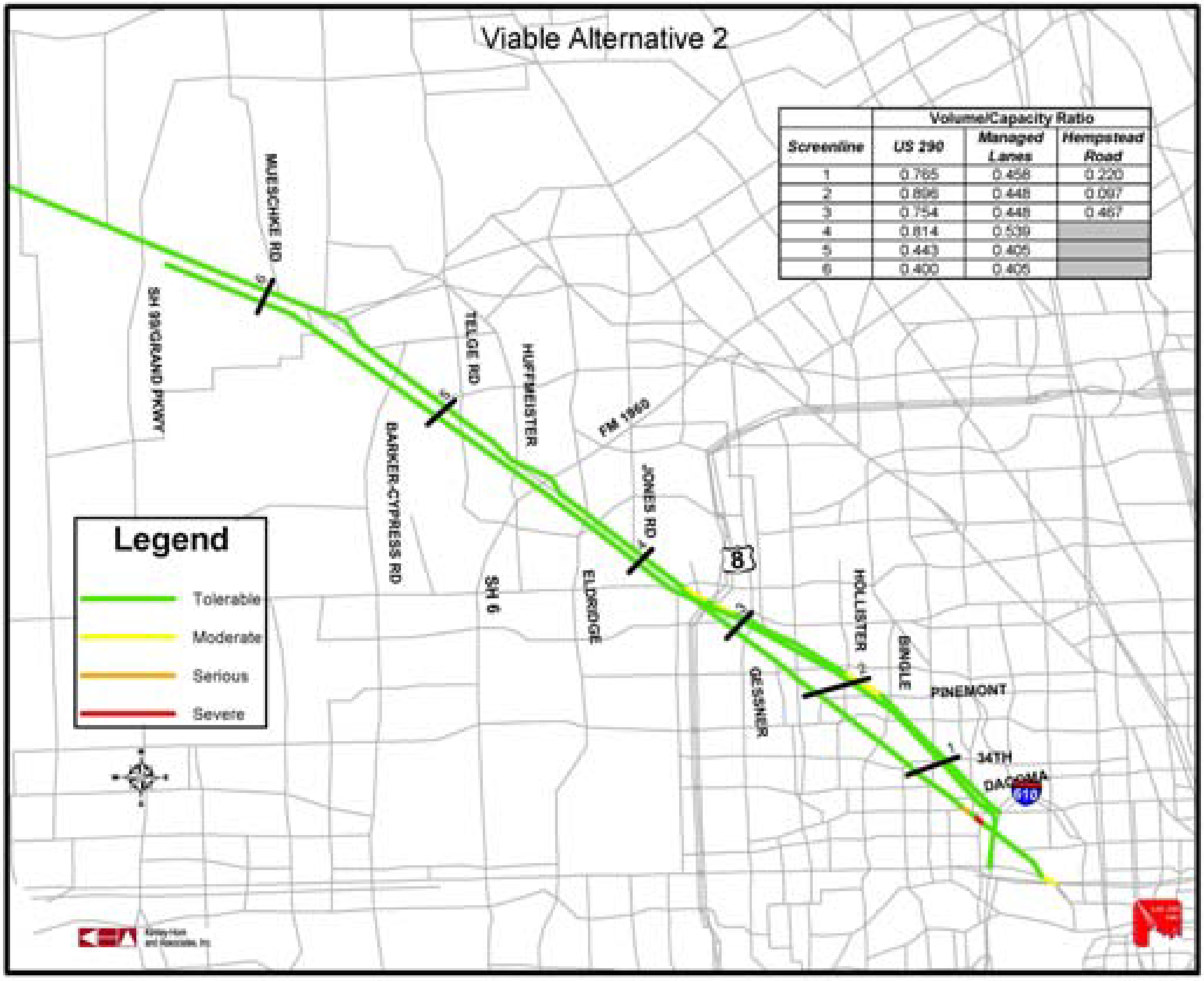


Figure 8.9-2: VA-1 LOM and Screenline Analysis



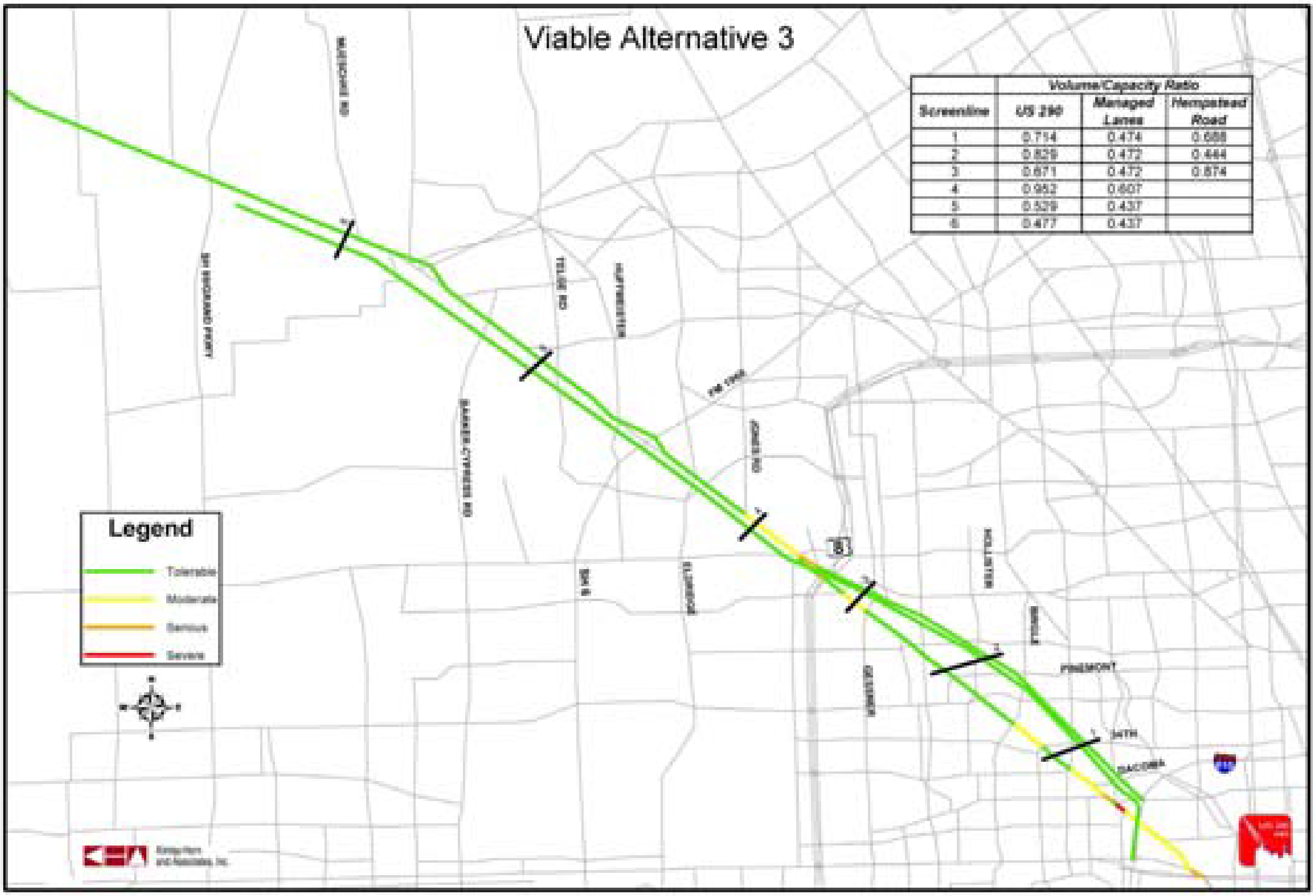
Screenline	Volume/Capacity Ratio US 290	Managed Lanes	Hempstead Road
1	0.784	0.460	0.219
2	0.895	0.448	0.097
3	0.750	0.448	0.466
4	0.950	0.620	
5	0.526	0.436	
6	0.473	0.436	

Figure 8.9-3: VA-2 LOM and Screenline Analysis



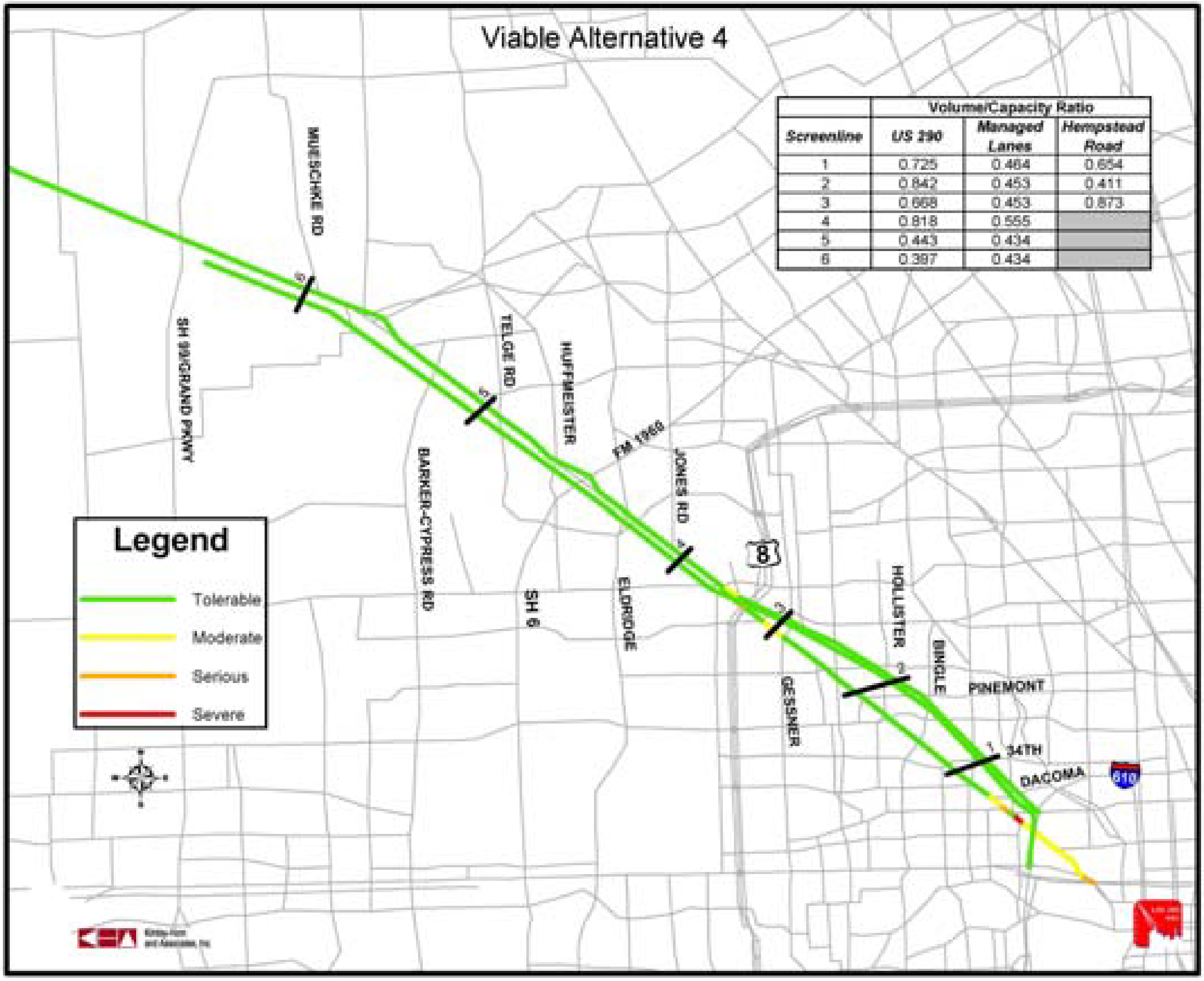
Screenline	Volume/Capacity Ratio		
	US 290	Managed Lanes	Hempstead Road
1	0.765	0.458	0.220
2	0.896	0.448	0.097
3	0.754	0.448	0.467
4	0.814	0.539	
5	0.443	0.405	
6	0.400	0.405	

Figure 8.9-4: VA-3 LOM and Screenline Analysis



Screenline	Volume/Capacity Ratio US 290	Managed Lanes	Hempstead Road
1	0.714	0.474	0.688
2	0.829	0.472	0.444
3	0.871	0.472	0.874
4	0.952	0.607	
5	0.529	0.437	
6	0.477	0.437	

Figure 8.9-5: VA-4 LOM and Screenline Analysis



Screenline	Volume/Capacity Ratio US 290	Managed Lanes	Hempstead Road
1	0.725	0.464	0.654
2	0.842	0.453	0.411
3	0.668	0.453	0.873
4	0.818	0.555	
5	0.443	0.434	
6	0.397	0.434	

8.10 Summary of Technical Analysis

Several of the evaluation measures yielded similar results for the build alternatives. However, it was the subtle differences and those measures which yielded significant differences between alternatives that provided the study team with invaluable information to make a recommendation for the locally preferred alternative. The technical analysis reinforced the fact that the no-build alternative will not be sufficient to support the corridor in the future. Overall, viable alternative 2 preformed better than the other three for several reasons:

- Safety measures were somewhat equal — an argument can be made that keeping the managed facility on a separate right-of-way will help eliminate merging and weaving maneuvers on US 290, thereby increasing safety
- Mobility analysis measures are equal — not much difference can be discerned between the alternatives
- Transit analysis shows similar ridership between the alternatives — however, better station access and transit development opportunities are available along the alternatives that have the AHCT envelope along Hempstead Highway
- Environmental analysis differences are significant along the corridor — as can be seen in the previous sections, viable alternative 2 has the least amount of right-of-way impacts along US 290; however, the impacts are intensified on Hempstead Highway. Residential displacements with viable alternative 2 are also much fewer than with the other three alternatives. In addition, the cost of viable alternative 2 is much less than the other three alternatives. Another benefit of alternative 2 is its ability to have Hempstead Highway provide relief during construction along US 290 (if the general-purpose and managed lanes along Hempstead Highway are built first)
- Viable alternatives 2 and 4 allow for the design of a seamless interchange directly from the managed facility to IH 610; other alternatives would create weaving and circulation issues at the US 290 / IH 610 interchange

Chapter 9
Preferred Alternative

9.1 RECOMMENDATION PROCESS

After thorough reviews of the results discussed in ***Chapter 8***, discussions with the Steering and Advisory Committees, coordination with TxDOT, and evaluations of opinions and concerns expressed at the public meetings, the following locally preferred alternative is recommended.

The locally preferred alternative represented the most appropriate choice for the corridor when taking into account cost, constructibility, environmental impacts, and construction staging. The analysis of the alternatives led to the conclusion that all three of the major components studied in this MIS (general-purpose lanes, managed facility, and AHCT) are necessary elements of the locally preferred alternative. The locally preferred alternative provides congestion relief by having an acceptable LOS throughout the corridor; the new design presents a great opportunity to improve public safety in the corridor and it meshes well with METRO's plans for transit in the corridor. H-GAC's Transportation Policy Council is the policy board ultimately responsible for adopting the locally preferred alternative.

9.2 LOCALLY PREFERRED ALTERNATIVE

The elements suggested for the locally preferred alternative are listed below. Exact alignments, locations, and lane breaks will be decided during schematic design.

- Five general-purpose lanes in each direction from IH 610 to just west of Beltway 8, plus auxiliary lanes where appropriate

- Four general-purpose lanes in each direction from just west of Beltway 8 to some location near the future Grand Parkway / SH 99

- Three general-purpose lanes in each direction from near the future Grand Parkway / SH 99 to the west study limit

- Four-lane, two-way managed facility along the Hempstead Highway Corridor from IH 610 to some location near the future Grand Parkway / SH 99

- Two general-purpose lanes in each direction reconstructed along the Hempstead Highway Corridor; possibly three lanes in each direction inside Beltway 8

- Advanced high capacity transit along the Hempstead Highway Corridor from IH 610 to some location near the future Grand Parkway / SH 99

- Two- or three-lane frontage roads in each direction throughout the corridor (will be determined during schematic design)

- Planning-level cost estimates indicate that the locally preferred alternative will cost $883 million in roadway construction (mobilization, contingency, and traffic control included), $35 million in right-of-way acquisition, and $873 million in AHCT construction (see ***Appendix E***)

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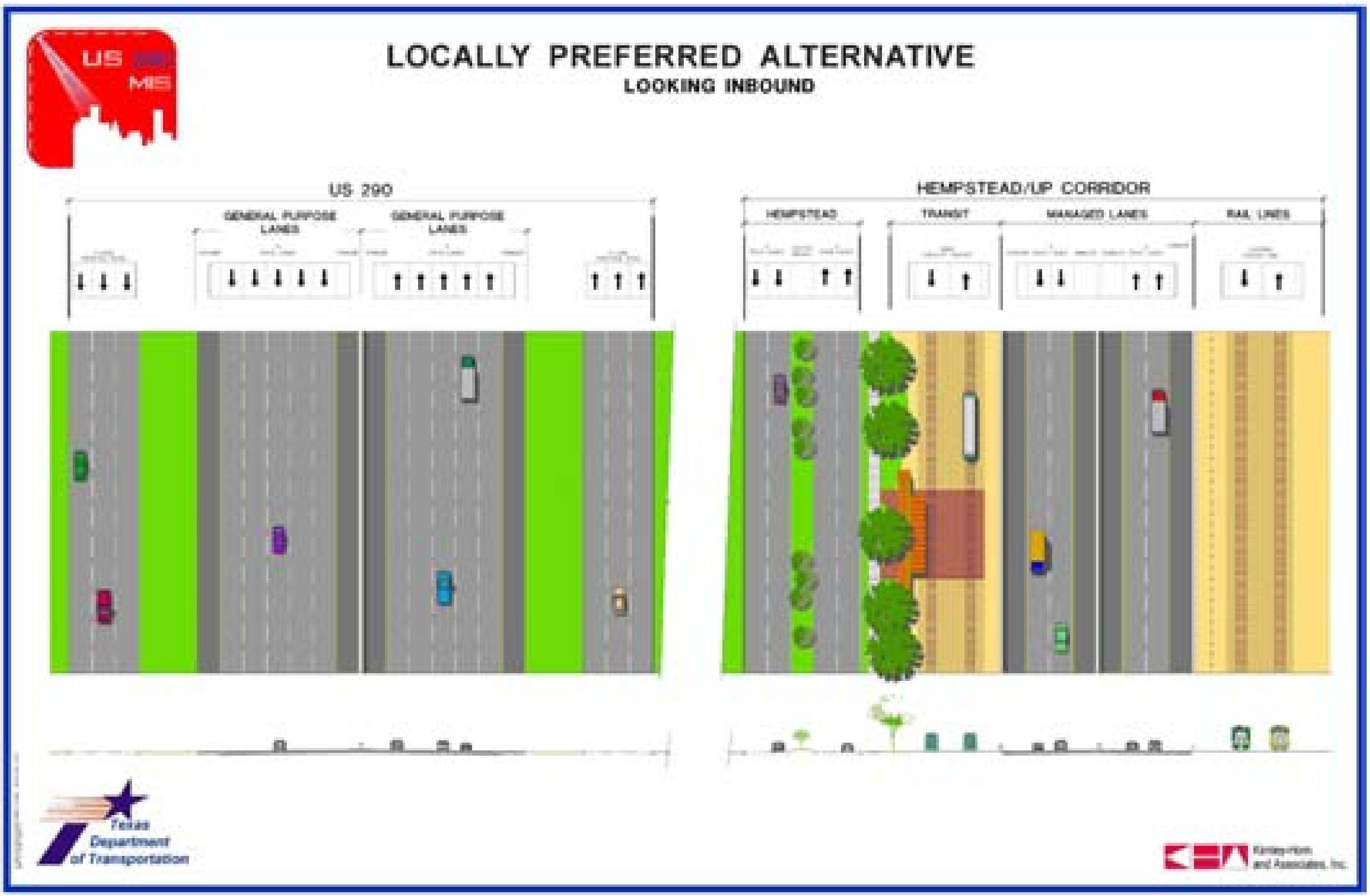
Figure 9.2-1: Locally Preferred Alternative



TSM / TDM / ITS Improvements (included as part of locally preferred alternative)

Widening / Roadway Improvements

- Widen to six lanes divided and install TSM along FM 529 from US 290 to Huffmeister Road
- TSM improvements for US 290 at 34th Street
- Bridge widening for US 290 at Brazos River relief structures
- Construct interim grade separation at US 290 and Roberts Road
- Construct interim grade separation at US 290 and Becker Road
- Construct interim grade separation at US 290 and Bauer Road
- Construct grade separation at US 290 and Mason Road
- Connect main lanes of US 290 at Mueschke Road (0.4 miles south to 0.1 miles south of Mueschke Road)
- Construct interim grade separation at US 290 and Mueschke Road
- Construct four-lane divided rural section of SH 99 from US 290 to SH 249
- Construct four-lane divided rural section of SH 99 from US 290 to Franz
- HOV lanes along US 290 terminating at Waller County park-and-ride; express bus service into Houston as well, which may require expanded transit service *(also fits into "Transit" category)*
- Continuous frontage roads adjacent to US 290, with provision for signal coordination along frontage road *(also fits into "Signal System" category)*
- Contra-flow arterials where strong directional flow occurs in the peak periods

Signal Systems / Other

- Northwest HOV, PNR signalization, traffic, and project management
- Increased mobility assistance patrols committed to the US 290 Corridor *(fits into "Other" category only)*
- Access management and signal coordination along Hempstead Highway, between North Gessner Road and IH 610
- Access management and signal coordination along FM 529, between SH 99 and US 290
- Access management and signal coordination along Telge Road, between Grant Road and US 290
- Access management and signal coordination along North Eldridge Parkway, between Grant Road and IH 10
- Access management and signal coordination along Cypress-Rosehill Road, between SH 99 and US 290
- Access management and signal coordination along W. Little York Road, between Barker-Cypress Road and West Sam Houston Parkway

- Access management and signal coordination along Clay Road, between SH 99 and West Sam Houston Parkway
- Access management and signal coordination along Addicks Howell Road / FM 1960, between Tomball Parkway and IH 10
- Demand-actuated signals at isolated intersections within the US 290 Corridor *(also fits into "Signal System" category)*

ITS

- Installation of computerized transportation management system (CTMS) along US 290 from Hockley to Waller County line
- Installation of CTMS along US 290 from Harris County line to Washington County line
- Installation of CTMS along US 290 at 0.3 miles east of Mueschke Road to 1.86 miles west of Telge Road
- Installation of CTMS along US 290 at 1.86 miles west of Telge Road to Huffmeister Road
- Installation of integrated corridor transportation management and traveler information system at TranStar, along US 290 at Huffmeister Road to 0.125 miles east of FM 529 and then to IH 610
- Ramp metering on US 290 at high-volume entries
- Changeable message signs along US 290 from Waller County to Huffmeister Road

Bicycle / Pedestrian

- North Houston on-street bikeway network
- West Houston on-street bikeway network
- Promote regional bicycle and pedestrian trail improvements within US 290 Corridor
- Bike lanes along Hempstead Highway
- Bike lanes from each transit station extending at least two miles into adjacent neighborhoods and retail centers (for example, a bike lane is planned from Jersey Village to the W. Little York park-and-ride facility [see ***Appendix F***])

Transit

- Construct park-and-ride on US 290 in Waller County
- Northwest Station PNR expansion

TDM Elements

- Public transportation improvements
  - New local bus service
  - Improvements to existing local bus service

- Employee trip reduction (ETR) and transportation management associations (TMAs)
  - Ridesharing programs
  - Parking management
  - Alternative work hours
  - Telecommuting
  - Employee transit pass program

- Bicycle / pedestrian strategies
  - Incorporation into roadway and neighborhood designs
  - Regional networks
  - Integration with transit facilities

ITS

Travel and transportation management: in-route driver information, route guidance traveler services information, traffic control, incident management, and emissions testing and mitigation

Travel demand management: pre-trip travel information, ride matching and reservation, and demand management

Public transportation operations: public transportation management, in-route transit information, personalized public transit, and public travel security

Electronic payment: electronic payment services (for example, EZ TAG)

Commercial vehicle operations: commercial vehicle electronic clearance, automated roadside safety inspection, onboard safety monitoring, commercial vehicle administrative processes, hazardous materials incident response, and commercial fleet management

Emergency management: emergency notification, personal security, and emergency vehicle management

Advanced vehicle control and safety systems: longitudinal collision avoidance, lateral collision avoidance, intersection collision avoidance, vision enhancement for crash avoidance, safety readiness, pre-crash avoidance, pre-crash restraint deployment, and automated highway systems

Chapter 10
Implementation of the Recommended Locally Preferred Alternative

With the initiation of a major investment study, a process begins to determine and implement an alternative to move people through a corridor, while aiming to meet other corridor-specific goals, such as those related to safety, transit, air quality, etc. From the Steering and Advisory Committees to public meetings, momentum is generated and consensus is gained toward a locally preferred alternative. A process that involves the community through a formal program is complemented by sound technical analysis and will result in a smooth implementation process.

10.1 METROPOLITAN PLANNING ORGANIZATION APPROVALS

Implementing the locally preferred alternative requires adoption of that particular alternative by the Metropolitan Planning Organization (MPO) and the alternative's incorporation into the *Metropolitan Transportation Plan* (MTP). The MTP must be financially feasible. H-GAC serves as the MPO for the Houston 13-county region. Also serving the H-GAC 13-county region is a Technical Advisory Committee (TAC) that provides input and feedback to the Transportation Policy Council (TPC), which is the policy board that will ultimately adopt a locally preferred alternative into the MTP.

Air Quality Compliance

The locally preferred alternative, along with other projects adopted into the MTP, must conform to the air quality requirements of the region. This is a regional conformity requirement, and the MPO is responsible for establishing MTP conformity.

10.2 US 290 / HEMPSTEAD HIGHWAY IMPROVEMENTS

There are multiple decisions that are related to the managed facility planned for the US 290 Corridor; this managed facility is intended to combine the operational capabilities of an HOV facility with the finance structure of a toll facility. The

Houston area toll road system is maintained and operated by the Harris County Toll Road Authority (HCTRA). A joint venture between HCTRA and METRO must be established in order to untap the benefits of this facility. A decision will need to be made related to the toll pricing and occupancy levels allowed, as well as the toll associated with each level. Additional thought should be given to value pricing, in which tolls are established by time of day or levels of congestion (the higher the congestion, the higher the toll). Several design decisions will need to be made in relation to the managed facility, such as connection to IH 610 and IH 10 and the exact termination point at the western study limits. Also, having either ingress and egress onto the managed facility via T-ramps or traditional ramping patterns will need to be determined.

Schematic Design and Environmental Documentation

Once adoption by the MPO is secured, design and environmental documentation can be completed. The design will be completed in two phases: phase one will consist of preliminary schematic design, which is intended to allow for full environmental documentation and analysis of alternatives, as well as development of mitigation strategies. Once environmental clearance is obtained, the second phase will likely begin. At this point, the corridor will be divided into reasonable segments in order to develop final design plans (plans, specifications, and estimates).

10.3 Advanced High Capacity Transit (AHCT) Metropolitan Transit Authority (METRO) Planning

Future high capacity transit was determined to be a major element for the northwest corridor. As such, the exact technology and operational plans for the corridor will need to be determined by METRO. As part of this MIS, the H-GAC travel demand model was used to determine mode choice and perform transit assignments. Most of the transit network coding and station locations were determined by METRO and given to H-GAC for the consultant team to evaluate. From that analysis, it was determined that AHCT is viable for this corridor. The exact technology and station locations will be determined by METRO as part of their alternative analysis (AA) process, which must include completion of the necessary environmental documentation for Federal Transit Administration (FTA) approval and compliance with the *New Starts* criteria.

10.4 IMPLEMENTATION SEQUENCE

- Locally preferred alternative adoption by Transportation Policy Council
- HCTRA toll studies
- METRO alternatives analysis / environmental impact statement
- TxDOT schematic design — environmental impact statement
- Plans, specifications, and estimates
- Construction

10.5 STAGING

The locally preferred alternative has many elements: managed lanes, general-purpose lanes, and AHCT. The urban Hempstead Highway project should be widened and improved first in order to offset traffic from the US 290 general-purpose lanes during construction. If the managed lanes and the Hempstead Highway portions are built first, many vehicles and buses can be accommodated in this corridor.

The limits of the construction should focus first on the most congested portion of the study area, which is inside of Beltway 8; second, from Beltway 8 to Fairfield; and finally, from Fairfield to FM 2920.

With both the managed and AHCT facilities located along Hempstead Highway, there is an opportunity to be had in building the managed facility first: it will move the current HOV patrons to the new facility before construction begins along US 290.

Appendix A
Steering and Advisory Committee Members

US 290 MIS Steering Committee

Name	Agency
Wilbur Lee Gibbons Urban Program Engineer	Federal Highway Administration
Gary Johnson Texas Division Area Engineer	Federal Highway Administration
Sheryl J. Bookman Right-of-Way Department	Texas Department of Transportation
Tom Bruechert Manager Field Area 1	Texas Department of Transportation
David Bryant Right-of-Way Department	Texas Department of Transportation
Elvia Cardinal Director, CCA	Texas Department of Transportation
Stan Cooper Environmental Coordinator	Texas Department of Transportation
Stuart Corder Transportation Systems	Texas Department of Transportation
Delvin Dennis Deputy District Engineer	Texas Department of Transportation
Jose A. Garza, P.E. Assistant Director of Maintenance	Texas Department of Transportation
Pat Henry, P.E. Director of Project Development	Texas Department of Transportation
Gabriel Johnson, P.E. Director of Transportation Planning & Development	Texas Department of Transportation
James Koch Director of Design	Texas Department of Transportation
Julie Lane Project Manager	Texas Department of Transportation
Carol Nixon Director of Transportation Planning	Texas Department of Transportation

Name	Agency
Mark D. Patterson Manager, CCA	Texas Department of Transportation
Greg Ranft Area Engineer	Texas Department of Transportation
James Roscher Project Manager, Environmental	Texas Department of Transportation
Mike Tello	Texas Department of Transportation
Gary Trietsch Houston District Engineer	Texas Department of Transportation
Rakesh Tripathi	Texas Department of Transportation
Jenise Walton Project Manager	Texas Department of Transportation
Sally Wegmann Director, Transportation Systems	Texas Department of Transportation
Carolyn Anderson Senior Planner	Houston-Galveston Area Council
Ursurla Anderson Transportation Planner	Houston-Galveston Area Council
Alan Clark MPO Director	Houston-Galveston Area Council
Scott Barker Senior Planner	Metropolitan Transit Authority, Planning & Development
Billy Graham Planner Leader	City of Houston
Katherine Parker Planner Leader	City of Houston
Gary Schatz, P.E. Senior Engineer	City of Houston / TMM
Andy Mao Manager, TRT	Harris County Public Infrastructure Department - ENG
Anita Stevens Manager, Administration	Harris County Toll Road Authority
Edith Erfling	US Fish & Wildlife Service – Houston

US 290 MIS Advisory Committee:

Name	Agency
The Honorable John Culberson	US Representative, District 7
Leslie Vigil	Legislative Assistant
Pat Wisniewski	Office of State Senator Lindsay, District 7
Charles Wilcox Manager of Engineering	Harris County Precinct 1
Paul Hawkins Assistant Manager of Engineering	Harris County Precinct 3
Paul D. Rushing Manager of Engineering	Harris County Precinct 3
Pamela Rocchi Project Coordinator	Harris County Precinct 4
George Hammerlein Assistant Chief Deputy	Harris County Tax Office
Charles Dean Planning Manager	Harris County, Public Infrastructure Department
Alisa Acheson Manager, Public Agency Coordination, Engineering Division	Harris County Flood Control District
Kenneth L. Sheblak	Harris County Flood Control District
Alan Clark MPO Director	Houston-Galveston Area Council
Carolyn Anderson Senior Planner	Houston-Galveston Area Council
Lisa Gonzales, P.E.	Harris County Toll Road Authority
Rick Dickson City Liaison	City of Houston
Earl A. LeBlanc Council Aide, Office of Bruce Tatro, District A	City of Houston
Dale Brown City Manager	City of Jersey Village
Roderick Hainey Director of Public Works	City of Jersey Village
Dan Troxell Assistant Superintendent, School & Community Relations	Cypress-Fairbanks ISD
Rick Terrell Transportation Director	Cypress-Fairbanks ISD
Roy Sprague	Cypress-Fairbanks ISD

Name	Agency
Ricky Thomas	Houston ISD
Richard McReavy Assistant Superintendent – Administration	Waller ISD
Kerry Stanley	US Army Corps of Engineers
W.R. "Bill" Rowden	Cypress-Fairbanks Chamber of Commerce
Jack Searcy Government Affairs Chairman	Houston Northwest Chamber of Commerce
Sandy Turbeville Executive Director	Houston Northwest Chamber of Commerce
Roger Hord	West Houston Association
Jennifer Rasco	West Houston Association
Catherine Wray	North Houston Association
Mark Kollmorgen Government Affairs	Reliant Energy
David Garret Executive Director	Grand Parkway Association
Robin Sterry Assistant Executive Director	Grand Parkway Association
Norm Wigington PIO	Texas Department of Transportation
Julie Perales	Texas Department of Transportation
James Roscher	Texas Department of Transportation
Ceneetra Banks	Federal Highway Administration
W. Lee Gibbons, P.E. Urban Program Engineer	Federal Highway Administration
Gary Johnson Area Engineer	Federal Highway Administration
Clarence Rumancik Area Engineer Representative	Federal Highway Administration Northwest Harris County M.U.D. #25

Appendix B
Corridor Influence Maps

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

MAINLANES
HOV LANES
CITY LIMITS
METRO BUS ROUTE
MAJOR UTILITIES
BRIDGE STRUCTURES
SIGNALIZED INTERSECTIONS
MAINLANE FRTG. RD. L — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
SCHOOLS
PARKS
PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants

Hicks & Company

Knudson & Asssociates, Inc.

US290 MIS

Figure - 1

22 MAR 2001

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

- MAINLANES
- HOV LANES
- CITY LIMITS
- METRO BUS ROUTE
- MAJOR UTILITIES
- BRIDGE STRUCTURES
- SIGNALIZED INTERSECTIONS
- PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
- SCHOOLS
- PARKS
- PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure - 2

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

- MAINLANES
- HOV LANES
- CITY LIMITS
- METRO BUS ROUTE
- MAJOR UTILITIES
- BRIDGE STRUCTURES
- SIGNALIZED INTERSECTIONS
- MAINLANE / FRTG. RD — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
- SCHOOLS
- PARKS
- PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

22 MAR 2001

Figure - 3

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

- MAINLANES
- HOV LANES
- CITY LIMITS
- METRO BUS ROUTE
- MAJOR UTILITIES
- BRIDGE STRUCTURES
- SIGNALIZED INTERSECTIONS
- MAINLANE / FRTG. RD. — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
- SCHOOLS
- PARKS
- PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation

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Engineering, Planning, and Environmental Consultants

Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure - 4

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

- MAINLANES
- HOV LANES
- CITY LIMITS
- METRO BUS ROUTE
- MAJOR UTILITIES
- BRIDGE STRUCTURES
- SIGNALIZED INTERSECTIONS
- MAINLANE / FRTG. RD — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
- SCHOOLS
- PARKS
- PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation
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Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

22 MAR 2001

Figure - 5

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

- MAINLANES
- HOV LANES
- CITY LIMITS
- METRO BUS ROUTE
- MAJOR UTILITIES
- BRIDGE STRUCTURES
- SIGNALIZED INTERSECTIONS
- MAINLANE / FRTG. RD / L — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES
- SCHOOLS
- PARKS
- PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation
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Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure - 6

SCALE

1000 0 500 1000 2000

Scale: 1" = 2000'

LEGEND

MAINLANES
HOV LANES
CITY LIMITS
METRO BUS ROUTE
MAJOR UTILITIES

BRIDGE STRUCTURES
SIGNALIZED INTERSECTIONS
MAINLANE FRTG. RD. L — PM PEAK TRAFFIC VOLUMES / NUMBER OF LANES

SCHOOLS
PARKS
PARK & RIDE

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
EXISTING ROADWAY FEATURES

Texas Department of Transportation
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US290 MIS

22 MAR 2001

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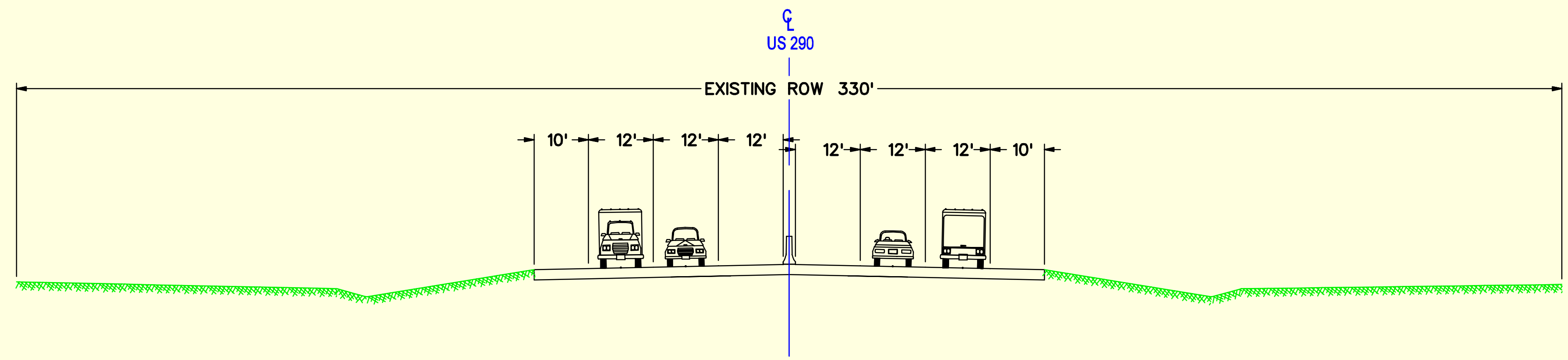

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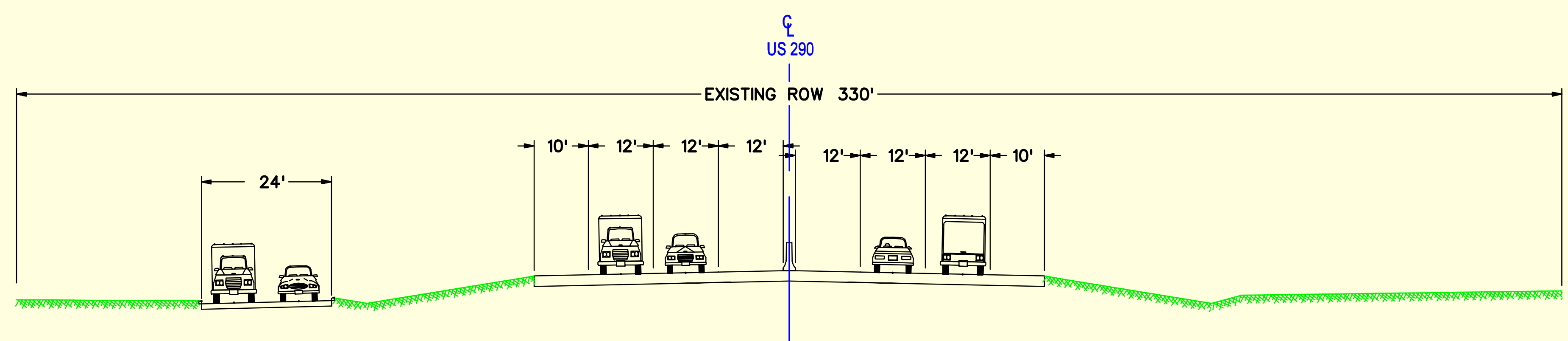

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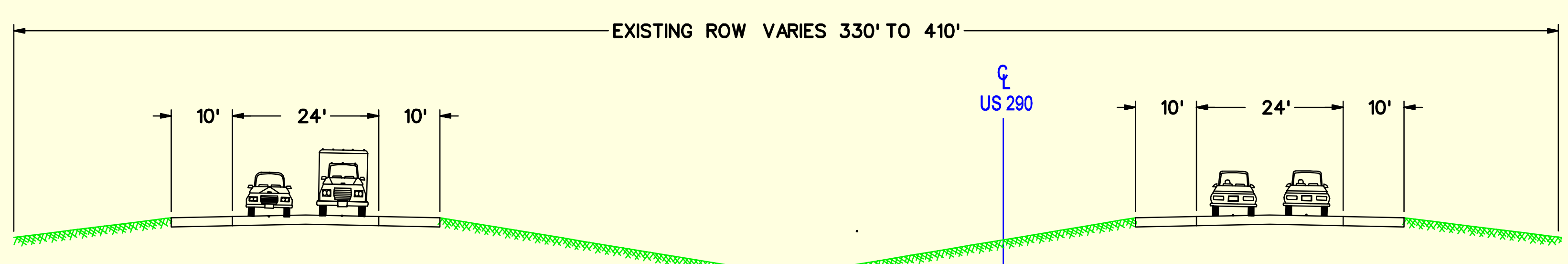

Section C-C

Not to Scale

US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
TYPICAL EXISTING CROSS SECTIONS

Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure - 8

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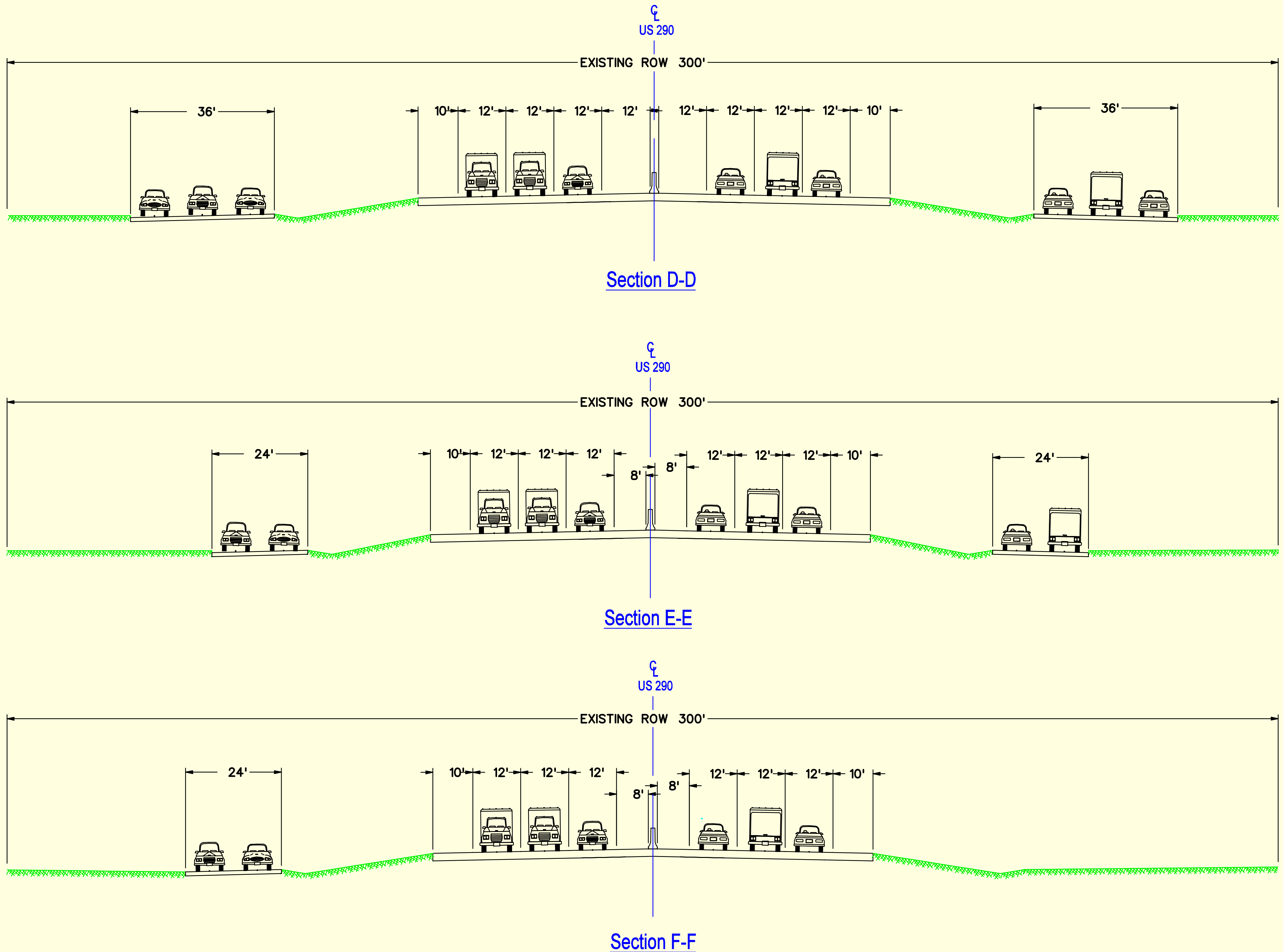

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US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
TYPICAL EXISTING CROSS SECTIONS

Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

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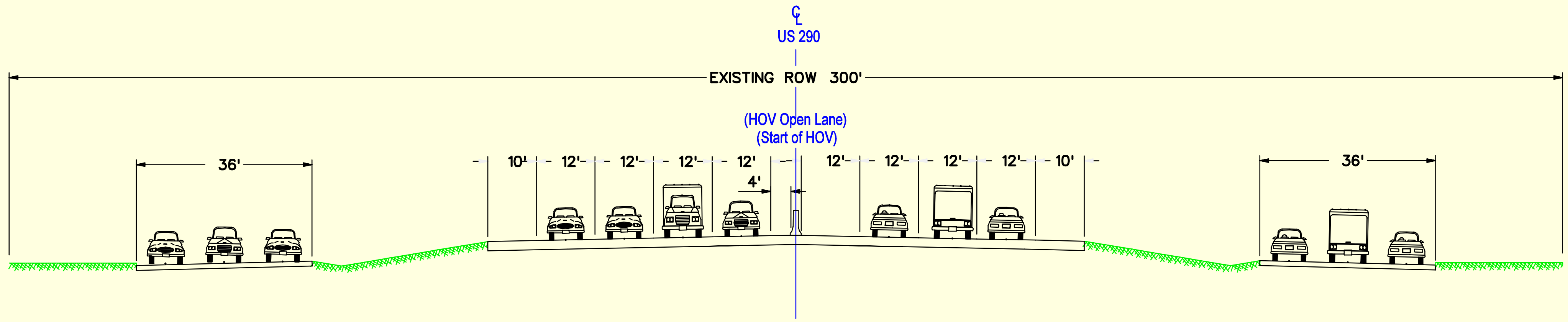

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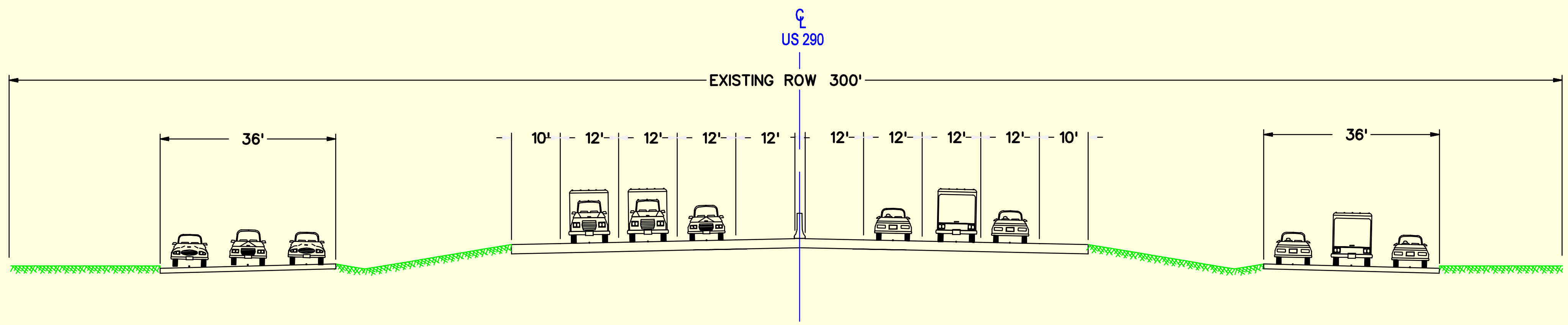

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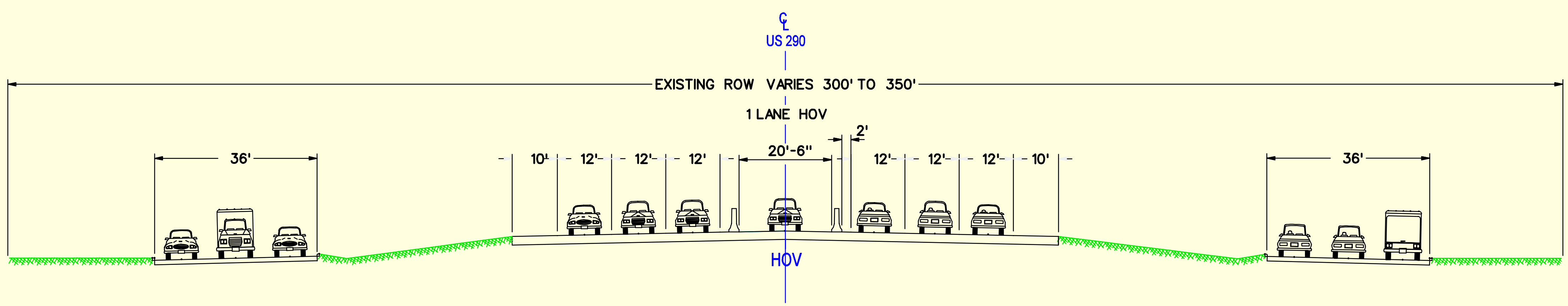

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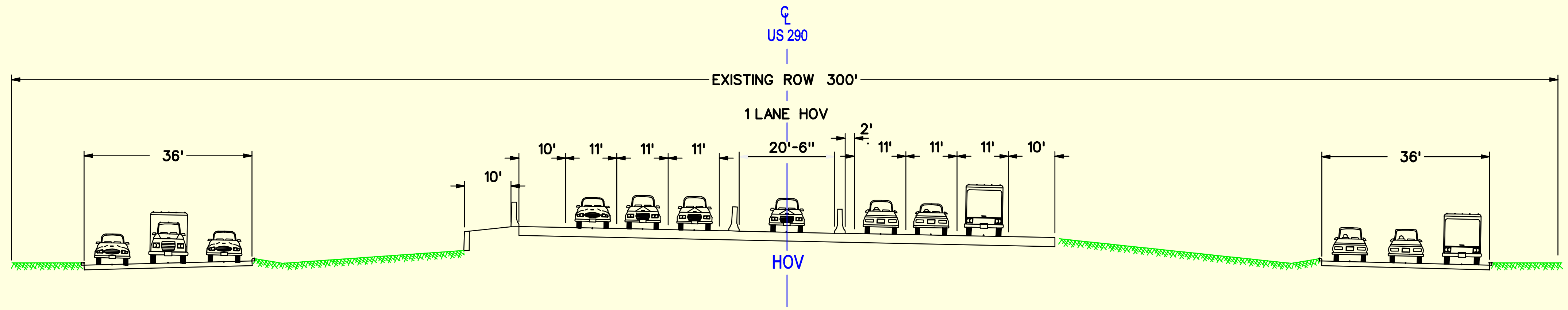
US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
TYPICAL EXISTING CROSS SECTIONS

Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure -10



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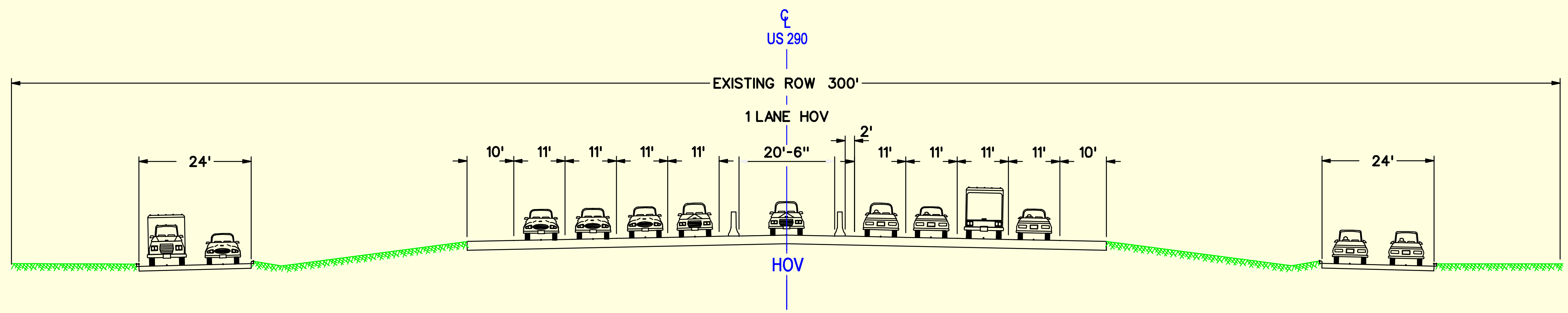

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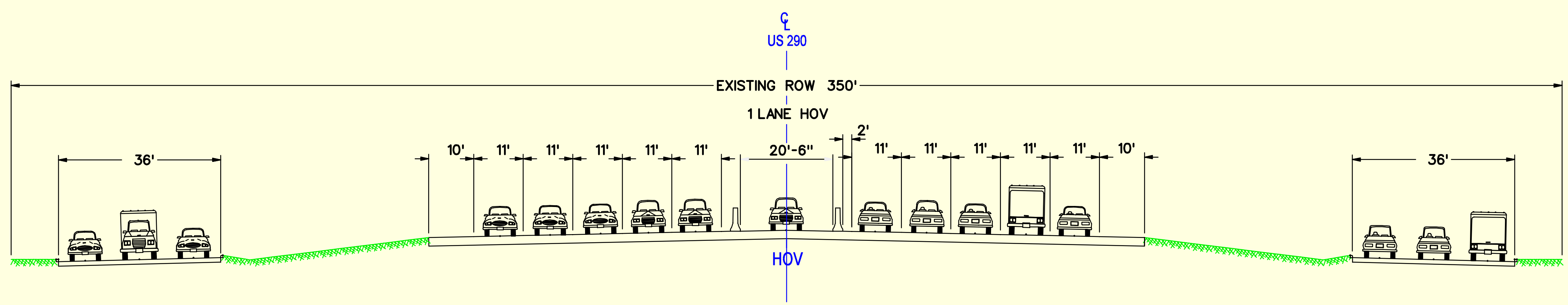

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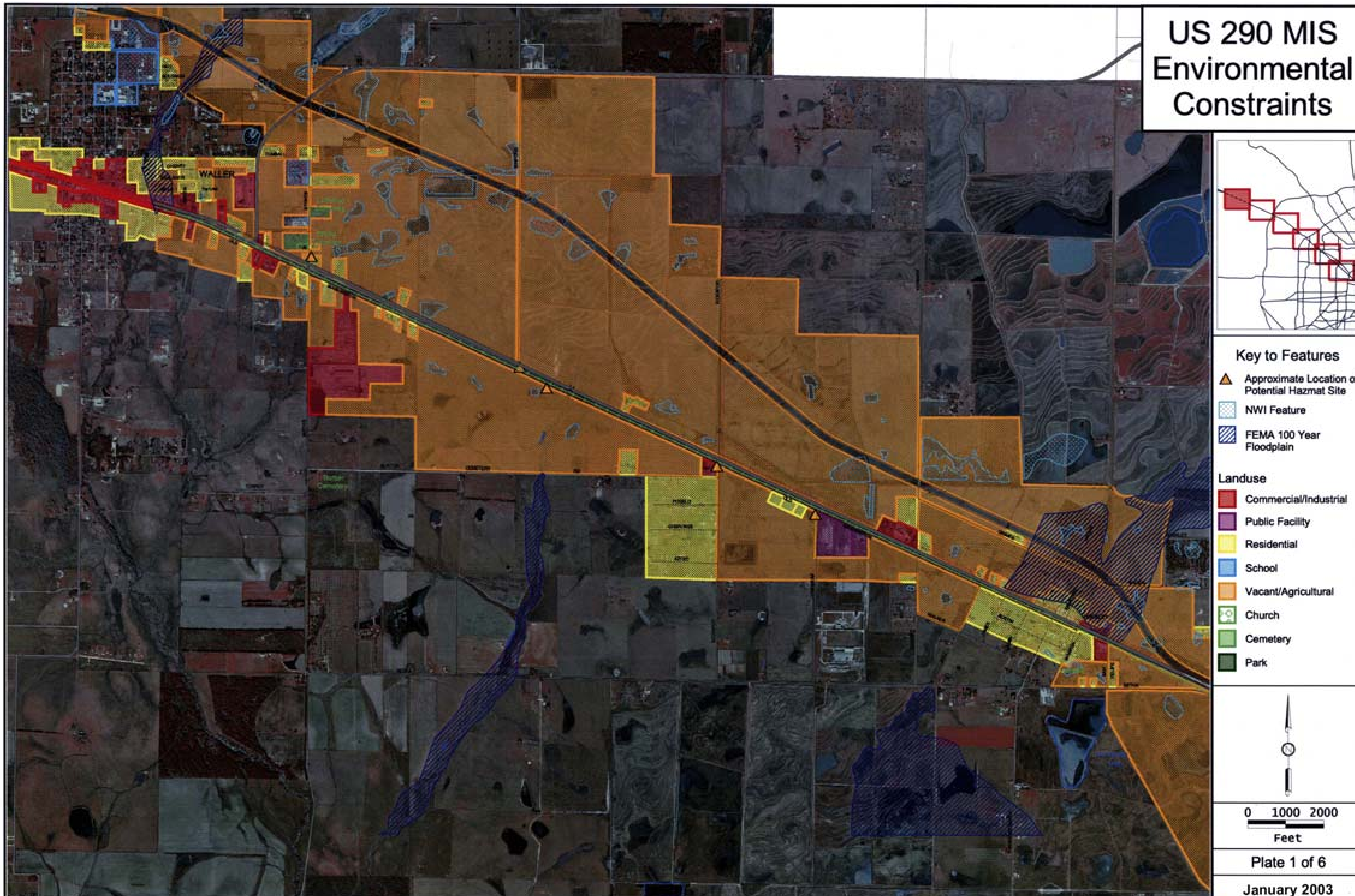
US 290 MAJOR INVESTMENT STUDY
CURRENT CORRIDOR INFLUENCES
TYPICAL EXISTING CROSS SECTIONS

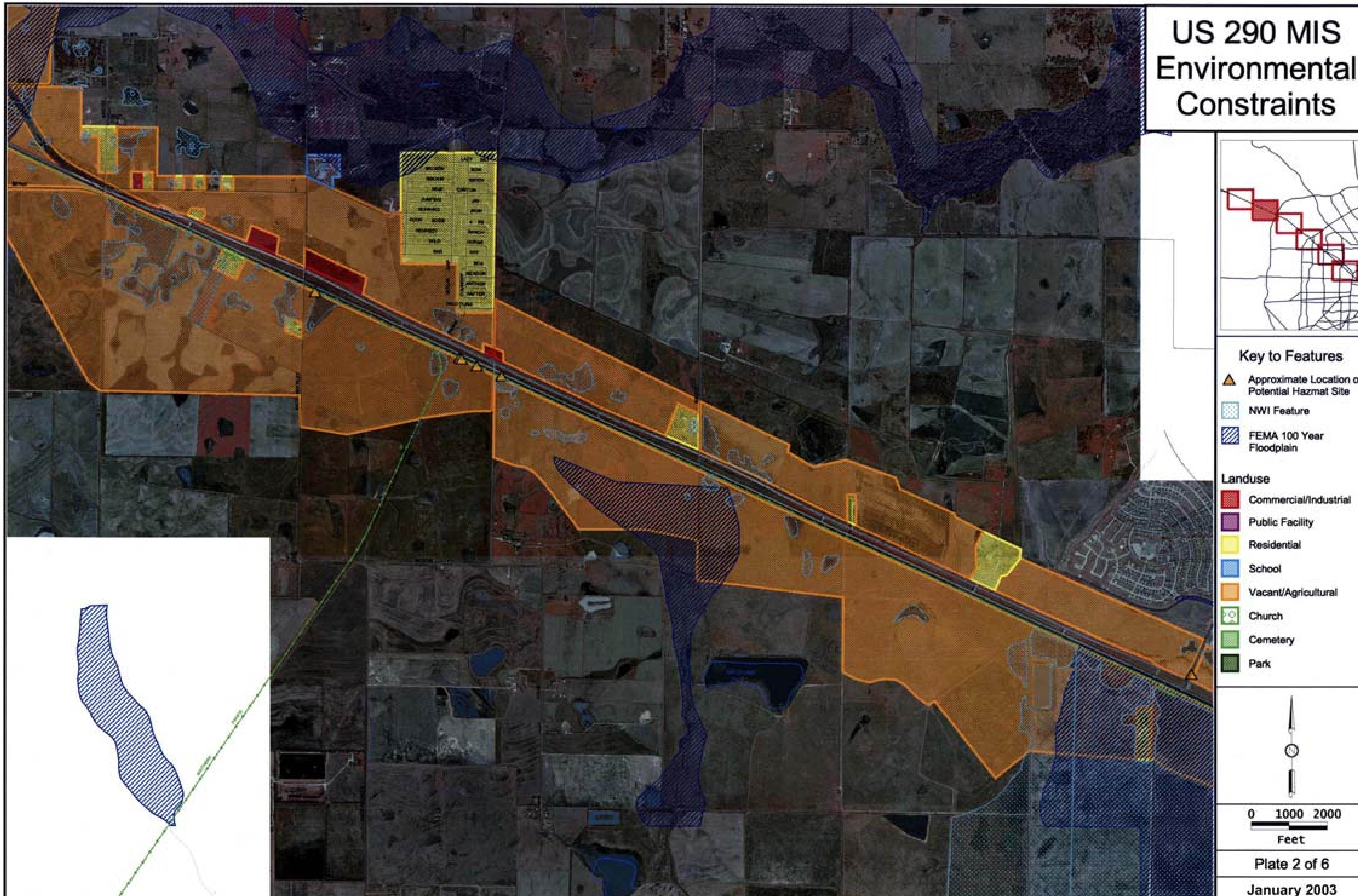
Texas Department of Transportation
Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
Hicks & Company
Knudson & Asssociates, Inc.

US290 MIS

Figure -11

Appendix C
Environmental Constraints and Census Data


US 290 MIS
Environmental
Constraints
WALLER
Key to Features
Approximate Location of Potential Hazmat Site
NWI Feature
FEMA 100 Year Floodplain
Landuse
Commercial/Industrial
Public Facility
Residential
School
Vacant/Agricultural
Church
Cemetery
Park
0 1000 2000
Feet
Plate 1 of 6
January 2003


US 290 MIS Environmental Constraints
Key to Features
Approximate Location of Potential Hazmat Site
NWI Feature
FEMA 100 Year Floodplain
Landuse
Commercial/Industrial
Public Facility
Residential
School
Vacant/Agricultural
Church
Cemetery
Park
0 1000 2000
Feet
Plate 2 of 6
January 2003

US 290 MIS Environmental Constraints

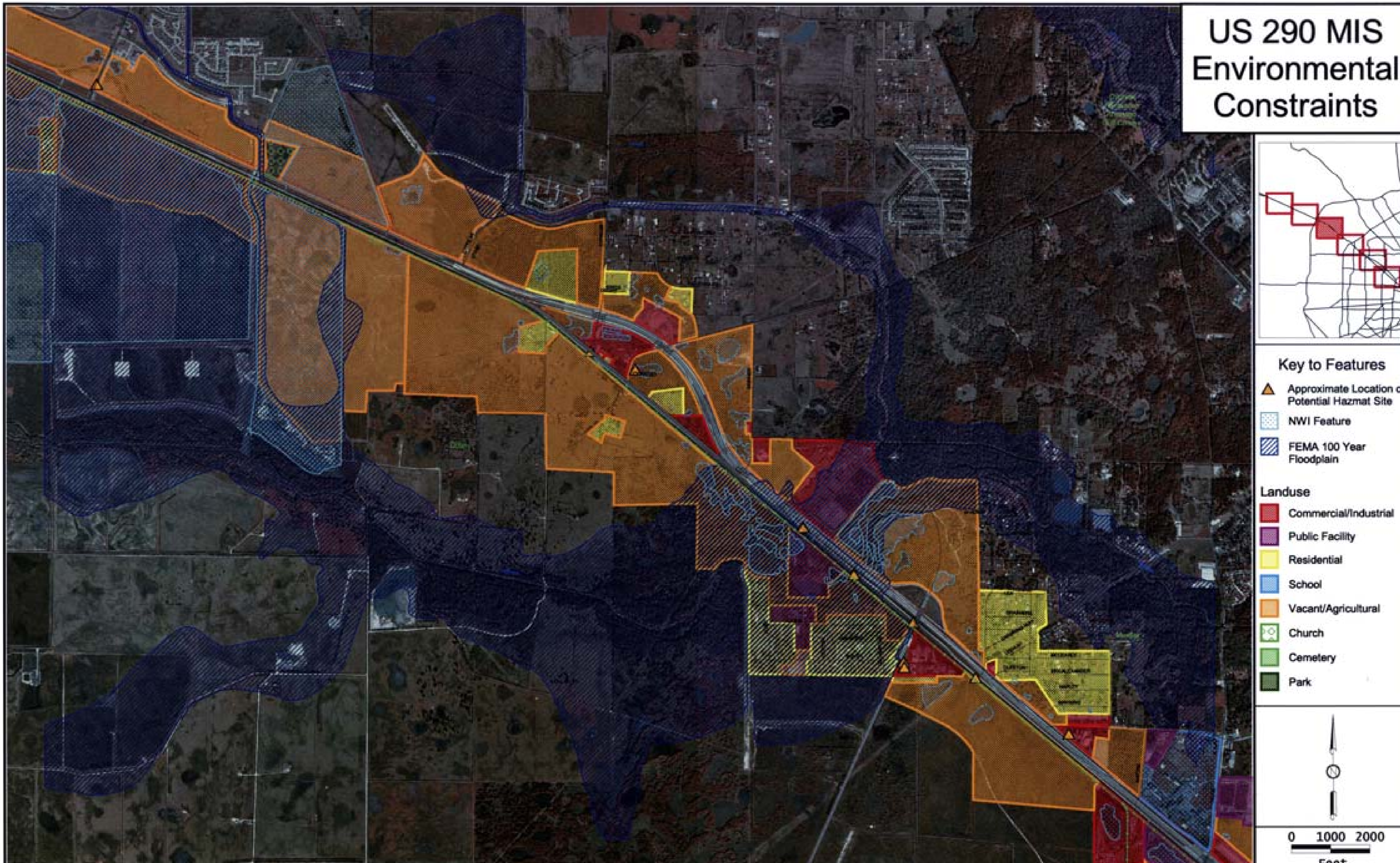
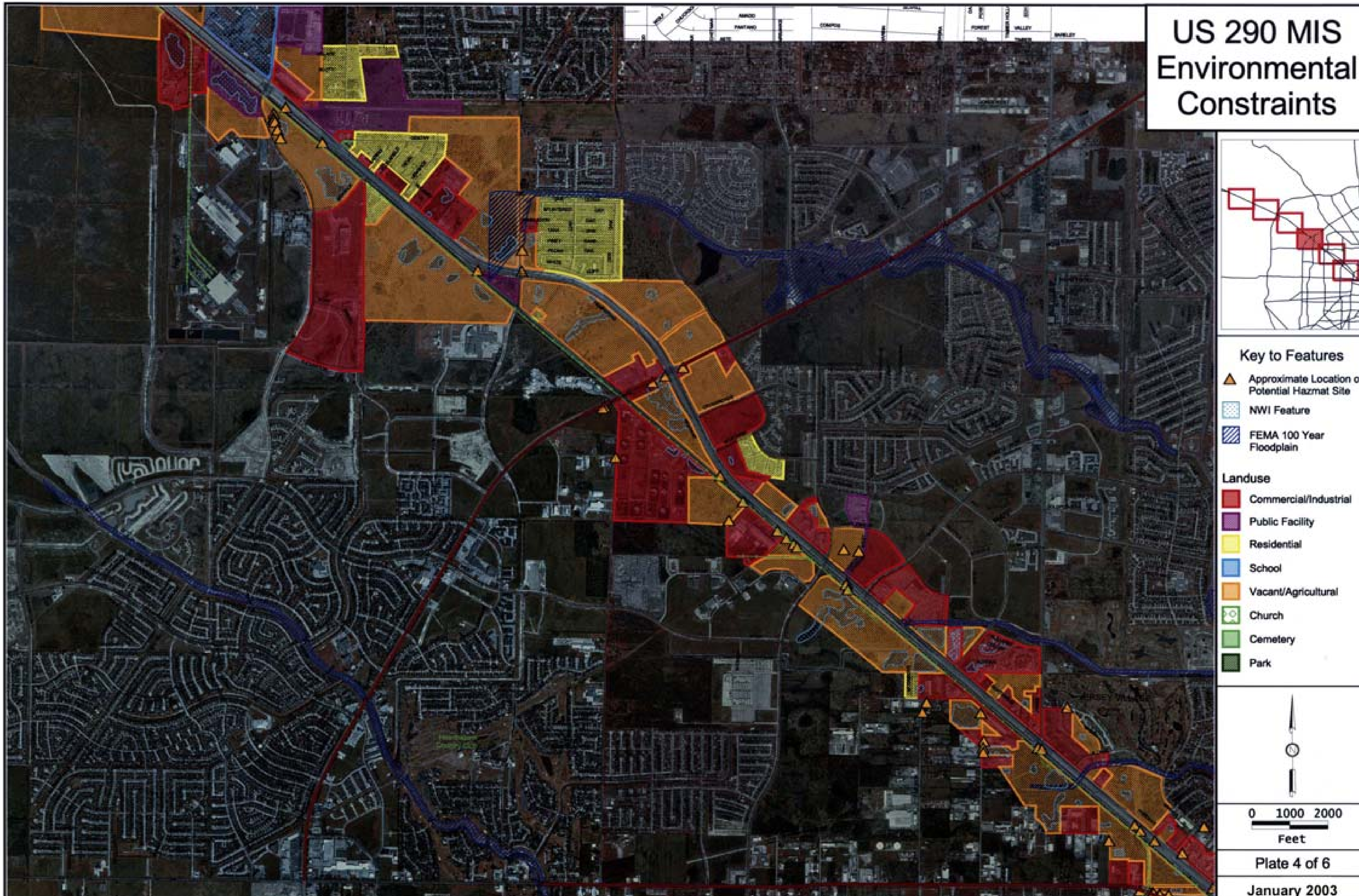
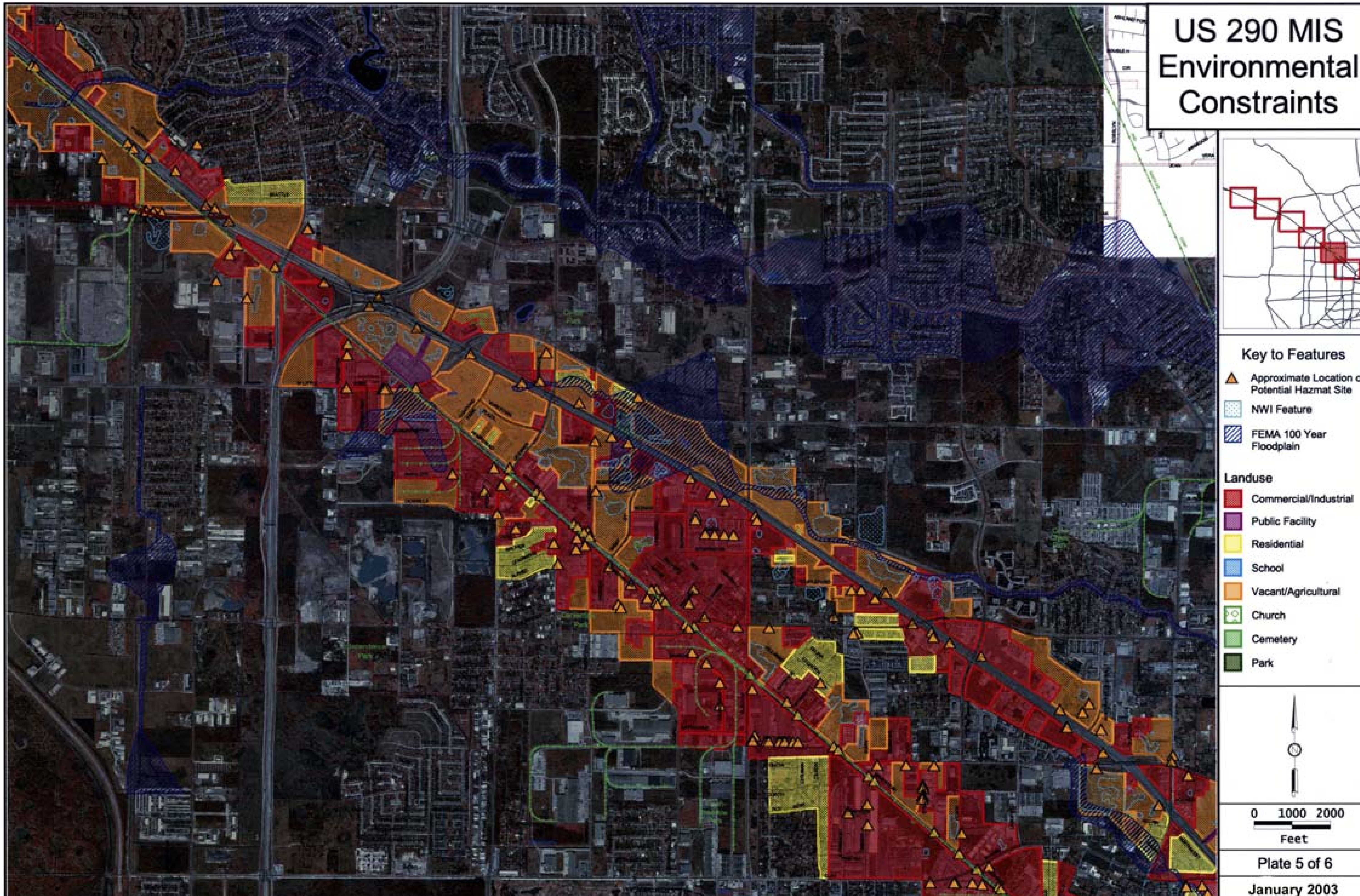


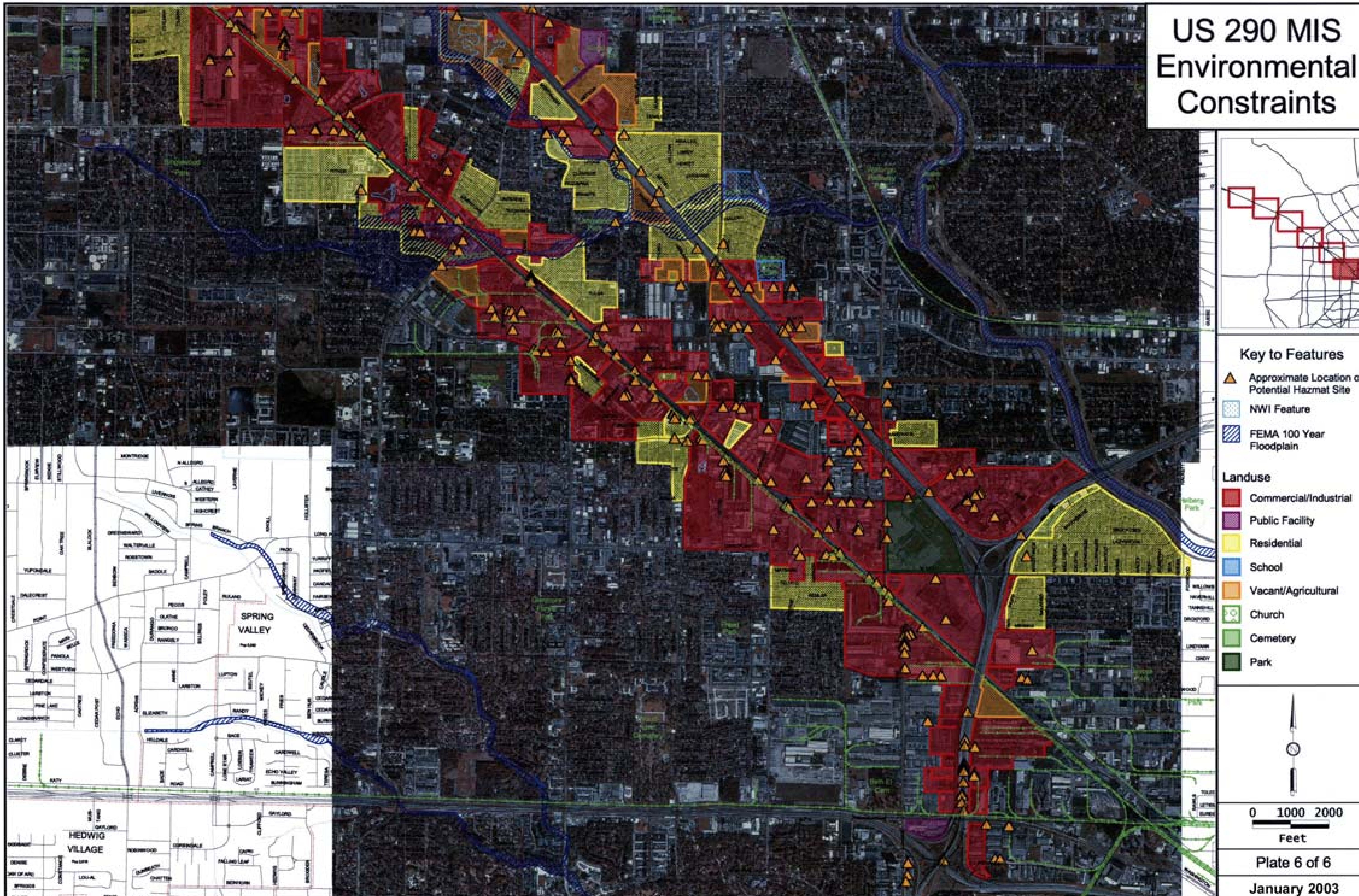
Plate 3 of 6

January 2003


US 290 MIS
Environmental
Constraints
Key to Features
Approximate Location of Potential Hazmat Site
NWI Feature
FEMA 100 Year Floodplain
Landuse
Commercial/Industrial
Public Facility
Residential
School
Vacant/Agricultural
Church
Cemetery
Park
0 1000 2000
Feet
Plate 4 of 6
January 2003



US 290 MIS Environmental Constraints
Key to Features
Approximate Location of Potential Hazmat Site
NWI Feature
FEMA 100 Year Floodplain
Landuse
Commercial/Industrial
Public Facility
Residential
School
Vacant/Agricultural
Church
Cemetery
Park
0 1000 2000
Feet
Plate 5 of 6
January 2003


US 290 MIS
Environmental
Constraints
Key to Features
Approximate Location of Potential Hazmat Site
NWI Feature
FEMA 100 Year Floodplain
Landuse
Commercial/Industrial
Public Facility
Residential
School
Vacant/Agricultural
Church
Cemetery
Park
0 1000 2000
Feet
Plate 6 of 6
January 2003
SPRING
VALLEY
HEDWIG
VILLAGE

US 290 - Study Area 2000 Population Characteristics

Area	Total	Percent 65 and Older	Percent Hispanic	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent other race	Percent two or more races
Census Tract 5109	4,725	8.8%	75.0%	22.9%	0.9%	0.2%	0.6%	0.0%	0.1%	0.4%
Census Tract 5110	6,275	19.5%	22.5%	68.9%	4.4%	0.3%	2.6%	0.0%	0.1%	1.2%
Census Tract 5111	2,219	17.7%	54.1%	36.2%	7.5%	0.4%	0.3%	0.1%	0.0%	1.3%
Census Tract 5112	3,569	10.6%	56.5%	34.6%	7.4%	0.3%	0.3%	0.1%	0.1%	0.7%
Census Tract 5201	1,615	12.0%	54.1%	41.5%	2.8%	0.1%	0.9%	0.0%	0.0%	0.6%
Census Tract 5202	3,423	10.6%	33.0%	55.8%	6.3%	0.4%	3.6%	0.0%	0.1%	0.9%
Census Tract 5203	5,567	7.2%	61.1%	29.5%	4.2%	0.3%	3.3%	0.0%	0.1%	1.5%
Census Tract 5204	3,223	4.8%	77.3%	17.0%	3.3%	0.2%	1.5%	0.0%	0.1%	0.6%
Census Tract 5205	7,805	5.7%	63.2%	25.4%	8.8%	0.4%	0.9%	0.0%	0.2%	1.1%
Census Tract 5206	8,885	5.7%	73.7%	18.1%	2.2%	0.1%	5.0%	0.0%	0.1%	0.8%
Census Tract 5207	3,596	17.9%	37.1%	54.3%	4.0%	0.2%	3.3%	0.1%	0.2%	0.8%
Census Tract 5208	720	17.6%	4.2%	90.0%	0.4%	0.1%	3.3%	0.0%	0.4%	1.5%
Census Tract 5209	3,611	13.7%	4.3%	91.2%	0.3%	0.4%	3.0%	0.0%	0.1%	0.6%
Census Tract 5212	6,145	7.4%	56.7%	29.5%	7.5%	0.2%	4.7%	0.0%	0.2%	1.2%
Census Tract 5213	5,497	9.7%	52.0%	32.7%	7.1%	0.2%	7.3%	0.1%	0.1%	0.6%
Census Tract 5214	8,143	3.1%	85.6%	12.0%	1.1%	0.0%	0.9%	0.0%	0.1%	0.3%
Census Tract 5215	6,007	9.8%	56.2%	36.3%	2.6%	0.1%	4.2%	0.0%	0.0%	0.6%
Census Tract 5216	2,398	11.9%	46.3%	23.0%	27.7%	0.0%	2.2%	0.0%	0.1%	0.7%
Census Tract 5217	5,863	3.1%	38.5%	26.7%	29.5%	0.3%	3.2%	0.1%	0.0%	1.7%
Census Tract 5218	4,920	4.9%	36.8%	27.1%	10.1%	0.1%	25.1%	0.0%	0.0%	0.8%
Census Tract 5219	5,994	13.7%	24.8%	55.5%	5.2%	0.2%	12.4%	0.0%	0.4%	1.5%
Census Tract 5220	4,763	16.3%	45.5%	44.3%	2.2%	0.1%	6.9%	0.0%	0.1%	0.8%
Census Tract 5221	6,901	12.2%	35.3%	46.3%	10.2%	0.2%	6.3%	0.1%	0.2%	1.4%
Census Tract 5301	7,017	4.8%	63.5%	22.1%	12.2%	0.2%	0.9%	0.0%	0.1%	1.0%
Census Tract 5302	4,145	11.2%	44.4%	49.7%	3.3%	0.3%	1.3%	0.0%	0.2%	0.9%
Census Tract 5312	3,853	12.3%	36.3%	51.3%	11.1%	0.2%	0.5%	0.0%	0.0%	0.6%

US 290 - Study Area 2000 Population Characteristics

Area	Total	Percent 65 and Older	Percent Hispanic	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent other race	Percent two or more races
Census Tract 5313	5,232	6.7%	44.3%	34.3%	17.8%	0.2%	2.2%	0.0%	0.1%	1.1%
Census Tract 5314	2,209	17.9%	30.1%	64.4%	2.2%	0.3%	1.7%	0.0%	0.1%	1.2%
Census Tract 5315	2,979	13.7%	33.4%	56.8%	5.4%	0.2%	3.0%	0.0%	0.2%	1.0%
Census Tract 5316	2,793	18.2%	26.4%	68.1%	3.7%	0.0%	1.0%	0.0%	0.0%	0.8%
Census Tract 5320	9,025	3.5%	21.4%	15.3%	61.1%	0.2%	0.9%	0.0%	0.2%	0.8%
Census Tract 5321	6,608	6.7%	37.8%	27.3%	31.4%	0.1%	2.1%	0.0%	0.3%	1.0%
Census Tract 5322	3,787	3.1%	26.6%	15.8%	55.5%	0.2%	0.9%	0.0%	0.0%	1.0%
Census Tract 5323	4,373	4.6%	20.8%	55.0%	17.2%	0.1%	5.5%	0.0%	0.1%	1.3%
Census Tract 5324	5,637	6.5%	35.1%	55.7%	5.5%	0.3%	2.7%	0.0%	0.0%	0.6%
Census Tract 5325	12,145	3.5%	48.1%	33.2%	9.0%	0.2%	8.3%	0.0%	0.1%	1.0%
Census Tract 5326	7,060	3.3%	20.7%	16.5%	46.0%	0.2%	14.7%	0.0%	0.3%	1.6%
Census Tract 5327	4,001	9.0%	14.3%	45.4%	34.3%	0.2%	4.1%	0.0%	0.2%	1.6%
Census Tract 5328	2,124	11.5%	21.6%	41.6%	29.9%	0.1%	5.6%	0.0%	0.2%	1.0%
Census Tract 5329	5,536	3.1%	19.3%	11.3%	53.3%	0.2%	14.4%	0.0%	0.1%	1.3%
Census Tract 5340	8,680	3.2%	42.1%	26.7%	21.7%	0.4%	7.2%	0.0%	0.1%	1.8%
Census Tract 5341	5,540	3.5%	37.9%	33.2%	13.7%	0.1%	13.0%	0.0%	0.1%	1.9%
Census Tract 5342	10,609	6.3%	21.0%	61.9%	5.1%	0.3%	9.9%	0.0%	0.2%	1.5%
Census Tract 5401	5,911	3.9%	32.2%	49.4%	5.8%	0.2%	10.4%	0.0%	0.1%	1.9%
Census Tract 5402	2,469	4.9%	37.1%	38.3%	8.5%	0.4%	14.5%	0.1%	0.2%	0.9%
Census Tract 5405	10,852	3.7%	21.0%	64.0%	8.7%	0.4%	4.1%	0.1%	0.1%	1.7%
Census Tract 5406	8,652	3.5%	18.1%	57.6%	12.2%	0.2%	9.2%	0.0%	0.3%	2.4%
Census Tract 5407	6,995	3.4%	26.0%	48.3%	7.4%	0.2%	15.5%	0.0%	0.3%	2.4%
Census Tract 5408	5,051	3.5%	49.6%	33.1%	7.9%	0.1%	8.1%	0.1%	0.0%	1.0%
Census Tract 5409	8,423	4.4%	11.6%	70.9%	7.0%	0.2%	8.6%	0.1%	0.1%	1.5%
Census Tract 5410	6,973	2.2%	11.3%	66.5%	9.7%	0.4%	9.7%	0.0%	0.4%	2.1%
Census Tract 5411	6,785	2.0%	11.2%	75.0%	5.7%	0.2%	6.0%	0.1%	0.3%	1.5%

US 290 - Study Area 2000 Population Characteristics

Area	Total	Percent 65 and Older	Percent Hispanic	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent other race	Percent two or more races
Census Tract 5412	17,094	2.7%	13.4%	73.2%	5.3%	0.3%	6.4%	0.0%	0.1%	1.3%
Census Tract 5413	7,367	2.4%	36.1%	43.6%	12.6%	0.3%	5.6%	0.1%	0.2%	1.5%
Census Tract 5414	4,898	3.7%	30.2%	47.1%	12.4%	0.3%	7.6%	0.0%	0.1%	2.3%
Census Tract 5415	4,188	2.4%	15.5%	64.8%	9.1%	0.2%	7.5%	0.0%	0.6%	2.1%
Census Tract 5416	10,846	4.7%	29.7%	58.9%	5.5%	0.4%	4.0%	0.1%	0.2%	1.3%
Census Tract 5421	9,490	2.8%	25.3%	56.8%	11.2%	0.3%	4.4%	0.0%	0.2%	1.8%
Census Tract 5422	4,370	2.6%	30.9%	52.2%	10.3%	0.3%	4.1%	0.0%	0.2%	2.2%
Census Tract 5430	3,876	3.9%	31.5%	51.6%	10.8%	0.2%	4.7%	0.0%	0.1%	1.1%
Census Tract 5431	1,378	6.5%	33.0%	54.4%	10.2%	0.2%	0.1%	0.4%	0.1%	1.7%
Census Tract 5515	3,230	3.8%	51.6%	32.6%	8.7%	0.1%	5.7%	0.0%	0.2%	1.1%
Census Tract 5516	7,191	5.9%	28.3%	48.6%	12.9%	0.2%	8.4%	0.0%	0.2%	1.3%
Census Tract 5517	18,550	2.9%	13.9%	62.0%	7.4%	0.2%	14.5%	0.1%	0.2%	1.7%
Census Tract 5518	4,823	10.2%	5.4%	87.4%	1.2%	0.1%	4.6%	0.1%	0.2%	1.0%
Census Tract 5519	4,278	2.0%	18.7%	61.3%	11.5%	0.4%	6.1%	0.0%	0.1%	2.0%
Census Tract 5520	7,190	5.2%	13.0%	69.2%	6.5%	0.1%	9.4%	0.0%	0.2%	1.6%
Census Tract 5521	11,373	4.2%	12.1%	69.2%	7.7%	0.4%	8.2%	0.0%	0.1%	2.2%
Census Tract 5522	4,390	6.2%	17.8%	72.8%	6.3%	0.3%	1.8%	0.0%	0.0%	0.9%
Census Tract 5523	8,129	5.8%	8.5%	84.5%	2.4%	0.2%	2.8%	0.0%	0.1%	1.4%
Census Tract 5524	4,266	6.8%	17.5%	69.2%	6.4%	0.4%	4.9%	0.2%	0.1%	1.3%
Census Tract 5525	7,236	3.9%	21.5%	63.8%	7.1%	0.3%	6.1%	0.0%	0.1%	1.0%
Census Tract 5526	5,546	8.8%	10.4%	74.0%	9.2%	0.1%	4.5%	0.1%	0.1%	1.7%
Census Tract 5543	11,086	5.9%	7.4%	85.8%	2.7%	0.3%	2.6%	0.0%	0.2%	1.0%
Census Tract 5544	10,918	3.7%	7.2%	86.4%	2.5%	0.1%	2.3%	0.0%	0.3%	1.1%
Census Tract 5545	6,942	3.0%	9.4%	83.8%	2.7%	0.2%	2.8%	0.0%	0.0%	1.1%
Census Tract 5546	4,732	3.4%	4.6%	89.1%	2.2%	0.0%	2.9%	0.0%	0.1%	1.1%
Census Tract 5547	4,406	3.2%	8.3%	82.5%	2.5%	0.1%	4.8%	0.0%	0.2%	1.6%

US 290 - Study Area 2000 Population Characteristics

Area	Total	Percent 65 and Older	Percent Hispanic	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent other race	Percent two or more races
Census Tract 5556	3,848	6.8%	10.1%	86.7%	1.4%	0.3%	0.4%	0.0%	0.2%	0.9%
Census Tract 5557	5,979	2.1%	6.7%	86.7%	2.1%	0.3%	3.1%	0.0%	0.1%	0.9%
Census Tract 5558	3,823	4.4%	22.2%	57.4%	17.4%	0.3%	0.7%	0.1%	0.1%	1.9%
Census Tract 5559	1,080	9.2%	15.8%	76.1%	6.1%	0.6%	1.0%	0.0%	0.0%	0.3%
Census Tract 6803	7,914	10.4%	17.9%	50.2%	30.0%	0.1%	0.7%	0.0%	0.1%	1.0%
Census Tract 6804	2,763	0.1%	1.4%	0.8%	97.1%	0.1%	0.1%	0.0%	0.0%	0.4%
Study Area	**500,528**	**5.8%**	**28.9%**	**52.2%**	**10.4%**	**0.2%**	**5.8%**	**0.0%**	**0.2%**	**1.3%**
Houston	**1,954,848**	**8.4%**	**37.4%**	**30.7%**	**24.9%**	**0.2%**	**5.2%**	**0.0%**	**0.1%**	**1.4%**
Harris County	**3,400,578**	**7.4%**	**33.0%**	**42.0%**	**18.2%**	**0.2%**	**5.0%**	**0.0%**	**0.1%**	**1.4%**
State of Texas	**20,851,820**	**9.9%**	**32.0%**	**52.4%**	**11.3%**	**0.3%**	**2.6%**	**0.0%**	**0.1%**	**1.2%**
United States	**281,421,906**	**12.4%**	**12.5%**	**69.1%**	**12.0%**	**0.7%**	**3.6%**	**0.1%**	**0.2%**	**1.8%**

Source: U.S. Census Bureau, 2000.

US 290 - Study Area 2000 Housing Characteristics

Area	Median year structure built	Median Value for Owner Occupied Housing	Percent Owner Ocupied	Percent Renter Occupied
Census Tract 5109	1957	$75,100	54.4%	45.6%
Census Tract 5110	1967	$129,900	51.3%	48.7%
Census Tract 5111	1962	$52,800	28.7%	71.3%
Census Tract 5112	1954	$67,400	64.5%	35.5%
Census Tract 5201	1950	$60,700	75.9%	24.1%
Census Tract 5202	1967	$204,100	56.0%	44.0%
Census Tract 5203	1964	$65,800	28.2%	71.8%
Census Tract 5204	1963	$59,000	33.5%	66.5%
Census Tract 5205	1969	$54,800	43.6%	56.4%
Census Tract 5206	1967	$61,200	36.8%	63.2%
Census Tract 5207	1962	$124,100	58.8%	41.2%
Census Tract 5208	1968	$294,400	96.5%	3.5%
Census Tract 5209	1961	$213,600	94.5%	5.5%
Census Tract 5212	1975	$68,400	23.4%	76.6%
Census Tract 5213	1973	$73,200	50.5%	49.5%
Census Tract 5214	1972	$60,400	24.1%	75.9%
Census Tract 5215	1970	$80,500	58.7%	41.3%
Census Tract 5216	1965	$60,000	72.7%	27.3%
Census Tract 5217	1978	$58,400	8.8%	91.2%
Census Tract 5218	1983	$77,700	85.8%	14.2%
Census Tract 5219	1975	$95,500	75.7%	24.3%
Census Tract 5220	1976	$83,300	37.7%	62.3%
Census Tract 5221	1970	$105,500	42.9%	57.1%
Census Tract 5301	1972	$91,400	16.2%	83.8%
Census Tract 5302	1955	$94,400	65.2%	34.8%
Census Tract 5312	1957	$83,600	62.6%	37.4%
Census Tract 5313	1973	$76,800	25.1%	74.9%
Census Tract 5314	1965	$74,100	77.4%	22.6%
Census Tract 5315	1968	$80,900	73.9%	26.1%
Census Tract 5316	1959	$95,200	79.8%	20.2%
Census Tract 5320	1982	$96,200	19.3%	80.7%
Census Tract 5321	1975	$89,300	29.6%	70.4%
Census Tract 5322	1976	$60,100	19.9%	80.1%
Census Tract 5323	1987	$65,600	19.1%	80.9%
Census Tract 5324	1976	$74,000	88.7%	11.3%
Census Tract 5325	1980	$69,100	82.9%	17.1%
Census Tract 5326	1980	$82,900	56.2%	43.8%
Census Tract 5327	1977	$89,600	62.5%	37.5%

US 290 - Study Area 2000 Housing Characteristics

Area	Median year structure built	Median Value for Owner Occupied Housing	Percent Owner Ocupied	Percent Renter Occupied
Census Tract 5328	1975	$99,500	81.6%	18.4%
Census Tract 5329	1981	$78,200	58.5%	41.5%
Census Tract 5340	1976	$61,100	53.1%	46.9%
Census Tract 5341	1978	$68,000	82.1%	17.9%
Census Tract 5342	1985	$89,600	79.6%	20.4%
Census Tract 5401	1996	$163,800	92.1%	7.9%
Census Tract 5402	1982	$74,100	49.5%	50.5%
Census Tract 5405	1982	$92,100	46.0%	54.0%
Census Tract 5406	1988	$103,900	72.0%	28.0%
Census Tract 5407	1990	$95,400	92.8%	7.2%
Census Tract 5408	1983	$62,800	80.6%	19.4%
Census Tract 5409	1988	$141,500	58.4%	41.6%
Census Tract 5410	1990	$148,000	63.8%	36.2%
Census Tract 5411	1987	$117,400	93.9%	6.1%
Census Tract 5412	1987	$125,300	88.8%	11.2%
Census Tract 5413	1985	$71,000	80.5%	19.5%
Census Tract 5414	1982	$76,700	71.9%	28.1%
Census Tract 5415	1990	$88,000	97.4%	2.6%
Census Tract 5416	1980	$82,700	76.3%	23.7%
Census Tract 5421	1988	$84,400	86.1%	13.9%
Census Tract 5422	1995	$88,300	89.2%	10.8%
Census Tract 5430	1987	$69,000	81.0%	19.0%
Census Tract 5431	1990	$79,100	90.4%	9.6%
Census Tract 5515	1982	$76,900	78.5%	21.5%
Census Tract 5516	1984	$83,100	61.2%	38.8%
Census Tract 5517	1993	$125,800	77.8%	22.2%
Census Tract 5518	1977	$141,600	98.5%	1.5%
Census Tract 5519	1997	$99,500	0.9%	99.1%
Census Tract 5520	1990	$107,200	70.2%	29.8%
Census Tract 5521	1987	$92,200	77.4%	22.6%
Census Tract 5522	1977	$75,900	76.5%	23.5%
Census Tract 5523	1982	$109,900	71.6%	28.4%
Census Tract 5524	1980	$102,700	70.2%	29.8%
Census Tract 5525	1985	$91,100	68.4%	31.6%
Census Tract 5526	1990	$132,100	58.6%	41.4%
Census Tract 5543	1981	$142,700	83.0%	17.0%
Census Tract 5544	1996	$147,600	97.4%	2.6%
Census Tract 5545	1993	$168,300	95.2%	4.8%

US 290 - Study Area 2000 Housing Characteristics

Area	Median year structure built	Median Value for Owner Occupied Housing	Percent Owner Ocupied	Percent Renter Occupied
Census Tract 5546	1992	$164,900	98.4%	1.6%
Census Tract 5547	1989	$155,900	73.6%	26.4%
Census Tract 5556	1988	$142,300	94.0%	6.0%
Census Tract 5557	1995	$142,100	98.6%	1.4%
Census Tract 5558	1984	$75,500	73.0%	27.0%
Census Tract 5559	1981	$78,400	75.4%	24.6%
Census Tract 6803	1979	$79,600	66.3%	33.7%
Census Tract 6804	1970	$0	0.0%	100.0%
Study Area	**NA**	**NA**	**64.1%**	**35.9%**
Houston	**1972**	**$77,500**	**45.8%**	**54.2%**
Harris County	**1976**	**$84,200**	**55.3%**	**44.7%**
State of Texas	**1977**	**$77,800**	**63.8%**	**36.2%**
United States	**1971**	**$111,800**	**66.2%**	**33.8%**

Source: U.S. Census Bureau, 2000.

US 290 Study Area 2000 Income Characteristics

Area	Median Houshold Income in 1999	Percent Below Poverty
Census Tract 5109	$35,491	25.7%
Census Tract 5110	$43,652	9.7%
Census Tract 5111	$37,008	14.4%
Census Tract 5112	$35,938	23.1%
Census Tract 5201	$38,710	13.3%
Census Tract 5202	$48,269	15.2%
Census Tract 5203	$28,163	24.3%
Census Tract 5204	$32,218	19.6%
Census Tract 5205	$30,163	20.1%
Census Tract 5206	$26,994	29.6%
Census Tract 5207	$44,500	17.8%
Census Tract 5208	$117,252	2.5%
Census Tract 5209	$96,392	2.7%
Census Tract 5212	$28,820	25.5%
Census Tract 5213	$34,797	20.0%
Census Tract 5214	$25,566	33.6%
Census Tract 5215	$40,536	14.6%
Census Tract 5216	$31,579	30.7%
Census Tract 5217	$27,797	17.8%
Census Tract 5218	$45,266	11.6%
Census Tract 5219	$53,426	7.9%
Census Tract 5220	$32,763	16.4%
Census Tract 5221	$43,387	7.6%
Census Tract 5301	$27,051	28.0%
Census Tract 5302	$49,028	14.2%
Census Tract 5312	$38,851	11.4%
Census Tract 5313	$32,474	11.6%
Census Tract 5314	$46,034	7.8%
Census Tract 5315	$43,214	3.4%
Census Tract 5316	$44,095	7.7%
Census Tract 5320	$26,534	27.1%
Census Tract 5321	$27,920	19.0%
Census Tract 5322	$27,926	23.7%
Census Tract 5323	$43,101	5.1%
Census Tract 5324	$53,613	11.4%
Census Tract 5325	$49,746	7.9%
Census Tract 5326	$41,875	14.5%
Census Tract 5327	$54,219	4.1%
Census Tract 5328	$55,417	8.2%
Census Tract 5329	$44,511	11.5%
Census Tract 5340	$36,597	10.2%

US 290 Study Area 2000 Income Characteristics

Area	Median Houshold Income in 1999	Percent Below Poverty
Census Tract 5341	$53,636	8.1%
Census Tract 5342	$61,069	8.1%
Census Tract 5401	$83,326	5.3%
Census Tract 5402	$44,185	8.0%
Census Tract 5405	$41,527	9.1%
Census Tract 5406	$60,205	5.7%
Census Tract 5407	$66,948	6.6%
Census Tract 5408	$52,129	9.0%
Census Tract 5409	$70,417	3.6%
Census Tract 5410	$67,257	2.9%
Census Tract 5411	$81,345	1.4%
Census Tract 5412	$82,202	3.0%
Census Tract 5413	$50,811	6.2%
Census Tract 5414	$49,958	5.3%
Census Tract 5415	$66,085	3.3%
Census Tract 5416	$61,150	5.3%
Census Tract 5421	$63,109	4.3%
Census Tract 5422	$57,896	6.7%
Census Tract 5430	$47,319	5.5%
Census Tract 5431	$57,500	2.9%
Census Tract 5515	$48,750	11.4%
Census Tract 5516	$51,835	7.3%
Census Tract 5517	$71,936	3.0%
Census Tract 5518	$89,441	3.5%
Census Tract 5519	$42,337	11.4%
Census Tract 5520	$69,559	2.8%
Census Tract 5521	$68,750	4.3%
Census Tract 5522	$55,238	7.4%
Census Tract 5523	$64,293	3.5%
Census Tract 5524	$55,434	3.5%
Census Tract 5525	$56,490	3.1%
Census Tract 5526	$56,026	7.7%
Census Tract 5543	$83,055	3.0%
Census Tract 5544	$82,959	2.8%
Census Tract 5545	$88,392	3.6%
Census Tract 5546	$102,257	3.5%
Census Tract 5547	$83,213	1.6%
Census Tract 5556	$66,641	3.3%
Census Tract 5557	$87,258	1.6%
Census Tract 5558	$43,438	9.5%
Census Tract 5559	$48,036	20.2%

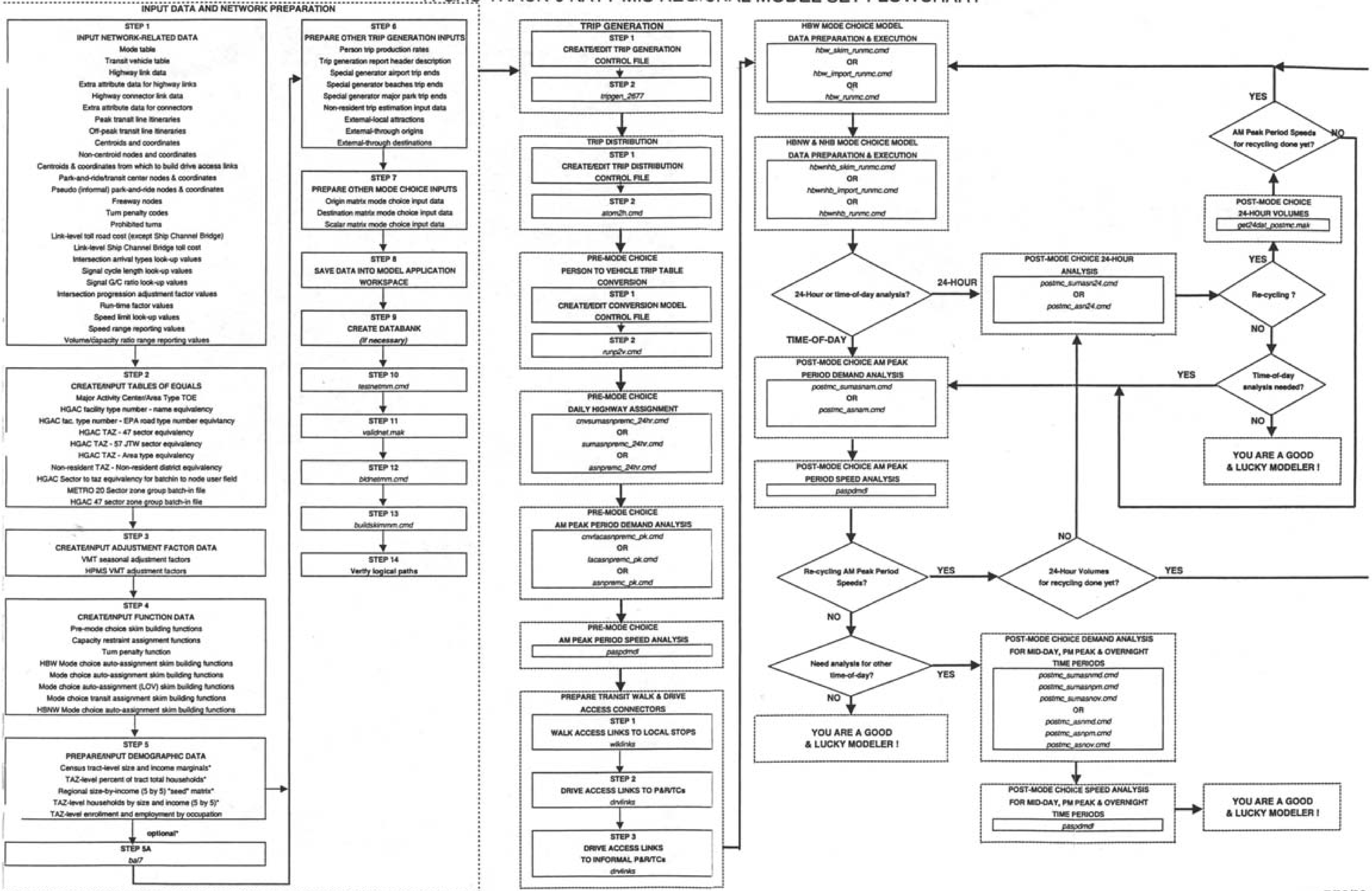
US 290 Study Area 2000 Income Characteristics

Area	Median Houshold Income in 1999	Percent Below Poverty
Census Tract 6803	$39,846	14.9%
Census Tract 6804	$10,179	46.2%
Study Area	**NA**	**9.6%**
Houston	**$36,616**	**19.2%**
Harris County	**$42,598**	**15.0%**
State of Texas	**$39,927**	**15.4%**
United States	**$41,994**	**12.4%**

Source: U.S. Census Bureau, 2000.

Appendix D
Regional Model Set Flow Chart

H-GAC TRACK-0 KATY MIS REGIONAL MODEL SET FLOWCHART



7/28/99

Appendix E
Planning Cost Estimates

INTRODUCTION

The purpose of this appendix is to document the methodology and results of the planning-level cost estimates that were developed for the alternatives studied in the US 290 Corridor Major Investment Study (MIS). The term planning-level is used to describe the cost estimates for the alternatives because there can be many interpretations of what is meant by (and included in) cost estimates for capital projects. The detail needed and the data available for cost estimates in this study are consistent with a long-range planning analysis.

The most important use for the implementation estimates is to *compare* the alternatives. This means that the estimate of cost for each alternative must be correct in relationship to each of the other alternatives. The estimate for the preferred alternative must also be consistent with and comparable to the estimates for projects that comprise the *2022 Metropolitan Transportation Plan* (MTP) for the Houston-Galveston transportation management area.

The cost estimates in the MIS are used to determine the most cost-effective alternative. Cost-effectiveness can be defined as the ratio of the net benefits that accrue because of the implementation of an alternative to the cost of the implementation. The cost estimate for the preferred alternative is also compared to the other projects in the MTP in order to determine that the preferred alternative and the MTP meet the standard of cost feasibility required by metropolitan transportation planning regulations.

The need for *relative* rather than absolute precision for the cost estimates is complemented by the opportunity to *refine* the estimates at each stage of the alternative analysis process. This means that at each stage of the process, more information is known about the alternative; it can be used to make the cost estimates more precise. It should be noted that the estimates will remain at a planning-level of accuracy (rather than a detailed level) throughout the MIS process.

Approach to Cost Estimation for the Viable Alternatives

The approach to establishing the planning-detail cost estimates focuses on the estimate associated with the viable alternatives. These cost estimates involve a detailed analysis of the various components required for constructing each alternative. The following breakdown of construction components was used for each viable alternative:

Right-of-Way Impact / Prep. Construction
- Right-of-way impact / building impact
- Prep. right-of-way
- Remove pavement
- Remove bridge
- Remove drainage

Roadway Sections
- Main lanes
- Frontage roads
- Managed lanes

Interchanges

Miscellaneous
- Ramps
- Bridges
- Storm sewer
- MBGF

Roadway Excavate / Fill
- Main lanes
- Frontage roads
- HOV / shoulder / ramps

Signing and Marking
- Main lanes
- Frontage roads
- Ramps

Lighting
- Main lanes
- Frontage roads
- Signals

Barriers
- Traffic barrier
- Retaining wall
- Fixed guideway

These subcategories and components define specific, individual cost indices on a per-mile basis, square yard basis, individual basis, etc. Interchanges, signalized intersections, and ramps were accounted for at a cost-per each basis. Pavement removal, bridge removal, and bridge construction were accounted for on a square yard basis. Right-of-way impacts and preparation of right-of-way were accounted for on a total corridor basis and station basis, respectively. All other components required for construction of the corridor were accounted for on a cost-per-mile basis. Costs were determined from actual unit costs prepared by the Texas Department of Transportation for each individual component and from costs associated with similar systems. Cost estimates took into account traffic control protocol (TCP), mobilization, and a design contingency.

AHCT cost analyses for each alternative were completed separate from roadway construction; these AHCT costs were calculated according to a similar component breakdown of transit-related cost indices across the corridor for each alternative. In order to further break down cost impacts along the corridor, sections were established along US 290 and Hempstead Highway. The following sections were defined along the corridor.

US 290
- IH 610 – Dacoma
- Dacoma – Pinemont
- Pinemont – Beltway 8
- Beltway 8 – Grand Parkway
- Grand Parkway – west study limit

Hempstead Highway
- IH 610 – Beltway 8
- Beltway 8 – Katy Road

These sections allow for a total construction cost per section as corridor geometry changes. The accompanying foldouts detail the breakdown of construction related costs including roadway, right-of-way, contingency, mobilization, and traffic control plan (TCP) costs for each viable alternative and the locally preferred alternative along the US 290 Corridor.

	US 290 Construction*	US 290 ROW	Hemsptead Construction	Hempstead ROW	Other**	Total
VA-1	$ 685,392,861	$ 139,962,963	$ 30,063,066	$ 4,580,378	$ 153,019,817	$ 1,013,019,085
VA-2	$ 626,452,497	$ 18,112,815	$ 138,983,793	$ 17,253,923	$ 138,220,757	$ 939,023,785
VA-3	$ 692,159,709	$ 194,706,718	$ 30,063,066	$ 1,137,427	$ 167,536,730	$ 1,085,603,650
VA-4	$ 635,330,762	$ 110,925,065	$ 137,783,793	$ 14,553,008	$ 162,668,157	$ 1,061,260,785

*Includes cost of interchanges (possibly including those along Hemsptead)

**Includes contingency, mobiliztion, and traffic control plan (TCP)

Locally Preferred Alternative				US 290										Hempstead Rd.								
US 290 MIS PRELIMINARY CONSTRUCTION COSTS				610-Dacoma		Dacoma-Pinemont		Pinemont-Belt		Belt-Grand Parkway		Grand Parkway-West Limit		Katy Road-610		610-Belt		Belt-Grand Parkway				
Item Description	#	Unit	Unit Price	0.59 miles		3.2 miles		4.71 miles		15.43 miles		18.79 miles		1.91 miles		8.94 miles		15.43 miles		#	% of Total	Total Cost
				Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost			
ROW Impact / Prep. Const.																						
Right-of-Way/Building Impact	1	Acre							16,609,432				1,503,383				10,994,675		6,259,248	1.00	5%	35,366,738
Prep ROW	2	Sta	1,421.07	31.20	44,337	169.00	240,161	249.00	353,846	815.00	1,158,172	992.00	1,409,701	101.00	143,528	472.00	670,745	815.00	1,158,172	2.00	1%	5,178,663
Remove Pvmnt	3	SY	4.27	70,611.00	301,509	382,976.00	1,635,308	464,217.00	1,982,207	1,520,781.00	6,493,735	1,322,816.00	5,648,424	67,232.00	287,081	314,688	1,343,718	543,136	2,319,191	3.00	3%	20,011,171
Remove Brdg	4	SY	5.00	21,000.00	105,000	31,680.00	158,400	135,872.00	679,360	148,121.00	740,605	84,000.00	420,000		0		0			4.00	0%	2,103,365
Remove Drng	5	LF	2.68	3,115.00	8,348	16,896.00	45,281	24,868.00	66,646	81,470.00	218,340	99,211.00	265,885	10,084.00	27,025	47,203	126,504	81,470.00	218,340	5.00	0%	976,370
Rdwy Excavate/Fill																						
Mainlanes *	6	Mile	400,000.00	0.30	120,000	2.75	1,100,000	2.78	1,112,000	12.80	5,120,000	17.30	6,920,000		0		0			6.00	2%	14,372,000
Frontage Roads	7	Mile	250,000.00	0.59	147,500	3.20	800,000	4.71	1,177,500	15.43	3,857,500	18.79	4,697,500	1.91	477,500	8.94	2,235,000	15.43	3,857,500	7.00	2%	17,250,000
HOV/Shoulder/Ramps	8	Mile	200,000.00	0.59	118,000	3.20	640,000	4.71	942,000	15.43	3,086,000	18.79	3,758,000		0		0			8.00	1%	8,544,000
Rdwy Sections																						
Mainlanes																						
6 lanes	9	Mile	2,766,016.00									18.79	51,973,441		0		0			9.00	7%	51,973,441
8 Lanes	10	Mile	3,319,219.00							10.43	34,619,454				0		0			10.00	4%	34,619,454
10 Lanes	11	Mile	3,872,422.00	0.59	2,284,729	3.20	12,391,750	4.71	18,239,108	5.00	19,362,110				0		0			11.00	7%	52,277,697
Frontage Roads																						
4 lanes	12	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539			12.00	3%	24,009,010
6 lanes	13	Mile	2,766,016.00	0.59	1,631,949	3.20	8,851,251	4.71	13,027,935	15.43	42,679,627	18.79	51,973,441		0		0			13.00	15%	118,164,204
8 lanes	14	Mile			0		0		0		0		0		0		0			14.00	0%	0
Managed Lanes																						
4 Lanes	15	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539	15.43	34,143,689	15.00	7%	58,152,699
Managed Ramps	16	Each	198,000.00		0		0		0		0		0	1.00	198,000	3.00	594,000	3.00	594,000	16.00	0%	1,386,000
Miscellaneous																						
Ramps	17	Each	99,000.00	8.00	792,000	10.00	990,000	12.00	1,188,000	34.00	3,366,000	24.00	2,376,000		0		0			17.00	1%	8,712,000
Bridges	18	SY	40.00	21,000.00	840,000	31,680.00	1,267,200	135,872.00	5,434,880	148,121.00	5,924,840	84,000.00	3,360,000	53,785.00	2,151,400	659,376.00	26,375,040			18.00	6%	45,353,360
Storm Sewer *	19	Mile	97,680.00	0.30	29,304	2.75	268,620	2.78	271,550	12.80	1,250,304	17.30	1,689,864		0		0			19.00	0%	3,509,642
Metal Beam Guard Fence	20	Ramp	13,500.00	8.00	108,000	10.00	135,000	12.00	162,000	34.00	459,000	24.00	324,000		0		0			20.00	0%	1,188,000
Signing & Marking																						
Mainlanes	21	Mile	10,000.00	0.59	5,900	3.20	32,000	4.71	47,100	15.43	154,300	18.79	187,900	1.91	19,100	8.94	89,400	15.43	154,300	21.00	0%	690,000
Frontage Roads	22	Mile	8,000.00	0.59	4,720	3.20	25,600	4.71	37,680	15.43	123,440	18.79	150,320	1.91	15,280	8.94	71,520			22.00	0%	428,560
Ramps	23	Ramp	4,000.00	8.00	32,000	10.00	40,000	12.00	48,000	34.00	136,000	24.00	96,000		0		0			23.00	0%	352,000
Lighting																						
Mainlanes	24	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926	15.43	30,999	24.00	0%	2,606,537
Frontage Roads	25	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926			25.00	0%	2,575,538
Signals	26	Intersection	8,489.00	4.00	33,956	7.00	59,423	6.00	50,934	15.00	127,335	15.00	127,335	7.00	59,423	9.00	76,401			26.00	0%	534,807
Barriers																						
Traffic Barrier	27	Mile	158,400.00	0.59	93,456	3.20	506,880	4.71	746,064	15.43	2,444,112	18.79	2,976,336	1.91	907,632	8.94	4,248,288	15.43	7,332,336	27.00	2%	19,255,104
Retaining Walls	28	% Bridge Cost.	0.30		252,000		380,160		1,630,464		1,777,452		1,008,000		0		0			28.00	1%	5,048,076
Fixed Guideway	29	Mile			0		0		0		0		0		0		0			29.00	0%	0
Interchanges																					32%	250,000,000
Single Item Total					7,008,961		29,872,402		64,260,741		134,584,986		142,673,631		12,919,721		87,250,221		56,067,774			784,638,436
Contigency	30	15.00%			1,051,344		4,480,860		9,639,111		20,187,748		21,401,045		1,937,958		13,087,533		8,410,166	30.00	10%	80,195,765
Mobilization	31	10.00%			700,896		2,987,240		6,426,074		13,458,499		14,267,363		1,291,972		8,725,022		5,606,777	31.00	7%	53,463,844
TCP (10 yrs)	32	Month																		32.00	1%	520,000
TOTAL COST					**8,761,201**		**37,340,503**		**80,325,926**		**168,231,232**		**178,342,038**		**16,149,651**		**109,062,777**		**70,084,718**			**918,818,046**
Cost per Mile					14,849,494		11,668,907		17,054,337		10,902,867		9,491,327		8,455,315		12,199,416		4,542,107			
% of Total					1%		4%		9%		18%		19%		2%		12%		8%			
									includes ROW				includes ROW				includes ROW		includes ROW			GRAND TOTAL

* Distances for excavation for mainlanes and construction for storm sewers reflect non-elevated distances.

Includes ROW refers to the fact that ROW calculations were made only for inside or outside the Belt, not for the individual sections used to estimate cost. Therefore ROW costs were included only in selected sections, causing its cost per section to appear elevated.

Viable Alternative 1				US 290										Hempstead Rd.								
US 290 MIS PRELIMINARY CONSTRUCTION COSTS				610-Dacoma		Dacoma-Pinemont		Pinemont-Belt		Belt-Grand Parkway		Grand Parkway-West Limit		Katy Road-610		610-Belt		Belt-Grand Parkway				
Item Description	#	Unit	Unit Price	0.59 miles		3.2 miles		4.71 miles		15.43 miles		18.79 miles		1.91 miles		8.94 miles		15.43 miles		#	% of Total	Total Cost
				Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost		Cost			
ROW Impact / Prep. Const.																						
Right-of-Way/Building Impact	1	290 Corr.							127,162,963				12,800,000		0		2,493,962		2,086,416.00	1	17%	144,543,341
Prep ROW	2	Sta	1,421.07	31.2	44,337.4	169.0	240,160.8	249.0	353,846.4	815.0	1,158,172.1	992.0	1,409,701.4	101.00	143,528	472.00	670,745			2	0%	4,020,491
Remove Pvmnt	3	SY	4.27	70,611.0	301,509.0	382,976.0	1,635,307.5	464,217.0	1,982,206.6	1,520,781.0	6,493,734.9	1,322,816.0	5,648,424.3	67,232.00	287,081	314,688	1,343,718			3	2%	17,691,981
Remove Brdg	4	SY	5.00	21,000.0	105,000.0	31,680.0	158,400.0	135,872.0	679,360.0	148,121.0	740,605.0	84,000.0	420,000.0		0		0			4	0%	2,103,365
Remove Drng	5	LF	2.68	3,115.0	8,348.2	16,896.0	45,281.3	24,868.0	66,646.2	81,470.0	218,339.6	99,211.0	265,885.5	10,084.00	27,025	47,203	126,504			5	0%	758,030
Rdwy Excavate/Fill																						
Mainlanes *	6	Mile	400,000.0	0.30	120,000	2.75	1,100,000	2.78	1,112,000	12.80	5,120,000	17.30	6,920,000		0		0			6	2%	14,372,000
Frontage Roads	7	Mile	250,000.0	0.59	147,500	3.20	800,000	4.71	1,177,500	15.43	3,857,500	18.79	4,697,500	1.91	477,500	8.94	2,235,000			7	2%	13,392,500
HOV/Shoulder/Ramps	8	Mile	200,000.0	0.59	118,000	3.20	640,000	4.71	942,000	15.43	3,086,000	18.79	3,758,000		0		0			8	1%	8,544,000
Rdwy Sections																						
Mainlanes																						
8 lanes	9	Mile	3,319,219.00		0		0		0	15.43	51,215,549	18.79	62,368,125		0		0			9	13%	113,583,674
10 lanes	10	Mile	3,872,422.00	0.59	2,284,729	3.20	12,391,750	4.71	18,239,108		0		0		0		0			10	4%	32,915,587
12 lanes	11	Mile			0		0		0		0		0		0		0			11	0%	0
Frontage Roads																						
4 lanes	12	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539			12	3%	24,009,010
6 lanes	13	Mile	2,766,016.00	0.59	1,631,949	3.20	8,851,251	4.71	13,027,935	15.43	42,679,627	18.79	51,973,441		0		0			13	14%	118,164,204
8 lanes	14	Mile			0		0		0		0		0		0		0			14	0%	0
Managed Lanes																						
4 Lanes	15	Mile	2,212,812.00	0.59	1,305,559	3.20	7,080,998	4.71	10,422,345	15.43	34,143,689		0		0		0			15	0.06	52,952,591
Managed Ramps	16	Each	198,000.00	0.00	0	1.00	198,000	2.00	396,000	2.00	396,000		0		0		0			16	0.00	990,000
Miscellaneous																						
Ramps	17	Each	99,000.00	8.00	792,000	10.00	990,000	12.00	1,188,000	34.00	3,366,000	24.00	2,376,000		0		0			17	1%	8,712,000
Bridges	18	SY	40.00	21,000.00	840,000	31,680.00	1,267,200	135,872.00	5,434,880	148,121.00	5,924,840	84,000.00	3,360,000		0		0			18	2%	16,826,920
Storm Sewer *	19	Mile	97,680.00	0.30	29,304	2.75	268,620	2.78	271,550	12.80	1,250,304	17.30	1,689,864		0		0			19	0%	3,509,642
Metal Beam Guard Fence	20	Ramp	13,500.00	8.00	108,000	10.00	135,000	12.00	162,000	34.00	459,000	24.00	324,000		0		0			20	0%	1,188,000
Signing & Marking																						
Mainlanes	21	Mile	10,000.00	0.59	5,900	3.20	32,000	4.71	47,100	15.43	154,300	18.79	187,900		0		0			21	0%	427,200
Frontage Roads	22	Mile	8,000.00	0.59	4,720	3.20	25,600	4.71	37,680	15.43	123,440	18.79	150,320	1.91	15,280	8.94	71,520			22	0%	428,560
Ramps	23	Ramp	4,000.00	8.00	32,000	10.00	40,000	12.00	48,000	34.00	136,000	24.00	96,000		0		0			23	0%	352,000
Lighting																						
Mainlanes	24	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050		0		0			24	0%	2,055,207
Frontage Roads	25	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926			25	0%	2,575,538
Signals	26	Intersection	8,489.00	4.00	33,956	7.00	59,423	6.00	50,934	15.00	127,335	15.00	127,335	7.00	59,423	9.00	76,401			26	0%	534,807
Barriers																						
Traffic Barrier	27	Mile	158,400.00	0.59	280,368	3.20	1,520,640	4.71	2,238,192	15.43	7,332,336	18.79	8,929,008		0		0			27	2%	20,300,544
Retaining Walls	28	% Bridge Cost.	0.30		252,000		380,160		1,630,464		1,777,452		1,008,000		0		0			28	1%	5,048,076
Fixed Guideway	29	Mile			0		0		0		0		0		0		0			29	0%	0
Interchanges																					29%	250,000,000
Single Item Total					8,501,432		38,165,161		187,124,744		171,246,884		170,317,604		5,326,713		27,230,315		2,086,416			859,999,268
Contingency	30	15.00%			1,275,215		5,724,774		28,068,712		25,687,033		25,547,641		799,007		4,084,547		312,962	30	11%	91,499,890
Mobilization	31	10.00%			850,143		3,816,516		18,712,474		17,124,688		17,031,760		532,671		2,723,032		208,642	31	7%	60,999,927
TCP (10 yrs)	32	Month																		32	1%	520,000
TOTAL COST					**10,626,790**		**47,706,451**		**233,905,930**		**214,058,605**		**212,897,005**		**6,658,391**		**34,037,894**		**2,608,020**			**1,013,019,085**
Cost per Mile					18,011,509		14,908,266		49,661,556		13,872,884		11,330,336		3,486,069		3,807,371		169,023			
% of Total					1%		5%		23%		21%		21%		1%		3%		0.26%			
									includes ROW				includes ROW				includes ROW		includes ROW			**GRAND TOTAL**

* Distances for excavation for mainlanes and construction for storm sewers reflect non-elevated distances.

Includes ROW refers to the fact that ROW calculations were made only for inside or outside the Belt, not for the individual sections used to estimate cost. Therefore ROW costs were included only in selected sections, causing its cost per section to appear elevated.

Viable Alternative 2				US 290										Hempstead Rd.								
US 290 MIS PRELIMINARY CONSTRUCTION COSTS				610-Dacoma		Dacoma-Pinemont		Pinemont-Belt		Belt-Grand Parkway		Grand Parkway-West Limit		Katy Road-610		610-Belt		Belt-Grand Parkway				
				0.59 miles		3.2 miles		4.71 miles		15.43 miles		18.79 miles		1.91 miles		8.94 miles		15.43 miles				
Item Description	#	Unit	Unit Price	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	#	% of Total	Total Cost
ROW Impact / Prep. Const.																						
Right-of-Way/Building Impact	1	Acre							16,609,432				1,503,383				10,994,675		6,259,248	1	4%	35,366,738
Prep ROW	2	Sta	1,421.07	31.20	44,337	169.00	240,161	249.00	353,846	815.00	1,158,172	992.00	1,409,701	101.00	143,528	472.00	670,745	815.00	1,158,172	2	1%	5,178,663
Remove Pvmnt	3	SY	4.27	70,611.00	301,509	382,976.00	1,635,308	464,217.00	1,982,207	1,520,781.00	6,493,735	1,322,816.00	5,648,424	67,232.00	287,081	314,688	1,343,718	543,136	2,319,191	3	2%	20,011,171
Remove Brdg	4	SY	5.00	21,000.00	105,000	31,680.00	158,400	135,872.00	679,360	148,121.00	740,605	84,000.00	420,000		0		0			4	0%	2,103,365
Remove Drng	5	LF	2.68	3,115.00	8,348	16,896.00	45,281	24,868.00	66,646	81,470.00	218,340	99,211.00	265,885	10,084.00	27,025	47,203	126,504	81,470.00	218,340	5	0%	976,370
Rdwy Excavate/Fill																						
Mainlanes *	6	Mile	400,000.00	0.30	120,000	2.75	1,100,000	2.78	1,112,000	12.80	5,120,000	17.30	6,920,000		0		0			6	2%	14,372,000
Frontage Roads	7	Mile	250,000.00	0.59	147,500	3.20	800,000	4.71	1,177,500	15.43	3,857,500	18.79	4,697,500	1.91	477,500	8.94	2,235,000	15.43	3,857,500	7	2%	17,250,000
HOV/Shoulder/Ramps	8	Mile	200,000.00	0.59	118,000	3.20	640,000	4.71	942,000	15.43	3,086,000	18.79	3,758,000		0		0			8	1%	8,544,000
Rdwy Sections																						
Mainlanes																						
8 lanes	9	Mile	3,319,219.00		0		0		0		0	18.79	62,368,125		0		0			9	8%	62,368,125
10 lanes	10	Mile	3,872,422.00	0.59	2,284,729	3.20	12,391,750	4.71	18,239,108	15.43	59,751,471		0		0		0			10	12%	92,667,058
12 lanes	11	Mile			0		0		0		0		0		0		0			11	0%	0
Frontage Roads																						
4 lanes	12	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539			12	3%	24,009,010
6 lanes	13	Mile	2,766,016.00	0.59	1,631,949	3.20	8,851,251	4.71	13,027,935	15.43	42,679,627	18.79	51,973,441		0		0			13	15%	118,164,204
8 lanes	14	Mile			0		0		0		0		0		0		0			14	0%	0
Managed Lanes																						
4 Lanes	15	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539	15.43	34,143,689	15	7%	58,152,699
Managed Ramps	16	Each	198,000.00		0		0		0		0		0	1.00	198,000	3.00	594,000	3.00	594,000	16	0%	1,386,000
Miscellaneous																						
Ramps	17	Each	99,000.00	8.00	792,000	10.00	990,000	12.00	1,188,000	34.00	3,366,000	24.00	2,376,000		0		0			17	1%	8,712,000
Bridges	18	SY	40.00	21,000.00	840,000	31,680.00	1,267,200	135,872.00	5,434,880	148,121.00	5,924,840	84,000.00	3,360,000	53,785.00	2,151,400	659,376.00	26,375,040			18	6%	45,353,360
Storm Sewer *	19	Mile	97,680.00	0.30	29,304	2.75	268,620	2.78	271,550	12.80	1,250,304	17.30	1,689,864		0		0			19	0%	3,509,642
Metal Beam Guard Fence	20	Ramp	13,500.00	8.00	108,000	10.00	135,000	12.00	162,000	34.00	459,000	24.00	324,000		0		0			20	0%	1,188,000
Signing & Marking																						
Mainlanes	21	Mile	10,000.00	0.59	5,900	3.20	32,000	4.71	47,100	15.43	154,300	18.79	187,900	1.91	19,100	8.94	89,400	15.43	154,300	21	0%	690,000
Frontage Roads	22	Mile	8,000.00	0.59	4,720	3.20	25,600	4.71	37,680	15.43	123,440	18.79	150,320	1.91	15,280	8.94	71,520			22	0%	428,560
Ramps	23	Ramp	4,000.00	8.00	32,000	10.00	40,000	12.00	48,000	34.00	136,000	24.00	96,000		0		0			23	0%	352,000
Lighting																						
Mainlanes	24	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926	15.43	30,999	24	0%	2,606,537
Frontage Roads	25	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926			25	0%	2,575,538
Signals	26	Intersection	8,489.00	4.00	33,956	7.00	59,423	6.00	50,934	15.00	127,335	15.00	127,335	7.00	59,423	9.00	76,401			26	0%	534,807
Barriers																						
Traffic Barrier	27	Mile	158,400.00	0.59	93,456	3.20	506,880	4.71	746,064	15.43	2,444,112	18.79	2,976,336	1.91	907,632	8.94	4,248,288	15.43	7,332,336	27	2%	19,255,104
Retaining Walls	28	% Bridge Cost.	0.30		252,000		380,160		1,630,464		1,777,452		1,008,000		0		0			28	1%	5,048,076
Fixed Guideway	29	Mile			0		0		0		0		0		0		0			29	0%	0
Interchanges																					31%	250,000,000
Single Item Total					7,008,961		29,872,402		64,260,741		140,354,893		153,068,315		12,919,721		87,250,221		56,067,774			800,803,028
Contigency	30	15.00%			1,051,344		4,480,860		9,639,111		21,053,234		22,960,247		1,937,958		13,087,533		8,410,166	30	10%	82,620,454
Mobilization	31	10.00%			700,896		2,987,240		6,426,074		14,035,489		15,306,831		1,291,972		8,725,022		5,606,777	31	7%	55,080,303
TCP (10 yrs)	32	Month																		32	1%	520,000
TOTAL COST					**8,761,201**		**37,340,503**		**80,325,926**		**175,443,616**		**191,335,394**		**16,149,651**		**109,062,777**		**70,084,718**			
Cost per Mile					14,849,494		11,668,907		17,054,337		11,370,293		10,182,831		8,455,315		12,199,416		4,542,107			**939,023,785**
% of Total					1%		4%		9%		19%		20%		2%		12%		7%			
									includes ROW				includes ROW				includes ROW		includes ROW			**GRAND TOTAL**

* Distances for excavation for mainlanes and construction for storm sewers reflect non-elevated distances.

Includes ROW refers to the fact that ROW calculations were made only for inside or outside the Belt, not for the individual sections used to estimate cost. Therefore ROW costs were included only in selected sections, causing its cost per section to appear elevated.

Viable Alternative 3				US 290										Hempstead Rd.						
US 290 MIS PRELIMINARY CONSTRUCTION COSTS				**610-Dacoma**		**Dacoma-Pinemont**		**Pinemont-Belt**		**Belt-Grand Parkway**		**Grand Parkway-West Limit**		**Katy Road-610**		**610-Belt**				
				0.59 miles		3.2 miles		4.71 miles		15.43 miles		18.79 miles		1.91 miles		8.94 miles				
Item Description	#	Unit	Unit Price	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	#	% of Total	Total Cost
ROW Impact / Prep. Const.																				
Right-of-Way/Building Impact	1	Acre							171,142,586				23,564,132		0		1,137,427	1	21%	195,844,145
Prep ROW	2	Sta	1,421.07	31.20	44,337	169.00	240,161	249.00	353,846	815.00	1,158,172	992.00	1,409,701	101.00	143,528	472.00	670,745	2	0%	4,020,491
Remove Pvmnt	3	SY	4.27	70,611.00	301,509	382,976.00	1,635,308	464,217.00	1,982,207	1,520,781.00	6,493,735	1,322,816.00	5,648,424	67,232.00	287,081	314,688	1,343,718	3	2%	17,691,981
Remove Brdg	4	SY	5.00	21,000.00	105,000	31,680.00	158,400	135,872.00	679,360	148,121.00	740,605	84,000.00	420,000		0		0	4	0%	2,103,365
Remove Drng	5	LF	2.68	3,115.00	8,348	16,896.00	45,281	24,868.00	66,646	81,470.00	218,340	99,211.00	265,885	10,084.00	27,025	47,203	126,504	5	0%	758,030
Rdwy Excavate/Fill																				
Mainlanes *	6	Mile	400,000.00	0.30	120,000	2.75	1,100,000	2.78	1,112,000	12.80	5,120,000	17.30	6,920,000		0		0	6	2%	14,372,000
Frontage Roads	7	Mile	250,000.00	0.59	147,500	3.20	800,000	4.71	1,177,500	15.43	3,857,500	18.79	4,697,500	1.91	477,500	8.94	2,235,000	7	1%	13,392,500
HOV/Shoulder/Ramps	8	Mile	200,000.00	0.59	118,000	3.20	640,000	4.71	942,000	15.43	3,086,000	18.79	3,758,000		0		0	8	1%	8,544,000
Rdwy Sections																				
Mainlanes																				
8 lanes	9	Mile	3,319,219.00		0		0		0	15.43	51,215,549	18.79	62,368,125		0		0	9	12%	113,583,674
10 lanes	10	Mile	3,872,422.00	0.59	2,284,729	3.20	12,391,750	4.71	18,239,108		0		0		0		0	10	4%	32,915,587
12 lanes	11	Mile			0		0		0		0		0		0		0	11	0%	0
Frontage Roads																				
4 lanes	12	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539	12	3%	24,009,010
6 lanes	13	Mile	2,766,016.00	0.59	1,631,949	3.20	8,851,251	4.71	13,027,935	15.43	42,679,627	18.79	51,973,441		0		0	13	13%	118,164,204
8 lanes	14	Mile			0		0		0		0		0		0		0	14	0%	0
Managed Lanes																				
4 Lanes	15	Mile	2,212,812.00	0.59	1,305,559	3.20	7,080,998	4.71	10,422,345	15.43	34,143,689		0		0		0	15	6%	52,952,591
Managed Ramps	16	Each	198,000.00	0.00	0	1.00	198,000	2.00	396,000	2.00	396,000		0		0		0	16	0%	990,000
Micellaneous																				
Ramps	17	Each	99,000.00	8.00	792,000	10.00	990,000	12.00	1,188,000	34.00	3,366,000	24.00	2,376,000		0		0	17	1%	8,712,000
Bridges	18	SY	40.00	21,000.00	840,000	31,680.00	1,267,200	135,872.00	5,434,880	148,121.00	5,924,840	84,000.00	3,360,000		0		0	18	2%	16,826,920
Storm Sewer *	19	Mile	97,680.00	0.30	29,304	2.75	268,620	2.78	271,550	12.80	1,250,304	17.30	1,689,864		0		0	19	0%	3,509,642
Metal Beam Guard Fence	20	Ramp	13,500.00	8.00	108,000	10.00	135,000	12.00	162,000	34.00	459,000	24.00	324,000		0		0	20	0%	1,188,000
Signing & Marking																				
Mainlanes	21	Mile	10,000.00	0.59	5,900	3.20	32,000	4.71	47,100	15.43	154,300	18.79	187,900		0		0	21	0%	427,200
Frontage Roads	22	Mile	8,000.00	0.59	4,720	3.20	25,600	4.71	37,680	15.43	123,440	18.79	150,320	1.91	15,280	8.94	71,520	22	0%	428,560
Ramps	23	Ramp	4,000.00	8.00	32,000	10.00	40,000	12.00	48,000	34.00	136,000	24.00	96,000		0		0	23	0%	352,000
Lighting																				
Mainlanes	24	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050		0		0	24	0%	2,055,207
Frontage Roads	25	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926	25	0%	2,575,538
Signals	26	Intersection	8,489.00	4.00	33,956	7.00	59,423	6.00	50,934	15.00	127,335	15.00	127,335	7.00	59,423	9.00	76,401	26	0%	534,807
Barriers																				
Traffic Barrier	27	Mile	158,400.00	0.59	373,824	3.20	2,027,520	4.71	2,984,256	15.43	9,776,448	18.79	11,905,344		0		0	27	3%	27,067,392
Retaining Walls	28	% Bridge Cost.	0.30		252,000		380,160		1,630,464		1,777,452		1,008,000		0		0	28	1%	5,048,076
Fixed Guideway	29	Mile			0		0		0		0		0		0		0	29	0%	0
Interchanges																			27%	250,000,000
Single Item Total					8,594,888		38,672,041		231,850,431		173,690,996		184,058,072		5,326,713		25,873,780			918,066,920
Contigency	30	15.00%			1,289,233		5,800,806		34,777,565		26,053,649		27,608,711		799,007		3,881,067	30	11%	100,210,038
Mobilization	31	10.00%			859,489		3,867,204		23,185,043		17,369,100		18,405,807		532,671		2,587,378	31	7%	66,806,692
TCP (10 yrs)	32	Month																32		520,000
TOTAL COST					**10,743,610**		**48,340,051**		**289,813,039**		**217,113,745**		**230,072,590**		**6,658,391**		**32,342,225**			**1,085,603,650**
Cost per Mile					18,209,509		15,106,266		61,531,431		14,070,884		12,244,417		3,486,069		3,617,699			
% of Total					1%		4%		27%		20%		21%		1%		3%			
									includes ROW				includes ROW				includes ROW			**GRAND TOTAL**

* Distances for excavation for mainlanes and construction for storm sewers reflect non-elevated distances.

Includes ROW refers to the fact that ROW calculations were made only for inside or outside the Belt, not for the individual sections used to estimate cost. Therefore ROW costs were included only in selected sections, causing its cost per section to appear elevated.

Viable Alternative 4				US 290										Hempstead Rd.								
US 290 MIS PRELIMINARY CONSTRUCTION COSTS				610-Dacoma		Dacoma-Pinemont		Pinemont-Belt		Belt-Grand Parkway		Grand Parkway-West Limit		Katy Road-610		610-Belt		Belt-Grand Parkway				
Item Description	#	Unit	Unit Price	0.59 miles		3.2 miles		4.71 miles		15.43 miles		18.79 miles		1.91 miles		8.94 miles		15.34 miles		#	% of Total	Total Cost
				Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost	Amount	Cost					
ROW Impact / Prep. Const.																						
Right-of-Way/Building Impact	1	Acre							104,125,065				6,800,000		0		10,380,176		4,172,832.00	1	14%	125,478,073
Prep ROW	2	Sta	1,421.07	31.20	44,337	169.00	240,161	249.00	353,846	815.00	1,158,172	992.00	1,409,701	101.00	143,528	472.00	670,745	815.00	1,158,172	2	1%	5,178,663
Remove Pvmnt	3	SY	4.27	70,611.00	301,509	382,976.00	1,635,308	464,217.00	1,982,207	1,520,781.00	6,493,735	1,322,816.00	5,648,424	67,232.00	287,081	314,688	1,343,718	543,136.00	2,319,191	3	2%	20,011,171
Rmove Brdg	4	SY	5.00	21,000.00	105,000	31,860.00	159,300	135,872.00	679,360	185,152.00	925,760	84,000.00	420,000		0		0			4	0%	2,289,420
Remove Drng	5	LF	2.68	3,115.00	8,348	16,896.00	45,281	24,868.00	66,646	81,470.00	218,340	99,211.00	265,885	10,084.00	27,025	47,203	126,504	81,470.00	218,340	5	0%	976,370
Rdwy Excavate/Fill																						
Mainlanes *	6	Mile	400,000.00	0.30	120,000	2.75	1,100,000	2.78	1,112,000	12.80	5,120,000	17.30	6,920,000		0		0			6	2%	14,372,000
Frontage Roads	7	Mile	250,000.00	0.59	147,250	3.20	800,000	4.71	1,177,500	15.43	3,857,500	18.79	4,697,500	1.91	477,500	8.94	2,235,000	15.43	3,857,500	7	2%	17,249,750
HOV/Shoulders/Ramps	8	Mile	200,000.00	0.59	118,000	3.20	640,000	4.71	942,000	15.43	3,086,000	18.79	3,758,000		0		0			8	1%	8,544,000
Rdwy Sections																						
Mainlanes																						
8 lanes	9	Mile	3,319,219.00		0		0		0		0	18.79	62,368,125		0		0			9	7%	62,368,125
10 lanes	10	Mile	3,872,422.00	0.59	2,284,729	3.20	12,391,750	4.71	18,239,108	15.43	59,751,471		0		0		0			10	10%	92,667,058
12 lanes	11	Mile			0		0		0		0		0		0		0			11	0%	0
Frontage Roads																						
4 lanes	12	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539			12	3%	24,009,010
6 lanes	13	Mile	2,766,016.00	0.59	1,631,949	3.20	8,851,251	4.71	13,027,935	15.43	42,679,627	18.79	51,973,441		0		0			13	13%	118,164,204
8 lanes	14	Mile			0		0		0		0		0		0		0			14	0%	0
Manaaged Lanes																						
4 Lanes	15	Mile	2,212,812.00		0		0		0		0		0	1.91	4,226,471	8.94	19,782,539	15.43	34,143,689.16	15	6%	58,152,699
Managed Ramps	16	Each	198,000.00		0		0		0		0		0	1.00	198,000	3.00	594,000	3.00	594,000.00	16	0%	1,386,000
Micellaneous																						
Ramps	17	Each	99,000.00	8.00	792,000	10.00	990,000	12.00	1,188,000	34.00	3,366,000	24.00	2,376,000		0		0			17	1%	8,712,000
Bridges	18	SY	40.00	21,000.00	840,000	31,680.00	1,267,200	135,872.00	5,434,880	185,152.00	7,406,080	84,000.00	3,360,000	53,785.00	2,151,400	629,376.00	25,175,040			18	5%	45,634,600
Storm Sewer *	19	Mile	97,680.00	0.30	29,304	2.75	268,620	2.78	271,550	12.80	1,250,304	17.30	1,689,864		0		0			19	0%	3,509,642
MBGF	20	Ramp	13,500.00	8.00	108,000	10.00	135,000	12.00	162,000	34.00	459,000	24.00	324,000		0		0			20	0%	1,188,000
Signing & Marking																						
Mainlanes	21	Mile	10,000.00	0.59	5,900	3.20	32,000	4.71	47,100	15.43	154,300	18.79	187,900	1.91	19,100	8.94	89,400	15.43	154,300	21	0%	690,000
Frontage Roads	22	Mile	8,000.00	0.59	4,720	3.20	25,600	4.71	37,680	15.43	123,440	18.79	150,320	1.91	15,280	8.94	71,520			22	0%	428,560
Ramps	23	Ramp	4,000.00	8.00	32,000	10.00	40,000	12.00	48,000	34.00	136,000	24.00	96,000		0		0			23	0%	352,000
Lighting																						
Mainlanes	24	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926	15.43	30,999	24	0%	2,606,537
Frontage Roads	25	Each	2,009.00	14.00	28,126	76.00	152,684	113.00	227,017	370.00	743,330	450.00	904,050	45.00	90,405	214.00	429,926			25	0%	2,575,538
Signal	26	Intersection	8,489.00	4.00	33,956	7.00	59,423	6.00	50,934	15.00	127,335	15.00	127,335	7.00	59,423	9.00	76,401			26	0%	534,807
Barriers																						
Traffic Barrier	27	Mile	158,400.00	0.59	186,912	3.20	1,013,760	4.71	1,492,128	15.43	4,888,224	18.79	5,952,672	1.91	907,632	8.94	4,248,288	15.43	7,332,336	27	3%	26,021,952
Retaining Walls	28	% Bridge Cost.	0.30		252,000		380,160		1,630,464		2,221,824		1,008,000		0		0			28	1%	5,492,448
Fixed Guideway	29	Mile			0		0		0		0		0		0		0			29	0%	0
Interchanges																					28%	250,000,000
Single Item Total					7,102,167		30,380,182		152,522,438		144,909,772		161,341,268		12,919,721		85,435,722		53,981,358.40			898,592,628
Contigency	30	15.00%			1,065,325		4,557,027		22,878,366		21,736,466		24,201,190		1,937,958		12,815,358		8,097,204	30	11%	97,288,894
Mobilization	31	10.00%			710,217		3,038,018		15,252,244		14,490,977		16,134,127		1,291,972		8,543,572		5,398,135.84	31	7%	64,859,263
TCP (10 yrs)	31	Month																		32		520,000
TOTAL COST					**8,877,709**		**37,975,228**		**190,653,047**		**181,137,215**		**201,676,585**		**16,149,651**		**106,794,653**		**67,476,698.00**			**1,061,260,785**
Cost per Mile					15,046,964		11,867,259		40,478,354		11,739,288		10,733,187		8,455,315		11,945,711		4,398,741.72			
% of Total					1%		4%		18%		17%		19%		2%		10%		6%			
									includes ROW				includes ROW				includes ROW		includes ROW			**GRAND TOTAL**

* Distances for excavation for mainlanes and construction for storm sewers reflect non-elevated distances.

Includes ROW refers to the fact that ROW calculations were made only for inside or outside the Belt, not for the individual sections used to estimate cost. Therefore ROW costs were included only in selected sections, causing its cost per section to appear elevated.

Appendix F
Jersey Village – White Oak Bayou Transit Connection Trail

Harris County Precinct 4
Jersey Village - White Oak Bayou Transit Connection Trail
2001 STEP - TxDOT CSJ 0912-71-807
Scale: 1 inch = 500 feet