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## CHAPTER 6 CUMULATIVE IMPACTS

This chapter examines the cumulative impacts of the proposed Grand Parkway Segments H and I-1. The Council on Environmental Quality (CEQ) has established regulations for implementing provisions of the National Environmental Policy Act (NEPA). The CEQ regulations direct agencies to assess the potential for project-related direct, indirect, and cumulative impacts. This analysis follows the requirements and process outlined in 23 Code of Federal Regulations (CFR) 771, the Federal Highway Administration (FHWA) Technical Advisory 6640.8A, the Transportation Research Board's (TRB) National Cooperative Highway Research Program (NCHRP) *Report 466: Desk Reference for Estimating the Indirect Effect of Proposed Transportation Projects* (TRB, 2002), *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ, 1997), *Questions and Answers Regarding the Consideration of Past Actions in Cumulative Effects Analysis* (FHWA, 2003), CEQ's memorandum *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ, 2005), the Texas Department of Transportation's (TxDOT) *Guidance on Preparing Indirect and Cumulative Impact Analyses* (TxDOT, 2006), and *Revised Guidance on Preparing Indirect and Cumulative Impact Analyses* (TxDOT, 2010).

A FHWA and TxDOT indirect and cumulative impacts (ICI) workshop was held in October 2008 that resulted in additional ICI guidance which influenced the preparation of this Final Environmental Impact Statement (FEIS). This evaluation of cumulative impacts follows the guidance from the 2008 workshop and the eight steps in TxDOT's *Revised Guidance on Preparing Indirect and Cumulative Impact Analyses* (September 2010).

### 6.1 TYPES OF IMPACTS: DIRECT, INDIRECT, AND CUMULATIVE

As shown in **Table 6-1**, there are three types of impacts that may be caused by a roadway project: direct, indirect, and cumulative. Direct impacts are those impacts which are caused by the action and occur at the same time and place (40 CFR § 1508.8). Indirect impacts are those impacts which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR § 1508.8). CEQ regulations define a cumulative impact as an impact which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR § 1508.7).

**Table 6-1: Distinction Between Types of Impact**

Type of Impact	Direct	Indirect	Cumulative
Nature of Impact	Typical/Inevitable/Predictable	Reasonably Foreseeable/Probable	Reasonably Foreseeable/Probable
Cause of Impact	Project	Project's Indirect Impacts	Project's Direct and Indirect Impacts and Impacts of Other Activities
Timing of Impact	Project Construction and Implementation	At Some Future Time Other Than Direct Impact	At Time of Project Construction, in the Future or in the Past
Location of Impact	At the Project Location	Within Boundaries of System Affected by the Project	Within Boundaries of System Affected by the Project

Source: NCHRP Report 466, 2002

Direct impacts are discussed and identified in **Chapter 4 (Environmental Consequences)** and indirect impacts are discussed in **Chapter 5 (Indirect Impacts)**. This chapter focuses on an analysis of cumulative impacts that were considered with the proposed project.

## 6.2 METHODOLOGY

Relatively minor individual impacts may collectively result in substantial cumulative impacts, and project-related direct and indirect impacts must be analyzed in the context of non-project-related impacts that may affect the same resources. Cumulative impacts are the incremental impacts that the project's direct or indirect impacts have on a resource in the context of the myriad of other past, present, and future impacts on that resource from related or unrelated activities. This analysis of cumulative impacts relies heavily on both existing land use impacts and the anticipated land use changes anticipated to occur in the project area and the impacts these changes would have on the resources considered in this analysis.

The cumulative impacts analysis allows the decision maker to evaluate the incremental impacts of any one of the proposed reasonable alternatives in light of the overall health and abundance of selected resources. In essence, a cumulative impacts evaluation creates a model of the predicted condition of each resource that is independent of the proposed project, and then analyzes the expected direct and indirect impacts or other past, current, or planned projects in the same area of the project within that context to determine if there is a cumulative effect. The evaluation process for each resource considered may be expressed in shorthand form as follows:

**BASELINE CONDITION + PROJECT IMPACTS + FUTURE EFFECTS = CUMULATIVE IMPACTS**  
 (historical and current) (direct and indirect) (expected projects)

The evaluation of cumulative impacts follows the eight steps in TxDOT's *Revised Guidance on Preparing Indirect and Cumulative Impact Analyses* (September 2010). To conduct the cumulative impact analysis it was essential to build on information derived on the direct and indirect impacts analyses. Unlike direct impacts, quantifying indirect and cumulative impacts may be difficult, since a large part of the analysis requires an eye to the future and what may happen in the study area. This eight-step approach was utilized to assess the potential cumulative impacts of the past, present, and reasonably foreseeable actions on the resources in the proposed study area. The eight-step methodology from TxDOT's *Revised Guidance* was utilized to assess the potential cumulative impacts of the past, present, and reasonably foreseeable actions to the resources in the project area and is depicted in **Table 6-2**.

**Table 6-2: TxDOT Eight-Step Approach to the Cumulative Impacts Analysis**

Step No.	Step
1	Identify the resources to consider in the analysis.
2	Define the study area for each affected resource.
3	Describe the current health and historical context for each resource.
4	Identify direct and indirect impacts that may contribute to a cumulative impact.
5	Identify other reasonably foreseeable actions that may affect resources.
6	Assess potential cumulative impacts to each resource.
7	Report the results.
8	Assess and discuss mitigation issues for all adverse impacts.

Source: Revised Guidance on Preparing Indirect and Cumulative Impact Analyses. TxDOT, September 2010

Steps 1 through 6 will be applied to each resource. Once each resource is analyzed, Steps 7 and 8 will follow and address all identified resources. The methodology used to prepare this evaluation is also in accordance with guidance from the CEQ, *Considering Cumulative Effects under the National Environmental Policy Act* (1997).

**Identify Resources (Step 1)**

**Step 1:** All of the resource categories considered in this FEIS were candidates for analysis with regard to indirect and cumulative impacts. The initial step of the cumulative impacts analysis uses information from the evaluation of direct and indirect impacts in the selection of environmental resources that should be evaluated for cumulative impacts. TxDOT's *Revised Guidance* states: "If a project will not cause direct or indirect impacts on a resource, it will not contribute to a cumulative impact on the resource. The cumulative impact analysis should focus only on: (1) those resources substantially impacted by the project; and (2) resources currently in poor or declining health or at risk even if the project impacts are relatively small (less

1 than significant).” Similarly, the CEQ guidance recommends narrowing the focus of the cumulative impacts  
2 analysis to important issues of national, regional, or local significance. This narrowing of focus would help  
3 produce a thoughtful analysis of the relevant issues of importance. Thus, the cumulative impacts analysis  
4 should focus only on the resources that are substantially affected by the proposed project by direct and/or  
5 indirect impacts. The extent to which a resource is affected is a function of the existing abundance and  
6 condition of the resource and would include resources that are currently in poor or declining health or that  
7 are at risk even if the proposed project impacts would not be substantial.

8  
9 As recommended by the CEQ guidance, specific indicators of each resource’s condition are identified and  
10 shown in **Table 6-3**. The use of indicators of a resource’s health, abundance, and/or integrity are helpful  
11 tools in formulating quantitative or qualitative metrics for characterizing overall impacts to resources. These  
12 indicators are also key aspects of each resource that have already been evaluated in terms of the project’s  
13 direct and indirect impacts associated with the Preferred Alternative and facilitate greater consistency and  
14 objectivity in the analysis of cumulative impacts.

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**Table 6-3: Resources Considered for the Cumulative Impacts Analysis**

Resource Category/Issue	Summary of Existing Resource Condition and Potential Impacts			Additional Concerns Raised During Project Development	Permitting or Mitigation Necessary?	Cumulative Impact "Triggers"		
	Existing Condition/ Current Health of Resource	Preferred Alternative Direct Impacts	Preferred Alternative Indirect Impacts			Would the resource be substantially impacted by the project?	Is the resource currently in poor or declining health or at risk even if anticipated impacts are less than substantial?	
Land Use	Changing – Historically, a highly disturbed study area due to farming, timbering, petro-chemical industrial activities. The existing land use continues to change due to increasing development. Changing land use from undeveloped to developed could contribute to the decline in the health of natural resources.	Conversion of 1,933 acres (ac) of undeveloped land to developed land.	Conversion of approximately 25,944 ac within the indirect impacts area of influence (AOI) as a result of the induced development anticipated as a result of the Preferred Alternative. Induced development in the study area would be consistent with all state and local government plans and policies.	Concerns over impacts to this resource were raised during the scoping for this project.	No	Yes	Yes	
Socio-economic	Community Impacts	Changing – Rural lifestyle is being replaced by expanding Houston metropolitan area. Land would continue to be converted to residential and commercial uses as area population increases.	A total of 98 potential displacements are anticipated from construction of the Preferred Alternative. These displacements include 77 residential properties, 1 church, 19 commercial properties, and 2 utility displacements.	In the study area, rural areas are expected to continue to transition slowly to a suburban setting. New development provides potential for new jobs and increased economic utility.	Individual concerns over loss of community connectivity and rural lifestyle.	No	No	No
	Environmental Justice	The EJ population of the Metropolitan Planning Organization (MPO) area is growing. Impacts to the community are stable. The passage of Title VI of the Civil Rights Act of 1964 ensures that "No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."	Although low-income, minority, and LEP populations are present within the study area, it is not anticipated that they would experience disproportionately high and adverse human health or environmental impacts. The origin-destination analysis indicated the majority of trips anticipated to utilize the Preferred Alternative would not originate from areas identified with high concentrations of environmental justice populations. Non-toll options exist for those who elect or can only afford on an occasional basis to pay tolls to access the tolled mainlanes.	Induced land development could create additional job opportunities and increased access to job opportunities through enhanced transportation infrastructure. Indirect impacts pertaining to public facilities and services, traffic operations, and traffic noise would be experienced by the environmental justice population to the same extent and in the same manner (whether positive or negative) as experienced by the non-environmental justice population.	Environmental justice was not identified as an issue of concern.	No	No	Yes
Pedestrians and Bicyclists	Based on review of the 2013-2016 Transportation Improvement Plan (TIP) Bicycle and Pedestrian Project section, no pedestrian or bicyclist improvements are planned for Grand Parkway Segments H and I-1 study area.	Grand Parkway Segments H and I-1 would accommodate access to "Proposed Shared-Use Path/Trails" as identified in Houston-Galveston Area Council (H-GAC)'s Regional Bikeway Plan. These include a shared-use path/trail along Farm to Market Road (FM) 2100. These "Proposed Shared-Use Path/Trails" would begin near the intersection of FM 2100 with Huffman-Cleveland Road on the western edge of the study area, approximately 3 miles west of the Preferred Alternative, and head south. The Preferred Alternative would not adversely impact any existing bicycle or pedestrian network. No new bicycle or pedestrian facilities are proposed for the controlled access portion of the facility. The restriction of bicycle and pedestrian use of a controlled-access facility is permitted under Texas Transportation Code 545.0651.	The Preferred Alternative would not indirectly impact existing pedestrian or bicyclist facilities. In the event that a bicycle or pedestrian facility is in place prior to the construction of the proposed project, the facility would be reconstructed to maintain continuity and function.	Pedestrians and bicyclists were not identified as an issue of concern.	No	No	No	
Visual and Aesthetic Qualities	Changing – Transition from a rural to suburban/developed landscape.	The proposed project would be predominately at-grade with vegetated shoulders, right-of-way, and medians. The roadway and landscape design would be consistent with the TxDOT Houston District's Green Ribbon Project.	Both positive and negative indirect impacts could result. A properly designed lighting system would minimize negative light pollution aspects and would increase the social and economic benefits to the public. Other indirect visual and aesthetic effects may be related to induced development. These impacts may include a change in viewshed or ambient light within the AOI. Indirect visual and aesthetic impacts within the AOI are anticipated to be minor.	Impacts to visual or aesthetic quality are not a substantial environmental concern associated with the proposed project.	No	No	No	

Resource Category/Issue	Summary of Existing Resource Condition and Potential Impacts			Additional Concerns Raised During Project Development	Permitting or Mitigation Necessary?	Cumulative Impact "Triggers"		
	Existing Condition/ Current Health of Resource	Preferred Alternative Direct Impacts	Preferred Alternative Indirect Impacts			Would the resource be substantially impacted by the project?	Is the resource currently in poor or declining health or at risk even if anticipated impacts are less than substantial?	
Soils and Farmlands	Farmland resources are declining - Land use would continue to be converted within the study area due to growth.	The Preferred Alternative may impact up to 960 ac of prime farmland soils. Completion of the formal CPA-106 NRCS form indicates no substantial direct impacts from any of the alternatives associated with the conversion of farmland soils.	There is a potential for 14,394 ac of farmlands to be converted under the Preferred Alternative. However, completion of the CPA-106 NRCS form indicates formal coordination with the NRCS is not necessary.	Coordination with the NRCS was not required by the completion of CPA-106. However, coordination will occur for approval of CPA-106 scoring.	No	No	No - While the area continues to see a change in land use, the NRCS has not determined this to be a substantial decline.	
Air Quality	CO and Ozone	<p>Currently in poor condition.</p> <p>The MPO Houston-Galveston-Brazoria (HGB) eight-county area is currently in attainment for CO. However, it is classified to be in marginal nonattainment for the eight-hour ozone National Ambient Air Quality Standards (NAAQS). Texas has made significant progress over the past 15 years in addressing ozone in the HGB eight-county area. These decreases are expected to continue despite a rapid growth in the area's economy and population.</p>	<p>Decrease in congestion on existing roadways systems would likely benefit air quality. According to studies conducted by H-GAC and the Texas Commission on Environmental Quality (TCEQ), and based on ambient air monitors managed by TCEQ and approved by the Environmental Protection Agency (EPA), the one-hour and eight-hour ozone concentrations for the HGB eight-county area from 1991 to 2005 have decreased 23 and 13 percent, respectively, over the 15 year period between 1991 and 2005. These decreases occurred despite a 36% increase in area population.</p> <p>Based on previous analyses of similar projects, it is unlikely that the CO standard would be exceeded as a result of the Preferred Alternative.</p> <p>The Houston-Galveston-Brazoria (HGB) eight-county region is included in the area's financially constrained 2035 RTP Update, as revised, and the 2013-2016 TIP, which were found to conform to the SIP by FHWA/FTA on January 25, 2011 and November 1, 2012, respectively.</p>	<p>No change in attainment status is anticipated within the study area as a result of emissions associated with the proposed project. The proposed project is not anticipated to result in indirect impacts to air quality.</p> <p>Indirect air quality impacts from MSAT are unquantifiable due to existing limitations to determine pollutant emissions, dispersion, and impacts to human health. Emissions would likely be lower than present levels in future years as a result of the EPA's national control regulations. Even with an increase in vehicle miles traveled and possible temporary emission increases related to construction activities, the EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial reductions of on-road emissions over time, including CO, MSAT, and the ozone precursors VOC and NOx.</p>	<p>Concerns over region air quality were raised during public meetings and meetings with the H-GAC.</p>	<p>Yes, transportation conformity rules apply. The project must be included in a conforming financially constrained RTP and corresponding TIP.</p>	No	Yes
	Mobile Source Air Toxics (MSAT)	Based on an FHWA analysis using EPA's MOVES2010b model, even if vehicle-miles travelled (VMT) increases by 102% as assumed from 2010 to 2050, a combined reduction of 83% in the total annual emissions for the priority MSAT is projected for the same time period.	The localized level of MSAT emissions for the Build Alternative could be higher relative to the No-Build Alternative.		The general public, resource agencies, and/or the Study Team's technical experts identified concerns related to air quality, specifically MSAT.	No		
Water Quality	Overall water quality is improving nationwide since the implementation of the CWA in 1972. Watersheds within the Resource Study Area (RSA) contain streams listed on the 2010 303(d) List of Impaired Waters. West Fork San Jacinto River: 2 Segments Impaired; East Fork San Jacinto: No Segments Impaired; Lower Trinity: 1 Segment Impaired; North Galveston Bay: 4 Segments Impaired; Buffalo-San Jacinto: 60 Segments Impaired; Spring: 13 Segments Impaired; Cedar Bayou Above Tidal (Segment ID: 0902), and Cedar Bayou Tidal (Segment ID: 0901) are within the project corridor.	<p>Direct project impacts to resources that would affect water quality include impacts to wetlands and riparian areas as well as direct crossings of water bodies. Two stream segments within the study area are listed on the 2010 303(d) list. They are Cedar Bayou Above Tidal (Segment 0902) and Cedar Bayou Tidal (Segment 0901). Project construction would result in temporary increase in sedimentation and turbidity.</p> <p>Construction impacts would be minimized through the incorporation of appropriate Best Management Practices (BMPs) for erosion control.</p>	Approximately 25,944 ac of undeveloped land would be converted to residential and commercial use as a result of the Preferred Alternative. This induced development could result in adverse effects to water resources through degradation of surface water and groundwater. The Preferred Alternative would require groundwater pollution prevention measures to minimize potential impacts to up to seven well capture zones. Indirect impacts to groundwater wells and capture zones are anticipated to be minor in the context of regional development as a whole.	Water quality was identified by technical experts as a major environmental concern associated with the proposed project.	Yes. Refer to Chapter 7 for mitigation proposed for direct impacts.	No	Yes	

Resource Category/Issue	Summary of Existing Resource Condition and Potential Impacts			Additional Concerns Raised During Project Development	Permitting or Mitigation Necessary?	Cumulative Impact "Triggers"	
	Existing Condition/ Current Health of Resource	Preferred Alternative Direct Impacts	Preferred Alternative Indirect Impacts			Would the resource be substantially impacted by the project?	Is the resource currently in poor or declining health or at risk even if anticipated impacts are less than substantial?
Waters of the U.S., including Wetlands and Vegetative Communities	Stable - continued changes in land use due to development are expected to convert more wetlands to non-wetlands. However, the U.S. Army Corps of Engineers (USACE)'s "no net loss" policy has continued to keep the losses of jurisdictional wetlands at a stable number. Declining - Vegetative communities will continue to be converted to developed uses as land use changes occur.	The Preferred Alternative would potentially impact approximately 327 ac of wetlands and 22.9 ac of Waters of the U.S.	The potential indirect impacts to Waters of the U.S. and wetlands due to induced development within the AOI is anticipated to be zero acreage of Waters of the U.S. and approximately 2,997 ac of wetlands.	Water resources were identified by technical experts as a major environmental concern associated with the proposed project.	Yes	Yes	Yes
Wildlife	Stable - Most wildlife species in the RSA are broadly distributed across southeastern Texas. While impacts to individuals may occur, population impacts are not anticipated. Changes in land use due to suburban growth are expected to convert more of the available wildlife habitat to other uses.	Direct impacts associated with the Preferred Alternative could include an increase in wildlife mortality associated with vehicle collisions. This does not include threatened and endangered species and EFH. The Preferred Alternative would impact up to approximately 665 ac of wildlife habitat. The primary impacts to wildlife species inhabiting the project area are loss of habitat and habitat fragmentation.	Indirect impacts to wildlife include loss of habitat and/or habitat fragmentation– the land use analysis determined that the Preferred Alternative would indirectly impact approximately 25,944 ac of undeveloped land. This portion of undeveloped land that would be indirectly impacted contains wildlife habitat consisting of forested wetlands, non-forested wetlands, farmland, and forest. Existing habitat has largely been fragmented by development, the timber industry, and agricultural practices. Species within the AOI are largely found throughout the region; substantial impacts are not anticipated as a result of indirect impacts.	Concerns related to habitat loss and habitat fragmentation were received.	No	No	No
Threatened and Endangered Species	Stable - The Endangered Species Act is intended to protect these species. No adverse effects or takings are permitted.	At the time of this publication, there are no known direct impacts to federally protected species associated with the Preferred Alternative. However, only 22% of the properties have been accessed due to limited right-of-entry. This information will be updated as more information becomes available and access to properties is obtained. On the ground surveys for federally protected species were performed for the Preferred Alternative.	Approximately 7 ac of potential habitat for federally protected species exists within the AOI. Based on the land use analysis (Chapter 4) and current federal and state laws and regulations, it is expected that the development of properties containing threatened or endangered species preferred habitat within the AOI would not be affected by the Preferred Alternative.	Texas Parks and Wildlife Department (TPWD) expressed concern for Texas Prairie Dawn, if habitat was found within the study area.	No	No	No for properties accessed, unknown at this time for properties that have not yet been accessed
Floodplains	Stable - Flooding in the Houston area continues to be an issue. Changes in land use due to suburban growth are expected to result in encroachment of the 100-year floodplain.	Direct impacts, as a result of the Preferred Alternative, include approximately 159 ac of impacts to the 100-year floodplain.	The potential exists for up to 2,006 ac of 100-year floodplains to potentially be impacted by indirect development within the AOI. However, it is unlikely that indirect development would occur in the floodplains. Access points to Grand Parkway Segments H and I-1 have also been located outside of the floodplains to the greatest extent practicable to minimize any potential for future floodplain development.	Individual concerns over floodplains and drainage were raised.	No	No	No
Wild and Scenic Rivers	None present within the project area.	The Preferred Alternative is not situated in the vicinity of any river on the National Inventory of River Segments included in the National Wild and Scenic River System (NPS, 1999); no impacts to wild and scenic rivers would occur.	The study area is outside any wild and scenic rivers; the Preferred Alternative would not have any indirect impacts to wild and scenic rivers resources.	Wild and scenic rivers were not identified as an issue of concern.	No	No	No

Resource Category/Issue	Summary of Existing Resource Condition and Potential Impacts			Additional Concerns Raised During Project Development	Permitting or Mitigation Necessary?	Cumulative Impact "Triggers"	
	Existing Condition/ Current Health of Resource	Preferred Alternative Direct Impacts	Preferred Alternative Indirect Impacts			Would the resource be substantially impacted by the project?	Is the resource currently in poor or declining health or at risk even if anticipated impacts are less than substantial?
Coastal Barriers	None present within the project area.	The proposed Grand Parkway Segments H and I-1 project area is wholly outside any coastal barrier system; the Preferred Alternative would not have any impacts to coastal barrier resources.	The study area is outside any coastal barrier system; the Preferred Alternative would not have any indirect impacts to coastal barrier resources.	The coastal barrier system was not identified as an issue of concern.	No	No	No
Coastal Zone Management	The Coastal Zone is a managed, stable resource.	The proposed Preferred Alternative is not within the CZMP boundary and therefore, is in compliance with the CZMA. Coordination with the CZMA is not required.	The study area falls along the coastal zone management area; however, the Preferred Alternative would not have any indirect impacts to coastal zone management resources.	The coastal zone management area was not identified as an issue of concern.	No	No	No
Essential Fish Habitat	None present within the project area.	The Preferred Alternative does not intersect tidally influenced coastal waters and would have no impact on EFH. Coordination with NMFS is not required.	The study area is outside any tidally influenced coastal waters; the Preferred Alternative would not have any indirect impacts to EFH.	EFH was not identified as an issue of concern.	No	No	No
Archeological Resources	Stable - Agency oversight is intended to minimize or avoid impacts to these resources.	As a result of the official archeological records review, no previously recorded sites were identified within the Grand Parkway Segments H and I-1 Preferred Alternative ROW.	There is a possibility for indirect impacts to historic archeological resources in the study area as land is converted to residential and commercial uses. Development in the floodplain would be minimized, thereby protecting the areas with some of the greatest potential for archeological resources.	Neither the general public resource agencies nor the public identified issues of concern for archeological resources.	No	No	No
Non-Archeological Historic Resources	Stable - Agency oversight is intended to minimize or avoid impacts to these resources.	As a result of the historic resources survey, it was determined a total of four resources within the Preferred Alternative's area of potential effects (300 ft) were previously determined or recommended NRHP Eligible. The two resources previously determined NRHP Eligible are associated with the Dayton Canal rice irrigation system; no adverse effects to these resources are anticipated. The two resources recommended NRHP Eligible are a house and garage located at 2669 FM 1485 in Harris County; no direct effects are anticipated to these resources.	Indirect impacts to land use changes attributed to the Preferred Alternative have the potential to indirectly impact historic resources. Some development may fall under federal or state regulatory resource protection review; however, the true degree of impact to historic resources resulting from future private development cannot be determined at this time.	The public agencies identified the canals in and around Dayton as an area of potential concern.	The Historic Resources Survey Report is under coordination with the SHPO. No adverse effects are anticipated.	No	No

Study Team, 2013

1 As documented in **Chapter 4 (Environmental Consequences)** and **Chapter 5 (Indirect Impacts)**, it was  
2 determined that the Preferred Alternative would not have considerable direct or indirect impacts on the  
3 following resources: social and economic resources, pedestrians and bicyclists, visual and aesthetic  
4 qualities, soils and farmlands, wildlife, threatened and endangered species, floodplains, wild and scenic  
5 rivers, coastal barriers, coastal zone management, essential fish habitat, archeological resources, non-  
6 archeological historic resources, hazardous materials, visual and aesthetics, parkland, or energy resources.  
7 Therefore, these resources were not carried forward through the cumulative impacts analysis. As **Table 6-**  
8 **3** indicates, the following resources were determined to be resources that warrant cumulative impacts  
9 analyses: land use; environmental justice populations; air quality (CO, ozone, and MSAT); water quality;  
10 and waters of the U.S., including wetlands.

11  
12 Define Resource Study Areas (RSAs) (Step 2)

13 **Step 2:** Cumulative impacts are considered within spatial and temporal boundaries. Each resource has its  
14 own RSA to best assess the impacts to that individual impact. The scope of this analysis seeks to evaluate  
15 the direct and indirect impacts and other potential impacts from other past, present, or future projects in the  
16 area as far away from the proposed project as the impacts are expected to be realized on each of the  
17 resources studied. The physical boundary of these impacts is the RSA.

18  
19 Because the resources/issues vary widely, the appropriate geographical context for evaluating cumulative  
20 impacts depends upon a myriad of factors. The setting of spatial limits for resource indicators was  
21 established using TxDOT and CEQ criteria, and considered factors such as each resource's physical  
22 characteristics, biological relationships, and affected institutional jurisdictions. The RSA defined for the  
23 examination of each indicator of resource condition and potential impacts is also noted in **Table 6-4**.

24  
25 The temporal boundary set for each resource is 1970 through 2035. The beginning timeframe of 1970 was  
26 considered to be the most appropriate for the area because the region experienced unprecedented growth  
27 in 1970 due to the opening of the George Bush Intercontinental Airport in 1969. The future date of the  
28 temporal boundary is set at 2035, based on the Houston-Galveston Area Council's (H-GAC) 2035 Regional  
29 Transportation Plan (RTP) Update. The H-GAC's 2035 RTP Update was created by community leaders to  
30 address regional mobility, air quality, and safety under the current growth projections for the eight-county  
31 area over the next two decades.

1 Any development, such as planned communities, cities, and industrial areas that existed and/or were  
2 developed prior to 1970 was not calculated in the cumulative impacts analysis. However, general land use  
3 trends are noted under the land use discussion. Present actions are those actions that have occurred  
4 generally between 2000 and 2013. The years 2013-2035 represent future actions which correlate with the  
5 H-GAC's 2035 RTP Update.

6  
7 Describe Resources, Identify Impacts, Assess Cumulative Effects, Report Results, and Assess Mitigation  
8 (Steps 3-8)

9 **Step 3:** Examination of the current health and historical context of each resource is necessary to establish  
10 a baseline for determining the impacts of the proposed action and other reasonably foreseeable actions on  
11 the resource. For the resource categories of special interest identified from the direct and indirect impacts  
12 analyses, each resource's abundance and quality at the present time, defined as the publishing date of the  
13 FEIS, was evaluated considering the impacts of historical activities, the resource's response to change, and  
14 the continuing stresses imposed on the resource and its capacity to withstand these stresses. Collectively,  
15 these factors capture the influences that have shaped and are shaping the amount and quality of each  
16 resource, and which would continue to shape each given resource in the future.

17  
18 The discussion describes the historical and current condition of each resource within the context of its RSA.  
19 A summary of existing conditions is included in **Table 6-3**, where it serves as a point of reference for  
20 summaries of impacts from the proposed project and from other projects within each resource's RSA.  
21 Demographic and land use information was obtained from local government planning offices, meetings with  
22 stakeholders, and websites. Vegetation was generally characterized through interpretation of high  
23 resolution aerial photography for the year 2008 from the H-GAC. USFWS National Wetland Inventory  
24 (NWI) maps were utilized for information regarding potential Waters of the U.S., including wetlands.  
25 Information on the various resources studied was digitized, and spatial data was developed through the use  
26 of Geographic Information Systems (GIS) software.

27  
28 **Table 6-4** provides a summary of the RSAs and the health of those resources considered during the  
29 cumulative impacts analyses.

1 **Table 6-4: Summary of Resource Study Areas (Step 2) and Health of Resources (Step 3) for the**  
2 **Cumulative Impacts Analysis**

Resource Category	Indicators of Resource Condition and Potential Impacts	Resource Study Area (RSA)	Health of Resource
Land Resources	Land use	Transportation projects have the potential to influence traffic patterns or land development. The land use RSA was defined by the adjacent 15-minute travel shed (same as the indirect impacts AOI). Outside the boundaries of the land use RSA, it is not anticipated that the improvements to Grand Parkway Segments H and I-1 would influence traffic patterns or land development, as areas outside of the defined RSA are better served by other roadways, and the land use in those areas would be impacted by these other facilities.	Historically disturbed RSA and changing.
Environmental Justice	Impacts on Environmental Justice populations	Toll facilities have the potential to impact low-income populations as a higher percentage of their income would be required to utilize these facilities than that of non-low-income populations. The H-GAC 8-county region was defined to be the RSA for environmental justice because the regional toll system (of which Grand Parkway Segments H and I-1 would be part of) is located within this region.	The EJ population of the MPO area is growing based on a comparison of 2000, 2010, and 2035 population data. Impacts to the community are stable. Title VI of the Civil Rights Act of 1964 states "No person in the United States shall, on the grounds of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."
Air Quality	<p>8-Hour Ozone Standard: ability of the region to meet this air quality standard.</p> <p>Carbon Monoxide: carbon monoxide concentrations along the ROW under worst meteorological conditions</p> <p>MSAT: trend of emissions over time</p>	Air quality impacts from mobile sources are evaluated and managed on a regional basis primarily through the MPO, in coordination with the EPA, TCEQ, TxDOT, and FHWA. The non-attainment areas represent the management unit for mobile source pollutants as regulated by federal, state, and local government agencies. Evaluating air quality in relation to cumulative impacts requires looking at the following three distinct RSAs: Houston-Galveston-Brazoria eight-county nonattainment area for ozone and MSAT, and proposed ROW line for CO. The RSA for CO was based on the proposed ROW line, which represents the location with highest potential for CO concentrations.	<p>Air Quality: poor, the Houston-Galveston-Brazoria eight-county region is classified as a marginal nonattainment area for ozone.</p> <p>MSAT: emissions are anticipated to decrease over time.</p>

Resource Category	Indicators of Resource Condition and Potential Impacts	Resource Study Area (RSA)	Health of Resource
Water Resources	Water Quality	The RSA for water quality was based on potential impacts to watersheds in the immediate area of the proposed ROW. These watersheds include: West Fork San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, Buffalo-San Jacinto, and Spring	Overall water quality is improving nationwide since the implementation of the CWA in 1972. However, watersheds within the RSA contain stream segments listed on the 2010 303(d) List of Impaired Waters. Low dissolved oxygen is the primary water quality concern for each listed stream segment.
	Waters of the U.S., including Wetlands	The RSA for Waters of the U.S., including wetlands, was based on potential impacts to wetlands and waters in the immediate area of the proposed ROW. These associated watersheds include: West Fork San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, Buffalo-San Jacinto, and Spring	The USACE's "no net loss" policy has continued to keep the losses of jurisdictional wetlands at a stable number.

1 Source: Study Team, 2012

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**Step 4:** The analysis of cumulative impacts must consider the direct and indirect impacts of the proposed action within the RSAs. Identification of the direct and indirect impacts of the proposed action would also assist in determining the project's contribution to the cumulative impact on the resource. The direct and indirect impacts expected from the proposed project were discussed in detail in the FEIS in **Chapter 4 (Environmental Consequences)** and **Chapter 5 (Indirect Impacts)**, respectively. The results of the study of direct and indirect impacts to resources included in this cumulative effects analysis are summarized in **Table 6-3**.

**Step 5:** CEQ regulations indicate that cumulative impacts analyses must include an assessment of impacts of other past, present, and/or reasonably foreseeable future actions affecting the resources studied (40 CFR Section 1508.7). This portion of the cumulative impacts analysis sought out other transportation projects and planned large-scale public or private developments in the watersheds. The identification of other past, present, and reasonably foreseeable future actions for the watershed RSA was based on a review of proposed and ongoing development projects that are associated with H-GAC plans, local municipality plans, local school district plans, master plan communities, and county economic development studies. In addition, a panel of experts on land use planning and development in the region were surveyed. H-GAC personnel, as well as local and county planning personnel, were consulted during the indirect impacts analysis of the proposed project. Past, current, short term, and long term transportation projects were determined from the H-GAC's 2035 RTP Update, the H-GAC's *Envision Houston Region* report,

1 surveys and interviews with city and county planning offices, TxDOT databases, and engineering  
2 documents.

3  
4 In addition to site-specific development plans, the anticipated impacts from the eventual development of the  
5 watershed RSA as reflected in comprehensive land use plans was considered in reviewing future impacts  
6 to biological and water resources. Qualitative inferences as to potential impacts on the resources studied  
7 are drawn from the description of each project or plan. Individual projects would not be identified for the O<sub>3</sub>  
8 nonattainment area because air quality is regulated and managed on a regional level, with expected  
9 development projects with substantial air emissions included in air pollution budgets, dispersion modeling,  
10 and air quality state implementation plans.

11  
12 **Steps 6, 7, and 8:** The information contained in **Tables 6-3** and **6-4** represents the starting point for  
13 assessing (**Step 6**) and reporting (**Step 7**) cumulative impacts in this subsection. Cumulative impacts were  
14 evaluated using the following factors: the historical context of each resource, current condition and trend,  
15 future land use and zoning plans, and the pertinent regulations and standards associated with each  
16 resource. These factors capture the influences that have shaped and are shaping the amount and quality  
17 of each resource, and which would continue to shape the resources into the future. Several key  
18 assumptions that are implicit in the approach to predicting the future condition of resources include:

- 19 • All reasonably foreseeable actions would be completed as currently planned;
- 20 • The relationships between the resources, ecosystems, and human communities that have  
21 been identified from historical experience would continue into the future; and
- 22 • The sponsors of government and private projects would abide by relevant federal, state, and  
23 local laws designed to protect each resource, and regulatory agencies would perform their  
24 duties in accordance with legal requirements and internal guidelines.

25  
26 Of particular importance is the assumption concerning compliance with relevant environmental laws  
27 designed to ensure the sustainability of resources. Over the past several decades, federal, state, and local  
28 lawmaking bodies have enacted statutes, regulations, and ordinances designed to preserve and enhance  
29 the abundance and quality of natural resources by requiring project sponsors to avoid, minimize, and  
30 mitigate the environmental impacts of their projects or actions. The cumulative impacts analysis focuses on  
31 the net effects on each resource that remain after full compliance with the regulatory requirements at all  
32 levels. To this point in this analysis, the approach has been to identify and report the potential unmitigated  
33 impacts to each of the resources, but net cumulative impacts must consider the long-term impacts in light of

1 mitigation that would likely be applied. The discussion of cumulative impacts for each resource studied  
2 would first outline the key regulatory measures government leaders and agencies have implemented to  
3 manage and sustain the resource for long-term use, then evaluates expected net cumulative impacts for  
4 each of the resources analyzed. This discussion of key mitigation measures affecting the expected  
5 potential cumulative impacts is an integral part (**Step 8**) of the cumulative impacts analysis. More detailed  
6 discussions of specific regulatory measures to control adverse impacts to various resources would be  
7 contained in discussions of direct impacts to specific resources in **Chapter 7 (Mitigation and Permitting)**  
8 of this FEIS document.

## 9 10 **6.3 CUMULATIVE IMPACTS ANALYSIS PER RESOURCE**

11 A discussion and application of the cumulative impacts analysis for each selected resource follows. The  
12 remainder of the cumulative impacts analysis consolidates the remaining steps from TxDOT *Guidance* so  
13 that the analytical steps may be grouped within the discussion about each resource (December 2006).  
14 Steps 1 through 6 were applied to each resource. Once each resource is analyzed in Steps 1 through 6,  
15 Steps 7 and 8 follow and address all identified resources, only if a substantial cumulative impact is  
16 identified.

17  
18 Cumulative impacts are analyzed in terms of the specific resource being affected based on direct and  
19 indirect impacts. The resources considered in the following cumulative impacts analyses are:

- 20 • **Land Use** – RSA is defined by a 15-minute travel shed (**Exhibit 6-1**);
- 21 • **Environmental Justice** - RSA is defined by the H-GAC eight-county region (**Exhibit 6-2**);
- 22 • **Air Quality/MSAT** – RSA for Ozone is defined by the Houston-Galveston-Brazoria eight-  
23 county marginal ozone non-attainment area; the RSA for MSATs is defined by the H-GAC  
24 eight-county region; and the CO RSA is defined by the proposed project ROW (**Exhibit 6-2**);  
25 and
- 26 • **Water Resources (Water Quality and Waters of the U.S., including Wetlands)** – RSA is  
27 defined by six watersheds (**Exhibit 6-3**).

### 28 29 **6.3.1 Land Use**

#### 30 **6.3.1.1 Step 1: Resource Identification - Land Use**

31 Based on a review of historical aerial photographs, the portions of the project area and the RSA considered  
32 for this analysis have experienced and continue to experience conversion from undeveloped land uses to  
33 residential and commercial uses in the Montgomery, Harris, and Chambers counties while the majority of

1 the project area in Liberty County has experienced a slower growth rate. These land use changes drive  
2 any impacts to the other resource categories in this analysis. There is a direct impact to existing land uses  
3 as a result of the proposed action.

#### 4 5 **6.3.1.2 Step 2: Resource Study Area - Land Use**

6 The RSA defined to determine cumulative impacts to land use as a result of the construction of Grand  
7 Parkway Segments H and I-1 is the same as the area of influence (AOI) utilized in the indirect impacts  
8 analysis (**Exhibit 6-1**). As explained in **Chapter 5**, the AOI was defined by the 15-minute travel shed.  
9 Outside the bounds of the land use RSA, it is not anticipated that the improvements to Grand Parkway  
10 Segments H and I-1 would influence traffic patterns or land development, as areas outside of the defined  
11 RSA are better served by other roadways, and the land use in those areas would be impacted by these  
12 other facilities. The land use RSA encompasses approximately 1,204 square miles (mi<sup>2</sup>), or approximately  
13 770,300 acres (ac), of Harris, Montgomery, Liberty, San Jacinto, and Chambers counties.

14  
15 As previously stated, the temporal boundaries for the cumulative impacts analysis are the years 1970 to  
16 2035. Historical actions are those actions which occurred between 1970 and 2000; present actions  
17 occurred between 2000 and 2013. The years 2013 to 2035 represent future actions, which correlate with  
18 the H-GAC's 2035 RTP Update.

#### 19 20 **6.3.1.3 Step 3: Resource Health and Historical Context - Land Use**

##### 21 Health

22 The central corridor of Grand Parkway Segments H and I-1 would be located in an area of Liberty County  
23 that has been experiencing relatively little growth. Most of the growth in the greater Houston metropolitan  
24 area has been to the north, west, and south of the proposed project. For example, between 1990 and  
25 2000, the Harris County population growth represented 62.1 percent of the eight-county metropolitan  
26 statistical area growth while Fort Bend County represented 13.7 percent, and Montgomery County  
27 represented an additional 12.9 percent. These three counties accounted for 88.7 percent of the  
28 metropolitan area growth between 1990 and 2000. Population estimates suggest that these three counties  
29 accounted for 86 percent of the population in the eight-county area between 2000 and 2005. Liberty  
30 County accounted for only 1.9 percent of the metropolitan area growth between 1990 and 2000, and an  
31 estimated 1.2 percent between 2000 and 2005.

1 Most of the historically developed land is within and adjacent to the northern portion of the RSA. Kingwood,  
2 a master planned community of approximately 60,000 residents which is a part of the City of Houston, falls  
3 within the RSA. North of Kingwood and within the RSA are the communities of Porter, New Caney,  
4 Woodbranch, Patton Village, and Roman Forest. A 4,919 ac Section 4(f) property (the Lake Houston  
5 Wilderness Park) is also located within the RSA. The Lake Houston Wilderness Park is operated by the  
6 City of Houston Parks and Recreation Department.

7  
8 Most of the RSA is currently forested or in agricultural production. A number of primarily residential  
9 developments stretch between the east shore of Lake Houston and Farm to Market Road (FM) 2100. The  
10 largest of these is The Commons of Lake Houston, a large lot subdivision. Incorporated communities in or  
11 near the RSA are Crosby (1,714), Dayton (5,709), and Mont Belvieu (2,324).

12  
13 Mont Belvieu sits on top of the 1 mi diameter Barbers Hill salt dome. The Barbers Hill dome is the largest  
14 Liquid Petroleum Gas storage complex in the United States, providing 36 percent of the nation's storage  
15 capacity. The more than 126 active solution-mined caverns store from 75 to 300 million barrels of light  
16 hydrocarbon products.

### 17 18 **Montgomery County**

19 Approximately 278 mi<sup>2</sup>, or 23.1 percent of the RSA is in Montgomery County. Montgomery County cities  
20 within the RSA include Patton Village, Roman Forest, and New Caney. The current development within the  
21 Montgomery County portion of the RSA is primarily residential and is focused along FM 1485 and U.S.  
22 Highway (US) 59 (N). Much of the development in Montgomery County has traditionally been on larger  
23 rural lots that are greater than one-half acre in size; however, the trend has been toward more dense  
24 residential development on lots smaller than one-half acre in size. Much of the Montgomery County portion  
25 of the RSA is currently developed or platted, with the remaining areas consisting of rural pasture and  
26 cropland.

### 27 28 **Harris County**

29 Approximately 347 mi<sup>2</sup>, or 28.8 percent of the RSA is in Harris County. The RSA falls within the limits of  
30 the incorporated cities in northern Harris County. Harris County cities within the RSA include Kingwood  
31 and Crosby. The Harris County portion of the RSA, particularly between US 59 (N)/I-69 and FM 1960, has  
32 typically developed with large, predominantly residential developments. Commercial uses consisting of

1 retail shopping centers, restaurants, and gas stations are concentrated at the intersections of major arterial  
2 roadways, and along the freeway corridors in the area. There is little undeveloped land remaining in this  
3 area.

#### 4 5 **Liberty County**

6 Approximately 403 mi<sup>2</sup>, or 33.5 percent of the RSA is in Liberty County. Liberty County is considered to be  
7 a largely rural county, though the developed uses in the Liberty County portion of the RSA are residential  
8 and commercial. The predominant land use in this county includes oil fields, crop and pasture land. The  
9 City of Dayton is the largest incorporated area in the county.

#### 10 11 **Chambers County**

12 Approximately 167 mi<sup>2</sup>, or 13.9 percent of the RSA is in Chambers County. The RSA includes the  
13 incorporated cities of Mont Belvieu and Baytown. The predominant developed uses north of I-10 in the  
14 Chambers County portion of the RSA are residential and industrial. South of I-10, the predominant use is  
15 residential.

#### 16 17 **San Jacinto County**

18 Approximately 9 mi<sup>2</sup> or 0.7 percent of the RSA is in San Jacinto County. The predominant land uses in this  
19 county includes oil fields, crops, and pasture land. San Jacinto County is outside of the H-GAC's MPO  
20 area; therefore, data regarding growth projections for San Jacinto County is not available at this time.

#### 21 22 Historic Context

23 The opening of the Bush Intercontinental Airport in 1969 was followed by a boom in residential  
24 development in the areas of southern Montgomery County and northeast Harris County, within the land use  
25 RSA. Along with the construction of these homes came the ancillary retail and public services.

26  
27 Development within the Harris and Montgomery county portions of the RSA has occurred within large  
28 subdivisions dominated by single family residential uses. Historical aerials dating back to 1970 were  
29 obtained and used to determine how much growth has occurred over the past 30 years. Within the past 30  
30 years, larger master planned subdivisions have developed, particularly outside of Beltway 8. One  
31 development, Kingwood, has provided a mix of single family, multi-family, and commercial uses. There has  
32 been little effective large area or regional land planning within the RSA. The result is automobile  
33 dependent development with limited travel mode options.

1 **6.3.1.4 Step 4: Direct and Indirect Impacts - Land Use**

2 Direct Impacts

3 The proposed action would directly convert approximately 1,933 ac of land (less than 0.3 percent of the  
4 RSA) from its current use to transportation uses. More detail on the types of uses to be converted may be  
5 found in **Chapter 4 (Environmental Consequences)** of this document.

6  
7 Indirect Impacts

8 Land indirectly converted to developed uses as a result of the Preferred Alternative is estimated to be  
9 25,944 ac (**Table 5-12**); this would account for approximately 3 percent of the total land in the RSA.  
10 Likewise, other indirect impacts (noise, runoff, erosion, etc.) are anticipated to also be minor. These  
11 conclusions were reached following meetings with local officials and during the stakeholder meetings held  
12 in conjunction with the improvements to Segments H and I-1. These included meetings with officials from  
13 Harris, Chambers, Liberty, and Montgomery counties, the H-GAC, local school districts and the cities of  
14 Baytown, Mont Belvieu, and Dayton. As noted in **Chapter 5 (Indirect Impacts)**, an expert panel was also  
15 surveyed in 2008-2009 to determine the extent of induced development within the study area. The expert  
16 panel survey results predicted that approximately 1,000 ac at the intersection of the Grand Parkway  
17 Segments H and I-1 and I-10 (E) would likely be developed for retail and commercial uses. Approximately  
18 5,000 ac at each intersection of the Grand Parkway Segments H and I-1 with SH 146 and FM 1960 would  
19 likely be developed for residential uses; and approximately 1,000 ac of commercial and retail development  
20 would occur at each intersection of Grand Parkway Segments H and I-1 with FM 1960, US 90, FM 1413,  
21 and SH 146. An additional 1,500 ac of industrial development is predicted within outlying parcels in the  
22 central portion of the AOI for each of the alternatives.

23  
24 **6.3.1.5 Step 5: Reasonably Foreseeable Actions - Land Use**

25 Land Development

26 Several sources were utilized to determine reasonably foreseeable land use and transportation changes  
27 that are anticipated to occur in the RSA. These sources included the H-GAC's 2035 projections, meetings  
28 with local and county officials, school boards, city planners, and an expert panel survey. **Table 5-10** in  
29 **Chapter 5** lists reasonably foreseeable projects which were identified during the 2007-2008 stakeholder  
30 meetings and research of platted developments. The H-GAC also provided the *Envision Houston Region*  
31 report with its 2008-2009 expert panel survey response. Scenario A of this report includes the current

1 growth forecast and development for the region, based on the H-GAC's 2035 population forecast, and  
 2 assumes the complete build-out of the planned regional toll system.

3  
 4 Transportation 2035 H-GAC Projects

5 There are added capacity and new location projects on various corridors identified in the H-GAC's 2035  
 6 RTP Update and located within the land use RSA. Projects listed on the H-GAC's Plan are considered  
 7 reasonably foreseeable transportation projects for the purposes of this analysis.

8  
 9 Major Thoroughfare Plan Projects

10 Within the land use RSA, the City of Houston plan identifies improvements to many area roadways. These  
 11 roadways are shown in **Table 6-5**. All of these roadways currently exist and are only proposed to be  
 12 upgraded according to the 2012 City of Houston Major Thoroughfare and Freeway Plan, with the exception  
 13 of the proposed Grand Parkway and the proposed SH 35 facilities.

14 **Table 6-5: City of Houston Major Thoroughfare and Freeway Plan**

Roadway Name	Roadway Name	Roadway Name
1st St	Genoa Red Bluff Rd	Preston
75th St	Grand Mission Blvd	Proposed SH 35
Addicks Clodine Rd	Grant Rd	Purple Sage Rd
Aerospace Ave	Gray	Queenston Blvd
Airline Dr	Green River Dr	Quitman
Airport Blvd	Greenbriar Dr	Ralston Rd
Airtex	Greenhouse Rd	Ranchester Dr
Airtex Dr	Greens	Rancho Bella
Alabama St	Greens Crossing Blvd	Rankin Rd
Aldine Bender Rd	Greens Pkwy	Rayford Rd
Aldine Mail Rd	Greens Rd	Reed Rd
Aldine Westfield Rd	Greenspoint Dr	Renwick
Alief Clodine Rd	Griggs	Research Forest Dr
Allen Genoa Rd	Grisby	Reveille
Allen Pkwy	Groeschke Rd	Rice Blvd
Allendale Rd	Grogams Mill Rd	Ricewood Dr
Allum Rd	Gulf Bank	Richey Rd
Almeda Genoa Rd	Gulf Bank Rd	Richmond Ave
Almeda Rd	Gulfton	Riley Fuzzel Rd
Altoona St	Haley Rd	Roberts Cemetery Rd
Anagnost Rd	Hamblen Rd	Roberts Rd
Anderson Rd	Hamilton	Rochen Rd

Roadway Name	Roadway Name	Roadway Name
Antoine Dr	Hammerly	Rockwell Blvd
Astoria Blvd	Hanna Nash	Roesner Rd
Atasca Oaks Blvd	Hardy	Rogerdale Rd
Atascocita Rd	Hardy Airport Connector	Roman Forest Blvd
Badtke Rd	Hardy Toll Rd	Rosslyn Rd
Bagby St	Hare Cook Rd	Runneburg
Baker Rd	Harlem Rd	Rusk
Bammel N Houston Rd	Harrisburg Blvd	Rutherglenn Dr
Barker Clodine Rd	Harwin Dr	S 75th St
Barker Cypress Rd	Hebert Rd	S Barker Cypress Rd
Barryknoll Ln	Hegar Rd	S Braeswood Blvd
Bartlett Rd	Heights Blvd	S Bw 8 E
Bauer Hockley Rd	Heiner	S Bw 8 W
Bauer Rd	Hempstead Hwy	S Dairy Ashford
Bay Area Blvd	Hermann Dr	S Diamondhead Blvd
Bay Hill Blvd	Highland Knolls Dr	S Fry Rd
Beamer Rd	Hillcroft	S Gessner Dr
Beaumont Hwy	Hillcroft St	S Greenhouse Rd
Beaumont Pl	Hiram Clarke Rd	S Heights Blvd
Beckendorff Rd	Hirsch Rd	S Hwy 59
Becker Rd	Hogan	S I-45
Beechnut St	Holcombe Blvd	S I-610 E
Belknap Rd	Holderrieth	S I-610 W
Bellaire Blvd	Hollister	S Jensen Dr
Bellfort Rd	Hollister Dr	S Katy Fort Bend Rd
Bennington St	Hollister St	S Kirkwood Rd
Bentley Rd	Holly Hall	S Lake Houston Pkwy
Berry Rd	Holmes Rd	S Lockwood Dr
Bertner Ave	Holt	S Macgregor Way
Betka Rd	Holzwarth Rd	S Main St
Binford Rd	Homestead Rd	S MAIN-HOLMES S
Bingle Rd	Hopfe Rd	S Mason
Binz St	Hopper Rd	S Mason Rd
Biram Wood Blvd	House Hahl Rd	S Peek Rd
Bissonnet St	Houston Ave	S Pinemont Dr
Blackhawk Blvd	Houston Rd	S Post Oak Blvd
Blalock Rd	Howard Dr	S Post Oak Ln
BLINKA RD	Huffman Cleveland Rd	S Post Oak Rd

Roadway Name	Roadway Name	Roadway Name
Blodgett St	Huffmeister Rd	S Rice Ave
Blue Ridge Rd	Hufsmith Kohrville Rd	S Richey
Bob White Dr	Hufsmith Kuykendahl Rd	S SH 6
Boone Rd	Hughes Ranch Rd	S Shaver St
Botkins Rd	Hughes Rd	S Sheldon Rd
Boudreaux Rd	Humble Pkwy	S Shepherd Dr
Boundary	Humble Westfield Rd	S Ssgt Macario Garcia Dr
Brandt Rd	Idleloch Dr	S US 59/I-69
Brazos St	I-10	S Victory Dr
Breen Dr	I-45 N	S Voss Rd
Briar Forest Dr	I-45 S	S Wayside
Briarpark Dr	I-45 N	S Wayside Dr
Brittmoore Rd	I-45 S	Sabo Rd
Broadway St	I-610	Saddle Creek Farms Dr
Broyles	Imperial Valley Dr	Sage Rd
Buffalo Speedway	Independence Blvd	Sampson
Bunker Hill Dr	Indian Hills Rd	San Felipe St
Bunker Hill Rd	Irvington Blvd	San Jacinto St
Burke Rd	Jacinto Port Blvd	Saums Rd
Burnett St	Jack Rd	Sawdust Rd
Burney Rd	Jackson Field	Sawmill Rd
Burton Cemetery Rd	James Muse Parkway	Sawyer
C E King Pkwy	Jarvis Rd	SB 59 S TO SB 288
Calhoun Rd	Jensen Dr	Scarsdale Blvd
Calumet	John Cooper Rd	Schiel Rd
Calvert Rd	John F Kennedy Blvd	Schlipf Rd
Cambridge St	John Ralston Rd	School Rd
Cameron Rd	Jones Rd	Schroeder
Campbell Rd	Juergen Rd	Schroeder Rd
Canal St	Jutland	Schurmier Rd
Cane Island Pkwy	K Z Rd	Scott St
Capitol St	Katy Flewellen Rd	Sendero Blvd
Cardiff Rd	Katy Fort Bend Rd	Settegast Ranch Rd
Carver Rd	Katy Gaston Rd	SH 225
Castle Rd	Katy Hockley Cut Off Rd	SH 249
Cavalcade	Katy Hockley Rd	SH 288
Cebra St	Katy Rd	SH 288 US 59/I-69 RAMP
Central Bridgeland	Keller	SH 290
Challenger 7 Pkwy	Kelley	SH 35

Roadway Name	Roadway Name	Roadway Name
Champion Forest Dr	Kempwood Dr	SH 6
Champion Forest Rd	Kenswick Dr	Sharp Rd
Chasewood Dr	Kermier Rd	Shaver St
Chimney Rock Rd	Kickapoo Rd	Shaw Rd
Cinco Ranch Blvd	Kieth Harrow Blvd	Sheldon Rd
Clara Rd	Kings Forest Rd	Shepherd Dr
Clay Rd	Kings Park Way	Silber
Clear Lake City Blvd	Kingsland Blvd	Skinner Rd
Clearwood	Kingspoint	Smalley Rd
Clinton Dr	Kingwood Dr	Snowden
Clinton Federal	Kirby Dr	Solon
Clodine Rd	Kirkpatrick Blvd	Sorters Rd
Clodine Reddick Rd	Kitzman Rd	South Wayside
College	Kleckley Dr	Southmore Blvd
College Park Dr	Kluge Rd	Space Center Blvd
Collingsworth	Kress	Spears Rd
Colonial Pkwy	Krezdorn	Spring Cypress Rd
Colorado Rd	Kuykendahl Rd	Spring Green Blvd
Commonwealth	La Porte Fwy	Spring Stuebner Rd
Community Dr	Lake Houston Pkwy	Spring West Dr
Cook Rd	Lake Olympia	Springer
Corbitt St	Lake Woodlands Dr	Springwoods Village Pkwy
Corporate Dr	Lakemont Dr	Spur 527
Cottingham Rd	Lakewood Dr	Ssgt Macario Garcia Dr
Court Rd	Langley	Stagewood Dr
CR 602	Lathrop	Stedman
CR 612	Lauder Rd	Stella Link
CR 622	Laura Koppe Rd	Stockdick
Crawford St	Lawndale	Stockdick School Rd
Creekbend Dr	Lazy Ln	Stokes Rd
Creeside Forest Dr	League Line	Stroker Rd
Creeside Green Dr	Lee Rd	Studemont
Creeside Park Blvd	Leeland St	Studewood
Crenshaw Rd	Lexington Blvd	Stuebner Airline Rd
Crestmont St	Ley Rd	Sunset Blvd
Crestvale	Liberty Rd	Synott Rd
Crockett St	Little York Rd	T C Jester Blvd
Crosby Fwy	Lockwood Dr	Tanner

Roadway Name	Roadway Name	Roadway Name
Crossover Rd	Lockwood Rd	Taylor St
Crosstimbers	Long Dr	Teal Bend Blvd
Crystal Lake Ln	Long Point Rd	Telephone Rd
Cullen Blvd	Longenbaugh Dr	Telge Rd
Cumberland Ridge Dr	Longenbaugh Rd	Teller Blvd
Cunningham Rd	Loop 494	Texas
Cutten Rd	Lorraine St	Texas Spur 5 Hwy
Cypress N Houston Rd	Lou Edd Rd	Tide St
Cypress Rosehill Rd	Louetta Rd	Tidwell Rd
Cypresswood Dr	Lyons	Timber Forest Blvd
Dacoma 290 HOV Ramp	Macedonia Rd	Timber Forest Dr
Dacoma St	Magnolia Rd	Tomball Pkwy
Dairy Ashford	Mahaffey Rd	Town Park Dr
Dallas Rd	Main	Townsen
Dallas St	Main St	Trammel Fresno Rd
Decker Prairie Rosehill Rd	Malcomson	Treaschwig Rd
Deer Run Ln	Manchester St	Treichel Rd
Deer Trail Dr	Mangum	Tuckerton Rd
Delldale	Margerstadt Rd	University Blvd
Deussen Pkwy	Market St	Unnamed
Dixie Dr	Martin Luther King Blvd	Upper Lake Dr
Dixie Farm Rd	Mason	US 290
Dowling St	Mason Rd	US 59/I-69
Dunlavy	Mathis Rd	US 59/I-69 Spur 527 Ramp
Durham Dr	Maxey Rd	US 90
E 11th St	Mayer Rd	US HWY 90 Bus Hwy
E 20th St	Mccarty	Uvalde Rd
E Airtex	Mcclellan Rd	Valley Ranch Bend Dr
E Anderson Rd	Mccrary Rd	Valley Ranch Crossing Dr
E BW 8	Mcgowen St	Valley Ranch Pkwy
E Bw 8 N	Mchard Rd	Van Hut Ln
E BW 8 S	Mckinney St	Veterans Memorial Dr
E Crosstimbers	Mckinnon Rd	Via Dora Dr
E Cypresswood Dr	Melendy	Vickery Dr
E Edgebrook Dr	Memorial Dr	Vickery St
E FM 1960	Mercury	Victory Dr
E FM 1960 BYPASS	Mesa Dr	Voss Rd
E Hardy Rd	Metro ROW	W 11th St

Roadway Name	Roadway Name	Roadway Name
E Hillcroft St	Middlebrook Dr	W 18th St
E Houston Rd	Miller Rd No 2	W 20th St
E I-10	Miller Rd No 3	W 34th St
E I-610 N	Miller Wilson Rd	W 43rd St
E I-610 S	Mills Branch Dr	W 6th St
E Lake Houston Pkwy	Mills Rd	W Airport Blvd
E Little York Rd	Mitchell Rd	W Alabama St
E Louetta Rd	Monroe Rd	W Bay Area Blvd
E Mossy Oaks Rd	Montrose Blvd	W Belfort St
E Navigation Blvd	Mop	W Bw 8 N
E Orem Dr	Morton Rd	W Bw 8 S
E Parker Rd	Mound Rd	W Cavalcade
E Richey Rd	Mount Houston Rd	W Crosstimbers
E T C Jester Blvd	Mueschke Rd	W Cypress Hill Cir
E Tidwell Rd	Murrell Rd	W Dallas St
E West Rd	Mykawa	W El Dorado Blvd
Echo Ln	N Braeswood Blvd	W FM 1960
Ed Ln	N Bridgelands Lake Pkwy	W FM 1960 BYP
Edgebrook Dr	N Bw 8 E	W FM 1960 Rd
Edloe St	N Bw 8 W	W Fuqua St
Egypt Ln	N Calumet	W Gray
El Camino Real	N Crawford St	W Greens Rd
El Dorado Blvd	N Dairy Ashford	W Gulf Bank
Elan Blvd	N Diamondhead Blvd	W Gulf Bank Rd
Eldridge Pkwy	N Durham Dr	W Hardy Rd
Elgin St	N Eldridge Pkwy	W Hillcroft St
Elgin- Texas Spur 5	N Gessner Dr	W Holcombe Blvd
Ella Blvd	N Houston Rosslyn Rd	W I-10
Ellington Bypass	N I-45	W I-610 N
Elysian St	N I-610	W I-610 S
Elysian Viaduct	N I-610 E	W Lake Houston Pkwy
Enclave Pkwy	N I-610 W	W Little York Rd
Ennis St	N Kirkwood Rd	W Memorial-Woodway W
Enos	N La Branch St	W Montgomery Rd
Ernestes Rd	N Lake Houston Pkwy	W Mossy Oaks Rd
Ernestine St	N Macgregor Way	W Mount Houston Rd
Fairbanks N Houston Rd	N Main	W Orem Dr
Fairfield Place Dr	N Main St	W Parker Rd

Roadway Name	Roadway Name	Roadway Name
Falcon Landing Blvd	N Mccarty	W Patton St
Fall Creek Bend	N Post Oak Ln	W Rankin Rd
Fallbrook Dr	N Post Oak Rd	W Rayford Rd
Falling Creek Dr	N Sampson	W Richey Rd
Falvel Rd	N SH 6	W Sam Houston Pkwy N
Fannin	N Shaver St	W Stroker Rd
Farmer Rd	N Shepherd Dr	W Sycamore St
Farnham St	N US 59/I-69	W T C Jester Blvd
Federal Clinton	N Wayside	W Tidwell Rd
Federal Rd	N Westgreen Blvd	Waco
Fidelity St	N Wilcrest Dr	Waller Spring Creek
Fields St	N York	Waller Tomball Rd
Fields Store Rd	N. MAIN	Wallisville Rd
First St	Nasa Pkwy	Warren Ranch Rd
Flukinger Rd	Navigation Blvd	Washington Ave
FM 1093	NB 610 E /EB 225 TO Broadway	Watonga Blvd
FM 1314	NB 610 W TO WB 290	Watson
FM 1463	Newcastle	Waugh
FM 1464	Nichols Rd	Waughcrest St
FM 1485	Nichols Sawmill Rd	Wayside
FM 1488	Normandy	Weaver Rd
FM 1736	Normandy St	Weeds Rd
FM 1959	North by Northwest	Weeping Willow
FM 1960	North Long Meadow Farms	Weslayan St
FM 2100	Northborough Dr	West Rd
FM 2351	Northgate Crossing Blvd	Westcott
FM 2855	Northpark Dr	Westgreen Blvd
FM 2920	Northpointe Blvd	Westheimer Pkwy
FM 2978	Northwest Fwy	Westheimer Place Dr
FM 359	Oak Leaf Dr	Westheimer Rd
FM 362	Oates Rd	Westmoor Dr
FM 521	Old Airline Dr	Westmoor Rd
FM 528	Old Atascocita Rd	Westpark Tollroad
FM 529	Old Bechkendorf Rd	Westview
FM 723	Old Humble Rd	Westwood Rd
Foley Rd	Old Katy Rd	Wheatley St
Fondren Rd	Old Main St Loop Rd	Wheeler
Ford Rd	Old Richmond Rd	White Oak Dr

Roadway Name	Roadway Name	Roadway Name
Fort Bend Tollway	Oold Riley Fuzzel Rd	Wilcrest Dr
Fountain View Dr	Old Spanish Trl	Will Clayton Pkwy
Fox Run Blvd	Old Spring Cypress Rd	Willardville Rd
Franklin St	Old Waller Tomball Rd	Willowbend Blvd
Franz Rd	Orem Dr	Willowbrook Dr
Freeman Rd	Owens Rd	Willowick
Freeport Blvd	Park Place Blvd	Wilshire Dr
Frey Rd	Park Row	Wilson Rd
Fry Rd	Parker Rd	Winfield
Fulshear Gaston Rd	Patterson Rd	Winfield Rd
Fulton St	Patton St	Winkler Dr
Fuqua St	Pearland Pkwy	Wirt Rd
Furman Rd	Pecore	Wolf Trot
Gaines Rd	Peek Rd	Woodforest Blvd
Galaxy Blvd	Peek Ridge Rd	Woodland Hills Dr
Galveston Rd	Penick Rd	Woodlands Pkwy
Garland Dr	Perry Rd	Woodridge Dr
Garrett Rd	Pin Oak Rd	Woods Rd
Gaston Rd	Pinelakes Blvd	Woodway Dr
Gears Loop	Pineloch Dr	Yale
Gears Rd	Pinemont Dr	Yellowstone Blvd
Gellhorn	Pitts Rd	York St
Genoa Red Bluff Rd	Polk	Yorktown St

Source: City of Houston Major Thoroughfare Plan, 2012

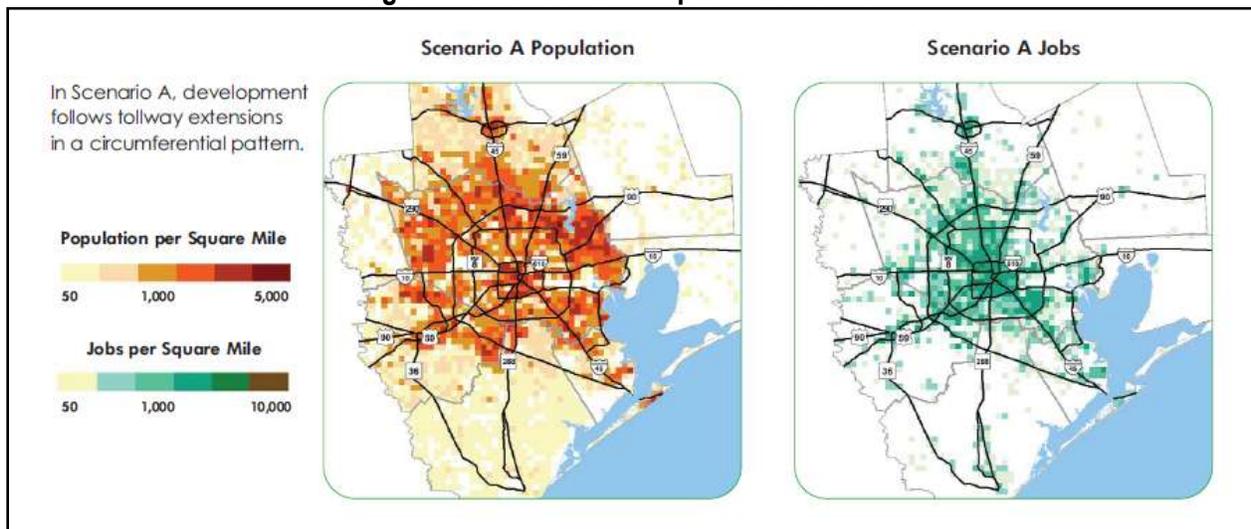
### Development Forecasts

The H-GAC 2035 population trends projections were reviewed for information on forecasts for development in the RSA. The H-GAC relies on past trends, current conditions, and anticipated growth influences to determine their projections. The H-GAC projections are to the year 2035 for Harris, Montgomery, Liberty, and Chambers counties. Forecast data was not available for San Jacinto County as this county is outside of the MPO jurisdiction. The H-GAC forecast is for continued growth in the counties already seeing increasing development trends, and steady growth in areas currently experiencing less development, continuing to the year 2035. Two large multi-modal rail yards are currently planned in Liberty County. These rail yards are planned for the area southwest of Dayton between SH 146 and US 90. Details concerning the size of these proposed rail yards were not available at the date of this study. In addition to

1 the reasonable foreseeable land use changes, these two facilities would potentially impact transportation  
 2 planning in the region.

3  
 4 The *Envision Houston Region* report, published by the H-GAC, was provided during the expert panel  
 5 survey conducted during 2008-2009. The *Envision Houston Region* report is the result of an innovative  
 6 public outreach effort designed to promote dialogue between the public and policymakers regarding future  
 7 growth and development of the eight-county Houston-Galveston region. The data provided by the *Envision  
 8 Houston Region* report was used to project future growth within the region. Scenario A, as defined in the  
 9 report, defines the current growth forecast and development pattern for the eight-county Gulf Coast region  
 10 based on H-GAC's 2035 demographic forecasts. Scenario A includes the build out of the Grand Parkway  
 11 toll road system. The report stated that "in Scenario A, mixed-use development is concentrated along the  
 12 highway system. Low-density housing developments fill the areas between major roadways, resulting in  
 13 floodplain development, more acreage consumption, more vehicle miles, and less transit use." This  
 14 scenario, illustrated in **Figure 6-1**, assumes no change to current land use plans or planning controls.

15  
 16 **Figure 6-1: H-GAC Developmental Forecast**



17  
 18 Source: H-GAC *Envision Houston Region* report. <http://2035plan.org/docs/final/Appendix%20A-Envision%20Houston%20Region%20Flyer.pdf> Accessed April  
 19 2009

20  
 21 For comparison, Scenarios B and C consisted of the workshop participants' visions of ideal planned growth  
 22 for the Houston region. Scenarios B and C required developmental regulations and incentives not currently  
 23 in place; therefore, they were not considered as likely to occur as Scenario A by the project team.

24  
 25 Scenario A used a growth pattern in this study resulting from current and planned growth in the region, and

1 combined with the expert panel survey, data from the stakeholder meetings, and other data noted above to  
2 determine all of the reasonably foreseeable actions within the land use RSA. The projected cumulative  
3 development within the land use RSA is shown on **Exhibit 6-1**.

#### 4 5 **6.3.1.6 Step 6: Cumulative Impacts Assessment - Land Use**

6 Potential cumulative impacts considered and discussed include land use and development impacts  
7 associated with commercial and residential growth as related to the access of the Preferred Alternative in  
8 combination with the effects of the other reasonably foreseeable actions. Cumulative impacts on land use  
9 resulting from indirect effects of the Preferred Alternative, in combination with the previously described  
10 reasonably foreseeable land development and transportation projects, would decrease the amount of open  
11 spaces and increase the north-south traffic volumes within the land use RSA.

12  
13 Not considering construction of the Grand Parkway Segments H and I-1, the land use RSA is steadily  
14 developing generally north and south of the proposed project's corridor; however, growth is slow throughout  
15 the majority of the central portion of the project corridor. Construction of the Preferred Alternative is  
16 anticipated to influence planned development, as well as induce development within the land use RSA.  
17 The area is also developing with respect to the MPO's roadway plan – a plan developed to address  
18 forecasted growth. The proposed Grand Parkway projects are a small percentage of the total proposed  
19 roadway projects planned to address the future transportation needs of the region in the 2035 plan. The  
20 MPO plan also lists several transportation related improvements to serve the RSA.

#### 21 22 **6.3.1.7 Step 7: Results- Land Use**

23 The combined effect of existing development (239,370 ac), the Preferred Alternative (conversion of  
24 approximately 1,933 ac to proposed ROW), and planned/reasonably foreseeable/induced development  
25 (approximately 50,100 ac, of which 25,944 ac is anticipated to be induced by the Preferred Alternative)  
26 could result in approximately 291,477 total acres of cumulative impacts to the land use RSA. Because of  
27 the various land use changes planned for the land use RSA, the likelihood of development as a cumulative  
28 effect is very high. The proposed project's contribution to the cumulative effect is relatively low, as  
29 approximately 9.6 percent (27,951 ac) of the 291,477 total ac of cumulative impacts can be directly and  
30 indirectly attributed to the Preferred Alternative. The anticipated cumulative land use effects (291,477 ac)  
31 represents approximately 38 percent of the land use RSA.

1 **6.3.1.8 Step 8: Mitigation - Land Use**

2 Mitigation for the development within the RSA considered for this analysis would rest with agencies that  
3 have the authority to implement such controls. This authority rests with municipal governments and to a  
4 lesser extent, county governments. The responsibility of transportation providers such as TxDOT, local and  
5 regional transit agencies, and local governments would be to implement a transportation system to  
6 complement the land use or development controls implemented. Grand Parkway Segments H and I-1, as  
7 well as any other links in the transportation network, would complement the land use and transportation  
8 changes in the area, but it cannot be considered the sole reason for the forecasted land use changes to  
9 occur. Therefore, no mitigation is proposed.

10  
11 **6.3.2 Environmental Justice**

12 **6.3.2.1 Step 1: Resource Identification - Environmental Justice**

13 The thresholds used to identify areas with high concentrations of low-income and/or minority populations in  
14 the RSA were set based on the definitions of low-income and minority established in the FHWA Order  
15 6640.23 and by the CEQ, Environmental Justice Guidance under NEPA documentation.

16  
17 The proposed toll facility has the potential to directly impact low-income populations (refer to **Chapter 4**  
18 **(Environmental Consequences)** and **Exhibit 3-2**), as a higher percentage of their income would be  
19 required to utilize the facility than that of non-low-income populations. Further, low-income populations  
20 would not benefit from improved system linkage that would be afforded those motorists who have the ability  
21 to pay for the proposed toll facility.

22  
23 **6.3.2.2 Step 2: Resource Study Area - Environmental Justice**

24 The RSA for socio-economic conditions is the H-GAC (MPO) boundary (**Exhibit 6-2**). The regional toll  
25 system (of which Grand Parkway Segments H and I-1 would be an element) is located within this MPO  
26 area. Quantitative U.S. Census Bureau data (*Census 2000 and 2010*) and H-GAC 2035 population  
27 forecast data was evaluated to determine the demographic trends for the RSA. The temporal boundaries  
28 for the cumulative impacts analysis are the years 1970 to 2035. Historical actions are those actions which  
29 occurred between 1970 and 2000; present actions are those actions which have occurred between 2000  
30 and 2010. The years 2010 through 2035 represent future actions. The year 2035 was chosen to correlate  
31 with the H-GAC's 2035 RTP Update.

### 6.3.2.3 Step 3: Resource Health and Historical Context - Environmental Justice

Executive Order (EO) 12898 was intended to ensure that federal departments and agencies identify and address disproportionately high and adverse human health and environmental impacts of their policies, programs, and activities on minority populations and low-income populations. It reinforced Title VI of the Civil Rights Act of 1964. It reminded all government agencies receiving federal funding that they are required to address discrimination as well as the consequences of their decisions or actions that might result in disproportionately high and adverse environmental and health impacts on minority and low-income communities.

Subsequent to EO 12898, U.S. Department of Transportation (USDOT) Order 5610.2 was published in the *Federal Register* in 1997. It describes the process for incorporating environmental justice principles into all USDOT programs, policies, and activities. The following year FHWA Order 6640.23 was issued establishing policies and procedures for FHWA to use in complying with EO 12898 and USDOT Order 5610.2.

From a historical demographic perspective, extensive growth has occurred within the environmental justice RSA since 1970. The H-GAC's eight-county region grew approximately 106.7 percent between 1970 and 2000 according to the U.S. Census Bureau's 1970 and 2000 decennial census, from 2,259,847 to 4,669,571 persons. Within the 1970 to 2000 timeframe, population growth by county ranged from approximately 47.3 percent (Galveston County) to 493.7 percent (Montgomery County). In 1979 and 1989, the median household income of the State of Texas was \$27,997 (in 1989 CPI-U adjusted dollars) and \$27,016 (in 1989 dollars), respectively. The median household income by county within the H-GAC's eight-county region ranged from \$28,153 (Liberty County) to \$42,882 (Fort Bend County) in 1979 [in 1989 CPI-U adjusted dollars]. In 1989, the median household income for the H-GAC region ranged by county from \$22,334 (Waller County) to \$42,809 (Fort Bend County) [in 1989 dollars]. A comparison of racial and ethnic profiles by county is not readily available for the H-GAC region for the 1970 through 2000 timeframe.

A comparative breakdown of environmental justice populations for each of the counties located within the H-GAC's eight-county region for the years 2000 and 2010 was reviewed. The total environmental justice population percentage for the RSA is anticipated to increase between 2000 and 2035 based on the demographic trend observed between 2000 and 2010, as shown in **Table 6-6**.

**Table 6-6: H-GAC MPO Environmental Justice Population Comparison  
(2000 and 2010) and 2035 Population Forecast**

County	2000			2010			Total 2035 Population Forecast
	Total Population	Percentage Minority Population (%)	Percentage Family Low-Income Population (%)	Total Population	Percentage Minority Population (%)	Percentage Family Low-Income Population (%)	
Brazoria	241,767	33.6	8	319,379	49.1	10.6	469,304
Chambers	26,031	21.2	8.3	35,522	32.7	10.5	52,617
Fort Bend	354,452	52.4	5.4	606,953	65.8	8	935,102
Galveston	250,158	35.8	10.1	295,747	42.8	12.8	404,471
Harris	3,400,578	56.9	12	4,180,894	69.9	16.8	5,769,193
Liberty	70,154	24.4	11.1	76,206	33.5	15.4	119,810
Montgomery	293,768	17.7	7.1	471,734	31.2	10.9	857,637
Waller	32,663	49.2	11.4	44,013	58.4	21.1	75,618
<b>H-GAC MPO TOTAL</b>	4,669,571	51	10.8	6,030,448.00	85.6	13.3	8,683,752

Source: U.S. Census Bureau (*Census 2000* and *2010*) and H-GAC 2035 Population Forecast

Of the counties located within the RSA, Harris County contained the largest concentration of minority and low-income populations in 2010. Harris County contains a minority population of approximately 69.9 percent and a low-income population (those living below the 2010 \$22,050 poverty guideline for a family of four) of approximately 16.8 percent. As documented in the *2010 Census*, the remaining RSA counties contain minority populations which range from approximately 31.2 to 65.8 percent and low-income populations ranging from approximately 8 to 21.1 percent.

#### 6.3.2.4 Step 4: Direct and Indirect Impacts - Environmental Justice

##### Direct Impacts

No substantial direct impacts to environmental justice populations would result from tolling Grand Parkway Segments H and I-1. The Preferred Alternative is anticipated to result in traffic noise impacts. There would be one residential displacement within an environmental justice community (CT 7009.00 BG 1 CB 1019). Tolling costs would be comparable to existing Harris, Montgomery, and Chambers county toll roads. The project impacts would not be isolated within a limited number of census tracts, but would be incurred by all users, including minority and low-income users of the Grand Parkway Segments H and I-1 facility. Although the impacts would not be substantial, it should be noted that low-income populations would be impacted by toll rates, toll collection, and other matters associated with user fees. No substantial indirect impacts are anticipated.

1 Should a low-income person be unable to pay the toll, this may result in a difference of time travel  
2 associated with utilizing non-toll alternatives. In addition, the economic impact of tolling would be higher for  
3 low-income users since the cost of paying tolls would represent a higher percentage of household income  
4 than for non-low-income users. Potential benefits of the new location roadway would include improved  
5 system linkage and access, improved mobility, and increased economic vitality to the area.

6  
7 Indirect Impacts

8 The environmental justice community, as a subset of the communities located within the AOI, would  
9 experience indirect impacts due to tolling that mirror those of the general population. No disproportional  
10 impacts are anticipated to affect environmental justice communities. Potential adverse effects would  
11 include displacements of low-income or minority persons, or groups of persons, and additional noise and  
12 visual impacts. Beneficial effects could also occur to these populations. For example, induced land use  
13 development could create additional job opportunities and increased access to job opportunities through  
14 enhanced transportation infrastructure. Indirect impacts pertaining to public facilities and services access,  
15 traffic operations, and traffic noise would be experienced by the environmental justice population to the  
16 same extent and in the same manner (whether positive or negative) as experienced by the non-  
17 environmental justice population. Because indirect effects to environmental justice communities of concern  
18 can be both adverse and beneficial, and because proactive public involvement and coordination with local  
19 planning officials can help avoid disproportionate impacts, potential indirect effects of Grand Parkway  
20 Segments H and I-1 on environmental justice communities of concern are not considered to be substantial.  
21 The proposed project may have a beneficial indirect impact on the overall socio-economic conditions within  
22 the AOI.

23  
24 **6.3.2.5 Step 5: Reasonably Foreseeable Actions - Environmental Justice**

25 Existing toll facilities that factor into the cumulative impacts of the proposed toll system include the Sam  
26 Houston Tollway, the Westpark Tollway, and the Hardy Toll Road. Linkage to these toll facilities would be  
27 available to users of Segments H and I-1 as well as the non-tolled alternatives associated with those  
28 existing toll facilities. Other reasonably foreseeable toll projects in the immediate area include the  
29 completion of Segments G and I-2 of the Grand Parkway.

1 **6.3.2.6 Step 6: Cumulative Impacts Assessment - Environmental Justice**

2 Historically, TxDOT has financed highway projects on a “pay-as-you-go” basis, using motor fuel taxes and  
3 other revenue deposited in the state highway fund. However, population increases and traffic demand  
4 have outpaced the efficiency of this traditional finance mechanism. As funding mechanisms evolve, the  
5 trend towards utilization of toll facilities in this region would through time create “user impacts” as access to  
6 highway systems becomes an issue to the economically disadvantaged.

7  
8 As acknowledged in the environmental justice assessment (**Chapter 4 (Environmental Consequences)**),  
9 the economic impact of tolling would be higher for low-income residents since the cost of paying tolls would  
10 represent a higher percentage of household income than for non-low-income households. Further, low-  
11 income residents would not directly benefit from system linkage that the Segments H and I-1 are proposed  
12 to provide if they are unable to use the roadway due to the cost of paying tolls. Grand Parkway Segments  
13 H and I-1, as an element of the system of toll roads now being developed for the greater Houston  
14 metropolitan area, would contribute to a cumulative impact on low-income users of the system.

15  
16 System Level Analysis

17 A system level analysis for Level of Service (LOS) impacts associated with Segments H and I-1 is provided  
18 in **Chapter 2 (Alternatives Analysis)**. According to the analysis, vehicle hours of total delay (signalized  
19 delays and congestion delays) decrease when Segments H and I-1 are added to the system. Additionally,  
20 the model indicates the LOS for arterial streets in the cities have a slight improvement. As stated earlier,  
21 non-toll alternatives would be available to all travelers, including low-income populations, via frontage roads  
22 (if available along FM 1485) and local arterials. The use of these alternative non-toll routes may result in a  
23 difference in travel time due to a lower speed limit and signalization.

24  
25 The Grand Parkway as an element of the system of toll roads now being developed for the H-GAC area  
26 would contribute to a cumulative impact on low-income users of the system. Although it is likely that a user  
27 may routinely travel one or more elements of the toll system en-route to and from various destination points  
28 throughout the city, it is unlikely that the user would travel the entire length of those elements. Further,  
29 given the lay-out and orientation of the regional system, it is not likely that a driver would routinely travel the  
30 entire length of the entire Houston-area toll system during the course of normal activities.

### 6.3.2.7 Step 7: Results- Environmental Justice

The combined effect of the historical growth patterns within the environmental justice RSA, forecasted growth of population, induced development associated with the proposed project described in **Chapter 5**, reasonably foreseeable developments, and improvements to other transportation facilities previously discussed results in a market attractive for continued residential and commercial development. As stated in Step 5, the anticipated increase of tolled mainlanes in the regional transportation network is indicative of an emerging regional tolling network.

Access to the mainlanes of the emerging regional tolling network would be limited to those who elect or can only on occasional basis afford to pay the toll. Additionally, as detailed in **Section 4.2.1.2**, the cash payment option for HCTRA's EZ TAG is not currently available. Because (at this time) cash accounts are not accepted to maintain an EZ Tag, individuals without a bank account or credit card would face limitations with using the regional tolling network. However if other forms of prepaid tolling transponder accounts are accepted, such as TxDOT's TxTag or NTTA's TollTag, users without a bank account would be able to utilize the regional tolling network by maintaining cash payments. The difference in travel times between the tolled mainlanes and the non-tolled alternatives would be the highest during peak periods of travel when traffic congestion would be the greatest.

The economic impact of tolling would be higher for the low-income individuals because the cost of paying tolls would represent a higher percentage of household income than for non-low-income households. Not maintaining a prepaid toll transponder account would impact any user, including low-income users, because the cost of paying the accumulated toll charges without an account would represent a higher toll rate than toll charges affiliated with a prepaid account.

It is reasonable to assume that there would be a cumulative impact on environmental justice populations upon build-out of the toll system due to the economic impacts of tolling and the difference in travel time should non-toll alternatives be utilized by low-income populations. However, given the lay-out and orientation of the regional system and examination of the traffic data associated with the origin-destination analysis, it is not anticipated that users (including low-income users) would be affected by travelling the entire length of the entire system during the course of normal activities.

1 **6.3.2.8 Step 8: Mitigation - Environmental Justice**

2 Mitigation: Regulatory Controls

3 The proposed tolling of Segments H and I-1 would not exclude any person on the ground of race, color, or  
4 national origin from participation in the project, be denied the benefits of the project, or be subject to  
5 discrimination under the proposed project; therefore, according to Title VI of the Civil Rights Act of 1964  
6 and EO 12898 regulation, mitigation associated with environmental justice is not currently proposed.  
7 Through the excess toll revenue generated from the proposed toll project, other transportation projects  
8 could be programmed to benefit the regional community including environmental justice populations.

9  
10 **6.3.3 Air Quality**

11 **6.3.3.1 Step 1: Resource Identification - Air Quality**

12 The proposed project area falls within the eight-county Houston-Galveston-Brazoria nonattainment area  
13 which is currently classified as a marginal nonattainment area for the eight-hour ozone NAAQS. All  
14 projects in the H-GAC's 2013-2016 Transportation Improvement Program (TIP) that are proposed for  
15 federal or state funds were initiated in a manner consistent with federal guidelines in Section 450, of Title  
16 23 CFR and Section 613.200, Subpart B, of Title 49 CFR. Air quality is among the considerations  
17 addressed in the programming of the TIP.

18  
19 *Ozone and Carbon Monoxide*

20 In order to protect human health and the environment, the Clean Air Act (CAA) of 1970 mandated the  
21 establishment of the NAAQS and regulations to reduce air pollutants. When the pollutant level within an  
22 area exceeds the NAAQS, U.S. Environmental Protection Agency (EPA) designates the area as  
23 "nonattainment" for the pollutant.

24  
25 *MSAT*

26 In addition to NAAQS, EPA also regulates air toxics. Most air toxics originate from human-made sources,  
27 including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry  
28 cleaners), and stationary sources (e.g., factories or refineries).

29  
30 **6.3.3.2 Step 2: Resource Study Area - Air Quality**

31 The RSA for evaluating air quality associated with the NAAQS and transportation conformity was  
32 designated as the eight-county Houston-Galveston-Brazoria non-attainment area for the eight-hour ozone  
33 standard, which includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and

1 Waller counties as depicted in **Exhibit 6-2**. This area represents the management unit for mobile source  
2 pollutants as regulated by federal, state, and local government agencies. The NAAQS criteria pollutants  
3 include ozone, carbon monoxide, particulate matter, nitrogen dioxide, sulfur dioxide, and lead. Unlike the  
4 other resources evaluated, air quality impacts from mobile sources are evaluated and managed on a  
5 regional basis primarily through the H-GAC, in coordination with the EPA, TCEQ, TxDOT, and FHWA.  
6 Evaluating Air Quality in relation to cumulative impacts requires looking at three distinct RSAs, as described  
7 below:

- 8 • **Ozone** – The RSA for evaluating the ozone NAAQS was designated as the Houston-  
9 Galveston-Brazoria eight-hour ozone nonattainment area, which includes: Brazoria, Chambers,  
10 Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller counties. The NAAQS criteria  
11 pollutants include ozone, carbon monoxide, particulate matter, nitrogen dioxide, sulfur dioxide,  
12 and lead.
- 13 • **Carbon Monoxide** – The RSA for carbon monoxide was based on the ROW line, which  
14 represents the locations with the highest potential for carbon monoxide concentrations.  
15 However, the nature of the proposed project does not warrant a Traffic Air Quality Analysis.  
16 Therefore, carbon monoxide levels resulting from this project would not be expected to exceed  
17 the NAAQS for carbon monoxide and negatively impact air quality in this area.
- 18 • **Mobile Source Air Toxics (MSAT)** – The RSA for MSAT is encompassed by the boundaries  
19 of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller counties.  
20 Unlike the other resources evaluated, air quality impacts from MSAT have been evaluated  
21 qualitatively in this proposed project by TxDOT and FHWA. MSAT are regulated by EPA on a  
22 national basis through requirements for fuels and vehicle technology. The MSAT analysis  
23 conducted for the proposed project qualitatively evaluated emission changes based upon the  
24 proposed project and national trends.

### 25 26 **6.3.3.3 Step 3: Resource Health and Historical Context - Air Quality**

27 The EPA establishes limits on atmospheric pollutant concentrations through enactment of the NAAQS for  
28 six principal, or criteria pollutants. The EPA designated eight counties in the Houston-Galveston-Brazoria  
29 area as nonattainment for ozone. The region is currently in attainment for all other criteria pollutants.  
30 Although there have been year-to-year fluctuations, the ozone trend continues to show improvement. The  
31 trend of improving air quality in the region is attributable in part to the effective integration of highway and  
32 alternative modes of transportation, cleaner fuels, improved emission control technologies, and H-GAC  
33 regional clean air initiatives.

1 **6.3.3.4 Step 4: Direct and Indirect Impacts - Air Quality**

2 Direct impacts on air quality and MSAT from the project are primarily those associated with the increased  
3 capacity, accessibility and the resulting projected increases in VMT. Emission reductions as a result of  
4 EPA's new fuel and vehicle standards are anticipated to offset impacts associated with VMT increases.

5  
6 Indirect impacts on air quality and MSAT are primarily related to any expected development resulting from  
7 project's increased accessibility, or capacity to the area. Any increased air pollutant or MSAT emissions  
8 resulting from the potential development of the area must meet regulatory emissions limits established by  
9 the TCEQ and EPA, as well as obtain appropriate authorization from the TCEQ, and therefore are not  
10 expected to result in any degradation of air quality or MSAT levels.

11  
12 **6.3.3.5 Step 5: Reasonably Foreseeable Actions - Air Quality**

13 Increased development and urbanization can result in increased air pollutant or MSAT emissions resulting  
14 from these actions. These must meet regulatory emissions limits established by the TCEQ and EPA, as  
15 well as obtain appropriate authorization from the TCEQ, and therefore are not expected to result in any  
16 degradation of air quality or MSAT levels. Reasonably foreseeable actions that could impact air quality  
17 within the RSA include projects within the H-GAC 2035 RTP Update – Appendix E Project Listing  
18 ([http://www.h-gac.com/taq/plan/documents/2035\\_update/Appendix%20E%20-%20Compiled%20-%202001-](http://www.h-gac.com/taq/plan/documents/2035_update/Appendix%20E%20-%20Compiled%20-%202001-21-11.pdf)  
19 [21-11.pdf](http://www.h-gac.com/taq/plan/documents/2035_update/Appendix%20E%20-%20Compiled%20-%202001-21-11.pdf)).

20  
21 **6.3.3.6 Step 6 and Step 7: Cumulative Impacts Assessment and Results - Air**  
22 **Quality**

23 Any increased air pollutant or MSAT emissions resulting from increased capacity, accessibility and  
24 development are projected to be more than offset by emissions reductions from EPA's new fuel and vehicle  
25 standards or addressed by EPA's and TCEQ's regulatory emissions limits programs. Projected traffic  
26 volumes are expected to result in no impacts on air quality; improved mobility and circulation may benefit  
27 air quality. Increases in urbanization would likely have a negative impact on air quality. However, planned  
28 transportation improvements in the project area as listed in the conforming 2035 RTP Update and 2013-  
29 2016 TIP, coupled with EPA's vehicle and fuel regulations and fleet turnover, are anticipated to have a  
30 cumulatively beneficial impact on air quality.

31  
32 The cumulative impact on air quality from the proposed project and other reasonably foreseeable  
33 transportation projects is addressed at the regional level by analyzing the air quality impacts of

1 transportation projects in the 2035 RTP Update and the 2013-2016 TIP. The proposed project and the  
2 other reasonably foreseeable transportation projects were included in the 2035 RTP Update and the 2013-  
3 2016 TIP, and have been determined to conform to the State Implementation Plan (SIP). When combined,  
4 planned transportation improvements, revised EPA fuel and vehicle regulations, and fleet turnover are  
5 anticipated to have a cumulatively beneficial impact on air quality.

#### 6 7 **6.3.3.7 Step 8: Mitigation- Air Quality**

8 The mitigation of future development within the region considered for this study would rest with the  
9 agencies with the authority to implement such controls. This authority rests with the municipal  
10 governments and to a lesser extent, the county governments. The responsibility of transportation providers  
11 such as TxDOT, local and regional transit agencies, and local governments would be to implement a  
12 transportation system to complement the land use or development controls implemented. The H-GAC  
13 would be responsible for determining the conformity of the RTP and TIP to air quality standards and  
14 mitigating air quality on a regional basis.

#### 15 16 **Mitigation: Regulatory Controls**

17 A variety of federal, state and local regulatory controls as well as local plans and projects have had, and  
18 would continue to have, a beneficial impact on overall regional air quality. The CAA, as amended, provides  
19 the framework for federal, state, tribal, and local rules and regulations to protect air quality. The CAA  
20 required the EPA to establish NAAQS for pollutants considered harmful to public health and the  
21 environment. In Texas, the TCEQ is responsible to develop, adopt and implement plans and strategies to  
22 protect and restore air quality in cooperation with local, regional, state, and federal stakeholders. TCEQ has  
23 the legal authority to implement, maintain, and enforce the NAAQS. Authorization in the Texas CAA allows  
24 the TCEQ to do the following: collect information and develop an inventory of emissions; conduct research  
25 and investigations; prescribe monitoring requirements; institute enforcement; formulate rules; establish air  
26 quality control regions; encourage cooperation with citizens' groups and other agencies and political  
27 subdivisions of the state as well as with industries and the federal government; and to establish and  
28 operate a system of permits for construction or modification of facilities. Local governments having some of  
29 the same powers as the TCEQ can make recommendations to the commission concerning any action of  
30 the TCEQ that may affect their territorial jurisdiction, and can execute cooperative agreements with the  
31 TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the  
32 control and abatement of air pollution not inconsistent with the orders of the TCEQ.

1 The CAA also requires states with areas that fail to meet the NAAQS prescribed for criteria pollutants to  
2 develop a SIP. The SIP describes how the state would reduce and maintain air pollution emissions in order  
3 to comply with the federal standards. Important components of a SIP include emission inventories, motor  
4 vehicle emission budgets, control strategies, and an attainment demonstration. The TCEQ develops the  
5 Texas SIP for submittal to the EPA. One SIP is created for each state, but portions of the plan are  
6 specifically written to address each of the nonattainment areas. These regulatory controls, as well as other  
7 local transportation and development initiatives implemented throughout the Houston-Galveston-Brazoria  
8 eight-county area by local governments (and others) provide the framework for growth throughout the area  
9 consistent with air quality goals. As part of this framework, all major transportation projects (including the  
10 proposed project) are evaluated at the regional level by the H-GAC for conformity with the SIP.

11  
12 The cumulative impact of reasonably foreseeable future growth and urbanization on air quality within this  
13 area would be minimized by enforcement activities of federal and state regulations by the EPA and TCEQ,  
14 which would help ensure that growth and urbanization would not prevent attainment with the ozone  
15 standard or threaten the maintenance of the other air quality standards.

#### 16 17 **6.3.4 Water Resources**

##### 18 **6.3.4.1 Step 1: Resource Identification -Water Resources**

19 The resource is all of the U.S. Army Corps of Engineers (USACE) jurisdictional waters within the water  
20 quality RSA. Particular attention is given to surface water quality conditions, habitat value and functions  
21 and values. Declining health trends in surface water quality nationally and concern for special aquatic sites  
22 make analysis necessary.

##### 23 24 **6.3.4.2 Step 2: Resource Study Area - Water Resources**

25 The RSA for water resources (specifically water quality and waters of the U.S., including wetlands) is  
26 shown in **Exhibit 6-3** and is comprised of approximately 3.3 million ac. The RSA includes six regional  
27 watersheds; a watershed represents a bounded hydrologic system wherein natural resources are  
28 interconnected and integrated through a common water course. Conversion of this resource would affect  
29 the hydrology and ecology that currently characterizes the watersheds. The six regional watersheds found  
30 within the RSA include: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay,  
31 Spring, and West Fork San Jacinto watersheds; these regional watersheds include sub-watersheds,  
32 notably including the San Jacinto River, Luce Bayou, Cedar Bayou, and Jackson Bayou watersheds within

1 the project area. The San Jacinto River watershed includes Caney Creek, Peach Creek, and the East Fork  
2 and West Fork of the San Jacinto River, and their tributaries. Luce Bayou and its tributaries comprise the  
3 Luce Bayou watershed. Cedar Bayou watershed is comprised of Cedar Bayou and Old River and their  
4 tributaries. Jackson Bayou flows west into Lake Houston. Within the water resources RSA, there are  
5 approximately 190,000 ac of waters and 343,000 ac wetlands, as defined by the National Wetland  
6 Inventory and the topographical maps utilized for this analysis.

7  
8 As previously stated, the temporal boundaries for the cumulative impacts analysis are the years 1970 to  
9 2035. Historical actions are those actions which occurred between 1970 and 2000; present actions  
10 occurred between 2000 and 2013. The years 2013 to 2035 represent future actions, which correlate with  
11 the H-GAC's 2035 RTP Update.

### 12 13 **6.3.4.3 Step 3: Resource Health and Historic Context -Water Resources**

14 According to the 2010 Texas 303(d) list, two listed segments are within the RSA. Segment ID: 0902, Cedar  
15 Bayou Above Tidal, is listed as impaired from a point 1.4 mile (mi) upstream of I-10 (E) in Chambers/Harris  
16 County to a point 4.6 mi upstream of FM 1960 in Liberty County; it is listed as a Category 5c, Rank D  
17 because of low dissolved oxygen. Category 5 waters are those which do not meet applicable water quality  
18 standards or are threatened for one or more designated uses by one or more pollutants. Category 5c  
19 waters are those where additional information would be collected before a Total Maximum Daily Load  
20 (TMDL) study is scheduled. Cedar Bayou Tidal (Segment ID: 0901) is listed along its entire length as  
21 impaired due to dioxin in catfish and crab tissue (Category 5a, Rank U). The Category 5a designation  
22 means that a TMDL study is scheduled, underway or would be scheduled for the waterway in question. The  
23 Rank of "U" indicates that a TMDL study is underway. Sixty stream segments are listed as impaired in the  
24 Buffalo-San Jacinto watershed. The West Fork San Jacinto watershed has two stream segments listed as  
25 Impaired, the East Fork San Jacinto watershed has no impaired segments, the Lower Trinity watershed has  
26 one listed segment impaired, the North Galveston Bay watershed has four listed impaired segments, and  
27 the Spring watershed has 13 listed impaired segments.

28  
29 These impairments are a function of historical (and many pre-regulatory) changes to the land around these  
30 waterways and introduced stress placed upon them by land use changes. CWA Section 303(d) requires  
31 the TCEQ to identify those waters within its boundaries for which the effluent limitations required by Section  
32 301(b)(1)(A) and Section 301(b)(1)(B) are not stringent enough to ensure compliance with applicable

1 surface water quality standards. If waterways do not meet these standards, a plan must be developed to  
2 meet the standards. The TCEQ must establish a priority ranking, taking into account the severity of the  
3 pollution and the uses of the streams.

4  
5 In the water resources RSA, development and urbanization has resulted in channelization, excavation, and  
6 filling of many of the area's natural streams and wetlands.

7  
8 In 1991, Texas adopted state goals for "no net loss" of acreage or aquatic function of wetlands. These  
9 goals reflect the regulatory program in the CWA legislation that prohibits the discharge of fill into Waters of  
10 the U.S. unless authorized by a permit issued under CWA Section 404. The USACE has authority over  
11 such actions and may require the permittee to restore, create, enhance, or preserve nearby aquatic  
12 features as compensation to offset unavoidable adverse impacts to the aquatic environment. This means  
13 compensatory mitigation is intended to comply with the general goals of the CWA and the specific goal of  
14 "no net loss" of aquatic functions. Several regulations, such as Nationwide Permits (NWP) and Individual  
15 Permits (IP) issued by the USACE and consistency with the Texas Coastal Management Program, have  
16 been enacted on a federal, state, and local level to achieve these goals.

#### 17 18 **6.3.4.4 Step 4: Direct and Indirect Impacts - Water Resources**

##### 19 Direct Impacts (Water Quality)

20 Impervious surfaces may be directly increased by as much as 419 ac with the construction of the Preferred  
21 Alternative. In addition, although not required by regulation, the project would include features to facilitate  
22 the control of possible spills of hazardous materials along the roadway. These features include, but are not  
23 limited to, silt fences, check dams, vegetative swales and filter strips, and detention basins. No such  
24 features currently exist within the project corridor.

25  
26 It is not anticipated that the Preferred Alternative or the No-Build Alternative would contaminate or  
27 otherwise adversely affect any surface waters including the public water supply, water treatment facilities,  
28 or water distribution systems. Rainfall runoff rates would increase slightly due to an increase in impervious  
29 cover. The TCEQ requires temporary and permanent Best Management Practices (BMPs) designed to  
30 assure that unacceptable impacts to water quality are avoided. These measures include, but are not  
31 limited to, silt fences, check dams, vegetative swales and filter strips, and detention basins. Indirect  
32 impacts are anticipated to be minor. Aquatic habitat values for ephemeral streams are absent and water

1 quality impacts would be minimized and mitigated by adherence to federal and state regulatory permits and  
2 conditions.

3  
4 Direct Impacts (Waters of the U.S., including Wetlands)

5 The proposed project would have direct impacts to approximately 338 ac of wetlands and 22.9 ac of Waters  
6 of the U.S. Impervious surfaces may be increased by as much as 419 ac due to direct impacts. In  
7 addition, although not required by regulation, the project would include features to facilitate the control of  
8 possible spills of hazardous materials along the roadway. No such features currently exist within the  
9 project corridor.

10  
11 It is not anticipated that the Preferred Alternative or the No-Build Alternative would contaminate or  
12 otherwise adversely affect any surface waters including public water supply, water treatment facilities, or  
13 water distribution systems. Rainfall runoff rates would increase slightly due to an increase in impervious  
14 cover. The TCEQ requires temporary and permanent BMPs designed to assure that unacceptable impacts  
15 to water quality are avoided. These measures include, but are not limited to, silt fences, check dams,  
16 vegetative swales and filter strips, and detention basins. As with all of the reasonable alternatives, much of  
17 this “jurisdictional area” is already disturbed (graded, piped, concrete-lined, etc.). Direct impacts to surface  
18 waters resulting from any of the reasonable alternatives are anticipated to require an individual permit.  
19 Indirect impacts are anticipated to be minor. Aquatic habitat values for ephemeral streams are absent and  
20 water quality impacts would be minimized and mitigated by adherence to federal and state regulatory  
21 permits and conditions.

22  
23 Indirect Impacts (Water Quality)

24 Approximately 25,944 ac of undeveloped land would be converted to residential and commercial use with  
25 the build alternative. New development indirectly caused by the project would result in an increase in  
26 impervious cover and greater volumes of runoff during storm events. Runoff could contain oil and grease  
27 constituents, which could be carried to off-site water bodies. New residential development would also  
28 result in new municipal discharges from sewage treatment facilities and storm water runoff from new off-  
29 system roadways. Induced development under the Preferred Alternative could result in adverse effects to  
30 water resources through degradation of surface water and groundwater, more rapid discharge of  
31 stormwater, and additional pollutant loadings of waterways. Indirect impacts to groundwater wells and  
32 capture zones are anticipated to be minor in the context of the regional development as a whole. As with

1 direct impacts, water quality effects from induced development would be minimized and mitigated by  
2 adherence to federal and state regulatory permits and conditions.

3  
4 Indirect Impacts (Waters of the U.S., including Wetlands)

5 Indirect impacts to Waters of the U.S. and wetlands are anticipated to be approximately 2,997 ac of  
6 wetlands and no Waters of the U.S., as a result of the Preferred Alternative. These estimates of indirect  
7 impacts are based on the existing resources within the RSA, and in fact, may not be a practical assumption  
8 of total impacts, as much of these resources are protected under the current federal regulations and the “no  
9 net loss” policy and these resources serve as a constraint to development.

10  
11 **6.3.4.5 Step 5: Reasonably Foreseeable Actions - Water Resources**

12 Envision Houston land development projections (H-GAC 2035), as well as development trends for the  
13 region documented during the indirect impacts analysis (**Chapter 5**), indicated approximately 22.2 percent  
14 of the water resources RSA is already developed or planned for development, resulting in an approximately  
15 1,270,000 ac increase of impervious surfaces and cumulative impacts to approximately 114,000 ac of  
16 Waters of the U.S. and wetlands (or 20 percent of Waters of the U.S. and wetlands within the RSA). These  
17 estimates of cumulative impacts are based on the existing resources within the RSA, and in fact, may not  
18 be a practical assumption of total impacts, as much of these resources are protected under the current  
19 federal regulations and the “no net loss” policy. However, it is imperative that the continued health of the  
20 resource is monitored and regulatory programs remain sensitive to the changes that are occurring. The  
21 trend for CWA Section 404 Nationwide permits has been a continued lowering of permit and reporting  
22 thresholds. Likewise CWA 303 and 305 programs continue to monitor the health of surface waters. USGS  
23 studies indicate that Total Suspended Solids (TSS) runoff rates for transportation corridors are lower than  
24 those levels generated naturally.

25  
26 **6.3.4.6 Step 6: Cumulative Impacts Assessment - Water Resources**

27 Increased development can and has historically resulted in aquatic habitat fragmentation and displacement.  
28 The aquatic habitat value of affected waters is low because the affected waters are ephemeral and only  
29 contain water for brief periods after a rainfall event. Therefore, they are dry most of the year. Increased  
30 construction would result in disturbance to ground cover, and sediment discharge resulting from the  
31 disturbance and increased impermeable area would be likely. Increases in runoff can cause erosion to

1 enter surface waters. These activities are regulated and subject to stormwater management criteria  
2 designed to minimize these impacts.

3  
4 Cumulative impacts are likely to be related to land use changes in and around the watershed. Cumulative  
5 impacts within all watersheds in the RSA may be up to approximately 114,000 ac of Waters of the U.S. and  
6 wetlands (or 20 percent of Waters of the U.S. and wetlands within the RSA). These estimates of  
7 cumulative impacts are based on the existing resources within the RSA, and in fact, may not be a practical  
8 assumption of total impacts as much of these resources are protected under the current federal regulations  
9 and the “no net loss” policy, and are often viewed as a constraint to development. Adherence to local, state  
10 and federal regulations and standards would minimize these adverse impacts. However, it is imperative  
11 that the continued health of the resource is monitored and regulatory programs remain sensitive to the  
12 changes that are occurring. The trend for CWA Nationwide permits has been a continued lowering of  
13 permit and reporting thresholds. Likewise CWA 303 and 305 programs continue to monitor the health of  
14 surface waters. USGS studies indicate that TSS runoff rates for transportation corridors are lower than  
15 those levels generated naturally.

#### 16 17 **6.3.4.7 Step 7: Results- Water Resources**

##### 18 Water Quality

19 Potential long-term surface water quality impacts for Segments H and I-1 within the project limits include  
20 the relocation from runoff of typical traffic pollutants (such as gasoline, oil, and antifreeze, among others)  
21 into surface waterways and the potential for isolated spill events.

22  
23 Water pollution due to erosion and sedimentation during construction could potentially have short-term  
24 temporary adverse impacts on receiving waters. The impacts of this project are anticipated to be minimal.  
25 The net effect of all development reasonably foreseeable within the RSA in the next 20 years may require a  
26 reassessment of CWA 401 goals and sedimentation and erosion guidelines. Stormwater runoff from the  
27 completed facility could also introduce pollutants into surface water, which could result in long-term adverse  
28 effects on surface water quality. There have been no documented water quality problems associated with  
29 the existing roadways operating in the area and no serious problems are anticipated by this proposed  
30 project. USGS studies seem to indicate that TSS from highway corridor runoff is less than TSS from  
31 undeveloped areas, inferring that BMPs and water pollution abatement procedures improve the quality of  
32 water from a suspended-solid perspective beyond natural conditions. Contaminants from highway use are

1 a concern, but implementation of stormwater quality requirements of Section 401 of the CWA would  
2 minimize potential impacts.

3  
4 The potential for erosion within the ROW increases during the construction phase of the roadway  
5 development. Vegetation clearing and grading accelerates erosion and sedimentation processes. Eroded  
6 sediment may redeposit downstream, resulting in disruption of the aquatic ecosystem and degraded water  
7 quality.

#### 8 Waters of the U.S., including Wetlands

9  
10 The Preferred Alternative would have approximately 338 ac of wetlands and 22.9 of impacts to Waters of  
11 the U.S. All potential impacts to Waters of the U.S. are regulated by the USACE and would be minimized  
12 or mitigated. There would be up to 2,997 ac of indirect impacts to Waters of the U.S., including wetlands.  
13 For the past, present, and reasonably foreseeable private development and roadway projects in the project  
14 area, it is estimated that up to approximately 114,000 ac (or approximately 20 percent) of the approximate  
15 190,000 ac of waters and 343,000 ac of wetlands within the RSA may be affected.

16  
17 Additionally, there are added capacity projects on various corridors within the land use RSA identified in  
18 H-GAC's 2035 Plan and the City of Houston's Major Thoroughfare and Freeway Plan (**Table 6-5**). The  
19 projects are anticipated to convert approximately 761 ac and 565 ac, respectively, of land from existing  
20 uses to transportation uses within the surface water RSA. These projects are in the planning stage, and as  
21 such, information regarding the permitting status and any proposed mitigation is incomplete. It is a  
22 certainty that some linear projects, such as these, would impact surface waters. Impacts to surface waters  
23 are not quantifiable at this time.

#### 24 **6.3.4.8 Step 8: Mitigation - Water Resources**

25  
26 Regulatory controls are an important component of assuring that future impacts to surface waters are  
27 minimized. Waters of the U.S. are regulated by the USACE under authority of Section 404 of the CWA.  
28 Section 404 of the CWA authorizes the USACE to issue permits for the discharge of dredged or fill material  
29 into Waters of the U.S., including wetlands. The intent of this law is to protect the nation's waters from the  
30 indiscriminate discharge of material capable of causing pollution, and to restore and maintain their  
31 chemical, physical, and biological integrity. Any discharge into Waters of the U.S. must be in accordance  
32 with Section 404(b)(1) guidelines developed by the EPA in conjunction with the USACE. In the Section 404

1 permit process, permit applications are reviewed by the USACE for compliance with Section 401 of the  
2 CWA.

3  
4 There would be only minor indirect impacts to Waters of the U.S., including wetlands. For the past,  
5 present, and reasonably foreseeable private development and roadway projects in the project area, it is  
6 estimated that up to 114,000 ac of waters and wetlands within the RSA may be affected; however, given  
7 the current federal “no net loss” policy, and the constraint these resources are to development, this total  
8 cumulative impact number is not likely to occur in the region.

9  
10 The proposed project’s impact to Waters of the U.S. would be avoided or minimized by compliance with the  
11 USACE NWP and IP programs and the federal “no net loss” policy. The cumulative impact of reasonably  
12 foreseeable future actions to Waters of the U.S. could be minimized by adherence to applicable USACE,  
13 USFWS, TPWD, and U.S. Coast Guard (USCG) regulations for projects subject to state and federal  
14 jurisdiction. The proposed project would not contribute to substantial cumulative impacts to the area  
15 Waters of the U.S.

16  
17 Due to these potentially adverse impacts, the minimization of erosion and sedimentation processes during  
18 highway construction would be included in the design of the highway through the use of strategically  
19 located, temporary BMPs which would be maintained throughout the construction phase.

20  
21 TxDOT would also comply with the TCEQ Texas Pollution Discharge Elimination System (TPDES) general  
22 permit for storm water discharges from construction sites. All development in the RSA is required to  
23 comply with the TCEQ TPDES general permit. In accordance with TCEQ regulation, a Notice of Intent  
24 (NOI) would be filed and a Stormwater Pollution Prevention Plan (SWPPP) would be implemented for the  
25 construction site because the project impacts over 5 ac. Any adverse impact caused by storm water runoff  
26 would be mitigated through the use of temporary and permanent erosion and sedimentation controls.  
27 Temporary controls would be implemented before the beginning of construction and permanent controls  
28 would be maintained throughout the construction phase. On-site inspections and regular maintenance  
29 would also be performed.

30  
31 These projects are in the planning stage and as such, information regarding the permitting status and any  
32 proposed mitigation is incomplete. It is a certainty that some linear projects, such as these, would impact  
33 surface waters. Impacts to surface waters are not quantifiable at this time.

1 It is important to stress with regard to this project that all impacts to jurisdictional waters associated with this  
2 project would be permitted and mitigated in compliance with all applicable regulatory standards.

## 3 4 **6.4 Cumulative Regional Effects of Tolled Facilities and Managed** 5 **Lanes**

### 6 Overview

7 As the MPO for the Houston-Galveston Region, the H-GAC is charged with enabling and creating a  
8 regional perspective for transportation and mobility. In its mission to provide effective regional  
9 transportation strategies, the MPO examines potential impacts to natural, cultural, and socioeconomic  
10 resources including Title VI (environmental justice) communities, air and water quality, land use, and  
11 vegetation implications at the planning and project development phases for individual transportation  
12 projects.

13  
14 In order to maintain mobility in the region, the 2035 RTP Update provides major strategies, which utilized  
15 together would preserve needed regional mobility. The 2035 RTP Update recognizes that although the  
16 region cannot build itself out of congestion, adding system capacity cannot be avoided and is thus an  
17 important strategy for improving mobility. Adding capacity to the roadway network is costly, and with  
18 dwindling funding, strategies such as tolled facilities have become an increasingly attractive option as a  
19 means of adding capacity to the network. The Houston-Galveston region is now one of the few regions in  
20 the country that has or is on the verge of having a regional tolled roadway network. The H-GAC conducted  
21 analyses on the regional indirect and cumulative effects of tolled facilities and managed lanes and in April,  
22 2009 prepared a report titled Regional Toll Analysis Summary for Inclusion in Houston Area Toll Road  
23 Environmental Documents). This report was updated (lastly) in October 2013 and the report is titled  
24 Regional Cumulative and Indirect Effects of Toll Facilities (**Appendix P**). The analysis focuses on a  
25 regional tolled roadway network and its indirect and cumulative impacts on the above mentioned resources.

26  
27 Cumulative impacts may result from individually minor, but collectively significant actions taking place over  
28 time. H-GAC plans for regional changes over a long time horizon, 30 years, thus providing a means to  
29 assess cumulative impacts to a region. Indirect effects are typically observed after the action occurs.  
30 Consideration of both the indirect and cumulative effects of a regional tolled roadway network is essential to  
31 the analysis of tolled facilities, as the existence of this type of network can cause long term changes in air  
32 and water quality, vegetation, and land use patterns. Air and water quality are most affected by the

1 increase the number of vehicles and non-permeable surface area, respectively. Furthermore, as the  
2 regional tolled roadway network increases, the potential for changes in land use also increase. Land use  
3 changes often result because the regional tolled roadway network and proposed additions are located  
4 outside of the core urban area where development is not yet clearly defined or existing.

5  
6 Indirect and cumulative impacts from a regional tolled roadway network may also be evident in EJ  
7 populations, as these populations are most sensitive to a tolled roadway network in relation to access.  
8 Restricting access based on pricing has the potential to create disproportionate adverse effects. The  
9 analysis focuses on quantifying the benefits and/or disbenefits to the identified EJ populations based on  
10 accessibility and travel time.

11  
12 It is also likely that a tolled roadway network would also have an impact on the regional economy as freight  
13 and transportation are vital to the health of the economy in the Houston-Galveston region. The analysis  
14 concludes that a regional tolled roadway network is not expected to have any significant adverse  
15 cumulative or indirect impacts.

#### 16 17 Air Quality

18 The CAAA of 1990 require transportation plans, programs, and projects in nonattainment areas, which are  
19 funded or approved by the FHWA or FTA, to conform to the SIP. This ensures that transportation plans,  
20 programs, and projects do not produce new air quality violations, worsen existing violations, or delay timely  
21 attainment of the NAAQS.

22  
23 Under the CAA, the EPA established criterion called the NAAQS to determine the health threat of criteria  
24 pollutants generally located within Consolidated Metropolitan Statistical Areas (CMSAs). If a CMSA has a  
25 health threat, it is designated as a 'nonattainment' area until compliance is achieved. The HGB region is  
26 classified as a nonattainment area for the 2008 8-hour ozone standard, and it has been further classified as  
27 "marginal".

28  
29 Transportation conformity is an analytical methodology that establishes the connection between projected  
30 on-road emissions from the 2035 RTP Update Transportation Plan (Plan) and the known reductions in the  
31 motor vehicle emission budget from the SIP. Through the process of transportation conformity, the 2035  
32 RTP Update uses the SIP on-road mobile strategies and air quality targets to demonstrate if the 2035 RTP

1 Update complies with the federal air quality requirements. Vehicle emissions resulting from the  
2 implementation of transportation projects in the 2035 RTP Update cannot exceed emission budgets  
3 established by the SIP. The Houston-Galveston region must demonstrate that the 2013-2016 TIP and the  
4 long-range plan (2035 RTP Update) result in less VOC and NO<sub>x</sub> than established and approved by EPA for  
5 each analysis year. The USDOT (FHWA and FTA) determined that the 2035 RTP Update and the 2013-  
6 2016 TIP conformed to the requirements of the SIP for the Houston-Galveston ozone nonattainment area  
7 on January 25, 2011 and November 1, 2012, respectively.

8  
9 Level of Mobility (LOM) was developed to illustrate the degree of congestion on roadways within the region.  
10 The H-GAC analyzed the relative distribution of morning peak period congestion levels for the current and  
11 future regional roadway network as a percentage of VMT in each LOM category (**Appendix P**, Page 7,  
12 Figure 2). There will be an increase in regional congestion levels if the forecasted growth occurs. The  
13 most significant changes would be at the low end of the range (tolerable congestion levels) and high end  
14 (severe) congestion levels, between the current system performance and a future scenario without the  
15 2035 RTP Update project (the No Build). The proposed 2035 RTP Update Regional Roadway Network  
16 would reduce the percentage of severely congested VMT in the morning peak period, from approximately  
17 50 percent to less than 30 percent compared to the 2035 No Build Scenario.

18  
19 *Air Quality Findings*

20 The introduction of additional priced facilities into the existing roadway network would not cause any  
21 cumulative impacts to air quality. Moreover, a regional priced roadway system provides additional travel  
22 capacity to the roadway network, which allows a greater flow of traffic throughout the region decreasing the  
23 amount of cars traveling at lower speeds or idling conditions. This would result in less fuel combustion and  
24 lower emissions including MSATs, CO, and Ozone. EPA's vehicle and fuel regulations, coupled with fleet  
25 turnover, are expected to result in significant reductions of on-road emissions, including MSATs, CO and  
26 ozone precursors.

27  
28 Water Quality

29 The Houston-Galveston region has an abundance of water resources including rivers, lakes, and bays,  
30 among others. The TCEQ, along with the Clean Rivers Program and numerous local agencies, are  
31 responsible for monitoring all major bodies of water and reporting those conditions in a biennial Texas

1 Water Quality Inventory report. Section 303(d) of this report details those waterbodies TCEQ has identified  
2 as impaired because of water contamination.

3  
4 The 303(d) list identifies several major water systems as impaired with pollutants and bacteria in the  
5 Houston-Galveston Transportation Management Area (TMA). A majority of the waterways located in the  
6 Trinity-San Jacinto Coastal Basin, San Jacinto River Basin, San Jacinto-Brazos Coastal Basin, Brazos-  
7 Colorado Coastal Basin, including bays and estuaries that flow to the Gulf of Mexico, are impaired and  
8 included in the 303(d) list. The construction of the proposed priced facility system would cross and impact  
9 the above mentioned waterbodies at multiple locations and could cause water quality impacts. The  
10 increase of impervious square footage from adding capacity to the roadway network greatly increases non-  
11 point source pollution and the potential to cause further impairment to the region's waterways.

12  
13 The TCEQ regulates water quality through SWP3, MS4, and BMPs. All construction of the priced facilities  
14 in the 2035 RTP Update would follow these water quality regulations that would aid in preventing further  
15 pollution to these impaired waters and to waters that are not impaired. Additionally, any land use  
16 development that would occur from the construction of these facilities would follow TCEQ's regulations for  
17 water quality through SWP3 and MS4.

18  
19 *Water Quality Findings*

20 Although overall impacts cannot be avoided, the above mentioned mitigation techniques would ensure that  
21 the regional priced facilities would not have significant cumulative impacts to water quality.

22  
23 Vegetation

24 Prairie, Wetland, Bottomland Forest, Upland Forest, and Riparian Corridor ecosystems are all located in  
25 the Houston region. Each of these resources provides vital functions such as flood protection, air quality,  
26 water quality and wildlife habitat. Vegetation aids in the health of water quality by filtering nutrients and  
27 trapping sedimentation before it has an opportunity to enter surface water resources. In much the same  
28 way, vegetation can filter air pollutants which can improve air quality. Also, shade produced by vegetation  
29 can reduce the demand for energy, further decreasing the production of associated air pollution. Protection  
30 of these natural resources that contribute to our region's quality of life is an important priority when planning  
31 for our region's future growth and transportation requirements, a desire that was strongly echoed at the  
32 Envision Houston Region workshops and forums. The H-GAC launched the Envision Houston Region

1 initiative in 2005 to facilitate citizen involvement in the process of analyzing how future population growth  
2 could affect land use and transportation plans across the region and to identify innovative approaches to  
3 meet transportation challenges associated with rapid growth.

4  
5 As growth and development are part of our region's future, it is not feasible that every environmental parcel  
6 would be able to be conserved. However, it is feasible that the region identifies and works to conserve  
7 those areas that are most significant ecologically. The H-GAC identified areas of concern that are distinct  
8 environmental resources within the H-GAC region for special consideration in the transportation planning  
9 process. The results are intended to be used for long-range planning purposes and screening to identify  
10 areas in which future transportation projects or development may potentially impact these sensitive  
11 resources. In addition, the identified environmental resources are areas in which mitigation efforts may be  
12 focused.

13  
14 In some instances, disturbing natural resources may be unavoidable for regionally significant projects or  
15 projects located on facilities that are multiple-lane, limited access facilities, such as highways and tollways.  
16 Due to their scale, regionally significant projects potentially have a larger impact on the environment than a  
17 local project and therefore are closely examined. Currently, projects within the 2035 RTP Update are  
18 individually subject to environmental requirements but have no mechanism for cumulatively identifying or  
19 mitigating environmental impacts. At the project level, the TxDOT Houston District can mitigate for loss of  
20 vegetation with the TPWD, and wetlands mitigation would occur through the permitting process under the  
21 jurisdiction of the USACE. Locally, cities can also curb vegetation loss by implementing measures to  
22 protect vegetation areas.

#### 23 24 *Vegetation Findings*

25 Impacts to vegetation would undoubtedly occur from the priced facility system. However, these impacts are  
26 best evaluated and mitigated at the project level; region-wide impacts on vegetation would be minimal from  
27 toll network facilities.

#### 28 29 *Land Use*

30 While we can increase system capacity, manage demand, and improve the efficiency of the existing  
31 system, the strategy with potentially the most effect upon improving mobility and quality of life is the  
32 strategy of connecting transportation and land use. Land use has a direct impact on the ability of the

1 region's transportation system and agencies to deliver a variety of travel choices. The 2035 RTP Update  
2 has shown that sustained major investments in roadway capacity would only moderate, and would not  
3 eliminate the level of future traffic congestion; however, significant mobility gains are possible through  
4 better coordinated land use and transportation planning.

5  
6 The Envision Houston Region process was initiated by H-GAC and its partners to engage residents in a  
7 discussion of the region's future growth and development. The process focused on land use and  
8 transportation alternatives. Citizen input from workshops was used to develop growth scenarios  
9 representing two different types of alternative development patterns. The objective was to provide  
10 information on the projected impacts of the alternatives and to highlight the difference between the two  
11 growth scenarios developed from the workshops and the Base Case or traditional growth scenario. **Table**  
12 **6-7** below shows the statistics produced through the analysis of each scenario. Brief descriptions of each  
13 scenario are below:

- 14  
15 • Scenario A: (fiscally constrained 2035 RTP Update network): denotes the current growth and  
16 development pattern for the Houston region, based on H-GAC's 2035 demographic forecasts. It is  
17 characterized by low-density housing development in currently undeveloped portions of the region  
18 with mixed-use development along major roadways. Jobs are concentrated in the central business  
19 district, and several other employment centers are scattered throughout the region.
- 20  
21 • Scenario B: indicates the workshop participants' ideal growth pattern, adjusted to the regional  
22 forecast of household and job growth. This scenario is characterized by development along major  
23 roadways, in a radial pattern, creating centers at major intersections.
- 24  
25 • Scenario C: signifies the workshop participants' ideal growth pattern, adjusted to the forecast of  
26 household and job growth by county. This scenario clusters mixed-use development in satellite  
27 cities and along major roadways in a radial pattern. Satellite employment centers emerge  
28 throughout the region.

**Table 6-7: Alternative Growth Scenarios**

Data of Interest	Scenario A	Scenario B	Scenario C
Transit Boardings	758,000	+10%*	+20%*
Vehicle Miles Traveled	248M	-7%*	-7%*
Vehicle Hours Traveled	7M	-16%*	-15%*
NOx Emissions	46.58	46.43	43.74
VOC Emissions	50.72	48.65	47.65

Source: H-GAC, Regional cumulative and Indirect Effects of Toll Facilities, October 2013.

\*Denotes change over Scenario A

These results reinforce the public’s intuitive notions about coordinated transportation and land use planning. The H-GAC has identified a three-pronged land use and transportation coordination strategy that is called the “3C’s” strategy. The “3C’s” strategy calls for the creation of bicycle and pedestrian friendly **centers**; establishment of better **connections** between the centers, and designs based on the **context** of the surrounding land uses.

In order to integrate the 3C’s concepts into regional transportation planning, the H-GAC has identified the following five strategies:

- Coordinate transit and roadway planning to connect existing and planned centers with the region’s multi-modal transportation network;
- Promote roadway designs appropriate for the context of the surrounding community to ensure safe, convenient travel choices for all user modes;
- Coordinate transportation improvements and private sector development efforts to promote projects that combine sustainable mobility and economic benefits;
- Help fund local planning studies to assist in the development of centers; and
- Provide funding support for infrastructure projects that enhance connections within and between centers.

In addition to expanding the regional transit system, transit ridership and efficiency can be improved by coordinating transit and land use. Development along transit lines that increases density and integrates transit with development can make transit more accessible and decrease the need for single-occupancy vehicle trips. Recommended strategies include:

- Promote community design that provides convenient access to transit systems;
- Promote transit-oriented development investments around regional transit facilities; and
- Enhance access opportunities for the transportation disadvantaged.

1 These land use/transportation coordination tools are tools that can be used in the H-GAC region to reduce  
2 the need for additional infrastructure, including utilities, transportation, water, and tolled facilities for the  
3 region. Without sustainable land use, the additional cost of new infrastructure items will increase beyond  
4 the current estimated costs.

5  
6 The current future roadway network outlined in the fiscally constrained 2035 RTP Update (Scenario A) is in  
7 support of the predicted land use changes and growth in the region. To meet the demand of the expansive  
8 growth and changes in land use from development, the aim of the 2035 regional roadway network is to  
9 supply the transportation portion of infrastructure requirements for the expanding growth and development.  
10 Current and future predicted available funds from the federal government for transportation alone will not  
11 be able meet the demands for the transportation infrastructure needed to support the predicted changes.  
12 Toll roads and managed lanes are methods that the 2035 RTP Update employs to ensure the  
13 transportation demands from future growth are met based on limited transportation funds.

14  
15 *Land Use Findings*

16 The proposed 2035 toll network may affect land use within the MPO boundaries by creating land  
17 development opportunities. However, the toll network is only one factor in creating favorable land  
18 development conditions; other prerequisites for growth in the region include demand for new development,  
19 favorable local and regional economic conditions, adequate utilities, and supportive local land development  
20 policies. The proposed 2035 toll network as currently envisioned may, with the right conditions, help  
21 influence the additional planned regional land use conversion, redevelopment, and growth.

22  
23 Economic

24 In 2006, H-GAC completed an extensive financial survey that included local governments and agencies  
25 with significant expenditures on the transportation network and services. The result is a more complete  
26 understanding of how much, by whom, and where transportation dollars are being spent. The results  
27 indicate a significant undercounting in previous plans (based on preliminary results) of the contribution by  
28 local governments on transportation investments. However, for the purposes of fiscal constraint, this  
29 undercounting is neither surprising nor alarming because a large portion of local transportation investment  
30 is done on local street networks that are not included in the 2035 RTP Update because they are not  
31 considered to be of regional significance. Fiscal constraint is demonstrated for the regionally significant  
32 transportation projects.

1 This financial summary is different from those in past Plans in that it conforms to new federal regulations  
2 requiring the expression of future costs and revenues in year-of-expenditure dollar values, that is, the  
3 effects of inflation must be included. The rate of inflation from 1996-2005 has been, on average, 2.53  
4 percent. Another innovation is expressing the costs of projects in terms of their total costs, including the  
5 costs of ROW, realignment of utilities, and engineering costs, all of which are paid for from statewide  
6 accounts, including federal and State dollars that are directly apportioned to the Houston-Galveston area.

7  
8 Expenditures

9 Expenditures on the transportation network include building new and improving existing roadways and  
10 transit lines (added capacity), operating the network and maintaining it in good repair (operations and  
11 maintenance), reconstructing existing facilities when they have reached the end of their useful life (system  
12 preservation), financing costs associated with debt incurred for transportation projects (financing), and  
13 wages and salaries paid to various staff of the roadway and transit agencies (administration). Total  
14 Estimated Expenditures 2035: \$158.9 Billion (Appendix P, Page 12, Graphic-Expenditures by Category).

15  
16 For the next several years the region is expecting to continue the trend of expanding the transportation  
17 network through added capacity projects. However, in the 2006, edition of the Texas Metropolitan Mobility  
18 Plan prepared by H-GAC, findings indicate that added capacity projects would decrease in spending  
19 relative to system preservation costs. Not only would there be a larger network to maintain in the future, but  
20 also system preservation efforts are currently under-funded. In the future, more revenues would be needed  
21 for system preservation to prevent further deterioration of roadway surfaces.

22  
23 When examined by mode of travel (roadway, transit, or bicycle), nearly 71 percent of all expenditures are  
24 for roadway projects that support the automobile (Appendix P, Page 13, Graphic-Expenditures by Mode).  
25 In a region known for its dispersed suburbanized housing, this percentage is not unusual. However, over  
26 the last several years transit investments have increased dramatically, and this trend is expected to  
27 continue.

28  
29 Revenues

30 The estimated total revenue available for the 2035 RTP Update is \$168.9 Billion (Appendix P, Page 13,  
31 Graphic-Revenue Sources). These revenues come from a variety of federal, State, and local sources.  
32 Among the federal sources is the federal gas tax, and programmed funds from the FHWA and FTA. State

1 sources include the motor fuel tax, vehicle registration fees, pass-through financing agreements, and other  
2 State allocations. Local sources include property and sales taxes collected by the cities and counties, toll  
3 revenues, bonds, and user fees from transit agencies. As a group, the local sources provide the greatest  
4 amount of revenues for the 2035 RTP Update.

5  
6 It is particularly important to note that the region's reliance on toll receipts to fund the 2035 RTP Update is  
7 growing each year. New toll roads, such as the SH 99 (Grand Parkway), as well as managed lanes, are  
8 scheduled to come on line in the next 30 years. Although the Harris, Fort Bend, Brazoria, and Montgomery  
9 County Toll Road Authorities are not obligated to spend tolling receipts on non-toll transportation projects,  
10 in the past they have reinvested all toll-generated revenues into the toll and connecting roadway road  
11 systems.

## 12 Environmental Justice

### 13 Methodology

14 The H-GAC conducted an evaluation to determine the effects of a regional tolled roadway network on EJ  
15 populations. The unit used for the analysis is the traffic analysis zone (TAZ). The TITLE VI/EJ TAZ were  
16 selected based on the Census 2000 block groups that contain 51 percent or greater minority and low-  
17 income populations. A TAZ is recognized as an EJ zone if 50 percent its area is covered by EJ block  
18 groups.

19  
20 As shown in **Table 6-8**, in the year 2000, approximately 31 percent of the H-GAC regional population has  
21 been identified as being within EJ zones, which represents approximately 46 percent of the total number of  
22 TAZ in the 8-county region. This equates to 1,383 of the total 3,000 TAZ are considered to be EJ TAZs. As  
23 can be seen in Appendix P, Page 17, Figure 3, there are significant EJ communities located throughout the  
24 H-GAC region, but the majority of EJ communities are located within Harris County and generally clustered  
25 within the Sam Houston Toll Road. Appendix P, Page 17, Figure 3 also shows a subset of the EJ zones  
26 that have minority or low-income population that are greater than 51 percent of the total TAZ population.

**Table 6-8: Distribution of EJ Communities in H-GAC Region**

	Population (2000)	Percent of Total	Number of TAZ	Percent of Total
Total Population within EJ zones	1,634,500	31.3	1,383	46.1
Total Regional Population	5,214,051	100.0	3,000	100.0

Source: H-GAC, Regional Cumulative and Indirect Effects of Toll Facilities, October 2013.

Analysis Approach

The analysis addresses the potential impacts of tolled facilities on accessibility by analyzing their impacts on the travel time choices of the persons residing in EJ zones and Non-EJ zones. The introduction of tolled facilities would generally result in a travel time benefit (i.e., a travel time savings) to those who choose to use the facilities (both EJ and Non-EJ users). It is a user decision whether or not to use one of the proposed new tolled facilities. From an EJ perspective, it appears the issue should be whether the introduction of the proposed tolled facilities is expected to have a significant and/or disproportionate adverse impact on the EJ population. This issue is addressed by analyzing forecasted trips made by the EJ population that are “candidate” trips for the new tolled facilities.

Two networks were used for purposes of the analyses: 2035 RTP Update Build and 2035 RTP Update No Build Managed Road. The full extent of the toll and managed lane system as contained in the fiscally constrained 2035 RTP Update can be seen in Appendix P, Page 18, Figure 4). As shown in Appendix P, Page 19, Figure 5, the No Build network is essentially the fiscally constrained 2035 RTP Update network with the existing plus committed managed lane system; the Katy Freeway HOT lanes are included.

Analysis Assumptions and Limitations

The region’s travel demand models do not provide a means for tracking travel at an individual household level, but do provide a means for tracking travel at a zonal level. For purposes of the analyses, the zones are specified as either EJ zones or non-EJ zones based on the socioeconomic characteristics of the zonal populations. Some regional travel models employ a generalized cost assignment procedure for toll analyses. The H-GAC models perform toll analyses at the mode choice level. Hence, the H-GAC travel model uses a multi-class assignment procedure rather than a generalized cost procedure.

The mode choice models are applied by trip purpose. For the mode choice toll analyses, two travel time estimates are developed from each zone to all other zones: 1) the travel time using both toll and non-toll links (commonly referred to as “toll path” travel times), and 2) the travel time using only non-toll links (commonly referred to as the “free path” travel time). In the mode choice model, if the toll path does not

1 offer a shorter travel time between two zones than the free path travel time, the trip is not considered a  
2 “candidate” for the toll facility. If a trip can save travel time using a toll path over a free path then it is  
3 considered a “candidate” trip. Of course, not all candidate trips will choose to use a tolled path. The  
4 probability of a candidate trip using a tolled path is a function of a number of variables such as the  
5 magnitude of the potential travel time savings, the toll costs and the income characteristics of the zones  
6 residents. Aspects of this approach are employed in the analyses presented in this report.

7  
8 In mode choice model applications, there is a single highway network which is used to estimate the travel  
9 times for toll paths and free paths. For the regional toll analyses, there are two networks: the “Build”  
10 network (i.e., the forecasted roadway network containing the subject toll facilities) and the “No Build”  
11 network (i.e., the network containing all the forecasted roadways except the subject toll facilities). Existing  
12 and committed toll facilities are contained in both networks. In this analytical setting, simply comparing the  
13 toll path versus free path option will not identify the candidate trips for only the new toll facilities being  
14 studied. Indeed, such a grouping would include trips using both existing and proposed toll facilities.

15  
16 To focus on candidate trips for the new toll facilities, the travel time for toll paths in the Build network is  
17 compared to the toll path travel time in the No Build network. Trips that have a shorter toll path travel time  
18 in the Build network than the toll path travel time in the No Build network are defined as candidate trips for  
19 the new toll facilities. The trips from EJ zones are stratified as either candidate trips or non-candidate trips  
20 using the data from the two networks. Likewise, the trips produced by the Non-EJ zone are similarly  
21 stratified. Stated differently, the trips for a given trip purpose is segmented into four groups:

- 22  
23
- 24 • Trips produced by EJ zones that are classified as “Candidate” trips;
  - 25 • The remaining trips produced by EJ zones are classified as non-“Candidate” trips;
  - 26 • Trips produced by non-EJ zones that are classified as “Candidate” trips;
  - 27 • The remaining trips produced by non-EJ zones are classified as non-“Candidate” trips.

28 Using toll path travel times and free path travel times from the Build and the No Build networks, there are  
29 four travel times for each trip, (i.e. 1) Build network-toll path option, 2) Build network-free path option, 3) No  
30 Build network-toll path option, and 4) No Build network – free path option). By computing the average trip  
31 lengths for each of the options, the impacts of the two networks on the choice options can be quantified,  
32 compared, and analyzed.

1 Using this approach, the results allow the comparison of the toll and free path options for each network for  
2 each segmentation of trips. Clearly, the implementation of new toll facilities should be expected to benefit  
3 those who might choose to use a toll facility. Of perhaps more interest is determining if there are any  
4 expected overall disadvantages to those who might chose not to use a toll facility or that are not candidates  
5 for using one of the new toll facilities.

6  
7 One of the interesting side benefits of the approach used is that it calls attention to the fact that there will be  
8 some potential travel time savings realized for trip makers who chose not to use a toll facility. These time  
9 savings would be expected to accrue from the reduced congestion on free facilities due to trips diverted to  
10 toll facilities.

11  
12 The analyses are regional level analyses and focus on average regional results. Such analyses do not  
13 isolate any zone specific analyses or the impacts in the immediate proximity of the new proposed facilities.  
14 These impacts were addressed by the analyses performed for the individual facilities. Indeed, the purpose  
15 of these analyses are to determine if there are any cumulative regional impacts to the EJ populations  
16 represented by the zones designated as EJ zones.

17  
18 A key focus of the analysis was to determine if the “free” path travel time under the Build scenario is  
19 significantly greater than the “free” path travel time under the No Build scenario for the EJ and Non-EJ  
20 zones. The analyses show the expected travel time benefits that may be realized by EJ and Non-EJ zone  
21 residents if they chose the pay options for their travel.

22  
23 Trips were divided into Home-Based-Work trips (HBW) and Home-Based Non-Work trips (HBNW), and for  
24 both EJ zones and Non-EJ zones that can save highway travel time by using one of the new proposed toll  
25 facilities. For a given trip purpose, the forecasted person travel was divided into four (4) market segments  
26 for analysis:

27  
28 Trips produced by a EJ zone that are candidates for using one of the proposed new toll facilities (i.e., that  
29 could save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel).  
30 Trips produced by a EJ zone that are not candidates for using one of the proposed new toll facilities (i.e.,  
31 that could not save travel time by electing to use one of the proposed new tolled facilities for their  
32 scheduled travel).

1 Trips produced by a EJ zone that are candidates for using one of the proposed new toll facilities (i.e., that  
2 could save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel).  
3 Trips produced by a Non-EJ zone that are not candidates for using one of the proposed new toll facilities  
4 (i.e., that could not save travel time by electing to use one of the proposed new tolled facilities for their  
5 scheduled travel).

6  
7 As mentioned in the discussion of the approach, the objective of the EJ analysis is to quantify the impacts  
8 of the Build and the No Build options on the travel time of potential users. Examination of the results will  
9 show whether the introduction of the proposed new tolled facilities is expected to generally have a  
10 significant and/or disproportionate negative impact on the EJ population of the region.

11  
12 **Table 6-9** shows the number of year 2035 HBW person trips and the expected average trip length (ATL) for  
13 free and tolled path options under both the Build and No Build Scenarios. The travel times are based upon  
14 AM peak period congested travel times. EJ and non-EJ population trips are each segmented into two  
15 separate groups:

- 16
- 17 • Those trips that can save travel time by using a toll facility; these trips are essentially trips that are
- 18 “candidate trips” for using a toll facility, and
- 19 • Those trips that cannot save travel time by using a toll road; these trips are essentially “non-
- 20 candidate trips” for using a toll facility. Consequently for purposes of the analysis, only the free
- 21 path is examined for these trips.
- 22
- 23

**Table 6-9: 2035 Home Base Work Person Trips**

Zones	2035 HBW Trip Scenarios	Number of 2035 HBW Person Trips	AM Peak Average Trip Length (ATL) in minutes for Free and Tolled Facilities under the Build and No Build Network Scenarios				Difference in AM Peak ATL in minutes	
			Build Network Scenario		Non-Build Network Scenario		Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
			ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL using Free Facility		
EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,124,064	34.72	42.88	36.30	43.70	1.58	0.82
	Trips that cannot save 0+ minutes using a new tolled facility	1,517,692	18.36	18.80	18.50	18.95	0.14	0.15
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,571,960	44.57	54.84	49.18	56.96	4.61	2.12
	Trips that cannot save 0+ minutes using a new tolled facility	1,526,036	20.56	20.89	20.96	21.3	0.40	0.41

24 Source: H-GAC, Regional Cumulative and Indirect Effects of Toll Facilities, October 2013.

Both EJ and Non-EJ Zones Benefit from the Build Alternative:

From an EJ perspective, perhaps the most important observation in **Table 6-9** is that ATL for both toll path options and free paths are reduced under the Build Alternative for both EJ and Non-EJ zones. Therefore, the analyses did not find any significant and/or disproportionate adverse impacts on the ATL of the path options for the EJ zones; in fact, these results show that both EJ and Non-EJ zones realize an overall benefit from the proposed new toll facilities in the Build Alternative.

**Table 6-10** shows the number of year 2035 HBNW person trips and their expected ATL for free and tolled path options under both the Build and No Build Alternatives. Since most of the HBNW trips do not occur during the peak traffic periods, the travel times based on the 24-hour speeds were used for these analyses. The 24-hour speeds are generally considered to represent typical off-peak speeds. Therefore, the 24-hour travel times are used by the H-GAC’s HBNW mode choice model rather than the peak travel times. Again, the EJ and Non-EJ population trips are each segmented into two separate sub-groups:

- Those trips that can save any travel time by using a toll facility (i.e., essentially trips that are “candidate trips” for using a toll facility), and
- Those trips that cannot save any travel time by using a toll road. Most of these trips don’t have a minimum time path that would use any toll facility. There are some trips in this group that do not have a toll path and hence are unable to be toll users. These trips are “non-candidate trips” for using a toll facility. Hence, for purposes of the EJ analyses, only the free path travel times will be examined for these trips.

**Table 6-10: 2035 Home Based Non-Work Person Trips**

Zones	2035 HBW Trip Scenarios	Number of 2035 HBW Person Trips	AM Peak Average Trip Length (ATL) in minutes for Free and Tolled Facilities under the Build and No Build Network Scenarios				Difference in AM Peak ATL in minutes	
			Build Network Scenario		Non-Build Network Scenario		Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
			ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL using Free Facility		
EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,134,814	25.65	30.07	27.27	31.08	1.62	1.01
	Trips that cannot save 0+ minutes using a new tolled facility	5,266,409	12.13	12.26	2.26	12.39	0.13	0.13
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,313,864	28.92	34.22	34.13	37.32	5.21	3.10
	Trips that cannot save 0+ minutes using a new tolled facility	5,306,422	13.54	13.59	14.09	14.14	0.55	0.55

Source: H-GAC, Regional Cumulative and Indirect Effects of Toll Facilities, October 2013

Toll Path Option Benefit for the Build Alternative for Both EJ and Non-EJ Zones:

From an EJ perspective, perhaps the most important observation in **Table 6-10** is that ATL for both the toll path and free path options are reduced under the Build Alternative for both EJ and Non-EJ zones. Hence, the analyses did not find any significant and/or disproportionate negative impacts on the ATL of the path options for the EJ zones. Indeed, these results show that both EJ and Non-EJ zones realize an overall benefit from the proposed new toll facilities in the Build Alternative.

Latent demand is essentially unrealized demand of travel due to constraints of the roadway network that becomes realized when improvements to the network are made, and can show increases in traffic on capacity-enhanced networks. The travel demand model used in the analysis uses an equilibrium assignment that disperses any latent demand throughout the toll and non-toll network, thus reducing the overall congestion in the region. This is evident by observing the changes in VMT and vehicle hours traveled (VHT) in the Build scenario, which includes the regional tolled roadway network. As seen in **Table 6-11** below, the daily VMT decreases by approximately 1.5 million miles in the Build scenario versus No Build scenario. Furthermore, daily VHT decreases by nearly 5 percent for the region when the network is fully built out. This gives evidence that the 2035 roadway network with toll facilities would improve the overall system performance and provide travel time savings to both EJ and Non-EJ populations.

**Table 6-11: Regional VMT and VHT**

	Build	No Build
Daily VMT	252,578,686	254,031,712
Daily VHT	7,349,969	7,761,311
AM VMT	42,929,640	43,058,792

Source: H-GAC, Regional Cumulative and Indirect Effects of Toll Facilities, October 2013.

Overall Toll Network Findings

For HBW trips and HBNW trips, EJ population trips that are candidate toll users are benefited by the introduction of the new toll facilities in terms of both the toll and free path travel times. Equally important, EJ population trips that are not candidate toll users benefit by the introduction of the new toll facilities, as the free path travel time ATL is reduced between the No Build and Build scenarios. As such, EJ populations experience an overall benefit under the Build Alternative for their HBW and HBNW travel.

Although EJ zones spread throughout the region, they are generally clustered within Beltway 8 and are not in close proximity to the majority of future toll facilities as the Non-EJ zones are. Consequently, as the ATL

1 of the EJ zones are less than the ATL of Non-EJ zones, the EJ zones cannot derive as much travel time  
2 savings as the longer trips from Non-EJ zones. However, the analysis did not explicitly examine the impact  
3 on ATL. As seen in Appendix P, Page 28, Figure 6, the significant amount of future transit improvements  
4 are targeted at EJ zones; the ATLs for the populations within those zones would tend to improve due to  
5 increased access to improved transit facilities.

6  
7 Although EJ populations would see an increase in spending for toll facilities, the entire region would also  
8 see an increase in spending and usage as the toll and managed lane system expands. Both EJ and Non-  
9 EJ populations would benefit greatly from future toll facilities. In fact, the 2035 RTP Update relies heavily  
10 on toll funding to finance a significant portion of future added capacity projects, both free and toll.  
11 Additionally, for both populations who choose to use non-toll options, the Build scenario for 2035 would  
12 provide a roadway network that would operate at better traffic conditions than the No Build scenario and  
13 would provide an increased benefit for those users over the No Build scenario.

14  
15 An analysis was also conducted to determine the annual financial burden of utilizing the toll road system for  
16 HBW trips. The analysis assumed a 2035 toll rate per mile of 19.96 cents (current toll rate of 10 cents per  
17 mile with an annual escalation rate of 2.5 percent). In addition the analysis assumed that an average HBW  
18 trip length is 23.30 miles and the SOV user makes 250 round-trips per year using the toll facility. Under this  
19 scenario, the annual cost would be approximately \$2,325 per year. However, the accrual cost should be  
20 substantially less since the likelihood of a trip using only tolled facilities is diminutive.

21  
22 The 2013 HHS poverty guideline for a family of four is \$23,550, of which approximately 10 percent would  
23 equate to the annual cost per year for utilizing the toll road system for HBW trips. According to the U.S.  
24 Census (2007-2011) the median household incomes within the Houston-Galveston region are as follows:

- 25  
26
- 27 • Brazoria County-\$67,018
  - 28 • Chambers County-\$72,850
  - 29 • Fort Bend County-\$82,571
  - 30 • Galveston County-\$59,645
  - 31 • Harris County-\$52,675
  - 32 • Liberty County-\$47,460
  - 33 • Montgomery County-\$66,657
  - 34 • Waller County-\$50,609

1 Based on the previous discussion and analysis, the Build scenario for the 2035 RTP Update would not  
2 cause cumulative disproportionately high and adverse effects on any EJ populations, as per EO 12898  
3 regarding EJ.

4  
5 The results of the analysis suggest that although most of the new toll facilities are not being implemented in  
6 EJ zones, EJ populations would enjoy benefits the of future toll facilities. It is important to note that future  
7 toll facilities are generally not being proposed in EJ zones because those zones are largely inside the urban  
8 core. The costs of ROW acquisitions, community disruption, etc. make those locations prohibitive.  
9 However, it is important to note that much of the proposed light rail and bus improvements in the region are  
10 being implemented in the EJ zones identified in the analysis, thereby improving mobility for those  
11 populations.

12  
13 The analysis only sought to determine whether disproportionate benefits or disbenefits are accruing to the  
14 EJ and Non-EJ populations based upon travel time savings. In no way does the analysis replace the work  
15 required in the project development phase of a project per NEPA.

16  
17 **6.4.1 Conclusion: Cumulative Regional Effects of Tolled Facilities and Managed**  
18 **Lanes**

19 The regional priced facility system would cause minor impacts to some resources discussed in the analysis.  
20 Regional mitigation for some of the resources is addressed by the H-GAC. As part of the Transportation  
21 Planning Process, H-GAC addresses issues related to air quality and EJ. The priced facility projects would  
22 be included in the STIP/TIP and MTP, and the STIP/TIP and MTP would need to be found to conform to the  
23 State Implementation Plan (SIP). Additionally, the transportation planning process would need to comply  
24 with the requirements of Title VI of the Civil Rights Act of 1964 and Executive Order 12898 on  
25 Environmental Justice. This assures that the STIP/TIP and the MTP are in compliance for air quality under  
26 the CAAA and for EJ under Title VI of the Civil Rights Act of 1964 and Executive Order 12898.

27  
28 Although land use impacts cannot be mitigated at a regional level, they can be mitigated and/or controlled  
29 at the municipality level because these entities have direct control over land use. However, the MPO can  
30 aid in land use impact avoidance at the regional level by only funding transportation projects consistent with  
31 the regional vision and by working with municipalities to address regional infrastructure changes in their  
32 comprehensive plans. State and federal regulatory agencies that have direct jurisdiction over natural and  
33 cultural resources would be responsible for requiring avoidance, minimization, and mitigation from any

1 entity whose proposed project (transportation or other type) has a direct impact to any of these resources  
2 on their project.

3

## 4 **6.5 Cumulative Impacts Analysis Summary**

5 **Table 6-12** summarizes the analysis and conclusions for each resource carried through the cumulative  
6 impacts analysis.

7

**Table 6-12: Cumulative Impacts Analysis Resource Summary**

Resource Category (Step 1)	Resource Study Area (Step 2)	Current Health/Historical Context of Resource (Step 3)	Direct Impacts (Step 4)	Indirect Impacts (Step 4)	Impacts from Other Past, Present, Foreseeable Projects (Step 5)	Potential Cumulative Impacts (Step 6)	Report Issues/Discuss Mitigation for Adverse Impacts (Steps 7 and 8)
Land Use	15-minute travel shed	Changing – Historically, a highly disturbed study area due to farming, timbering, petro-chemical industrial activities. The existing land use continues to change due to increasing development. Changing land use from undeveloped to developed could contribute to the decline in health of natural resources.	Conversion of 1,933 ac of undeveloped land to transportation land use (less than 0.3% of total RSA). Development in the RSA would be consistent with all state and local government plans and policies.	Conversion of approximately 25,944 ac of undeveloped land to developed land (3% of RSA). Induced development in the study area would be consistent with all state and local government plans and policies.	Within the land use RSA, impacts from other past, present and foreseeable projects were gathered from the H-GAC's 2035 projections, the RTPs, the expert panel survey, and meetings with local planners and elected officials.	Existing and proposed land development and transportation improvements would result in conversion of 291,477 ac of undeveloped land to developed land. Based on this acreage calculation, it was determined that anticipated cumulative effects represents approximately 38% of the land use RSA.	The mitigation of the development of the area considered for this study would rest with the agencies which have the authority to implement such controls. Grand Parkway Segments H and I-1, as well as any other links in the transportation network, would complement the land use and transportation changes in the area, but it cannot be considered the sole reason for the changes to occur. Therefore, no mitigation is proposed.
Environmental Justice	H-GAC's MPO region, including Harris, Chambers, Fort Bend, Liberty, Brazoria, Galveston, Montgomery, and Waller counties	The EJ population of the MPO area is growing. The total environmental justice population percentage for the RSA is anticipated to increase between 2000 and 2035 based on the demographic trend observed between 2000 and 2010.	Although the Preferred Alternative would result in traffic noise impacts, no substantial direct socio-economic impacts would result from tolling Grand Parkway Segments H and I-1. No displacements are anticipated in census blocks with median household incomes below the HHS 2013 poverty guideline of \$23,550. Tolling costs would be comparable to existing Harris, Montgomery, and Chambers County toll roads. The project impacts would not be isolated within a limited number of census tracts, but would be incurred by all users, including minority and low-income users of the Grand Parkway Segments H and I-1 facility. Although the impacts would not be substantial, it should be noted that low-income populations would be impacted by toll rates, toll collection, and other matters associated with user fees.	Induced land development could create additional job opportunities and increased access to job opportunities through enhanced transportation infrastructure. Indirect impacts pertaining to public facilities and services, traffic operations, and traffic noise would be experienced by the environmental justice population to the same extent and the same manner (whether positive or negative) as experienced by the non-environmental justice population.	Existing toll facilities that factor into the cumulative impacts of the proposed toll system include the Sam Houston Tollway, the Westpark Tollway, and the Hardy Toll Road. Linkage to these toll facilities would be available to users of Segments H and I-1 as well as the non-tolled alternatives associated with those existing toll facilities. Other reasonably foreseeable toll projects in the immediate area include the completion of Segments G and I-2 of the Grand Parkway.	The Grand Parkway, as an element of the system of toll roads now being developed for the H-GAC area, would contribute to a cumulative impact on low-income users of the system. Although it is likely that a user may routinely travel one or more elements of the toll system en-route to and from various destination points throughout the city, it is unlikely that the user would travel the entire length of those elements. Further, given the lay-out and orientation of the regional system, it is not likely that a driver would routinely travel the entire length of the entire Houston-area toll system during the course of normal activities.	The anticipated increase of tolled mainlanes in the regional transportation network is indicative of an emerging regional tolling network. It is reasonable to assume that there would be a cumulative impact on environmental justice populations upon build-out of the toll system; however, given the lay-out and orientation of the regional system, it is not anticipated that a driver would routinely travel the entire length of the entire system during the course of normal activities.  The proposed tolling of Segments H and I-1 would not exclude any person on the grounds of race, color, or national origin from participation in the project, be denied the benefits of the project, or be subject to discrimination under the proposed project; therefore, according to Title VI of the Civil Rights Act of 1964 and EO 12898, mitigation associated with environmental justice is not currently proposed. Through the excess toll revenue generated from the proposed toll project could be programmed to benefit the regional community including environmental justice populations.
Air Resources	Air Quality	Houston-Galveston-Brazoria 8-hour nonattainment eight-county area, including Harris, Chambers, Fort Bend, Liberty, Brazoria, Galveston, Montgomery, and Waller counties  Air Quality: Poor, the Houston-Galveston-Brazoria region is classified as a marginal nonattainment area. Texas has made substantial progress over the past 15 years in addressing ozone in the MPO area. The 1-hour and 8-hour ozone concentrations have decreased over the 15 year period from 1991 to 2005. This trend is expected to continue despite a rapid growth in the area's economy and population.  Controlling air toxic emissions became a national priority with the passage of the CAA Amendments of 1990, whereby Congress mandated that the EPA regulate 188 air toxics which include MSAT. Based on an FHWA analysis using EPA's MOVES2010b model, national trends indicate that even if vehicle-miles travelled (VMT) increases by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period.	Direct impacts on air quality from the project are primarily those associated with the increased capacity, accessibility and the resulting projected increases in VMT.  The Grand Parkway Segments H and I-1 are included in H-GAC's 2035 RTP Update and 2013-2016 TIP found to conform to the SIP by FHWA and FTA on January 25, 2011 and November 1, 2012, respectively.	Indirect impacts on air quality are primarily related to any expected development resulting from project's increased accessibility, or capacity to the area. Any increased emissions resulting from the potential development of the area must meet regulatory emissions limits established by the TCEQ and EPA, as well as obtain appropriate authorization from the TCEQ, and therefore are not expected to result in any degradation of air quality or MSAT levels.	Increase in urbanization would likely have a negative effect on air quality. This would be minimized by the enforcement activities by EPA and TCEQ to help ensure that growth and urbanization would not prevent attainment with the ozone standard or threaten the maintenance of the other air quality standards.	Increase in urbanization would likely have a negative effect on air quality. This would be minimized by the enforcement activities by EPA and TCEQ to help ensure that growth and urbanization would not prevent attainment with the ozone standard or threaten the maintenance of the other air quality standards.	The evaluation for direct, indirect, and cumulative impacts from the proposed toll project did not result in the identification of any negative impacts for which specific mitigation actions are necessary and required. Due to traffic redistribution, traffic congestion along the frontage roads and the local arterial network is anticipated to increase, causing a potential for localized degradation of air quality. In an effort to reduce congestion, TxDOT would continue to promote appropriate congestion reduction strategies through the H-GAC. Overall, current federal, state, and local regulatory controls as well as local plans and projects have had, and would continue to have a beneficial impact on overall regional air quality.

**Table 6-12: Cumulative Impacts Analysis Resource Summary**

Resource Category (Step 1)	Resource Study Area (Step 2)	Current Health/Historical Context of Resource (Step 3)	Direct Impacts (Step 4)	Indirect Impacts (Step 4)	Impacts from Other Past, Present, Foreseeable Projects (Step 5)	Potential Cumulative Impacts (Step 6)	Report Issues/Discuss Mitigation for Adverse Impacts (Steps 7 and 8)	
		The Houston-Galveston-Brazoria Area is currently in attainment for CO.						
Water Resources	Water Quality	Six regional watersheds are found within the study area: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, Spring, and West Fork San Jacinto watersheds	Declining – continued changes in land use due to development are expected to increase impervious surfaces and increase run-off.	Impervious surfaces may be directly increased by as much as approximately 419 ac with the construction of the Preferred Alternative. Direct project impacts to resources that would affect water quality include impacts to wetlands and riparian areas as well as direct crossings of water bodies. The Preferred Alternative would cross three ecologically substantial stream segments, including Caney Creek, East Fork San Jacinto River and Luce Bayou. Project construction would result in temporary increase in sedimentation and turbidity. Construction impacts would be minimized through the incorporation of appropriate BMPs for erosion control.	Approximately 25,944 ac of undeveloped land would be converted to residential and commercial use as a result of the Preferred Alternative. This induced development could result in adverse effects to water resources through degradation of surface water and groundwater. The Preferred Alternative would require groundwater pollution prevention measures to minimize potential impacts to up to seven well capture zones. Indirect impacts to groundwater wells and capture zones are anticipated to be minor in the context of regional development as a whole.	Regional land development projections from the Envision Houston report and the H-GAC for the area indicated approximately 22.2% of the water resources RSA is already developed or planned for development, resulting in an approximately 1,270,000 ac increase of impervious surfaces.	Increased construction would result in disturbance to ground cover, and sediment discharge resulting from the disturbance and increased impermeable area would be likely. Increases in runoff can cause erosion of surface waters. These activities are regulated and subject to stormwater management criteria designed to minimize these impacts. Stormwater runoff from the completed facility could also introduce pollutants into surface water, which could result in long-term adverse effects on surface water quality.	The cumulative impact of reasonably foreseeable future actions to water quality could be minimized by adherence to applicable USACE, USFWS, TCEQ, TPWD, and USCG regulations for projects subject to state and federal jurisdiction. The net effect of all development reasonably foreseeable within the RSA in the next 20 years may require a reassessment of CWA 401 goals and sedimentation and erosion guidelines. The proposed project would not contribute to substantial cumulative impacts to the area water quality due to the regulatory guidelines in place to protect this resource.
	Waters of the U.S.	Six regional watersheds are found within the study area: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, Spring, and West Fork San Jacinto watersheds	Declining – continued changes in land use due to development are expected to convert more wetlands to non-wetlands. However, the USACE’s “no net loss” policy has continued to keep the losses of jurisdictional wetlands at a stable number. According to the 2010 Texas 303(d) list, several listed segments are within the RSA. In the project RSA, development and urbanization has resulted in channelization, excavation, and filling of many of the area’s natural streams and wetlands.	The Preferred Alternative would potentially impact approximately 327 ac of wetlands and 22.9 ac of Waters of the U.S.	The potential indirect impacts to Waters of the U.S. and wetlands due to induced development within the AOI is anticipated to be zero acreage of Waters of the U.S. and approximately 2,997 ac of wetlands.	Regional land development projections from the Envision Houston Report and the H-GAC for the area indicated approximately 22.2% of the water resources RSA is already developed or planned for development. Up to 114,000 ac of waters and waters may be cumulatively impacted.	There is a high likelihood that minor regulatory infractions would occur in the proposed development in the RSA, resulting in limited unpermitted and unmitigated impacts to waters of the U.S., including wetlands. It is impossible to predict how large impacts would be because of the federal “no net loss” policy and limits to development these constraints present, but development of land in the RSA may result in some loss of surface waters and wetlands, both permitted and unpermitted.	The cumulative impact of reasonably foreseeable future actions to Waters of the U.S., including wetlands, could be minimized by adherence to applicable USACE, USFWS, TPWD, and USCG regulations for projects subject to state and federal jurisdiction. The proposed project would not contribute to substantial cumulative impacts to the area Waters of the U.S., including wetlands, due to the regulatory framework that exists to protect this resource.

Source: Study Team, 2012