DRAFT

ENVIRONMENTAL ASSESSMENT

STATE HIGHWAY 288
US 59 TO CR 60
HARRIS AND BRAZORIA COUNTIES

0598-01-090	US 59 to IH 610
0598-01-092	IH 610 to County Line
0598-01-096	BW 8 Interchange
0598-02-092	County Line to SH 6
0598-01-901	US 59 to IH 610
0598-01-902	IH 610 Interchange
0598-01-905	IH 610 to County Line
0598-01-906	IH 610 to BW 8
0598-01-907	BW 8
0598-02-900	County Line to SH 6
0598-02-093	SH 6 to SH 99

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Acronyms

%	percent
ACS	American Community Survey
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
ANPR	advanced notice of proposed rulemaking
AOI	Area of Influence
APE	area of potential effect
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
ATL	Average Trip Length
BLS	Bureau of Labor Statistics
BMP	best management practices
BMS	Brownfield Management System
BW 8	Beltway 8
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information Service
CFR	Code of Federal Regulations
CGP	construction general permit
CMA	Congestion Mitigation Analysis
CMAQ	Congestion Mitigation and Air Quality Improvement
CMP	Congestion Management Process
CMS	Congestion Management System
CMSA	Consolidated Metropolitan Statistical Area
CTMS	Computerized Transportation Management System
CO	carbon monoxide
CO_2	carbon dioxide
COR	Corrective Action Report
CR	County Road
CSJ No.	Control-Section-Job
CWA	Clean Water Act
dB	Decibels
dB(A)	A-weighted decibels
dbh	diameter at breast height

DE	diesel exhaust
DOT	Department of Transportation
DPM	diesel particulate matter
e.g.	exempli gratia, for example
EA	Environmental Assessment
EMS	emergency medical services
EO	Element of Occurrence
EPA	Environmental Protection Agency
ERNS	Emergency Response Notification System
ETC	□□□□□□□□□ Time of Completion
ETJ	extraterritorial jurisdiction
FHWA	Federal Highway Administration
FINDS	Facility Index System
FM	Farm-to-Market Road
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FR	Federal Register
GC	gas chromatograph
GEN	RCRA Generator
GIS	Geographic Information System
HAP	hazardous air pollutants
HBW	Home-Based Work
HBNW	Home-Based Non-Work
H-GAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria
HH	Household
HHS	U.S. Department of Health and Human Services
HOT	high occupancy toll
HOV	high occupancy vehicle
i.e.	id est, that is
IH	Interstate Highway
IHWNOR	Texas Industrial Hazardous Waste Notice of Registration
IOP	Innocent Owner/Operator Program
IRIS	Integrated Risk Information System
lbs	pounds
LEP	limited English proficiency

L_{eq}	equivalent sound level
LI	linguistically isolated
LOS	level of service
LUST	leaking underground storage tank
MBTA	Migratory Bird Treaty Act
MFA	Most Feasible Alternative
MOA	memorandum of agreement
MOU	memorandum of understanding
MPA	Metropolitan Planning Area
MPO	Metropolitan Planning Organization
MSAT	Mobile Source Air Toxics
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NATA	National Air Toxics Assessment
NCHRP	National Cooperative Highway Research Program
NDD	Natural Diversity Database
NEPA	National Environmental Policy Act
NFRAP	No Further Remedial Action Planned
NGVD	National Geodetic Vertical Datum
NMHC	non-methane hydrocarbon
No.	number
NOI	Notice of Intent
NOT	Notice of Termination
NO_x	Nitrogen Oxides
NPL	National Priority List
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWP	Nationwide Permit
PA	First Amended Statewide Programmatic Agreement
PALM	Potential Archeological Liability Map
PA-TU	First Amended Statewide Programmatic Agreement for Implementation of Transportation Undertakings
PCB	polychlorinated biphenyl
PDR	Purchase of Development Rights
PM	particulate matter
ppb	parts per billion

ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Information Service
ROW	right-of-way
RPW	relatively permanent water
RSA	Resource Study Area
RTP	Regional Transportation Plan
SAL	State Archeological Landmark
SH	State Highway
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SOC	species of concern
SOV	single occupancy vehicle
SW3P	storm water pollution prevention plan
SWL	Solid Waste Facilities/Landfill Sites
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TAZ	Traffic Analysis Zone
THC	Texas Historical Commission
TIP	Transportation Improvement Program
TMA	Transportation Management Area
TMC	Texas Medical Center
TMDL	Total Maximum Daily Load
TNW	traditional navigable water
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks & Wildlife Department
TRIS	Toxic Release Inventory System
TSD	treatment, storage, or disposal
TTI	Texas Transportation Institute
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
ULI	Urban Land Institute
UPRR	Union Pacific Railroad
US	United States Highway
USACE	United States Army Corps of Engineers
USC	United States Code

USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
VCP	Voluntary Cleanup Program
VMT	vehicle miles traveled
VOC	volatile organic compounds
vpd	vehicles per day

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I. Introduction

This Environmental Assessment (EA) evaluates the socioeconomic, physical, and biological environmental impacts that would result from the proposed Texas Department of Transportation (TxDOT) project to construct roadway improvements along State Highway (SH) 288 from United States Highway (US) 59 south of downtown Houston, Harris County to County Road (CR) 60 in Brazoria County (*Figures 1* and *2*), a distance of approximately 26 miles. SH 288 currently provides two to four general-purpose travel lanes in each direction, separated by a grassy median. Representative photographs of the existing roadway are included in *Appendix A*. The proposed roadway improvements would include construction of toll lanes in each direction within the existing grassy median between US 59 and CR 60, interchange improvements at Interstate Highway (IH) 610 and Beltway 8 (BW 8), additional general-purpose lanes between IH 610 and BW 8, and improved access to the Texas Medical Center (TMC). Travel on the toll lanes would be tolled while travel on the existing and proposed general-purpose lanes would not require a toll or fee.

The proposed SH 288 improvements would be constructed in phases. The interim phase (Phase 1) of the project would involve the construction of two toll lanes from US 59 to SH 6 and direct connector (DC) improvements at BW 8. The direction of travel on the toll lanes would be reversible, based on peak travel times, with traffic on both lanes moving from north to south, or south to north. New overpasses at selected, existing at-grade intersections (part of the toll facility) and some ramp and frontage road improvements would be constructed during the interim phase of the project. The ultimate project (Phase 2) would add two additional toll lanes from US 59 to SH 6, providing a total of four toll lanes (two in each direction); add one additional general-purpose lane in each direction from IH 610 to BW 8, resulting in a total of four general-purpose lanes in each direction; and would extend four toll lanes from SH 6 southward to CR 60. Direct-connector improvements at IH 610 and BW 8, and new overpasses at selected, existing at-grade intersections (part of the toll facility) would be constructed during the ultimate phase of the project. Implementation of the proposed project would accommodate additional traffic and improve access to the TMC, thereby improving the operational efficiency of the roadway.

Estimated construction costs for the proposed roadway improvements total approximately $1.4 billion as of November 2012; this estimate does not include right-of-way (ROW) acquisition. Construction is proposed to begin in 2015. The proposed action is consistent with the area's financially constrained *2035 Regional Transportation Plan (RTP) Update*, as amended, and the *2013-2016 Transportation Improvement Program (TIP)* for the Houston-Galveston Transportation Management Area. The RTP and the TIP were found to conform to the TCEQ State Implementation Plan (SIP) by FHWA on January 25, 2011 and November 1, 2012, respectively. Copies of the RTP pages are included in *Appendix* B. The CSJ Numbers and the project limits are listed below. The CSJ Numbers reflect the correct project scope and limits.

CSJ No.	Project Limits	Description
0598-01-090	US 59 to IH 610	Construct 2 Toll Lanes (reversible)
0598-01-092	IH 610 to County Line	Construct 2 Toll Lanes (reversible)
0598-01-096	BW 8 Interchange	Construct 4 DCs at BW 8 Interchange
0598-02-092	County Line to SH 6	Construct 2 Toll Lanes (reversible)
0598-01-901	US 59 to IH 610	Widen to 4 Toll Lanes
0598-01-902	IH 610	Reconstruct Interchange
0598-01-095	IH 610 to County LIne	Widen to 4 Toll Lanes
0598-01-906	IH 610 to BW 8	Reconstruct and Widen to 8 Main Lanes
0598-01-907	BW 8	Construct 4 DCs at BW 8 Interchange
0598-02-900	County Line to SH 6	Widen to 4 Toll Lanes
0598-02-093	SH 6 to SH 99	Construct 4 Toll Lanes with Grade Separations

II. Need and Purpose

SH 288 traverses Harris and Brazoria Counties between Houston and Freeport and provides a vital route for commuters, freight and commercial trucking, and is a hurricane evacuation route. Population increases associated with new residential subdivisions within the area of the SH 288 corridor have increased the number of vehicles using the highway as a primary travel route along much of the corridor. Residential and commercial development is projected to continue in the area over the next 20 years (see *Traffic* section below). According to the *SH 288 Corridor Feasibility Study: Houston to Freeport*, 2005 (Feasibility Study, 2005), the population was projected to increase approximately 60 percent in the corridor between 2005 and 2025, causing traffic conditions to continue to become more congested. As travel demand increases, mobility is projected to deteriorate to unacceptable levels with congestion extending south to SH 6 and eventually to CR 60. With the increase in traffic, the roadway would become less efficient if transportation improvements are not constructed.

The proposed SH 288 improvements need to be implemented to address the continued growth that is expected in the vicinity of the project corridor and the resulting increase in congestion, and to address improving access and travel to the TMC. If additional lanes are not added, the existing SH 288 and other area roadways would become more congested, and mobility in the corridor would decrease. The purpose of the proposed project is to alleviate congestion along the SH 288 corridor from US 59 to CR 60 and to improve access to the TMC.

III. Traffic

Residential and commercial development within the SH 288 corridor has continued to occur over the last decade. Projected growth models show the number of households in the entire corridor (Houston to Freeport) would increase by 36 percent between the years 2000 and 2025, and job growth is estimated to increase by 28 percent during the same period (Feasibility Study 2005). To understand the stress placed on the roadway by this increase in traffic volume, level of service (LOS) is provided. LOS is a qualitative measure of traffic operations, ranging from LOS A to LOS F (*Figure 3* and *Table 1*). LOS A/B represents good traffic operations with high traffic speeds and virtually no congestion. LOS C/D, which is considered the limit of acceptable traffic operations, represents some but reasonable traffic delays. LOS E/F represents conditions where traffic volumes are approaching or exceeding the highway capacities, which results in congestion and unacceptable traffic delays and speeds. *Table 1* describes the various LOS characteristics.

Table 1. Level of Service Characteristics

Level of Service (LOS)	**Description**
A	Free flow with low volumes and high speeds
B	Reasonably free flow, but speeds beginning to be restricted by traffic conditions
C	In stable flow zone, but most drivers are restricted in the freedom to select their own speeds
D	Approaching unstable flow; drivers have little freedom to select their own speeds
E	Unstable flow; may be short stoppages
F	Unacceptable congestion; stop-and-go; forced flow

Source: Developed from Federal Highway Administration (FHWA) 2006

A comparison of LOS between the No Build alternative in the Year 2035 and the Most Feasible Alternative (MFA) (See *Section IV*), which is the Build alternative, shows an improvement in traffic mobility in the Year 2035. With the No Build alternative, peak traffic is projected to range from LOS D to F between US 59 and FM 2234, whereas the MFA traffic is projected to range from LOS C to LOS E. Between FM 2234 and SH 6, the No Build alternative would range from LOS C to D and the MFA would operate at LOS C. The LOS for the No Build south of SH 6 would range from LOS B to C, and the LOS

for the MFA south to CR 60 would operate similarly to the No Build alternative (*Table 2*). With growth and development projected to continue over the next 20 years, there is a need to provide enhanced roadway capacity.

Table 2. Range of Level of Service

Sections of SH 288	Estimated Traffic Volumes (ADT)				Estimated Level of Service		
	Existing 2011	Projected 2017	Projected No Build 2035	Projected Build 2035	Existing 2011	Projected No Build 2035	Projected Build 2035
US 59 to Binz Road	177,200	188,000	233,700	243,900	E	D	E
Binz Road to Holly Hall Road	172,100	186,200	231,400	203,400	D	D	D
Holly Hall Road to IH 610	132,500	158,000	204,700	193,900	D	D	D
IH 610 to Reed Road	159,500	185,500	242,400	231,600	D	F	D
Reed Road to Airport Boulevard	151,000	176,800	240,200	229,200	D	F	D
Airport Boulevard to Orem Road	144,800	170,800	230,600	219,200	D	F	D
Orem Road to BW 8	135,000	159,400	213,900	178,500	C	F	C
BW 8 to FM 2234	92,600	135,100	174,100	165,800	D	D	D
FM 2234 to FM 518	103,900	113,300	146,400	127,900	C	D	C
FM 518 to CR 59	85,100	97,100	128,000	112,400	C	C	C
CR 59 to CR 58	71,800	86,500	106,100	93,900	C	C	C
CR 58 to SH 6	62,900	71,000	87,300	77,500	C	C	C
SH 6 to CR 57	43,800	56,400	76,000	66,600	C	C	C
CR 57 to CR 64	43,800	56,400	71,400	62,200	B	C	B
CR 64 to CR 60/future SH 99	36,200	41,300	54,200	42,500	B	B	B

Existing and projected average daily traffic (ADT) volumes along SH 288 are shown in *Table 3*. According to H-GAC travel demand model estimates, traffic volumes on SH 288 range from a high of 177,200 vehicles per day (vpd) just south of downtown Houston to a low of 36,200 vpd at the southern end of the project area at CR 60. The decrease in traffic volumes from north to south reflects the lower level of residential and commercial development as SH 288 extends farther from Houston. By 2017, the estimated traffic volumes increase to 188,000 vpd south of downtown Houston to 41,300 vpd at CR 60. By 2035, the projected traffic volumes for the No Build alternative are expected to increase by 51 percent on average, with 243,900 vpd in the northern section of the project area and 42,500 vpd in the southern section of the SH 288 corridor. With this growth predicted in the area, roadway capacity would affect mobility in the area. The project build year (letting year) is 2015 and the design year is 2035.

Table 3. Existing and Projected Average Daily Traffic Volumes Along SH 288

Sections of SH 288	Estimated Traffic Volumes (ADT)		Projected No Build Traffic Volumes 2035 (ADT)	Projected Build Traffic Volumes 2035 (ADT)
	Existing 2011	Projected 2017		
US 59 to Binz Road	177,200	188,000	233,700	243,900
Binz Road to Holly Hall Road	172,100	186,200	231,400	203,400
Holly Hall Road to IH 610	132,500	158,000	204,700	193,900
IH 610 to Reed Road	159,500	185,500	242,400	231,600
Reed Road to Airport Boulevard	151,000	176,800	240,200	229,200
Airport Boulevard to Orem Road	144,800	170,800	230,600	219,200
Orem Road to BW 8	135,000	159,400	213,900	178,500
BW 8 to FM 2234	92,600	135,100	174,100	165,800
FM 2234 to FM 518	103,900	113,300	146,400	127,900
FM 518 to CR 59	85,100	97,100	128,000	112,400
CR 59 to CR 58	71,800	86,500	106,100	93,900
CR 58 to SH 6	62,900	71,000	87,300	77,500
SH 6 to CR 57	43,800	56,400	76,000	66,600
CR 57 to CR 64	43,800	56,400	71,400	62,200
CR 64 to CR 60/future SH 99	36,200	41,300	54,200	42,500

Source: H-GAC travel demand model results, 2012

IV. Design and Alternative Analysis

Introduction

The Feasibility Study was sponsored by TxDOT. The purpose of the study was to "…select a Most Feasible Alternative consisting of recommended transportation improvements that address mobility and safety while minimizing environmental and land use impacts." The project goals set by the study team were to improve existing and future mobility and access to the SH 288 corridor and provide a feasible and cost effective transportation system that would allow for expansion or modification in the future. Three Steering Committee Meetings were held between June 2003 and November 2004, and three public meetings were held between September 2003 and December 2004. The purpose of the meetings was to solicit input to evaluate the various transportation modes and alternative improvements in order to determine a MFA.

Feasibility Study

The initial design and alternative analysis is based on the findings of the Feasibility Study. Within the study, a range, or "universe," of alternatives was established. The universe of alternatives was evaluated to determine the MFA. Initial alternatives were identified through meetings with local municipalities and agencies; input from the public, the Steering Committee, and the Feasibility Study Team; and previous studies. The Steering Committee was composed of area agencies, major stakeholders, the TxDOT consultant team, and representatives from the public. Nine transportation improvement alternatives representing a wide variety of "modal components" (a variety of transportation modes, ranging from minor improvements to the addition of highway lanes and rail) were ultimately developed for initial screening. Four criteria were used to evaluate the initial nine alternatives: traffic/mobility, environmental/socioeconomic, engineering/cost, and public involvement. Based upon the screening evaluation, the nine initial alternatives were reduced to six "Viable Alternatives" for further consideration.

General evaluation categories used for analysis of the six Viable Alternatives included traffic/mobility impacts, economic feasibility, social/environmental impacts, engineering/costs, and public input. The Viable Alternatives were compared to the No Build alternative. Of the six Viable Alternatives selected for detailed evaluation, four added highway travel lanes along SH 288 and two considered rail improvements along the FM 521 (Almeda Road) corridor. The Viable Alternatives included the following:

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

Managed lanes are high occupancy toll (HOT) lanes that allow the flexibility to charge higher tolls for fewer passengers (or no tolls for high occupancy vehicles) and the flexibility to allow for variations to better meet travel demand while providing increased choice for motorists. Express toll lanes are separated from general-purpose lanes and all motorists are charged a toll. Light rail transit is an "urban electric railway system" that can operate single cars or short trains at ground level, on aerial structures, in subways, or in streets. Commuter rail is often used for travel between suburbs and the city and is designed to carry large numbers of passengers in a short time.

The Feasibility Study confirmed that the rail alternatives (E and F) along the FM 521 (Almeda Road)/UPRR alignment would not effectively reduce congestion as stand-alone alternatives. High costs, constructability, and ROW issues made these two alternatives difficult to compare to the viable highway alternatives on SH 288. Additional travel lanes would be needed on SH 288 to accommodate projected travel demands along the corridor.

With Alternatives E and F eliminated from consideration as stand-alone improvements, Alternatives A-D were evaluated in more detail. Each alternative was evaluated using five criteria – traffic/mobility, economics, social/environmental, engineering/costs, and public acceptance. For each of the five criteria, six to eight sub-criteria were established. For example, under traffic/mobility impacts six sub-criteria were evaluated: LOS, average travel speed, average travel time, multimodal efficiency, traffic utilization, and vehicle miles of travel. Each alternative was then rated as most favorable, favorable, neutral, unfavorable, or most unfavorable.

A summary of the results of the evaluation of the alternatives is presented in *Table 4*. The evaluation did not weight the criteria during the ranking process (i.e., all criteria had the same importance). Alternatives A and C rated favorable compared to the neutral rating for the other alternatives. Alternative C, adding managed lanes to SH 288, was selected as the recommended MFA. Alternative C best met the goals of the study team for developing a transportation plan that was cost effective, minimized the environmental and socioeconomic impacts, planned for the future, and reflected public input. Ultimate development of the MFA would also result in a "multimodal" transportation system that provides a number of alternative transportation solutions and choices for users of the SH 288 corridor, such as light rail or commuter rail. This EA addresses only the proposed SH 288 roadway improvements.

Table 4. Summary of Detailed Evaluation

Alternative	Traffic/ Mobility	Economics	Social/ Environ-mental	Engineering Costs	Public Accep-tance	Overall
No Build	MU	MU	N	N	MU	U
A. SOV/HOV	F	F	U	N	MF	F
B. HOV	F	F	U	N	N	N
C. Managed	F	MF	U	N	F	F
D. Express Toll	F	MF	U	F	N	N

Source: SH 288 Feasibility Study MF – Most Favorable N – Neutral U – Unfavorable
F – Favorable MU – Most Unfavorable

The Managed lanes alternative was identified as the MFA in the Feasibility Study. Managed lanes can be operated as both free and toll lanes, typically based on ridership and travel demand. After completion of the Feasibility Study in 2005, TxDOT determined that it would be necessary to toll all vehicles that would use the proposed managed lanes, as toll revenues would provide an additional funding source, and to allow faster implementation of the needed improvements. Historically, TxDOT has financed highway projects on a "pay-as-you-go" basis, using motor fuel taxes and other revenue deposited in the state highway fund. However, population increases and traffic demands have outpaced the efficiency of this traditional finance mechanism. Developing projects as toll roads can help bridge the gap between transportation needs and resources.

Build Alternative

After the Feasibility Study was completed, schematic design alternatives were developed and evaluated. Preliminary schematic designs were shown at public meetings in February 2007. Preliminary schematic designs were revised for some areas to address access and mobility. The resulting preferred alternative is the Build Alternative described below. The Build Alternative would meet the purpose of the project by increasing the roadway capacity to accommodate future traffic demands, making access to TMC more efficient, and increasing mobility. A summary description of the proposed improvements follows, and is organized by project area, from north to south. Information about toll policies, methods of toll collection, toll rates, and toll booth locations can be found in *Section VII Environmental Justice*, *Project Level Environmental Justice (EJ) Toll Analysis*.

SH 288 between US 59 and IH 610

The proposed project would retain four general-purpose lanes in each direction along SH 288 with auxiliary lanes for entrance and exit ramps (*Figure 4, Sheet 1*). The proposed project includes the following improvements:

- Construct two toll lanes in each direction within the SH 288 median, beginning just south of US 59.
- Construct southbound entrance ramp and northbound exit ramp for toll lanes near US 59.
- Construct southbound entrance ramp and northbound exit ramp for toll lanes between Macgregor Way and Binz Street.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes near Holcombe Boulevard.
- Reconstruct overpass at Southmore Boulevard.

SH 288 at IH 610 Interchange

The proposed project would retain three general-purpose lanes in each direction along IH 610 with auxiliary lanes for entrance and exit ramps (*Figure 4, Sheet 2*). The proposed project includes the following improvements:

- Construct two toll lanes in each direction within the SH 288 median.
- Construct direct connectors in all eight directions at the interchange.
- Construct entrance and exit ramps from IH 610 main lanes to frontage roads in both eastbound and westbound directions.

Connection to the TMC

The proposed project in the TMC area includes the improvements listed below (See *Figure 4, Sheet 3*):

- Construct northbound direct connector from SH 288 to Almeda Road (general-purpose lanes and toll lanes).
- Construct entrance ramp from the IH 610 eastbound frontage road to access the eastbound direct connector from IH 610 main lanes to SH 288 (to general-purpose lanes and toll lanes).
- Extend Cambridge Street south of IH 610 (IH 610 main lanes would be elevated over Cambridge Street).
- Remove existing eastbound entrance ramp to IH 610 between Fannin Street and Almeda Road.
- Remove existing westbound exit ramp from IH 610 between Almeda Road and Fannin Street.

SH 288 between IH 610 and BW 8

The proposed project would increase the number of general-purpose lanes in each direction along SH 288, with auxiliary lanes for entrance and exit ramps (*Figure 4, Sheet 4*). The proposed project includes the following improvements:

- Construct one additional general-purpose lane in each direction.
- Construct two toll lanes in each direction within the SH 288 median.
- Construct southbound exit ramp from toll lanes to general-purpose lanes, north of Reed Road.
- Construct northbound entrance ramp from general-purpose lanes to toll lanes, south of Reed Road.
- Construct southbound exit ramp from toll lanes to general-purpose lanes, south of Almeda-Genoa Road.
- Construct northbound entrance ramp from general-purpose lanes to toll lanes, north of Almeda-Genoa Road.
- Construct southbound exit ramp from general-purpose lanes to frontage road, south of Almeda-Genoa Road.
- Construct southbound connection from frontage road to access road, north of BW 8.
- Construct southbound frontage road between Almeda-Genoa Road and BW 8.
- Construct southbound entrance ramp from frontage road to general-purpose lanes, north of BW 8.
- Widen existing SH 288 bridges at Airport Road, Sims Bayou, and W. Orem Drive.

- Reconstruct and widen existing bridges at Reed Road and Almeda-Genoa Road.

SH 288 at BW 8 Interchange

The proposed project would retain three general-purpose lanes in each direction along SH 288 (*Figure 4, Sheet 5*). The proposed project includes the following improvements:

- Construct two toll lanes in each direction within the SH 288 median.
- Construct direct connectors in all eight directions. Direct connectors would provide access to BW 8 from SH 288 general-purpose lanes and toll lanes from north and south sides of the interchange.

SH 288 between BW 8 and SH 6

The proposed project would retain two or three general-purpose lanes in each direction along SH 288 with auxiliary lanes for entrance and exit ramps (*Figure 4, Sheets 6* and *7*). The proposed project includes the following improvements:

- Construct two toll lanes in each direction within the SH 288 median.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes between McHard Road and FM 518.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes near FM 518.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes near Rodeo Palms Parkway.
- Reconstruct bridge at Clear Creek, FM 2234/McHard Road, and FM 518.
- Construct bridge at Mustang Bayou and Rodeo Palms Parkway.

SH 288 between SH 6 and CR 60 (Proposed SH 99)

The proposed project would retain two general-purpose lanes in each direction along SH 288 with auxiliary lanes for entrance and exit ramps (*Figure 4, Sheet 8*). The proposed project includes the following improvements:

- Construct two toll lanes in each direction within the SH 288 median.
- Construct bridges over SH 288 at cross streets: CR 56, CR 64, and CR 63.
- Widen bridges at SH 6 and BNSF Railroad.
- Construct bridges at CR 48 and CR 60.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes near CR 57.
- Construct southbound exit ramp and northbound entrance ramp for toll lanes between CR 63 and CR 60.
- Construct frontage roads at various locations.

No Build Alternative

Under the No Build alternative, the existing SH 288 roadway between US 59 and CR 60 would remain in operation and only routine maintenance (e.g., applying chip seals, overlays, restriping, etc., as needed) would be conducted per TxDOT guidelines. The proposed roadway improvements would not be constructed, and no ROW acquisition would be required. As discussed in *Sections II* and *III*, without the proposed project, the roadway capacity would remain unchanged, and as development continues in the corridor, congestion would increase and mobility would decrease. Access to the TMC would become more congested as traffic increases. The No Build alternative does not satisfy the need for and purpose of the proposed project as discussed in *Section II*, but is the baseline condition for the assessment of potential impacts of the preferred alternative.

V. Right-of-Way and Displacements

The Final EIS for the development of the existing SH 288 corridor received approval from FHWA on November 12, 1974. Therefore, all existing ROW was acquired by TxDOT upon completion of the NEPA process and in compliance with the Uniform Relocation and Real Properties Acquisition Act of 1970.

The proposed project would require approximately 69 acres of additional ROW, of which approximately 95 percent is currently agricultural/undeveloped use, and five percent is residential and commercial/industrial uses. Property in the southern portion of the project area is primarily agricultural/undeveloped. One residential apartment/condominium building (7 rented units) would be displaced at the Park Yellowstone Apartments (*Figure 5*, *Sheet 3*). Replacement housing is available and is discussed in *Section VII Environmental Justice*. ROW would be acquired from commercial properties along IH 610, west of SH 288; and along SH 288, south of Yellowstone Blvd. Three commercial businesses are adjacent to the eastbound IH 610 frontage road, east of Almeda Road, in an area of proposed ROW acquisition (*Figure 5, Sheet 2*). The businesses along IH 610 are (as of December 2012): Russell & Smith Collision Super Center, TNT Crane & Rigging, and one property used for equipment and materials storage that appears to be utilized by Abrasive Warehouse & Equipment and/or Reliant Leasing Systems. ROW acquisition in this area could remove parking, loading/storage, or entrance areas. Access to and from the businesses would be maintained throughout the construction period. If adequate parking and loading/storage areas would not be available on other areas of the properties, the businesses would be displaced. The businesses along SH 288 in the area of proposed ROW acquisition are (as of December 2012): Gulf gas station, located east of SH 288 and South of Yellowstone Blvd.; and The Hurt Company, located east of SH 288 and south of Alice St. (*Figure 5, Sheet 3*). Although ROW acquisition at the Gulf gas station may require relocation of underground storage tanks (USTs), the gas pumps and the building would not be displaced. Acquisition of ROW at the Hurt Company property would displace areas currently used for customer/employee parking, and truck loading. If adequate parking and truck loading would not be available on other areas of the property, the business would be displaced. One billboard sign would be displaced on Almeda Road north of IH 610 (*Figure 5, Sheet 2*).

Texas Department of Transportation's (TxDOT's) acquisition and relocation assistance program would provide assistance and counseling to residential property owners that would be required to relocate as a result of ROW acquisition along SH 288. The relocation assistance program is conducted in accordance with the *Uniform Relocation and Real Property Acquisition Policies Act of 1970*, as amended; *49 CFR Part 24, Subparts C through F*; *Title VIII of the Civil Rights Act of 1968* (Federal Fair Housing law); *Housing and Urban Development (HUD) Amendment Act of 1974* and TxDOT policies and procedures. Relocation resources would be available, without discrimination, to all affected property owners required to relocate as a result of the implementation of the proposed project. No person would be displaced by this project unless and until adequate replacement housing has been provided or is in place. Replacement housing would be offered to all displaced persons regardless of their race, color, religion, sex, disability, or national origin. All replacement housing would be decent, safe, and sanitary, without causing undue financial hardship. An adequate supply of housing meeting this description is available for this project at apartment sites in the study area. Non-residential property owners, such as businesses,

would be provided information on adequate replacement locations for their current property and may be reimbursed for costs based on TxDOT policies and procedures.

Utilities

Numerous public and private utilities cross the proposed project. All of the utilities could be either adjusted or relocated prior to construction of the proposed project using standard procedures. The existing facilities consist of subsurface, aerial, surface, and subterranean utilities. These utilities include sanitary sewers, buried telephone cables, gas lines, water lines, overhead power and telephone lines, and an electric transmission line that may require partial relocation or adjustment. Some utilities may be located deep enough that relocation may not be needed.

VI. Socioeconomic Data

A. Population

The proposed project is located in Harris and Brazoria Counties, Texas. The proposed project crosses the city limits of Houston, Pearland, Manvel, and Iowa Colony, and unincorporated portions of Harris and Brazoria Counties. The 2010 population and 2020 and 2030 population projections for the cities and counties are shown in *Table 5*.

Table 5. Population Statistics for Counties and Cities Within or Adjacent to SH 288

Geographic Area	Population		
	2010	2020**	2030**
Harris County	4,092,459	4,629,335	5,180,439
Brazoria County	313,166	354,708	401,684
City of Houston	2,099,451	2,472,783	2,741,099
City of Pearland	91,252	108,518	129,166
City of Manvel	5,179	4,510	4,510
Iowa Colony	1,170	1,022	1,129

Sources: * U.S. Census 2010 (redistricting population numbers), **Texas Water Development Board (TWDB) 2012

Based on data shown in Table 5, the populations of the Cities of Houston, Pearland, Manvel, and Iowa Colony are forecast to have a 31, 42, -13, and -4 percent change, respectively, between 2010 and 2030. Data provided by TWDB for the City of Manvel shows no increase in population from 2010 to 2060, which does not appear to be valid; therefore, H-GAC's 2035 Regional Growth Forecast was also reviewed. H-GAC's forecast indicates a 135 percent increase in population in Manvel between 2010 and 2030, from 4,791 to 11,274. For Iowa Colony, H-GAC's forecast indicates a 251 percent increase in population between 2010 and 2030, from 881 to 3,095. The populations of Harris and Brazoria Counties between 2010 and 2030 are forecast to increase by 27 and 28 percent, respectively. Continued population growth near the project corridor has created demand for increased roadway capacity.

The civilian labor force and unemployment rates for counties and cities associated with the project study area with populations over 25,000 are listed in *Table 6*. Cities under a population of 25,000 are not listed by the Bureau of Labor Statistics (BLS) for labor force or unemployment rate. The 2010 average median household income for Census block groups adjacent to the proposed project and cities located within the project study area is listed in *Table 6*.

Table 6. Civilian Labor Force, Median Household Incomes, and Unemployment Rates

Data Set	City of Houston	City of Pearland	Harris County	Brazoria County
Employment Data [1]				
Labor Force*	1,038,202	50,634	2,100,490	156130
Unemployment Rate*	7.1%	5.3%	7.0%	7.1%
Median Household Income Average (2010)**				
23 Census Tract Average	**City of Houston**	**City of Pearland**	**City of Manvel**	**City of Iowa Colony**
$50,768.20	$42,962	$85,452	$65,864	$77,961

[1] Iowa Colony and Manvel are not listed for labor force or unemployment rate in the BLS data as of August 2012.
Source: *BLS 2012 and **American Community Survey 2010.

B. Community Impacts and Public Involvement

Community Impacts

There are several residential neighborhoods, subdivisions, apartment and townhome communities located adjacent to the SH 288 project corridor, as shown in *Figures 5 and 6B*. Defining neighborhoods in the northern portion (north of Beltway 8) of the project corridor was limited because not all of the neighborhoods or subdivisions are named. Named neighborhoods, subdivisions, apartments and townhome communities are shown in on *Figures 5* and *6B*. The City of Houston has a classification system that breaks up geographic areas into Super Neighborhoods. Super Neighborhoods are defined as a geographically designated area where residents, civic organizations, institutions and businesses work together to identify, plan, and set priorities to address the needs and concerns of their community. The Super Neighborhood boundaries extend beyond adjacent Census tracts, block groups and blocks. The proposed project is adjacent to seven Super Neighborhoods as shown in *Figure 6A*. The information provided in *Table 7* provides a demographic profile of these Super Neighborhoods. As shown in *Table 7*, most of the seven adjacent Super Neighborhoods are greater than 50 percent Black or African American. The Greater Third Ward, OST/South Union, and Sunnyside have populations with median household incomes below the poverty level, and unemployment rates are relatively higher in these Super Neighborhoods.

Demographic and income data was reviewed in order to identify areas with high minority (i.e., greater than 50 percent), or areas with low-income residents (living below the poverty guideline) (*Appendix C)*. As discussed in *Section VII, e*nvironmental justice (EJ) areas (i.e., areas with high percentage minority or low-income populations) are primarily located north of BW 8 along the SH 288 corridor. *Figure 6B* and *Appendix C* depict and discuss the adjacent blocks and block groups with EJ areas. A few other areas south of BW 8 along the project corridor have EJ populations, but most of these areas are residents within rural residential areas or small housing developments. *Figure 6B* shows Super Neighborhood boundaries.

Table 7. Demographics of Super Neighborhoods Adjacent to the SH 288 Corridor

Super Neighborhood Name	Population*	% White*	% African American*	% Hispanic*	% Asian*	% Other*	Median Household income **	Unemployment rate (%) **
Greater Third Ward	13,295	10.1	69.6	14.4	4.4	1.5	$13,811	39.0
OST/South Union	20,152	1.5	80.0	17.1	0.4	1.1	$19,521	14.1
Sunnyside	21,053	0.9	89.6	8.2	0.6	0.8	$18,627	17.5
Astrodome Area	17,697	30.1	20.7	10.4	35.9	2.9	$37,159	2.4
Macgregor	17,323	18.7	64.2	8.8	5.8	2.4	$27,679	9.1
Central Southwest	60,857	3.5	43.0	51.2	1.5	0.9	$38,419	8.6
South Acres/Crestmont Park	18,941	1.5	88.7	8.4	0.5	0.9	$30,569	9.6

Source: *City of Houston *2010 Census* demographic profile; **City of Houston 2000 Census income profile. Updated Super Neighborhood average income and employment data is not yet available from the City of Houston.

One building of an apartment community located in an EJ area would be displaced as a result of the proposed project, as shown on *Figure 6B, Sheet 2*. However, as discussed in *Section VII,* there is available replacement apartment housing within the same price range and in the vicinity of the displaced apartment community.

The proposed project improvements would require a total of approximately 69 acres of ROW, the majority of which is currently agricultural or undeveloped (*Figure 5*). As discussed in *Section XXIII*, noise would increase in some areas. The proposed project would not bisect any established neighborhoods or isolate any neighborhoods or communities, nor would it affect planned development of the project area. Because SH 288 is a limited access facility without frontage roads for most of its length, existing bicycle and pedestrian facilities are limited in the project area. Sidewalks would be constructed at all intersections that would be affected by construction of the proposed project. Where frontage roads are proposed, the pavement width would include an outside lane that is 15 feet wide to accommodate bicycles.

Public Involvement

Two public meetings were held on February 21 and 22, 2007. The public meetings were held at Rogers Middle School in Pearland, Texas, and St. Paul's United Methodist Church in Houston, Texas, to accommodate persons living in different areas along the project corridor. The meetings were announced in local newspapers including t*he Houston Chronicle, Rumbo de Houston, The Alvin Sun,* and *The Pearland Journal.* Notices were mailed in English and Spanish to adjacent landowners, elected officials, government officials, local organizations, and civic groups, and published on the TxDOT website. The mailed notices and newspaper announcements provided opportunities for citizens to request language interpreters. No requests for language interpreters were received.

The meeting format consisted of an open house public meeting with a PowerPoint presentation and handout. Exhibits displayed at the public meetings included diagrammatic layouts with proposed roadway improvements and one set of aerial photographs identifying environmental constraints.

Representatives from TxDOT and the study team answered questions from the public. The public had the option of completing a comment form the night of the public meeting, submitting the form by email, or mailing the forms to TxDOT by March 9, 2007. Thirty-eight written comments were received at the public meetings – 29 at Rogers Middle School and 9 at St. Paul's United Methodist Church. Forty-five comments were received by mail or email by March 9, 2007. The total number of written comments received was 86. The comments are summarized below:

- 15 requested some form of mass transit, with rail being the most popular choice
- 9 preferred HOV lanes to toll lanes
- 5 would like frontage road access
- 2 expressed low-income concerns
- 5 expressed concerns about flooding and drainage in the area
- 12 specifically opposed toll lanes
- 12 would like a noise abatement wall built
- 1 requested a bike lane
- 1 expressed concerns about wildlife
- 1 expressed concerns about the entrance/exit ramps
- 1 expressed concern about construction activities
- 4 mentioned projects other than SH 288
- 8 identified enhancements to the project such as ramp locations and access points
- 6 requested follow-up items such as being added to the mailing list or receiving materials
- 1 identified a correction to a display at the meeting
- 1 mentioned traffic concerns
- 1 mentioned landscaping
- 1 requested the timeframe of the project be moved up and completed sooner

The public meetings provided the opportunity for members of surrounding communities to voice their concerns. One residential community (Southerland Place) located east of SH 288 directly south of Holmes Road (*Figure 5*, *Sheet 3*), requested a noise wall. The noise analysis performed for the proposed project determined that noise barriers would not meet the FHWA's criteria for inclusion in the proposed SH 288 project in the area of Southerland Place (see *Section XXIII Noise*). Residents of Holly Hall Townhomes/Condominiums discussed concerns about drainage near the IH 610 and US 59 interchange; this community is located west of SH 288, and directly south of Holly Hall Street (*Figure 5, Sheet 3)*. A drainage study has been performed and will be taken into consideration during the final design phase of the project. Some roadway users indicated that they travel SH 288 to Houston from Lake Jackson, Clute, or Pearland, and want a mass transit component to the TMC or downtown Houston, and/or HOV lanes/free rides for van pools. The proposed improvements to SH 288 include construction of toll lanes from US 59 to CR 60, and addiotnal general purpose lanes from IH 610 to BW 8. No mass transit or HOV lanes/free rides for van pools are included as part of this proposed project. A public meeting summary report was completed and is available on TxDOT's website. Upon approval from FHWA to proceed with further public involvement, a public hearing would be conducted to solicit public input on a preferred alternative for the proposed project, and on the environmental assessment.

C. Economic Impacts

Roadway construction activities would create new job opportunities and income potential in the area in the short term. The number of construction-related jobs would vary, depending on the phasing of the project construction. The total jobs that would be created, directly and indirectly, by implementation of the proposed project are estimated to be 46,987 and 45,588 jobs, respectively. The total additional income that would be created, directly and indirectly, by implementation of the proposed project is estimated to be $404 million and $811 million, respectively. The total statewide effect from the proposed project is estimated to be $3.8 billion, based on the Texas State Comptroller model (Texas State Comptroller 1986). ROW would be acquired from commercial properties along IH 610, west of SH 288, and along SH 288, south of Yellowstone Blvd. Three commercial businesses are adjacent to the eastbound IH 610 frontage road, east of Almeda Road. Two businesses are along SH 288. Land currently used as parking or loading/storage areas at four businesses would be acquired. If adequate parking and loading/storage areas would not be available on other areas of the properties, the businesses would be displaced (see *Section V*).

VII. Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was enacted on February 11, 1994, and mandates that federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of programs on minority and low-income populations. A minority population is defined as a group of people and/or a community experiencing common conditions of exposure or impact that consists of persons classified by the U.S. Census Bureau as Black, Asian, American Indian or Alaska Native, Hispanic, or other non-white persons, including those persons of two or more races. A low-income population is defined as a group of people and/or a community that, as a whole, lives below the national poverty level. The average poverty level threshold for a family of four people in 2012, as defined by the U.S. Department of Health and Human Services (HHS) guidelines, was a total annual household income of $23,050. According to Federal Highway Administration (FHWA) Order 6640.23 and U.S. Department of Transportation (DOT) Order 5610.2, disproportionately high and adverse effects on minority or low-income populations generally means an adverse effect that is predominantly borne by a minority population and/or low-income population, or would be suffered by the minority population and/or low-income population, and is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by the non-minority population and/or non-low-income population.

The proposed project crosses 23 Census tracts, 35 Census block groups, and 506 Census blocks (*Appendix C*). A Census block group is a collection of Census blocks within a Census tract. Census tracts, typically averaging approximately 4,000 persons, are small statistical subdivisions of a county.

Ninety-six of the 506 Census blocks located adjacent to the project area have high (i.e., more than 50 percent) minority populations. Of the 506 Census blocks, 246 of the blocks located within Harris County and 140 of the blocks located in Brazoria County have zero population; ethnicity percentages are calculated for Census blocks with a greater than zero population.

Individual Census blocks and block groups were examined to identify minority and low-income populations at a smaller geographic level. Minority populations within Census blocks, block groups, and tracts were considered high if the minority population was greater than 50 percent. Low-income populations were considered high if (1) the block group median household income was below the 2012 HHS poverty level, or (2) the block group median household income is substantially lower than the Census tract comparison group. For block groups located within Brazoria and Harris County, the comparison group was the average median household income of all tracts within the county (see *Appendix C*). In 2012, the HHS poverty level for a family of four people was a total annual household income of $23,050. In 1999, it was $17,029.

Of the 321 blocks and 25 block groups located within Harris County, 73 blocks have a high (i.e., more than 50 percent) minority population. Three Census tracts (3124.00, 3138.00, and 3311.00) have low

median household incomes, below the 2012 HHS poverty level. Six additional Census tracts (3312.00, 3137.00, 3313.00, 3315.00, 3130.00, and 3140.02) have incomes below the 17-tract average ($39,290.24). Within the 73 blocks with high minority populations, one of the blocks (3138.00:4, Block 4006) has potential residential displacements. However, as discussed later in this section, available replacement housing is available in surrounding apartment/condominium communities. The 321-block area has an 86.8 percent minority population, which is higher than the 25-block group comparison group average of 86.6 percent.

Of the 185 blocks and 10 block groups located within Brazoria County, 23 blocks have high minority populations and no block groups have high low-income populations. Two tracts (6618.00 and 6619.00) have a median household income below the 6-tract average of $83,289. Within the 3 blocks with high minority populations, no residential displacements would occur. The 185-block area has a 46.5 percent minority population, which is lower than the 10-block group comparison group average of 53.3 percent.

One building with 7 rented units would be displaced in an apartment/townhome community (Park Yellowstone). It is located in Census Block Group 3138.00:4, Block 4014, which has a 100 percent minority population; therefore, it is expected that some minority individuals would be displaced from this building. Park Yellowstone is an apartment/townhome community with a total of 210 units, and a portion of the apartment units are part of the Section 8 Housing Choice Voucher Program. The Section 8 housing program is a government subsidized housing assistance program for low-income families or individuals. The program subsidizes monthly rent for these families or individuals where the tenant pays 30 percent and the program pays the additional 70 percent (City of Houston Housing Authority 2006).

If residents currently using Section 8 Housing Vouchers at Park Yellowstone could not relocate in the same apartment complex, they could relocate to townhome/apartment communities within a three-mile area that accept Section 8 housing vouchers: Bellfort Pines, Spanish Village, Scott Street Townhomes, or Parkside Point. The total numbers of units available for rent and vacancy rates for these townhome/apartment communities are listed in *Table 8*, as of May 2012. The location of each of these apartment communities is identified in *Figure 6B*.

Table 8. Apartment Availability Near Displaced Apartment/Condominium Community

Apartment Community Name	Address	Total Number of Units	Percent Vacancy	Number of Available Units	Section 8 Housing Voucher Program	Number of Bedrooms	Price Range*	Distance (miles)
Bellfort Pines	8300 Canyon Houston, Texas 77051	248	6	15	Y	1-3	$575-$787	2.9
Spanish Village Gentry House	4000 Griggs Houston, Texas 77021	126	16	20	Y	1-3	$680-$1,050	1.7
Scott Street Townhomes	7245 Scott Street Houston, Texas 77021	96	1	1	Y	1-3	$680-$900	1.4
Parkside Point	3360 Alice Street Houston, Texas 77021	260	1	3	Y	2-3	$609-$703	0.4
Displaced Apartments/Condominiums								
Park Yellowstone Apartment/ Townhomes	3322 Yellowstone Boulevard Houston, Texas 77021	210	N/A	-7	Y	1-3	$530-$870	N/A

* Prices for apartment communities are based on the market price listed in the apartment database as of May 2012.

Bellfort Pines, Spanish Village, Scott Street Townhomes, and Parkside Point have similar rates and number of bedrooms as Park Yellowstone, and these apartment communities also accept Section 8 Housing vouchers. No additional ROW would be required in other residential areas.

Impacts to low-income and minority individuals and communities would be expected as result of the proposed project. Traffic noise would increase in some adjacent communities, including some areas with low-income and minority populations. The locations of noise receivers are discussed in *Section XXIII*. The level at which traffic noise would increase is addressed and mitigated through the TxDOT *Guidelines for Analysis and Abatement of Highway Traffic Noise*. Residential displacements would occur in a high minority area; however, as shown in *Table 8,* adequate replacement housing is located within two miles of the displaced residential property.

The proposed project is expected to improve mobility by reducing congestion along existing mainlanes and frontage roads. In the long term, because the proposed SH 288 improvements would improve mobility, it would benefit all individuals traveling in the vicinity of the proposed project. Implementation of the proposed project would not cause disproportionate adverse impacts to low-income or minority populations.

Project Level Environmental Justice (EJ) Toll Analysis

A project-level toll analysis was conducted to determine the potential impact that tolling would have on the Environmental Justice communities within the project area. To complete this study, H-GAC utilized their travel demand model to identify potential toll road users, and also performed a travel time analysis for persons residing in Environmental Justice (EJ) traffic analysis zones (TAZs) and Non-Environmental Justice TAZs. An Environmental Justice TAZ is identified if the minority or low-income population in the TAZ is 50 percent or greater. In addition, an evaluation of toll policies, toll rates, and available free facilities was conducted to fully evaluate the potential for disproportionate impacts to EJ communities.

Non-Toll Facilities

The proposed TxDOT project is to construct roadway improvements along SH 288 from US 59 south of downtown Houston, in Harris County, to County Road (CR) 60 in Brazoria County, a distance of approximately 26 miles. SH 288 currently provides two to four general-purpose travel lanes in each direction, separated by a grassy median. The proposed roadway improvements would include construction of toll lanes in each direction within the existing grassy median, interchange improvements at Interstate Highway (IH) 610 and Beltway 8 (BW 8), and improved access to the TMC. Travel on the toll lanes would be tolled, while travel on the existing general-purpose lanes would not require a toll or fee.

Toll Policies

The Harris County Toll Road Authority (HCTRA) sets the toll policies for all toll roads within their jurisdiction. HCTRA's toll policies have identified various circumstances for which free passage on area toll roads is allowed to individuals, certain types of vehicles, and under special circumstances. The categories of free passage for toll roads that HCTRA has jurisdiction over are explained in *Table 9*. Free passage for mass transit or HOV would not be provided on the tolled portions of the proposed project.

Table 9. Categories of Free Passage on Toll Roads

Category	Description
Vehicles	1. Marked police vehicles, fire department vehicles, and ambulances.
	2. Authorized emergency vehicles identified in Texas Transportation Code §541.201
	3. Vehicles designated by the Department of Public Safety as emergency vehicles during disasters declared by the governor of Texas (Texas Transportation Code §546.006).
	4. Individual military vehicles and convoys (considering the technological and personnel limitations of operating the toll project) (Texas Transportation Code §362.901). • Clearly identifiable military vehicles may use the electronic tolling lanes. • Military vehicles that are not clearly identifiable should use the collector lane and "sign through" on a log maintained by the collector. • Military vehicles that are not clearly identifiable will not be allowed free passage on toll roads where there are no collector lanes.
	5. Vehicles that are part of a funeral procession, provided that: • HCTRA is notified at least 24 hours in advance; • HCTRA's Director determines that it is in the interest of public safety that the procession be routed onto the toll road system; • The procession is escorted by certified peace officers; and • The procession enters and exits the toll road system outside of these hours: Monday through Friday – 6:00 AM to 9:00 AM. and 4:00 PM to 7:00 PM
	6. Processions and motorcades for heads-of-state and dignitaries (if the procession/motorcade is escorted by the United States Secret Service, Texas Department of Public Safety, or other law enforcement agency responsible for safety and security).
	7. Harris County owned/leased vehicles while used in the performance of County business.
Individuals	1. Current federal and state military members with Military identification are permitted free passage through collector lanes. • Requires presenting valid military identification and signing a non-revenue sheet. • Free passage not available on Toll Roads with no collector lanes or through combination collector/electronic tolling lanes if vehicle is equipped with an EZ TAG device.
	2. HCTRA employees who must incur a toll to access or depart their duty stations at Hardy North Toll Plaza, Hardy South Toll Plaza, Sam Houston North Toll Plaza, and Sam Houston South Toll Plaza.
	3. HCTRA employees assigned to the Sam Houston Toll Bridge or Sam Houston East Plaza, whose route to work includes crossing the Toll Bridge are permitted sign through privileges for the Toll Bridge.
	4. HCTRA employees who must use the Toll Roads on HCTRA-related business (during working hours) in their private vehicles are permitted sign-through privileges upon presentation of proper authorization.
Circumstances	The Commissioners Court authorizes free passage on the Toll Roads when there is sufficient notice of an impending catastrophic event. When the emergency or event is unexpected or unforeseen, authority is delegated to persons in the best position to exercise informed judgment as outlined below: • ***Large-scale emergency or calamity:*** The County Judge is authorized to permit free passage on part or all of the Toll Roads when a large-scale emergency or calamity (natural or man-made) threatens public safety and necessitates the immediate evacuation or relocation of large numbers of people that may obstruct or impede rapid movement on the Toll Roads.

Category	Description
	• ***Localized emergency or condition:*** In the event of a localized emergency or condition (such as refinery explosions, gas leaks, hazardous material spills, flooding, traffic accidents, lane closures, etc.) that substantially threatens public safety and mobility, an on-site Incident Management certified peace officer may permit limited free passage for a period of no more than one hour. Approval of the County Judge, Executive Director of Harris County Public Infrastructure, or the Director of HCTRA must be obtained to extend free passage beyond the initial one-hour period. • ***Lane and/or road closures:*** When closures required for construction and maintenance of the Toll Roads are expected to substantially and adversely affect traffic flow and/or threaten public safety, free passage may be permitted by the Director of HCTRA, the Executive Director of Harris County Public Infrastructure, or their designee. • ***Ramp tolls:*** HCTRA may elect to not collect tolls at ramps on dates or during hours where the Director concludes that the amount of vehicle traffic at those ramps and the tolls likely to be collected do not justify the cost of assigning collectors during those times. • ***Opening a new road project or segment:*** HCTRA's Director may designate a time period where free passage may be permitted to allow for testing of the infrastructure supporting the toll collection process. If the test period needs to exceed 45 days, HCTRA's Director should obtain authorization from Commissioners Court to extend the test period.

Source: HCTRA, no date.

SH 288 serves as a hurricane and emergency evacuation route. In order to alleviate congestion during mass evacuations and create safer, more efficient evacuation conditions, the suspension of tolls on SH 288 would be considered during hurricane evacuation.

Anticipated Toll Rate

The anticipated toll rate for the SH 288 toll lanes project would be a schedule of rates that would not exceed the average per mile toll rates for electronic toll transactions in force and effect for the HCTRA operated toll road system. The toll rates identified in *Table 10* were in effect on November 12, 2012 for most of the toll road system in the region. Toll rates on Katy Managed Lanes vary based on time of day and number of occupants in the vehicle. Toll rate increases would need to be approved by Harris County Commissioners Court.

Table 10. HCTRA Toll Rates

Vehicle Axles	Mainlane Plaza
2 axle	$1.40 EZ Tag $1.75 Cash*
3 axle	$3.50
4 axle	$5.25
5 axle	$7.00
6 axle	$8.75

*Where cash payment is accepted

Source: https://www.hctra.org/tollroads_rates (Accessed 11/12/2012)

Methods of Toll Collection

Tolls would be collected using a completely electronic toll collection (ETC) system. No toll booths are proposed, and therefore no cash payment would be accepted along the roadway. The ETC system requires that users of the roadway have a toll tag that registers on the ETC system as the vehicles pass under the toll gantry. The ETC equipment would be placed on toll gantries positioned at specific locations along the mainlanes and at some ramps.

The ETC allows participating motorists to prepay their tolls using a major credit/debit card or direct debit payment option. A small adhesive transponder (toll tag) that communicates electronically with a computer via radio frequencies is affixed to the inside of the windshield. As motorists use the facility, tolls are electronically deducted from their pre-paid account. When an account reaches the minimum balance level, it automatically charges (debits) the customer's credit card or bank account to bring it back to the original deposit amount.

Motorists using the toll road without a toll tag would be charged via the video tolling system. The ETC video records a photograph of the vehicle's license plate and a (monthly) invoice would be mailed to the registered owner of the vehicle. The assessed toll fee for these motorists is higher than that for toll tag users, and an additional collection fee is included on the monthly invoices. This tolling program allows infrequent users without a transponder/toll tag to travel local toll roads. The video tolling method is more expensive for users who do not have an active toll account because fees associated with billing and handling of the periodic billing statements are added to the costs. Payment for violations can be made at the EZ TAG stores with a check, money order, or credit card; by phone or online with a credit card; or by mail with a check or money order.

Any EZ TAG account set up with a toll facility operator in Texas would be able to access toll roads or managed lanes in any of the toll authority areas while having the tolls charged to the user's home account. To achieve this objective, toll tags or transponders issued by a toll authority in one area of the state would be capable of registering toll transactions to the user's home toll account. Users from other states or international drivers would be billed similarly to users without toll tags.

The EZ TAG program requires an initial prepayment of $40 for credit/debit card payment and $80 for funds directly deducted from a bank, plus a $15 per-tag activation fee for the first three TAGs, and $10 per tag thereafter. Monthly statements for the previous eighteen months of an account usage are available at no charge with an online account, or printed statements may be mailed. The associated fees for enrolling in the EZ TAG program are shown in *Table 11*.

Table 11. EZ Tag Fees

Number of Vehicle(s)	Pre-Paid Deposit	Balance at which Replenishment Required (¼ of Deposit)	Activation Fee (per EZ TAG)
1 - 3	$40	$10	$15
4 - 6	$80	$20	$10
7 - 9	$120	$30	$10
etc	Maximum $600 (or optional higher balance)	Maximum $150 (or ¼ of optional higher balance)	$10

Source: EZ_TAG_Agreement_revJan2010(1)pdf at https://www.hctra.org/about_forms/ (Accessed 11/12/2012)

The user would be required to set up a pre-paid account that would automatically transfer funds from their credit card or bank account to the toll account. The minimum account balance is determined by the type

of payment used for the account as well as the number of EZ TAGs on the account. The typical credit card-backed account with one to three EZ TAGs has a required replenishment amount of $40 and a low balance amount of $10. This means that as a motorist travels through the EZ TAG lanes and the account goes to $10 or below, the credit/debit card will automatically be charged $40 per the EZ Agreement.

The typical EZ TAG account that is paid via bank account, with one to three EZ TAGs, has higher pre-paid deposits, and has a required replenishment amount of $80 and a low balance amount of $20. Similarly, if the balance falls below $20, the system will automatically replenish the EZ TAG account to the $80 minimum. Frequent toll road users would therefore see multiple replenishment charges on their bank account in a month. A $25.00 fee is applied to each rejected withdraw from the bank account. If a bank charge fails after three consecutive attempts or three times in a twelve-month period, a credit card would be required as the primary form of payment. Currently, cash accounts are not accepted to maintain an EZ TAG. Toll accounts issued by other Texas transportation entities such as the TxTag and Texas Toll Tag would be accepted on the EZ TAG system.

Toll Booth Locations

Since the SH 288 project is proposed as an all-electronic toll road with no cash payments, no toll booths are proposed. The mainlane toll gantries would span both directions of travel on a structure similar to a typical sign bridge. The gantry would support ETC reader units, video enforcement system cameras, illumination devices, automatic vehicle identification antennae, communications gear, and other necessary equipment. This equipment would be supported approximately 20 feet above the roadway surface and would be used to collect electronic toll data. Similar, smaller gantries would be needed at some ramps as well, except these would only span the width of the particular entrance or exit ramp. The exact location of toll gantry locations (ramps and mainlane) would be determined during final design. Advantages of the ETC system include the following:

- Minimizes the amount of right-of-way needed for the proposed toll collection facilities because additional lanes for cash toll booths and parking and other facilities for toll attendants would not be required.
- The gantry minimizes the acceleration and deceleration of traffic that usually accompanies toll booth collections because cash would not be accepted.
- Last-minute lane changes between toll and cash lanes would not occur, providing smoother traffic conditions at toll collection locations.
- Lighting impacts would be minimized because the gantries would not require any lighting beyond typical roadway-specific lighting for the video enforcement cameras.

Since the ETC system does not require the installation of toll booths, there would be no disproportionate impact to EJ communities regarding toll booth placement.

Environmental Justice

H-GAC's analysis to determine the effects of SH 288 toll lanes on EJ populations utilized the travel demand model in conjunction with those 2000 Census block groups that contained 50 percent or higher minority and/or low-income populations. The 2000 Census data is consistent with that used for H-GAC's current conformity analysis and *2035 RTP Update,* as amended. Once the EJ block groups were identified, EJ Traffic Analysis Zones (TAZs) were identified if 50 percent or more of its population was identified as an EJ population. *Figure 6C* shows the EJ-related demographic data for the TAZs within the SH 288 Study Area. Following the identification of the EJ TAZs, two regional roadway network scenarios were utilized, the *2035 RTP Update* Build Scenario and the *2035 RTP Update* No Build Scenario, to conduct an analysis on travel time for persons within the EJ TAZs and non-EJ TAZs. The Build Scenario includes all tolled lanes, managed lanes, and high occupancy tolled (HOT) lanes projects identified in the *2035 RTP Update*. The No Build Scenario includes the current roadway network, the fiscally constrained

2035 RTP Update roadway network, and the existing and committed managed lane system (e.g. BW 8), but excludes the proposed SH 288 improvements.

Travel Demand Assumptions and Methodology

The region's travel demand model does not provide a means for tracking travel at an individual household level, but does 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 offer a shorter travel time between two zones than the free path travel time, the trip is not considered a "candidate" for the toll facility. If a trip can save travel time using a toll path over a free path then it is considered a "candidate" trip. Not all candidate trips will choose to use a tolled path. The probability of a candidate trip using a tolled path is a function of a number of variables such as the magnitude of the potential travel time savings, the toll costs, and the income characteristics of the zones residents. Aspects of this approach are employed in the analyses presented.

In mode choice model applications, there is a single highway network that is used to estimate the travel times for toll paths and free paths. For the regional toll analyses, there are two networks: the "Build" network (i.e., the forecasted roadway network containing the subject toll facilities) and the "No Build" network (i.e., the network containing all the forecasted roadways without any SH 288 improvements). Existing and committed toll facilities are contained in both networks. In this analytical setting, simply comparing the toll path versus free path option will not identify the candidate trips for only the new toll facilities being studied. Such a grouping would include trips using both existing and proposed toll facilities.

To focus on candidate trips for the SH 288 toll facility, the travel time for toll paths in the Build network is compared to the toll path travel time in the No Build network. Trips that have a shorter toll path travel time in the Build network than the toll path travel time in the No Build network are defined as candidate trips for the new toll facilities. The trips for a given trip purpose are segmented into four groups:

- Trips produced by EJ zones that are classified as "Candidate" trips
- The remaining trips produced by EJ zones are classified as non-"Candidate" trips
- Trips produced by non-EJ zones that are classified as "Candidate" trips
- The remaining trips produced by non-EJ zones are classified as non-"Candidate" trips

In summary, assumptions and limitations specifically for the SH 288 project-level toll analysis are as follows:

1. The model is based on the lates adoped H-GAC 2035 household and employment forecast released in August 2006. Household and employment numbers are used for Trip Generation only, not population.

2. The model was validated to 2009 annual traffic counts within acceptable industry and H-GAC standards.

3. The model includes all system expansions as listed in the *2035 RTP Update*; the "No Build" scenario removes only the improvements being tested.

4. The model uses the same H-GAC 2035 household and employment forecast for all scenarios, both "Build" and "No Build".

5. For this analysis, an EJ zone is any TAZ that meets the minimum criteria as defined under Title VI. The model does not use separate individual households. All travels in the model from households in an EJ zone are assumed to be EJ, regardless of their individual income levels or composition. The model's Trip Generation step does consider household's income level as a factor for trip generation. (The general assumption is that higher income households tend to make more trips.)

   This modeling analysis includes only direct Home-Based Work and Home-Based Non-Work trips. Non-home-based trips, i.e. "trip chains", are not included in this analysis. (The H-GAC model includes Non-home-based trips for travel demand forecasting; however, for the project level EJ analysis, only HBW and HBNW trips are used).

Results

To determine the time analysis for the different types of trip scenarios, trips were divided into home based work trips (HBW) and home based non-work trips (HBNW) for both tolled and free facilities. The numbers of HBW trips and HBNW trips for the SH 288 project are depicted in *Table 12.*

Table 12. Potential Trips in the EJ and Non-EJ Zones

	2035 HBW Person Trips			2035 HBNW Person Trips		
	Toll Candidate	Non-Candidate	Total	Toll Candidate	Non-Candidate	Total
EJ Zone	570,757	2,071,068	2,641,825	512,949	5,889,591	6,402,540
Percent of Total	21.60%	78.40%		8.01%	91.99%	
Non-EJ Zone	808,402	2,289,479	3,097,881	484,127	6,138,457	6,622,585
Percent of Total	26.10%	73.90%		7.31%	92.69%	

Source: H-GAC, 2012.

Using toll path travel times and free path travel times from the Build and the No Build networks, there are four travel times (e.g. Build network-toll path option, Build network-free path option, No Build network-toll path option, and No Build network – free path option) for each type of trip (HBW and HBNW). By computing the average trip lengths for each of the options, the impacts of the two networks on the choice options can be quantified, compared, and analyzed.

As shown in *Table 12*, approximately 21.6 percent of the HBW trips identified within EJ zones were toll candidates. Additionally, nearly 26.1 percent of the HBW trips identified within non-EJ zones were toll candidates. Of the HBNW trips, approximately 8.0 percent of the trips identified within EJ zones were toll candidates and 7.3 percent of the HBNW trips identified within non-EJ zones were toll candidates.

Utilizing this data, further evaluation was conducted to determine the free path travel and tolled travel path for both the Build and No Build Network Scenarios. The average trip length (ATL) in minutes was the measure used in this evaluation for both types of trips within the EJ and non-EJ zones.

The results of the HBW and HBNW trips analysis for the SH 288 project are presented in *Table 13* and *Table 14*, respectively.

Table 13. Home Base Work Trips

			Average Trip Length (ATL) in minutes for Free and Tolled Facilities under the Build and No Build Network Scenarios				Difference in ATL in minutes	
			Build Network Scenario		No Build Network Scenario			
Zones	2035 HBW Trip Scenarios	Number of 2035 HBW Person Trips	ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL Using Free Facility	Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
EJ Zone	Trips that save 0+ minutes using a new tolled facility	570,757	34.71	41.89	35.57	41.92	0.86	0.03
	Trips that cannot save 0+ minutes using a new tolled facility	2,071,068	22.68	25.39	22.36	25.17	-0.32	-0.22
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	808,402	45.02	54.95	46.27	54.89	1.25	-0.06
	Trips that cannot save 0+ minutes using a new tolled facility	2,289,479	28.19	32.07	27.89	31.84	-0.30	-0.23

Source: H-GAC, 2012.

Table 14. Home Base Non-Work Trips

Zones	2035 HBNW Trip Scenarios	Number of 2035 HBNW Person Trips	Average Trip Length (ATL) in minutes for Free and Tolled Facilities under the Build and No Build Network Scenarios				Difference in ATL in minutes	
			Build Network Scenario		No Build Network Scenario			
			ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL Using Free Facility	Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
EJ Zone	Trips that save 0+ minutes using a new tolled facility	512,949	33.13	36.84	33.48	36.84	0.35	0.00
	Trips that cannot save 0+ minutes using a new tolled facility	5,889,591	12.89	13.52	12.75	13.41	-0.14	-0.11
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	484,127	28.16	32.36	28.53	32.31	0.37	-0.05
	Trips that cannot save 0+ minutes using a new tolled facility	6,138,457	15.69	16.54	15.48	16.36	-0.21	-0.18

Source: H-GAC, 2012.

The results for the HBW and HBNW trips analysis indicate:

- For trips that would save travel time using SH 288 toll lanes, there would be a reduction in travel time for populations in the EJ and Non-EJ Zones: 0.86 and 1.25 minutes, respectively, for HBW trips; and 0.35 and 0.37 minutes, respectively, for HBNW trips. For both EJ and Non-EJ Zones, travel time would be faster on the toll lanes than on free lanes, and the travel time on the free facility would be approximately the same.

- For trips that would not save travel time using SH 288 toll lanes, there would be an increase in travel times for populations in the EJ and Non-EJ Zones: -0.32 and -0.30 minutes, respectively, for HBW trips; and -0.14 and -0.21 minutes, respectively, for HBNW trips. This decrease in travel time may result from congestion at intersections between arterials and increased traffic on the highway (H-GAC, 2012).
- The analysis of predicted travel time differences indicates there is no potential for a disproportionate negative effect to the Environmental Justice populations due to the proposed SH 288 project.

Potential Economic Impact

Potential economic impacts to individuals using the SH 288 toll lanes can be illustrated using the projected SH 288 toll rates and the median household income for the study area. The low, mid range, and high toll rates are 17.0, 33.5, and 50.0 cents per mile. The potential cost per household calculations assume that a toll road user makes 500 trips (250 round-trips) per year along the 26-mile tollway from US 59 to CR 60. As shown in *Table 15*, the annual cost for low, mid range, and high toll rates would be approximately $2,210, $4,355, and $6,500, respectively.

A user with an annual household income that equals the median Harris County household income of $51,444 would spend 4.3, 8.5, and 12.6 percent of their household income on tolls. Brazoria County users with a median household income of $65,607 would spend 3.4, 6.6, and 9.9 percent of their income on tolls. Users with an annual household income that falls at or below the HHS poverty level of $23,050 would spend 9.6, 18.9, and 28.2 percent of their household income on tolls.

Table 15. Potential Economic Impact

					Harris County	Brazoria County	
Toll Range	**Toll Rate Per Mile[1]**	**Trips Per Year**	**Miles Per Trip**	**Total Cost Per Year**	**Percent of Median HH Income[2]**	**Percent of Median HH Income[3]**	**Percent of Poverty Level Income[4]**
Low	$0.170	500	26	$2,210.00	4.3	3.4	9.6
Mid-range	$0.335	500	26	$4,355.00	8.5	6.6	18.9
High	$0.500	500	26	$6,500.00	12.6	9.9	28.2

Source: The latest income characteristics are available from the Census Bureau 2006-2010 American Community Survey (ACS).

[1] Per TxDOT, based on projected toll rates

[2] Median household income for Harris County is $51,444

[3] Median household income for Brazoria County is $65.607

[4] 2012 Health and Human Services poverty guideline level is $23,050 for a family of four

Assuming the same level of use, low-income populations would pay a larger percentage of their income in tolls when compared to the general population. If toll costs are beyond the affordability of low-income travelers, they would have the alternative of using the existing non-tolled transportation network in the SH 288 corridor, which includes general-purpose lanes throughout the entire corridor, and frontage roads in some locations.

Availability of Tolling Information

The HCTRA website provides information regarding the EZ TAG, toll road network, toll charges or violations, and safety on the toll roads. Currently this information is available in English and no information is provided regarding the availability of translation services or hearing impaired assistance.

Limited English Proficiency

Executive Order 13166, *Improving Access to Services for Persons with Limited English Proficiency* (*LEP)*, sets a framework to improve access to federally conducted and federally assisted programs and activities for persons who, as a result of national origin, are limited in their English proficiency. According to the 2010 Census, approximately 10.1 percent of persons residing within the 36 Census block groups within or adjacent to the proposed project speak English "less than very well," which is considered LEP, and approximately 6.0 percent are Linguistically Isolated (LI). The LEP language distribution is shown in *Table 16. Table 16* also lists the LEP and LI data for the county, city, and block groups in the proposed project area.

TxDOT has ensured that opportunities for community input in the National Environmental Policy Act (NEPA) process have been and will continue to be provided. A reasonable attempt to solicit public comments during this phase of study was made at the public meetings held on February 21 and 22, 2007. The meetings were announced in local newspapers including *the Houston Chronicle, Rumbo de Houston, The Alvin Sun,* and *The Pearland Journal.* Notices were mailed in English and Spanish to adjacent landowners, elected officials, government officials, local organizations, civic groups, and published on the TxDOT website. The mailed notices and newspaper announcements provided opportunities for citizens to request language interpreters. No requests were received. In addition, three public meetings were held during the Feasibility Study.

VIII. Project Setting and Land Use

The proposed project is located in Brazoria and Harris Counties, Texas, within portions of the Cities of Houston, Pearland, Manvel, and Iowa Colony (*Figure 1*). The project setting is relatively flat, with a typical elevation of 50-60 feet National Geodetic Vertical Datum (NGVD), but elevations are as low as 20 feet NGVD at the stream crossings (*Figure 2*), according to U.S. Geological Survey (USGS) 7.5 minute quadrangle maps for Bellaire, Almeda-Juliff, Rosharon, and Angleton, Texas (1982).

Pearland and Manvel have developed comprehensive plans that direct growth and development toward SH 288. Pearland has directed its growth toward SH 288 to take advantage of the development opportunities on SH 288 and at BW 8. Manvel has projected the conversion of the existing commercial and industrial activities in the vicinity of SH 288 and SH 6 to mixed-use commercial and multi-family residential developments. The proposed project is consistent with the plans of Pearland and Manvel, as well as private developments in the vicinity. The proposed project could make undeveloped land in the area more appealing for development because of the increased accessibility.

Land use in the immediate vicinity of the project was classified by seven general categories including: (1) Residential, (2) Public/Institutional (3) Cemeteries, (4) Commercial/Industrial, (5) Parks/Recreational, (6) Undeveloped/Agricultural, and (7) Utility/Transportation. Land use in the vicinity of the proposed project is generally described in *Table 17*. *Figure 5, Sheets 1* through *13* depict the seven categories by colored shading over 2010 aerial photography. Descriptions of the categories are provided below:

- Residential land use includes single-family residential, multi-family residential, and retirement communities.
- Public/Institutional land use includes churches, schools, government offices, police and fire stations, airports and airport facilities, community gathering places, and child-care facilities.
- Cemetery land includes various cemeteries throughout the area.

- Commercial/Industrial land use includes industrial and commercial businesses such as auto repair facilities, restaurants, oil and gas operations, sand and gravel operations, petroleum tank farms, the CenterPoint Energy power plant, and other properties.
- Parks/Recreational land includes public parks, golf courses, and other recreational areas throughout the area.
- Undeveloped/Agricultural land includes small areas or acreages with no businesses or residential properties, or land used for agricultural purposes.
- Utility/Pipeline/Transportation land use includes electrical substations and easements, public water and wastewater (sanitary sewer) pump stations and equipment, UPRR tracks and easement, and pipeline easements.

Table 16. Limited English Proficiency and Linguistically Isolated

Geographic Area	Limited English Proficiency			% Composition LEP by Language				Linguistically Isolated		
	Total Population Sampled	Total LEP	LEP %	% Spanish	% Indo-European	% Asian	% Other	Total Population Sampled	Total LI	% LI
36-Census Tract Area	142,354	14,334	10.1					55,289	3,343	6.0
County or City										
Brazoria County, Texas	276,565	23,765	8.6	78.3	5.7	14.3	1.7	101,656	4,728	4.7
Harris County	3,619,935	760,315	21.0	84.7	3.5	10.6	1.2	1,372,163	173,122	12.6
Houston city	1,898,242	462,071	24.3	86.3	3.4	9.0	1.4	764,758	115,997	15.2
Iowa Colony village	1,294	160	12.4	68.1	0.0	31.9	0.0	435	9	2.1
Manvel city	4,316	296	6.9	90.5	9.5	0.0	0.0	1,712	76	4.4
Pearland city	74,901	5,360	7.2	47.5	10.2	38.7	3.6	28,583	1,086	3.8
Harris County Census Tracts										
Census Tract 3124	1,925	453	23.5	95.6	0.0	4.4	0.0	840	133	15.8
Census Tract 3126	4,592	379	8.3	87.6	1.6	10.8	0.0	2,512	175	7.0
Census Tract 3127	1,911	71	3.7	100.0	0.0	0.0	0.0	1,001	0	0.0
Census Tract 3130	1,981	62	3.1	72.6	9.7	17.7	0.0	1,058	48	4.5
Census Tract 3131	2,869	245	8.5	22.9	31.8	36.7	8.6	1,556	88	5.7
Census Tract 3132	3,646	140	3.8	60.7	13.6	0.0	25.7	1,528	0	0.0
Census Tract 3137	2128	57	2.7	2.3	0.4	0.0	0.0	913	10	1.1
Census Tract 3138	4416	353	8.0	7.9	0.0	0.1	0.0	1807	90	5.0
Census Tract 3139	3398	239	7.0	1.7	0.0	5.3	0.0	1962	98	5.0
Census Tract 3140.02	7,164	1,401	19.6	4.9	17.8	74.5	2.8	3,887	528	13.6
Census Tract 3308	6,612	1,053	15.9	94.7	0.0	5.3	0.0	2,428	247	10.2
Census Tract 3309	5,991	1,368	22.8	96.1	1.5	1.8	0.7	2,450	301	12.3
Census Tract 3311	3,043	179	5.9	100.0	0.0	0.0	0.0	1,251	10	0.8
Census Tract 3312	2,760	114	4.1	93.9	6.1	0.0	0.0	1,096	17	1.6
Census Tract 3313	4,729	77	1.6	100.0	0.0	0.0	0.0	1,729	0	0.0
Census Tract 3315	6,755	244	3.6	71.3	0.0	21.7	7.0	2,539	69	2.7
Census Tract 3341	7,925	909	11.5	85.7	2.6	10.3	1.3	3,109	224	7.2
Brazoria County Census Tracts										
Census Tract 6606.01	11,120	970	8.7	9.9	5.4	67.9	16.8	4,404	225	5.1
Census Tract 6606.02	18,513	2,431	13.1	68.2	4.2	23.6	4.0	6,874	484	7.0
Census Tract 6607.01	13,463	1,006	7.5	18.8	25.4	55.8	0.0	5,173	183	3.5
Census Tract 6607.02	10,136	789	7.8	63.0	18.9	18.1	0.0	3,906	192	4.9
Census Tract 6618	4,975	634	12.7	71.9	0.0	14.4	13.7	1,676	137	8.2
Census Tract 6619	12,302	1,160	9.4	87.8	2.2	10.1	0.0	1,590	84	5.3

Source: U.S. Census 2010

Table 17. Land Use

Segment	Land Use
US 59 to US 90	Land use to the east of SH 288 (*Figure 5, Sheet 1*) consists almost entirely of heavily developed residential areas with small amounts of park land and undeveloped area. A railroad crosses the area from southwest to northeast, crossing both SH 288 and Macgregor Way. Land use to the west (*Figure 5, Sheets 1* and *2*) includes several use types. The northwestern area includes both residential and commercial development and several hospitals, including the TMC. The southwest area consists of smaller sections of residential, commercial, and public land bordering the west area of SH 288 and the north area of US 90. A large portion of the southwestern quadrant is park land occupied by the Hermann Park Golf Course.
US 90 to IH 610	Land use in this area (*Figure 5, Sheet 2*) is primarily residential, commercial, and utility, with isolated areas of undeveloped/agricultural land to the east of SH 288. Rail lines cross the area roughly parallel to SH 288, adjacent to Almeda Road. The area includes a hospital complex near the intersection of IH 610 and Almeda Road.
IH 610 to BW 8	Land use in the SH 288 corridor between IH 610 and BW 8 consists mainly of undeveloped/agricultural uses (*Figure 5, Sheets 2, 3, 4,* and *5*). There is some high density development, including residential and commercial land use, between IH 610 and Bellfort Street (*Figure 5, Sheet 3*.) The Houston Community College South Campus is located adjacent to SH 288 near Airport Boulevard. Farther south, there are several smaller residential areas with only partial development, as well as commercial development along SH 288 near the intersection with BW 8.
BW 8 to FM 518	Land use to the west of SH 288 (*Figure 5, Sheets 5* and *6*) consists of large areas of residential and undeveloped/agricultural land, with smaller areas of commercial and public/institutional land. The area to the east (*Figure 5, Sheets 5* and *6*) includes a larger amount of residential land as well as some commercial properties, undeveloped/agricultural land, and park land. Tom Bass Regional Park is located near the intersection of BW 8 and SH 288, with the Country Place Country Club in the residential area immediately to the south.
FM 518 to the American Canal	Use in this area (*Figure 5, Sheets 6* and *7*) includes residential, commercial, public, and undeveloped/agricultural land. The western half of the corridor contains most of the undeveloped land, with the residential areas to the west only partially developed. The eastern half is primarily dense residential development with a large shopping center at the intersection of SH 288 and FM 518.
The American Canal to SH 6	The land in this area (*Figure 5, Sheets 7, 8,* and *9,*) is primarily in large tracts of agricultural/undeveloped land with some areas of residential, public/institutional, and commercial land. The majority of residential land is to the west of SH 288. Mustang Bayou is located in the northern part of the area near the American Canal.
SH 6 to CR 60	This area (*Figure 5, Sheets 9, 10, and 11*) is primarily undeveloped/agricultural, with some residential, commercial, and park land. Residential land use is scattered throughout the area. The greatest concentration is near the SH 288/SH 6 intersection (*Figure 5, Sheet 9*) where the Rawling Lakes area is to the east and the City of Iowa Colony is to the west. The Arcola Oil Field is approximately 1 mile west of SH 288. A railroad crosses the northern part of the area parallel to SH 6 (*Figure 5, Sheet 9*). The area is also crossed by the North Canal (*Figure 5, Sheet 10*) and a number of smaller streams.

IX. Soils

The project area is underlain by 11 soil types as mapped by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS). These soils generally occur in nearly level to gently sloping landscape positions. Drainage characteristics of the soils range from moderately well drained to poorly drained (*Table 18*). Three of the soils, Aris, Beaumont, and Gessner, are listed by the NRCS as hydric soils.

Table 18. Soil Descriptions

Soil Type	Soil Characteristics	County	Prime Farmland
Lake Charles clay, 0 to 1 percent slopes	Moderately well drained	Brazoria	Yes
Bernard-Edna complex	Somewhat poorly drained	Brazoria	Yes
Bernard clay loam	Somewhat poorly drained	Brazoria	Yes
Edna fine sandy loam, 0 to 1 percent slopes	Somewhat poorly drained	Brazoria	No
Lake Charles-Urban Land complex	Moderately well drained	Harris	No
Beaumont-Urban Land complex	Poorly drained	Harris	No
Aris-Urban Land complex	Somewhat poorly drained	Harris	No
Vamont-Urban Land complex	Somewhat poorly drained	Harris	No
Urban Land	N/A	Harris	No
Bernard-Edna complex	Somewhat poorly drained	Harris	Yes
Lake Charles clay, 0 to 1 percent slopes	Moderately well drained	Harris	Yes
Bernard clay loam	Somewhat poorly drained	Harris	Yes
Gessner loam	Poorly drained	Harris	Yes*
Aris fine sandy loam	Somewhat poorly drained	Harris	Yes*

*Prime farmland, if drained.
Source: NRCS Harris and Brazoria Counties Soil Surveys, 1976 and 1981 respectively.

Shallow excavation for installation of signs, drainage modifications, minor cut and fill activities, and leveling of certain portions for the proposed project site would result in soil mixing and potential short-term erosion during the construction period. Guidance documents, such as the TxDOT *Storm Water Management Guidelines for Construction Activities*, provide discussion of storm water controls, such as hay bales and silt fences, to be implemented during construction to minimize soil erosion.

Prime Farmland

Prime and unique farmland soils and those of statewide or local importance are subject to protection under the Farmland Protection Policy Act (FPPA). There are no designated unique farmland soils in the State of Texas. Prime farmland soils, as defined by the NRCS, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources because of their quality, growing season, and moisture supply, and farming these soils results in the least damage to the environment. The purpose of the FPPA is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of prime farmland (7 United States Code [USC] § 4201). According to the NRCS (August 3, 1999), “lands that are already in or committed to urban development or water storage, including those with a density of 30 structures per 40 acres” are not subject to the FPPA.

Of the 69 acres proposed for acquisition, approximately 65.5 acres are undeveloped land adjacent to the existing ROW, and 3.5 acres are property occupied by apartments (approximately 2 acres) and commercial uses (approximately 1.5 acres). The proposed project ROW is underlain by various soil types as listed in *Table 18*. Some of these soils are listed by the NRCS as prime farmland. The project area to the north of the American Canal is adjacent to residential and industrial properties that would not be subject to FPPA. The project area south of the American Canal is adjacent to undeveloped land with a density of less than 30 structures per 40 acres, and would be subject to the FPPA. A Farmland Conversion Rating Form (AD 1006) was submitted to the NRCS for the proposed project segment south of the American Canal in November 2007. A copy of the form is included in *Appendix D*.

X. Beneficial Landscape Practices

In accordance with *Executive Order 13112 on Invasive Species and the Executive Memorandum on Beneficial Landscaping*, landscaping would be limited to seeding and replanting the ROW with native species of plants where possible. A mix of native grasses and native forbs would be used to revegetate the ROW. In accordance with the Executive Memorandum, TxDOT would adhere to the following sustainable landscape measures and practices where cost effective and to the extent practicable:

- Use regionally native plants for landscaping.
- Design, use, or promote construction practices that minimize adverse effects on the natural habitat.
- Seed to prevent pollution by, among other things, reducing fertilizer and pesticide use.
- Implement water efficient and runoff reduction practices.
- Create outdoor demonstration projects employing the above measures and practices.

Any landscaping that may be included with the proposed project would be in compliance with the Executive Order and the guidelines for environmentally and economically beneficial landscape practices.

XI. Invasive Species

On February 3, 1999, the President issued Executive Order 13112 to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts. To minimize potential impacts to vegetation resources, areas adjacent to the proposed roadway improvements that are cleared during construction would be reseeded as quickly as possible following completion of construction activities to control soil erosion and to reestablish stable vegetative communities. Locally adapted native species would be used for reseeding to provide a long-term, low-maintenance roadside vegetation community. In accordance with Executive Order 13112, the ROW would be reseeded using native species, when practicable, and soil disturbance would be minimized to prevent the establishment of invasive species.

XII. Vegetation

The project area is located in the Gulf Coast Prairies and Marshes natural region of Texas, which encompasses approximately 20,312 square miles (Gould 1975). In addition to wildlife habitat, the prairies are used for crops, livestock grazing, and urban and industrial centers. It is estimated that as much as 99 percent of the coastal prairies in Texas have been converted to agricultural land (Gould 1975; McMahan, et al. 1984).

According to the *Vegetation Types of Texas* by the Texas Parks & Wildlife Department (TPWD), the project traverses Urban and Crops vegetation types (McMahan et al. 1984). The Urban vegetation type includes man-induced floral assemblages of ornamental trees and shrubs, and the Crops vegetation type includes cultivated cover or row crops providing food and/or fiber for man or livestock.

The project area is composed primarily of concrete roadway and maintained ROW. The majority of natural vegetation assemblages previously occurring within the ROW have been disturbed by construction activities associated with the roadway and replaced with herbaceous species that are routinely maintained. Ornamental plantings as well as some native and invasive trees and shrubs are also present within the ROW. Vegetation in areas outside the existing ROW has mostly been disturbed by urban or agricultural development. These areas support ornamental plantings or voluntary growth typically associated with livestock pasture and crop lands.

Local Vegetation Types

In accordance with Provision (4)(A)(i) of the TxDOT-TPWD Memorandum of Understanding (MOU), an investigation was conducted to identify and map vegetation types within the project area. Vegetation within the existing project ROW is primarily herbaceous vegetation maintained by routine mowing. Areas adjacent to the project ROW between US 59 to IH 610 consist of highly modified urban vegetation with little native or natural vegetation. Between IH 610 and SH 6, areas adjacent to the project ROW are a mix of urban and undeveloped fallow land. South of SH 6, areas adjacent to the project ROW consist primarily of undeveloped fallow lands, crops, and small areas of scrub-shrub. Other vegetation communities within and adjacent to the project corridor include aquatic features and periodically inundated wetlands. The vegetative communities are described below.

Aquatic Features – While not vegetated, these areas include natural named and unnamed aquatic features (i.e., watercourses) and canals that intersect the project area. Named aquatic features (listed from north to south) include Brays Bayou, Sims Bayou, Clear Creek, Mustang Bayou, West Fork of Chocolate Bayou, and Hayes Creek. The project also crosses three man-made canals: the American Canal, Brazos River Authority Canal System B (Briscoe Canal), and Texas Water Company Canal.

Riparian Areas – These areas include vegetated zones adjacent to aquatic features and man-made drainage ditches. These areas are considered separate from the periodically inundated wetlands described below. These areas may exhibit the three wetlands parameters of hydrophytic vegetation, hydric soils, and wetland hydrology [as defined by the United States Army Corps of Engineers (USACE)], but can also be non-wetland forested areas buffering a natural watercourse. Two areas in the corridor were classified as riparian areas: Clear Creek and West Fork of Chocolate Bayou. Black willow (*Salix nigra*) was the dominant tree species observed at Clear Creek. Dominant species observed at West Fork of Chocolate Bayou included black willow, Chinese tallow (*Triadica sebifera*) , water oak (*Quercus nigra*), live oak (*Quercus virginiana*), green ash (*Fraxinus pennsylvanica*), and trifoliate orange (*Poncirus americana*).

Periodically Inundated Wetlands – Areas classified as periodically inundated wetlands exhibit the three wetlands parameters of hydrophytic vegetation, hydric soils, and wetland hydrology. These areas include depressional wetlands adjacent to SH 288. Vegetation observed within these areas of the proposed project are dominated by a variety of herbaceous species, including alligator weed (*Alternanthera philoxeroides*), erect coinleaf (*Centella erecta*), southern carpet grass (*Axonopus affinis*), sticky flatsedge (*Cyperus elegans*), yellow nutsedge (*Cyperus esculentus*), Bermudagrass (*Cynodon dactylon*), sand spikerush (*Eleocharis montevidensis*), largeleaf pennywort (*Hydrocotyle bonariensis*), Cherokee sedge (*Carex cherokeensis*), soft rush (*Juncus effusus*), jointleaf rush (*Juncus articulatus*), marsh seedbox (*Ludwigia palustris*), floating primrose-willow (*Ludwigia peploides*), turkey tangle frog-fruit (*Phyla nodiflora*), curly dock (*Rumex crispus*), nipplebract arrowhead (*Sagittaria papillosa*), and broad-leaf cattail (*Typha latifolia*).

Crops – This type includes cultivated cover or row crops providing food and/or fiber for man or livestock. These areas include hay pastures, areas grazed by livestock, and a few former rice fields.

Scrub-Shrub – This wooded vegetation type is co-mingled with native and invasive trees. Common tree species include Chinese tallow, sugarberry (*Celtis laevigata*), loblolly pine (*Pinus taeda*), and American elm (*Ulmus americana*). Common herbaceous species observed include Cuman ragweed (*Ambrosia*

psilostachya), bushy bluestem (*Andropogon glomeratus*), calico aster (*Symphiotrichum lateriflora*), Cherokee sedge, Paraguayan windmill grass (*Chloris canterai*), Kleberg bluestem (*Dichanthium annulatum*), bigtop lovegrass (*Eragrostis hirsuta*), bushy goldentop (*Euthamia leptocephala*), swamp sunflower (*Helianthus angustifolius*), annual marsh elder (*Iva annua*), shiny cone-flower (*Rudbeckia nitida*), longspike tridens (*Tridens strictus*), and Missouri ironweed (*Vernonia missurica*). Common shrubs and vines include eastern baccharis (*Baccharis halimifolia*), yaupon (*Ilex vomitoria*), Chinese privet (*Ligustrum sinense*), dwarf palmetto (*Sabal minor*), poisonbean (*Sesbania drummondii*), Alabama supple-jack (*Berchemia scandens*), Japanese honeysuckle (*Lonicera japonica*), sawtooth blackberry (*Rubus argutus*), southern dewberry (*Rubus trivialis*), and poison ivy (*Toxicodendron radicans*).

Urban Land – Urban areas include residential and commercial properties. This land is highly disturbed and contains man-induced floral assemblages of ornamental trees and shrubs. Common herbaceous species of urban land observed within the project area include southern carpet grass, Bermudagrass, narrowleaf marsh elder (*Iva angustifolia*), annual marsh elder, crowpoison (*Nothoscordum bivalve*), common evening primrose (*Oenothera biennis*), Vasey's grass (*Paspalum urvillei*), Johnsongrass (*Sorghum halepense*), common dandelion (*Taraxacum officinale*), and bur clover (*Medicago polymorpha*). Common shrubs and vines include yaupon, cabbage palmetto (*Sabal palmetto*), wax myrtle (*Morella cerifera*), crapemyrtle (*Lagerstroemia indica*), and southern dewberry. Tree species include Chinese tallow, live oak, water oak, loblolly pine, and eastern red cedar (*Juniperus virginiana*).

Maintained ROW – Maintained ROW is located adjacent to the existing roadway and within the existing ROW. These areas are highly disturbed and do not generally support high-quality native floral communities. Herbaceous species observed within the maintained ROW of the project area include southern carpet grass, Bermuda grass, narrow-leaf sumpweed, annual sumpweed, common-evening primrose, Vasey's grass, Paraguayan windmill grass, knotroot bristle-grass (*Setaria geniculata*), Johnson grass, smutgrass (*Sporobolus indicus*), common dandelion, Carolina geranium (*Geranium carolinianum*), Brazilian vervain (*Verbena brasiliensis*), and bur clover. Common shrubs and vines include yaupon, wax myrtle, Drummond's rattle-bush, and southern dewberry. Tree species typically include landscape ornamentals, live oak, pecan (*Carya illinoiensis*), loblolly pine, and eastern red cedar.

Clearing, grading, and other roadbed preparation activities associated with construction of the proposed project would permanently or temporarily affect approximately 274 acres of vegetation within the existing and proposed ROW. These vegetation communities include aquatic features, periodically inundated jurisdictional wetlands, crops, and scrub-shrub areas. Portions of the existing ROW may be converted from their current state to maintained ROW, excavated for the installation of culvert extensions and bridge crossings, or cleared, graded, and paved to accommodate construction. Additional details regarding the effects of these activities to vegetation are presented in *Table 19.*

Table 19. Estimated Vegetation Effects by Type

Vegetation Type	Area Within Existing and Proposed ROW (acre)	Area Affected by the Build Alternative (acre)
Scrub-Shrub	4.50	4.50
Riparian Areas	5.30	1.00
Aquatic Features [(1)]	4.81	1.37
Crops	69.10	69.10
Periodically Inundated Wetlands	3.40	2.54
Mowed and Maintained ROW [(2)]	1,147.79	195.29
Total	**1,234.90**	**273.80**

Note: The effects calculated are preliminary and subject to revision. Actual effects would be determined once bridge and culvert designs are finalized.
(1) Effects to aquatic features include potentially jurisdictional wetlands.
(2) Does not include existing paved surfaces (675 acres).

According to Provision (4)(A)(i) of the TxDOT-TPWD MOU, many vegetation types observed are not considered unusual vegetation or a special habitat feature. Tree surveys were limited to the riparian areas only. Tree survey results are presented in *Table 20.* No unusually large native trees were observed within the Clear Creek riparian area. This area is of poor quality and low diversity, as it lies primarily under existing SH 288 bridges and is dominated by one tree species.

Table 20. Tree Survey Results

Area	Percent Canopy Cover	Average dbh[1] (inches)	Range of dbh (inches)	Range of Height (feet)	Dominant Tree Species
Clear Creek	30	6	1 — 8	8 — 22	Black willow
West Fork of Chocolate Bayou, within existing ROW	20	5	3 — 8	10 — 25	Black willow, Chinese tallow
West Fork of Chocolate Bayou, proposed ROW[2]	90	12	— 60	10 — 50	Live oak, Water oak, Green ash, Sugarberry

[1] dbh = diameter at breast height
[2] Estimated. Right-of-Entry to this area was not obtained.

The riparian areas surrounding West Fork of Chocolate Bayou were observed from the existing ROW and publicly-accessible areas (private property adjacent to West Fork of Chocolate Bayou was not accessed). Approximately 40 acres of ROW would be acquired under the Build Alternative in the area surrounding West Fork of Chocolate Bayou. Of this area, an estimated 35 acres are crops and three acres are open water and riparian areas. The riparian areas within the existing ROW are low-diversity areas dominated by black willow and Chinese tallow. Forested areas of the proposed ROW exhibit greater diversity. Typical tree species included live oak, water oak, green ash, and sugarberry. These areas have a mature upper canopy, stratified mid-story, and minimal understory. The banks of West Fork of Chocolate Bayou are incised, with no appreciable adjacent wetlands observed. One large live oak (approximately 60-inch dbh and an estimated 40-foot height) was observed in the northeast quadrant of this area, but this individual was atypical. A few large individuals of water oak and black willow (between 16 and 20 inches dbh) were observed. Most trees in the forested areas were mature, but not unusually large.

Potential Mitigation

TxDOT would design, use, and promote construction activities that would avoid and preserve as many trees as practicable. In accordance with Provision (4)(A)(ii) of the TxDOT-TPWD MOU, some habitats may be given consideration for non-regulatory mitigation during project planning. These habitats may include:

- Habitat for federal candidate species if mitigation would assist in the prevention of the listing of the species
- Rare vegetation series (S1, S2, or S3) that also locally provide habitat for a state-listed species
- All vegetation communities listed as S1 or S2, regardless of whether or not the series in question provide habitat for state listed species
- Bottomland hardwoods, native prairies, and riparian areas
- Any other habitat feature considered to be locally important

The area surrounding West Fork of Chocolate Bayou may meet the habitat requirements stated in the TxDOT-TPWD MOU, therefore non-regulatory mitigation may be requested. Due to funding limitations, TxDOT does not propose mitigation for non-regulated habitat at this time.

XIII. Wildlife

The vegetation types described in this document could support various wildlife species, such as small birds and mammals, amphibians, and reptiles. Periodically inundated wetlands and riparian habitats along West Fork of Chocolate Bayou and Clear Creek are used by mammals. Some mammals may exist in disturbed areas for extended periods of time because of their ability to adapt to urban environments. Due to heavy vehicular traffic and development adjacent to SH 288, larger mammals are not likely to use the ROW, except possibly as a transient occurrence. Typical mammals that may occur within the project area include Virginia opossum (*Didelphis virginiana*), house mouse (*Mus musculus*), common raccoon (*Procyon lotor*), hispid cotton rat (*Sigmodon hispidus*), and eastern cottontail (*Sylvilagus floridanus*).

Grassy fields located throughout the project area may serve as habitat for avian species, which can range from small game birds to larger birds of prey. Birds that may occur within these areas include Cooper's Hawk (*Accipiter cooperii*), Mallard (*Anas platyrhynchos*), Great Egret (*Ardea alba*), Great Blue Heron (*A. herodias)*, Cattle Egret (*Bubulcus ibis*), Red-tailed Hawk (*Buteo jamaicensis*), Green Heron (*Butorides virescens*), Turkey Vulture (*Cathartes aura*), Belted Kingfisher (*Ceryle alcyon*), Killdeer (*Charadrius Americana*), Rock Pigeon (*Columba livia*), Black Vulture (*Coragyps atratus*), American Crow (*Corvus brachyrhynchos*), Snowy Egret (*Egretta thula*), Tricolored Heron (*E. tricolor*), White Ibis (*Eudocimus albus*), American Kestrel (*Falco sparverius*), Common Snipe (*Gallinago gallinago*), Northern Mockingbird (*Mimus polyglottos*), Black-crowned Night-heron (*Nycticorax nycticorax*), Osprey (*Pandion haliaetus*), Great-tailed Grackle (*Quiscalus mexicanus*), Eastern Meadowlark (*Sturnella magna*), European Starling (*Sturnus vulgaris*), Brown Thrasher (*Toxostoma rufum*), American Robin (*Turdus migratorius*), and Mourning Dove (*Zenaida macroura*). These birds may occur in the project area on a transient basis.

Reptiles and amphibians are common within the project area. Amphibians include the cricket frog (*Acris crepitans*), Gulf coast toad (*Bufo valliceps*), gray treefrog (*Hyla versicolor*) and southern leopard frog (*Rana sphenocephala*). Common reptiles include the green anole (*Anolis carolinensis*), ground skink (*Scincella lateralis*), broad-banded water snake (*Nerodia fasciata*), ribbon snake (*Thamnophis proximus*), and rough earth snake (*Virginia striatula*). In addition, the American alligator (*Alligator mississippiensis*) was observed in Mustang Bayou and in wetlands near the American Canal.

No new barriers to wildlife movement would be introduced since the proposed project is associated with an existing transportation corridor. Construction of the project may widen existing barriers. Temporary effects to wildlife habitat include the decreased attractiveness of habitat adjacent to the project corridor, as well as possible disturbances to normal behavior patterns of wildlife as a result of increased noise levels from construction activities.

The build alternative would result in small amounts of habitat loss through its conversion to transportation infrastructure and maintained ROW. *Table 19* provides an estimate of the estimated vegetation impacts loss for the Build Alternative. Fragmentation of wildlife habitat has already occurred in the area as a result of the existing SH 288 roadway construction and land use changes/development in the surrounding area. These land use changes eliminate potentially suitable habitat for wildlife species immediately adjacent to the improvements associated with the build alternative. Where land use changes do not occur, the Build Alternative may exacerbate habitat fragmentation that has already occurred. Wildlife in the project area has and would continue to be dominated by species that are better able to adapt to a disturbed physical environment and could tolerate possible disturbances from the proposed project.

Migratory Birds

Several bird species potentially occurring in the project area are considered migratory; however, the proposed project would not affect the migration patterns of these species. In the event that migratory

birds or their nests are observed prior to construction activities, measures would be taken to avoid harm to migratory birds, their nests, eggs, or young.

Cliff Swallow (*Petrochelidon pyrrhonota*) nests were observed during the 2007 and 2012 nesting seasons on bridge structures at the following locations: Sims Bayou, Clear Creek, American Canal, Mustang Bayou, Brazos River Authority Canal System B, West Fork of Chocolate Bayou, drainage ditch intersecting CR 56, Hayes Creek, and the South Texas Water Company Canal north of CR 60. The existing bridges at these locations are not expected to be removed or otherwise affected as part of the proposed project.

To ensure compliance with the Migratory Bird Treaty Act (MBTA), vegetation clearing and work within the proposed project area would be conducted outside of the normal nesting season or measures would be taken to discourage birds from nesting in existing structures. Additionally, contractors would be notified about and be responsible for complying with the MBTA for migratory birds that may inhabit the project area throughout the construction period of the proposed project.

XIV. Threatened and Endangered Species

Databases of sensitive species maintained by the United States Fish and Wildlife Service (USFWS) and TPWD were reviewed to determine state and/or federally listed threatened or endangered species that occur or historically have occurred in Harris and Brazoria Counties. Potential effects of the proposed project on these species were determined by reviewing the TPWD-Natural Diversity Database (NDD) Element of Occurrence (EO) Records (May 30, 2012) and by conducting habitat assessments. A species list for each county outlining the species and habitat potentially present in the proposed project area is found in *Table 21*. No unique, critical, designated, or proposed designated habitat exists in or near the proposed project.

Table 21. Potential Effects to Listed Species Potentially Occurring Within the Project Area (Harris and/or Brazoria County)

Common Name (*Scientific Name*)	State Status	Federal Status	Description of Suitable Habitat	Unique, Critical, or Designated Habitat	Effects Discussion
Amphibians					
Houston toad (*Bufo houstonensis*)	E	E†	Sandy soil, breeds in ephemeral pools	No	No effect; habitat not present.
Birds					
American Peregrine Falcon (*Falco peregrinus anatum*)	T	DL†	Resident, nests in west Texas	No	No impact; rare transitory migrant.
Arctic Peregrine Falcon (*Falco peregrinus tundrius*)	-	DL†	Potential migrant, winters along coast	No	No impact; rare transitory migrant.
Bald Eagle (*Haliaeetus leucocephalus*)	T	DL†	Near water areas, in tall trees	No	No impact; suitable habitat is not present within the project study area.
Black Rail *(Laterallus jamaicensis)*	-	-†	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nest usually hidden in marsh grass or base of Salicornia	No.	May impact; marginally suitable habitat in freshwater marshes is present within the project study area.
Brown Pelican (*Pelecanus occidentalis*)	-	DL	Roosts and nests on islands and near shore coastal areas	No	No effect; habitat not present.

Table 21. Potential Effects to Listed Species Potentially Occurring Within the Project Area (Harris and/or Brazoria County)

Common Name (*Scientific Name*)	State Status	Federal Status	Description of Suitable Habitat	Unique, Critical, or Designated Habitat	Effects Discussion
Eskimo Curlew (*Numenius borealis*)	E	E†	Historic; non-breeding; grasslands, pastures, plowed fields, and less frequently, marshes and mudflats	No	No effect; believed to be extirpated.
Henslow's Sparrow (*Ammodramus henslowii)*	-	-†	Weedy fields or cut-over areas where lots of bunch grasses occur	No	No impact; habitat not present.
Mountain Plover *(Charadrius montanus)*	-	-†	Winters in short-grass fields and plains, plowed fields, and sandy deserts	No	No impact; habitat not present
Piping Plover (*Charadrius melodus*)	T	T	Wintering in coastal areas, beach and bayside mud or salt flats	No	No effect; habitat not present.
Red-Cockaded Woodpecker (*Picoides borealis*)	E	E†	Cavity nests in older pine (60+ yrs); forages in younger pine (30+ yrs); prefers longleaf, shortleaf, and loblolly	No	No effect; habitat not present.
Reddish Egret (*Egretta rufescens*)	T	-†	Brackish marshes and tidal flats	No	No impact; habitat not present.
Snowy Plover *(Charadrius alexandrinus)*	-	-†	Potential migrant; winters along coast	No	No impact; rare transitory migrant.
Southeastern Snowy Plover (*Charadrius alexandrinus tenuirostris*)	-	-†	Wintering migrant along Texas Gulf coast beaches and bayside mud or salt flats	No	No impact; habitat not present and rare transitory migrant.
Sooty Tern (*Sterna fuscata*)	T	-†	Maritime bird	No	No impact; habitat not present
Sprague's Pipit *(Anthus spragueii)*	-	C†	Native upland prairies and coastal grasslands	No	No impact; habitat not present
Western Snowy Plover *(Charadrius alexandrinus nivosus*)	-	T†	Wintering migrant along Texas Gulf coast beaches and bayside mud or salt flats	No	No impact; habitat not present
White-Faced Ibis *(Plegadis chihi*)	T	-†	Freshwater marshes, but some brackish or salt marshes	No	May impact; no occurrences observed and no NDD occurrences for this species. Habitat available in the project study area is marginally suitable for the species.
White-Tailed Hawk *(Buteo albicaudatus*)	T	-†	Coastal prairies; cordgrass flats, scrub-live oak	No	No impact; transitory migrant.
Whooping Crane (*Grus americana*)	E	E	Winters in Aransas, Calhoun, and Refugio counties; potential migrant	No	No effect; habitat not present.
Wood Stork (*Mycteria americana*)	T	E†	Prairie ponds, flooded pastures, mud flats	No	No impact; no occurrences observed and no NDD occurrences for this species. Suitable habitat is not present.

Table 21. Potential Effects to Listed Species Potentially Occurring Within the Project Area (Harris and/or Brazoria County)

Common Name (*Scientific Name*)	State Status	Federal Status	Description of Suitable Habitat	Unique, Critical, or Designated Habitat	Effects Discussion
Fishes					
American Eel *(Anguilla rostrata)*	-	UR†	Coastal waterways. Anadramous fish.	No	No impact; habitat not present.
Creek Chubsucker (*Erimyzon oblongus*)	T	-†	Variety of small rivers and creeks, prefers headwaters	No	No impact; habitat not present.
Sharpnose shiner *(Notropis oxythynchus*)	-	-†	Endemic to Brazos River drainage. Large turbid rivers, with bottom a combination of sand, gravel, and clay-mud	No	No impact; habitat not present.
Smalltooth Sawfish (*Pristis pectinata*)	E	E†	Muddy and sandy bottoms, sheltered bays less than 32 feet in depth, shallow banks, estuaries and river mouths	No	No effect, habitat not present.
Mammals					
Jaguarundi (*Herpailurus yagouaroundi*)	E	E†	Thick brushland near water	No	No effect; habitat not present.
Louisiana Black Bear (*Ursus americanus luteolus*)	T	T†	Bottomland hardwoods; large, undisturbed forested areas	No	No effect; habitat not present.
Ocelot (*Leopardus pardalis*)	E	E†	Dense chaparral; mesquite-thorn scrub and live oak mottes	No	No effect; habitat not present.
Plains Spotted Skunk *(Spilogale putorius interrupta)*	-	UR†	Catholic; open fields, prairies, croplands, fence rows, farmyards; Prefers wooded, brushy areas and tallgrass prairie.	No	May impact; marginally suitable habitat exists within the project study area.
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*)	T	-†	Cavity trees in hardwood forest, concrete culverts, abandoned buildings	No	May impact; habitat in the project study area is marginally suitable for the species.
Red Wolf (*Canis rufus*)	E	E†	Extirpated; formerly eastern Texas in brushy/forested areas, coastal prairies	No	No effect; extirpated.
Southeastern myotis bat *(Myotis austroriparius)*	-	-†	Roosts in cavity trees of bottomland hardwoods, concrete culverts and abandoned man-made structures	No	May impact; marginally suitable habitat is present within the project study area.
West Indian manatee (*Trichechus manatus*)	E	E†	Gulf and bay system	No	No effect; habitat not present.

Table 21. Potential Effects to Listed Species Potentially Occurring Within the Project Area (Harris and/or Brazoria County)

Common Name (*Scientific Name*)	State Status	Federal Status	Description of Suitable Habitat	Unique, Critical, or Designated Habitat	Effects Discussion
Mollusks					
False spike mussel (*Quadrula mitchelli*)	T	-†	Substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins	No	No impact; suitable habitat is not present
Little spectaclecase *(Villosa lienosa)*	-	-†	Creeks, rivers, reservoirs, sandy substrates in slight to moderate current, usually along banks in slower currents. Cypress through San Jacinto River Basins.	No	May impact; marginally suitable habitat may be present within the project study area.
Louisiana pigtoe *(Pleurobema riddellii)*	T	-†	Streams and moderate size rivers. Sabine, Neches and Trinity (historic) River basins.	No.	No impact; suitable habitat is not present.
Sandbank pocketbook (*Lampsilis satura*)	T	-†	Small to large rivers with moderate flows.	No	No impact; suitable habitat is not present.
Smooth pimpleback (*Quadrula houstonenisis*)	T	-†	Small to moderate streams and rivers as well as moderate size reservoirs. Mixed, mud, sand and fine gravel and tolerates very slow to moderate flow rates.	No	No impact; suitable habitat is not present.
Texas fawnsfoot *(Truncilla macrodon)*	T	C†	Possibly rivers and larger streams, and intolerant of impoundment, flowing rice irrigation canals.	No	No impact; suitable habitat is not present.
Texas pigtoe (*Fusconaia askewi*)	T	-†	Rivers with mixed mud, sand and fine gravel	No	No impact; suitable habitat is not present.
Wabash pigtoe *(Fusconaia flava)*	-	-†	Creeks to large rivers on mud, sand, and gravel.	No	No impact; suitable habitat is not present.
Reptiles					
Alligator Snapping Turtle (*Macroclemys temminckii*)	T	-†	Deep water of rivers, canals, lakes, swamps, and bayous	No	No impact; no occurrences observed and no NDD occurrences for this species. Suitable habitat is not present.
Atlantic Hawksbill Sea Turtle (*Eretmochelys imbricata*)	E	E	Gulf and bay system	No	No effect; habitat not present.
Green Sea Turtle (*Chelonia mydas*)	T	T	Gulf and bay system	No	No effect; habitat not present.
Gulf Saltmarsh Snake *(Nerodia clarkii)*	-	-†	Saline flats, coastal bays, and brackish river mouths	No	No impact; habitat not present.
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	E	E	Gulf and bay system	No	No effect; habitat not present.
Leatherback Sea Turtle (*Dermochelys coriacea*)	E	E	Gulf and bay system	No	No effect; habitat not present.

Table 21. Potential Effects to Listed Species Potentially Occurring Within the Project Area (Harris and/or Brazoria County)

Common Name (*Scientific Name*)	State Status	Federal Status	Description of Suitable Habitat	Unique, Critical, or Designated Habitat	Effects Discussion
Loggerhead sea turtle (*Caretta caretta*)	T	T	Gulf and bay system	No	No effect; habitat not present.
Smooth green snake (*Liochlorophis vernalis*)	T	-†	Gulf coastal plain, mesic coastal shortgrass prairies, dense vegetation	No	No impact; habitat not present.
Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*)	-	-†	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches	No	No impact; habitat not present.
Texas Horned Lizard (*Phrynosoma cornutum*)	T	-†	Open, semi-arid regions, with sparse vegetation, grass, cactus, and brush.	No	No impact; habitat not present.
Timber/canebrake rattlesnake (*Crotalus horridus*)	T	-†	Swamps/floodplains of hardwood/upland pine	No	No impact; habitat not present.
Vascular Plants					
Coastal gay feather *(Liatris bracteata)*	-	SOC†	Coastal prairie grasslands	No	No impact; suitable habitat is not present within the project study area.
Giant sharpstem umbrella sedge *(Cyperus cephalanthus)*	-	SOC†	Saturated fine sandy loams, depressional area with coastal prairie remnant	No	No impact; suitable habitat is not present.
Houston daisy *(Rayjacksonia aurea)*	-	SOC†	On and around naturally barren or sparsely vegetated saline slick spots or pimple mounds on coastal prairies. Sandy to sandy loam soils, occasionally in pastures and on roadsides in similar soil types where mowing may mimic natural prairie disturbance regimes.	No	No impact; suitable habitat is not present
Texas meadow rue (*Thalictrum texanum*)	-	SOC†	Mesic woods or forests, including wet ditches on partially shaded roadsides	No	May impact; marginally suitable habitat may be present along streams and watercourses within the project study area.
Texas prairie dawn (*Hymenoxys texana*)	E	E	Poorly drained areas in open grasslands; pimple mounds	No	No effect; habitat not present. No occurrences observed and no NDD occurrences for this species.
Texas windmill grass *(Chloris texensis)*	-	SOC†	Sandy to sandy loam soils in bare areas of coastal prairie grassland remnants	No	No impact; suitable habitat is not present.
Threeflower broomweed *(Thurovia triflora)*	-	SOC†	Black clay soils of remnant grasslands	No	No impact; suitable habitat is not present.

Note:

- These species occur on the TPWD listing of threatened or endangered species (date June 1, 2012) and are considered rare; however, they have no regulatory listing status (accessed June 2012). NDD data was obtained in May 11, 2012.

† These species are listed by the USFWS; however, they are not listed to occur within Brazoria or Harris County by the Clear Lake office of the USFWS (accessed June 2012).

E - Endangered; T - Threatened; DL - Delisted Taxon, recovered, being monitored first five years

SOC - Species of Concern C - Candidate UR - Under Review

According to the TPWD-NDD EO records search conducted June 11, 2012, in conjunction with analysis of geographic data analysis, no documented occurrences of species or vegetation series listed in the NDD records are known within the limits of the proposed project or within 1.5 miles of the proposed project. However, the TPWD-NDD revealed documented occurrences for the following listed threatened, endangered, or rare species within 10 miles of the project site: Houston toad (*Bufo houstonensis*), smooth green snake (*Liochlorophis vernalis*), alligator snapping turtle (*Macrochelys temmincki*), bald eagle (*Haliaeetus leucocephalus*), Texas windmill-grass (*Chloris texensis*), Texas meadow-rue (*Thalictrum texanum*), Houston daisy (*Rayjacksonia aurea*), and Texas prairie dawn (*Hymenoxys texana*). A list of all elements of occurrence for species of concern with EO ID numbers can be found in *Appendix E*.

Qualified biologists conducted surveys within the project study area and listed species were not observed during field investigation. Based on lack of suitable habitat, no observation of listed species and no known historical occurrences of these species in the project study area or within 1.5 miles of the project study area, the proposed project would have no effect on any federally endangered or threatened species, their habitat, or designated critical habitat. Due to the presence of marginally suitable habitat within the project study area, the proposed project may impact two species of state-listed threatened species, the white-faced ibis and Rafinesque's big-eared bat.

Marginally suitable habitat for the white-faced Ibis is present within the project study area. These birds may utilize wetland habitats on-site; however, these habitats are not preferred. This species generally inhabits larger marsh complexes and makes nests from reeds, sticks, and marsh grasses within these marshes. No white-faced Ibis or their nests were observed during field investigations. The proposed project is anticipated to affect four existing wetland habitats; however, these areas will be reconstructed and wetland fringe vegetation is anticipated to recruit in these areas, recreating this marginally suitable habitat.

Marginally suitable habitat for the Rafinesque's big-eared bat is present in the study area, particularly within concrete culverts and girdered bridges present within the project limits. This species are typically found in lowland pine and hardwood forests that are more prevalent in north and northeastern Harris County. No individual bats or evidence of bats (guano stains) were observed during field observations. The proposed project would be anticipated to affect culverts through their removal and replacement; however, marginally suitable habitat would be replaced upon completion of construction.

The project is anticipated to have no impacts to any other state-listed endangered or threatened species. The project may impact five state-listed "rare species" including the black rail, plains spotted skunk, southeastern myotis bat, little spectaclecase, and Texas meadowrue. Marginally suitable habitat was found to exist for each of these species within the project study area. No impacts to any other state-listed species are anticipated. Additionally, the plains spotted skunk is listed as under review and the Texas meadow-rue is listed as a species of concern, both by the USFWS.

XV. Essential Fish Habitat

Section 305(b) of the Magnuson-Stevens Fishery Management and Conservation Act (1996) requires that the Fishery Management Councils (FMC) and other federal agencies identify and protect important marine and anadromous fish habitat, referred to as Essential Fish Habitat (EFH). EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. The proposed project is located within Harris and Brazoria Counties, Texas which have been identified as containing tidally influenced waters. The proposed project does not contain a tidally influenced tributary. Neither the No Build nor the Build Alternative would affect EFH. Therefore, the requirements of the Magnuson-Stevens Fishery Management and Conservation Act do not apply.

XVI. Cultural Resources

Historic Resources

A review of the National Register of Historic Places (NRHP), the list of State Archeological Landmarks (SAL), and the list of Recorded Texas Historic Landmarks (RTHL) indicated that no historically significant resources have been previously documented within the area of potential effects (APE). It has been determined through consultation with the State Historic Preservation Officer (SHPO) that the APE for the proposed project would vary according to the need for additional right-of-way:

- From US 59 to IH 610 the APE is limited to the existing ROW except in limited areas where ROW would be acquired. At those locations, the APE is 150 ft from the proposed ROW boundaries.
- From IH 610 to FM 518 no new ROW would be required, and the APE is limited to the existing ROW boundary.
- From FM 518 to SH 6 the widening would occur within the existing median. However, since the widening would more than double the width of the roadway, the APE is 150 ft beyond the existing ROW boundary.
- From SH 6 to CR 60 the widening would occur within the existing median. However, since the widening would more than double the width of the roadway, the APE is 150 ft beyond the existing ROW boundary.

A site visit conducted by a TxDOT qualified historian revealed that there 35 historic-age resources on 12 distinct legal parcels within the project APE. The Historic Resources Survey Report (HRSR) used a cut-off date for historic-age resources of 1965 based on an anticipated construction letting date of 2010. Due to the anticipated let date of 2012, TxDOT Historians examined the APE for historic-age resources constructed from 1965-1967. No additional historic-age resources were found that were not documented in the HRSR.

Pursuant to Stipulation VI "Undertakings with Potential to Cause Effects," Appendix 4 of the PA-TU and MOU, TxDOT Historians have determined that the proposed action has no potential to affect historic properties and that individual project coordination with SHPO is not required. A copy of TxDOT's memorandum is included in *Appendix H*.

Archeological Resources

A TxDOT archeologist evaluated the potential for the proposed undertaking to affect archeological historic properties (36 CFR 800.16(l)) or State Archeological Landmarks (13 TAC 26.12) in the APE. The area of potential effects comprises the existing ROW within the project limits, any areas of new ROW or easements, and the depth of construction impacts. The APE extends to a maximum depth of 10 feet below the modern ground surface. Section 106 review and consultation proceeded in accordance with the First Amended Programmatic Agreement among the FHWA, the TxDOT, the Texas SHPO, and the Advisory Council on Historic Preservation regarding the Implementation of Transportation Undertakings (PA-TU), as well as the MOU between the Texas Historical Commission (THC) and TxDOT. The following documentation presents TxDOT's findings and explains the basis for those findings.

The project setting is unlikely to contain intact archeological sites. A review of the Houston Potential Archeological Liability Map (PALM) developed by the Archeology Division of TxDOT, Environmental Affairs Division (Abbott 2001) shows that the majority of the APE crosses Pleistocene landforms (Map Unit 4, Abbott 2001), which are typically stable and have low potential for intact deeply buried archeological deposits (*Appendix F*). A review of the Texas Archeological Sites Atlas in September 2007 shows that no archeological sites have been identified within the APE, and no sites occur within one kilometer of the APE. The APE was previously surveyed by a professional archeologist and no archeological materials were encountered. The integrity of any archeological sites that do occur within

the APE would be poor. Any sites in the APE would lack sufficient integrity of location, association, and materials to be able to address important questions of prehistory or history.

TxDOT completed its review on February 9, 2011. Section 106 consultation with federally recognized Native American tribes with a demonstrated historic interest in the area was initiated on December 5, 2008. No objections or expressions of concern were received within the comment period ending on January 19, 2009.

Pursuant to Stipulation VI of the PA and 43 TAC 2.24(f)(1)(C) of the MOU, TxDOT finds that the proposed undertaking would not affect archeological historic properties (36 CFR 800.16(l)) or State Archeological Landmarks. No further investigations are warranted. In the event that unanticipated archeological deposits are encountered during construction, work in the immediate area would cease, and TxDOT archeological staff would be contacted to initiate post-review discovery procedures under the provisions of the PA-TU and MOU.

XVII. Section 4(f) Properties

The project area is predominantly commercial, residential, public use, agricultural, and undeveloped land. Community resources and facilities, which include schools, colleges, police and fire stations, emergency medical service (EMS) facilities, hospitals, churches/religious facilities, cemeteries, parks and recreational areas and centers, were identified through a compilation of existing mapping sources, aerial photography, limited field reconnaissance surveys, and information provided by local and state agencies and organizations. Community resources and facilities that are located within the land use study area or are located in close proximity to the proposed project are shown on *Figure 5*.

There would be no impact on publicly owned parklands, recreation areas, wildlife refuges, or areas of unique beauty; therefore, a Section 4(f) evaluation is not required.

XVIII. Waters of the United States, Including Wetlands

Pursuant to Executive Order 11990 (Protection of Wetlands) and Section 404 of the Clean Water Act (CWA), a wetland delineation was conducted to determine the presence of waters of the United States (U.S.), including wetlands, within the project area. According to the USACE, the federal agency having authority over waters of the United States, wetlands are those areas that are inundated or saturated with surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Wetlands are transitional areas between terrestrial and aquatic systems resulting from the interaction of hydrophytic vegetation, wetlands hydrology, and hydric soils. A wetlands delineation of the entire project corridor, including the existing and proposed ROW, was performed using the methodology described by the U*SACE Wetlands Delineation Manual* (USACE 1987) and subsequent guidance on the clarification, interpretation, and implementation of wetlands regulations. Potentially jurisdictional areas are shown on *Figure 7*.

The proposed project is located within the boundaries of Phase I, Phase II, and undesignated Urbanized Municipal Separate Storm Sewer System (MS4) areas. The Phase I areas include the City of Houston and Harris County, which includes all Harris County Municipal Utility Districts (MUDs). The Phase II areas include several Brazoria County MUDs. Brazoria County is currently undesignated. The proposed project would comply with the applicable MS4 requirements.

Potentially Jurisdictional Areas

Twelve aquatic resources were delineated and evaluated for their jurisdictional status under the CWA. Of the 12 aquatic resources delineated, the following areas are potentially subject to jurisdiction under the CWA: six Traditional Navigable Waters (TNWs), two Relatively Permanent Waters (RPWs), and four wetland areas that are either adjacent to, or have a continuous surface connection to, jurisdictional

waters. At the time this report was prepared, a preliminary jurisdictional determination of these features was submitted to the USACE for review. This analysis will be updated to reflect those findings once determined. A detailed description of necessary Section 404 permitting is included in *Section XXII – Permits*).

Waters of the United States – Six named TNWs were identified within the project area for a total of approximately 4.38 acres. These waters are subject to CWA jurisdiction under 33 Code of Federal Regulations (CFR) 328.3(a)(1) and 40 CFR 230.3(s)(1).

Two RPWs were found within the existing and proposed ROW for a total area of approximately 0.43 acres. These water bodies are regulated under the CWA as relatively permanent non-navigable tributaries of TNWs. "Relatively permanent" is defined as tributaries having year round flow or continuous seasonal flow for at least three months per year. Examples of these in the project area include unnamed tributaries to TNWs, diverted natural waterways, and channelized waterways that flow into TNWs. The TNW and RPW features and their areas within the existing and proposed ROW are shown in *Table 22*.

Wetlands – Four wetland areas potentially subject to jurisdiction under the CWA were found within the existing and proposed ROW, for a total area of approximately 3.40 acres. These areas are either adjacent to, abut, or neighbor TNWs or have a continuous surface connection to RPWs. Areas classified as wetlands meet the three wetlands criteria of hydrophytic vegetation, hydric soils, and wetland hydrology. Vegetation observed within these areas is dominated by a variety of herbaceous species as described in the vegetation section under periodically inundated wetlands. These wetland areas are listed in *Table 22.*

Table 22. TNW and RPW Features and Effects to Potentially Jurisdictional Waters of the United States

Description	Area Within ROW (acre)	Estimated Effect [1] (acre)
Traditional Navigable Waters (TNW)		
Sims Bayou	1.41	0.00
Brays Bayou	0.55	0.00
Clear Creek	0.34	0.16
Mustang Bayou	0.95	0.45
West Fork of Chocolate Bayou [2]	0.98	0.50
Hayes Creek	0.15	0.10
Subtotal [2], [3]	**4.38**	**1.21**
Relatively Permanent Waters (RPW)		
Unnamed tributary to Sims Bayou	0.27	0.00
Unnamed tributary to Hickory Slough	0.16	0.16
Subtotal [2], [3]	**0.43**	**0.16**
Potentially Jurisdictional Wetlands, Associated Water Body		
Clear Creek	0.63	0.07
Unnamed tributary to Mustang Bayou	2.06	1.85
West Fork of Chocolate Bayou [2]	0.44	0.35
Hayes Creek	0.27	0.27
Subtotal [2], [3]	**3.40**	**2.54**
Total [2], [3]	**8.21**	**3.91**

Notes: (1) All effects are estimated and subject to change. It is anticipated that permanent effects would occur from installation of additional bridge columns; however, bridge and culvert designs are not complete and impacts are not quantifiable. Effects include all permanent and temporary effects within Section 404 jurisdictional limits. (2) Estimated; no right-of-entry obtained for area outside existing ROW. (3) Slight differences may occur due to rounding.

Table 22 summarizes the effects to potentially jurisdictional waters of the United States, including wetlands, which would result from the proposed project, considering the permanent effects from placement of fill and the temporary effects from construction activities. The proposed project would affect six (6) crossings of waters of the United States.

The proposed project would require USACE authorization under Section 404 of the CWA prior to the discharge of fill materials into waters of the United States, including wetlands. The proposed project may involve the discharge of dredged or fill materials into greater than 0.5 acre of non-tidal waters, which would exceed the allowable threshold acreages in non-tidal waters to qualify for a Nationwide Permit (NWP). If so, a USACE Section 404 Individual Permit would likely be required to authorize the proposed project. No navigable waterways occur within the area traversed by the proposed project; therefore, permitting under Section 10 of the Rivers and Harbors Act (administrated by the USACE) is not anticipated. All appropriate permits would be acquired by TxDOT prior to construction.

A review of USACE requirements would be conducted as design plans are finalized. Compensatory mitigation for Section 404 effects would be coordinated with the USACE and performed in accordance with the terms of the approved permits.

Potential Mitigation

In accordance with the provisions of Section 404(b)(1) Guidelines, an applicant must demonstrate that the proposed project has avoided and minimized effects to waters of the United States, including wetlands, to the greatest extent practicable before compensatory mitigation can be proposed. A majority of the proposed project has been aligned immediately adjacent to the existing ROW, thus avoiding and minimizing effects to surrounding areas to the greatest extent practicable.

XIX. Water Quality

Water Bodies flowing through the project area include Brays Bayou, Sims Bayou, Clear Creek, Mustang Bayou, and the Brazos River Authority Canal System B, Briscoe Canal, American Canal, Texas Water Company Canal, West Fork of Chocolate Bayou, and Hayes Creek (*Figure 7).* No long-term water quality impacts are expected as a result of the proposed project. Subsurface water would not be required for this project; therefore, no adverse effects to groundwater are expected to occur. The proposed project is not expected to alter rainfall drainage patterns, or contaminate or otherwise adversely affect the public water supply, water treatment facilities, or water distribution systems. The proposed bridge construction would not change, divert, or add to the existing water resource. Construction phase impacts may occur, but best management practices (BMP) would be implemented throughout the duration of the project.

Clean Water Act: Section 303(d)

The proposed project is located within the San Jacinto River Basin and the San Jacinto-Brazos Coastal Basin. The Brazos River Authority Canal System, North Canal, and Briscoe Canals are not designated stream segments by the Texas Commission on Environmental Quality's (TCEQ) 2008 303(d) list. Section 303(d) of the federal CWA requires state agencies to make a list of water bodies with impairments or water quality concerns. *Table* 23 lists impaired water bodies near the proposed project.

Table 23. Water Bodies Near the Proposed Project

Water Body	Location	Segment ID	Reason for Impairment	Monitoring Station
Brays Bayou	Buffalo Bayou Tidal	1007 and 1007B	Edible tissues [Dioxin and polychlorinated biphenyls (PCBs)] , bacteria	Monitoring Station 11138 is at Brays Bayou and Almeda Road
Sims Bayou	East of SH 288 between Airport Road and Reed Road	1007N_01	Bacteria concerns	Monitoring Station 16655 is at Sims Bayou and Dulcimer
Sims Bayou	South of Airport Road and North of Almeda-Genoa Road	1007D	Bacteria concerns	Monitoring Station 11134 is at Sims Bayou at Robin Road
Clear Creek	Above tidal	1102_01 1102_02	Bacteria concerns, impaired fish community	Monitoring Station 20009 is at Clear Creek and Kirby Road

Source: 2008 Texas Water Quality Inventory Status and 303(d) List

Clear Creek (Segment ID 1102_01 and 1102_02) and Sims Bayou (Segment ID 1007N_01 and 1007D) are listed for bacteria concerns. Clear Creek is also listed for an impaired fish community. Brays Bayou (Segment ID 1007 and 1007B) is listed for edible tissue (dioxin and PCBs) and bacteria concerns. Since segments of Brays Bayou, Sims Bayou, and Clear Creek are on the 303(d) list and cross or are in close proximity to the proposed project, coordination with TCEQ is required.

Storm water control measures and Best Management Practices (BMPs) would be implemented during and after construction of the preferred alternative to prevent and minimize impacts to water resources. During construction, BMPs may include, but not be limited to, silt fences, hay bales, and seeding or sodding of excavated areas. Permanent BMPs may include a combination of storm water retention, vegetated drainage ditches, seeding of disturbed areas of soil with native species of grasses, shrubs, or trees in accordance with TxDOT's specification "Seeding for Erosion Control". The No Build alternative would not result in new direct impacts to water quality within the study area.

XX. Floodplains

Topography along the proposed project area is relatively flat. The proposed project crosses several 100-year floodplain boundaries, primarily at creek and river crossings along Mustang Bayou, Clear Creek and tributaries, Sims Bayou and tributaries, and Brays Bayou (*Figure 7*). The existing bridges at these water crossings would be widened to accommodate the proposed roadway improvements. Currently the floodplain is bridged, and after construction it would remain bridged. The hydraulic design of the project would be in accordance with current TxDOT policies and standards. The project would be designed to prevent inundation at recurrence intervals of at least 100 years, inundation of the roadways being acceptable, without causing significant damage to the roadway, stream, or other property. The proposed project would not increase the base flood elevations to a level that would violate applicable floodplain regulations and ordinances. Harris and Brazoria Counties, the Cities of Houston and Pearland, and the City of Manvel are participants in the National Flood Insurance Program.

XXI. Coastal Zone Management

The Texas Coastal Management Program, under authority of the Federal Coastal Zone Management Act of 1972, directs federal agencies proposing activities or projects within the state coastal zone to assure

that those activities or projects are consistent, to the maximum extent practicable, with the state coastal management program. The project is not located within the designated Texas coastal management zone. Thus, coordination with the Coastal Zone Management Agency is not required.

XXII. Permits

TCEQ

The project involves development of more than 1 acre of land along SH 288, and TxDOT would be required to meet the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit (CGP) requirements. TxDOT would be required to meet the following TPDES CGP requirements for the proposed project:

- Obtain a copy of the TCEQ CGP (TPDES Permit Number TXR150000)
- Develop and implement a Storm Water Pollution Prevention Plan (SW3P)
- Complete and submit a Notice of Intent (NOI) to the TCEQ
- Submit a Notice of Termination (NOT) once the site has reached final stabilization

TxDOT would develop a new SWP3 or amend a previous plan to address the project, and measures would be taken to prevent or correct erosion that would occur during construction. Guidance documents, such as the TxDOT *Storm Water Management Guidelines for Construction Activities*, provide discussion of storm water controls to be implemented during construction.

The project would fall under the qualifications subject to the TCEQ's Section 401 water quality certification because jurisdictional waters of the United States are within the SH 288 ROW and impacts from construction could occur.

The amount of disturbed earth would be limited so that the potential for excessive erosion is minimized and sedimentation outside of the ROW is avoided. Existing vegetation would be preserved to the extent practicable. Temporary erosion and sedimentation controls would be in place according to the construction plans prior to commencement of construction-related activities and inspected on a regular basis to ensure maximum effectiveness. Disturbed areas would be stabilized to prevent construction-related soil erosion and sedimentation during wet weather conditions. Approved erosion and sedimentation control BMPs would be maintained and remain in place until the area has been stabilized.

Permanent soil erosion control features would be constructed as soon as feasible during the early stages of the contract through proper sodding and/or seeding techniques. Disturbed areas would be restored and stabilized as soon as the construction schedule permits, and temporary sodding would be considered where large areas of disturbed ground would be left bare for a considerable length of time. Temporary erosion control measures would be coordinated with the permanent soil erosion control features that are to be part of the completed project to assure economical, effective, and continuous erosion control throughout the construction and post construction periods. In addition, efforts would be made to prevent long-term water pollution by reducing fertilizer and pesticide use during the installation and maintenance of landscaping.

The contractor would take appropriate measures to prevent, minimize, and control hazardous materials spills in the construction staging areas. Removal and disposal of all materials by the contractor would be in compliance with applicable federal and state laws, with no degradation of ambient water quality. Implementation of the proposed project would not result in any direct impacts to surface water quality or affect public water supply.

USACE

The proposed project would require USACE authorization under Section 404 of the CWA prior to the discharge of fill materials into waters of the United States, including wetlands. The build alternative may affect more than the allowable threshold acreage in non-tidal waters to qualify for a NWP; therefore, it is anticipated that a USACE Section 404 Individual Permit would be required. It is likely that the proposed project would involve the discharge of dredged or fill materials into greater than 0.5 acre of non-tidal water bodies. No navigable in-fact waterways occur within the proposed project area and therefore permitting under Section 10 (administrated by the USACE) of the Rivers and Harbors Act is not anticipated. All appropriate permits would be acquired by TxDOT prior to construction. TxDOT is not able to apply for specific permits until more detailed design is completed.

United States Coast Guard

No navigable waterways are present within the proposed project area. Therefore, a United States Coast Guard Section 9 Permit is not required.

XXIII. Noise

This analysis was accomplished in accordance with TxDOT's (FHWA approved) Guidelines for Analysis and Abatement of Roadway Traffic Noise (2011).

Sound from highway traffic is generated primarily from a vehicle's tires, engine and exhaust. It is commonly measured in decibels and is expressed as "dB."

Sound occurs over a wide range of frequencies. However, not all frequencies are detectable by the human ear; therefore, an adjustment is made to the high and low frequencies to approximate the way an average person hears traffic sounds. This adjustment is called A-weighting and is expressed as "dB(A)."

Also, because traffic sound levels are never constant due to the changing number, type and speed of vehicles, a single value is used to represent the average or equivalent sound level and is expressed as "Leq."

The traffic noise analysis typically includes the following elements:

- Identification of land use activity areas that might be impacted by traffic noise.
- Determination of existing noise levels.
- Prediction of future noise levels.
- Identification of possible noise impacts.
- Consideration and evaluation of measures to reduce noise impacts.

The FHWA has established the following Noise Abatement Criteria (NAC) for various land use activity areas that are used as one of two means to determine when a traffic noise impact would occur.

Table 24. FHWA Noise Abatement Criteria

Activity Category	FHWA dB(A)/L_{eq}	TxDOT dB(A)/L_{eq}	Description of Land Use Activity Areas
A	57 (exterior)	56 (exterior)	Lands on which serenity and quiet are of extra-ordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	66 (exterior)	Residential
C	67 (exterior)	66 (exterior)	Active sports areas, amphitheaters, auditoriums, campgrounds, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (interior)	51 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	71 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
F	--	--	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	--	Undeveloped lands that are not permitted.

Note: Primary consideration is given to *exterior* areas (Category A, B, C, or E) where frequent human activity occurs. However, *interior* areas (Category D) are used if exterior areas are physically shielded from the roadway, or if there is little or no human activity in exterior areas adjacent to the roadway.

A noise impact occurs when either the absolute or the relative criterion is met:

Absolute criterion: the predicted noise level at a receiver approaches, equals or exceeds the NAC. "Approach" is defined as one dB(A) below the NAC. For example: a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dB(A) or above.

Relative criterion: the predicted noise level substantially exceeds the existing noise level at a receiver even though the predicted noise level does not approach, equal or exceed the NAC. “Substantially exceeds” is defined as more than 10 dB(A). For example: a noise impact would occur at a Category B residence if the existing level is 54 dB(A) and the predicted level is 65 dB(A).

When a traffic noise impact occurs, noise abatement measures must be considered. A noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area.

The FHWA traffic noise modeling software was used to calculate existing and predicted traffic noise levels. The model primarily considers the number, type and speed of vehicles; highway alignment and grade; cuts, fills and natural berms; surrounding terrain features; and the locations of activity areas likely to be impacted by the associated traffic noise.

Existing and predicted traffic noise levels were modeled at receiver locations (*Table 25* and *Figure 8*) that represent the land use activity areas adjacent to the proposed project that might be impacted by traffic noise and potentially benefit from feasible and reasonable noise abatement.

Table 25. Traffic Noise Levels (L_{eq} [dB(A)])

Receiver	NAC Category	NAC Level	Existing 2015	Predicted 2035	Change (+/-)	Noise Impact
1 – Single-Family Home	B	66	62	66	+4	Yes
2 – Single-Family Home	B	66	63	66	+3	Yes
3 – Single-Family Home	B	66	65	67	+2	Yes
4 - Multi-Family Home	D	51	40	42	+2	No
5 - Multi-Family Home	D	51	39	42	+3	No
6 - Multi-Family Home	D	51	39	42	+3	No
7 – Single-Family Home	B	66	65	68	+3	Yes
8 – Single-Family Home	B	66	66	69	+3	Yes
9 – Single-Family Home	B	66	65	69	+4	Yes
10 – Church	C	66	68	69	+1	Yes
11 – Single-Family Home	B	66	66	69	+3	Yes
12 - Multi-Family Home	D	51	42	45	+3	No
13 – Single-Family Home	B	66	71	72	+1	Yes
14 – Single-Family Home	B	66	72	73	+1	Yes
15 – Single-Family Home	B	66	71	72	+1	Yes
16 - Multi-Family Home	D	51	47	47	0	No
17 – Single-Family Home	B	66	71	72	+1	Yes
18 – Single-Family Home	B	66	69	71	+2	Yes
19 – Single-Family Home	B	66	70	73	+3	Yes
20 - Multi-Family Home	D	51	46	49	+3	No
21 – Single-Family Home	B	66	72	74	+2	Yes
22 – Single-Family Home	B	66	73	75	+2	Yes
23 – Single-Family Home	B	66	72	74	+2	Yes
24 – Single-Family Home	B	66	72	73	+1	Yes
25 – Single-Family Home	B	66	71	74	+2	Yes
26 – Single-Family Home	B	66	72	73	+1	Yes
27 – Single-Family Home	B	66	72	73	+1	Yes
28 – Single-Family Home	B	66	73	73	0	Yes
29 – Single-Family Home	B	66	70	72	+2	Yes
30 – Single-Family Home	B	66	74	73	-1	Yes
31 – Single-Family Home	B	66	72	72	0	Yes
32 – Single-Family Home	B	66	72	72	0	Yes
33 – Single-Family Home	B	66	72	71	-1	Yes
34 - Multi-Family Home	E	51	45	44	-1	No

Receiver	NAC Category	NAC Level	Existing 2015	Predicted 2035	Change (+/-)	Noise Impact
35 – Single-Family Home	B	66	71	71	0	Yes
36 – Multi-Family Home	D	51	45	44	-1	No
37 – Single-Family Home	B	66	70	70	0	Yes
38 – Single-Family Home	B	66	71	72	+1	Yes
39 – Single-Family Home	B	66	71	72	+1	Yes
40 - Multi-Family Home	D	51	48	48	0	No
41 – Single-Family Home	B	66	70	70	0	Yes
42 – Single-Family Home	B	66	68	69	+1	Yes
43 – Single-Family Home	B	66	71	72	+1	Yes
44 – Single-Family Home	B	66	72	72	0	Yes
45 – Single-Family Home	B	66	66	68	+2	Yes
46 – Recreational Area	C	66	68	76	+9	Yes
47 – School	D	51	46	45	-1	No
48 – Single-Family Home	B	66	74	73	-1	Yes
49 – Single-Family Home	B	66	74	76	+2	Yes
50 – Multi-Family Home	D	51	48	48	0	No
51 - Multi-Family Home	D	51	47	47	0	No
52 - Multi-Family Home	D	51	48	49	+1	No
53 - Multi-Family Home	D	51	49	48	-1	No
54 - Multi-Family Home	D	51	49	47	-2	No
55 - Multi-Family Home	D	51	50	48	-2	No
56 - Multi-Family Home	D	51	51	52	+1	Yes
57 - Multi-Family Home	D	51	51	53	+3	Yes
58 - Multi-Family Home	D	51	46	48	+2	No
59 - Multi-Family Home	D	51	44	45	+1	No
60 - Multi-Family Home	D	51	43	44	+1	No
61 - Multi-Family Home	D	51	42	42	0	No
62 - Multi-Family Home	D	51	42	42	0	No
63 - Multi-Family Home	D	51	45	47	+2	No
64 – Single-Family Home	B	66	68	70	+2	Yes
65 – Single-Family Home	B	66	70	67	-3	Yes
66 – Single-Family Home	B	66	70	71	+1	Yes
67 – Single-Family Home	B	66	69	71	+2	Yes
68 – Single-Family Home	B	66	69	70	+1	Yes
69 – Single-Family Home	B	66	69	69	0	Yes

Receiver	NAC Category	NAC Level	Existing 2015	Predicted 2035	Change (+/-)	Noise Impact
70 – Single-Family Home	B	66	69	69	0	Yes
71 – Church	C	66	69	68	-1	Yes
72 - Multi-Family Home	D	51	43	45	+2	No
73 - Multi-Family Home	D	51	43	45	+1	No
74 - Recreation Area	B	66	65	69	+4	Yes
75 - Recreation Area	B	66	65	70	+5	Yes
76 - Multi-Family Home	D	51	44	46	+2	No
77 – School	C	66	61	62	+1	No
78 – Church	C	66	63	63	0	No
80 – Church	C	66	69	69	0	No
81 – Church	C	66	65	65	0	No
82 – Single-Family Home	B	66	71	70	-1	Yes
83 – Single-Family Home	B	66	70	69	-1	Yes
84 – Single-Family Home	B	66	69	68	-1	Yes
85 – Single-Family Home	B	66	66	66	0	Yes
86 – Single-Family Home	B	66	65	65	0	No
87 – Single-Family Home	B	66	63	63	0	No
88 – Recreational Area	C	66	64	67	+3	**Yes**
89 – Church	C	66	64	67	+3	**Yes**
90 – Hospital	C	66	64	69	+5	**Yes**
91 – Multi-Family Home	D	51	39	42	+3	No
92 – Single-Family Home	B	66	56	58	+2	No
93 – Single-Family Home	B	66	65	68	+3	**Yes**
94 – Single-Family Home	B	66	57	61	+4	No
95 – Business	B	66	66	66	0	Yes
96 – Church	C	66	58	60	+2	No
97 – Single-Family Home	B	66	49	51	-1	No
98 – Single-Family Home	B	66	62	63	+3	No
99 – Single-Family Home	B	66	55	58	+3	No
100 – Single-Family Home	B	66	62	63	+1	No
101 – Single-Family Home	B	66	67	65	-2	No
102 – Single-Family Home	B	66	62	64	+2	No
103 – Single-Family Home	B	66	62	64	+2	No
104 – Single-Family Home	B	66	60	63	+3	No
105 – Single-Family Home	B	66	65	68	+3	Yes

Receiver	NAC Category	NAC Level	Existing 2015	Predicted 2035	Change (+/-)	Noise Impact
106 – Single-Family Home	B	66	56	59	+3	No
107 – Single-Family Home	B	66	61	64	+3	No
108 - Multi-Family Home	B	66	59	61	+2	No
109 - Multi-Family Home	B	66	54	57	+3	No
110 - Multi-Family Home	B	66	52	56	+4	No
111 – School and Active sports area	C	66	72	74	+2	Yes
112 - Single-Family Home	D	51	47	49	+2	No
113 – Single-Family Home	B	66	68	69	+1	Yes
114 – Single-Family Home	B	66	69	71	+2	Yes
115 – Single-Family Home	B	66	71	72	+1	Yes
116 – Single-Family Home	B	66	72	72	+1	Yes

Noise Abatement

As indicated in *Table 25*, the proposed project would result in a traffic noise impact and the following noise abatement measures were considered: traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise barriers.

Before any abatement measure can be proposed for incorporation into the project, it must be both feasible and reasonable. In order to be "feasible," the abatement measure must be able to reduce the noise level at greater than 50 percent of impacted, first row receivers by at least five dB(A); and to be "reasonable," it must not exceed the cost-effectiveness criterion of $25,000 for each receiver that would benefit by a reduction of at least five dB(A), and the abatement measure must be able to reduce the noise level at one impacted, first row receiver by at least seven dB(A).

Traffic management: Control devices could be used to reduce the speed of the traffic; however, the minor benefit of one dB(A) per five-mile-per-hour (mph) reduction in speed does not outweigh the associated increase in congestion and air pollution. Other measures such as time or use restrictions for certain vehicles are prohibited on state highways.

Alteration of horizontal and/or vertical alignments: any alteration of the existing alignment would displace existing businesses and residences, require additional right-of-way and not be cost effective/reasonable.

Buffer zone: the acquisition of undeveloped property to act as a buffer zone is designed to avoid rather than abate traffic noise impacts and, therefore, is not feasible.

Noise barriers: this is the most commonly used noise abatement measure. Noise barriers were evaluated for each of the impacted receiver locations.

Noise barriers were evaluated for each of the impacted receiver locations with the following results:

Noise barriers would not be feasible and reasonable for the following impacted receivers and, therefore, are not proposed for incorporation into the project: R1-R3, R7-R11, R13, R15, R17-R19, R21-R22, R25, R29-R33, R35, R37-R39, R41-R45, R56-R57, R64-R71, R74-R75, R79-R80, R82-R85, R88-R90, R93, R95, R105, R111, and R113-R116.

These are receivers at locations where a noise barrier could not be constructed that is either reasonable or feasible. At some receivers, a noise wall would not reduce the noise levels by five dB(A) while achieving a seven dB(A) reduction at one receiver and, therefore, would not meet the feasibility criterion. At other locations, a noise wall that is feasible could not be constructed for less than reasonable criterion, which is $25,000 per benefited receiver.

R1-R3, R7-R9: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R10: This receiver is a place of worship. A proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R11, R13, R15, R17-R19: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R21: This receiver is an individual residence. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at this receiver, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R22: This receiver is an individual residence. A proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R25, R29-R30: These receivers are individual residences. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at these receivers, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R31: This receiver is an individual residence. A proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R32-R33, R35: These receivers are individual residences. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at these receivers, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R37: This receiver is an individual residence. A proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R38, R39: These receivers are individual residences. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at these receivers, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R41, R42, R43: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R44: This receiver is an individual residence. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at this receiver, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R45: This receiver is an individual residence. A proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R56: This receiver is a multi-family housing residence. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at this receiver, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R57: This receiver is a multi-family housing residence. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R64, R65, R66: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R67: This receiver is an individual residence. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at this receiver, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R68, R69, R70: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R71: This receiver is a place of worship. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R74, R75: these receivers represent the 14-acre Presbyterian School Outdoor Education Campus. At this location, the existing SH 288 main lanes and frontage road are elevated adjacent to these receivers. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at one of these receivers.

R80: This receiver is a place of worship. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R82-R85: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R88: This receiver is a recreational area. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R89: This receiver is a place of worship. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R90: This receiver is a hospital facility. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R93: This receiver is an individual residence. Proposed noise barrier was modeled and could not achieve the required minimum reduction of seven dB(A) at this receiver.

R95: This receiver is a retail business. A noise barrier would have a detrimental effect on this receiver by restricting advertising of the business. The owners have stated that they are not interested in a noise barrier, because it would adversely affect their business.

R105: This receiver is an individual residence. A noise barrier that would achieve the minimum feasible reduction of five dB(A) at this receiver would exceed the reasonable, cost-effectiveness criterion of $25,000 per benefitted receiver.

R111: This receiver is a school and outdoor sports area at the school. A proposed noise barrier was modeled and could achieve the minimum feasible reduction of five dB(A) at these receivers, but was not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

R113 and R116: These receivers are individual residences. Proposed noise barriers were modeled and could not achieve the required minimum reduction of seven dB(A) at these receivers.

R114-R115: These receivers are individual residences. Proposed noise barriers were modeled and could achieve the minimum feasible reduction of five dB(A) at both receivers, but were not able to reduce the noise level of one impacted, first row receiver by at least seven dB(A).

Noise barriers are considered reasonable and feasible for receivers R14, R23-R24, R26, R27-R28, R46, and R48-R49. Six preliminary noise walls would reduce noise levels by at least five dB(A), and be able to reduce the noise level at one impacted, first row receiver by at least seven dB(A) for an estimated 29 benefited receivers. These barriers were also able to achieve the design goals, and stay under the cost of $25,000 per benefited receiver; therefore, the barriers are both feasible and reasonable. Noise barriers that would be feasible and reasonable, as listed in *Table 26*, are therefore proposed for incorporation into the project. TxDOT would conduct noise workshops with benefitted receivers, and property owners would be surveyed to determine whether they desire a noise barrier.

Table 26. Preliminary Noise Barrier Proposal

Barrier	Representative Receivers Benefited	Total # Benefited Receivers	Length (feet)	Height (feet)	Total Cost*	Cost per Benefited Receiver
1	R14	3	242	16	$69,696	$23,232
2	R23-R24	3	315	10	$56,700	$18,900
3	R26	4	300	10	$54,000	$13,500
4	R27-R28	3	280	14	$70,560	$23,520
5	R46	12+	810	16	$233,280	$19,440
6	R48-R49	4	518	10	$93,240	$23,310

*Using a construction cost of $18.00/square foot.

Any subsequent project design changes may require a reevaluation of this noise barrier proposal. The final decision to construct the proposed noise barrier would not be made until after the completion of the project design, utility evaluation, and polling of adjacent property owners.

Land use activity areas located adjacent to the roadway consists of Category B (residential), Category C (commercial), and Category D (undeveloped land) properties. In addition, no known new residential development is currently platted in this area. There is no NAC for undeveloped land. However, to avoid noise impacts that may result from future development of properties adjacent to the project, local officials responsible for land use control programs should ensure, to the maximum extent possible, no new activities are planned or constructed along or within the following predicted noise impact contours (*Table 27*).

Table 27. Noise Impact Contours

Undeveloped Areas From US 59 to BW 8		
Land Use	**Impact Contour**	**Distance from Proposed Road ROW**
Residential	66 dB(A)	Approximately 250 feet
Commercial	71 dB(A)	Approximately 150 feet
Undeveloped Areas From BW 8 to CR 60		
Land Use	**Impact Contour**	**Distance from Proposed Road ROW**
Residential	66 dB(A)	Approximately 150 feet
Commercial	71 dB(A)	Approximately 50 feet

Noise associated with construction of the project is difficult to predict. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are tolerable. None of the receivers is expected to be exposed to construction noise for long periods of time; therefore, extended disruption of normal activities is not expected. Provisions would be included in the plans and specifications to require the contractor to make reasonable efforts to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems.

A copy of this traffic noise analysis would be made available to local officials to ensure, as much as possible, that future developments are planned to avoid traffic noise impacts. On the date of approval of this document (date of public knowledge), the FHWA and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the project.

XXIV. Air Quality

This project is located within Brazoria and Harris Counties, which are located in the Houston-Galveston-Brazoria (HGB) area. The HGB area is designated as in "marginal" nonattainment for the 2008 8-hour ozone standard under the National Ambient Air Quality Standards (NAAQS), effective July 20, 2012. As part of implementing the 2008 8-hour ozone standard, EPA is revoking the 1997 8-hour ozone standard for purposes of transportation conformity (77 FR 30160) this will be effective July 20, 2013. Therefore, the transportation conformity rule does apply. Segments of SH 288 for the Estimated Time of Completion (ETC) year 2035 and design year 2035 exceed 140,000 ADT; therefore, a Traffic Air Quality Analysis is required.

All projects in the Metropolitan Planning Organization's (MPO), or the Houston-Galveston Area Council's (H-GAC), Transportation Improvement Program (TIP) that are proposed for federal or state funds were initiated in a manner consistent with federal guidelines in 23 CFR 450 and Subpart B of 49 CFR 613.200. Energy, environment, air quality, cost, and mobility considerations are addressed in the programming of the TIP. The proposed action is consistent with the area's financially constrained *2035 RTP Update*, as amended, and the *2013-2016 TIP* for the Houston-Galveston Transportation Management Area. The RTP and the TIP were found to conform to the TCEQ State Implementation Plan (SIP) by FHWA on January 25, 2011 and November 1, 2012, respectively.

The congestion management process (CMP) is a systematic process for managing congestion that provides information on transportation system performance and on alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs. The project was developed from HGAC's operational CMP, which meets all requirements of 23 CFR 500.109. The CMP/CMS was adopted by H-GAC on January 25, 2013.

The region commits to operational improvements and travel demand reduction strategies at two levels of implementation: program level and project level. Program level commitments are inventoried in the regional CMP, which was adopted by H-GAC; they are included in the financially constrained RTP, and future resources are reserved for their implementation.

The CMP element of the plan carries an inventory of all project commitments (including those resulting from major investment studies) that details type of strategy, implementing responsibilities, schedules, and expected costs. At the project's programming stage, travel demand reduction strategies and commitments will be added to the regional TIP or included in the construction plans. The regional TIP provides for programming of these projects at the appropriate time with respect to the single occupancy vehicle (SOV) facility implementation and project-specific elements.

Computerized Transportation Management System (CTMS) will be applied throughout the project length, as the project is constructed, as a congestion mitigation measure in the corridor. See *Appendix G* for the Congestion Mitigation Analysis for SH 288.

In an effort to reduce congestion and the need for SOV lanes in the region, TxDOT and H-GAC will continue to promote appropriate congestion reduction strategies through the Congestion Mitigation and Air Quality Improvement (CMAQ) program, the CMP, and the RTP. The congestion reduction strategies considered for this project would help alleviate congestion in the SOV study boundary, but would not eliminate it.

Therefore, the proposed project is justified. The CMP analysis for added SOV capacity projects in the Transportation Management Area (TMA) is on file and available for review at H-GAC.

The primary pollutants from motor vehicle are volatile organic compounds (VOCs), carbon monoxide (CO), and nitrogen oxides (NO_x). VOCs and NO_x can combine under the right conditions in a series of photochemical reactions to form ozone. These reactions take place over a period of several hours. Therefore, maximum concentrations of ozone are often found far downwind of the precursor sources. Thus, ozone is a regional problem and not a localized condition.

The modeling procedures for ozone require long-term meteorological data and detailed area-wide emission rates for all potential sources (industry, business, and transportation) and are normally too complex to be performed within the scope of an environmental analysis for a highway project. Accordingly, concentrations of ozone for the purpose of comparing the results of the NAAQS are modeled by the regional air quality planning agency for the SIP. However, concentrations for CO are readily modeled for highway projects and are required by federal regulations.

Topography and meteorology of the area in which the proposed project is located would not seriously restrict dispersion of the air pollutants. Due to differences in traffic volumes, the traffic analysis for highway design and data for use in air analysis was divided into 15 segments.

Carbon monoxide concentrations for the proposed project were modeled using CALINE3. The worst-case scenario (adverse meteorological conditions and sensitive receptors adjacent to the proposed ROW) was modeled, in accordance with TxDOT's Air Quality Guidelines. Traffic data was obtained from the H-GAC Travel Demand Model (2012) and the LOS Analysis prepared by Atkins in November 2012. Background concentrations for CO in the Houston-Galveston region were provided in the TxDOT Air Quality Guidelines. Consistent with Appendix D of the Air Quality Guidelines, the 8-hour ambient concentration was assumed to be 2.8 parts per million (ppm), and the 1-hour ambient concentration was assumed to be 4.5 ppm. The CO emissions factors were obtained from the MOBILE6.2 Carbon Monoxide Look-Up Tables available from TxDOT (http://www.txdot.gov/txdot_library/consultants_contractors/publications/environmental_resources.htm). The tables provide regional CO emissions factors for freeways and arterial roadways through year 2030, for speeds ranging from 2.5 to 65 miles per hour. The emissions factors for a freeway in Houston for year 2030 and speeds of 60 and 65 miles per hour were assumed in this analysis, based on the roadway speed limit. The Year 2030 emissions factors represent a conservative analysis because emissions factors decrease over time with more stringent fuel standards. Under the worst-case scenario, local concentrations of CO would not be expected to exceed the national standard at any time. *Table 28* summarizes the results of the analysis.

Table 28. Projected Carbon Monoxide Concentrations

Segment Location	Model Year	1-Hour CO (ppm)	1-Hour % NAAQS	8-Hour CO (ppm)	8-Hour % NAAQS
US 59 to Binz Road	2035	5.2	14.9	3.3	36.7
Binz Road to Holly Hall Road	2035	7.2	20.6	4.7	52.2
Holly Hall Road to IH 610	2035	6.5	18.6	4.2	46.7
IH 610 to Reed Road	2035	8.1	23.1	5.3	58.9

Segment Location	Model Year	1-Hour CO (ppm)	1-Hour % NAAQS	8-Hour CO (ppm)	8-Hour % NAAQS
Reed Road to Airport Boulevard	2035	8.7	24.9	5.7	63.3
Airport Boulevard to Orem Road	2035	8.9	25.4	5.9	65.6
Orem Road to BW 8	2035	8.5	24.3	5.2	57.8
BW 8 to FM 2234	2035	8.6	24.6	5.3	58.9
FM 2234 to FM 518	2035	8.7	24.9	5.3	58.9
FM 518 to CR 59	2035	8.3	23.7	5.1	56.7
CR 59 to CR 58	2035	7.9	22.6	4.8	53.3
CR 58 to SH 6	2035	7.3	20.9	4.5	50.0
SH 6 to CR 57	2035	7.1	20.3	4.4	48.9
CR 57 to CR 64	2035	6.9	19.7	4.2	46.7
CR 64 to SH 99 (future)/CR 60	2035	6.4	18.3	3.9	43.3

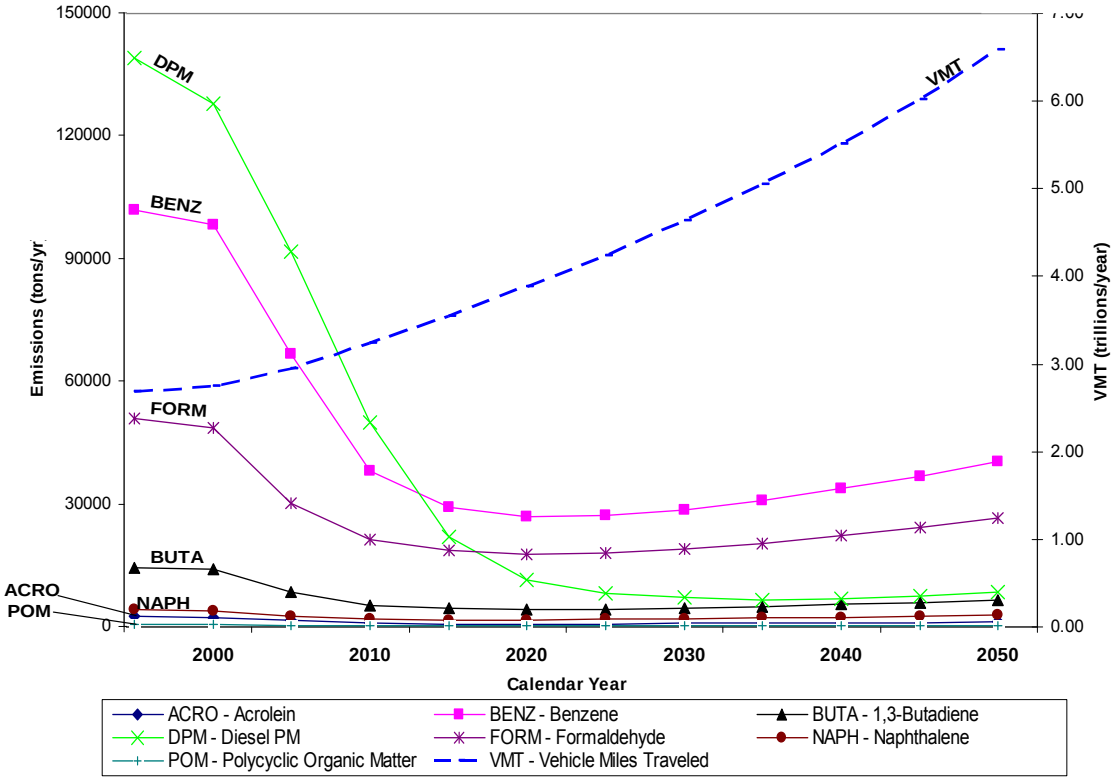
Note. The NAAQS for CO is 35 parts per million (ppm) for 1-hour and 9 ppm for 8-hour. Analysis includes a 1-hour background concentration of 4.5 ppm and 8-hour background concentration of 2.8 ppm.

Mobile Source Air Toxics

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the U.S. Environmental Protection Agency (EPA) regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (Hhttp://www.epa.gov/ncea/iris/index.htmlH). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (Hhttp://www.epa.gov/ttn/atw/nata1999/H). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

The 2007 EPA Mobile Source Air Toxics (MSAT) rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using EPA's MOBILE6.2 model, even if vehicle activity (vehicle-miles travelled, VMT) increases by 145 percent as assumed, a combined reduction of 72 percent in the total annual emission rate for the priority MSAT is projected from 1999 to 2050, as shown in *Exhibit 1* and *Table 29*.

Exhibit 1. National MSAT Emission Trends 1999-2050 for Vehicles Operating on Roadways Using EPA's MOBILE6.2 Model



Source: Table 29 below.
Note:

(1) Annual emissions of polycyclic organic matter are projected to be 561 tons/yr for 1999, decreasing to 373 tons/yr for 2050.
(2) Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors

Table 29. Projected National MSAT Emissions and Percent Reduction for 1999-2050 for Vehicles Operating on Roadways Using EPA's MOBILE6.2 Model

Pollutant/VMT	Pollutant Emissions (tons) and Vehicle-Miles Traveled (VMT) by Calendar Year							Reduction
	1999	2000	2010	2020	2030	2040	2050	1999 to 2050
Acrolein	2570	2430	1000	775	824	970	1160	-55%
Benzene	102000	98400	38000	27000	28700	33900	40500	-60%
1,3-Butadiene	14400	14100	5410	4360	4630	5460	6520	-55%
Diesel PM	139000	128000	50000	11400	7080	7070	8440	-94%
Formaldehyde	50900	48800	21400	17800	19000	22400	26800	-47%
Naphthalene	4150	4030	1990	1780	2030	2400	2870	-31%
Polycyclic Organic Matter	561	541	259	233	265	313	373	-33%
Trillions VMT	2.69	2.75	3.24	3.88	4.63	5.51	6.58	145%

Source: U.S. Environmental Protection Agency. MOBILE6.2 Model run 20 August 2009

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure should be factored into project-level decision-making within the context of the National Environmental Policy Act (NEPA). The FHWA, EPA, the Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this emerging field.

SH 288 MSAT Analysis

MSAT analysis in the SH 288 study considered the on-road sources for the five priority MSAT, in accordance with the TxDOT 2011 Air Quality Guidelines Addendum: acrolein, benzene, 1,3-butadiene, formaldehyde, diesel particulate matter. Two additional pollutants were also included based on input from TxDOT: naphthalene and polycyclic organic matter (POM). The MSAT analysis includes H-GAC travel demand network inputs for 2011 (base year) for existing traffic volumes, and future traffic volumes for 2035 (future year). An affected transportation network was derived by comparing the 2035 No Build Scenario to the 2035 Build Scenario to determine roadway links with a ±5 percent change in traffic volume in the HGB transportation network. The affected network was applied across all model years.

Priority pollutant emissions were calculated using the FHWA Easy Mobile Inventory Tool (EMIT), which provides a graphical-user interface to the MOBILE6.2 model and allows for implementation of locale- and project-specific parameters including meteorological conditions, vehicle fleet characteristics, vehicle activity, vehicle fuel specifications, state programs, and link-by-link project specific traffic information. The program executes the MOBILE6.2 model and provides a MOBILE6.2 model output. Model inputs were obtained from TxDOT, H-GAC, EPA, and other sources and are primarily based on inputs used for the H-GAC 2012 Conformity Determination for Amendments to the 2035 Regional Transportation Plan Update and the 2013-2016 Transportation Improvement Program, for the Houston-Galveston Transportation Management Area. The H-GAC model inputs are provided in Appendix 8 to the Conformity Determination, MOBILE Input Parameters. Naphthalene and POM emissions were estimated using guidance from TxDOT based on the MOBILE6.2 model output for PM_{10} emissions.

MSAT Analysis Results

The model results for the 2011 (base year) and 2035 (design year) are included in *Table 30*. Both the 2011 and 2035 model runs had two scenarios (Build and No Build).

Table 30. MSAT Emissions in 2007, 2025, and 2035

Compound	Year/Scenario				Percent Change	
	2011 No Build	2011 Build	2035 No Build	2035 Build	2011 to 2035 No Build Scenario	2011 to 2035 Build Scenario
Acrolein	0.6	1.2	0.7	0.7	+16.7	-41.7
Benzene	24.3	49.8	25.3	23.5	+4.11	-52.8
1, 3-Butadiene	4.1	8.2	4.4	4.1	+7.3	-50.0
Formaldehyde	14.2	28.5	17.9	16.8	+26.1	-41.1
Diesel Particulate Matter	25.2	43.3	4.9	4.8	-80.6	-88.9
Naphthalene	3.5	6.0	6.7	6.5	+91.4	+8.3
POM	0.5	0.9	0.9	0.9	+80.0	0
Total MSAT	72.4	137.9	60.8	57.3	-16.0	-58.4
Total VMT (miles/day)	4,402,820	7,563,838	8,673,486	8,469,973	+97.0	+12.0

Source: FHWA. Easy Mobile Inventory Tool.

Note: Emission reductions associated with EPA's 2007 *Control of Hazardous Air Pollutants from Mobile Sources* are not reflected in estimated emissions included in this table.

The analysis indicates a decrease in total MSAT emissions for the both the Build and No Build Scenarios in 2035 versus the base year No Build Scenario. Total MSAT emissions are predicted to decrease by 20.9 percent for the 2035 Build Scenario compared to 2011 No Build levels. At the same time, VMT in year 2035 would almost double compared to baseline levels. If emissions are plotted over time, as shown in *Exhibit 2* below, MSAT emissions decrease between the 2011 scenarios and the 2035 No Build and Build Scenarios although VMT increases due to anticipated improvements in fuels and emission standards. Differences in total MSAT emissions between the 2035 No Build and Build Scenarios were found. The 2035 No Build Scenario has slightly higher emissions than the 2035 Build Scenario. Emissions could be lower for the Build Scenario due to congestion reduction as a result of the added roadway capacity of SH 288, as well as a reduction in total VMT, as described below.

VMT for the 2035 Build Scenarios is slightly lower than the 2035 No Build Scenario. Although the proposed project would add capacity to Houston-Galveston transportation network, the VMT for the Build

Scenarios likely decreases due to redistribution of traffic in the travel demand model. For the Build Scenario, there was a VMT increase of approximately 12 percent from 2011 to 2035. This amount of increase in VMT is offset by the benefits from the change in emission standards that both light-duty and heavy-duty on-road motor vehicles must meet in the future, as evidenced by the decrease in MSAT emissions for the both the Build and No Build Scenarios for 2035 compared to 2011 emissions.

Of the seven MSAT compounds included in the SH 288 study, benzene and diesel particulate matter (DPM) contribute the most to the emissions total in 2011, as shown on *Exhibit 3* below. In future years a substantial decline in benzene is anticipated (52.8 percent reduction in benzene from 2011 to 2035 Build Scenario), and an even larger reduction in DPM emissions is predicted (88.9 percent decrease from 2011 to 2035 Build Scenario). Benzene would continue to contribute the most of the emissions total in 2035, followed by formaldehyde. Is it important to note that EPA's MOBILE6.2 model does not take into consideration the emission reductions set forth in EPA's 2007 *Control of Hazardous Air Pollutants from Mobile Sources*. EPA predicts that the 2007 standards will significantly lower emissions of benzene and the other air toxics from mobile sources.

Differences in MSAT emissions among transportation alternatives is difficult to predict given the uncertainties associated with forecasting travel activity, inconsistencies in the regional transportation networks, and air emissions 25 years or more into the future. The main analytical tool for predicting emissions from on-road motor vehicles is the EPA's MOBILE6.2 model. The MOBILE6.2 model is regional in scope and has limited applicability to a project-level analysis. However, for the study, the effects of the proposed project were evaluated for the entire affected transportation network in the HGB travel demand transportation network. MSAT emissions as a result of the proposed project are not expected to increase overall air toxics in the HGB area for the evaluation years analyzed.

Exhbit 2: Comparison of MSAT Emissions vs VMT by Alternative

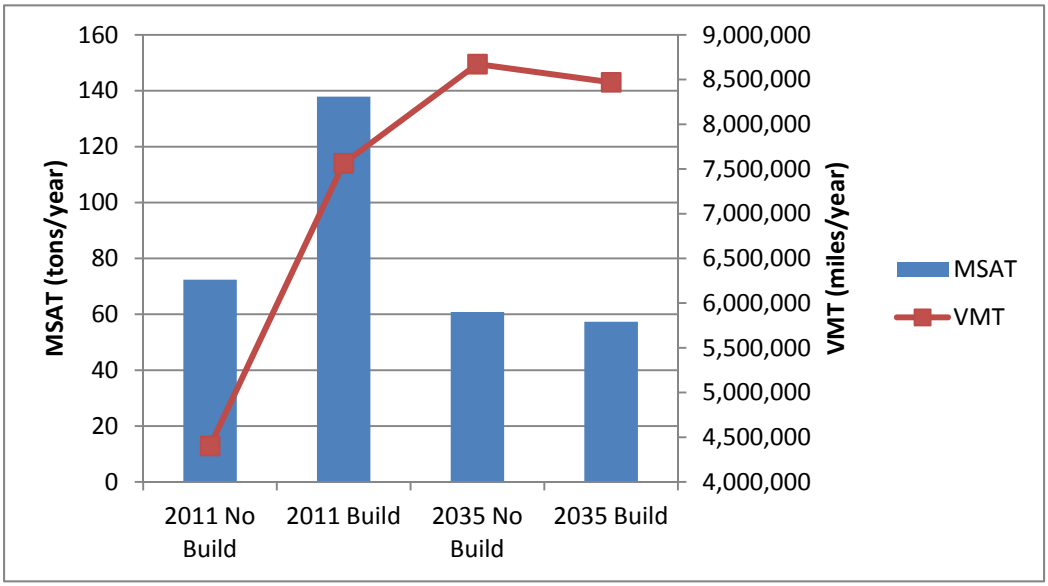
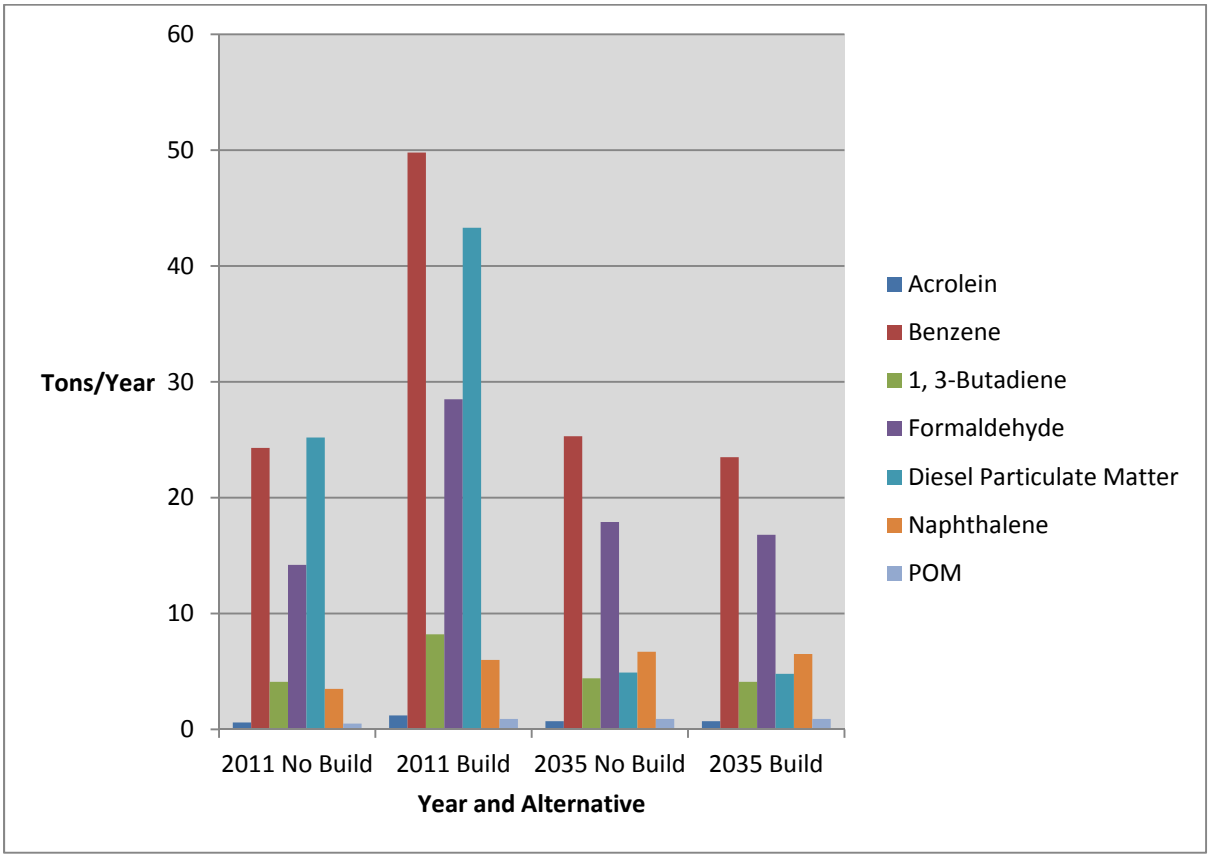


Exhibit 3. Projected MSAT Emissions by Alternative for SH 288 Over Time



Note: Emission reductions associated with EPA's 2007 *Control of Hazardous Air Pollutants from Mobile Sources* are not reflected in estimated emissions included in this table.

The reasons for the dramatic improvement between the 2011 Build and 2035 Build Scenarios are two-fold, a change in vehicle fuels, both gasoline and diesel fuel, and a change in emission standards that both light-duty and heavy-duty on-highway motor vehicles must meet. EPA regulations for vehicle engines and fuels will cause overall MSAT emissions to decline significantly over the next several decades. Based on regulations now in effect, an analysis of national trends with EPA's MOBILE6.2 model forecasts a combined reduction of 72 percent in the total annual emission rate for the priority MSAT from 1999 to 2050 while vehicle-miles of travel are projected to increase by 145 percent[1]. This will both reduce the background level of MSAT as well as the MSAT emissions associated with this project.

Conclusion

These estimated emission levels are for all MSATs evaluated and are based on the projected total VMT. This project has been determined to generate minimal air quality impacts related to MSAT emissions and has not been linked with any special MSAT concerns.

[1] Texas Department of Transportation (TxDOT), Environmental Affairs Division. 2011. Air Quality Standards of Uniformity. August 31, 2011.

Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The U.S. Environmental Protection Agency (EPA) is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/ncea/iris/index.html). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's 2009 Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents, which can be found at the following address: (http://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/100109guidmem.cfm). This Appendix also discusses a variety of FHWA research initiatives related to air toxics. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable. The results produced by the EPA's MOBILE6.2 model, the California EPA's Emfac2007 model, and the EPA's MOVES model in forecasting MSAT emissions are highly inconsistent. Indications from the development of the MOVES model are that MOBILE6.2 significantly underestimates diesel particulate matter (PM) emissions and significantly overestimates benzene emissions.

Regarding air dispersion modeling, an extensive evaluation of EPA's guideline CAL3QHC model was conducted in an NCHRP study (http://www.epa.gov/scram001/dispersion_alt.htm#hyroad), which documents poor model performance at ten sites across the country - three where intensive monitoring was conducted plus an additional seven with less intensive monitoring. The study indicates a bias of the CAL3QHC model to overestimate concentrations near highly congested intersections and underestimate concentrations near uncongested intersections. The consequence of this is a tendency to overstate the air quality benefits of mitigating congestion at intersections. Such poor model performance is less difficult to manage for demonstrating compliance with National Ambient Air Quality Standards for relatively short time frames than it is for forecasting individual exposure over an entire lifetime, especially given that some information needed for estimating 70-year lifetime exposure is unavailable. It is particularly difficult to reliably forecast MSAT exposure near roadways, and to determine the portion of time that people are actually exposed at a specific location.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://wwwcf.fhwa.dot.gov/exit.cfm?link=http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine a "safe" or "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than safe or acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

XXV. Air-Highway Clearance

Since the project area is not located within 2 miles of an airport, a Federal Aviation Administration Airway-Highway clearance would not be required.

XXVI. Hazardous Materials

A review of public and proprietary environmental regulatory databases was conducted in accordance with American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments and TxDOT standards to identify potential sources of hazardous materials within or near the State Highway (SH) 288 project limits. The regulatory database review was obtained from Environmental Data Resources, Inc. (EDR) in two reports: 1) EDR DataMap™ Environmental Atlas™ (Inquiry Number 3433825.1s, October 17, 2012); and 2) EDR DataMap™ Corridor Study (Inquiry Number 3433825.1s, October 26, 2012). EDR Report 1 includes a review area within one mile of the approximate centerline SH 288 from Interstate Highway 45 (near downtown Houston) to Brazoria County Road 60. EDR Report 2 includes a review area within one mile of the approximate centerline of South Loop 610 from a point east of Niagara Street west to a point east of Kirby Drive, and within one mile of the approximate centerline of Almeda Road from a point south of SH 288 north to a point north of Hepburn Street.

The following is an abbreviated list of ASTM- and TxDOT-recommended federal and state databases and records that were searched for relevant information:

- National Priority List (NPL); U.S. Environmental Protection Agency (EPA) list of confirmed or proposed Superfund sites

- Comprehensive Environmental Response, Compensation, and Liability Information Service (CERCLIS); proposed or possible NPL sites from the EPA database of current and potential Superfund sites currently or previously under investigation

- No Further Remedial Action Planned (NFRAP) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites where contamination was removed quickly or was not considered serious

- Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal (TSD) sites; EPA database of sites that treat, store, dispose, or incinerate hazardous waste

- RCRA Corrective Action Report (CORRACTS); EPA database of Resource Conservation and Recovery Information Service (RCRIS) sites (hazardous waste handlers) under reported corrective action

- RCRA Non Generator (Non GEN); U.S. EPA database of Resource Conservation and Recovery Information Service (RCRIS) sites that generate less than 100 kilograms of hazardous waste per month or meet other RCRA requirements including the RCRA Administrative Action Tracking System and Compliance Monitoring and Enforcement List

- RCRA Conditionally Exempt Small Quantity (CESQG); U.S. EPA database of Resource Conservation and Recovery Information Service (RCRIS) sites that in the past generate, transport, store, treat and/or dispose of hazardous waste as defined by RCRA. Non generators do not presently generate hazardous waste

- RCRA Small quantity generator (SQG); U.S. EPA database of RCRIS sites that generate between 100 kilograms and 1,000 kilograms of hazardous waste per month or meet other RCRA requirements including the RCRA Administrative Action Tracking System and Compliance Monitoring and Enforcement List

- RCRA Large quantity generator (LQG); U.S. EPA database of RCRIS sites that generate more than 1000 kilograms of hazardous waste per month or meet other RCRA requirements including the RCRA Administrative Action Tracking System and Compliance Monitoring and Enforcement List

- Emergency Response Notification System (ERNS); EPA database of emergency response actions for reported spills of regulated materials

- Spills-1990, SPILLS Database of emergency response actions and spill releases dating from 2002 to present

- Groundwater Contamination Cases (GCC); the Texas Water Code requires company to annual report any activities where groundwater contamination has been identified

- Toxic Release Inventory System (TRIS); EPA database of facilities have had, or may be prone to release of toxic materials

- State Sites; TCEQ databases for the State Superfund, Voluntary Cleanup Program (VCP), and the Innocent Owner/Operator Program (IOP) sites

- Solid Waste Facilities/Landfill Sites (SWL/LF), TCEQ database of both active and inactive solid waste disposal facilities, landfills, or open disposal areas that failed to meet RCRA criteria for solid waste landfills or disposal sites

- Other; the Texas Industrial Hazardous Waste Notice of Registration (IHWNOR) data. The TCEQ enters all information submitted by industrial and hazardous waste transporters, receivers (including recyclers), generators, and one-time shipments into a database that tracks industrial and hazardous waste generation and management activities in the state of Texas. All facilities of this type receive a solid waste registration number.

- Registered Underground Storage Tanks (UST)/Aboveground Storage Tanks (AST); TCEQ database of USTs that are registered with the state

- Leaking Petroleum Storage Tanks (LPST); TCEQ database of USTs that have reported leaks of petroleum substances

- Brownfield; TCEQ's brownfield database of all former industrial properties that lie dormant or underutilized due to liability associated with real or perceived contamination. Some sites are noted as having institutional and/or engineering controls placed on them. Also contained in this database is TCEQ's listing of all sites in the VCP and the Innocent IOP. Some VCP and IOP sites are noted as having institutional and/or engineering controls placed on them. EPA's Brownfield Management System (BMS) is an analytical database designed to assist EPA in collecting, tracking, and updating information, as well as reporting on the major activities and accomplishments of the various Brownfield grant programs.

The EDR reports included a review of 86 federal, state and local, tribal, and EDR proprietary databases. The results of the database record review are summarized in *Table 31*. The databases reviewed are defined and described in the EDR reports on pages GR1 to GR22. *Table 31* includes only those databases for which sites were reported.

Table 31. Environmental Database Summary

Database	Sites Found (EDR Report #1)	Sites Found (EDR Report #2)
Federal Records		
NPL	1	1
CERCLIS	2	2
CERC-NFRAP	2	4
CORRACTS	3	3
RCRA-TSDF	1	2
RCRA-LQG	4	3
RCRA-SQG	4	5
RCRA-CESQG	6	7
RCRA-NonGen	19	31
US ENG CONTROLS	3	3
US INST CONTROL	1	1
US BROWNFIELDS	2	1
CONSENT	1	1
ROD	1	1
TRIS	2	1
FINDS	30	44
US FIN ASSUR	1	2
PRP	1	1
2020 COR ACTION	3	3
State and Local Records		
SWF/LF	2	2
CLI	2	0
UIC	2	0
LPST	50	46
UST	73	58
AST	12	9
DEL SHWS	1	1
NY MANIFEST	0	2
SPILLS	0	2
AUL	2	2
VCP	13	10
DRYCLEANERS	14	5
ENF	2	3
Ind. Haz Waste	12	18
AIRS	0	1
MSD	1	0
TIER 2	2	3
HIST LIENS	1	0
FINANCIAL ASSURANCE	27	19
GCC	15	9
Grand Total	**318**	**306**

Source:
EDR DataMap™ Environmental Atlas™ (Inquiry Number 3433825.1s, October 17, 2012)
EDR DataMap™ Corridor Study (Inquiry Number 3433825.1s, October 26, 2012)

A site reconnaissance was completed in October 2012 to confirm the location of sites of environmental concern, and observe existing environmental conditions within the project limits. *Table 32* lists those sites within 500 feet of the centerline of SH 288 project area, identified either through site reconnaissance or review of the EDR reports, which are potential environmental concerns. *Table 32* provides detailed site location information, risk assessment information (Hazard Rank), site status, facility type, and Map ID. There are 61 sites of environmental concern in close proximity to the SH 288 project area. Ten of sites pose a high risk due to either the confirmed presence of soil and/or groundwater contamination, or the site conditions observed during the site reconnaissance. Three of the 10 high-risk sites (Map ID 271, 272, and 273) were not listed in the EDR reports, but were observed during the site reconnaissance. *Figure 5* identifies the approximate locations of sites identified during review of the EDR reports and site reconnaissance. A table included as *Figure 5 Sheet 13* indicates the sheet number of *Figure 5* where each site is mapped.

The Sol Lyn Superfund Site, located west of the intersection of SH 288 and IH 610 is a high risk site (Map ID 2). The contaminants of concern reported for this site include polychlorinated biphenyls (PCBs) and tricholorethylene (TCE). Groundwater contaminated with TCE extends from the source area on the south side of IH 610 across and beyond the north side of IH 610, as shown in the EDR report. Groundwater is contaminated from the shallow groundwater bearing zone at 20-foot depth, to the nine deeper groundwater zones that extend to 200-foot depth. Any soil or groundwater handled from this area would be treated as a hazardous waste in accordance with the Resource Conservation and Recovery Act (RCRA, 40 CFR 260), and the requirements of the Texas Commission on Environmental Quality (TCEQ, 30 TAC 350). In addition, since the waste would be associated with a Superfund Site, additional restrictions implemented by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, 40 CFR 300.440) would be applicable. The other high-risk sites LPST sites are where ROW acquisition would occur and final closure has not been issued, illicit dumps/undocumented landfills, and VCP sites that are active or in close proximity to the project corridor.

The proposed project would require ROW from four sites with documented hazardous materials. ROW being acquired from the (Yellowstone Mobil) service station, located at 3300 Yellowstone Boulevard (Map ID 202), would impact the underground infrastructure, and may require removal of existing USTs. The Hurt Company (Wesco Industries), located at 3310 Alice Street (Map ID 207), is a former Brownfield site that contained a LPST, UST, and AUL that has undergone the necessary remediation and state-directed closure by TCEQ. ROW acquisition would also be required at Phillips Crane and Rigging (Map ID 1), which is a LPST, RCRA Non-Gen, FINDS, and GCC site. The site is not closed, and according to TCEQ records is still in the preassessment/release determination part of the regulatory process. A-1 Petroleum (Map ID 46) is a LPST site, but final closure was issued by the TCEQ. The removal of UST systems, and handling of soil or groundwater contaminated with fuels or motor oils, would be completed in accordance TCEQ regulations (30 TAC 334). Contaminated material from other sites would be managed in accordance with TCEQ Texas Risk Reduction Program regulations (TRRP, 30 TAC 350). A Baylor College of Medicine facility (Map ID 40) is located across the street from area where ROW acquisition would take place. This facility is a LPST and RCRA CORRACT site.

Table 32 lists 17 moderate-risk sites, and 34 low-risk sites. The moderate risk sites include UST facilities where ROW acquisition is anticipated; sites observed in dilapidated condition; LPST sites in close proximity to the project corridor; and VCP sites not directly adjacent to the project, but are still active. The low risk sites include automobile dealerships; UST facilities; small industrial facilities; listed facilities where no ROW acquisition is anticipated, no site contamination was reported in the regulatory database, and no evidence of contamination was observed during the site reconnaissance.

Oil/Gas Sites and Pipelines

The EDR reports include a search of state and federal records for water wells, and oil and gas wells. *Figure 5A* includes a map with the plotted locations of 486 oil and gas wells within one mile of the centerline of the SH 288 project limits. *Figure 5A* includes a map with the plotted locations of 251 oil and gas wells within one-mile of the centerline of the SH 288 project limits. The large number of oil and gas

wells locations reported is due to the proximity of the project to the Pierce Junction Oil Field, which was in production from 1906 to 1984. Numerous oil and gas well locations were identified by the regulatory database to be located on the west side of SH 288, south of IH 610 and north of Airport Boulevard. Contamination from oil and gas exploration and production would be handled in accordance the Texas Railroad Commission (RRC, 16 TAC 4) and TCEQ (30 TAC 350) regulations.

During the preliminary investigations, multiple pipelines were identified that bisect the proposed project. The locations of 37 pipeline crossings are shown on *Figure 5A*. Negotiations would be conducted with the pipeline owners to properly relocate or deepen the affected pipelines, if necessary.

Table 32. Summary of Sites of Environmental Concern

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
1	Phillips Crane and Rigging	925	So Loop W	Houston	77054	150	South	High	LPST, RCRA Non-Gen, FINDS, GCC	The groundwater on-site was affected by a gasoline leak. The site status is listed as preassessment/ release determination.
2	Sol Lynn/Industrial Transformers Superfund Site	2173	Mansard Street	Houston	77054	300	South	High	NPL (CERCLA)	Groundwater contamination plume extends from source area north beneath IH 610; depth to groundwater is about 20 ft. The distance provided is from the source area. The contamination plume is within the project limits.
14	UTHSC -Harris Co Psychiatric Center	2800	S MacGregor Way	Houston	77021	450	East	Low	UST, RCRA Non-Gen, FINDS,	UST-currently in use (emergency generator). No longer handles hazardous waste but handled waste historically as a SQG.
16	US Bellows	3701	Holmes Road	Houston	77051	300	South	Moderate	Industrial activities	According to the TCEQ Central Registry, this site has an active solid waste and air permit.
16	Piping Products and Technology	3701	Holmes Road	Houston	77051	250	South	Moderate	Industrial activities	According to the TCEQ Central Registry, this site has an active solid waste and air permit.
25	Aluminum Finishing Co	6006	Ardmore	Houston	77021	450	East	High	VCP, Ind Haz Waste, DEL SHWS, FINDS, HIST LIENS, RCRA Non-Gen	This facility currently does not generate waste. Historically, this facility was a LQG. In 1993, this facility was sent into enforcement by the State. The facility was discharging metal plating waste to the City's sanitary sewer system. Due to clean up under the VCP program, this facility was later deleted from the Superfund registry.

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
28	Waukesha-Pearce Industries (International	825	So Loop W	Houston	77054	150	South	High	VCP, GCC	Groundwater and soils contaminated with Total petroleum hydrocarbon and metals (28 acre site).
29	Grocer's Supply	3131	E Holcombe	Houston	77021	300	West	Low	LPST, UST,RCRA Non Gen, FINDS	Minor soil contamination, TCEQ issued final concurrence cased closed in 1993. All USTs have been removed from the ground. No longer handles hazardous waste.
32	Chevron station	7410	Cullen Blvd	Houston	77051	200	South	Low	UST	USTs currently in use.
36	Harris County Annex (Wedge Dia-Log Inc)	3330	Old Spanish Trail	Houston	77021	500	East	Low	AST, RCRA Non Gen, FINDS, UST	AST observed on-site. USTs were removed from the ground in 1988. No longer handles hazardous waste.
40	Abandoned warehouse and yard in maintained condition (Baylor College of Medicine)	3325	Yellowstone Blvd	Houston	77021	440	East	High	LPST, RCRA-TSDF, CORRACTS, RCRA-CESQG, 2020 COR ACTION	LPST status-final concurrence case closed. This facility address listed as both as CESQG and LQG of hazardous waste. They abide by a TCEQ corrective action plan. This facility is located across the street from an area of ROW acquisition
46	A-1 Petroleum	911	S Loop W	Houston	77021	50	South	High	LPST, RCRA Non Gen, FINDS, Ind. Haz Waste	This facility is located adjacent to an area of ROW acquisition. TCEQ issued final concurrence case closed.
59	Texas Steel Conversion	3101	Almeda	Houston	77045	400	West	Moderate	RCRA-CESQG, FINDS	Active industrial facility.
61	One Hour Cleaners	5314	Almeda	Houston	77005	500	West	Moderate	Dry Cleaner, RCRA Non-Gen, FINDS	This site currently does not handle hazardous waste but historically was a CESQG.
63	Valero station (Ana Facility)	2800	Reed Road	Houston	77051	350	East	Low	UST	USTs currently in use.
84	Chevron station (Alameda Food Store)	8550	Almeda	Houston	77054	230	North	Moderate	LPST, UST, Financial Assurance	Groundwater was affected; TCEQ issued final concurrence case closed in 1994.

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
95	Allen Samuels Chrysler Jeep	1515	S Loop W	Houston	77045	250	South	Low	AST	Active fleet refueling facility.
97	ACI Glass	3333	Holly Hall	Houston	77021	350	East	Low	UST, AST	2 USTs removed from the ground in 1993
115	Exxon Pierce Junction -	29 36' 31.27" 95 23' 18.21"	South of Bellfort at SH 288	Houston	77051	300	East	Moderate	VCP	Note: address in regulatory database appears to be incorrect, coordinates for a possible location near the COH Bellfort Landfill and Holmes Rd Incinerator are listed Site is a gas and oil storage facility. This VCP site was affected by a petroleum release which impacted soil and groundwater. Status of site is still active.
120	Chevron station	8550	Almeda	Houston	77054	120	West	Moderate	LPST, AIRS, FINANCIAL ASSURANCE	Groundwater was affected. Final concurrence cased closed issued in 1994.
131	South Loop CITGO station (owner Ida Authorlee)	3839	IH 610 E	Houston	77021	200	North	Moderate	LPST	Groundwater contamination documented, final concurrence case closed.
132	Houston Crushed Concrete	4601	Holmes Road	Houston	77045	190	North	Moderate	ENF, Financial Assurance Information Listing, VCP, SWF/LF	This is an active Solid Waste Landfill. The VCP site known to have TPH and metals.
141	Medical Center Muffler	1522	South Loop West	Houston	77054	150	North	Moderate	LPST, UST	This site is pending final concurrence of well plugging. Groundwater was not affected.
143	Pilgrim Discount 66	5015	Almeda	Houston	77004	500	West	Low	Dry Cleaner	No status available.
150	Almeda $1.00 Cleaners	5424	Almeda	Houston	77004	400	West	Low	Dry Cleaner	Active Dry Cleaner.
154	Chevron station (Susser	2665	Reed Road	Houston	77051	550	West	Low	UST	USTs currently in use.

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
	Petroleum)									
168	Ryerson (Metal Goods Div Alcan Aluminum)	3530	S Loop E	Houston	77021	200	South	Low	UST, Other Industrial/Manufacturing	USTs removed from ground in 1991.
178	ICSH - Access Control Specialists (Amerigas)	4340	Holmes Road	Houston	77051	390	North	Low	UST	UST permanently filled in place in 1987.
184	Riverside Co	3247	Yellowstone Blvd	Houston	77021	300	East	Low	UST	USTs currently in use.
193	Stripes Chevron	2329	Southmore	Houston	77004	480	East	Moderate	UST, LPST, Financial Assurance	Final Concurrence cased closed.
195	Closed service station (Former Chevron)	2100	Binz	Houston	77004	500	West	Low	UST, FINDS, RCRA-NLR	All USTs are removed from the ground. The RCRA site no longer generates waste.
202	Yellowstone Mobil (formerly Sunmart 352)	3300	Yellowstone Blvd	Houston	77021	250	East	Moderate	UST	The USTs are currently active. Due the displacement of property it is possible that removal of USTs could occur.
203	Texas Bus Lines (Midtown Redevelopment Authority)	2222	Cleburne	Houston	77004	300	East	High	LPST, GCC, UST	Groundwater remediation system in place. The groundwater was affected by gasoline, diesel, and waste oil, and is currently following a TCEQ corrective action plan.
207	The Hurt Company (Wesco/South Freeway Building Property)	3310	Alice	Houston	77021	200	East	High	VCP, LPST, AUL	USTs removed from ground or out of use. Only soil contamination was reported. TCEQ issued final concurrence cased. VCP status- In 1996, Total Petroleum Hydrocarbon (TPH), affected the soil. Areas affected by TPH were excavated and sent to a landfill.
208	Shell station	7401	Cullen Blvd	Houston	77051	300	South	Low	UST	USTs currently in use.

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
218	Closed service station and junkyard (Not Company Owned)	4600	Holmes Road	Houston	77033	120	North	Moderate	LPST	Soil contamination only. TCEQ issued final concurrence, case closed. USTs are removed from the ground as of 1991.
224	Texaco station (Rubys Food Store)	7500	Almeda	Houston	77054	120	West	Low	UST, Financial Assurance	USTs currently in use.
227	Brinks	3232	Dixie Dr	Houston	77021	300	East	Low	UST, Financial Assurance	Active site.
228	Star Stop Exxon	2111	Southmore	Houston	77004	330	West	Low	UST, Financial Assurance	Active gas station.
231	Mobil station (Subway)/Sun mart 139	3200	Holcombe	Houston	77021	300	West	Low	UST, Financial Assurance	Active gas station.
243	Valero station (Formerly Fuel Express)	7555	Scott	Houston	77021	200	North	Moderate	LPST	The LPST site was issued final concurrence case closed.
257	Texaco (formerly Speedmart)	3250	Old Spanish Trail	Houston	77021	290	East	Low	UST, Financial Assurance	Active gas station.
259	Valero (Almeda Food Mart)	5203	Almeda	Houston	77004	500	West	Low	UST, Financial Assurance	TCEQ reports that USTs are still in use. Field observation - Charles Burgers and Chicken -several dispensers are boarded over at the facility.
260	Texaco Food Mart station (South Freeway Truck Stop)	12602	SH 288	Houston	77047	400	West	Low	UST, Financial Assurance	Facility appeared to be in good condition.
262	Shell station	2705	Reed Road	Houston	77051	400	East	Low	UST	USTs currently in use.
268	Julian Preston Property	3333	Raleigh St	Houston	77021	400	East	Low	UST	USTs- Currently out of service (since 1995).

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
271	Automotive Service Center - facility	6613	Bowling Green	Houston	77021	300	East	Moderate	Automobile repair	Facility observed to be located on the northbound feeder of SH 288. Appears to be in poor condition.
272	Illicit Dump Site - south end of McGrath Road, south of Almeda-Genoa	29 36' 31.27" 95 23' 18.21"	McGrath	Houston	77047	500	West	High	Illicit dumping	Area of illicit dumping observed at the end of McGrath Road south of intersection with Almeda.
272	Texas Pipe and Supply	2330	Holmes Road	Houston	77051	500	West	Moderate	Industrial activities	Large industrial facility, appeared to be in fair condition.
273	Heavy Equipment Junk Yard	13450	SH 288	Houston	77047	350	West	High	Junk Yard	Property contains several pieces of heavy equipment in rusty or dilapidated condition.
273	Junk Yard	7430	Cullen Blvd	Houston	77051	300	South	Moderate	Industrial activities	Tract of land with several pieces of heavy equipment in junk condition.
275	Admiral Linen Service	2116	McGowen	Houston	77004	450	East	Low	Dry Cleaner	No status available.
276	Air Gas facility	4751	S Loop E	Houston	77033	200	South	Low	Industrial activities	Industrial facility appeared to be in fair condition.
278	Shell station	8700	Almeda	Houston	77054	350	South	Low	UST	The new service station was under construction.
279	Texaco station	7810	Almeda	Houston	77054	110	West	Low	UST	USTs currently in use. Old service station was observed to be in fair condition.
280	Shell station	17510	Highway 6	Manvel	77578	500	East	Low	UST	USTs currently in use.
281	South Post Oak Recycling Center	4370	Holmes Road	Houston	77051	400	North	Low	Industrial activities	Recycling facility was observed to be in fair condition.
282	Shell station (Handi Stop)	1620	South Loop West	Houston	77054	150	North	Low	UST, Financial Assurance	USTs currently in use.
283	Sam's Club station	1615	South Loop West	Houston	77054	380	South	Low	UST, Financial Assurance	USTs currently in use.

Map ID	Site Name	Street Address	Street Name	City	Zip Code	Distance (feet)	Direction	Hazard Rank	Facility Description	Site Status
284	Davis Chevrolet	2277	S Loop W	Houston	77054	230	West	Low	Vehicle maintenance	Automobile dealership appeared to be in good condition.
285	Wireline Control Systems	3330	County Road 56	Rosharon	77583	300	East	Low	Oilfield equipment maintenance	Industrial facility appeared to be in good condition.

Notes:
Distance - approximate distance (feet) from the centerline of the project limits to the site described.
Direction - approximate compass direction from the centerline of the project limits to the site described.
Hazard Rank - the approximate relative risk of contamination for the site described and surrounding property

Petroleum Storage Tanks

According to the environmental database records, there are approximately 13 LPST sites within 500 feet of the centerline of the proposed project. LPSTs can cause soil and groundwater contamination, including soils proposed to be excavated during construction of the proposed project. LPSTs are known to be in or directly adjacent to the proposed ROW; however, if found in the proposed ROW, the LPST sites would be addressed during the ROW negotiation and acquisition process. Coordination with property owners, tank owners, operators, and TCEQ would be an ongoing process up to and during construction. If the removal of any UST is necessary, removal would be conducted in accordance with 30 TAC § 350, technical standards and any other applicable requirements. Excavation, pumping, and/or dewatering activities of contaminated soil or water would require proper treatment and disposal. The rule provides specific procedures for the removal and handling of a UST system and associated materials, and provides for the proper management of work and public safety during construction. All tanks would be removed from the ground and proper closure activities would be conducted prior to construction. In addition, implementation of a Materials Management Plan would require proper handling of anticipated and unanticipated contaminated materials during the construction phase of the project.

Asbestos Containing Materials

The proposed project would include the widening of bridge structures and construction of retaining walls. Suspect asbestos-containing materials may be encountered during this process. The EPA's National Emission Standards for Hazardous Air Pollutants and Occupational Safety and Health Administration (OSHA) regulations require that asbestos be properly handled during renovation or demolition. Asbestos inspections, notifications, abatement and disposal, as applicable, would be in compliance with federal, state, and local regulations. Asbestos issues would be addressed prior to construction.

The proposed project would include the construction of direct connector ramps at IH 610 and BW 8. Construction of the direct connector ramps would require the excavation of drilled shafts, which may increase the potential of encountering hazardous material contamination during construction. Additional investigation would be required to determine whether hazardous materials contamination might be encountered during any underground construction in the area of the IH 610 near the Sol Lyn Superfund Site, located west of the intersection of SH 288 and IH 610. If hazardous constituents are confirmed, appropriate soils and/or groundwater management plans for activities within these areas would be developed.

Landfill or Undocumented/Illicit Dump Sites

Within 500 feet of the SH 288 project limits, three documented landfills and/or undocumented/illicit dump sites were identified in the regulatory database or were observed during the field investigation. Map ID 272 was observed during the field reconnaissance; the approximate one acre site contained demolition/construction waste, paint-related materials, and suspect asbestos materials. This site had overgrown vegetation, indicating it could have existed for several years. Map ID 273 was observed during the site reconnaissance, this 0.25-acre site contained rusted construction equipment, vehicles, and building materials. Because these sites are undocumented, little is known about potential contamination. The Cherry Crushed Concrete landfill (Map ID 132) is located outside the project limits but is an active solid waste landfill located on approximately 15 acres, and is also registered as a VCP site for TPH and metals. Due the location of the facility and the location of construction of the proposed project, this landfill would have a low potential of affecting the proposed project.

Conclusions

The hazardous materials sites listed as high or moderate risks should have further investigation to determine the potential of encountering hazardous materials during construction of the project. A Phase II investigation may be needed at sites that are known to have active LPST, VCP, or undocumented/illicit dump sites. Due to the high volume of oil and gas sites identified in the EDR databases, further studies

would be conducted to identify oil and gas sites that could be impacted by construction of the proposed project.

XXVII. Construction Impacts

Traffic control during project construction would be in accordance with Part VI (Traffic Controls for Street and Highway Construction and Maintenance Operations) of the *Texas Manual on Uniform Traffic Control Devices*. During construction, travel lanes in each direction would be maintained. However, short-term lane closures may occur during off-peak hours. Access to adjacent property would be maintained during construction. Street intersections would be constructed in phases to maintain through traffic.

There may be some short-term noise impacts resulting from construction of the project. It is possible that the areas adjacent to the project ROW would experience above normal noise levels during road construction. To minimize construction noise, provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. Due to the relatively short-term exposure periods imposed on any one receiver, extended disruption of normal activities is not considered likely. Reasonable effort would be made to minimize construction noise.

There may be short-term, localized effects to air quality (e.g., increase in dust) in the immediate area adjacent to the project during construction, which may temporarily degrade air quality through dust and exhaust gases associated with construction equipment. Measures to control dust would be considered and incorporated into the final project design and construction specifications.

The proposed project includes the demolition of a structure. The structure may contain asbestos-containing materials. Asbestos inspections, specifications, notification, abatement, and disposal, as applicable, should be conducted in compliance with federal and state regulations.

TxDOT would require its contractors to take appropriate measures to prevent, minimize, and control accidental spills that may occur during roadway construction. All construction equipment and materials would be removed as soon as the schedule permits.

XXVIII. Indirect and Cumulative Effects

This section describes the indirect and cumulative effects analyses conducted for this EA. This analysis examines the indirect and cumulative effects SH 288 may have on the surrounding area to the year 2035 with the addition of the proposed toll lanes and other related improvements. In general, indirect and cumulative effects include those consequences of a proposed action that are not direct and may not be readily observable. Indirect effects are those effects that would be expected to be caused by the proposed project but would be later in time or removed in distance. Cumulative effects are those impacts that would result from the incremental consequences of an action when added to other past, present, and reasonably foreseeable future actions. Indirect and cumulative effects are less defined than direct effects, and by definition, cumulative effects are incremental in nature and usually are less defined than indirect effects.

This analysis follows the requirements and processes outlined in the following regulations and guidance:

- 23 CFR 771 – This regulation prescribes the policies and procedures of the FHWA for implementing NEPA and the regulations of the CEQ, 40 CFR 1500 through 1508
- Revised Guidance on Preparing Indirect and Cumulative Impact Analyses, TxDOT, September 2010

- Guidance for Preparing and Processing Environmental and Section 4(f) Documents, FHWA Technical Advisory T6640.8A, 1987
- Position Paper – Secondary and Cumulative Impact Assessment in the Highway Project Development Process, FHWA, 1992
- Report 466 – Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects, NCHRP, 2002
- Report 25-25/Task 22 – Forecasting Indirect Land Use Effects of Transportation Projects, NCHRP, 2007
- Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process (Interim Guidance), FHWA, 2003
- Considering Cumulative Effects Under the National Environmental Policy Act, CEQ, 1997
- Guidance on the Consideration of Past Actions in Cumulative Effects Analysis, CEQ, 2005
- Guidance for Preparers of Cumulative Impact Analysis Approach and Guidance, California Department of Transportation, 2005

This section describes the analysis of potential indirect and cumulative effects of the proposed addition of four toll lanes to SH 288, direct connectors to IH 610 and BW 8, and improved access to the TMC.

A. Indirect Effects Analysis

The CEQ regulations define indirect effects as:

> "…effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8).

Indirect effects often occur outside of the project ROW, and may include induced growth-related effects on air, water, and other natural resources.

There are three broad categories of indirect effects:

- Encroachment-Alteration Effects alter the behavior and functioning of the physical environment. These effects are related to project design features, but are separated from the project by time and/or distance.
- Access-Alteration Effects, also known as Project-Influenced Effects or the Land Use Effect. Changes in traffic, access, and mobility can result in changes in land use. Highway projects might promote development, or influence and increase in the rate of development; these effects are often referred to as induced growth.
- Effects Related to Project-Influenced Development, or Induced Growth-Related Effects, are attributable to the induced growth itself.

Examples of potential indirect effects of transportation projects include:

- Development and land use changes due to improved access

- Increase in storm water runoff due to changes in land use and increased development on land surrounding a proposed roadway facility
- Increased sedimentation of wetlands and streams and decreased water quality due to future development of land adjacent to a new roadway facility
- Loss of vegetation and wildlife habitat and decreased habitat value in areas of increased land development caused indirectly by improved access
- Impact to historic or archeological resource sites from development projects on private property that do not require cultural resource investigation because public funds or permits are not required
- Increased use of parks and recreational areas due to more convenient access provided by a new facility

Stimulation of the local economy from the circulation of construction spending; improved access to employment opportunities, markets, goods, or services such as health and education; an increased work force related to construction; and developments stemming from a new facility.

TxDOT's *Revised Guidance on Preparing Indirect and Cumulative Impact Analyses (September 2010)* is adapted from NCHRP Report 466 and describes a seven-step process for conducting an indirect impacts analysis. The steps listed in *Table 33* are the process followed for analysis of indirect effects of the proposed project.

Table 33. Steps for Conducting an Indirect Impacts Analysis

1	Scoping
2	Identify the study area's goals and trends
3	Inventory the study area's notable features
4	Identify impact-causing activities of the proposed action and alternatives
5	Identify potentially substantial indirect effects for analysis
6	Analyze indirect effects and evaluate results
7	Assess consequences and consider/develop mitigation

Source: TxDOT 2010.

A.1 Scoping

The approximately 90,580-acre, 142-square mile area of influence (AOI) for the SH 288 project was defined using a 2- to 3-mile radius from the SH 288 ROW (*Figure 9*). This radius was selected because the next major north-south road to the east, Cullen/FM 865, is approximately 2 miles from SH 288, and the next major north-south roadway to the west is Almeda/FM 521, shifting to Kirby Drive at Holmes Road, and varying between 2 to 3 miles from SH 288. Almeda/FM 521 and Cullen/FM 865 provide north-south travel routes, defining the approximate travelshed of the proposed project. Recent studies in the corridor showed that most of the traffic movement in the AOI is oriented in a north-south direction. FM 1462, an east-west thoroughfare south of the southern limit of the proposed toll lanes at CR 60, is the southern boundary of the AOI. The northern boundary of the AOI is IH 45, at the southern edge of downtown Houston. The temporal boundary of the indirect effects analysis is 2035, the horizon year of the current *2035 RTP Update*.

A.2 Identify the Study Area's Goals and Trends

The AOI includes areas in Houston, Pearland and its ETJ, Manvel, and unincorporated areas of Harris and Brazoria Counties. In the area within Houston, the TMC area is undergoing redevelopment. In 1999, the TMC, responding to substantial growth on the medical center campus, published the "Vision for Growth: A 50 Year Master Plan for the Institutions of the Texas Medical Center," and updated the plan in 2006. The plan established a framework to guide institutional growth and improve the physical environment of the TMC, located in the AOI northwest of the SH 288/IH 610 interchange. Subsequently, additional master plans were initiated to provide guidelines on Hazard Mitigation, Pedestrian Circulation, a Skywalk System for the Main Campus, and Stormwater Management. The TMC area includes approximately 1,000 acres, with 13 hospitals, 19 academic institutions, and 15 support services organizations. The TMC reports that "Significant infrastructure growth has been realized in the last seven years, and development will occur at an accelerated rate over the next three to five years." Approved building and infrastructure investments between 2008 and 2012 were budgeted at $7.1 billion. Improved pedestrian and vehicle access and mobility are included in ongoing and future projects.

Pearland's 2020 comprehensive plan shows existing undeveloped and low-density residential uses proposed for conversion to higher intensity multi-family and commercial uses. The City of Manvel developed a comprehensive plan to the year 2025 that directs growth and development toward SH 288. The comprehensive plan indicates the future conversion of existing commercial and industrial activities in the vicinity of SH 288 and SH 6 to mixed-use commercial and multi-family residential developments.

Development projects are planned on 12,000 acres of undeveloped land in the AOI, including approximately 700 acres of farmland - 4.4 percent of the active farmland in the AOI (*Figure 9*). Development in the AOI is regulated through the subdivision ordinances of city and county jurisdictions. The cities of Houston and Pearland require floor elevations in the 100-year floodplain to be 12 inches above base flood levels. Harris County requires that the first floor be 18 inches above the base flood level, and Brazoria County and the City of Manvel require the first floor to be 24 inches above base flood level. All jurisdictions restrict improvements in the floodplain from contributing to increased runoff and flooding onto adjacent properties. This type of restriction typically requires construction of detention ponds, or berms and swales to manage storm water. The City of Houston and Harris County require no net loss of floodplain capacity.

The regional economy is expected to remain strong, according to Barton Smith (Director of the Institute for Regional Forecasting, University of Houston). The largest employers in the HGB area include Wal-Mart; Administaff; Continental Airlines; grocers: Kroger and HEB; the Methodist, Memorial Herman and M.D. Anderson hospital systems; and various oil, gas, and other energy-related companies. According to Adriana Fernandez, economist with the Federal Reserve Bank of Dallas Houston Branch, Houston is among the top U.S. metropolitan areas in terms of job creation. (Houston Chronicle 2009)

The acreage of wetlands in the AOI has decreased since 1989. This is mainly attributable to land use modifications. Based on the NWI mapping, there are approximately 2,200 acres of wetlands and approximately 127 acres of waters within the AOI. Water bodies include bayous, creeks, and canals. Water quality is impaired in some of these waters.

Between 2010 and 2030, the populations of the Cities of Houston and Pearland are forecast to increase by 31 and 42 percent, respectively. The populations of Manvel and Iowa Colony are projected to decrease slightly, by 13 and 4 percent, respectively, between 2010 and 2030. During the same period, the populations of Harris and Brazoria Counties are forecast to increase by 27 and 28 percent, respectively. H-GAC predicts that between 2000 and 2030, an additional 3.5 million people will live in the HGB area, bringing the regional population to a total of 8.8 million, with 4 million jobs. H-GAC attributes the region's outlook to many factors, including strategic access to the Gulf of Mexico, natural resources (including oil and gas), and quality of life (H-GAC 2035 RTP Update).

Land use changes have impacted vegetation, wildlife, and habitat within the AOI. Vegetation, soils, breeding, roosting and nesting habitats have been converted to agriculture or land development (or other development land uses). This has diminished wildlife habitat in the AOI.

The air quality in the AOI is currently considered in poor or declining health, because the AOI is within the HGB severe nonattainment area for ozone. The *2035 RTP Update* defines transportation systems and services in the area containing the boundaries of the AOI. The RTP addresses regional transportation needs that are identified through forecasting current and future travel demand, developing and evaluating system alternatives, and selecting those options which best meet the mobility needs of the region. The proposed facility is included in this plan.

A.3 Inventory the Study Area's Notable Features

The AOI for the proposed project consists of urban and rural areas. Fifty-six percent of the AOI is undeveloped or in agricultural use. The terrain is relatively flat and large areas of cropland (including pasture/grazing lands) are present in the southern portion of the AOI. Riparian vegetation is around some bayous and aquatic features. The AOI is traversed by Brays Bayou, Sims Bayou, and Chocolate Bayou and contains approximately 18,300 acres (20 percent) of floodplain. Based on the NWI mapping available from the USFWS, there are approximately 2,200 acres of wetlands and approximately 127 acres of waters within the AOI.

Part of Downtown Houston is in the northern part of the AOI. The TMC is near the SH 288/IH 610 interchange. The Houston Zoo, Herman Park, and Museum District are west of SH 288 in the TMC area. Residential subdivisions, churches, cemeteries, schools, and other community resources are located in the AOI. *Figure 5A* includes a table that lists the churches, cemeteries, hospitals, schools and parks in the AOI which are shown on *Figure 5*. As described in the Community Impacts section of this document, the subdivisions located along the corridor are part of seven of the City of Houston's Super Neighborhoods (see *Figure 6B*). The proposed project would not bisect any established neighborhoods or isolate any neighborhoods or communities, nor would it affect planned development of the project area.

A.4 Identify Impact-Causing Activities of the Proposed Action and Alternatives

The proposed project would include construction of additional lanes in each direction within the existing grassy median of SH 288, interchange improvements at IH 610 and BW 8, improved access to the TMC, and associated frontage road and bridge improvements. The proposed improvements would be constructed in phases. The interim phase of the project would involve the construction of toll lanes from US 59 to SH 6, and the ultimate phase would extend the toll lanes from SH 6 southward to CR 60. Direct-connector improvements at IH 610 and BW 8, and new overpasses at selected, existing at-grade intersections would be constructed during the ultimate phase of the project.

Construction of roadways and bridges would require clearing of vegetation, excavation and fill in some locations, and modification of existing drainages within the project ROW. The proposed project would add four toll lanes to the SH 288 between US 59 and CR 60, two general-purpose lanes between IH 610 and BW 8, additional ramps, auxiliary lanes, frontage road improvements (in some locations), and direct connectors at BW 8. Depending on the phasing of construction and negotiations with the contractor, storage of some construction materials may be allowed within the project ROW. The proposed project would add or relocate entrance/exit ramps along the project limits, and includes improved access to the TMC via a direct connector to Almeda Road. The proposed project is expected to help alleviate traffic congestion in the project area.

Most of the construction would be performed within existing ROW, in previously disturbed areas that have mowed and maintained vegetation. In areas of new ROW (approximately 69 acres), 95 percent is in agricultural/undeveloped use. Vegetation in the existing and proposed ROW would be disturbed, and some areas would be permanently disturbed. Approximately 274 acres of vegetation would be affected by construction, including 190 acres of maintained vegetation in the existing ROW. Approximately

2.55 acres of waters of the United States, including wetlands, would be affected as a result of the proposed project. The toll lanes are proposed to be located between the existing general-purpose lanes from US 59 to CR 60, a distance of approximately 26 miles. Twelve grade-separated crossings would be constructed at various creeks, bayous, irrigation canals, and other drainage channels. While these crossings would be between the existing general-purpose lanes, new support columns may be required in the floodway.

The proposed project would require the relocation of the tenants of seven apartment units along SH 288 north of IH 610, and commercial parking and loading areas at commercial properties along IH 610 and SH 288. The majority of the property to be acquired for project ROW is vacant land adjacent to SH 288 at various cross streets in the southern area of the proposed project. Long-term economic effects of the proposed project would include the permanent removal of taxable property from the tax rolls of local government entities and school districts. Revenue collected from the proposed SH 288 toll lanes would help fund the construction, operation, and maintenance of SH 288.

Based on the State Comptroller's input-output model, roadway construction activities would indirectly create up to 45,588 jobs in the short term. The total additional income that would be created indirectly by implementation of the proposed project is projected to be $811 million. The total statewide effect from the proposed project is estimated to be $3.8 billion, based on the Texas State Comptroller model.

A.5 Identify Potentially Substantial Indirect Effects for Analysis

Potential indirect effects were examined for the potential to be substantial. Types of indirect effects include: encroachment-alteration effects, induced growth effects, and effects related to induced growth.

Encroachment-alteration effects (ecological) – A team of biologists and ecologists have determined that ecological encroachment-alteration effects have no potential to be substantial. The proposed project would affect approximately 274 acres of vegetation, of which 70 percent is existing mowed and maintained roadway ROW, and a total of 15 acres is aquatic features, riparian areas, wetlands, and scrub-shrub vegetation. The existing SH 288 crosses numerous aquatic features (bayous, creeks, tributaries). The bayous and some creeks are bridged, and some water features are in culverts across the project ROW. Potential fill in wetlands and other waters of the United States would be minimal and would not substantially alter the hydric regime. Impacts to waters of the United States would be avoided and minimized to the greatest extent practicable through the use of design modifications such as bridges or bridge-class culvert structures. Wildlife habitat in the project vicinity is limited, as most of the area is developed or used for agricultural purposes. No new barriers to wildlife movement would be introduced by the proposed project. Fragmentation of wildlife habitat has occurred in the area due to past roadway, land development, and agricultural land uses.

Encroachment-alteration effects (socioeconomic) – The proposed project would help alleviate congestion and improve mobility in the corridor, but would not substantially change travel patterns and access in the corridor. Access would change in some areas where entrance/exit ramps are being constructed and/or modified.

For this project, ramps would not be removed in areas of neighborhoods that have grown accustomed to their availability. In some instances, ramps would be relocated in order to provide higher safety standards. The safety standards for a limited access freeway vs. the original highway would be enhanced by these modifications. While final design may adjust some locations, the areas that would experience change are:

- Rodeo Palms Parkway (currently a right-in/right-out and would now have a new intersection);
- The entrance ramp to southbound SH 288 from south of Southmore Boulevard would change; traffic would continue through the traffic light at Binz;
- Northbound Almeda Road from IH 610 westbound would have new access;

- A new ramp would be provided at Scott Street for IH 610 westbound;
- Areas northeast of Belfort Boulevard would have a change in accessing IH 610 eastbound and westbound, they would access from a ramp on SH 288 slightly north from the current access location;
- The exit ramp from IH 610 to Fannin Street would be moved; the exit would be at Almeda Road; and
- The proposed connector to Almeda Road/FM 521 would improve access to the TMC area.

ROW acquisition would temporarily impact access and permanently impact parking at several businesses along IH 610 and SH 288, but is not expected to cause the businesses to relocate. No adverse encroachment-alteration effects would be expected to cemeteries, churches, schools, hospitals, or parks. No substantial encroachment-alteration effects would be expected to neighborhoods, travel patterns, the economy, aesthetics, or other socioeconomic resources. The proposed improvements would improve access to the TMC area, which is consistent with the TMC's goals of improving vehicle access and mobility.

Induced growth effects – The AOI includes undeveloped land. Although some development since 1975 in the AOI can be attributed to the construction of SH 288, the increase in the rate of development in the AOI since 1995 corresponds to the completion of construction of BW 8. Based on review of historical aerial photographs and the current city plans of Manvel and Pearland, a correlation can be drawn between the change in land use in the AOI and the construction/operation of SH 288. SH 288 has influenced development in the AOI, and the communities located south of BW 8 plan to direct future development toward the SH 288 corridor. Analysis of development trends and local land use plans indicate that continued development in the AOI is likely. Induced growth effects may have the potential to be substantial.

Effects related to induced growth – Induced growth is not expected to result in substantial ecological effects, because most of the AOI that is undeveloped is agricultural/farmland. Habitat throughout the AOI is already fragmented, and exists mainly in areas of bayous, creeks, and other natural waterways. Because development in these areas is typically regulated, it is likely that induced growth would not substantially impact ecologically sensitive areas. Socioeconomic effects related to induced growth will be evaluated. The AOI is part of the EPA-designated 8-county nonattainment area for ozone. The AOI is currently in attainment for all other NAAQS pollutants. As the proposed project is anticipated to result in indirect air quality impacts, further evaluation and discussion of air quality and MSATs is included in Steps 6 and 7.

A.6 Analyze Indirect Effects and Evaluate Results

The primary indirect effects of the proposed project would be the result of induced development. Several factors are present to facilitate development in the AOI. Fifty-six percent of the AOI is currently undeveloped, the terrain is flat, state and local codes provide few restrictions, and the school district covering most of the AOI is moderately growing compared to other suburban districts in the area. Development in the AOI has been occurring at a steady rate for the past 10 years. The proposed project could primarily have an effect on the timing, location, and type of development that takes place, if other factors affecting development do not change. If development occurs at an average of 4 percent per year, the 90,580-acre AOI would be 95 percent developed by 2035. This four percent growth rate is the approximate average annual growth rate from 1975 to 2005.

Although there is an undeniable relationship between infrastructure and regional development, many factors determine when and where development occurs. Transportation, economics, quality schools, available utilities, suitable land, and favorable development regulations are all factors that contribute to growth. According to the Urban Land Institute (ULI), programmed transportation improvements are not the driving force in development processes (ULI 2004). Regional development is primarily driven by

regional economics and the major effect of highways is the distribution of development within a region (FHWA 2004; Cevero 2003; Hartgen 2003a and 2003b). Access and improved mobility provided by SH 288 and BW 8 have been factors in the development of the area. As a result, the City of Pearland made efforts to direct its growth toward SH 288. In 1999, Pearland entered into an agreement with the City of Houston to extend Pearland's extraterritorial jurisdiction (ETJ) to include the BW 8/SH 288 interchange, to take advantage of the development opportunities at that location. The proposed project could induce development in the AOI to occur sooner than originally planned by improving roadway capacity and mobility; however, the proposed project would not improve access to previously inaccessible property. Development may continue to be directed toward SH 288, which is consistent with the plans of the cities of Pearland and Manvel, and private developments in the vicinity, but other factors, such as the economy, will have a greater influence on when development occurs. Local plans indicate approximately 12,000 acres are proposed for suburban development in the AOI, and the timeline for these projected developments ranges from 10 to 15 years.

Based on other projects in the region and empirical studies by other transportation agencies (NCHRP Report 25-25 [Task 22]), added capacity projects on existing roadway facilities tend to have less of an effect on induced development than new facilities. Estimated impacts from induced development in a project's AOI from added capacity projects in the region has varied from 10 to 15 percent for existing facilities, up to 30 percent for new facilities. As an improvement to an existing facility, the proposed project could be expected to influence approximately 10 to 15 percent additional development compared to the No Build alternative. Assuming that undeveloped land in the AOI is developed at an average rate of 4 percent per year, approximately 47,300 acres would be developed by 2035. If the proposed project induces an additional 10 to 15 percent more development than the No Build alternative, between 4,730 to 7,095 additional acres would develop in the AOI. If current trends continue, the AOI would be 100 percent developed by 2033.

The primary economic indirect effects of the proposed project would be the result of project-related job creation and income in the economic AOI as a result of project construction, and as a result of induced development in the AOI. Construction of the proposed project would have indirect effects on local, regional, and state employment, output, and income. Indirect effects are the sum of all the rounds of purchases by all the interrelated sectors of the state economy (including direct, induced, and all additional effects) beginning with those that supply the suppliers of the new roadway/highway construction sector. Indirect effects distribute throughout the economy at each round of purchases, and are generated by the consumption of goods and services made possible by the payrolls associated with the construction project. Indirect economic effects could also include increased property values as a result of induced development, sales taxes from new commercial activity, and increased employment accompanying new businesses. Residential and commercial development would lead to the construction of additional schools, parks, and public services for the benefit of the growing population. New commercial businesses and residential properties would provide additional tax base and employment opportunities in the land use AOI.

Direct impacts on air quality and MSATs from the project are primarily those associated with the increased capacity and accessibility, as well as the resulting projected increases in VMT. EPA's new fuel and vehicle standards projected to reduce emissions of air pollutants and MSATs are expected to offset these impacts resulting from the increases in VMT. These net emissions reductions are expected to contribute to continued maintenance and improvement of air quality and MSAT levels in the AOI.

The potential indirect impacts on air quality and MSATs/VOCs are primarily related to induced development in the AOI. Induced development could impact timing, location, and type of development. Assuming the AOI develops at an average rate of 4 percent per year, approximately 47,300 acres would be developed by 2035. If the proposed project induces an additional 10 to 15 percent more development than the No Build alternative, then 4,730 to 7,095 additional acres would develop in the AOI. The induced development would be expected to include businesses associated with residential development, including areas sources such as bakeries, gas stations, automotive repair facilities, dry cleaners, etc.

Future development projects would likely impact some wetlands and waters of the United States in the AOI. The USACE maintains a "no net loss" policy for losses of waters of the United States, including wetlands, and any impacts resulting from induced development would require compensatory mitigation to offset the functions and services these areas provide to the surrounding environment. Increased impervious surfaces and runoff from surrounding areas within the watershed could adversely affect the effectiveness of the functions and services they provide. Loss of the functions of wetlands and waters of the United States could cause higher flow rates with less attenuation and settling of pollutants and suspended solids, which could adversely affect water quality within the receiving waters and downstream watersheds.

Induced development within the AOI may affect habitats for wildlife species, depending on the location, the habitat present, and the potential occurrence of that species at that location. Induced development would convert of cropland or undeveloped land to impervious surface and would result in changes in the vegetation communities to urban vegetation types, which might result in impacts to marginal habitat for some species, if the habitat supports these species. Wildlife communities may change in their type and biodiversity as a result of this induced development, with those species more adaptive to a more urbanized area invading and competing with other wildlife species in the project vicinity. Operational noise, noise generated by use of the roadway, may increase within the immediate vicinity of the roadway. This increase in operational noise would have negligible effects to wildlife and other species immediately outside the immediate vicinity of the project.

A.7 Assess Consequences and Consider/Develop Mitigation

Induced development could result in improved mobility and public safety in the AOI. As more land development occurs, more segments of the major thoroughfares are likely to be built and roadway interconnectivity would increase. Induced development and its related impacts would be the primary indirect impacts of the proposed project. Development in the AOI is subject to the City of Houston, Pearland, Manvel, Harris County, and Brazoria County subdivision regulations, depending on jurisdiction. Many of the larger master planned developments incorporate design concepts to maximize detention, open space, and aesthetics. Commercial centers and mixed use developments may also be incorporated to provide services, employment, and travel options for residents. These development practices may reduce the overall impact the development could have on resources. Limited development restrictions are imposed by the cities or counties in the AOI, and only Pearland has zoning regulations. Development projects in the vicinity of the proposed project would be required to comply with local floodplain regulations and guidelines to mitigate for potential fill activities within floodplain areas. Federal, state, and local regulations would be the primary methods used to avoid or minimize potential adverse impacts of future development on land use and floodplains. There is currently no protection policy for farmlands in the area.

The proposed project would indirectly create an estimated 45,588 jobs in the short term. The total additional income that would be created indirectly by implementation of the proposed project is projected to be $811 million. The total statewide effect from the proposed project is estimated to be $3.8 billion, based on the Texas State Comptroller's model.

The proposed project could induce up to 10 to 15 percent additional development in the land use AOI. Economic benefits to the local economy could be additional residential and commercial development, which would provide additional property and sales tax to the local economy.

Effects from future development projects to regulated resources such as waters of the U.S., including wetlands, would be mitigated through the Department of the Army permitting process or possibly through other measures. Regulations related to floodplains and water quality would prohibit or mitigate potential degradation of some existing terrestrial and aquatic wildlife habitat.

Induced development may affect vegetation and wildlife species; however, this is largely dependent on the rate at which the area develops and the jurisdiction of various municipality and local governments that

identify planning and zoning within the AOI. It is expected that most of the land in the AOI would be developed by 2035. Federal and state regulations would be the primary methods used to regulate impacts to vegetation and wildlife, in particular to protected species. Development of greenbelts within planned communities could provide some limited benefits to wildlife species by providing corridors by which to travel to more suitable habitat. Native plant species can be encouraged to be planted in developed areas instead of invasive non-native species.

Any increased air pollutant or MSAT emissions resulting from the potential development or redevelopment of the area must meet regulatory emissions limits established by the TCEQ and EPA, as well as obtain appropriate authorization from the TCEQ. Regulatory emission limits set by TCEQ and EPA are established to attain and maintain the NAAQS by assuring any emissions sources resulting from new development or redevelopment will not cause or contribute to a violation of those standards. Therefore, because the project's potential direct and indirect impacts on air quality and MSATs are projected to be offset by federal fuel and vehicle control programs or state and federal regulatory programs, negative impacts on air quality are not anticipated.

Regional Indirect Effects of Toll Facilities and Managed Lanes

The freeway and toll road system is a major component of the Houston-Galveston regional roadway network. Currently, the freeway/toll road system represents nearly 19 percent of regional lane miles. The 2009 regional roadway network consists of nearly 24,571 total lane miles. This includes nearly 658 tolled lane miles and 289 managed lane miles (*Table 34*). By 2035, these numbers are expected to increase to 27,997 lane miles of which 1,584 are tolled lane miles and 425 are managed lane miles.

Table 34. Regional Roadway Network (lane miles)

	Freeway	Toll Roads	Managed Lanes	Arterial	Total Lane Miles
2009 Network	3,669	658	289	19,955	24,571
2035 Network	3,862	1,584	425	22,126	27,997

Note: Table data is based on the 2035 RTP Update conducted by H-GAC in 2011.
Source: GP-GEC 2012.

In addition, the transit system has 485,000 daily passenger boardings and is expected to increase to nearly 725,000 by 2035. This increase will be attributed to:

- Expansion of transit services (increased bus and rail transit services),
- New transit modes (commuter rail transit and signature express bus service),
- Transit connectivity to multiple employment centers, and
- Coordination of transit services among regional public transportation providers.

METRO's 2035 Long Range Plan recommends significant expansion of the current transit system and includes a network of integrated high capacity transit facilities on major travel corridors. This plan also identifies service expansions beyond the METRO service area. New improvements scheduled for implementation through the year 2035 include high occupancy tolls, a new intermodal terminal, park-n-ride facilities, and several new high capacity transit corridors throughout the region. Additional key elements of the plan include:

- 89 miles of fixed guideway transit – Light Rail Transit (LRT)
- 84 miles of Commuter Rail Transit (CRT)
- 40 miles of Signature Bus (H-GAC 2009)

Exhibit 4 shows the future corridor and capital facilities projects in the 2035 METRO Long Range Plan.

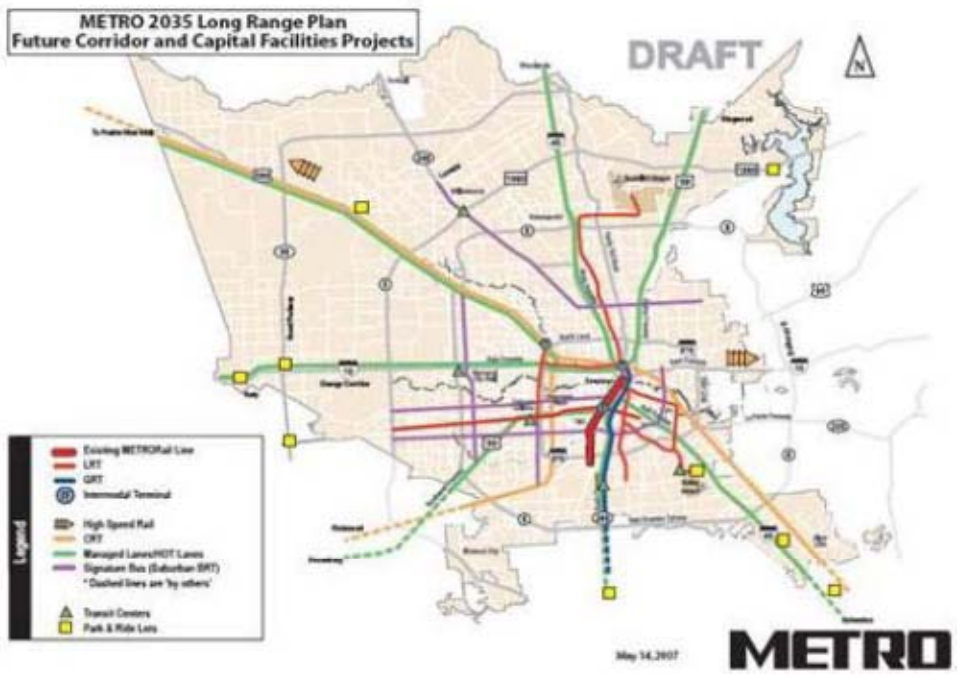


Exhibit 4: 2035 Future Corridor and Capital Facilities Projects

Source: H-GAC 2009.

Conclusion

The expanding regional roadway network, including tolled facilities and managed lanes, along with the expanding transit network could have indirect and cumulative impacts. However, the impacts are not isolated to one location and would be better considered at the regional level. As a result, the consideration of the regional tolled roadway network is included in the cumulative impacts portion of this document.

B. Cumulative Effects Analysis

This section presents the cumulative effects analysis conducted for this EA. This section includes an introduction to the background and project-specific requirements for the cumulative effects evaluation followed by a description of the methodology utilized to perform the analysis. Subsequent subsections provide the resource-specific cumulative effects evaluations, followed by a summary of the results of the analysis.

B.1. Introduction

The CEQ regulations define cumulative effects as:

> "…the impact on the environment which results from the incremental impact of the action (project) 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Cumulative effects (impacts) include both direct and indirect, or induced, effects that would result from the project, as well as the effects from other projects (past, present, and reasonably foreseeable future actions) not related to or caused by the proposed action. The cumulative effects analysis considers the magnitude of the cumulative effect on the resource health. Health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if more or less stress on the resource is likely in the foreseeable future.

Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects of the proposed project would be the incremental effects that the project's direct or indirect effects have on that resource in the context of other past, present, and reasonably foreseeable future effects on that resource from unrelated activities.

B.2. Methodology for Cumulative Impact Analysis

An eight-step process was followed to assess cumulative impacts, based on TxDOT's *Revised Guidance on Preparing Indirect and Cumulative Impact Analyses*. The steps are listed in *Table 35.*

Table 35. Steps for Identifying and Assessing Cumulative Impacts

1	Identify the resources to consider in the analysis
2	Define the study area for each resource
3	Describe the current status/viability and historical context for each resource
4	Identify direct and indirect impacts of the project that might contribute to a cumulative impact
5	Identify other reasonably foreseeable future effects
6	Identify and assess cumulative impacts
7	Report the results
8	Assess the need for mitigation

Source: TxDOT 2010.

The eight steps used in this cumulative effects analysis are described below.

Step 1: Identify the Resources to Consider in the Analysis

The first step in performing the cumulative impact analysis was to identify which resources to consider in the analysis. The cumulative impact analysis should focus only on (1) those resources substantially impacted (directly or indirectly) by the proposed project; and (2) resources currently in poor or declining health or at risk, even if project impacts are relatively small (less than significant).

Construction of the proposed project would not be expected to have substantial direct or indirect impacts to any resources evaluated. *Table 36* summarizes direct and indirect impacts of the proposed project, presents a determination of which resources would be carried forward and evaluated in the cumulative effects analysis, and identifies the resources and effects categories were eliminated from the cumulative effects evaluation.

Step 2: Define the Study Area for Each Resource

The cumulative effects analysis considered both geographic and temporal study limits, where applicable. A Resource Study Area (RSA) was defined for each resource and is discussed in the subsection for each resource. The RSAs are used for characterization of the resource status/viability and historical context for each resource and to determine the potential cumulative effects on a resource when quantitative information was not available. Cumulative effects were determined considering the potential cumulative effect on the health and trend of the resource within the RSA.

Step 3: Describe the Current Status/Viability and Historical Context for Each Resource

The current status/viability and historical context of each resource is described and presented in each resource subsection. This information is important to establish the baseline condition and trend the resource is experiencing, and to be able to estimate the magnitude of effects to the resource. The historical context is described to provide an explanation of the factors that have caused the current health, condition, or status of the resource. As previously mentioned, health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Past actions represent the projects or activities in the area that have collectively caused the current status, health, vitality, and trend of the resources summarized in each resource section. Where possible, a quantitative assessment of the current health condition and the trend it is experiencing was provided; however, for many resources, quantitative data were not available to document the current health or trend of the resource. For these resources, a qualitative discussion of the resource health and trend is presented, and the types of actions that have caused or influenced resource health and trends are discussed.

Step 4: Identify Direct and Indirect Impacts of the Project that Might Contribute to a Cumulative Impact

In this step, the direct and indirect effects are identified that could result from the proposed project that may contribute to a cumulative effect when added to non-project related effects. Direct and indirect impacts are defined by CEQ regulations (40 CFR 1508.8) as follows: "Direct impacts are caused by the action and occur at the same time and place", "Indirect (secondary) impacts are caused by the action and are later in time and farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate and related effects on air and water and other natural systems, including ecosystems." A summary of the direct and indirect effects is presented for each resource.

Step 5: Identify Other Reasonably Foreseeable Future Effects

A cumulative and indirect effects analysis requires consideration of past and present actions, and reasonably foreseeable future actions. The approach used for this cumulative effects analysis included an assessment of past, present, and future actions with the purpose of characterizing the types of actions that are representative of past, present, and future development and activities in the RSA. This provides a context for the types of development projects that have caused the current status/viability of the land and other resources, and the trends the resources are experiencing. It also provides insight as to the effect of development on future resource stress and future trends.

Step 6: Identify and Assess Cumulative Impacts

Quantitative assessment of the cumulative effects on resource health and trends in the RSA was the goal of the cumulative effects analysis. However, where incomplete or unavailable information precluded a quantitative assessment of all resources, a qualitative assessment of the cumulative effect on each resource was performed. The cumulative effects analysis considered the direct and indirect effects of the project, together with the effects of past, present, and reasonably foreseeable future projects. The magnitude of the cumulative effect was determined by comparing the effect to the health and trend of the affected resource.

Step 7: Report the Results

The results of the cumulative effects analysis are reported herein. Direct effects are summarized under each resource and indirect effects were reported in the *Indirect Effects Analysis* section above. Both are summarized below as they are included in the cumulative effects analysis. The assumptions and analysis methods used are described in each resource section.

Step 8: Assess the Need for Mitigation

Opportunities for mitigation of adverse effects are discussed for each resource. These are not meant to be mitigation measures that TxDOT would, or has the authority to, implement. Rather, they are intended to disclose steps or actions that could be undertaken by local, state, and federal agencies and organizations to minimize the potential cumulative effect on each resource health and trend.

Table 36. Determination of Resources/Issues Considered in Cumulative Effects Analysis

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Land Use			
Within the 142 square mile RSA, land use is a mix of residential, commercial, industrial, institutional, agricultural, and undeveloped uses. In general, higher density development occurs in the northern portion of the RSA, in association with established communities and along major roadway facilities. Large areas of undeveloped land are common in the southern portion of the RSA. Development will continue in response to predicted population and employment increases. SH 288 has influenced land use in the area.	Approximately 69 acres of ROW would be acquired, primarily for improvements at intersections. One residential apartment/ townhome building (7 rented units) would be displaced at the Park Yellowstone apartments. Some parking and loading/storage areas at several businesses would be displaced due to ROW acquisition, and an off-premise sign would be relocated.	Development within the RSA would be affected by the proposed project. Improved roadway capacity and mobility would influence planned development in the RSA. Approximately 20,660 acres of development is planned within the RSA. While no changes in overall land use patterns in the area would be anticipated as a direct or indirect result of implementation of the proposed project, the proposed project would increase development by 10 to 15 percent. The proposed project is consistent with local community plans.	Yes
Farmland			
Farmlands in Texas are increasingly being developed, with 2.2 million acres of rural land in Texas converted to developed use in a five-year period between 1992 and 1997. Large amounts of farmland are being converted and proposed to be converted to residential and other developed use as the population grows.	Of the 69 acres of ROW to be acquired, approximately 65 acres are undeveloped, and most are in agricultural use as pasture or farming.	Most of the 20,660 acres of anticipated development in the vicinity of the proposed project could convert existing farm and pasture land to residential and commercial uses. A portion of the development could result in the loss of prime farmland.	Yes
Communities/Quality of Life (The communities/quality of life resource/issue encompasses human environment effects. The issues listed below were evaluated.)			
Displacements and Relocations	Approximately 69 acres of ROW would be acquired. One residential apartment/townhome building (7 rented units) would be displaced at the Park Yellowstone apartments. Some parking spaces and loading/storage areas at several businesses would be displaced, and one commercial billboard sign would be displaced.	Induced development could cause displacements and relocations. Most land planned for development is currently vacant and/or used for agriculture/pasture.	No

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Community and Public Resources	In the short term, an increase in traffic congestion and potential changes in travel patterns would be expected during roadway construction. In the long term, the proposed project would improve mobility in the RSA, having a positive impact for citizens living in nearby neighborhoods and/or trying to access community and public facilities. As the regional population grows and congestion on SH 288 increases, improved access to the TMC would have a positive impact for residents in the RSA. Emergency response and accessibility to medical services would be improved with increased roadway capacity. Community impacts in the RSA would not be expected as a result of tolling of the proposed project. All users of the roadway including local communities and neighborhoods would be able to use the existing SH 288 free lanes or other existing roads that are not tolled.	Development in the AOI induced by the proposed project would require additional infrastructure elements and public services. New roadways, drainage, water supply and treatment facilities, schools, libraries, and medical services, would be expected to be constructed as residential and commercial development occurs. While ramp modifications are included for this project, no indirect impacts are anticipated as a result. Access would still be available where ramps are being relocated, and new ramp locations are within the existing ROW.	No

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Environmental Justice Population and Demographics	Impacts to low-income and minority communities would be expected as result of the proposed project. Noise receivers in adjacent communities including some areas with low-income and minority populations would experience increased traffic noise. The locations of the noise receivers are discussed in *Section XXIII*. Residential displacements would occur in a high minority area; however, as shown in *Table 8,* adequate replacement housing is located within two miles of the displaced residential property. The project level impacts of tolling on low-income individuals would be that motorists who choose to use toll lanes would pay a toll regardless of their income; the tolling of the proposed improvements may constitute a greater burden on lower-income motorists. However, the existing SH 288 roadway would continue to have free lanes. Overall improved mobility in the vicinity of the project area would benefit all roadway users. Within the HGB transportation network, the proposed project would be 0.28 percent of the total planned tolled miles in 2035.	No indirect impact to environmental justice populations or demographics changes of the study area would be expected as a result of the proposed project. Increased overall mobility may expedite development in the RSA, bringing expanded public facilities and services.	No
Economic Resources	Direct effects to economic resources would include the acquisition of an apartment building, a billboard sign, and the loss of parking/loading areas at several businesses.	Indirect economic benefits of the proposed project are estimated to be 45,588 jobs and $811 million in additional income during project construction. Indirect economic benefits would also be associated with induced development within the land use AOI.	No

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Visual and Aesthetic Qualities Visual and aesthetic qualities vary throughout the project area. Much of the study area north of IH 610 is generally densely developed, with multi-level highway interchanges at US 59 and IH 610. The majority of the study area south of IH 610 is currently undeveloped agricultural land with some wooded areas near streams. Master planned developments have been built and more are planned.	Elevated ramps at SH 288 interchanges could cause some direct visual and aesthetic impacts in those areas.	Increased land development along the project corridor could affect the visual quality of the RSA.	No
Noise Roadway traffic is the dominant source of noise in the project area. The study area south of IH 610 is primarily undeveloped land with low-density residential and commercial activity.	Traffic noise impacts would occur at various locations along the project. Specific information on impacts and proposed noise abatement is addressed in *Section XXIII*.	Induced development could cause changes in noise levels. Construction noise would be temporary. If undeveloped areas become urbanized, typical urban noise sources would be present.	No

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Air Quality			
Ozone & Carbon Monoxide The proposed project is located within Brazoria and Harris Counties, which are in the HGB area that is classified as a "marginal" nonattainment area for the 2008 8-hour ozone standard, effective July 20, 2012. According to studies conducted by H-GAC, the regional MPO, air quality has been improving in the Houston-Galveston area over the past 30 years and is expected to continue to improve. The HGB area is currently in attainment for all NAAQS, except for ozone.	The proposed action is consistent with the area's financially constrained *2035 RTP Update*, as amended, and the *2013-2016 TIP* for the Houston-Galveston Transportation Management Area. Both the RTP and the TIP were found to conform to the TCEQ State Implementation Plan (SIP) by FHWA and FTA on January 25, 2011 and November 1, 2012, respectively. Through transportation conformity, transportation projects proposed for implementation within the HGB nonattainment area are required to demonstrate consistency with the area's SIP for attaining the ozone standard. Carbon monoxide concentrations for the proposed project were modeled using CALINE3. The worst-case scenario (adverse meteorological conditions and sensitive receptors adjacent to the proposed ROW) was modeled, in accordance with TxDOT's Air Quality Guidelines. Local concentrations of CO would not be expected to exceed the national standard at any time. There may be short-term, localized effects to air quality (e.g., increase in dust, diesel exhaust) during construction in the immediate area adjacent to the project.	Proposed transportation projects in the HGB area must be included in the RTP and must conform to the SIP. Induced development may lead to activities that contribute to increased hazardous air pollutants/volatile organic compounds, which are precursors to ozone; however, these facilities must meet federal regulations and conform to SIP standards. Therefore, air quality impacts would be minor. The regional trend has been an improvement in air quality as a result of more efficient vehicles and cleaner burning fuel. This trend is expected to continue.	Yes

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Mobile Source Air Toxics According to EPA studies, Mobile Source Air Toxics (MSAT) are expected to be much lower in the future compared to current levels due to improvements in vehicle technology and fuels.	The analysis indicates a decrease in MSAT emissions for both the Build and No Build Scenarios (2035) versus the base year (2011). Total MSAT emissions are predicted to decrease by 17.9 percent for the 2035 Build Scenario compared to 2011 levels. Differences in total MSAT emissions between the 2035 No Build and Build Scenarios were found. The 2035 No Build Scenario has slightly higher emissions than the 2035 Build Scenario. Emissions could be lower for the Build Scenario due to congestion reduction as a result of the added roadway capacity of SH 288, and an overall reduction of traffic on SH 288. MSAT emissions as a result of the proposed project are not expected to increase overall air toxics in the HGB area for the evaluation year analyzed. There may be short-term, localized effects to air quality (e.g., increase in dust, diesel exhaust) during construction in the immediate area adjacent to the project.	Induced development may lead to activities or business development that could contribute to increased hazardous air pollutants/volatile organic compounds that are precursors to ozone. However, all area sources must meet federal regulations and SIP standards. Construction of residential and commercial facilities due to induced development may contribute to dust and diesel exhaust; however, these effects would be temporary.	Yes
Water Quality			
Water quality has been impacted in Harris and Brazoria Counties primarily due to agricultural practices, oil and gas production, and the conversion of undeveloped land to an urban environment. Brays Bayou (Segment 1007) is on the TCEQ's 2008 Texas Water Quality Inventory and 303(d) list for edible tissue (dioxin and PCBs) and bacteria concerns. Sims Bayou (Segment 1007N_01) and Clear Creek (Segments 1102_01 and 02) are listed for bacteria concerns. Clear Creek is also listed for impaired fish community.	During construction, exposed soil could erode into streams and increase turbidity and sediment loading downstream. Use of BMPs would minimize the impact to water quality. The presence of additional pavement would increase the non-permeable area, thus increasing storm water runoff. Landscaping efforts and roadway design would minimize potential water quality effects from increased runoff.	It is expected that the proposed roadway improvements would have an indirect effect on land use. Indirect effects to water quality would be minor because land developers would have to comply with local, state, and federal water quality standards for protection of water quality.	Yes

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Floodplains			
Land development has caused encroachment in the floodplain. Development in the floodplain is typically offset with storm water detention. Flooding continues to be a problem in the Houston area.	Direct impacts would include additional lanes in the median of SH 288,crossing existing floodplains at Clear Creek, Sims Bayou, Brays Bayou, Mustang Bayou, and West Fork of Chocolate Bayou and associated tributaries. The proposed project would not raise base floodplain elevations.	Development within floodplains could occur as an indirect impact and would be subject to federal and local regulations. Storm water detention and hydraulic features would offset any fill in the floodplain or increase in impermeable cover.	No
Wetlands/Waters of the United States			
Changes in land use due primarily to residential development have impacted wetlands.	The project area contains approximately 4.38 acres of potential jurisdictional waters/wetlands. Direct impacts, primarily through the construction of bridges and culverts, would include approximately 3.40 acres of these waters/wetlands, based on the preliminary assessment. Impacted wetlands would likely be mitigated at an offsite mitigation bank. Non-jurisdictional waters/wetlands identified within the project area include man-made channels and depressions, and roadside ditches.	Induced development could affect waters of the United States and wetlands. Future development would need to comply with Section 404 of the CWA for any impacts to jurisdictional waters of the United States, including wetlands.	Yes
Vegetation			
Continued development has caused fragmentation and habitat loss, which affects species in the immediate vicinity. Vegetation species occurring throughout the region are not anticipated to be diminished to a level by which it may become threatened or endangered.	□□□ proposed project would impact up to 274 acres of vegetation located adjacent to and in the highway ROW, based on the preliminary assessment.	The proposed project would have an indirect effect on land use and indirect impacts to vegetative communities. Increased development may remove habitats and introduce new plant varieties. Most of the vegetation in the AOI is classified as crops (agriculture and pasture) and urban.	Yes
Wildlife			
Continued development has caused fragmentation and habitat loss, which affects species in the immediate vicinity.	Direct impacts to wildlife could be mortality as a result of construction of the proposed project.	The proposed roadway improvements could have an indirect effect on wildlife through development that would disrupt or remove wildlife habitats.	Yes
Wild and Scenic Rivers			
Not Applicable	Not Applicable	Not Applicable	No

Table 36. ***cont.***

Current Health of Resource	Direct Effects	Indirect Effects	Included in Cumulative Effects Analysis?
Coastal Barrier			
Not Applicable	Not Applicable	Not Applicable	No
Essential Fish Habitat			
Not Applicable	Not Applicable	Not Applicable	No
Threatened and Endangered Species			
Impacts to individuals may occur, especially to plant species, but threats to overall populations are not expected. Suitable habitat could continually be lost through land conversion.	No known direct impacts.	Impacts to threatened and endangered species could occur as future development in the RSA encroaches into plant and wildlife habitats. State listed threatened and endangered species may be affected by temporary construction noise and noise resulting from operation of the roadway after construction within the immediate vicinity of the proposal project, but not within the majority of the AOI.	No
Cultural Resources: Historic and Archeological			
No historic properties, archeological historic properties, or State Archeological Landmarks were identified within the APE of the proposed project.	The proposed project has no potential to affect historic or archeological historic properties, or State Archeological Landmarks. In the event that unanticipated archeological deposits are encountered during construction, work in the immediate area will cease, and TxDOT archeological staff will be contacted to initiate post-review discovery procedures under the provisions of the PA-TU and MOU.	No known indirect impacts.	No

B.3. Land

B.3.a. Resource Study Area

The approximately 90,580-acre land use RSA for the cumulative effects analysis was defined using a 2- to 3-mile radius from the SH 288 ROW (*Figure 9)*. This radius was used because the next major road to the east, Cullen/FM 865, is approximately 2 miles from SH 288. To the west, the next major parallel roadway varying from 2 to 3 miles from SH 288 is Almeda/FM 521 shifting to Kirby near IH 610. FM 1462, an east-west thoroughfare just south of the southern limit of the proposed toll lanes at CR 60, serves as the southern boundary of the RSA. The northern limit of the RSA is IH 45, at the southern edge of downtown Houston. These boundaries roughly define the limits of SH 288's travelshed and the effects the roadway has on land use, based on historical aerial photography and development trends. The time period of the cumulative effects analysis is from 1975, the date of the earliest available aerial photographs and about the time that construction of SH 288 first began in Brazoria County, to 2035, the horizon of the current *2035 RTP Update*.

B.3.b. Summary of Current Status/Viability and Historical Context

Current Health

In 2003, the Texas A&M University System, in cooperation with American Farmland Trust, published *Texas Rural Lands: Trends and Conservation Implications for the 21st Century*. The 2003 *Texas Rural Lands* study found that Texas leads all other states in the loss of rural farming and ranching lands. According to the study, "…if the trend continues at the same rate for the next two decades, much more of the land in south, central, and east-central portions of the state would become fragmented." Land use adjacent to SH 288 consists of a mixture of residential areas with some commercial uses concentrated at major roadway crossings. Existing developed land uses in the RSA include residential, commercial, public (such as schools and libraries), parks/open space, with some industrial uses along the UPRR adjacent to Almeda Road/FM 521 and SH 6 at SH 288. The prevailing type of development within the RSA is rural property and low-density residential development. Large tracts of undeveloped land are present throughout the RSA; however, approximately 12,000 acres are proposed for residential development.

Historical Context

The purchase of ROW and initial construction of SH 288 into Brazoria County began in the mid-1970s. The design of SH 288 at the time was as a divided rural highway with overpasses only at railroads and major roadway crossings, such as SH 6. All other intersections were at-grade with configurations for later conversion to grade-separated overpasses. Acquisition of ROW for SH 288 caused fragmentation of neighborhoods such as Riverside and Riverside Terrace, which were developed in the early 20th century. According to the FEIS (TxDOT 1974) there were three public hearings held: August 1963, July 1965 and January 1966. The FEIS stated that, "There were no controversial items brought up at these hearings and most of the citizen comments were of the nature of desiring to have the highway constructed and the need to have the highway as a part of the transportation system of the City of Houston."

The number of displacements identified in the FEIS totaled 295 for the SH 288 corridor. (Note: The limits for the 1974 FEIS were Bellfort Street to Elgin Street.) According to the FEIS, 30 percent of those displaced agreed that "they now have equal or better facilities than they had before displacement. An effort was made to minimize dividing existing neighborhoods and disturbance of institutions of social value." Since it has been nearly fifty years since the project was authorized by FHWA, the areas that were displaced have adjusted to the changes to the neighborhood layout and access. During this duration of time, what had been historically a bisection of established neighborhoods ultimately created new dynamics in the project corridor.

By the early 1990s, SH 288 was built to full freeway standards with overpasses at all intersections in Brazoria County. BW 8 has also influenced development of the area. BW 8 was constructed in 1997 as an east-west tollway crossing SH 288, and created a major highway interchange. As a result, the City of Pearland made efforts to direct its growth toward SH 288. In 1999, Pearland entered into an agreement with the City of Houston to extend Pearland's extraterritorial jurisdiction (ETJ) to include the BW 8/SH 288 interchange, to take advantage of the development opportunities at that location.

The RSA experienced tremendous change in the 1990s after the construction of SH 288. Development in the RSA increased by over 16,200 acres between 1995 and 2005 - an increase of approximately 70 percent. Construction of BW 8 at SH 288 in 1997 was also an impetus for development activity in the area and a focus of Pearland's growth efforts. Subdivisions near Pearland and Manvel such as Silvercreek, Country Place, and Shadow Creek Ranch began to grow rapidly after the construction of BW 8. Along with these residential developments, retail centers were constructed along SH 288 and at key cross streets in Pearland.

Figure 5 shows existing and past land use in the RSA. Aerial photographs produced by TNRIS (1975), USGS (1995) and H-GAC (2006) were reviewed to determine the extent of past and present development within the RSA. Approximately 16,500 acres (18 percent) of the RSA were developed in 1975. By 1995, developed acreage in the RSA had increased to 23,400 acres (26 percent), am average growth rate of 2 percent per year. By 2005, the developed acreage in the study area was 39,570 acres (44 percent), a 70 percent increase in development as compared to 1995, or an average growth rate of approximately 6 percent each year.

The current comprehensive plans for both Pearland and Manvel propose a concentration of commercial and low to moderate density residential development along SH 288. Currently, the only concentration of commercial development is at SH 288 and FM 518, which is in Pearland. The Pearland comprehensive plan also shows a proposed mixed use development at the junction of SH 288 and BW 8, which would include residential, commercial, office and light industrial activities.

The timeframe for the land use cumulative impact analysis is from 1975 to 2035. This limit covers the period from the beginning of the construction of SH 288 to the planning horizon years of the Pearland and Manvel comprehensive plans, as well as the roadway projects in the *2035 RTP Update*. The timeline for the construction of proposed development projects ranges from the current year to an undetermined future date, and the build out for the proposed developments typically ranges from 10 to 15 years.

The proposed SH 288 improvements would require approximately 69 acres of additional ROW, requiring the relocation of the tenants of seven apartment units on SH 288 north of IH 610, and some commercial parking and loading areas along IH 610 and SH 288. Most of the property to be acquired is undeveloped land adjacent to SH 288 at various cross streets in the southern area of the proposed project. The 69 acres of additional ROW are approximately 0.08 percent of the RSA, and the use of the land for roadway and associated ROW would have a negligible direct effect on overall land use.

B.3.d. Summary of Indirect Effects

The proposed project is in an area with a long-term development trend. Construction of the proposed SH 288 toll lanes would induce development. Indirect land use changes have occurred and would continue to occur as a result of construction of proposed improvements to SH 288. Since the completion of SH 288 to a full grade-separated facility and the construction of BW 8 in the area in the 1990s, there has been a 70 percent increase in developed land in the RSA. Projected development and local municipal plans indicate that up to 12,000 additional acres are proposed for development in the RSA. The typical timeline for these development projects is 10 to 15 years. Not all of these projects would be attributable to the proposed toll lanes on SH 288, as many are already planned. Based on local development plans and the past growth rate, 95 percent of land in the RSA is anticipated to be developed by 2035. The proposed project could influence development by 4,730 to 7,095 acres (10 to 15 percent) as compared to the No Build alternative.

SH 288 has made remote areas more accessible and attractive for residential and commercial development. Overall mobility and accessibility would improve as the RSA continues to develop and the arterial roadway network is built.

B.3.e. Other Reasonably Foreseeable Effects

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the RSA include roadway projects listed in the *2035 RTP Update* and large master planned communities. These reasonably foreseeable projects could contribute to land use changes in the study area.

Land Use

The Houston area and Harris and Brazoria Counties are expected to continue to have steady economic growth and development. The proposed improvements in the SH 288 corridor would not provide a new road, but would provide additional capacity. No changes in the overall land use patterns in the area would be anticipated as a direct or indirect result of the implementation of the project due to the existing footprint of the mainlanes on the outermost edge of the overall corridor; however, the proposed project may factor into the timing of regional development. The project is consistent with the plans and policies of the local governmental entities.

Approximately 16,200 acres of residential development occurred in the RSA between 1995 and 2005. This trend is projected to continue. Several new residential and mixed use developments, totaling approximately 20,660 acres, are in progress or are currently planned in the RSA, as shown in *Table 37*. The acreages listed were provided by developers, the Cities of Manvel and Pearland, and recorded plats. The locations of these land development projects are shown on *Figure 9.* Smaller-scaled development is shown on *Figure 9* and is included in *Table 37* as Other. At the time this report was prepared, the City of Manvel was planning a new Town Center with some adjacent ancillary commercial development northeast of the SH 6/SH 288 interchange. This development is still under review and has not secured its financing.

Table 37. Land Development Projects in the RSA

	Land Development in the RSA	Project Location	Project Type	Project Acreage*	Status**	RSA Affected
1	Argovitz Capital Corp.	East of SH 288 at Croix Road	Retail	150	P	Land Use
2	Brunswick Meadows	Located at BW 8 and SH 288	Residential development	317	□□°□□L	Land Use
3	City Park	West of SH 288, South of Orem Road	Residential development	220	IP	Land Use
4	Houston Community College campus expansion	West of SH 288, South of Airport Blvd.	School Expansion	80	IP	Land Use
5	HCA Hospital	West of SH 288, south of McHard Road	Future Hospital	6	P	Land Use
6	Lakes of Savannah	2.3 miles west of SH 288, 1.6 miles east of FM 521	Residential development	1,425	IP	Land Use
7	Mustang Creek Community	East of SH 288 on CR 58	Residential development	1013	P	Land Use

	Land Development in the RSA	Project Location	Project Type	Project Acreage*	Status**	RSA Affected
8	Presidio at Manvel	Located at SH 6 and SH 288	Planned mixed use: residential, civic, commercial, etc.	394	P	Land Use
9	Rodeo Palms	East SH 288, on Rodeo Palms Parkway	Residential development	600	E/IP	Land Use
10	Seven Oaks Ranch	South of SH 6, east of SH 288 at CR 56	Mixed residential, civic, open space and commercial	1,498	P	Land Use
11	Shadow Creek Ranch	Located west of SH 288, south of McHard Road	Primarily residential, some commercial and public/institutional	3,500	IP	Land Use
12	Shadow Creek II	South of SH 6 and west of FM 1128	Residential and commercial	3,000	P	Land Use
13	Silverlake	Pearland, divided by FM 518 west of SH 288	Residential development	2,782	E/IP	Land Use
14	South Fork	West of SH 288 at CR 59	Residential development	266	IP	Land Use
15	Southpointe Crossing	East of SH 288, between SH 6 and Croix Road	Mixed use development	911	P	Land Use
16	Sterling Lakes	Located south of SH 6, north of Juliff-Manvel Road	Residential development	2,700	P	Land Use
NA	Other (shown in blue on *Figure 9*)	Throughout RSA	Commercial	1,798	E	Land Use
			Total Acres	**20,660**		

* Acreage of land development projects is approximate.

** E - Existing P - Planned IP - In Progress

Transportation

SH 288 is the primary transportation facility in the area. Other north-south routes are Almeda/ FM 521 to the west and Cullen/FM 865 to the east. There are no other continuous north-south roadways in the RSA. Traffic volumes section of SH 288 are projected to increase 39 percent to 63 percent between 2011 and 2035, with the greatest percent increase in the southern portion of the RSA, as shown in *Table 38*. Using data from a 2003 study of the SH 288 corridor, an estimated 33 percent of the residents in the corridor commute to downtown Houston, TMC, Greenway Plaza, or the Galleria area via SH 288 (*SH 288 Corridor Planning Study METRO 2003*).

Table 38. Existing and Projected Traffic Volumes

Section	2011 Volumes	2035 No Build Volumes	% Increase
US 59 to IH 610	160,600	223,300	39
IH 610 to BW 8	147,600	231,800	57
BW 8 to SH6	83,300	128,400	54
SH 6 to CR 60 (SH 99)	41,300	67,200	63

Source: H-GAC travel demand model results, 2012

Major east-west thoroughfares include Old Spanish Trail and Holcombe Drive near the TMC, IH 610, BW 8, McHard/FM 2234, FM 518, SH 6, and the proposed SH 99/Grand Parkway at CR 60. The vehicle miles traveled (VMT) in the corridor are expected to increase by 48 percent between the years 2000 and 2035. Many roadway improvements are planned in the RSA to serve the projected growth. *Table 39* lists the proposed roadway projects in the RSA that are included in the *2035 RTP Update,* as amended, not including the proposed SH 288 improvments project (Note: list does not include bridge replacements or projects already under construction).

Table 39. Proposed 2035 Transportation Projects in the RSA

Project Name	Limits	Description[1]	Distance within RSA (miles)	Acres[2]	Resource Area Affected	Estimated Letting Date[3]
CR 48	FM 518 to CR 894	Widen from 2 lanes to 4 lanes, divided, with shoulders	4.7	11.4	Land Use, Water Quality	2014
CR 48	CR 894 to SH 6	Reconstruct and widen from 2 lanes to 4 lanes	4	9.7	Land Use, Water Quality	2013
CR 58	SH 288 to FM 1128	Widen from 2 lanes to 4 lanes	3.37	8.2	Land Use, Water Quality	2018
CR 59	Fort Bend C/L to SH 288	Widen from 2 lanes to 4 lanes w/bridge	0.9	2.2	Land Use, Water Quality	2023
CR 59	CR 48 to SH 288	Widen from 2 lanes to 4 lanes w/bridge	1.9	4.6	Land Use, Water Quality	2018
CR 403	FM 865 to CR 94	Widen from 2 lanes to 4 lanes	2.1	5.1	Land Use, Water Quality	2019
SH 99 (Seg. C-3)	SH 288 to Fort Bend C/L	Construct 4-lane tollway with frontage roads	3.5	169.7	Land Use, Water Quality, Vegetation, Wildlife	2017
SH 99 (Seg. B)	SH 288 to Galveston C/L	Construct 4-lane tollway with frontage roads	5	242.4	Land Use, Water Quality, Vegetation, Wildlife	2020
Woodfin Rd.	500 feet west of Broadway St. to Southfork Dr.	Construct 4-lane divided on new aligment	1	9.7	Land Use, Water Quality, Vegetation, Wildlife	2020
CR 894	Fort Bend C/L to CR 48	Construct 4-lane divided curb and gutter on new alignment	2	19.4	Land Use, Water Quality, Vegetation, Wildlife	2031

Project Name	Limits	Description[1]	Distance within RSA (miles)	Acres[2]	Resource Area Affected	Estimated Letting Date[3]
Smith Ranch Road	Hughes Ranch Road to Broadway	Widen from 2 to 4-lane divided curb and gutter	1	2.4	Land Use, Water Quality	2015
Business Center Dr.	Broadway St. to Southfork Dr.	Construct 4-lane divided curb and gutter	1	9.7	Land Use, Water Quality	2014
Total Acres of Additional ROW – Brazoria County				494.5		
Harris County						
BW 8	SH 288 to IH 45S	Widen from 4 to 8 lanes in sections	1.1	0	Water Quality	2016
Orem Dr. E	SH 288 to Cullen Blvd.	Construct 4-lane concrete blvd. section with bridges and drainage	1.8	17.5	Land Use, Water Quality	2018
Fuqua St.	SH 288 to Cullen Blvd.	Widen from 2 lanes to 4 lanes	1.7	4.1	Land Use, Water Quality	2020
FM 865	Almeda Genoa to BW 8	Widen from 2 lanes to 4 lanes with curb and gutter	1.2	2.9	Land Use, Water Quality	2013
CR 48	BW 8 to Clear Creek	Widen from 2 lanes to 4 lanes	0.9	2.2	Land Use, Water Quality	2017
IH 45	US 59 to SP 5	Construct entrance and exit ramps, remove and replace US 59 NB and SB direct connectros	1.8	0		2021
Almeda Rd.	MacGregor Way to Old Spanish Trail	Reconstruct and widen to 6 lanes including shared pathway and other features	1	2.4	Land Use, Water Quality	2013
Holmes Rd	Main St. to Kirby Dr.	Widen to 4 lanes	1.9	4.6	Land Use, Water Quality	2016
Total Acres of Additional ROW – Harris County				33.7		

Source: 2035 RTP Update, as amended, Appendix E – Project Listing; H-GAC RTP project viewer (at http://rtp.h-gac.com/, accessed February 8, 2013)

[1] Descriptions are summarized from project listing in source referenced.

[2] Roadway widening based on 20 feet of additional ROW; new roadway construction based on 80 feet of ROW; SH 99 (Grand Parkway) based on 400 feet of ROW.

[3] Letting dates from H-GAC RTP project viewer (http://rtp.h-gac.com/, accessed February 8, 2013).

Of the approximately 18,800 acres of development planned or in progress in the RSA, approximately 12,000 acres are proposed new development that has not started. Much of this proposed development is in the vicinity of the City of Manvel and Iowa Colony Village. The character of the RSA would change from large areas of undeveloped pasture to large, planned residential communities with areas of concentrated commercial and institutional uses at major roadway intersections.

In addition to over 465 acres of programmed roadway improvements, a high capacity transit corridor is proposed in the Almeda/FM 521 corridor. This could include commuter rail on the existing UPRR or some type of commuter bus service in or adjacent to Almeda Road. There is currently no commuter bus service on SH 288, but efforts are underway to implement Park & Ride service from the vicinity of FM 518 to the TMC. Commuter bus service could use the proposed toll lanes.

B.3.f. Potential Cumulative Effects

The listed projects from the *2035 RTP Update* could require approximately 465 acres of ROW in the RSA, which could affect properties where land would be acquired. Roadway improvements could also require drainage improvements. The completion of the roadway network in the RSA and the added roadway capacity would improve overall mobility and access in the area and facilitate development. The construction of SH 99/Grand Parkway at CR 60 would also induce development. Estimates based on other studies indicate that new roadway construction could increase development by 25 to 30 percent as compared to the No Build alternative.

B.3.g. Results of Cumulative Effects Analysis

Construction of the proposed SH 288 toll lanes and the direct connectors at IH 610, BW 8, and the TMC would directly convert approximately 69 acres of land to roadway ROW. Since SH 288 was constructed, some undeveloped land has become developed, and development would likely continue within the RSA. The indirect effects of the proposed project would result from the conversion of undeveloped land to residential and other uses. Portions of the RSA would likely develop without the proposed SH 288 improvements, such as areas adjacent to US 59, IH 610, BW 8, FM 518, and SH 6, because these roads provide access to business centers. Property south of IH 610 would have had little access without SH 288; thus, SH 288 has influenced land use to the south. Pearland and Manvel have been influenced by SH 288 because the roadway provides shorter travel times to major employment centers. The improved mobility has made adjacent land more attractive to developers and home buyers. The addition of the proposed toll lanes would increase the roadway capacity and improve mobility in the SH 288 corridor. The proposed improvements to SH 288, combined with the construction of SH 99/Grand Parkway and favorable economic conditions, would continue to support existing and future planned developments.

A summary of the cumulative effects to land use in the RSA through 2035 includes:

- Roadway construction and widening in the RSA to improved mobility and access.
- Loss of farm and pasture land as residential and commercial development in the RSA continues to increase.
- Increased concentration of development along SH 288 as Pearland and Manvel direct development towards SH 288.

Future development in the RSA may be typified by concentrated commercial and industrial activities along SH 288 in Pearland and Manvel, with single-family residential located behind these areas. The combined effect of the proposed improvements on SH 288, which could increase development in the RSA by 10 to 15 percent, and the planned future construction of SH 99/Grand Parkway, which could increase development in the RSA by up to 25 percent, could increase the rate of development in the RSA by up to 35 percent. At that rate of development, the 90,580-acre RSA would be 100 percent developed by 2025. The cumulative effects of the induced development would be the loss of farm and pasture land as well as the potential alteration of existing wetlands and drainage patterns.

B.3.h. Mitigation Opportunities

The 2003 *Texas Rural Lands* study indicated that Purchase of Development Rights (PDR) programs are used in other states to slow the land use conversion and fragmentation of farms, ranches, and wildlife habitats. According to the study, PDR programs buy development rights from willing landowners, and based on simulation models, the study found that Texas would benefit most if a PDR program were to be implemented in areas where relatively large ownerships (greater than 2,000 acres) are present. A PDR program by the State of Texas would not be an effective mitigation within the RSA because the average

farm size in Harris County is 117 acres with a median size of only 20 acres; and in Brazoria County the average farm size is 205 acres with a median size of 29 acres (USDA Census of Agriculture 2007).

Incorporated areas such as the Cities of Houston, Pearland, and Manvel can manage growth issues through local ordinances to reduce negative impacts. The Cities of Pearland and Manvel have zoning ordinances to manage land uses in their jurisdictions. The City of Houston does not have zoning, but it can manage land use impacts through specific regulations, such as the subdivision ordinance, and traffic, drainage and utility requirements. Development activities outside the incorporated areas are under the jurisdiction of Harris and Brazoria Counties, which use subdivision ordinances primarily to regulate lot sizes and density. Master planned developments are commonly designed with land uses arranged such that incompatible uses are not in close proximity. Developers often provide parks and open space convenient to the residents of the development.

B.4. Water Quality, Waters of the United States, Vegetation, and Wildlife

B.4.a. Resource Study Area

Water Quality & Waters of the United States, including Wetlands

The cumulative effects RSA for waters of the United States (including wetlands) was developed by identifying the major watersheds intersecting the proposed project. The cumulative effects RSA boundary was formed by connecting the outer limits of each of the watersheds that intersect the proposed project (*Figure 10*). Over the past 15 to 20 years, agencies and local governments have moved toward managing water quality by using the watershed approach (EPA 2005). The RSA encompasses approximately 433,536 acres in Brazoria, Galveston, Harris, and Fort Bend Counties. The watersheds included are Sims Bayou, Brays Bayou, Clear Creek, Mustang Bayou, Chocolate Bayou, and Hayes Creek.

Water quality is generally regulated through Sections 401 and 402 of the CWA. These rules provide guidelines and permitting requirements for point-source and non-point source runoff into waters of the United States. The TCEQ is responsible for monitoring water quality within the watersheds to determine if specific streams and stream segments are not meeting specific state water quality standards. These water quality standards are tied with providing specified essential beneficial uses, such as aquatic life, contact recreation, and oyster waters. If specified water quality standards are not met over a given period of time, the TCEQ may determine these water bodies, within a certain designated area (segment), are threatened and/or impaired and recommend total maximum daily loads (TMDLs) for pollution in that water body in an effort to restore its quality to state standards.

The USACE has regulatory jurisdiction over waters of the United States, including wetlands. The National Wetlands Inventory (NWI) of 1992 was used to estimate the area of open water and associated wetlands within the RSA for waters of the United States, including wetlands.

Vegetation

The RSA for vegetation is the same as the RSA for land use, and area of approximately 90,580 acres. The vegetation RSA lies within the Gulf Coast Prairies and Marshes natural region of Texas, which encompasses urban areas south of the Houston metropolitan area, and some farmland/ranchland in Brazoria and Galveston Counties. The primary type of vegetation effect would be farmland/ranchland and undeveloped scrub-shrub areas.

Wildlife

The RSA for wildlife is also the same as the RSA for land use. The wildlife RSA lies in a transitional zone between the Texan and Austroriparian Biotic Provinces. The vegetation types described in this document could support various wildlife species, such as small birds and mammals, amphibians, and reptiles.

Periodically inundated wetlands and riparian habitats along natural water courses are used by mammals and a variety of migratory birds.

The temporal boundary for the waters of the United States, vegetation, and wildlife RSAs is 2035. This limit encompasses the planning horizon for the comprehensive plans of Pearland and Manvel. It also encompasses the timeline of roadway projects in the RTP.

B.4.b. Summary of Current Health and Historical Context

Water Quality, Waters of the United States, including Wetlands

Since the late 1970's, Harris and Brazoria Counties have experienced an increase in land development projects, resulting in a loss of wetlands. The loss of waters of the United States, including wetlands, is due to development projects, channelization and stream modifications, flood protection, conversion to agriculture, and other land use alterations. Waters of the United States within the AOI have historically been altered to reduce flooding problems in Harris and Brazoria Counties. These alterations include channelization and rectification of stream channels, which results in straightening watercourses and removing riparian communities, including fringe and adjacent wetlands. Many of the watercourses within the AOI have been altered due to stream modifications and/or encroachment by adjacent agricultural activities. The watercourses in Brazoria County have been generally less altered than those in the heavily urbanized portion in Houston.

Urbanization of the watersheds identified in the RSA will continue to result in reducing pervious surfaces and replacing them with impervious surfaces, as well as potentially creating point-source discharges that may affect water quality. As pervious surfaces decrease and impervious surfaces increase, there could be a need for additional modification of streams and other watercourses within the RSA to manage flood risk. These stream modifications may result in preventing "polishing" of water quality through increasing flow rates, versus slowing them down and allowing suspended solids and various pollutants to be filtered by adjacent riparian and/or wetland areas.

There have been substantial losses to wetlands and other habitats in the Greater Houston Area since the 1950s. Continued urbanization and industrialization will continue to place pressure on remaining ecosystems. Since the early to mid-1990s, the area south of Houston has experienced increased land development, leading to the construction of residential areas, retail centers, and other businesses. Land development activities have led to the loss of open, undeveloped land in the RSA.

Some waters of the United States within the RSA have been modified to reduce flood risks. The majority of the modifications have included vegetation clearing and channel rectification. Rectifying stream channels usually requires the removal of streamside vegetation and straightening meanders in the streams. This improves flow, but reduces the natural diversity of the stream channels and potentially removes riparian habitat. The majority of natural riparian habitat has been altered in the RSA; however, Chocolate Bayou and Hayes Creek have relatively unaltered riparian corridors. Watersheds in the vicinity of the proposed project are currently under development pressure, causing the need to increase channel capacity and flow in streams located in the RSA.

Vegetation

The RSA contains farmland/ranchland in Brazoria, and Galveston Counties. Natural vegetation that existed on land prior to these activities was disturbed by clearing, hay production, or grazing. This alteration has been ongoing and increasing in area for more than 50 years in rural portions of the RSA. The riparian corridors adjacent to Chocolate Bayou and Hayes Creek are relatively unaltered by farming/ranching practices. The riparian corridors provide habitat diversification within a predominantly open landscape. In developed areas, including roadway ROW, maintained grass and other vegetation exists.

Wildlife

Various wildlife populations, such as small birds and mammals, amphibians, and reptiles are under pressure from land conversion, development, and anthropogenic activities. These activities have fragmented wildlife habitat and created barriers that impede wildlife movements, thereby confining wildlife to riparian corridors, wetlands, and other areas where suitable habitat is present.

B.4.c. Summary of Direct Effects

Water Quality & Waters of the United States, including Wetlands

Six named TNWs totaling approximately 4.8 acres were identified within the proposed project ROW. These waters are subject to CWA jurisdiction under 33 CFR 328.3(a)(1) and 40 CFR 230.3(s)(1). Nine RPWs totaling approximately 2.3 acres were identified within the proposed project ROW. These water bodies are regulated under the CWA as relatively permanent non-navigable tributaries of TNWs. Six potentially jurisdictional wetland areas, a total of approximately 1.8 acres, were identified within the existing and proposed ROW. Approximately 4.1 acres of RPWs and wetlands occur within the existing and proposed ROW. Of these 4.1 acres, approximately 2.5 acres would be affected by the proposed project.

Brays Bayou, Sims Bayou, and Clear Creek are listed as impaired waters by the TCEQ. Impairment is as a result in elevated levels of dioxin, PCBs, bacteria, or impaired fish community, depending on the water body. Storm water control measures and BMPs would be utilized during construction and operation of the proposed project. Each stream segment is evaluated every two years by the TCEQ to determine whether they remain impaired, threatened, or meeting state water quality standards, so the status of these water bodies may change.

Vegetation

Clearing, grading, and other roadbed preparation activities associated with the proposed project would permanently or temporarily affect approximately 274 acres of vegetation within the existing and proposed ROW. These vegetation communities include aquatic features, riparian areas, periodically inundated wetlands (including jurisdictional and non-jurisdictional aquatic resources), crops, scrub-shrub areas, and mowed and maintained ROW. Construction activities would include excavation for the installation of culvert extensions and bridge crossings, or clearing, grading, and paving to accommodate the proposed project. The removal of mowed and maintained ROW may reduce the aesthetic character of the ROW, but species diversity would not be affected.

Wildlife

Temporary effects to wildlife habitat would include decreased attractiveness of habitat adjacent to the project corridor and disturbance of normal behavior patterns from construction activities. The proposed project would result in minor adverse effects on wildlife habitat, including 274 acres of habitat loss through conversion into transportation infrastructure and maintained ROW. The potential displacement of wildlife into adjacent habitats could increase competition for food and shelter for some resident and migratory species and potentially affecting the carrying capacity for surrounding areas.

B.4.d. Summary of Indirect Effects

It is expected that the proposed roadway improvements would have an indirect effect on land use, and indirect effects to water quality would be minor. Local developments would have to comply with local, state, and federal water quality standards.

The proposed project may induce residential, commercial, and industrial development in areas adjacent to the proposed project that are already experiencing growth. Disturbance of these areas would likely

affect wetlands, natural vegetation, and wildlife habitats. Areas that are minimally disturbed by human activities would be expected to continue to provide habitat for indigenous and migratory wildlife. Regional human population growth would exert development pressure on many of these undeveloped tracts.

Effects from future development projects to regulated resources such as waters of the United States, including wetlands, would be mitigated through the Department of the Army permitting process or possibly through other measures. A number of factors may influence the conversion of other areas without the benefit of required mitigation if no regulated resources are present.

B.4.e. Other Reasonably Foreseeable Effects

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the area include roadway projects and large master planned communities. *Table 37* and *Table 39 describe reasonably* foreseeable land development and transportation projects, respectively, in the RSAs. These reasonably foreseeable projects could cause potential degradation or loss of naturally-occurring wetlands, pastures, scrub-shrub land, and potential loss and degradation of wildlife habitats.

B.4.f. Results of Cumulative Effects Analysis

Water Quality & Waters of the United States, including Wetlands

Water quality may be cumulatively affected as a result of the induced development within the RSA. It is reasonable and foreseeable that the increased impervious surfaces and potential point-source pollution sources could increase within the RSA. The increases in these surfaces may result in additional pollutants entering the watershed, thus potentially adversely affecting water quality. The reduction in riparian areas and/or wetlands within the RSA may result in a decrease in "polishing" of water quality within the watershed.

Several waters of the United States traversing the project corridor would be affected through the construction of bridges, culverts, or the extension of existing culverts. The proposed improvements would not change the 100-year base flood elevation. No quantifiable cumulative effect to waters of the United States is expected. An analysis of wetlands in the RSA was performed using Geographic Information System (GIS), aerial photography, and NWI mapped wetlands. NWI data show approximately 35,856 acres of wetlands mapped within the RSA. The proposed project would directly affect approximately 3 acres of wetlands, or 0.008 percent of the NWI mapped wetlands, which is a minimal area when compared to the estimated wetlands within the RSA. Potential land use changes associated with future residential, commercial, industrial, and transportation development could impact approximately 45 acres, or approximately 0.13 percent, of the wetlands mapped within the RSA. The master planned communities currently under construction or planned within the RSA would include some green space, but the majority of the proposed residential communities would be housing and other amenities. Proposed major construction projects in the RSA include Segments B and C of the Grand Parkway (SH 99), a proposed four lane controlled access toll road with non-continuous frontage roads from US 59 to IH 45. Jurisdictional wetlands lost as a direct effect of these and other future projects would be mitigated in compliance with applicable regulations.

Vegetation

Most of the native vegetation within the RSA was previously altered by urbanization or farming practices. Vegetation that would be affected by the proposed project includes approximately 274 acres of aquatic features, riparian areas, periodically inundated wetlands (including jurisdictional and non-jurisdictional aquatic resources), crops, scrub-shrub areas, and mowed and maintained ROW. Most vegetated areas affected by the proposed project have been previously disturbed. Approximately 51,010 acres within the RSA are undeveloped. Anticipated development through 2035 would convert approximately 11,925 acres of this undeveloped acreage to a developed condition. As land is developed, vegetation is eliminated by

clearing and grading, and then replaced with landscaped areas and impervious surfaces. Development has steadily increased within the RSA, and the Houston-Galveston area is expected to experience continued economic growth and land development for decades.

Wildlife

The proposed project would impact approximately 274 acres of vegetation, but would result in minor adverse effects on wildlife habitat, which include small amounts of habitat loss through conversion into transportation infrastructure and maintained ROW. Most of the 51,010 acres of undeveloped area within the RSA has been previously disturbed. Only limited areas are suitable as wildlife habitat. The anticipated conversion of approximately 11,925 acres to a developed condition through 2035 would eliminate much of the habitat available to wildlife. The potential displacement of wildlife into adjacent habitats could increase competition for food and shelter for some resident and migratory species.

B.4.g. Mitigation Opportunities

Water Quality

Potential mitigation opportunities that could be implemented by developers and/or local jurisdictions to offset potential adverse effects to water quality include:

- Development of storm water detention basins that treat water quality through biological and/or engineering controls, i.e., wet detention
- Implementation and stronger enforcement of current standards for BMPs during construction
- Development and implementation of an urban-based watershed approach to improving water quality
- Minimization and avoidance of impacts to riparian areas and waters of the United States, including wetlands
- Stream channel modifications, designed to accommodate potential opportunities for water quality "polishing" and treatment

Waters of the United States, Including Wetlands

Potential mitigation opportunities for impacts to waters of the United States could include planting vegetation along disturbed stream banks, purchasing credits within a wetlands mitigation bank, or an in-lieu fee to another entity as compensation for adverse effects. Potential adverse effects to wetlands would include discharges of fill material for the roadway grade, overpasses, or bridge crossings. Preliminary mitigation options for unavoidable effects would include offsite mitigation. Onsite mitigation is not favored because of limited space within the proposed ROW and the high costs of obtaining additional land parcels immediately adjacent to the ROW. Offsite mitigation would likely include the purchase of credits within an approved wetlands mitigation bank or payment of an in-lieu fee as compensation. Mitigation options would need to be investigated and evaluated throughout the USACE permitting process. A compensatory mitigation plan would be prepared, as necessary, and submitted to the USACE as part of a Section 404 permit application. Mitigation would only be implemented by TxDOT for direct effects to jurisdictional wetlands.

Vegetation and Wildlife

Unavoidable vegetation effects would be partially mitigated through replanting and landscaping exposed areas of the ROW, as appropriate, with trees, shrubs, grasses, and approved seed mixes. Landscaping would be in accordance with *EO 13112 on Invasive Species and the Executive Memorandum on*

Beneficial Landscaping. Habitats given special consideration under the TxDOT-TPWD MOU for non-regulatory mitigation would be avoided to the extent practicable. Even though attempts would be made to avoid areas such as riparian forests, complete avoidance of special habitat features would not be practicable. Due to funding limitations, the TxDOT Houston District is not proposing compensatory mitigation for non-regulatory mitigation at this time. Mitigation for cumulative effects, other than direct effects, would not be considered by TxDOT.

B.5. Air Quality

B.5.a. Resource Study Area

Evaluating air quality in relation to cumulative impacts requires looking at three distinct RSAs. The RSA for evaluating the ozone NAAQS was designated as the Houston-Galveston-Brazoria 8-hour ozone nonattainment area, which includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. The RSA for carbon monoxide was based on the ROW line, which represents the locations with the highest potential for carbon monoxide concentrations.

Unlike the other resources evaluated, air quality impacts from MSATs have been evaluated quantitatively in this proposed project by TxDOT and FHWA. MSATs are regulated by EPA on a national basis through requirements for fuels and vehicle technology. The MSAT RSA quantitatively evaluated emission changes based upon the proposed project. The affected transportation network (model area) was derived by comparing the 2035 No Build Scenario to the 2035 Build Scenario to determine which roadway links in the model achieved a $\pm$ five percent volume change. These links were then compared to the 2007 model in order to define a baseline traffic network. The application methodology was adopted as the basis to determine the model area RSA located within the H-GAC Metropolitan Planning Area (MPA).

B.5.b. Summary of Current Health and Historical Context

The EPA establishes limits on atmospheric pollutant concentrations through enactment of the NAAQS for six principal, or criteria, pollutants. The EPA designated eight counties in Houston-Galveston-Brazoria area as nonattainment for ozone. The region is currently in attainment for all other criteria pollutants. Although there have been year-to-year fluctuations, the ozone trend continues to show improvement. The trend of improving air quality in the region is attributable in part to the effective integration of highway and alternative modes of transportation, cleaner fuels, improved emission control technologies, and H-GAC regional clean air initiatives. However, HAPs and MSAT are regulated under the CAA, and in 2007 the EPA issued a set of final rules on *Control of Hazardous Air Pollutants for Mobile Sources*, as discussed in *Section XXIV*. Other regulatory controls for motor vehicle efficiency and improved fuels (gasoline and diesel) and other air toxics reductions are in place or will be phased in to reduce MSAT in the future. The population increase of Harris County and the surrounding region has led to an increase in VMT and mobile source emissions. Industrial activities and growing suburban development has led to land uses that contribute to regulated emissions. However, all area sources (i.e., dry cleaners, gas stations, etc.) and point sources (i.e., industrial facilities) must follow federal regulations and meet SIP standards.

This project is located within Brazoria and Harris Counties, which are located in the Houston-Galveston-Brazoria (HGB) area that is classified as in "severe" nonattainment for the 1997 8-hour ozone standard under the National Ambient Air Quality Standards (NAAQS); therefore; the transportation conformity rule does apply. On May 21, 2012, the EPA designated the HGB area "marginal" nonattainment under the 2008 8-hour ozone standard (77 FR 30088). This rulemaking become effective July 20, 2012. As part of implementing the 2008 8-hour ozone standard, EPA is revoking the 1997 8-hour ozone standard for purposes of transportation conformity (77 FR 30160), effective July 20, 2013. After this date, transportation conformity will continue to apply for the HGB nonattainment area, but under the 2008 8-hour ozone standard. Under the 2008 8-hour ozone standard, the HGB ozone nonattainment area must reach attainment by December 31, 2015.

B.5.c. Summary of Direct Effects

The analysis of MSATs indicates a reduction of approximately 14.6 tons/year of MSATs is expected between 2011 (base year) and the 2035 Build Scenario. The proposed project could potentially reduce MSAT emissions by 4.2 tons/year of MSAT in 2035 as compared to the No Build Scenario, as shown in *Table 30*. Other direct impacts, although not quantifiable, would be emissions such as non-road vehicle exhaust and dust that would be generated from construction activities associated with roadway construction.

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

B.5.d. Summary of Indirect Effects

Induced land development would be primarily residential and commercial uses, bringing with it the types of associated businesses that generate emissions that can contribute to a decline in air quality. This type of indirect commercial development may lead to activities or business development, which could contribute to increased HAPs/VOCs, which are precursors to ozone. Based on current development trends, the proposed project would not be expected to induce construction of large industrial facilities with associated air emissions. Although some induced development could increase the rate of emissions, all area sources must follow state and federal regulations and meet SIP standards. Induced development may also contribute to dust and other air pollutants; however, these effects would occur over the time period of analysis and would be temporary.

B.5.e. Other Reasonably Foreseeable Effects

The temporal boundary of the cumulative impact analysis is 2035. This corresponds to the region's RTP and population projections. Reasonably foreseeable projects within the air RSA include all proposed projects in the *2035 RTP Update*. Many other transportation projects are planned within the air RSA that would contribute to MSAT. According to the *2035 RTP Update*, the RSA is expected to grow to 8.8 million residents by 2035. Based on the current rate of growth in the SH 288 corridor, a large portion of the projected regional population increase could occur in the corridor.

B.5.f. Results of Cumulative Effects Analysis

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

The MSAT emissions projected as a result of the proposed project show a substantial decrease from 2011 (base year) to the 2035 Build and No Build Scenarios. MSAT for the SH 288 affected transportation network are projected to decrease 17.9 percent by 2035. Of the seven priority MSAT pollutants, benzene and DPM are expected to have the greatest decline in emissions, as shown in *Table 30*. As discussed in *Section XXIV*, MSAT for the entire air quality RSA are expected to decrease due to improved vehicle technology, changes in fuel (gasoline and diesel), and other regulatory controls of air toxics that are currently in place or will be phased in to reduce MSAT in the future.

Between 2005 and 2035, the population in the vicinity of the project is expected to increase by 60 percent, and the HGB area is expected to have similar increases in population. Rapid population growth would continue to create air quality challenges for the HGB area. The TCEQ continues to evaluate potential options to further reduce pollutant emissions. Growth patterns will lead to increased VMT and induced land changes would increase area source emissions that contribute to HAP/VOC emissions. Quantifying the associated emissions of future area sources is not possible due to uncertainties of future land use.

The cumulative impacts on air quality from the proposed project and other reasonably foreseeable transportation projects are addressed at the regional level by analyzing the air quality impacts of transportation projects in the *2035 RTP Update, as amended* and the *2013-2016 TIP*. The proposed project and the other reasonably foreseeable transportation projects included in the *2035 RTP Update, as amended* and the *2013-2016 TIP* have been determined to conform to the SIP. When combined, planned transportation improvements, revised EPA fuel and vehicle regulations, and fleet turnover are anticipated to have a cumulatively beneficial impact on air quality.

B.5.g. Mitigation Opportunities

A variety of federal, state, and local regulatory controls as well as local plans and projects have had a beneficial impact on regional air quality. The CAA, as amended, provides the framework for federal, state, tribal, and local rules and regulations to protect air quality. The CAA required the EPA to establish NAAQS for pollutants considered harmful to public health and the environment. In Texas, the TCEQ has the legal authority to implement, maintain, and enforce the NAAQS. The TCEQ establishes the level of quality to be maintained to control the quality of the state's air by preparing and developing a general comprehensive plan. Authorization in the Texas Clean Air Act (TCAA) allows the TCEQ to do the following: collect information and develop an inventory of emissions; conduct research and investigations; prescribe monitoring requirements; institute enforcement; formulate rules to control and reduce emissions; establish air quality control regions; encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the federal government; and to establish and operate a system of permits for construction or modification of facilities. Local governments having some of the same powers as the TCEQ can make recommendations to the commission concerning any action of the TCEQ that may affect their territorial jurisdiction, and can execute cooperative agreements with the TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA or the rules or orders of the TCEQ.

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

The cumulative impact of reasonably foreseeable future growth and urbanization on air quality within this area would be minimized by enforcement of federal and state regulations, enforced by EPA and TCEQ, which are mandated to ensure that such growth and urbanization would not prevent attainment with the ozone standard or threaten the maintenance of the other air quality standards.

Regional Cumulative Effects of Tolled Facilities and Managed Lanes

As the Metropolitan Planning Organization (MPO) for the Houston Galveston region, H-GAC is charged with enabling and creating a regional perspective for transportation and mobility. The 2035 RTP provides the major strategies that would accommodate forecasted growth and preserve mobility in the region. In 2009, H-GAC prepared a planning-level assessment, *Regional Cumulative and Indirect Effects of Toll Facilities*[3] report, to determine how the 2035 RTP regional toll roadway network could indirectly or cumulatively affect socioeconomic and natural resources. Resources evaluated in this planning study included Environmental Justice (EJ) populations (low-income and/or minority populations as defined in Executive Order (EO) 12898[4]), air quality, water resources, vegetation, and land use. However, the majority of the H-GAC analysis focused on the potential impact of the regional toll roadway network on EJ populations in the region. The RTP and the *Regional Cumulative and Indirect Effects of Toll Facilities* report were updated in 2010 to consider the impact of changes in toll rates on EJ populations. The RTP was again updated in 2011 to address changes in the projects that are included in the 2035 roadway network. For more information on the resources evaluated and for more detail on the EJ analysis, please see the H-GAC *Regional Cumulative and Indirect Effects of Toll Facilities* report and the project technical files**.**

The indirect impact portion of this document identified the need to consider impacts of the expanding regional roadway network, specifically the expansion of toll facilities and managed lanes. An evaluation of the regional cumulative effects of these facilities was considered for potential impacts on Environmental Justice (EJ) populations, air quality, water quality, vegetation, and land use. The Resource Study Area (RSA) for this evaluation is the H-GAC eight county region.

Environmental Justice

Methodology

H-GAC conducted an evaluation to determine the effects of a regional tolled roadway network on Environmental Justice (EJ) populations. Initially, the evaluation identified those 2000 Census block groups which contained 51 percent or more of minority and/or low income populations. Once the EJ block groups were identified, EJ Traffic Analysis Zones (TAZs) were identified if 50 percent or more of its area was identified as an EJ population. Approximately 46 percent of the TAZs are EJ TAZs. In addition, they contain nearly a third of the regional population (*Table 40*). *Exhibit 5* depicts the EJ TAZ for low income populations and/or minority populations.

[3] HGAC, Regional Cumulative and Indirect Effects of Toll Facilities April 2009.

[4] Executive Order 12898: Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations.

Table 40. Traffic Analysis Zone Data

	2000 Population	Percent of Regional Population	Number of TAZ	Percent of Total TAZ
Total EJ TAZ Population	1,634,500	31	1,383	46
Total Regional Population	5,214,051	100	3,000	100

Note: Table data is based on the original 2035 RTP but is consistent with the RTP Update conducted by H-GAC in 2011 as they did not change their growth scenarios for this update.

Source: H-GAC 2009.

Following the identification of the EJ TAZs, two regional roadway network scenarios were utilized, the 2035 RTP Update Build Scenario and the 2035 RTP Update No Build Scenario, to conduct an analysis on travel time for persons within the EJ TAZs and non-EJ TAZs. The Build Scenario includes the new tolled lanes, managed lanes, and high occupancy tolled lanes (HOT) projects identified in the 2035 RTP Update (*Exhibit 6*). The No Build Scenario includes the current roadway network, the fiscally constrained 2035 RTP Update roadway network and the Katy Freeway HOT lanes (*Exhibit 7*).

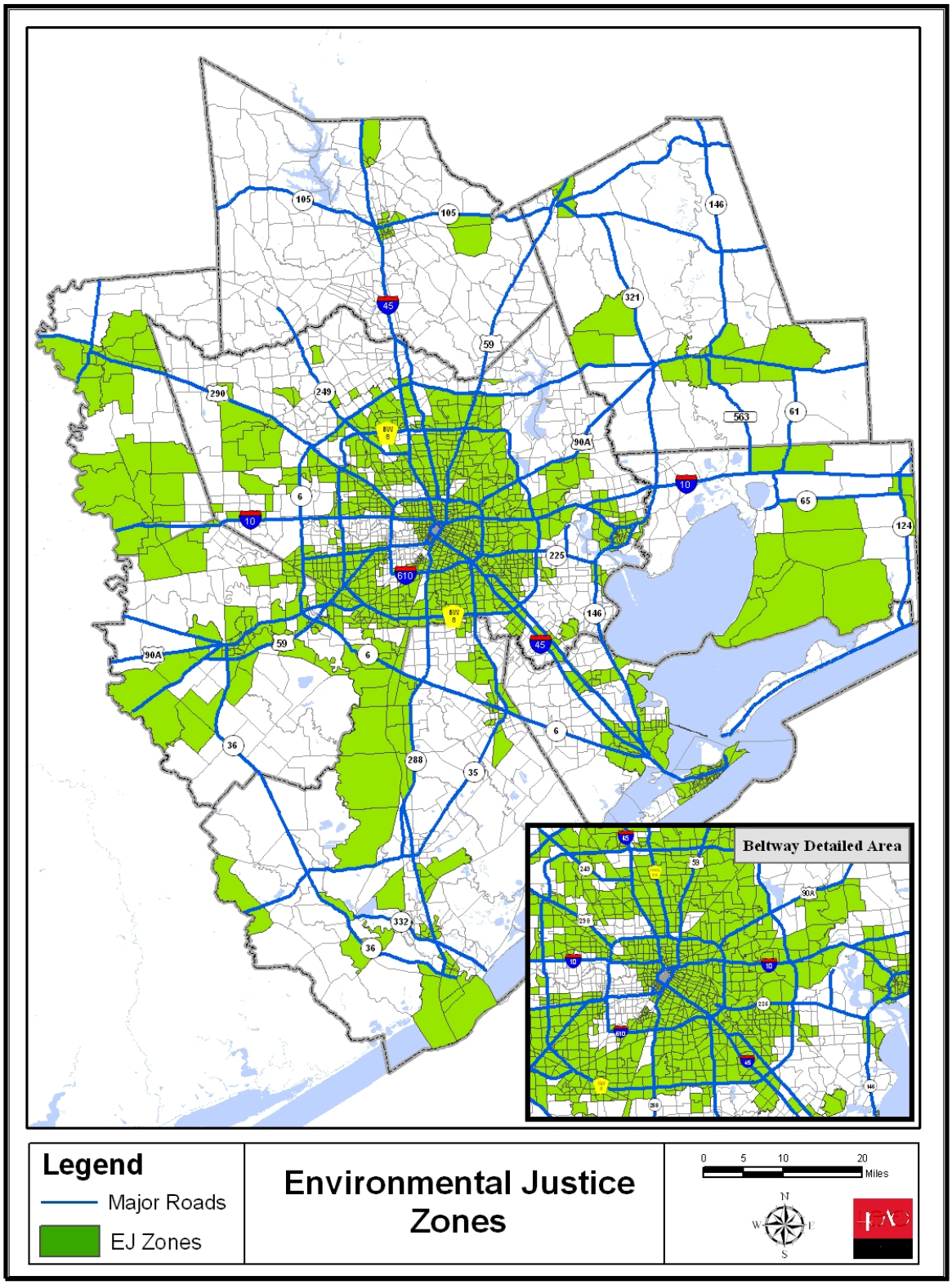


Exhibit 5: Environmental Justice Traffic Analysis Zones

Source: GPA-GEC 2012.

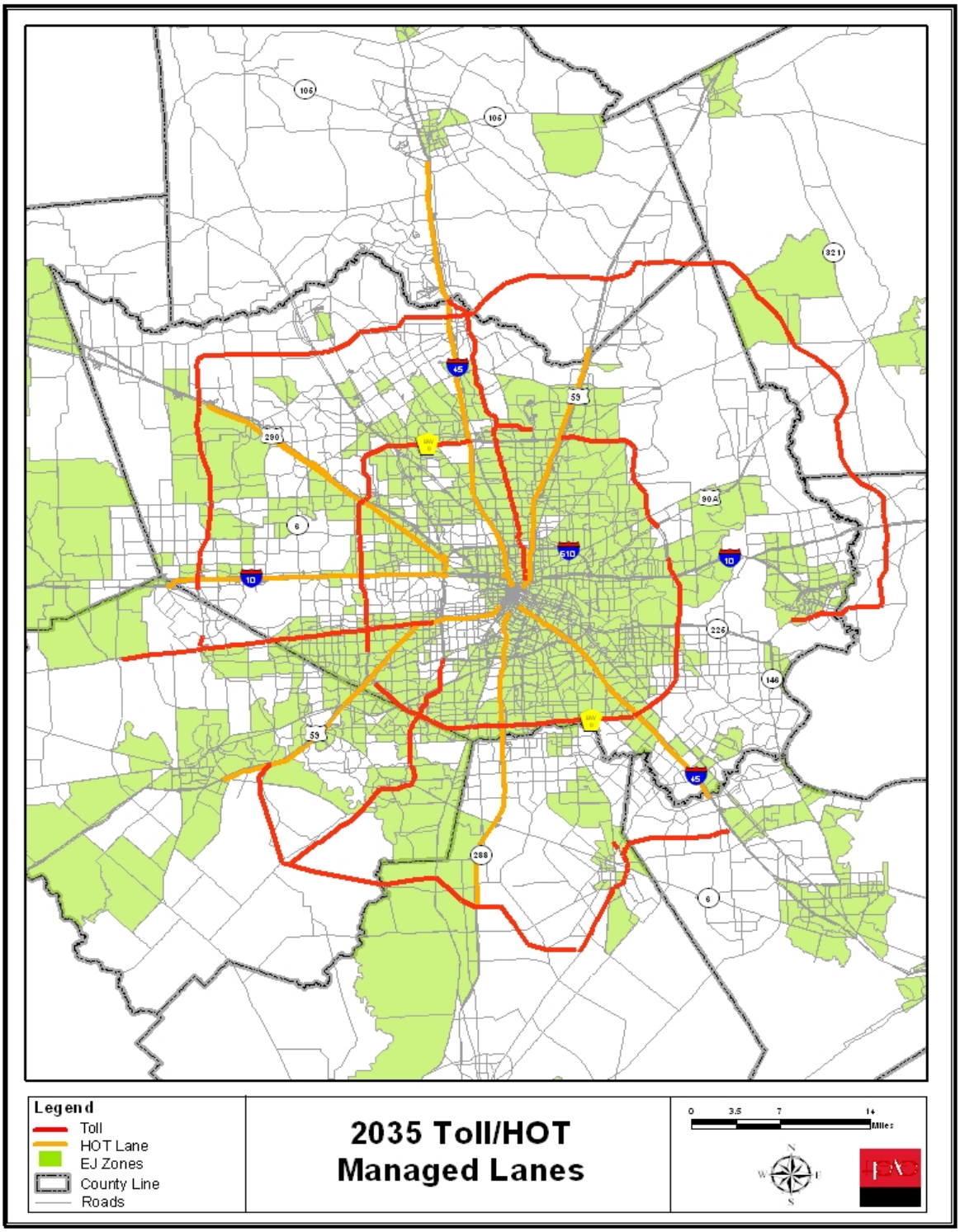


Exhibit 6: 2035 Toll/HOT Managed

Source: GP-GEC 2012.

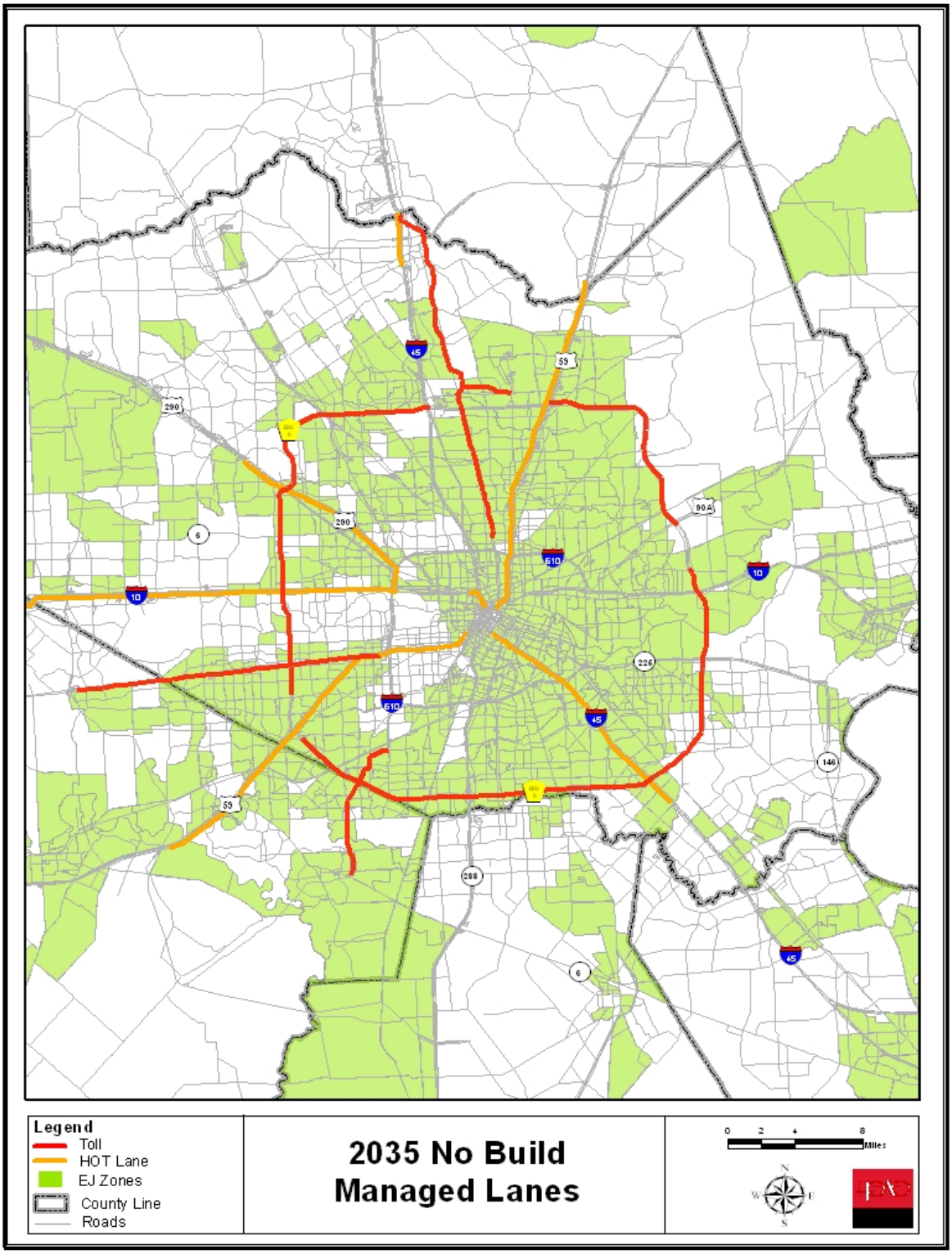


Exhibit 7: 2035 No Build Managed Lanes Network

Source: GP-GEC 2012.

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

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

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

1. Trips produced by EJ zones that are classified as "Candidate" trips

2. The remaining trips produced by EJ zones are classified as non-"Candidate" trips

3. Trips produced by non-EJ zones that are classified as "Candidate" trips

4. The remaining trips produced by non-EJ zones are classified as non-"Candidate" trips

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

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

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

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

To determine the time analysis for the different scenarios, trips were divided into home based work trips (HBW) and home based non-work trips (HBNW) for both tolled and free facilities.

Table 41 shows the 2035 HBW person trips and the average trip length (ATL) in minutes for the Build and No Build Scenarios.

The results for the home based work trips analysis indicate:

- *Stratification of HBW Trips:* Of the 5,578,077 trips forecasted, 2,650,979 (46%) are produced by EJ Zones while 3,707,098 (54%) are produced by Non-EJ Zones. For the EJ Zone, 924,197(35%) were identified as trips that could save travel time using one of the proposed new tolled facilities. For the Non-EJ Zones, 1,313,564 (58%) were identified as trips that could save travel time by using one of the proposed new tolled facilities.

- *Candidate Toll Trips have Longer ATL:* For both the EJ and Non-EJ Zones, the trips that can save travel time by using a new toll facility have a longer average trip length than those that cannot save travel time. Toll roads, like normal freeways, are designed to serve longer trips. Hence trips that can save substantial time using such facilities exhibit a longer average trip length. A large majority of the shorter trips simply do not have a path that can save time using the proposed toll facilities and hence are included in the subset of trips that cannot save travel time.

- *Differences in the ATL of Build Scenario versus ATL of No-Build Scenario for EJ Zones:* Under the Build Scenario, the 924,197 HBW trips produced by the EJ Zones that can save travel time by using the new toll facility have an average trip length under the toll path choice option of 45.43 minutes, as compared to an average trip length for the free choice option of 51.14 minutes. In essence, the average toll path option is 5.71 minutes shorter than the free path option of the Build Scenario. Under the No-Build Scenario, these same 924,197 HBW trips would have an average trip length of 48.96 minutes for the toll path option and 53.07 minutes for the free path option. Therefore, the additional new toll facilities results in there being more opportunities for travel time savings using toll facilities under the Build Scenario.

- *Differences in the ATL of Build Scenario versus ATL of No-Build Scenario for Non-EJ Zones:* Under the Build Scenario, the 1,313,564 HBW trips produced by the Non- EJ Zones that can save travel time by using the new toll facility have an average trip length under the toll path choice option of 58.75 minutes, as compared to an average trip length for the free choice option of 66.25 minutes. In essence, the average toll path option is 7.50 minutes shorter than the free path option of the Build Scenario. Under the No-Build Scenario, these same 1,313,564 HBW trips would have an average trip length of 66.40 minutes for the toll path option and 70.20 minutes for the free path option. Therefore, the additional new toll facilities results in there being more opportunities for travel time savings using toll facilities under the Build Scenario.

- *Differences in the ATL for Build Scenario for EJ and Non-EJ Zones:* For those trips that can save travel time by using the new toll facilities, the EJ Zones ATL for the toll option was reduced by 3.53 minutes and the Non-EJ Zones ATL for the toll option was reduced by 7.65 minutes. While both EJ and Non-EJ Zones benefit, the difference in the ATLs for the toll optione is smaller for the

EJ Zones than for the Non-EJ zones. As documented by H-GAC, the EJ zones are generally more centrally located; therefore, they are not located as close to many of the proposed new toll facilities as the EJ Zones.

- *Differences in the ATL for No-Build Scenario for EJ and Non-EJ Zones:* For those trips that can save travel time by using the new toll facilities, the EJ Zones ATL for the toll option was reduced by 1.93 minutes and the Non-EJ Zones ATL for the toll option was reduced by 7.65 minutes. While both EJ and Non-EJ Zones benefit, the difference in the ATLs for the toll option is smaller for the EJ Zones than for the Non-EJ zones. As documented by H-GAC, the EJ zones are generally more centrally located; therefore, they are not located as close to many of the proposed new toll facilities as the EJ Zones. Hence, the Non-EJ zones receive a greater benefit since there are more Non-EJ trips being made in travel corridors served by the proposed new toll facilities.

- Overall, the Build Scenario provides a reduction in travel time for both the tolled and free facilities within the regional roadway network for all zones. As a result, there is no potential for a disproportionate negative effect to the Environmental Justice populations from the regional tolled roadway network. In fact, the entire region, including the EJ Zones, would recognize a benefit in travel time savings because of the added capacity the tolled roadway facilities provide to the regional roadway network.

Table 41. AM Peak Home Base Work 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			
Zones	2035 HBW Trip Scenarios	Number of 2035 HBW Person Trips	ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL Using Free Facility	Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
EJ Zone	Trips that save 0+ minutes using a new tolled facility	924,197	45.43	51.14	48.96	53.07	3.53	1.93
	Trips that cannot save 0+ minutes using a new tolled facility	1,726,782	24.78	24.83	25.52	25.57	0.74	0.74
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,313,564	58.75	66.25	66.4	70.2	7.65	3.95
	Trips that cannot save 0+ minutes using a new tolled facility	1,793,534	29.30	29.35	30.66	30.71	1.36	1.36

Note: Table data is based on the 2035 RTP Update conducted by H-GAC in 2011.

Source: GP-GEC 2012.

Table 42 shows the 2035 HBNW person trips and the average trip length (ATL) in minutes for the Build and No Build Scenarios.

Table 42. AM Peak Home Based Non-Work 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			
Zones	2035 HBW Trip Scenarios	Number of 2035 HBW Person Trips	ATL Using Tolled Facility	ATL Using Free Facility	ATL Using Tolled Facility	ATL Using Free Facility	Difference in ATL for the Tolled Facility (No Build – Build)	Difference in ATL for Free Facility (No Build – Build)
EJ Zone	Trips that save 0+ minutes using a new tolled facility	674,267	32.23	34.32	35.54	36.51	3.31	2.19
	Trips that cannot save 0+ minutes using a new tolled facility	5,736,756	14.78	14.79	15.18	15.19	0.4	0.4
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,019,058	45.77	49.01	54.84	55.61	9.07	6.60
	Trips that cannot save 0+ minutes using a new tolled facility	5,811,141	23.05	23.06	24.28	24.30	1.23	1.24

Note: Table data is based on the 2035 RTP Update conducted by H-GAC in 2011.

Source: GP-GEC 2012.

The results for the HBNW trips analysis indicate:

- *Stratification of HBNW Trips:* Of the 13,241,222 trips forecasted, 6,411,023 (48%) are produced by EJ Zones while 6,830,199 (52%) are produced by Non-EJ Zones. For the EJ Zone, 674,267 (11%) were identified as trips that could save travel time using one of the proposed new tolled facilities. For the Non-EJ Zones, 1,019,058 (15%) were identified as trips that could save travel time by using one of the proposed new tolled facilities.

- *Candidate Toll Trips have Longer ATL:* For both the EJ and Non-EJ Zones, the trips that can save travel time by using a new toll facility have a longer average trip length than those that cannot save travel time. Toll roads, like normal freeways, are designed to serve longer trips. Hence, trips that can save substantial time using such facilities exhibit a longer average trip length. A large majority of the shorter trips simply do not have a path that can save time using the proposed toll facilities, and hence, are included in the subset of trips that cannot save travel time.

- *Differences in the ATL of Build Scenario versus ATL of No-Build Scenario for EJ Zones:* Under the Build Scenario,, the 674,267 HBNW trips produced by the EJ Zones that can save travel time by using the new toll facility have an average trip length under the toll path choice option of 32.23 minutes, as compared to an average trip length for the free choice option of 34.32 minutes. In essence, the average toll path option is 2.09 minutes shorter than the free path option of the Build Scenario. Under the No-Build Scenario, these same 674,267 HBNW trips would have an average trip length of 35.54 minutes for the toll path option and 36.51 minutes for the free path option. Therefore, the additional new toll facilities results in there being more opportunities for travel time savings using toll facilities under the Build Scenario.

- *Differences in the ATL of Build Scenario versus ATL of No-Build Scenario for Non-EJ Zones:* Under the Build Scenario, the 1,019,058 HBNW trips produced by the Non- EJ Zones that can save travel time by using the new toll facility have an average trip length under the toll path choice option of 45.77 minutes, as compared to an average trip length for the free choice option of 49.01 minutes. In essence, the average toll path option is 3.24 minutes shorter than the free path option of the Build Scenario. Under the No-Build Scenario, these same 1,019,058 HBNW trips would have an average trip length of 54.84 minutes for the toll path option and 55.61 minutes for the free path option. Therefore, the additional new toll facilities results in there being more opportunities for travel time savings using toll facilities under the Build Scenario.

- *Differences in the ATL for Build Scenario for EJ and Non-EJ Zones:* For those trips that can save travel time by using the new toll facilities, the EJ Zones ATL for the toll option was reduced by 3.31 minutes and the Non-EJ Zones ATL for the toll option was reduced by 9.07 minutes. While both EJ and Non-EJ Zones benefit, the difference in the ATLs for the toll optione is smaller for the EJ Zones than for the Non-EJ zones. As documented by H-GAC, the EJ zones are generally more centrally located; therefore, they are not located as close to many of the proposed new toll facilities as the EJ Zones.

- *Differences in the ATL for No-Build Scenario for EJ and Non-EJ Zones:* For those trips that can save travel time by using the new toll facilities, the EJ Zones ATL for the toll option was reduced by 2.19 minutes and the Non-EJ Zones ATL for the toll option was reduced by 6.60 minutes. While both EJ and Non-EJ Zones benefit, the difference in the ATLs for the toll option is smaller for the EJ Zones than for the Non-EJ zones. As documented by H-GAC, the EJ zones are generally more centrally located; therefore, they are not located as close to many of the proposed new toll facilities as the EJ Zones. Hence, the Non-EJ zones receive a greater benefit since there are more Non-EJ trips being made in travel corridors served by the proposed new toll facilities.

- Overall, the Build Scenario provides a reduction in travel time for both the tolled and free facilities within the regional roadway network for all zones. As a result, there is no potential for a disproportionate negative effect to the Environmental Justice populations from the regional tolled roadway network. In fact, the entire region, including the EJ Zones would recognize a benefit in travel time savings because of the added capacity the tolled roadway facilities provide to the regional roadway network.

In addition, the Build Scenario, which includes the regional tolled roadway network, provided an overall reduction in daily vehicle hours traveled (VHT). Essentially, daily VHT decreased by nearly two percent for the 2035 regional roadway network (*Table 43)*. This reduction indicates that the 2035 roadway network with tolled facilities would improve system performance and provide travel time savings for EJ and non-EJ populations.

Table 43. 2035 Regional VMT and VHT

	Build	No Build
Daily VMT	273,728,894	272,667,394
Daily VHT	9,723,213	9,971,737
AM VMT	58,603,316	45,028,280

Note: Table data is based on the 2035 RTP Update conducted by H-GAC in 2011.

Source: GP-GEC 2012.

Overall Environmental Justice Toll Network Findings

For HBW 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 average trip length 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 are 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 of the EJ zones are less than the ATL of non-EJ zones, the EJ zones cannot derive as much travel time savings as the longer trips from Non-EJ zones. A substantial amount of future transit improvements are targeted at EJ zones; the ATLs for the populations within those zones will tend to improve due to increased access to improved transit facilities. As previously mentioned, METRO's 2035 Long Range Plan recommends significant expansion of the current transit system and includes a network of integrated high capacity transit facilities on major travel corridors. This plan also identifies service expansions beyond the METRO service area. New improvements scheduled for implementation through the year 2035 include high occupancy tolls, a new intermodal terminal, park-n-ride facilities, 40 miles of Signature Bus lines, and several new high capacity transit corridors throughout the region including the 89 miles of LRT, and 84 miles of CRT.

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

Although EJ populations will see an increase in spending for toll facilities, the entire region will also see an increase in spending and usage as the toll and managed lane system expands. Both EJ and Non-EJ

populations will benefit from future toll facilities. In fact, the 2035 RTP Update relies heavily on toll funding to finance a portion of future added capacity projects, both free and toll. Additionally, for both populations who choose to use non-toll options, the Build Scenario for 2035 will provide a roadway network that will operate at better traffic conditions than the No Build Scenario and would provide an increased benefit for those users over the No Build Scenario. Consideration was included in the this 2011 regional toll analysis for the 2035 RTP Update changes in the 2035 roadway network and toll increases which were implemented and evaluated in 2010.

Based on the previous discussion and analysis, the Build Scenario for the 2035 RTP Update, even with the network changes and the 2010 toll increases, would not cause cumulative disproportionately high and adverse effects on EJ populations as per Executive Order 12898 regarding environmental justice.

Air Quality

The Clean Air Act Amendments of 1990 (CAAA) require transportation plans, programs, and projects in nonattainment areas, which are funded or approved by the Federal Highway Administration (FHWA) or Federal Transit Administration (FTA), to conform to the State Implementation Plan (SIP). This ensures that transportation plans, programs, and projects do not produce new air quality violations, worsen existing violations, or delay timely attainment of the National Ambient Air Quality Standards (NAAQS). Under the Clean Air Act, the Environmental Protection Agency (EPA) established criterion called the National Ambient Air Quality Standards (NAAQS) to determine the health threat of criteria pollutants, generally located within Consolidated Metropolitan Statistical Areas (CMSAs). If a CMSA has a health threat, it is designated as a 'non-attainment' area until compliance is achieved. The HGB area is designated as "marginal" nonattainment for the 2008 8-hour ozone standard under the NAAQS, effective July 20, 2012. As part of implementing the 2008 8-hour ozone standard, EPA is revoking the 1997 8-hour ozone standard for purposes of transportation conformity (77 FR 30160) this will be effective July 20, 2013. Therefore, the transportation conformity rule does apply.

Transportation conformity is an analytical methodology that establishes the connection between projected on-road emissions from the RTP Update and the known reductions in the motor vehicle emission budget from the SIP. Through the process of transportation conformity, the RTP Update uses the SIP on-road mobile strategies and air quality targets to demonstrate if the RTP Update complies with the federal air quality requirements. Vehicle emissions resulting from the implementation of transportation projects in the 2035 RTP Update cannot exceed emission budgets established by the SIP. The Houston-Galveston region must demonstrate that the 2013 - 2016 Transportation Improvement Plan (TIP) and the long-range plan (2035 RTP Update) result in less volatile organic compounds (VOC) and nitrogen oxides (NOx) than established and approved by EPA for each analysis year. The USDOT determined that the *2035 RTP Update* and the *2014-2016 TIP* conformed to the requirements of the SIP for the Houston-Galveston ozone non-attainment area on January 25, 2011 and November 1, 2012, respectively. The Level of Mobility (LOM) was developed to illustrate the degree of congestion on roadways within the region. *Exhibit 8* shows the relative distribution of morning peak period congestion levels for the current and future regional roadway network as a percentage of vehicle miles traveled in each LOM category. Based on the forecasted growth predicted in the 2035 RTP Update, regional congestion levels would still exist on the regional roadway network. However, the 2035 RTP Update Regional Roadway Network would improve morning peak congestion approximately 50 percent to less than 30 percent when compared to the 2035 No Build Scenario.

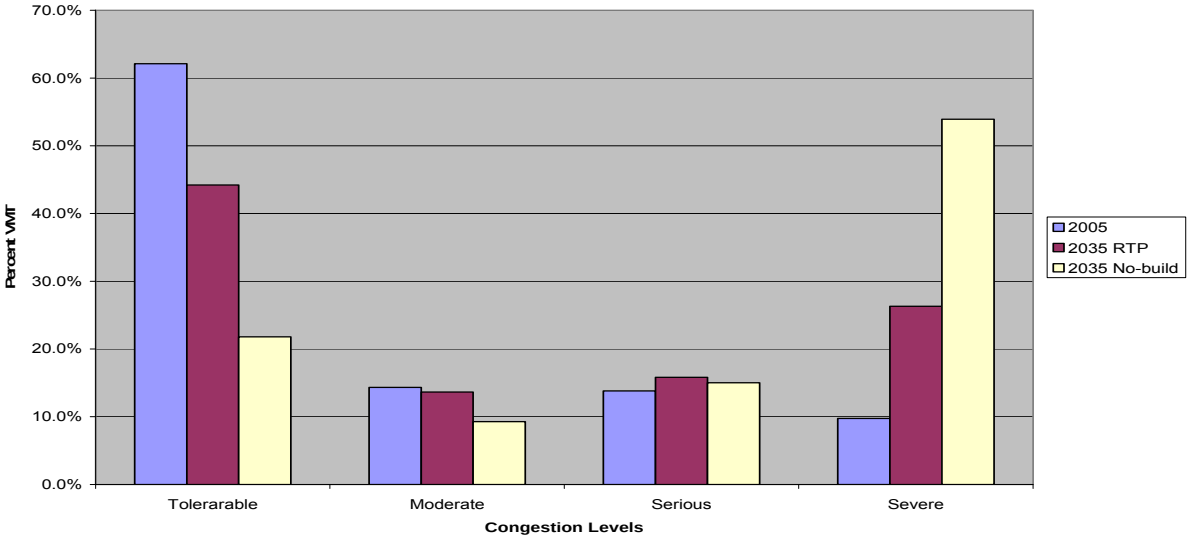


Exhibit 8: Level of Mobility – AM Peak

Note: Data is based on the 2035 RTP Update conducted by H-GAC in 2011.

Source: GP-GEC 2012.

Air Quality Findings

The addition of tolled facilities and managed lanes into the existing regional roadway network would not have any cumulative impacts to air quality. Moreover, a tolled roadway network adds capacity to the regional roadway network, thus allowing a better flow of traffic and decreasing the amount of cars traveling at lower speeds or idling conditions. The improved traffic flow results in less fuel combustion and lower emissions including Mobile Source Air Toxics (MSATs), Carbon Monoxide (CO), and Ozone. As noted in the direct, indirect, and project level cumulative analysis discussions, EPA's vehicle and fuel regulations, coupled with fleet turnover, are expected to result in substantial reductions of on-road emissions, including MSATs, CO and ozone precursors.

Water Quality

The Houston-Galveston region has an abundance of water resources including rivers, lakes, and bays. The Texas Commission on Environmental Quality (TCEQ), along with the Clean Rivers Program and numerous local agencies, are responsible for monitoring all major bodies of water and reporting those conditions in a biennial Texas Water Quality Inventory report. Section 303(d) of this report details those water bodies TCEQ has identified as impaired because of water contamination. The 303(d) list identifies several major water systems as impaired with pollutants and bacteria in the RSA. A majority of the waterways located in the Trinity-San Jacinto Coastal Basin, San Jacinto River Basin, San Jacinto-Brazos Coastal Basin, Brazos-Colorado Coastal Basin, including bays and estuaries that flow to the Gulf of Mexico, are impaired and included in the 303(d) list. The construction of the regional tolled roadway network would cross and impact the above mentioned water bodies at various locations and could cause water quality impacts. The increase of impervious cover from adding capacity to the regional roadway network greatly increases non-point source pollution and the potential to cause further impairment to the region's waterways. As stated previously, TCEQ regulates water quality through Storm Water Pollution Prevention Plans (SWP3), Municipal Separate Storm Sewer Systems (MS4), and Best Management Practices (BMPs). All construction of the regional tolled roadway network in the RTP Update would follow these water quality regulations that would aid in preventing further pollution to these impaired waters and

to waters that are not impaired. Additionally, any land use development that would occur from the construction of these facilities would follow TCEQ's regulations for water quality through SWP3 and MS4.

Water Quality Findings

Although overall impacts cannot be avoided, the above mentioned mitigation techniques will ensure that the regional tolled roadway network would not have significant cumulative impacts to water quality.

Vegetation

Prairie, Wetland, Bottomland Forest, Upland Forest, and Riparian Corridor ecosystems are all located in the Houston-Galveston region. Each of these resources provide vital functions such as flood protection, air quality, water quality and wildlife habitat. Protection of these natural resources which contribute to our region's quality of life is an important priority when planning for our region's future growth and transportation infrastructure. This sentiment was voiced strongly at the Envision Houston Region workshops and forums.

As growth and development are part of our region's future, it is not feasible that every undeveloped parcel be preserved. However, it is feasible that the region identify and work to conserve those areas that are most ecologically sensitive. H-GAC identified areas that have sensitive environmental resources for special consideration in the transportation planning process. However, the identification is not intended to be used for project-level screening. The results are intended to be used for long-range planning purposes and screening to identify areas in which future transportation projects or development may potentially impact these sensitive resources. In addition, the identified environmental resources are areas in which mitigation efforts may be focused.

In some instances, disturbing natural resources may be unavoidable for regionally significant projects or projects located on facilities that are multiple-lane, limited access facilities, such as highways and toll roads. Currently, projects within the 2035 RTP Update are individually subject to environmental requirements but have no mechanism for cumulatively identifying or mitigating environmental impacts. At the project level, the Texas Department of Transportation (TxDOT) Houston District can mitigate for loss of vegetation with the Texas Parks and Wildlife Department, and wetlands mitigation would occur through the permitting process under the jurisdiction of the U.S. Army Corps of Engineers. Locally, cities can also curb vegetation loss by implementing measures to protect vegetation areas.

Vegetation Findings

Impacts to vegetation will undoubtedly occur from the regional tolled roadway network. However, these impacts are best evaluated and mitigated at the project level.

Land Use

While we can increase system capacity, manage demand, and improve the efficiency of the existing regional roadway network, the greatest potential effect upon improving mobility and quality of life is connecting transportation and land use planning. Land use has a direct impact on the ability of the region's transportation system and agencies to deliver a variety of travel choices. The 2035 RTP Update has shown that sustained major investments in roadway capacity will only moderate, and will not eliminate the level of future traffic congestion. However, improved mobility is possible through better coordinated land use and transportation planning.

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

- Scenario A: (Base Case) denotes the current growth and development pattern for the Houston-Galveston region, based on H-GAC's 2035 demographic forecasts. It is characterized by low-density housing development in currently undeveloped portions of the region with mixed-use development along major roadways. Jobs are concentrated in the central business district, and several other employment centers are scattered throughout the region.

- Scenario B: denotes the workshop participants' ideal growth pattern, adjusted to the *regional forecast* of household and employment growth. This scenario is characterized by development along major roadways, in a radial pattern, creating centers at major intersections.

- Scenario C: denotes the workshop participants' ideal growth pattern, adjusted to the forecast of household and employment *growth by county*. This scenario clusters mixed-use development in satellite cities and along major roadways in a radial pattern. Satellite employment centers emerge throughout the region.

Table 44 identifies the transportation related data associated with the growth scenarios.

Table 44. 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

Note: Table data is based on the original 2035 RTP but is consistent with the RTP Update conducted by H-GAC in 2011 as they did not change their growth scenarios for this update.

Source: H-GAC 2009.

*Denotes change over Scenario A

These results reinforce the public's intuitive notions about coordinated transportation and land use planning. H-GAC has identified a three-pronged land use and transportation coordination strategy that 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. This "3C's" strategy, in addition to enhancing mobility choices, is expected to produce economic, environmental and "quality of place" benefits for the region.

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

1. Coordinate transit and roadway planning to connect existing and planned centers with the region's multi-modal transportation network,

2. Promote roadway designs appropriate for the context of the surrounding community to ensure safe, convenient travel choices for all user modes,

3. Coordinate transportation improvements and private sector development efforts to promote projects that combine sustainable mobility and economic benefits,

4. Help fund local planning studies to assist in the development of centers, and

5. 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.

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

The proposed 2035 regional roadway network is in support of the predicted land use changes and growth in the region. To meet the demand of the expansive growth and changes in land use from development, the aim of the 2035 regional roadway network is to supply the transportation portion of infrastructure requirements for the expanding growth and development. Current and future predicted available funds from the federal government for transportation alone will not be able meet the demands for the transportation infrastructure needed to support the predicted changes. Tolled roads and managed lanes are methods that the RTP Update employs to ensure the transportation demands from future growth is met when considering the limited transportation funds available.

Land Use Findings

The proposed 2035 regional tolled roadway network may affect land use within the MPO boundaries by creating land development and/or redevelopment opportunities. However, the regional tolled roadway network is only one factor in creating favorable land development conditions; other prerequisites for growth in the region include demand for new development, favorable local and regional economic conditions, adequate utilities, and supportive local land development policies. The proposed 2035 regional tolled roadway network may influence and facilitate the additional planned regional land use conversion, redevelopment, and growth.

Conclusion

The regional tolled roadway network would cause some impacts to natural and socio-economic resources. However, the regional tolled roadway network would have a beneficial impact on EJ populations and air quality in the Houston-Galveston area. Overall, with the 2035 build scenario, which includes the regional tolled roadway network in place, travel efficiencies in the region will benefit both EJ and non-EJ populations. The net benefit may be slightly greater for the non-EJ populations because the average trip length in these zones is greater than the average trip length from the EJ zones. The additional vehicle lane miles that the regional tolled roadway network provides enables traffic to flow more efficiently thereby reducing emissions associated with cars traveling at lower speeds or idling conditions.

In addition, regional mitigation for air quality and EJ populations are also addressed by the H-GAC as part of 2035 RTP Update. The Transportation Planning Process at the MPO regional level is required to incorporate measures to minimize the potential to affect the environment and communities, including populations protected under Title VI of the Civil Rights Act of 1964 and Executive Order 12898 and air quality which is protected by the CAAA. Any transportation facility including the regional tolled roadway network would be required to meet these standards in order to be included in the TIP/STIP and RTP

Update. Furthermore, all new projects to be added to the TIP/STIP and RTP Update must be in conformance with the SIP.

Although land use impacts cannot be mitigated at a regional level, they can at a municipal level because these entities have direct control over land use. However, the MPO can aid in land use impact avoidance at the regional level by only funding transportation projects consistent with the regional vision and by working with municipalities to address regional infrastructure changes in their comprehensive plans. State and Federal regulatory agencies are required to institute policies and monitor project-level effects to the natural and cultural resources that are found in their jurisdictions. Avoidance, minimization and mitigation strategies are used to support those policies in order to reduce impacts to these resources.

Finally, as required by NEPA, appropriate mitigation for direct impacts would occur at the project level. Because of these mitigation measures, the regional proposed tolled roadway network is not anticipated to have a substantial cumulative impact on the resources considered in this section.

C. Conclusion

Growth and development are the principle indirect impacts related to highway improvement projects. By definition, cumulative impacts are incremental in nature and tend to be less defined than secondary impacts. Land development has been active in the RSA since the initial completion of SH 288 and is projected to continue. The proposed project would improve mobility and access to employment centers such as downtown Houston and the TMC. It would also improve travel time in the corridor, supporting development in Pearland and Manvel.

In the short term, construction of the project would create new construction-related employment opportunities. Project planning, design, and construction activities would generate additional employment, income, and sales tax revenues in the area over the short term. The economic effects of the project were estimated by using Texas State Comptroller Office's input-output model, which has multipliers for employment and income related to new roadway construction. When multiplied by the total construction costs of the project, the factors produce estimates of the economic impacts of project construction on a statewide basis. The proportion of economic effects retained locally depends on capturing local materials and labor during the construction process. In the short term, construction of the proposed project would generate over 90,000 jobs (46,987 direct and 45,588 indirect) and approximately $1.2 billion in income ($404 million direct and $811 million indirect).

Long-term economic effects of implementation of the proposed project would include the removal of approximately 69 acres of taxable property (for ROW acquisition) from the tax rolls of local government entities and school districts. In the long term, the operational efficiency SH 288 would be improved as a result of implementation of the proposed project.

XXIX. Recommendation of the Build Alternative

A. Build Alternative

Section IV of this EA describes the Build Alternative, which includes construction of toll lanes and associated improvements. This alternative achieves the project goals and minimizes environmental impacts of the proposed project.

B. Support Rationale

The Build Alternative would meet the purpose of the project by increasing the roadway capacity to accommodate future traffic demands, making access to TMC more efficient, and increasing mobility. Proposed improvements have been designed to minimize ROW acquisition and potential adverse impacts to properties and communities.

C. Mitigation and Monitoring Commitments

TxDOT would design, use, and promote construction activities that would avoid and preserve as many trees as practicable. Vegetation clearing and work within the proposed project area would be conducted outside of the normal nesting season for migratory birds, or measures would be taken to discourage birds from nesting in existing structures. Additionally, contractors would be notified about, and be responsible for, complying with the MBTA for migratory birds that may inhabit the project area throughout the construction period of the proposed project.

The proposed project would require USACE authorization under Section 404 of the CWA prior to the discharge of fill materials into waters of the United States, including wetlands. All appropriate permits would be acquired by TxDOT prior to construction. A review of USACE requirements would be conducted as design plans are finalized. Compensatory mitigation for Section 404 effects would be coordinated with the USACE and performed in accordance with the terms of the approved permits. In accordance with the provisions of Section 404(b)(1) Guidelines, an applicant must demonstrate that the proposed project has avoided and minimized effects to waters of the United States, including wetlands, to the greatest extent practicable before compensatory mitigation can be proposed.

Storm water control measures and BMPs would be implemented during and after construction of the project to prevent and minimize impacts to water resources. During construction, BMPs may include, but not be limited to, silt fences, hay bales, and seeding or sodding of excavated areas. Permanent BMPs may include a combination of storm water retention, vegetated drainage ditches, seeding of disturbed areas of soil with native species of grasses, shrubs, or trees in accordance with TxDOT's specification "Seeding for Erosion Control".

The proposed project includes mitigation for noise impacts. The preliminary noise barriers shown in *Table 26* are considered reasonable and feasible for this project. TxDOT would decide whether to construct noise barriers and how they are designed when project design and the public involvement process are complete. To minimize construction noise, provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems.

Measures to control dust would be considered and incorporated into the final project design and construction specifications.

TxDOT would require its contractors to take appropriate measures to prevent, minimize, and control accidental spills that may occur during roadway construction. All construction equipment and materials would be removed as soon as the schedule permits. Demolition of structures may contain asbestos-containing materials; and necessary asbestos inspections, specifications, notification, abatement, and disposal, as applicable, would be conducted in compliance with federal and state regulations.

Traffic control during project construction would be in accordance with Part VI (Traffic Controls for Street and Highway Construction and Maintenance Operations) of the *Texas Manual on Uniform Traffic Control Devices*. During construction, travel lanes in each direction would be maintained. However, short-term lane closures may occur during off-peak hours. Access to adjacent property would be maintained during construction. Street intersections would be constructed in phases to maintain through traffic.

D. Coordination Requirements

Prior to construction of the proposed project, TxDOT would coordinate with other government agencies regarding the following:

- TxDOT would be required to develop and implement a Storm Water Pollution Prevention Plan (SW3P) and complete and submit a Notice of Intent (NOI) to the TCEQ.

- TxDOT would coordinate with the USACE during final design of the proposed project to obtain necessary Section 404 permit(s) for the project, including mitigation requirements, as necessary.

E. Conclusions and Recommendations

The environmental assessment concludes that the proposed project is necessary for more efficient travel within the project corridor. The project would have no significant adverse social, economic, or environmental impacts of a level that would warrant an environmental impact statement. Alternative selection would occur following the completion of a public comment period, which would include a public hearing. Unless significant impacts are identified as a result of public review, a Finding of No Significant Impact (FONSI) is expected to be prepared for this proposed action as a basis for federal-aid corridor location approval.