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CHAPTER 2
ALTERNATIVES ANALYSIS

Chapter 2 discusses the alternatives development, corridor-level analysis, and decision-making process utilized during the project planning phase. A full range of alternatives, including the No-Build Alternative, were analyzed during the study process. This chapter also summarizes the alternative selection criteria and its interdisciplinary approach involving analysis of environmental, traffic operations, and engineering aspects of each alternative. Input and comments from members of the public and local, state, and federal agencies were carefully considered during the evaluation process.

The environmental analysis was conducted thoroughly and systematically considering resource and constraints mapping, environmental issues, traffic, engineering, and public involvement. This process enabled the reviewers to compare and evaluate alternatives through an iterative series of evaluation criteria phases. It also provided the basis to select a single Preferred Alternative that best serves the proposed project's purpose and need and avoids or minimizes environmental impacts.

The identification of the Preferred Alternative in this Final Environmental Impact Statement (FEIS) was consistent with the guidelines and regulations that were set forth by the Federal Highway Administration (FHWA) and the Council on Environmental Quality (CEQ) (23 Code of Federal Regulations [CFR] 771.125, 40 CFR 1502, and FHWA, 1987). The multi-step development process also meets various requirements of the National Environmental Policy Act (NEPA) and Section 404 of the Clean Water Act (CWA).

2.1 UNIVERSE OF ALTERNATIVES

Prior to development of any alternatives, initial public scoping meetings were held on February 28 and March 1, 2006 to present project information to members of the public and governmental and agency officials, and thus receive feedback on resource mapping, schedule, and methodologies to be used in the development and analysis of alternatives. The constraints map was revised based on the input received during the scoping meetings. In addition, comments were received from members of the public and taken into consideration.

In addition to public comments, input was also obtained from agencies including the U.S. Army Corps of Engineers (USACE), Texas Parks and Wildlife Department (TPWD), Texas Commission on Environmental

Quality (TCEQ), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (EPA). Useful information was received related to:

- Location of potential habitat for protected species;
- Distinction between floodplains and wetlands;
- Preferred locations for linear stream crossings; and
- Previous wetland mitigation sites.

The transportation build alternatives known as the "universe of alternatives" were developed from three sources:

- Results from the Corridor Analysis Tool (CAT), a Geographic Information System (GIS) based spatial analysis software (**Appendix C**);
- Existing and previously studied corridors, including those found in the Texas Department of Transportation's (TxDOT) Environmental Overview of the Grand Parkway, the City of Houston's 2007 Major Thoroughfare Map, the Mount Belvieu Comprehensive Plan, the Houston-Galveston Area Council's (H-GAC) 2035 Regional Transportation Plan (RTP) Update, and 2005 public hearing exhibits for transfer of the Lake Houston Wilderness Park from TPWD to the City of Houston; and
- Alternatives generated by the study team incorporating public and agency input.

Refer to **Exhibit 2-1** for previously mapped and publically available alternatives in the Segments H and I-1 study area.

Alternatives for Segments H and I-1 start at United States Highway (US) 59 North (N)/Interstate Highway (I) 69 just south of Splendora and continue southeast across US 90, ending at I-10 (E) near Mont Belvieu. Four beginning and four end points along US 59 (N)/I-69 and I-10 (E), respectively, were selected at logical points based on constraints and existing cross street locations. The CAT was used to map alternatives using GIS software that plotted alternatives while avoiding and minimizing impacts to environmental constraints. Refer to **Exhibit 2-2** for the CAT beginning and end points and alternatives. Similarly, the study team used the constraints map to develop other combinations of alternatives that would likely meet the purpose and need of the project. Constraints were considered at different levels of avoidance as described below:

- Schools, high density and clustered developments, archeological sites, cemeteries, parks, potential habitats of threatened and endangered species, a potential state superfund site, and clusters of oil/gas wells were considered as total avoidance constraints;

- Churches, 100-year floodplains, non-impaired and ecologically significant streams, individual oil wells, high-value wetlands, water/wastewater plants, electric substations, water wells, and other major utility facilities were considered points of high-value constraints for avoidance or minimization; and
- Public facilities, major roads, rail lines, impaired streams, hazardous materials locations, and medium-value wetlands were ranked as medium- to low-value constraints for avoidance or minimization.

The study team evaluated the maps from previous studies as well as the CAT-generated alternatives. Based on the CAT results, the study team made adjustments near the beginning and end points to improve feasibility of the initial alternatives. Although four end points were input into CAT, the resulting outcome yielded only two feasible connections to I-10 (E). To supplement the initial set of alternatives, the study team used the constraints map to generate additional alternatives across a wider range within the study area. In addition, the study team created alternatives using portions of the previously published alternatives (**Exhibit 2-1**) with adjustments to avoid impacts to the Lake Houston Wilderness Park. The alternatives generated by the study team are shown together with the previously published alternatives which yielded the 11 alternatives comprising the universe of alternatives (**Exhibit 2-3**).

To evaluate the universe of alternatives, a broad set of initial criteria was used. To be conservative, an 800-foot (ft) wide corridor was established for identifying potential impacts. The universe of alternatives was studied in multidiscipline team workshops using professional judgment and input received from the first series of public scoping meetings. The study team performed a constraints analysis on the universe of alternatives. Due to both agency and public input, it was determined early in scoping that parklands and any potential habitat for threatened and endangered species should be avoided whenever possible.

2.2 PRELIMINARY ALTERNATIVES

Corridors were assessed utilizing alternatives analysis screening criteria, and those warranting further study were assessed as preliminary alternatives. The preliminary alternatives traversed a wide band of the study area and were divided into three sections: A, B, and C, for further analysis (**Table 2-1**). The section limits were established where several alternatives passed through a common point of intersection before dispersing again. This common point was used as a natural divide between adjacent sections. The portions of the alternatives within each section were then independently studied and compared for impacts (**Exhibit 2-4**). This allowed the study team to compare the alternatives at a more detailed level and then combine various sections to create more flexibility in consideration of the overall alternatives.

Table 2-1: Description of Sections of Preliminary Alternatives

Section	Description of Section Limits	Avoided or Minimized Impacts to Constraints
A	Begins at US 59 (N)/I-69 and proceeds east, ending near the East Fork of the San Jacinto River, east of the Lake Houston Wilderness Park	The Lake Houston Wilderness Park, developed areas, wetlands, potential threatened and endangered species habitat, the confluence of streams, and forested habitat.
B	From Section A, proceeds southeast, crossing FM 1960, and staying southwest of Dayton to approximately 1 mile south of US 90	Developed areas, two salt domes, Cox Road Dump Site and minimizing impacts to other constraints such as floodplains, wetlands, oil and gas wells, schools, and churches.
C	From Section B, proceeds south through the City of Mont Belvieu to I-10 (E)	Developed areas, industrial areas, utility stations, floodplains, schools, and churches.

Source: Study Team, 2006

2.2.1 Preliminary Alternatives Evaluation

The purpose of the proposed facility is to improve the mobility of people and goods in the region by enhancing the existing transportation system in terms of discontinuous system linkage, decreased mobility, compromised safety, and a lack of infrastructure to support population growth while avoiding and/or minimizing adverse impacts to the community, natural resources, and existing infrastructure. The preliminary analysis was based on a broad range of multidisciplinary evaluation criteria including environmental, engineering, traffic/mobility, and public/agency input. Although a 400-ft wide corridor is proposed for Segments H and I-1, as a conservative approach, an 800-ft wide corridor was used to quantify the impacts of the preliminary alternatives for comparison. The 800-ft corridor allows for minor adjustments to the alignment to avoid and minimize impacts, if needed. The study team obtained outputs of all quantifiable impacts through CAT analysis.

The environmental criteria at this level evaluated the impacts on buildings, developed areas, floodplains, wetlands, managed land (parkland), hazardous materials sites, threatened and endangered species, and major streams. The Lake Houston Wilderness Park was a major constraint within the study area that was avoided during the development of the preliminary alternatives. The engineering criteria considered right-of-way (ROW) needs, construction complexity, and cost factors including length of alternative, floodplain crossings, road and railroad crossings, major utilities, and existing facilities to be reconstructed. Traffic and mobility criteria considered included emergency and hurricane evacuation facilitation, connectivity to existing roadway systems, travel time along alternatives, and conformance with area transportation plans. Following the technical evaluations, additional input was sought and gathered from the Fast-Track Advisory and Streamlining Team (FAST). The FAST included representatives from TxDOT Environmental Affairs

Division (TxDOT ENV), TxDOT Houston and Beaumont Districts, FHWA, Grand Parkway Association (GPA), and the consultant team.

To complete the evaluation of preliminary alternatives, a second series of public scoping meetings was held on May 8 and 9, 2007. The universe of alternatives and preliminary alternatives were presented, as well as the recommendations for reasonable alternatives. **Exhibit 2-4** shows the preliminary alternatives divided into three sections and in two colors to distinguish between those recommended to be carried forward for the second series of public scoping meetings. Feedback was received from the general public and public and agency officials on the alternatives shown within each of the three sections. **Section 2.2.2** discusses the outcome of the May 2007 public scoping meetings and preliminary alternatives evaluation.

2.2.2 Alternative Sections Not Recommended

The preliminary alternatives discussed below were shown at the second series of public scoping meetings held in May of 2007 as recommended reasonable alternatives. Upon completion of the preliminary alternatives evaluation and consideration of input received from the public, some of the preliminary alternatives were eliminated from further study as detailed below.

2.2.2.1 Section A

Preliminary Alternative A-1 was originally selected as a recommended reasonable alternative. However, it had the longest offset from Segment G, an adjacent Grand Parkway segment to the west under study (**Exhibit 2-4**), and was considered confusing and difficult to navigate by the general public because it connects to State Highway (SH) 242 on the west side of US 59 (N)/I-69. Further, Preliminary Alternative A-1 received low support from the public and elected officials.

Preliminary Alternative A-3 would require reconstruction of existing Farm-to-Market Road (FM) 1485 for its entire length, which also would result in impacts to developed areas; therefore, this alternative was not selected as a recommended reasonable alternative.

Preliminary Alternative A-5 was very similar to Preliminary Alternative A-4; however, Preliminary Alternative A-5 required ROW from the Lake Houston Wilderness Park which would result in approximately 5.7 acres of impacts to the park as compared to A-4 with 0 acres, according to information the study team had while the preliminary alternatives were being evaluated. Based on subsequent information provided regarding the revised park boundaries learned in 2011, Preliminary Alternatives A-4 and A-5 would impact the park. The

revised boundaries show that Preliminary Alternative A-4 would impact 10.74 acres and Preliminary Alternative A-5 would impact 16.44 acres. Because of these impacts, Preliminary Alternative A-5 was eliminated from further study. Additional coordination was completed with Lake Houston Wilderness Park personnel, and the preference was to maintain Preliminary Alternative A-4 due to the opportunity for improved access to the park.

In summary, Preliminary Alternatives A-1, A-3 and A-5 within Section A were eliminated from further detailed study.

2.2.2.2 Section B

Preliminary Alternative B-3 was originally selected as a recommended reasonable alternative; however, it was later eliminated from further study. Preliminary Alternative B-3 would require more permanent closures of existing local roadways than Preliminary Alternatives B-2 and B-5, which were carried forward. Preliminary Alternative B-3 would cross FM 686 at three separate locations and could result in portions of FM 686 being closed permanently due to engineering requirements. Impacts to FM 686 eliminated Preliminary Alternative B-3 from further study.

Preliminary Alternative B-4 crossed US 90 in close proximity to FM 1413 and would have significantly impacted future residential development. In addition, general comments were received at the public hearing concerning flooding along this alternative.

Preliminary Alternatives B-6, B-7, and B-8 follow existing roadways resulting in impacts to populated areas and received unfavorable public input. A large portion of Preliminary Alternative B-6 was within the floodplain, and a large portion of Preliminary Alternative B-8 impacted existing roadways.

In summary, due to potential impacts including displacements, Preliminary Alternatives B-3, B-4, B-6, B-7 and B-8 within Section B were eliminated from further detailed study.

2.2.2.3 Section C

Preliminary Alternative C-1 utilizes portions of the existing SH 146 facility; therefore would require reconstruction of SH 146 for approximately 4.4 miles. Utilizing SH 146 would not provide an additional alternate route that meets the mobility needs for this area due to the proximity to I-10 (E) and the elevated

traffic demands. In addition, Preliminary Alternative C-1 was very similar to Preliminary Alternative C-2 which received more public support, but did not require the use of SH 146.

Preliminary Alternatives C-4 and C-7 were offset approximately 4.5 miles from Grand Parkway Segment I-2 (adjacent Grand Parkway segment to the south), which could create traffic handling difficulties during evacuations and were considered confusing and difficult to navigate by the general public. The area within Preliminary Alternatives C-4 and C-7 is developed primarily as industrial, including oil and gas production; therefore, the cost, schedule, and potential hazardous material impacts to pipeline crossings would be significantly greater than that of other alternatives, further reducing the viability of Preliminary Alternatives C-4 and C-7. Local businesses and the public at-large expressed concerns at locations where the roadway would cross underground and aboveground pipelines. Most of the underground pipelines would have to be bridged as opposed to crossing at-grade, which would increase cost. These alternatives received unfavorable support from the public and elected officials.

Preliminary Alternative C-5 was similar to Preliminary Alternative C-6 but had more impacts to industrial and residential development and received less support from the public and elected officials than Preliminary Alternative C-6.

In summary, Preliminary Alternatives C-1, C-4, C-5, and C-7 within Section C were eliminated from further detailed study.

2.2.3 Alternative Sections Carried Forward for Further Analysis

Public input was evaluated and incorporated into the preliminary alternatives evaluation. Multidiscipline team workshops were conducted to review the technical analyses, public input, project purpose and need, and to recommend the alternatives to be carried forward for further study. Listed below are the alternatives recommended as reasonable within each of the three sections.

2.2.3.1 Section A

Preliminary Alternative A-2 received positive public feedback. Compared to the eliminated alternatives, it would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1**. This alternative would avoid parklands and would not bisect any developed communities. However, Preliminary Alternative A-2 would bisect an undeveloped platted community (Kings Colony) that has been platted since the 1970s but has remained undeveloped.

Preliminary Alternative A-4 received the highest level of public support with no opposition from elected officials. During this stage of the analysis, impacts to the Lake Houston Wilderness Park property were not anticipated; however, a property survey later commissioned by the City of Houston determined the boundaries of the park extended north of FM 1485. Construction of this portion of Segments H and I-1 would affect 10.74 acres of parkland. However, construction would improve access to the park by enhancing the existing access point, which complies with the Lake Houston Park Master Plan dated March 24, 2009. The improved park entrance design would be determined further along in the project development process based on coordination between TxDOT, TPWD, and the City of Houston. At the time of the analysis of the alignment for Preliminary Alternative A-4, there were no relocations anticipated for any other sites within the project area. Additionally, this alternative would not bisect any communities. This alternative would meet the purpose and need of the project while minimizing impacts to the environmental and engineering criteria listed in **Section 2.2.1**. Preliminary Alternative A-4 would directly connect to the selected alternative alignment of Grand Parkway Segment G at US 59 (N)/I-69 and facilitate hurricane evacuation needs.

Within Section A, Preliminary Alternatives A-2 and A-4 were carried forward for further detailed study.

2.2.3.2 Section B

Preliminary Alternative B-1 received the highest level of support from the public and elected officials and would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1**. Preliminary Alternative B-1 would serve Dayton and underserved populated areas in the eastern portion of the study area.

Preliminary Alternative B-2 received a high level of public support because it is centrally located and would serve the entire study area. Preliminary Alternative B-2 would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1** and would contribute to an improved level of service (LOS) for study area traffic. It would also provide a transportation facility to underserved areas of Liberty County.

Preliminary Alternative B-5 received a moderate level of public support and little opposition and would provide an interchange at US 90. It would provide a transportation facility to underserved areas. This alternative would have minimal environmental impacts and would contribute to an improved LOS for study area traffic.

Within Section B, Preliminary Alternatives B-1, B-2, and B-5 were carried forward for further detailed study.

2.2.3.3 Section C

Preliminary Alternative C-2 received the highest level of public support and would follow the 2010 Mont Belvieu Thoroughfare Plan. Preliminary Alternative C-2 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to the Grand Parkway Segment I-2, serving as an additional north-south evacuation route.

Preliminary Alternative C-3 received public support and would follow the 2010 Mont Belvieu Thoroughfare Plan. Preliminary Alternative C-3 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to Grand Parkway Segment I-2, thus providing an additional north-south evacuation route. It would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1** and would contribute to an improved LOS for study area traffic.

Preliminary Alternative C-6 received strong support from elected officials and would also follow the 2010 Mont Belvieu Thoroughfare Plan. Preliminary Alternative C-6 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to Grand Parkway Segment I-2, serving as an additional north-south evacuation route.

Within Section C, Preliminary Alternatives C-2, C-3, and C-6 were carried forward for further detailed study.

2.2.4 Adjustments to Preliminary Alternative Sections

The universe and preliminary alternatives were developed using GIS as a series of line segments connected together. While this was acceptable for the scale and level of detail used for the screening process, the preliminary alternatives carried forward as reasonable were further refined using Computer Aided Design and Drafting (CADD) software to add curves between the lines and develop horizontal alignments that meet the TxDOT Roadway Design Manual (2010) criteria for a 70 mile-per-hour (mph) design speed. During the refinement process, the alternatives were adjusted where possible to further minimize potential impacts. Some of the adjustments are described below:

- Preliminary Alternative A-4 was better aligned to provide opportunities for continued adjacent development within the Grand Parkway dedicated corridor at Community Drive east of US 59 (N)/I-69. Where A-4 parallels FM 1485, the alignment was shifted slightly north to minimize impacts to the Lake Houston Wilderness Park.

- The northern portion of Preliminary Alternative B-1 was shifted south to minimize impacts to existing local roads and maintain access to farmlands.
- Preliminary Alternative B-2 was modified to reduce impacts to sensitive habitats near Cedar Bayou.
- Preliminary Alternative B-5, near the Harris County line, was shifted west to minimize Luce Bayou floodplain impacts.
- Preliminary Alternative C-3 was modified to address public input and avoid impacts to development in Mont Belvieu.

Refer to **Exhibit 2-5** for the locations of the reasonable alternatives.

2.2.5 Reasonable Alternatives

Following refinement, the preliminary alternatives recommended for further study within each of the three sections were combined to form complete end-to-end reasonable alternatives from US 59 (N)/I-69 to I-10 (E) for a comprehensive analysis of impacts for each alternative. All possible combinations from the three different sections were formed. The result was 10 reasonable build alternatives plus the No-Build Alternative, resulting in 11 total reasonable alternatives. The reasonable alternatives to be carried forward for further study are listed for future reference in **Table 2-2.**

Table 2-2: Reasonable Alternatives

Reasonable Alternative	Description
1	No-Build
2	A-2, B-1, C-2
3	A-2, B-1, C-3
4	A-2, B-2, C-2
5	A-2, B-2, C-3
6	A-2, B-5, C-6
7	A-4, B-1, C-2
8	A-4, B-1, C-3
9	A-4, B-2, C-2
10	A-4, B-2, C-3
11	A-4, B-5, C-6

Source: Study Team, 2007

Within the Segments H and I-1 study area, the 10 reasonable build alternatives would meet the purpose and need of the project while avoiding and/or minimizing potential environmental impacts. As the reasonable alternatives have common sections, they overlap each other demonstrating similar environmental and engineering impacts within those reaches. The end-to-end combinations for reasonable alternatives are shown in **Exhibit 2-5**.

2.3 TRANSPORTATION MODE STUDY

An analysis was conducted for 10 distinct reasonable build alternatives which were derived from the previous analysis of the preliminary alternatives. These 10 build alternatives were evaluated against the No-Build Alternative to evaluate the extent to which the stated purpose and need for the proposed project were met. Within this section, there are references to the Segments H and I-1 "traffic study area" for the proposed project. The traffic study area extends beyond the Segments H and I-1 study area. Because implementation of the proposed Segments H and I-1 would affect traffic beyond the Segments H and I-1 study area, it is necessary to quantify these effects when discussing traffic impacts and benefits. The traffic study area includes all roadways within the study area, as well as roadways outside the Segments H and I-1 study area that experience changes in traffic volumes of plus or minus 5 percent, based on the traffic model due to the addition of Segments H and I-1 (**Exhibit 1-4**).

2.3.1 No-Build Alternative

The No-Build Alternative comprises all committed projects included in the 2035 RTP Update with the exception of Segments H and I-1. The 2035 RTP Update is the H-GAC's transportation plan for the eight-county Houston area. These improvements include added-capacity projects such as new roadways and roadway widening, as well as modal improvements such as transit. These improvements are already a part of the ongoing plan for upgrades to the existing roadway system. Transportation system management (TSM), travel demand management (TDM), modal transportation improvements, and Smart Street components of the No-Build Alternative are detailed in the following sections.

Both SH 146 and FM 2100 are identified in the 2035 RTP Update for widening from two lanes to four lanes. For the traffic needs analysis, 2039 was selected as the horizon year (design year), with 2019 as the interim year (construction completion date for Phase I). The TDM utilized for analysis used the 2035 RTP Update, which was adopted in October 2010 and approved in January 2011. The H-GAC provided demographic forecasts through 2050 and, therefore, provided a 2039 dataset which comprises 2039 travel demand on the 2035 RTP Update roadway network. The 2035 Travel Demand Model used for analysis was obtained from H-GAC in June 2012. In the 2039 No-Build Alternative, SH 146 is projected to carry 29,174 vehicles per day (vpd) between US 90 and I-10 (E), which would result in a level of mobility (LOM) rating of *severe* (refer to **Chapter 1, Section 1.2.2.1** for a description of LOM).

2.3.1.1 Transportation System Management Measures

TSM measures implemented at critical locations can improve traffic operations and safety. These types of improvements are typically low-cost measures that improve traffic flow by making better use of the existing transportation system. They typically include intersection improvements, parking and turn restrictions, traffic signal upgrades, signal coordination, median improvements, and access-control improvements. TSM measures identified for the Segments H and I-1 traffic study area in the 2035 RTP Update are summarized in **Table 2-3**.

Table 2-3: TSM Projects in the 2035 RTP Update

Project ID	Description	Location
14552	Construct Railroad Grade Separation Structure And Approaches	On FM 1960 at Union Pacific Railroad (UPRR) in Liberty County
15178	Install Computerized Traffic Management System	On I-10 (E) from Spur 330 to Chambers County Line
15458	Install Left Turn Lane (Westbound – Southbound)	FM 1485 at Huffman New Caney Road
15459	Add Left Turn Lane on FM 1492 Eastbound To Bohemian Hall Road Northbound	FM 1492 at Bohemian Hall Road
15461	Install Southbound Left Turn Lanes	FM 2100 at Sundown Meadow

Source: H-GAC 2035 RTP Update

One of the major benefits of proposed Segments H and I-1 is the improvement of north-south mobility. Currently, north-south mobility in the study area is provided by SH 146, SH 321, and FM 2100. These roadways are located near the far ends of the study area and do not adequately serve the center of the study area or current regional radial network. FM 2100 is projected to carry 39,407 vpd between FM 1485 and US 90, which would result in a LOM rating of *severe* (refer to **Table 1-5**). Based on these projections, these facilities would not adequately handle projected average daily traffic (ADT), and because they are not controlled-access facilities, they would not be adequate or serve for long distance trips. The presence of traffic signals along these roadways would also result in more vehicular stops (a potential safety concern), and less mobility compared to the LOS that a controlled-access roadway such as Segments H and I-1 could provide. Additionally, because these roadways are not controlled-access, future development along the ROW would likely hamper mobility and result in reduced efficiency for local trips as well.

While the TSM improvements included in the 2035 RTP Update are expected to ease congestion and travel time for local trips, these improvements do not adequately address the critical issues identified in the proposed project's purpose and need.

2.3.1.2 Travel Demand Management Measures

TDM measures are strategies and programs that encourage commuters to use alternatives to driving alone, especially during periods of heavy congestion. These strategies typically contribute to reducing congestion along a corridor as they manage the demand placed on the transportation system. TDM measures are generally behavioral changes for the commuting public that result in modifications to travel patterns and modes. Examples of TDM measures include carpooling/vanpooling, park-and-pool/park-and-ride lots, flexible work hours, telecommuting, employer incentives, and transit. The TDM measure identified in the 2035 RTP Update for the Grand Parkway Segments H and I-1 study area is the Atascocita Park-and-Ride Facility to be located on FM 1960 west of Lake Houston Parkway.

Although TDM measures could help improve congestion in an urban area, these measures alone would not be sufficient to effectively accommodate the projected increase in travel demand through 2039. The TDM components of the No-Build Alternative, by themselves, would not address the critical issues identified in the proposed project's purpose and need.

A Congestion Mitigation Analysis (CMA) was conducted for parallel roadway facilities that would be impacted by the construction of Segments H and I-1. The CMA included TSM and TDM improvements too small to be incorporated into the H-GAC's regional travel demand model. The study revealed that both TSM and TDM measures alone would not sufficiently improve LOM for the study area.

2.3.1.3 Modal Transportation Improvements

Modal transportation improvements include bus transit, rail transit, and high-occupancy vehicle (HOV) lanes. The largest public transit provider in the region is the Metropolitan Transit Authority of Harris County (METRO). The 2035 RTP Update incorporates the 2035 METRO Long Range Plan, which is an iterative process incorporating the 2025 METRO Solutions Plan and future mobility needs identified in regional planning efforts. METRO's 2035 Long Range Plan recommends substantial expansion of the current transit system and includes a network of integrated high capacity transit facilities on major travel corridors; however, there are no improvements planned in the Segments H and I-1 study area.

Bus Transit

In addition to METRO, public transit services in the H-GAC Transportation Management Area are provided by the Brazos Transit District, Island Transit, and Connect Transportation. Neither METRO nor any of

these other transit providers currently serve the immediate study area or have documented plans to do so in the near future.

Rail Transit

METRO Solutions does not include improvements in the Segments H and I-1 study area. Currently, there are no plans to serve the study area with rail transit.

High-Occupancy Vehicle/High-Occupancy Toll Lanes

The TDM toolbox includes the HOV lane which is a roadway lane(s) reserved for exclusive use by cars with a driver and one or more passengers and by buses and vanpools. It is a congestion mitigation measure typically utilized on an existing highway facility to improve traffic operation particularly for commuting traffic during the peak hours. Closely related to the HOV concept is the implementation of high-occupancy toll (HOT)/managed lanes. A HOT lane is a designated lane for high-occupancy vehicles (2 or more passengers) as well as for toll-paying vehicles that do not meet the required occupancy. This concept is seen as especially important in congested corridors with limited potential for the building of additional lanes. The 2035 RTP Update identifies regional increases in HOT-lane and regular toll-lane miles. METRO currently operates a number of HOT/HOV lanes in the H-GAC area.

The only highways in the Grand Parkway Segments H and I-1 traffic study area are US 59 (N)/I-69 and I-10 (E). The 2035 RTP Update shows plans for HOT/managed lanes along US 59 (N)/I-69 north of FM 1960. The 2035 RTP Update does not show any HOV or HOT/managed lanes along I-10 (E) in the study area.

2.3.1.4 No-Build Alternative Summary

The No-Build Alternative includes all improvements identified in the 2035 RTP Update, with the exception of Segments H and I-1, and includes all TSM, TDM, and modal transportation improvements. Based on analysis of these components individually and collectively, it was found that although the No-Build Alternative would result in some improvements to regional congestion due to planned improvements to the existing roadway network listed in the 2035 RTP Update, it would not adequately address the purpose and need for the proposed project.

2.3.2 Build Alternatives

Segments H and I-1 are planned by TxDOT and the GPA as a controlled-access toll facility to be constructed on new location, consistent with the 2035 RTP Update. The build alternatives are proposed to complement the No-Build Alternative, not replace any of the improvements identified therein. The build alternatives include all improvements identified in the No-Build Alternative such as added capacity projects, TSM, and TDM. All build alternatives meet the purpose and need of the proposed project.

Funding for new roadways through traditional means has become difficult as travel demand has outpaced roadway network improvements. This trend is projected to continue, and as such, the 2035 RTP Update identifies the key role that toll roads and other managed facilities would play in the expansion of the regional roadway system. Segments H and I-1 are specifically included in the 2035 RTP Update as a four-lane toll facility.

2.3.2.1 Alternative Transportation Improvement Measures Eliminated from Detailed Study

The alternatives analysis process followed a sequential and logical methodology designed to evaluate alternatives for their ability to meet the purpose and need of the proposed project. Other considerations included avoidance and/or minimization of adverse environmental impacts and public input. Alternatives that met these criteria were advanced to the next phase of study. Alternative improvement measures comprising TSM, TDM, bus transit, rail transit, and HOV/HOT lanes alternatives were eliminated from detailed study.

TSM Alternatives

Although TSM measures are designed to relieve congestion and improve traffic flow, they are generally most effective in areas with a roadway system that is operating at or above design capacity. Without a roadway system in place that serves the circumferential travel demands of the study area, implementation of additional TSM measures on existing roadways would not adequately accommodate the projected travel demands. Without increased circumferential roadway capacity, TSM alternatives would not sufficiently improve the congestion projected for the No-Build Alternative.

TDM Alternatives

TDM measures rely heavily on behavioral changes by commuters and other roadway users. These improvements would not provide the magnitude of benefits needed to accommodate the local and regional

demands for improved transportation system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth.

Bus Transit

There are no plans for bus transit service in the study area. Although implementation of bus transit could potentially provide congestion relief on some sections of existing roadways, it would not address the absence of a circumferential roadway to meet the needs for improved transportation system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth.

Rail Transit

Rail alternatives have been found to be most effective when oriented radially to serve commuters traveling during peak hours into and out of the central business core of a city. A rail transit alternative positioned radially or circumferentially, as would be required in the Segments H and I-1 study area, would not be anticipated to serve enough of the study area to satisfy the purpose and need of the project.

Smart Street Alternatives

It was found that the Smart Street component of the No-Build Alternative had substantial deficiencies in meeting the demand for circumferential travel within the Segments H and I-1 study area. This alternative would provide some improvement for existing roadways, but would neither provide circumferential connectivity nor meet the identified need for enhanced safety and improved mobility to accommodate projected travel demand.

2.3.2.2 Alternative Transportation Improvement Measures Advanced for Further Study

The alternatives analysis process followed a sequential and logical methodology designed to evaluate alternatives for their ability to meet the purpose and need of the proposed project. Other considerations included avoidance and/or minimization of adverse environmental impacts and public input. Alternatives that met these criteria were advanced to the next phase of study.

No-Build Alternative

Although the No-Build Alternative would not satisfy the proposed project's purpose and need, it was retained and utilized as the basis of comparison for the build alternatives and further consideration as required by CEQ regulations.

Build Alternatives

The build alternatives are approximately 35-41 miles in length. For all proposed build alternatives, the facility would consist of a four-lane controlled-access toll road within 400 ft of ROW. The proposed facility would have logical termini at US 59 (N)/I-69 and I-10 (E) and provide access via interchanges to highways and major cross streets such as US 90, FM 1960, and others. As described in **Section 2.2**, 10 build alternatives were developed through a cooperative process of public outreach, agency coordination, and avoidance and minimization of impacts to various resources. All projects in the No-Build Alternative are also part of the Build Alternative, including added-capacity improvements, TSM, TDM, and other improvement measures. The build alternatives would provide the system linkage lacking in the No-Build Alternative, accommodate circumferential travel demand, improve mobility, enhance safety, provide a new emergency evacuation route, and provide the infrastructure to support population growth in a previously underserved area.

2.3.2.3 Traffic and Transportation Analysis

Discontinuous System Linkage

The existing transportation system in the Segments H and I-1 study area does not have efficient circumferential connections to major radial roadways such as US 59 (N)/I-69 and I-10 (E). The interstate and regional highways are predominantly oriented in either an east-west or a north-south direction at the boundaries of the Segments H and I-1 study area. I-10, US 90, and US 59/I-69 are three radial facilities connecting Houston to its suburbs and further destinations. Beyond Beltway 8, these radial facilities become increasingly further apart and there are limited connecting facilities within the Segments H and I-1 study area. Below are additional existing system linkage conditions within the study area:

- The existing transportation system within the study area does not provide efficient connections to the suburban communities of Kingwood, New Caney, Huffman, Dayton, and Mont Belvieu;
- Major industrial complexes within the Segments H and I-1 study area include a Chevron refinery plant located along I-10 (E), the Dow Industrial Chemical Plant, an Exxon refinery plant, a Wal-Mart Distribution Center north of Dayton, and numerous gas storage facilities associated with two salt dome formations in Mont Belvieu and west of Dayton. The study area

lacks an efficient circumferential connection for these industrial complexes to US 59 (N)/I-69 and I-10 (E);

- The study area is bound by radial roadways, US 59 (N)/I-69 and I-10 (E), which are circuitously connected by minor arterials and collector roadways within the study area, such as FM 1485, FM 2100, FM 3360, FM 1413, Loop 494, and SH 146. To accomplish circumferential movements across the study area, travelers must use the radial roadways to reach the minor arterial and collector roadways; and
- Freight traffic is transported via trucks from the Port of Houston through the study area to the major industrial complexes, as well as to US 59 (N)/I-69 for national distribution. Trucks currently use the existing two-lane local roadways in the study area for long trips which present traffic operation and safety issues.

Table 2-4 summarizes daily Vehicle Hours of Travel (VHT) per 24 hours for the No-Build Alternative and the build alternatives for 2019 and 2039. The change in daily VHT varies depending on the facility type. The proposed Segments H and I-1 would reduce VHT on arterials and collector roads as trips would be attracted to the more efficient controlled-access toll facility.

The proposed Grand Parkway Segments H and I-1 would result in time savings across the entire traffic study area. Daily VHT in 2039 is projected to reduce by approximately 7 percent (31,265 hours) along interstates, 16 percent (49,945 hours) along principal arterials, 5 percent (39,019 hours) along minor arterials, and 4 percent (16,165 hours) along collector roads.

Table 2-4: Daily VHT by Facility Type in the Segments H and I-1 Traffic Study Area

Facility	2011 (Hours)	2019			2039		
		No-Build (Hours)	Build (Hours)	% Change (Hours)	No-Build (Hours)	Build (Hours)	% Change (Hours)
Interstates	150,724	202,406	201,001	-0.7%	436,213	404,948	-7.2%
Principal Arterials	62,456	87,264	84,468	-3.2%	310,259	260,314	-16.1%
Proposed Grand Parkway (H and I-1)	N/A	N/A	5,646	N/A	N/A	14,915	N/A
Minor Arterials	107,930	160,290	158,754	-1.0%	783,834	744,815	-5.0%
Collector Roads	27,537	43,768	42,595	-2.7%	375,519	359,354	-4.3%
Total	348,647	493,728	492,464		1,905,825	1,784,346	

Source: Study Team, 2012; H-GAC, 2012

Decreased Mobility

The H-GAC regional travel demand model for the eight-county greater Houston metropolitan area was utilized in estimating base- and future- year traffic volumes for the No-Build Alternative and build alternatives. The model incorporates existing and planned roadway infrastructure as well as existing and

forecasted demographics for the region. **Table 2-5** summarizes ADT volumes and LOM for the No-Build Alternative and the build alternatives for Segments H and I-1 and other major roadways in the traffic study area. The time horizons utilized for comparison are base year (2011), opening year (2019), and design year (2039). The No-Build Alternative includes all projects in the 2035 RTP Update, excluding Segments H and I-1.

Table 2-5: Segments H and I-1 Traffic Study Area Base and Future ADT and LOM

Facility	From	To	2011 Base Year		2019					2039				
			ADT (vpd)	LOM	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change
US Highways and Interstates														
US 59 (N)/I-69	SH 105	Community Dr.	54,805	*Tolerable*	71,466	*Tolerable*	69,831	*Tolerable*	-2%	122,890	*Serious*	108,510	*Moderate*	-12%
US 59 (N)/I-69	Community Dr.	BW 8	136,406	*Tolerable*	163,971	*Tolerable*	166,212	*Tolerable*	1%	270,392	*Serious*	270,332	*Serious*	0%
I-10 (E)	BW 8	FM 2100	103,510	*Tolerable*	124,974	*Tolerable*	121,709	*Tolerable*	-3%	199,291	*Serious*	182,838	*Serious*	-8%
I-10 (E)	FM 2100	SH 146	67,327	*Tolerable*	78,035	*Tolerable*	74,659	*Tolerable*	-4%	117,302	*Serious*	94,583	*Moderate*	-19%
I-10 (E)	SH 146	FM 1410	64,131	*Tolerable*	73,048	*Tolerable*	73,036	*Tolerable*	0%	102,778	*Serious*	103,154	*Serious*	0%
BW 8	US 59/I-69	West Lake Houston Pkwy	42,865	*Tolerable*	60,716	*Tolerable*	59,060	*Tolerable*	-3%	125,175	*Serious*	112,460	*Moderate*	-10%
BW 8	West Lake Houston Pkwy	US 90	41,669	*Tolerable*	56,802	*Tolerable*	52,690	*Tolerable*	-7%	112,746	*Moderate*	98,886	*Tolerable*	-12%
BW 8	US 90	I-10 (E)	49,674	*Tolerable*	65,660	*Tolerable*	63,395	*Tolerable*	-3%	141,367	*Moderate*	131,905	*Tolerable*	-7%
Grand Parkway	I-45 (N)	US 59 (N)/I-69	N/A	N/A	37,513	*Tolerable*	42,635	*Tolerable*	14%	74,714	*Moderate*	81,898	*Serious*	10%
Grand Parkway	US 59 (N)/I-69	US 90	N/A	N/A	0	N/A	13,519	*Tolerable*	N/A	N/A	N/A	31,443	*Tolerable*	N/A
Grand Parkway	US 90	I-10 (E)	N/A	N/A	0	N/A	6,687	*Tolerable*	N/A	N/A	N/A	22,441	*Tolerable*	N/A
Grand Parkway	I-10 (E)	SH 146	N/A	N/A	2,908	*Tolerable*	3,264	*Tolerable*	12%	25,016	*Tolerable*	41,773	*Tolerable*	67%
Principal Arterials														
US 90	BW 8	FM 2100	33,185	*Tolerable*	49,547	*Tolerable*	47,702	*Tolerable*	-4%	106,319	*Severe*	102,976	*Severe*	-3%
US 90	FM 2100	SH 321	21,712	*Moderate*	24,531	*Serious*	25,734	*Serious*	5%	30,304	*Severe*	36,782	*Severe*	21%
US 90	SH 321	SH 61	15,441	*Moderate*	17,397	*Moderate*	17,918	*Serious*	3%	21,418	*Serious*	23,542	*Severe*	10%
FM 1960	BW 8	FM 2100	20,364	*Severe*	33,132	*Serious*	32,641	*Serious*	-1%	51,504	*Severe*	45,842	*Severe*	-11%
FM 1960	FM 2100	SH 321	3,864	*Tolerable*	12,249	*Serious*	13,150	*Serious*	7%	16,469	*Severe*	16,548	*Severe*	0%
Kingwood Drive/ Treaschwig Rd.	US 59 (N)/I-69	FM 2100	17,642	*Tolerable*	24,612	*Tolerable*	24,231	*Tolerable*	-2%	24,073	*Tolerable*	46,567	*Severe*	93%
Kingwood Drive	FM 2100	FM 686	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	27,941	*Tolerable*	N/A

Table 2-5: Segments H and I-1 Traffic Study Area Base and Future ADT and LOM

Facility	From	To	2011 Base Year		2019					2039				
			ADT (vpd)	LOM	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change
SH 105	SH 321	FM 2518	7,482	*Tolerable*	9,292	*Moderate*	8,880	*Tolerable*	-4%	13,832	*Severe*	11,947	*Serious*	-14%
SH 105	FM 2518	SH 146	6,056	*Tolerable*	7,751	*Tolerable*	7,310	*Tolerable*	-6%	12,482	*Serious*	11,341	*Serious*	-9%
West Lake Houston Pkwy.	FM 1485	Kingwood Dr.	13,629	*Tolerable*	14,459	*Tolerable*	14,468	*Tolerable*	0%	13,026	*Tolerable*	30,609	*Severe*	135%
West Lake Houston Pkwy.	Kingwood Dr.	BW 8	25,401	*Moderate*	32,505	*Serious*	32,717	*Serious*	1%	49,939	*Severe*	47,560	*Severe*	-5%
SH 146	FM 787	US 90	5,471	*Tolerable*	6,050	*Tolerable*	5,947	*Tolerable*	-2%	7,981	*Tolerable*	7,721	*Tolerable*	-3%
SH 146	US 90	I-10 (E)	8,983	*Tolerable*	12,323	*Tolerable*	12,624	*Tolerable*	2%	29,174	*Severe*	28,610	*Severe*	-2%
SH 146	I-10 (E)	SH 99	27,883	*Tolerable*	36,921	*Tolerable*	36,647	*Tolerable*	-1%	63,821	*Tolerable*	61,238	*Tolerable*	-4%
SH 321	US 59/I-69	US 90	8,210	*Tolerable*	10,047	*Moderate*	8,760	*Tolerable*	-13%	16,268	*Severe*	13,304	*Serious*	-18%
Spur 330	I-10 (E)	SH 146	32,537	*Tolerable*	39,563	*Tolerable*	39,310	*Tolerable*	-1%	50,088	*Tolerable*	53,059	*Tolerable*	6%
Minor Arterials														
FM 787	SH 321	SH 146	7,189	*Tolerable*	8,587	*Tolerable*	8,541	*Tolerable*	-1%	14,471	*Severe*	12,647	*Serious*	-13%
FM 1008	SH 321	US 90	3,499	*Tolerable*	4,226	*Tolerable*	4,062	*Tolerable*	-4%	6,786	*Tolerable*	6,541	*Tolerable*	-4%
FM 1010	SH 321	FM 1485	3,598	*Tolerable*	4,592	*Tolerable*	5,393	*Tolerable*	17%	11,206	*Serious*	9,945	*Moderate*	-11%
FM 1405	SH 146	FM 2354	1,579	*Tolerable*	2,071	*Tolerable*	1,958	*Tolerable*	-5%	2,936	*Tolerable*	2,356	*Tolerable*	-20%
FM 1409	US 90	FM 565	4,486	*Tolerable*	4,820	*Tolerable*	4,008	*Tolerable*	-17%	16,172	*Severe*	13,556	*Severe*	-16%
FM 1485	US 59 (N)/I-69	W. Lake Houston Pkwy.	9,113	*Tolerable*	12,045	*Serious*	11,191	*Moderate*	-7%	14,253	*Severe*	17,285	*Severe*	21%
FM 1485	West Lake Houston Pkwy.	FM 2100	7,057	*Tolerable*	10,812	*Serious*	12,560	*Tolerable*	16%	15,101	*Severe*	19,253	*Serious*	27%
FM 1942	Crosby Lynchburg	SH 146	8,246	*Tolerable*	10,235	*Serious*	10,207	*Serious*	0%	19,551	*Severe*	19,120	*Severe*	-2%
FM 2100	FM 1485	US 90	14,706	*Moderate*	20,099	*Severe*	19,642	*Severe*	-2%	39,407	*Severe*	37,885	*Severe*	-4%
FM 2354	FM 565	FM 1405	814	*Tolerable*	1,240	*Tolerable*	1,249	*Tolerable*	1%	3,254	*Tolerable*	1,976	*Tolerable*	-39%

Table 2-5: Segments H and I-1 Traffic Study Area Base and Future ADT and LOM

Facility	From	To	2011 Base Year		2019					2039				
			ADT (vpd)	LOM	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change	No-Build ADT (vpd)	No-Build LOM	Build ADT (vpd)	Build LOM	% ADT Change
FM 3180	I-10 (E)	FM 2354	2,004	*Tolerable*	2,997	*Tolerable*	2,890	*Tolerable*	-4%	14,612	*Severe*	4,804	*Tolerable*	-67%
FM 3360	SH 146	I-10 (E)	2,026	*Tolerable*	3,497	*Tolerable*	3,237	*Tolerable*	-7%	11,167	*Serious*	8,615	*Tolerable*	-23%
FM 563	US 90	I-10 (E)	4,014	*Tolerable*	4,994	*Tolerable*	5,060	*Tolerable*	1%	13,539	*Severe*	12,236	*Serious*	-10%
FM 565	Loop 207	SH 146	7,999	*Tolerable*	8,921	*Moderate*	8,692	*Tolerable*	-3%	13,961	*Severe*	12,898	*Severe*	-8%
Collector Roads														
FM 1410	Kingwood Dr.	I-10 (E)	1,937	*Tolerable*	2,327	*Tolerable*	2,323	*Tolerable*	0%	7,613	*Serious*	5,595	*Tolerable*	-27%
FM 1413	US 90	SH 146	2,680	*Tolerable*	4,954	*Tolerable*	4,758	*Tolerable*	-4%	12,757	*Severe*	13,142	*Severe*	3%
FM 2090	US 59/I-69	FM 1010	3,864	*Tolerable*	5,826	*Tolerable*	4,673	*Tolerable*	-20%	14,352	*Severe*	8,392	*Moderate*	-42%
FM 686	FM 1960	SH 321	1,195	*Tolerable*	1,486	*Tolerable*	1,919	*Tolerable*	29%	3,500	*Tolerable*	12,537	*Severe*	258%
FM 770	SH 105	FM 563	2,564	*Tolerable*	3,405	*Tolerable*	3,388	*Tolerable*	-1%	8,411	*Tolerable*	7,402	*Tolerable*	-12%
Roman Forest Blvd	US 59/I-69	Tram (Galaxy)	10,170	*Tolerable*	13,904	*Tolerable*	12,283	*Tolerable*	-12%	28,213	*Severe*	23,057	*Severe*	-18%
Tram (Galaxy)	FM 2090	Roman Forest Blvd	2,157	*Tolerable*	3,388	*Tolerable*	5,293	*Tolerable*	56%	7,299	*Tolerable*	9,804	*Tolerable*	34%

Source: H-GAC, 2012

Overall, the results summarized in **Table 2-5** demonstrate that the construction of the Build Alternative would result in reduced traffic volumes on the traffic study area roadway network. **Table 2-5** shows that in 2039 construction of the proposed Grand Parkway Segments H and I-1 would result in a 12 percent reduction in ADT along US 59 (N)/I-69 (SH 105 to Community Drive). Without the Grand Parkway Segments H and I-1, there is limited north-south access in the study area. There are proposed ramp connections for FM 1010 (Huffman/Cleveland Road) at the Grand Parkway Segments H and I-1. For example, traffic from Cleveland headed south could use FM 1010 to travel to proposed Grand Parkway Segments H and I-1 and travel south, rather than use US 59 (N)/I-69. The same holds true for traffic headed to Cleveland from the east along major routes such as I-10 (E), FM 1960, and US 90. These diversions would result in a reduction in volume on US 59 (N)/I-69. Additionally, the Build Alternative would result in a 19 percent reduction in ADT along I-10 (E) (FM 2100 to SH 146) and a 12 percent reduction in ADT along Beltway 8 (W Lake Houston Parkway to US 90). The proposed Grand Parkway Segments H and I-1 are projected to reduce daily traffic along SH 321, a principal arterial, by up to 18 percent in 2039. LOM on this facility is projected to improve from *severe* without the Grand Parkway to *serious* with the Grand Parkway. Traffic volumes in 2039 are also projected to be reduced up to 11 percent and 14 percent along sections of FM 1960 and SH 105 respectively, as a result of the Build Alternative.

In general, minor arterials and collector roadways are projected to experience reduced traffic volumes as a result of the proposed Grand Parkway Segments H and I-1. Assuming the Build Alternative in 2039, FM 3180 is projected to experience a reduction in ADT of up to 67 percent. FM 3360, FM 2354, FM 1405, FM 563, FM 1410, and Roman Forest Boulevard, among others, are projected to experience a reduction in ADT of up to 39 percent.

Traffic volumes on some arterials and collectors are projected to increase with the construction of the Grand Parkway Segments H and I-1. For example, assuming the Build Alternative in 2039, FM 1413 is projected to experience a 3 percent increase in ADT, Tram (Galaxy) a 34 percent increase, West Lake Houston a 135 percent increase, and FM 686 a 258 percent increase. However, this is attributable to their unique function in the roadway network within the study area. As currently proposed, all of these roadways would provide direct access to the Grand Parkway, hence the projected increase in traffic volumes. Others, such as Spur 330 with a projected increase of 6 percent in 2039, do not have a direct connection to the Grand Parkway but serve as the primary roadway connection to roads such as SH 146 which connect to

the Grand Parkway. The projected increase in traffic volume along these roadways is therefore reflective of the desire of traffic to utilize the more efficient Grand Parkway Segments H and I-1 for longer trips.

Compromised Safety

A crash analysis was conducted to determine how travel safety would be affected by a new circumferential highway. According to TxDOT, highways have lower crash rates than lower classified roads due to the design of the highways, fewer access points, fewer driver distractions, and less stop-and-go conditions. Therefore, diverting traffic from collector roadways to a controlled-access facility such as Segments H and I-1, would be expected to reduce the crash rates within the study area.

Crash rates were previously calculated for roadways within the study area based on the number of crashes per 100 Million Vehicle Miles Traveled (MVMT). Crash rates are influenced by traffic volume, roadway segment length, roadway type, conditions, travel speed, and accessibility. Typically, roadways are considered to have a substantial crash problem when the crash rate is at least double the statewide average for that particular facility type. **Table 2-6** shows the roadways that were found to have a crash rate more than double the statewide average. The table also shows the amount of projected traffic that would be diverted by Segments H and I-1.

Table 2-6: Crash Rates within the Segments H and I-1 Study Area (2010 - 2012)

Roadway Segment	Limits	Length (Miles)	Crash Rate (crashes/ 100 MVMT)	Statewide Average (crashes/ 100 MVMT)	ADT and % Change with Construction of Segments H and I-1					
					2019			2039		
					No-Build ADT (vpd)	Build ADT (vpd)	% Change	No-Build ADT (vpd)	Build ADT (vpd)	% Change
FM 1485	US 59/I-69 to FM 2100	8.96	333.9	120.26	11,261	12,062	7%	14,792	18,536	25%
FM 3360	FM 565 to SH 146	2.28	364.5	120.26	1,672	1,512	-10%	3,970	1,494	-62%
FM 1314	Loop 494 to Andrew Lane	1.8	733.2	120.26	27,860	25,674	-8%	38,420	36,546	-5%
SH 321	US 90 to FM 1008	14.03	188.0	84.19	8,477	6,977	-18%	13,487	10,967	-19%
Loop 494	Northpark Dr to US 59/I-69	7.15	277.9	97.81	9,352	9,540	2%	15,191	15,591	3%

Note: This table includes facilities with crash rates more than or close to double the statewide average
Source: TxDOT, 2012

As shown in **Table 2-6**, traffic volumes on these roadways with high crash rates would be reduced by as much as 10 percent in 2019 and by as much as 62 percent in 2039. These are facilities that would have traffic diverted onto the proposed Segments H and I-1, thereby potentially improving safety. It should be noted that traffic along FM 1485 is projected to increase by approximately 7 percent in 2019 under the Build Alternative. The additional capacity would therefore be expected to positively impact crash rates.

Segments H and I-1 would provide additional evacuation capacity and a direct route to US 59 (N)/I-69, as well as connectivity to Grand Parkway Segment G. The No-Build Alternative does not address this need. During a hurricane or emergency evacuation, it is anticipated that tolls would be waived for the proposed Segments H and I-1.

2.3.2.4 Preferred Alternative Transportation Improvement Measures

The results of the traffic and transportation analysis for the Segments H and I-1 study area are summarized in **Chapter 1** with regard to discontinuous system linkage, decreased mobility, and compromised safety. The lack of infrastructure to support population growth was not included in the traffic and transportation analysis because this need is based on population projections instead of traffic projections.

Discontinuous System Linkage

The Segments H and I-1 study area is served by only two highways: US 59 (N)/I-69 and I-10 (E). US 59 (N)/I-69 provides north-south mobility on the northwestern edge of the study area, and I-10 (E) provides east-west mobility along the southern edge. Principal arterials include SH 146/SH 321, US 90, and FM 1960. SH 146 and SH 321 are two-lane, north-south roadways along the eastern edge of the study area. US 90 is a four-lane roadway and FM 1960 is a two-lane roadway. Both serve east-west movements in the study area.

No current facility connecting all major radial facilities exists in the Segments H and I-1 study area. Currently, travelers utilize FM 1485, FM 1960, FM 2100, and SH 146 to make such connections. Secondary roads include FM 3360, FM 1942, FM 1413, and FM 1314. The central portion of the study area is especially deficient in good transportation infrastructure to support north-south and circumferential mobility. Although the 2035 RTP Update identifies plans to upgrade some of the existing facilities, the roadway network would not be sufficient to handle the projected traffic volumes.

Decreased Mobility

Under the No-Build Alternative, which includes the existing roadway infrastructure and committed improvements, congestion on the roadway network would increase as the study area experiences growth. **Table 2-7** summarizes the percentage of roadway miles, by functional classification, operating at different levels of mobility for 2011, 2019, and 2039. The percent of interstate miles operating at a *tolerable* LOM is projected to decrease from 100 percent in 2011 to zero in 2039 under the No-Build Alternative, while the build alternatives maintain 13 percent at *tolerable* LOM. For minor arterials, the percentage operating at

serious and *severe* LOM is projected to improve from 79 percent (11 percent operating at an LOM of *serious* and 68 percent operating at an LOM of *severe*) under the No-Build Alternative to 66 percent (26 percent operating at an LOM of *serious* and 40 percent operating at an LOM of *severe*) assuming the Build Alternative in 2039.

Table 2-7: LOM by Percentage of Roadway Miles for Segments H and I-1 Traffic Study Area

LOM	2011 Base Year	2019		2039	
		No-Build	Build	No-Build	Build
Interstates					
Tolerable	100%	100%	100%	0%	13%
Moderate	0%	0%	0%	13%	26%
Serious	0%	0%	0%	87%	61%
Severe	0%	0%	0%	0%	0%
Principal Arterials					
Tolerable	75%	57%	68%	33%	25%
Moderate	16%	24%	0%	0%	0%
Serious	0%	19%	28%	16%	22%
Severe	9%	0%	0%	51%	53%
Proposed Grand Parkway					
Tolerable	N/A	N/A	100%	N/A	100%
Moderate	N/A	N/A	0%	N/A	0%
Serious	N/A	N/A	0%	N/A	0%
Severe	N/A	N/A	0%	N/A	0%
Minor Arterials					
Tolerable	85%	66%	77%	21%	26%
Moderate	15%	9%	1%	0%	8%
Serious	0%	10%	7%	11%	26%
Severe	0%	15%	15%	68%	40%
Collector Roadways					
Tolerable	100%	100%	100%	58%	64%
Moderate	0%	0%	0%	0%	8%
Serious	0%	0%	0%	20%	0%
Severe	0%	0%	0%	22%	28%
Total Roadway Miles					
Tolerable	86%	72%	82%	27%	28%
Moderate	11%	12%	0%	2%	8%
Serious	0%	11%	13%	26%	27%
Severe	3%	5%	5%	45%	37%

Source: H-GAC, 2012

Currently, 3 percent of all roadway miles within the study area operate at *serious* and *severe* LOM. Assuming that all programmed improvements are implemented, excluding the proposed Segments H and I-1, it is projected that 71 percent (26 percent operating at an LOM of *serious* and 45 percent operating at an LOM of *severe*) of the roadway miles within the study area would operate at *serious* and *severe* LOM by 2039, in contrast to the build alternatives for which only 64 percent (27 percent operating at LOM *serious* and 37 percent at LOM *severe*) would operate at *serious* and *severe* LOM. In addition, 29 percent (27 percent operating at LOM *tolerable* and 2 percent at LOM *moderate*) of all the roadway miles within the study area would operate at *tolerable* and *moderate* LOM by 2039 under the No-Build Alternative while construction of Segments H and I-1 would result in 36 percent (28 percent operating at LOM *tolerable* and 8 percent at LOM *moderate*) of all roadway miles within the study area operating at a *tolerable* and *moderate* LOM.

Compromised Safety

Nationally, highways have lower crash rates than lower classified roads due to the design of the highways, fewer access points, fewer driver distractions, and less stop-and-go conditions. Therefore, diverting traffic from collector roadways to a controlled-access facility, such as the proposed Segments H and I-1, is expected to reduce roadway crash rates within the study area. In addition, Segments H and I-1 would provide additional emergency evacuation capacity and a direct route to US 59 (N)/I-69, as well as connectivity to Grand Parkway Segment G. The No-Build Alternative does not address this need.

Conclusion

Given the above results, the build alternatives were advanced for further study. Although the No-Build Alternative would not satisfy the purpose and need of the proposed project, it was retained and utilized as the basis of comparison for the build alternatives and for further consideration as required by CEQ regulations. The next section summarizes analyses conducted for the individual build alternatives selected as reasonable alternatives within the Segments H and I-1 study area.

2.4 REASONABLE ALTERNATIVES

2.4.1 Description of Reasonable Alternatives

Refer to **Exhibit 2-5** for an illustration of the section alignments that create the reasonable alternatives described in detail below.

2.4.1.1 Alternative 1

The No-Build Alternative does not satisfy the purpose and need for the proposed improvements and it is not consistent with the 2035 RTP Update; however, FHWA (1987), TxDOT (2012), and CEQ (1978) guidelines for the preparation of environmental documents require that the No-Build Alternative be carried forward as the basis of comparison for all reasonable alternatives.

The No-Build Alternative involves the construction of other projects currently planned and programmed in the H-GAC's 2035 RTP Update. The No-Build Alternative would offer no additional capacity and only minor mobility improvements to the study area. In addition, the No-Build Alternative would not provide an additional evacuation route to enhance safety or provide additional infrastructure to support population growth.

2.4.1.2 Alternative 2

Alternative 2 combines Alignments A-2, B-1, and C-2, and is approximately 38.2 miles in length. Alternative 2 begins at Roman Forest Boulevard and US 59 (N)/I-69, approximately 1.5 miles north of FM 1485. After bridging over Loop 494 and the Union Pacific Railroad (UPRR), it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 2 traverses further east for approximately 9 miles before turning south and traversing 7 miles while crossing over the UPRR, FM 1960, and US 90 approximately 3 miles east of Dayton. Alternative 2 crosses FM 1413 and the UPRR and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at I-10 (E), 2 miles east of SH 146. All 38.2 miles of Alternative 2 would be on a new location. Alternative 2 would require approximately 1,852 acres (ac) of ROW.

2.4.1.3 Alternative 3

Alternative 3 combines Alignments A-2, B-1, and C-3, and is approximately 39.4 miles in length. Alternative 3 begins at Roman Forest Boulevard on US 59 (N)/I-69, approximately 1.5 miles north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 3 traverses further east for approximately 9 miles before turning south and traversing 7 miles while crossing over the UPRR, FM 1960, and US 90, approximately 3 miles east of Dayton. Approximately 3 miles south of US 90, Alternative 3 turns in a southwesterly direction, crossing FM 1413, and traversing south while staying west of the UPRR. It then turns east bridging over the UPRR, intersects with SH 146, FM 565 east of Mont Belvieu, and eventually

terminates at I-10 (E). All 39.4 miles of Alternative 3 would be on new location. Alternative 3 would require approximately 1,910 ac of ROW.

2.4.1.4 Alternative 4

Alternative 4 combines Alignments A-2, B-2, and C-2, and is approximately 35.4 miles in length. Alternative 4 begins at Roman Forest Boulevard on US 59 (N)/I-69, approximately 1.5 miles north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 4 traverses further east for approximately 1.5 miles before turning southeast for approximately 13 miles, crossing over the UPRR, FM 1960, and US 90 approximately 3 miles east of Dayton. Alternative 4 crosses FM 1413 and the UPRR, and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at I-10 (E), 2 miles east of SH 146. All 35.4 miles of Alternative 4 would be on new location. Alternative 4 would require approximately 1,716 ac of ROW.

2.4.1.5 Alternative 5

Alternative 5 combines Alignments A-2, B-2, and C-3, and is approximately 36.6 miles in length. Alternative 5 begins at Roman Forest Boulevard on US 59 (N)/I-69, approximately 1.5 miles north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 5 traverses further east for approximately 1.5 miles before turning southeast for approximately 13 miles, crossing over the UPRR, FM 1960, and US 90 approximately 3 miles east of Dayton. Approximately 3 miles south of US 90, Alternative 5 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the UPRR, intersects with SH 146, FM 565 east of Mont Belvieu, and eventually terminates at I-10 (E). All 36.6 miles of Alternative 5 would be on new location. Alternative 5 would require approximately 1,775 ac of ROW.

2.4.1.6 Alternative 6

Alternative 6 combines Alignments A-2, B-5, and C-6, and is approximately 35.4 miles in length. Alternative 6 begins at Roman Forest Boulevard on US 59 (N)/I-69, approximately 1.5 miles north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 6 traverses further east for approximately 1 mile before turning south where it traverses approximately 7 miles before crossing FM 1960 and the UPRR. It

continues southeast for approximately 6 miles to its crossing with US 90 near the Liberty/Harris County line. Alternative 6 traverses for another 6 miles southeast in Liberty and Harris counties before entering Chambers County. Alternative 6 then turns east north of Mont Belvieu, crosses the UPRR, SH 146, FM 565 east of Mont Belvieu, and eventually terminates at I-10 (E). All 35.4 miles of Alternative 6 would be on new location. Alternative 6 would require approximately 1,716 ac of ROW.

2.4.1.7 Alternative 7

Alternative 7 combines Alignments A-4, B-1, and C-2, and is approximately 39.7 miles in length. Alternative 7 begins at Community Drive on US 59 (N)/I-69, approximately 1.5 miles south of FM 1485. It then bridges over Loop 494 and the UPRR and continues east for approximately 3 miles. Alternative 7 then crosses Caney Creek before turning northeast near Peach Creek where it overlaps with FM 1485 north of the Lake Houston Wilderness Park for approximately 3.5 miles, crossing the East Fork San Jacinto River. Alternative 7 continues east of FM 1485 for roughly 10.5 miles before turning south and traversing 7 miles while crossing over the UPRR, FM 1960, and US 90, approximately 3 miles east of Dayton. Alternative 7 crosses FM 1413 and the UPRR and then travels south between the UPRR and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at I-10 (E), 2 miles east of SH 146. Approximately 3.5 miles of Alternative 7 follows existing FM 1485, with the remaining 36.2 miles on new location. Alternative 7 would require approximately 1,925 ac of ROW.

2.4.1.8 Alternative 8

Alternative 8 combines Alignments A-4, B-1, and C-3, and is approximately 41.0 miles in length. Alternative 8 begins at Community Drive on US 59 (N)/I-69, approximately 1.5 miles south of FM 1485. It then bridges over Loop 494 and the UPRR and continues east for approximately 3 miles. Alternative 8 then crosses Caney Creek before turning northeast near Peach Creek, where it overlaps with FM 1485 north of the Lake Houston Wilderness Park for approximately 3.5 miles, crossing the East Fork San Jacinto River. Alternative 8 continues east of FM 1485 for roughly 10.5 miles before turning south and traversing 7 miles while crossing over the UPRR, FM 1960, and US 90, approximately 3 miles east of Dayton. Approximately 3 miles south of US 90, Alternative 8 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over UPRR, crosses SH 146, FM 565 east of Mont Belvieu, and eventually terminates at I-10 (E). Approximately 3.5 miles of Alternative 8 follows existing FM 1485, with the remaining 37.5 miles on new location. Alternative 8 would require approximately 1,988 ac of ROW.

2.4.1.9 Alternative 9

Alternative 9 combines Alignments A-4, B-2 and C-2, and is approximately 36.9 miles in length. Alternative 9 begins at Community Drive on US 59 (N)/I-69, approximately 1.5 miles south of FM 1485. It then bridges over Loop 494 and the UPRR and continues east for approximately 3 miles. Alternative 9 then crosses Caney Creek before turning northeast near Peach Creek, where it overlaps with FM 1485 north of the Lake Houston Wilderness Park for approximately 3.5 miles, crossing the East Fork San Jacinto River. Alternative 9 continues east of FM 1485 for roughly 2.5 miles before turning southeast for approximately 13 miles, crossing over the UPRR, FM 1960, and US 90, approximately 3 miles east of Dayton. Alternative 9 crosses FM 1413 and UPRR and then travels south between the UPRR and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at I-10 (E), 2 miles east of SH 146. Approximately 3.5 miles of Alternative 9 follows existing FM 1485, with the remaining 33.4 miles on new location. Alternative 9 would require approximately 1,789 ac of ROW.

2.4.1.10 Alternative 10

Alternative 10 combines Alignments A-4, B-2, and C-3, and is approximately 37.4 miles in length. Alternative 10 begins at Community Drive on US 59 (N)/I-69, approximately 1.5 miles south of FM 1485. It then bridges over Loop 494 and the UPRR and continues east for approximately 3 miles. Alternative 10 then crosses Caney Creek before turning northeast near Peach Creek where it overlaps with FM 1485 north of the Lake Houston Wilderness Park for approximately 3.5 miles, crossing the East Fork San Jacinto River. Alternative 10 continues east of FM 1485 for roughly 2.5 miles before turning southeast for approximately 13 miles crossing over the UPRR, FM 1960, and US 90, approximately 3 miles east of Dayton. Approximately 3 miles south of US 90, Alternative 10 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the UPRR and crossing the Alternative 2 proposed location and SH 146, FM 565 east of Mont Belvieu, and eventually terminates at I-10 (E). Approximately 3.5 miles of Alternative 10 follows existing FM 1485, with the remaining 33.9 miles on new location. Alternative 10 would require approximately 1,813 ac of ROW.

2.4.1.11 Alternative 11

Alternative 11 combines Alignments A-4, B-5, and C-6, and is approximately 37.0 miles in length. Alternative 11 begins at Community Drive on US 59 (N)/I-69, approximately 1.5 miles south of FM 1485. It then bridges over Loop 494 and the UPRR and continues east for approximately 3 miles. Alternative 11 then crosses Caney Creek before turning northeast near Peach Creek where it overlaps with FM 1485

north of the Lake Houston Wilderness Park for approximately 3.5 miles, crossing the East Fork San Jacinto River. Alternative 11 continues east of FM 1485 for roughly 2.5 miles before turning south where it traverses approximately 7 miles before crossing FM 1960 and the UPRR. It continues southeast for approximately 6 miles to its crossing with US 90 near the Liberty/Harris County line. Alternative 11 traverses for another 6 miles southeast in Liberty and Harris counties before entering Chambers County and turning east where it joins the Alternative 2 proposed location north of Mont Belvieu crossing the UPRR, SH 146, FM 565 east of Mont Belvieu, and eventually terminates at I-10 (E). Approximately 3.5 miles of Alternative 11 follows existing FM 1485, with the remaining 33.5 miles on new location. Alternative 11 would require approximately 1,794 ac of ROW.

2.4.2 Evaluation of Reasonable Alternatives

The environmental criteria listed along the top of **Table 2-8** were used to evaluate the potential impacts of the reasonable alternatives on the natural and human environment. When possible, the CAT was used to quantify impacts. Desktop aerial interpretation with limited field visits for data verification facilitated the evaluation. The desktop aerial interpretation consisted of using a GIS software program to view mapped environmental constraints that were layered on top of the H-GAC aerial photographs of the study area. Input from the public, agencies (such as FHWA and TxDOT), and elected officials was also considered during the selection of Reasonable Alternative 10 as the Recommended Preferred Alternative prior to the release of the DEIS and public hearings. The reasonable alternatives were evaluated following FHWA Technical Advisory T 6640.8A guidance and other applicable regulations.

The public and elected agency officials supported the build alternatives versus the No-Build Alternative. All build alternatives that provided system connectivity with Grand Parkway Segments G and I-2 received positive feedback from the public. These included Reasonable Alternatives 7-11 (all including Preliminary Alternative A-4). Reasonable Alternative 8 (A-4, B-1, C-3) had the highest public and agency support.

Environmental evaluation criteria included: impacts to land use; total proposed ROW; visual and potential access impacts; impacts to natural resources including forested and non-forested wetlands, impaired and ecologically significant streams, threatened and endangered species, species of concern, wildlife habitat, floodways and 100-year (yr) floodplains, prime farmlands and century farms; impacts to cultural resources including recorded archeological sites, archeological high probability areas, historic resources, and cemeteries; impacts to air quality sensitive receptors and traffic noise receivers; socioeconomic impacts

including residential and commercial displacements, churches displaced, changes in community cohesion, and environmental justice issues; impacts to public and private water wells; and hazmat issues including regulated sites, oil and gas wells, and other sites of concern. All of these constraints were evaluated equally for comparison purposes in selection of the Recommended Preferred Alternative. Refer to **Table 2-8** for the matrix that documented the results of the reasonable alternatives environmental evaluation.

Engineering evaluation criteria included estimated ROW cost, major utility lines impacted, complexity of drainage consisting of the number and length of floodplain crossings and length of the corridor with limited access to outfalls, and finally construction cost, excluding ROW, utilities and special drainage facilities accounted for in the other three criteria. Refer to **Table 2-9** for a matrix with the results of the engineering evaluation for each of the reasonable alternatives.

Traffic and mobility evaluation criteria included: emergency evacuation consisting of evacuation efficiency, population served, and average study area travel speed; transportation system connections including average daily volume on the proposed alternative, regional VMT and street closures; travel efficiency measured by LOS on study area roadways, vehicle hours of travel reductions in study area and in region, and travel time on alternative; and conformance with transportation plans. Reasonable alternatives that would result in high numbers of street closures were considered less favorable than alternatives with low numbers of proposed street closures. Refer to **Table 2-10** for a matrix with the results of the traffic evaluation for each of the reasonable alternatives.

Table 2-8: Environmental Evaluation Matrix of Reasonable Alternatives

Reasonable Alternative	Length (miles)	Land Use												Natural Resources											Cultural Resources				Noise	Socioeconomic/EJ					Water Wells		Hazmat		
														Wetlands		Streams																								
		Commercial (acres)	Agricultural (acres)***	Residential (acres)	Schools (acres)	Churches (acres of parcels)**	Industrial (acres)	Preliminary Platted (acres)	Undeveloped Platted (acres)	Managed Lands (acres)	Other Undeveloped (acres)	Total Proposed ROW (acres)	Visual and Potential Access Impacts	Forested Wetlands (acres)	Non-Forested Wetlands (acres)	Impaired Streams Crossed	Ecologically Significant Streams Crossed	Threatened and Endangered Species	Species of Concern	Wildlife Habitat ****	Floodway	100-Year Floodplain (acres)	Prime Farmlands (acres)	Century Farms	Recorded Archeological Sites	Archeological High Probability Areas (acres)	Historic Resources	Cemeteries	Number of Representative Noise Receivers	Residential Displacements	Commercial Displacements	Churches Displaced	Changes in Community Cohesion	Environmental Justice Issues	Public	Private	Regulated Sites	Oil Wells	Other sites of Concern
1	0	0	0	0	0	0	0	0	0	0	0	0	No	0	0	-	-	-	-	0	0	0	0	-	0	0	0	0	0	0	0	0	No	No	0	0	0	0	0
2	38.2	0	1008	56	0	0	31	22	132	0	603	1852.1	Yes	4.4	40.9	-	2	-	-	674.9	38.5	84.1	906	-	0	1981	0	0	48	6	0	0	Yes	Yes	5	2	4	8	2
3	39.4	0	1058	56	0	0	34	22	132	0	608	1910.3	Yes	23.7	38.6	-	2	-	-	694.8	38.5	84.1	917	-	0	996	0	0	49	6	0	0	Yes	Yes	5	2	8	9	2
4	35.4	0	922	41	0	0	31	22	132	0	568	1716.4	Yes	2.8	19.1	-	2	-	-	635.5	46.4	129.0	900	-	0	1622	0	0	7	10	0	0	Yes	Yes	3	2	3	15	2
5	36.6	0	972	41	0	0	34	22	132	0	574	1774.5	Yes	22.1	16.8	-	2	-	-	655.4	46.4	129.0	911	-	0	1637	0	0	8	10	0	0	Yes	Yes	3	2	7	16	2
6	35.4	0	634	53	0	0	32	37	132	0	827	1715.0	Yes	27.3	23.1	3^	2	-	-	808.6	57.9	183.0	1071	-	0	1180	0	0	35	7	0	0	Yes	Yes	3	1	6	13	2
7	39.7	6	1008	152	0	7	35	0	0	0	717	1924.8	Yes	6.1	41.2	-	3	-	-	663.9	35.4	113.6	941	-	0	2040	1	0	120	37	3	2	Yes	Yes	9	3	7	8	4
8	41.0	6	1058	152	0	7	38	0	0	0	727	1987.9	Yes	25.4	38.8	-	3	-	-	683.7	35.4	113.6	952	-	0	2055	1	0	121	37	3	2	Yes	Yes	9	3	11	9	4
9	36.9	6	922	138	0	7	35	0	0	0	681	1789.1	Yes	4.5	19.3	-	3	-	-	824.4	43.3	158.6	935	-	0	1681	1	0	79	41	3	2	Yes	Yes	7	3	6	15	4
10	37.4	6	972	138	0	7	29	0	0	0	595	1813.3	Yes	23.8	17.0	-	3	-	-	644.3	36.2	158.6	946	-	0	1696	1	1	80	41	3	2	Yes	Yes	7	3	10	16	4
10R*	37.4	7	1072	130	2	3	22	0	0	11	687	1813.3	Yes	26.5	15.5	-	3	-	-	664.75	43.26	158.6	960	-	0	1696	1	0	38	77	19	1	No	No	7	0	9	11	9
11	37.0	6	634	150	0	7	36	16	0	0	944	1793.9	Yes	28.9	23.3	3^	3	-	-	797.5	54.5	212.5	1106	-	0	1239	1	0	107	38	3	2	Yes	Yes	7	2	9	13	4

Source: Study Team, 2007

^ The same stream (Cedar Bayou) is crossed 3 different times

"-" No resource located within alternative

* Preferred Alternative

** 7 acres of church parcels consist of 2 separate parcels that contain 1 church each that would be displaced; 10R would displace 3 acres of church property, but only one church structure

*** Acreages have been determined using H-GAC data

**** Acreages presented are a summary of wetlands, forested wetlands, non-forested wetlands, and forested areas. These acreages exclude agricultural land

Table 2-9: Engineering Evaluation Matrix of Reasonable Alternatives

Data Category		Data Description	Reasonable Alternatives										
			1	2	3	4	5	6	7	8	9	10	11
			No-Build	A-2 B-1 C-2	A-2 B-1 C-3	A-2 B-2 C-2	A-2 B-2 C-3	A-2 B-5 C-6	A-4 B-1 C-2	A-4 B-1 C-3	A-4 B-2 C-2	A-4 B-2 C-3	A-4 B-5 C-6
ROW	Cost	Total cost of ROW required from different land uses (in Millions)	0.00	8.28	8.77	7.79	8.28	8.93	12.95	13.44	12.46	12.95	13.60
UTILITIES	Major Utility Lines	Major Pipelines, Electric Transmission Lines (Number of Crossings)	0	313	492	313	492	456	318	497	318	497	461
DRAINAGE	Outfall Spacing	Total length of sections between canals with inadequate outfalls (in Miles)	0.00	22.00	23.10	13.90	15.00	3.60	22.00	23.10	13.90	15.00	3.60
	Number of Floodplain Crossings	Total number of sites requiring mitigation for fill in floodplain	0	5	5	7	7	13	5	5	7	7	13
	Total Length of Floodplain Crossings	Total length of floodplain crossings indicating amount/cost of mitigation (in Miles)	0.00	2.61	2.61	3.47	3.47	5.28	2.94	2.94	3.79	3.79	5.67
CONSTRUCTION	Cost	Roadway, Bridges, Ret Walls, Ditches, Signing, Lighting, TCP, Misc (in Millions)	0.00	506.80	513.50	497.90	504.60	516.20	526.00	532.70	517.20	523.90	535.50

Source: Study Team, 2007

Table 2-10: Traffic Evaluation Matrix of Reasonable Alternatives

Criteria	Measure	Reasonable Alternatives										
		1	2	3	4	5	6	7	8	9	10	11
		No-Build	A-2 B-1 C-2	A-2 B-1 C-3	A-2 B-2 C-2	A-2 B-2 C-3	A-2 B-5 C-6	A-4 B-1 C-2	A-4 B-1 C-3	A-4 B-2 C-2	A-4 B-2 C-3	A-4 B-5 C-6
Emergency Evacuation	Evacuation efficiency (Qualitative)		Medium	Medium	Medium	Medium	Medium	High	High	High	High	High
	Population Served (persons)		76,900	74,100	77,800	75,000	106,200	106,800	104,000	107,700	104,900	136,100
	Average Study Area Travel Speed (mph)	41.0	44.1	43.9	43.9	44.0	44.2	44.1	44.0	44.0	44.0	43.5
Transportation System Connections	Average Daily Volume on the Grand Parkway H and I-1 (vpd)		12,533	11,203	17,729	16,480	17,908	14,467	13,263	19,591	18,312	19,236
	Regional VMT Reduction (over No-Build)		-8,065,600	-7,962,900	-7,979,500	-8,003,400	-7,923,400	-8,060,000	-8,080,800	-7,951,000	-8,095,100	-7,918,700
	Street Closures		29	30	30	31	39	10	11	11	12	20
Travel Efficiency	LOS by Study Area Roadway Miles											
	% Roadway Miles LOS A-C	19%	39%	39%	40%	41%	40%	38%	39%	39%	42%	41%
	% Roadway Miles LOS E-F	65%	46%	47%	50%	49%	48%	47%	47%	50%	48%	49%
	VHT Reduction (over No-Build)											
	Study Area VHT Reduction		-2,700	-2,800	-2,600	-3,400	-2,500	-3,400	-3,600	-3,300	-3,727	-1,200
	Regional VHT Reduction		-347,100	-338,700	-343,400	-342,600	-338,700	-348,900	-346,900	-342,000	-340,614	-341,300
	Travel Time (minutes) on Grand Parkway		36.0	37.0	33.7	34.7	34.1	33.4	34.4	31.1	32.0	31.5
Coformance with Transportation Plans	Degree of Conformity/Compliance	0.0	Medium	Medium	Medium	Medium	Medium	High	High	High	High	High

Source: Study Team, 2007

2.5 RECOMMENDED ALTERNATIVE AND PREFERRED ALTERNATIVE

During the evaluation of the reasonable alternatives, emphasis was placed on criteria distinguishing those alternatives which best met the proposed project's purpose and need. The traffic/mobility criteria provided the strongest measure with regard to meeting the purpose and need, while the engineering and environmental criteria provided a measure of cost. These combined criteria provided a measure of comparison for each reasonable alternative. However, in most instances, the differences in the engineering and environmental evaluation were not large enough to clearly distinguish one particular alternative over another. The alternatives discussed below did not meet the evaluation criteria and were eliminated from further consideration. Refer to **Table 2-8**, **Table 2-9**, and **Table 2-10** for the evaluation matrices comparing the impacts for each of the alternatives discussed below.

2.5.1 Reasonable Alternatives Not Recommended

Reasonable Alternatives 2 through 6 were not recommended because they have undesirable traffic and mobility effects as a result of a lack of connectivity with Grand Parkway Segment G and, therefore, provide a lower level of regional transportation system connectivity. Reasonable Alternatives 2 through 6 are located far north of the Lake Houston Wilderness Park and do not improve access to the park. Improved access was requested by the City of Houston during the study. These alternatives also traverse through the Roman Forest residential neighborhood and would have a higher number of street closures.

Reasonable Alternatives 2, 3, 7, and 8 were not recommended because they are located near the northeastern limits of the study area, thereby attracting fewer travelers than alternatives more centrally located within the study area. These alternatives included the B-1 alignment, which when modeled, caused longer travel times than the other alternatives and approximately 5,000 to 6,000 fewer vpd than the other alternatives.

Reasonable Alternatives 2, 4, 7, and 9 are confined between the UPRR and SH 146. This narrow area is constrained with very limited grade separations to cross the UPRR. The area east of the railroad is currently served by SH 146, but there is no major roadway which serves the area immediately west of the UPRR. These alternatives do not adequately serve the large portion of the study area west of the railroad and may hinder additional forecasted development, and, thus, were eliminated from further consideration.

Alternatives 6 and 11 were not recommended due to the substantially higher number of floodplain impacts throughout the study area and particularly in the vicinity of Cedar Bayou near the Liberty/Harris County line. These impacts would result in a greater amount of floodplain mitigation, detention ponds, and longer bridges, all resulting in higher costs.

2.5.2 Selection of the Recommended and Preferred Alternative

After careful review of public and agency input and environmental, engineering, and traffic criteria, Reasonable Alternative 10 (A-4, B-2, C-3) was selected as the Recommended Alternative to be carried forward into the FEIS for further detailed evaluation (**Exhibit 2-6**). A discussion of the reasons for selection of Alternative 10 is discussed below.

The northern portion of the Recommended Alternative provides direct connectivity with Grand Parkway Segment G. This connection to Segment G is important as it allows traffic direct access to I-45 which is officially designated as an evacuation route. Without a direct connection to Segment G, evacuating traffic from Segment H headed to I-45 would have to exit onto US 59 (N)/I-69 and travel south in order to get to Grand Parkway Segment G. The southern portion of the Recommended Alternative also provides a direct connection to Grand Parkway Segment I-2. This also provides improved connectivity during evacuations.

Description of the Recommended Alternative Alignment

On the north end, the Recommended Alternative follows the existing FM 1485 alignment. This is beneficial for the Lake Houston Wilderness Park as it provides direct access for traffic to and from the Grand Parkway Segments H and I-1. An important benefit of the Recommended Alternative on the north end is the safety improvement to FM 1485. The Recommended Alternative includes the reconstruction of FM 1485 from a two-lane roadway, to a pair of one-way non-tolled frontage roads with two travel lanes in each direction on either side of the Grand Parkway Segments H and I-1 toll facility. In addition to increasing the capacity on FM 1485, the Recommended Alternative is projected to reduce the ADT on FM 1485 from 28,800 vpd in 2039 under the No-Build Alternative to 22,400 vpd in the Build Alternative. The increase in capacity for FM 1485 and the reduction in traffic volume would result in a reduction in the crash rate and an improvement in safety. These benefits are applicable to Reasonable Alternatives 7-11. The central portion of the Recommended Alternative is located closer to the center of the study area, which has the benefit of serving a greater portion of the study area. This is directly reflected by the higher travel demand attracted by Reasonable Alternatives 4, 5, 6, 9, 10, and 11. This is evident when comparing Reasonable Alternative 8

and the Recommended Alternative, for example. These alternatives follow the same alignment in the north and south and the only difference is in the central portion of the alternative where Reasonable Alternative 8 is comprised of Preliminary Alternative B-1 (closer to Dayton) and the Recommended Alternative is comprised of Preliminary Alternative B-2. The weighted average daily traffic volume for the Recommended Alternative as a whole is 5,000 vpd more than for Reasonable Alternative 8 in the year 2039.

The southern portion of the Recommended Alternative lies west of the UPRR, improving transportation system connections for what is currently an underserved area. With SH 146 located east of the UPRR, a new facility located west of the UPRR would help support the economic growth this area is anticipated to experience in the future. Location of the proposed Grand Parkway Segments H and I-1 at a distance greater than 1 mile from SH 146 would better complement the area transportation network than having the Grand Parkway Segments H and I-1 either along or immediately adjacent to the existing SH 146 facility. As such, the Recommended Alternative, which passes west of the UPRR and SH 146, is more favorable than Reasonable Alternatives 2, 4, 7 and 9, which all pass between the UPRR and SH 146. The Recommended Alternative is also more favorable than Reasonable Alternatives 6 and 11, the western-most corridors closer to Cedar Bayou, due to the floodplain and drainage impacts associated with these alternatives. All of the benefits described in the southern portion of the study area are realized by Reasonable Alternatives 3, 5, 8 and 10.

Considering the benefits in the northern, central, and southern portions of the study area discussed above, the Recommended Alternative is the alternative which best realizes the benefits described in all three portions of the study area.

The Recommended Alternative (A-4, B-2, C-3) is proposed as a four-lane rural controlled-access toll road on new location and would meet the purpose and need of the proposed project. The Recommended Alternative would begin at US 59 (N)/I-69 and continue to I-10 (E), and would consist of an open-ditch design within a 400-ft wide ROW. Refer to **Exhibit 2-7** for a proposed typical section for Segments H and I-1. The Recommended Alternative is proposed as a toll road in order to be consistent with the H-GAC 2035 RTP Update that identifies the addition of tolled facilities, including the Grand Parkway Segments H and I-1, as necessary to address congestion and future growth in the H-GAC planning region.

2.5.3 Selection of the Preferred Alternative

Subsequent to the August 2011 public hearings, coordination with the public, stakeholders and adjacent property owners resulted in a slightly modified or revised alignment of Recommended Alternative 10 to create the Preferred Alternative 10R (**Exhibit 2-8**)**.** The primary goal in the consideration of an alignment revision was to continue to practice avoidance as well as working with property owners to determine the alignment that best fit the purpose and need of the proposed project as well as accommodating the property owners' plans for their tracts. A Meeting with Affected Property Owners (MAPO) was held in May 2013 to present an alignment shift in the proximity of FM 1960. This alignment shift was made to address comments received from the public hearing, as well as the opportunity to practice avoidance of impacts to residential properties. The MAPO was held to inform the newly impacted property owners of the alignment shift. The property owners that were previously impacted were also invited to attend the meeting. The Preferred Alternative 10R has been carried forward into the FEIS for further detailed evaluation.

Description of the Preferred Alternative Alignment Revisions

The revisions creating the Preferred Alternative 10R include two separate alignment revisions on FM 1485, two separate alignment revisions due to development north and south of FM 1960, and two separate alignment revisions south of US 90 as detailed below. The Preferred Alternative includes the reconstruction of FM 1485 from a two-lane roadway, to a pair of one-way non-tolled frontage roads with two travel lanes in each direction on either side of the Grand Parkway Segments H and I-1 toll facility.

- An alignment revision on FM 1485, approximately 0.67 miles in length, is necessary to avoid a cemetery that was previously not identified within the ROW presented in the DEIS Recommended Alternative.
- A second revision on FM 1485 begins at the Harris County line and shifts the alignment north by approximately 3,500 ft for a distance of 3.95 miles. This revision was requested to accommodate planned development within the Houston Green Land Tract.
- An alignment revision extending on both sides of FM 1960 is needed to avoid new development and reduce impacts, and is approximately 2.96 miles in length.
- An alignment revision between FM 1960 and US 90 totals approximately 1.11 miles in length and would avoid potential displacements shown in the DEIS Recommended Alternative. This change shifts the alignment on the same property parcels.
- The alignment revision south of US 90 and north of FM 1413 totals 2.28 miles in length and is necessary to provide better alignment geometry due to a previous avoidance constraint being removed while still remaining within the original tract.

- An alignment revision south of US 90 begins just south of FM 1413 within the original tract and continues approximately 3.72 miles south to the Chambers County line. This revision was requested to accommodate planned rail development on the original tract.

Access has been reviewed for conflicts, and local access roads or frontage roads would be added where necessary to maintain local road connectivity. Alternative 10R is the alternative which best realizes the benefits described in all three portions of the study area. Refer to **Table 2-11** for the evaluation matrix comparing the impacts for the Recommended and Preferred Alternatives.

Preferred Alternative 10R is proposed as a four-lane rural controlled-access toll road on new location and would fulfill the purpose and need of the proposed project. The Preferred Alternative 10R would begin at US 59 (N)/I-69 and continue to I-10 (E) and would consist of an open-ditch design within a 400-ft wide ROW. The total length of the Preferred Alternative 10R is approximately 37.4 miles, and would require approximately 1,933 ac of ROW. Refer to **Exhibit 2-7** for a proposed typical section for Segments H and I-1.

The Preferred Alternative 10R is proposed as a toll road in order to be consistent with the H-GAC 2035 RTP Update that identifies the addition of tolled facilities, including the Grand Parkway Segments H and I-1, as necessary to address congestion and future growth in the H-GAC planning region. The estimated construction cost for the proposed Segments H and I-1, per the 2035 RTP Update (January 25, 2011), is approximately $1.2 billion. Construction for Phase I is estimated to begin in 2016, with a projected opening year of 2019. Construction of the ultimate project would be completed with construction of Phase II, with a projected construction completion year and open to traffic in 2025.

Table 2-11: Environmental Impact Summary for the Recommended and Preferred Alternatives*

		Environmental Impact	Recommended Alternative 10	Preferred Alternative 10R
		Total Project Length (miles)	37	37
		Total Project ROW (acres)	1,813	1,933
Land Use		Commercial (acres)	6	7
		Agricultural (acres)	1,038	1,072
		Residential (acres)	138	130
		Government Building (ac)	0	2
		Churches (acres)	7	3
		Industrial (acres)	29	22
		Preliminary Platted (acres)	0	0
		Undeveloped Platted (acres)	0	0
		Managed Lands (acres)	0	11
		Other Undeveloped (acres)	535	537
		Visual and Potential Access Impacts (yes/no)	Yes	Yes
Natural Resources	Wetlands	Forested Wetlands (acres)	24	27
		Non-Forested Wetlands (acres)	17	16
		Agricultural wetlands (acres)	228	285
	Streams	Impaired Streams Impacted (number)	0	0
		Ecologically Significant Streams Crossed (number)	3	3
		Threatened and Endangered Species (number)	0	0
		Species of Concern (number)	0	0
		Wildlife Habitat (acres)	644	665
		Floodway (acres)	43	43
		100-Year Floodplain (acres)	159	158
		Prime Farmland (acres)	947	960
		Century Farms (acres)	0	0
Cultural Resources		Recorded Archaeological Sites (number)	0	0
		Archeological High Probability Areas (acres)	1,696	1,696
		Historic Resources (number)	1	1
		Cemeteries (number)	1	0
Noise		Representative Noise Impacts (number)	80	38
Socioeconomic/ EJ		Residential Displacements (number)	41	77
		Commercial Displacements (number)	5	19
		Churches Displaced (number)	2	1
		Changes in Community Cohesion (yes/no)	Yes	No
		Environmental Justice Issues (yes/no)	Yes	No
Water Wells		Public (number)	7	7
		Private (number)	3	0
HazMat		Regulated Sites (number)	10	9
		Oil Wells (number)	16	11
		Other Sites of Concern (number)	4	9

Source, Study Team, 2013
*The values within this table have been updated to reflect the analysis impacts discussed in Chapter 4