Final
Environmental Impact Statement

North Houston Highway Improvement Project, Houston District

From US 59/I-69 at Spur 527 to I-45 at Beltway 8 North
CSJ: 0912-00-146
Harris County, Texas
August 2020

TxDOT is issuing the Final Environmental Impact Statement prior to issuing a Record of Decision document. TxDOT is not issuing a combined document pursuant to Pub. L. 112-141, 126 Stat. 405, Section 1319(b) due to project design changes after the Draft Environmental Impact Statement and new information relevant to environmental concerns and impacts of the project. TxDOT will issue the Record of Decision document no sooner than 30 days after publication of the Final Environmental Impact Statement.

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NORTH HOUSTON HIGHWAY IMPROVEMENT PROJECT

FROM US 59/I-69 AT SPUR 527 TO I-45 AT BELTWAY 8 NORTH

CSJ: 0912-00-146

HARRIS COUNTY, TEXAS

FINAL ENVIRONMENTAL IMPACT STATEMENT

Submitted Pursuant to 42 U.S.C. § 4332(2)(C)

and 49 U.S.C. § 303 by the

Lead Agency:

Texas Department of Transportation

Aug. 18, 2020

Date of Approval

Texas Department of Transportation

August 2020

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried out by Texas Department of Transportation (TxDOT) pursuant to 23 U.S.C. 327, and a Memorandum of Understanding dated December 9, 2019 and executed by Federal Highway Administration (FHWA) and TxDOT.

TxDOT is issuing the Final Environmental Impact Statement prior to issuing a Record of Decision document. TxDOT is not issuing a combined document pursuant to Pub. L. 112-141, 126 Stat. 405, Section 1319(b) due to project design changes after the Draft Environmental Impact Statement and new information relevant to environmental concerns and impacts of the project. TxDOT will issue the Record of Decision document no sooner than 30 days after publication of the Final Environmental Impact Statement.

El Resumen Ejecutivo está disponible en español. The Executive Summary is available in Spanish.

Comments on the Final EIS (due 30 days from the date the Notice of Availability is published in the Federal Register) should be sent to the Texas Department of Transportation, Attention: Director of Project Development, P.O. Box 1386, Houston, Texas 77251.

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ABSTRACT: Texas Department of Transportation (TxDOT), as lead agency, proposes improvements to create additional roadway capacity to manage congestion, enhance safety, and improve mobility and operational efficiency on Interstate Highway 45 (I-45) from U.S. Highway 59 (US 59)/I-69 to Beltway 8 North, including improvements along US 59/I-69 between I-45 and Spur 527 in Harris County, Texas. The proposed North Houston Highway Improvement Project (NHHIP) includes roadway improvements to add four managed express (MaX) lanes on Interstate Highway 45 (I-45) from Downtown Houston to Beltway 8 North, reroute I-45 to be parallel with I-10 on the north side of Downtown Houston and parallel to US 59/I-69 on the east side of Downtown Houston, realign sections of I-10 and US 59/I-69 in the Downtown area to eliminate the current roadway reverse curves that limit capacity (a reverse curve is a section of the horizontal alignment of a highway in which a curve to the left or right is followed immediately by a curve in the opposite direction), and depress US 59/I-69 between I-10 and Spur 527 south of Downtown to remove the problematic weaving sections. The proposed project also includes reconstruction of mainlanes and frontage roads, the addition of bicycle/pedestrian realms along the 44 Downtown streets that cross the freeways, including a 15–17 foot wide pedestrian realm that will create a buffer between the bicycle/pedestrian traffic and the vehicular traffic, add sidewalks along frontage roads, and add pass-through lanes on I-10 that will separate traffic desiring to go to Downtown from traffic destined to go through Downtown. The social, economic, and environmental impacts of the proposed NHHIP are evaluated for land use, soils and geology, social, economics, air quality, noise, wetlands, floodplains, water quality, biological resources, cultural resources, parklands, hazardous/regulated materials, and visual aesthetics. The Preferred Alternative for the NHHIP was proposed after the evaluation of numerous Build Alternatives as documented in the Draft Environmental Impact Statement (EIS) and this Final EIS. The Preferred Alternative is based on its ability to best accomplish the need for and purpose of the transportation improvements, while minimizing impacts to social, economic, and environmental resources. The Preferred Alternative would require the acquisition of new right-of-way. It is estimated that approximately 160 single-family residences, 433 multi-family residential units, 486 public and low-income housing multi-family units, 344 businesses, 58 billboards, five places of worship, two schools/universities, five parking business, and 11 other displacements would be required. Five historic properties and two historic districts would be directly adversely affected. Impacts to parks protected under Section 4(f) would be avoided. There are no feasible and prudent avoidance alternatives to the use of Section 4(f) historic properties including one district and four properties eligible for the National Register of Historic Places. The evaluation of impacts to historic resources and parks has been completed, including coordination with the Texas Historical Commission, other consulting parties, and officials with jurisdiction. The Preferred Alternative is presented in this Final EIS because the public comment period for the Draft EIS is completed, comments on the Draft EIS and Technical Reports have been received and considered, agency coordination is completed, the individual Section 4(f) evaluation is completed, and the environmental impacts are fully evaluated. A Record of Decision will be prepared after the notice period for the Final EIS. Comments on this Final EIS are due 30 days from the date of publication of the Notice of Availability in the Federal Register and should be sent to:

Texas Department of Transportation
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EXECUTIVE SUMMARY

The Texas Department of Transportation (TxDOT), as the lead agency, is proposing improvements to create additional roadway capacity to manage congestion, enhance safety, and improve mobility and operational efficiency on Interstate Highway 45 (I-45) from U.S. Highway 59 (US 59)/I-69 to Beltway 8 North, including improvements along US 59/I-69 between I-45 and Spur 527 in Harris County, Texas. The proposed North Houston Highway Improvement Project (NHHIP) includes roadway improvements to add four managed express (MaX) lanes on I-45 from Downtown Houston to Beltway 8 North, reroute I-45 to be parallel with I-10 on the north side of Downtown Houston and parallel to US 59/I-69 on the east side of Downtown Houston, realign sections of I-10 and US 59/I-69 in the Downtown area to eliminate the current roadway reverse curves that limit capacity (a reverse curve is a section of the horizontal alignment of a highway in which a curve to the left or right is followed immediately by a curve in the opposite direction), and depress US 59/I-69 between I-10 and Spur 527 south of Downtown to remove the problematic weaving sections. The proposed project also includes reconstruction of mainlanes and frontage roads, the addition of bicycle/pedestrian realms along the 44 Downtown streets that cross the freeways, including a 15–17 foot wide pedestrian realm that will create a buffer between the bicycle/pedestrian traffic and the vehicular traffic, add sidewalks along frontage roads, and add pass-through lanes on I-10 that will separate traffic desiring to go to Downtown from traffic destined to go through Downtown.

To facilitate in the design and analysis of alternatives, the project area was divided into three segments and, in general, the segment limits are (from north to south): Segment 1: Beltway 8 North to I-610, Segment 2: I-610 to I-10, and Segment 3: Downtown Loop System (I-45, I-10, and US 59/I-69). Multiple alternatives were generated for each study segment, from which three Reasonable Alternatives per segment were selected for detailed evaluations and documented in the Draft Environmental Impact Statement (EIS). All of the alternatives would require the acquisition of new right-of-way (ROW) to accommodate the proposed project. There were 31 alternatives in the "Universe of Alternatives"; 21 were "Preliminary Alternatives," and three "Reasonable Alternatives" were evaluated.

This Final EIS builds on the documentation in the Draft EIS. Technical reports were updated to focus on the Preferred Alternative and posted online for public comment. Those technical reports are included as attachments to this Final EIS. The current recommended designs are discussed in detail in Section 2 of this Final EIS.

Since the release of the NHHIP Draft EIS in 2017, TxDOT has continued public engagement through community meetings and by posting updated technical reports for public comments.

Feedback received during that robust public engagement period resulted in project design changes as well as new information on the project's environmental concerns, impacts, and mitigation. This input resulted in changes to the EIS.

Following a minimum of 30 days after notice of availability of the Final EIS is published in the Federal Register, TxDOT will issue a Record of Decision (ROD). The ROD will identify the selected alternative; present the basis for the decision; identify the alternatives considered; specify the environmentally

preferable alternative; and provide information on the adopted means to avoid, minimize, and compensate for environmental impacts. The release of the Final EIS and subsequent signature of the ROD are milestones in the National Environmental Policy Act process for the EIS.

Achieving environmental clearance (the ROD) is a necessary step for the project to begin detailed project design and utility work. Although the ROD is the final step in the EIS process and will result in a selected alternative, future changes and refinements to the project can still occur.

In the event a build alternative is selected by TxDOT in the ROD, TxDOT will proceed with the proposed mitigation measures outlined in the Final EIS to minimize and compensate for noise, air quality, travel patterns, and socioeconomic impacts to communities. TxDOT also anticipates continued refinements and improvements to the project as the project design continues to develop and additional input is received from the public and other stakeholders.

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by TxDOT pursuant to 23 U.S. Code (U.S.C.) 327, and a Memorandum of Understanding (MOU) dated December 9, 2019 and executed by Federal Highway Administration (FHWA) and TxDOT.

ES 1 Project Background

From 2002–2005, the Metropolitan Transit Authority of Harris County (METRO), TxDOT, and the Houston-Galveston Area Council (H-GAC) conducted a series of planning studies to identify and address transportation needs in the North-Hardy Corridor. The conclusions of the studies were that even with improved transit and extension of the Hardy Toll Road to Downtown Houston, additional capacity would be needed on I-45. The proposed project addressed in this Final EIS includes adding four managed lanes to the I-45/Hardy Toll Road corridor. See Section 1.1.1 in the Final EIS for more information about the prior planning studies.

ES 2 Project Need and Purpose

TxDOT, with input from the public, agencies, and other stakeholders, defined needs (problems) and purposes (solutions) for highway transportation improvements in the NHHIP area from Downtown Houston northward to Beltway 8 North, as summarized in Table ES-1.

Table ES-1: Summary of Need and Purpose for Proposed Action

Need	Purpose
Congestion	
The roadway facility does not provide adequate capacity for existing and future traffic demands, resulting in congestion, longer travel times, and reduced mobility.	Manage I-45 traffic congestion in the NHHIP area through added capacity, options for high-occupancy vehicle (HOV) lanes, and improved operations.

Need	Purpose
The average daily traffic volumes on I-45 in the areas from US 59/I-69 to I-10 and I-610 to Beltway 8 North are projected to increase by approximately 40 percent between 2015 and 2040. The average daily traffic volume on I-45 between I-10 and I-610 is projected to increase by approximately 15 percent during the same period. Congestion on I-45 currently ranges from "moderate" to "serious" conditions. Without improvements, I-45 will have "serious" to "severe" congestion by 2040, as measured by traffic volume and capacity.	Improve mobility on I-45 between US 59/I-69 and Beltway 8 North by accommodating projected population growth and latent demand in the project area.
The reversible HOV lane on I-45 serves traffic in only one direction during the peak periods and is unused for large portions of the day. During peak hours, the HOV lane congestion is classified as "tolerable." Forecasts for commuter service indicate that even with parallel high-capacity transit in the corridor, managed lanes would be needed to support commuter traffic and express bus service.	Provide expanded transit and carpool opportunities with two-way, all-day service on MaX lanes, and access to METRO Park & Ride facilities.
Design Standards/Safety	
Portions of I-45 do not meet current roadway design standards, creating a traffic safety concern.	Bring I-45 up to current design standards with shoulders and auxiliary lanes to improve safety and operations.
Roadway design deficiencies also include inadequate storm water drainage in some locations. Intense rainfall causes high water levels at the I-45/I-10 underpass and on the outside lanes and frontage roads between Parker Road and Gulf Bank Road. I-45 would not operate effectively as an evacuation route with high water closures, especially during hurricane evacuations when high rainfall events are likely.	Eliminate areas of flooding on the I-45 mainlanes.
All sections of I-45 show a considerably higher crash rate than the statewide average crash rate.	Provide an improved facility with additional capacity and current design standards to reduce the crash rate.
Emergency Evacuation	
I-45 is a designated evacuation route in case of major storm, hurricane, or chemical spill. At its present capacity, evacuation effectiveness would be limited in the event of a hurricane or other regional emergency.	Expand capacity for emergency evacuations by providing proper design and flexible operations.

ES 3 Summary of Alternatives Considered

The alternatives evaluation process is documented in detail in Section 2 of the Final EIS.

ES 3.1 BUILD ALTERNATIVES

Beginning in 2011, TxDOT began the process of developing and evaluating a full range of reasonable project alternatives. Alternatives and the evaluation criteria used in each stage of the analysis were presented to the public and agencies at meetings in November 2011, October 2012, November 2013, April 2015, and September 2016. One Proposed Recommended Alternative per project segment was identified

in the Draft EIS (April 2017). During preparation of the Draft EIS, TxDOT continued conducting public, agency, and other stakeholder coordination. In response to comments received and further engineering evaluation, the Proposed Recommended Alternatives were revised and presented in May 2017 at the Public Hearing and additional public meetings.

Based on comments received during the Draft EIS comment period and from continuing stakeholder input and coordination, the project design was revised between May 2017 and June 2018. The revised alternatives for each project segment are identified as Preferred Alternatives, and when combined, is the Preferred Alternative for the proposed NHHIP. Section 2.2.6 details the design changes proposed since publication of the Draft EIS. Preliminary sizes and locations of storm water detention basins were identified after the Draft EIS and included as part of the Preferred Alternative. The Final EIS and associated technical reports document the analysis of the potential impacts of the Preferred Alternative, described more specifically in section ES 5 below.

ES 3.2 NO BUILD ALTERNATIVE

The No Build Alternative represents the proposed NHHIP not being constructed. No roadway improvements would be constructed to provide additional capacity to reduce congestion and improve mobility, and the current design deficiencies, including drainage issues in some areas, would not be corrected. Although the No Build Alternative does not meet the need and purpose, this alternative was carried forward through the environmental impact analysis as a basis for assessing the impacts of no action.

ES 4 Summary of Environmental Impacts

This summary includes an overview of the resources and issues evaluated by the Study Team and the environmental impacts of the Preferred Alternative. Information about the analysis of existing conditions; impacts of the proposed project; and environmental permits, issues, and commitments is included in the Final EIS, with reference to the Draft EIS where appropriate, plus associated technical reports that are included as appendices to the Final EIS.

ES 4.1 BUILD ALTERNATIVES

Table ES-2 summarizes by segment the impacts of the Preferred Alternative for some of the resources and issues discussed in this section.

ES 4.1.1 LAND USE

The NHHIP crosses through urban and developing areas. The project area includes residential, commercial, industrial, public use/institutional, parks/open space, vacant, and undevelopable land uses. New ROW would be required for all alternatives. All land uses that would be directly impacted by the NHHIP would be permanently converted to transportation use. See Section 3.1 in the Final EIS for discussions of existing conditions and direct impacts to land use. See Section 5 in the Final EIS for the analysis of potential project-related induced development.

ES 4.1.2 COMMUNITY RESOURCES

In a community impacts assessment, potential impacts of a proposed action to community resources are evaluated. The evaluation includes but is not limited to displacements of residences and businesses, loss of community facilities, isolation and reconnection of neighborhoods, changes in mobility and access, and noise and visual impacts. Adverse and beneficial impacts are considered. Impacts to neighborhoods and community facilities, residences and businesses, and environmental justice populations are discussed in Section 3.2 in the Final EIS. All alternatives would require new ROW which would displace homes, schools, places of worship, businesses, billboards, and other uses. See Section 3.2.3 in the Final EIS for the displacements analysis.

Executive Order (EO) 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations requires federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Office of the President 1994). EO 12898 also directs agencies to develop a strategy for implementing environmental justice. While minority and low-income individuals and community facilities in the project area would be adversely impacted by the proposed project, no Reasonable Alternatives would avoid adverse impacts. Impacts to environmental justice (EJ) populations and sensitive populations are discussed in Sections 3.2.4 and 3.2.5, respectively, in the Final EIS.

ES 4.1.3 ECONOMIC CONDITIONS

All alternatives could require new ROW and could result in loss of property and sales tax revenues for local jurisdictions. Conversion of taxable property to roadway ROW and displacements of businesses that are significant sources of sales tax revenue would have a negative impact on the local economy. Tax revenue losses may be temporary if displaced businesses and residents relocate within the same taxing jurisdiction. Construction of the proposed project would have direct, indirect, and induced effects on local, regional, and state employment, output, and income. See Section 3.3 in the Final EIS for discussions of direct impacts to tax revenues and employment, and indirect impacts to employment and income.

ES 4.1.4 TRANSPORTATION FACILITIES

Transportation facilities in the project area include bus and light rail services, freight railroads, an airport, roadways, bicycle/pedestrian facilities, and transit centers. Transportation facilities in the project area are illustrated on the project schematics and on exhibits in the Community Impacts Assessment Technical Report. See Section 3.4 in the Final EIS for a discussion of impacts to transportation facilities.

ES 4.1.5 AIR QUALITY

This project is located within Harris County, which is part of the Houston-Galveston-Brazoria area that has been designated by the Environmental Protection Agency (EPA) as a serious and marginal nonattainment area for the 2008 and 2015 ozone National Ambient Air Quality Standards (NAAQS), respectively; therefore, transportation conformity rules apply.

The proposed action is consistent with the Houston-Galveston Area Council (H-GAC)'s fiscally constrained 2045 Regional Transportation Plan (RTP) and the 2019–2022 Transportation Improvement Program (TIP), as amended, which were found to conform to the TCEQ State Implementation Plan (SIP) by FHWA and the Federal Transit Administration on August 2, 2019. TxDOT received a project-level conformity determination from FHWA on June 25, 2020.

A traffic air quality analysis (TAQA) was completed to assess whether the project would adversely affect local air quality by contributing to carbon monoxide (CO) levels that exceed the 1-hour or 8-hour CO NAAQS. Using the steady-state Gaussian dispersion model CALINE3, the analysis factored in worst-case assumptions along areas of the project with the highest design hour volume of vehicles and narrowest ROW for each segment. The analysis results for each segment of the project indicate that CO concentrations are not expected to exceed the national standard and would remain relatively consistent from the estimated time of completion (ETC) to the design year.

A quantitative mobile source air toxics (MSAT) analysis for the nine priority MSAT was conducted for the affected transportation network of the NHHIP project. This analysis calculated a reduction of over 72 percent for both the build and no build scenarios for total MSAT emissions from 2018 to 2040, even as vehicle miles traveled (VMT) is projected to increase between 45–58 percent. The H-GAC regional congestion management process and construction emissions are also discussed in this Final EIS. See Section 3.5 for more details on the air quality analysis.

ES 4.1.6 NOISE

A traffic noise analysis was conducted in accordance with TxDOT's (FHWA-approved) Guidelines for the Analysis and Abatement of Roadway Traffic Noise. Existing and future traffic noise levels were determined for a variety of noise-sensitive land uses adjacent to the NHHIP project, including exterior areas of single-family homes, apartments, churches, schools, and parks. Traffic noise impacts for the Preferred Alternative are predicted to occur at locations represented by a total of 222 receiver points across the three project segments. Noise abatement measures were evaluated for each traffic noise impact. Where reasonable and feasible, noise barriers are proposed for 76 locations, which would benefit 138 representative receivers. The quantitative examination of potential mitigation measures including traffic noise barriers was conducted and is discussed in Section 3.6 of this Final EIS.

ES 4.1.7 WATER RESOURCES

Within the proposed project area, the City of Houston operates and maintains the public water system that distributes public drinking water to end users. According to the Texas Water Development Board's groundwater database, seven registered water wells are located within the ROW for the Preferred Alternative, all of which use the Gulf Coast Aquifer as source water. Implementation of storm water best management practices (BMPs) and spill prevention measures would minimize potential impacts to groundwater quality. Wells located within the Preferred Alternative that would be unavoidably impacted by the Preferred Alternative would be plugged and abandoned according to the TCEQ regulations to eliminate the potential for impacts to groundwater resources.

A storm water pollution prevention plan (SW3P) would be developed according to TxDOT policies, and measures would be implemented to prevent or correct erosion that may develop during construction. The proposed project would comply with the Texas Pollutant Discharge Elimination System Construction General Permit (CGP). The implementation of storm water BMPs and the construction of detention facilities would minimize potential impacts to surface water quality. Impacts to surface water quality because of surface spills would be minimized by the implementation of spill prevention measures established in the SW3P.

No coastal barriers as mapped in the Coastal Barrier Resources System occur for the Preferred Alternative within Segments 1, 2, or 3; therefore, the proposed project would have no impact on coastal barrier resources. A portion of the Texas Coastal Management Zone associated with Buffalo Bayou traverses east-west through Segment 3. Construction activities of the Preferred Alternative requiring permit authorization from the U.S. Army Corps of Engineers (USACE) would necessitate formal coordination between TxDOT and the General Land Office regarding consistency with the Texas Coastal Management Program, thereby minimizing impacts to the coastal zone. TxDOT coordination with the U.S. Coast Guard (USCG) would also be conducted for permitting related to bridge structures constructed over Buffalo Bayou. See Section 3.7 in the Final EIS.

ES 4.1.8 FLOODPLAINS

Portions of the proposed project traverse areas designated by the Federal Emergency Management Agency (FEMA) as special flood hazard areas (regulatory floodways, 100-year floodplains, and 500-year floodplains). Approximately 70 percent of the project area is outside 100-year floodplains and other flood hazard areas as currently mapped by FEMA. Portions of the existing and proposed project ROW are within mapped 100-year floodplains. Studies to update floodplain mapping for Harris County are ongoing and are using updated precipitation-frequency data. See Section 3.8 in the Final EIS for additional information. As noted in Section 3.8.2 in the Final EIS, the Atlas 14 precipitation-frequency data is currently required to be used for project design in Harris County, and TxDOT is using the updated precipitation-frequency estimates when designing new construction projects.

TxDOT would coordinate with the City of Houston Department of Public Works and Engineering, and Harris County Flood Control District (HCFCD) as needed, relative to regulatory floodplains and floodplain management during the design and evaluation of the proposed project. A detailed hydrologic and hydraulic study would be performed for the proposed project during the design phase to determine the appropriate locations and sizes of bridges, culverts, or other drainage structures that would be required. Federal, state, and local authorities would have the opportunity to review the hydrologic and hydraulic study to verify that appropriate measures have been proposed such that the project would not increase the flood risk to adjacent properties. Bridges, culverts, and cross-drainage structures would be designed to FHWA and TxDOT standards for design events up to the 100-year storm event. The study would also confirm that the project would not adversely impact existing floodplain conditions within the vicinity of the project for extreme events (i.e., storm events in excess of a 100-year storm event). BMPs, such as the construction of detention facilities, would be incorporated into the final design of the proposed project to offset increased flows from areas of impervious surface. Construction of the proposed project would

be in compliance with county and local floodplain guidelines and policies, including use of updated precipitation-frequency estimates during project design.

ES 4.1.9 Wetlands And Other Waters Of The United States

Waters and wetlands occurring within or traversing the existing and proposed new ROWs were assessed for each individual project segment. Buffalo Bayou and a section of White Oak Bayou within the limits of the proposed project within Segment 3 are navigable waterways (i.e., waters that are subject to the ebb and flow of the tide, or are presently used, have been used in the past, or may be susceptible for use to transport interstate or foreign commerce). A Section 9 permit from the USCG would be anticipated for bridges or other structures constructed in or over Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence. A Section 10 permit from the USACE would be anticipated for project construction activities that would involve the discharge of dredged or fill material within the jurisdictional limits of Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence.

The areal extent of aquatic resources identified within the existing and proposed new ROWs was calculated based on a combination of data collection in the field (from public ROWs and where right-of-entry was granted) and interpretation of remotely sensed desktop data (described in detail in Section 3.9 of the Final EIS). Subsequent to publication of the Draft EIS, a survey of Buffalo Bayou, White Oak Bayou, Little White Oak Bayou, and Halls Bayou was conducted by Registered Professional Land Surveyors to more accurately define the areas of these water courses occurring within the existing I-45 ROW and the proposed new ROW of the Preferred Alternative. The Final EIS presents the acreage and linear feet of the 29 water bodies, which include both waters of the United States and wetlands, occurring within the existing I-45 ROW and the Preferred Alternative ROW. Of the 29 identified water bodies, 25 were preliminarily assessed as being potentially jurisdictional waters of the United States. Approximately 26 acres of potentially jurisdictional features occur within the existing and proposed ROWs.

TxDOT will coordinate with the USACE regarding permit authorization for unavoidable discharges of dredged or fill material into jurisdictional waters of the United States regulated under Section 404 of the Clean Water Act (CWA) and/or Section 10 of the Rivers and Harbors Act. TxDOT will also coordinate with the USCG per the requirements of Section 9 of the Rivers and Harbors Act and the General Bridge Act regarding bridge permit authorization for the construction of bridge structures over the navigable waters of Buffalo Bayou and White Oak Bayou. Additionally, per the requirements of 33 U.S.C. Section 408, TxDOT will coordinate with the USACE and the HCFCD to determine if the occupation or alteration of the White Oak Bayou federal project, a portion of which occurs within the proposed project area, would be injurious to the public interest or would impair the usefulness of the federal project. See Section 3.9 of this Final EIS for more detail.

ES 4.1.10 Vegetation And Wildlife

The proposed project is located in a highly urbanized area of the City of Houston. Review of the Texas Parks and Wildlife Department's (TPWD's) Ecological Mapping Systems of Texas revealed that approximately 98 percent of the proposed project area is mapped as urban (including existing transportation infrastructure), with the remaining 2 percent including urban vegetation, disturbed prairie,

or riparian vegetation. Field investigations were conducted to verify existing conditions within the Preferred Alternative alignment. Although the majority of the alignment occurs within a highly urbanized area, dominated by pavement, vegetation within the undeveloped portions of the project is primarily ornamental plantings or routinely mowed and maintained grasses. Construction of the Preferred Alternative would impact herbaceous, shrub, tree, and other plantings through site preparation activities. Clearing and grading would remove existing vegetative cover and replace it with mostly impervious cover associated with travel lanes, entrance and exit ramps, and frontage roads. Any remaining open areas occurring adjacent to the ROW or medians would be planted with herbaceous vegetation that would be routinely maintained by mowing.

Native wildlife populations in the general region of the proposed project have been largely displaced by the development and urbanization of Houston, leaving remaining habitat areas highly fragmented. However, certain wildlife species have adapted to the urbanized conditions; therefore, the developed urban conditions provide habitat for wildlife species in the proposed project area. Construction impacts to wildlife would result from the removal of vegetation and structures that provide habitat. Operation of the proposed project could impact wildlife from vehicle strikes because of the additional travel lanes and impervious cover. According to National Oceanic and Atmospheric Administration mapping, no Essential Fish Habitat (EFH) is identified in the proposed project area.

The project required coordination with the TPWD in accordance with the 2013 TxDOT-TPWD MOU. TPWD, as a participating agency, reviewed and commented on the Draft EIS, which served as coordination under the MOU. Coordination with TPWD was completed on December 1, 2016. No additional coordination with TPWD would be required for this project unless future design modifications resulted in a reevaluation that was determined to be a substantial change from previous coordination or if the scope of the reevaluation relates to an issue on which TPWD commented. See Section 3.10 in the Final EIS for discussions of existing conditions and potential impacts to vegetation and wildlife.

ES 4.1.11 Threatened And Endangered Species

The U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Conservation website lists five species as potentially occurring within the proposed project area. The three listed bird species were removed from consideration in this review because the proposed project is not related to wind energy generation. The Texas prairie dawn-flower and West Indian manatee would not be impacted because of an absence of suitable habitat. Therefore, no effects to any federally listed species are anticipated as a result of the proposed project.

Potential impacts to state-listed species and species of greatest conservation need (SGCNs) could be attributed to mobile species interacting with or avoiding construction machinery, the loss of wildlife habitat, habitat fragmentation, vehicle collisions, and the direct removal/disturbance of plant populations or individuals. The Preferred Alternative would require the removal of more than 120 acres of non-urban vegetation that may provide suitable habitat for eight state-listed species. In accordance with the *Best Management Practices Programmatic Agreement* between TxDOT and TPWD under the 2013 MOU, BMPs have been defined for implementation by TxDOT in order to minimize impacts to state-listed species and

SGCNs. See Section 3.11 in the Final EIS for discussions of existing conditions and potential impacts along with a table of BMPs for state-listed species and SGCNs.

ES 4.1.12 SOILS AND GEOLOGY

Soil erosion that could result from construction activities would be controlled or minimized through the use of proper construction techniques and the implementation of BMPs. The use of appropriate design standards and construction methods would minimize adverse impacts associated with surface faults, topography, and soils such that natural processes would not be affected. See Section 3.12 in the Final EIS for discussions of existing conditions and potential impacts to soils and geology.

ES 4.1.13 ARCHEOLOGICAL RESOURCES

The proposed NHHIP includes state and federal funds managed through TxDOT; therefore, the proposed project is subject to regulations defined in Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. Under Section 106 of the NHPA, and in accordance with the Advisory Council on Historic Preservation (ACHP) regulations pertaining to the protection of historic properties (36 Code of Federal Regulations [CFR] 800), federal agencies are required to locate, evaluate, and assess the effects of their undertaking on historic properties. For transportation projects such as this one, where ground disturbance occurs on state-owned ROW, compliance with Section 106 of the NHPA and the Antiquities Code of Texas is implemented under the Programmatic Agreement among FHWA, TxDOT, the Texas State Historic Preservation Officer, and the ACHP Regarding the Implementation of Transportation Undertakings (PA-TU). Pursuant to 36 CFR 800.4, TxDOT shall make a "reasonable and good faith effort to carry out appropriate identification efforts" of historic properties.

In 2015–2017, Raba Kistner Environmental, Inc. identified areas within the proposed project ROW that had a low, moderate, or high probability to contain intact archeological deposits based on proximity to known resources and levels of previous disturbance. Archeologists from Raba Kistner then conducted an intensive pedestrian archeological survey within some high-probability areas distributed across 23 parcels for which right-of-entry permission was granted. In 2018, a follow-up archeological background study conducted by TxDOT further refined archeological probability areas within the proposed project ROW on the basis of proximity to water, historic land use, archival research, additional disturbance information, and updated design details.

In April 2018, TxDOT moved forward with survey of three high-probability locations adjacent to Buffalo Bayou for which access was granted but where hazardous materials concerns required pre-fieldwork contaminant testing. TxDOT's soil testing contractor, TRC Solutions, conducted subsurface contaminant testing in October 2018, identifying areas where chemicals and bacteria of concern were elevated. These areas were digitally and physically flagged for avoidance during subsequent archeological survey. In November 2018, in consultation with TxDOT, Cox McLain Environmental Consulting (CMEC) excluded the need to survey two high-probability locations due to evidence of disturbance. Then, in November and December 2018, CMEC archeologists conducted survey and limited testing under Texas Antiquities Permit 8613, using mechanical trenching in one high-probability area that intersected sites 41HR982 and 41HR1037. Following survey and testing, TxDOT recommended that the portions of these sites within the

NHHIP area of potential effects (APE) were heavily disturbed, provided redundant data when viewed in the context of adjacent work by others, and could not contribute to either site's eligibility for the National Register of Historic Places.

On February 25, 2019, the Texas Historical Commission (THC)/Texas State Historic Preservation Office (SHPO) concurred with TxDOT recommendations that no further work or consultation is required for the surveyed portions of the APE. TxDOT shall ensure that all archeological assessments as well as Section 106 and Antiquities Code of Texas consultation are completed prior to the commencement of construction within the remaining unsurveyed acres of proposed new ROW/easements. The remaining portions of the project's APE that require further investigation, including medium-probability areas located near the northern terminus of the project and two high-probability areas located within and near the Clayton Homes apartment complex, are shown in Figure 3-4 of this document. On February 25, 2019, the THC concurred with TxDOT's commitment to complete survey of these areas. See Section 3.14 in the Final EIS for discussions of existing conditions and potential impacts to archeological resources.

ES 4.1.14 HISTORIC RESOURCES

TxDOT conducted identification, documentation, and evaluation of historic properties for this project per provisions of the Section 106 Programmatic Agreement (PA), as executed among FHWA, TxDOT, the Texas SHPO, and the ACHP. These efforts were executed in compliance with Section 106 of the NHPA as codified at 36 CFR 800.

TxDOT used a phased approach to identify, document, and evaluate historic properties in the project area, with an initial Historic Resources Research Design, four reconnaissance-level Report for Historic Studies Survey (Report) documents, and two focused intensive-level survey reports prepared between 2015 and 2018. A *Historical Resources Survey Report — Update* (Appendix H to the Final EIS), finalized in September 2019, brought together the findings of the various reports and addressed comments and questions raised by the Texas SHPO in response to previous reports. The September 2019 Report was submitted to the Texas SHPO and other consulting parties as part of the Section 106 consultation process. In accordance with Section 106 and 36 CFR 800, TxDOT conducted public involvement and outreach efforts focused on historic resources.

The Texas SHPO concurred with TxDOT's determinations of effect on September 9, 2019, on the condition that design prescriptives to avoid or minimize adverse effects are incorporated into the design-build contract. Section 3.15 of the Final EIS summarizes adverse direct effects, indirect effects, and cumulative impacts along with design commitments. The September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of direct, indirect, and cumulative effects to all identified historic properties in the APE. See also Section 7.15 of the Final EIS.

ES 4.1.15 HAZARDOUS MATERIALS

An evaluation of hazardous materials issues for the proposed NHHIP was based on a review of environmental regulatory records and observations made during field investigations. A regulatory database search was performed by Environmental Data Resources Inc. on May 22, 2014. A second regulatory database search was performed by Banks Environmental Data (Banks) on October 4, 2017, to

facilitate review of areas where new ROW would be required for design changes. The 2017 Banks report identified a total of 833 records within the search radii prescribed by ASTM E 1527-13. Of those records in the Banks report, 137 sites (primarily Leaking Petroleum Storage Tanks [LPST] and Voluntary Cleanup Program [VCP] sites) were determined to have the potential to impact the project corridor. This determination was based on the type of database listing, the information provided in the database report, and the distance and direction of the listing to the corridor. Additionally, 33 orphan or unlocatable sites were identified in the database search. For the Preferred Alternative, impacts associated with hazardous materials would most likely occur during construction and would be related to activities on or near existing hazardous material sites in the vicinity of the proposed project.

Construction of the proposed NHHIP could include the demolition of building structures, some of which may contain asbestos materials. Asbestos issues would be addressed during the ROW acquisition process prior to construction. Use and handling of hazardous materials associated with construction machinery and equipment would pose a minimal risk to the environment, as BMPs and appropriate safety and spill prevention/containment measures would be implemented. Should construction crews encounter contaminated soil or groundwater during construction of the proposed project, all activities would cease until contaminated materials are properly removed from the area and transported to an appropriate disposal site in compliance with applicable federal, state, and municipal laws. See Section 3.16 in the Final EIS for discussions of existing conditions and potential of hazardous materials.

ES 4.1.16 Visual And Aesthetic Resources

The detailed visual impact analysis was conducted after the Draft EIS and is discussed in Section 3.17 of the Final EIS. The extent of any potential impact is based on compatibility of the impact, viewer sensitivity of the impact, and the degree of the impact. The analysis concludes that while there may be specific areas close to the Proposed Facility which may be negatively impacted by a reduction in visual quality, the majority of viewers would have no impacts. Some viewers would have improved views where elevated structures have been removed, or where mitigation measures have reduced visual impacts. Areas where adverse impacts could occur could be mitigated to minimize the visual impact (see Section 7.17 of the Final EIS). The visual impact summary concluded the following: for landscape unit #1 (Segment 1), the visual impact would be neutral, existing viewer sensitivity is low, and the project is compatible. For landscape unit #2 (Segment 2), the visual impact would be neutral, existing viewer sensitivity is low, and the project is compatible. For landscape unit #3 (Segment 3), the visual impact would be neutral, existing viewer sensitivity is moderate, and the project is compatible. For some residential and other viewers outside of Downtown with views of the Downtown skyline, the majority of viewsheds in the Segment 3 area would have improved views or no impacts to views, and visual quality would remain moderate. Specific areas where adverse impacts could occur (north of Downtown) could be mitigated to minimize the impact (see Section 3.17.3 of the Final EIS).

The project will be developed under TxDOT's Green Ribbon Program, which allocates funds for trees and plants within roadway ROW. A detailed landscaping plan will be developed as part of the final design process. TxDOT will coordinate with local groups and agencies to accommodate enhancements to standard landscaping and recreational use of green space in and around storm water detention areas,

where feasible. Wet bottom detention basins will be considered if a partner entity agrees to maintain them. The detention areas will not be parks as their primary use is for drainage and flood mitigation. See Section 3.17 of the Final EIS for a detailed discussion.

ES 4.1.17 SECTION 4(F) RESOURCES

Section 4(f) of the Department of Transportation Act of 1966 prohibits the Secretary of Transportation from approving any program or project that requires the "use" of 1) any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance as determined by federal, state, or local officials having jurisdiction thereof, or 2) any land from an historic site of national, state, or local significance as so determined by such officials unless there is no feasible and prudent alternative to the use of such land and the project includes all possible planning to minimize harm to the resource.

TxDOT coordinated with the Texas SHPO as part of the Section 106 process and as the Official with Jurisdiction for historic sites under Section 4(f). The SHPO concurred with TxDOT's findings of eligibility and preliminary effects on September 9, 2019. In a letter dated February 27, 2020, SHPO as the Official with Jurisdiction had no comment on the Section 4(f) findings. The SHPO concurred with TxDOT's determination that the project would have an adverse effect to:

- Houston Warehouse Historic District
- Carlisle Plastics North Warehouse
- Readers Distributors Warehouse
- Cheek-Neal Coffee Company Building and associated property parcel
- Rossonian Cleaners

There are no feasible and prudent avoidance alternatives to the use of Section 4(f) properties: Warehouse Historic District, Readers Distributors Warehouse, Carlisle Plastics, Cheek-Neal Coffee Company Building, and Rossonian Cleaners. The project includes all possible planning to minimize harm to the Section 4(f) properties. The project complies with other related laws, including Section 6(f) of the Land and Water Conservation Fund Act and Chapter 26 of the Texas Parks and Wildlife (TPW) Code, when applicable.

Public parks and recreational facilities within 500 feet of the proposed project ROW of the Build Alternatives were evaluated for potential Section 4(f) effects. See Section 3.18 in the Final EIS and Appendix O *Individual Section 4(f) Evaluation* for details.

Due to extensive efforts to avoid direct impacts and uses to park resources, there are no direct impacts to parks. The Preferred Alternative would not result in a use of or adverse impact to any Section 4(f) park properties. Although there would be no use and no adverse impact to Sam Houston Park, it bears mentioning for beneficial impacts. The proposed action would substantially reduce the highway footprint in the area of Sam Houston Park. With the proposed project, noise levels are predicted to decrease by 3 decibels at approximately the center of the park. In addition, project designers worked to improve and optimize open space resources throughout the project corridor.

ES 4.1.18 Energy Requirements; Short-term Uses and Long-Term Productivity; and Irreversible and Irretrievable Commitments of Resources

Decreased vehicle delays and more efficient vehicle operating speeds would allow for increased energy efficiency on the improved roadway. Construction-related energy consumption would be for a limited time and could be offset by operational energy efficiencies gained through the use of the improved transportation facility and changing vehicle and fuel technology over many decades.

The local, short-term uses of the environment associated with construction of the Preferred Alternative would be typical of roadway construction and would have limited long-term effects. Construction of the Preferred Alternative would involve the commitment of natural, physical, human, and fiscal resources. The decision to commit these resources for construction of the Preferred Alternative would be based on the concept that residents in the immediate area, region, and state would benefit by the improved quality of the regional transportation system. The benefits would be anticipated to outweigh the commitment of resources.

Short-term and long-term energy requirements; the relationship between local short-term uses and the maintenance and enhancement of long-term productivity; and irreversible and irretrievable commitments of resources are addressed in Sections 3.19, 3.20, and 3.21 of this Final EIS, respectively.

ES 4.1.19 Greenhouse Gas and Climate Change

TxDOT has prepared a Statewide On-Road Greenhouse Gas Emissions Analysis and Climate Change Assessment technical report. A summary of key issues in this technical report (which details how TxDOT is responding to a changing climate) is provided in Section 4 of the Final EIS.

ES 4.1.20 Indirect Impacts

Transportation projects that provide new or improved access to adjacent land could induce development of undeveloped land or redevelopment of land to more intensive uses. A planning judgment approach, supported by planning assumptions and land use projections from the H-GAC, City of Houston, Harris County, and management districts within the project area, was used to identify areas of potential growth, development trends, and the probability of the proposed project to influence local land use decisions within the Area of Influence (AOI). Most of the AOI is already developed and developable land within the AOI is relatively limited.

The proposed project is expected to induce redevelopment in two general locations: throughout the Downtown Management District and within a 0.25-mile buffer along I-45 from I-610 to Beltway 8. The proposed project may also slow development rates in areas that would experience access changes or access limitations resulting from the proposed improvements or in areas that would be physically impacted (e.g., proposed displacements). Such slowdowns may be compounded by redevelopment in areas flooded during Hurricane Harvey and increasing floodplain regulations. The proposed project would add capacity to existing facilities and would not induce development to the same degree as a new roadway. The Downtown area and the surrounding neighborhoods are experiencing various degrees of

redevelopment, and growth trends identified in questionnaire responses indicate that redevelopment would continue independent of the proposed improvements to existing facilities. Additionally, several roadway projects are planned or under development throughout the Houston area and coincide temporally with the proposed NHHIP improvements; these projects could influence growth and, therefore, the proposed NHHIP project may contribute to induced growth impacts as one of many factors affecting growth in the area. See Section 5 in the Final EIS for the analysis of induced growth impacts. Encroachment alteration effects are discussed by resource category as appropriate in Section 3 of the Final EIS.

ES 4.1.21 CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) defines cumulative impact as impact "on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Section 6 of this Final EIS discusses the project's potential cumulative impacts.

Based on the results of the cumulative impacts risk assessment, supported by the information included in this Final EIS and associated technical reports, the proposed project may potentially have cumulative impacts on community resources. The cumulative impacts analysis for community resources (specifically neighborhoods/public facilities and EJ populations) assessed the health of these resources, described relevant trends, and identified a specific Resource Study Area boundary and appropriate temporal boundary for the analysis. The construction of the proposed project was considered in conjunction with past, present, and reasonably foreseeable future actions to estimate the cumulative impacts on community resources. The proposed project maintains urban development trends from other past, present, and reasonably foreseeable future large infrastructure projects that resulted or are expected to result in both beneficial and adverse impacts to community resources. Mitigation of direct adverse impacts from the proposed project substantially reduces the project's incremental contribution to adverse cumulative impacts on community resources. Urban development trends are not likely to be substantially changed by this project. See Section 6 and the *Cumulative Impacts Technical Report*.

ES 4.2 NO BUILD ALTERNATIVE

With the No Build Alternative, there would be no impacts related to construction and operation of the proposed project. The No Build Alternative would not result in the acquisition of new ROW and no existing land uses would be converted to transportation uses. There would be no direct impacts to the human environment including neighborhoods, community resources, minority and low-income populations, existing transportation facilities, archeological or historic resources, and Section 4(f) properties. The No Build Alternative would not change the existing visual environment. There would be no direct impacts to hazardous materials sites.

The No Build Alternative would not impact current property or sales tax revenues and would not have the positive regional and statewide economic impact of creating additional jobs and income during

construction. The community would also not experience the benefits of decreased traffic congestion, improved mobility, and improved safety conditions resulting from the proposed project. Decreasing mobility due to traffic congestion may adversely impact existing and future businesses. Increased congestion on the existing I-45 and other roadways in and near the proposed project area may result in additional air emissions. No short-term noise would be generated from construction-related activities; however, traffic noise levels would be expected to increase with an associated increase in future traffic volumes on existing roadways.

The No Build Alternative would not result in direct impact to the natural environment, including water resources, floodplains, wetlands and waters of the United States, wildlife, vegetation, and threatened and endangered species. There would be no anticipated impacts to topography, soils, or geological resources, and no direct impacts to prime or unique farmland soils.

Additional information on the impacts of the No Build Alternative is provided in the Final EIS in Section 2 Alternatives Analysis.

ES 5 Preferred Alternative

The need for and purpose of the proposed NHHIP is to improve mobility and safety in the I-45 corridor from Downtown Houston to Beltway 8 North. The No Build Alternative would neither safely or adequately accommodate existing and future traffic volumes on I-45 within the study area. Therefore, the No Build Alternative does not meet the need for and purpose of the proposed project.

The Preferred Alternative was selected based on detailed analysis of engineering and traffic evaluation factors, environmental impacts, and extensive agency coordination and public involvement. Section 2 of the Final EIS describes the alternatives analysis process conducted since the initiation of the EIS process in 2011, including several levels of screening (evaluation) of alternatives. The Preferred Alternative for the proposed project is described below, by study segment. The Preferred Alternative includes changes to the Recommended Alternative (for each segment) presented and evaluated in the Draft EIS. Section 2 of the Final EIS discusses the design changes, including the proposed locations of storm water detention areas. The total project length is approximately 25.3 miles.

ES 5.1 Segment 1: I-45 from Beltway 8 North to North of I-610 (North Loop)

The Preferred Alternative would widen the existing I-45 primarily on the west side of the roadway to accommodate four MaX lanes. The proposed typical section would include eight to ten general purpose lanes (four to five lanes in each direction), four MaX lanes (two lanes in each direction), and four to six frontage road lanes (two to three lanes in each direction). Between Tidwell Road and I-610, there would be 12 general purpose lanes (six in each direction) to accommodate ramps and connections to and from I-610. The general purpose lanes and MaX lanes would be at-grade except at major cross streets, where they would be elevated over the intersecting streets. Approximately 200 to 225 feet of new ROW would be required for the roadway widening, mostly to the west of the existing I-45. New ROW would also be required on the west side of I-45 for proposed storm water detention areas. New ROW would be required

to the east of the existing I-45 ROW at intersections with major streets and between Crosstimbers Street and I-610. Approximately 246 acres of new ROW would be required in Segment 1.

ES 5.2 SEGMENT 2: I-45 FROM NORTH OF I-610 (NORTH LOOP) TO I-10 (INCLUDING THE INTERCHANGE WITH I-610)

The Preferred Alternative would widen the existing I-45 to accommodate four MaX lanes. The proposed typical section would include ten general purpose lanes (five lanes in each direction), four MaX lanes (two lanes in each direction), and four to six frontage road lanes (two to three lanes in each direction). From north of Cottage Street to Norma Street, the general purpose lanes and the MaX lanes would be depressed, while the frontage road lanes would be at-grade. The proposed I-45 and I-610 frontage roads would be continuous through the I-45/I-610 interchange. New ROW would be required from both the east and west sides of the existing I-45. The new ROW would include proposed storm water detention areas on the east side of I-45, south of Patton Street. Approximately 44 acres of new ROW would be required in Segment 2.

The Preferred Alternative provides a structural "cap" over a portion of the depressed lanes of I-45 from north of Cottage Street to south of N. Main Street. Future use of the structural cap area for another purpose would require additional development and funding by entities other than TxDOT.

ES 5.3 SEGMENT 3: DOWNTOWN LOOP SYSTEM (I-45, US 59/I-69, AND I-10)

The Preferred Alternative would reconstruct all the existing interchanges in the Downtown Loop System and reroute I-45 to be parallel to I-10 on the north side of Downtown and parallel to US 59/I-69 on the east side of Downtown. Access to the west side of Downtown would be provided via "Downtown Connectors" that would consist of entrance and exit ramps for various Downtown streets. A section of the Downtown Connectors would be below-grade (depressed) between approximately W. Dallas Street to Andrews Street. The existing elevated I-45 roadway along the west and south sides of Downtown would be removed. The portion of I-45 (Pierce Elevated) between Brazos Street and US 59/I-69 could be left in place for future use and redevelopment by others; however, an alternative use for the structure is not proposed by TxDOT and is not evaluated in this Final EIS.

To improve safety and traffic flow in the north and east portions of Segment 3, portions of both I-10 and US 59/I-69 would be realigned (straightened) to eliminate the current roadway curvature. I-45 and US 59/I-69 would be depressed along a portion of the alignment east of Downtown. South of the George R. Brown Convention Center, the rerouted I-45 would begin to elevate to tie to existing I-45 southeast of Downtown, while US 59/I-69 would remain depressed as it continues southwest toward Spur 527. US 59/I-69 would be widened from 8 to 12 general purpose lanes between I-45 and State Highway (SH) 288 and would be reconstructed to ten general purpose lanes from SH 288 to Spur 527.

The four proposed I-45 MaX lanes in Segments 1 and 2 would terminate/begin in Segment 3 at Milam Street/Travis Street, respectively. I-10 express lanes (two lanes in each direction) would be located generally in the center of the general purpose lanes within the proposed parallel alignment of I-10 and

I-45 on the north side of Downtown. The I-10 express lanes would vary between being elevated and at-grade.

New ROW to the east of the existing US 59/I-69 along the east side of Downtown would be required to accommodate the proposed realigned I-45. A new continuous southbound access road would be provided adjacent to US 59/I-69 and would tie to existing Hamilton Street on the south side of the Convention Center. The existing St. Emanuel Street would serve as a northbound access road. The project ROW would include areas to be developed as storm water detention. Approximately 160 acres of new ROW would be required, the majority of which would be for the I-10 and US 59/I-69 realignments (straightening) and to construct the proposed I-45 lanes adjacent to US 59/I-69 along the east side of Downtown.

The Preferred Alternative provides a structural "cap" over the proposed depressed lanes of I-45 and US 59/I-69 from approximately Commerce Street to Lamar Street. There would also be a structural cap over the depressed lanes of US 59/I-69 between approximately Main Street and Fannin Street, and in the area of the Caroline Street/Wheeler Street intersection. Future use of the structural cap areas for another purpose would require additional development and funding by entities other than TxDOT. For the latest schematics of the Preferred Alternative please visit: http://www.ih45northandmore.com/.

Table ES-2 summarizes impacts from the Preferred Alternative.

Table ES-2: Summary of Impacts of the Preferred Alternative

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)
Land Use
Segment 1 — approximately 246 acres of land impacted. The land use type impacted the most is commercial land use (139 acres). Segment 2 — approximately 44 acres of land impacted. The land use type impacted the most is commercial land use (21 acres). Segment 3 — approximately 160 acres of land impacted. The land use types impacted the most are transportation/utility (45 acres) land uses and commercial (35 acres) land uses.
Community Resources
▪ Displacement of 5 Places of Worship ▪ Displacement of 2 schools/universities ▪ Some "business" displacements may include community services such as medical care facilities, non-profit facilities, drug rehabilitation centers, grocery stores ▪ Other impacts such as impacts to parking, changes in access to public transportation
Displacements
▪ 160 Single-family residences ▪ 433 Multi-family residential units (multi-family units are all located within apartment communities) ▪ 486 Public and Low-Income Housing multi-family units ▪ 344 Businesses ▪ 58 Billboards ▪ Mitigation is discussed in Section 7 of the Final EIS
Environmental Justice
▪ The Preferred Alternative would result in impacts to low-income and minority populations. Specific impacts and mitigation measures are detailed in the Final EIS and the *Community Impacts Assessment Technical Report*. Public involvement activities included proactive outreach to ensure meaningful access to public participation.
Economic Conditions
▪ Estimated employment impact — 344 businesses would be displaced, and employees would be expected to relocate with the business. ▪ Based on $7 Billion in construction spending and using Texas State Comptroller economic multipliers — direct and indirect income is estimated to be $6.1 Billion; direct and indirect employment is estimated to be 181,387 jobs, and statewide final demand impact is estimated to be $19.2 Billion. ▪ Estimated property tax and sales tax losses totaling from $152.9 M to $313.9 M annually due to displacements.

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)
Transportation Facilities
▪ Segment 1 would not affect access to transit centers, Park & Ride facilities, or Light Rail Transit (LRT) services. ▪ Segment 2 would not affect existing bus service routes; no Park & Ride facilities are located in Segment 2. ▪ Segment 3 would not permanently affect bus service; Wheeler Transit Center access is being coordinated with TxDOT. ▪ Displacement of bus stops could affect people that do not have access to automobiles or that are dependent on public transportation. ▪ Close coordination between TxDOT and METRO would facilitate proactive communications with transit users for schedules, routes, and service changes, compliance with Americans with Disabilities Act of 1990 (ADA) requirements. ▪ During construction, the proposed project may require re-routing or redirecting of existing rail lines and infrastructure. Relocation or rerouting of existing rail lines could temporarily disrupt operations and result in delays for rail traffic that is rerouted as well as rail traffic on rail lines to which traffic is rerouted. TxDOT has previously coordinated with Houston Belt & Terminal Railway (HB&T), BNSF Railway, and Union Pacific Railroad (UPRR) representatives, and TxDOT does not anticipate permanently affecting current operations and rail locations.
Air Quality
▪ TAQA results for each segment of the project indicate that CO concentrations are not expected to exceed the national standard and would remain relatively consistent from the ETC to the design year. ▪ Based on regulations now in effect, overall MSAT emissions will decline significantly over the next several decades. A quantitative MSAT analysis for this project forecasts a combined reduction of over 72 percent for both the build and no build scenarios for total MSAT emissions from 2018 to 2040, while VMT is projected to increase between 45–58 percent. ▪ Congestion Management Process Strategies are in place in the travel corridor. ▪ TxDOT received a project-level conformity determination from FHWA on June 25, 2020.
Noise
▪ Traffic noise impacts were identified in each project segment for a variety of noise-sensitive land uses, including exterior areas of single-family homes, apartments, churches, schools, and parks. Traffic noise impacts are predicted to occur at locations represented by 222 receiver points along the project corridor. Noise abatement measures were evaluated for each traffic noise impact. Where reasonable and feasible, noise barriers are proposed for 76 locations, which would benefit 138 representative receivers. ▪ Segment 1: 7 barriers proposed to mitigate noise impacts. ▪ Segment 2: 12 barriers proposed to mitigate noise impacts. ▪ Segment 3: 57 barriers proposed to mitigate noise impacts. ▪ The final decision to construct proposed noise barriers will not be made until completion of the proposed NHHIP design, utility evaluation, and polling of adjacent property owners.

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)		
Water Resources		
▪ Potential impacts to groundwater would be primarily related to storm water discharges from both construction and operation of the proposed project. ▪ Groundwater wells exist within the proposed ROW (7 in Segment 1, none in Segment 2 or 3). ▪ Construction of the proposed project would cause an increase in the overall area of impervious cover, resulting in minor increases in localized storm water runoff. ▪ Short-term and long-term BMPs implemented as part of the proposed project would minimize water quality degradation of surface waters and groundwater in the proposed project area. ▪ TxDOT will coordinate with the TCEQ during the review and evaluation of the proposed project relative to the TCEQ's 303(d) List of impaired water bodies occurring within the proposed project area that could potentially be impacted by construction and operation of the proposed project.		
Floodplains		
▪ Segment 1: Approximately 211 acres of 100-year floodplains would be within the existing and proposed ROWs of the Preferred Alternative. ▪ Segment 2: Approximately 118 acres of 100-year floodplains would be within the existing and proposed ROWs of the Preferred Alternative. ▪ Segment 3: Approximately 169 acres of 100-year floodplains would be within the existing and proposed ROWs of the Preferred Alternative.		
Wetlands and Other Waters of the U.S.		
A Section 9 permit from the USCG would be anticipated for bridges or other structures constructed in or over Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence. A Section 10 permit from the USACE would be anticipated for project construction activities that would involve the discharge of dredged or fill material within the jurisdictional limits of Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence. The Final EIS presents the acreage and linear feet of the 29 water bodies occurring within the existing I-45 ROW and the Preferred Alternative ROW. Of the 29 identified water bodies, 25 were preliminarily assessed as being potentially jurisdictional waters of the United States. Approximately 26 acres of potentially jurisdictional features occur within the existing and proposed ROWs.		
Segment 1 Potentially jurisdictional waters of the U.S. (acres and linear feet of streams): ▪ Existing ROW: 1.06 acres; 2,342 linear ft. ▪ Proposed ROW: 1.46 acres; 1,637 linear ft.	Segment 2 Potentially jurisdictional waters of the U.S. (acres and linear feet of streams): ▪ Existing ROW: 4.18 acres; 4,839 linear ft. ▪ Proposed ROW: 0.34 acres; 698 linear ft.	Segment 3 Potentially jurisdictional waters of the U.S. (acres and linear feet of streams): ▪ Existing ROW: 11.49 acres; 6,609 linear ft. ▪ Proposed ROW: 7.44 acres; 3,025 linear ft.
Threatened and Endangered Species		
No effects to any federally listed species are anticipated as a result of the proposed project. In accordance with the *Best Management Practices Programmatic Agreement* between TxDOT and TPWD under the 2013 MOU, BMPs have been defined for implementation by TxDOT in order to minimize impacts to the state-listed species and SGCNs that could occur in the project area.		

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)
Wildlife and Vegetation
▪ Approximately 480 acres of observed vegetation types could be affected by the Preferred Alternative; 98 percent of the project area is transportation infrastructure or urban development. ▪ Construction of the Preferred Alternative would impact herbaceous, shrub, tree, and other plantings through site preparation activities. ▪ Construction of the Preferred Alternative would directly impact any animals that reside within the path of the proposed roadway improvements; could displace mobile species; and could impact fewer mobile species. Construction could cause loss of habitat, habitat fragmentation, or pollution from increased impervious cover.
Soils and Geology
Soil erosion that could result from construction activities would be controlled or minimized through the use of proper construction techniques and the implementation of BMPs. The use of appropriate design standards and construction methods would minimize adverse impacts associated with surface faults, topography, and soils such that natural processes would not be affected.
Archeological Resources
Archeological studies performed to date identified some areas within the proposed project ROW that are classified as high probability and moderate probability areas. Two intensive pedestrian archeological surveys were conducted for some high-probability areas for which right-of-entry permission was granted. On February 25, 2019, the THC/Texas SHPO concurred with TxDOT recommendations that no further work or consultation is required for the surveyed portions of the APE. TxDOT shall ensure that all archeological assessments as well as Section 106 and Antiquities Code of Texas consultation are completed prior to the commencement of construction within the remaining unsurveyed acres of proposed new ROW/easements. The remaining portions of the project's APE that require further investigation, including medium-probability areas located near the northern terminus of the project and two high-probability areas located within and near the Clayton Homes apartment complex, are shown in Figure 3-4. On February 25, 2019, the THC concurred with TxDOT's commitment to complete survey of these areas.
Historic Resources
TxDOT used a phased approach to identify, document, and evaluate historic properties in the project area, with an initial Historic Resources Research Design, four reconnaissance-level Report for Historic Studies Survey (Report) documents, and two focused intensive-level survey reports prepared between 2015 and 2018. A *Historical Resources Survey Report — Update* (September 2019) consolidated findings and addressed Texas SHPO concerns. The September 2019 Report was utilized for Section 106 consultation. Per Section 106 and 36 CFR 800, TxDOT conducted public involvement and outreach efforts focused on historic resources. The Texas SHPO concurred with TxDOT's determinations of effect on September 9, 2019, on the condition that design prescriptives to avoid or minimize adverse effects are incorporated into the design-build contract. ▪ In Segment 1, one historic district and one individual historic property were located in the APE; no direct or indirect adverse effects would occur. ▪ In Segment 2, two historic districts were in the APE; design revisions were made to avoid impacts to the historic districts and contributing properties; no direct or indirect adverse effects would occur. ▪ In Segment 3, 5 historic properties and two historic districts would be directly adversely affected. Design refinements were made where possible; design prescriptives to be undertaken by the design-build contractor were incorporated into the SHPO conditional concurrence.

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)
Hazardous Materials
▪ Of the records in the 2017 Banks database search report, 137 sites (primarily LPST and VCP sites) were determined to have the potential to impact the project corridor. An ASTM-conforming Phase I environmental site assessment is recommended prior to ROW acquisition. ▪ Construction of the proposed NHHIP could include the demolition of building structures, some of which may contain asbestos materials. Asbestos issues would be addressed during the ROW acquisition process prior to construction. ▪ Use and handling of hazardous materials associated with construction machinery and equipment would pose a minimal risk to the environment, as BMPs and appropriate safety and spill prevention/containment measures would be implemented.
Visual and Aesthetic Resources
▪ The analysis concludes that while there may be specific areas close to the Proposed Facility which may be negatively impacted by a reduction in visual quality, the majority of viewers would have no impacts. ▪ Some viewers may have improved views where elevated structures have been removed, or where mitigation measures have reduced visual impacts. ▪ The visual impact summary concluded the following: for landscape unit #1 (Segment 1), the visual impact would be neutral, existing viewer sensitivity is low, and the project is compatible. For landscape unit #2 (Segment 2), the visual impact would be neutral, existing viewer sensitivity is low, and the project is compatible. For landscape unit #3 (Segment 3), the visual impact would be neutral, existing viewer sensitivity is moderate, and the project is compatible.
Section 4(f) Resources
TxDOT has coordinated with the SHPO as part of the Section 106 process and as the Official with Jurisdiction for historic sites under Section 4(f). The SHPO concurred with TxDOT's findings of eligibility and preliminary effects on September 9, 2019. In a letter dated February 27, 2020, SHPO as the Official with Jurisdiction had no comment on the Section 4(f) findings. The SHPO concurred with TxDOT's determination that the project would have an adverse effect to: ▪ Houston Warehouse Historic District ▪ Carlisle Plastics North Warehouse ▪ Readers Distributors Warehouse ▪ Cheek-Neal Coffee Company Building and associated property parcel ▪ Rossonian Cleaners There are no feasible and prudent avoidance alternatives to the use of Section 4(f) properties: Houston Warehouse Historic District, Readers Distributors Warehouse, Carlisle Plastics, Cheek-Neal Coffee Company Building, and Rossonian Cleaners. The project includes all possible planning to minimize harm to the Section 4(f) properties. The project complies with other related laws, including Section 6(f) of the Land and Water Conservation Fund Act and Chapter 26 of the TPW Code, when applicable. Section 4(f) parks resources are fully assessed including alternatives analysis in the Section 4(f) Evaluation under separate cover. The Preferred Alternative would not result in a use of or adverse impact to any Section 4(f) park properties.

Segment 1 Preferred Alternative (Alternative 4 Proposed Recommended); Segment 2 Preferred Alternative (Alternative 10 Proposed Recommended); Segment 3 Preferred Alternative (Alternative 11 Proposed Recommended)
Indirect Impacts
The proposed project is expected to induce redevelopment in two general locations: throughout the Downtown Management District and within a 0.25-mile buffer along I-45 from I-610 to Beltway 8. The proposed project may also slow development rates in areas that would experience access changes or access limitations resulting from the proposed improvements or in areas that would be physically impacted (e.g., proposed displacements). The proposed project would add capacity to existing facilities and would not induce development to the same degree as a new roadway. The Downtown area and the surrounding neighborhoods are experiencing various degrees of redevelopment, and growth trends identified in questionnaire responses indicate that redevelopment would continue independent of the proposed improvements to existing facilities.
Cumulative Impacts
Considering past, present, and reasonably foreseeable future actions, the construction of the proposed project was considered in conjunction with these other actions to consider cumulative impacts. The proposed project maintains urban development trends from large infrastructure projects that result in both beneficial and adverse impacts to community resources. Mitigation of direct adverse impacts from the proposed project substantially reduces the project's incremental contribution to adverse cumulative impacts on community resources. Urban development trends are not likely to be substantially changed by this project.

VOLUME I: FINAL EIS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Meaning
AASHTO	American Association of State Highway and Transportation Officials
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act of 1990
AOI	Area of Influence
APE	Area of Potential Effects
Banks	Banks Environmental Data
BBS	Breeding Bird Survey
BMPs	best management practices
BNSF	BNSF Railway
BRT	bus rapid transit
c.	circa
CAGR	compounded annual growth rate
CBC	Christmas Bird Counts
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CLG	Certified Local Government
CMEC	Cox|McLain Environmental Consulting
CMP	Congestion Management Plan
CO	carbon monoxide
CO2	carbon dioxide
CO2E	carbon dioxide equivalent
Corridor	North-Hardy Corridor
CSJ	Control-Section-Job
CWA	Clean Water Act
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMST	Ecological Mapping Systems of Texas
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETC	estimated time of completion

Acronym/Abbreviation	Meaning
ETJ	extra-territorial jurisdiction
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRMs	Flood Insurance Rate Maps
FM	Farm-to-Market Road
FPPA	Farmland Protection Policy Act of 1981
FTA	Federal Transit Administration
GH&SA Railway	Galveston, Harrisburg & San Antonio Railway
GHG	greenhouse gas
GIS	geographic information system
GPS	global positioning system
HABS	Historic American Buildings Survey
HB&T	Houston Belt and Terminal Railway
HCAD	Harris County Appraisal District
HCFCD	Harris County Flood Control District
HDMD	Houston Downtown Management District
H-GAC	Houston-Galveston Area Council
HHA	Houston Housing Authority
HISD	Houston Independent School District
HOT	high occupancy toll
HOV	high occupancy vehicle
HVL	highly volatile liquid
I-10	Interstate Highway 10
I-45	Interstate Highway 45
I-69	Interstate Highway 69
I-610	Interstate Highway 610
IPaC	Information for Planning and Conservation
ISA	Initial Site Assessment
ISD	Independent School District
KAST	Kills and Spills Team
KVP	Key View Points
LEP	Limited English Proficiency
LiDAR	light detection and ranging
LOS	Level of Service

Acronym/Abbreviation	Meaning
LPST	Leaking Petroleum Storage Tank
LRT	Light Rail Transit
MaX	managed express (lanes)
MBTA	Migratory Bird Treaty Act
METRO	Metropolitan Transit Authority of Harris County
MMPA	Marine Mammal Protection Act
MMT	million metric tons
MOU	Memorandum of Understanding
mph	miles per hour
MSAT	mobile source air toxics
MS4	municipal separate storm sewer system
MTP	Metropolitan Transportation Plan
MUD	Municipal Utility District
NAAQS	National Ambient Air Quality Standard
NAC	Noise Abatement Criteria
NAD	North American Datum
NCHRP	National Cooperative Highway Research Program
NCSS	National Cooperative Soil Survey
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NHHIP	North Houston Highway Improvement Project
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWP	Nationwide Permit
PA	Programmatic Agreement
PA-TU	Programmatic Agreement Regarding the Implementation of Transportation Undertakings
PM	particulate matter
PSL	Project-specific locations

Acronym/Abbreviation	Meaning
PWC	Parks and Wildlife Code
PWS	public water system
REMI	Regional Economic Model, Inc.
RKEI	Raba Kistner Environmental, Inc.
ROE	right-of-entry
ROW	right-of-way
RRC	Railroad Commission of Texas
RTP	Regional Transportation Plan
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SGCN	species of greatest conservation need
SH	State Highway
SH 288	State Highway 288
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SOV	single occupancy vehicle
STIP	Statewide Transportation Improvement Program
SW3P	storm water pollution prevention plan
T.A.C.	Texas Administrative Code
TAQA	traffic air quality analysis
TCEQ	Texas Commission on Environmental Quality
TDM	travel demand management
TEA	Texas Education Agency
TERP	Texas Emissions Reduction Plan
THC	Texas Historical Commission
TIP	Transportation Improvement Program
TIRZ	Tax Increment Reinvestment Zone
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TPW	Texas Parks and Wildlife
TPWD	Texas Parks and Wildlife Department
TSM	transportation systems management
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation

Acronym/Abbreviation	Meaning
TxDOT ENV	Texas Department of Transportation Environmental Affairs Division
TXNDD	Texas Natural Diversity Database
UPRR	Union Pacific Railroad
U.S.	United States
US	U.S. Highway
US 59/I-69	U.S. Highway 59/Interstate Highway 69
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
v/c	volume-to-capacity ratio
VCP	Voluntary Cleanup Program
VMT	vehicle miles traveled

VOLUME II: FINAL EIS APPENDICES

(UNDER SEPARATE COVER)

Appendix A:	Final EIS Exhibits
Appendix B:	Preferred Alternative Schematic and Typical Sections
Appendix C:	Air Quality Technical Report (including the Mobile Source Air Toxics Technical Report and Carbon Monoxide Traffic Air Quality Analysis)
Appendix D:	Archeological Survey Report and Coordination
Appendix E:	Biological Resources Technical Report
Appendix F:	Community Impacts Assessment Technical Report
Appendix G:	Hazardous Materials Technical Report
Appendix H:	Historical Resources Survey Report — Update
Appendix I:	Traffic Noise Technical Report
Appendix J:	Water Resources Technical Report
Appendix K:	Waters of the United States Technical Report
Appendix L:	Visual Impact Assessment Technical Report
Appendix M:	Agency Coordination Documentation
Appendix N:	Public Involvement
Appendix O:	Individual Section 4(f) Evaluation
Appendix P:	Indirect Impacts Technical Report
Appendix Q:	Cumulative Impacts Technical Report
Appendix R:	Programmatic Agreement

VOLUME III: COMMENTS AND RESPONSES

(UNDER SEPARATE COVER)

COMMENTS AND RESPONSES ON DRAFT EIS

Introduction
Comment Response Matrix
Draft EIS Comments

COMMENTS AND RESPONSES ON DRAFT TECHNICAL REPORTS

Introduction
Public Comment Response Matrices
Public Comments on the Draft Community Impacts Assessment Technical Report and Cumulative Impacts Technical Report

1 NEED FOR AND PURPOSE OF PROPOSED ACTION

1.1 Introduction

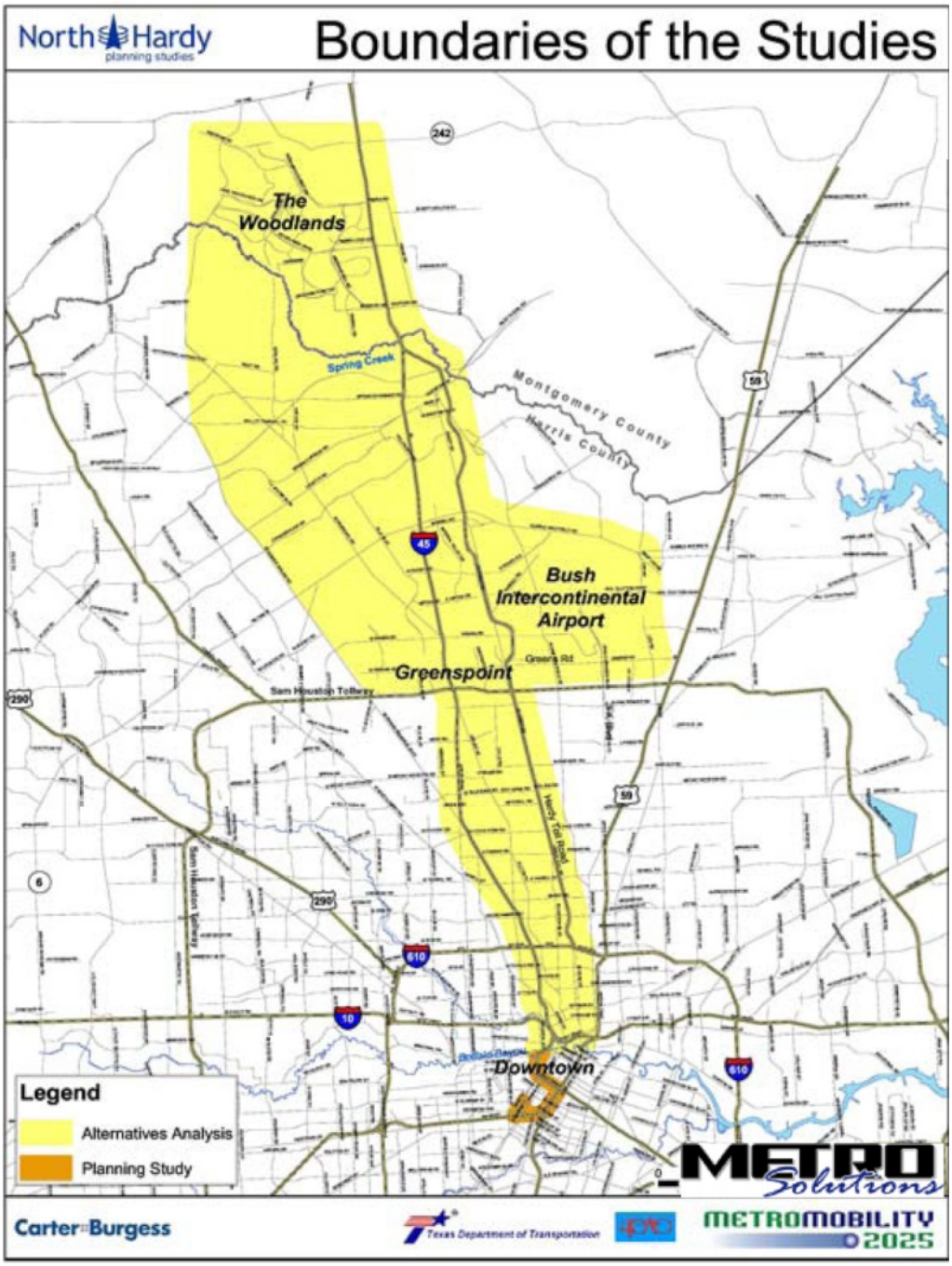
Per Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) prepared for a proposed action should describe the problem(s) or other needs that the proposed action is intended to address (40 Code of Federal Regulations [CFR] 1502.13). Section 1 has been updated since the Draft EIS to include additional information about the project background, need, and purpose, and updated information about public involvement. The revisions are primarily in response to comments received on the Draft EIS about the project history, project area, and project need and purpose.

In general, transportation improvements are needed within the North Houston Highway Improvement Project (NHHIP) area in Harris County, Texas because the Interstate Highway 45 (I-45) facility currently operates near capacity, resulting in congestion during peak and off-peak periods. Future transportation demand from projected population and economic growth is expected to place a greater strain on the existing facility. The population of the eight central counties of the 13-county Houston-Galveston Area Council (H-GAC) region (the Houston-Galveston region) is expected to grow considerably over the next 25 years. According to H-GAC, the region had 6.5 million residents and 3.2 million jobs in 2015. By 2040, the region is expected to add 3.5 million more people for a total of approximately 10.0 million residents. That is an increase of 54 percent over 25 years, or a 1.75 percent growth each year. Similarly, for jobs, the region is expected to create an additional 1.3 million jobs for a total of 4.5 million. This is an increase of 41 percent or 1.4 percent growth for each year (H-GAC 2017a). Also, transportation improvements for I-45 are needed because the existing facility does not meet current Texas Department of Transportation (TxDOT) design standards, and drainage improvements are necessary to improve storm water drainage in some areas during heavy rainfall events. The purpose of the proposed NHHIP is to help manage the existing and projected transportation problems in the area of the NHHIP to improve mobility and safety.

1.1.1 PROJECT BACKGROUND

In 2001, the Metropolitan Transit Authority of Harris County (METRO), TxDOT, and H-GAC began conducting planning studies to identify and address transportation needs in an area identified as the North-Hardy Corridor. The North-Hardy Corridor extended approximately 30 miles, beginning south of Downtown Houston, in Harris County, Texas, to State Highway (SH) 242 near The Woodlands in Montgomery County, Texas. A portion of the corridor extended east of Hardy Toll Road to include George Bush Intercontinental Airport. South of Beltway 8 North, the corridor generally encompassed the area between I-45 and Hardy Toll Road and included segments of United States Highway (US) 59/I-69 south of Downtown Houston. The study area boundary for the North-Hardy Corridor analysis is shown in Figure 1-1.

Figure 1-1: Study Area for North-Hardy Planning Studies



Source: METRO et al. 2005

The studies conducted by METRO, TxDOT, and H-GAC evaluated transit and highway improvement alternatives for the North-Hardy Corridor in consideration of projected increases in population and employment over 25 years, or to the year 2025. Early in the planning process, the community asked the Study Team to first maximize the use of transit, including advanced high-capacity transit, in the corridor and maximize the use of the Hardy Toll Road before considering expansion of I-45. Following this request,

the study of transit alternatives was completed first and the results were factored into the examination of potential highway alternatives. The results of the studies were presented in the North-Hardy Planning Studies — Alternatives Analysis Report (Transit Component) (February 2004) and the North-Hardy Planning Studies — Alternatives Analysis Report (Highway Component) (November 2005).

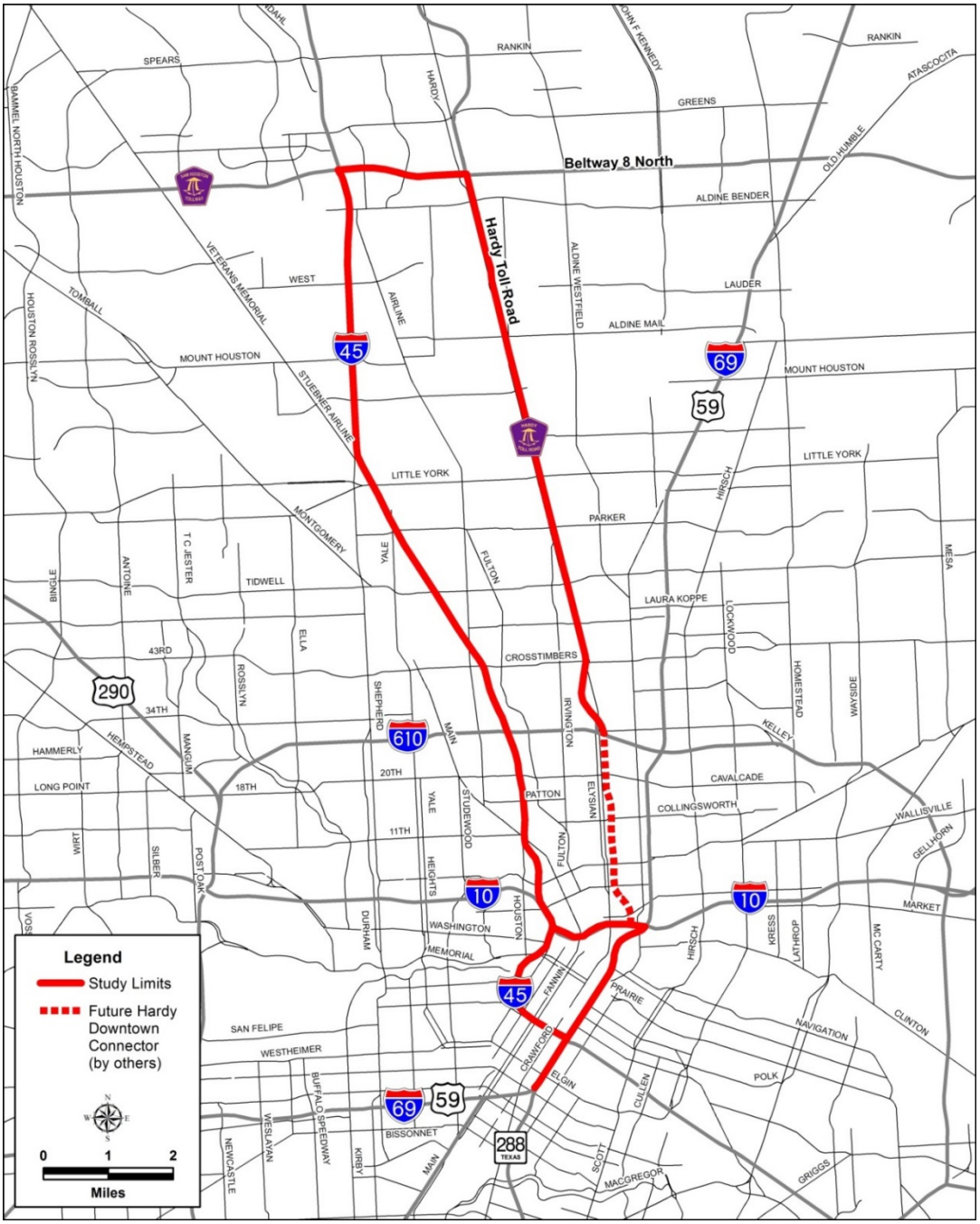
Findings from the Transit Component report were used by METRO to develop a regional Transit System Plan that combined an aggressive bus service program with advanced high-capacity transit (light rail). METRO implemented plans for light rail transit (LRT) and other system improvements. The Highway Component report examined highway alternatives within the North-Hardy Corridor. The Recommended Highway Alternative from Downtown Houston to Beltway 8 North was to add four managed lanes to the I-45/Hardy Toll Road corridor and recommended additional study, which TxDOT has conducted and documented during the development of the NHHIP.

The alternatives analysis determined that even with parallel high-capacity transit and the extension of Hardy Toll Road to Downtown Houston, additional capacity would still be needed on I-45. The alternatives analysis also concluded that, at a minimum, two-way high occupancy vehicle (HOV) service would be needed in the corridor. The preferred highway alternative proposed a total of 12 lanes on I-45 from I-10 to Beltway 8 North (eight general purpose lanes and four managed lanes) and 12 lanes on I-45 from Beltway 8 North to Farm-to-Market (FM) 1960 (10 general purpose lanes and two HOV/high occupancy toll [HOT] lanes). General purpose lanes are lanes on a highway that are open to all motor vehicles. In order to promote the use of mass transit and high occupancy vehicles, “managed” lanes, also known as HOV or HOT lanes, are restricted to vehicles with multiple occupants or charge a fee for use depending on the number of passengers in a vehicle and the time of day. Managed lanes are also called managed express (MaX) lanes. The primary goal of MaX lanes is to move the maximum number of people at maximum speed, and to integrate the use of both HOV lanes and single occupancy vehicle (SOV) lanes, which have the potential to be tolled.

Several years later, TxDOT began an update to the North-Hardy Highway Component study that aimed at updating the traffic data and model for the I-45/Hardy Toll Road corridor, along with examining the Downtown “Loop System” (i.e., the highways that move traffic around Downtown: I-10, US 59, I-45), since improvements/changes to I-45 and/or the Hardy Toll Road would affect the traffic accessing the Downtown Loop System. At the same time that this updated traffic analysis was being conducted, TxDOT was conducting a separate study regarding the Pierce Elevated (I-45) and US 59 roadway segments leading into/out of southeast Downtown. Based on the preliminary traffic analysis, TxDOT concluded that the Downtown Loop System essentially operates as one large interchange around Downtown Houston and that to fix the deficiencies of the I-45 (Pierce Elevated)/US 59 connection and accommodate the future traffic volumes, the entire Downtown Loop System of highways would need to be evaluated in one study. These conclusions were reached around 2010/2011. As such, when the study for the NHHIP was beginning in 2011, the separate study in the area of the I-45/US 59 interchange was stopped and the NHHIP study limits were proposed to include I-45, Hardy Toll Road, US 59 and I-10 in the Downtown area, and US 59 south of Downtown to SH 288, as depicted in Figure 1-2. These study limits were documented in the Notice of Intent (NOI) for the EIS and in the draft purpose and need statement for the project. Following publication/distribution of the NOI in October 2011, TxDOT held the first round of agency and public

scoping meetings in November 2011 to discuss the project goals, need and purpose, the extent of impact analyses, agency coordination, and public involvement. Through the initial analysis of I-45 and other highways in the Downtown area, the identified transportation issues included: inadequate capacity for existing and future traffic demands, safety (high crash and fatality locations), and roadway geometric deficiencies. The study area and project limits for the NHHIP project, including I-45, I-10, and US 59/I-69 in the Downtown area, were presented at the agency and public scoping meetings in 2011.

Figure 1-2: NHHIP Initial Study Area (2011)



As discussed above, Figure 1-2 depicts the initial study limits for the NHHIP in 2011. The southern limit of the study area was the interchange of US 59/I-69 and SH 288, and the northern limit on I-45 and Hardy Toll Road was the interchange with Beltway 8 North. The proposed project area included I-45 from its connection to US 59/I-69 to Beltway 8 North, portions of I-10 and US 59/I-69 in the Downtown Houston area, Hardy Toll Road from north of Downtown Houston to Beltway 8 North, and I-610 and Beltway 8 North between I-45 and Hardy Toll Road.

The North-Hardy Planning Studies completed in November 2005 relied partly on information and goals from both H-GAC's 2022 Metropolitan Transportation Plan (MTP) and 2025 Regional Transportation Plan (RTP). When the initial studies began, the 2022 MTP was the approved plan and by the end of the Highway Component study (2005), the 2025 RTP was in effect. The analysis of highway alternatives specifically addressed the MTP and RTP goals for increasing mobility. The need for highway improvements in the study corridor was reevaluated beginning in 2011 and was based on more recent traffic and demographic information, including H-GAC's 2035 and 2040 regional travel demand models and other sources. The 2014 I-45/Hardy Corridor Study update utilized the 2040 H-GAC travel demand model and validated the previous recommendation/findings to add four bi-directional managed lanes on I-45 from Beltway 8 to Downtown to address congestion needs.

The current 2045 RTP includes the proposed NHHIP as one of the recommended highway investments in the Houston-Galveston region to support the significant growth in regional travel (H-GAC 2019). Appendix D of the 2045 RTP includes details of the proposed project, including reconstruction of interchanges, reconstruction and widening of mainlanes and frontage roads, and increasing the number of managed lanes on I-45 from I-10 to Beltway 8.

Based on the findings of the I-45/Hardy Corridor Study Update (2014), the study limit on US 59/I-69 was extended to Spur 527. The study area for the 2014 traffic study update included the existing I-45 and Hardy Toll Road corridors from Sam Houston Tollway/Beltway 8 to Downtown Houston; the Downtown Loop System consisting of I-45, I-10, and US 59/I-69; and US 59/I-69 from the I-45/US 59/I-69 interchange to Spur 527

The project study area was divided into three analysis segments. A single alternative for each of the three study segments was identified as the Proposed Recommended Alternative and was evaluated in the Draft EIS published in April 2017. At the May 2017 Public Hearing, some proposed design changes subsequent to the Draft EIS were presented by TxDOT. The design changes included storm water detention sites, mostly within the project right-of-way, and modifications to some entrance and exit ramps, highway interchanges, and frontage roads. The proposed design changes were shown on the exhibits at the Public Hearing and on the project website. In response to comments received at the Public Hearing and at many meetings with stakeholders, and during the Draft EIS comment period, other design changes are now proposed and are discussed in detail in Section 2 of this Final EIS.

1.2 Need for Proposed Action

TxDOT, with input from the public, agencies, and other stakeholders, defined needs for highway transportation improvements in the NHHIP area from Downtown Houston northward to Beltway 8 North, which are summarized as follows:

- Relieve Traffic Congestion: The I-45 roadway facility in the study area does not provide adequate capacity for existing and future traffic demands, resulting in congestion, longer travel times, and reduced mobility. The average daily traffic volumes on I-45 in the areas from US 59/I-69 to I-10 (Downtown area) and I-610 to Beltway 8 North are projected to increase up to approximately 40 percent between 2015 and 2040. The average daily traffic volume on I-45 between I-10 and I-610 is projected to increase up to approximately 15 percent during the same period. Section 1.2.1 includes existing and projected traffic volumes and congestion levels for I-45 and other major highways in the study area, including Downtown.

  The one-lane reversible HOV lane on I-45 serves traffic in only one direction during the peak periods and is unused for large portions of the day. During peak hours, the HOV lane congestion is classified as "tolerable." Forecasts for commuter service indicate that even with parallel high-capacity transit in the corridor, managed lanes would still be needed to support commuter traffic and express bus service.
- Update Highway to Current Design Standards: Portions of I-45 do not meet current roadway design standards, creating a traffic safety concern. There are also roadway design deficiencies on I-10 and US 59/I-69 in the Downtown area. Section 1.2.2 describes the existing major design deficiencies of the highways in the NHHIP project area.
- Improve Stormwater Drainage: Roadway design deficiencies also include inadequate storm water drainage in some locations and with intense rainfall this can cause high water levels. I-45 does not operate effectively as an evacuation route with high water closures, especially during hurricane evacuations when high rainfall events are likely. Section 1.2.2 discusses stormwater drainage in more detail.
- Improve Evacuation Route: I-45 is designated by H-GAC as an evacuation route for the region in case of a major storm, hurricane, or chemical spill. At its present capacity, evacuation effectiveness would be limited in the event of a hurricane or other regional emergency. This was readily apparent during the evacuations for Hurricane Rita in 2005 and Hurricane Ike in 2008. Section 1.2.3 discusses emergency evacuation in more detail.

1.2.1 CONGESTION

Congestion is defined as the level at which transportation system performance is no longer acceptable due to traffic interferences (23 CFR 500.109). The level of system performance deemed acceptable by state and local officials varies by type of transportation facility, geographic location (metropolitan area or subarea, rural area), and/or time of day. Congestion may be a result of excess travel demand, change in roadway capacity, and the number of commuters traveling during peak travel times. It may also be a result of crashes or weather conditions. Heavily congested areas are generally where more crashes occur.

I-45 is a major transportation facility serving the Houston metropolitan area and the surrounding region. Houston is the fourth most populous city in the United States and the largest city in the southern United States and Texas (City of Houston 2017a). The regional population and employment are forecasted to increase, adding 3.5 million people and 1.3 million jobs from 2015 to 2040 (H-GAC 2017a). Travel destinations along or near I-45 include Downtown Houston, Texas Medical Center, University of Houston, and Texas Southern University on the south end of the study area; and The Woodlands, ExxonMobil Houston campus, and the Greenspoint area to the north. I-45 is a link to the three major regional airports: George Bush Intercontinental Airport, Hobby Airport, and Ellington Field. I-45 is also used for through trips for travel origins and destinations that are outside the NHHIP area. The facility is currently congested in the peak periods, and the projected population and employment growth will continue to increase travel demand within the project area. Without improvements in the project area, congestion during the peak periods would increase in duration, resulting in increased traffic delays and diversions onto surrounding local streets.

In addition to overall travel demand, congestion is intensified by bottlenecks, merging traffic, and weaving to access entrance and exit ramps. Bottlenecks are segments of a road where there is a change in traffic capacity, such as the loss of a lane, which can cause traffic to slow and create additional delays. Critical bottlenecks on I-45 in the project area occur at:

- Beltway 8 North
- The Shepherd Drive curve, where there is an entrance/exit to the HOV lane
- Ramp connections north and south of I-610
- I-10 to Allen Parkway, where merges and limited sight distance slow traffic
- The interchange with US 59/I-69 and SH 288

In 2018, TxDOT released its list of Top 100 congested roadways in Texas, which is developed in coordination with the Texas Transportation Institute.

Table 1-1 lists the roadways on the Top 100 list that overlap with any portion of the proposed I-45 NHHIP.

As shown, seven segments of roadway fall within the Top 20 of the Top 100 list. The total annual cost of congestion for these segments is over $560 million dollars. This cost is expected to increase with urban growth and increases in traffic demand.

Table 1-1: Most Congested Roadways in Texas in 2018

Rank	Roadway	From	To	Annual Hours of Delay per Mile	Annual Congestion Cost (Million)
2	US 59/I-69	I-610 W	SH 288	1,372,657	$146.5
5	US 59/I-69	SH 288	I-10	962,892	$59.8
10	I-45 N	Beltway 8 N	I-610 N	707,582	$131.3
11	I-45 S	I-10	I-610 N	707,080	$114.5
12	SH 288	I-45 S	I-610 S	628,484	$61.1
16	I-10	I-45 N	US 59/I-69	544,872	$18.4
20	I-45	I-610 N	I-10	496,325	$31.0
				Total	**$562.6**

Source: Texas A&M Transportation Institute and TxDOT (2019); Texas A&M Transportation Institute (2017)

In 2018 the American Transportation Research Institute released its 2018 Top Truck Bottleneck List of the 100 most congested highway locations for heavy-duty trucks that carry freight. Of the 100 specific locations across the U.S. that were analyzed, four of the top truck "bottleneck" locations are in the area of the proposed NHHIP:

- No. 18 — I-10 at I-45
- No. 19 — I-45 at US 59/I-69
- No. 23 — I-10 at US 59/I-69
- No. 41 — I-45 at I-610 North

The 2045 RTP identifies the NHHIP as one of the recommended highway investments in the Houston-Galveston region to support the significant growth in regional travel. The plan is a coordinated effort, led by H-GAC, the designated metropolitan planning organization, to address the present transportation concerns and to prepare for the mobility needs of the future in the eight-county Transportation Management Area.

1.2.1.1 Traffic Volumes and Level of Service

An update to a September 2006 I-45/Hardy Traffic Study was completed in August 2014. The purpose of the study was to re-evaluate the existing and future transportation conditions along the I-45 and Hardy Toll Road corridors based on the latest available information. The study area for the traffic study update included the existing I-45 and Hardy Toll Road corridors from Beltway 8 North to Downtown Houston, including the Downtown Loop System, which consists of I-45, I-10, and US 59/I-69; and US 59/I-69 from its interchange with I-45 to Spur 527.

Level of Service (LOS) is a qualitative measure of traffic operations, ranging from LOS A through LOS F. LOS A–C represents traffic ranging from free-flow conditions to stable flow conditions causing minor traffic flow disruptions. LOS D represents unstable traffic flow conditions with severely restricted travel speeds. LOS E represents noticeable traffic congestion with travel demand approaching or at roadway capacity, and LOS F represents severe traffic congestion with travel demand exceeding roadway capacity causing stop-and-go traffic flow conditions. A quantitative measure to represent LOS is the ratio of traffic volume to the capacity (v/c ratio) of the roadway. The higher the v/c ratio, the more congested the roadway. The level of mobility can be evaluated by the v/c ratio: less than 0.87 represents "tolerable" traffic conditions, between 0.87 and 1.00 indicates "moderate" traffic congestion, between 1.00 and 1.25 indicates "serious" traffic congestion, and greater than 1.25 indicates a "severe" level of traffic congestion. Table 1-2 provides definitions of the different levels of service associated with the maximum v/c ratio and congestion levels.

Table 1-2: Level of Service Definitions

LOS	Maximum V/C Ratio	LOS Description	Congestion Level
A	0.29	**Highest quality of traffic service**; free-flow conditions; motorists drive at desired speed; minor traffic flow disruptions.	Free Flow  Severe Congestion
B	0.47	**Good quality of traffic service**; reasonable flow conditions; noticeable presence of other vehicles; ability to maneuver is slightly restricted.	
C	0.68	**Stable traffic flow**; noticeable increase in platoon formation; ability to maneuver noticeably restricted; minor disruptions could cause traffic service deterioration.	
D	0.87	**Approaching unstable traffic flow**; speed and ability to maneuver severely restricted; limit of acceptable operations.	
E	1.00	**Unstable traffic flow**; travel demand approaching or at roadway capacity.	
F	>1.00	**Heavily congested flow**; traffic demand exceeds roadway capacity; forced or breakdown traffic flow.	

Source: TxDOT 2014a

Based on existing (Year 2015) and predicted future (Year 2040) traffic volumes, congestion along the traffic study corridors will continue to worsen if there are no improvements to roadway capacity in the study corridors. Table 1-3 shows the existing and future v/c ratios, congestion level, and LOS for roadway segments in the traffic study area.

Table 1-3: Existing (2015) and Future (2040) Volume-to-Capacity Ratios, Congestion Level, and LOS

Roadway	Segment	2015			2040		
		V/C Ratio	Congestion Level	LOS	V/C Ratio	Congestion Level	LOS
I-45	Beltway 8 North to Shepherd Drive	1.13	Serious	F	1.23	Severe	F
	Shepherd Drive to I-610	1.08	Serious	F	1.13	Serious	F
	I-610 to I-10	0.99	Moderate	E	1.07	Serious	F
	I-10 to Allen Parkway	1.09	Serious	F	1.13	Serious	F
	Allen Parkway to US 59/I-69	1.22	Serious	F	2.09	Severe	F
Hardy Toll Road	Beltway 8 North to I-610	0.55	Tolerable	C	1.22	Serious	F
US 59/I-69	I-10 to I-45	0.79	Moderate	D	0.97	Moderate	E
	I-45 to Spur 527	1.15	Serious	F	1.27	Severe	F
I-10	I-45 to US 59/I-69	0.77	Moderate	D	1.02	Serious	F
I-610	I-45 to Hardy Toll Road	0.81	Moderate	D	1.05	Serious	F
Beltway 8 North	I-45 to Hardy Toll Road	0.82	Moderate	D	1.21	Serious	F
SH 288	South of US 59/I-69	0.60	Tolerable	C	0.70	Moderate	D

Source: H-GAC 2015

Existing traffic volumes on I-45 during the maximum three-hour peak periods result in unacceptable v/c ratios between 0.99 and 1.22, and in 2040 the v/c rations are projected to range from 1.07 to 2.09. Based on the v/c ratios, congestion levels on I-45 would worsen over time, with serious to severe congestion in all of areas of I-45 from Beltway 8 North to US 59/I-69.

Although the v/c ratio is a standard indicator to measure LOS along a roadway, motorists generally experience LOS based on the speed at which they are traveling. As reported in the I-45/Hardy Corridor Study Update (TxDOT 2014a), travel speeds during morning or evening rush hours (peak hours of travel) in 2011 on I-45 were approximately 30 to 40 miles per hour (mph) between Beltway 8 North and Shepherd Drive, and between I-610 and I-10. Travel speeds on I-45 were less than 30 mph between Shepherd Drive and I-610. Travel speeds on I-45 and US 59/I-69 in the Downtown Houston area were typically less than 30 mph. The degree of traffic congestion is reflected in the peak period speeds versus the posted speed limit of 60 mph. Use of the reversible HOV lane is controlled, thereby allowing it to operate at higher speeds. Weaving and merging at the HOV entrance/exit at Shepherd Drive contribute to further congestion.

In addition to the volume-to-capacity and LOS assessment performed, an operational analysis was completed to assess the existing (2018) and No Build operational impacts. This analysis included calibrating an existing traffic model to replicate existing conditions and developing future-year traffic

demands during peak periods of the day. The existing condition results showed the high level of congestion in the project area.

Travel times were collected to display the speeds during morning and afternoon peak periods through the project area. Traffic models were developed that replicate the existing congestion levels by project segment and feed into future-year alternative operational analysis scenarios.

After existing traffic models accepted by the Federal Highway Administration (FHWA) were developed, future-year traffic volumes in a "No Build" scenario were applied to show the impact of maintaining the existing transportation infrastructure in the study area. The No Build scenario included projects expected to occur separate from the I-45 NHHIP, including the Hardy Toll Extension. These scenarios included 2025 and 2045 analysis years to show an opening year and a 20-year design year. Table 1-4 shows the results with the "No Build" scenario.

Table 1-4: Existing (2018) and Future (2025 and 2045) Travel Speeds

	Year	Peak Period	Average Speed (mph) Systemwide
Existing	2018	AM	27.5
		PM	25.2
No Build	2025	AM	25.6
		PM	19.8
No Build	2045	AM	19.7
		PM	17.7

Source: H-GAC 2018e

As shown in Table 1-4, both the AM and PM peak periods show deterioration in average speed from 2018 to 2045, as expected with increased traffic demand. By 2045, freeway mainlane speeds would decrease to 30 mph across I-45, I-10, US 59/I-69, and I-610. I-10 westbound and US 59/I-69 would decrease to below 15 mph during morning and afternoon peak periods.

TxDOT is required to continue providing the ability to accommodate HOV/bus/transit service in the I-45 corridor. In November 2019, the bond proposal for the METRONext Moving Forward Plan was approved by the voters. This plan includes the use of the proposed I-45 MaX lanes to accommodate METRO's planned METRORapid Bus Rapid Transit (BRT) system. This will not be possible without TxDOT constructing the MaX lanes to serve as a dedicated corridor. The MaX lanes will also accommodate future automated technologies such as Automated Vehicles/Connected Vehicles that can travel closer together than traditional vehicles. METRO has previously evaluated connected buses which would also utilize the MaX lanes but does not currently have the bus technology. A Preferred Alternative would also achieve the purpose of providing expanded transit and carpool opportunities by providing reduced congestion and managed lanes that could be used by transit vehicles.

1.2.1.2 Population and Employment

Population and employment data are used to assess demand for travel in the region. Population and employment data for the base year (2015) and future year (2040) for Downtown and the I-45 Study Area were obtained from H-GAC's 2015 regional travel demand model. Population and employment data for Harris County and the Region were obtained from H-GAC 2017 regional growth forecasts. The population in the study area is projected to increase approximately 17 percent from 2015 to 2040, at a compounded annual growth rate (CAGR) of 0.6 percent. Employment in the study area is expected to increase 16 percent from 2015 to 2040, at a CAGR of 0.6 percent. Population and employment growth projections for the Houston Downtown area, the study area, Harris County, and the Houston-Galveston region are presented in Table 1-5. The greatest annual increase in population is in Downtown, with a 3.2% CAGR between 2015 and 2040.

Table 1-5: Household Population and Employment (2015 and 2040)

Area	Population		Percent Increase	CAGR	Employment		Percent Increase	CAGR
	2015	2040			2015	2040		
Downtown[1]	5,835	12,820	119.7%	3.20%	148,034	160,493	8.4%	0.32%
I-45 Study Area[1]*	199,139	232,277	16.6%	0.62%	284,544	330,586	16.2%	0.60%
Harris County[2]	4,468,113	6,276,493	40.5%	1.40%	2,482,334	3,413,420	37.5%	1.30%
Region[2]	6,533,662	10,084,468	54.3%	1.75%	3,198,168	4,504,906	40.9%	1.38%

Source: [1] H-GAC 2015
[2] H-GAC 2017a
*The I-45 Study Area referred to in this table and section is the study area used for the update to the I-45/Hardy Traffic Study.

H-GAC regional growth forecasts reported that population and employment within the Houston-Galveston region is expected to grow by 1.75 and 1.38 percent per year between 2015 and 2040, respectively. Compared to the Houston-Galveston region, the I-45 study area shows a relatively lower growth rate per year of less than one percent. This lower growth rate is mainly because of the limited developable land within the NHHIP area compared to the region. The Downtown Houston area shows significantly higher growth in population, and only a slight growth in employment by 2040. This trend is due to the decentralization of employment activities in the Houston-Galveston region, and current and planned revitalization efforts in the Downtown Houston area to add more residential/mixed-use development.

All of the H-GAC region will experience increased vehicular travel over the next 25 years (from 2015 to 2040). In the region vehicular travel is projected to increase 64 percent, from 170 million vehicle miles of travel on an average weekday to 285 million vehicle miles. Travel to, from, or within the area outside of Beltway 8 will represent 70 percent of the trips. Additionally, employment growth and the development of employment centers in suburban areas has increased commuting in non-peak directions on several

major freeways and toll roads, including US 59/I-69 southbound, I-10 westbound, and I-45 northbound (H-GAC 2016).

Latent travel demand in the NHHIP area could also add traffic to I-45 and other major roadways, including Beltway 8 North, I-610, I-10, and US 59/I-69. Latent demand refers to traffic that does not use a facility once it reaches a certain level of congestion but would use the facility if the capacity increased or congestion lessened. Therefore, additional travelers may use a facility once additional capacity is available. Latent demand is based on several factors such as the capacity and condition of alternate routes and the availability of transit.

1.2.2 DESIGN STANDARDS/SAFETY

The existing I-45 roadway facility does not meet current TxDOT design standards. There are narrow lane widths, narrow or nonexistent shoulders, low bridge clearances, and several structures that are functionally obsolete and could have a negative impact on transportation safety and operations in the NHHIP area. Existing major design deficiencies of I-45 in the NHHIP area include:

- Lane and shoulder widths were reduced in certain portions of I-45 to accommodate the reversible HOV lane, resulting in shoulder widths being less than the minimum design criterion of 10 feet. There are no inside shoulders between I-10 and Shepherd Drive. Some lane widths have also been reduced from the minimum and usual criterion of 12 feet. Portions of the reversible HOV lane and HOV shoulders along I-45 are also substandard. A potential consequence of the substandard HOV lane and shoulders is that when there is an incident on the HOV lane, the reduced shoulder widths or absence of shoulders often result in travelers being stopped on the HOV lane with no option to pass around the incident, thereby requiring the incident to be cleared before traffic movement can resume.
- Multiple bridges have low vertical clearances (i.e., distance between top of pavement and bottom of structure). TxDOT design guidelines recommend a desired vertical clearance of 16 feet 6 inches. Bridges at Cottage Street, North Main Street, North Street, Quitman Street, Crockett/Hogan Street, and West Dallas Street all have clearances of 14 feet 10 inches or less. These bridges are substandard based on current design guidelines. Between 2014 to April 2018, bridges along I-45 that have been struck due to loads that were too high include:
  - Cottage Street – hit once
  - North Street – hit once
  - Crockett/Hogan Street – hit 4 times
  - Houston Avenue – hit 18 times
  - McKinney Street – hit once
  - Dallas Street – hit 3 times
- Various structures in the NHHIP area, while not structurally deficient, are functionally obsolete, meaning that the width, vertical clearance, waterway adequacy, or approach roadway alignment are not adequate for the traffic type, traffic volume, or drainage needs.

- The vertical alignment of I-45 from US 59/I-69 to Beltway 8 North contains multiple vertical curves that do not meet desired design speeds. Substandard vertical alignment affects safety because the driver's sight distance is less than optimum causing traffic to unnecessarily slow down.
- The horizontal alignment of I-45 from US 59/I-69 to Beltway 8 North contains multiple horizontal curves that do not meet desired design speeds.

Standard lane widths with adequate sight distances and clearances provide safety and comfort for drivers, and inside shoulders offer a place of refuge for disabled vehicles. A roadway that does not meet these design standards may be a safety hazard.

Pavement rehabilitation is also needed within the I-45 corridor. Approximately 10.5 miles of pavement on the mainlanes and frontage roads of I-45 in the NHHIP area (4.0 miles of mainlanes and 6.5 miles of frontage roads) were determined to be in poor or very poor condition in 2017.

Existing major design deficiencies of I-10 in the NHHIP area include:

- The horizontal alignment of I-10 from I-45 to US 59/I-69 contains multiple horizontal curves that do not meet desired design speeds.
- An entrance ramp to I-10 merges with the highway travel lane without providing sufficient acceleration distance for entering vehicles to reach highway speeds.

Existing major design deficiencies of US 59/I-69 in the NHHIP area include:

- The horizontal alignment of US 59/I-69 from to I-10 contains multiple horizontal curves that do not meet desired design speeds.

Safety is a top regional priority. As reported in the 2040 RTP, in 2012 the region experienced a significant increase in the number of vehicular crashes compared to 2011. In addition to this, impaired driving fatalities increased 10 percent in the same time period and two of the top ten counties for impaired driving related fatalities in Texas are in the Houston-Galveston region. Population and economic growth will increase system demand, increasing congestion and contributing to system deterioration, both of which are implicated in safety issues.

Crash history and data were extracted from TxDOT's Crash Records Information System. Table 1-6 summarizes crash severity data for the highway segments predominantly within the NHHIP area by fatal, injury, and property damage only crash (TxDOT 2019a). Table 1-6 also presents the average crash rate for the highway segments within the NHHIP area over the same time period. Both the reported crashes on the highway segments and those used to calculate average statewide crash rates include crashes on the frontage roads wherever available. Crash rates are calculated on the basis of 100 million VMT. The range of the 2015 to 2018 statewide average crash rates for Urban Interstate is presented for comparison purposes. As shown in this table, all the sections along I-45 analyzed show a considerably higher crash rate than the statewide average crash rate. A total of 13,562 crashes, including 56 fatal crashes, was reported on I-45 from Cullen Boulevard to Beltway 8 North from 2015 to 2018. This section of I-45 includes the NHHIP area from US 59/I-69 to Beltway 8 North. In 2018 alone, there were 234 crashes on I-45

between I-10 and I-610 (Segment 2); 79 of those were fatal or injury crashes, and 783 were crashes on I-45 between I-10 and Scott Street (Segment 3). Between 2015 and 2018, there were 66 incidents within the area of Segments 2 and 3 of the project when a bridge was hit by a truck passing underneath; four bridge strikes occurred in Segment 1 during the same period.

Table 1-6: Years 2015 through 2018 Crash Summary for NHHIP Area

Roadway	Limits	Fatal	Injury	Property Damage Only	Total	Average Crash Rate	Statewide Average Crash Rate (Urban Interstate)
I-45	Beltway 8 to I-610	30	2,083	4,889	7,188	231.80	135.95–145.87
	I-610 to I-10	7	521	1,301	1,862	233.10	135.95–145.87
	I-10 to Cullen Blvd.	19	1,303	3,108	4,512	192.15	135.95–145.88
US 59/ I-69	Mandell St. to Quitman St.	9	437	1,023	1,498	78.27	135.95–145.88
I-10	Taylor St. to Lockwood Dr.	4	587	1,546	2,204	160.81	135.95–145.88
I-610	Main St. to Hardy Toll Road	8	567	1,270	1,889	168.42	135.95–145.88

Source: TxDOT 2019a

The depressed section of I-45 in the vicinity of North Main Street is currently drained by a gravity storm sewer system that outfalls to Little White Oak Bayou. Under storm events greater than a 10-year 24-hour storm event the depressed section has the potential to flood due to the flood levels along Little White Oak Bayou. This section of I-45 has previously flooded during the 2015 Memorial Day storm event, the 2016 Tax Day storm event, and the 2017 Harvey storm event. The flooding experienced during these historic storm events resulted in the closure of the roadway at this location, reducing the capacity of the roadway for evacuation. In addition to these historical storm events, TxDOT has observed drainage and flooding problems on the freeway mainlanes at this location during times of intense rainfall. Flooding/drainage problems also occur at the I-45/I-10 underpass and on the outside lanes and frontage roads between Parker Road and Gulf Bank Road. Three primary locations for drainage and flooding problems along frontage roads include: between Tidwell Road and Parker Road, at North Shepherd Drive, and at SH 249/West Mount Houston Road. This was particularly evident during Hurricane Harvey in August 2017. There were numerous high water locations along the I-45 corridor on both the mainlanes and the frontage roads. A current TxDOT drainage criterion requires storm sewers draining interstate highways to be designed for the 10-year design storm event. Some existing roadways, including I-45 in the NHHIP area, are not designed per current drainage design criteria and, when flooded, have reduced capacity for evacuating vehicles.

1.2.3 EMERGENCY EVACUATION

Another safety issue for the Houston region is emergency evacuation. I-45 is identified by H-GAC as an emergency evacuation route for the Houston-Galveston region in the event of a major storm, hurricane, or chemical spill. During Hurricane Rita in 2005, approximately 2.5 million people attempted to evacuate

the region, resulting in stopped traffic for miles on major arterial freeways, where it took up to nine hours to travel a distance of 10 to 20 miles. A similar situation also occurred during the evacuation for Hurricane Ike in 2008. TxDOT determined that there was a need to improve this evacuation route.

1.3 Purpose of Proposed Action

The purpose of the proposed NHHIP is to implement an integrated system of transportation improvements that would:

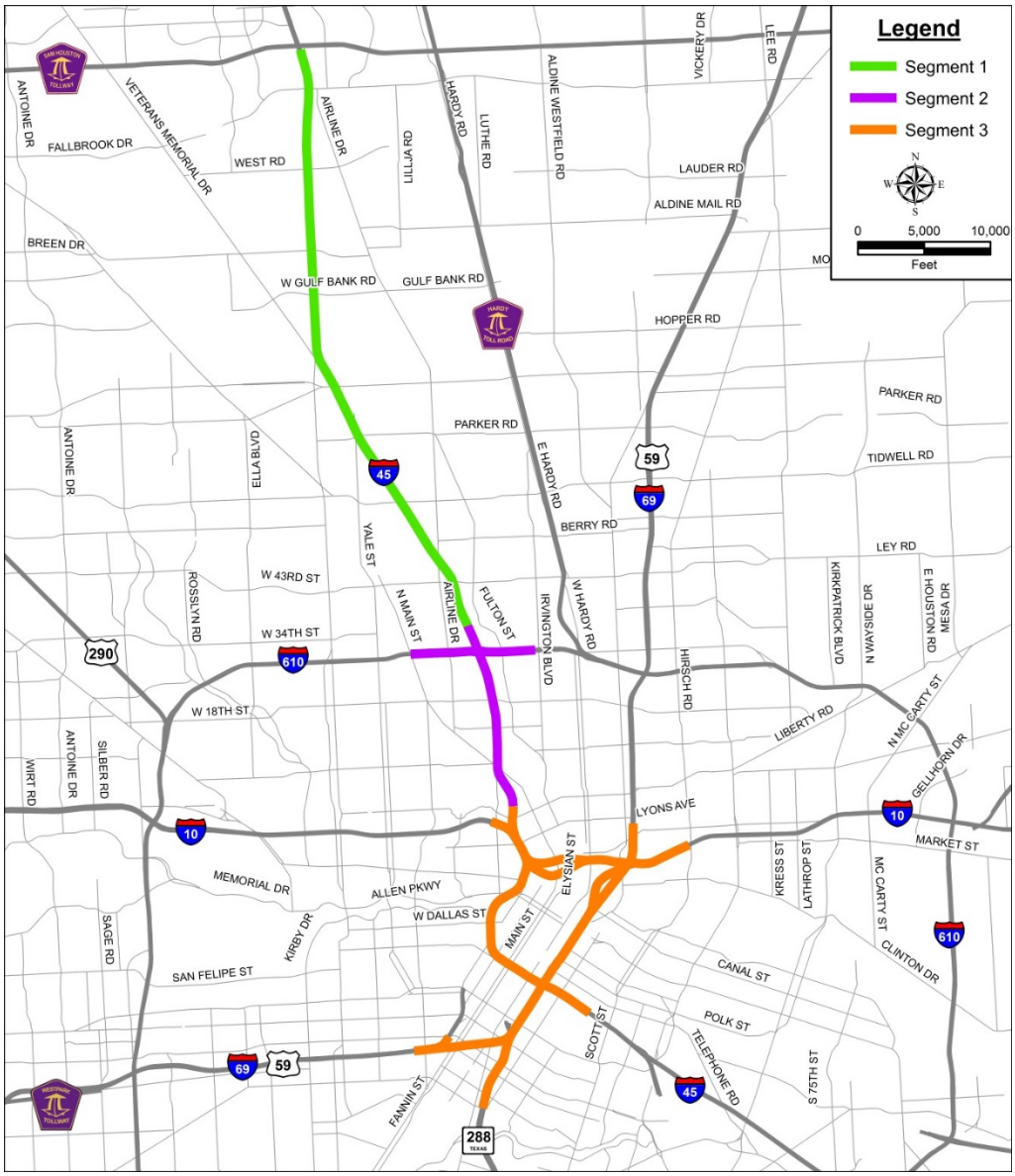
- Manage I-45 traffic congestion in the NHHIP area through added capacity, MaX lanes, options for SOV lanes, and improved operations.
- Improve mobility on I-45 between US 59/I-69 and Beltway 8 North by accommodating projected population growth and latent demand in the project area.
- Provide expanded transit and carpool opportunities.
- Bring I-45, I-10, and US 59/I-69 up to current design standards to improve safety and operations.
- Improve the capabilities of I-45 as an emergency evacuation route.
- Improve stormwater drainage on I-45.
- Support the projected significant increase in travel on the regional highways in the Houston-Galveston area.

The ultimate goal is to provide a facility with additional capacity for projected travel demand by incorporating transit opportunities, travel demand and management strategies, and flexible operations. Such a facility would help manage congestion, improve mobility, enhance safety, and provide travelers with options to reach their destinations. The purpose is based on findings in the North-Hardy Planning Studies and the I-45/Hardy Corridor Study Update.

1.4 Proposed Action

The proposed project includes improvements to address highway transportation needs in the I-45 corridor extending from south of Downtown Houston to Beltway 8 North, with associated improvements to US 59/I-69 and I-10 in the Downtown Houston area. The project area and study segments are shown on Figure 1-3. The proposed improvements would create additional roadway capacity to manage congestion, enhance safety, and improve mobility and operational efficiency on I-45 from US 59/I-69 to Beltway 8 North. The proposed project would add four MaX lanes on I-45 from Downtown Houston to Beltway 8 North, reroute I-45 to be parallel with I-10 on the north side of Downtown Houston and parallel to US 59/I-69 on the east side of Downtown Houston, realign sections of I-10 and US 59/I-69 in the Downtown area to eliminate the current roadway reverse curves (a reverse curve is a section of the horizontal alignment of a highway in which a curve to the left or right is followed immediately by a curve in the opposite direction), and depress US 59/I-69 between I-10 and Spur 527 (south of Downtown).

Figure 1-3: NHHIP Project Area (2018)



Source: NHHIP Study Team, NHHIP Project Area Map, 2018

The proposed project also includes reconstruction of mainlanes and frontage roads, the addition of bicycle/pedestrian realms along city streets that cross the freeways, including a pedestrian realm that will create a buffer between the bicycle/pedestrian traffic and the vehicular traffic, adding sidewalks along frontage roads, and constructing pass-through lanes on I-10 that will separate traffic desiring to go to Downtown from traffic destined to go through Downtown.

The proposed action, which is now referred to as the Preferred Alternative, includes the following improvements:

1.4.1 SEGMENT 1: BELTWAY 8 NORTH TO I-610

New Roadway Capacity/Other Improvements

- Add four (4) MaX lanes
- Add one (1) frontage road lane in each direction
- Add full-width shoulders
- Add bike/pedestrian features along frontage roads
- Requires approximately 246 acres of new right-of-way (ROW)
- Add storm water detention areas

1.4.2 SEGMENT 2: I-610 TO I-10

New Roadway Capacity/Other Improvements

- Add four (4) MaX lanes
- Add full-width shoulders
- Add bike/pedestrian features along frontage roads
- Requires approximately 44 acres of new ROW
- Add storm water detention areas

Between I-610 and Cavalcade Street

- Mainlanes would be elevated
- Frontage roads would be at-grade

Between Cavalcade Street and Quitman Street

- Mainlanes would be depressed
- Frontage roads would be at-grade

1.4.3 SEGMENT 3: DOWNTOWN LOOP SYSTEM

New Roadway Capacity/Other Improvements

- Realign I-45 to be parallel with I-10 and US 59/I-69 and convert existing I-45 alignment to a Downtown Connector
- Reconstruct US 59/I-69 to create a continuous depressed section between Spur 527 to Commerce Street in Downtown
- Add I-10 Express Lanes from I-45 to US 59/I-69
- Realign sections of I-10 and US 59/I-69
- Requires approximately 160 acres of new ROW
- Add storm water detention areas

1.5 Planning Process

The early planning process for the North-Hardy Corridor, which included evaluation of I-45 and Hardy Toll Road, is described in Section 1.1.1. Details of the planning process for the NHHIP are discussed in Section 2.

1.6 Public Involvement

Public involvement conducted for the NHHIP, including agency coordination, is discussed in Section 2. For the EIS process, public involvement and agency coordination was initiated in 2011. Public and agency coordination meetings conducted between November 2011 and May 2017 included two scoping meetings, two public meetings, and a Public Hearing. Early opportunities for input on the purpose and need for the project were provided at the agency and public scoping meetings in 2011 and 2012. The draft Need and Purpose statement and related information was available for review at the meetings, discussed at the meetings, posted on the project website, and available at the TxDOT Houston District office. Details about the meetings, including meeting materials, and comments and responses are posted on the project website (http://www.ih45northandmore.com/) and are available at the TxDOT Houston District office.

In addition to the public meetings and Public Hearing, TxDOT attended more than 300 stakeholder meetings with individuals, groups, or organizations between July 2013 and August 2019. At most stakeholder meetings, project information was shared in presentations, display boards, and handouts. Input from agency, public, and other stakeholder meetings was considered during the development and evaluation of project alternatives and refinement of the Proposed Recommended Alternative. TxDOT has coordinated directly with representatives of community facilities, public and other housing facilities, and businesses used by environmental justice, Limited English Proficiency (LEP), and other sensitive populations to discuss the proposed project, potential impacts, and mitigation. The results of this coordination are documented in this Final EIS. Some of the project design changes that resulted from public and agency input during the study process are discussed in Section 2 and in the Community Impacts Assessment Technical Report.

1.7 Logical Termini and Independent Utility

Per FHWA regulations (CFR 771.111(f)), logical termini for project development are defined as (1) rational end points for a transportation improvement, and (2) rational end points for a review of the environmental impacts.

As discussed in Section 1.1, the North-Hardy Corridor planning studies identified a need for additional lanes between Downtown Houston and Beltway 8 North. Downtown Houston is a major employment center and trip destination. The I-45/Beltway 8 North interchange is a frequent trip destination, given its proximity to residential neighborhoods and places of employment in the Greenspoint area. Additionally, the I-45/Beltway 8 North interchange does not need any redesign in order to implement the proposed project, as it was completed in 1999 and continues to meet current design standards. The proposed project originally had a southern limit at the SH 288 and US 59/1-69 interchange south of Downtown Houston. During the alternatives analysis process, it was determined that extending the project along

US 59/I-69 to Spur 527 would be necessary to accommodate transitioning the proposed improvements to the existing US 59/I-69 depressed roadway. Therefore, the limits of the proposed project were adjusted for transitions, and the current project limits are US 59/I-69 at Spur 527 and I-45 at Beltway 8 North. The project termini, therefore, are rational endpoints identified for construction and for review of environmental impacts.

A project reviewed under NEPA must have independent utility or independent significance, i.e., be usable and be a reasonable expenditure even if no additional transportation improvements are implemented in the area. The proposed action has independent utility, as it can function properly without the implementation of other transportation improvements and does not rely on any other projects to meet the project purpose as described in Section 1.3. Additionally, the project would not restrict the consideration of alternatives for other foreseeable transportation improvements. The study area of this Final EIS allows for consideration of environmental matters on a broad scope and is intended to ensure meaningful evaluation of alternatives and avoid commitments to transportation improvements before they are fully evaluated.

1.8 Cost and Funding Source

The general construction cost of the project is currently estimated to be approximately $7 Billion (in 2017 dollars), which does not account for estimated ROW costs. Portions of the proposed project are funded, and TxDOT is seeking funding for the remainder. The project will be paid for with a combination of state and federal funds.

2 ALTERNATIVES ANALYSIS

This section describes the alternatives considered for the proposed project and the alternatives screening process and analyses that resulted in the identification of a Preferred Alternative. This section has been updated since the Draft EIS to include more project history and more discussion of the early development and evaluation of transit and highway alternatives, more information about the analysis of highway alternatives performed since 2011, additional rationale for the segmentation of the study corridor, and updates to design changes that have occurred between the Public Hearing and early 2020.

Through the years of study for the NHHIP, numerous alternatives were developed and analyzed. This section provides detailed information about the alternative analysis process and the results of the evaluation at each level of screening. After consideration of a range of alternatives and the public, agency, and other stakeholder input throughout the study process, three alternatives for each project segment were determined by TxDOT to best meet the need and purpose for the proposed project, while also considering engineering, traffic, and environmental factors. The three alternatives per segment to be carried forward for further development were presented as the "Reasonable Alternatives". At that time, in late 2013, the Segment 1 Reasonable Alternative eventually identified by TxDOT as the Preferred Alternative (Alternative 4) had the least direct impacts to residential properties, community facilities, and commercial properties, of the three alternatives. The Segment 2 Reasonable Alternative eventually identified by TxDOT as the Preferred Alternative (Alternative 10) had the same impact to residential and commercial properties as the other two alternatives, and no direct impact to community facilities. The Segment 3 Reasonable Alternative eventually selected to be the Preferred Alternative (Alternative 11, realignment of I-45) had slightly more impacts to residential properties – 7 parcels as compared to 4 and 5 parcels for the other two alternatives; more impacts to commercial properties - 46 parcels as compared to 18 and 29 parcels for the other two alternatives; and no direct impact to community facilities. The Reasonable Alternatives were developed and analyzed in more detail between 2013 and 2017. Over time, with continuing public input and more detailed analysis, the schematic design was revised and became more detailed, resulting in identification of additional ROW needed for the Proposed Recommended Alternatives, particularly in the area of the interchanges, as documented in the Draft EIS. As a result of the refinement of the schematic design for the Proposed Recommended Alternatives since their selection in 2015, including proposed realignment (straightening) of I-10 and US 59/I-59 to eliminate the current roadway curvatures to improve safety and traffic flow in the north and east portions of Segment 3, as well as a more detailed impact analysis than was performed in previous screenings of the alternatives, the impacts of the Preferred Alternative to community resources, including protected populations, are documented to be more adverse than the impacts of the other alternatives for Segments 1, 2, and 3 when the other alternatives were considered in 2015. TxDOT did not refine the schematic designs for the eliminated alternatives (the alternatives other than the Proposed Recommended Alternatives), nor has TxDOT performed a more detailed impact analysis for the eliminated alternatives. Refinement of the schematic designs and a more detailed impact analysis for the eliminated alternatives would have increased the adverse impacts of those alternatives, as it did for the Proposed Recommended Alternative. However, by implementing proposed mitigation measures, TxDOT has made a number of commitments to substantially reduce the effects of the project on minority and low-income populations related to

relocation of residents and facilities, affordable housing, local access, safety, traffic noise, air quality, and homelessness. In some of these areas there would be improvements over the existing conditions such as new facilities for the residents of Clayton Homes and Kelly Village, restoring local access in the area around the I-45/I-610 interchange, and improving safety (e.g., improved pedestrian and bicycle accommodations) on cross streets in neighborhoods. A substantial amount of the adverse effects of the project would be minimized and mitigated through a variety of commitments and programs that will be implemented by TxDOT.

One Proposed Recommended Alternative per project segment was identified in the Draft EIS (April 2017). The evaluation of the Reasonable Alternatives (three alternatives for each project segment) included in the Draft EIS is incorporated in this Final EIS by reference. The Draft EIS is available on the project website at: http://www.ih45northandmore.com/draft_eis.aspx. During preparation of the Draft EIS, TxDOT continued conducting public, agency, and other stakeholder coordination. In response to comments received and further engineering evaluation, the Proposed Recommended Alternatives were revised and presented in May 2017 at the Public Hearing and additional public meeting. Based on comments received during the Draft EIS comment period and from continuing stakeholder input and coordination, the project design was revised between May 2017 and early 2020. The revised alternatives for each project segment are identified as Preferred Alternatives, and when combined, is the Preferred Alternative for the proposed NHHIP. The Preferred Alternative was selected because it best implements an integrated system of transportation improvements that would provide a facility with additional capacity in the I-45/Hardy Toll Road corridor for projected travel demand by incorporating transit opportunities, travel demand and management strategies, and flexible operations, while minimizing and mitigating adverse impacts. Such a facility would help manage congestion, improve mobility, enhance safety, and provide travelers with options to reach their destinations.

Sections 2.3.6.2 through 2.3.6.4 detail the design changes proposed since publication of the Draft EIS. Preliminary sizes and locations of storm water detention basins were identified after the Draft EIS and are included as part of the Preferred Alternative. The Final EIS and associated technical reports document the analysis of the potential impacts of the Preferred Alternative.

2.1 Process Used to Develop and Evaluate Alternatives

As discussed in Section 1.1.1, the Federal Transit Administration (FTA), the FHWA, TxDOT, METRO, and H-GAC partnered to conduct a series of planning studies to identify and address transportation needs in the North-Hardy Corridor (Corridor). The North-Hardy Corridor planning studies were completed in 2005 in partnership with the elected officials representing the Corridor's constituency, the various public agencies responsible for transportation system planning and operation, a diverse group of stakeholders that lived or worked in the Corridor, and numerous interested citizens. The input and feedback received from the meetings and workshops held during the planning studies were integrated into the technical tasks of defining and evaluating the Corridor alternative transportation improvements.

Transit alternatives were examined and documented in the North-Hardy Corridor planning studies Alternatives Analysis Report (Transit Component) (METRO, TxDOT, and H-GAC 2004). A Locally Preferred

Investment Strategy for transit improvements was identified prior to the detailed evaluation of highway alternatives.

Highway alternatives were examined and documented in the North-Hardy Planning Studies Alternatives Analysis Report (Highway Component) (METRO, TxDOT, and H-GAC 2005). The Recommended Alternative for highway improvements between Downtown Houston and Beltway 8 North was the addition of four bi-directional managed lanes to the Interstate Highway 45 (I-45)/Hardy Toll Road Corridor.

In 2011, following the FHWA's approval of a draft Need and Purpose Statement and a Draft Agency Coordination and Public Involvement Plan, TxDOT and FHWA began preparation of an EIS to evaluate alternatives to meet the proposed project's goals in the I-45 and Hardy Toll Road corridors. The need and purpose for the project was developed based on findings of the North-Hardy Planning Studies and refined during analyses for the EIS. Pursuant to the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), TxDOT and FHWA, as joint lead agencies when the NHHIP EIS was initiated, involved Cooperating and Participating agencies and the public in a formal scoping process for the EIS. Through agency and public scoping meetings, agency and public meetings, and other stakeholder meetings, the federal, state, and local agencies and the public have been afforded the opportunity to participate in defining the need for and purpose of the proposed project; the range of alternatives to be considered for the proposed project, including input on preliminary design concepts; environmental and other factors or issues to be considered; and the process and methods for evaluating the alternatives. A list of the Cooperating and Participating agencies and a summary of agency coordination and public involvement conducted during preparation of the EIS is in Section 8.

Figure 2-1 summarizes the key activities and milestones in the development and analysis of project alternatives during the North-Hardy Corridor planning studies and the NHHIP EIS process.

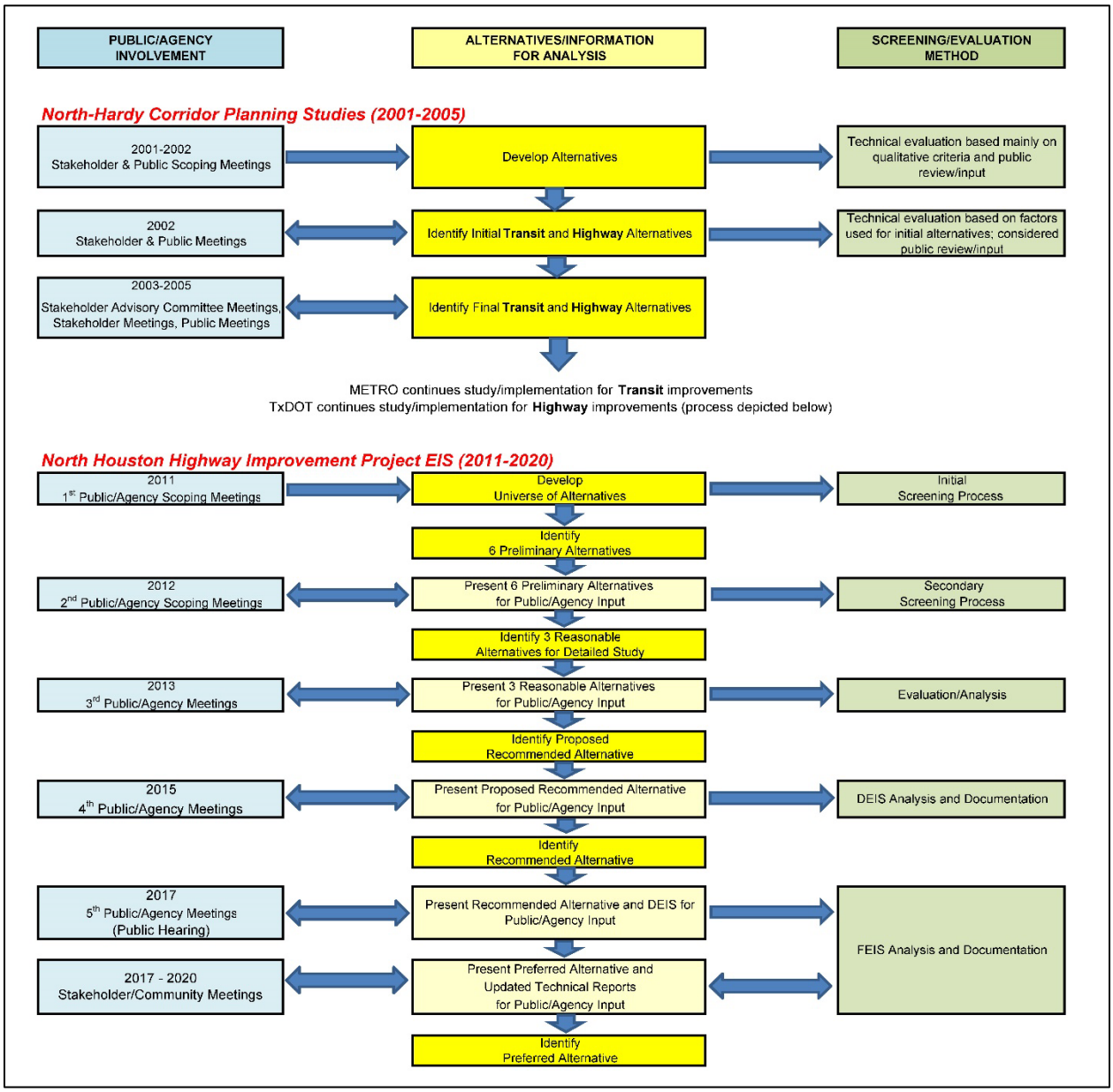
2.2 North-Hardy Corridor Planning Studies – Transit and Highway Alternatives

The North-Hardy Corridor planning studies developed and evaluated transit and highway alternatives and were conducted in partnership by FTA, FHWA, METRO, TxDOT, and H-GAC. The 2004 Alternatives Analysis Report — Transit Component documents the analysis of transit alternatives and the 2005 Alternatives Analysis Report — Highway Component documents the analysis of highway alternatives.

During preparation of the 2005 study, it was assumed that METRO and Harris County Toll Road Authority (HCTRA) would complete the transit and highway projects listed below.[1] The assumptions for transit were the solutions for the North-Hardy Corridor as approved by voters in November 2003, as follows:

[1] During continuing analyses for the NHHIP (see Section 2.3), more recent information about existing and future METRO and the HCTRA facilities was considered. Both agencies participated during development of this EIS.

Figure 2-1: Alternatives Screening Process



- North Corridor LRT from University of Houston-Downtown to George Bush Intercontinental Airport.
  - The first phase of the North Corridor LRT was to be from University of Houston-Downtown to Northline Mall, as an extension of the "Red Line" LRT. This extension opened in 2013.
- Two-way express bus service on I-45.
  - Today there is a reversible HOV lane in the middle of the facility from Beltway 8 North to I-10.

The assumptions for the Hardy Toll Road improvements are those that were planned by HCTRA and are as follows:

- Hardy Toll Road Extension from I-610 to Downtown.
  - Construction of this project began in October 2016 and completion is anticipated to occur by late 2024.
- Widen Hardy Toll Road to six lanes from Beltway 8 North to I-45 in Montgomery County.
  - Currently, Hardy Toll Road is six lanes (three lanes in each direction) for approximately 11.5 miles between Beltway 8 North and SH 99 (Grand Parkway), and two lanes in each direction for approximately 1.5 miles between SH 99 and I-45.

In creating the 2004 and 2005 Alternative Analysis reports, numerous public meetings, stakeholder meetings, and agency meetings were conducted throughout the study process to receive comments on the alternatives development. Numerous transit and highway alternatives were evaluated, and some were subsequently eliminated from further study. The following provides a brief summary of some of the alternatives that were eliminated during the planning process:

Transit Alternatives:

- Commuter Rail – this alternative was eliminated because 1) Union Pacific Railroad (UPRR) was not responsive to sharing its facilities; 2) extending commuter rail into Downtown was not practical due to the LRT facility that was being constructed in Downtown at that time, 3) there was insufficient space for station locations; and 4) commuter rail along UPRR/Hardy Toll Road would bypass the inner city.
- People Mover – typically used to operate in airport or campus environments and operate at moderate speeds (approximately 40 miles per hour). People Movers are not generally suitable for regional transit operations where trips are longer than several miles. They are typically automated (i.e. driverless) and need to be grade separated from vehicular and pedestrian traffic which attributes to a high cost of implementation. Additionally, they are proprietary technology and require a complicated procurement process to comply with government procurement regulations.
- LRT on Kuykendahl Road would provide a circuitous route to The Woodlands and southern Montgomery County. It was recommended as a way to give consideration to preserving ROW on Kuykendahl Road for future LRT or BRT development.

Highway Alternatives

- Upgrade North Shepherd Drive to a “super arterial” (arterial with grade separations at all major cross streets) – South of Tidwell Road, conversion of North Shepherd Drive would significantly impact access to existing businesses and homes, and further analysis was not pursued.
- Potential widening of Airline Drive was considered. Comments from the community indicated that this was unacceptable, and any transit alternatives need to be on structure to avoid widening the roadway.

- Build Alternative 1: 12-lane cross section from I-10 to FM 1960 consisting of 10 general purpose lanes and two reversible, special purpose lanes operating in the peak direction - one lane dedicated to HOV use.
- Build Alternative 3: 12-lane cross section from I-10 to FM 1960 consisting of 10 general purpose lanes and two barrier-separated HOV lanes. The HOV lanes are envisioned to be a two-way operation at all times.
- Build Alternative 4: 12-lane cross section from I-10 to FM 1960 consisting of 10 general purpose lanes and two non-barrier-separated HOV lanes. The HOV lanes are envisioned to be a two-way operation at all times.
- Build Alternative 5: 10-lane cross section from I-10 to Beltway 8 consisting of eight general purpose lanes and two barrier-separated HOV lanes. The HOV lanes are envisioned to be a two-way operation at all times.
- Build Alternative 6: 10-lane cross section from I-10 to Beltway 8 consisting of eight general purpose lanes and two non-barrier-separated HOV lanes. The HOV lanes are envisioned to be a two-way operation at all times.

An alternative that was not evaluated was changes in land use. The City of Houston has no zoning laws that could redirect or influence land use (residential land patterns, distribution of employment centers) to reduce existing and future congestion. This alternative would require implementation by and cooperation among multiple jurisdictions. The effects to traffic congestion of land use controls cannot be easily or accurately assessed for the project area or region at this time.

Based on the evaluation criteria used for the North-Hardy Corridor studies, the five Highway Build Alternatives listed above did not rank as high as Highway Build Alternative 2. The study identified Alternative 2 as the Draft Recommended Highway Alternative that consisted of a 12-lane cross section from I-10 to Beltway 8 with eight general purpose lanes and four managed lanes. It was not determined where the managed lane capacity would be implemented – on I-45, on Hardy Toll Road, or split between the two facilities. Note that Highway Build Alternatives 1–6 included improvements north to SH 242 in Montgomery County; details can be found in the North-Hardy Planning Studies Alternatives Analysis Report (Highway Component). This report is located on the project website and can be found at: http://ih45northandmore.com/documents.aspx.

Some of the recommendations from the North-Hardy Corridor studies were ultimately included in H-GAC's 2025 RTP project listing which included adding mainlanes and managed lanes, and reconstructing interchanges at various locations along I-45.

2.3 Further Development of Alternatives

TxDOT has considered a range of alternatives for the proposed project in accordance with 40 CFR 1502.14. A reasonable range of alternatives that would satisfy the identified need for and purpose of the proposed project was developed and evaluated. The alternatives included the No Build Alternative, which serves as a baseline against which the other alternatives (Build Alternatives) are compared.

The justification to carry forward the 2005 highway improvement recommendation to add four bi-directional managed lanes in the North-Hardy Corridor included:

1) At a minimum, a highway would need to continue providing the HOV/bus/transit operations that the existing HOV lane provides.
2) The 2005 study analyzed multiple improvement alternatives, including adding general purpose lanes in lieu of additional HOV/bus/transit lanes and the traffic analysis determined that the four-lane, bi-directional managed lanes that included HOV/bus/transit would provide the best congestion relief and options to current and future users. H-GAC modeling validated this.

As discussed in Section 1, several years later TxDOT was conducting a separate study regarding the Pierce Elevated (I-45) and US 59/I-69 roadway segments leading into/out of southeast Downtown. Based on the preliminary traffic analysis, TxDOT concluded that the Downtown Loop System essentially operates as one large interchange around Downtown Houston and that to fix the deficiencies of the I-45 (Pierce Elevated)/US 59/I-69 connection and accommodate the future traffic volumes, the entire Downtown Loop System of highways would need to be evaluated in one study. These conclusions were reached around 2010/2011. As such, when the study for the NHHIP was beginning in 2011, the separate study in the area of the I-45/US 59/I-69 interchange was stopped and the NHHIP study limits were proposed to include I-45, Hardy Toll Road, US 59/I-69 and I-10 in the Downtown area, and US 59/I-69 south of Downtown to SH 288. These study limits were documented in the NOI for the EIS and in the draft purpose and need statement for the project. Subsequently, the August 2014 I-45/Hardy Corridor Study update, which utilized the most current H-GAC travel demand model (2040 RTP) at that time, revalidated the need for highway improvements in the study area. Based on the updated traffic data, the effectiveness of alternatives in improving traffic and mobility conditions, as compared to the No Build scenario, was evaluated and showed that the 2005 study recommendation/findings to add four bi-directional managed lanes (2 each way) from Beltway 8 to I-10 was warranted to address congestion and improve mobility (TxDOT 2014a).

The project was divided into three analysis segments that reflect the distinct characteristics and functionality of specific segments of I-45 and Hardy Toll Road along the corridor (see Figure 1-3).

- From Beltway 8 North to I-610, I-45 functions as a traditional interstate and Hardy Toll Road functions as a barrier-separated toll facility. The improvement alternatives involved the addition of managed (MaX) lanes within the existing corridor (not a new alignment outside of the corridor).
- From I-610 to I-10, I-45 functions as an interstate. In this approximately two-mile-long segment, TxDOT was able to design the ROW to avoid the Hollywood Cemetery on the east side of I-45 and the Germantown Historic District on the west side of I-45 with a different approach to the engineering solutions to add the managed (MaX) lanes. As mentioned previously, this project assumes the Hardy Toll Road Extension to be in place from I-610 to I-10. Portions of the project have been constructed and it is expected that this extension will be completed by late 2024.

- From I-10 to SH 288 (south of Downtown), I-45 interfaces with two other interstates (I-10 and US 59/I-69) and an interstate type facility (SH 288) and thus functions as one large interchange around Downtown Houston. The proposed managed (MaX) lanes from the north (either on I-45 or Hardy Toll Road) would terminate Downtown. Developing engineering alternatives to accommodate the projected traffic volumes and to safely move drivers from I-45 or Hardy Toll Road to other highways in the Downtown area and to Downtown destinations required innovative engineering and traffic analysis. Additional detail on traffic operations in Segment 3 is described in Section 2.3.3.

The project study segments generally included:

- Segment 1: I-45 and Hardy Toll Road from Beltway 8 to I-610
- Segment 2: I-45 and future Hardy Toll Road from I-610 to I-10 (assumed Hardy Toll Road extension is completed)
- Segment 3: I-45 from I-10 to US 59/I-69, I-10 from I-45 to US 59/I-69, and US 59/I-69 from I-10 to I-45 (later termed the "Downtown Loop System"); and US 59/I-69 to SH 288.

Because traffic moves to/from each study segment from the adjacent segment, the analysis and development of alternatives considered the adjacent segments. The design for each segment affects the design of other segments because the proposed managed lanes are included in and extend from Beltway 8 (north end of Segment 1), through Segment 2, and into Segment 3, including the connectors from the managed lanes to Downtown streets.

The Study Team developed and evaluated alternatives using specific evaluation, or "screening," criteria during each step in the analysis. The evaluation methods become more detailed as the study progressed and the number of alternatives selected for further study is reduced. Table 2-1 shows the alternatives studied during the steps in the analysis, and Sections 2.3.1 – 2.3.6 provide details about the analyses.

Table 2-1: Alternatives Evaluation

Year	Alternative Group	Number of Build Alternatives	Evaluation Method	Result
2011–2012	Universe of Alternatives	Unlimited (full range of Reasonable Alternatives) (30 total)	Initial Screening Process	Six Preliminary Alternatives per segment
2012–2013	Preliminary Alternatives	Six per segment (18 total)	Secondary Screening Process	Three Reasonable Alternatives per segment
2013–2015	Reasonable Alternatives	Three per segment (9 total)	More Detailed Evaluation and Analyses	One Proposed Recommended Alternative per segment
2015–2017	Proposed Recommended Alternatives	One per segment	Draft EIS Analyses	Recommended Alternatives
2017–2020	Recommended Alternative	One per segment	Final EIS Analyses	Preferred Alternative and Record of Decision

2.3.1 UNIVERSE OF ALTERNATIVES

In November 2011, TxDOT presented information about the proposed project and the EIS process to the public and agencies at the first scoping meeting. The purpose of the meeting included soliciting input on the project Need and Purpose Statement and draft Agency Coordination and Public Involvement Plan and gathering information about the proposed project area. The EIS process and the proposed alternatives development and evaluation process were presented. Following the meeting, the Study Team analyzed the public and agency comments to determine the issues of interest and developed the initial alternatives evaluation criteria and a group of project alternatives called the "Universe of Alternatives," which included a full range of reasonable alternatives. The alternatives included:

- Segment 1: Alternatives 1–8
- Segment 2: Alternatives 1–15
- Segment 3: Alternatives 1–10

A summary description of the Universe of Alternatives is included in Figure 2-2, Figure 2-3, and Figure 2-4. Exhibits showing plan views and section views (also known as cross-sections or typical sections) are available on the NHHIP website, which will be maintained through the duration of the EIS process (http://ih45northandmore.com/scoping_documents2.aspx).

The evaluation of the alternatives was conducted independently for each segment. Each alternative for each segment was assigned a number, which was maintained through all steps of the alternatives analysis. Alternative 1 for each segment is the "No Build" Alternative, and advances for evaluation in the EIS. Alternative 2 for each segment is transportation systems management (TSM) upgrades. Each TSM alternative included consideration of both TSM and travel demand management (TDM). TSM and TDM are transportation policies, strategies, or projects aimed at reducing traffic congestion and improving roadway mobility without major capital expenditures to increase physical roadway traffic capacity.

Figure 2-2: Segment 1 – Initial Screening of Universe of Alternatives

North Houston Highway Improvement Project — UNIVERSE OF ALTERNATIVES - INITIAL SCREENING SEGMENT 1 — Alternatives Screening and Evaluation Matrix

			EVALUATION CRITERIA							
			Initial Screening of Universe of Alternatives							
				Engineering		Traffic	Environmental			
							Land Use and Cultural Resources within the Right-of-Way			
SEGMENT 1 BW 8 to IH 610	Alternative Type	Description	Meets Need and Purpose and Project Goals (Yes/No)	Meets Current Design Criteria (Yes/No)	Additional ROW - Cavalcade to Quitman (Yes/No)	Traffic/Mobility Improvements* (High/Medium/Low)	Community Parks (Yes/No)	Cemeteries (Yes/No)	National Register of Historic Places (Yes/No)	Recorded Archeological Sites (Yes/No)
Alternative 1	Existing Configuration	NO BUILD SCENARIO	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 2	TSM Upgrades	TRANSPORTATION SYSTEMS MANAGEMENT (TSM) PROJECTS	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 3	WIDEN EXISTING WITH ELEVATED MANAGED LANES	ADDITION OF DIRECT CONNECTOR FROM IH 45 TO HARDY TOLL ROAD THAT INCLUDES FOUR (4) MANAGED LANES. ALSO INCLUDES WIDENING OF HARDY TOLL ROAD TO PROVIDE ONE ADDITIONAL LANE INBOUND AND OUTBOUND.	Yes	Yes	N/A	Medium	No	No	No	No
Alternative 4	WIDEN EXISTING	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) MANAGED LANES. ADDITIONAL ROW WILL BE ACQUIRED ON WEST SIDE OF IH 45.	Yes	Yes	N/A	High	No	No	No	No
Alternative 5	WIDEN EXISTING	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) MANAGED LANES. ADDITIONAL ROW WILL BE ACQUIRED ON EAST SIDE OF IH 45.	Yes	Yes	N/A	High	No	No	No	No
Alternative 6	WIDEN EXISTING	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) MANAGED LANES. ADDITIONAL ROW WILL BE ACQUIRED ON BOTH SIDES OF IH 45.	Yes	Yes	N/A	High	No	No	No	No
Alternative 7	ELEVATED MANAGED LANES	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) ELEVATED MANAGED LANES ON A SINGLE STRUCTURE AT CENTER.	Yes	Yes	N/A	High	No	No	No	No
Alternative 8	ELEVATED MANAGED LANES	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) ELEVATED MANAGED LANES ON TWO (2) SEPARATE STRUCTURES ON LEFT AND RIGHT SIDES OF CENTERLINE.	Yes	Yes	N/A	High	No	No	No	No

Selected as Preliminary Alternative

Alternative 1, the "No Build" Alternative, will advance with the Build Alternatives through the process.

*Traffic/Mobility Improvements is a rating determined using outputs from the travel demand models. The model provides information on how many drivers will use the highway if improved, how this compares among various alternative improvements, and how many hours drivers can expect to save traveling on the highway if improved, also known as Vehicle-Hours Traveled (VHT).

Source: NHHIP Study Team, Initial Screening of Universe of Alternatives, October 2012

Figure 2-3: Segment 2 – Initial Screening of Universe of Alternatives

North Houston Highway Improvement Project — UNIVERSE OF ALTERNATIVES - INITIAL SCREENING SEGMENT 2 — Alternatives Screening and Evaluation Matrix

			EVALUATION CRITERIA							
			Initial Screening of Universe of Alternatives							
				Engineering		Traffic	Environmental			
							Land Use and Cultural Resources within the Right-of-Way			
SEGMENT 2 IH 610 to IH 10	Alternative Type	Description	Meets Need and Purpose and Project Goals (Yes/No)	Meets Current Design Criteria (Yes/No)	Additional ROW - Cavalcade to Quitman (Yes/No)	Traffic/Mobility Improvements* (High/Medium/Low)	Community Parks (Yes/No)	Cemeteries (Yes/No)	National Register of Historic Places (Yes/No)	Recorded Archeological Sites (Yes/No)
Alternative 1	Existing Configuration	NO BUILD SCENARIO	N/A	No	No	N/A	N/A	N/A	N/A	N/A
Alternative 2	TSM Upgrades	TRANSPORTATION SYSTEMS MANAGEMENT (TSM) PROJECTS	N/A	No	No	N/A	N/A	N/A	N/A	N/A
Alternative 3	Widen Existing	TWELVE (12) LANE SECTION - INCLUDES TEN (10) GENERAL PURPOSE LANES AND TWO (2) REVERSIBLE, SPECIAL PURPOSE LANES.	Yes	Yes	No	Medium	No	No	No	No
Alternative 4	Widen Existing	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) MANAGED LANES.	Yes	No	No	High	No	No	No	No
Alternative 5	Elevated HOT Lanes	TWELVE (12) LANE SECTION - INCLUDES TEN (10) GENERAL PURPOSE LANES AND TWO (2) ELEVATED HOT LANES.	No	Yes	No	Low	No	No	No	No
Alternative 6	Widen Existing	TWELVE (12) LANE SECTION - INCLUDES TEN (10) GENERAL PURPOSE LANES AND TWO (2) NON-BARRIER SEPARATED HOT LANES.	No	Yes	No	Low	No	No	No	No
Alternative 7	Widen Existing	TEN (10) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND TWO (2) BARRIER SEPARATED HOT LANES.	No	No	No	Low	No	No	No	No
Alternative 8	Widen Existing	TEN (10) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND TWO (2) NON-BARRIER SEPARATED HOT LANES.	No	Yes	No	Low	No	No	No	No
Alternative 9	Widen Existing	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND TWO (2) REVERSIBLE MANAGED LANES.	No	Yes	No	Low	No	No	No	No
Alternative 10	Widen Existing	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) MANAGED LANES.	Yes	Yes	No	High	No	No	No	No
Alternative 11	Widen Existing with Elevated Managed Lanes	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) ELEVATED MANAGED LANES ON A SINGLE STRUCTURE AT CENTER.	Yes	Yes	No	High	No	No	No	No
Alternative 12	Widen Existing with Elevated Managed Lanes	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) ELEVATED MANAGED LANES ON DOUBLE DECKER STRUCTURE AT CENTER.	Yes	Yes	No	High	No	No	No	No
Alternative 13	Widen Existing with Elevated Managed Lanes	TWELVE (12) LANE SECTION - INCLUDES EIGHT (8) GENERAL PURPOSE LANES AND FOUR (4) ELEVATED MANAGED LANES ON TWO (2) SEPARATE STRUCTURES ON LEFT AND RIGHT SIDES OF CENTERLINE.	No	Yes	No	High	No	No	No	No
Alternative 14	Add Tunnel to Existing	TUNNELED ROADWAY UNDERNEATH IH 45. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	No	High	No	No	No	No
Alternative 15	Add Direct Connector	ADDITION OF DIRECT CONNECTORS ALONG IH 610 CORRIDOR FROM IH 45 TO HARDY TOLL RD. INCLUDES FOUR (4) MANAGED LANES. THIS ALTERNATIVE ALSO INCLUDES WIDENING OF HARDY TOLL ROAD TO PROVIDE ONE ADDITIONAL LANE INBOUND AND OUTBOUND.	Yes	Yes	No	Medium	No	No	No	No

Selected as Preliminary Alternative

Alternative 1, the "No Build" Alternative, will advance with the Build Alternatives through the process.

*Traffic/Mobility Improvements is a rating determined using outputs from the travel demand models. The model provides information on how many drivers will use the highway if improved, how this compares among various alternative improvements, and how many hours drivers can expect to save traveling on the highway if improved, also known as Vehicle-Hours Traveled (VHT).

Source: NHHIP Study Team, Initial Screening of Universe of Alternatives, October 2012

Figure 2-4: Segment 3 – Initial Screening of Universe of Alternatives

North Houston Highway Improvement Project — UNIVERSE OF ALTERNATIVES - INITAL SCREENING SEGMENT 3 — Alternatives Screening and Evaluation Matrix

			EVALUATION CRITERIA							
			Initial Screening of Universe of Alternatives							
				Engineering		Traffic	Environmental			
							Land Use and Cultural Resources within the Right-of-Way			
SEGMENT 3 Downtown Loop System	Alternative Type	Description	Meets Need and Purpose and Project Goals (Yes/No)	Meets Current Design Criteria (Yes/No)	Additional ROW - Cavalcade to Quitman (Yes/No)	Traffic/Mobility Improvements* (High/Medium/Low)	Community Parks (Yes/No)	Cemeteries (Yes/No)	National Register of Historic Places (Yes/No)	Recorded Archeological Sites (Yes/No)
Alternative 1	Existing Configuration	NO BUILD SCENARIO	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 2	TSM Upgrades	TRANSPORTATION SYSTEMS MANAGEMENT (TSM) PROJECTS	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 3	Convert Downtown Loop to One Way Loop	CONVERT EXISTING DOWNTOWN LOOP ROADWAY NETWORK TO A ONE-WAY LOOP.	Yes	Yes	N/A	Medium	No	No	No	No
Alternative 4	Add Tunnel to Existing	TUNNELED ROADWAY UNDERNEATH LA BRANCH ST AND TERMINATES AT THE US 59/SH 288 INTERCHANGE. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	Medium	No	No	No	No
Alternative 5	Add Tunnel to Existing	TUNNELED ROADWAY UNDERNEATH IH 45, THEN CONTINUES UNDERNEATH BAGBY ST AND TERMINATES AT SPUR 527. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	Medium	No	No	No	No
Alternative 6	Add Tunnel to Existing	TUNNELED ROADWAY UNDERNEATH IH 45, THEN CONTINUES TO JEFFERSON ST AND TERMINATES AT IH 45 SOUTH OF THE IH 45/US 59 INTERCHANGE. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	Medium	No	No	No	No
Alternative 7	Add Tunnel to Existing	TUNNELED ROADWAY UNDERNEATH HOUSTON AVE AND SPLITS TO JEFFERSON ST AND BAGBY ST. TUNNEL TERMINATES AT IH 45 SOUTH OF THE IH 45/US 59 INTERCHANGE AND SPUR 527. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	High	No	No	No	No
Alternative 8	Elevated Managed Lanes	ELEVATED ROADWAY ALONG HOUSTON AVE AND TERMINATES AT IH 45 NEAR ALLEN PARKWAY. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	Low	No	No	No	No
Alternative 9	Add Tunnel to Existing	UTILIZES EXISTING IH 10 HOV BRIDGE INTO DOWNTOWN AND THEN BECOMES TUNNELED ROADWAY UNDERNEATH IH 45 AND JEFFERSON ST AND TERMINATES AT IH 45 SOUTH OF THE IH 45/US 59 INTERCHANGE. INCLUDES FOUR (4) MANAGED LANES.	Yes	Yes	N/A	Low	No	No	No	No
Alternative 10	Widen Existing	EIGHT (8) LANE SECTION FROM IH-10 TO IH 45/US 59 INTERCHANGE INCLUDES EIGHT (8) GENERAL PURPOSE LANES.	Yes	Yes	N/A	Medium	No	No	No	No

Selected as Preliminary Alternative

Alternative 1, the "No Build" Alternative, will advance with the Build Alternatives through the process.

*Traffic/Mobility Improvements is a rating determined using outputs from the travel demand models. The model provides information on how many drivers will use the highway if improved, how this compares among various alternative improvements, and how many hours drivers can expect to save traveling on the highway if improved, also known as Vehicle-Hours Traveled (VHT).

Source: NHHIP Study Team, Initial Screening of Universe of Alternatives, October 2012

The Initial Screening evaluation was conducted to reduce the Universe of Alternatives to six Preliminary Alternatives per segment for further analysis. The evaluation criteria for the Initial Screening was developed based on the project need and purpose, project goals, environmental constraints, and agency and public input from the first scoping meeting, and was based on preliminary data and best estimates based on the data and judgment of the Study Team. The alternatives were evaluated based on the following factors:

- Meets the need for the project, purpose of the project, and specific project goals: Yes or No
- Meets current design criteria: Yes or No
- Requires new ROW between Cavalcade Street and Quitman Street (not including at intersections): Yes or No
- Provides traffic/mobility improvements: High/Medium/Low. Rating is based on travel demand modeling and considers how many drivers will use the highway if improved, how this compares among the alternatives, and how many hours drivers can expect to save traveling on the highway if improved. High is the best rating
- Impacts community parks, cemeteries, historic properties currently listed on the National Register of Historic Places (NRHP), or recorded archeological sites (due to ROW acquisition): Yes or No

The results of the analysis of the Universe of Alternatives are shown in Figure 2-2, Figure 2-3, and Figure 2-4. The N/A and NA in all evaluation matrices included in Section 2 means that the alternative cannot be evaluated with subject screening criteria. From this evaluation, the Study Team identified for further study the six alternatives for each segment that appeared to best meet the evaluation criteria; these were named "Preliminary Alternatives." Reasons for the elimination of the other alternatives are:

- TSM projects (Alternative 2 for each segment) would not improve the design of I-45 and, therefore, I-45 would not meet current roadway design criteria. TSM, which included TDM strategies as discussed above, would not suffice as stand-alone alternatives but are included as components of all of the Build Alternatives. TSM and TDM are typically low-cost strategies that include improvements such as ramp metering, variable message signs, promoting carpooling and working from home to reduce congestion on facilities, and other various techniques to help manage congestion and improve safety.
- For Segment 1, the Study Team evaluated six alternatives (Alternatives 3–8) which included widening the existing facility with elevated managed lanes, widening the existing facility (on the west side, on the east side, and on both sides), and elevated managed lanes (in the center and to the left and right of the center). All six of these alternatives were selected as Preliminary Alternatives.
- For Segment 2, the Study Team evaluated five alternatives (Alternatives 5–9) that had only two managed lanes, to assess whether these would provide desired mobility improvements. This concept was an alternative from the North-Hardy Planning Studies. These five alternatives did not provide the recommended number of managed lanes (four) and achieved the lowest rating for the "Traffic/Mobility Improvements" evaluation criterion. Alternative 4

did not meet current project design criteria, because the alternative could not provide sufficient shoulder widths for I-45 mainlanes. Alternative 13 did not meet the project need and purpose and project goals because the proposed elevated lanes were in close proximity to residential neighborhoods.

- For Segment 3, Alternatives 8 and 9 achieved the lowest rating for the "Traffic/Mobility Improvements" evaluation criteria. In addition, the proposed elevated roadway for Alternative 8 would be very close to existing residential properties.

The selected Preliminary Alternatives (not including the No Build Alternative) were:

- Segment 1: Alternatives 3, 4, 5, 6, 7, 8
- Segment 2: Alternatives 3, 10, 11, 12, 14, 15
- Segment 3: Alternatives 3, 4, 5, 6, 7, 10

The results of the Initial Screening of the Universe of Alternatives were presented to agencies and the public in October 2012 at the second scoping meeting. Engineering and traffic evaluations for alternatives are summarized in the *North Houston Highway Improvement Project Alternatives Analysis: Engineering and Traffic Criteria Report* (TxDOT 2018c).

2.3.2 PRELIMINARY ALTERNATIVES

The Preliminary Alternatives selected in October 2012 underwent further development and additional analysis during the secondary screening evaluation. The alternatives were modified, where possible, to avoid and/or minimize adverse impacts to existing development and community resources (e.g., parks and cemeteries), and to improve traffic flow or connectivity with other alternatives. The evaluation process resulted in additional changes to the alternatives, which are described below:

- During the evaluation process, three design options for Segment 1, Alternative 3 (which included widening of Hardy Toll Road) were developed. These options were varied configurations of connectors along Beltway 8 from I-45 to Hardy Toll Road.
- As the Segment 3 tunnel alternatives (Alternatives 4–7) were compared with other non-tunnel alternatives, the tunnel alternatives did not rate as favorably as the non-tunnel alternatives. The non-favorable ratings were due to limited shoulder widths, lower speeds, challenging incident management issues, and the complexity of tunnel construction compared with traditional roadway construction. In addition, the operational and maintenance requirements for tunnels were more complex than for a traditional roadway. As a result, the tunnel alternatives had "Undesirable" ratings in one or more of the traffic evaluation criteria when compared to the non-tunnel alternatives. The Segment 2 tunnel alternative (Alternative 14) generally rated well from a traffic perspective when evaluated as a stand-alone section. The tunnel would allow for effective use of the proposed managed lanes along I-45, reduce traffic on I-45 by between 10,000 to 33,000 vehicles daily, and reduce the volume-to-capacity ratio along the I-45 mainlanes by up to 14 percent. However, the Segment 3 tunnel alternatives did not perform as well in the traffic evaluation criteria. One of the tunnel alternatives resulted in increased traffic and travel time on I-45, thereby negatively

impacting mobility as compared to the other alternatives. From a traffic perspective, Segments 2 and 3 were evaluated together because the tunnel would extend into both segments and could not terminate at I-10. For this analysis, both tunnel alternatives rated as "Undesirable" for one or more of the traffic evaluation criteria. As a result, all Segment 2 and Segment 3 tunnel alternatives were eliminated during the secondary screening evaluation (TxDOT 2018c).

- Based on additional and more detailed traffic analyses for the Segment 3 alternatives, the Study Team found that widening the existing I-45 in the Downtown Houston area would increase roadway capacity and improve traffic flow; however, other alternatives involving the possible realignment of I-45 may provide a greater improvement in traffic mobility. Additional evaluation of the "Downtown Loop" (I-45, I-10, and US 59/I-69) system and additional outreach with project stakeholders were conducted and two new alternatives were developed by the Study Team.
  - Alternative 11 included the realignment of both northbound and southbound I-45, to be adjacent to US 59/I-69 on the east side of Downtown, and along/within the I-10 alignment on the north side of Downtown.
  - Alternative 12 included the realignment of northbound I-45 to be adjacent to US 59/I-69 on the east side of Downtown, with southbound I-45 being located on the west and south sides of Downtown.

The resulting Preliminary Alternatives (including the No Build Alternative) included:

- Segment 1: Alternatives 1, 3 (with Options 1–3), 4, 5, 6, 7, 8
- Segment 2: Alternatives 1, 3, 10, 11, 12, 14, 15
- Segment 3: Alternatives 1, 3, 5, 6, 10, 11, 12

A summary description of the Preliminary Alternatives that were evaluated in more detail is included in Figure 2-5, Figure 2-6, and Figure 2-7.

Figure 2-5: Segment 1 — Secondary Screening of Preliminary Alternatives

SEGMENT 1

Secondary Screening Process of Preliminary Alternatives

Segment 1 BW8 to I-610	Alternative Type	Description	Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Engineering: Constructability (Undesirable/Desirable/Neutral)	Engineering: Functionality Requirements (Undesirable/Desirable/Neutral)	Engineering: Operations and Maintenance (Undesirable/Desirable/Neutral)	Traffic: Managed Lane Utilization - *Along New Managed Lane Facility* (Undesirable/Desirable/Neutral)	Traffic: Travel Demand - *Along I-45* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along I-45* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along Study Area Freeway System* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along Downtown Street System* (Undesirable/Desirable/Neutral)	Traffic: Volume-to-Capacity Ratio - *Along I-45* (Undesirable/Desirable/Neutral)	Environmental: Land Use: Community Parks (Yes/No)	Land Use: Cemeteries (Yes/No)	Land Use: Commercial (acres)	Land Use: Residential (acres)	Land Use: Industrial (acres)	Land Use: Public Use Areas (acres)	Land Use: Other (acres)	Land Use: Total Additional ROW (acres)	Cultural Resources: National Register of Historic Places (number)	Cultural Resources: Recorded Archeological Sites (Yes/No)	Cultural Resources: Archeological High Probability Areas (acres)	Natural Resources: Flooding: Floodway (acres)	Natural Resources: Flooding: 100-Year Floodplain (acres)	Natural Resources: Flooding: Detention Basins (acres)	Natural Resources: Wildlife: Threatened & Endangered Species Habitat (Yes/No)	Natural Resources: Wetlands (acres)	Natural Resources: Streams (linear feet)	Noise: Noise Impacts (number)	Socioeconomics: Residential Parcel Impacts (number)	Socioeconomics: Commercial Parcel Impacts (number)	Socioeconomics: Churches (number)	Socioeconomics: Schools (number)	Socioeconomics: Visual Impacts (Undesirable/Desirable/Neutral)	Socioeconomics: Adverse Changes in Community Cohesion (Parks, Schools, Churches - Yes/No)	Socioeconomics: Environmental Justice (Yes/No)	HazMat: Superfund Sites (number)
Alternative 1	Existing Configuration	No Build Scenario (Project Not Constructed)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 3 Option 1	Widen existing with elevated managed lanes	Addition of direct connector from I-45 to Hardy Toll Road that includes four (4) managed lanes; also includes widening of Hardy Toll Road to provide one additional lane inbound and outbound	Yes	No	U	N	N	U	N	N	N	NA	N	Yes	No	46	12	3	2	2	65	0	No	No	<1	<1	0	No	0	0	197	115	145	1	1	U	Yes	Yes	0
Alternative 3 Option 2	Widen existing with elevated managed lanes	Addition of direct connector from I-45 to Hardy Toll Road that includes four (4) managed lanes; also includes widening of Hardy Toll Road to provide one additional lane inbound and outbound	Yes	No	U	N	N	U	N	N	N	NA	N	Yes	No	46	12	3	2	2	65	0	No	No	<1	15	0	No	0	0	197	115	132	1	1	U	Yes	Yes	0
Alternative 3 Option 3	Widen existing with elevated managed lanes	Addition of direct connector from I-45 to Hardy Toll Road that includes four (4) managed lanes; also includes widening of Hardy Toll Road to provide one additional lane inbound and outbound	Yes	No	U	N	N	U	N	N	N	NA	N	Yes	No	46	12	3	2	2	65	0	No	No	<1	6	0	No	0	0	197	115	160	1	1	U	Yes	Yes	0
Alternative 4	Widen existing	Twelve (12) lane section - includes eight (8) general purpose lanes and four (4) managed lanes; additional ROW will be acquired on the west side of I-45	Yes	No	D	D	D	D	D	D	D	NA	D	No	No	166	12	<1	5	2	186	0	No	No	6	73	0	No	<1	0	102	55	212	0	0	U	No	Yes	0
Alternative 5	Widen existing	Twelve (12) lane section - includes eight (8) general purpose lanes and four (4) managed lanes; additional ROW will be acquired on the east side of I-45	Yes	No	D	D	D	D	D	D	D	NA	D	No	No	168	11	<1	13	2	195	0	No	No	3	47	0	No	0	0	146	87	223	1	1	U	Yes	Yes	0
Alternative 6	Widen existing	Twelve (12) lane section - includes eight (8) general purpose lanes and four (4) managed lanes; additional ROW will be acquired on both sides of I-45	Yes	No	D	D	D	D	D	D	D	NA	D	No	No	161	9	<1	8	2	181	0	No	No	2	59	0	No	0	0	98	62	285	1	1	U	Yes	Yes	0
Alternative 7	Elevated managed lanes	Twelve (12) lane section - includes eight (8) general purpose lanes and four (4) elevated managed lanes on a single structure at center	Yes	No	D	D	D	D	D	D	D	NA	D	No	No	115	8	<1	5	2	131	0	No	No	0	0	0	No	0	0	92	56	275	1	1	U	Yes	Yes	0
Alternative 8	Elevated managed lanes	Twelve (12) lane section - includes eight (8) general purpose lanes and four (4) elevated managed lanes on two separate structures on left and right sides of the centerline	Yes	No	D	D	D	D	D	D	D	NA	D	No	No	206	13	<1	9	2	231	0	No	No	0	0	0	No	<1	0	121	86	267	1	1	U	Yes	Yes	0

IDENTIFIED REASONABLE ALTERNATIVE

DESIRABLE

UNDESIRABLE

NEUTRAL

Source: NHHIP Study Team, Secondary Screening of Preliminary Alternatives, December 2013

Figure 2-6: Segment 2 — Secondary Screening of Preliminary Alternatives

SEGMENT 2

EVALUATION CRITERIA

Secondary Screening Process of Preliminary Alternatives

					Engineering			Traffic						Environmental																									
														Land Use								Cultural Resources			Natural Resources						Noise	Socioeconomics							HazMat
																									Flooding			Wildlife	Wetlands	Streams									
SEGMENT 2 I-610 to I-10	**Alternative Type**	**Description**	Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Constructability (Undesirable/Desirable/Neutral)	Functionality Requirements (Undesirable/Desirable/Neutral)	Operations and Maintenance (Undesirable/Desirable/Neutral)	Managed Lane Utilization - *Along New Managed Lane Facility* (Undesirable/Desirable/Neutral)	Travel Demand - *Along I-45* (Undesirable/Desirable/Neutral)	Vehicle Hours Traveled - *Along I-45* (Undesirable/Desirable/Neutral)	Vehicle Hours Traveled - *Along Study Area Freeway System* (Undesirable/Desirable/Neutral)	Vehicle Hours Traveled - *Along Downtown Street System* (Undesirable/Desirable/Neutral)	Volume-to-Capacity Ratio - *Along I-45* (Undesirable/Desirable/Neutral)	Community Parks (Yes/No)	Cemeteries (Yes/No)	Commercial (acres)	Residential (acres)	Industrial (acres)	Public Use Areas (acres)	Other (acres)	Total Additional ROW (acres)	National Register of Historic Places (number)	Recorded Archeological Sites (Yes/No)	Archeological High Probability Areas (acres)	Floodway (acres)	100-Year Floodplain (acres)	Detention Basins (acres)	Threatened & Endangered Species Habitat (Yes/No)	Wetlands (acres)	Streams (linear feet)	Noise Impacts (number)	Residential Parcel Impacts (number)	Commercial Parcel Impacts (number)	Churches (number)	Schools (number)	Visual Impacts (Undesirable/Desirable/Neutral)	Adverse Changes in Community Cohesion (Parks, Schools, Churches - Yes/No)	Environmental Justice (Yes/No)	Superfund Sites (number)
Alternative 1	Existing Configuration	No Build Scenario (Project Not Constructed)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 3	Widen Existing	Twelve (12) lane section; includes ten (10) general purpose lanes and two (2) reversible, special purpose lanes	Yes	No	D	U	N	U	U	U	U	NA	U	No	No	6	2	0	0	<1	9	0	No	No	<1	4	0	No	0	0	215	25	19	0	0	U	No	Yes	0
Alternative 10	Widen Existing	Twelve (12) lane section; includes eight (8) general purpose lanes and four (4) managed lanes	Yes	Yes	D	N	N	D	D	D	D	NA	D	No	No	6	2	0	0	<1	9	0	No	No	<1	4	0	No	0	0	215	25	19	0	0	U	No	Yes	0
Alternative 11	Widen Existing with Elevated Managed Lanes	Twelve (12) lane section; includes eight (8) general purpose lanes and four (4) elevated managed lanes on a single structure at the center of the roadway	Yes	No	D	N	D	D	D	D	D	NA	D	No	No	6	2	0	0	<1	9	0	No	No	<1	4	0	No	0	0	215	25	19	0	0	U	No	Yes	0
Alternative 12	Widen Existing with Elevated Managed Lanes	Twelve (12) lane section; includes eight (8) general purpose lanes and four (4) elevated managed lanes on a double decker structure at the center of the roadway	Yes	No	D	N	N	D	D	D	D	NA	D	No	No	6	2	0	0	<1	9	0	No	No	<1	4	0	No	0	0	214	25	19	0	0	U	No	Yes	0
Alternative 14	Add Tunnel to Existing	Tunneled roadway underneath I-45; includes four (4) managed lanes	Yes	No	U	U	U	D	D	D	D	NA	D	No	No	9	3	0	0	<1	13	0	No	Yes	<1	4	0	No	0	0	0	37	31	0	0	D	No	Yes	0
Alternative 15	Add Direct Connector	Addition of direct connectors along the I-610 corridor from I-45 to Hardy Toll Road; includes four (4) managed lanes; this alternative also includes widening of Hardy Toll Road to provide one additional lane inbound and outbound	Yes	No	N	N	D	U	N	N	N	NA	N	No	No	7	4	0	<1	<1	13	0	No	No	<1	4	0	No	0	0	224	38	32	0	0	U	No	Yes	2

IDENTIFIED REASONABLE ALTERNATIVE

DESIRABLE

UNDESIRABLE

NEUTRAL

Source: NHHIP Study Team, Secondary Screening of Preliminary Alternatives, December 2013

Figure 2-7: Segment 3 — Secondary Screening of Preliminary Alternatives

SEGMENT 3

EVALUATION CRITERIA

Secondary Screening Process of Preliminary Alternatives

SEGMENT 3 Downtown Loop	Alternative Type	Description	Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Engineering: Constructability (Undesirable/Desirable/Neutral)	Engineering: Functionality Requirements (Undesirable/Desirable/Neutral)	Engineering: Operations and Maintenance (Undesirable/Desirable/Neutral)	Traffic: Managed Lane Utilization - *Along New Managed Lane Facility* (Undesirable/Desirable/Neutral)	Traffic: Travel Demand - *Along I-45* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along I-45* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along Study Area Freeway System* (Undesirable/Desirable/Neutral)	Traffic: Vehicle Hours Traveled - *Along Downtown Street System* (Undesirable/Desirable/Neutral)	Traffic: Volume-to-Capacity Ratio - *Along I-45* (Undesirable/Desirable/Neutral)	Environmental – Land Use: Community Parks (Yes/No)	Land Use: Cemeteries (Yes/No)	Land Use: Commercial (acres)	Land Use: Residential (acres)	Land Use: Industrial (acres)	Land Use: Public Use Areas (acres)	Land Use: Other (acres)	Land Use: Total Additional ROW (acres)	Cultural Resources: National Register of Historic Places (number)	Cultural Resources: Recorded Archeological Sites (Yes/No)	Cultural Resources: Archeological High Probability Areas (acres)	Natural Resources – Flooding: Floodway (acres)	Flooding: 100-Year Floodplain (acres)	Flooding: Detention Basins (acres)	Wildlife: Threatened & Endangered Species Habitat (Yes/No)	Wetlands: Wetlands (acres)	Streams: Streams (linear feet)	Noise: Noise Impacts (number)	Socioeconomics: Residential Parcel Impacts (number)	Socioeconomics: Commercial Parcel Impacts (number)	Socioeconomics: Churches (number)	Socioeconomics: Schools (number)	Socioeconomics: Visual Impacts (Undesirable/Desirable/Neutral)	Socioeconomics: Adverse Changes in Community Cohesion (Parks, Schools, Churches - Yes/No)	Socioeconomics: Environmental Justice (Yes/No)	HazMat: Superfund Sites (number)
Alternative 1	Existing Configuration	No Build Scenario (Project Not Constructed)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 3	Convert Downtown Loop to One Way Loop	Convert existing downtown loop roadway network to a one-way loop	Yes	No	N	U	N	NA	NA	U	D	U	D	No	No	7	<1	2	1	3	14	0	Yes	No	<1	1	0	No	0	0	526	8	47	0	0	U	No	Yes	2
Alternative 5	Add Tunnel to Existing	Tunneled roadway underneath I-45, continues underneath Bagby Street and ends at Spur 527; includes four (4) managed lanes	Yes	No	U	N	U	NA	NA	U	N	N	U	No	No	0	0	0	0	0	0	0	No	Yes	0	0	0	No	0	0	0	1	0	0	0	D	No	Yes	0
Alternative 6	Add Tunnel to Existing	Tunneled roadway underneath I-45,continues to Jefferson Street and ends at I-45, south of the I-45/US 59 interchange; includes four (4) managed lanes	Yes	No	U	U	U	NA	NA	U	D	N	D	No	No	<1	<1	0	0	<1	<1	0	No	Yes	0	0	0	No	0	0	0	0	10	0	0	D	No	Yes	1
Alternative 10	Widen Existing	Eight (8) lane section from I-10 to I-45/US 59 interchange; includes eight (8) general purpose lanes	Yes	No	N	N	N	NA	NA	N	D	N	N	Yes	No	4	0	0	1	1	6	0	No	No	2	2	0	No	<1	166	518	4	18	0	0	U	No	Yes	0
Alternative 11	Realignment of I-45	Realign I-45 Northbound and Southbound lanes to the east and place along US 59, existing I-45 North to be converted into a parkway/boulevard for downtown access	Yes	Yes	U	N	N	NA	NA	D	D	U	D	No	No	19	5	1	2	3	30	0	No	Yes	0	0	0	No	0	0	519	7	46	0	0	D	No	Yes	0
Alternative 12	Convert Downtown Loop to One Way Loop - Hybrid	Realign I-45 Northbound lanes to the east and place along US 59, while maintaining two-directional flow on both I-10 and US 59	Yes	No	D	N	N	NA	NA	N	D	D	D	No	No	5	1	1	1	1	9	0	No	Yes	0	0	0	No	0	0	518	5	29	0	0	N	No	Yes	0

IDENTIFIED REASONABLE ALTERNATIVE

DESIRABLE

UNDESIRABLE

NEUTRAL

Source: NHHIP Study Team, Secondary Screening of Preliminary Alternatives, December 2013

The secondary screening evaluation was conducted to reduce the Preliminary Alternatives to three Reasonable Alternatives per segment for further analysis. The evaluation criteria for the secondary screening was developed based on the project need and purpose, project goals, engineering and traffic considerations, environmental constraints, and agency and public input from the second scoping meeting. The evaluation of the alternatives was based on preliminary data and best estimates, including limited field investigation, and included the following criteria:

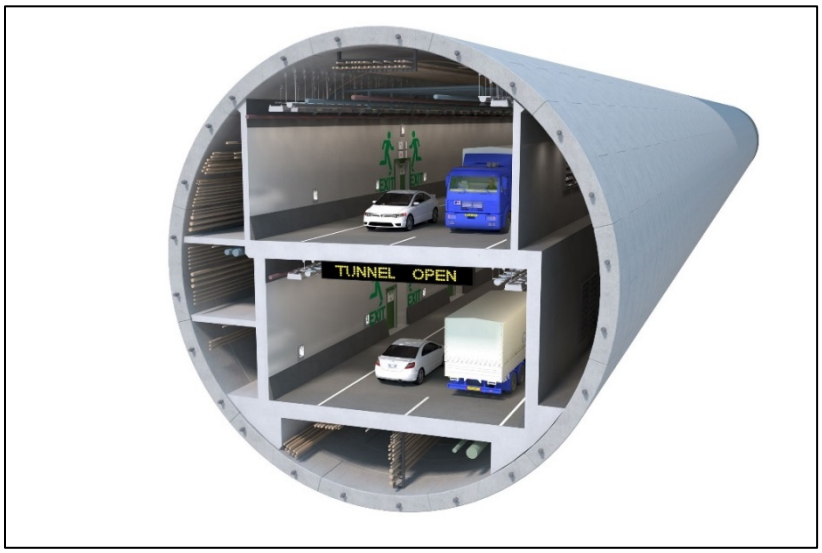
- Meets need for the project, purpose of the project, and specific project goals: Yes or No
- Has potential to be a "Signature Project": Yes or No
  - There is an opportunity to implement "signature" bridges to signify and distinguish various neighborhoods and districts within the study corridor, while improving the visual qualities of the project.
- Engineering: Desirable/Undesirable/Neutral, based on qualitative assessment.
  - Constructability: Construction duration, contractor availability, construction risk, construction staging/sequencing complexity, permanent ROW acquisition, utility relocation, and long-term geotechnical risk.
  - Functionality Requirements: Design life expectancy, design criteria limitations, opportunity for future expansion, and incident management (related to design factors).
  - Operations and Maintenance: Traffic and systems control, incident management (operations), maintenance requirements, and incident recovery (recovery time).
- Traffic: Desirable/Undesirable/Neutral, based on initial assessment of the potential for each alternative to improve traffic conditions in the project area. The evaluation criteria include:
  - Managed lane utilization – represents the utilization of managed lanes based on travel demand and capacity. If the added capacity is underutilized, then capacity exceeds demand. If the added capacity is over-utilized, then demand exceeds capacity.
  - Travel demand along I-45 – represents the level of travel demand on the I-45 mainlanes and measures the collective distance that all drivers travel. When the number of vehicles on a roadway segment begins to reach capacity of that particular segment, congestion occurs and travel time increases.
  - Vehicle hours traveled along I-45, the study area freeway system, and the Downtown street system, as applicable – represents the total amount of travel time in hours that motorists spend traveling in their vehicles.
  - Volume-to-capacity ratio along I-45 – represents the level of congestion. Congested roadway segments are those where the volume-to-capacity ratio is equal or greater than 0.87.
- Environmental: Where a numeric evaluation is listed for the factors below, it does not indicate an absolute measure of the project impact, but is a preliminary measure of potential impact, and was used for assessing differences among the alternatives. At this point in the alternatives evaluation process, the environmental analysis was based on available data, with limited field investigation.

- Impacts to community parks or cemeteries (due to new ROW): Yes or No
- Impacts to existing land uses (due to new ROW): Acres
- Impacts to cultural resources (due to new ROW)
  - Properties listed on the NRHP: Number
  - Recorded Archeological Sites: Yes or No
  - Archeological High Probability Areas: Acres
- Impacts to natural resources
  - Encroachment on the regulatory floodway and 100-year floodplain, and existing detention basins (due to new ROW): Acres
  - Threatened or endangered species habitat within proposed ROW: Yes or No
  - Wetlands within new ROW: Acres
  - Streams within new ROW: Linear feet
- Traffic noise impacts: Total number of residential, charitable, religious, and cemetery parcels abutting the proposed or existing ROW
- Socioeconomics. Note: the parcels (properties) noted below are based on Harris County Appraisal District records.
  - Residential: number of parcels within proposed ROW
  - Commercial: number of parcels within proposed ROW
  - Churches: number within proposed ROW
  - Schools: number within proposed ROW
  - Visual Impacts: Desirable/Undesirable/Neutral
    - Elevated to elevated = Neutral
    - Elevated to at-grade = Desirable
    - At-grade to elevated = Undesirable
    - Tunnel = Desirable
    - Widening
      - With new ROW = Undesirable
      - Without new ROW = Neutral
  - Impacts to Specific Community Facilities. Impacts to parcels with churches, schools, or parks (due to new ROW): Yes or No
  - Environmental Justice (EJ). New ROW is in an EJ area: Yes or No
- Hazardous Materials Superfund Sites within one mile of project ROW: Number

The results of the analysis of the Preliminary Alternatives are shown in Figure 2-5, Figure 2-6, and Figure 2-7. From this evaluation, the Study Team identified the three alternatives for each segment that appeared to best meet the evaluation criteria; these were named the "Reasonable Alternatives." The primary reasons for the elimination of some of the Preliminary Alternatives are:

- Segment 1, Alternative 3, Options 1–3 did not score well for the traffic criteria evaluation because traffic modeling predicted that users would not divert from I-45 to access the Hardy Toll Road north of I-610. One of the alternatives studied included a direct connection between I-45 and the Hardy Toll Road along Beltway 8 and I-610. Traffic modeling showed the Beltway 8 connector would be used at only 30 percent or less of its capacity and the I-610 connector would be used at only 55 percent or less. In contrast, the managed lanes alternatives along I-45 showed significantly higher use – from 73 to 85 percent higher – than on the Hardy Toll Road.
- In addition, insufficient traffic would be diverted to the Hardy Toll Road to improve mobility and reduce congestion on I-45, as compared to other alternatives. The Hardy Toll Road alternatives would divert less than 3,500 vehicles daily from I-45 between Beltway 8 and I-610, whereas the other alternatives would divert 16,000 to 22,000 vehicles per day. From I-610 to I-10, the Hardy Toll Road alternatives would reduce I-45 traffic by about 10,000 vehicles daily, but other alternatives would reduce I-45 traffic by as much as 33,000 vehicles per day.
- Options 1–3 would directly impact one park; the other Build Alternatives would not affect a park.
- Segment 1, Alternative 6 proposed at-grade managed lanes with new ROW acquisition on both the east and west sides of I-45. Alternative 7 proposed elevated managed lanes, also with new ROW on both the east and west sides of I-45. Alternative 6 would require approximately 184 acres of new ROW, as compared to approximately 136 acres of new ROW for Alternative 7, which would result in Alternative 6 impacting more residential and commercial properties.
- Segment 1, Alternative 8 proposed four elevated managed lanes on a structure, as did Alternative 7. Both achieved desirable ratings for the traffic and engineering evaluation. However, Alternative 8 would require approximately 234 acres of new ROW, as compared to approximately 136 acres of new ROW for Alternative 7, which would result in Alternative 8 impacting more residential and commercial properties.
- Segment 2, Alternative 3 had undesirable ratings for some of the engineering criteria and all of the applicable traffic evaluation criteria.
- Segment 2, Alternative 14 had undesirable ratings for all of the engineering evaluation criteria. The proposed tunnel used for this alternative is based on the largest diameter deep-bored tunnel in the world today (Figure 2-8). However, due to its limitations, the tunnel could only carry four lanes of traffic (two lanes each direction) and could not be expanded to carry more lanes in the future. Also, due to the limitation in diameter, the tunnel would introduce safety issues such as reduced shoulder widths (2 feet versus 10 feet desirable) and reduced vertical clearances.

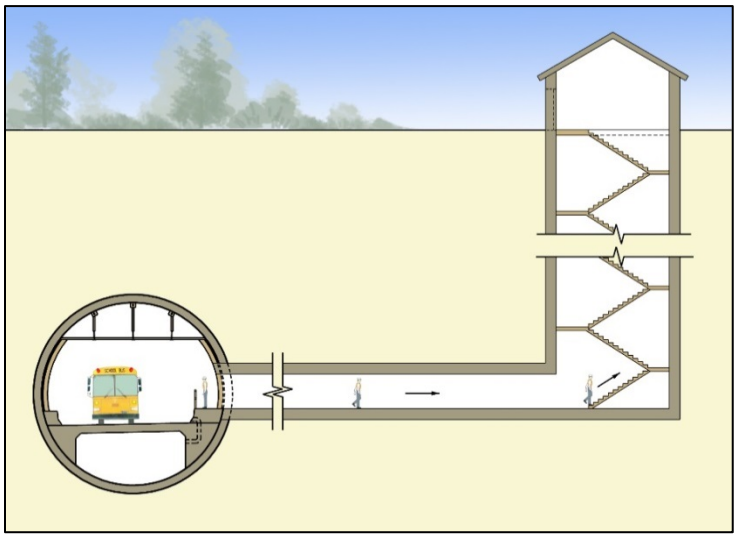
Figure 2-8: Tunnel Concept for Alaskan Way Viaduct



Source: NHHIP Study Team

- Another factor that resulted in the tunnel being dropped from further consideration was the length of the tunnel. This tunnel would connect to the tunnel alternatives in Segment 3 (Alternatives 5 and 6), creating a tunnel over two miles in length. This would create operational deficiencies such as increased incident management, emergency response times, and constructability issues related to drainage, ventilation, and available ROW for emergency egress points because the tunnels would be at least 60 feet below the ground surface (Figure 2-9).

Figure 2-9: Cross Section of Tunnel Concept for Alaskan Way Viaduct



Source: NHHIP Study Team

- Segment 2, Alternative 15 had neutral or undesirable ratings for almost all of the engineering and traffic evaluation criteria.
- Segment 3, Alternatives 3, 5, and 6 had undesirable or neutral ratings for most of the engineering evaluation criteria, and undesirable or neutral ratings for many of the traffic evaluation criteria. Alternatives 5 and 6 were eliminated for the same reasons described above for the Segment 2 tunnel alternatives. The other Segment 3 alternatives had primarily desirable and neutral ratings for the engineering and traffic evaluation criteria, and similar ROW requirements.

The selected Reasonable Alternatives (not including the No Build Alternative) included:

- Segment 1: Alternatives 4, 5, 7
- Segment 2: Alternatives 10, 11, 12
- Segment 3: Alternatives 10, 11, 12

The results of the secondary screening of the Preliminary Alternatives and the selected Reasonable Alternatives were presented in November 2013 to agencies and the public at the third public and agency meetings. Exhibits showing plan views and section views are available on the NHHIP website, which will be maintained through the duration of the EIS process (http://ih45northandmore.com/scoping_documents3.aspx).

2.3.3 REASONABLE ALTERNATIVES

The Reasonable Alternatives and the reasons for their selection were presented at the third public and agency meetings on November 13, 14, and 19, 2013. With input from the meetings, other comments received, and additional coordination with agencies, groups, the public, and other interested stakeholders, the Reasonable Alternatives underwent further development and additional evaluation. The alternatives were modified, where possible, to avoid and/or minimize adverse impacts to cultural, natural, social and economic resources, and hazardous materials. For Segments 1 and 2, there were minor design modifications to the Reasonable Alternatives.

For Segment 3, the three-interstate Downtown freeway system functions as one large interchange between I-10 and US 59/I-69/SH 288. Of the three fully directional interchanges in the Downtown system, traffic studies showed that the I-45/US 59/I-69/SH 288 interchange south of Downtown is the primary reason for the daily congestion experienced on the entire Downtown system. Over 50 percent of the traffic passing through Downtown from the north side on I-45 desires to go to the US 59/I-69 compared to SH 288 or continue onto I-45; 70 percent of drivers entering Downtown on US 59/I-69 want to continue along US 59/I-69. The existing configuration of I-45/US 59/I-69/SH 288 interchange requires drivers traveling south on US 59/I-69 from the north side of Downtown to weave over at least one lane and quickly merge with drivers coming from I-45. This is replicated on the US 59/I-69 northbound approach to the I-45/US 59/I-69 interchange.

Therefore, the major focus of the design modifications and changes to anticipated ROW requirements for the Reasonable Alternatives focused on how to address the I-45/US 59/I-69/SH 288 interchange. Through

previous studies, the Study Team determined that the daily congestion in the section of US 59/I-69 between Spur 527 and the I-45/US 59/I-69/SH 288 interchange could not be improved without switching the physical locations of US 59/I-69 and SH 288 between I-45 and SH 288.

The only way to accomplish this and maintain existing local and freeway-to-freeway access was to place all freeways as close to the same level as possible between Spur 527/SH 288 and I-45/Congress Avenue to create a continuous depressed section. This in turn required I-45 to be rerouted to the northern and eastern sides of Downtown so it could follow US 59/I-69 and create an improved I-45/US 59/I-69 interchange which would improve traffic as well as reducing, and in many cases eliminating, problematic weaving maneuvers.

Design modifications and proposed ROW changes were made to Alternative 11. These modifications included depressing I-45/US 59/I-69 in the vicinity of the George R. Brown Convention Center; shifting the proposed coincidental alignment of I-10 and I-45 to improve roadway geometry, thereby improving safety and traffic flow; adding a capped section or potential open space (both would be developed by others) over I-45 and US 59/I-69 in the vicinity of the George R. Brown Convention Center; and revising the project limits to include the portion of US 59/I-69 from the interchange with I-45 to Spur 527. The extension of the project limits to Spur 527 was necessary to transition the proposed depressed lanes of US 59/I-69 continuing south of Downtown Houston to the existing US 59/I-69 depressed lanes near Spur 527.

The Study Team evaluated design options for the US 59/I-69 at Spur 527 connections to include a future depressed roadway section for Spur 527 that the traffic study estimated would shift 10 percent of the traffic off I-69 to directly access their Downtown destination. Implementing this depressed section would require adjustments to the Spur 527/Richmond Street overpass. Due to additional proposed modifications to US 59/I-69, the concept of a depressed roadway section for Spur 527 was eliminated from further consideration in this study (TxDOT 2014a).

I-10 express lanes would be part of all Segment 3 alternatives and would separate through traffic from Downtown-destined traffic, which would improve traffic flow and safety. The I-10 express lanes would allow drivers to continue on I-10 through Downtown without interacting with local access traffic.

Further refinements to the design and evaluation of the proposed alternatives resulted in the selection of the Reasonable Alternatives listed below:

- Segment 1: Alternatives 4, 5, 7
- Segment 2: Alternatives 10, 11, 12
- Segment 3: Alternatives 10, 11, 12

Summary descriptions of the final Reasonable Alternatives are included in Figure 2-10, Figure 2-11, and Figure 2-12. Exhibits showing plan views and typical sections are available on the NHHIP website, which will be maintained through the duration of the EIS process (http://ih45northandmore.com/scoping_documents4.aspx).

Figure 2-10: Segment 1 – Evaluation of Reasonable Alternatives

SEGMENT 1: BELTWAY 8 TO I-610

EVALUATION CRITERIA																																				
Evaluation of Reasonable Alternatives																																				
		Engineering / Traffic			Environmental																																
					Cultural Resources			Natural Resources					Noise	Social and Economic Resources														Hazardous Materials										
								Floodplains		Wildlife	Wetlands	Streams																											
Improvements Common to Segment 1 Alternatives: Complete reconstruction of I-45 to provide: • Addition of one (1) frontage road lane in each direction • Addition of full-width shoulders • Addition of bike/pedestrian features along frontage roads **Additional Improvements/Needs per Alternative:**		Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Reduction in Systemwide Delay (D=Desirable, N=Neutral, U=Undesirable)	Increase in Systemwide Travel Speed (D=Desirable, N=Neutral, U=Undesirable)	Improvement to Freeway Ramping/Access (D=Desirable, N=Neutral, U=Undesirable)	Listed in or Eligible for National Register of Historic Places (number in Area of Potential Effect)	National Register of Historic Places (number potentially eligible in Area of Potential Effect)	Potential for Archeological Deposits (Yes or No)	Floodplain Fill (L=Low, M=Medium, H=High; comparison of Segment 1 alternatives)	Potential Detention Needs (L=Low, M=Medium, H=High)	Threatened & Endangered Species Habitat (Yes/No) (State only, No Federal)	Wetlands (acres)	Streams (linear feet)	Noise Impacts (number of impacted representative receivers)	Residential Displacements (number of single-family units)	Residential Displacements (number of multi-family units)	Business Displacements (number)	Religious/Fraternal Facility and Center Displacements	Parks (acres within proposed right-of-way)	School Displacements (number)	Impacts to Specific Community Facilities (Parks, Schools, Churches - Yes/No)	Visual Impacts (D=Desirable, N=Neutral, U=Undesirable)	Environmental Justice (Yes/No)	Regulatory Database Sites (number of regulated sites within proposed right-of-way)	Regulatory Database Sites (number of regulated sites within proposed right-of-way evaluated as moderate and high risk sites)	Former Gas Stations and Dry Cleaners Sites (number plotted within proposed right-of-way)
Alternative 4	• Addition of four (4) at-grade managed lanes • New Right-of-Way required mostly along the west side of I-45	Yes	No	N	D	N	0	1	Yes	H	H	Yes	0.71	9,490	26	63	90	241	3	0	2	Yes	N	Yes	10	6	12
Alternative 5	• Addition of four (4) at-grade managed lanes • New Right-of-Way required mostly along the east side of I-45	Yes	No	N	D	N	0	1	Yes	L	M	Yes	0.19	9,793	15	72	97	353	5	0	3	Yes	N	Yes	23	19	28
Alternative 7	• Addition of four (4) elevated managed lanes (on a single structure) • New Right-of-Way required on both sides of I-45	Yes	No	N	D	U	0	1	No	M	L	Yes	0.22	9,023	20	37	40	260	4	0	1	Yes	U	Yes	8	6	8

Proposed Recommended Alternative

Source: NHHIP Study Team, Evaluation of Reasonable Alternatives, April 2015

Figure 2-11: Segment 2 – Evaluation of Reasonable Alternatives

SEGMENT 2: I-610 TO I-10

		EVALUATION CRITERIA																												
		Evaluation of Reasonable Alternatives																												
				Engineering / Traffic			Environmental																							
							Cultural Resources			Natural Resources						Noise	Social and Economic Resources										Hazardous Materials		
										Floodplains		Wildlife	Wetlands	Streams															
	Improvements Common to Segment 2 Alternatives: Complete reconstruction of I-45 to provide: • Addition of full-width shoulders • Addition of bike/pedestrian features along frontage roads • New Right-of-Way required on both sides of I-45 from I-610 to Cavalcade St. Additional Improvements/Needs per Alternative:	Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Reduction in Systemwide Delay (D=Desirable, N=Neutral, U=Undesirable)	Increase in Systemwide Travel Speed (D=Desirable, N=Neutral, U=Undesirable)	Improvement to Freeway Ramping/Access (D=Desirable, N=Neutral, U=Undesirable)	Listed in or Eligible for National Register of Historic Places (number in Area of Potential Effect)	National Register of Historic Places (number potentially eligible in Area of Potential Effect)	Potential for Archeological Deposits (Yes or No)	Floodplain Fill (L=Low, M=Medium, H=High; comparison of Segment 2 alternatives)	Potential Detention Needs (L=Low, M=Medium, H=High)	Threatened & Endangered Species Habitat (Yes/No) (State only; No Federal)	Wetlands (acres)	Streams (linear feet)	Noise Impacts (number of impacted representative receivers)	Residential Displacements (number of single-family units)	Residential Displacements (number of multi-family units)	Business Displacements (number)	Religious/Fraternal Facility and Center Displacements	Parks (acres within proposed right-of-way)	School Displacements (number)	Impacts to Specific Community Facilities (Parks, Schools, Churches - Yes/No)	Visual Impacts (D=Desirable, N=Neutral, U=Undesirable)	Environmental Justice (Yes/No)	Regulatory Database Sites (number of regulated sites within proposed right-of-way)	Regulatory Database Sites (number of regulated sites within proposed right-of-way evaluated as moderate and high risk sites)	Former Gas Stations and Dry Cleaners Sites (number plotted within proposed right-of-way)
Alternative 10	• Addition of four (4) depressed managed lanes	Yes	Yes	N	N	N	0	4	No	H	M	Yes	0	4,676	11	27	18	17	0	0	0	No	D	Yes	0	0	1
Alternative 11	• Addition of four (4) elevated managed lanes (on a single structure)	Yes	No	N	N	N	0	4	No	M	M	Yes	0	4,603	11	26	18	12	0	0	0	No	U	Yes	0	0	1
Alternative 12	• Addition of four (4) elevated managed lanes (on a double-decked structure)	Yes	No	N	N	N	0	4	No	M	M	Yes	0	4,694	11	26	18	11	0	0	0	No	U	Yes	0	0	1

Proposed Recommended Alternative

Source: NHHIP Study Team, Evaluation of Reasonable Alternatives, April 2015

Figure 2-12: Segment 3 – Evaluation of Reasonable Alternatives

SEGMENT 3: DOWNTOWN LOOP

EVALUATION CRITERIA

Evaluation of Reasonable Alternatives

Improvements Common to Segment 3 Alternatives:

Complete reconstruction of I-45, I-10 and US 59/I-69 to provide:

- Addition of four (4) at-grade managed lane connections into Downtown
- Addition of full-width shoulders
- Addition of bike/pedestrian features along frontage roads
- Addition of I-10 express lanes from I-45 to US 59/I-69
- New Right-of-Way required in various areas along the Downtown loop

				Engineering / Traffic			Environmental																				
							Cultural Resources			Natural Resources					Noise	Social and Economic Resources									Hazardous Materials		
										Floodplains		Wildlife	Wetlands	Streams													
	Additional Improvements/Needs per Alternative:	Meets Need and Purpose and Project Goals (Yes/No)	Signature Project Potential (Yes/No)	Reduction in Systemwide Delay (D=Desirable, N=Neutral, U=Undesirable)	Increase in Systemwide Travel Speed (D=Desirable, N=Neutral, U=Undesirable)	Improvement to Freeway Ramping/Access (D=Desirable, N=Neutral, U=Undesirable)	Listed in or Eligible for National Register of Historic Places (number in Area of Potential Effect)	National Register of Historic Places (number potentially eligible in Area of Potential Effect)	Potential for Archeological Deposits (Yes or No)	Floodplain Fill (L=Low, M=Medium, H=High; comparison of Segment 3 alternatives)	Potential Detention Needs (L=Low, M=Medium, H=High)	Threatened & Endangered Species Habitat (Yes/No) (State only, No Federal)	Wetlands (acres)	Streams (linear feet)	Noise Impacts (number of impacted representative receivers)	Residential Displacements (number of single-family units)	Residential Displacements (number of multi-family units)	Business Displacements (number)	Religious/Fraternal Facility and Center Displacements	Parks (acres within proposed right-of-way)	School Displacements (number)	Impacts to Specific Community Facilities (Parks, Schools, Churches - Yes/No)	Visual Impacts (D=Desirable, N=Neutral, U=Undesirable)	Environmental Justice (Yes/No)	Regulatory Database Sites (number of regulated sites within proposed right-of-way)	Regulatory Database Sites (number of regulated sites within proposed right-of-way evaluated as moderate and high risk sites)	Former Gas Stations and Dry Cleaners Sites (number plotted within proposed right-of-way)
Alternative 10	• Addition of one (1) I-45 mainlane in each direction	Yes	No	N	N	U	10	1	Yes	L	M	Yes	0	9,393	7	33	247	26	1	3.4	2	Yes	U	Yes	4	3	4
Alternative 11	• Realign I-45 NB and SB lanes to be parallel with I-10 and US 59/I-69 • US 59/I-69 would be below grade from Spur 527 to Downtown • Remove existing I-45 Pierce Elevated structure	Yes	Yes	D	D	D	10	1	Yes	H	H	Yes	0	8,741	7	31	869	49	1	0.5	1	Yes	D	Yes	13	8	21
Alternative 12	• Realign I-45 NB lanes to be parallel with I-10 and US 59/I-69	Yes	No	N	U	U	10	1	Yes	M	M	Yes	0	10,109	7	36	873	41	2	3.4	0	Yes	U	Yes	8	5	19

Legend (shaded): **Proposed Recommended Alternative** (Alternative 11)

Source: NHHIP Study Team, Evaluation of Reasonable Alternatives, April 2015

The further evaluation of the Reasonable Alternatives was conducted to identify one "Proposed Recommended Alternative" per segment for further analysis. The evaluation criteria for this was developed based on the project need and purpose, project goals, engineering and traffic considerations, environmental constraints, and agency and public input. The evaluation of the alternatives was based on preliminary data and best estimates, including limited field verification, and included the following criteria:

- Meets need for the project, purpose of the project, and specific project goals: Yes or No.
- Has potential to be a "Signature Project": Yes or No.
- Engineering and Traffic: Desirable/Undesirable/Neutral. Based on assessments of the potential reduction in systemwide traffic delay, increase in systemwide travel speed, and improvements to freeway ramping and access.
- Environmental. Where a numeric evaluation is listed for the factors below, it does not indicate an absolute measure of the project impact, but is a preliminary measure of potential impact, and was used for assessing differences among the alternatives. At this point in the alternatives evaluation process, the environmental analysis was based on available data, with some field investigation.
  - Impacts to cultural resources
    - Properties listed in or eligible for the NRHP: Number in Area of Potential Effect
    - Properties potentially eligible for the NRHP: Number in Area of Potential Effect
    - Potential for archeological deposits (mapped high-probability areas): Yes or No
  - Impacts to natural resources
    - Floodplain fill: Low/Medium/High based on comparison of acres of floodplain in the new ROW of the segment alternatives
    - Potential stormwater detention needs: Low/Medium/High
    - Threatened or endangered species (State-listed) habitat within proposed ROW: Yes or No
    - Wetlands within new ROW: Acres
    - Streams within new ROW: Linear feet
  - Social and Economic Resources
    - Traffic noise impacts: Number of impacted representative receivers, based on preliminary traffic noise analysis
    - Residential displacements single-family units: Number
    - Residential displacements multi-family units: Number
    - Business displacements: Number
    - Religious/fraternal facility and center displacements: Number
    - Parks: Acres within new ROW
    - School displacements: Number

- Impacts to Specific Community Facilities. Impacts to parcels with parks, schools, or churches (due to new ROW): Yes or No
- Visual Impacts: Desirable/Undesirable/Neutral
  - Elevated to elevated = Neutral
  - Elevated to at-grade = Desirable
  - At-grade to elevated = Undesirable
  - Widening
    - With new ROW = Undesirable
    - Without new ROW = Neutral
- Environmental Justice. New ROW is in an EJ area: Yes or No

– Hazardous Materials: Number

- Regulatory database sites within project ROW
- Regulatory database sites within project ROW considered moderate- or high-risk sites
- Former gas stations and dry cleaner sites within project ROW

The results of the analysis of the Reasonable Alternatives are shown in Figure 2-10, Figure 2-11, and Figure 2-12. From this evaluation, the Study Team identified one "Proposed Recommended Alternative" for each segment. The results of the alternatives evaluation and the selection of a Proposed Recommended Alternative for each segment were presented for review and comment in April 2015 at the fourth public and agency meetings. Exhibits showing plan views and typical sections are available on the NHHIP website, which will be maintained through the duration of the EIS process (http://ih45northandmore.com/ scoping_documents4.aspx).

The Proposed Recommended Alternative for each segment was:

- Segment 1: Alternative 4
- Segment 2: Alternative 10
- Segment 3: Alternative 11

The primary reasons for selection of these alternatives are summarized below. During this phase of the planning process, the proposed I-45 managed lanes began to be referred to as MaX lanes, which are managed express lanes designed to move the maximum number of people at maximum speed.

Segment 1, Alternative 4

- Alternative 4 would not have the negative visual impact of an elevated structure as proposed for Alternative 7 and would allow for improved access to/from the MaX lanes as compared to Alternative 7. Having the MaX lanes at the same level of the I-45 general purpose lanes, as proposed for Alternatives 4 and 5, would provide more access points to the MaX lanes, which in turn would help accommodate traffic demand.
- Alternatives 4, 5, and 7 are similar for many of the environmental evaluation factors. Some differences include:

- Alternative 4 would have fewer overall residential and business displacements than Alternative 5. Alternative 4 would have more residential displacements and fewer business displacements than Alternative 7. All alternatives would require ROW in areas identified as identified as EJ areas.
- Alternative 4 would have fewer religious/fraternal facility and center displacements than Alternatives 5 and 7, and fewer school displacements than Alternative 5.
- Alternative 5 would impact more than twice as many properties with known and potential hazardous materials concerns than Alternatives 4 and 7.
- Alternative 4 would avoid a large commercial center (Northline Mall), an Aldine Independent School District middle school, and the ExxonMobil North Terminal, all of which are located on the east side of I-45.
- Noise impacts could be greater for Alternative 4; mitigation measures may reduce noise impacts.

▪ Public comments favored Alternative 4 as compared to the other alternatives.

Segment 2, Alternative 10

▪ The Alternative 10 proposed MaX lanes would be at the same vertical elevation as the I-45 general purpose lanes. Although the proposed number of general purpose and MaX lanes, and the configuration of proposed ramps and direct connectors would be similar for all three Segment 2 alternatives, the MaX lanes for Alternatives 11 and 12 would be on elevated structures throughout Segment 2. Having the MaX lanes at the same elevation as the I-45 general purpose lanes would require less ROW than constructing MaX lanes on elevated structures.

▪ Alternatives 10, 11, and 12 are similar for many of the environmental evaluation factors. The estimated number of residential displacements is almost the same for all alternatives. The number or business displacements would be slightly higher for Alternative 10. For all alternatives, no religious/fraternal facilities or centers, parks, or schools would be displaced.

▪ Alternative 10 received favorable public support.

Segment 3, Alternative 11

▪ Alternative 11 would have a beneficial visual impact by removing the Pierce Elevated and depressing the roadway lanes on the east side of Downtown, which would enhance community cohesion.

▪ Alternatives 10, 11, and 12 are similar for many of the environmental evaluation factors. Some differences include:

- Alternative 11 would provide the greatest improvement to mobility by increasing travel speeds around the Downtown Loop System by 20 to 25 mph. The increased travel speeds would be achieved by means of reconfiguring the Downtown Loop System, which would allow through traffic to bypass Downtown via the I-10 express lanes and the I-45 general

purpose lanes on the east side of Downtown. Local traffic would have improved access to Downtown.

- Alternative 11 would displace fewer single-family residences than Alternatives 10 and 12. Alternatives 11 and 12 would displace approximately the same number of multi-family units.
- Alternative 11 would impact fewer parks and acquire less land from parks (for project ROW).

- Alternative 11 received favorable public support and community consensus, as extensive outreach was conducted between November 2013 and April 2015 to refine the design to benefit surrounding communities. Proposed Recommended Alternative

The Proposed Recommended Alternatives and the reasons for their selection were presented at the fourth agency and public meetings on April 22, 23, 28, and 30, 2015. The evaluation of the Reasonable Alternatives and primary reasons for identifying the Proposed Recommended Alternative for each study segment are discussed in Section 2.3.3. The evaluation included assessing many factors, as discussed and presented in Section 2.3.3. Summary descriptions of the Proposed Recommended Alternatives that were presented are shown in Figure 2-10, Figure 2-11, and Figure 2-12. With input from the meetings, other comments received, and additional coordination with agencies, groups, the public, and other interested stakeholders, the Proposed Recommended Alternative underwent further development and additional evaluation. The alternatives were modified, where possible, to avoid and/or minimize adverse impacts to cultural, natural, social and economic resources, and hazardous materials, and to improve traffic operations.

Specific design modifications were made to the Proposed Recommended Alternative for each segment between April 2015 and September 2016.

2.3.3.1 Segment 1

Most of the design modifications in Segment 1 were developed as a result of additional engineering evaluation, including drainage. The Segment 1 Proposed Recommended Alternative (Alternative 4) included the following design modifications:

- **Beltway 8 Interchange:** Alternative 4 was revised on the west side of I-45 between Fallbrook Drive and Beltway 8 to avoid impacts to a multi-story office building.
- **Shepherd Drive:** A separate TxDOT-led project to construct direct connectors between I-45 and Shepherd Drive was reviewed in relation to the Reasonable Alternatives to determine if the new interchange could be maintained with minimal additional cost and construction impacts from the NHHIP. The Alternative 4 design was modified to maintain the Shepherd Drive/I-45 northbound direct connector that was under construction at the time of the evaluation.
- **I-610 Interchange:** As the Reasonable Alternatives were evaluated, the potential impacts related to drainage were investigated. In the southern portion of Segment 1, Little White Oak Bayou generally parallels the west side of I-45. The Study Team determined that Alternative 4 would significantly impact the Little White Oak Bayou floodway between I-610 and

Crosstimbers Street; therefore, the alignment of Alternative 4 was shifted to the east in that area to reduce the floodway impacts.

- **MaX Lane access at the I-610 interchange:** The Study Team evaluated access to and from the proposed I-45 MaX lanes in the area of the I-610 interchange. I-45 MaX lane traffic, both northbound and southbound, desiring to travel on I-610 must first exit the MaX lanes, merge onto the I-45 mainlanes, then exit the I-610 eastbound or westbound direct connectors. Similarly, traffic on I-610 desiring to travel on the I-45 MaX lanes must exit the I-610 direct connectors to I-45 northbound or southbound, merge onto the I-45 mainlanes, and then enter the I-45 MaX lanes. MaX lane entrances and exits north and south of the I-610 interchange were configured to provide adequate distance for traffic to maneuver from the I-45 MaX lanes to the mainlanes then to the I-610 direct connectors, and from the I-610 direct connectors to the I-45 mainlanes then to the MaX lanes.

2.3.3.2 Segment 2

Most of the design modifications in Segment 2 were developed in response to public comments received at the public meeting and during the subsequent comment period. The Study Team conducted public outreach and held workshops with neighborhood associations and other agencies and stakeholders to develop a design that would receive public consensus. The Segment 2 Proposed Recommended Alternative (Alternative 10) included the following design modifications:

- **I-45 northbound entrance ramp at Quitman Street**: The alternative presented at the public meeting did not include the existing northbound Quitman Street entrance ramp. Based on comments from the public and the City of Houston, the design was modified to include access to northbound I-45 from Quitman Street. Access from Quitman Street would be provided via an entrance ramp to the proposed direct connector from eastbound I-10 to northbound I-45. The proposed direct connector would provide direct access to I-45 immediately south of N. Main Street.
- **I-45 Mainlanes**: To provide the necessary capacity for future demand and to allow for improved traffic flow, an additional I-45 general purpose lane was added throughout Segment 2 so that at least three lanes in each direction are maintained. In addition, as the design was further refined following the public meeting, the Study Team determined that the depressed section of I-45 in the Woodland Heights area would need to be lengthened to bring the mainlanes (general purpose lanes) up to ground level south of Patton Street.
- **I-45 northbound exit ramp at W. Cavalcade Street:** The initial design concept included a northbound entrance ramp south of W. Cavalcade Street. However, this ramp was reversed to an exit ramp. An I-45 northbound entrance ramp was added north of Link Road.
- **I-45 southbound exit ramp at W. Cavalcade Street:** The initial design concept included a southbound exit ramp to Link Road. However, the design was modified to extend the exit ramp over Link Road to connect with the southbound frontage road, south of Link Road. This eliminated the need for traffic exiting from I-45 to travel through Link Road intersection, which currently does not have traffic signals and is used for local traffic movements.

- **I-610 eastbound access to Fulton/Irvington:** The initial design concept for the I-610 eastbound exit ramp to Fulton Street was redesigned to a collector-distributor (C-D) system. A C-D road is a type of road that parallels and connects the mainlanes of a highway and frontage roads or entrance ramps. The redesign included reversing the proposed Airline Drive entrance ramp and the Fulton Street exit ramp, which would allow eastbound traffic on the I-610 mainlanes and frontage road west of I-45 to access the I-610 mainlanes and/or frontage road on the east side of I-45. The C-D system allows for I-610 eastbound mainlane traffic to queue (form a line) for exiting the eastbound Fulton Street exit ramp without interfering with through traffic on the I-610 mainlanes.
- **I-610 westbound access to Fulton/Irvington:** The initial design concept for the I-610 westbound exit ramp to Airline Drive was redesigned to include a C-D system. The redesign included reversing the proposed Fulton Street entrance ramp and the Airline Drive exit ramp, which would allow westbound traffic on the I-610 mainlanes and frontage road east of I-45 to access the I-610 mainlanes and/or frontage road on the west side of I-45. The C-D system allows for I-610 westbound mainlane traffic to queue for the westbound Airline Drive exit ramp without interfering with through traffic on the I-610 mainlanes.
- **Improved local circulation via U-turns**: Design modifications to local circulation movements were conducted after the public meeting and include U-turns at Cottage Street from the northbound and southbound frontage roads and at N. Main Street for the northbound frontage road. U-turn lanes would incorporate a receiving lane on the frontage road to eliminate merging.
- **Houston Avenue:** The initial design concept proposed Houston Avenue as a one-way, southbound street between N. Main Street and Bayland Avenue. The Study Team modified the design to include a roundabout on Houston Avenue at the I-45 southbound entrance ramp to allow the existing two-way traffic to be maintained.

2.3.3.3 Segment 3

Most of the design modifications in Segment 3 were developed as a result of public and agency comments received at the public meeting and during the subsequent comment period. The Study Team conducted extensive outreach and held workshops with neighborhood associations, agencies, and stakeholders to develop a design that would receive public and stakeholder consensus. The Segment 3 Proposed Recommended Alternative (Alternative 11) included the following design modifications:

- **I-45 Mainlanes**: The number of I-45 mainlanes to be provided in Segment 3 was adjusted to maintain at least three lanes in each direction.
- **I-45 and US 59/I-69, depressed section from the interchange of I-45 and US 59/I-69 to Commerce Street:** Following the fourth public meeting, the Study Team conducted extensive coordination with key stakeholders, including the Houston Downtown Management District (HDMD) and Houston First, a local government corporation, to refine the design of the Proposed Recommended Alternative in the depressed section adjacent to the George R. Brown Convention Center to provide the optimal design for George R. Brown Convention

Center operations, to minimize impacts to historic structures, and to provide adequate local access and circulation in this area. Comments received following the fourth public meeting from the public, agencies, and stakeholders were considered during this process. A summary of the design modifications implemented in this section of I-45 and US 59/I-69 includes:

- Maintain a minimum of three mainlanes on I-45 in each direction.
- Adjust the horizontal alignment of the I-45 and US 59/I-69 mainlanes to avoid impacts to the historic Cheek-Neal Coffee Building, located on St. Emanuel Street between Preston Street and Congress Street.
- Relocate the southbound frontage road in the immediate vicinity of the George R. Brown Convention Center to be above the I-45 and US 59/I-69 southbound depressed mainlanes. The southbound frontage road would shift from its alignment on Hamilton Street, beginning at Texas Avenue, and would return to the existing Hamilton Street alignment near Bell Street.
- Reconfigure the US 59/I-69 southbound exit ramp at Hamilton Street/Bell Street to be above the US 59/I-69 southbound mainlanes and to connect to Hamilton Street immediately north of Leeland Avenue.
- Add a full-height barrier separating the I-45 and US 59/I-69 depressed mainlanes. The barrier would create a tunnel effect, thereby necessitating sufficient vertical clearance to accommodate a required tunnel ventilation and sprinkler system.
- Relocate various direct connectors to enhance the geometric design and to facilitate access to/from the interstate systems, including: I-45 northbound to US 59/I-69 northbound, I-45 northbound to US 59/I-69 southbound, and US 59/I-69 southbound to I-45 southbound.

- **Downtown Connector:** Various modifications were made to the design of, and access provided by, the proposed Downtown Connector. The modifications implemented following the fourth public meeting include:
  - Provide a connection for I-10 westbound traffic to access Downtown.
  - Maintain the at-grade connectivity of Walker Street to Houston Avenue under the Downtown Connector.
  - Maintain the at-grade connectivity of Clay Street, Dallas Street, and Lamar Street to Allen Parkway under the Downtown Connector.
  - Provide outbound Clay Street traffic access to the Downtown Connector.
  - Maintain local circulation on Pease Street from W. Dallas Street to Houston Avenue.
  - Maintain the at-grade connectivity of W. Dallas Street under the Downtown Connector.
- **US 59/I-69 between SH 288 and Spur 527:** The initial design concept of US 59/I-69 between SH 288 and Spur 527 was modified following the fourth public meeting to enhance local access and mobility. Modifications in this area included:
  - Add a continuous US 59/I-69 southbound frontage road that would extend from the proposed Hamilton Street frontage road to La Branch Street. Existing local street access

from this additional proposed US 59/I-69 southbound frontage road would include connections to Almeda Road, Isabella Street, Cleburne Street, and La Branch Street.

- Modify the US 59/I-69 northbound Main Street exit ramp to include a two-lane approach at Main Street and a dedicated right-turn lane.
- Redesign the vertical and horizontal alignment of the SH 288 northbound direct connector to US 59/I-69 southbound to accommodate the proposed US 59/I-69 southbound frontage road.

- **SH 288 northbound frontage road:** The SH 288 northbound frontage road would use the existing Hutchins Street alignment beginning at Wheeler Avenue and would parallel SH 288 to intersect with Cleburne Street and Alabama Street. After merging with the SH 288 northbound Elgin Street exit ramp, the proposed frontage road would connect to the proposed US 59/I-69 northbound frontage road, using the existing Chartres Street alignment.
- **I-10 between I-45 and US 59/I-69:** The alignment of I-10 between its interchanges with I-45 and US 59/I-69 was modified following the fourth public meeting to minimize potential adverse impacts to historic properties in the vicinity of N. Main Street. Modifications in this area include:
  - Relocate the I-45 northbound to I-10 westbound connection to be west of N. Main Street.
  - Relocate the I-45 southbound to I-10 eastbound connection to be south of White Oak Bayou.
  - Establish a connection between Conti Street and the I-10 westbound frontage road.
  - Change the design so that the I-10 eastbound mainlanes are under the I-45 southbound mainlanes.
- **San Jacinto Street Realignment:** The initial design concept was for San Jacinto Street to be aligned with Naylor Street at I-10. Based on the City of Houston's plan to extend San Jacinto Street, the design was modified to allow for a future connection to Fulton Street.
- **Use of St. Emanuel Street as US 59/I-69 northbound frontage road:** The initial design concept used Chartres Street as the US 59/I-69 northbound frontage road. The revised design would use Chartres Street until the connection to the US 59/I-69 northbound exit ramp to Gray Street, where the northbound frontage road would shift to the east to use the existing St. Emanuel Street. This allows the US 59/I-69 alignment to straighten at the interchange of I-45 and US 59/I-69.
- **Local access for Chenevert Street at SH 288 managed lanes access:** Chenevert Street would be maintained as a one-way southbound street between Stuart Street and Holman Street. Local street connectivity at Francis Street would also be maintained.
- **Interchange of I-10, US 59/I-69, and I-45 near Buffalo Bayou:** The alignment of this proposed interchange near Buffalo Bayou was modified to straighten the curve of the highways, and to enhance local connectivity to and from the Downtown area. Modifications in this area include:

- Modify the US 59/I-69 HOV lanes to include one lane in each direction. The US 59/I-69 northbound (outbound) HOV lane would begin at Chenevert Street, and the US 59/I-69 southbound (inbound) HOV lane would terminate at Jackson Street.
- Relocate the US 59/I-69 mainlanes into and out of Downtown to coincide with the US 59/I-69 southbound frontage road using the Hamilton Street alignment. The US 59/I-69 northbound mainlane entrance ramp, outbound, would begin at Chenevert Street. The US 59/I-69 southbound mainlane exit ramp to Downtown (inbound) would terminate at Hamilton Street.
- Modify the vertical and horizontal alignment of the I-45 mainlanes and various direct connectors in this area to minimize the roadway footprint and to enhance freeway-to-freeway connections. The I-45 mainlanes were shifted northeast. Changes to the following direct connectors were made: I-10 westbound to I-45 and US 59/I-69 southbound, and I-10 eastbound to I-45 and US 59/I-69 southbound. Both of these connections from I-10 would join with US 59/I-69 at Franklin Street, which is farther south than the initial design concept presented at the fourth public meeting. Traffic would be able to enter the southbound I-45 mainlanes near McKinney Street.

- **I-45 south of US 59/I-69:** The southern project limits on I-45 were revised and extended to Scott Street to improve traffic operations by separating the I-45 and US 59/I-69 traffic exiting and entering the interchange of I-45 and US 59/I-69.

The revised Proposed Recommended Alternatives for Segments 1–3 described above were included in the group of Reasonable Alternatives evaluated in detail in the Draft EIS.

2.3.4 Description of Reasonable Alternatives Evaluated in the Draft EIS

Plan views and section views of the Reasonable Alternatives evaluated in the Draft EIS are included in Appendix B of the Draft EIS and can be viewed at: http://www.ih45northandmore.com/draft_eis.aspx. The Proposed Recommended Alternative for each segment is indicated in the list below. The detailed evaluation of the Reasonable Alternatives is included in the Draft EIS.

Segment 1: I-45 from Beltway 8 North to north of I-610 (North Loop)

Segment 1, Alternative 4: Widen I-45 Mostly to the West (Proposed Recommended)

Alternative 4 would widen the existing I-45 on the west side of the roadway to accommodate four MaX lanes. The proposed typical section would include eight general purpose lanes (four lanes in each direction), four MaX lanes (two lanes in each direction), and six frontage road lanes (three lanes in each direction), all at-grade. Alternative 4 would require approximately 200 to 225 feet of new ROW, mostly to the west of the existing I-45. This alternative would require small amounts of land to the east of the existing I-45 ROW at major intersections and between Crosstimbers Street and I-610. Approximately 212 acres of new ROW would be required for this alternative. The length of this alternative would be approximately 8.8 miles.

Segment 1, Alternative 5: Widen I-45 Mostly to the East

Alternative 5 would widen the existing I-45 along the east side of the roadway to accommodate four MaX lanes. The proposed typical section would include eight general purpose lanes (four lanes in each direction), four MaX lanes (two lanes in each direction), and six frontage road lanes (three lanes in each direction), all at-grade. Alternative 5 would require approximately 200 to 225 feet of new ROW to the east of the existing I-45. This alternative would require small amounts of land to the west of the existing I-45 ROW at major intersections. Approximately 239 acres of new ROW would be required for this alternative. The length of this alternative would be approximately 8.8 miles.

Segment 1, Alternative 7: Widen I-45 on Both Sides

Alternative 7 would widen the existing I-45 along both the east and west sides of the roadway to accommodate four elevated MaX lanes. The proposed typical section would include eight general purpose lanes (four lanes in each direction) at-grade, four elevated MaX lanes (two lanes in each direction) on a single structure constructed along the center of the roadway, and six frontage road lanes (three lanes in each direction) at-grade. Alternative 7 would require approximately 45 to 80 feet of new ROW along both sides of the existing I-45. Approximately 120 acres of new ROW would be required for this alternative. The length of this alternative would be approximately 8.8 miles.

Segment 2: I-45 from north of I-610 (North Loop) to I-10 (including the interchange with I-610)

Segment 2, Alternative 10: Add Four MaX Lanes to I-45 (Proposed Recommended)

Alternative 10 would widen the existing I-45 to accommodate four MaX lanes. Within the at-grade section of I-45, the proposed typical section would include eight general purpose lanes (four lanes in each direction), four MaX lanes (two lanes in each direction), and four frontage road lanes (two lanes in each direction), all at-grade. For this alternative, I-45 would be depressed from north of Cottage Street to Norma Street, a distance of approximately 1,800 feet. Within the depressed section of I-45, the proposed typical section would include eight below-grade general purpose lanes (four lanes in each direction), and four below-grade MaX lanes (two lanes in each direction), while the four frontage road lanes (two lanes in each direction) would be at-grade. The proposed I-45 and I-610 frontage roads would be continuous through the I-45/I-610 interchange. Alternative 10 would require new ROW for the at-grade section between I-610 and Cottage Street, and between Little White Oak Bayou and Norma Street. Approximately 19 acres of new ROW would be required for this alternative. The length of this alternative, including interchange improvements, would be approximately 4.5 miles.

This alternative provides an opportunity to include a structural “cap” over a portion of the depressed lanes of I-45 from north of Cottage Street to south of N. Main Street. This area could be used as open space. The open space option is conceptual only and would be separate from TxDOT’s roadway project. Any open space would require development and funding by parties other than TxDOT.

Segment 2, Alternative 11: Add Four Elevated MaX Lanes in the Center of I-45

Alternative 11 would widen the existing I-45 and add four elevated MaX lanes. Within the at-grade section of I-45, the proposed typical section would include eight general purpose lanes (four lanes in each

direction) and four frontage road lanes (two lanes in each direction), all at-grade, while the four MaX lanes (two lanes in each direction) would be elevated on a single structure at the center of the roadway. Within the depressed section of I-45, the proposed typical section would include eight general purpose lanes (four lanes in each direction) below grade, four MaX lanes (two lanes in each direction) elevated on a single structure at the center of the roadway, and four frontage road lanes (two lanes in each direction) at-grade. The proposed I-45 and I-610 frontage roads would be continuous through the I-45/I-610 interchange. New ROW would be required for the at-grade section between I-610 and Cavalcade Street to accommodate the proposed improvements at the I-45/I-610 interchange. No new ROW would be required for the depressed section. Approximately 10 acres of new ROW would be required for this alternative. The length of this alternative, including interchange improvements, would be approximately 4.5 miles.

Segment 2, Alternative 12: Add Four MaX Lanes (Two Elevated) in the Center of I-45

Alternative 12 would widen the existing I-45 and add two elevated and two at-grade MaX lanes. Within the at-grade section of I-45, the proposed typical section would include eight general purpose lanes (four lanes in each direction) and four frontage road lanes (two lanes in each direction), all at-grade, while the four MaX lanes (two lanes in each direction) would be stacked (the two northbound MaX lanes would be at-grade and the two southbound MaX lanes would be elevated on a single structure along the center of the roadway). Within the depressed section of I-45, the proposed typical section would include eight general purpose lanes (four lanes in each direction) below grade, four MaX lanes (two lanes in each direction) that would be stacked (the two northbound MaX lanes would be below grade and the two southbound MaX lanes would be elevated on a single structure along the center of the roadway), and four frontage road lanes (two lanes in each direction) that would be at-grade. The proposed I-45 and I-610 frontage roads would be continuous through the I-45/I-610 interchange. New ROW would be required for the at-grade section between I-610 and Cavalcade Street to accommodate the proposed improvements at the I-45/I-610 interchange. No new ROW would be required for the depressed section. Approximately 12 acres of new ROW would be required for this alternative. The length of this alternative, including interchange improvements, would be approximately 4.5 miles.

Segment 3: Downtown Loop System (I-45, US 59/I-69, and I-10)

Segment 3, Alternative 10: Widen I-45 to 10 Lanes

Alternative 10 is an "improve existing" alternative, with the existing interstate highways around Downtown Houston remaining in their current configuration. Alternative 10 would widen the existing I-45 within its existing footprint along the west and south sides of Downtown Houston. The elevated portion of I-45 west and south of Downtown would be reconstructed. The proposed typical section of the widened I-45 would include 10 elevated general purpose lanes; however, the lane configuration would be altered to have six northbound lanes and four southbound lanes. The I-45 MaX lanes proposed in Segments 1 and 2 would terminate in the Downtown area in Segment 3. The I-45 MaX lanes would be parallel to I-10 in the vicinity of the I-45/I-10 interchange and would terminate/begin at Milam Street/Travis Street, respectively. I-10 along the north side of Downtown, between I-45 and US 59/I-69, would be slightly realigned to accommodate four elevated I-10 express lanes (two lanes in each direction) on this segment

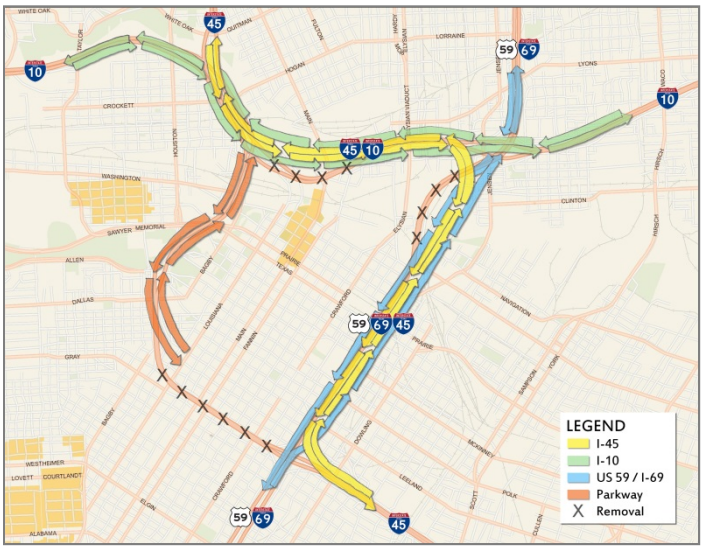
of I-10. The I-10 express lanes would generally be parallel to I-10 and would be located on the north side of White Oak Bayou. West of the I-45/I-10 interchange, the I-10 express lanes would connect to the existing I-10 HOV lanes. US 59/I-69 along the east side of Downtown would generally remain in its current configuration. Alternative 10 would require new ROW along I-45 from I-10 to Houston Avenue and from Brazos Street to US 59/I-69. Alternative 10 would require approximately 76 acres of new ROW. The length of this alternative, including interchange improvements, would be approximately 4.4 miles.

Segment 3, Alternative 11: Realign I-45 along I-10 and US 59/I-69 (Proposed Recommended)

Alternative 11 would reroute I-45 to be coincident with US 59/I-69 on the east side of Downtown Houston (Figure 2-13). The existing elevated I-45 roadway along the west and south sides of Downtown would be removed and relocated to be parallel to I-10 on the north side of Downtown and parallel to US 59/I-69 on the east side of Downtown. Access to the west side of Downtown would be provided via "Downtown Connectors," which would provide access to and from various Downtown streets. To improve safety and traffic flow in the north and east portions of the proposed project area, both I-10 and US 59/I-69 would be realigned to eliminate the current roadway curvature. I-45 and US 59/I-69 would be depressed along a portion of the alignment east of Downtown. South of the George R. Brown Convention Center, I-45 would begin to elevate to the interchange of I-45 and US 59/I-69 southeast of Downtown, while US 59/I-69 would remain depressed as it continues southwest toward Spur 527. The four proposed I-45 MaX lanes in Segments 1 and 2 would terminate/begin in Segment 3 at Milam Street/Travis Street, respectively. I-10 express lanes (two lanes in each direction) would be located generally in the center of the general purpose lanes within the proposed coincidental alignment of I-10 and I-45 on the north side of Downtown. The I-10 express lanes would vary between being elevated and at-grade. Approximately 190 feet of new ROW to the east of the existing US 59/I-69 along the east side of Downtown would be required to accommodate the proposed realigned I-45. The existing Hamilton Street would be realigned to be adjacent to US 59/I-69 to serve as the southbound frontage road, and the existing St. Emanuel Street would serve as the northbound frontage road. Alternative 11 would require approximately 160 acres of new ROW, the majority of which would be for the I-10 and US 59/I-69 realignments, and to construct the proposed I-45 lanes adjacent to US 59/I-69 along the east side of Downtown. The length of this alternative, including roadway realignments and interchange improvements, would be approximately 12.0 miles.

This alternative provides an opportunity to include a structural "cap" over the proposed depressed lanes of I-45 and US 59/I-69 from approximately Commerce Street to Lamar Street. This area could be used as open space. The open space option is conceptual only and would be separate from TxDOT's roadway project. Any open space project would require development and funding by parties other than TxDOT.

Figure 2-13: Segment 3 Alternative 11 Proposed Traffic Flow Diagram



Segment 3, Alternative 12: Realign Northbound I-45 along US 59/I-69 and I-10

Alternative 12 would reroute northbound I-45 to be coincident with US 59/I-69 on the east side of Downtown Houston. An elevated structure would be constructed to accommodate four I-45 northbound general purpose lanes that would be located east of the existing US 59/I-69 general purpose lanes. Northbound I-45 traffic would continue on elevated lanes constructed between the I-10 general purpose lanes, then would move northward into Segment 2. Southbound I-45 traffic at the I-45/I-10 interchange northwest of Downtown would be directed onto one-way general purpose lanes along the west and south sides of Downtown, following the existing Pierce Elevated footprint. The four proposed I-45 MaX lanes in Segments 1 and 2 would terminate/begin in Segment 3 at Milam Street/Travis Street, respectively. I-10 express lanes (two lanes in each direction) are proposed to be located along the portion of the existing I-10 north of Downtown between the interchanges of I-10 and I-45, and I-10 and US 59/I-69. Near the US 59/I-69 interchange, the I-10 express lanes would be located at-grade in the center of the general purpose lanes, then would shift to become elevated and generally parallel to I-10, but located on the north side of White Oak Bayou. West of the I-45/I-10 interchange, the I-10 express lanes would connect to the existing I-10 HOV lanes. US 59/I-69 along the east side of Downtown would generally remain in its current configuration, with the I-45 one-way northbound lanes being immediately adjacent to this segment of US 59/I-69. Alternative 12 would require approximately 109 acres of new ROW. The length of this alternative, including interchange improvements, would be approximately 9.8 miles.

2.3.5 Changes to the Proposed Recommended Alternative after the Draft EIS

After the release of the Draft EIS in April 2017, TxDOT considered public input, community impacts, environmental factors, the defined purpose of the project, and determined that the Preferred Alternative is the best alternative given the project need and purpose, project impacts, and the ability to minimize and mitigate adverse impacts. The Final EIS documents the evaluation of the Preferred Alternative, which was developed from the evaluation of the Reasonable Alternatives and in consideration of public, agency,

and other stakeholder comments received during the study process. The Draft EIS documents the evaluation of the Universe of Alternatives, Preliminary Alternatives, and Reasonable Alternatives. The evaluation of the Reasonable Alternatives (three alternatives for each project segment) included in the Draft EIS is incorporated in this Final EIS by reference. The Draft EIS is available on the project website at: http://www.ih45northandmore.com/draft_eis.aspx.

Subsequent to release of the Draft EIS, additional reconnaissance surveys for historical resources were completed. Based on the updated information, it was determined that the Proposed Recommended Alternative would impact historic properties in Segment 3. The *Historical Resources Survey Report — Update* is included in an appendix in this Final EIS. Section 4(f) of the Department of Transportation Act (49 US Code [U.S.C.] 303 and 23 U.S.C. 138) and its implementing regulations (23 CFR Part 774) prohibit the FHWA from using publicly owned land of a public park, recreation area, or wildlife and waterfowl refuges of national, state or local significance, or land of a historic site of national, state or local significance for transportation projects unless there is no feasible and prudent alternative to using the land and the project includes all possible planning to minimize harm to the property resulting from the use, or the impact is de minimis. In this context, the terms feasible and prudent are specifically defined in FHWA's Section 4(f) regulations at 23 CFR 774.17.

For parks, recreation areas, and wildlife and waterfowl refuges, a de minimis impact is one that will not adversely affect the features, attributes, or activities qualifying the property for protection under Section 4(f).

For historical resources, the Study Team reevaluated the Segment 3 Preliminary Alternatives to determine if there is a feasible and prudent alternative that addresses the project purpose and need without a use of Section 4(f) property. Preliminary Alternative 1, No Build, does not address the project purpose and need. Preliminary Alternative 3 would impact a historic building and a historic district. The tunnel alternatives, Preliminary Alternatives 5 and 6, are not feasible and prudent because of mobility and safety concerns, as discussed in Section 2.3.2. Preliminary Alternatives 10, 11, and 12 were further developed after the 2013 evaluation, and would impact historic properties. The *Individual Section 4(f) Evaluation* discusses all possible planning to minimize harm to historic properties resulting from the Preferred Alternative, and it is included in an appendix in this Final EIS.

Based on stakeholder input and engineering review, design changes were developed for the Proposed Recommended Alternative in each of the project segments. Design changes primarily include modifications to some entrance and exit ramps, highway interchanges, and frontage roads. The design changes also include proposed storm water detention basins along the project corridor. Some design changes developed in the latter phase of the Draft EIS preparation were not evaluated in the Draft EIS. However, proposed design changes (as of April 2017) were presented at the Public Hearing and additional public meeting in May 2017. In response to comments received during the Draft EIS comment period and from continuing stakeholder input and coordination, the project design was revised between May 2017 and December 2019. The revised alternatives for each project segment are identified as Preferred Alternatives, and when combined, is the Preferred Alternative for the proposed NHHIP that is evaluated

in the Final EIS. Proposed storm water detention areas and other design changes are discussed in Sections 2.3.6.1–2.3.6.4.

2.3.5.1 Storm Water Detention Areas

Table 2-2 lists the preliminary storm water detention basins and approximate depth and size of each. Approximately 46 acres of the approximately 99 acres of land that is proposed to be storm water detention basins is within the project ROW that was evaluated in the Draft EIS. Approximately 48 acres were not evaluated in the Draft EIS. Locations of proposed storm water detention basins are shown on the Locator Maps for each segment – Figure 2-14 for Segment 1, Figure 2-18 for Segment 2, and Figure 2-23 for Segment 3.

2.3.5.2 Segment 1 – Design Changes

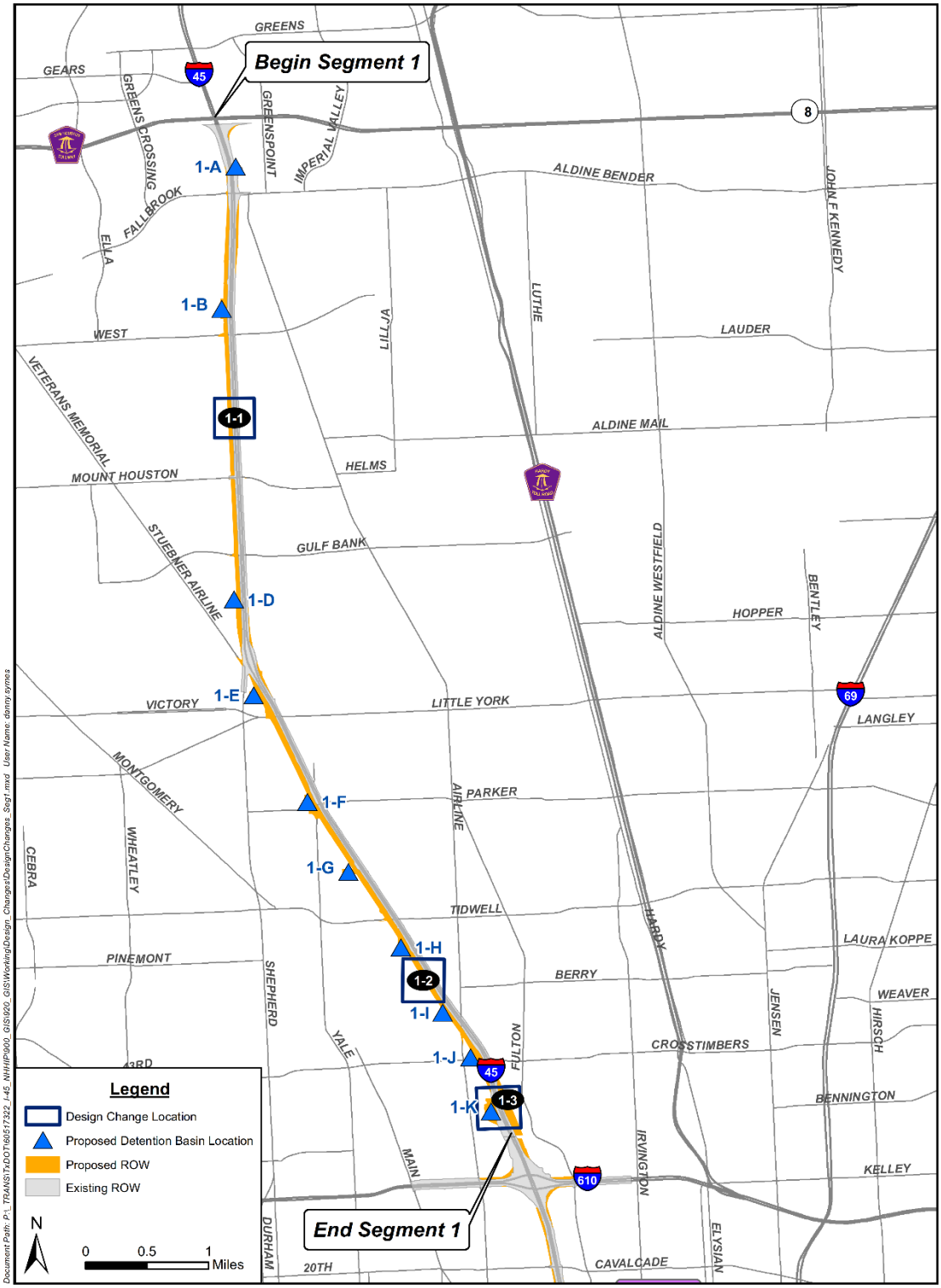
The design changes in Segment 1 were related primarily to the acquisition of additional ROW to accommodate 11 proposed storm water detention basins, and modifications at three intersections (Figure 2-14). The intersection modifications are described below. The locations of the modifications correspond to the numbers shown in Figure 2-14.

Table 2-2: Preliminary Storm Water Detention Basin Locations

Detention Basin ID	Detention Basin Avg. Depth (feet)	Detention Basin Area (acres)	Detention Basin Area within Project ROW Studied in Draft EIS (acres)	Additional Detention Basin Area (acres)
Segment 1				
1-A	8.0	0.60	0.60	
1-B	4.5	2.38		2.38
1-D	2.0	2.33		2.33
1-E	2.0	2.45		2.45
1-F	2.3	2.80	0.04	2.76
1-G	3.2	2.80		2.80
1-H	2.2	2.67		2.67
1-I	4.5	1.41		1.41
1-J	7.7	1.01	0.13	0.88
1-K	10.0	11.51	0.97	10.54
Segment 2				
2-A	8.0	2.29	2.29	
2-B	5.0–12.0	19.5		19.50
Segment 3				
3-A	5.0	4.76	4.76	
3-B	5.0	2.78	2.78	
3-C	5.0	7.02	7.02	
3-D TxDOT Regional Detention Basin	10.0	6.10	6.10	
3-D TxDOT Regional Detention Basin	18.0	20.80	20.80	
Total		93.21	45.49	47.72

Source: NHHIP Study Team

Figure 2-14: Locator Map – Design Changes and Proposed Detention Basins – Segment 1

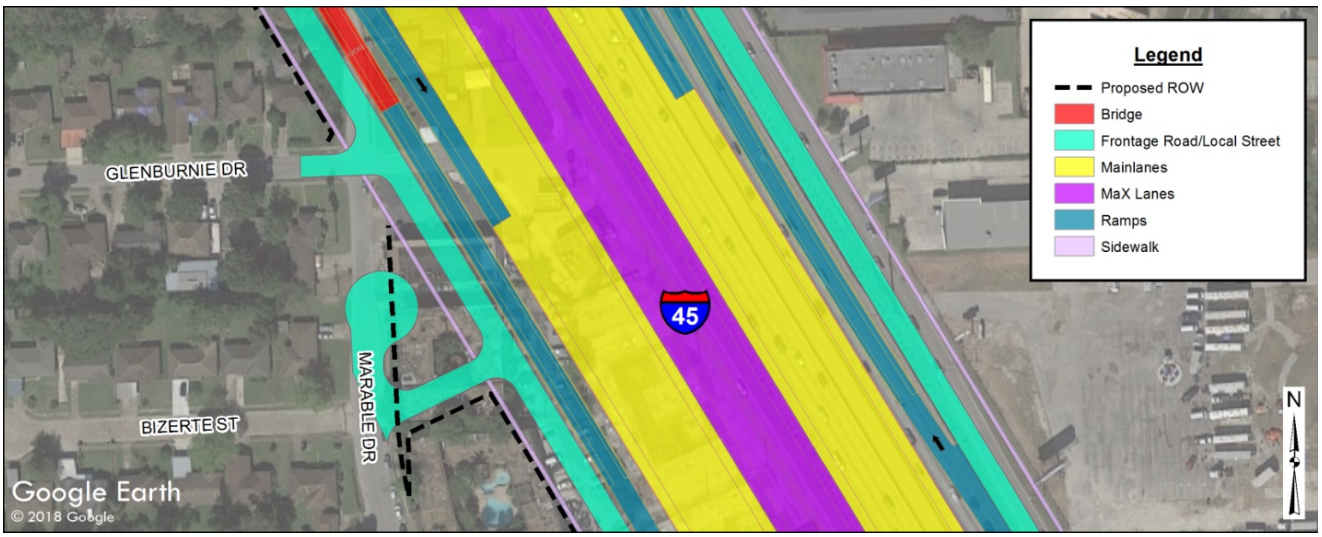


- Location 1-1: I-45 at Blue Bell Road (between West Road and Mount Houston Road) – An I-45 overpass was added at this location in response to a request from the City of Houston (Figure 2-15). Currently, Blue Bell Road terminates at the frontage roads on the east and west sides of I-45 and is not continuous at I-45. An overpass of I-45 at Blue Bell Road would allow for connectivity of Blue Bell Road under I-45. Minor acquisition of ROW would be needed on Blue Bell Road to accommodate turns at the intersections with I-45.

Figure 2-15: Design Change 1-1

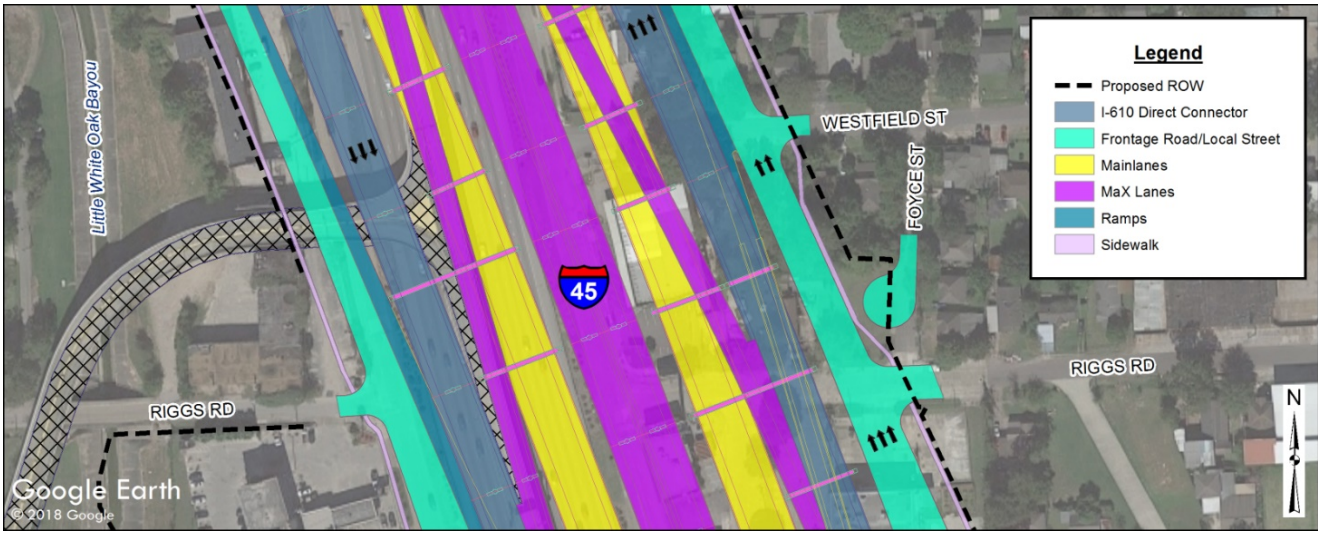
- Location 1-2: I-45 at Bizerte Street (between Tidwell Road and Crosstimbers Street) – The proposed I-45 improvements would necessitate the termination of Marable Drive at the west I-45 ROW limits (Figure 2-16). Additional ROW would be required on the east side of Marable Drive north of Bizerte Street to accommodate construction of a cul-de-sac.

Figure 2-16: Design Change 1-2



- Location 1-3: I-45 at Foyce Street (between Crosstimbers Street and I-610) – The proposed I-45 improvements would necessitate the termination of Foyce Street at the east I-45 ROW limits (Figure 2-17). Additional ROW would be required on the south side of Foyce Street to accommodate construction of a cul-de-sac.

Figure 2-17: Design Change 1-3



In addition to these design changes, minor ROW acquisitions would be required at various intersections to ensure that roadway lanes correctly align and transition smoothly to existing lanes, or to accommodate turns at the intersections. Some ROW acquisitions would be of residual portions of parcels that would otherwise be unusable when the expanded I-45 corridor ROW is established.

2.3.5.3 Segment 2 Design Changes

The design changes for Segment 2 are related to ramp and direct connector refinements, a pedestrian/bike trail connection, frontage road realignment, and proposed detention basins. The locations of the proposed design changes are shown in Figure 2-18. Figure 2-19 through Figure 2-22 provide detailed drawings, descriptions of the design changes, and the reasons for implementing the proposed design changes.

Figure 2-18: Locator Map — Design Changes and Proposed Detention Basins – Segment 2

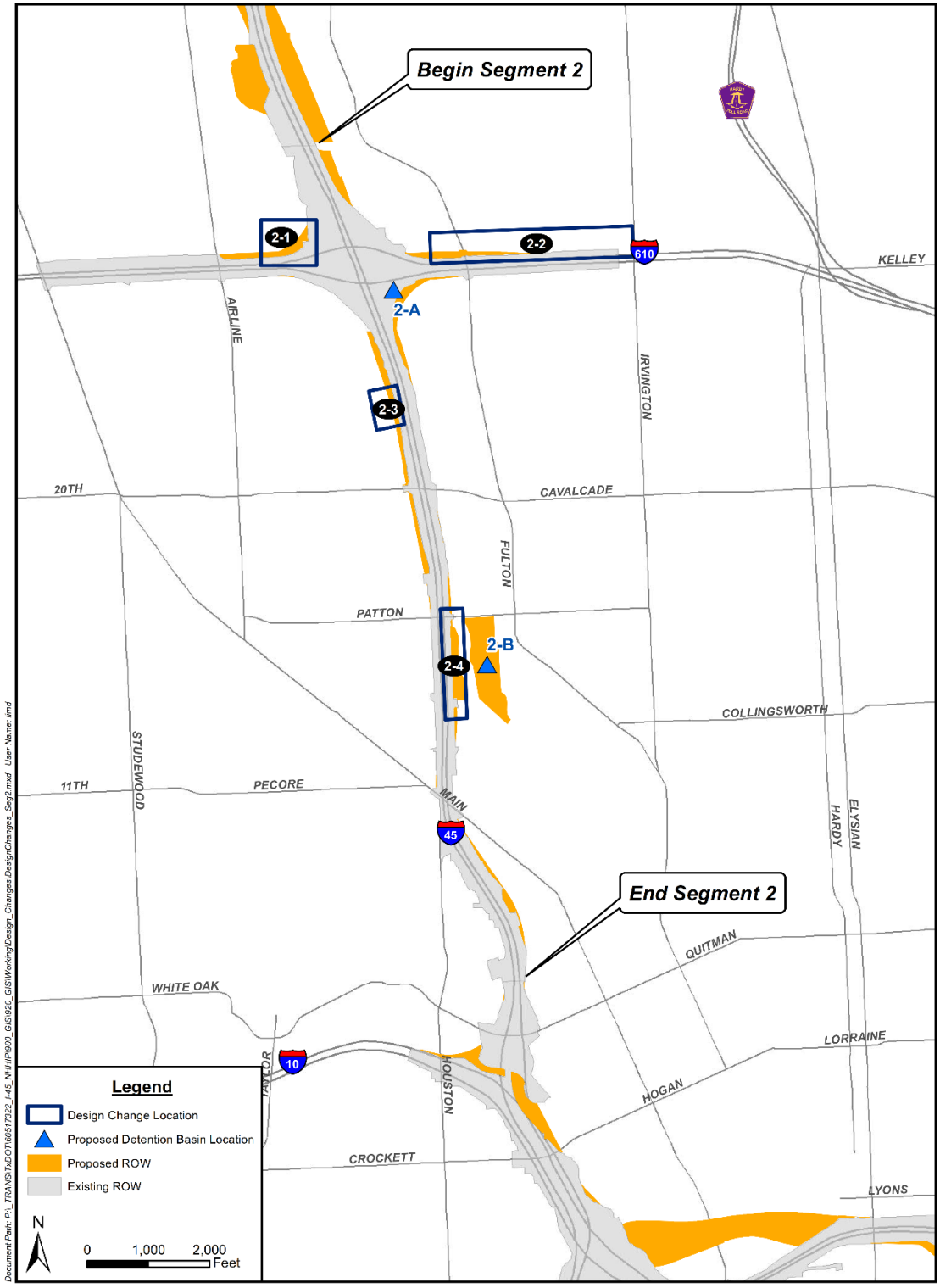
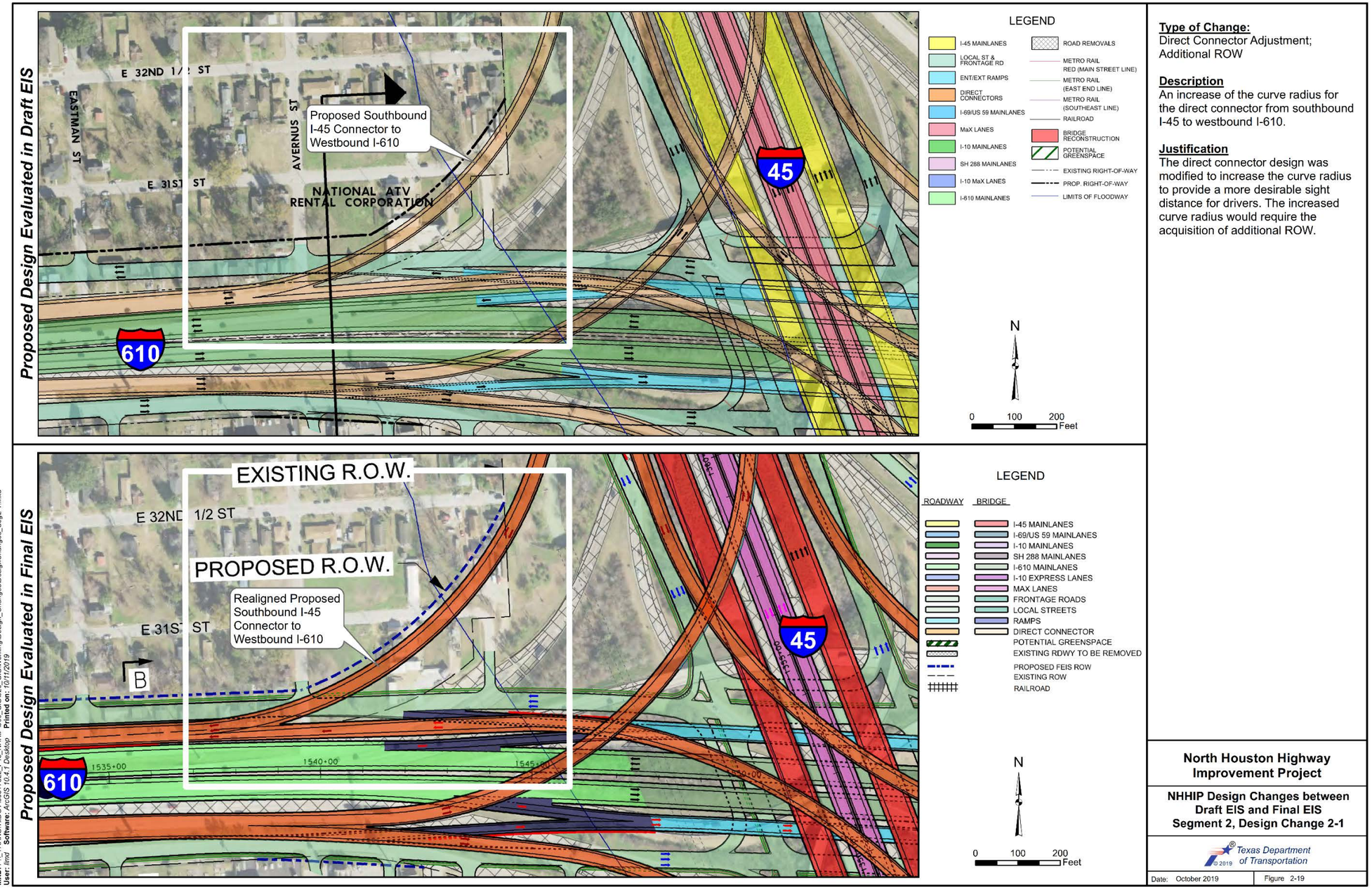


Figure 2-19: Design Change 2-1



Type of Change:
Direct Connector Adjustment; Additional ROW

Description
An increase of the curve radius for the direct connector from southbound I-45 to westbound I-610.

Justification
The direct connector design was modified to increase the curve radius to provide a more desirable sight distance for drivers. The increased curve radius would require the acquisition of additional ROW.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 2, Design Change 2-1

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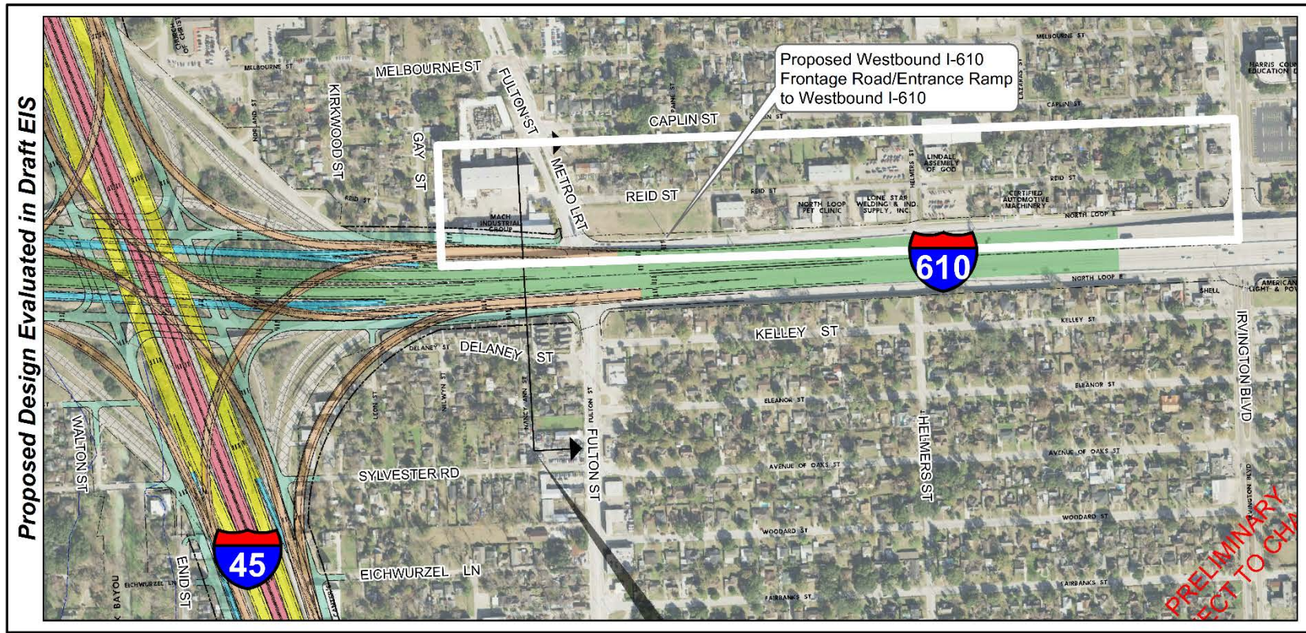
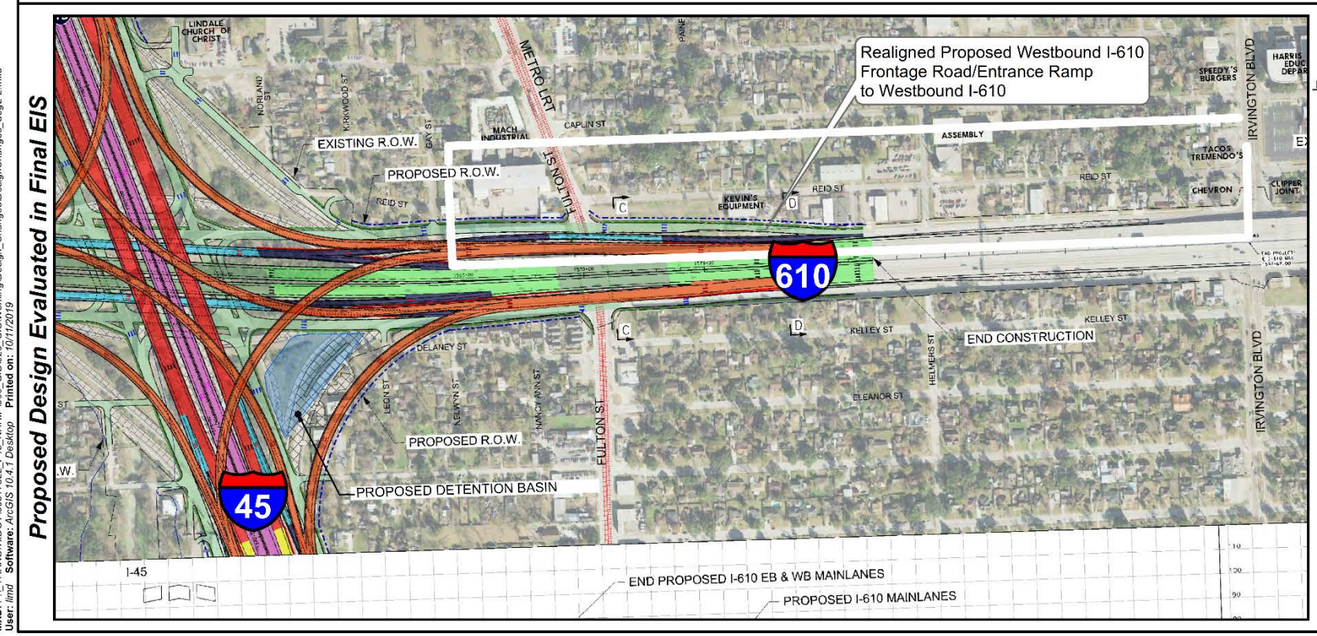
Date: October 2019 Figure 2-19

Figure 2-20: Design Change 2-2





MXD: P:_TRANSITx\DOT\60517322_I-45_NHHIP\900_GIS\920_GIS\Working\Design_Changes\DesignChanges_Seg2-2.mxd
User: lmd Software: ArcGIS 10.4.1 Desktop Printed on: 10/17/2019

Type of Change:
Ramp/Frontage Road Access Change; Additional ROW

Description
Redesign of a proposed westbound frontage road/entrance ramp from Irvington Boulevard to westbound I-610 to be elevated to span the existing METRO light rail tracks along Fulton Street.

Justification
The reconfigured frontage road/ entrance ramp required the replacement of the entrance ramp from Irvington Boulevard to westbound I-610. In response to community comments relating to traffic congestion in this area, the design of the proposed frontage road/entrance ramp was modified to elevate the frontage road over the METRO light rail line along Fulton Street. The design change would require the acquisition of additional ROW.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 2, Design Change 2-2

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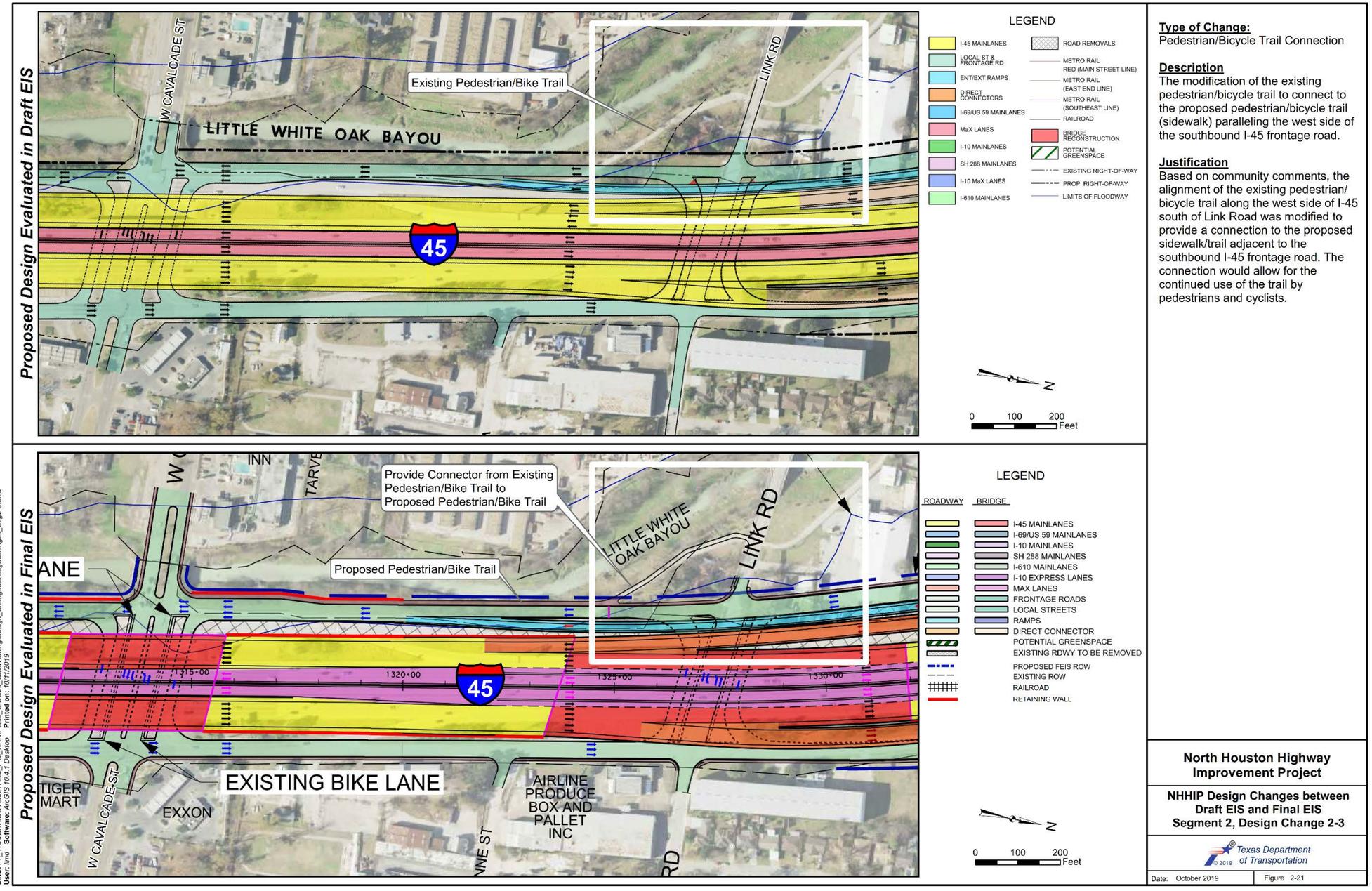
Date: October 2019 Figure 2-20

Figure 2-21: Design Change 2-3



Type of Change:
Pedestrian/Bicycle Trail Connection

Description
The modification of the existing pedestrian/bicycle trail to connect to the proposed pedestrian/bicycle trail (sidewalk) paralleling the west side of the southbound I-45 frontage road.

Justification
Based on community comments, the alignment of the existing pedestrian/ bicycle trail along the west side of I-45 south of Link Road was modified to provide a connection to the proposed sidewalk/trail adjacent to the southbound I-45 frontage road. The connection would allow for the continued use of the trail by pedestrians and cyclists.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 2, Design Change 2-3

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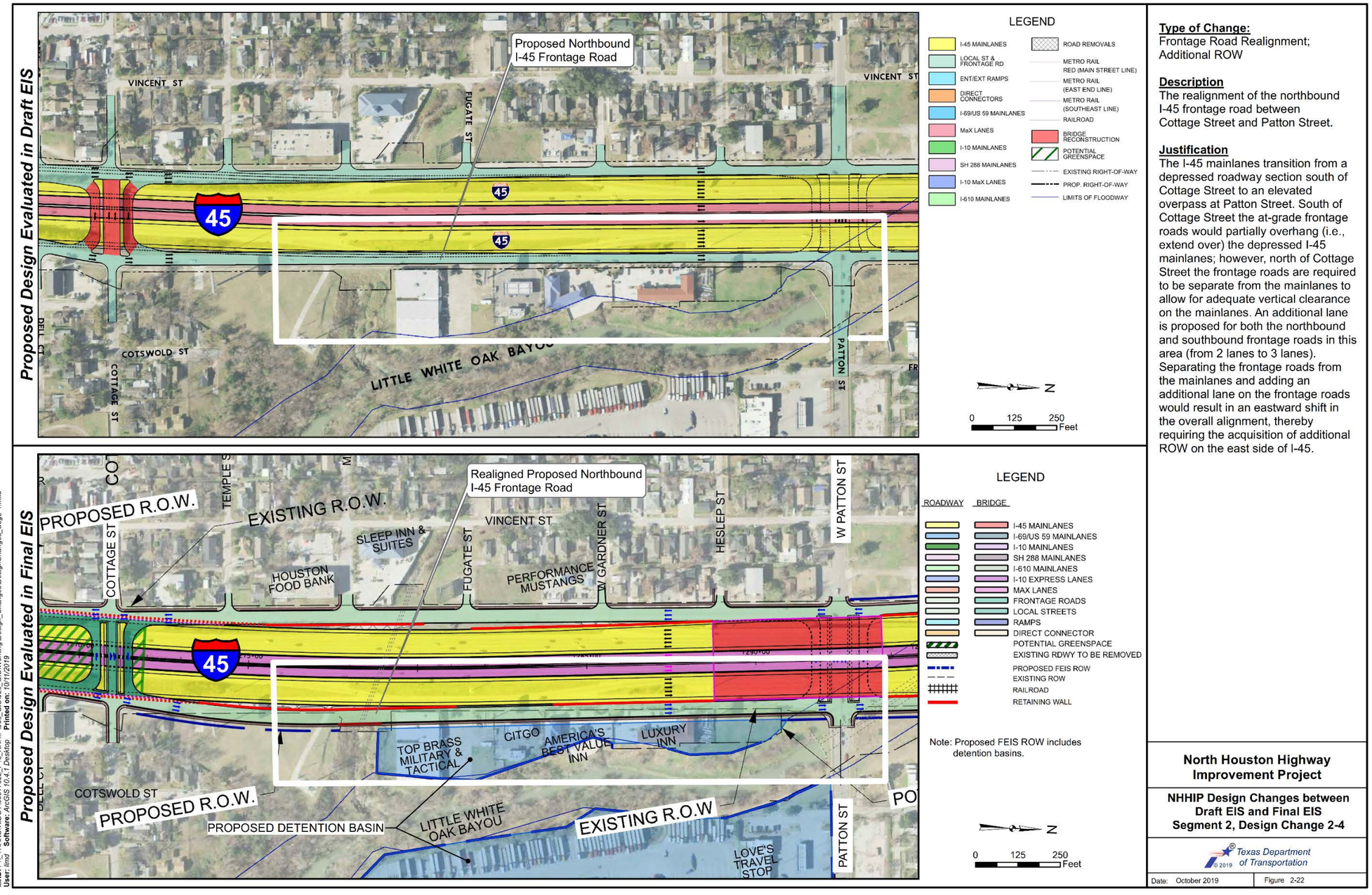
Date: October 2019 Figure 2-21

MXD: P:_TRANSITxDOT\60517322_I45_NHHIP\900_GIS\920_GIS\Working\Design_Changes\DesignChanges_Seg2-3.mxd
User: lmd Software: ArcGIS 10.4.1 Desktop Printed on: 10/17/2019

Figure 2-22: Design Change 2-4



Type of Change:
Frontage Road Realignment; Additional ROW

Description
The realignment of the northbound I-45 frontage road between Cottage Street and Patton Street.

Justification
The I-45 mainlanes transition from a depressed roadway section south of Cottage Street to an elevated overpass at Patton Street. South of Cottage Street the at-grade frontage roads would partially overhang (i.e., extend over) the depressed I-45 mainlanes; however, north of Cottage Street the frontage roads are required to be separate from the mainlanes to allow for adequate vertical clearance on the mainlanes. An additional lane is proposed for both the northbound and southbound frontage roads in this area (from 2 lanes to 3 lanes). Separating the frontage roads from the mainlanes and adding an additional lane on the frontage roads would result in an eastward shift in the overall alignment, thereby requiring the acquisition of additional ROW on the east side of I-45.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 2, Design Change 2-4

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Date: October 2019 Figure 2-22

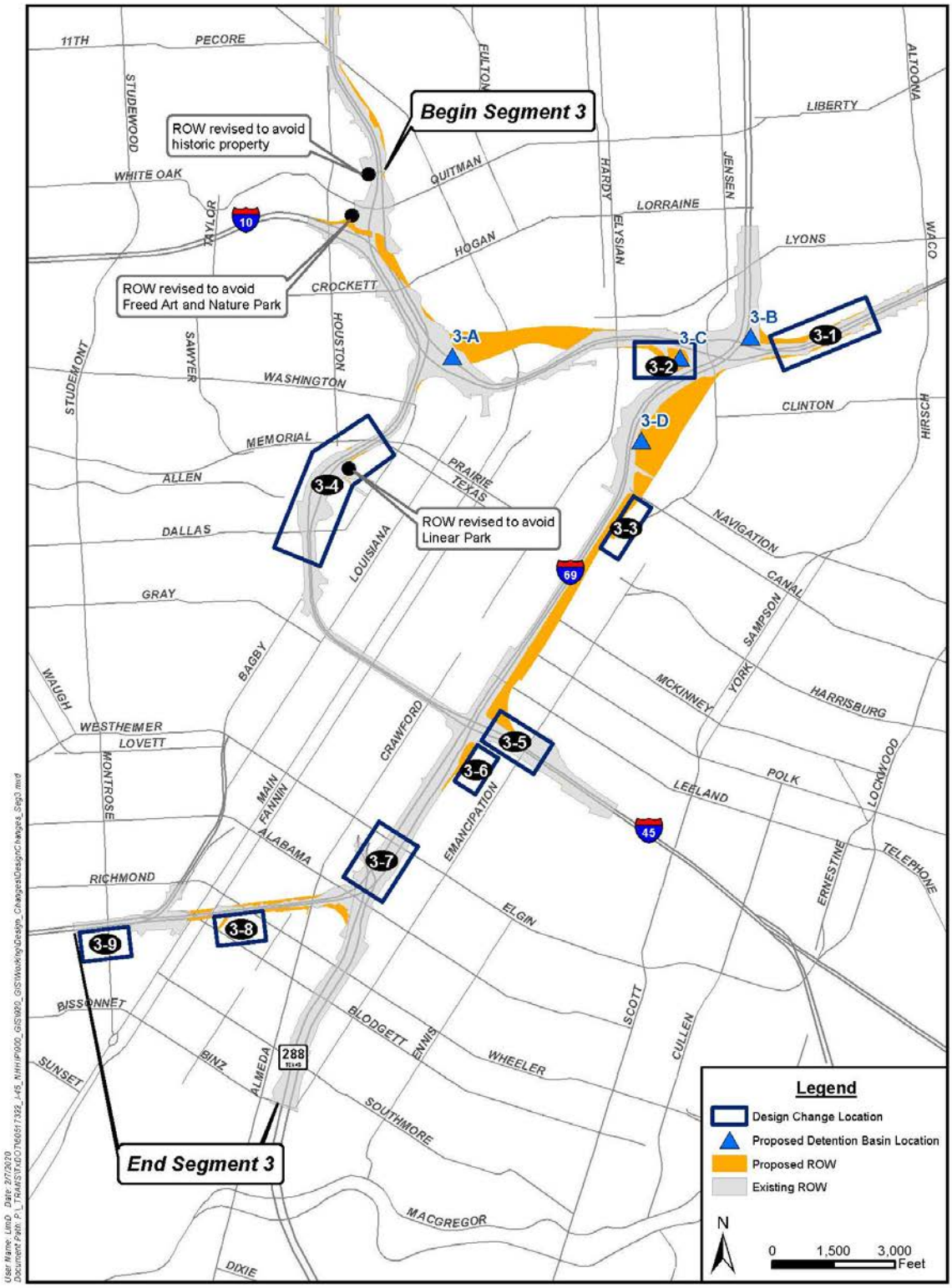
2.3.5.4 Segment 3 Design Changes

The design changes developed for Segment 3 are primarily related to frontage road and surface street realignments, ramp modifications, realignment of the Downtown Connectors, managed lane connections to the Downtown area, and proposed detention basins. The locations of the proposed design changes are shown in Figure 2-23. Figure 2-24 through Figure 2-32 provide detailed drawings, descriptions of many of the design changes, and the reasons for implementing the proposed design changes.

Three design changes noted on Figure 2-23 are not detailed on the following figures:

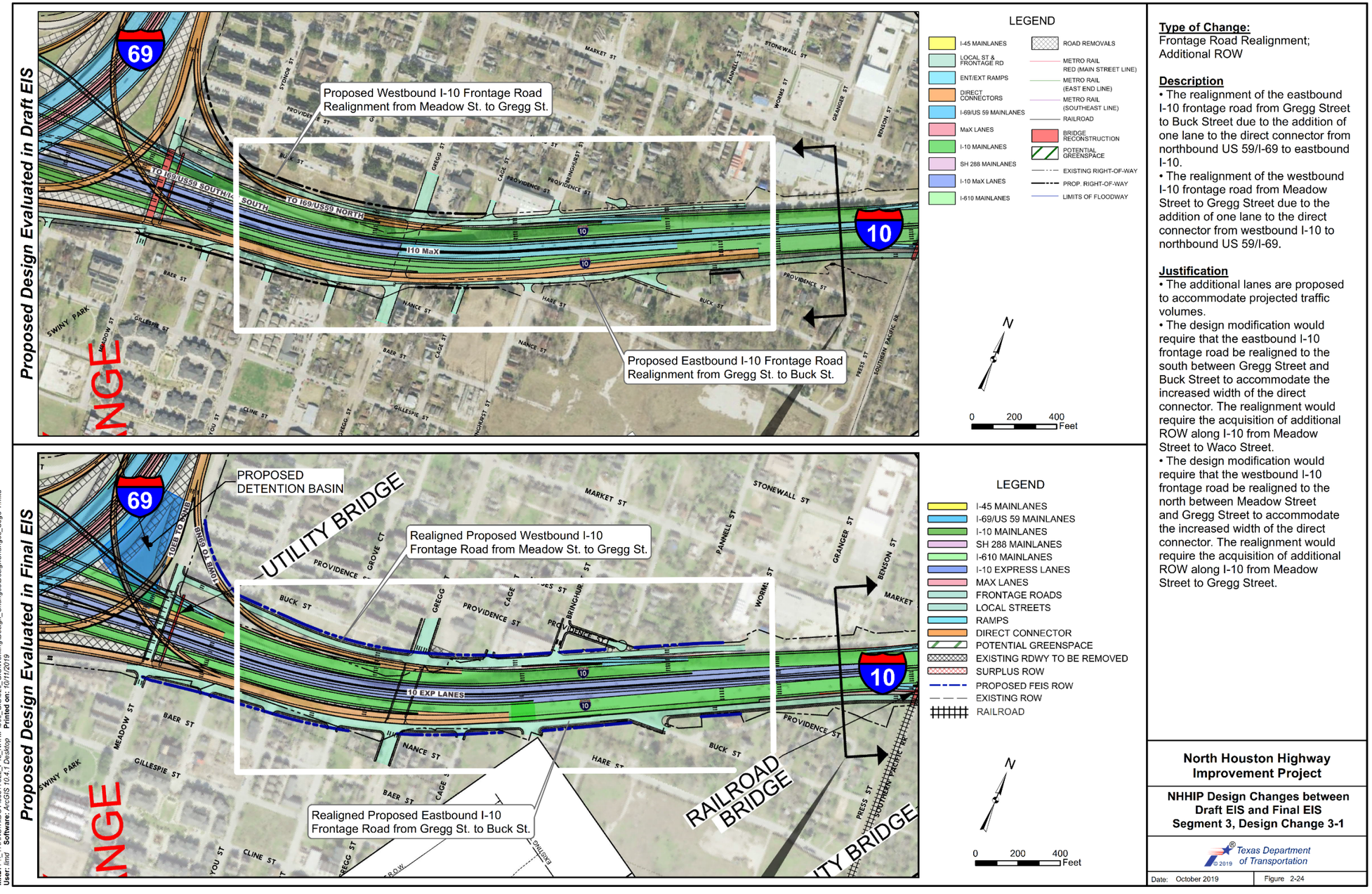
- The project design was modified to avoid ROW acquisition at a historic property on Wrightwood Street in the northern portion of Segment 3.
- The project design was modified to avoid ROW acquisition at Freed Art and Nature Park.
- The project design was modified to avoid ROW acquisition at Linear Park.

Figure 2-23: Locator Map — Design Changes and Proposed Detention Basins – Segment 3



1

Figure 2-24: Design Change 3-1



Type of Change:
Frontage Road Realignment; Additional ROW

Description
- The realignment of the eastbound I-10 frontage road from Gregg Street to Buck Street due to the addition of one lane to the direct connector from northbound US 59/I-69 to eastbound I-10.
- The realignment of the westbound I-10 frontage road from Meadow Street to Gregg Street due to the addition of one lane to the direct connector from westbound I-10 to northbound US 59/I-69.

Justification
- The additional lanes are proposed to accommodate projected traffic volumes.
- The design modification would require that the eastbound I-10 frontage road be realigned to the south between Gregg Street and Buck Street to accommodate the increased width of the direct connector. The realignment would require the acquisition of additional ROW along I-10 from Meadow Street to Waco Street.
- The design modification would require that the westbound I-10 frontage road be realigned to the north between Meadow Street and Gregg Street to accommodate the increased width of the direct connector. The realignment would require the acquisition of additional ROW along I-10 from Meadow Street to Gregg Street.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-1

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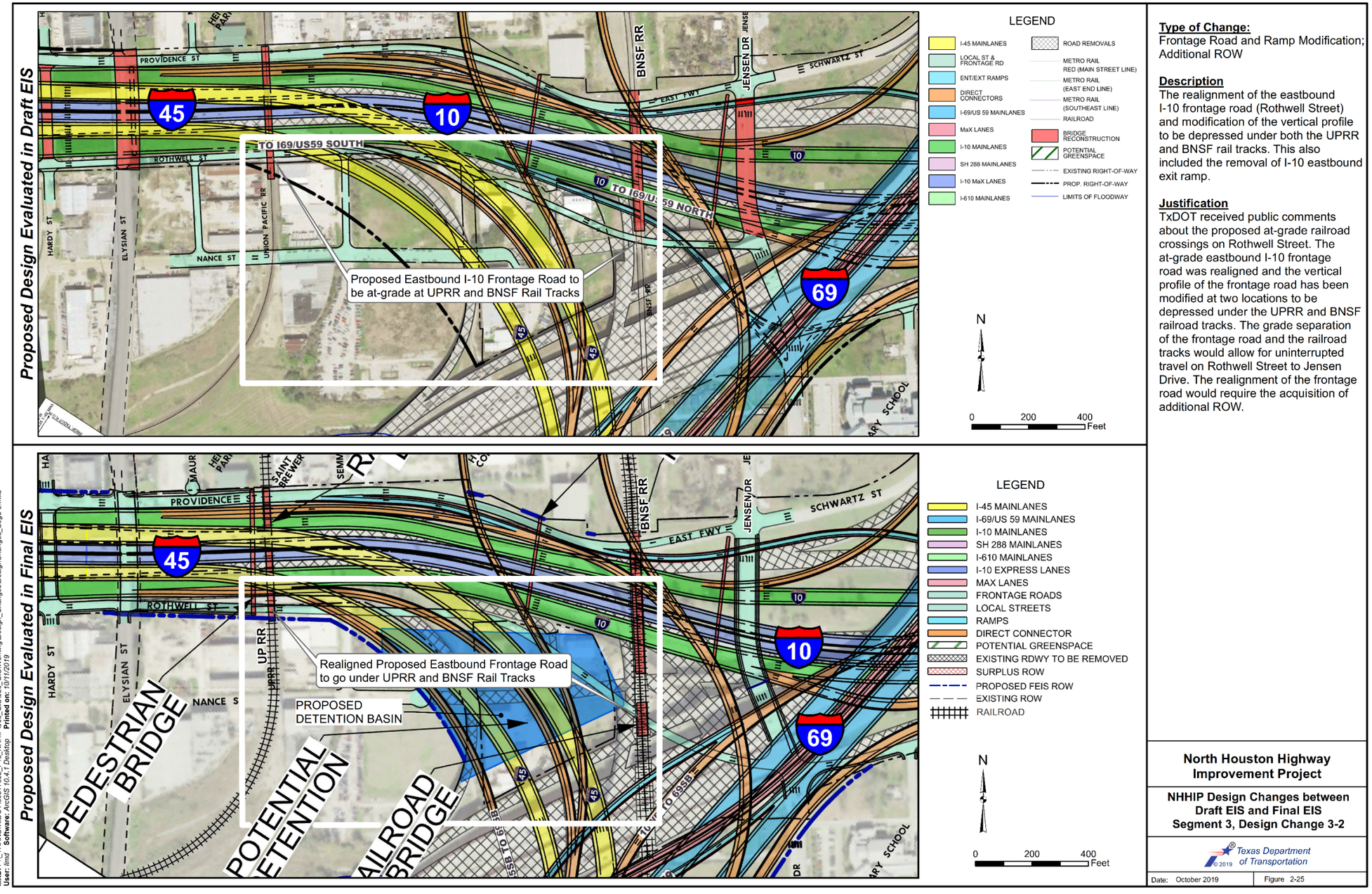
Date: October 2019 Figure 2-24

2

Figure 2-25: Design Change 3-2



Type of Change:
Frontage Road and Ramp Modification; Additional ROW

Description
The realignment of the eastbound I-10 frontage road (Rothwell Street) and modification of the vertical profile to be depressed under both the UPRR and BNSF rail tracks. This also included the removal of I-10 eastbound exit ramp.

Justification
TxDOT received public comments about the proposed at-grade railroad crossings on Rothwell Street. The at-grade eastbound I-10 frontage road was realigned and the vertical profile of the frontage road has been modified at two locations to be depressed under the UPRR and BNSF railroad tracks. The grade separation of the frontage road and the railroad tracks would allow for uninterrupted travel on Rothwell Street to Jensen Drive. The realignment of the frontage road would require the acquisition of additional ROW.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-2

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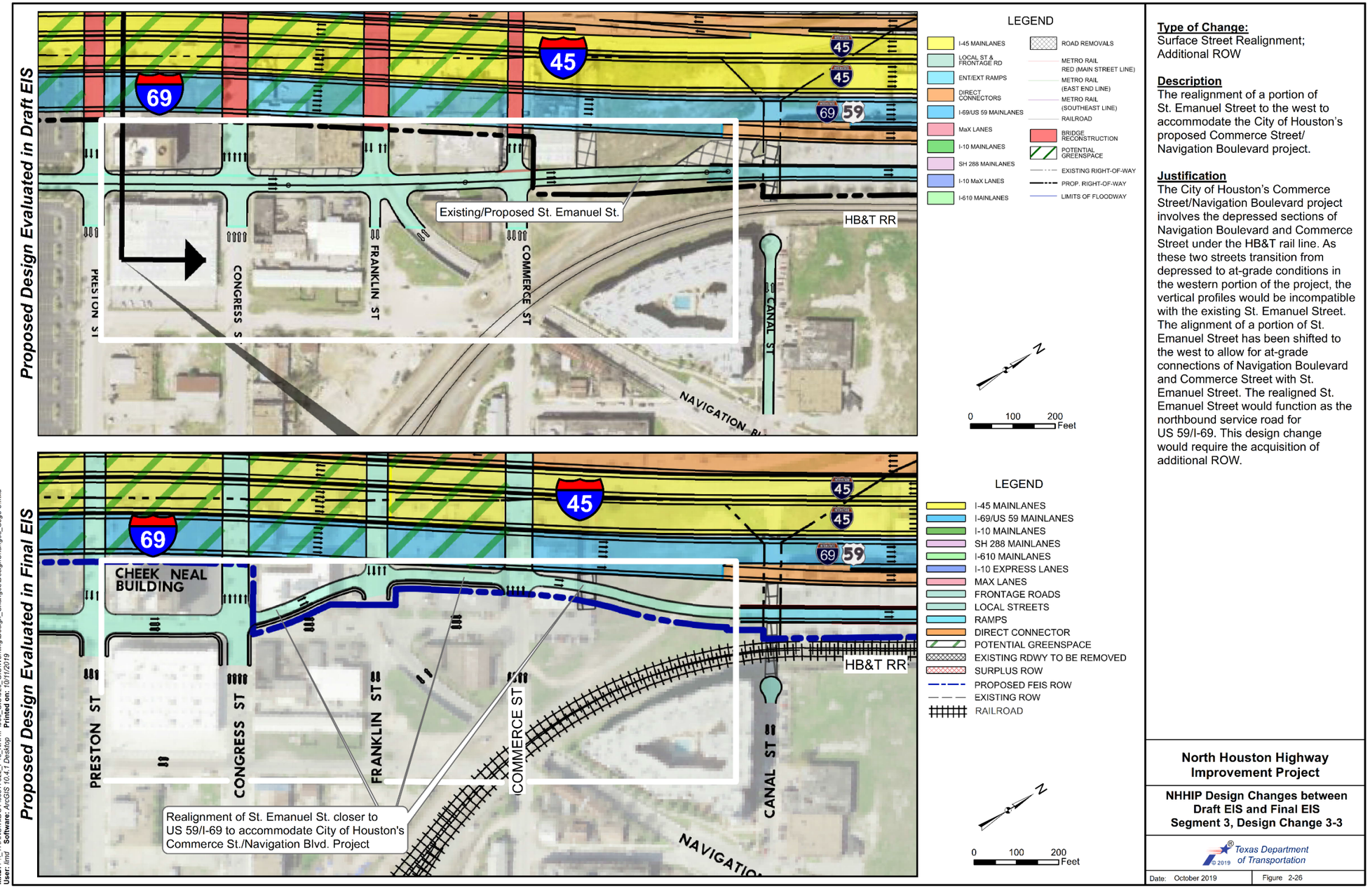
Date: October 2019 Figure 2-25

Figure 2-26: Design Change 3-3



Type of Change:
Surface Street Realignment; Additional ROW

Description
The realignment of a portion of St. Emanuel Street to the west to accommodate the City of Houston's proposed Commerce Street/ Navigation Boulevard project.

Justification
The City of Houston's Commerce Street/Navigation Boulevard project involves the depressed sections of Navigation Boulevard and Commerce Street under the HB&T rail line. As these two streets transition from depressed to at-grade conditions in the western portion of the project, the vertical profiles would be incompatible with the existing St. Emanuel Street. The alignment of a portion of St. Emanuel Street has been shifted to the west to allow for at-grade connections of Navigation Boulevard and Commerce Street with St. Emanuel Street. The realigned St. Emanuel Street would function as the northbound service road for US 59/I-69. This design change would require the acquisition of additional ROW.

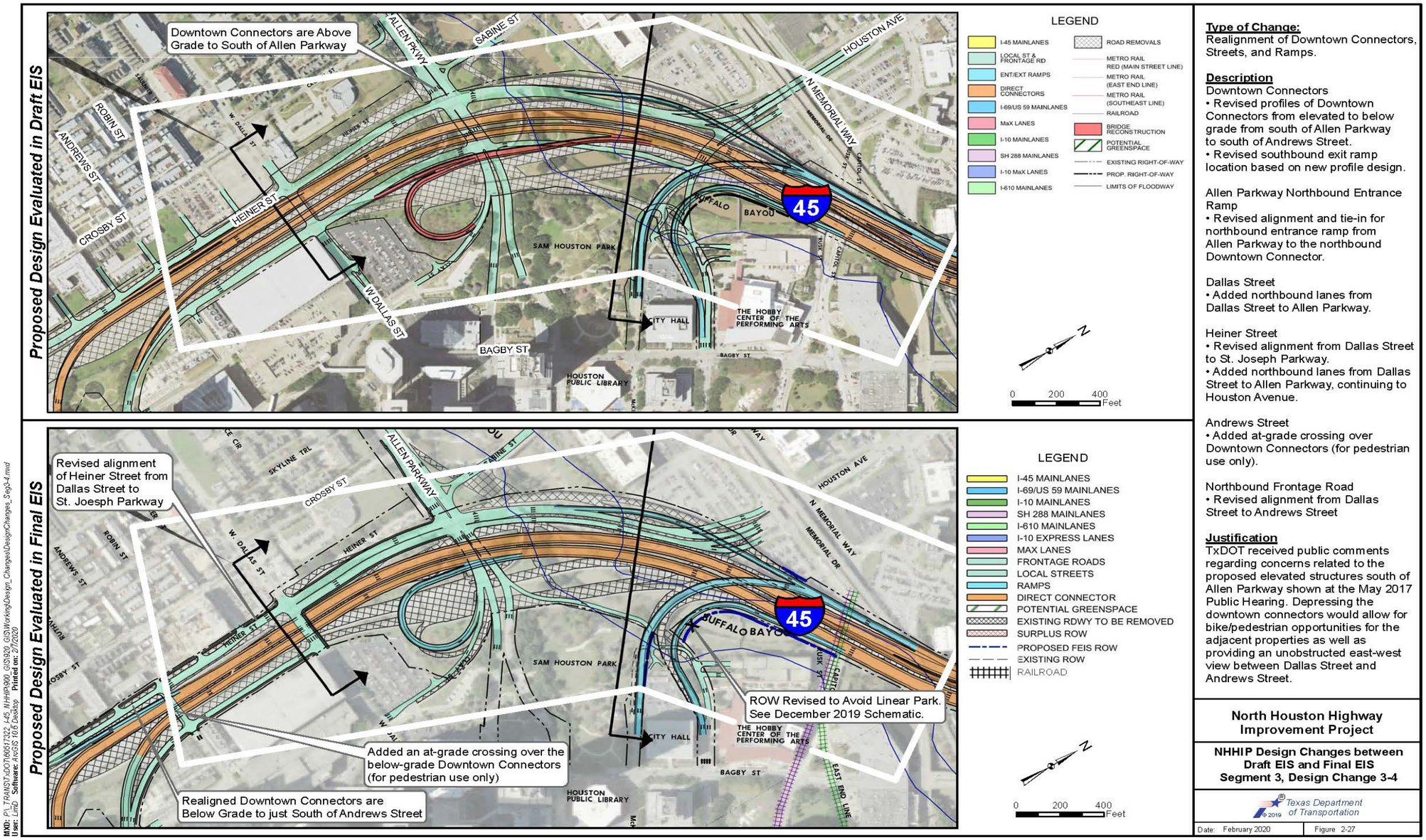
North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-3

Texas Department of Transportation

Date: October 2019 Figure 2-26

Figure 2-27: Design Change 3-4



Type of Change:
Realignment of Downtown Connectors, Streets, and Ramps.

Description
Downtown Connectors
- Revised profiles of Downtown Connectors from elevated to below grade from south of Allen Parkway to south of Andrews Street.
- Revised southbound exit ramp location based on new profile design.

Allen Parkway Northbound Entrance Ramp
- Revised alignment and tie-in for northbound entrance ramp from Allen Parkway to the northbound Downtown Connector.

Dallas Street
- Added northbound lanes from Dallas Street to Allen Parkway.

Heiner Street
- Revised alignment from Dallas Street to St. Joseph Parkway.
- Added northbound lanes from Dallas Street to Allen Parkway, continuing to Houston Avenue.

Andrews Street
- Added at-grade crossing over Downtown Connectors (for pedestrian use only).

Northbound Frontage Road
- Revised alignment from Dallas Street to Andrews Street

Justification
TxDOT received public comments regarding concerns related to the proposed elevated structures south of Allen Parkway shown at the May 2017 Public Hearing. Depressing the downtown connectors would allow for bike/pedestrian opportunities for the adjacent properties as well as providing an unobstructed east-west view between Dallas Street and Andrews Street.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-4

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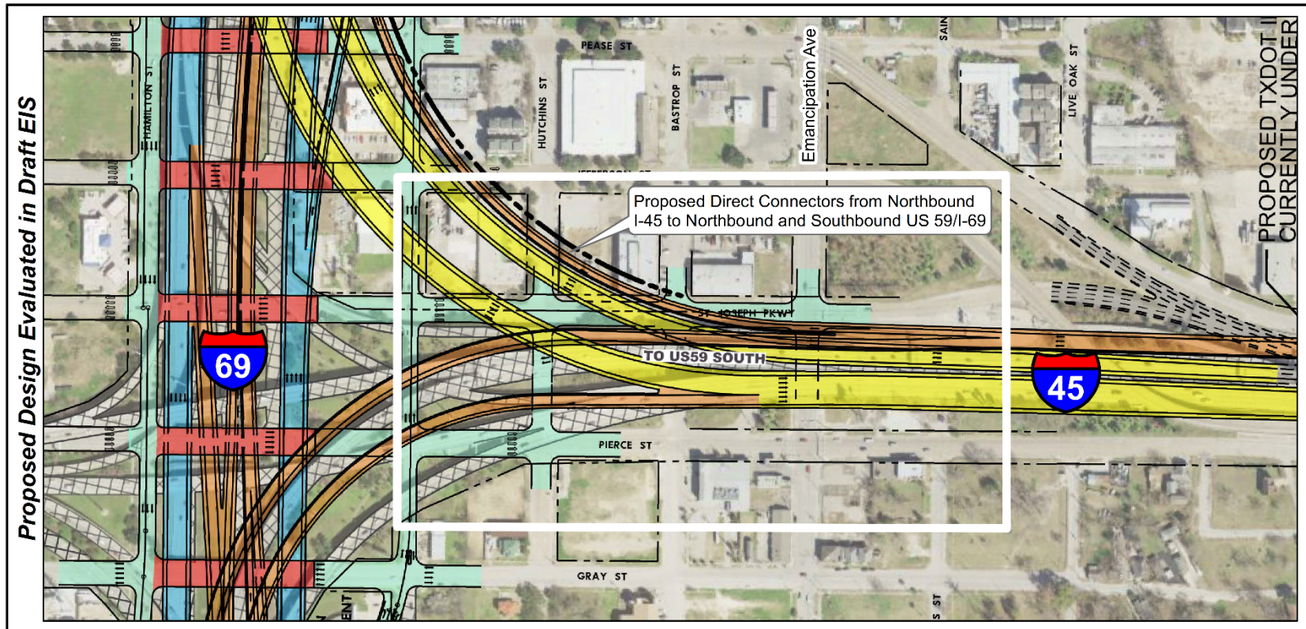
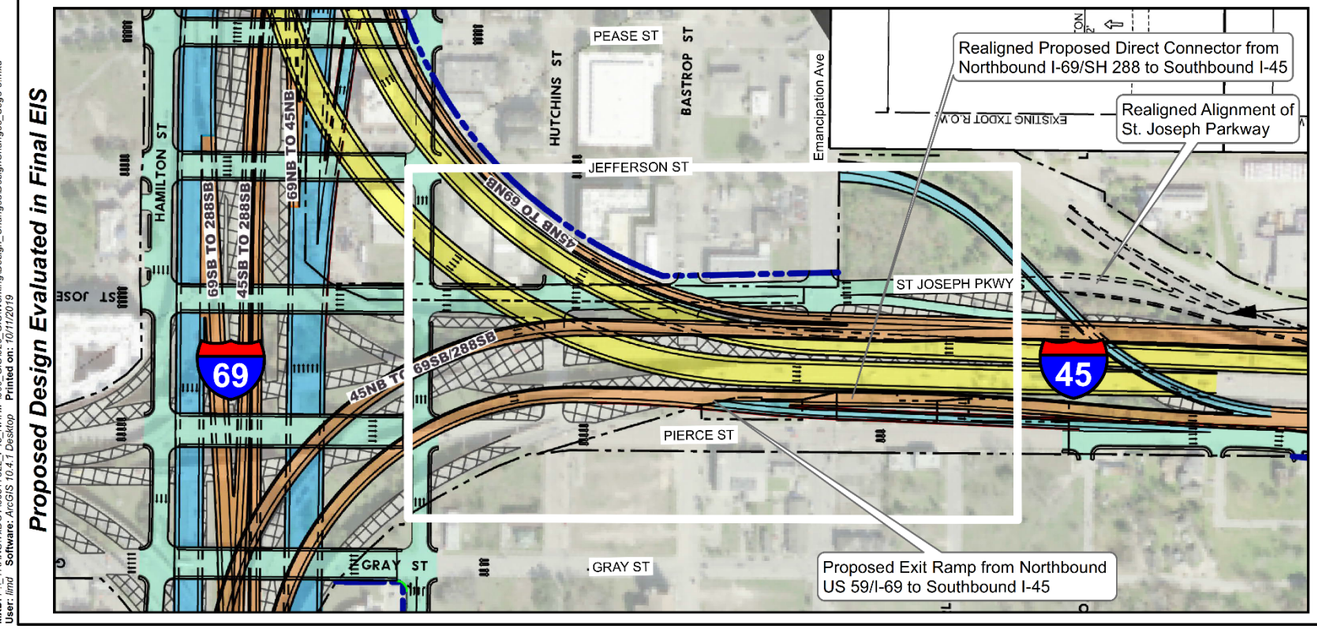
Date: February 2020 Figure 2-27

Figure 2-28: Design Change 3-5





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User: limd Software: ArcGIS 10.4.1 Desktop Printed on: 10/11/2019

Type of Change:
Direct Connector Modification;
St. Joseph Parkway Connection;
Additional ROW

Description
- Modification of the direct connectors from northbound I-45 to northbound and southbound US 59/I-69.
- The addition of an exit ramp from the northbound US 59/I-69 direct connector to southbound I-45.
- The reconfiguration of the northbound I-45 exit and connection to St. Joseph Parkway.

Justification
- Northbound I-45 traffic connecting to either northbound US 59/I-69 or southbound US 59/I-69 would exit from the I-45 northbound mainlanes onto separate lanes leading to the US 59/I-69 direct connectors. Separating the I-45 through traffic from the traffic connecting to US 59/I-69 would relieve congestion at the interchange.
- The addition of an exit ramp from the northbound US 59/I-69 direct connector to southbound I-45 would provide access to the surface street system leading to the University of Houston and other destinations rather than exiting farther south on I-45.
- Reconfiguration of the northbound I-45 exit and connection to St. Joseph Parkway would provide a safer and more desirable link to St. Joseph Parkway and the Downtown surface street system. The reconfiguration would require the acquisition of additional ROW from Hutchins Street to Emancipation Avenue.

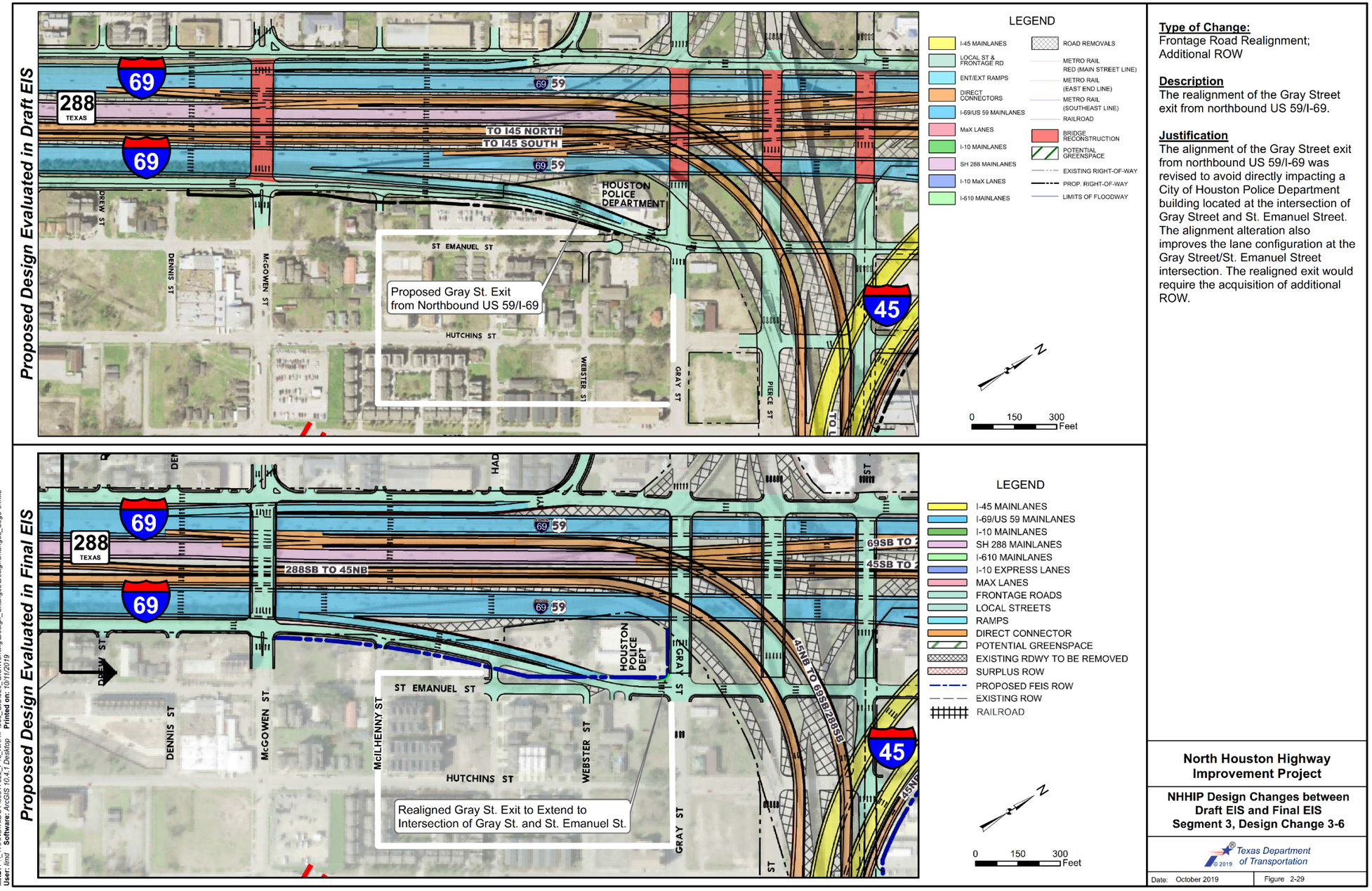
North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-5

Texas Department of Transportation

Date: October 2019 Figure 2-28

Figure 2-29: Design Change 3-6



Type of Change:
Frontage Road Realignment; Additional ROW

Description
The realignment of the Gray Street exit from northbound US 59/I-69.

Justification
The alignment of the Gray Street exit from northbound US 59/I-69 was revised to avoid directly impacting a City of Houston Police Department building located at the intersection of Gray Street and St. Emanuel Street. The alignment alteration also improves the lane configuration at the Gray Street/St. Emanuel Street intersection. The realigned exit would require the acquisition of additional ROW.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-6

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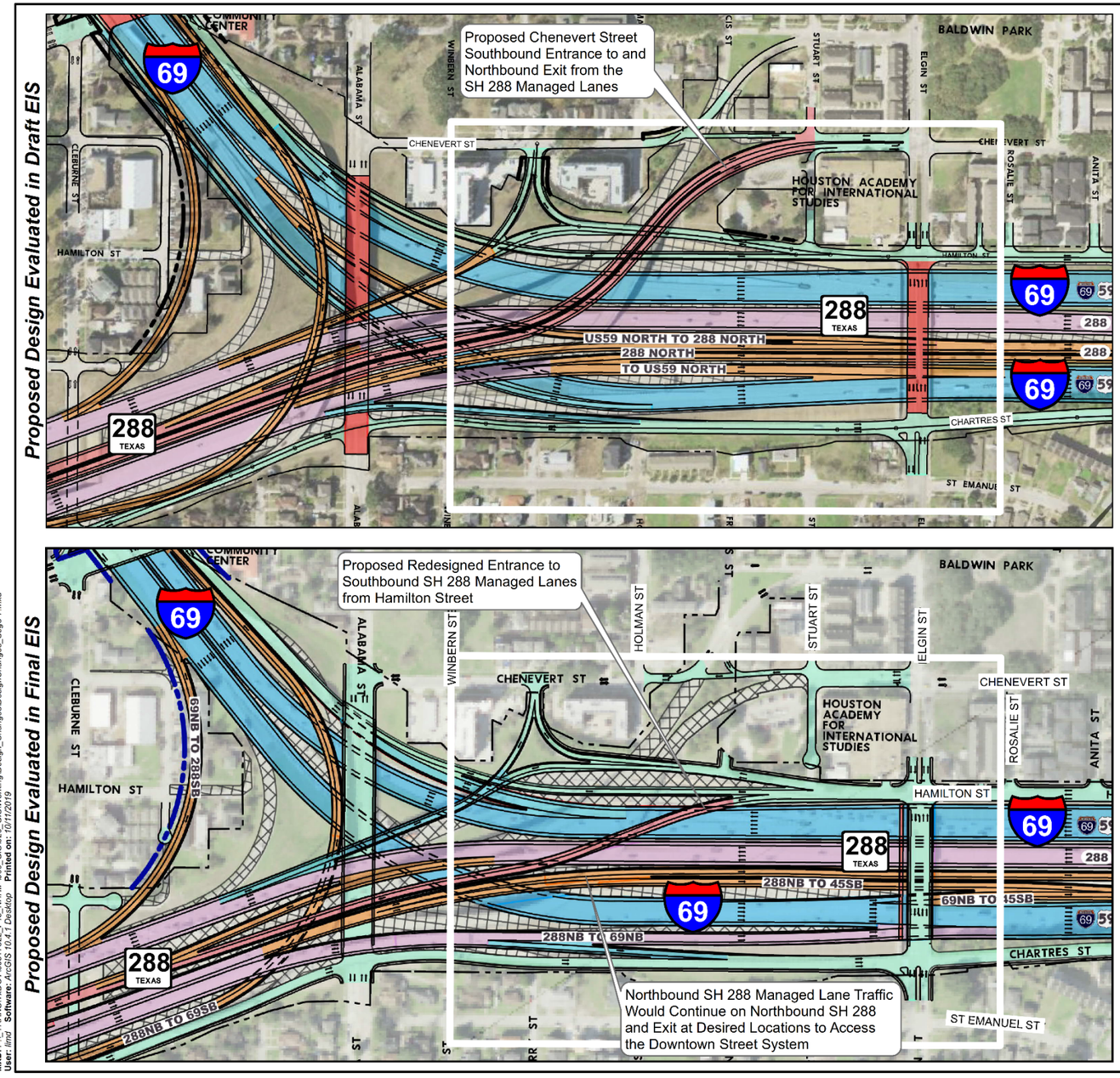
Date: October 2019 Figure 2-29

Figure 2-30: Design Change 3-7



Type of Change:
Redesign of Access to the SH 288 Managed Lanes at the Interchange of SH 288 and US 59/I-69

Description
- Design modification to eliminate the southbound entrance to and the northbound exit from the SH 288 managed lanes at Chenevert Street.
- Design modification to relocate the entrance to the southbound SH 288 managed lanes from Chenevert Street to Hamilton Street.
- Design modification to redirect the northbound SH 288 managed lane traffic onto the northbound SH 288 mainlanes to access the surface street system and Downtown Houston north of the interchange of SH 288 and US 59/I-69.

Justification
Public comments were received regarding the use of Chenevert Street as the entrance to and exit from the SH 288 managed lanes at the interchange of SH 288 and US 59/I-69. The access was redesigned to relocate the SH 288 managed lane access from Chenevert Street to Hamilton Street. This change also results in not impacting the property at 3501 Chenevert Street.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-7

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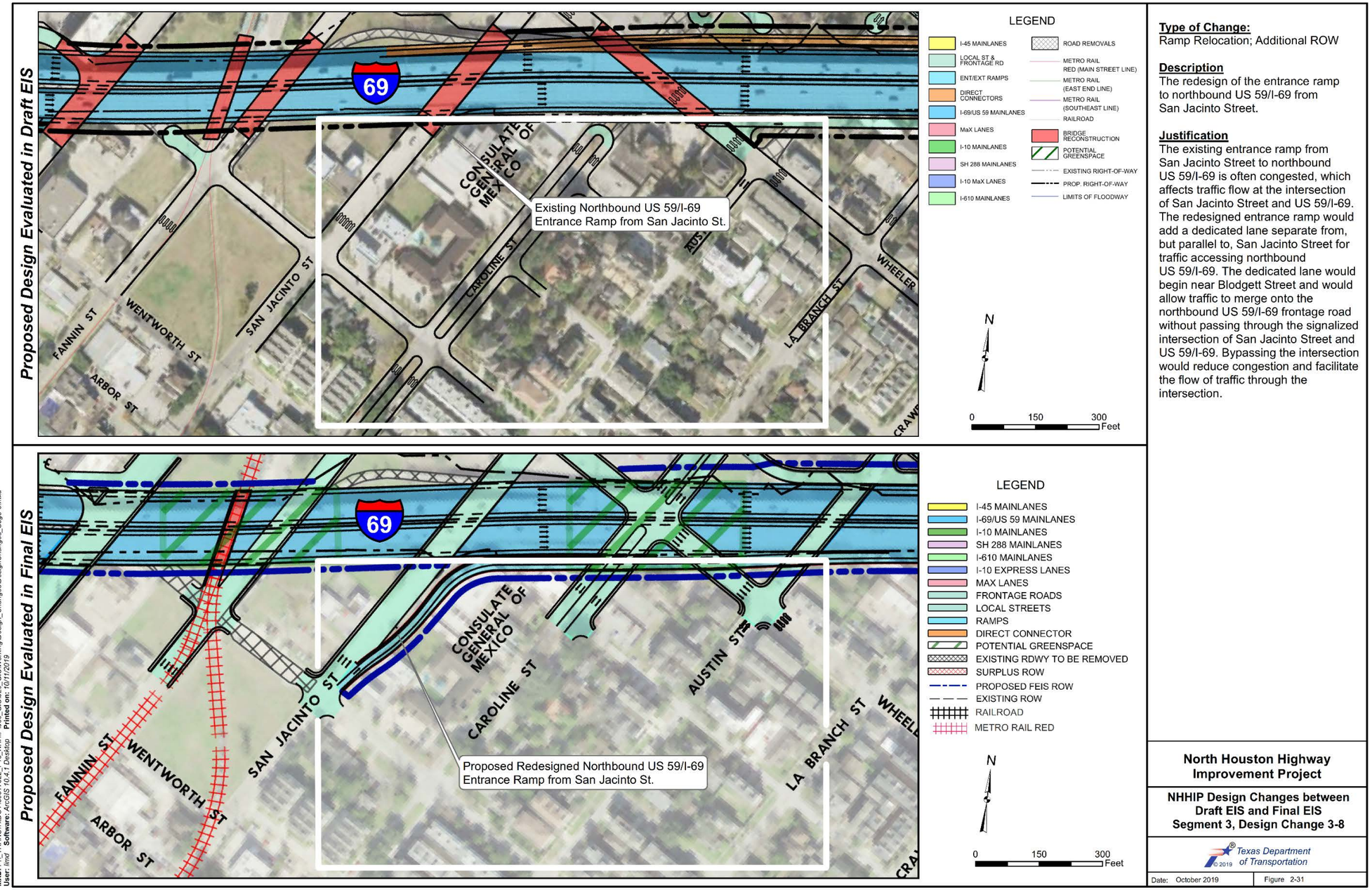
Date: October 2019 Figure 2-30

MXD: P:_TRANSITxDOT\60517322_I-45_NHHIP\900_GIS\920_GIS\Working\Design_Changes\DesignChanges_Seg3-7.mxd
User: limd Software: ArcGIS 10.4.1 Desktop Printed on: 10/17/2019

Figure 2-31: Design Change 3-8



Type of Change:
Ramp Relocation; Additional ROW

Description
The redesign of the entrance ramp to northbound US 59/I-69 from San Jacinto Street.

Justification
The existing entrance ramp from San Jacinto Street to northbound US 59/I-69 is often congested, which affects traffic flow at the intersection of San Jacinto Street and US 59/I-69. The redesigned entrance ramp would add a dedicated lane separate from, but parallel to, San Jacinto Street for traffic accessing northbound US 59/I-69. The dedicated lane would begin near Blodgett Street and would allow traffic to merge onto the northbound US 59/I-69 frontage road without passing through the signalized intersection of San Jacinto Street and US 59/I-69. Bypassing the intersection would reduce congestion and facilitate the flow of traffic through the intersection.

North Houston Highway Improvement Project

NHHIP Design Changes between Draft EIS and Final EIS Segment 3, Design Change 3-8

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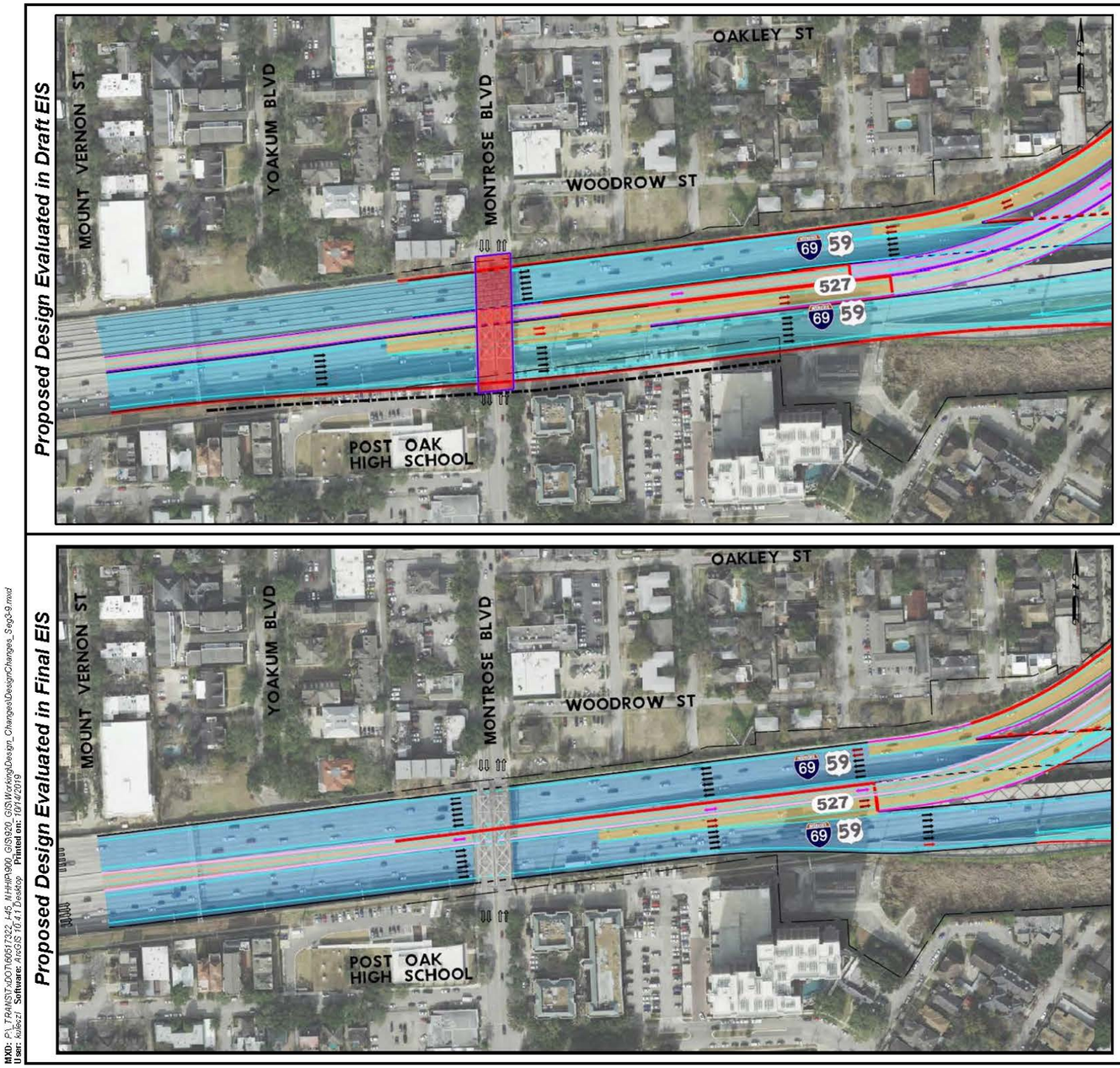
Date: October 2019 Figure 2-31

Figure 2-32: Design Change 3-9



2.3.6 DESCRIPTION OF EXISTING FACILITY AND PREFERRED ALTERNATIVE

The following provides a detailed description of the existing facility by segment and the Preferred Alternative by segment. The Preferred Alternative is evaluated in the Final EIS.

2.3.6.1 Existing Facility

Segment 1: I-45 from Beltway 8 North to north of I-610 (North Loop)

I-45 within this segment consists of eight general purpose lanes (i.e., mainlanes; four lanes in each direction), four to six frontage road lanes (two to three lanes in each direction), and a reversible HOV lane in the middle, all within a variable ROW width of 250 to 300 feet. The existing posted speed limit along the general purpose lanes and reversible HOV lane is 60 mph. The existing posted speed limit for the frontage roads is 45 mph. The length of Segment 1 is approximately 8.8 miles, and the area of the existing ROW is approximately 349 acres.

Segment 2: I-45 from north of I-610 (North Loop) to I-10 (including the interchange with I-610)

I-45 within this segment primarily consists of eight at-grade general purpose lanes (four lanes in each direction), four to six frontage road lanes (two to three lanes in each direction), and a reversible HOV lane in the middle, all within a variable ROW width of 300 to 325 feet. Segment 2 also includes a depressed section that consists of eight general purpose lanes (four lanes in each direction) and a reversible HOV lane in the middle, all below grade, within a 245-foot ROW. The frontage road lanes associated with the depressed section are located at-grade. The existing posted speed limit is 60 mph along the general purpose lanes, 55 mph along the reversible HOV lane, and 40 mph along the frontage road lanes. The I-45 and I-610 frontage roads are discontinuous at the I-45/I-610 interchange. The length of Segment 2 is approximately 4.5 miles, and the area of the existing ROW is approximately 220 acres.

Segment 3: Downtown Loop System (I-45, US 59/I-69, and I-10)

The Downtown Loop System consists of three interstate highways that create a loop around Downtown Houston. I-45 forms the western and southern boundaries of the loop and is known locally as the Pierce Elevated because it partially follows the alignment of Pierce Street. I-10 forms the northern boundary of the loop, and US 59/I-69 forms the eastern boundary of the loop. The loop includes three major interchanges: I-45 and I-10, I-10 and US 59/I-69, and US 59/I-69 and I-45. The interchange of US 59/I-69 and Spur 527 is located southwest of Downtown Houston.

I-45 along the western and southern sides of Downtown consists of six elevated general purpose lanes (three lanes in each direction) within a variable ROW that is typically 205 feet to 320 feet wide. I-10 north of Downtown, between I-45 and US 59/I-69, consists of six general purpose lanes (three lanes in each direction) within an existing ROW width of 420 feet. US 59/I-69 along the east side of Downtown consists of six general purpose lanes (three lanes in each direction) within an existing ROW width of 225 feet. US 59/I-69 south of Downtown from I-45 to Spur 527 has eight general purpose lanes (four in each direction). Generally, local streets serve as one-way frontage roads within Segment 3, except near the I-10 and US 59/I-69 interchange, where the frontage roads are discontinuous. The length of Segment 3, which includes the Downtown Loop System, is approximately 13.1 miles, and the existing ROW is approximately 638 acres.

2.3.6.2 Proposed Facility (Preferred Alternative)

The Preferred Alternative for the proposed project is described below, by study segment. The Preferred Alternative includes changes to the Recommended Alternative (for each segment) presented and evaluated in the Draft EIS. Section 2.3.6 of the Final EIS discusses the design changes, including the proposed locations of storm water detention areas.

Based on current state policy, the managed (MaX) lanes will not be tolled. There are three critical reasons for TxDOT to continue with the proposed four-lane, bi-directional MaX lanes:

- TxDOT is required to continue providing the ability to accommodate HOV/bus/transit service in the I-45 corridor; the MaX lanes would accommodate HOV along with the other modes of travel.
- In November 2019, the METRONext bond proposal was approved by the voters. METRO's plan includes the use of the proposed I-45 MaX lanes to accommodate planned METRORapid BRT system.
- Future technologies / Automated Vehicles / Connected Vehicles: as a dedicated, separated facility from the general purpose lanes, the MaX lanes will easily accommodate future automated technologies. Automated Vehicles / Connected Vehicles can travel closer together than traditional vehicles and thus the capacity of the MaX lanes will be higher than what the H-GAC 2040 RTP predicts. METRO has previously explored connected buses that will be able to utilize the MaX lanes when METRO has the bus technology.

TXDOT has begun acquiring ROW in Segment 3 and, to a much lesser extent, in Segments 2 and 1. The advance acquisition did not influence the environmental assessment of the project, the decision relative to the need to construct the project, the consideration of any alternatives, or the selection of the project design or location.

Segment 1: I-45 from Beltway 8 North to north of I-610 (North Loop)

The Preferred Alternative would widen the existing I-45 primarily on the west side of the roadway to accommodate four managed express (MaX) lanes. The proposed typical section would include eight to ten general purpose lanes (four to five lanes in each direction), four MaX lanes (two lanes in each direction), and four to six frontage road lanes (two to three lanes in each direction). Between Tidwell Road and I-610, there would be 12 general purpose lanes (six in each direction) to accommodate ramps and connections to and from I-610. The general purpose lanes and MaX lanes would be at-grade except at major cross streets, where they would be elevated over the intersecting streets. Approximately 200 to 225 feet of new ROW would be required for the roadway widening, mostly to the west of the existing I-45. New ROW would also be required on the west side of I-45 for proposed storm water detention areas. New ROW would be required to the east of the existing I-45 ROW at intersections with major streets and between Crosstimbers Street and I-610. Approximately 246 acres of new ROW would be required in Segment 1.

Segment 2: I-45 from north of I-610 (North Loop) to I-10 (including the interchange with I-610)

The Preferred Alternative would widen the existing I-45 to accommodate four MaX lanes. The proposed typical section would include ten general purpose lanes (five lanes in each direction), four MaX lanes (two lanes in each direction), and four to six frontage road lanes (two to three lanes in each direction). From north of Cottage Street

to Norma Street, the general purpose lanes and the MaX lanes would be depressed, while the frontage road lanes would be at-grade. The proposed I-45 and I-610 frontage roads would be continuous through the I-45/I-610 interchange. New ROW would be required from both the east and west sides of the existing I-45. The new ROW would include proposed storm water detention areas on the east side of I-45, south of Patton Street. Approximately 44 acres of new ROW would be required in Segment 2. The Preferred Alternative provides a structural "cap" over a portion of the depressed lanes of I-45 from north of Cottage Street to south of N. Main Street. Future use of the structural cap area for another purpose would require additional development and funding by entities other than TxDOT.

Segment 3: Downtown Loop System (I-45, US 59/I-69, and I-10)

The Preferred Alternative would reconstruct all the existing interchanges in the Downtown Loop System and reroute I-45 to be parallel to I-10 on the north side of Downtown and parallel to US 59/I-69 on the east side of Downtown. Access to the west side of Downtown would be provided via "Downtown Connectors" that would consist of entrance and exit ramps for various Downtown streets. A section of the Downtown Connectors would be below-grade (depressed) between approximately W. Dallas Street to Andrews Street. The existing elevated I-45 roadway along the west and south sides of Downtown would be removed. The portion of I-45 (Pierce Elevated) between Brazos Street and US 59/I-69 could be left in place for future use and redevelopment by others; however, an alternative use for the structure is not proposed by TxDOT and is not evaluated in this Final EIS.

To improve safety and traffic flow in the north and east portions of Segment 3, portions of both I-10 and US 59/I-69 would be realigned (straightened) to eliminate the current roadway curvature. I-45 and US 59/I-69 would be depressed along a portion of the alignment east of Downtown. South of the George R. Brown Convention Center, the rerouted I-45 would begin to elevate to tie to existing I-45 southeast of Downtown, while US 59/I-69 would remain depressed as it continues southwest toward Spur 527. US 59/I-69 would be widened from 8 to 12 general purpose lanes between I-45 and SH 288, and would be reconstructed to ten general purpose lanes from SH 288 to Spur 527.

The four proposed I-45 MaX lanes in Segments 1 and 2 would terminate/begin in Segment 3 at Milam Street/Travis Street, respectively. I-10 express lanes (two lanes in each direction) would be located generally in the center of the general purpose lanes within the proposed parallel alignment of I-10 and I-45 on the north side of Downtown. The I-10 express lanes would vary between being elevated and at-grade.

New ROW to the east of the existing US 59/I-69 along the east side of Downtown would be required to accommodate the proposed realigned I-45. A new continuous southbound access road would be provided adjacent to US 59/I-69 and would tie to existing Hamilton Street on the south side of the Convention Center. The existing St. Emanuel Street would serve as a northbound access road. The project ROW would include areas to be developed as storm water detention. Approximately 160 acres of new ROW would be required, the majority of which would be for the I-10 and US 59/I-69 realignments (straightening) and to construct the proposed I-45 lanes adjacent to US 59/I-69 along the east side of Downtown.

The Preferred Alternative provides a structural "cap" over the proposed depressed lanes of I-45 and US 59/I-69 from approximately Commerce Street to Lamar Street. There would also be a structural cap over the depressed lanes of US 59/I-69 between approximately Main Street and Fannin Street, and in the area of the Caroline

Street/Wheeler Street intersection. Future use of the structural cap areas for another purpose would require additional development and funding by entities other than TxDOT. For the latest schematics of the Preferred Alternative please visit: http://www.ih45northandmore.com/.

3 AFFECTED ENVIRONMENT AND CONSEQUENCES

This chapter summarizes information building on the Draft EIS analysis and from various technical reports, referenced herein. See Appendix A Project Location Map for basic orientation. A variety of detailed maps supporting components of this analysis are available within individual technical reports.

3.1 Land Use

This section describes current land use patterns and development trends in the proposed project area and the potential effect of the Preferred Alternative on existing land uses and proposed developments. Land uses are identified within a one-half-mile distance from the existing project corridor ROW, and direct impacts are estimated in the proposed ROW of the Preferred Alternative. Existing land uses were based on H-GAC's Geographic Information System (GIS) data (H-GAC 2018b). Detailed information on the methodology and existing conditions of land use discussions is provided in Appendix F: *Community Impacts Assessment Technical Report.* Exhibits showing land uses within the proposed project area are also provided in this appendix.

3.1.1 EXISTING CONDITIONS

The NHHIP crosses through urban and developing areas. The majority of the project is located in the city limits of Houston, but in Segment 1 the Preferred Alternative would cross a portion of the Harris County Municipal Utility District (MUD) 321 and Fallbrook Utility District boundaries. MUD 321 and Fallbrook Utility District, located west of I-45 between Fallbrook Drive and West Mount Houston Road, are part of the City's extra-territorial jurisdiction (ETJ). This is a limited-purpose annexation area in which the City of Houston provides a limited array of services such as water and sewer service; however, these properties are not assessed for city taxation purposes.

3.1.1.1 Existing Land Use

Segment 1: I-45 from Beltway 8 to I-610

The Segment 1 study area is primarily comprised of residential and commercial land uses. Commercial development is concentrated along the frontage roads of I-45, and residential areas are located along both sides of the I-45 corridor. A few residential areas front the freeway on the east and west side. Industrial and public/institutional land uses are located along the frontage roads and throughout the entire Segment 1 study area.

Parks and open space account for approximately one percent of the total land uses in the Segment 1 study area. A few channels and streams cross I-45. Halls Bayou crosses Segment 1 just north of Mount Houston Road, and Little White Oak Bayou runs along the west side of I-45 between Tidwell Road and I-610 but does not cross the freeway in the Segment 1 corridor.

Segment 2: I-45 from I-610 to I-10

The Segment 2 study area is comprised mostly of residential land use. Residential development is located east and west of the existing I-45 ROW, and some residential areas are adjacent to the freeway. Commercial development occurs primarily along I-45, Airline Drive, North Main Street, and Fulton Street.

Larger areas of commercial uses include various retail establishments located southwest of the I-45/I-610 interchange. Public/institutional uses, industrial uses, and undevelopable lands are dispersed throughout the segment study area.

Parks and open space account for approximately five percent of the total land uses in the Segment 2 study area. Montie Beach Park and Woodland Park are located on west side of I-45, and Moody Park is located on the east side of I-45. Little White Oak Bayou runs generally parallel to the I-45 corridor and passes under the freeway between Patton Street and Quitman Street. Existing bike paths are located west of I-45 along Little White Oak Bayou between Link Road and Cavalcade Street, and the City's latest long-term bikeway vision plan includes future bike paths and trails along Little White Oak Bayou and through Moody Park on the east side of I-45 (City of Houston 2019a). Little White Oak Bayou has historically limited development adjacent to I-45 in this area. The Historic Hollywood and Holy Cross Catholic cemeteries are located between I-45 and the Little White Oak Bayou where it curves around the Near Northside neighborhood.

Segment 3: Downtown Loop System

The Segment 3 study area is a densely developed area that is comprised primarily of residential, commercial, and existing transportation/utility land uses. One percent of the Segment 3 study area is considered undevelopable land use, which includes storm water detention areas, drainage channels, bayous, and waterbodies. Commercial and multiple purpose land uses are concentrated in the central portion of the Segment 3 study area, and residential land use is located primarily outside of the Downtown Loop. Industrial land use is located east of Downtown and along I-10.

Parks and open space account for approximately three percent of the total land uses in the Segment 3 study area. Parks/open space uses include White Oak Parkway, Freed Art and Nature Park, Hogg Park, and Stude Park located north of I-10 along White Oak Bayou; Tinsley/Jamail Skate Park located west of I-45 along Buffalo Bayou; and several park areas in the Downtown Loop. Public use facilities in the Segment 3 study area include libraries, government buildings, universities, stadiums, sport arenas, and theaters.

3.1.1.2 Local Land Use Plans and Policies

The project study area is mostly located within the City of Houston jurisdiction. The City is not zoned for different types of development; however, the City of Houston Legal Department assists with the "enforcement of recorded deed restrictions for the protection of neighborhoods, for the benefit of all residents, citizens, and taxpayers of the City, and to promote the health, safety, morals, and general welfare of the City". (City of Houston 2019b)

In 2015, the City of Houston adopted their first general plan. *Plan Houston* is a tool to guide future growth and establish long-range planning policies. The plan identifies the community vision and goals and core strategies to achieving the vision. (City of Houston 2019c) Additionally, H-GAC has completed Livable Center Planning Studies and Complete Communities Action Plans for various communities within the project study area that identify specific recommendations to improve mobility and livability within each community. While these studies provide guidance for future growth and development, they do not establish land use regulations or zoning districts.

3.1.1.3 Planned and Proposed Land Uses

Segment 1: I-45 from Beltway 8 to I-610

The Segment 1 study area is mostly developed, and approximately one percent of property in the study area is vacant developable land. A large tract of recently developed land, which is located in the northern portion of Segment 1, is the 971-acre Pinto Business Park located on the west side of I-45 between Beltway 8 and West Road. Initial developments started in this business park in 2014 and the Amazon Fulfillment Center began operation in July 2017 (Houston Business Journal 2018). No other planned developments are proposed in the study area.

The City's long-term bikeway vision plan includes future bike paths along Little White Oak Bayou (City of Houston 2019a). Long-term vision bikeway projects support the City's goal of providing citywide access; however, these projects do not have dedicated funding or an established implementation schedule. Long-term projects are likely to be capital-intensive or require street reconstruction.

Segment 2: I-45 from I-610 to I-10

The Segment 2 study area is largely built-out and only one percent of property in the study area is developable vacant land. No planned developments were identified in the Segment 2 study area.

Segment 3: Downtown Loop System

The Segment 3 study area is mostly built-out and only one percent of property in the study area is developable vacant land. As the City continues to grow, Downtown and the surrounding neighborhoods are redeveloping. Several office towers, multi-family unit complexes, hotels, and mixed-use developments are under construction or planned inside of the Downtown Loop. Other planned developments in the vicinity include the expansion of the Memorial Hermann Hospital located south of the Downtown area. Midtown, which was originally a commercial district, is undergoing residential redevelopment but still has significant areas of commercial development. Higher density residential land use, such as townhouses and apartment buildings, and mixed-use development are increasing in older neighborhoods to the west, east, and south of central Downtown. The area east of Downtown is experiencing high- to medium-density residential redevelopment, but this area is still comprised largely of industrial land use. The former UPRR railyard, located two blocks north of I-10 between I-45 and US 59/I-69, has been redeveloped to a 43-acre site for residential, retail, and office development. The Residences at Hardy Yards is a mixed-use complex that will ultimately include 350 apartment units, a music center, retail shops, restaurants, and business centers. Of the 350 apartments, 179 units of affordable workforce housing are targeted to renters who earn $40,000-$50,000 per year (Zieben 2019a, 2019b).

Several residential developments are planned in the Greater Fifth Ward. The Midway East River Development is a proposed 150-acre master planned community located southeast of the I-10 and US 59/I-69 interchange along the banks of the Buffalo Bayou. The proposed development will be constructed in multiple phases over 10 years and will includes a mix of office, residential, restaurant, retail, and park space (Midway 2018). Sheffield Green subdivision is a proposed residential development on 10.4 acres of land south of the I-10 and US 59/I-69 interchange between Buffalo Bayou and Jensen Drive. The proposed subdivision would include 150 single-family residential lots. A Subdivision Final Plat

application was filed with the City of Houston Planning and Development Commission in 2017 (City of Houston 2017b). Bayou Fifth is another proposed residential development on a former Superfund site located south of I-10 between Bringhurst Street and Hirsch Road. Remediation of the 36-acre site is complete, and the redevelopment can move forward (Environmental Protection Agency [EPA] 2008). A Subdivision Final Plat application was filed with the City of Houston Planning and Development Commission in 2017 for Bayou Fifth Section 2 (City of Houston 2017c).

3.1.2 IMPACTS OF THE PREFERRED ALTERNATIVE

All land uses that would be directly impacted by the NHHIP would be permanently converted to transportation use; however, land uses in the footprint of an elevated portion of the roadway may not be permanently impacted. The land use impacts of the Reasonable Alternatives are found in Table 3-1 in the Draft EIS. The increase in total acres of impact for the Preferred Alternative is due to the addition of storm water detention areas to the project ROW evaluated in the Final EIS.

The Preferred Alternative impacts to land uses for Segments 1, 2, and 3 are as follows:

- Segment 1 — approximately 246 acres of land impacted. Most of the land is from commercial land use (139 acres).
- Segment 2 — approximately 44 acres of land impacted. Most of the land is from commercial land use (21 acres).
- Segment 3 — approximately 160 acres of land impacted. Most of the land is from transportation/utility (45 acres) and commercial (35 acres) land uses.

3.1.3 IMPACTS OF THE NO BUILD ALTERNATIVE

The No Build Alternative would not result in the acquisition of new ROW and no existing land uses would be converted to transportation uses.

3.1.4 ENCROACHMENT ALTERATION EFFECTS

I-45 is an established interstate that traverses highly urbanized and developed areas throughout the north side of the City of Houston; therefore, encroachment alteration impacts to land use are not anticipated as a result of the proposed project. Development of varying intensities has already occurred throughout the limits of the proposed project area. The potential for induced growth and associated effects is discussed in Section 5.

3.2 Community Resources

This section describes communities within the proposed project area and summaries potential effects of the proposed action on the community resources. Population and demographic characteristics, including sensitive or protected populations such as low income, minorities, LEP persons, children, elderly, and persons with disabilities, are discussed in Section 3.2.1.1, and neighborhood and community facilities are discussed in Section 3.2.1.2. Potential impacts include displacement of residences and businesses; relocation of community facilities, service providers, business, and bus stops; both positive and negative changes in bicycle and pedestrian amenities, mobility and accessibility, and noise and visual impacts. Impacts to neighborhoods, displacements, and environmental justice populations are addressed in Section 3.2.3, Section 3.2.4, and Section 3.2.5, respectively. Noise and visual condition and related impacts are discussed in more detail in Final EIS Section 3.6 and Section 3.17, respectively.

3.2.1 EXISTING CONDITIONS

3.2.1.1 Population and Demographics

Community profile data was collected for Census tracts, block groups, and blocks that intersect or that are adjacent to the proposed ROW of the project alternatives. Collectively, this Census profile area includes 42 Census tracts, 78 block groups, and 1,108 blocks. H-GAC's 2040 Regional Growth Forecast projections were used to determine population growth rates. Appendix F: *Community Impacts Assessment Technical Report* includes detailed tables of population estimates, race, and ethnicity characteristics for Census tracts, block groups, and blocks in the Census profile area.

Low-income populations were identified if the median household income at the Census block group level was at or below the U.S. Department of Health and Human Services 2019 poverty guideline for a family of four persons, which is an annual household income of $25,750. The number of low-income Census block groups and the median household income data are discussed in Appendix F: *Community Impacts Assessment Technical Report*.

The Segment 1 Census profile area consists of 17 Census tracts, 27 block groups, and 291 blocks (Note: two Census tracts and three block groups are located in both Segments 1 and 2). Of 291 Census blocks, only 72 blocks have a population greater than zero. The total population of the Segment 1 Census profile area at the Census block level is 12,389 (U.S. Census Bureau 2010). Approximately 87 percent of the Segment 1 Census block area is a minority population, of which the largest minority populations are Hispanic (65.6 percent) and Black (17.6 percent).

The Segment 2 Census profile area consists of 9 Census tracts, 15 block groups, and 175 blocks. (Note: two Census tracts are located in both Segments 2 and 3). Of the 175 Census blocks, 66 blocks have a population greater than zero. The population within the Segment 2 Census block area is 83.5 percent minority, of which 69.6 percent is Hispanic.

The Segment 3 Census profile area consists of 24 Census tracts, 36 block groups, and 642 blocks. (Note: two Census tracts are located in both Segments 2 and 3). Of the 642 Census blocks, 163 Census blocks

have a population greater than zero. The population within the Segment 3 Census profile area is 73.6 percent minority, of which 42.3 percent is Black and 24.7 percent is Hispanic.

3.2.1.2 Limited English Proficiency and Sensitive Populations

Limited English Proficiency

Executive Order (EO) 13166, Improving Access to Services for Persons with LEP, requires federal agencies to examine the services they provide, identify needs for services to LEP persons, and develop and implement a system to provide LEP persons with meaningful access to those services (LEP 2015). EO 13166 requires that the federal agencies work to ensure that recipients of federal financial assistance provide meaningful access to their LEP applicants and beneficiaries (LEP 2015).

Individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English can be LEP (LEP 2015). The 2009–2013 American Community Survey provides data on LEP populations at the Census block group level. Field observations were used to identify areas of LEP populations. Evidence of LEP populations includes businesses, places of worship, and signs in languages other than English.

LEP population estimates are approximately 51.7 percent of the total population in the Segment 1; 21.5 percent of the total population in the Segment 2; and 10.9 percent of the total population in the Segment 3. In all project segments, Spanish is the predominant language of the LEP populations. Appendix F: *Community Impacts Assessment Technical Report* includes detailed information of composition of LEP populations by languages and a comparison of the LEP population totals for the City of Houston, Harris County, and the Census block groups in each segment. The *Community Impacts Assessment Technical Report* also includes exhibits that show the Census blocks groups in the project area with LEP populations greater than 50 percent.

In Segment 1, several businesses and places of worship have Spanish-language names or signs. In Segment 3, a few businesses with Asian-language names are located on the east side of Downtown, including a bakery and restaurants that would be displaced. TxDOT contacted these facilities to discuss the project and get input on potential impacts on these business owners. An example of places of worship with a name in non-English language include Centro Cristiano Church. TxDOT is in the process of advance acquisition of this place of worship and their associated school Alpha and Omega School. Advance acquisition would allow the school and place of worship to rebuild prior to displacement and without disruption to classes or services. The TxDOT Study Team also met with the owners of Yen Huong Bakery, which makes specialty deserts and pastries for the Vietnamese and Chinese community. This bakery is owned by an Asian property owner who speaks limited English. TxDOT met with the owner and English-speaking brother to discuss the option of applying for advance acquisition of the property. Outreach to these businesses and places of worship are discussed in Appendix F.

As discussed in Appendix F, TxDOT has made accommodations for LEP individuals during project development, to ensure that opportunities for community input in the NEPA process have been and would continue to be provided.

Children, Elderly, and Disabled Populations

Other protected populations include children (persons 0 to 19 years of age), elderly (65 years of age and older), and persons with disabilities. Persons with disabilities are described by the U.S. Census Bureau using the term "civilian non-institutionalized disabled persons" and defines this population as all civilians not residing in institutional group quarters facilities such as correctional institutions, juvenile facilities, skilled nursing facilities, and other long-term care living arrangements. Age distribution data was obtained at the Census tract level. Population data for persons with disabilities was obtained at the Census tract level, which is the lowest Census geographic area with available data for disabled persons of all ages. Appendix F: *Community Impacts Assessment Technical Report* provides population estimates of children, elderly, persons with disabilities in each segment Census profile area.

The percentage of children in the Segment 1 Census tract area (30.0 percent) higher in comparison to the percentage of children in the City of Houston (27.7 percent) and Harris County (29.8 percent); the percentage of children in the Segment 2 Census tract area (24.2 percent) and in the Segment 3 Census tract area (19.8 percent) is lower than the percentage of children in the City of Houston and Harris County (U.S. Census Bureau 2016a).

The percentage of elderly persons in the Segment 1 Census tract area (8.4 percent) is lower in comparison to the percentage of elderly persons in the City of Houston (9.8 percent percent) and Harris County (9.2 percent); the percentage of elderly persons in the Segment 2 Census tract area (1.5 percent) is lower than the percentage of elderly persons in the City of Houston and Harris County; the percentage of elderly persons in the Segment 3 Census tract area (8.4 percent) is lower than the percentage of elderly persons in the City of Houston and lower than the percentage of elderly persons in Harris County (U.S. Census Bureau 2016a).

Bussey, Roosevelt, and Jefferson Elementary Schools; Aldine Ninth Grade School, and Aldine High School Football Stadium are located within 500 feet of the proposed project ROW. According to the Texas Education Agency (TEA), Aldine High School, Aldine Ninth Grade School and Bussey Elementary School are considered Title I schools. Title I schools receive supplemental funds schools due to a large concentration of low-income students. These schools receive supplemental funds to assist in meeting student's educational goals. The number of low-income students is determined by the number of students enrolled in the free and reduced lunch program. The types of students served by Title 1 funds include migrant students, students with LEP, homeless students, students with disabilities, neglected students, delinquent students, at-risk students or any student in need (US Legal, Inc. 2019). The student population for all three schools have a 98 percent or greater minority population, and the schools are considered economically disadvantaged (TEA 2018).

Houston Academy for International Studies, Young Women's College Preparatory School, Secondary Disciplinary Alternative Education Program, Yes Prep Fifth Ward, Fifth Ward Head Start Center, Young Scholars Academy for Excellence and Bruce Elementary School are also located within 500 feet of the proposed project ROW. According to the TEA, Houston Academy for International Studies, Young Women's College Preparatory School, and Bruce Elementary School are considered Title I schools. The

student populations have a 90 percent or higher minority population and are considered economically disadvantaged (TEA 2018).

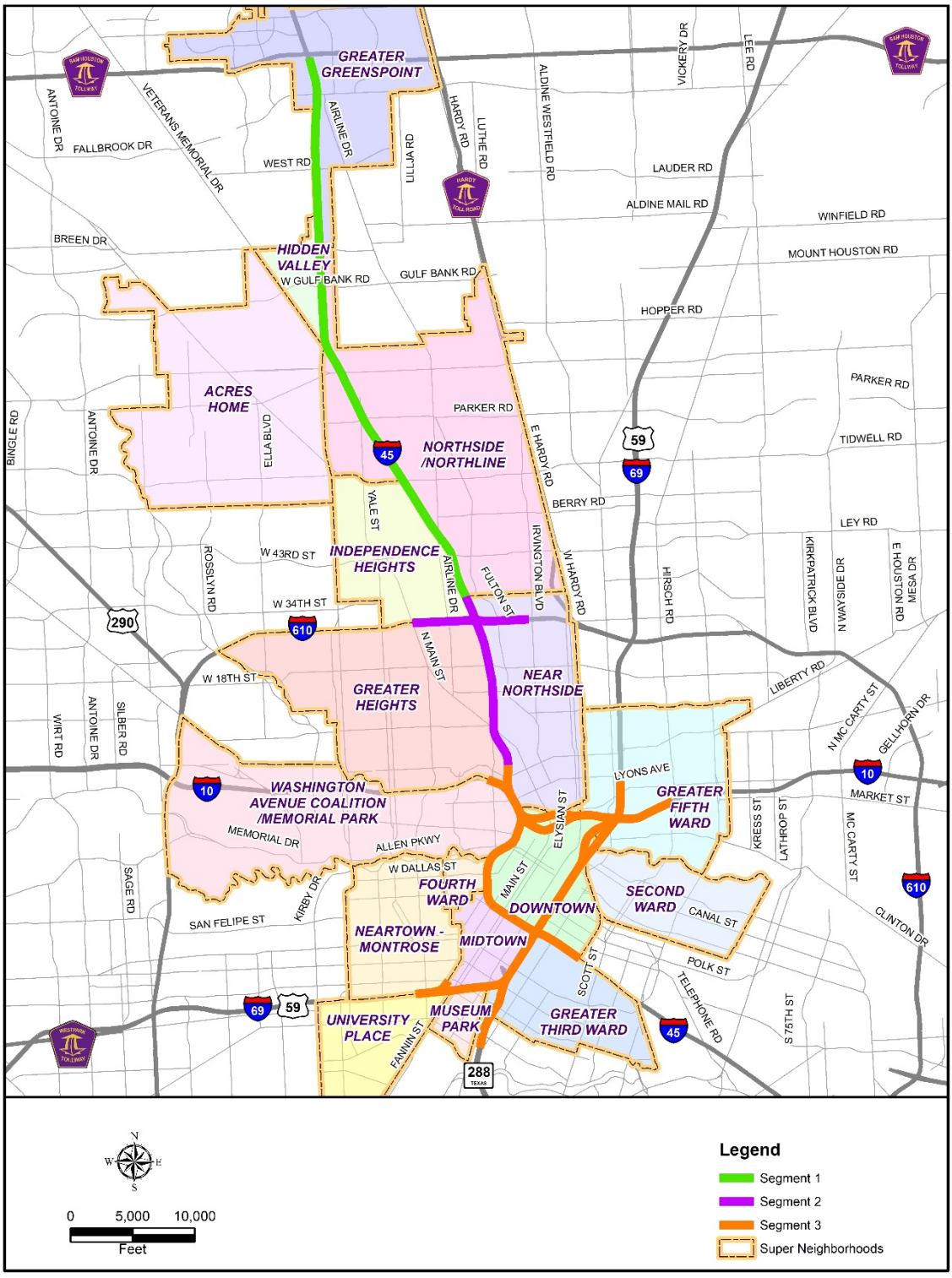
The percentage of persons with disabilities in the Segment 1 Census tract area (8.8 percent) is lower than the percentage of persons with disabilities in the City of Houston (9.8 percent) and Harris County (9.3 percent); percentages of persons with disabilities in the Segment 2 Census tract area (14.1 percent) and in the Segment 3 Census tract area (12.0 percent) are higher than the percentage of persons with disabilities in the City of Houston and Harris County (U.S. Census Bureau 2016b).

3.2.1.3 Neighborhoods and Community Facilities

Community facilities were identified within one-half mile of the existing project corridor roadways, and specific impacts to community resources were evaluated for facilities in the proposed ROW of each segment. The community cohesion status is based on field investigations and input from local residents and business owners. Field surveys included observation of pedestrian activities, conditions of houses and buildings, number and type of community facilities, local businesses, and accessibility to community facilities and services. Additionally, comments collected during the public meetings and multiple other subsequent meetings were used to identify specific community values and concerns from residents and local business owners. Neighborhood facilities data was obtained from the City of Houston GIS files (City of Houston 2014), TEA GIS files (TEA 2012), and H-GAC GIS files (H-GAC 2018c), and data were verified through additional field surveys.

Communities in the proposed project area are referred to as “super neighborhoods”, which are geographically designated areas that are divided by major physical features and share common characteristics. Each super neighborhood has an elected council and guiding by-laws that create a framework to prioritize and address issues of concern for their community. Direct impacts to community resources were evaluated for facilities in the proposed ROW of the Preferred Alternative, as well as indirect impacts to nearby community facilities. Figure 3-1 shows the super neighborhoods in the NHHIP area. Exhibits showing community facilities in the NHHIP area are provided in Appendix F: *Community Impacts Assessment Technical Report.*

Figure 3-1: Super Neighborhoods



Segment 1: I-45 from Beltway 8 to I-610

Super neighborhoods in Segment 1 include Greater Greenspoint, Hidden Valley, Acres Home, Northside/Northline, and Independence Heights. Greater Greenspoint and Hidden Valley are in the northern portion of Segment 1. Greater Greenspoint is mostly comprised of single-family residences and apartment complexes, and Hidden Valley is characterized by single-family tract homes. Acres Home is located on the west side of I-45 between West Gulf Bank Road and Pinemont Drive and consists mostly of single-family residences. Northside/Northline, which is divided on the east and west side of I-45, is mostly comprised of single-family homes with a few large apartment complexes. The east side of Northside/Northline has commercial businesses and some community facilities near the I-45 frontage road, with a moderate level of pedestrian activity. Businesses on the west side of Northside/Northline and along the I-45 frontage road include automobile dealerships, restaurants, retail stores, motels, and storage facilities. Several abandoned buildings are located along the frontage road. Independence Heights is a historical community on the west side of I-45 between Tidwell Road and I-610. The area consists primarily of single-family residences. This neighborhood has several community facilities and parks and a high level of pedestrian activity. Community facilities in the Segment 1 study area, including schools, places of worship, community centers, and neighborhood parks are discussed in detail in Appendix F: *Community Impacts Assessment Technical Report*.

The northern portion of Segment 1 is in the Aldine ISD, and approximately nine schools are located within one-half mile of the northern portion. The southern portion is in the HISD, and approximately six schools are located within one-half mile of the southern portion of Segment 1. Additionally, two community college campuses and one culinary school are located east of I-45 near the Crosstimbers Street intersection.

Parks within approximately one-half mile of the Segment 1 corridor include Lincoln Park, Northline Park, Victoria Gardens Park, Kerr Park, Mccullough Park, and Independence Heights Park. The City's long-term bikeway vision plan includes future bike paths along Halls Bayou and Little White Oak Bayou (City of Houston 2019a). Long-term vision bikeway projects support the City's goal of providing citywide access; however, these projects do not have dedicated funding or an established implementation schedule.

Segment 2: I-45 from I-610 to I-10

Segment 2 crosses Near Northside neighborhood on the east side of I-45 and Independence Heights and Greater Heights neighborhoods on the west side of I-45. These super neighborhoods are predominantly residential and well-established communities dating back to the late 1800s/early 1900s. The individual residential communities in the Segment 2 study area have a significant historical character and a strong sense of community cohesion. Community facilities in the Segment 2 study area, including schools, places of worship, community centers, and neighborhood parks are discussed in detail in the Appendix F: *Community Impacts Assessment Technical Report.*

Recreational facilities in the Segment 2 study area include Montie Beach Park and Community Center, Woodland Park, Woodland Community Center, and Moody Park. Montie Beach Park and Woodland Park are located on west side of I-45, and Moody Park is located on the east side of I-45. Existing bike paths are

located west of I-45 along Little White Oak Bayou between Link Road and Cavalcade Street, and the City's long-term bikeway vision plan includes future bike paths and trails along Little White Oak Bayou and near Moody Park on the east side of I-45 (City of Houston 2018). The City of Houston is planning to add new on-street bikeways along Quitman Street and South Street to connect the White Oak Bayou Bike Trail to the Fulton Street bike lanes, as well as new shared-use paths from Woodland Park to the Heights Hike and Bike Trail (City of Houston 2015).

Segment 3: Downtown Loop System

Segment 3 crosses ten super neighborhoods including Near Northside, Downtown, Second Ward, Greater Third Ward, Fourth Ward, Greater Fifth Ward, Midtown, Museum Park, Neartown-Montrose, University Place, and Washington Avenue Coalition/Memorial Park. These super neighborhoods are among some of the original and most historic communities in Houston, dating back to the mid-1800s. Downtown is the City of Houston's central business district. The east side of Downtown has historically been an industrial area, but much of the area started to redevelop in the 1990s and 2000s with residential and commercial growth. Some warehouse buildings have been redeveloped as lofts, offices, studio, and retail spaces. Fourth Ward, Midtown, and Third Ward, located west and south of Downtown, have also experienced significant residential redevelopment. Museum Park is located farther south of Downtown and is home to several well-establish residential communities and cultural institutions. Public service facilities in the Segment 3 study area include libraries, government buildings, universities, stadiums, sports areas, and theaters. Community facilities in the Segment 3 study area, including schools, places of worship, community centers, and neighborhood parks are discussed in detail in Appendix F: *Community Impacts Assessment Technical Report.*

Parks in the Segment 3 study area include White Oak Parkway, Freed Art and Nature Park, Hogg Park, and Stude Park located north of I-10 along White Oak Bayou; Tinsley/Jamail Skate Park located west of I-45 along Buffalo Bayou; and several park areas in the Downtown Loop. Several existing pedestrian and bicycle routes are located along White Oak and Buffalo Bayous and through Downtown and adjacent neighborhoods in the Segment 3 corridor.

3.2.2 Impacts of the Build Alternatives — Neighborhoods and Community Facilities

The Preferred Alternative would result in displacements that would impact the communities and potentially affect community cohesion. The estimated number of displaced residences in each super neighborhood is provided in Appendix F: *Community Impacts Assessment Technical Report*. Community cohesion and other community impacts are discussed by super neighborhood. The Preferred Alternative that includes elevated structures which may create physical barriers between neighborhoods or affect the existing visual conditions of the communities. Similarly, the Preferred Alternative include depressing sections of the project corridor may improve connectivity between neighborhoods if the depressed sections include an open space highway "cap" over the depressed lanes. The open space option is conceptual only and would be separate from TxDOT's roadway project. Any open space would require development and funding by parties other than TxDOT.

Detailed information regarding impacts on existing and proposed community facilities (including schools, places of worship, community centers, parks, and service facilities), pedestrian and bikeway access, and travel patterns is provided in Appendix F: *Community Impacts Assessment Technical Report*. A summary of the Preferred Alternative impacts to community resources for the study area is provided in Table 3-1. Several of the listed impacts are listed in more than one community resource category and marked with a number.

Table 3-1: Summary of Preferred Alternative Impacts on Community Resources

Neighborhoods and Community Facilities
▪ Displacement of 5 places of worship (Centro Cristiano Church, Iglesia Evangelica Vida, Faith Tabernacle, Greater Mount Olive Baptist Church, and Goodwill Missionary Baptist Church)[1]
▪ Displacement of 2 schools (Alpha and Omega Christian Academy and Culinary Institute LeNotre)[2]
▪ Displacement of medical care facilities and non-profit facilities[3,4]
▪ Displacement of a City of Houston Police Station
▪ No direct impacts to parks, community centers, or other neighborhood facilities
▪ No impact to fire stations
▪ Displacement of drug rehabilitation center[5]
▪ Displacement of bus stops could affect people that do not have access to automobiles or that are dependent on public transportation; no permanent affect to existing bus service routes[6]
▪ Limited or redirected access to bicycle routes during construction
▪ Minor change would occur in access to I-45; however, changes will not likely affect existing traffic patterns in neighborhoods or affect circulation and access to other cross streets
▪ Preferred Alternative would not change access across the project corridor or restrict access to properties and amenities in the communities
▪ No anticipated change to access or use of local roads that may serve as emergency response routes
▪ The North Street bridge that currently provides access across I-45 from Glen Park subdivision to Greater Heights would be removed; closing the bridge would eliminate the shortest passage across the freeway from Glen Park subdivision to Travis Elementary School
▪ The Preferred Alternative will not create a new barrier between communities
▪ May affect University of Houston-Downtown campus parking during construction
▪ Temporary rerouting of trails along White Oak and Buffalo Bayous during project construction
▪ Elevated lanes would further create a barrier disconnecting Near Northside and the future Hardy Yards development from Houston's central business district
▪ Removal of Pierce Elevated would eliminate visual barrier between Downtown and Midtown and enhance connectivity between communities
▪ Removal of the Pierce Elevated would improve mobility on local streets between Downtown and Midtown; proposed boulevard along Pierce Street would improve access to south Downtown streets from I-45
▪ Changes in freeway access on I-45, I-10, and US 59/I-69 would likely affect existing traffic patterns in neighborhoods and improve access to Downtown

Displacements
▪ 160 Single-family residences ▪ 433 Multi-family residential units (multi-family units are all located within apartment communities) ▪ 486 Public and Low-Income Housing multi-family units[6] ▪ 344 Businesses ▪ 5 Places of Worship (Centro Cristiano Church, Iglesia Evangelica Vida, Faith Tabernacle, Greater Mount Olive Baptist Church, and Goodwill Missionary Baptist Church)[1] ▪ Displacement of 2 schools (Alpha and Omega Christian Academy, and Culinary Institute LeNotre)[2] ▪ 58 Billboards
Environmental Justice
▪ Loss of parking spaces at the UT Health Women Infants Children Greenspoint Clinic, which serves low-income communities ▪ Loss of parking at La Michaocana Meat Market (grocery store) ▪ Displacement of AVANCE Training Center, non-profit organization that assists low-income and at-risk families workforce training and family therapy ▪ Displacement of Texas Department of Health and Human Services, which serves low-income communities ▪ Displacement and relocation of Loaves and Fishes Magnificat Houses Ministries, SEARCH Homeless Services, and Fatima House that provide services to low-income and homeless populations[4] ▪ Displacement of medical offices that serve low-income and high-minority communities[3] ▪ Displacement of 2 places of worship and 1 school that serve Spanish-speaking populations[1,2] ▪ Displacement of 3 places of worship with predominately African American members and the Helping Hands Charity (operated by Sloan Memorial United Methodist Church), an organization that supports children and other low-income individuals in the surrounding community[1,4] ▪ Displacement of 346 Houston Housing Authority (HHA) multi-family housing units and units in other complexes where HHA housing vouchers are accepted[6] ▪ Displacement of 60 multi-family residential units in one building at Midtown Terrace Suites, low-income housing for veterans, some with disabilities[6] ▪ Displacement of 80 multi-family residential units at Temenos Place Apartments II, low-income housing which also provides support services[6] ▪ Relocation of the Consulate General of Mexico[7] ▪ Potential relocation of Casa Quetzal, a facility which provides shelter to refugee children ▪ Potential relocation of bus stops in low-income and high-minority communities[5] ▪ Potential noise impacts to low-income and high-minority communities ▪ Minority and/or low-income individuals/families may be affected by displacement of housing ▪ Construction-related impacts; potential increase of traffic noise and temporary construction-related air emissions

Sensitive Populations (Children, Elderly, Disabled, and LEP Populations)
▪ Construction-related impacts; potential increase of traffic noise and temporary construction-related air emissions ▪ Displacement of 2 places of worship and 1 school that serve Spanish-speaking populations[1,2] ▪ Displacement of 60 multi-family residential units in one building at Midtown Terrace Suites, low-income housing for veterans, some with disabilities[6] ▪ Displacement of 2 Asian-named restaurants and one Chinese/Vietnamese bakery with a LEP owner in East Downtown Houston ▪ Potential relocation of Casa Quetzal, non-profit which provides shelter to refugee children ▪ Displacement of the Consulate General of Mexico[7]

Notes:
[1] Places of Worship impacts discussed in multiple categories
[2] Schools impacts discussed in multiple categories
[3] Medical care facility impacts discussed in multiple categories
[4] Non-profit facilities impacts discussed in multiple categories
[5] Bus stop impacts discussed in multiple categories
[6] Public and low-income housing impacts discussed in multiple categories
[7] Consulate General of Mexico impacts discussed in multiple categories

3.2.3 IMPACTS OF THE PREFERRED ALTERNATIVE — DISPLACEMENTS

The proposed project would require new ROW which would displace homes, schools, places of worship, businesses, billboards, and other uses. Exhibits and detailed lists of displacements for each project alternative are provided in Appendix F: *Community Impacts Assessment Technical Report*. Displacements listed the *Community Impacts Assessment Technical Report* include a unique map identification number (Map ID No.) that corresponds to the Map ID No. labels for each parcel shown in the exhibits. Additionally, the *Community Impacts Assessment Technical Report* includes HCAD property identification numbers, type of displacement, and address (if available). The locations of displaced billboards are displayed in Appendix G, Exhibit G-2 in Appendix F: *Community Impacts Assessment Technical Report* of the Final EIS. If the proposed ROW crosses a portion of a property but would not displace any buildings, it is not shown in the exhibits.

3.2.4 IMPACTS OF THE PREFERRED ALTERNATIVE — ENVIRONMENTAL JUSTICE

As discussed in Table 3-1. the proposed project would have some impact to minority and low-income populations related to relocation of residences and facilities, local access, safety, traffic noise, air quality, and homeless populations. Exhibits and detailed information is provided in Appendix F: *Community Impacts Assessment Technical Report*.

The NHHIP is an exceptionally large, 26.4-mile long undertaking in a city that is predominantly minority. Segments 1, 2, and 3 of the NHHIP are 87 percent, 83.5 percent, and 73.6 percent minority, respectively, as measured by adjacent Census block groups. Similarly, 10 of the 17 super neighborhoods in the study area are predominantly minority. Adverse effects from the proposed project would be experienced by EJ populations.

As directed by FHWA Order 6640.23A, when determining whether a particular program, policy, or activity will have disproportionately high and adverse effects on minority and low-income populations, the decision maker should take into account mitigation and enhancement measures and potential offsetting benefits to the affected minority and/or low-income populations. The mitigation actions and improvements described in this assessment substantially offset the adverse effects on minority and low-income populations that would result from the construction of the NHHIP. It is difficult, however, to determine the extent of effects to certain resources and populations since the context of each impact might be specific to an individual, a business, or a service. For example, the relocation of a medical service provider that caters to low-income patients would be dependent on what access to those services would be after the medical office moves. It is possible that, with the relocation benefits provided by TxDOT, the medical office would relocate locally and the new location would be more convenient for some patients and less convenient for others. Some effects would be dictated by an individual's circumstances or preferences. Other effects are pending future actions (e.g., decisions by businesses or service providers about where to relocate).

TxDOT has made a number of commitments to offset the adverse effects of the project on minority and low-income populations related to relocation of residences and facilities, affordable housing, local access, pedestrian safety, traffic noise, air quality, and homelessness. In some of these areas there would be improvements over the existing conditions such as new facilities for the residents of Clayton Homes and Kelly Village, restoring local access in the area around the I-45/Loop 610 interchange, providing the opportunity for noise barriers, and improving safety (e.g., improved pedestrian and bicycle accommodations) on cross-streets in EJ neighborhoods. Overall, the proposed improvements to the existing freeway facilities would have benefits that extend to EJ populations including improved safety, expanded capacity for transit use, and improved drainage.

Taking all of these factors into account, TxDOT has concluded that the Preferred Alternative as a whole would not have "disproportionately high and adverse effects" on EJ populations. Nonetheless, TxDOT recognizes that some of the specific impacts of the Preferred Alternative may adversely affect EJ populations. Therefore, where possible, the alignment options have been refined through the NEPA process to minimize impacts. Environmental commitments and mitigation measures identified above and in the Final EIS and Record of Decision will address impacts from the NHHIP construction and operation activities that may affect EJ populations. TxDOT proposes measures to mitigate adverse impacts throughout both EJ and non-EJ communities. TxDOT will, however, provide enhanced outreach to EJ communities, particularly Spanish-speaking communities with LEP, to implement mitigation strategies effectively in those communities.

3.2.5 Impacts of the Build Alternatives — Sensitive Populations (Children, Elderly, Disabled, and Limited English Proficiency)

Potential impacts of the Preferred Alternative include displacement of schools and places of worship that with services in languages other than English. In addition, Pecan Grove Manor and Woodland Christian Towers, which provide housing for low- to very low–income seniors and persons with disabilities, are

located on the east side I-45. While these facilities would not be displaced by the proposed project, they may experience increased noise and temporary construction-related air emissions during construction. A summary of impacts to sensitive populations for the Preferred Alternative is provided in Table 3-1.

3.2.6 PROJECT-LEVEL ENVIRONMENTAL JUSTICE TOLL ANALYSIS — UPDATE

In the Draft EIS, a project-level toll analysis was conducted to determine the potential impact that tolling would have on the EJ communities within the NHHIP project area. Since the Draft EIS, TxDOT has decided to no longer toll additional travel lanes; therefore, any impacts to environmental justice communities are no longer anticipated.

3.2.7 IMPACTS OF THE NO BUILD ALTERNATIVE

3.2.7.1 Neighborhoods and Community Facilities

The No Build Alternative would not result in direct impacts to neighborhoods and community cohesion, public facilities, or bikeway and pedestrian access.

3.2.7.2 Displacements

The No Build Alternative would not result in residential, business, or other relocations, including potential impacts on jobs due to relocation of businesses.

3.2.7.3 Environmental Justice

The No Build Alternative would not result in disproportionately high or adverse impacts to environmental justice populations. Under the No Build Alternative, the entire community, including minority and low-income populations would not experience impacts related to construction and operation of the proposed project. However, the community would also not experience the benefits of decreased traffic congestion, improved mobility, improved bikeway and pedestrian access and improved safety conditions resulting from the proposed project.

3.2.8 ENCROACHMENT ALTERATION EFFECTS

With respect to encroachment alteration effects, indirect impacts would be driven by changes in travel patterns and access associated with the proposed project. As discussed in Section 5, potential indirect impacts would include improved vehicular access to employment opportunities, markets, goods, or services, residential uses, and public facilities due to increased vehicular mobility.

The Preferred Alternative would result in substantial displacements including community facilities, places of worship (including those serving Hispanic populations), and schools. Encroachment alteration socioeconomic impacts from displacements are closely tied to community cohesion and environmental justice considerations. With respect to displacements, encroachment alteration impacts would be driven by the relocation of residential, commercial, and other properties. Encroachment alteration impacts due to relocations and displacements include a reduction in the supply of affordable housing, changes in residential and commercial property values due to the proposed increase in access and mobility, changes in the local tax base, and impacts to employees (such as potential increased commuting time) who could

be displaced by the proposed project. Residential and commercial properties located near the proposed project that are not physically impacted by the proposed project could also experience a change in market value, either positive or negative.

Encroachment alteration impacts also could occur to residents and others who depend on services provided by community facilities. Loss of the facilities and services discussed in Section 3.2.3 would have adverse impacts on dependent populations in the proposed project area and in the surrounding area. If these facilities and service providers are able to relocate in their current area, adverse impacts may be limited in terms of duration.

To the extent that the services provided by these community facilities and public housing organizations could be relocated within their original service area, it is possible that these services would only be lost temporarily and could be replaced to again serve their original populations and persons in surrounding communities. The degree to which encroachment alteration impacts could occur to environmental justice communities of concern is tied to the effectiveness of any mitigation efforts, as discussed in Section 7.

3.3 Economic Conditions

3.3.1 Existing Conditions

The Houston Metropolitan Statistical Area's economic assets are often linked to petrochemical industries, area universities and colleges, and medical complexes. The proposed project area is a portion of the Greater Houston area. As such, the proposed project area's economic growth depends on economic activity at a broader and more regional level. Detailed socioeconomic information on labor force, income, and employment for the Census tract areas is provided in Appendix F: *Community Impacts Assessment Technical Report*. Leading occupational categories in the project area differ slightly between each segment Census profile area and are also discussed in the *Community Impacts Assessment Technical Report*. The types of businesses potentially impacted by ROW acquisition are discussed in Table 5-11 in the *Community Impacts Assessment Technical Report*.

Median household income is defined as the income of householders and all other individuals 15 years or older (U.S. Census Bureau 2014). The definition for per capita income is defined as income per person, or the mean income received per person in a geographic area (ages 15 years and older) divided by the total population in that area (U.S. Census Bureau 2014). The average median household incomes for the Segment 1 Census block group area ($30,159), Segment 2 Census block group area ($42,298), and Segment 3 Census block group area ($55,574) are lower than the average median household income for Harris County ($55,584). The average median household incomes for the Segment 1 and 2 Census block group areas are lower than the City of Houston's median household income ($47,010) (U.S. Census Bureau 2016c). The average per capita incomes for the Segment 1 Census block group area ($13,015) are lower than the average per capita income for Harris County ($29,850) and the City of Houston ($29,224) (U.S. Census Bureau 2016d). The average per capita income for Segment 2 Census block group area ($34,474) and Segment 3 Census block group area ($43,646) is higher than the average per capita income for Harris County and the City of Houston (U.S. Census Bureau 2016d).

3.3.2 Impacts of the Preferred Alternative

Tax revenue, property value, income, and employment are factors that were considered when determining economic impacts of the project. Conversion of land to roadway ROW and the resulting displacement of businesses that provide property and sales tax revenue could have a negative impact on the local economy as current tax-generating properties would no longer be on the tax rolls. It is likely that many of the displaced businesses would choose to relocate in the area, and tax revenue impacts would be temporary if they reestablish within the same taxing jurisdiction. The proposed project would result in beneficial impacts such as an increase in jobs and sales revenue in the local and state economy in the short term, due to construction spending. The proposed project may also promote redevelopment and economic growth.

3.3.2.1 Impacts on Employment and Income

Employment

Between 4,840 and 13,713 jobs exist at businesses that are within the proposed project ROW. This represents between 0.43 and 1.2 percent of the 1,126,894 jobs in the City of Houston as of June 2018 (Texas Workforce Commission 2018).

Because there are available office, retail, and industrial properties and vacant land for sale or lease in the vicinity of the proposed project, it is expected that businesses could relocate in the area if they desire.

The proposed project has the potential to directly and indirectly affect employment and income, including creating over 100,000 construction-related jobs, as shown in Table 3-2.

Table 3-2: Estimates of Economic Effects from Construction of the Proposed Project

Range of Construction Cost	Income (Billion)			Employment (Jobs)			Statewide Final Demand (Billion)
	Direct	Indirect	Total	Direct	Indirect	Total	
$7 billion	$2.0	$4.1	$6.1	92,064	89,323	181,387	$19.2

Source: NHHIP Study Team 2018
Notes: Annual amounts were rounded to nearest $100,000.
Key: M= million

TxDOT will facilitate opportunities such as job fairs to promote hiring individuals from the local communities for general employment and for project construction. TxDOT will conduct at least two job fairs in each segment during construction and would research opportunities to invest funds in a local workforce development program aimed at job readiness training prior to construction.

Construction of the proposed project would have direct and indirect effects on local, regional, and state employment, output, and income. Direct effects would include those arising from purchases made by the new highway construction sector. Direct costs would be wages and salaries paid to workers directly engaged in constructing the proposed project, as well as capital costs for equipment, materials, and supplies during construction. Indirect effects would be the sum of all the rounds of purchases by the interrelated sectors of the state's economy (including direct, induced, and all additional effects), beginning with those that supply the suppliers of the new highway construction sector. Indirect effects would distribute throughout the economy with each round of purchases.

The number of construction-related jobs would vary depending on the phasing of construction. Regardless of the phasing, the local economy would likely experience a temporary increase in spending by construction employees at businesses and restaurants near the proposed project during construction. Roadway construction activities would create new job opportunities and income potential in the area over the short term.

The economic effects of the proposed project are estimated by using multipliers generated by the Texas State Office of the Comptroller's input/output model and the Regional Economic Model, Inc., the multipliers are used to determine final demand, employment, and income related to highway

construction. When multiplied by the total construction cost of the proposed project, the multipliers produce estimates of the economic impacts of construction on a statewide basis. The proportion of economic effects retained locally depends on capturing local materials and labor during the construction process. The general construction cost of the project is currently estimated to be $7 billion, which does not account for estimated ROW costs. Table 3-2 presents the estimated total direct and indirect employment, income, and statewide effect economic effects from the proposed project.

3.3.2.2 Tax Revenue Impacts of the Preferred Alternative

ROW acquisition for the proposed project would result in impacts to property and sales tax revenues and potential impacts to sales tax revenues for local jurisdictions. The City of Houston, HISD, Aldine ISD, Harris County (and associated authorities), and MUDs collect property taxes from landowners in the project area. Sales taxes generated by businesses are collected by the State of Texas, the City of Houston, and METRO.

Conversion of land to roadway ROW and displacements of businesses that provide property and sales tax revenue would have a negative impact on the local economy as current tax-generating properties would no longer be on the tax rolls. It is likely that many of the displaced businesses would choose to relocate in the area, and tax revenue impacts would be temporary if they reestablish within the same taxing jurisdiction. The proposed project would result in beneficial impacts such as an increase of jobs and sales revenue in the local and state economy in the short term due to construction spending. The proposed project may also promote redevelopment and economic growth.

The proposed project would require ROW from property on the west side of I-45 between Fallbrook Drive and West Mount Houston Road, which is outside of the Houston city limits and within the jurisdiction of MUD 321 and Fallbrook Utility District. This is a limited-purpose annexation area where the City of Houston has an agreement with the MUDs to provide limited services and in return, the City collects a portion of the commercial sales tax revenue. The City does not collect property taxes in the limited-purpose annexation areas; property taxes are paid to the MUDs.

Most of the displaced businesses could relocate within the Houston city limits and could continue to generate sales tax for the City. The proposed ROW of the Preferred Alternative would displace approximately 33 businesses within the limited-purpose annexation area. Some businesses within the limited-purpose annexation area have a regional draw (i.e., Fry's Electronics), and if displaced, these businesses may not relocate in the same area. Business displacements and ROW acquisition could result in reduced sales and property tax revenues for MUD 321 and the Fallbrook Utility District.

If new businesses are constructed or reestablished within the City, the sales tax impacts could be offset. Since local ordinances in the City of Houston operate on a case-by-case basis for replacement of displaced billboards, the property owners could potentially lose income earned from billboard advertisements.

TxDOT would attempt to maintain access to all businesses during construction. Loss of customers due to temporary changes in access could result in temporary loss of income to businesses affected by the proposed construction. 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 project construction.

The estimated potential annual property and sales taxes losses for the entire project area are summarized in Table 3-3. A list of estimated annual sales taxes for businesses that would be displaced is provided in Appendix F: *Community Impacts Assessment Technical Report* in Appendix G, Table G-2.

Table 3-3: Summary of Annual Property Tax and Sales Tax Impacts

Impact	Entire Project Area	
	$ Annual Amount	$ Annual Amount
Property Tax Loss	$13.6 M	
Business Sales Tax	$139.3 M (Low Range)	$300.3 M (High Range)
Total	$152.9 M (Low Range)	$313.9 M (High Range)

Source: NHHIP Study Team 2018
Notes: Annual amounts were rounded to nearest $100,000.
Key: M= million

According to *City of Houston*, *Texas Comprehensive Annual Financial Report*, *For Fiscal Year Ended June 30, 2017*, during the last 2016–2017 Fiscal year the City of Houston collected approximately $1.2 billion in property taxes. Based on an estimation that the City of Houston would have received a maximum of 23 percent of the property taxes collected by HCAD, the total annual property taxes for the land to be acquired for the project ROW is approximately 0.26 percent of the City of Houston's annual property tax revenue. This potential decrease in property tax revenue may be offset as property owners reestablish and potentially develop or redevelop other parcels in the City, which could potentially increase assessed values and tax revenues. Some of the existing state-owned ROW could become available for sale as surplus property in the future, and these areas could eventually be added back to the local tax rolls, which could generate additional tax revenue

Business Property Replacement and Relocation

As discussed in Appendix F: *Community Impacts Assessment Technical Report* the current availability of office/retail properties would likely be adequate for displaced businesses that currently operate in strip shopping centers, and office/retail spaces. However, businesses dependent on freeway frontage such as service stations, motel/hotels, and auto dealers may have a harder time finding a place to relocate directly adjacent to freeway. Available large industrial properties and land for sale or lease near the proposed project may accommodate the relocation of businesses that currently operate on larger properties. Other retail/office and industrial properties may be available for sale or lease that are not included in the LoopNet™ listings. Redevelopment of commercial properties in the project corridor could also accommodate displaced businesses interested in relocating. Real estate availability fluctuates and could change by the time ROW acquisition occurs.

3.3.3 IMPACTS OF THE NO BUILD ALTERNATIVE

3.3.3.1 Employment

The No Build Alternative would provide some additional short-term employment opportunities through income generated by current planned improvements to roadways within the proposed project area. However, the increase in employment would not be as extensive or for as long of a period of time as under the Preferred Alternative.

3.3.3.2 Employment and Income during Construction

Because the proposed project area is primarily developed, it is experiencing redevelopment in many areas, especially near Downtown. Under the No Build Alternative, decrease in mobility due to traffic congestion may adversely impact existing and future businesses.

3.3.3.3 Tax Revenue

The No Build Alternative would not impact current property or sales tax revenues. Additionally, the No Build Alternative would not have the positive regional and statewide economic impact of creating additional jobs and income.

3.3.4 ENCROACHMENT ALTERATION EFFECTS

Potentially adverse economic impacts could include property tax revenue and sales tax revenue impacts due to displacement of businesses. However, it is anticipated that most business would relocate in the same taxing jurisdictions. Travel pattern changes could adversely affect some businesses during construction. Temporary economic impacts during construction could be both a direct and indirect impact. Employment impacts and related reductions in indirect and induced economic impacts from spending is an adverse encroachment alteration impact.

Beneficial impacts from construction of the proposed project would be an expansion of modal choices for individuals traveling either along I-45 or along local streets, which would support the pedestrian and biking facilities incorporated into the proposed project. Other socioeconomic indirect impacts that could result from implementation of the proposed project include expedited and localized economic growth due mainly to increases in land rents, market capture, and related development pressures associated with increased visibility and improved access. In summary, it is anticipated that the proposed project would have a combination of adverse and beneficial effects on overall socioeconomic conditions in the City of Houston.

3.4 Transportation Facilities

Transportation facilities in the project area include bus and light rail services, freight railroads, roadways, transit centers, and bicycle and pedestrian facilities. Existing and proposed roadways are discussed in detail in Section 2 of this Final EIS. Data relative to transportation facilities was obtained from METRO GIS files, the City of Houston's Bikeway Plan (City of Houston 2018), the City of Houston's Bikeway Mapviewer (City of Houston 2018), a letter from METRO (METRO 2017), the City of Houston's Bike Plan Map (City of Houston 2019a). METRO facilities include bus routes throughout the proposed project area with several stops and transit centers where bus routes and/or rail converge. METRO LRT lines run north-south through Downtown to the Northline Transit Center, and east-west across Downtown and through East Downtown. Bicycle and pedestrian facilities in the project area include shared-use bikeways through residential and recreational areas, and designated bike lanes along roadways. The City of Houston completed the Houston Bike Plan in March 2017 which includes long-term goals for a citywide bicycle network and improvements in transportation choices (City of Houston 2015, 2018). Transportation facilities in the project area are illustrated on the project schematics and on exhibits in the *Community Impacts Assessment Technical Report*.

3.4.1 EXISTING CONDITIONS

3.4.1.1 Transit Facilities

Transit centers are important access nodes that support high levels of service to a variety of destinations. The Greenspoint Transit Center (12455 Greenspoint Drive), Acres Home Transit Center (1220 West Little York Road), and the Northline Transit Center (7705 Fulton Street) are located within one mile of I-45 in Segment 1 project area. The only Park & Ride facility within the proposed project area is the METRO North Shepherd Park & Ride in Segment 1, located west of I-45 near North Shepherd Drive. The METRO North Shepherd Park & Ride has a direct connection with the I-45 HOV lane and provides service to the central Downtown business district and other transit centers. There are no transit centers located in the Segment 2 project area. In the Segment 3 project area, the Burnett Transit Center (1450 North Main Street) is located approximately one-half mile east of I-45, the Downtown Transit Center is located at 1900 Main Street, and the Wheeler Transit Center is located at 4500 ½ Main Street.

The METRO LRT system began operation on January 1, 2004. The first portion of the Red Line travels along Main Street from NRG Park to the University of Houston-Downtown campus with 16 stops along the route. The North/Red Line extension, which opened in December 2013, connects the University of Houston-Downtown campus to the Northline Transit Center. Today the Red Line extends 13 miles and serves a total of 25 stations.

The East End/Green Line extends 3.3 miles and travels along Harrisburg Boulevard from the Magnolia Transit Center, located east of Downtown, to the Theater District Station, and serves nine stations. The Southeast/Purple Line extends 6.6 miles and connects the Downtown area to the Palm Center Transit Center which is southeast of the Third Ward super neighborhood. On November 5, 2019 voters approved the METRONext Moving Forward Plan, which included a $3.5 billion bond referendum (METRO 2019). The Plan includes 290 miles of route enhancements, and signature bus service plus accessibility and other

improvements for disabled and senior residents. Funding for the rest of the $7.5 billion Plan is expected to come from federal grants and future revenue (METRO 2019).

3.4.1.2 Railroads

Three freight rail lines traverse the general vicinity of the proposed project area. These are currently either owned and/or operated by the UPRR.

- One railroad track parallels the Hardy Toll Road from north of Beltway 8 to I-610, then parallels the Elysian Viaduct and continues to I-10 and US 59/I-69. The rail line passes under I-10 and US 59/I-69 then veers to the east near Franklin Street.
- One rail line runs north-south between I-610 and I-10 on the west side of US 59/I-69 and parallels the UPRR tracks. The rail line has an underpass at I-10 then veers west, paralleling Washington Avenue beyond the study area. Another rail line enters the proposed project area approximately one-half mile north of the I-10/US 59 interchange and continues westward on the north side of I-10.
- An east-west rail line parallels the north side of I-610.

3.4.1.3 Airports

The George Bush Intercontinental Airport (2800 North Terminal Road) is located north of the proposed project area but was included in the study area for the initial project alternatives analysis study. Taxis and shuttles, and one METRO bus route (METRO 2019) connects George Bush Intercontinental Airport to hotels and employment centers, including Greenspoint Mall and Downtown Houston.

3.4.1.4 Pedestrian and Bicycle Facilities

Bikeways are considered part of the local transportation system and function primarily for transportation purposes. Pedestrian sidewalks are available along most major thoroughfares. The City of Houston developed its latest bike plan “Houston Bikeways” in 2017.

3.4.2 IMPACTS OF THE PREFERRED ALTERNATIVE

The following sections discuss the impacts to transit facilities, railroads, and bicycle/pedestrian facilities within the NHHIP study area.

3.4.2.1 Transit Facilities

In Segment 1 the Preferred Alternative would not affect access to transit centers, Park & Ride facilities, or LRT services. Based on METRO’s New Bus Network, 37 bus routes cross or are parallel to I-45 within one mile of the Segment 1 corridor (METRO 2017). The Preferred Alternative would not permanently affect existing public bus service routes; however, bus stops along I-45 that are in the proposed ROW would be displaced, either permanently or temporarily during project construction. The estimated number of potentially displaced bus stops in Segment 1 is 27. Relocation of bus stops may affect populations that do not have access to automobiles or that are dependent on public transportation. The existing I-45 from Beltway 8 to Downtown Houston has one reversible HOV lane, which limits the timeframe and direction for bus service operations in the northern portion of Houston to Downtown. The

Preferred Alternative includes four MaX lanes (two in each direction) that would provide the opportunity to expand bus service in the proposed project area. For more information on transit facilities refer to the *Community Impacts Assessment Technical Report*.

In Segment 2 the Preferred Alternative would not affect existing public bus service routes. Based on METRO's New Bus Network, 37 bus routes cross or parallel I-45 within one mile of the Segment 2 corridor (METRO 2017). One bus stop within the existing ROW at the intersection of Quitman Street and the proposed northbound I-45 entrance ramp, which could be impacted or displaced. Relocation of bus stops may affect populations that do not have access to automobiles or that are dependent on public transportation. No Park & Ride facilities are located in the Segment 2 project area and the Preferred Alternative would not directly affect public transit services.

The North Line LRT travels along Fulton Street, which has one lane of traffic on each side of the rail line. Access to the I-45/I-610 interchange from the east side is often delayed due to traffic on Fulton Street and at the intersection of Fulton Street and I-610. The Preferred Alternative would add frontage roads through the I-45/I-610 interchange, which would improve connectivity and access to the freeways. Improving connectivity and access to the freeways would be expected to reduce traffic on local streets by vehicles attempting to avoid the congested conditions at the I-45/I-610 interchange.

Based on METRO's New Bus Network, 60 bus routes and three LRT lines (Main Street, East End, and Southeast) cross or parallel portions of the Downtown Loop System in the Segment 3 project area. The Preferred Alternative would not permanently affect existing public bus service routes. The Downtown Transit Center (1900 Main Street) and the Wheeler Transit Center (4500½ Main Street) are located in the Downtown area of the Segment 3 project area. The estimated number of potentially displaced bus stops in Segment 3 is 33. A portion of the Wheeler Transit Center property is located within the proposed ROW of the Preferred Alternative. However, access to the transit center and rail services provided at the transit center would not be permanently impacted, as US 59/I-69 would be depressed in that area, and the rail lines would be located above the freeway at ground level. TxDOT is coordinating with METRO on the project design in the area of the Wheeler Transit Center. The Preferred Alternative would not affect access to any other transit centers or rail services.

To minimize impacts to transit facilities and operations, TxDOT will:

- Coordinate with METRO for review of the 30 percent design plans.
- Conduct monthly follow-up meetings with METRO as requested.
- Coordinate with METRO for the temporary and permanent relocation of affected bus stops.
- In cooperation with METRO, install temporary bus stops outside of the proposed ROW and as close as possible to the original bus stop location.
- In cooperation with METRO, design new and reestablished bus stop locations in accordance with the Americans with Disabilities Act of 1990 (ADA) requirements.
- Coordinate with METRO for phasing of improvements to minimize disruptions to transit operations.

- Coordinate with METRO at least 2 to 3 weeks in advance of construction to minimize disruptions to services and schedules.
- Coordinate with METRO for notification to riders at least one week in advance of any closures, delays, or modifications in bus routes, and bus stop relocations or closures. Additional public notifications would include:
  - A list of detours and changes to bus stops posted on METRO's website
  - Notices at bus stops with new bus stop location and bus route map
  - Information on social media (Twitter, Facebook); notifications on social media are typically posted one month in advance
  - Mail-out to riders registered to receive notifications
- Limit periods of disruption to the existing HOV lane and coordinate with METRO to define the limits so they can be planned for and communicated with the public.
- Maintain LRT operations by utilizing shoofly and temporary track alignments with very limited outages for connections and cut-overs.
- Allow for improved bus service in the I-45 corridor — Add two-way METRO T-ramp north of the Shepherd Drive and Veteran's Memorial Drive intersection that would connect directly to the Shepherd Park & Ride facility.
- Maintain Bus/HOV lane connection to Downtown — Add dedicated bus/HOV lane to the I-10 express lanes with direct access to Smith Street and Louisiana Street to replace the existing Downtown HOV connector to Heiner from I-10.
- Coordinate with school districts when students utilize METRO transit services to go to and from school.

3.4.2.2 Impacts of the Preferred Alternative to Railroads

During construction, the proposed project may require re-routing or redirecting of existing rail lines and infrastructure. Relocation or rerouting of existing rail lines could temporarily disrupt operations and result in delays for rail traffic that is rerouted as well as rail traffic on rail lines to which traffic is rerouted.

I-45 currently bridges over the Houston Belt & Terminal Railway (HB&T) tracks on the north side of I-610. The Preferred Alternative would require new ROW for the additional lanes over the railroad. Construction would not impede railroad operations. The existing railroad tracks that parallel Winter Street and bridge over I-10/I-45 and White Oak Bayou would be temporarily impacted during project construction. To minimize impacts to rail operations, TxDOT would construct a shoofly (a temporary track) that offsets the existing bridge (commonly known as the "Be Someone Bridge") and serves as a detour route for rail traffic during construction. The shoofly would be constructed within the existing railroad ROW. TxDOT would schedule tie in connections to rail mainlines with sufficient advance notice to allow railroad companies to plan for alternative routes. If alternate routes are not planned, rerouting connections could cease rail operations for approximately two days.

TxDOT has previously coordinated with HB&T, BNSF Railway (BNSF), and UPRR representatives, and TxDOT does not anticipate permanently affecting current operations and rail locations.

TxDOT will coordinate with UPRR, BNSF, and HB&T for phasing of improvements to minimize disruptions to railroad operations. For temporary impacts to railroad tracks that parallel Winter Street and bridge over I-10/I-45 and White Oak Bayou, TxDOT will construct a shoofly (a temporary track) that offsets the existing bridge and serves as a detour route for rail traffic during construction. TxDOT will schedule tie in connections to rail mainline with sufficient advance notice to allow railroad companies to plan for alternative routes.

3.4.2.3 Impacts of the Preferred Alternative to Bicycle/Pedestrian Facilities

In the Segment 1 study area, existing bike routes on Crosstimbers Street cross the proposed ROW of the Preferred Alternative. The City's long-term bikeway vision includes dedicated bikeways within the street ROW along several roadways that cross the project corridor including Little York Road, Parker Road, and Tidwell Road (City of Houston 2018). During construction, access to bike routes could be limited or redirected; however, impacts would be minimized as much as possible. TxDOT will coordinate with the City of Houston and METRO during project design to minimize the temporary and permanent impacts to bicycle facilities.

The proposed project would include sidewalks along I-45 and at the major intersections. The proposed project would also provide continuity of sidewalks and shared-use lanes along the frontage roads by adding sidewalks and pathways in areas as needed. In response to public comments, TxDOT will include a sidewalk within the I-45 ROW on the south side of Stokes Street and would accommodate a trail connection by others between the proposed frontage road and the south side of Stokes Street.

The City's long-term bikeway vision plan includes future bike paths and trails along Halls Bayou and Little White Oak Bayou. In Segment 1, the Preferred Alternative would cross future bikeways along Halls Bayou north of West Mount Houston Road and future bikeways along Little White Bayou between Tidwell Road and I-610. TxDOT will continue to coordinate with the City of Houston to accommodate space for future bike trails as shown on the City of Houston Bike Plan and to ensure that the proposed NHHIP project supports the plan.

In Segment 2, the Preferred Alternative would require new ROW in existing bicycle routes on Cavalcade Street and Stokes Street and hike and bike trails along White Oak Bayou between Link Road and Cavalcade Street on the west side of I-45. The City of Houston is planning to add new on-street bikeways along Quitman Street and South Street to connect the White Oak Bayou Bike Trail to the Fulton Street bike lanes, as well as new shared-use paths from Woodland Park to the Heights Hike and Bike Trail (City of Houston 2018). ROW acquisition in bike routes may redirect pathways that connect to neighborhoods and other bike routes. During construction, access to trails could be limited; however, impacts would be minimized as much as possible. TxDOT will coordinate with the City of Houston Parks Board to provide the same level of connectivity as the existing conditions.

Based on community comments, the alignment of the existing pedestrian/bicycle trail along the west side of I-45 south of Link Road would be modified to provide a connection to the proposed sidewalk/trail adjacent to the southbound I-45 frontage road. The connection would allow for the continued use of the trail by pedestrians and cyclists.

TxDOT has taken into consideration the Houston Parks Board's vision to extend trails along Little White Oak Bayou; the proposed opening at the Little White Oak Bayou crossing at I-45 south of North Street provides an opportunity for a trail to connect Woodland Park and Moody Park, which does not currently exist. TxDOT will propose openings conducive to bicycle/pedestrian crossings at Little White Oak Bayou under I-45 just north of Patton Street and at Little White Oak Bayou under I-610. The size of the openings will be coordinated with HCFCD, taking into account potential upstream and downstream impacts. TxDOT will continue to work with HCFCD on these elements during detailed design.

In Segment 3, several existing pedestrian and bicycle routes are located along White Oak and Buffalo Bayous and through Downtown and adjacent neighborhoods in the Segment 3 corridor. The Preferred Alternative would cross the White Oak Bayou Trail, which includes an off-street bike path along White Oak Bayou on the north side of I-10 through White Oak Parkway and on the east side of I-45 through Hogg Park into Downtown. The Preferred Alternative would also cross the Buffalo Bayou Trail that follows the bayou through several parks into Downtown. The proposed ROW includes land where hike and bike trails are along White Oak Parkway, in the Downtown area, and in locations where pathways connect neighborhoods. Impacts to hike and bike trails would be temporary during construction, and the Preferred Alternative would not affect the long-term use of facilities. The proposed project considers trails and will accommodate or replace existing trails and allow for planned future trails. During detailed design, TxDOT will coordinate with entities who desire to create greenways or develop trails and connections in the proposed project area, and will accommodate plans by others, if feasible.

Ultimately, TxDOT will coordinate with the City of Houston, Independent School Districts and METRO during project design to minimize the temporary and permanent impacts to bicycle and pedestrian facilities.

3.4.3 Impacts of the No Build Alternative

The No Build Alternative would not require the acquisition of new ROW, and therefore would not result in direct impacts to transit centers, Park & Ride facilities, railroads, LRT, or bus routes. No bus stops within the proposed project area would be displaced. The No Build Alternative would not directly affect the City of Houston's existing and planned bicycle and pedestrian facilities.

The No Build Alternative would not result in improvements to I-45, I-10, I-610, or US 59/I-69 in the proposed project area, and the existing condition of these facilities would remain the same. The No Build Alternative would not change the local roadway network. New pedestrian crossings would not be added along I-45 and at major intersections, and sidewalks and shared-use lanes would not be added along the frontage roads.

3.4.4 Encroachment Alteration Effects

I-45 is an established interstate that is highly interconnected with multi-modal transportation facilities throughout the north side and through the City of Houston; therefore, substantial adverse encroachment alteration impacts to transportation facilities are not anticipated as a result of the proposed project. To the extent that providing connectivity to intermodal facilities is increasingly a priority of transportation agencies, and to the extent that multi-modal connectivity is a stronger focus of planning at all levels of

government, encroachment alteration effects on transportation facilities could be beneficial and could take the form of improved service to drivers, transit riders, and individuals who use bicycle and pedestrian facilities.

3.5 Air Quality

3.5.1 Existing Conditions

This project is located within Harris County, which is part of the Houston-Galveston-Brazoria area that has been designated by the EPA as a serious nonattainment area for the 2008 Ozone National Ambient Air Quality Standard (NAAQS) and a marginal nonattainment area for the 2015 NAAQS. The area is currently designated as attainment or unclassifiable for all other NAAQS.

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments of 1990, whereby Congress mandated that the 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; 40 CFR Parts 80, 85, and 86), and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System[2]. In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers or contributors and non-cancer hazard contributors from the 2011 National Air Toxics Assessment.[3] These are 1,3-butadiene, acetaldehyde, acrolein, benzene, diesel particulate matter (diesel PM), ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter. While FHWA considers these the priority mobile source air toxics (MSATs), the list is subject to change and may be adjusted in consideration of future EPA rules.

3.5.2 Impacts of the Preferred Alternative

This project is located within Harris County, which is part of the Houston-Galveston-Brazoria area that has been designated by EPA as a serious and marginal nonattainment area for the 2008 and 2015 ozone NAAQS, respectively; therefore, transportation conformity rules apply.

The proposed action is consistent with the Houston-Galveston Area Council (H-GAC)'s fiscally constrained 2045 RTP and the 2019–2022 Transportation Improvement Program (TIP), as amended, which were found to conform to the TCEQ State Implementation Plan (SIP) by FHWA and FTA on August 2, 2019. TxDOT received a project-level conformity determination from FHWA on June 25, 2020.

3.5.2.1 Carbon Monoxide Traffic Air Quality Analysis

A traffic air quality analysis (TAQA) was completed to assess whether the project would adversely affect local air quality by contributing to carbon monoxide (CO) levels that exceed the 1-hour or 8-hour CO NAAQS. Using the steady-state Gaussian dispersion model CALINE3, the analysis factored in worst-case assumptions along areas of the project with the highest design hour volume of vehicles and narrowest ROW for each segment. The analysis results for each segment of the project indicate that CO concentrations are not expected to exceed the national standard and would remain relatively consistent from the estimated time of completion (ETC) to the design year. Table 3-4 depicts the worst-case 1-hour

[2] See: http://www.epa.gov/iris/.

[3] See: https://www.epa.gov/national-air-toxics-assessment.

and 8-hour CO concentration for each analyzed segment of the project. See the *Carbon Monoxide Traffic Air Quality Analysis (June 2020)* for additional details about this analysis.

Table 3-4: Worst-Case 1-Hour and 8-Hour CO Concentrations by Segment

Segment	1-Hour CO PPM NAAQS: 35 ppm		8-Hour CO PPM NAAQS: 9 ppm	
	2035 (ETC)	2040 (Design)	2035 (ETC)	2040 (Design)
Segment 1	2.7	2.8	2.0	2.1
Segment 2	2.8	2.8	2.1	2.1
Segment 3	3.9	3.7	2.7	2.6

Source: *Traffic Air Quality Analysis Technical Report* (June 2020)

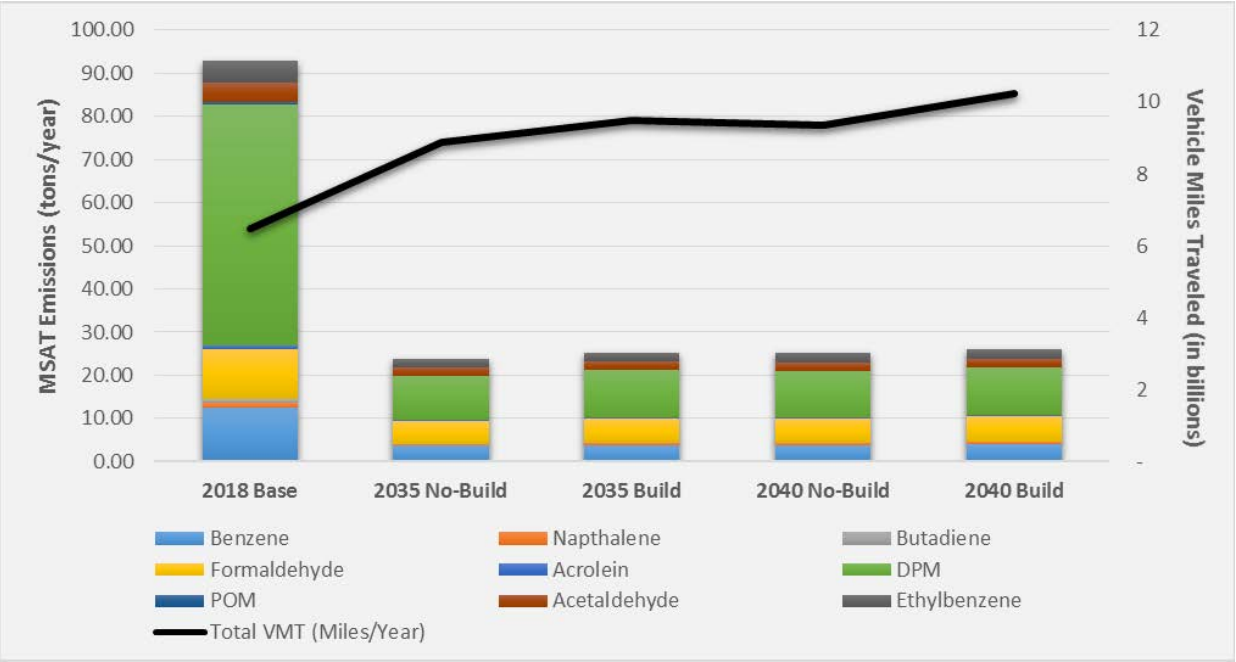
3.5.2.2 Mobile Source Air Toxics Analysis

A quantitative MSAT analysis for the nine priority MSAT was conducted for the affected transportation network of the NHHIP project. An affected transportation network was derived by comparing the roadway link traffic volumes for the No Build Alternative to the Preferred Build Alternative in the design year for the full H-GAC network to determine which roadway links in the model achieve a ±5 percent volume change due to the Preferred Build Alternative.

The analysis compares the Preferred Build Alternative against the No Build Alternative in the design (2040) and interim year (2035). Each scenario is also compared to the existing, base year (2018). As Figure 3-2 depicts, the analysis forecasts a combined reduction of over 72 percent for both the build and no build scenarios in the total MSAT emissions from 2018 to 2040, even as VMT is projected to increase between 45–58 percent. For each scenario, the amount of MSAT emitted would be proportional to the VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for the Build scenarios in the interim and design year are slightly higher than that for the No Build scenarios, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network.

Of the nine priority MSAT compounds, diesel PM contributes the most to the emissions total for all scenarios, followed by formaldehyde and benzene. In future years, a large reduction in diesel PM, formaldehyde, and benzene emissions is predicted. Diesel PM is expected to decrease by 80 to 81 percent, formaldehyde is expected to decrease by 98 percent, and benzene is expected to decrease by 68 to 69 percent from 2018 to 2020 in both scenarios. While EPA has not yet incorporated the recently released Corporate Average Fuel Economy (CAFE) standards into MOVES2014 for incorporation into this analysis, “it is expected that incremental impacts on criteria and air toxic pollutant emissions would be too small to observe under any of the regulatory alternatives under consideration”, as indicated in the Final Rule (85 FR 25061).

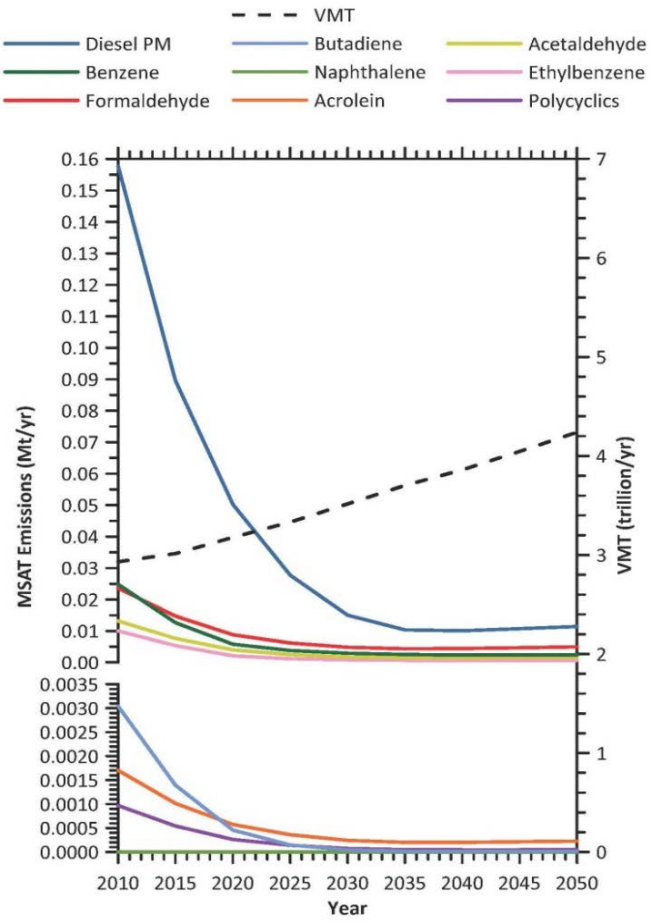
Figure 3-2: Projected MSAT Emissions vs. VMT by Scenario



Source: *Mobile Source Air Toxics Technical Report* (February 2018)

Though VMT is projected to increase from 2018 to 2040, emissions are expected to decrease during this timeframe because of the offset of significantly better fuel efficiency of vehicles over time. Based on modeling using MOVES2014a, overall MSAT emissions will decline significantly over the next several decades as a result of EPA's vehicle and fuel regulations, coupled with fleet turnover, as shown in Figure 3-3. This significant decline will reduce both the background level of MSAT as well as the possibility of even minor MSAT emissions from this project. While MOVES2014a does not use the recently released CAFE standards (85 FR 24174), the new rule is not expected to have any significant impact on project-level analyses for the area. See the *Mobile Source Air Toxics Quantitative Technical Report* (June 2020) for additional details about this analysis.

Figure 3-3: Projected National MSAT Emissions Trends for Vehicles Operating on Roadways (2010–2050)



Source: EPA MOVES2014a model runs conducted by FHWA, September 2016.
Note: Trends for specific locations may be different, depending on locally derived information representing vehicle miles traveled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorological, and other factors.

3.5.2.3 Congestion Management Process

The congestion management process 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 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 Congestion Management Plan (CMP), which was adopted by H-GAC; they are included in the financially constrained MTP, 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 SOV facility implementation and project-specific elements.

Congestion mitigation strategies identified in the project-level CMP analysis that will be implemented as part of the proposed project include:

1) Ridesharing/carsharing (HOV) — two-way, 24/7 managed lanes will replace the existing reversible HOV/HOT lane. This will promote ridesharing and carsharing for reverse commute trips.
2) Infill and Densification — NHHIP will provide three planned highway caps which will provide opportunities for higher density redevelopment in the project area.
3) Transit-Oriented Development — The new design will foster transit-oriented developments, such as the improved Wheeler Transit Station and Hardy Yards connectivity to the Burnett Transfer Station.
4) Increasing Bus-Route coverage — two-way, 24/7 managed lanes will replace the existing reversible HOV/HOT lane and allow bi-directional bus trips throughout the day.
5) New Sidewalks and Designated Bicycle lanes on local streets — the NHHIP will incorporate the COH Bike Plan on city streets within the project area and include increased pedestrian realm on cross streets and frontage roads. The project includes sidewalks and shared-use lanes for bicycles on the I-45 frontage roads.
6) Geometric Design Improvements — NHHIP incorporates major improvements to the existing horizontal geometric deficiencies that degrade freeway capacity, particularly on the north end of Downtown to the US 59/I-69/I-10/I-45 interchange where the s-curve is replaced with one sweeping curve.
7) Acceleration and Deceleration lanes — NHHIP provides for acceleration/deceleration at ramps through the use of auxiliary lanes. The project also provides acceleration/deceleration lanes at the I-45 frontage road intersections.

8) Major Intersection / Interchange Improvements — The NHHIP will make major improvements to five fully directional interchanges, including a full restacking of the I-45/I-610 North Loop interchange to remove the left-hand exits, s-curves for I-610 through the interchange, and the sight-distance limiting capacity on the I-45 mainlanes. Another major interchange improvement is at US 59/I-69/SH 288 where the short weave/merges will be removed.

Other committed congestion reduction strategies and operational improvements within the study boundary will consist of the addition of lanes and interchange improvements. Individual projects are listed in Table 3-5.

Table 3-5: Congestion Management Process Strategies Near NHHIP

Operational Improvements in Travel Corridor		
Location	**Type**	**Implementation Date**
Inner Katy Corridor from I-610 (West Loop) to Katy Freeway — Downtown Connector Two-Way Ramp	Construct Multi-modal Dedicated bus rapid transit (BRT) busway, including grade-separation and connection to HOV lanes and transit center	2021
SH 249 from Sam Houston Tollway/Beltway 8 and Interstate 45 (I-45N)	Various access management treatments	2032
Westheimer Signature Bus Service	Rapid Transit Service from Hayes Road to Edloe Street and Express Service on I-69 between Edloe Street and Downtown Houston	2035
University Line Corridor	New BRT busway from Westchase Park and Ride to Tidwell Transit Center via Westpark, Richmond, Alabama, Elgin, and Lockwood; includes 41 stations	2040
Hardy Toll Road	Construct four-lane toll road to complete Hardy Toll Road	2021
Hardy Toll Road	Construct eastbound/southbound and northbound/westbound connectors on Hardy Toll Road	2021

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 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 is on file and available for review at H-GAC.[4]

[4] H-GAC's CMP: http://www.h-gac.com/congestion-management/documents/HGAC_CMP_Update_Jan2015.pdf

3.5.2.4 Construction Emissions

Construction emissions are discussed in Section 7.6.

3.5.3 IMPACTS OF THE NO BUILD ALTERNATIVE

The No Build Alternative would not result in improvements to I-45, I-10, I-610, or US 59/I-69 in the proposed project area; therefore, the existing condition of these facilities would remain the same, and the annual average daily traffic would continue to increase over time. The VMT estimated for the Preferred Build Alternative is higher than that for the No Build Alternative, so it would be expected that the MSAT emissions for the No Build Alternative would be lower than the Preferred Build Alternative. Under both the Preferred Build Alternative and the No Build Alternative, the current trend of improving air quality in the region is expected to continue at the same pace for both criteria pollutants and MSAT as a result of EPA regulations for vehicle engines and fuels, as the recently released update to the CAFE standard will still result in "year-over-year improvements in fleetwide fuel economy, resulting in energy conservation that helps address environmental concerns, including criteria pollutant, air toxic pollutant, and carbon emissions" (85 FR 24176).

3.5.4 ENCROACHMENT ALTERATION EFFECTS

Base-year and future-year vehicles miles traveled and associated ozone emissions for this and other projects are captured through the regional conformity process; therefore, any encroachment alteration effects are captured through this process.

3.6 Noise

A traffic noise analysis was conducted in accordance with TxDOT's (FHWA-approved) Guidelines for Analysis and Abatement of Roadway Traffic Noise (TxDOT 2011) and Reasonable Cost Proposal for 2018 Noise Policy (FHWA 2017).

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 3-6).

Table 3-6: Noise Abatement Criteria

Activity Category	FHWA dB(A) Leq	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary 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)	Residential.
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, 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)	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)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F

Activity Category	FHWA dB(A) Leq	Description of Land Use Activity Areas
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.

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

Absolute criterion: the predicted noise level at a receiver approaches, equals or exceeds the NAC. "Approach" is defined as 1 dB(A) below the FHWA 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) [11 dB(A) increase].

FHWA traffic noise modeling software (TNM 2.5) was used to calculate existing and predicted (2040) traffic noise levels for the three segments of the NHHIP project. 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.

3.6.1 EXISTING CONDITIONS

The proposed project lies within an existing developed urban corridor within the City of Houston. Land uses adjacent to the project area represent single- and multi-family residences (NAC B); schools, place of worship, and public parks/recreation (NAC C and D); and restaurants with outside seating and hotels with swimming pools (NAC E). Additionally, some undeveloped/vacant lands (NAC G) can also be found within the project area. Residential areas are located throughout the project area. An initial site visit was conducted in January 2015 to determine sources of existing noise within the project area, and additional field visits were conducted to document changing land uses, as needed through completion of the traffic noise analysis.

Following TxDOT’s 2011 Guidelines, existing noise levels for all existing roadways within the project limits were determined based on computer modeling and existing year traffic data. Receiver locations were selected that best represent the land use activity adjacent to the proposed project that might be impacted by traffic noise and potentially benefit from feasible and reasonable noise abatement. Due to the large number of individual noise-sensitive receptors and land uses adjacent to the proposed project area, a “representative receiver” approach was used, in which multiple receptors, such as a neighborhood of single-family residences or an apartment complex, were represented by one or several locations with

similar distances from the proposed ROW. Receiver locations that would be displaced by the proposed project were not included in the analysis.

Traffic noise is an existing issue for receivers adjacent to the project area, and the analysis confirmed that there are existing traffic noise impacts. The detailed existing conditions traffic noise levels for each segment are included in Appendix I: *Traffic Noise Technical Report* and summarized in Table 3-7 in Section 3.6.2.

A validation study was performed to demonstrate that the existing condition model is an accurate representation of the real-world noise levels within the limitations of the noise model algorithm. In accordance with FHWA guidance, field-measured traffic noise levels must be compared to the predicted results from the traffic noise model. The NHHIP noise model was successfully validated. Detailed information regarding the noise model validation can be found in Appendix I: *Traffic Noise Technical Report*.

3.6.2 IMPACTS OF THE PREFERRED ALTERNATIVE

The Preferred Alternative would add travel lanes and physically alter the horizontal and vertical alignments of the highways in each of the three project segments. In addition, average daily traffic volumes are projected to continue to increase in the project area. Increases in traffic volumes and proposed physical alterations to the highway would affect the amounts of traffic noise experienced by adjacent receivers.

In Segment 1, the proposed widening of I-45 from Beltway 8 North to north of I-610 would require new ROW and move traffic closer to receivers on the west side of the highway. Existing receivers on the east side of the highway would also continue to experience traffic noise. Receivers in this segment are primarily residential.

In Segment 2, the proposed widening of I-45 from I-610 to I-10 would continue to generate traffic noise that could affect adjacent receivers on both sides of the highway, though some receivers may experience lower traffic noise levels due to changes in lane elevations and traffic distribution. Proposed changes to the I-45 and I-610 interchange would also affect adjacent receivers. Receivers in this segment are also primarily residential, but also include cemeteries and a park.

In Segment 3, proposed changes to I-10, I-45, US59/I-69, and SH 288 would continue to generate traffic noise that could affect adjacent receivers. Along I-10, widening and horizontal shifts in alignment would continue to generate traffic that could affect adjacent receivers on both sides of the highway. The proposed rerouting of I-45 parallel to I-10 would increase both the number of lanes and traffic volumes in this area. The removal of the portion of I-45 west and south of Downtown (Pierce Elevated) would reduce traffic noise levels in this part of the Downtown area. Proposed widening and changes to interchanges associated with US 59/I-69 and SH 288 would continue to affect adjacent receivers on both sides of these highways. Segment 3 has many different types of noise-sensitive receivers, including many single- and multi-family residential land uses, as well as parks, schools, churches, and other community resources.

As previously described in Section 3.6.1, a "representative receiver" approach was used for the traffic noise analysis. Traffic noise impacts were identified in each project segment for a variety of noise-sensitive land uses. Table 3-7 presents a summary of results, which includes the number of representative receivers modeled and the number of impacted representative receivers for each segment.

Table 3-7: Summary of Traffic Noise Analysis Results

Segment	Number of Representative Receivers Modeled	Numbers of Representative Receivers Impacted (Existing)	Numbers of Representative Receivers Impacted (Proposed)	Number of Representative Receivers Predicted to Experience Noise Reduction*
1	47	38	43	13
2	73	61	60	29
3	163	127	119	60
Total	283	226	222	102

* Some representative receivers are predicted to experience a decrease in future noise levels of at least 1 dB(A) but may still be impacted by noise.

The detailed predicted noise level results for each segment are presented in tabular and graphic formats in Appendix I: *Traffic Noise Technical Report*.

The proposed NHHIP would result in traffic noise impacts in all three segments associated with the Preferred Alternative. Residential noise receivers located throughout the project area are predicted to experience future traffic noise impacts. Additionally, the Preferred Alternative would result in future traffic noise impacts at other land use areas including parks, churches, and schools. Results also indicated that compared to existing noise levels, predicted noise levels would be reduced for some receivers, due to proposed horizontal and/or vertical alignment changes associated with the Preferred Alternative.

3.6.2.1 Noise Abatement Measures

When a traffic noise impact occurs, noise abatement must be considered. A noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area. Before any abatement measure can be proposed for incorporation into the project, it must be both feasible and reasonable. Feasibility and reasonableness considerations include constructability, the predicted acoustic reductions provided by the abatement measure, and cost effectiveness. 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 $52,500 (FHWA 2017) 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 least one impacted, first row receiver by at least seven dB(A). The cost-effectiveness criteria can be met through evaluation of individual noise walls or through corridor-wide cost averaging of acoustically feasible noise walls. This noise analysis was conducted using the corridor-wide cost averaging strategy by segment. More detailed information about cost averaging used in the noise analysis can be found in Appendix I: *Traffic Noise Technical Report.*

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 walls.

Traffic Management

Control devices could be used to reduce the speed of the traffic; however, the minor benefit of 1 dB(A) per five 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 new ROW, 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 the impacted receiver locations. The noise barrier evaluation conducted for the NHHIP Final EIS is described below. The analysis focused on noise-sensitive representative receivers in NAC locations adjacent to the Preferred Alternative's existing and proposed ROW.

Table 3-8 presents a summary of reasonable and feasible abatement proposed for impacts associated with the Preferred Alternative. Proposed noise barriers in Segment 1 would be 14 feet in height. Proposed noise barriers in Segments 2 and 3 would primarily be 16 feet in height.

Table 3-8: Summary of Noise Abatement Analysis Results

Segment	Number of Representative Receivers Modeled	Numbers of Representative Receivers Impacted	Number of Representative Receivers Benefited	Number of Barriers Proposed (Preliminary)	Estimated Number of Benefited Receptors
1	47	43	27	7	40
2	73	60	33	12	104
3	163	119	77	57	270
Total	283	222	137	76	414

A quantitative examination of the proposed abatement measures and specific proposed mitigation details (i.e., noise barrier dimensions, estimated costs, etc.) can be found in Appendix I: *Traffic Noise Technical Report*.

Any subsequent design changes may require a reevaluation of the preliminary noise barrier proposal. Adjustments to noise barrier locations may occur during final design. The final decision to construct a proposed noise barrier will not be made until completion of the proposed NHHIP design, utility evaluation, and polling of benefited and adjacent property owners and residents.

3.6.2.2 Construction Impacts

During the construction phase of this project, temporary increases in noise may result from construction activities. Noise associated with construction of the project is difficult to predict. Heavy machinery, the major sources of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receivers would be expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities would not be expected. Provisions would be included in the construction 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.

3.6.2.3 Predicted Noise Impact Contours

Land use activity within the three segments includes parcels that are currently undeveloped land. 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 make sure, to the maximum extent possible, no new activities are planned or constructed along or within the predicted (2040) noise impact contour. A summary of the distances from the proposed project ROW to each NAC category is presented in Table 3-9. The detailed predicted noise impact contours for each segment can be found in Appendix I: *Traffic Noise Technical Report*.

Table 3-9: Traffic Noise Impact Contours

Segment	Distance from Right-of-Way (feet)	
	NAC Categories B&C 66 dB(A)	NAC Category E 71 dB(A)
Segment 1	Varies from 400 to 550	Varies from 15 to 225
Segment 2	Varies from 240 to 340	Varies from Inside the ROW to 40
Segment 3	Varies from 90 to 585	Varies from Inside the ROW to 340

A copy of the traffic noise analysis will be made available to local officials. On the date of approval of the Record of Decision (Date of Public Knowledge), FHWA and TxDOT would no longer be responsible for providing noise abatement for new development adjacent to the project.

3.6.3 BEST MANAGEMENT PRACTICES FOR NOISE MITIGATION

In addition to noise mitigation by way of noise barriers, BMPs that will be implemented to reduce noise levels of the project include the use of longitudinally tined pavement, which creates shallow grooves in the roadway surface running lengthwise and decreases noise compared to transverse tining. The tined

pavement will be used on non-elevated mainlanes and frontage roads. However, since FHWA does not currently consider pavement as a formal noise abatement measure, potential noise reduction from tined pavement is not quantified in the Traffic Noise Technical Report. Such reduction would be in addition to the noise mitigation quantified in the Traffic Noise Technical Report.

3.6.4 IMPACTS OF THE NO BUILD ALTERNATIVE

If the No Build Alternative were implemented, noise levels would be expected to increase with an associated increase in future traffic volumes.

3.6.5 ENCROACHMENT ALTERATION EFFECTS

No project-related encroachment alteration noise impacts are anticipated as a result of the proposed project.

3.7 Water Resources

Based on comments received during the Draft EIS public comment period, changes were made to the design and the proposed new ROW of the Preferred Alternative. Consequently, water resources were reassessed for the Preferred Alternative alignment. Below is a summary of the updated analysis of water resource features documented in the Draft EIS.

3.7.1 REGULATORY OVERVIEW

3.7.1.1 Water Quality

In 1948, the U.S. Congress passed the Federal Water Pollution Control Act, which was later amended in 1972, to provide protection for the nation's waters. The 1972 amendment is commonly known as the Clean Water Act (CWA). The CWA was created to establish a basic structure for regulating pollutant discharges into the waters of the United States, provide the EPA the authority to implement pollution control programs, maintain existing requirements to establish water quality standards for contaminants in surface waters, make discharges of any pollutant from a point source into surface waters illegal, recognize the need for plans to address critical problems posed by non-point source pollution, and fund the construction of sewage treatment plants under the construction grants program.

There are multiple sections of the CWA that further specify requirements for various entities to comply with the rules and regulations set by the CWA. Section 402 regulates the discharge of wastewater or storm water from municipal, industrial, and commercial facilities and construction sites. Permission for such discharges must be obtained from the EPA through a National Pollutant Discharge Elimination System (NPDES) permit. In September 1998, the TCEQ assumed responsibility for administering the NPDES program in Texas. The TCEQ, through the Texas Pollutant Discharge Elimination System (TPDES), has statutory authority to issue permits for the discharge of pollutants into or adjacent to waters in the state.

The TCEQ has developed surface water quality standards that apply to all surface waters in the State of Texas (Texas Administrative Code [T.A.C.] Title 30, Chapter 307). These standards represent rules designed to establish goals for water quality throughout the state**.** During the triennial review, the TCEQ revised and adopted the 2016 standards and submitted the package to the EPA. This means that the 2016 standards are in effect for non-federal programs. The standards provide a basis on which TCEQ regulatory programs can establish reasonable methods to implement and attain the established goals for water quality**.**

The TCEQ assigns each water body in the state a category designation from 1 to 5. The higher the category number, the higher the level of effort that is required to manage the water quality. Category 1 water bodies meet all designated uses and require only routine monitoring and preventive action. Category 5 waters require TCEQ action to restore water quality. A water body is considered impaired if its designated use(s) is affected by a pollutant or condition of concern and the water quality standards are not met. Water bodies assigned to Category 4 or 5 are considered by the TCEQ to be impaired waters. The TCEQ is required under Section 303(d) of the CWA to identify water bodies that do not meet, or are not expected to meet, applicable water quality standards for their designated uses. The TCEQ maintains two lists for impaired waters. The 303(d) List includes Category 5 impaired waters for which Total Maximum Daily

Loads (TMDLs) or other management strategies are planned but not yet implemented. TMDL is a regulatory term from the CWA describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. The second list is the Water Quality Index, which includes both Category 4 and 5 waters. Category 4 waters are impaired waters for which TMDLs have already been adopted, or for which other management strategies are underway to improve the water quality. TCEQ reviews the standards for one or more parameters before a management strategy is selected, including the possible revision of the water quality standards (TCEQ 2019a).

3.7.1.2 Texas Pollutant Discharge Elimination System and Storm Water

As stated above, the TCEQ assumed responsibility for administering the NPDES program in Texas. The TPDES is the state program for issuing, amending, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements. The TPDES program requires the preparation of a storm water pollution prevention plan (SW3P) for construction projects that disturb more than one acre of land to confirm that measures would be implemented to prevent or correct erosion that may develop during construction. Projects disturbing more than five acres of land are required to obtain a Construction General Permit (CGP), Permit No. TXR150000, to authorize discharges of storm water associated with construction activities. To meet the TPDES CGP requirements, the entity responsible for the project must develop and implement an SW3P, complete a NOI for submittal to the TCEQ, post a notice at the construction site, and submit a Notice of Termination once the site has reached final stabilization. Guidance documents, such as TxDOT's *Storm Water Management Guidelines for Construction Activities*, provide discussions of storm water controls to be implemented during construction (TxDOT 2018a). Water quality impacts from development can be minimized through the implementation of a SW3P in compliance with TPDES requirements and a municipal separate storm sewer system (MS4) in conjunction with City of Houston improvements. Polluted storm water runoff is often transported to MS4s and ultimately discharged into local rivers and streams without treatment. EPA's storm water Phase II Rule establishes a MS4 storm water management program that is intended to improve the nation's waterways by reducing the quantity of pollutants that storm water collects and carries into storm sewer systems during storm events. The proposed project is located within the City of Houston's MS4 boundary. TxDOT would coordinate with the City of Houston regarding construction of the proposed project within the MS4 boundary.

3.7.1.3 Public Drinking Water Systems

The state's Source Water Protection Program is a community-based, voluntary pollution prevention program that helps public water systems (PWSs) protect their drinking water sources. The program was created by the 1986 Safe Drinking Water Act Amendments and the expansion of the Wellhead Protection Program. The Safe Drinking Water Act emphasizes groundwater and wellhead programs to protect source waters. The Wellhead Protection Program sets in place public health protection measures to ensure safe drinking water for citizens served by public drinking water supplies. A PWS provides potable water for the public's use. A system must be a certain size to be considered public. It must have at least 15 service connections or serve at least 25 individuals for at least 60 days annually (TCEQ 2019b). These water systems are classified as either Community Water systems that serve the same people year-round (e.g., in homes or businesses), Non-Transient Non-Community Water systems that serve the same people, but

not year-round (e.g., schools that have their own water system), or Transient Non-Community Water systems that do not consistently serve the same people. All public water supply systems are eligible to participate in the program, which establishes procedures and criteria for identifying the boundaries of areas that constitute the sources of water used by PWSs. The program also defines procedures for identifying potential sources of contaminants within the same areas and provides for the development and implementation of plans for managing potential contaminant sources to prevent contamination.

3.7.1.4 Coastal Barrier Resources Act

The U.S. Congress recognized that during the 1970s and early 1980s increasing development pressure on coastal barriers was resulting in the loss of natural resources. In 1982, Congress enacted the Coastal Barrier Resources Act, which was later amended in 1990 by the Coastal Barrier Improvement Act. The legislation was implemented as part of a Department of the Interior initiative to preserve the integrity of these unique landforms that provide protection for important and diverse fish and wildlife habitats and serve to buffer the United States mainland from severe coastal storms and erosion. The Coastal Barriers Resources Act designated relatively undeveloped coastal barriers along the Atlantic and Gulf coasts as part of the Coastal Barrier Resources System (U.S. Fish and Wildlife Service [USFWS] 2019). To protect coastal areas, the Act encourages the conservation of hurricane prone, biologically rich coastal barriers by discouraging development through limitations on most new federal expenditures that encourage development, and through restrictions on financial assistance, including disaster relief assistance provided by the Federal Emergency Management Agency (FEMA).

3.7.1.5 Coastal Zone Management Program

Originally created by the National Oceanic and Atmospheric Administration (NOAA) in 1972, the Coastal Zone Management Act and was later amended in 1996 with the intent to manage the nation's coastal resources and provide for the preservation, protection, development, restoration, and enhancement (where feasible) of coastal zones in the United States (NOAA 2019). In Texas, the General Land Office is designated as the lead agency that coordinates the development and implementation of the Texas Coastal Management Plan. The Coastal Coordination Advisory Committee assists in administering the program and adopting uniform goals and policies to guide decision making by all entities that regulate or manage the use of natural resources within the Texas coastal area.

The boundary of the Texas Coastal Management Zone was delineated in accordance with the requirements of the Coastal Zone Management Act's federal program development and approval regulations, and the Texas Coastal Coordination Act. Coastal Zone Management Act requirements dictate that a state's coastal zone boundaries include four elements: an inland boundary, a seaward boundary, interstate boundaries, and federal land excluded from the boundary.

The General Land Office typically requires Coastal Consistency determinations for projects located in the coastal zone if the project is required to receive permit authorization for impacts to waters of the United States under Section 10 of the Rivers and Harbors Act or Section 404 of the CWA. Formal coordination with the General Land Office would be required to verify consistency with the Texas Coastal Management Program. Additionally, a bridge permit or permit amendment from the U.S. Coast Guard (USCG) would be

required for a proposed project's crossing of a navigable water determined to be within the Texas Coastal Management Zone.

3.7.1.6 Rivers and Harbors Act of 1899

Sections 9 and 10 of the Rivers and Harbors Act of 1899 prohibit the unauthorized obstruction (including bridge construction) or alteration of any navigable waters of the United States (i.e., waters subject to the ebb and flow of the tide), unless the work has been authorized by permit from the USCG and the U.S. Army Corps of Engineers (USACE). Coordination with the USCG would be required per Section 9 of the Rivers and Harbors Act and the General Bridge Act for bridge construction activities that would occur over any navigable waters. Coordination with the USACE would be necessary to authorize bridge construction should bridge structures require discharges of dredged or fill material into waters regulated by the USACE under Section 10 of the Rivers and Harbors Act.

3.7.2 EXISTING CONDITIONS

3.7.2.1 Groundwater Resources

The major aquifer in the Houston area is known as the Gulf Coast Aquifer, which consists of complexly interbedded clays, silts, sands, and gravels of Cenozoic age that are hydrologically connected to form a large, leaky, artesian aquifer system. The Gulf Coast Aquifer parallels the coastline and increases in thickness in the direction of the Gulf of Mexico. This aquifer system includes four major components and several recognized water-producing formations. The Chicot Aquifer, which is the upper component of the Gulf Coast Aquifer system, consists of the Willis Sand, the Bentley and Montgomery Formations, the Beaumont Clay, and overlying alluvial deposits. The Lissie Formation is considered by some to be equivalent in age to the Montgomery and Bentley Formations. The Burkeville Clay lies beneath the Evangeline Aquifer and separates it from the Jasper Aquifer. The Gulf Coast Aquifer is not designated as a sole source aquifer by the state, and the project is not located in a protected aquifer recharge or discharge zone. A description of these aquifer systems and stratigraphic information may be found in *Aquifers of the Gulf Coast of Texas Report* 365 (Mace et al. 2006).

The regional Gulf Coast Aquifer system is recharged by the infiltration of precipitation that falls on topographically elevated aquifer outcrop areas farther to the north and west of the Houston area. Groundwater in the recharge area is normally under unconfined, water-table conditions, and is most susceptible to contamination. Some water-bearing formations dip below the surface and are covered by other formations (Texas Water Development Board [TWDB] 2011). In the project area, the Gulf Coast Aquifer is a confined aquifer, and the location of the recharge area is controlled by the presence and location of the Beaumont Clay. The Willis Sand and Lissie Formation are located in the northern part of the project area (Segment 1). This is the outcrop, or recharge area, of the Chicot Aquifer. There is little to no Gulf Coast Aquifer recharge occurring the in the area of Segments 2 or 3 (Noble et al. 1996).

The shallow groundwater table in the study area generally ranges from 10 to 30 feet below the ground-level surface. The estimated total recharge to the saturated zone in the project area is about 6 inches per year, since some percentage of the total aquifer recharge discharges locally to streams, creeks, ditches, seeps, or canals.

The TWDB's groundwater database was searched for water wells located within the project area (the area of existing and proposed ROWs for the Preferred Alternative). A total of seven registered water wells documented in the database were identified as being in the project area (Table 3-10). All wells used the Gulf Coast Aquifer as source water. Primary uses listed for the wells include commercial, domestic, industrial, public supply, and unused (TWDB 2019). Of the seven water wells, two wells are listed as used for public water supply.

Table 3-10: Water Wells within the NHHIP Preferred Alternative Right-of-Way

Water Well Primary Use	Segment 1	Segment 2	Segment 3
Commercial	1	0	0
Domestic	1	0	0
Industrial	1	0	0
Public Supply	2	0	0
Stock	0	0	0
Unused	2	0	0
Alternative Total	7	0	0

Source: TWDB 2019

The TCEQ's drinking water database (https://dww2.tceq.texas.gov/DWW/) was searched for information pertaining to PWSs located in the proposed project area. There are 676 active community water utilities in Harris County. These utilities include municipalities, private corporations, and district ownership. In all, 1,243 active PWSs in Harris County are listed in the TCEQ Texas Drinking Water Watch (TCEQ 2019b). Within the project area, the City of Houston operates and maintains the PWS that distributes public drinking water to end users.

3.7.2.2 Surface Water Resources

The TCEQ has individually defined and assigned a unique identification number to the surface waters in the state. The major surface waters of the state are grouped into 25 basins, with each basin assigned a number. The waters are further separated into segments, with each segment having relatively homogeneous chemical, physical, and hydrological characteristics. A water quality segment provides a basic unit for assigning site-specific water quality standards, based on designated uses, for implementing a watershed-based approach to water quality management programs. Segments are identified as classified or unclassified. Classified waters include most rivers and their major tributaries, major reservoirs, bays, estuaries, and the Gulf of Mexico. Classified segments refer to water bodies that have designated uses defined in the Texas Surface Water Quality Standards (TSWQS) and are protected by general or site-specific water quality criteria and screening levels. Unclassified waters are usually the smaller water bodies and tributaries where data may be lacking or is not available, and where designated uses are not defined in the TSWQS. The state presumes a high aquatic life use designation for unclassified waters, and these waters are protected by the general standards and screening levels corresponding to the high aquatic life use designation until data is available or generated through a Use Attainability Analysis study or otherwise.

Unique water body segment identification numbers are typically four digits, with the initial two digits representing the basin within which the segment is located. For example, the proposed project area is located in Basin 10, the San Jacinto River Basin. Therefore, segments in the San Jacinto River Basin begin with 10. The second two digits represent a specific segment of the San Jacinto River system. These specific segments are numbered sequentially beginning with 01 and increasing numerically as needed. For example, the segment of the San Jacinto River system named Houston Ship Channel/Buffalo Bayou Tidal, with designated upstream and downstream limits, is identified as Segment 1007, and the segment named Buffalo Bayou Tidal, having designated upstream and downstream limits that do not overlap other named segments, is identified as Segment 1013 (Table 3-11). Some tributaries flowing into a river are not classified, but rather are unclassified waters that may need to be reviewed for the assignment of site-specific water quality standards. Such unclassified waters are assigned a letter after the unique identification number. For example, the segment named Little White Oak Bayou, which flows into Buffalo Bayou, is identified as Segment 1013A (see Table 3-11).

Table 3-11: Texas Surface Water Quality Water Segments Within the Project Area

Water Segment	Name and Location	Water Crossing of NHHIP Preferred Alternative by Segment	Category	Designated Uses
1006D	**Halls Bayou:** From Greens Bayou confluence upstream to Frick Road	1	4	Aquatic Life, Recreation, and General
1007	**Houston Ship Channel/Buffalo Bayou Tidal:** From a point immediately upstream of Greens Bayou to a point 100 meters upstream of US 59/I-69, including tidal portion of tributaries	3	5	Aquatic Life, General, and Fish Consumption
1013	**Buffalo Bayou Tidal:** From a point 100 meters upstream of US 59/I-69 to a point 400 meters upstream of Shepherd Drive	2, 3	4	Aquatic Life, Recreation, and General
1013A	**Little White Oak Bayou:** From White Oak Bayou confluence to Yale Street	1, 2	5	Aquatic Life, Recreation, and General
1016C	**Unnamed Tributary of Greens Bayou:** From the confluence with Greens Bayou, east of Aldine Westfield Road, to the Hardy Toll Road	1	4	Aquatic Life, Recreation, and General
1017	**White Oak Bayou Above Tidal:** From a point immediately upstream of confluence of Little White Oak Bayou to point 3 kilometers (1.9 miles) upstream of FM 1960	2	4	Aquatic Life, Recreation, and General

Source: TCEQ 2020c

Some of the streams in Basin 10 are located in heavily urbanized areas and receive treated domestic and industrial wastewater, and agricultural and urban runoff. In compliance with Section 303(d) of the CWA, the TCEQ identifies water bodies in the state that do not meet the TSWQS. The compiled listing of these water bodies is known as the 303(d) List. Category 5 waters comprise the 303(d) List (TCEQ 2020).

Segments 1007 and 1013A are Category 5 waters and are included in the 2020 TCEQ 303(d) List. Segments 1006D, 1013, 1016C, and 1017 are listed in TCEQ's Water Quality Index as Category 4 waters, which are waters where TMDLs have already been adopted, or for which other management strategies are underway to improve water quality. The TCEQ prioritizes water bodies on the 303(d) List to schedule development of a TMDL. A TMDL is a technical analysis that determines maximum loadings of a pollutant of concern that a water body can receive and still meet water quality standards. A TMDL allocates the allowable loading to different point and non-point pollutant sources in a watershed (TCEQ 2019d). Construction, operation, and maintenance activities associated with the proposed project would not impair designated uses of the waterbodies in the proposed project area. BMPs implemented during construction and operation would reduce the introduction of pollutants into receiving waters.

3.7.3 Impacts of the Preferred Alternative — Groundwater

Potential impacts to shallow groundwater of the upper Gulf Coast Aquifer system could result from activities associated with construction and operation of the proposed project. Construction-related impacts could include actions that occur during excavation, grading or trenching that could expose soils and shallow groundwater and potentially result in impacts to groundwater or surface water quality; footing excavations for pier foundations resulting in, or possibly encountering, groundwater contamination; potential surface water impacts from excavation and dewatering operations, concrete pouring, and washout activities; management and application of chemical products; construction activities that may affect shallow aquifer recharge or discharge areas; and the potential for accidental spills from construction equipment and from material storage. Additional construction-related impacts may be associated with the dismantling and replacement of existing bridges, roads, and road base, which may include discharges of waste material, accidental spills, and discharge or generation of impacted soils, and impacts to surface water or to shallow groundwater in recharge areas.

During construction, spills would be mainly limited to fuels (i.e., petrochemicals) and lubricants used for construction equipment. The project area is in a highly urbanized portion of the City of Houston; therefore, much of the area is composed of impervious cover (e.g., streets and roadways, driveways, parking areas, residential and commercial buildings, etc.). There is little opportunity for undeveloped land to absorb and filter precipitation and storm water runoff to recharge groundwater resources. Rather, the majority of storm water runoff in the project area is directed to storm water management facilities to be conveyed to area receiving waters. Potential impacts to groundwater from the proposed project would be related to storm water discharges carrying hydrocarbon elements associated with construction equipment, and the construction of drilled shafts for bridges or other support structures. The SW3P would describe erosion control measures to be implemented by the contractors and BMPs to be implemented to control and prevent, to the maximum extent practicable, the discharge of pollutants to surface waters and groundwater. Such measures may include the use of silt fencing, temporary berms, inlet protection

barriers, hay bales, seeding or sodding of bare areas, or other suitable means of containment. Temporary erosion control structures would be installed where appropriate before construction begins and would be maintained throughout construction of the proposed project. During construction, the amount of cleared or non-vegetated soil would be restricted to minimize additional erosion and sedimentation. When construction is completed, disturbed areas would be restored according to TxDOT specifications.

3.7.3.1 Segment 1: I-45 from Beltway 8 to I-610

Preferred Alternative

Potential impacts on groundwater quality would be primarily related to storm water discharges from both construction and operation of the proposed project. Impacts to groundwater quality would be minimized through the implementation of storm water best management practices (BMPs) (Section 3.7.4). Impacts to groundwater quality because of surface spills would be minimized by the implementation of spill prevention measures. Wells occurring within the Preferred Alternative that would be unavoidably impacted by the proposed project would be plugged during construction according to TCEQ regulations to eliminate the potential for impacts to groundwater resources. A total of seven groundwater wells occur within the proposed ROW of the Preferred Alternative. During the ROW acquisition process, TxDOT would coordinate with well owners whose wells would be adversely affected by the project to compensate owners for impact and to complete utility adjustments and water line connections or reconnections.

3.7.3.2 Segment 2: I-45 from I-610 to I-10

Preferred Alternative

Potential impacts on groundwater quality would be primarily related to storm water discharges from both construction and operation of the proposed project. Impacts to groundwater quality would be minimized through the implementation of storm water BMPs (Section 3.7.4). Impacts to groundwater quality because of surface spills would be minimized by the implementation of spill prevention measures. No groundwater wells occur within the proposed Segment 2 ROW of the Preferred Alternative; therefore, there would be no potential for impacts to groundwater resources related to the plugging and abandoning of an existing well.

3.7.3.3 Downtown Loop System

Preferred Alternative

Potential impacts on groundwater quality would be primarily related to storm water discharges from both construction and operation of the proposed project. Impacts to groundwater quality would be minimized through the implementation of storm water BMPs (Section 3.7.4). Impacts to groundwater quality because of surface spills would be minimized by the implementation of spill prevention measures. No groundwater wells occur within the proposed Segment 3 ROW of the Preferred Alternative; therefore, there would be no potential for impacts to groundwater resources related to the plugging and abandoning of an existing well.

3.7.3.4 Impacts of the No Build Alternative – Groundwater

The No Build Alternative would have no direct impacts to groundwater resources within the area of the proposed project.

3.7.4 IMPACTS OF THE PREFERRED ALTERNATIVE — SURFACE WATER

Construction of the proposed project would result in an increase in the overall area of impervious cover, which would result in an increase in localized runoff contributed by the proposed project compared to existing conditions. Local runoff, including runoff from the increased area of impervious cover, would be directed to the proposed storm water drainage improvements to be constructed as part of the proposed project. The anticipated highway runoff would be expected to have no adverse effect on area flooding, as the proposed drainage improvements would be designed to accommodate the increased storm water runoff generated by the project. A SW3P would be developed for the proposed project in accordance with TxDOT policies, and measures would be implemented to prevent or correct erosion that may develop during construction. Guidance documents, such as TxDOT's *Storm Water Management Guidelines for Construction Activities*, discuss temporary erosion control measures to be implemented to minimize impacts to water quality during construction (TxDOT 2018a). Temporary erosion control structures would be installed where appropriate before construction begins and would be maintained throughout construction of the proposed project. Temporary soil erosion and sedimentation controls may include the use of silt fencing, temporary berms, inlet protection barriers, hay bales, seeding or sodding of bare areas, or other suitable means of containment. During construction, the amount of cleared or non-vegetated soil would be restricted to minimize additional erosion and sedimentation. When construction is completed, disturbed areas would be restored according to TxDOT specifications. These practices would be in place prior to and during the construction period and would be continuously monitored and maintained throughout construction of the proposed project to ensure that adverse impacts to surface water quality are minimal. Storm water drainage improvements such as detention either in-line (within upsized storm sewers) or off-line (detention basins) would serve as long-term measures to control erosion and sedimentation within the project area. The detention systems would outfall to existing drainage systems within the project limits. The detention systems would be sized such that the proposed rf3oadway improvements would result in no adverse impact to existing drainage conditions for storm events up to and including the 100-year storm event (see Section 3.8 for information about revised precipitation-frequency data for Texas). A reduction in the volume of pollutants through the implementation of temporary and permanent erosion and sedimentation controls and storm water detention facilities would result in a reduced pollutant load potentially being conveyed with storm water runoff into receiving waters, thereby protecting water quality.

Contractors would take appropriate measures to prevent or minimize and control hazardous material spills in construction assembly areas. Removal and disposal of waste materials by the contractors would be in compliance with applicable federal and state guidelines and laws.

3.7.4.1 Segment 1: I-45 from Beltway 8 to I-610

Preferred Alternative

Potential impacts on surface water quality from the proposed project would be primarily related to storm water discharges into streams and drainageways that traverse the Preferred Alternative. There are two impaired streams that traverse the Preferred Alternative: Halls Bayou and an unnamed tributary of Greens Bayou. The crossing of streams and drainageways occurring within the Preferred Alternative, and the discharge of storm water runoff into these drainage features, would be unavoidable. Implementation of storm water BMPs and the construction of detention facilities would minimize potential impacts to surface water quality. Impacts to surface water quality because of surface spills would be minimized by the implementation of spill prevention measures established in the SW3P.

3.7.4.2 Segment 2: I-45 from I-610 to I-10

Preferred Alternative

Potential impacts on surface water quality from the proposed project would be primarily related to storm water discharges into streams and drainageways that traverse the Preferred Alternative. Little White Oak Bayou, an impaired stream, traverses the Preferred Alternative at two separate locations. The crossing of streams and drainageways occurring within the Preferred Alternative, and the discharge of storm water runoff into these drainage features, would be unavoidable. The implementation of storm water BMPs and the construction of detention facilities would minimize potential impacts to surface water quality. Impacts to surface water quality because of surface spills would be minimized by the implementation of spill prevention measures established in the SW3P.

3.7.4.3 Downtown Loop System

Preferred Alternative

Potential impacts on surface water quality from the proposed project would be primarily related to storm water discharges into streams and drainageways that traverse the Preferred Alternative. There are two impaired streams that traverse the Preferred Alternative, Buffalo Bayou and White Oak Bayou. The crossing of streams and drainageways occurring within the Preferred Alternative, and the discharge of storm water runoff into these drainage features, would be unavoidable. The implementation of storm water BMPs and the construction of detention facilities would minimize potential impacts to surface water quality. Impacts to surface water quality because of surface spills would be minimized by the implementation of spill prevention measures established in the SW3P.

TxDOT will coordinate with the TCEQ during the review and evaluation of the proposed project relative to the TCEQ's 303(d) List of impaired water bodies occurring within the proposed project area that could potentially be impacted by construction and operation of the proposed project.

3.7.4.4 Impacts of the No Build Alternative – Surface Waters

The No Build Alternative would have no direct impacts on surface water resources within the project area, as the existing roadway system would remain in its current condition.

3.7.5 IMPACTS OF THE PREFERRED ALTERNATIVE — COASTAL ZONE AND COASTAL BARRIERS

3.7.5.1 Segment 1: I-45 from Beltway 8 to I-610

Preferred Alternative

No areas of the Texas Coastal Management Zone are mapped as occurring within Segment 1. Likewise, no areas mapped in the Coastal Barrier Resources System occur in Segment 1. Therefore, the Preferred Alternative would have no impacts to the Texas coastal zone or coastal barrier resources.

3.7.5.2 Segment 2: I-45 from I-610 to I-10

Preferred Alternative

No areas of the Texas Coastal Management Zone or coastal resources included in the Coastal Barrier Resources System are mapped as occurring within Segment 2. Therefore, the Preferred Alternative would have no impacts to the Texas coastal zone or coastal barrier resources.

3.7.5.3 Downtown Loop System

Preferred Alternative

No coastal barrier resources are mapped as occurring in Segment 3; therefore, the Preferred Alternative would have no impacts on coastal barrier resources. A portion of the Texas Coastal Management Zone associated with Buffalo Bayou traverses east-west through Segment 3. Construction activities of the Preferred Alternative requiring permit authorization from the USACE would necessitate formal coordination between TxDOT and the General Land Office regarding consistency with the Texas Coastal Management Program, thereby minimizing impacts to the coastal zone. TxDOT coordination with the USCG would also be conducted for permitting related to bridge structures constructed over Buffalo Bayou.

3.7.5.4 Impacts of the No Build Alternative – Coastal Zone and Coastal Barriers

The No Build Alternative would have no impacts on coastal barrier resources. Similarly, the No Build Alternative would have no impacts on the portion of the Texas Coastal Management Zone, as the current roadways and bridge structures occurring within the portion of the coastal zone in the southern part of the project area would remain in place. No coordination with the General Land Office would be required relative to a Coastal Consistency determination, and no coordination with the USCG would be required to permit bridge structures.

3.7.6 ENCROACHMENT ALTERATION EFFECTS

The proposed project area includes an existing roadway located within a highly urbanized portion of the City of Houston; therefore, encroachment alteration effects to water quality would be minor. Encroachment alteration effects could occur primarily due to increased impervious surface area, which could result in increased non-point source runoff, altered recharge (flow and quality) into the aquifer system, increased localized erosion, and degraded water quality downstream. Impervious cover would increase directly by the addition of MaX lanes and associated roadway infrastructure. Effects would also occur in limited areas where vegetation in the proposed project area is removed during construction,

which could accelerate off-site erosion due to runoff. Construction of the proposed roadway improvements could encroach on the surface or subsurface drainage areas of adjacent aquatic features, altering the hydrologic regime in those features.

The proposed project would include the construction of storm water drainage improvements that would be designed to accommodate the anticipated increased runoff from the project. The use of short-term and long-term BMPs within the proposed project area would minimize water quality effects both within the project area and downstream of the project. Regarding groundwater, adverse ecological effects could occur if highway runoff reaches the water table due to infiltration of overland flow, or if water quality impairment precludes additional development of the water table, which could result in freshwater shortages. Potential impacts to surface and groundwater resources during construction would be mitigated through implementation of BMPs that may include, but would not be limited to, silt fencing, temporary berms, inlet protection barriers, hay bales, and seeding or sodding of bare areas. The BMPs would minimize the introduction of pollutants and sediments into natural aquatic features by filtering particulates and pollutants from storm water. For example, silt fences allow water to flow through a geotextile fabric while retaining sediment and other unwanted solids on the inside of the fence. Storm water filter socks are an example of inlet protection barriers that capture liquids and particulate pollutants from storm water as it passes through the filter sock. Filter socks have the capability to remove solids, debris, and liquids from storm water, as well as specific constituents like petroleum-based liquids, heavy metals, and hazardous chemicals. Another method of controlling storm water is the addition of vegetation to bare areas. Vegetated areas would slow storm water runoff, stabilize soil around the project location, and reduce the amount of sediment available to be carried by storm water. BMPs implemented for the proposed project would be maintained and replaced to ensure effectiveness throughout the construction period. The combination of BMPs used during construction and the proposed storm water drainage improvements, which include the construction of several detention basins, would minimize potential short-term and long-term adverse impacts to water quality.

3.8 Floodplains

Based on comments received during the Draft EIS public comment period, changes were made to the design and the proposed new ROW of the Preferred Alternative. In addition, after the adoption of the Atlas 14 rainfall data in development regulations in Harris County, the City of Houston, and HCFCD now require that all projects within the effective floodplain provide floodplain mitigation based on the effective 500-year floodplain. (see Section 3.8.2). Consequently, floodplains were reassessed for the Preferred Alternative alignment.

3.8.1 Regulatory Overview

In 1968, the U.S. Congress passed the National Flood Insurance Act, which created the National Flood Insurance Program (NFIP) administered by the Federal Insurance Administration. The intent of the NFIP was to reduce future flood losses through the adoption of local floodplain management regulations, and to provide a premium-based insurance mechanism to protect property owners against potential losses. FEMA was created in 1979 to coordinate the federal government's role in preparing for, preventing, mitigating the effects of, responding to, and recovering from domestic disasters, whether natural or man-

made. The Federal Insurance Administration, and correspondingly the NFIP, was incorporated into the responsibilities of FEMA. FEMA is also responsible for promulgating and maintaining NFIP Flood Insurance Rate Maps (FIRMs). FIRMs depict flood hazard information such as regulatory floodways, one percent annual exceedance probability (100-year) floodplains, and 0.2 percent annual exceedance probability (500-year) floodplains. FIRMs are used as the basis for the planning and design of flood risk reduction programs and projects (FEMA 2019a). In accordance with 23 CFR 650.111, NFIP FIRMs were used to determine if a highway location alternative would encroach onto floodplains

For a community to have the availability of flood insurance, the NFIP requires the community to adopt floodplain management ordinances that meet certain minimum requirements intended to reduce future flood losses. The community official or agency responsible for floodplain management is usually the official or agency responsible for engineering, public works, flood control, or planning in the community (FEMA 2019b). For the City of Houston, the Director of Public Works and Engineering, working through the Floodplain Management Department, is the official responsible for administering the regulatory system related to flood protection and flood risk reduction. The Director's authority to implement and review ordinances, codes, and official determinations relative to flood protection and flood risk reduction is provided pursuant to Chapter 19 of the City of Houston Code of Ordinances (City of Houston 2016). The City of Houston also coordinates floodplain issues with the Harris County Flood Control District (HCFCD), which is a Cooperating Technical Partner with FEMA that reviews floodplain modeling and mapping.

3.8.2 EXISTING CONDITIONS

Portions of the proposed project would traverse areas that are designated by FEMA as special flood hazard areas (i.e., regulatory floodways, 100-year floodplains, and 500-year floodplains). The following FEMA FIRMs were reviewed for the project area (the effective dates of the maps are shown in parentheses): 48201C0460M (10/16/2013), 48201C0470L (6/18/2007), 48201C0660M (6/9/2014), 48201C0680L (6/18/2007), 48201C0670M (6/9/2014), 48201C0690N (1/6/2017), 48201C0860L (6/18/2007), and 48201C0880M (1/6/2017) (FEMA 2019a). The FIRMs indicate that approximately 70 percent of the project area is outside the 100-year floodplain, or other flood hazard areas as determined by FEMA (see Appendix K: *Waters of the United States Technical Report*). In 2018, NOAA released revised precipitation-frequency data for Texas, termed "Atlas 14" data. The data included in Atlas 14 updates rainfall depth information that had been used since the 1960s, and included data in Texas through December 2017, which incorporates rainfall from Hurricane Harvey. It is estimated that the future Atlas 14 one-percent (100-year) floodplain can be estimated by using the current published 0.2 percent (500-year) floodplain (HCFCD 2019). As of July 2019, the Atlas 14 rainfall data must be used when designing and constructing drainage features as part of development in Harris County. The remapping of the floodplains within Harris County based on Atlas 14 data is ongoing, and the models that are used to design drainage systems based on Atlas 14 rainfall data within Harris County are still being updated as of the date of this Final EIS.

3.8.2.1 Floodplain Areas

Areas adjacent to Brays Bayou, Buffalo Bayou, a tributary of Greens Bayou, Halls Bayou, Little White Oak Bayou, and White Oak Bayou are mapped as being within the effective 100-year and 500-year floodplains as mapped by FEMA. Table 3-12 below presents the approximate acreages of the pre-Atlas 14 500-year

FEMA floodplain within the existing and proposed new ROW for each segment of the Preferred Alternative, based on the assumption that the current effective 500-year floodplain approximates the Atlas 14 100-year floodplain.

Table 3-12: Pre-Atlas 14 500-Year Floodplain Acreage within NHHIP Existing and Preferred Alternative Rights-of-Way

NHHIP Right-of-Way		Floodplain Acres (Approximate)
Segment 1	Existing	141
	Preferred Alternative	148
Segment 2	Existing	138
	Preferred Alternative	16
Segment 3	Existing	179
	Preferred Alternative	45

3.8.3 IMPACTS OF THE PREFERRED ALTERNATIVE

TxDOT has performed a preliminary drainage study for the proposed project and detailed drainage studies for Segments 2 and 3 of the proposed project and will perform a detailed drainage study for Segment 1. The drainage studies will be used to determine the appropriate locations and sizes of detention basins, bridges, culverts, or other drainage structures that would be required to mitigate risks incurred by construction of the proposed project. Federal, state, and local authorities will have the opportunity to review the drainage studies to verify that appropriate measures have been proposed such that the project would not increase the flood risk to adjacent properties. Bridges, culverts, and cross-drainage structures will be designed to FHWA and TxDOT standards for design events up to the 100-year storm event. The studies will also confirm that the project would not adversely impact existing floodplain conditions within the vicinity of the project for extreme events, (i.e., storm events in excess of a 100-year storm event). BMPs, such as the construction of detention facilities, would be incorporated into the final design of the proposed project to offset increased flows from areas of impervious surface. Construction of the proposed project would comply with county and local floodplain guidelines and policies. The floodplain acreages listed in Table 3-12 and discussed in the following sections are subject to change as updated floodplain mapping occurs. As noted in Section 3.8.2, Atlas 14 data is currently required to be used in project design, and TxDOT is using the updated precipitation-frequency estimates when designing new construction projects. The acreages in Sections 3.8.3.1 through 3.8.3.3 are based on the estimated Atlas 14 100-year floodplain (effective 500-year floodplain) within the existing and proposed project ROW.

3.8.3.1 Segment 1: I-45 from Beltway 8 to I-610

Approximately 141 acres of 500-year floodplains as currently mapped by FEMA, which approximates the Atlas 14 100-year floodplain, occur within the existing I-45 ROW for Segment 1.

Preferred Alternative

Approximately 148 acres of 500-year floodplains as currently mapped by FEMA (pre-Atlas 14) occur within the new ROW of the Preferred Alternative. The waterbodies and acreage of floodplains include the following:

- Tributary of Greens Bayou: 0.02 acre
- Halls Bayou: 34.05 acres
- Little White Oak Bayou: 114.09 acres

Drainage Improvements

TxDOT prepared a preliminary drainage study that included all segments of the NHHIP project area (AECOM 2018). To be conservative, a preliminary mitigation assessment was completed for the project alternative that would have the most additional pavement. The following summarizes the preliminary drainage analysis findings for Segment 1:

Preliminary Detention Assessment

- Potential area needed for detention: approximately 36.0 acres.
- Majority of preliminary detention sites were located in parcels identified to be partially acquired by the future roadway ROW.

Preliminary Profile Analysis

Recommended mainlane profile adjustments to bring mainlanes up to a 100-year LOS:

- I-45 crossing of Halls Bayou — minor adjustments to the mainlane roadway profile approaching the bridge crossing.
- I-45 between West Little York and HB&T Railroad — minor adjustments to the mainlane roadway profile in the vicinity of West Little York Road, Parker Road, Tidwell Road, Airline Drive, and Crosstimbers Street.
- These adjustments are not anticipated to impact ROW needs or result in significant design changes.

Preliminary Floodplain Analysis

- Each alternative results in net fill within the floodplain.
- It is anticipated that the required floodplain fill mitigation could be provided for in an oversized detention facility along the east bank of Little White Oak Bayou north of Crosstimbers Street.

Preliminary Conveyance Analysis

- Based on the preliminary analysis, no mitigation measures were recommended in regard to floodway conveyance within Segment 1.

- Conveyance considerations were not anticipated to impact ROW needs or result in significant roadway/bridge design changes.

The preliminary drainage study for the NHHIP completed in October 2018 did not utilize the Atlas 14 data. TxDOT will prepare a detailed drainage study using the Atlas 14 data for Segment 1 during detailed design. The analyses conducted during detailed design will be based on drainage design criteria in effect at the time of the study. The study will include evaluation of detention, floodplain fill, floodway conveyance, and mitigation for all impacts, and will be based on the detailed design of the roadway and drainage system. A detailed hydraulic analysis will be completed to determine the appropriate configuration of the storm sewer system. Detention basin locations will be further refined based on the project ROW needs and property availability at the time of the design.

3.8.3.2 Segment 2: I-45 from I-610 to I-10

Approximately 138 acres of 500-year floodplains as currently mapped by FEMA, which approximates the Atlas 14 100-year floodplain, occur within the existing I-45 ROW for Segment 2.

Preferred Alternative

Approximately 16 acres of 500-year floodplains as currently mapped by FEMA (pre-Atlas 14) occur within the new ROW of the Preferred Alternative. The waterbody and floodplain acreage in Segment 2 is:

- Little White Oak Bayou: 16.37 acres

Drainage Improvements

In March 2020, a drainage study was completed for Segment 2 and the portion of Segment 3 of the NHHIP project area that includes Little White Oak Bayou, White Oak Bayou, and Buffalo Bayou watersheds (CivilTech Engineering, Inc. 2020). TxDOT coordinated closely with the HCFCD and the City of Houston regarding previously identified and/or potential future drainage improvements projects within the limits of Segments 2 and 3. These project elements were considered as part of the floodplain impact analysis. The following summarizes the recommendations, which are subject to change during detailed project design:

Drainage Crossings

Replace four (4) major drainage crossings under I-45 and I-610 as listed below:

- Little White Oak Bayou at Cavalcade Street: Replace 3 – 15' × 16' box culverts with bridge over open channel
- Tributary to Little White Oak Bayou at I-45: Replace 1 - 10' × 10' box culvert with 3 – 10' × 10' box culverts
- Little White Oak Bayou at Patton Street: Replace 3 – 15' × 16' box culverts with bridges over open channel
- Little White Oak Bayou at I-610 (I-45 & I-610 Interchange): Replace 3 – 15' × 16' box culverts with bridges over open channel

Storm Drain Systems

The preliminary sizing of the proposed storm sewer systems was performed for the following roadways:

- I-45 Northbound and Southbound Mainlanes, MaX Lanes and Frontage Roads
- I-610 Eastbound and Westbound Mainlanes and Frontage Roads

Preliminary storm sewer plan and profiles are provided in the drainage study. The preliminary design did not include inlets or storm drain laterals for the mainlanes storm sewer trunkline, and drainage system components (bridge deck drains, piping, etc.) were not included for bridges, direct connectors, and ramps. These will be determined during detailed design.

Pump Station Facility

The I-45 Segment 2 proposed depressed section of highway between North Main Street and Melwood Street would be serviced by one (1) pump station facility located southwest of the I-45 and North Main interchange, at the corner of W. Norma Street and Houston Avenue, on the west side of I-45. The pump station was designed to handle the 100-year storm event (Atlas 14). The pump station will have multiple pumps.

Roadway Mitigation Facilities (Detention Basins)

Two detention basins located within the I-45 and I-610 interchange within the proposed ROW were preliminarily designed to mitigate the increased runoff from the proposed highways and for hydraulic system changes due to the proposed storm drainage improvements for NHHIP Segment 2. Three additional basins would provide for impacts to floodplain storage.

Floodplain Mitigation

The floodplain mitigation volume required to compensate for the proposed fill within the floodplain for Segment 2 would be provided in two detention basins on the east side of I-45, south of Patton Street The floodplain mitigation volume includes the loss of floodplain volume within the depressed section in Segment 2.

Based on the mitigation analysis presented in the study, the proposed roadway and storm drainage improvements for NHHIP Segment 2 would not adversely impact existing conditions for storm events up to and including the 100-year storm (Atlas 14) and the 500-year storm (pre-Atlas 14).

3.8.3.3 Segment 3: Downtown Loop System

Approximately 179 acres of 500-year floodplains as currently mapped by FEMA, which approximates the Atlas 14 100-year floodplain, occur within the existing I-45 ROW for Segment 3.

Preferred Alternative

Approximately 45 acres of 500-year floodplains as currently mapped by FEMA (pre-Atlas 14) occur within the new ROW of the Preferred Alternative. The waterbodies and acreages of floodplain include the following:

- Little White Oak Bayou: 0.0 acres (there is no proposed ROW in the Little White Oak Bayou floodplain)
- White Oak Bayou: 25.98 acres
- Buffalo Bayou: 19.39 acres
- Brays Bayou: 0.0 acres (there is no proposed ROW in the Brays Bayou floodplain)

Drainage Improvements

The drainage study completed for Segment 2 included a portion of the Segment 3 project area, including evaluation of potential impacts to Little White Oak, White Oak, and Buffalo Bayou floodplains (see Section 3.8.3.2). In addition, five separate drainage studies were completed for various sections of Segment 3 that evaluated existing drainage conditions and proposed drainage improvements such that the Segment 3 project would not adversely impact existing conditions for storm events up to and including the 100-year storm event.

Depressed sections of the proposed project will be designed to handle extreme weather events with rainfall levels similar to the region's three most recent flood events: Memorial Day (2015), Tax Day (2016), and Hurricane Harvey (2017). Additionally, the project will be designed to meet and/or exceed the most recent guidelines set by the HCFCD. In some cases, there may be water over the roadway during an extreme rainfall event, but the road is designed to still be passable. This will be achieved through a pumped drainage system that will collect rainwater falling inside the depressed sections and discharge it to an adjacent detention basin or receiving channel. For example, the rainwater that falls within the depressed section along US 59/I-69 between Main Street and Alabama Street would be conveyed to a detention facility where it would be held and then discharged at a controlled rate to Brays Bayou. The detention facilities will be sized to accommodate extreme rain events so that the water pumped out of the depressed sections does not overwhelm the receiving bayous. To further protect the depressed sections, the entrance points to these areas would be constructed above the new 500-year water surface elevation such that adjacent floodwaters do not enter the depressed sections and overwhelm the pumps. The pump stations for the depressed sections of highway will be designed with backup pumps and backup generators to reduce the likelihood of a pump system failure. TxDOT is currently exploring the development of an alert system that will close access to depressed sections of the highways in the event of a pump failure.

Drainage Crossings

Replace four (4) major bridge crossings of waterways:

- I-45 bridge crossing of Buffalo Bayou
- I-45 bridge crossing of White Oak Bayou
- I-10/I-45 bridge crossing of White Oak Bayou
- US 59/I-69 bridge crossing of Buffalo Bayou

Roadway Mitigation Facilities (Detention Basins)

Seven detention basins located within the Segment 3 proposed ROW were preliminarily designed to mitigate the increased runoff from the proposed highways and for hydraulic system changes due to the proposed storm drainage improvements.

Floodplain Mitigation

The floodplain mitigation volume required to compensate for the proposed fill within the floodplain for Segment 3 would be provided in three detention basins that would be located along Buffalo Bayou and White Oak Bayou. The floodplain mitigation volume includes the loss of floodplain volume within the depressed sections in Segments 3.

Based on the mitigation analysis presented in the Segment 3 drainage studies, the proposed roadway and storm drainage improvements for NHHIP Segment 3 would not adversely impact existing conditions for storm events up to and including the 100-year storm (Atlas 14) and the 500-year storm (pre-Atlas 14).

3.8.3.4 Segments 1, 2, and 3: Floodplain Impact Analysis

The March 2020 Segment 2 drainage study (CivilTech 2020) included a floodplain impact analysis on the three (3) major drainage systems: Little White Oak Bayou, White Oak Bayou, and Buffalo Bayou for Segment 2 and the sections of Segment 3 that are impacted by White Oak Bayou and Buffalo Bayou. The purpose of the floodplain analysis was to evaluate the impact from the proposed NHHIP on existing floodplains and determine the appropriate mitigation required in order for the NHHIP project to have no adverse impacts on existing conditions.

The floodplain impact analysis shows the proposed drainage improvements along Segment 2 and Segment 3, which include drainage crossing improvements and addition of detention basins, results in a lowering of the 500-year pre-Atlas 14 water surface elevations compared to existing conditions. The proposed Segment 2 and Segment 3 NHHIP improvements would not adversely impact existing conditions for storm events up to and include the 500-year pre-Atlas 14 storm events. In addition, the proposed NHHIP drainage improvements would enhance the resiliency of the roadway project and the adjacent areas.

This project is subject to and will comply with EO 11988 on Floodplain Management. TxDOT adheres to this Executive Order through the procedures and policies in its Hydraulic Design Manual. Design of this project will be conducted in accordance with the department's Hydraulic Design Manual. The design and construction of Segments 1, 2, and 3 of the NHHIP will not increase the base flood elevation and will not result in a "significant encroachment" as defined by FHWA's rules implementing EO 11988 at 23 CFR 650.105(q). TxDOT will coordinate with the City of Houston Department of Public Works and Engineering, and the HCFCD as needed, relative to regulatory floodplains and floodplain management during the design and evaluation of the proposed project.

3.8.4 IMPACTS OF THE NO BUILD ALTERNATIVE

The No Build Alternative would result in no new roadway construction within, or encroachment on, flood hazard areas mapped in the project area. Therefore, the No Build Alternative would have no direct impacts

on flood hazard areas. However, in the vicinity of the project area, but outside the existing I-45 ROW, land use changes and construction activities could alter areas of impervious cover, thereby affecting surface drainage patterns and the volume of storm water runoff, which may potentially impact FEMA-mapped floodplains. Potential floodplain impacts would be regulated by the City of Houston, in cooperation with HCFCD.

3.8.5 ENCROACHMENT ALTERATION EFFECTS

23 CFR 650.105(o) defines risk as consequences associated with the probability of flooding attributable to an encroachment, including the potential of property loss and hazard to life during the life of the highway. Practicable location alternatives to construct the proposed NHHIP improvements are limited because the improvements must necessarily be near the existing highway. The Preferred Alternative would increase the area of impermeable surface and encroach within sections of the mapped regulatory floodplains. The resulting increased volume and velocity of storm water runoff from impervious surfaces will be mitigated by the proposed detention basins such that there is no change to the flood risk within the project area.

A preliminary drainage study was done for all segments. Additionally, the detailed drainage studies conducted for Segments 2 and 3 included combinations of separate hydraulic components and alternative scenarios. The alternative recommended for implementation proposes TxDOT drainage improvements in combination with drainage improvements proposed by the City of Houston. The drainage systems would be designed to ensure that the mainlanes would not be inundated during a 100-year storm event, and only shallow ponding would likely be experienced during a 500-year event. The design and construction of Segments 1, 2, and 3 of the NHHIP will not increase the base flood elevation and will not result in a "significant encroachment" as defined by FHWA's rules implementing EO 11988 at 23 CFR 650.105(q). Based on the modeling conducted, the combined proposed project design and drainage improvements would reduce the 500-year floodplain water surface elevation, thereby having a beneficial effect on flood risk reduction.

The proposed drainage improvements and floodplain mitigation will help address many of the drainage issues in the immediate vicinity of the proposed project. However, it is unreasonable to expect that the project would resolve flooding issues beyond the project's limits. TxDOT is working with the City of Houston, HCFCD and local partners to develop improvements that will add resiliency to the drainage systems. These systems are planned to meet or exceed the most recent drainage system guidelines and criteria established by HCFCD. Overall, the proposed roadway and storm drainage improvements will not adversely impact existing conditions for storm events up to and including the 100-year storm (Atlas 14) and the 500-year storm (pre-Atlas 14).

Plans and specifications will include temporary drainage measures and facilities during construction so that construction will not increase the flood risk and will maintain positive drainage during storm events. Additionally, maintenance crews will routinely check drainage outlets and clear debris along the roadway system to make sure runoff drains properly during major rainfall events.

3.9 Wetlands and Other Waters of the United States

Based on comments received during the Draft EIS public comment period, changes were made to the design and the proposed ROW of the Preferred Alternative. Consequently, waters of the United States, including wetlands, were reassessed for the Preferred Alternative alignment. Below is a summary of the updated analysis of waters of the United States as documented in the Draft EIS.

3.9.1 REGULATORY OVERVIEW

EO 11990, Protection of Wetlands, directs federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands on federal lands. Section 404 of the CWA conveys to the USACE the regulatory authority to regulate discharges of dredged or fill material into waters of the United States, including wetlands. Section 10 of Rivers and Harbors Act of 1899 authorizes the USACE to regulate work and/or structures in navigable waters of the United States. The discharge of dredged or fill material into jurisdictional waters requires CWA Section 401 water quality certification from the TCEQ. The purpose of the certification is to determine whether a project with proposed discharges adheres to the state water quality standards. TCEQ water quality certification is generally evaluated as part of Department of the Army permitting. The TCEQ has granted water quality certification for projects qualifying for authorization through the USACE's nationwide permitting program (i.e., projects having minimal impacts on the aquatic environment). Department of the Army standard permit applications are joint applications between the USACE and the TCEQ. The USACE evaluates the permit application for impacts to jurisdictional waters and wetlands, and the TCEQ concurrently evaluates the application for Section 401 water quality certification. There are two tiers of TCEQ Section 401 water quality certification: Tier I certifications are required for projects that affect less than 1,500 linear feet of stream and/or 3 acres of waters of the United States, while Tier II certifications are required for projects that affect larger areas than the Tier I extents. TCEQ Section 401 water quality certification must be granted before a Department of the Army permit can be issued. The implementation of short-term BMPs during construction and long-term BMPs that would be incorporated into the proposed storm water drainage improvements would be expected to minimize potential adverse impacts to water quality within the project area such that water quality certification would be granted for the proposed project.

The Navigable Waters Protection Rule (NWPR), which became effective June 22, 2020, establishes the scope of federal authority under the CWA and redefines "waters of the United States," replacing and re-codifying the regulatory text of the previous definition. The agencies (US EPA and USACE) are streamlining the definition to include four categories of jurisdictional waters, to provide clear exclusions for many water features that traditionally have not been regulated, and to define terms used in the regulatory text that have previously not been defined. The NWPR separates waters of the United States into four categories: the territorial seas and traditional navigable waters; tributaries of such waters; certain lakes, ponds, and impoundments of jurisdictional waters; and wetlands adjacent to other jurisdictional waters (other than waters that are themselves wetlands). The NWPR details waters that are excluded from regulatory protection (85 FR 22250). The USACE and the EPA, which has regulatory oversight authority relative to waters of the United States, are the agencies that make the official determinations as to the

location and extent of waters of the United States, including wetlands, and the jurisdictional status of such waters and wetlands.

The General Bridge Act of 1946 and Sections 9 and 10 of the Rivers and Harbors Act of 1899 prohibit the unauthorized obstruction, including bridge construction, or alteration of any navigable waters of the United States, unless the work has been authorized by permit from the USCG and the USACE.

Under Texas State Code, TxDOT and the Texas Parks and Wildlife Department (TPWD) are required to adopt a Memorandum of Understanding (MOU) that addresses protection of the natural environment, including the review of potential environmental effects of highway projects (Transportation Code, 201.607 and Texas Parks and Wildlife [TPW] Code, 12.0011). TPWD has the primary responsibility for protecting the state's fish and wildlife resources. Under the MOU, a Biological Evaluation Form is completed that includes an identification of waters of the United States, including wetlands. The Biological Evaluation Form also includes information relative to the Endangered Species Act (ESA), Essential Fish Habitat (EFH), Coastal Barrier Resources Act, Marine Mammal Protection Act (MMPA), Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act, Fish and Wildlife Coordination Act, EO 13112 on Invasive Species, the Executive Memorandum on Beneficial Landscaping, and Farmland Protection Policy Act. Completion of the Form requires data from TPWD's Texas Natural Diversity Database (TXNDD), Element Occurrence Identification lists, and Ecological Mapping Systems of Texas (EMST).

3.9.2 EXISTING CONDITIONS

The project area for the assessment of wetlands and other waters of the United States within Segments 1 and 2 is defined as the existing I-45 and I-610 ROWs and the combined proposed new ROWs of the Preferred Alternative. For Segment 3, the project area is the existing I-45, I-10, and US 59/I-69 ROWs and the combined proposed new ROWs of the Preferred Alternative. Waters and wetlands occurring within or traversing the existing and proposed new ROWs were assessed for each individual project segment.

3.9.2.1 Navigable Waters

Buffalo Bayou and a section of White Oak Bayou within the limits of the proposed project are navigable waterways (i.e., waters that are subject to the ebb and flow of the tide, or are presently used, have been used in the past, or may be susceptible for use to transport interstate or foreign commerce) (Tables 1 and 2 in Appendix K: *Waters of the United States Technical Report*). The information presented in Tables 1 and 2 of Appendix K represents a combination of data collected using global positioning system (GPS) units and estimated lengths and widths of identified water courses. Portions of Buffalo Bayou and White Oak Bayou are spanned by one or more multi-lane roadways. Because the spanned bridge structures precluded GPS satellite signal reception, the lengths and widths of the portions of open channel of Buffalo Bayou and White Oak Bayou under the bridge structures were estimated based on field observations and interpretation of remotely sensed desktop data sources.

A Section 9 permit from the USCG would be anticipated for bridges or other structures constructed in or over Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence. A Section 10 permit from the USACE would be anticipated for project construction activities that would involve the discharge

of dredged or fill material within the jurisdictional limits of Buffalo Bayou and the portion of White Oak Bayou subject to tidal influence.

3.9.2.2 Waters of the United States

The areal extent of aquatic resources identified within the existing and proposed new ROWs was calculated based on a combination of data collection in the field and interpretation of remotely sensed desktop data. The project area was reviewed and assessed using available rectified aerial photography, high-resolution elevation light detection and ranging (LiDAR) data, and the following databases: U.S. Geological Survey (USGS) national hydrography dataset (NHD), HCFCD channels feature class, and City of Houston ditches. The field investigations were limited to publicly accessible ROWs and where right-of-entry was granted. Similar to Buffalo Bayou and White Oak Bayou discussed above, a portion of Halls Bayou in Segment 1 occurs beneath the multi-lane bridge structure of I-45. The area of the portion of Halls Bayou under the I-45 bridge was estimated based on field observations and interpretation of remotely sensed desktop data.

As documented in Appendix K: *Waters of the United States Technical Report*, the investigation, which included all proposed alternatives for each project segment, resulted in the identification of 35 water bodies that collectively totaled approximately 33 acres. Of the 35 identified water bodies, 29 were preliminarily assessed as being potentially jurisdictional waters of the United States that collectively totaled approximately 29 acres. Following selection of the Preferred Alternative, the identification of waters of the United States, including wetlands, within the project segments was refined to focus on the existing roadway ROWs and the proposed new ROW of the Preferred Alternative. The refined investigation resulted in the identification of 29 water bodies, 25 of which were preliminarily assessed as being potentially jurisdictional waters of the United States that collectively totaled approximately 26 acres.

Subsequent to publication of the Draft EIS, a survey of Buffalo Bayou, White Oak Bayou, Little White Oak Bayou, and Halls Bayou was conducted by Registered Professional Land Surveyors to more accurately define the areas of these water courses occurring within the existing I-45 ROW and the proposed new ROW of the Preferred Alternative. Based on a combination of the previously delineated water bodies and the survey of the four water courses noted above, Table 3-13 presents the acreage and linear feet of the 29 water bodies occurring within the existing I-45 ROW and the Preferred Alternative ROW. Of the 29 identified water bodies, 25 were preliminarily assessed as being potentially jurisdictional waters of the United States. The naming convention for the identified water bodies is the same as used in Appendix K: *Waters of the United States Technical Report*. Named water courses are identified by name. Unnamed drainage features that are associated with an NHD stream, as identified by the USGS, are labeled with the NHD permanent identifier NHD code (e.g., 113251601). Unnamed drainage features not associated with an NHD stream were identified as unnamed ditches.

Table 3-13: Acreages and Linear Feet of Water Bodies within the Existing Right-of-Way and Preferred Alternative Right-of-Way

Segment	Water Body	Wetland Type	Acreage in Existing ROW	Acreage in Proposed ROW	Linear Feet in Existing ROW	Linear Feet in Proposed ROW	Subject to Section 404 Jurisdictional	Subject to Section 10 Jurisdiction
1	Wetland 1	PEM	0	0.01	N/A	N/A	Yes	No
	Wetland 2	PEM	0	0.63	N/A	N/A	Yes	No
	Wetland 3	PEM	0	0.02	N/A	N/A	Yes	No
	Wetland 4	PEM	0.02	0	N/A	N/A	Yes	No
	Wetland 5	PEM	0.01	0	N/A	N/A	Yes	No
	Subtotal PEM Wetlands		**0.03**	**0.66**				
	113251601	R	0.19	0	453	0	Yes	No
	113252111	R	0	0.04	0	160	Yes	No
	Halls Bayou	R	0.19	0.17	365	547	Yes	No
	113252481	R	0.11	0.05	300	199	Yes	No
	113252861	R	0	0.02	N/A	N/A	No	No
	113253277	R	0.04	0.01	218	26	Yes	No
	113253377	R	0.08	0.03	264	57	Yes	No
	113253359	R	0	0.17	0	178	Yes	No
	Janowski Ditch	R	0	0.33	0	470	Yes	No
	Unnamed Ditch 1	R	0.02	0	154	0	Yes	No
	Little White Oak Bayou 1 in Segment 1	R	0.40	0	588	0	Yes	No
	Subtotal Streams		**1.03**	**0.82**	**2,342**	**1,637**		
2	Little White Oak Bayou 1 in Segment 2	R	2.44	0	2,862	0	Yes	No
	Little White Oak Bayou 2	R	0	0.04	0	216	Yes	No
	Little White Oak Bayou 3	R	0.76	0.27	660	459	Yes	No
	Unnamed Ditch 2	R	0.14	0	460	0	Yes	No
	Little White Oak Bayou 4	R	0.51	0.03	584	23	Yes	No
	Little White Oak Bayou 5	R	0.33	0	273	0	Yes	No
	Subtotal Streams		**4.18**	**0.34**	**4,839**	**698**		
3	Little White Oak Bayou 6	R	0.40	0.06	610	152	Yes	No
	White Oak Bayou	R	2.76	2.16	2,990	1,559	Yes	Yes
	Buffalo Bayou East	R	4.91	5.07	1,419	1,235	No	Yes
	Buffalo Bayou West 1	R	1.42	0.04	610	29	No	Yes

Segment	Water Body	Wetland Type	Acreage in Existing ROW	Acreage in Proposed ROW	Linear Feet in Existing ROW	Linear Feet in Proposed ROW	Subject to Section 404 Jurisdictional	Subject to Section 10 Jurisdiction
	Buffalo Bayou West 2	R	2.00	0.11	980	50	No	Yes
	Subtotal Streams		**11.49**	**7.44**	**6,609**	**3,025**		
	Water Fountain	PUB	0.12	N/A	N/A	N/A	No	No
	Detention Basin 1	PUB	0.34	0	N/A	N/A	No	No
	Detention Basin 2	PUB	2.81	0	N/A	N/A	No	No
	Subtotal PUB Features		**3.27**					
All Water Bodies Total		**N/A**	**20.00**	**9.26**	**13,790**	**5,360**	**N/A**	**N/A**
Potentially Jurisdictional Water Bodies Total		**N/A**	**16.73**	**9.24**	**13,790**	**5,360**	**N/A**	**N/A**

R = Riverine; PEM = Palustrine Emergent; PUB = Palustrine Unconsolidated Bottom; N/A = Not Applicable

The 29 features were categorized using the Cowardin classification system. Five aquatic features were identified as palustrine emergent (PEM) wetlands (Wetlands 1 through 5). The identified wetlands are generally dominated by perennial herbaceous grass-like plants. Twenty-one (21) features were classified as riverine (R). Riverine systems include aquatic features contained within a channel. Three aquatic features were classified as palustrine unconsolidated bottom (PUB) resources. Two of the PUB features are associated with storm water detention basins near the southern limit of the proposed project, and the other feature is a man-made fountain in Downtown Houston. The Cowardin classification of the aquatic features is provided in Table 3-14.

Table 3-14 summarizes the total acreage and linear feet of the identified water bodies within the existing and proposed new ROWs by project segment and presents separately the acreage and linear feet of the water bodies preliminarily assessed as being potentially jurisdictional and potentially non-jurisdictional waters of the United States.

Table 3-14: Potentially Jurisdictional and Non-Jurisdictional Waters of the United States within the Existing Right-of-Way and Preferred Alternative Right-of-Way

Segment	Right-of-Way	Total Water Bodies Identified (Acres)	Potentially Jurisdictional Water Bodies (Acres)	Potentially Non-Jurisdictional Water Bodies (Acres)	Total Linear Feet of Streams Identified	Potentially Jurisdictional Streams (Linear Feet)	Potentially Non-Jurisdictional Streams (Linear Feet)
1	Existing Right-of-Way	1.06	1.06	0	2,342	2,342	0
	Preferred Alternative Right-of-Way	1.48	1.46	0.02	1,652	1,637	15

Segment	Right-of-Way	Total Water Bodies Identified (Acres)	Potentially Jurisdictional Water Bodies (Acres)	Potentially Non-Jurisdictional Water Bodies (Acres)	Total Linear Feet of Streams Identified	Potentially Jurisdictional Streams (Linear Feet)	Potentially Non-Jurisdictional Streams (Linear Feet)
	Segment 1 Total	2.54	2.52	0.02	3,994	3,979	15
2	Existing Right-of-Way	4.18	4.18	0	4,839	4,839	0
	Preferred Alternative Right-of-Way	0.34	0.34	0	698	698	0
	Segment 2 Total	4.52	4.52	0	5,537	5,537	0
3	Existing Right-of-Way	14.76	11.49	3.27	6,609	6,609	0
	Preferred Alternative Right-of-Way	7.44	7.44	0	3,025	3,025	0
	Segment 3 Total	22.20	18.93	3.27	9,634	9,634	0
	Project Total	**29.26**	**25.97**	**3.29**	**19,165**	**19,150**	**15**

Source: NHHIP Study Team

3.9.3 IMPACTS OF THE PREFERRED ALTERNATIVE

The design of the proposed project is currently in the conceptual phase; therefore, the details of structures and facilities (e.g., culverts, bridges, detention areas, etc.) that may affect the identified water bodies and streams in the project area are not known. Appendix K: *Waters of the United States Technical Report* discusses possible impacts from the proposed alternatives to the identified potentially jurisdictional water bodies and streams by segment and alternative, based on the assumption that waters in the project area that are presently enclosed within culverts in the existing roadway ROWs would remain in culverts, and the culverts may be extended in areas of new ROW. Also assumed is that waters that are presently bridged would continue to be bridged with replacement or expanded bridges.

Within Segments 1 and 2, culverts may be extended in areas of proposed new ROW that would enclose portions of both streams and wetlands. Construction activities that would involve the discharge of dredged or fill material, or the erection of structures within or over the identified potentially jurisdictional waters of the United States would be expected to require permit authorization from the USACE and/or the USCG.

Identified impacts to jurisdictional waters of the United States, including wetlands and navigable waters of the United States, would be evaluated for USACE and USCG permitting requirements. Discharges of dredged or fill material into waters of the United States, including wetlands, require permit authorization from the USACE under Section 404 of the CWA prior to the initiation of project activities involving

discharges. Fill, structures, or work in navigable waters of the United States, including tidal wetlands, require permit authorization from the USACE under Section 10 of the Rivers and Harbors Act of 1899 prior to the initiation of project activities. Depending on the area and/or volume of fill or structural elements to be placed in jurisdictional waters or wetlands, the bridges or other structures within or over navigable waters of the United States would require permit authorization from the USCG to ensure that there would be no impediment to vessels or watercraft operating in navigable waters. In accordance with Section 14 of the Rivers and Harbors Act of 1899, as codified in 33 U.S.C. Section 408, coordination with the USACE would be required for activities that would alter, occupy, or use any USACE civil works project. A federally funded Section 408 civil works project is present within White Oak Bayou, with HCFCD as the local sponsor. TxDOT will coordinate with the appropriate resource and regulatory agencies to obtain permit approvals as needed to construct and operate the proposed project.

A detailed identification and delineation of potentially jurisdictional waters of the United States was performed in December 2017 and August 2019 for the existing roadway and the Preferred Alternative.

To accommodate the anticipated phased construction of the proposed project, two reports documenting the identification and delineation of waters of the United States were prepared for Segment 3. The reports were submitted to the USACE, Galveston District Regulatory Division for verification. In April 2020, the USACE, Galveston District issued an approved jurisdictional determination, concurring with the potentially jurisdictional waters as identified in the Segment 3 reports. The determination excluded the two storm water detention basins and the man-made water fountain from regulatory jurisdiction.

Separate reports documenting the identification and delineation of waters of the United States for Segments 1 and 2 are in progress and will be submitted to the USACE accompanied by requests for approved jurisdictional determinations. USACE determinations are typically valid for five years. During preliminary and final design of the proposed project, impacts to waters of the United States, including wetlands, would be avoided or minimized to the extent practicable. Jurisdictional waters of the United States are expected to be present within the ROW of all three segments of the Preferred Alternative, and complete avoidance of the jurisdictional waters and wetlands is likely not be feasible, thereby requiring permit authorizations from the appropriate agencies.

TxDOT would follow, to the extent practicable, sequencing of impacts to jurisdictional waters of the United States, avoiding impacts, minimizing unavoidable impacts, and compensating for unavoidable impacts. In accordance with the 2008 Final Rule on Compensatory Mitigation for Losses of Aquatic Resources, TxDOT would pursue the purchase of appropriate mitigation credits from an approved mitigation bank to compensate for the unavoidable loss of aquatic resources. The purchase of mitigation bank credits is the preferred method of compensatory mitigation from the options described in the final rule. Should the project area not be situated within the service area of approved mitigation banks in the region, TxDOT will coordinate with the USACE and other agencies as needed to identify an appropriate compensatory mitigation plan.

An accurate quantification of project impacts to jurisdictional waters of the United States would not be known until final design. As project plans are finalized, unavoidable impacts to individual waterbodies

would be identified and assessed for permitting requirements. To the extent possible, TxDOT would attempt to permit project impacts through the USACE's nationwide permit program, primarily Nationwide Permit (NWP) 14 – Linear Transportation Projects. Should impacts at a specific waterbody crossing exceed the threshold limits of NWP 14, a standard permit may be required. According to the 2017 Nationwide Permit Regional Conditions specific to the Galveston District, impacts to special aquatic sites (e.g., wetlands) that exceed 0.1 acre and/or losses to streams exceeding 200 linear feet require compensatory mitigation.

TxDOT will coordinate with the USACE regarding permit authorization(s) for unavoidable discharges of dredged or fill material into jurisdictional waters of the United States regulated under Section 404 of the CWA and/or Section 10 of the Rivers and Harbors Act. TxDOT will prepare NWP pre-construction notifications or a standard permit application to authorize project activities within jurisdictional waters. The pre-construction notifications or permit application will include a compensatory mitigation plan for review as part of the permit notification or application. TxDOT will also coordinate with the USCG per the requirements of Section 9 of the Rivers and Harbors Act and the General Bridge Act regarding bridge permit authorization for the construction of bridge structures over the navigable waters of Buffalo Bayou and White Oak Bayou. Additionally, per the requirements of 33 U.S.C. Section 408, TxDOT will coordinate with the USACE and HCFCD to determine if the occupation or alteration of the White Oak Bayou federal project, a portion of which occurs within the proposed project area, would be injurious to the public interest or would impair the usefulness of the federal project.

3.9.4 IMPACTS OF THE NO BUILD ALTERNATIVE

There would be no impacts to waters of the United States, including wetlands, within the project area for the No Build Alternative. Water bodies within or traversing existing roadway ROWs would continue to be maintained to expedite the conveyance of storm water flows. Vegetated riparian areas adjacent to some of the water bodies within existing ROWs would likely persist in their present condition. Areas outside the existing I-45 ROW would be expected to be maintained by current and future landowners.

3.9.5 ENCROACHMENT ALTERATION EFFECTS

Encroachment alteration effects are those effects that alter the behavior and functioning of the physical environment, and are related to design features, but are removed in time or distance from the direct effect. Anticipated fill impacts to waters of the United States, including wetlands, would generally be limited to the proposed project footprint. Temporary and permanent impacts to waters of the United States would not be expected to disrupt any natural processes in the project area. Because induced development is not anticipated as a result of the proposed project, encroachment alteration impacts to wetlands and other waters of the United States that are farther removed in distance or time would be unlikely to occur.

3.10 Vegetation and Wildlife

3.10.1 REGULATORY OVERVIEW

The following regulations were reassessed for the *Preferred Alternative*: EFH, MBTA, Fish and Wildlife Coordination Act, EO 13112 on Invasive Species, and the Executive Memorandum on Beneficial Landscaping. Per this review and consideration of public comments following the release of the Draft EIS and subsequent technical reports, it was determined that no updated factual corrections or revisions were necessary. As such, the summary, analysis, and environmental commitments presented in Section 3.10.3.3–3.10.3.5 of the Draft EIS and included in the *Biological Resources Technical Report* would not change under the Preferred Alternative. The following sections provide a summary of the applicable regulations and the proposed impacts resulting from the Preferred Alternative.

3.10.1.1 Essential Fish Habitat

The 1976 Magnuson-Stevens Fishery Conservation and Management Act, most recently reauthorized in 2007 (Public Law 109-469), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Section 305(b)(2) of the 1976 Magnuson-Stevens Fishery Conservation and Management Act requires federal action agencies to consult with NOAA's National Marine Fisheries Service (NMFS) on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH.

3.10.1.2 Migratory Bird Treaty Act

The MBTA of 1918 states that it is unlawful to kill, capture, collect, possess, buy, sell, trade, or transport any migratory bird, nest, or egg in part or in whole, without a federal permit issued in accordance with the Act's policies and regulations.

3.10.1.3 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires federal agencies that construct, license, or permit water resources development projects to first consult with the USFWS, and in some instances the NMFS, as well as state fish and wildlife agencies regarding potential impacts on fish and wildlife resources, and measures to mitigate these impacts.

3.10.1.4 Executive Order 13112 on Invasive Species

EO 13112 on Invasive Species, effective February 3, 1999, directs federal agencies to prevent the introduction and control the spread of invasive species. Invasive species are defined by the EO as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health."

3.10.1.5 Texas Parks and Wildlife Department Memorandum of Understanding

As discussed in the Draft EIS, Transportation Code 201.60 requires TxDOT to adopt an MOU with each state agency that has a responsibility for the protection of the natural environment or for the preservation of historic or archeological resources. The T.A.C. (Title 43, Chapter 2, Subchapter G) contains the MOU between TxDOT and the TPWD, which became effective on September 1, 2013. The Draft EIS previously

discussed the TxDOT/TPWD MOU on Non-regulatory Mitigation (Section 3.10.2.3 and Section 3.10.3.6), however, the MOU regarding Non-regulatory Mitigation was superseded by the 2013 MOU; therefore, discussions regarding this topic have been removed.

3.10.2 EXISTING CONDITIONS

3.10.2.1 Vegetation

As described in the Draft EIS and the *Biological Resources Technical Report, t*he NHHIP Preferred Alternative traverses highly urbanized areas of the City of Houston where there are minimal undeveloped spaces. The existing I-45 ROW is approximately 90 percent concrete pavement and comprises over 65 percent of the proposed project area. The remainder of the proposed project area is highly developed with landscaped ornamental plant communities within residential, commercial, and industrial areas. According to the Ecoregions of Texas, the proposed project area is situated within the Western Gulf Coastal Plain Ecoregion of Texas. This ecoregion is characterized by relatively flat topography and primarily grassland as its potential natural vegetation (Griffith et al. 2007).

Based on field investigations conducted by qualified biologists in December 2017, it was determined that the majority of vegetation within the current ROW consists mainly of maintained grasses, which appear to be mowed regularly, and landscaped assemblages of trees and shrubs along roadway medians. Therefore, the majority of the existing ROW fits the description of the "Urban Low Intensity" vegetation type. The proposed ROW is a mixture of native and non-native invasive vegetation that is best described as unmaintained mixed Chinese tallow (*Triadica sebifera*) forests, native and non-native mixed woodlands along riparian edges, maintained grasses and forbs, and disturbance grasslands. These vegetation types are best described as "Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland;" "Pineywoods: Disturbance or Tame Grassland;" "Native Invasive: Deciduous Woodland;" "Pineywoods: Small Stream and Riparian Temporarily Flooded Hardwood Forest;" or "Urban Low Intensity." Section 3.0 of the *Biological Resources Technical Report* includes a complete description of the observed vegetation types, including the representative species noted during field investigations.

In general, ornamental plantings of woody species include crepe myrtle (*Lagerstroemia indica*), loblolly pine (*Pinus taeda*), and other species of trees, shrubs, and bushes. Bermuda grass (*Cynodon dactylon*) and Saint Augustine grass (*Stenotaphrum secundatum*) are the most common herbaceous plants within landscaped areas. Small portions of several maintained parks are located within the Preferred Alternative, including landscaped riparian areas associated with streams and drainageways and Freed Art and Nature Park along White Oak Bayou and Hogg Park. Similarly, portions of Linear Park and Sam Houston Park occur adjacent to Buffalo Bayou and are routinely maintained within the park boundaries. The banks of Buffalo Bayou in the eastern portion of the project area are overgrown with volunteer vegetation such as sycamore (*Platanus occidentalis*), red mulberry (*Morus rubra*), green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis laevigata*), black willow (*Salix nigra*), mimosa (*Albizia julibrissin*), China-berry tree *(Melia azedarach*), and giant reed (*Arundo donax*), which is a similar species assemblage found along many of the unmaintained waterways in the project area.

3.10.2.2 Wildlife

Native wildlife populations within central Harris County have been largely displaced by the development and urbanization of Houston, leaving remaining habitat areas highly fragmented. The majority of riparian and upland woody vegetation within the region, which provides cover for wildlife, has been removed. However, a number of common wildlife species and avifauna have adapted to the urbanized conditions and would be expected to occur within the project area.

Birds that use open habitats in the region include the northern mockingbird (*Mimus polyglottos*), red-winged blackbird (*Agelaius phoeniceus*), scissor-tailed flycatcher (*Tyrannus forficatus*), mourning dove (*Zenaida macroura*), and chipping sparrow (*Spizella passerina*). Birds commonly found within urban and residential areas include the northern cardinal (*Cardinalis cardinalis)*, common grackle (*Quiscalus quiscula*), northern mockingbird, European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and blue jay (*Cyanocitta cristata*). Riparian habitat adjacent to water courses and drainages provides cover, foraging, and perching habitat for many species of birds, including neo-tropical migrants. The open water of drainage ditches and bayous provides limited habitat for waterfowl and wading birds.

Mammal species adapted to living in urban and fragmented habitats are likely to occur within the Preferred Alternative alignment. These species include Virginia opossum (*Didelphis virginiana*), black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), and gray squirrel (*Sciurus carolinensis*). Because of the lack of suitable cover, the presence of larger mammals is limited within the proposed project area. However, transient observations of nutria (*Myocastor coypus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and skunk (*Mephitis mephitis*) might occur within the proposed project area.

Southeast Texas has a diverse assemblage of reptiles and amphibians. Turtles and lizards that could be present within the residential, riparian, and open water areas include the red-eared slider (*Trachemys scripta elegans*), snapping turtle (*Chelydra serpentina*), Mediterranean house gecko (*Hemidactylus turcicus*), green anole (*Anolis carolinensis*), and five-lined skinks (*Eumeces fasciatus*). The eastern garter snake (*Thamnophis sirtalis sirtalis*), western cottonmouth (*Agkistrodon piscivorous leucostama*), Texas rat snake (*Elaphe obsolete lindheimerii*), and diamondback water snake (*Nerodia rhombifer*) are common snakes that might occur in the proposed project area. Amphibians that could be found in the proposed project area include the southern leopard frog (*Rana utricularia*), bullfrog (*Rana catesbeiana*), and cricket frog (*Acris crepitans blanchardi*).

3.10.3 IMPACTS OF THE PREFERRED ALTERNATIVE

3.10.3.1 Vegetation

Approximately 98 percent of the project area includes existing transportation infrastructure or urban development. Of the remaining 2 percent, approximately 72 percent (346.18 acres) of the area includes vegetation mapped as urban, approximately 23.25 percent (111.84 acres) mapped as disturbed prairie, and less than 2.4 percent (11.76 acres) mapped as riparian (Table 3-15). Field investigations were conducted to verify existing conditions within the Preferred Alternative alignment. Although the majority of the alignment occurs within a highly urbanized area, dominated by pavement, vegetation within the

undeveloped portions of the project is primarily ornamental plantings or routinely mowed and maintained grasses. Construction of the Preferred Alternative would impact herbaceous, shrub, tree, and other plantings through site preparation activities. Clearing and grading would remove existing vegetative cover and replace it with mostly impervious cover associated with travel lanes, entrance and exit ramps, and frontage roads. Any remaining open areas occurring adjacent to the ROW or medians would likely be planted with herbaceous vegetation that would be routinely maintained by mowing.

Table 3-15: Impacts to Observed Vegetation Types from the Preferred Alternative

MOU Type	Observed Vegetation Type (EMST)	Impacts (acres)	MOU Threshold (acres)	Threshold Exceeded?
Urban	Urban Low Intensity	346.18	None	N/A
Riparian	Pineywoods: Small Stream and Riparian Temporarily Flooded Hardwood Forest	11.76	0.1	Yes
Disturbed Prairie	Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland	78.01	3.0	Yes
	Pineywoods: Disturbance or Tame Grassland	20.43		
	Native Invasive: Deciduous Woodland	13.40		
Open Water	Open Water: No vegetation	11.06	None	N/A
	Total	**480.84**		

Source: Elliott et al. 2009–2014; field verified by Project Team 2017.

The Preferred Alternative would include the removal of vegetation surrounding Halls Bayou, Little White Oak Bayou, White Oak Bayou, and Buffalo Bayou. Although many of these riparian areas have been previously modified for parkland uses or have been routinely maintained within the existing transportation ROW, several isolated patches of woodland and overgrown banks may be impacted by bridge construction, and possibly by shading resulting from newly constructed bridges. Section 3.0 and Figures 5a–5y of the *Biological Resources Technical Report* provides a completed description of observed vegetation communities along the Preferred Alternative alignment. Table 3-15 also includes the generic "MOU Type" vegetation description that is used to determine coordination thresholds with TPWD, which is further discussed in **Section 3.10.3.7** below.

3.10.3.2 Wildlife

Wildlife occurring within the project area has adapted to the existing urban developed conditions. Construction of the Preferred Alternative would directly impact any animals that reside within the path of the proposed roadway improvements. As with the vegetation, wildlife communities would be impacted by the permanent loss of habitat. Mobile species would be expected to leave the proposed project area as construction activities are initiated. Less mobile species or species sheltering in vegetation or structures within the proposed project area could be injured or killed by demolition activities, movements of heavy construction equipment, or debris removal. The conversion of existing developed and landscaped conditions to roadway ROW would cause a loss of habitat and could possibly cause further fragmentation of remaining habitat areas. Operation of any of the project alternatives would potentially result in adverse

impacts to wildlife from vehicle strikes because of the additional travel lanes. Increased impervious cover associated with the proposed project may introduce additional roadway pollutants to which wildlife could be directly exposed or that might degrade the quality of habitat adjacent to the proposed project area. Wildlife remaining in areas immediately adjacent to the proposed project area would be expected to adapt to the changed conditions (e.g., increased or decreased traffic movements and noise levels).

Impacts to non-rare fish and wildlife would be minimized through initial project design considerations and through the avoidance and minimization of vegetation removal and stream channel disturbance. Construction activities would disturb only that which is necessary to construct the proposed project, including minimizing disturbance to inert microhabitats (e.g., snags, brush piles). The removal of native vegetation would be avoided to the greatest extent practicable, and BMPs would be utilized to avoid impacts to fish and wildlife within the project area during construction activities.

3.10.3.3 Essential Fish Habitat

According to TPWD's Freshwater/Saltwater boundary descriptions (2018) and the TCEQ stream segments a portion of Buffalo Bayou (Segments 1007 and 1013) and the lower portion of White Oak Bayou (Segment 1017) are identified as tidally influenced waters within the project area. The NOAA EFH mapper was accessed for the proposed project area. No Habitat Areas of Particular Concern or EFH areas protected from fishing were identified within or adjacent to the project area. Therefore, no impacts to protected areas or EFH are anticipated as a result of the Preferred Alternative.

3.10.3.4 Migratory Bird Treaty Act

The project area was investigated for any structures containing migratory birds or indications of nesting migratory birds. Evidence of nesting birds (vacant nests) was observed throughout the proposed project area in stands of woody vegetation, below existing bridges and within culverts. Measures would be taken to avoid the take of migratory birds, their occupied nests, eggs, or young, in accordance with the MBTA, through phasing of work or preventive measures. Bird BMPs would be followed to minimize impacts: not disturbing, destroying, or removing active nests, including ground nesting birds, during the nesting season; avoiding the removal of unoccupied, inactive nests, as practicable; preventing the establishment of active nests during the nesting season on TxDOT owned and operated facilities and structures proposed for replacement or repair; and not collecting, capturing, relocating, or transporting birds, eggs, young, or active nests without a permit.

As a result of public comments resulting from the Draft EIS, a review of outside data sources such as the USGS's Breeding Bird Survey (BBS) and the Audubon Society's Christmas Bird Counts (CBC) were reviewed for overlap with the Preferred Alternative. These citizen science-based studies are focused on providing long-term datasets of observed avifauna across the U.S, including both migratory and resident species. Although there are no long-term BBS routes located within or adjacent to the NHHIP area there are several CBC focused around the greater Houston area. Both of these tools (CBC and BBS) collect data that can be used to inform federal and state agency policy makers of changes in bird population trends. This data can be used in setting national and regional avian conservation priorities by regulatory agencies, but it is not

designed to provide project-specific analysis, such as effects to local bird populations stemming from transportation improvement projects.

3.10.3.5 Beneficial Landscaping

All landscaping that would be implemented as part of the proposed project would be in accordance with EO 13112 on Invasive Species and the April 26, 1994, Executive Memorandum on Beneficial Landscaping. 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
- Reduce fertilizer and pesticide use
- Implement water-efficient and runoff-reduction practices
- Create outdoor demonstration projects employing the above measures and practices

Where possible, the ROW of the Preferred Alternative would be revegetated upon completion of roadway construction. Open areas would be revegetated and maintained according to standard TxDOT practices. Other landscape measures may include tree and shrub plantings.

3.10.3.6 Invasive Species

In accordance with EO 13112 on Invasive Species, the Executive Memorandum on Beneficial Landscaping, and the 1999 FHWA guidance on invasive species, all revegetation within the Preferred Alternative alignment would, to the extent practicable, use only native species. Upon completion of earthwork activities, disturbed areas would be reseeded according to TxDOT specifications and in compliance with EO 13112, where applicable.

3.10.3.7 TxDOT/TPWD Memorandum of Understanding

A Tier I Site Assessment in accordance with TxDOT's 2013 *MOU with TPWD* was performed to determine whether coordination with TPWD would be required for the proposed project. The Tier I Site Assessment defines the type and amount of habitat impacted using information from the Texas Conservation Action Plan, EMST, Texas TXNDD, lists of threatened and endangered species and species of greatest conservation need (SGCNs) maintained by TPWD and USFWS, information collected during field investigations, and the most current aerial photography available. Table 3-16 includes a summary of the coordination triggers identified in the TxDOT-TPWD MOU and the impacts resulting from the Preferred Alternative.

Table 3-16: Tier 1 Site Assessment — TPWD Coordination Triggers

Trigger	Applies to the Project?	Explanation
The project is within the range of a state threatened or endangered species or SGCN, as identified by the TPWD county list, and there is suitable habitat for the species within the project area unless BMPs as defined in the MOU are implemented as provided by a programmatic agreement.	Yes	The alligator snapping turtle, timber rattlesnake, Louisiana pigtoe, sandbank pocketbook, Texas pigtoe, Rafinesque's big-eared bat, creek chubsucker, American eel, plains spotted skunk, Southeastern myotis bat, Texas meadow-rue, Texas tauschia, Texas windmill-grass, and the wood stork have potentially suitable habitat within the proposed project area. No BMPs have been established for the state-designated SGCN plant species. BMPs for the remaining species are discussed in Section 7, Environmental Permits, Issues, and Commitments.
The project may adversely impact important remnant vegetation based on the judgment of a qualified biologist or as mapped in the TXNDD.	No	No remnant vegetation occurs in the project area.
The project requires a nationwide permit with pre-construction notification, or an Individual Permit issued by the USACE.	Yes	An identification and delineation of waters of the U.S., including wetlands, was conducted for the proposed project, and is documented in the *Waters of the United States Technical Report*. The investigation was refined after selection of the Preferred Alternative. Based on the refined investigation, approximately 26 acres of potentially jurisdictional waters and wetlands are located within the limits of the proposed project. Conceptual design plans indicate that some of these potentially jurisdictional waters and wetlands could be unavoidably impacted by construction activities. These impacts may qualify for USACE authorization by Nationwide Permit (NWP) 14, with or without pre-construction notification. Should permanent impacts be determined during the design phase of the project to exceed the NWP threshold(s), an Individual Permit application would be prepared and coordinated prior to the commencement of construction activities.
The project includes in the TxDOT ROW or conservation, construction, or drainage easement, more than 200 linear feet of stream channel for each single and complete crossing of one or more of the following that is not already channelized or otherwise maintained: a) channel realignment; or b) stream bed or stream bank excavation, scraping, clearing, or other permanent disturbance.	No	All streams, ditches, and tributaries, including Halls Bayou, Little White Oak Bayou, White Oak Bayou, and Buffalo Bayou are channelized or maintained within the project area.

Trigger	Applies to the Project?	Explanation
The project contains known isolated wetlands outside existing TxDOT ROW that will be directly impacted by the project.	No	Project would not impact known isolated wetlands outside of the existing TxDOT ROW.
The project may impact at least 0.10 acre of riparian vegetation based on the judgment of a qualified biologist or as mapped in the EMST.	Yes	Approximately 11.76 acres of riparian vegetation may be impacted as a result of the Preferred Alternative.
The project disturbs habitat in an area equal to or greater than the area of disturbance indicated in the Threshold Table Programmatic Agreement (PA).	Yes	The project will disturb more than the allowable threshold for the following field-verified vegetation types: Riparian and Disturbed Prairie.

Note: The plains spotted skunk and the creek chubsucker were included in TPWD coordination completed in 2016; however, these species are no longer listed as rare species on the Harris County list and the western creek chubsucker has been added, as discussed in **Section 3.11.2.2** below.

As described in Table 3-16, the project required coordination with TPWD in accordance with the 2013 TxDOT-TPWD MOU. TPWD, as a participating agency, reviewed and commented on the Draft EIS which served as coordination under the MOU. Coordination with TPWD was completed on December 1, 2016. No additional coordination with TPWD would be required for this project unless future design modifications resulted in a reevaluation that was determined to be a substantial change from previous coordination or if the scope of the reevaluation relates to an issue on which TPWD commented.

3.10.4 IMPACTS OF THE NO BUILD ALTERNATIVE

There would be little to no impact on existing vegetation with the No Build Alternative. Existing vegetation within open areas of existing roadway ROWs would continue to be maintained by mowing, and more densely vegetated riparian areas within the existing ROWs would remain undisturbed. Areas outside the existing I-45 ROW would likely be maintained by existing landowners in their present state, with potential alterations possibly resulting from future development activities.

3.10.5 ENCROACHMENT ALTERATION EFFECTS

The selection of the Preferred Alternative did not result in the identification of additional encroachment alteration effects. The effects of removing areas of particular importance as wildlife habitat would not extend beyond the existing predominantly urban, developed conditions present within the proposed project construction footprint. Development in general encroaches on vegetation, and reductions in vegetation typically equate to reduced wildlife habitat. For this project, which is located in a highly urbanized area, however, impacts to habitat would be limited to the area of direct impacts, and no encroachment impacts would be expected. The limited direct impacts on wildlife habitat would not be expected to adversely affect the populations of any wildlife species in the area, nor is it expected that there would be indirect impacts to such species elsewhere as a result of habitat removal. Furthermore, the existing habitats have been fragmented by the construction of I-45 and surrounding commercial and residential properties. Due to the close interconnectivity of the proposed project with adjacent developed

1 properties in northern Houston, further habitat fragmentation resulting from impacts of the proposed
2 project would not be expected beyond what already exists in this urban environment.

3.11 Threatened and Endangered Species

3.11.1 REGULATORY OVERVIEW

The regulations below were reassessed for the Preferred Alternative. Per this review and consideration of public comments following the release of the Draft EIS and subsequent technical reports, it was determined that no updated factual corrections or revisions were necessary. As such, the summary, analysis, and environmental commitments presented in **Section 3.11** of the Draft EIS and included in the *Biological Resources Technical Report* would not change under the Preferred Alternative. The following sections provide a summary of the applicable regulations and the proposed impacts resulting from the Preferred Alternative.

3.11.1.1 Endangered Species Act

At the federal level, the USFWS and the NMFS are responsible for the regulations and enforcement of ESA requirements. Section 7 of the ESA requires federal agencies to consult with the USFWS and/or NMFS to ensure that any federal action authorized, funded, or carried out is not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or modification of critical habitat, unless granted an exemption for such action. The CFR at 50 CFR 402 provides the implementing regulations for interagency cooperation with respect to Section 7.

Section 9 of the ESA defines prohibited actions, including the take of species listed as federally threatened or endangered and their habitat. Furthermore, 16 U.S.C. 1538 defines prohibited acts with respect to federally listed fish and wildlife species, declaring it unlawful for any person subject to the jurisdiction of the United States to conduct any of the following actions.

- Import or export any such species into or from the United States;
- Take any such species within the United States or the territorial sea of the United States;
- Take any such species upon the high seas;
- Possess, sell, deliver, carry, transport, or ship, by any means whatsoever, any such species taken in violation of the prohibited acts above “take any such species within the United States or the territorial sea of the United States” and “take any such species upon the high seas”;
- Deliver, receive, carry, transport, or ship in interstate or foreign commerce, by any means whatsoever and in the course of a commercial activity, any such species;
- Sell or offer for sale in interstate or foreign commerce any such species; and
- Violate any regulation pertaining to such species or to any threatened species of fish or wildlife listed pursuant to Section 4 of the ESA.

3.11.1.2 Bald and Golden Eagle Protection Act

Although the bald eagle was delisted from the USFWS threatened and endangered species list on August 8, 2007, the USFWS continued to work with state wildlife agencies to monitor eagles for the last 5 years, where at that time the USFWS could propose to relist the species if it appears that the bald eagle would need further protection under the ESA. While the bald eagle is no longer protected under the ESA, the bird is currently protected under the Bald and Golden Eagle Protection Act and the MBTA. In addition, the

bald eagle currently retains its status as a state threatened species on the TPWD's annotated list of rare, threatened, and endangered species.

3.11.1.3 Marine Mammal Protection Act

The MMPA was enacted on October 21, 1972. All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The Act grants USFWS governing authority over the management of sea otters, walrus, polar bears, dugong and manatees, and the Act grants NMFS governing authority over the management of cetaceans and pinnipeds other than the walrus.

3.11.1.4 State — Texas Parks and Wildlife Department Regulatory Oversight

The Texas legislature authorized regulations pertaining to the management, regulation, and protection of native animals and plants listed as state threatened or endangered. The following are definitions of threatened and endangered species in Texas.

- Endangered animal species: Species of fish or wildlife indigenous to Texas are endangered if listed on the United States List of Endangered Native Fish and Wildlife or the list of fish or wildlife threatened with statewide extinction as filed by the director of the TPWD.
- Endangered plant species: A species of plant life that is in danger of extinction throughout all or a significant portion of its range.
- Threatened animal species: Any species that TPWD has determined is likely to become endangered in the future.
- Threatened plant species: A species of plant life that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

No person may capture, trap, take, or kill, or attempt to capture, trap, take, or kill, threatened or endangered fish or wildlife. Details concerning state endangered or threatened animal species are contained in Chapters 67 (Nongame Species) and 68 (Endangered Species) of the TPW Code, and Sections 65.171–65.177 (Threatened and Endangered Nongame Species) of Title 31 of the T.A.C.

Except as provided in TPW Code Chapter 88, no person may: (1) take, possess, transport, or sell an endangered, threatened, or protected native plant from the public lands of this state unless that person possesses a valid scientific plant permit authorizing such activity, or (2) take, possess, transport, or sell an endangered, threatened, or protected native plant for commercial purposes from private lands unless that person possesses a valid commercial plant permit authorizing such activity. Details concerning endangered or threatened plant species are contained in Chapter 88 (Endangered Plants) of the TPW Code and Sections 69.01–69.9 (Endangered, Threatened, and Protected Native Plants) of the T.A.C.

As discussed above, the Texas legislature authorized an MOU between TxDOT and TPWD that addresses protection of the natural environment, including the review of potential environmental effects of highway projects. The coordination triggers identified by the 2013 TxDOT-TPWD MOU were evaluated for the Preferred Alternative and are presented in Table 3-16 above.

3.11.2 EXISTING CONDITIONS

3.11.2.1 Federally Listed Species

The purpose of the ESA is to protect threatened and endangered species and their critical habitat. Endangered is defined as a species that is in danger of extinction throughout all or a substantial portion of its range. Threatened is defined as a species that is likely to become endangered in the future throughout all or a substantial portion of its range. In addition to endangered and threatened species, the USFWS maintains a list of "candidate" species. According to the USFWS, candidate species are plants and animals for which the agency has sufficient information on the species' biological status and threats to propose the species as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher-priority listing activities.

Section 4 of the ESA identifies five criteria for a species to be listed as threatened or endangered:

- The present or threatened destruction, modification, or curtailment of a species' habitat or range;
- Overutilization for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms; or
- Other natural or man-made factors affecting the species' continued existence.

The USFWS Information for Planning and Conservation (IPaC) Official Species List identified three birds (least tern [*Sterna antillarum athalassos*], piping plover [*Charadrius melodus*], and red knot [*Calidris canutus*]), one plant (Texas prairie dawn-flower [*Hymenoxys texana*]), and one mammal (West Indian manatee [*Trichechus manatus*]) as federally endangered or threatened and potentially occurring within Harris County. No candidate species were listed by the IPaC. The three bird species (least tern, piping plover, and red knot) are conditionally listed on the IPaC website for proposed projects that are related to wind energy generation. The proposed NHHIP project is a linear transportation project; therefore, effects to the three listed bird species were not considered in the threatened and endangered species analysis.

The Preferred Alternative is located within an urbanized area surrounding the City of Houston and no suitable habitat for the other two species listed (Texas prairie dawn-flower or West Indian manatee) was observed during field investigation. Therefore, no effects to federally listed species are anticipated as a result of the construction or operation of the Preferred Alternative. Additional discussion of these species, including their required habitat components and justification of effect determinations, is in included in the *Biological Resources Technical Report.*

In addition to the protections afforded by the ESA, the West Indian manatee is also protected under the MMPA. Although the USFWS IPaC indicates that the proposed project area is within a county that has suitable habitat for this species, the waterways crossed by the Preferred Alternative area do not contain suitable habitat (submerged aquatic or floating vegetation) and are primarily channelized or concrete lined. Additionally, no portion of the proposed project occurs within intertidal or beach areas where

marine mammals would be routinely expected to occur. Therefore, no impacts to marine mammals are expected as a result of the proposed project.

Bald eagles are primarily piscivorous and prefer habitats associated with large bodies of water. In Texas, the bald eagle is found along quiet rivers, coastal areas, and lakeshores with large, tall trees. Man-made reservoirs also provide excellent habitat. They breed in the eastern third of the state and winter near open water. Wintering and nesting activities occur mainly near large freshwater impoundments with standing timber located in or around water. The proposed project area does not contain any rivers or stream channels that would be suitable for bald eagle foraging. A review of TPWD's TXNDD did not record any eagle occurrences within 1.5 miles of the project area. Although forested parcels within the project area may be used as flyover or stopover habitat for the species, no nests were observed, and no eagles were identified during field investigations; these findings were verified by a qualified biologist. The NHHIP area is a highly disturbed urbanized area; due to the distance between the proposed project and the known nesting eagles at Spring Creek and between the proposed project and the higher quality foraging and nesting habitat near other suitable water bodies (e.g., the San Jacinto River and Lake Houston), it is unlikely that the proposed project would have any impact on Bald Eagles. The project area is outside the known range for Golden Eagles; therefore, no impact to this species is anticipated. The project would comply with the National Bald Eagle Management Guidelines of 2007.

3.11.2.2 State-Listed Species

Impacts to state-listed species and SGCN were reassessed for the Preferred Alternative. Per this reanalysis and review of public comments, it was determined that no updated factual corrections to this section were necessary; however, suitable habitat was noted for several species during the December 2017 field investigations that were not addressed in the Draft EIS due to recent updates in the TPWD county list. Therefore, a brief summary of the potential impacts to these species as a result of the Preferred Alternative is included below.

In addition to the federally listed species discussed above, eight state-listed species — Alligator snapping turtle (*Macrochelys temminckii*), timber rattlesnake (*Crotalus horridus*), Louisiana pigtoe (*Pleurobema riddellii*), sandbank pocketbook (*Lampsilis satura*), Texas pigtoe (*Fusconaia chunii*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), Wood Stork (*Mycteria americana*), and western creek chubsucker (*Erimyzon claviformis*) — and five SGCN species — American eel (*Anguilla rostrata*), Southeastern myotis bat (*Myotis austroriparius*), Texas meadow-rue (*Thalictrum texanum*), Texas tauschia (*Tauschia texana*), and Texas windmill-grass (*Chloris texensis*) — have potentially suitable habitat within the proposed project area. The Draft EIS addressed two additional species — creek chubsucker (*Erimyzon oblongus*) and plains spotted skunk (*Spilogale putorius interrupta*) that are no longer identified as rare species by TPWD.

Pedestrian surveys were conducted where right-of-entry was granted in December 2017. No individuals of any state-listed species or SGCNs were identified during these surveys.

3.11.3 IMPACTS OF THE PREFERRED ALTERNATIVE

None of the five IPaC federally listed species would be impacted by construction of the Preferred Alternative. The three listed bird species were removed from consideration in this review because the

proposed project is not related to wind energy generation. The Texas prairie dawn-flower and West Indian manatee would not be impacted because of an absence of suitable habitat. Therefore, no effects to any federally listed species are anticipated as a result of the proposed project.

Potential impacts to the state-listed and SGCNs discussed above could be attributed to mobile species interacting with or avoiding construction machinery, the loss of wildlife habitat, habitat fragmentation, vehicle collisions, and the direct removal/disturbance of plant populations or individuals. The Preferred Alternative would require the removal of approximately 123.6 acres of non-urban vegetation that may provide suitable habitat for the species discussed above. Additionally, the two bat species may roost in culvert locations, abandoned buildings, swallow nests, or bridge joints and crevices within the project area and therefore, could be impacted by construction or demolition activities. For aquatic species, work within any of the waterways has the potential to directly harm slow moving or sedentary species, such as the alligator snapping turtle or mussels. Additionally, potential water quality impacts associated with the construction and operational phases of roadways include impacts from altered hydrology and impacts from roadway-associated pollution. Pollutants can enter the aquatic environment via untreated storm water runoff or spills, and the addition of impervious cover can influence the volume and quality of runoff leaving the project area.

In accordance with the *Best Management Practices Programmatic Agreement* between TxDOT and TPWD under the 2013 MOU, BMPs have been defined for implementation by TxDOT in order to minimize impacts to federally and state-listed species and SGCNs. Table 3-17 summarizes those BMPs related to species that have suitable habitat within the proposed project area. There are no TPWD-approved BMPs for the SGCN plant species.

Table 3-17: Best Management Practices for State-listed Species and Species of Greatest Conservation Need

Species Name	BMP
Plains spotted skunk*	Contractors will be advised of potential occurrence in the project area, to avoid harming the species if encountered, and to avoid unnecessary impacts to dens.
Southeastern myotis bat Rafinesque's big-eared bat	To determine the appropriate BMP to avoid or minimize impacts to bats, review the habitat description for the species of interest on the TPWD Rare, Threatened, and Endangered Species of Texas by County List or other trusted resources. All bat surveys and other activities that include direct contact with bats shall comply with TPWD-recommended white-nose syndrome protocols located on the TPWD Wildlife Habitat Assessment Program website under "Project Design and Construction." The following survey and exclusion protocols should be followed prior to commencement of construction activities. For the purposes of this document, structures are defined as bridges, culverts (concrete or metal), wells, and buildings. ▪ For activities that have the potential to impact structures, cliffs or caves, or trees; a qualified biologist will perform a habitat assessment and occupancy survey of the feature(s) with roost potential as early in the planning process as possible or within one year before project letting. ▪ For roosts where occupancy is strongly suspected but unconfirmed during the initial survey, revisit feature(s) at most four weeks prior to scheduled disturbance to confirm absence of bats.

Species Name	BMP
	▪ If bats are present or recent signs of occupation (i.e., piles of guano, distinct musky odor, or staining and rub marks at potential entry points) are observed, take appropriate measures to ensure that bats are not harmed, such as implementing non-lethal exclusion activities or timing or phasing of construction. ▪ Exclusion devices can be installed by a qualified individual between September 1 and March 31. Exclusion devices should be used for a minimum of seven days when minimum nighttime temperatures are above 50°F AND minimum daytime temperatures are above 70°F. Prior to exclusion, ensure that alternate roosting habitat is available in the immediate area. If no suitable roosting habitat is available, installation of alternate roosts is recommended to replace the loss of an occupied roost. If alternate roost sites are not provided, bats may seek shelter in other inappropriate sites, such as buildings, in the surrounding area. See Section 2: Standard Recommendations for recommended acceptable methods for excluding bats from structures. ▪ If feature(s) used by bats are removed as a result of construction, replacement structures should incorporate bat-friendly design or artificial roosts should be constructed to replace these features, as practicable. ▪ Conversion of property containing cave or cliff features to transportation purposes should be avoided where feasible. ▪ Large hollow trees, snags (dead standing trees), and trees with shaggy bark should be surveyed for colonies and, if found, should not be disturbed until the bats are no longer occupying these features. Post-occupancy surveys should be conducted by a qualified biologist prior to tree removal from the landscape. ▪ Retain mature, large-diameter hardwood forest species and native/ornamental palm trees where feasible. ▪ In all instances, avoid harm or death to bats. Bats should only be handled as a last resort and after communication with TPWD.
Louisiana pigtoe Sandbank pocketbook Texas pigtoe	▪ When work is in the water; survey project footprints for state-listed species where appropriate habitat exists. ▪ When work is in the water and mussels are discovered during surveys; relocate state-listed and SGCN mussels under TPWD authorization and implement Water Quality BMPs. ▪ When work is adjacent to the water; Water Quality BMPs implemented as part of the SW3P for a CGP or any conditions of the 401 water quality certification for the project will be implemented. (Note, SW3P and 401 BMPs are not listed in this PA). No TPWD coordination required.
American eel Creek chubsucker*	▪ For projects within the range of a SGCN or state-listed fish and work is adjacent to water: Water Quality BMPs. No TPWD Coordination required. ▪ For projects within the range of a SGCN or state-listed fish, and work is in the water: TPWD coordination required. (TPWD Coordination was completed on 12/1/2016).
Alligator snapping turtle	Minimize impacts to wetland and riverine habitats. Apply Amphibian and Aquatic Reptile BMPs: ▪ Unless absence of the species can be demonstrated, assume presence in suitable habitat and implement the following BMPs. Absence can only be demonstrated using TPWD-approved survey efforts (contact TPWD for minimum survey protocols for species and project site conditions).

Species Name	BMP
	▪ For projects within one mile of a known occupied location or observation of the species recorded from 1980 until the current year and suitable habitat is present, coordinate with TPWD. ▪ For new location roadway projects, coordinate with TPWD. ▪ For projects within existing ROW when work is in water or will permanently impact a water feature and potential habitat exists for the target species complete the following: • Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered. • Minimize impacts to wetland, temporary and permanent open water features, including depressions, and riverine habitats. • Maintain hydrologic regime and connections between wetlands and other aquatic features. • Use barrier fencing to direct animal movements away from construction activities and areas of potential wildlife-vehicle collisions in construction areas directly adjacent, or that may directly impact, potential habitat for the target species. • Apply hydromulching and/or hydroseeding in areas for soil stabilization and/or revegetation of disturbed areas where feasible. If hydromulching and/or hydroseeding are not feasible due to site conditions, using erosion control blankets or mats that contain no netting, or only contain loosely woven natural fiber netting is preferred. Plastic netting should be avoided to the extent practicable. • Project-specific locations (PSLs) proposed within state-owned ROW should be located in uplands away from aquatic features. • When work is directly adjacent to the water, minimize impacts to shoreline basking sites (e.g., downed trees, sand bars, exposed bedrock) and overwinter sites (e.g., brush and debris piles, crayfish burrows) where feasible. • Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter, which may be refugia for terrestrial amphibians, where feasible. • If gutters and curbs are part of the roadway design, where feasible install gutters that do not include the side box inlet and include sloped (i.e., mountable) curbs to allow small animals to leave roadway. If this modification to the entire curb system is not possible, install sections of sloped curb on either side of the storm water drain for several feet to allow small animals to leave the roadway. Priority areas for these design recommendations are those with nearby wetlands or other aquatic features. ▪ For projects that require acquisition of additional ROW and work within that new ROW is in water or will permanently impact a water feature, implement the items listed above plus the items listed below, where applicable: • For sections of roadway adjacent to wetlands or other aquatic features, install wildlife barriers that prevent climbing. Barriers should terminate at culvert openings in order to funnel animals under the road. The barriers should be of the same length as the adjacent feature or 80 feet long in each direction, or whichever is the lesser of the two.

Species Name	BMP
	• For culvert extensions and culvert replacement/installation, incorporate measures to funnel animals toward culverts such as concrete wingwalls and barrier walls with overhangs. • When riprap or other bank stabilization devices are necessary, their placement should not impede the movement of terrestrial or aquatic wildlife through the water feature. Where feasible, biotechnical streambank stabilization methods using live native vegetation, or a combination of vegetative and structural materials should be used.
Timber rattlesnake	Terrestrial Reptile BMPs ▪ Apply hydromulching and/or hydroseeding in areas for soil stabilization and/or revegetation of disturbed areas where feasible. If hydromulching and/or hydroseeding are not feasible due to site conditions, using erosion control blankets or mats that contain no netting or contain loosely woven, natural fiber netting is preferred. Plastic netting should be avoided to the extent practicable. ▪ For open trenches and excavated pits, install escape ramps at an angle of less than 45 degrees (1:1) in areas left uncovered. Visually inspect excavation areas for trapped wildlife prior to backfilling. ▪ Inform contractors that if reptiles are found on project site allow species to safely leave the project area. ▪ Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter where feasible. ▪ Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered.
Wood Stork	Bird BMPs In addition to complying with the MBTA, perform the following BMPs: ▪ Prior to construction, perform daytime surveys for nests including under bridges and in culverts to determine if they are active before removal. Nests that are active should not be disturbed. ▪ Do not disturb, destroy, or remove active nests, including ground nesting birds, during the nesting season. ▪ Avoid the removal of unoccupied, inactive nests, as practicable. ▪ Prevent the establishment of active nests during the nesting season on TxDOT owned and operated facilities and structures proposed for replacement or repair. ▪ Do not collect, capture, relocate, or transport birds, eggs, young, or active nests without a permit.

Source: Best Management Practices Programmatic Agreement between TxDOT and TPWD Under the 2013 MOU. Reapproved in 2017

*Note: BMPs for the plains spotted skunk and the creek chubsucker have been retained due to their inclusion in TPWD coordination in 2016; however, they are no longer listed as rare species on the Harris County list.

3.11.4 IMPACTS OF THE NO BUILD ALTERNATIVE

There would be no impacts to listed threatened and endangered species from the No Build Alternative. Open areas within the existing I-45 ROW would continue to be maintained and the overgrown vegetated riparian areas within existing roadway ROWs would be expected to remain undisturbed. Existing undeveloped or unmaintained areas within the proposed ROW would be maintained by existing landowners in their present state, with alterations potentially occurring as a result of future development.

Future development could cause a reduction of habitat by the removal of abandoned buildings or the development of vegetated areas within the proposed project area.

3.11.5 ENCROACHMENT ALTERATION EFFECTS

Based on observations from field reconnaissance, there would be no anticipated encroachment impacts to federally protected species, state-listed, or SGCNs because of the existing dense urbanization of the proposed project area and its surroundings. As previously discussed in this section, the proposed NHHIP could pose potential minor impacts to individuals of state-listed species and SGCNs if encountered during construction activities. Beyond these species, the Preferred Alternative would have no impact on any of the remaining SGCN, threatened, or endangered species that may occur in Harris County, their habitats, or designated critical habitats. The proposed project would not alter the long-term hydrologic regime or reduce diversity within the ecosystem. Indirect effects to vegetation and wildlife habitat as a result of the proposed project would be anticipated to be minimal.

3.12 Soils and Geology

This section describes the physical setting sources and resources of the proposed project area. The regional geology of the proposed project area influences the topography, quality and presence of groundwater resources, the presence and characteristics of soils, the occurrence and severity of geologic hazards such as faults and areas of subsidence and also influences the depth to groundwater. The geology of the proposed project area has been controlled by the structural development of the Gulf of Mexico. The Houston area is located on the northern part of the Gulf coastal plain along a 40-to-50-mile swath of land along the Texas coast. Land surface elevations increase about one foot per mile moving inland from the coast. Beneath the land surface of the Houston area are unconsolidated clays, clay silts, and poorly cemented sands. The Houston area contains more than 300 active surface faults that are normal faults also known as gravity faults with their strike paralleling the coastline, oriented in a southwest to northeast direction. Structurally, the proposed project area is relatively stable, there are no earthquakes in this part of Texas, but there are named and mapped fault zones and areas of subsidence that have caused the elevation of the land surface to decline throughout the Houston area (TxDOT 2015). In the Baytown area of southwestern Harris County the land surface elevation declined by more than 10 feet between 1915 to 2001 (USGS 2013, and Kasmarak et al., 2009).

3.12.1 EXISTING CONDITIONS

3.12.1.1 Topography

Land surface subsidence has occurred in the Houston area and in the area of the Preferred Alternative. Land surface declines are caused by groundwater and/or hydrocarbon withdrawals followed by sediment compaction. Land surface elevations within the proposed project area are all referenced to the North American Datum (NAD) 1983 High Accuracy Reference Network and range from approximately 88 feet above mean sea level (msl) at the topographically highest area near the I-45 and Beltway 8 interchange to approximately 0 feet msl at Buffalo Bayou in the vicinity of Downtown Houston. Generally, the land elevation decreases in the direction of the major river systems and to the south in the direction of Galveston Bay. Along US 59/I-69 at the southern end of the Preferred Alternative, the elevation is approximately 48 feet above msl while at SH 288 the land surface elevation is approximately 44 feet above msl. At I-10, at the eastern end of the Preferred Alternative, the land surface elevation is approximately 42 feet above msl. The project area is relatively level with less than one percent slope from Beltway 8 to Buffalo Bayou.

3.12.1.2 Soils

The National Cooperative Soil Survey (NCSS) is a joint effort of the U.S. Department of Agriculture (USDA) and other federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) is responsible for the leadership of soil survey activities of the USDA, and for the leadership and coordination of NCSS activities. Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information. These reports identify soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Data from the soil

survey report for Harris County provides soil type, total acres in the county, percentage of the total county area, hydric qualities of the soil, and if the soil is classified as a prime farmland soil.

According to the NRCS, the soils in the proposed project area (for soils, the study area is the existing I-45 ROW and the ROW limits of the Preferred Alternative) are predominantly classified as Urban, with one exception. Urban land consists of soils that have been altered or covered by buildings and other structures. In the northern part of the proposed project area, approximately 67 acres of soils are mapped as Clodine fine sandy loam. The field investigation conducted includes the area of the existing and proposed ROW. These soils have been disturbed and the area developed. Detailed soil information is available in Appendix K: *Waters of the United States Technical Report*.

Land classifications are specified land use and management groupings that are assigned to soil areas based on soil properties and other factors. The USDA is the agency primarily responsible for the implementation of federal policy concerning farmland. Guiding farmland policy is the Farmland Protection Policy Act of 1981 (FPPA), U.S.C., Title 7, Chapter 73, Section 4201. The general provisions of Section 4201 state that "the Nation's farmland is a unique natural resource that provides food and fiber necessary for the continued welfare of the people of the United States." Section 4201 also states that "the Department of Agriculture and other Federal agencies should take steps to assure that the actions of the Federal Government do not cause United States farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland nor otherwise outweigh the benefits of maintaining farmland resources."

As stated by the NRCS, for the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements does not have to be currently used for cropland. The NRCS's *National Soil Survey Handbook* Part 622.3(A)(1) defines prime farmland generally as having "soils [which] are permeable to water and air…not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding." These qualities make soil and the associated land conducive to agriculture with prime farmland soils being important resources. Projects that are federally funded are subject to the provisions of the FPPA. According to the NRCS, there are no unique or prime farmland soils present in the area of the proposed project (USDA 2016).

3.12.1.3 Geology

The USGS considers the Houston area to be seismically stable although more than 300 surface faults have been historically identified. Recent fault studies have increased the number of identified faults and their location. The surface geology in the proposed project area consists predominantly of Quaternary (Pleistocene) Age relict alluvial, deltaic, and coastal deposits that have been uplifted to form topographic terraces with modern (Holocene) age alluvial deposits occurring within the project area watershed and along local streams. Shallow sediments are composed predominantly of clays and silty clays interbedded with discontinuous layers of silts and sands. The USGS's *Geologic Database of Texas* identifies the Beaumont and Lissie Formations as the underlying geological formations within the proposed project area (USGS 2010). The Beaumont Formation is mapped across much of the Downtown Houston area. The clay, silt, and sand deposits of the Beaumont Formation date to the Pleistocene and Holocene epochs. The

deposits are relatively deep, often reaching 100 feet or greater. Although the deposits are generally flat, they often contain depressions from relic river channels or uplifts in the form of pimple (prairie) mounds. Iron oxide and iron manganese concretions are found with depth. Typically, these deposits have low permeability but are highly plastic. North of Downtown, between I-610 and Beltway 8, the Lissie Formation outcrops and serves as the Chicot Aquifer recharge zone. The Lissie Formation dates to the Pleistocene and consists of sand, silt, and clay with occasional fine gravels that may contain iron oxide, iron manganese, or calcareous deposits. The surface of the Lissie Formation is typically level to gently rolling and is frequently marked by with shallow ponded depressions and pimple mounds. The formation generally trends parallel to the Gulf coast and deposits in the study area are approximately 200 feet thick although these deposits increase in thickness in the downdip or coastal direction. The Lissie Formation is the most laterally continuous major geomorphic surface of the Houston region and is only interrupted by more recent, cross-cutting valley fills (TxDOT 2001).

Within the upper geologic section, the Beaumont Formation is the youngest, continuous coastwise terrace fronting the modern Gulf of Mexico. The Beaumont Formation consists of clay, silt and fine sand arranged in spatial patterns that reflect the distribution of fluvial (channel, point bar, levee, and backswamp environments) and mudflat/coastal marsh conditions. The youngest coastwise terrace is informally known as the Deweyville and this terrace is between the youngest Beaumont terrace and Quaternary age sedimentation. Quaternary Age alluvial and coastal sediments from the deposition of the outer coastal plain, deltas, and stream valleys were established between 1.8 million to 8,000 years ago and have been elevated into topographic terraces. The type of sediments encountered would be composed of unconsolidated material typical of the surrounding Deweyville, Recent Alluvium, and the Beaumont Formation. The sediments of the Beaumont Formation are characterized in the San Jacinto River watershed by primarily clays and silty clays with interbedded, discontinuous layers of silts and sands that are alluvial, deltaic, and coastal in origin. Large, looping meander scars of the fluvial terraces of the Deweyville Formation demonstrate that discharge regimes are clearly greater than experienced in modern streams. Holocene Age alluvial deposits (approximately 8,000 years ago to present) have been deposited as a veneer on top of the older sediments along modern-age streams such as Buffalo Bayou in the proposed project area (TxDOT 2001).

3.12.1.4 Segment 1: I-45 from Beltway 8 to I-610

Segment 1 encompasses approximately 347 acres of land in an area mapped as the Quaternary Lissie Formation consisting of clay, silt sand and minor siliceous gravel of granule size with small pebble size gravel more prevalent to the northern part of the Preferred Alternative. The thickness of this unit is approximately 200 feet, and the landscape is very gently rolling. A normal gravity fault trends southwest-northeast and extends to I-45 from the west, and the fault trace intersects I-45 near Airline Drive. North of I-610 at SH 249, the surface geology transitions to the Quaternary Beaumont Formation consisting of mostly clay, silt and sand deposits that may be characterized by relict river channels with meander patterns and pimple mounds on meanderbelt ridges and a thickness of approximately 100 feet. In this area, the geologic unit is dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high-swell potential, poor drainage, level to depressed relief, low shear

strength, and high plasticity. Soils are predominantly Urban soil map series, with an exception of approximately 67 acres along the northern part of Segment 1 that are mapped as Clodine fine sandy loam.

3.12.1.5 Segment 2: I-45 from I-610 to I-10

Segment 2 encompasses approximately 220 acres of land in an area mapped as the Quaternary Beaumont Formation consisting of mostly clay, silt and sand deposits that are dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high-swell potential, poor drainage, level to depressed relief, low shear strength, and high plasticity. Soils in the Segment 2 project area are mapped as predominantly Urban soil map series.

3.12.1.6 Segment 3: Downtown Loop System

Segment 3 encompasses approximately 637 acres of land in an area mapped as the Quaternary Beaumont Formation consisting of mostly clay, silt and sand deposits that are dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high-swell potential, poor drainage, level to depressed relief, low shear strength, and high plasticity. In a few areas that extend into the Fourth Ward and Midtown, the underlying Beaumont Formation includes sediments that are dominantly clayey sand and silt of moderate permeability, and drainage, low to moderate compressibility and shrink-swell potential level relief with local mounds and ridges, and high shear strength. Soils in the Segment 3 project area are mapped as predominantly Urban soil map series.

3.12.2 IMPACTS OF THE PREFERRED ALTERNATIVE

The Preferred Alternative would include at-grade, elevated and/or depressed sections and construction of access roads and installation of utilities that would require excavation, mixing, stockpiling, testing, and management of excavated soils and fill material. Roadway design best practices would be used to design the Preferred Alternative and incorporation of these requirements would address general and specific requirements to effectively manage the variable conditions of topography, soils, and geology that would be encountered. Specifications and design criteria used for the Preferred Alternative would address issues related to various soils, topographic or geologic conditions and limitations associated with the Preferred Alternative. The primary impact to the physical setting or landscape (topography, soils, or geology) for the Preferred Alternative would occur during construction.

Construction would include land surface grading, trenching and backfilling of surface soils; excavation to facilitate roadway and bridge and construction, access or service road and drainage ditch construction; installation of surface water and water crossing structures; rerouting or installation of existing driveways, access roads, pipelines, and utility lines; relocation of above ground utilities; installation or restoration of existing irrigation and drainage structures; installation of security features, light poles, and signage; construction of elevated roadways, shoulders, lanes, and ancillary support facilities; installation of support beams and pilings; support structures or embankments; storm water management, site restoration, and management of soil and dust to avoid and minimize erosion in compliance with applicable federal and state regulations and guidelines and in conformance with specific requirements of project permits.

The Preferred Alternative would include the construction of drilled shafts and retaining walls. Excavation in these areas may increase the potential of encountering hazardous material contamination during construction. Additional subsurface environmental investigations would be required to determine whether possible contamination might be encountered during construction. If hazardous constituents were confirmed, then appropriate soil and/or groundwater management plans for activities within these areas would be developed and implemented during project construction.

Operations of the Preferred Alternative would include roadway and landscape maintenance, accident and emergency response including debris and spill cleanup, guardrail, pavement and bridge painting and other activities as needed. None of the anticipated activities associated with highway operation for the Preferred Alternative would be expected to affect topography, soils, or geology.

3.12.3 Impacts of the No Build Alternative

The impacts of the No Build Alternative on the physical setting would include no surface and subsurface soil disturbance and relocation, the landscape would remain unaltered, utilities tunneling and replacement would not occur, shallow groundwater would not be generated or affected, dust emissions would not occur during construction, area streams and bayous would not be affected by soil or sediment discharges during construction, surface water quality would not be affected by the Preferred Alternative construction or operation, and earthmoving would not occur.

3.12.4 Encroachment Alteration Effects

I-45 is an established interstate that traverses highly urbanized and developed areas throughout northern Houston; therefore, encroachment alteration impacts to soils and geology would be limited as a result of the Preferred Alternative. Development of varying intensities has already occurred throughout the limits of the Preferred Alternative. Use of BMPs during construction would minimize erosion and sedimentation, with particular attention paid to water crossings or any areas with steep embankments.

3.13 Wild and Scenic Rivers

The Wild and Scenic Rivers Act was enacted by the U.S. Congress on October 2, 1968. The Act established a National Wild and Scenic Rivers System to preserve forever in a free-flowing condition some of the nation's most precious rivers. Section 1(b) of the Act defines Congressional policy regarding the protection and preservation of certain rivers of the United States. The Act states that if a selected river's immediate environment possesses outstandingly remarkable scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar values, the river is to be preserved in free-flowing condition. The river's immediate environment is also to be protected for the benefit and enjoyment of present and future generations (National Park Service 2012).

Wild and scenic river impacts were reassessed for the Preferred Alternative. Only the 191.3-mile portion of the Rio Grande in Brewster and Terrell counties Texas is designated as a Wild and Scenic River of National Importance. Due to the NHHIP's location in Harris County, there would be no impacts on wild and scenic rivers as discussed in Section 3.13 of the Draft EIS.

3.14 Archeological Resources

The proposed NHHIP includes state and federal funds managed through TxDOT; therefore, the proposed project is subject to regulations defined in Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. Under Section 106 of the NHPA, and in accordance with the Advisory Council on Historic Preservation (ACHP) regulations pertaining to the protection of historic properties (36 CFR 800), federal agencies are required to locate, evaluate, and assess the effects of their undertaking on historic properties. For transportation projects such as this one, where ground disturbance will occur within state-owned ROW, compliance with Section 106 of the NHPA and the Antiquities Code of Texas is implemented under the Programmatic Agreement among the FHWA, TxDOT, the Texas State Historic Preservation Office (SHPO), and the ACHP Regarding the Implementation of Transportation Undertakings (PA-TU), and in conjunction with the MOU between TxDOT and the Texas Historical Commission (THC). Pursuant to 36 CFR 800.4, TxDOT shall make a "reasonable and good faith effort to carry out appropriate identification efforts" of historic properties.

3.14.1 Archeological Assessment

TxDOT performed an initial archeological survey in 2015–2017 and a follow-up background study in 2018. Much of the APE did not warrant an archeological survey because extensive prior development and disturbances would have destroyed any archeological sites there. Raba Kistner Environmental, Inc. (RKEI) conducted the initial 2015–2017 survey under Texas Antiquities Permit 7458 (see attached redacted survey report in Appendix D). During this survey, RKEI recorded no archeological materials in the 23 parcels (2.25 acres) of previously identified medium- and high-probability areas to which they had access. RKEI identified a single cemetery (Third City Cemetery in Parcel 55) that should be avoided, and further recommended that medium- and high-probability areas to which access was not yet available or within which hazardous materials concerns precluded survey be assessed once access had been obtained and/or concerns had been addressed.

In 2017, Cox McLain Environmental Consulting (CMEC) obtained Texas Antiquities Permit 8256 in order to complete the survey of these medium- and high-probability areas. However, continued lack of access and hazardous materials concerns led to the cancellation of the permit in March 2018 without any fieldwork being undertaken.

In 2018, a follow-up archeological background study conducted by TxDOT further refined RKEI's archeological probability areas within the proposed project ROW on the basis of proximity to water, historic land use, archival research, additional disturbance information, and updated design details. The background study also identified a few locations with previously recorded archeological sites or conditions favorable for the preservation of such sites. The areas selected for survey were divided into two groups, one with a "medium" probability to contain intact archeological sites and another with a "high" probability to contain intact archeological sites. The THC, in its capacity as the SHPO, formally concurred with this assessment on May 25, 2018 (see attached concurrence in Appendix D).

In April 2018, TxDOT moved forward with survey of three high-probability locations adjacent to Buffalo Bayou for which access was granted but where hazardous materials concerns required pre-fieldwork

contaminant testing. TxDOT's soil testing contractor, TRC Solutions, conducted subsurface contaminant testing in October 2018, identifying areas where chemicals and bacteria of concern were elevated. These areas were digitally and physically flagged for avoidance during subsequent archeological survey. In November 2018, in consultation with TxDOT, CMEC excluded the need to survey two high-probability locations due to evidence of disturbance. Then, in November and December 2018, CMEC archeologists conducted survey and limited testing under Texas Antiquities Permit 8613, using mechanical trenching in one high-probability area that intersected sites 41HR982 and 41HR1037 (see attached redacted survey and testing report in Appendix D). Following survey and testing, TxDOT recommended that the portions of these sites within the NHHIP APE were heavily disturbed, provided redundant data when viewed in the context of adjacent work by others, and could not contribute to either site's eligibility for the NRHP.

The remaining portions of the project's APE that require further investigation, including medium-probability areas located near the northern terminus of the project and two high-probability areas located within and near the Clayton Homes apartment complex, are shown below in Figure 3-4. On February 25, 2019, the THC concurred with TxDOT's commitment to complete survey of these areas (see attached in Appendix D). The THC also concurred with TxDOT recommendations that no further work or consultation is required for the surveyed portions of the APE. TxDOT shall ensure that all archeological assessments as well as Section 106 and Antiquities Code of Texas consultation are completed prior to the commencement of construction within the remaining unsurveyed acres of proposed new ROW/easements.

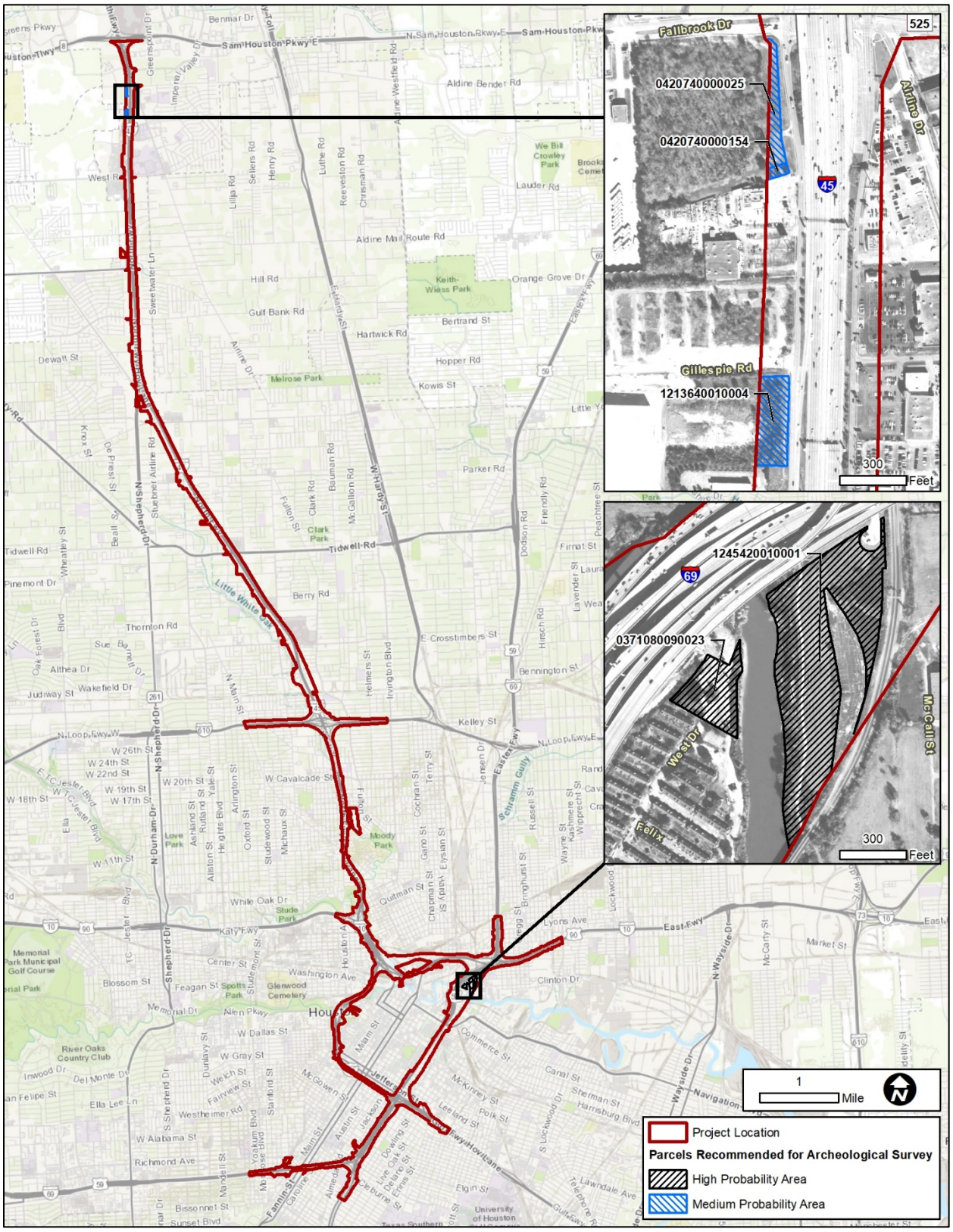
3.14.2 TRIBAL CONSULTATION

TxDOT consulted with representatives of federally recognized tribes with an interest in the APE in February 2017 following RKEI's intensive survey report; in response, the Alabama-Coushatta, Comanche, and Tonkawa tribes responded that they had no specifically designated properties or locations of historical, religious, and/or cultural significance that would be impacted by the proposed projects. Following the completion of CMEC's 2018 field investigations of high-probability areas at sites 41HR982 and 41HR1037, a second request for consultation was submitted to federally recognized tribes in February 2019. No tribal representatives submitted responses.

3.14.3 OTHER CONSULTING PARTIES CONSULTATION

In partial fulfillment of Section 106 responsibilities, in June 2018 TxDOT hosted a stakeholder's meeting to present plans for archeological investigations of medium- and high-probability areas not initially surveyed by RKEI. Following completion of fieldwork in these locations, TxDOT sought further consultation with local landowners and stakeholders with an interest in the APE in February 2019. Only one substantive public response was received. The communication, which adjacent landowner Kirk Farris submitted via email, contained several comments and questions, all of which were addressed by TxDOT personnel.

Figure 3-4: Portions of the APE that Require Additional Investigation



3.15 Historic Resources

TxDOT conducted identification, documentation, and evaluation of historic properties for this project per provisions of the Section 106 Programmatic Agreement (PA), as executed among FHWA, TxDOT, the THC (which is the Texas SHPO), and the ACHP. These efforts were executed in compliance with Section 106 of the NHPA as codified at 36 CFR 800.

TxDOT used a phased approach to identify, document, and evaluate historic properties in the project area, with a Historic Resources Research Design (a procedural step to gain approval from TxDOT on the technical approach), four reconnaissance-level Report for Historic Studies Survey (Report) documents, and two focused intensive-level survey reports prepared between 2015 and 2018. A *Historical Resources Survey Report — Update* (Appendix H to the Final EIS), finalized in September 2019, brought together the findings of the various reports and addressed comments and questions raised by the Texas SHPO in response to previous reports. The September 2019 Report was submitted to the Texas SHPO and other consulting parties as part of the Section 106 consultation process. A methodological summary of these reports is provided below.

Report for Historical Studies Survey, CSJ 0912-00-146, North Houston Highway Improvement Project, Harris County, Houston District. October 15, 2015.

In this initial phase, TxDOT identified NRHP-listed and previously determined eligible properties within the Survey Study Area, defined as 1,300 feet beyond the proposed ROW for the three reasonable Build Alternatives within each project segment. The Survey Study Area encompassed all three Reasonable Alternatives, while a more focused APE was subsequently defined for each of the Reasonable Alternatives. Known historic properties and potentially historic properties in the APE of each Reasonable Alternative were then documented.

Report for Historical Studies Survey, CSJ 0912-00-146, North Houston Highway Improvement Project, Harris County, Houston District. December 9, 2016.

This survey phase documented and evaluated four mid-twentieth-century residential subdivisions extending into the APE of one or more of the Reasonable Alternatives. It also incorporated the findings of a resurvey and reevaluation of the Houston Warehouse Historic District, which was undertaken as part of regulatory coordination for a project unrelated to NHHIP activities.

Report for Historical Studies Survey, CSJ 0912-00-146, North Houston Highway Improvement Project, Harris County, Houston District. October 19, 2017.

All historic-age resources (those built in 1975 or earlier) located within the APE of the Preferred Alternative were documented and evaluated, excepting those properties already included in the 2015 and 2016 Reports. Approximately 940 historic-age resources were newly surveyed in this phase.

Historical Resources Survey Report, North Houston Highway Improvement Project: Birdsall Place Intensive Survey and Historical Resources Survey Report, North Houston Highway Improvement Project: Kenilworth Grove Intensive Survey. September 14, 2018.

Intensive-level research and documentation of two subdivisions to finalize determinations of NRHP eligibility for the subdivisions as potential historic districts and for individual properties within the neighborhoods.

Report for Historical Studies Survey, CSJ 0912-00-146, North Houston Highway Improvement Project, Harris County, Houston District. September 28, 2018.

Reconnaissance-level evaluation of all historic-age resources within the APE of the Preferred Alternative, incorporating revisions based on comments received from the Texas SHPO on the October 2017 Report. This report also included a section discussing project effects to historic properties in the APE.

Historical Resources Survey Report — Update, North Houston Highway Improvement Project, CSJ 0912-00-146. September 18, 2019.

This report compiled and organized results of previous historic resource surveys, presented more detailed historic contexts for potentially NRHP-eligible neighborhoods and individual properties in the APE, addressed questions raised in previous correspondence by the Texas SHPO and other parties including stakeholders and the public, presented a comprehensive list of NRHP-listed and NRHP-eligible properties in the APE, and provided a discussion of the project's effects, including determinations of effect, to historic properties. The Texas SHPO concurred with the determinations of NRHP eligibility and determinations of effect on September 9, 2019. The report is included as Appendix H to the Final EIS.

In accordance with Section 106 and 36 CFR 800, TxDOT conducted public involvement and outreach efforts focused on historic resources. These activities included stakeholder meetings, Section 106 consulting party meetings, and requesting review of the 2019 Historical Resources Survey Report — Update by Section 106 consulting parties. Historic resources were also included as part of overall NEPA public involvement efforts. Based on stakeholder and public comments, TxDOT conducted additional historic resources investigations to re-document and re-evaluate resources in areas of concern. TxDOT revised portions of the Historical Resources Survey Report — Update to reflect the additional investigations and findings.

3.15.1 EXISTING CONDITIONS

3.15.1.1 Segment 1: I-45 from Beltway 8 to I-610

Based on historic resources surveys and subsequent consultation with the Texas SHPO, the following NRHP-listed or NRHP-eligible historic properties are located within the APE (Table 3-18):

Table 3-18: Historic Properties in Segment 1 APE

Resource #	Property Name	Property Address	NRHP Status
No number	Hidden Valley Historic District	Roughly bounded by SH 249/W. Mount Houston Road to the north, SH 261/Veterans Memorial Drive to the west, Bertrand Street to the south, Sunnywood Drive to the east.	Eligible (NRHP Criterion A). Three contributing resources to the district are located in the APE.
179	Former Phillips 66 Gas Station	5610 North Freeway.	Eligible (Criterion C).

3.15.1.2 Segment 2: I-45 from I-610 to I-10

Based on historic resources surveys and subsequent consultation with the Texas SHPO, the following NRHP-listed or NRHP-eligible historic properties are located within the APE (Table 3-19):

Table 3-19: Historic Properties in Segment 2 APE

Resource #	Property Name	Property Address	NRHP Status
No number	Brooke Smith Historic District	Roughly bounded by Cavalcade Street to the north, Northwood Street to the west, I-45 southbound frontage road to the east, N. Main Street to the south and southwest.	Eligible (NRHP Criteria A, C). 21 contributing resources to the district are located in the APE.
No number	Germantown Historic District	Roughly bounded by Oleander Street to the north, Houston Street to the west, Wrightwood Street to the south, I-45 to the east.	Eligible (NRHP Criteria A, C). 36 contributing resources to the district are located in the APE.

3.15.1.3 Segment 3: Downtown Loop System

Based on historic resources surveys and subsequent consultation with the Texas SHPO, the following NRHP-listed or NRHP-eligible historic properties are located within the APE (Table 3-20):

Table 3-20: Historic Properties in Segment 3 APE

Resource #	Property Name	Property Address	NRHP Status
No number	Near Northside Historic District	Roughly bounded by Little White Oak Bayou on the north, the block between North Main and Keene on the east, Hogan Street on the south and I-45 on the west.	Listed (NRHP Criteria A, C). 22 contributing resources to the district are located in the APE. Two of the contributing properties are also individually eligible for the NRHP (see below).

Resource #	Property Name	Property Address	NRHP Status
No number	Houston Warehouse Historic District	Discontiguous district: North portion roughly bounded by UPRR to the north, half-block west of Vine Street to west, Walker Street to east, Providence St/I-10 to south. South portion bounded by half-block west of San Jacinto Street to west, Rothwell St/Nance St to north, McKee St to east, UPRR to south.	Eligible (NRHP Criteria A, C). Six contributing resources to the district are located in the APE. Two of the contributing properties are also individually eligible for the NRHP (see below).
No number	Third Ward Historic District	Roughly bounded by Gray St/I-45 to north, Bastrop St/Hutchins St/SH 288 to west, Blodgett St/Alabama St to south, Ennis St/Scott St. to east.	Eligible (NRHP Criteria A, C). 34 contributing resources to the district are located in the APE.
001	Robert E. Lee Elementary	2101 South Street.	Contributing to NRHP-listed Near Northside Historic District, also individually NRHP-eligible.
002	Galveston Harrisburg and San Antonio (GH&SA) Railway Hospital	2015 Thomas Street.	Contributing to NRHP-listed Near Northside Historic District, also individually NRHP-eligible.
004	Houston Water Works	27 Artesian Street.	Listed (NRHP Criterion A).
007A	Kellum-Noble House	In Sam Houston Park, 212 Dallas Street.	Listed (NRHP Criteria A, C).
015	Young Women's Prep Academy/ former Johnston Jr. High	1906 Cleburne Street.	Eligible (NRHP Criterion C).
016	Cheek-Neal Coffee Company	2017 Preston Avenue.	Listed (NRHP Criterion A).
017	Myers-Spalti Manufacturing Plant	2115 Runnels Street.	Listed (NRHP Criteria A, C).
019	Houston Fire Station No. 5	910 Hardy Street.	Eligible (NRHP Criterion A).
024	Readers Distributors Warehouse	1201 Naylor Street.	Contributing to NRHP-eligible Houston Warehouse Historic District, also individually NRHP-eligible.
025	San Jacinto Warehouse	1125 Providence Street.	Contributing to NRHP-eligible Houston Warehouse Historic District, also individually NRHP-eligible.
581	Downtown Houston Post Office	401 Franklin Street.	Listed (NRHP Criteria A, C).

Resource #	Property Name	Property Address	NRHP Status
590	Rossonian Cleaners	3921 Almeda Road.	Eligible (NRHP Criteria A, C).
603	Residence	4120 Austin Street.	Eligible (NRHP Criterion C).
738	Gribble Stamp Building	121 St. Emanuel Street.	Eligible (NRHP Criterion C).
908	Butler Brothers Union Terminal Warehouse	1002–1008 Washington Avenue.	Eligible (NRHP Criterion C).
956	Residence	3417 Baer Street.	Eligible (NRHP Criterion C).
966	HB&T Railway Bascule Bridge	Over Buffalo Bayou.	Eligible (NRHP Criterion C).
975	Judge Hernandez Tunnel	Main Street under former GH&SA Railway.	Eligible (NRHP Criterion C).
981	Former Crawford Elementary School	1510 Jensen Drive.	Eligible (NRHP Criterion C).
983	City Hall Annex	900 Bagby Street.	Eligible (NRHP Criterion C).
No number	Navigation Boulevard Underpass	Navigation Boulevard at Commerce Street.	Eligible (NRHP Criterion C).

3.15.2 IMPACTS OF THE PREFERRED ALTERNATIVE

In accordance with 36 CFR 800, TxDOT examined and documented the direct effects of the proposed Build Alternative on historic properties. Examples of direct effects include acquisition of land for project ROW or easements, or alterations or removal of historic buildings or structures. The Texas SHPO concurred with TxDOT's determinations of effect on September 9, 2019, on the condition that design prescriptives to avoid or minimize adverse effects are incorporated into the design-build contract. The sections below provide a summary of adverse direct effects to historic properties in the APE. Indirect effects were addressed in the *Indirect Impacts Technical Report* and in the Encroachment Alteration discussion below. TxDOT has agreed to design commitments to avoid unanticipated adverse effects to historic properties within and adjacent to the APE. These commitments are discussed in Section 7.15 of the Final EIS. The September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of direct, indirect, and cumulative effects to all identified historic properties in the APE.

3.15.2.1 Segment 1: I-45 from Beltway 8 to I-610

One historic district and one individual historic property are located in the APE in Segment 1 of the project. The proposed Build Alternative would have no adverse direct effects to these historic properties. Section 5 of the September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of project effects to historic properties in the APE.

3.15.2.2 Segment 2: I-45 from I-610 to I-10

Two historic districts are located in the APE in Segment 2 of the project. Additional historical research and documentation conducted for the September 2019 *Historical Resources Survey Report — Update* resulted in changes to the NRHP-eligible boundaries of the Germantown Historic District, including identification of contributing resources to the historic district on Wrightwood Street. TxDOT subsequently made refinements to the project design to avoid direct effects to contributing resources along Wrightwood Street and to the historic district as a whole.

The proposed Build Alternative would have no adverse direct effects to these historic properties. Section 5 of the September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of project effects to historic properties in the APE.

3.15.2.3 Segment 3: Downtown Loop System

The proposed Build Alternative would have direct effects to several historic properties in the APE in Segment 3 of the project. TxDOT made numerous design refinements to avoid or minimize direct effects, including changes to proposed alignment of I-45/I-10 on the north side of Downtown and reducing the overall roadway footprint in several locations in Segment 3.

Ten historic properties and two historic districts would be directly affected by the proposed Build Alternative. A summary of direct effects is provided below:

- Near Northside Historic District — The proposed NHHIP would require acquisition of about 0.02 acres of additional ROW from a property parcel at 109 Carl Street (Resource 554), or about 0.03 percent of the total historic district area. The project would have no adverse effect to the Near Northside Historic District.
- Residence/garage at 109 Carl Street (Resource 554) — A noncontributing garage at 109 Carl Street would be removed for the project. A portion of the noncontributing garage already extends into the existing I-45 ROW. The contributing house on the same parcel would remain in place. The project would have no adverse effect to the property at 109 Carl Street. The minor acquisition of ROW from the parcel would result in a finding of a *de minimis* Section 4(f) use of land.
- Downtown Houston Post Office (401 Franklin Street, Resource 581) — The NHHIP would acquire about 904 square feet (0.021 acres) of land from the property, representing about 0.13 percent of the total parcel area. The ROW to be taken is a small portion of the paved parking area adjacent to existing I-45 and northwest of the former post office building. The proposed project would have no adverse effect to the NRHP-listed building. The minor acquisition of ROW from the parcel would result in a finding of a *de minimis* Section 4(f) use of land.
- Houston Warehouse Historic District — The NHHIP would result in acquisition of 5.1 acres of ROW from properties in the Houston Warehouse Historic District, representing about 12.5 percent of the historic district's total area. The NHHIP would result in demolition of two of the district's contributing resources and would acquire ROW from three additional parcels

containing contributing resources. The proposed project would have an adverse effect to the historic district as a whole.

- Reader's Wholesale Distributor's Warehouse (1201 Naylor Street, Resource 024) — The NHHIP would result in ROW acquisition of the property and demolition of the warehouse building, which is individually NRHP-eligible and a contributing resource to the Houston Warehouse Historic District. The proposed project would therefore have an adverse effect to the historic property.
- San Jacinto Warehouse (1125 Providence Street, Resource 025) — The NHHIP would take 88.23 square feet of land from this property parcel, which is about 0.01 percent of the parcel's total area. ROW acquisition would be limited to a small portion of the current paved parking area adjacent to the raised loading dock that extends along the building's east elevation. The proposed project would have no adverse effect to the historic property, provided design prescriptives are incorporated into the design-build contract to avoid potential vibratory impacts. The minor acquisition of ROW from the parcel would result in a finding of a *de minimis* Section 4(f) use of land.
- Bottling Works/Walter's Downtown (1120 Naylor Street, Resource 028) — The NHHIP would take 0.07 acres of land from this property parcel, which is 27.62 percent of the parcel's total area. Much of the unpaved parking area north of the building would be taken by the new ROW acquisition. There would be no taking or other direct effects to the building. The proposed project would have no adverse effect to the historic property, provided design prescriptives are incorporated into the design-build contract to avoid potential vibratory impacts. The minor acquisition of ROW from the parcel would result in a finding of a *de minimis* Section 4(f) use of land.
- Carlisle Plastics Warehouse, north building (1133 Providence Street, Resource 029) — This property parcel contains two attached buildings, both contributing buildings to the Houston Warehouse Historic District. The project would take 0.16 acres of land from the parcel, or about 15.91 percent of the parcel's total area. The ROW acquisition would require demolition of the north warehouse building. The proposed project would therefore have an adverse effect to the building.
- Carlisle Plastics Warehouse, south building (1133 Providence Street, Resource 030) — This property parcel contains two attached buildings, both contributing buildings to the Houston Warehouse Historic District. The project would take 0.16 acres of land from the parcel, or about 15.91 percent of the parcel's total area. There would be no taking or other direct effects to the building. The proposed project would have no adverse effect to the south warehouse building, provided design prescriptives are incorporated into the design-build contract to avoid potential vibratory impacts.
- METRO Transit Authority Building (1116 Naylor Street [building faces Vine Street], Resource 820) — The NHHIP would take a small strip of land from the parcel, at the northeast edge of the paved parking area along Naylor Street. There would be no taking or other direct

effects to the METRO Warehouse building. The minor acquisition of ROW from the parcel would result in a finding of a *de minimis* Section 4(f) use of land.

- Cheek-Neal Coffee Company Building (2017 Preston Street, Resource 016) — The NHHIP would acquire a 150-foot-wide strip of additional ROW from this property parcel, or about 27.5 percent of the Cheek-Neal property parcel. The proposed additional ROW is currently used as a paved parking area adjacent to the Cheek-Neal Coffee Company Building. The proposed NHHIP ROW boundary would be located 16 feet from the building's west edge. There would be no taking or other direct effects to the Cheek-Neal building itself. However, the acquisition of substantial additional ROW would result in an adverse effect to the historic property.
- Rossonian Cleaners (3921 Almeda Road, Resource 590) — The NHHIP would acquire 0.079 acres of land from this property parcel, or about 28.7 percent of the total parcel area. The ROW boundary would extend into the existing Rossonian Cleaners building and would require demolition of the circa (c.) 1945 addition that makes up the southern half of the building and would likely require acquisition and removal of the entire building. The proposed project would therefore have an adverse effect to the property.

The Texas SHPO concurred with the above determinations of effect on September 9, 2019. Section 5 of the September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of project effects to historic properties in the APE. TxDOT is also coordinating with the ACHP. The ACHP will participate as a consulting party to the Section 106 agreement process. TxDOT developed a PA that identifies historic properties adversely affected by the NHHIP, stipulates TxDOT's mitigation commitments, and specifies procedures and processes to be implemented during the design-build process to avoid and minimize harm to historic properties. TxDOT consulted with ACHP, Texas SHPO, and other consulting parties in the development and execution of the PA, signed on July 7, 2020, and included in Appendix R.

Additional information regarding coordination with additional groups and individuals who have requested status as consulting parties under Section 106 is described in the September 2019 *Historical Resources Survey Report — Update* prepared for the NHHIP (Appendix H to the Final EIS). Additional information regarding overall public outreach and involvement for the NHHIP is included in other sections of the Final EIS.

3.15.3 Impacts of the No Build Alternative

Under the No Build Alternative, no new roadway ROW would be acquired. No historic resources would be directly or indirectly affected.

3.15.4 Encroachment Alteration Effects

For historic resources, encroachment alteration effects may include an increase in existing noise levels, visual impacts, or loss of access to a historic property, such that the encroachment effect diminishes the characteristics that cause a resource or district of resources to be historic. These types of effects have the

potential to diminish the integrity of feeling or setting of historic properties. In the Section 106 process, encroachment alteration effects are referred to as indirect effects.

The proposed project would result in changes to visual character, elevated noise levels, or potential for vibratory impacts to some historic properties in the NHHIP APE. TxDOT determined that these indirect effects would not alter the characteristics that qualify the historic properties for inclusion in the NRHP. Therefore, the proposed project would have no adverse indirect effects to historic properties.

TxDOT also determined that the project would not result in adverse cumulative effects to historic properties. This project does not represent a deviation from the past, present, or anticipated future trends of development in the Downtown area and would not significantly change the historic character of Downtown Houston. Future developments with potential to affect historic properties would be subject to compliance with applicable federal, state, and local regulations. Project components, such as relocation of I-10/I-45 north of Downtown, have the potential to improve connectivity in historic districts in the APE.

The Texas SHPO concurred with TxDOT's determinations of effect on September 9, 2019, on the condition that design prescriptives to avoid or minimize indirect noise, visual, and vibratory effects are incorporated into the design-build contract. The September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS) contains a full discussion of direct, indirect, and cumulative effects to all identified historic properties in the APE.

3.16 Hazardous Materials

3.16.1 Existing Conditions

A *Hazardous Materials Technical Report* was produced for the NHHIP, and an Initial Site Assessment (ISA) form was completed documenting hazardous materials within the project corridor. The ISA included a visual survey of the existing ROW and surrounding area, and research into existing and previous land uses was performed by the project team to identify possible hazardous materials within the project limits. Documentation of the ISA is maintained in the Houston District project files. Hazardous Materials were reevaluated after selection of the Preferred Alternative. Below is a summary of these conditions and an analysis of impacts.

3.16.2 Review of Federal, State, and Supplemental Databases

A regulatory database search was performed by Environmental Data Resources Inc. on May 22, 2014. A second regulatory database search was performed by Banks Environmental Data (Banks) on October 4, 2017 to facilitate review of areas where new ROW would be required for design changes. The 2017 Banks report identified a total of 833 records within the search radii prescribed by ASTM E 1527-13. Of those records in the Banks report, 137 sites (primarily Leaking Petroleum Storage Tanks [LPST] and Voluntary Cleanup Program [VCP] sites) were determined to have the potential to impact the project corridor (moderate- or high-risk sites). This determination was based on the type of database listing, the information provided in the database report, and the distance and direction of the listing to the corridor. Additionally, 33 orphan or unlocatable sites were identified in the database search.

3.16.3 Environmental Consequences

The Preferred Alternative would require the acquisition of approximately 246 acres of new ROW for Segment 1 I-45 from Beltway 8 North to north of I-610 (North Loop); 44 acres of new ROW for Segment 2 I-45 from north of I-610 (North Loop) to I-10 (including the interchange with I-610); and 160 acres of new ROW for Segment 3 Downtown Loop System (I-45, US 59/I-69, and I-10). This includes acquisition of residential and commercial properties.

The databases searched included federal, state, local, and tribal databases as defined by ASTM E 1527-13. Further analysis of potential sites of concern will be considered prior to construction. The depth to groundwater will be determined for locations where construction is proposed to occur to determine the likelihood of reaching groundwater and to determine whether contaminants held in the groundwater would be likely to impact construction.

The proposed project would include the excavation and construction of detention pond locations. Excavation in these areas may increase the potential of encountering hazardous material contamination during construction. Additional subsurface environmental investigation services would need to be coordinated by the TxDOT Environmental Affairs Division (TxDOT ENV) Hazardous Materials Group to determine whether possible contamination might be encountered during construction of the detention ponds in the vicinity of the 137 identified medium and high-risk sites. If hazardous constituents were

confirmed, then appropriate soils and/or groundwater management plans for activities within those areas would be developed.

For any of the sites located adjacent to or within the footprint of the Preferred Alternative, impacts associated with hazardous materials would most likely occur during construction and would be related to activities within or near existing hazardous material sites. The hazardous material sites either have already impacted and/or have the potential to impact the existing environment if disturbed during construction. The regulated sites also create the potential to contaminate sites adjacent to them if disturbed during construction, posing a risk for the acquisition of those properties. However, risks would be potentially minimized by coordinating with the TxDOT ENV Hazardous Materials Group to conduct additional assessment for the moderate and high-risk sites identified in the *Hazardous Materials Technical Report*. Additional assessment could include regulatory file reviews, Phase 1 Environmental Site Assessments, and/or subsurface investigations, as appropriate to resolve or address hazardous materials concerns, considering project design and ROW requirements relative to the sites. Additional assessment would be conducted prior to construction in accordance with TxDOT guidance.

The NHHIP project includes the demolition of building structures. The buildings may contain asbestos-containing materials. Asbestos inspections, specification, notification, license, accreditation, abatement, and disposal, as applicable, would comply with federal and state regulations. Asbestos issues would be addressed during the ROW acquisition process prior to construction.

In accordance with TxDOT specifications, construction contractors would be instructed to be required to stop work and immediately notify the engineer to stop all subsurface activities in the event that potentially hazardous materials are encountered, an odor is identified, or significantly stained soil is visible. In addition, contractors and maintenance personnel are required by standard specification to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process.

3.16.4 OTHER SITES OF CONCERN

Active gas wells that are located within the footprint of the Preferred Alternative would be required to be properly plugged and abandoned prior to construction. Requirements for the proper procedures to plug these types of wells are provided in the T.A.C., Title 16, Part 1, Chapter 3, 3.14 under the jurisdiction of the Railroad Commission (RRC) of Texas. Well plugging would need to be performed by cementing companies, service companies, or operators approved by the RRC of Texas. Arrangements with the responsible well operator for proper plugging according to applicable regulations would be addressed during the ROW acquisition and negotiation process. If not plugged prior to construction, the wells would be addressed per TxDOT Standard Specification Item 103, Disposal of Wells. If contamination were encountered at any of the identified well or abandoned well sites, remediation would be conducted prior to construction. If a well were damaged during construction, the responsible party would be required to correct the damage and remediate any pollution resulting from the damage.

The RRC GIS maps show natural gas transmission lines and pipelines for non-HVL (highly volatile liquid) products (liquid products that are not highly volatile) intersecting the Preferred Alternative as well as

numerous liquid propane tank locations. During ROW negotiation, determinations would be required to make necessary adjustments and/or relocate pipelines. Location and depth of pipelines that would remain in place would need to be marked on the ground (in the field) prior to construction activities in order to prevent accidental damage to or rupture of the pipelines. TxDOT intends to take proper precautions in order to avoid impacts related to petroleum pipelines.

3.17 Visual and Aesthetic Resources

Highways and major transit facilities can affect the visual and aesthetic character of surrounding landscapes and the perceptions of the individuals who live within and visit these environments. The 2015 FHWA guidance, *Visual Impact Assessments for Highway Projects*, provides a framework for evaluating impacts to visual and aesthetic resources for vehicular highway projects. The National Cooperative Highway Research Program (NCHRP) issued a report entitled *Evaluation of Methodologies for Visual Impact Assessment* in 2013 (Churchward et al., 2013). Following the guidance established by the FHWA, supplemented by the best practices identified in the NCHRP study, where applicable, a standard visual impact assessment was conducted and included in the April 2017 Draft EIS for the NHHIP. The Visual Impact Assessment Technical Report (February 2017) is Appendix L of the Draft EIS.

In response to comments received regarding the assessment of the proposed project's visual impact to several specific areas, as well as new design changes to the Preferred Alternative, some areas near the proposed project were reassessed for the Preferred Alternative. Detailed information for the updated visual impact analysis for aesthetics and scenic resources is provided in Appendix L: *Addendum 1 to Visual Impact Assessment Technical Report*. The methodology of the visual impact assessment follows the same process as described in Section 2 of the February 2017 VIA Technical Report and follows Federal Highway Administration guidance for a standard level VIA for assessing visual and aesthetic resources for vehicular highway projects.

3.17.1 Summary of Local Plans

With this visual impact assessment update, local plans and studies that include actions or goals related to visual resources, views, or visual quality were reviewed. The following bullets summarize actions and goals related to visual resources in the project area.

Plan Houston is the City of Houston's first general plan, established in September 2015 (City of Houston 2015). The following bullets summarize actions and goals related to visual resources in the City of Houston.

- Strategic Goal: Grow responsibly. An action under this strategy commits incorporating context sensitive design principles for development of the transportation network, with attractive streetscapes and public spaces.
- Strategic Goal: Protect and conserve our resources. Actions and goals under this strategy include:
  - Limit City's impact on the environment
  - Preserve and enhance the public tree canopy
  - Attractive streetscapes and public spaces

For geographic areas within the study area there are several H-GAC Livable Centers studies and other plans which identify projects and goals of the communities that border the project area. The following bullets summarize actions and goals related to visual resources.

- The *North Houston District/Greenspoint Livable Centers Study* (H-GAC 2020) includes a northern portion of the Greater Greenspoint super neighborhood and was completed in April 2020. Projects within the plan include pedestrian network improvements at the I-45 intersection and Green Bayou, helping to complete goals established in the Bayou Greenways 2020 plan.
- The *Independence Heights — Northline Livable Centers Study* (H-GAC 2012a) recommends developing a pedestrian crossing at the Crosstimbers Street and I-45 intersection. Projects would include lighting and bollards at the I-45 underpass, as well as landscaping improvements, sidewalk and bike lane construction, and vertical gateway signage located on either side of -45.
- A portion of the southern half of the Near Northside super neighborhood is included in the study area of the *Northside Livable Centers Study* (Van Meter Williams Pollack 2010). This study recommended projects within the study area including neighborhood gateway signage near I-45 and bike routes along Little White Oak Bayou.
- An eastern portion of the Washington Avenue Coalition/Memorial Park super neighborhood is included in the *Washington Avenue Livable Centers Study* (H-GAC 2012b), the study area of which is defined as I-10 to the north, Memorial Parkway to the south, I-45 to the east, and Washington Avenue and Westcott Street to the west. Projects recommended in this study within the study area would include increasing density near I-45 and develop open space as an extension of Buffalo Bayou.
- A portion of the Downtown super neighborhood is included in the *Downtown/EaDo Livable Centers Study* (H-GAC 2011), the study area of which is defined by Pease Street, St. Charles Street, Commerce Street, and Austin Street. The plan recommended improving pedestrian crossings at major intersections under US 59.
- The *Near Northside Complete Communities Action Plan* (City of Houston 2018) recommends transforming vacant or leftover spaces into green spaces. The goal recommends working in partnership with projects to identify and develop opportunities for new green spaces.

3.17.2 EXISTING CONDITIONS

The project study area was broken into three landscape units, which are geographical units used with similar visual characteristics for assessing visual impacts. The landscape units for this analysis are the three project segments. Segment 1 contains more retail and commercial properties facing the I-45 frontage roads. Residential homes are generally located behind the retail and commercial buildings. Segment 2 has more residential homes near I-45 and less retail and commercial properties adjacent to the interstate. Segment 3 contains the Downtown central business district. While there may be unique characteristics differentiating parts of the Downtown, as noted in the prior report and further evaluated in this report, the cultural order and natural harmony are similar enough to group into one segment.

The assessment of the existing conditions for each landscape unit describes (1) visual character and visual quality and (2) viewer exposure and sensitivity. The visual character includes components of the landscape and the relationship between the natural environment and built environment, and the visual quality is the

viewers' perception of visual resources that compose the visual character of each landscape unit based on natural harmony, cultural order, and vividness.

- **Natural harmony —** what a viewer perceives about the natural environment, labeling the environment as being either harmonious or inharmonious.
- **Cultural order —** how viewers perceive the organization of the cultural visual environment or the man-made built environment, including buildings, transportation facilities, structures, or historical artifacts, labeling the built environment as orderly or disorderly.
- **Vividness** — the degree of memorable, dramatic, or distinctive components of the landscape. Vividness is an overall aggregation of topography, vegetation, water features, and cultural elements created by people.
- **Project coherence —** the viewer's perception about how constructed facilities associated with the Build Alternatives would fit into the existing environment.

The primary views of each landscape unit were identified through field observations and aerial mapping. The sensitivity of the primary viewers or viewer groups within each landscape unit was determined by viewer type (neighbor or traveler) and their sensitivity to potential views and the visual resources in each landscape unit.

3.17.2.1 Visual Character and Quality

Segment 1: I-45 from Beltway 8 to I-610

The physical geography of Segment 1 is generally characterized as flat terrain. This landscape unit is mostly developed and is primarily comprised of commercial and industrial development along the frontage roads of I-45 and residential areas generally located behind the commercial developments. A few residential areas face both sides of I-45 between Parker Road and I-610. Industrial and public/institutional land uses are also located along the frontage roads and throughout the entire Segment 1 study area. The I-45 corridor consists of eight lanes of general traffic, four lanes of frontage roads, and one reversible HOV lane. The interstate corridor is mostly at-grade and elevated over major intersecting roads.

The natural environment of Segment 1 is flat grassland mixed with pockets of dense forested areas. Two streams, Halls Bayou and White Oak Bayou, are located in this landscape unit. The areas around these streams have moderate to moderately low natural harmony for recreational and residential viewer groups. Residential areas include many trees which provide a higher sense of natural harmony for residential and recreational users by restricting views of the I-45 corridor and adjacent developments. Therefore, the natural harmony of this area is moderate.

The cultural order of this landscape unit ranges from low to moderate. Areas with a lower sense of cultural order are mostly located closer to I-45 and adjacent to a combination of many land uses that appear to have little organization. Some of the residential and recreational areas in this landscape unit are well-maintained and have a sense of cultural order. The vividness of this landscape unit is low. There are few memorable, dramatic, or distinctive visual resources. The overall visual quality of this landscape unit is moderately low. Table 3-21 describes the visual quality of this landscape unit.

Table 3-21: Visual Quality Assessment Landscape Unit #1

Landscape Unit	Vividness	Natural Harmony	Cultural Order	Visual Quality
1	Low	Moderate	Moderately low	Moderately low

Segment 2: I-45 from I-610 to I-10

Similar to Segment 1, the physical geography of Segment 2 is generally characterized as flat terrain. This landscape unit is mostly developed and is primarily comprised of residential development. A small amount of commercial and industrial development is concentrated along the frontage roads of I-45. Little White Oak Bayou runs generally parallel to the I-45 corridor, which has historically limited development adjacent to I-45 in this area. Montie Beach Park and Woodland Park are located on west side of I-45, and Moody Park is located on the east side of I-45. The Historic Hollywood and Holy Cross Catholic cemeteries are located between I-45 and the Little White Oak Bayou. The I-45 corridor consists of eight lanes of general traffic, six lanes of frontage roads, and one reversible HOV lane. The interstate corridor is mostly at-grade and elevated over major intersecting roads. There is also a 0.5-mile section of the corridor where the general lanes of traffic are below grade near Moody Park and the cemeteries.

The natural environment of this landscape unit is flat grassland mixed with dense forested areas. In the residential areas, there are many trees which provide interest for residential and recreational users. The natural harmony of this landscape unit is moderate because Little White Oak Bayou has limited development and the area is organized in an aesthetically pleasing composition with low levels of disruptive visual detractors.

The cultural order of this landscape unit ranges from low to moderate. Areas with a lower sense of cultural order are mostly located closer to I-45 and adjacent to a combination of many land uses that appear to have little organization. Most of the residential and recreational areas in this landscape unit are well-maintained and have a sense of cultural order. The vividness of this landscape unit is moderately low. The areas containing Moody Park, Little White Oak Bayou, and the historic cemeteries provide a distinct viewshed within this landscape unit. The overall visual quality of this landscape unit is moderate. Table 3-22 describes the visual quality of this landscape unit.

Table 3-22: Visual Quality Assessment Landscape Unit #2

Landscape Unit	Vividness	Natural Harmony	Cultural Order	Visual Quality
2	Moderately low	Moderate	Moderately low	Moderate

Segment 3: Downtown Loop System

Similar to the other segments, the physical geography of Segment 3 is generally characterized as flat terrain; however, this segment includes Downtown Houston which is the central business district with several tall buildings. This landscape unit is densely developed and is comprised of commercial and mixed-use land uses concentrated in the Downtown area with residential areas located primarily outside of the

Downtown Loop. More undevelopable land, including storm water detention areas, drainage channels, bayous, and waterbodies, occur in this landscape unit in comparison to the other segments.

The natural environment of this landscape unit is flat urban land with several urban park areas and a bayou running east and west through the north part of Downtown. Within the residential areas out of the Downtown Loop, there are many trees which provide interest for residential and recreational users. The natural harmony of Segment 3 is moderate due to the presence of many natural areas and urban parks such as Buffalo Bayou, White Oak Parkway, Freed Art and Nature Park, Hogg Park, and Stude Park located north of I-10 along White Oak Bayou.

The cultural order of this landscape unit can range from low to moderately high. Generally, Segment 3 has a moderate culture order. Areas with a lower sense of cultural order, mostly located east of Downtown, are adjacent to a combination of a variety of land uses which appear to have little organization. This area is typically comprised of industrial uses or vacant properties. These areas are experiencing some revitalization as new developments continue to appear. Most of the residential neighborhoods outside of the Downtown Loop in this landscape unit are well-maintained and have a sense of cultural order. These neighborhoods are among some of the original and most historic communities in Houston, dating back to the mid-1800s.

The vividness of this landscape unit is moderately high. Downtown Houston has a distinct viewshed and strong sense of place. Historic neighborhoods and most recreational areas are well-maintained. Additionally, southbound travelers on I-45 have a view of The American Statesmanship Park, which contains four large statues of important political figures.

The overall visual quality of this landscape unit is moderate. Table 3-23 describes the visual quality assessment of this landscape unit.

Table 3-23: Visual Quality Assessment Landscape Unit #3

Landscape Unit	Vividness	Natural Harmony	Cultural Order	Visual Quality
3	Moderately high	Moderate	Moderate	Moderate

3.17.2.2 Viewer Sensitivity

The combination of exposure and awareness of each viewer group within each landscape unit determines the viewers' sensitivity to the proposed changes as a result of the project. Exposure is a measure of the proximity (distance), extent (number of people viewing), and duration (length of viewing time) a viewer may perceive a visual attribute, resource, or the project. Awareness is the measure of a viewer's attention (level of observation based on routine and familiarity), focus (level of concentration), and protection (legal and social constraints on the use of visual resources).

Segment 1: I-45 from Beltway 8 to I-610

The primary viewers in this landscape unit are residents and travelers along I-45. A smaller group of viewers consists of workers in commercial or industrial areas and recreational viewers in neighborhoods,

parks, trails, or open spaces located within the landscape unit. Travelers along I-45 comprise a large number of viewers in this landscape unit; however, their exposure to the proposed project area is typically short due to the speed of their travel. Additionally, the attention and focus of travelers is not on the transportation corridor, but rather on the vehicles ahead of and around the traveler. Therefore, because exposure and awareness are low, the sensitivity of travelers is low.

Residents and recreational users closest to the I-45 corridor will have more exposure and will likely be more attentive to visual changes; however, the viewshed for many residents does not expose the viewer to the I-45 corridor as views of the infrastructure may be restricted by commercial developments, trees, billboards along the interstate ROW, and the roofs of neighboring houses. Additionally, most viewers may not pay full attention to the I-45 corridor because the presence of the transportation infrastructure has become integrated into their routine. Therefore, because exposure and awareness are generally low, the sensitivity of the residential viewer ranges from low to moderate depending on the location of the viewer.

While most of the employment areas are located adjacent to the I-45 corridor and are directly exposed to the project, most workers' awareness is likely focused inside buildings and not on the I-45 corridor. Workers in the landscape unit have moderately low viewer sensitivity. Similar to workers, recreational or institutional viewers (those attending schools near I-45), would have low sensitivity to the project. Some recreational users nearest to the I-45 corridor may have moderate sensitivity, but several industrial land uses are adjacent to the I-45 corridor and help reduce exposure and sensitivity to visual changes.

Therefore, because the viewer exposure is typically low and most viewers have low awareness, the sensitivity rating for this landscape unit is typically low.

Segment 2: I-45 from I-610 to I-10

Travelers along I-45 comprise a large number of viewers in this landscape unit; however, their exposure to the proposed project area is typically limited due to the speed of their travel. Additionally, the awareness of travelers is not on the transportation corridor, but rather on the vehicles ahead of and around the traveler. Therefore, because exposure and awareness are low, the sensitivity of travelers is low.

Residents and recreational users closest to the I-45 corridor will have the most exposure; however, the viewshed for many residents does not include the I-45 corridor as views of the infrastructure may be restricted by commercial developments, trees, billboards along the interstate ROW, and the roofs of houses. Additionally, most viewers do not pay full attention to the I-45 corridor because the presence of the transportation infrastructure has become integrated into their routine. Therefore, because exposure and awareness are generally low, the sensitivity of the residential viewer ranges from low to moderately high depending on the location of the viewer.

While most of the employment opportunities are located adjacent to the I-45 corridor, workers' attention is likely focused inside buildings and not on the I-45 corridor. Therefore, workers in the landscape unit have moderately low awareness. Recreational users along Little White Oak Bayou would have moderate to moderately high exposure and awareness as the viewer gets closer to the I-45 corridor; however,

recreational facilities farther from the project, such as Moody Community Center or parts of Little White Oak Bayou, would have reduced exposure and awareness because views of the project are restricted by trees and natural vegetation.

Therefore, because the viewer exposure is typically low and most viewers have low awareness, the sensitivity rating for this landscape unit is typically low.

The viewer sensitivity in this landscape unit ranges from low to moderate but is typically low.

Segment 3: Downtown Loop System

A large number of viewers come from the thousands of travelers along I-45, I-10, and US 59/I-69; however, their exposure to the proposed project area is typically short due to the speed of their travel. Additionally, the awareness of travelers is not on the transportation corridor, but rather on the vehicles ahead of and around the traveler. Although some parts of the interstate corridors in this landscape unit are elevated and offer more expansive viewsheds, the sensitivity of travelers is low.

Some viewer groups, especially workers, in Downtown are typically not focused on one particular location if they have a view of the surrounding environment from their office or home. Workers, residents, and recreational viewers turn their attention to particular activities within their surroundings, and most focus is not outside their windows or away from their particular activity. In addition, many buildings in Downtown are very tall and would likely block the views of the proposed project unless the viewer was on the edges of Downtown. Therefore, the exposure and awareness of the view of the project for most downtown workers and residents would be low to moderately low, and the sensitivity is generally moderately low.

The viewshed for many residents outside of the downtown loop does include interstate corridors; however, most views of the infrastructure may be restricted by other buildings, vegetation and/or trees, and other transportation infrastructure unless the viewer is adjacent to the project. Additionally, most residential viewers do not pay full attention to the infrastructure corridors because the presence of the transportation infrastructure has become integrated into their routine and their focus on their own property or immediate adjacent properties. Therefore, the sensitivity of the residential viewer outside of the downtown loop ranges from low to moderately high depending on the location of the viewer.

The viewshed for recreational users varies depending on the location of the viewer. Except for a majority of the Downtown area along the bayous, and near Moody Park, viewers would have views of the Downtown skyline. Some of these views in Downtown along the bayous would include elevated transportation structures, or concrete drainage ditches which may not be well-maintained. Therefore, recreational users in this area have become accustomed to viewing elevated transportation structures; however, the sensitivity of recreational viewers is moderate to moderately high because recreational users typically spend longer periods of time viewing surroundings.

The viewer awareness in this landscape unit ranges from low to moderately high but is typically moderate due to the high number of people viewing the proposed project area; however most viewers would have low exposure to the project. Additionally, the presence of elevated transportation infrastructure and

drainage ditches has remained in this area for several years, and the awareness of the infrastructure for some viewers may not be a focus of attention. Therefore, because the viewer exposure is typically low and most viewers have moderate viewer awareness, the sensitivity rating for this landscape unit is typically moderate.

3.17.3 IMPACTS OF THE PREFERRED ALTERNATIVE

Visual impacts were evaluated based on professional judgment and, in Segment 3, simulated views to predict viewer groups' perceptions of the change to the environment. The extent of any potential impact is based on compatibility of the impact, viewer sensitivity of the impact, and the degree of the impact. At the time the Draft EIS was prepared, there were no simulations (renderings) of the project alternatives from the location of parks and bicycle/pedestrian trails adjacent to or intersecting the proposed project area. To address the comments about visual impacts of the proposed project in the Segment 3 study area, TxDOT prepared four simulations from Key View Points (KVPs) within Landscape Unit 3. These simulations were assessed to provide an updated visual impact assessment for the Preferred Alternative in the area of Segment 3 of the NHHIP; locations of KVPs for the simulations are shown on an exhibit in *Addendum 1 to Visual Impact Assessment Technical Report*.

3.17.3.1 Segment 1

Design changes were proposed to Alternative 4 after the release of the Draft EIS. These design changes were primarily related to acquisition of minor amounts of ROW (corner clips) at intersections to ensure that roadway lanes correctly lined up and transitioned smoothly to existing lanes or to accommodate radius returns. Refer to *Addendum 1 to Visual Impact Assessment Technical Report* for a detailed description of the design changes and visual impact analysis.

Part of the additional new ROW includes construction of storm water detention basins. Segment 1 would have 10 detention basins ranging in size from 0.6 acres to 11.5 acres (see Section 2 of the Final EIS for additional details). The location of the detention basins determines the level of visual impact. Recreational and residential viewers closest to the detention basins would be the most sensitive; however, the visual quality of the detention basins could become a benefit for all viewers. TxDOT would construct the detention basins with a wet bottom, if a partner agrees to maintain it and any other amenities that may be added; however, for the purposes of this analysis, wet-bottom ponds were not assumed.

Overall, the visual impacts of the Segment 1 Preferred Alternatives are expected to be neutral, as shown in Table 3-24. While some specific sites within this landscape unit would have reduced visual quality, the viewer groups have low viewer sensitivity.

Table 3-24: Visual Impact Summary Segment 1 Alternative 4

LU #	Visual Quality — No Build	Visual Quality — Build Alternative	Existing Viewer Sensitivity	Project Compatibility
1	Moderately low	Moderately low	Low	Yes

3.17.3.2 Segment 2

Design changes were proposed to Alternative 10 after the release of the Draft EIS. Refer to *Addendum 1 to Visual Impact Assessment Technical Report* for a detailed description of the design changes. These proposed design changes would not adversely impact the visual quality for this landscape unit. The additional new ROW includes construction of two storm water detention basins. The detention basin sizes would be 2.3 acres and 19.5 acres.

The viewers most impacted by changes to the proposed project would be recreational and residential viewers closest to the new detention basins. The visual quality of the detention basins could become a benefit for all viewers. TxDOT would construct the detention basins with a wet bottom if a partner agrees to maintain it and any other amenities that may be added; however, for the purposes of this analysis, wet-bottom ponds were not assumed.

Overall, the visual impacts of the Segment 2 Preferred Alternative are expected to be neutral, as shown in Table 3-25. While some specific sites within this landscape unit would have reduced visual quality, the viewer groups have low viewer sensitivity.

Table 3-25: Visual Impact Summary Segment 2 Alternative 10

LU #	Visual Quality — No Build	Visual Quality — Build Alternative	Existing Viewer Sensitivity	Project Compatibility
2	Moderately low	Moderately low	Low	Yes

3.17.3.3 Segment 3

Design changes were proposed to Alternative 11 after the release of the Draft EIS. Refer to *Addendum 1 to Visual Impact Assessment Technical Report* for a detailed description of the design changes. This section includes a reassessment of the visual impact analysis for Alternative 11 presented in the Draft EIS. With respect to several comments received regarding impacts to recreational and open space areas within this segment, TxDOT prepared four simulations from four different areas illustrating Alternative 11. These simulations and more detailed analysis of Alternative 11 can be found in *Addendum 1 to Visual Impact Assessment Technical Report*.

Alternative 11 would realign I-45 along I-10 to the north of Downtown and then turn south along US59/I-69 to the east of Downtown. The land requirements for this alternative are greater than the other two alternatives. The new ROW required would be primarily north and east of Downtown. Under this Alternative, the Pierce Elevated segment of I-45 along a portion of the west and south side of Downtown would be removed and replaced with "Downtown Connectors." The Pierce Elevated on the side south of Downtown would be removed, eliminating the visual barrier between Downtown and communities on the west and south side, including the Midtown neighborhood.

Although the proposed design changes would not substantially change the visual quality of the proposed project as compared to the previous assessment, the proposed revised design of the Downtown Connectors will eliminate a portion of elevated roadway, improving views on both sides of the corridor.

Near Buffalo Bayou, there would only be three elevated structures for the direct connectors. The project would remove three elevated structures in this area, which would enhance visual quality for all viewers in this area.

To the north of Downtown, the proposed elevated lanes along the realignment of I-10 would increase the visual barrier between Near Northside and Downtown neighborhoods, visually disconnecting Near Northside and the future Hardy Yards development from Houston's central business district. Efforts have been made to maintain existing open spaces. There are opportunities for aesthetic enhancements under elevated sections of the highways. The realignment of I-45 to parallel I-10 on the north side of Downtown would remove the existing elevated highway between the University of Houston-Downtown's business school and main building, enhancing the visual quality of the campus.

Four storm water detention areas are proposed for Segment 3, all within the project ROW evaluated in the Draft EIS. The visual quality of the detention basins could become a benefit for all viewers. TxDOT would construct the detention basins with a wet bottom, if a partner agrees to maintain it and any other amenities that may be added; however, for the purposes of this analysis, wet-bottom ponds were not assumed.

TxDOT will consider options for "signature" bridges to distinguish the Near Northside neighborhood and improve the visual quality of the proposed project area. The design of the bridges will be conducted as a collaboration between the Greater Northside Management District and TxDOT. TxDOT will consider options for a "signature bridge" over Sam Houston Park and Buffalo Bayou and will collaborate during design with the management districts or neighborhood groups. Funding for "signature" bridges would be determined in a later phase of project development.

Although this alternative would degrade the visual quality for some viewer groups north of Downtown, and for some residential and other viewers outside of Downtown with views of the skyline, the majority of viewsheds in the Segment 3 area would have improved views or no impacts to views as a result of the Proposed Facility, and visual quality would remain moderate. Specific areas where adverse impacts could occur (North Downtown) could be mitigated to minimize the impact (see Section 3.17.3). Additionally, the form and materials of the Proposed Facility would remain compatible with the existing environment. Therefore, the overall visual quality impact would be neutral for Segment 3 as a result of this alternative.

Table 3-26 provides a summary of the visual quality impact as a result of the Segment 3 Preferred Alternative. While there may be specific areas close to the Proposed Facility which may be negatively impacted by a reduction in visual quality, the majority of viewers would have no impacts. Some viewers may have improved views where elevated structures have been removed, or where mitigation measures would reduce visual impacts.

Table 3-26: Visual Impact Summary Segment 3 Alternative 11

LU #	Visual Quality — No Build	Visual Quality — Build Alternative	Existing Viewer Sensitivity	Project Compatibility
3	Moderate	Moderate	Moderate	Yes

3.17.3.4 Impact Summary

While there may be specific areas close to the Proposed Facility that may be negatively impacted by a reduction in visual quality, the majority of viewers would have no impacts. Some viewers may have improved views where elevated structures have been removed or where mitigation measures have reduced visual impacts. Areas where adverse impacts could occur could be mitigated to minimize the visual impact (see Section 3.17.4). Table 3-27 summarizes the visual impact of the Proposed Facility to the landscape unit, as a whole, represented by the individual segments of the project.

Table 3-27: Visual Impact Summary

LU #	Visual Impact	Existing Viewer Sensitivity	Project Compatibility
1	Neutral	Low	Yes
2	Neutral	Low	Yes
3	Neutral	Moderate	Yes

3.17.4 MITIGATION TO IMPROVE VISUAL AND AESTHETIC QUALITIES

As indicated by FHWA's Guidelines for the Visual Impact Assessment of Highway projects (January 2015), design-related mitigation considerations often occur during the design process rather than during NEPA but may result from input received on the project during the public involvement process. Additionally, FHWA's regulations prohibit final design activities until the NEPA process is complete (23 CFR 771.113(a)). Some types of specific design elements and specific details regarding design elements cannot be determined until the project enters the final design phase, after completion of the NEPA process. However, certain elements intended to mitigate the visual impacts of the project were considered during the NEPA process, as discussed below.

In developing the Build Alternatives, opportunities to locate transportation and utility corridors together were identified to maximize compatibility with existing aesthetic views. During the alternatives analysis, displacements were documented and evaluated to determine the degree of impact to all land uses. Roadway and structural design were developed to be compatible with the surrounding natural and cultural environment in order to minimize visual impacts. TxDOT anticipates continued refinements and improvements to the proposed project and mitigation measures during detailed project design.

Where practicable, mitigation to improve the visual and aesthetic qualities of the project area would include the following features:

- Landscape plantings and revegetation per TxDOT's Green Ribbon Landscape Improvement Program, which allocates funds for trees and plants within roadway ROW.
- Promoting roadside native wildflower planting programs.
- Noise barriers which are integrated into the context of the surrounding environment.

- Providing adequate signage and easy access to roadway facilities.
- Treatment of the side surfaces and columns of the project using façade materials of varying texture, color, etc.
- Installing landscaping and maintenance for the detention basins.
- Coordinating with local groups and agencies to accommodate enhancements to standard landscaping and recreation use of open space in and around storm water detention areas, where feasible. Wet bottom storm water detention basins will be considered if a partner entity agrees to maintain them. The detention areas will not be designated as parks as their primary use is for drainage and flood mitigation.
- Miscellaneous aesthetic improvements along Heights Bike Trail between Taylor Street and Main Street will be provided (coordinated by TxDOT with City of Houston, Houston Parks Board, and other entities).
- Conducting the design of bridges in the area of the Near Northside neighborhood as a collaboration between the Greater Northside Management District and TxDOT.
- Conducting the design of bridges over Sam Houston Park and Buffalo Bayou as a collaboration between the management districts or neighborhood groups and TxDOT.

The project will be developed under TxDOT's Green Ribbon Program, which allocates funds for trees and plants within roadway ROW. TxDOT will apply the Green Ribbon themes to the proposed project, including landscaping and hardscaping elements. A detailed landscaping plan will be developed as part of the final design process. Landscaping would include regionally native plants for landscaping and implementing design and construction practices that minimize adverse effects on the natural habitat. To the extent possible, the proposed project would be designed to create an aesthetically and visually pleasing experience for both roadway users and roadway viewers.

There are opportunities for aesthetic enhancements under elevated sections of the highways. The Mayor of Houston has appointed a committee to oversee the potential designs and funding options for uses for the open space areas in Segment 3 and TxDOT will consider its recommendations.

All lighting would be in accordance with the Texas Health and Safety Code Title 5 425.002 regarding light pollution. To the extent possible, outdoor lighting fixtures would only be installed and operated if the purpose of the lighting cannot be achieved by the installation of reflective road markers, lines, warning, or informational signs, or other effective passive methods.

Additionally, full consideration would be given to energy conservation, reduction of glare, minimizing light pollution, and preserving the natural light environment. An example of commonly used lighting meeting these considerations is the use of high-pressure sodium lamps equipped with glare shields.

3.17.5 IMPACTS OF THE NO BUILD ALTERNATIVE

The No Build Alternative would not change the existing visual and aesthetic qualities in the landscape units. The I-45 corridor would continue to be a local visual landmark and serve as the primary transportation corridor in the area.

3.17.6 ENCROACHMENT ALTERATION EFFECTS

No project-related encroachment alteration impacts to visual and aesthetic resources would be anticipated as a result of the proposed project Build Alternatives for Segments 1 and 2. However, encroachment alteration effects associated with adverse visual impacts for Segment 3 alternatives would be addressed and mitigated as described in Section 3.17.3 and Section 7.

3.18 Section 4(f) Resources

3.18.1 INTRODUCTION

TxDOT prepared a Section 4(f) Evaluation (Appendix O to the Final EIS) for the proposed project to satisfy the requirements of Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1996. In 1983, Section 4(f) of the USDOT Act was codified as 49 U.S.C. 303, but this law is still commonly referred to as Section 4(f). This evaluation was also prepared in accordance with the FHWA implementing regulations for Section 4(f) codified in 23 CFR Part 774, and the FHWA's Section 4(f) Policy Paper (July 20, 2012).

Section 4(f) and its implementing regulations prohibit the FHWA from using publicly owned land of a public park, recreation area, or wildlife and waterfowl refuges of national, state or local significance, or land of a historic site of national, state or local significance for transportation projects unless there is no feasible and prudent alternative to using the land and the project includes all possible planning to minimize harm to the property resulting from the use, or the impact is *de minimis*. Where the use of Section 4(f) property for a transportation project cannot be avoided, FHWA may approve, from among the remaining alternatives that use Section 4(f) property, only the alternative that causes the least overall harm in light of the statute's preservation purpose. The alternative selected must include all possible planning to minimize harm to Section 4(f) property. If the assessment of overall harm finds that two or more alternatives are substantially equal, FHWA can approve any of those alternatives.

The "use" of a protected Section 4(f) property can be classified as a direct use, a temporary occupancy, or a constructive use. In addition, a finding of *de minimis* impact can be made if the use of a Section 4(f) resource is determined to be minimal. These terms are defined below.

- Direct Use. A direct use of a Section 4(f) resource occurs when the land is permanently incorporated into a transportation facility.
- Temporary Occupancy. A temporary occupancy results in a use of a Section 4(f) property when there is a temporary impact to the Section 4(f) property that is considered adverse in terms of the preservationist purposes of the Section 4(f) statute.
- Constructive Use. Constructive use occurs when the transportation project does not incorporate land from a Section 4(f) property, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the resource are substantially diminished.
- *De minimis*. A finding of *de minimis* impact may be made for historic sites when no historic property is affected by the project or the project will have "no adverse effect" on the historic property in question. For parks, recreation areas, and wildlife and waterfowl refuges, a finding of *de minimis* impact may be made when impacts will not adversely affect the activities, features, and attributes that qualify the resource for protection under Section 4(f). A *de minimis* impact finding may be made without the evaluation of avoidance alternatives typically required in a Section 4(f) evaluation.

The parks that would be adjacent to or nearby the project are in an urban setting and in proximity to existing transportation facilities. The proposed action would not substantially impair the activities, features, or attributes of the parks. Noise barriers are proposed as abatement measures for predicted traffic noise impacts to some parks, where reasonable and feasible (see the Traffic Noise Technical Report for more details).

The SHPO and the ACHP concurrences on determinations of eligibility and effect for this project, as well as the proposed mitigation process are embedded in the Section 106 PA for this project, which is in Appendix R of the Final EIS. The THC and TxDOT coordination letters are in Attachment F of the Section 4(f) Analysis.

3.18.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action (Preferred Alternative) includes the addition of four MaX lanes on I-45 from Beltway 8 North to Downtown Houston, including reconstruction of mainlanes and frontage roads, and the rerouting of I-45 in the Downtown area to be parallel with I-10 on the north side of Downtown and parallel with US 59/I-69 on the east side of Downtown. The existing elevated I-45 roadway along the west and south sides of Downtown, also known as the "Pierce Elevated," would be removed. Access to the west side of Downtown would be provided via "Downtown Connectors" that would allow access to and from various Downtown streets. The Pierce Elevated between Brazos Street and US 59/I-69 could be left in place for future use and redevelopment by others. A future use of the property is not proposed or evaluated by TxDOT. TxDOT will coordinate with the City of Houston regarding disposition of that portion of the Pierce Elevated. Both I-10 and US 59/I-69 within the proposed project area would be realigned to eliminate the current roadway curvature, and four I-10 express lanes would be added between I-45 and US 59/I-69.

To facilitate in the design and analysis of alternatives, the project area was divided into three segments. In general, the segment limits are (from north to south): Segment 1: Beltway 8 North to I-610, Segment 2: I-610 to I-10, and Segment 3: Downtown Loop System (I-45, I-10, and US 59/I-69).

Segment 3 is the only one of the three contiguous segments in which the Preferred Alternative would result in a use of Section 4(f) properties and is, therefore, the only segment of the project discussed in the Section 4(f) Evaluation.

3.18.3 DESCRIPTION OF SECTION 4(F) PROPERTIES

This section includes brief descriptions of historic resources in the Segment 3 study area for which use as a result of the proposed action were determined. More detailed descriptions of these historic resources and descriptions of additional historic resources evaluated in the study area are in Sections 3.1–3.6 of the Section 4(f) Evaluation (Appendix O to the Final EIS). Location maps, and photographs of the properties are also included in the Section 4(f) Evaluation and/or the September 2019 Historical Resources Survey Report — Update.

Public parks and recreational facilities within approximately 500 feet of the proposed project ROW of the Build Alternatives were evaluated for potential Section 4(f) impacts. See Section 1 of the Section 4(f)

Evaluation for details on how these properties were evaluated. Section 3.6 of the Section 4(f) Evaluation describes the parks, bikeways and open space along bayous in Segment 3, and Section 4.6 of the Section 4(f) Evaluation discusses the analysis of impacts of Build Alternatives to 23 parks in the Segment 3 study area, including White Oak Park, American Statesmanship Park, Buffalo Bayou Park, Baldwin Park, Houston Academy for International Studies SPARK Park, Peggy's Point Plaza Park, Peggy Park, James Bute Park, Freed Art and Nature Park, Hogg Park, Linear Park, Sam Houston Park, Tranquility Park, Emancipation Park, Discovery Green, Guadalupe Plaza Park, Swiney Park, Hennessy Park, Allen's Landing Memorial Park, Confederate Ship Area Park, Goyen Park, Brewster Park, and Sesquicentennial Park. Due to extensive efforts to avoid direct impacts and uses of park resources, there would be no direct impacts to parks. The Preferred Alternative would not result in a use of any Section 4(f) park properties. Although there would be no use of Sam Houston Park, it bears mentioning for beneficial impacts. The proposed action would substantially reduce the highway footprint in the area of Sam Houston Park. With the proposed project, noise levels are predicted to decrease by 3 decibels at approximately the center of the park. In addition, project designers worked to improve and optimize open space resources throughout the project corridor.

The bikeways and open spaces in the project area are not considered Section 4(f) resources. Section 3.6.24 of the Section 4(f) Evaluation summarizes TxDOT's review of the potential applicability of Section 4(f) to bikeways and open space along bayous in the project area.

Table 3-28 lists the Section 4(f) resources evaluated for all of the NHHIP study area and the results of the impact analysis. As noted above, Segment 3 is the only one of the three segments in which the Preferred Alternative would use Section 4(f) properties. Therefore, only the resources in Segment 3 are discussed in detail here and in the Section 4(f) Evaluation.

Table 3-28: Section 4(f) Resources

Resource	Use Y/N	Type of Section 4(f) Determination
Segment 1		
Recreation Area		
Aldine High School Track	N	N/A
Historic Properties		
Hidden Valley Historic District	N	N/A
Phillips 66 Gas Station	N	N/A
Segment 2		
Parks		
Woodland Park	N	N/A
Jefferson Elementary School SPARK Park	N	N/A
Historic Properties		
Brooke Smith Historic District	N	N/A
Germantown Historic District	N	N/A

Resource	Use Y/N	Type of Section 4(f) Determination
Segment 3		
Parks		
White Oak Parkway	N	N/A
American Statesmanship Park	N	N/A
Buffalo Bayou Park	N	N/A
Baldwin Park	N	N/A
Houston Academy for International Studies SPARK Park	N	N/A
Peggy Park	N	N/A
James Bute Park	N	N/A
Freed Art and Nature Park	N	N/A
Hogg Park	N	N/A
Linear Park	N	N/A
Sam Houston Park	N	N/A
Tranquility Park	N	N/A
Swiney Park	N	N/A
Hennessy Park	N	N/A
Allen's Landing Memorial Park	N	N/A
Confederate Ship Area	N	N/A
Goyen Park	N	N/A
Brewster Park	N	N/A
Sesquicentennial Park	N	N/A
Historic Properties		
Near Northside Historic District	Y	De Minimis
Residential property at 109 Carl Street	Y	De Minimis
Houston Warehouse Historic District	Y	Individual
San Jacinto Warehouse	Y	De Minimis
Walter's Downtown (former Bottling Works)	Y	De Minimis
METRO Transit Building	Y	De Minimis
Carlisle Plastics Warehouses • South Building (Brick warehouse) • North Building (Metal warehouse)	 N Y	 N/A Individual
Third Ward Historic District	N	N/A
Former Robert E. Lee Elementary School (Baker Ripley Lionel Castillo Community Center)	N	N/A

Resource	Use Y/N	Type of Section 4(f) Determination
Former Galveston Harrisburg and San Antonio (GH&SA) Railway Hospital	N	N/A
Houston Water Works	N	N/A
Kellum-Noble House	N	N/A
Former Albert Sidney Johnston Jr. High School (now Houston ISD Young Women's Preparatory Academy)	N	N/A
Cheek-Neal Coffee Company Building	Y	Individual
Myers-Spalti Manufacturing Plant	N	N/A
Fire Station No. 5	N	N/A
Readers Distributors Warehouse	Y	Individual
Former Downtown Post Office, Processing and Distribution Center	Y	De Minimis
Rossonian Cleaners	Y	Individual
House (4120 Austin Street)	N	N/A
Gribble Stamp Company Building	N	N/A
Butler Brothers Union Terminal Warehouse	N	N/A
House (3417 Baer Street)	N	N/A
Strauss-Bascule Bridge (former HB&T Railroad)	N	N/A
Judge Hernandez Tunnel	N	N/A
Former Crawford Elementary School	N	N/A
City Hall Annex	N	N/A
Navigation Boulevard Underpass	N	N/A

Key: Y = Yes, N = No, N/A = not applicable

3.18.3.1 Houston Warehouse Historic District

The Houston Warehouse Historic District is comprised of about 40.7 acres on either side of I-10, just north of Downtown Houston. The existing I-10 ROW is not included within the district boundaries, making the historic district discontiguous. The north portion of the district is roughly bounded by one-half block west of Vine Street to the west, the UPRR to the north, Walker Street to the east, and Providence Street and I-10 to the south. The south portion is roughly bounded by one-half block west of San Jacinto Street to the west, Rothwell Street and Nance Street to the north, McKee Street to the east, and the UPRR to the south. The historic district contains a total of 39 resources, of which 31 are contributing to the district. A map showing the location of the Warehouse Historic District is in Attachment B (page B-1) and photographs of the contributing resources are in Attachment C of the Section 4(f) Evaluation.

The following properties are three of the contributing resources to the Houston Warehouse Historic District.

- San Jacinto Warehouse — The San Jacinto Warehouse at 1125 Providence Street is located on the south side of the proposed I-45/I-10 ROW. This property is a one-story warehouse building constructed in 1929. It is constructed of reinforced concrete and is clad with variegated red brick. It is composed of 13 connected units, each with front and rear triangular red brick parapets. A long concrete loading dock extends the length of the building's east side. This building was designed with multiple units for the purpose of leasing space to small wholesale businesses that used both rail and trucking to transport goods. Five of the building's original 18 warehouse units were removed for the construction of I-10 in the late 1960s. The warehouse is also individually NRHP-eligible.
- Former Bottling Works — The former Bottling Works building is located at 1120 Naylor Street, on the southwest corner of Vine Street and Naylor Street. It is a c. 1930, one-story, rectangular-plan building with concrete block exterior. Brickwork is present at building corners and at the primary door surround. Historically, the building was entered via Vine Street. A bottling works was operating at this location in 1951, with an attached one-story warehouse to the north of the main building. The north warehouse was removed by the 1980s and the area north of the bottling works was converted to paved parking. Following the removal of the north warehouse an additional entry was added to the north side of the building, facing Naylor Street.
- Houston METRO Warehouse — The METRO Warehouse at 1116 Naylor Street is comprised of adjoining building masses. The historic-age front portion of the building is a c. 1930 one-story or one-and-one-half-story rectangular-plan warehouse building facing east to Vine Street. Thick vegetation covers the entire east façade of the building. A large one-story addition, constructed between 1978 and 1989, extends westward from the rear of the original building. The rear addition is clad in metal, with large, fixed, metal-frame windows. A second-story metal-clad addition, also built in the late 1970s or 1980s, rises from the middle of the building. A paved parking area extends north to Naylor Street from the rear building extension, to form an L-shaped parcel. The property appears to be accessed through the driveway to Naylor Street. The building was used historically as a general supply store and a warehouse.

3.18.3.2 Carlisle Plastics Warehouses

The Carlisle Plastics Warehouses are located on the parcel now addressed as 1133 Providence Street in Houston, Texas. The parcel is bound by Jackson Street on the west, Naylor Street on the north, Walnut Street on the east, and a vacant, heavily vegetated parcel to the south. No portion of the parcel adjoins Providence Street. This property parcel contains two warehouse buildings, attached to one another. Until the mid-2010s the north building was addressed as 1110 Naylor Street and the south building was addressed as 1119 Naylor Street. In TxDOT's Section 106-related Historical Resources Survey Reports for the NHHIP, the north building was identified as the Carlisle Plastic North Warehouse or the "metal warehouse" and the south building was identified as the Carlisle Plastics South Warehouse or the "brick warehouse." A map showing the location of the Carlisle Plastics Warehouses is in Attachment B (page B-2) and photographs are in Attachment C (pages C-1 through C-3) of the Section 4(f) Evaluation.

The Carlisle Plastics North Warehouse was constructed c. 1940 and is one story in height. It is arranged in a roughly rectangular plan, with two side-gable primary rooflines and lower-height shed-roof extensions on the building's north and west sides. A narrow flat-roof addition extends along the east side of the building. The east addition is made of similar materials as the Carlisle Plastics South Warehouse. The building's roof and walls are clad in corrugated metal.

3.18.3.3 Readers Distributors Warehouse

The Readers Warehouse property is made up of three associated parcels, collectively addressed as 1201 Naylor Street in Houston, Texas. The Readers Warehouse building is a one-story, flat-roof, commercial/industrial building, constructed in 1954, that serves as office and warehouse space for a furniture and flooring materials distributor. The Readers Warehouse is distinguished for its irregular form and Moderne stylistic detailing along the building's curved southwest wall and entry area, unusual for a warehouse building of the period. The building was designed by the Houston architectural firm Irving Klein and Associates. A large addition was appended to the rear (north) side of the building in 1998. The addition is not easily visible from the public ROW and does not markedly detract from the significant features of the original building. A map showing the location of the warehouse is in Attachment B (page B-3) and photographs are shown in Attachment C (pages C-4 and C-5) of the Section 4(f) Evaluation. As noted above, the Readers Warehouse is composed of three interrelated parcels, all sharing the same ownership:

- The 1954 portion of the Readers Warehouse building.
- The 1998 addition to the building's north side and concrete access driveways on the east and west sides of the building.
- Concrete access drives that function as an extension of Naylor Street between Vine Street and Walnut Street. These access drives are privately owned but are commonly used for public ingress and egress to adjacent streets and businesses.

3.18.3.4 Near Northside Historic District

The Near Northside Historic District is located on the east side of I-45, just east and northeast of the multi-level I-45/I-10 interchange. The interchange is in the vicinity of the confluence of White Oak Bayou and Little White Oak Bayou, which adds to the complexity of the interchange. This District represents a typical late 19th and early 20th century working-class neighborhood that developed in response to nearby industrial centers. It includes an intact collection of working-class homes dating to the District's period of significance (c.1890–1940) with very little postwar infill. The Near Northside Historic District is listed in the NRHP under Criteria A and C. Figure 3-1 in the Section 4(f) Evaluation shows the location and boundary of the Near Northside Historic District.

3.18.3.4.1 Residential Property at 109 Carl Street

The residential property at 109 Carl Street contains two built resources: a 1910 house that is a contributing resource to the Near Northside Historic District, and a garage that is a noncontributing resource to the historic district. The noncontributing garage is located at the northwest edge of the parcel and touches the existing ROW. The contributing house is located 24 feet from the existing ROW boundary and about

57 feet from the nearest I-45 pavement edge. In the Section 4(f) Evaluation, the location of the property is shown in Figure 3-1 and Photo 3-3 shows the noncontributing garage at the property.

3.18.3.5 Cheek-Neal Coffee Company Building

The Cheek-Neal property is located at 2017 Preston Street, on the east side of US 59/I-69 just east of Downtown Houston. It is made up of four lots and an additional tract that comprises the south-central and southeast portions of Block 168, bounded by Chartres Street on the west, Congress Street on the north, St. Emanuel Street on the east, and Preston Street on the south. The building takes up most of the parcel, with paved parking area on the west portion of the property. The remainder of the city block is also used as paved parking area. A map showing the location of the building and property is in Attachment B (page B-4) and photographs are shown in Attachment C (pages C-10 and C-11) of the Section 4(f) Evaluation.

The main portion of the building is five stories in height, with a one-story extension on the building's northeast side. The concrete framing forms four bays on the north and south elevations and nine bays on the east and west elevations. The bays are defined by a regular grid of exposed, horizontal floor plates and vertical concrete columns with red brick infill. One large, steel, multi-light industrial-type window is in each bay on floors two through five on the west, south and east elevations. There are triplet grouped, one-over-one-light wood-sash windows on the ground floor of the south elevation. The ground floor of the east elevation has a mix of window sizes and overhead loading bays. The building features elements of the Arts and Crafts movement such as the diamond and triangular tiles set into shallow brick-framed rectangular panels below most of the window openings. The parapet is outlined with red brick and is divided into three bays with small gabled parapets flanking a large, flat, central parapet that historically served as a signboard. There are concrete loading docks on the east and west elevations. The building retains a high level of its architectural integrity.

The building was designed by Houston architects Joseph Finger and James Ruskin Bailey as a regional coffee processing facility for the developers of the Maxwell House brand, which accounted for one-third of the U.S. coffee market by the 1920s. The company's Houston building was one of seven similar multi-story buildings across the country where the company roasted, blended, packaged, and shipped coffee nationwide. It was in use as a coffee processing facility from its 1917 construction until 1947. The Cheek-Neal Coffee Company Building is representative of Houston's rapid growth in the early twentieth century into an industrial and transport hub, which led to construction of numerous warehouses and shipping facilities around the periphery of Downtown Houston.

3.18.3.6 Rossonian Cleaners

The Rossonian Cleaners property is located south of Downtown Houston, immediately north and west of existing US 59/I-69 near the US 59/I-69 at SH 288 interchange. SH 288 enters the interchange from the south/southwest and US 59/I-69 enters from the west. US 59/I-69 and SH 288 merge together in a multi-level interchange that includes direct connector ramps and collector/distributor ramps to and from nearby local streets. The merged freeway is designated as US 59/ I-69 at SH 288 north of the interchange to the Downtown Loop (at the interchange with existing I-45). A map showing the location of the building is in

Attachment B (pages B-5 and B-6). and photographs are shown in Attachment C (pages C-12, C-13, and C-14) of the Section 4(f) Evaluation.

The Rossonian Cleaners is located at 3921 Almeda Road, immediately north and west of existing US 59/I-69 near the US 59/I-69 at the SH 288 interchange. It is situated on a triangular-shaped 0.275-acre property parcel. The building takes up most of the parcel, with a small paved parking area at the south end of the property. The parking area contains a large-diameter tubular steel monopole, which supports an overhead billboard that extends over the Rossonian Cleaners.

The Rossonian Cleaners, originally established in 1920 at the Rossonian Hotel (no longer extant) in Downtown Houston, moved to this building in 1928. The building is comprised of two distinct portions. The original 1928 portion, which makes up the north half of the building, features a polychrome brick exterior with cast-stone detailing including sign panels and prominent finials extending above the parapet. A c. 1940–1945 addition comprises the south half of the building. The addition, originally used for cold storage, has undergone notable exterior alterations but retains its overall form and fenestration. The Rossonian Cleaners has served as an anchor for the Almeda Road commercial strip and surrounding community.

3.18.3.7 Former Downtown Houston Post Office, Processing and Distribution Center

The Former Downtown Houston Post Office, Processing and Distribution Center is located on the east side of I-45, between Franklin Street on the south and railroad ROW on the north. The post office building occupies the north-central portion of the property, surrounded by large surface parking lots to the south and east and smaller paved surface parking areas to the north and west of the building. Existing I-45 at this location is carried on the Pierce Elevated structure about 27 feet above ground level. There are four travel lanes in each direction.

3.18.4 IMPACTS AND MITIGATION FOR IMPACTS TO SECTION 4(F) PROPERTIES

TxDOT coordinated with the Texas SHPO as part of the Section 106 process and as the Official with Jurisdiction for historic sites under Section 4(f). The Texas SHPO concurrences with the NRHP eligibility and effect determinations are in Attachment F of the Section 4(f) Evaluation and also in the Section106 PA for this project that is included in Appendix R of the Final EIS. The Texas SHPO concurred with TxDOT's determination that the project would have an adverse effect to:

- Houston Warehouse Historic District
- Carlisle Plastics North Warehouse
- Readers Distributors Warehouse
- Cheek-Neal Coffee Company Building and associated property parcel
- Rossonian Cleaners

The Texas SHPO had no comments on TxDOT's determination that the project would have *de minimis* impacts to six historic properties:

- Near Northside Historic District
- Residential property at 109 Carl Street
- San Jacinto Warehouse
- Walter's Downtown (former Bottling Works)
- METRO Warehouse
- Former Downtown Post Office, Processing and Distribution Center

TxDOT coordinated with the SHPO, ACHP, and consulting parties regarding potential mitigation measures to compensate for impacts of the NHHIP to the historic properties. The *de minimis* impacts and adverse effects to the historic properties and potential mitigation measures are described below.

3.18.4.1 Houston Warehouse Historic District

The realignment of I-45/I-10 would result in acquisition of 5.1 acres of ROW from properties in the Houston Warehouse Historic District, representing about 12.5 percent of the historic district's total area. The NHHIP would result in the use of five of the district's contributing resources. Impacts to three contributing resources would be *de minimis* (San Jacinto Warehouse, Former Bottling Works, METRO Warehouse), and effects to two contributing resources would be adverse (Carlisle Plastics North Warehouse, Readers Distributors Warehouse). Effects to the historic district would be adverse.

- San Jacinto Warehouse— The proposed action would acquire 88.23 square feet of land from the property (about 0.01 percent of the parcel's area) from a paved parking area at the northeast edge of the property. TxDOT determined that the proposed action would have no adverse effect to the San Jacinto Warehouse property. TxDOT has prepared a determination of *de minimis* impact to this property.
- Former Bottling Works— The proposed action would acquire 0.07-acre of land from the property (about 27.62 percent of the parcel's area) from a parking area north of the Bottling Works building. TxDOT determined that the proposed action would have no adverse effect to the Bottling Works property. TxDOT has prepared a determination of *de minimis* impact to this property.
- METRO Warehouse— The proposed action would acquire a small strip of land (0.024 acre) at the northeast edge of a paved parking area along Naylor Street. TxDOT determined that the proposed action would have no adverse effect to the METRO Warehouse property. TxDOT has prepared a determination of *de minimis* impact to this property.
- Carlisle Plastics North Warehouse — The proposed action would acquire 0.16-acre of land from the 1133 Providence Street property parcel, or about 15.91 percent of the parcel's total area. The ROW acquisition would require demolition of the Carlisle Plastics North Warehouse. TxDOT determined that the proposed action would have an adverse effect to the Carlisle Plastics North Warehouse and no adverse effect to the Carlisle Plastics South Warehouse. The Texas SHPO concurred with these determinations of effect, on the condition that TxDOT provide the demolition plan for the north building to the Texas SHPO for review prior to any demolition work. In addition, the ACHP also concurred with the determination.

- Readers Distributors Warehouse — The proposed action would acquire the entire property parcel and the warehouse building would be demolished. Through Section 106 coordination, TxDOT determined that the proposed action would have an adverse effect to the Readers Warehouse.

Through Section 106 coordination, TxDOT determined that the proposed action would have an adverse effect to the Houston Warehouse Historic District as a whole.

To mitigate adverse effects, TxDOT will document two contributing resources within the historic district (Readers Distributors Warehouse and Carlisle Plastic North Warehouse) to Historic American Building Survey (HABS)-like Level I/Level II standards, with digital photography, measured drawings of the building or full-size Mylar copies of as-built building plans, and a detailed textual history and description of the building. TxDOT will also conduct a comprehensive survey of similar early and mid-twentieth-century warehouses in the East Downtown area, in an effort to identify relevant property types, evaluate relative significance of individual properties, and provide information to facilitate future planning decisions relating to historic properties in the area. The mitigation documents will be available to the public on the project website and at local repositories such as the City of Houston's Historic Preservation Office and the Julia Ideson Historic Library.

3.18.4.2 Near Northside Historic District

The Near Northside Historic District is about 70.5 acres in size. Existing I-45 ROW makes up about 2.09 acres of the historic district. The proposed NHHIP work would require acquisition of approximately 0.01 acre of additional ROW from a property parcel at 109 Carl Street, or about 0.03 percent of the total historic district area. A noncontributing garage at 109 Carl Street would be removed for the project. A portion of the noncontributing garage already extends into the existing I-45 ROW. The contributing house on the same parcel would remain in place. The NHHIP would not result in the use of any of the district's contributing resources and the impact to the Near Northside Historic District would be *de minimis* and no mitigation is proposed.

- Residential property at 109 Carl Street (contributing resource) — The proposed project would acquire 437.22 square feet (about 0.01 acre) of additional ROW from this parcel. The additional ROW represents 8.17 percent of the total parcel size. Effects from the proposed project would consist of taking of a garage, a noncontributing secondary building, and a small percentage of the overall property. A portion of the noncontributing garage already extends into the existing I-45 ROW. The contributing house on the same parcel would remain in place. The NHHIP would not result in the use of any of the district's contributing resources; the impact would be de *minimis* and no mitigation is proposed.

3.18.4.3 Cheek-Neal Coffee Company Building

Proposed I-45 and US 59/I-69 would be in a depressed configuration in this location, with 10 southbound travel lanes and 11 northbound travel lanes. To accommodate the additional freeway width, a 150-foot-wide strip of additional ROW would be acquired on the east side of existing US 59/I-69, for a total ROW

width of 375 feet. The additional ROW acquisition includes about 27.5 percent of the Cheek-Neal property parcel. Proposed I-45 and US 59/I-69 would move much closer to the Cheek-Neal building face, to a point about 16 feet from the one-story building extension.

Visually, the Cheek-Neal building would benefit from the NHHIP through removal of the elevated freeway structures and replacement with a depressed facility. Existing traffic noise on the building exterior is 71 dB(A), which is projected to decrease to 70 dB(A) after completion of the proposed NHHIP. Based on the window type and placement, interior noise is assumed to be 20 dB(A) lower than exterior levels, or 50 dB(A) after NHHIP work. This interior noise level is 2 dB(A) below the minimum level for noise abatement and mitigation.

The potential indirect effect to the Cheek-Neal property is from soil movement and vibratory impacts to the Cheek-Neal building associated with construction of the depressed freeway facility. TxDOT's engineering consultant conducted an impact avoidance analysis to study structural and vibratory impacts to the Cheek-Neal building. From the analysis, the structural layouts of the proposed action were adjusted to maximize the distance between the building face and the proposed drilled-shaft retaining wall on the east side of the depressed I-45/US 59/I-69 facility. The face of the retaining wall would be 25 feet from the building face and the drilled shafts would be 16 feet from the assumed building foundation. It should be noted that the structural foundation of the Cheek-Neal main building and extension are not definitively known and may require additional investigation prior to construction. If the Cheek-Neal building uses a deep foundation, there would be negligible effects from soil movement during or after construction. If a shallow foundation system is in place, additional stiffening of the retaining wall may be needed to minimize lateral movements.

For vibratory impacts, engineers studied the vibrations induced by types of equipment likely to be used for NHHIP construction activities in terms of velocity and frequency, as well as distance to the Cheek-Neal building. Vibration generated by construction equipment likely to be used during I-45 construction and US 59/I-69 reconstruction would not be significant; that is, it would not meet the threshold for structural damage to historic buildings from continuous or transient vibration sources at 25 feet from the building face. The engineers also studied the potential for traffic vibration, particularly low-frequency sound levels produced by trucks. Based on the distance between the I-45 and US 59/I-69 facilities and the Cheek-Neal building, traffic-induced vibration would be under the annoyance threshold as well as the structural damage threshold.

Through Section 106 coordination, TxDOT determined that the proposed action would have an adverse effect to the Cheek-Neal property as a result of the amount of property needed for the project.

TxDOT initiated discussions with the Texas SHPO, ACHP, and other consulting parties regarding mitigation measures to compensate for impacts of the NHHIP to the Cheek-Neal property. Following selection of a design-build contractor, TxDOT will conduct a comprehensive survey of similar early and mid-twentieth-century warehouses in the East Downtown area. Results of these efforts will identify and evaluate relevant historic property types. This information will be shared with SHPO, local governmental agencies, heritage

organizations, and property owners to inform planning decisions and encourage historic preservation outcomes in in the area.

3.18.4.4 Rossonian Cleaners

The NHHIP would include addition of travel lanes to US 59/I-69 to four travel lanes in each direction and reconstruction of the US 59/I-69 at SH 288 interchange. At the Rossonian Cleaners location, the closest freeway lanes would be a two-lane southbound US 59/I-69 frontage road along the ROW boundary and a reconstructed ramp from northbound SH 288 to southbound US 59/I-69. The NHHIP would acquire 0.079 acres of land from the Rossonian Cleaners property, or about 28.7 percent of the total parcel area. The ROW boundary would extend into the existing Rossonian Cleaners building and would require demolition of the c. 1940–1945 addition that makes up the southern half of the building and would likely require acquisition and removal of the entire building.

TxDOT sought to minimize or avoid impacts to the Rossonian Cleaners property but was constrained by the property's proximity to the US 59/I-69 at SH 288 interchange and by the conversion of US 59/I-69 to a depressed configuration between Spur 527 and SH 288 to match the existing depressed freeways on both ends.

Through Section 106 coordination, TxDOT determined that the proposed action would have an adverse effect to the Rossonian Cleaners.

TxDOT initiated discussions with the Texas SHPO, ACHP, and other consulting parties regarding mitigation measures to compensate for impacts of the NHHIP to the Rossonian Cleaners. TxDOT will complete archival documentation of the Rossonian Cleaners prior to its demolition, to include a history of the property and the Almeda Road commercial area. TxDOT will document the Rossonian Cleaners to HABS-like Level I/Level II standards, with digital photography, measured drawings of the building or full-size Mylar copies of as-built building plans, and a detailed textual history and description of the building. The mitigation documents will be available to the public on the project website and at local repositories such as the City of Houston's Historic Preservation Office and the Julia Ideson Historic Library.

3.18.4.5 Former Downtown Houston Post Office, Processing and Distribution Center

With the NHHIP, I-45 would be relocated north and east of Downtown Houston and the Pierce Elevated would be replaced with a "Downtown Connector" that provides access from I-45 and I-10 to the west side of Downtown. The Downtown Connector would be constructed with three to four travel lanes in each direction, generally within existing I-45 ROW. However, a narrow strip of ROW would be acquired for a ramp between the northbound Downtown Connector and eastbound I-10. The NHHIP would acquire about 904 square feet (0.021 acres) of land from the property, representing about 0.13 percent of the total parcel area. The ROW to be taken is a small portion of the paved parking area adjacent to existing I-45 and northwest of the former post office building. The proposed project would have no direct effect to the NRHP-listed building. Indirect effects would be negligible, as there is already considerable noise and visual intrusion from existing I-45. The existing Pierce Elevated was constructed in the mid-1960s, in the same period as the former post office building. The NHHIP would have no adverse effect to the Former

Downtown Houston Post Office, Processing and Distribution Center at 401 Franklin Street. TxDOT will prepare a determination of *de minimis* impact to this property and no mitigation is proposed.

3.18.5 AVOIDANCE ALTERNATIVES

TxDOT used a comprehensive, multi-phase process to develop and evaluate a full range of project alternatives for highway improvements in the project corridor. Detailed information regarding the alternative analysis process is in Section 2 of the Final EIS. TxDOT also employed a phased approach to identify and evaluate potential historic properties and the effect of the NHHIP on historic properties. For the initial screening phase (which examined 30 Build Alternatives, 10 for each of the three project segments), a basic yes/no determination was made for the presence of community parks, cemeteries, and cultural resources (see Figure 2-4). For the secondary screening phase (which examined 18 Preliminary Alternatives, six for each project segment), the evaluation took into account the number of NRHP-listed properties impacted by the alternative and other direct impacts to other known cultural resources (see Figure 2-7).

TxDOT examined alternatives that would avoid use of any Section 4(f) property. See Attachment E of the Section 4(f) Evaluation for maps and typical sections for the avoidance alternatives. These alternatives were removed from further consideration following the secondary screening process due to a combination of constructability issues, lack of functionality, and/or undesirable operations and maintenance requirements. None of the avoidance alternatives were determined to be feasible and prudent.

3.18.5.1 No Build Alternative

Under this alternative, the project would not be constructed. The existing highway alignments would remain in the same configuration and no work would occur. Segment 3/Alternative 1 would avoid use of Section 4(f) properties. However, it would not address existing and projected traffic congestion along the I-45 corridor. Current traffic congestion would increase to "serious" to "severe" conditions by 2035, resulting in longer travel times and reduced mobility. I-45 would continue to be an ineffective evacuation route for the region in the event of a hurricane or other regional emergency. This alternative would not address safety concerns due to existing conditions such as narrow lane widths, narrow or nonexistent shoulders, low-clearance bridges, and functionally obsolete bridges. Segment 3/Alternative 1 is feasible from an engineering standpoint and would avoid use of Section 4(f) properties. However, it would not meet the project's stated purpose and need and is therefore considered not prudent.

3.18.5.2 Segment 3/Alternative 2 — Transportation Systems Management (TSM)/ Travel Demand Management (TDM) Upgrades

This alternative consists of upgrades to TSM and TDM, which are transportation policies, strategies, or projects aimed at reducing traffic congestion and improving roadway mobility without major capital expenditures to increase physical roadway traffic capacity. Examples of potential TSM/TDM actions for limited-access freeways are dynamic message signs, ramp metering, reversible travel lanes, and focused interchange improvements. A TSM/TDM alternative would likely result in no use to Section 4(f) properties. However, early stage engineering analysis found that TSM/TDM projects would not improve the design of

I-45 to the extent that I-45 and the Downtown Loop System would meet current roadway design criteria. Segment 3/Alternative 2 was therefore removed from consideration in the initial screening stage of analysis and evaluation and is considered not prudent.

3.18.5.3 Segment 3/Alternative 3 — One-Way Loop

Under Segment 3/Alternative 3, existing freeways in the Downtown Loop would be reconfigured into a one-way loop network. Analysis conducted during the secondary screening process found that this alternative would have undesirable impacts to freeway functionality and would result in increased travel times on the freeway system and on the Downtown Houston local street system. It would not meet the project's stated purpose and need and was therefore considered not prudent.

3.18.5.4 Segment 3/Alternatives 4, 5, 6, 7, 9 — Tunnel

Five Segment 3 alternatives examined various scenarios for adding tunnels to the existing freeway facility to provide additional travel lanes and managed lanes. Alternative 9 was removed from further consideration in the initial screening phase due to poor results in travel demand modeling. Alternatives 4 and 7 were carried forward into the secondary screening phase but removed during that phase as additional project alternatives that better met the project's purpose and need were developed and added to the alternatives analysis.

Two tunnel alternatives (Alternatives 5 and 6) were examined in the secondary screening phase of evaluation. Under Alternative 5, a tunneled roadway carrying four managed lanes would be constructed under existing I-45 and would then continue under Bagby Street before terminating at Spur 527. Under Alternative 6, a tunneled roadway carrying four managed lanes would be constructed under the existing I-45, continuing to Jefferson Street and terminating at I-45 south of the I-45 at US 59/I-69 interchange. For purposes of the secondary screening evaluation, it was assumed that any tunneling activity would be undertaken in a manner that would not disturb historic properties or park resources and would therefore have no use of Section 4(f) properties.

Engineering and traffic analyses found that the tunnel alternatives would have several major constructability issues, such as construction duration, high construction risks, staging/sequencing issues, complex and costly utility relocations, and limited contractor availability. The tunnel alternatives also pose major functionality issues. Limitations in tunnel size would result in reduced shoulder width and reduced height clearances for large-capacity vehicles. Emergency response time would increase, as would time to clear traffic accidents within the tunnel, creating congestion and increasing travel times. For these reasons, the tunnel alternatives do not meet the project's purpose and need and are considered not prudent. Alternatives 5 and 6 were not carried forward beyond the secondary screening phase of evaluation.

3.18.6 MEASURES TO MINIMIZE HARM

The proposed action has incorporated all possible planning to minimize harm to and preserve the historic activities, features, or attributes of each Section 4(f) property, as discussed below. As a result, six properties would have *de minimis* impacts, as discussed in previous sections: Near Northside Historic

District; Residential property at 109 Carl Street; San Jacinto Warehouse; Walter's Downtown (former Bottling Works); METRO Warehouse; and Former Downtown Post Office, Processing and Distribution Center.

The measures to minimize harm for the five historic proprieties that would be adversely affected are discussed below.

3.18.6.1 Houston Warehouse Historic District and Contributing Resources

The overall NHHIP design has been modified to reduce direct impacts to historic properties including modification of the Segment 3/Alternative 11 alignment in the vicinity of the Houston Warehouse Historic District. In the northwest and north-central portions of the historic district, the I-45 and I-10 roadways would be carried on several elevated structures. These structures would be cantilevered over one another to reduce ROW width. Local streets used as one-way frontage roads would be placed underneath the elevated I-10 mainlane structures, also reducing ROW width. The narrower roadway section in this vicinity allows for retention of the Carlisle Plastics South Warehouse and avoids demolition of the San Jacinto Warehouse, former Bottling Works, and METRO Warehouse, all contributing resources to the historic district.

While the proposed action would include acquisition of more land than the other Reasonable Alternatives, much of the land acquisition is limited to the Readers Distributors Warehouse property at the north edge of the historic district, with reduced impacts to most of the district's contributing resources in comparison to other alternatives. The proposed action would remove the existing I-10 elevated structure that bisects the historic district and would extend San Jacinto Street north to provide connectivity between these two formerly discontiguous portions of the historic district.

3.18.6.2 Carlisle Plastics North Warehouse

The overall NHHIP design has been modified to reduce direct impacts to historic properties, including modification of the Segment 3/Alternative 11 alignment in the vicinity of the Houston Warehouse Historic District. In the vicinity of the Carlisle Plastic North Warehouse and other nearby historic properties, the I-45/I-10 roadways would be carried on several elevated structures. These structures would be cantilevered over one another to reduce ROW width. Local streets used as one-way frontage roads would be placed underneath the elevated I-10 mainlane structures, also reducing ROW width. The narrower roadway section in this vicinity allows for retention of the Carlisle Plastics South Warehouse and avoids demolition of part or all of the San Jacinto Warehouse and the former Bottling Works, located west of the Carlisle Plastics Warehouse buildings. In this area, an existing railroad track is a constraint to the north of the Warehouse Historic District, and the proposed ROW is as narrow as it can be to accommodate the proposed action, which best meets the purpose and need for the proposed project.

3.18.6.3 Readers Distributors Warehouse

While the Readers Warehouse would be demolished under the proposed action, the overall NHHIP design has been modified to reduce direct impacts to historic properties including modification of the Segment 3/Alternative 11 alignment in the vicinity of the Houston Warehouse Historic District. In the

vicinity of the Readers Warehouse and other nearby historic properties, the I-45 and I-10 roadways would be carried on several elevated structures. These structures would be cantilevered over one another to reduce ROW width. Local streets used as one-way frontage roads would be placed underneath the elevated I-10 mainlane structures, also reducing ROW width. The narrower roadway section in this vicinity avoids demolition of part or all of the San Jacinto Warehouse and the former Bottling Works, located west and southwest of the Readers Warehouse. In this area, an existing railroad track is a constraint to the north of the Warehouse Historic District, and the proposed ROW is as narrow as it can be to accommodate the proposed action, which best meets the purpose and need for the proposed project.

3.18.6.4 Cheek-Neal Coffee Company Building

The overall NHHIP design has been modified to reduce impacts to historic properties, including modification of Segment 3/Alternative 11 to provide a depressed configuration for I-45/I-69 on the east side of Downtown, rather than the elevated structure originally included in Alternative 11. While the depressed configuration increases the direct ROW acquisition from the Cheek-Neal property, it reduces the considerable visual and noise impacts associated with expansion of the existing elevated freeway.

Hamilton Street and Chartres Street, which currently serve as one-way streets and de facto access roads on either side of US 59/I-69, would be reconfigured under the proposed action. Hamilton Street would continue as a one-way southbound street but would be relocated on the highway cap over the I-45/I-69 freeway lanes. Chartres Street would not be reconstructed on the east side of I-45/I-69. Existing St. Emanuel Street would instead serve as a northbound access road. The reconfiguration of local surface streets would reduce overall ROW in the vicinity of the Cheek-Neal property, and would avoid demolition of the Cheek-Neal building. The design-build contractor would perform a traffic study for traffic volumes on St. Emanuel Street prior to construction, during construction, and after construction when the street is converted to one-way traffic. The traffic study would assess if additional or excessive vibratory impacts to the Cheek-Neal building result from the changes to St. Emanuel Street traffic flow.

TxDOT would also incorporate design specification requirements to the design-build Agreement for implementation during final design, to avoid potential adverse soil movement and vibratory impacts to the Cheek-Neal property. Prior to any work, the design-build contractor would assess existing building foundation and soil conditions and would recommend potential strategies for avoiding impacts to the Cheek-Neal building. The design-build contractor would install instrumentation to monitor the effects of vibration during construction and in service, in accordance with an instrumentation plan reviewed and approved by TxDOT prior to work. The design-build contractor would be required to cease work and develop mitigation measures if the vibration level exceeds identified thresholds.

3.18.6.5 Rossonian Cleaners

TxDOT has undertaken design modifications to minimize impacts to the Rossonian Cleaners; however, several factors limited TxDOT's ability to avoid the Rossonian Cleaners property. The proposed action includes converting the existing freeway from elevated to depressed (or below grade) between Spur 527 and SH 288 to match the existing depressed freeway configuration on both ends. This conversion required shifting the existing US 59/I-69 southbound to the Fannin Street exit from the current location south of

Almeda Road to north of Almeda Road. This shifted ramp also includes an extension southbound of the parallel Chenevert Street to reconnect drivers directly to SH 288, as exists today. The existing connection from Chenevert Street to SH 288 needs to be removed to accomplish the planned improvements to remove the short weave sections between SH 288 and I-45. These conversion conditions and the proximity of Almeda Road and the Rossonian Cleaners property to the US 59/I-69 at SH 288 interchange made avoiding the property not feasible. The design team also studied shifting the US 59/I-69 alignment to the south away from the property, but this shift would result in moving the US 59/I-69 northbound to SH 288 southbound connection closer to residences within a potential historic district, and would create conflicts with critical connections between US 59/I-69 and SH 288.

The proposed action would convert the existing US 59/I-69 freeway from an elevated profile to a depressed (or below grade) configuration between Spur 527 and SH 288 to match the existing depressed freeway configuration on both ends. This conversion required shifting the existing exit from southbound US 59/I-69 to Fannin Street from the current location south of Almeda Road to north of Almeda Road. Traffic exiting from southbound US 59/I-69 main lanes would merge into the southbound frontage road just north of the Rossonian Cleaners. To minimize impacts to the Rossonian Cleaners and other properties, TxDOT reduced the southbound frontage road design to two lanes. Further reductions to the roadway width or horizontal shifts of the roadway would not be prudent.

The proximity of the Rossonian Cleaners property to the US 59/I-69 at SH 288 interchange also constrained design modifications. To reduce impacts to the Rossonian Cleaners and other properties, TxDOT tightened the curvature of the northbound SH 288 to southbound US 59/I-69 ramp in this location to reduce ROW acquisition, with design speeds reduced to 45 miles per hour given the sharper curvature. The design team also studied shifting the US 59/I-69 alignment southward, but the southward shift would result in moving the northbound US 59/I-69 to southbound SH 288 ramp closer to residences in the NRHP-eligible Third Ward Historic District and also created alignment conflicts with critical connections between US 59/I-69 and SH 288, making this shift infeasible from an engineering standpoint.

3.18.7 COORDINATION

TxDOT has coordinated with the Texas SHPO as part of the Section 106 process and as the Official with Jurisdiction for historic sites under Section 4(f). The ACHP is participating as a consulting party to the Section 106 agreement process. TxDOT developed a PA that identifies historic properties adversely affected by the NHHIP, stipulates TxDOT's mitigation commitments, and specifies procedures and processes to be implemented during the design-build process to avoid and minimize harm to historic properties. TxDOT consulted with ACHP, SHPO, and other consulting parties in the development and execution of the PA. The SHPO and the ACHP concurrences on determinations of eligibility and effect for this project, as well as the proposed mitigation process are embedded in this PA, which is in Appendix R of the Final EIS.

Coordination with SHPO, ACHP and consulting parties is ongoing to identify additional mitigation options and to ensure that the project construction will avoid adverse effects to historic properties as it moves through the design-build process. TxDOT will provide strict technical provisions to design, design-build,

and construction contractors, as applicable, with clear guidance about historical properties and the provisions in the PA that must be carried out.

3.18.8 CONCLUSION

Based on the above considerations, there is not a feasible and prudent alternative to the use of five Section 4(f) properties (Warehouse Historic District, Readers Distributors Warehouse, Carlisle Plastics, Cheek-Neal Coffee Company Building, and Rossonian Cleaners) and the proposed action includes all possible planning to minimize and mitigate harm to the Section 4(f) properties resulting from the use.

The project complies with other related laws, including Section 6(f) of the Land and Water Conservation Fund Act and Chapter 26 of the TPW Code, when applicable.

3.19 Energy Requirements

Energy, in the form of various fossil fuels and electricity, would be necessary during construction, maintenance, and future repair of the Preferred Alternative. ROW clearing; road base grading and preparation; construction of bridges and at-grade, elevated, and depressed lanes; and travel lane ramp installations would require varying levels of energy inputs. Following construction, routine maintenance of the ROW and travel lanes, and roadway repairs conducted on an as-needed basis, would also require energy inputs. Petroleum fuels are currently the primary type of energy required for construction, maintenance, and repair activities. Changing vehicle and fuel technology such as electric or hydrogen fuel options may alter the use of petroleum fuels in the future. Necessary fuel supplies would be expected to be available from fuel storage or vending sources in the area. Electrical demand for the Preferred Alternative would not affect the electrical supply characteristics of the region. Prudent energy conservation features, such as energy-efficient or solar lighting, would be incorporated into the Preferred Alternative whenever possible.

3.19.1 Impacts of the Preferred Alternative

Completion of the Preferred Alternative would ease congestion within the project area by providing four additional lanes (MaX lanes) to accommodate a portion of northbound and southbound traffic traveling to and from Beltway 8 and Downtown Houston. In the Downtown Houston area, the proposed improvements would increase travel speeds. Decreased vehicle delays and more efficient vehicle operating speeds would allow for increased energy efficiency on the improved roadway. Construction-related energy consumption would be for a limited time and could be offset by operational energy efficiencies gained through the use of the improved transportation facility and changing vehicle and fuel technology over many decades.

3.19.1.1 Short-Term Requirements

Short-term impacts would include the consumption of energy during petroleum-dependent activities such as operation and maintenance of equipment used to build the proposed improvements, which would be directly attributable to the Preferred Alternative. Indirect short-term impacts would include energy-consuming factors such as commutes by individuals participating in the construction of the Preferred Alternative and temporarily increased travel time in the project area due to operation activities.

3.19.1.2 Long-Term Requirements

Long-term direct impacts related to the proposed project would include required energy for activities such as vehicle operation on the improved/expanded roadway. Energy consumption related to use of the improved facility would be dependent on vehicle efficiency, which includes such variables as roadway geometry, surface conditions, weather conditions, and traffic flows. With the anticipated reduction in future projected levels of traffic congestion and improved mobility in the project area, the Preferred Alternative would result in a net savings of operational energy, compared to the consequences of the No Build Alternative. Vehicle and fuel technology will likely reduce the need for future petroleum products in operational energy requirements in ways that cannot be accurately estimated now. Indirect energy impacts that would occur over the long term for the Preferred Alternative would include activities such as

the operation of facility-related lighting and electronic messaging, for which the energy requirements would be negligible.

3.19.2 IMPACTS OF THE NO BUILD ALTERNATIVE

Under the No Build Alternative, the Preferred Alternative would not be constructed, which would not result in energy consumption related to construction and operation of the improved facility within the proposed project area. However, congestion would continue to increase on the existing I-45 and the local arterial roadways, and travelers would not have improved highway options to accommodate travel within the vicinity of the project area and the larger region. The lack of travel options would lead to increased travel times and energy consumption in and around the proposed project area. Vehicle and fuel technology will likely reduce the need for future petroleum products in operational energy requirements in ways that cannot be accurately estimated now.

3.20 Relationship between Local Short-term Uses and the Maintenance and Enhancement of Long-Term Productivity

The local, short-term uses of the environment associated with construction of the Preferred Alternative would be typical of roadway construction and would have limited long-term effects. Short-term impacts from construction may include disturbances to local businesses and residences that have the potential to produce minor traffic delays. Other short-term environmental impacts may involve:

- Minor air quality impacts from clearing, earthwork, construction, and fugitive dust from construction vehicles;
- Unavoidable construction-related noise impacts that would normally be limited to daylight hours when occasional loud noises are more tolerable;
- Possible minor impacts to water quality related to the limited potential for erosion, sedimentation, and turbidity, and the potential displacement of aquatic flora and fauna; and
- Visual impacts related to construction.

Adverse and beneficial impacts of the Proposed Recommended Alternative for the proposed NHHIP were evaluated and documented in the Draft EIS. The analysis of potential project impacts and proposed mitigation measures for the Preferred Alternative are completed and documented in this Final EIS. Proposed mitigation measures, some temporary and some permanent, would minimize adverse short-term effects and avoid any substantial long-term damage.

The primary long-term benefits of the Preferred Alternative are transportation improvements: decreased congestion, improved mobility, increased safety, and enhanced emergency evacuation. Construction-related employment would help to offset the short-term loss of employment due to displacements and relocations. These benefits offered by the long-term productivity of this project should offset the short-term adverse effects on the natural, physical, and human environments.

3.20.1 NO BUILD ALTERNATIVE

Under the No Build Alternative, there would be no short-term, construction-related impacts, but the No Build Alternative would not maintain and/or support long-term productivity or provide the recognized benefits of the Preferred Alternative. The No Build Alternative would not result in improvements to I-45, I-10, I-610, or US 59/I-69 in the proposed project area, and the existing condition of these facilities would remain the same. The No Build Alternative would not change the local roadway network.

The No Build Alternative would not require the acquisition of new ROW, and therefore would not result in direct or indirect impacts associated with ROW or property acquisition

3.21 Irreversible and Irretrievable Commitments of Resources

Construction of the Preferred Alternative would involve the commitment of natural, physical, human, and fiscal resources. Land used for the Preferred Alternative would be considered an irreversible commitment during the period that the land is used for a transportation purpose. However, if a greater need arose, or

if the highway is no longer needed, the land could be converted to another use. Presently, there is no reason to consider that such a conversion would be necessary or desirable.

A considerable amount of labor, fuel, and materials involving natural resources would be expended for construction of the Preferred Alternative, including aggregate, cement, asphalt, sand, and iron ore for steel products. These materials would be considered generally irretrievable once allocated to construction of the Preferred Alternative. As these resources are readily available and not in short supply, the use of these materials would not result in an adverse effect on the continued availability of any particular resource.

Construction would also require an expenditure of fossil fuels to supply construction equipment and worker vehicles. Although fossil fuel is an irretrievable resource, the amount expended during construction could be offset by the benefits of improved regional mobility that could improve fuel efficiency through a reduction of transportation travel times and traffic congestion.

The decision to commit these resources for construction of the Preferred Alternative would be based on the concept that residents in the immediate area, region, and state would benefit by the improved quality of the regional transportation system. The benefits would include improved mobility and roadway safety, travel time savings on the improved transportation facility, and a transportation infrastructure designed to support population growth. The benefits would be anticipated to outweigh the commitment of resources.

3.21.1 NO BUILD ALTERNATIVE

The No Build Alternative would not involve improvements to the existing I-45 in the project area and would not use or dedicate natural or labor resources to the Preferred Alternative; therefore, there would be no irreversible or irretrievable commitment of resources.

4 GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

TxDOT has prepared a *Statewide On-Road Greenhouse Gas Emissions Analysis and Climate Change Assessment* technical report (TxDOT 2018b). This statewide approach is consistent with the CEQ draft Guidance on the Consideration of Climate Change in NEPA Reviews (dated June 26, 2019). A summary of key issues in this technical report is provided below. Please refer to the technical report for more details, including the climate change assessment and how TxDOT is responding to a changing climate.

The Earth has gone through many natural changes in climate over time. However, since the industrial revolution began in the 1700s, atmospheric concentration of greenhouse gas (GHG) emissions have continued to climb, primarily due to humans burning fossil fuel (e.g., coal, natural gas, gasoline, oil and/or diesel) to generate electricity, heat and cool buildings, and power industrial processes, vehicles, and equipment. According to the Intergovernmental Panel on Climate Change, this increase in GHG emissions is projected to contribute to future changes in climate (Solomon 2007, Stocker 2013).

Unlike air pollutants evaluated in federal NEPA reviews, sources for GHG emissions are typically evaluated globally or per broad-scale sector (e.g., transportation, industrial, etc.) and are not assessed at the local or project-specific level, since the impacts are global and not localized or regional. In addition, from a quantitative perspective and in terms of both absolute numbers and emission source types, global climate change is the cumulative result of numerous and varied natural and human emission sources. Each source makes a relatively small addition to global atmospheric GHG concentrations.

4.1 Statewide On-road GHG

TxDOT provided a GHG analysis for the statewide on-road transportation system and associated emissions generated by motor vehicle fuels processing called "fuel-cycle emissions." EPA's Motor Vehicle Emissions Simulator (MOVES2014 version) emissions model was used to estimate emissions. In the base-year 2010, Texas on-road and fuel-cycle carbon dioxide equivalent (CO2E) emissions[5] are estimated to be 171 million metric tons (MMT); by 2040, emissions are estimated to be 168 MMT. Emissions are estimated to peak in 2017 at 176.6 MMT and reach a minimum in 2032 at 161.1 MMT. Changes to future regulations, market penetration for new vehicle and/or fuel technological advances, economics, and personal decisions regarding travel options could substantially lower future emissions.

MOVES2014 does not yet account for two sets of EPA GHG and NHTSA CAFE standards issued after its release: (1) the medium and heavy-duty diesel CAFE standards for model years (MY) 2018–2029[6] that

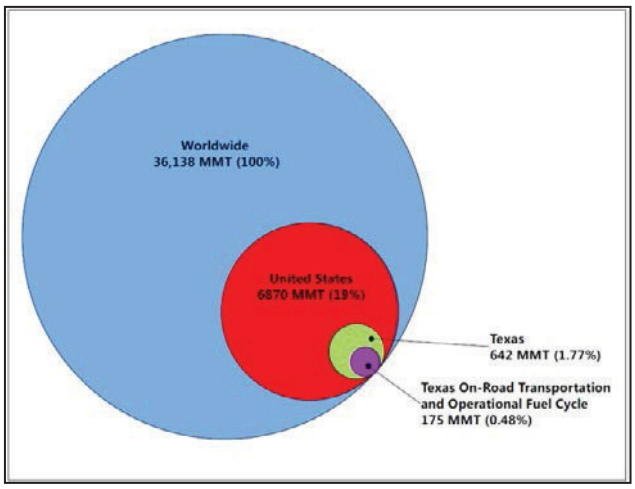
[5] CO2E stands for "carbon dioxide equivalent" and means the number of metric tons of CO2 emissions with the same global warming potential as one metric ton of another greenhouse gas. CO2E is calculated using Equation A-1 in 40 CFR Part 98.

[6] EPA and National Highway Traffic Safety Administration (NHTSA): *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles— Phase 2*, Federal Register Vol. 81, Tuesday, October 25, 2016, pp 73478-74274.

would reduce national lifetime carbon dioxide (CO2) emissions by 12,100[7] MMT and (2) the 2020 SAFE Vehicle Rules,[8] which added a new MY2026 standard and revised the 2012 issued MY2021–2025 light-duty vehicle standards. Compared to the previous 2012 rule, the 2020 rule would increase national lifetime CO2 emissions up to 7,800 MMT[9]. The national lifetime CO2 net emissions difference for these two rules is a reduction of 4,300 MMT. Though the current analysis does not account for these two rules, the CO2 trends over time should remain similar since the national net lifetime reductions should slightly lower future Texas annual emissions.

In 2014, approximately 36,138 MMT of CO2 emissions were emitted worldwide, of which 175 MMT CO2E (0.49 percent of total global emissions) were due to Texas on-road and fuel-cycle emissions (World Bank 2017). Figure 4-1 provides a comparison of 2014 Texas (on-road transportation and fuel-cycle CO2E and total Texas CO2 emissions) to U.S. and worldwide CO2 emissions. For the given year, the purple circle represents all vehicles traveling on existing and newly constructed roadways in Texas.

Figure 4-1: Comparison of 2014 Texas, U.S., and Worldwide CO2 Emissions



Sources: TxDOT 2018b; World Bank 2017; EPA 2016; Energy Information Agency 2017; TCEQ 2015
Notes: Different sources provide data for CO2 and CO2E. CO2 is less than CO2E. For example, the World Bank (2017) estimate for CO2 worldwide for 2013 is 49,000 MMT, and the estimate for CO2 for 2014 was 36,138 MMT. To obtain fuel-cycle emissions, TxDOT multiplied the statewide annual emissions by 1.27 (EPA fuel-cycle factor is 27% of on-road emissions). TxDOT used the following for the MMT conversion (annual tons/1.10231131092 metric tons/U.S. tons)/1,000,000.

[7] NHTSA Phase 2 Fuel Efficiency Standards for Medium and Heavy-Duty Vehicles Final EIS Summary, August 2016, Docket No. NHTSA-2014-0074. Washington, D.C. See page S-25 for lifetime (up to year 2100) CO_2 emission reduction. The final standards align with the preferred alternative in this EIS summary.
[8] EPA and NHTSA, *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks*, Federal Register, Volume 85, April 30, 2020, pp 24174- 25278.
[9] NHTSA *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021 – 2026 Passenger Cars and Light Trucks Final EIS,* March 2020, Docket No. NHTSA-2017-0069, Washington, D.C. See Page 5-35 for the lifetime (up to year 2100) CO_2 emission increase for the 2020 rule compared to the 2012 rule. The final standards align with alternative 3 in this EIS.

4.2 Mitigation Measures

Strategies that reduce on-road GHG emissions fall under four major categories:

- Federal engine and fuel controls under the Clean Air Act implemented jointly by EPA and USDOT, which includes CAFE standards;
- "Cash for clunker" programs which remove older, higher-emitting vehicles from roads;
- TSM which improves the operational characteristics of the transportation network (e.g., traffic light timing, pre-staged wrecker service to clear accidents faster, or traveler information systems); and
- TDM which provides reductions in VMT (e.g., transit, rideshare, and bicycle and pedestrian facilities) and requires personal choice decisions.

The majority of on-road emission reductions have been achieved through federal engine and fuel controls. Lesser reductions have been achieved through the other three options.

5 INDIRECT IMPACTS

Transportation projects that provide new or improved access to adjacent land could induce development of undeveloped land or redevelopment of land to more intensive uses. A technical report describing the detailed analysis conducted to assess indirect impacts associated with the proposed project is provided in Appendix P: *Indirect Impacts Technical Report*. In accordance with NCHRP Report 466 (2002) and TxDOT's July 2016 Guidance, Encroachment Alteration Effects have been addressed after direct effects within the specific resource sections in this FEIS. The following discussion provides a summary of potential induced growth impacts that could be attributed to the proposed NHHIP.

5.1 Induced Growth

This induced growth analysis was developed using TxDOT'S July 2016 Guidance on Indirect Impacts Analysis. The proposed NHHIP was evaluated using TxDOT's *Risk Assessment Tool* questionnaire, which serves as an initial step to evaluate whether a proposed project could induce growth and would warrant further analysis. Based on the results of the *Risk Assessment Tool*, TxDOT determined that an induced growth analysis would be necessary for the proposed NHHIP. Determination for further analysis was based on the following factors:

- Availability of land for development/redevelopment
- Added capacity from proposed project action
- Substantial increase in access and mobility in the project area
- Existing population and economic growth in the project area

The following six steps are addressed in the induced growth impact analysis:

1) Define the methodology.
2) Define the Area of Influence (AOI) and study time frame.
3) Identify areas subject to induced growth in the AOI.
4) Determine if growth is likely to occur in the induced growth areas.
5) Identify resources subject to induced growth impacts.
6) Identify mitigation, if applicable.

5.1.1 STEP 1 — DEFINE THE METHODOLOGY

A planning judgment approach, supported by planning assumptions and land use projections from the H-GAC, City of Houston, Harris County, and management districts within the project area, was used to identify areas of potential growth, development trends, and the probability of the proposed project to influence local land use decisions within the AOI.

The methodology for the induced growth analysis was developed using the TxDOT 2016 *Indirect Impacts Analysis Guidance*, which is based on the 2002 NCHRP Report entitled *NCHRP Report 466: Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* (NCHRP 2002) and the American Association of State Highway and Transportation Officials (AASHTO) *Practitioner's Handbook 12: Assessing*

Indirect and Cumulative Impacts Under NEPA (AASHTO 2016). Additional guidance utilized throughout the analysis includes the NCHRP Project 25-25 Task 22 report entitled *Forecasting Indirect Land Use Effects of Transportation Projects* (NCHRP 2007).

Local expert interviews conducted through the use of questionnaires, planning judgment, and cartographic techniques were employed in this analysis. In order to obtain specific information from local experts, detailed questionnaires were developed and administered. These customized questionnaires were sent to agencies, organizations, and governmental jurisdictions within the project's AOI.

5.1.2 STEP 2 — DEFINE THE AREA OF INFLUENCE AND STUDY TIMEFRAME

The AOI for the induced growth analysis represents the geographical area where indirect effects related to project-influenced development and land use changes would most likely occur. The NCHRP Report 466 states that "development effects are most often found up to one mile around a freeway interchange, up to two to five miles along major feeder roadways to the interchanges, and up to one-half mile around a transit station." This is a general guideline, and individual projects must be analyzed case-by-case.

The AOI for the induced growth effects analysis encompasses a total of approximately 103,536 acres in north Houston and in the Downtown inner loop, which includes areas of potential growth and redevelopment. See Appendix A for a map of the AOI boundary. Several considerations were factored into the development of the AOI boundary:

- Consideration of political and geographic boundaries (existing roadways, natural features, jurisdictional limits, and Census tracts);
- Consideration of the initial corridor study area as basis of study area;
- Consideration of U.S. Census Bureau data. The AOI coincides with Census tracts within an approximate 1-to-2-mile radius of the I-45 corridor. U.S. Census tracts were used to facilitate data collection of population and employment projections;
- Consideration of the general travelshed for the NHHIP corridor;
- Consideration of future land development. The AOI includes areas of potential growth based on H-GAC future land use maps, vacant developable areas within 1-to-2-mile radius of the I-45 corridor;
- Consideration of redevelopment trends. The AOI includes areas of potential redevelopment surrounding the Downtown area based on recent trends (e.g. the inner loop); and
- Consideration that the area surrounding the project is mostly urbanized and nearly built-out.

The AOI extends north along the I-45 corridor to FM 1960, between SH 249 and the Hardy Toll Road, and south to Brays Bayou between Shepherd Drive and I-610 East. From I-45, the eastern limit extends to the Hardy Toll Road; south of I-10, the eastern boundary extends to I-610 East. The western limit extends from I-45 to SH 249/West Montgomery Road between FM 1960 and Tidwell Road and then to Shepherd Drive between Tidwell Road and Brays Bayou.

The temporal boundary for the induced growth effects analysis is from the present year (2016) to 2040, which is the planning horizon year for the Houston-Galveston Area RTP. The year 2040 is also utilized in other components of the Final EIS analyses.

5.1.3 STEP 3 — IDENTIFY AREAS SUBJECT TO INDUCED GROWTH IN THE AOI

Vacant land and undevelopable areas (such as waterbodies, floodplains, parklands, and existing development) were identified to determine where induced growth could occur in the AOI and where development would be limited; this analysis used H-GAC's land use GIS data files (H-GAC 2018a). Input from the induced growth questionnaire respondents was also utilized to confirm or update recent development trends. Future land use plans and local planning regulations were reviewed to identify projected areas of growth, areas of redevelopment, and policies that may encourage or restrict development. Future land use data in this analysis was derived from H-GAC's 2045 land use GIS data files (H-GAC 2018b).[10]

Approximately 2,812 acres in the AOI are undeveloped property (vacant and developable land; H-GAC 2018a). This acreage represents approximately 2.7 percent of the 103,536-acre AOI and has decreased since the preparation of the Draft EIS; this decrease can be attributed to updated H-GAC land use data and the fact that development is continuing throughout the region. Large tracts of vacant land are located in the northern portion of the AOI (between Beltway 8 and The Woodlands) and in the northwest corner of the central portion of the AOI (between Beltway 8 and I-610). Smaller vacant lots are scattered throughout existing residential areas in the central portion of the AOI, particularly near the Acres Home and Independence Heights neighborhoods. The southern portion of the AOI (south of I-610) is densely populated and has minimal land available for new development; areas of potential growth are more suitable to redevelopment and infill development.

The H-GAC's 2045 Regional Growth Forecast projections show population and employment growth throughout the suburban areas of Harris County for the year 2045, including the north and west part of the county, as well as in the Downtown area (H-GAC 2018d). Land use and growth projections estimated in the 2040 RTP include the proposed NHHIP (H-GAC 2016). Information obtained from local experts about announced developments helps analysts understand what is already happening (existing conditions) and identify the areas that could potentially experience new induced development. This also helps identify areas for potential redevelopment.

The questionnaire responses submitted by agencies, organizations, and governmental jurisdictions within the project's AOI included information related to substantial proposed developments (varying degrees of detail were provided). These planned developments include schools, hospitals, medium- to high-density residential, commercial, retail, industrial, hotel, University of Houston expansions, and medical offices, for example. A small portion of the planned developments would involve the redevelopment of previously

[10] The current future land use data available from the H-GAC was released in early 2018 and forecasts through the year 2045. The data set extends past the temporal boundary for this analysis (2040) but is considered the best available source for this type of data.

developed parcels. Quantified information provided by the H-GAC respondent regarding announced developments indicates that approximately 1,777 announced developments are located within the AOI.

The small percentage of vacant developable land within the AOI and the number of announced developments in the AOI indicate that the AOI is nearing build-out and has a limited potential for new construction. Redevelopment is considered a potential real estate trend given the density of existing development throughout the AOI.

5.1.4 STEP 4 — DETERMINE IF GROWTH IS LIKELY TO OCCUR IN INDUCED GROWTH AREAS

Improvements in transportation infrastructure that increase mobility or reduce travel times may attract development, and new roadways can provide access that leads to new development. Redevelopment and changes in land use patterns may also occur as a result of ROW acquisition and the displacement of businesses and residences. In addition to transportation improvements, several factors contribute to where growth may occur including suitability of land, available utilities, physical constraints, favorable planning policies, and development trends.

Summaries of regional and local trend data (planning studies, documents, and ordinances) presented in the technical report indicate that there are numerous initiatives underway to direct development throughout the AOI. TxDOT consulted with local planning officials and agencies with knowledge and/or responsibilities for land use planning to seek their input on whether the proposed project improvements could increase the rate of development or attract additional development in the AOI.

5.1.4.1 Potential for Induced Development

The findings in the technical report demonstrate an *existing* moderate to strong potential for growth and established the planning framework within which that growth would occur in the AOI during the analysis period of 2016–2040. This section evaluates the nature of this potential for growth and attempt to determine whether it can be causally linked to the proposed NHHIP project. The evaluation of whether the proposed project is likely to result in project-induced land use change is patterned after the development trends presented in NCHRP Project 25-25, Task 22. When reviewing the analysis presented, it is important to remember that **project-induced land use change can include project-induced development, the redevelopment of previously developed land, or a change in the rate of development/redevelopment.** In order to make reasonable judgments about potential project-induced impacts, the Planning Judgment forecasting tool incorporated data collected via questionnaires with planning professionals in the project vicinity, and ultimately incorporated data collected from numerous professionals with relevant expertise. The planning experts were asked where development is expected to occur and whether the proposed project would induce growth. Questionnaire responses were summarized in a table format and are provided in Attachment B of the technical report.

5.1.4.2 Summary of Induced Development Potential

Based on demographic and land use trends, it can be concluded that there is an *existing* moderate to strong potential for future growth in the AOI during the analysis period of 2016–2040. Local plans

reflecting a variety of planning scales exist within the AOI to promote, guide, and monitor various development opportunities in the City of Houston and unincorporated Harris County. Information obtained from questionnaire responses confirmed the validity of the AOI boundary (which was developed during the preparation of the Draft EIS) and to identify the following potential induced growth assessments that may be attributed to this project:

- Potential areas of redevelopment exist throughout the Downtown Management District (Exhibit 3b of the technical report)
- Potential redevelopment is expected within a 0.25-mile buffer along I-45 from I-610 to Beltway 8 (Exhibit 3c of the technical report)
- Areas where the rate of development may be slowed due to access changes imposed by the proposed project exist within the Greater East End Management District and the future Hardy Yards development (Exhibit 3b of the technical report)
- Areas where the rate of development may be slowed due to complications with anticipated displacements that are located within or near 100-year or 500-year floodplains exist north of I-610 and west of I-45 (e.g., Independence Heights neighborhood; Exhibit 3c of the technical report)
- Potential redevelopment and increased community cohesion are expected to result from the removal of Pierce Elevated between West Dallas Street and I-69 (Exhibit 3b of the technical report)

Digitized boundaries of the delineated redevelopment areas associated with the 0.25-mile buffer along I-45 and the Downtown Management District are illustrated on Exhibits 3a–3c in the technical report. The combined areas of potential redevelopment within these two general locations total approximately 4,804 acres, which is approximately 5 percent of the 103,536-acre AOI. The exact type, location, timing, and density of redevelopment potential within these two general locations, along with the potential redevelopment within the Pierce Removal limits cannot be definitively calculated. Calculating acreages of areas that may experience slowed rates of development is not possible at this time because development is dependent on many economic factors beyond the improvements to I-45. This assessment and any other captures only a snapshot of development at a particular point in time.

5.1.5 STEP 5 — IDENTIFY RESOURCES SUBJECT TO INDUCED GROWTH IMPACTS

Through interview questionnaires and cartographic assessment, the analysis has revealed that a minimum of approximately 4,804 acres of land has indirect induced growth potential (in the form of redevelopment) within the AOI. This area identified for potential redevelopment includes land that has already been developed.

Data from the EMST was used to determine which resources are present in the areas identified for potential redevelopment. Table 5-1 summarizes the characteristics of resources present in these areas that are essentially boundaries of potential redevelopment.

Table 5-1: Resource Characteristics in Areas of Potential Development and Redevelopment

EMST Vegetation Type	Areas of Potential Redevelopment in Downtown Management District (acres)	Areas of Potential Redevelopment along I-45 between I-610 and Beltway 8 (acres)
Open Water	4.4	-
Urban High Intensity	114.6	1,855.3
Urban Low Intensity	10.5	2,283.1
Barren	-	32.1
Grass Farm	-	9.9
Gulf Coast: Coastal Prairie	-	236.8
Gulf Coast: Coastal Prairie Pondshore	-	2.8
Native Invasive: Deciduous Woodland	-	212.0
Native Invasive: Huisache Woodland or Shrubland	-	15.4
Post Oak Savanna: Live Oak Motte and Woodland	-	19.8
Post Oak Savanna: Post Oak — Redcedar Motte and Woodland	-	7.7
Total	**129.4**	**4,675.0**

Source: Elliott et al. 2009–2014

Table 5-2 (a condensed version of Table 7 from the technical report) lists the resources at risk in the two general areas (the 0.25-mile buffer along I-45 and the Downtown Management District) that could be redeveloped and identifies the potential for indirect impacts from induced redevelopment. Note that not all resources are considered at risk from induced growth impacts.

Table 5-2: Resources Analyzed for Induced Growth Impacts

Resource	Could the resource be indirectly impacted by potential induced growth?	Is this resource at risk?
Community Resources (includes Neighborhoods/Public Facilities and Environmental Justice)	Yes; property values could be either positively or negatively influenced by future redevelopment. The proposed project may cause travel pattern and access changes that could result in adverse impacts to business operations, including more circuitous routes in some locations. Proposed changes in roadway alignments and new ROW requirements through the Downtown area may create barriers that disconnect surrounding neighborhoods from Houston's central business district, potentially reducing future growth and redevelopment in these areas.	Yes; redevelopment could result in denser commercial, retail, and residential developments along the I-45 corridor, which could alter the character of the community. Although the City of Houston does not have zoning regulations that control land use (residential versus commercial, for example), the City reviews and approves platting proposals to ensure that proposed developments are properly subdivided based on City code. The City's Code of Ordinances Chapter 42: Subdivisions, Development and Platting governs development activity and applies to areas within the ETJ. This chapter of the City code establishes minimum lot sizes and minimum building lines and ensures that new development or redevelopment projects respect existing community character. Many developers in Houston employ private covenant and deed restrictions that function like zoning; the City also plays a role in ensuring that these restrictions are enforced. Environmental justice individuals/populations could be adversely impacted by increased property values, increased traffic noise, permanent and temporary visual impacts due to roadway design, construction activities, and potential displacement of homes, businesses, and places of worship in their communities. Mitigation for direct impacts to this resource is discussed in Section 7.2.

Resource	Could the resource be indirectly impacted by potential induced growth?	Is this resource at risk?
Vegetation and Wildlife Habitat	Yes; the areas of potential redevelopment are vegetated to varying degrees and provide wildlife habitat. The majority of vegetation within the existing I-45 ROW is classified as urban low intensity and consists mainly of maintained grasses and landscaped assemblages of trees and shrubs along roadway medians. The proposed I-45 ROW and areas beyond are a mixture of native and non-native invasive vegetation that is best described as unmaintained mixed Chinese tallow (*Triadica sebifera*) forests, native and non-native mixed woodlands along riparian edges, maintained ROW grasses and forbs, and disturbance grasslands. These habitat types are not considered rare or important remnant vegetation as mapped by the Texas Conservation Action Plan.	Yes; however, public and private redevelopment would be regulated by the City of Houston Code of Ordinances, which include ordinances related to land development regulations, site development, and tree protection/preservation. Harris County regulations would regulate redevelopment within unincorporated areas.

Resource	Could the resource be indirectly impacted by potential induced growth?	Is this resource at risk?
Threatened and Endangered Species	Yes for state-listed species; the project is within range with suitable habitat present for several SGCNs and for the state threatened Alligator snapping turtle (*Macrochelys temminckii*), timber rattlesnake (*Crotalus horridus*), Louisiana pigtoe (*Pleurobema riddellii*), sandbank pocketbook (*Lampsilis satura*), Texas pigtoe (*Fusconaia askewi*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), Wood stork (*Mycteria americana*), and western creek chubsucker (*Erimyzon claviformis*). Potential impacts to state-listed species or SGCNs would be possible, but the potential for encountering these species during construction is low. Any impacts to species would be limited to individuals within the construction area. A review of the TXNDD did not indicate any records of state or federally listed species occurring within 1.5 miles of the project area. No for federally listed species; No suitable habitat for any federally listed threatened or endangered species was identified within or adjacent to the proposed project area; therefore, no effect to any federally listed species is anticipated as a result of the proposed project.	Yes for state-listed species; however, the ESA affords protection for federally listed threatened/endangered species and their habitats; the USFWS and TPWD maintain lists of potential occurrences for listed species in each Texas county. State regulations prohibit harm to state-listed species. All redevelopment, whether public or privately funded, is subject to state and federal regulations.

5.1.6 STEP 6 — IDENTIFY MITIGATION

In summary, the overall consensus from the questionnaire responses is that the proposed project would have an influence on redevelopment patterns and rates of redevelopment within the AOI, particularly in Downtown and along I-45 from I-610 to Beltway 8. The areas of potential redevelopment associated with

the proposed project have been considered and assessed by the H-GAC's future planning documents and the City of Houston's corresponding land use objectives.

This step of the indirect impacts analysis assesses the consequences of the expected induced growth impacts and considers/develops strategies or mitigation measures available as part of the existing regulation regimes that would apply to potential development projects. The potential areas of indirect induced growth (approximately 4,804 acres of redevelopment potential) account for approximately 5 percent of the AOI (103,536 acres).

Future land development activities would generally be private ventures regulated by the City of Houston's Code of Ordinances. The regulations in the Code address environmental and social impacts by requiring mitigation as part of site design and construction such that development is in accordance with overall City objectives. In addition, the agencies and programs that would guide any development of a potential project would be similar to the typical mitigation and permitting measures required of TxDOT. For example, all development (public or private developers) must comply with flood control regulations under FEMA and the local floodplain administration, the ESA, the CWA, CWA Section 401 Water Quality Certification requirements, CWA Section 404 permits for projects impacting waters of the U.S., and other regulations requiring mitigation if there are effects on species habitat.

Ultimately, because the proposed project is not anticipated to conflict with City of Houston or Harris County development goals or cause substantial negative indirect induced growth impacts, the requirement for mitigation of environmental impacts would be limited to mitigating only the direct impacts associated with this proposed project. Any mitigation for project-induced land development impacts that may arise after construction of the proposed project would be overseen by the City of Houston and/or Harris County and would be the responsibility of the land developer. Mitigation for indirect induced growth impacts would not be required of the proposed project sponsors based on the analysis presented herein.

5.2 Conclusion

Most of the AOI is already developed and developable land within the AOI is relatively limited. The proposed project is expected to induce redevelopment in two general locations. The proposed project may also slow development rates in areas that would experience access changes or access limitations resulting from the proposed improvements or in areas that would be physically impacted (e.g., proposed displacements). Such slowdowns may be compounded by redevelopment in areas flooded during Hurricane Harvey and increasing floodplain regulations. The proposed project would add capacity to existing facilities and would not induce development to the same degree as a new roadway. The Downtown area and the surrounding neighborhoods are experiencing various degrees of redevelopment, and growth trends identified in questionnaire responses indicate that redevelopment would continue independent of the proposed improvements to existing facilities. Additionally, several roadway projects are planned or under development throughout the Houston area and coincide temporally with the proposed NHHIP improvements; these projects could influence growth and, therefore, the proposed

NHHIP project may contribute to induced growth impacts as one of many factors affecting growth in the area.

6 CUMULATIVE IMPACTS

6.1 Definition of Cumulative Impacts

The CEQ defines cumulative impact as the impact "on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

6.2 Guidance

The approach for conducting cumulative impacts analyses is ultimately guided by the following TxDOT publications, which are available online in the TxDOT Indirect and Cumulative Impacts Toolkit: *Risk Assessment for Cumulative Impacts* (TxDOT 2014b) and *Cumulative Impacts Analysis Guidelines* (TxDOT 2019c).

Additional guidance was published in 2011 and updated in 2016 by the AASHTO, and those guidelines were followed in this analysis. Practitioners Handbook — 12, "Assessing Indirect Effects and Cumulative Impacts under NEPA (AASHTO 2016)," emphasizes the following key tasks:

1) Describe Resource Conditions and Trends
2) Summarize Effects of the Proposed Action on Key Resources
3) Describe Other Actions and Their Effects on Key Resources
4) Estimate Combined Effects on Key Resources
5) Consider Minimization and Mitigation

See Appendix A Resources Study Area for an overview map pertinent to this discussion.

6.3 Cumulative Impacts Analysis

The evaluation of cumulative impacts follows TxDOT's *Cumulative Impacts Analysis Guidelines* (TxDOT 2019c). According to TxDOT's Guidance, a cumulative effects analysis for a TxDOT project has five steps:

1) Identify the resource study area, conditions, and trends.
2) Assess the direct and indirect effects on each resource from the proposed project.
3) Identify other actions — past, present, and reasonably foreseeable — and their effects on each resource.
4) Analyze the overall effects of the proposed project combined with other actions.
5) Mitigate cumulative effects.

To determine which resources will be assessed in detail in the cumulative impact analysis, a screening table was prepared to summarize the direct and indirect impacts of the NHHIP Preferred Alternative based

on information available to date (*Cumulative Impacts Technical Report*, Table 1). This information represents a broad look at potential cumulative impacts.

6.4 Step 1: Resource Study Area, Conditions, and Trends

6.4.1 IDENTIFICATION OF RESOURCES

According to TxDOT's *Cumulative Impacts Analysis Guidelines* (TxDOT 2019c), if a project does not cause direct or indirect impacts on a resource, it will not contribute to a cumulative impact on that resource. For example, cumulative flooding impacts for this project are not anticipated for this project for the reasons given in Table 1 of the *Cumulative Impacts Technical Report*. Table 1 in the *Cumulative Impacts Technical Report* describes direct and indirect impacts for each resource category based on the Preferred Alternative and whether the resource is in poor or declining health or at risk. For specific direct impacts from the Preferred Alternative on each resource, see Section 3 of the Final EIS and the technical reports appended to the Final EIS.

As discussed in the previous section, with regard to indirect impacts and the potential for induced development in the Area of Influence, this general statement is applicable to all resources: Most of the AOI is already developed, and developable land within the AOI is relatively limited. The proposed project is expected to induce redevelopment in two general locations: within a 0.25-mile buffer along I-45 from I-610 to Beltway 8 and the Downtown Management District. The proposed project may also slow development rates in areas that would experience access changes or access limitations resulting from the proposed improvements or in areas that would be physically impacted (e.g., proposed displacements). Such slowdowns may be compounded by recent flooding-event redevelopment and increasing floodplain regulations. The proposed project would not induce development to the same degree as a new roadway.

This cumulative impacts analysis focuses on those resources substantially impacted by the proposed project or those that are currently in poor or declining health or at risk, even if proposed project impacts (either direct or indirect) are relatively small; only those resources meeting these criteria are brought forward for further analysis of cumulative effects. The topics of greenhouse gas emissions and climate change are addressed separately in the Final EIS. The following table (Table 6-1) is an excerpt from the *Cumulative Impacts Technical Report* focusing on the resource that was analyzed in detail for the proposed project: community resources including environmental justice. Again, certain resources were ruled out as not requiring a more detailed cumulative impacts analysis because they were determined to either not be in poor or declining health or at risk (e.g., soils and geology) or not adversely impacted by the project (e.g., floodplains).

1 Table 6-1: Resource/Issues Considered for Cumulative Impacts Analysis — Preferred Alternative — Resources Analyzed in Detail

Resource	Direct Impacts	Indirect Impacts (Induced Growth and Encroachment Alteration)	Is the Resource in Poor or Declining Health?	Included in the Cumulative Impacts Analysis? Reason for Inclusion/Exclusion
Community Resources: Neighborhoods and Public Facilities (including potential displacement impacts)	The Preferred Alternative would displace: ▪ 160 single-family residences ▪ 433 multi-family residential units ▪ 486 public and low-income housing multi-family residential units ▪ 344 businesses ▪ 58 billboards ▪ 5 places of worship ▪ 2 schools/universities ▪ 5 parking businesses ▪ 11 other structures The Preferred Alternative would result in residential displacements in the Northside/Northline, Independence Heights, Near Northside, Greater Heights, Downtown, Midtown, Second Ward, Greater Third Ward, Greater Fifth Ward, and Museum Park super neighborhoods. The *Community Impacts Assessment Technical Report* details direct impacts to residences and proposed mitigation measures. Community cohesion was addressed by super neighborhood in detail in the *Community Impacts Assessment Technical Report*. Community cohesion can be affected by displacement of businesses, community facilities, and residences; disruption associated with moving outside a social structure; and indirect or ambient impacts that can occur to communities that remain after project development, such as noise, air quality, and changes in travel patterns. In general, efforts have been made throughout project development to interface with community representatives to address their concerns through avoidance, minimization, and mitigation where possible. Specific discussions by super neighborhood are included in the *Cumulative Impacts Technical Report*. Changes in travel patterns and access are discussed in detail in the *Community Impacts Assessment Technical Report*. Development of the proposed project could benefit adjacent neighborhoods and communities by improving mobility and safety in the study area. The Preferred Alternative is not anticipated to change access or impact the use of local roads that may serve as emergency response routes to neighborhoods. The Preferred Alternative would require new ROW in existing bicycle routes. During construction, access to bike routes could be limited or redirected; however, impacts would be minimized as much as possible. Sidewalks would not be eliminated; the proposed project would include sidewalks along I-45 and at the major intersections. The proposed project would also provide continuity of sidewalks and shared-use lanes along the frontage roads by adding sidewalks and pathways in areas as needed. The Preferred Alternative would reduce some open space along the bayou greenways; however, visibility and open space along the greenways would be improved in other locations where the freeway overpasses are eliminated. The noise barriers that have been identified throughout the project area are shown in the *Community Impacts Assessment Technical Report* (Appendix F), as well as the *Traffic Noise Technical Report* (Appendix I). TxDOT's standard noise workshop protocols would be followed for those public engagement activities, and that process would determine which proposed reasonable and feasible noise barriers would be constructed.	Most of the AOI is already developed, and developable land within the AOI is relatively limited. The proposed project is expected to induce redevelopment in two general locations: within a 0.25-mile buffer along I-45 from I-610 to Beltway 8 and the Downtown Management District. The proposed project may also slow development rates in areas that would experience access changes or access limitations resulting from the proposed improvements or in areas that would be physically impacted (e.g., proposed displacements). Such slowdowns may be compounded by recent flooding-event redevelopment and increasing floodplain regulations. The proposed project would not induce development to the same degree as a new roadway. (NOTE: this statement is applicable for all resources discussed in this table.) Changes in visual conditions could result in encroachment alteration impacts to neighborhoods. Elevated structures may create visual and physical barriers that disconnect neighboring communities, while removal of elevated roadways and depressing roadways would result in the removal of visual barriers that would improve connectivity. These visual impacts and how they affect development or redevelopment patterns could extend farther in time and distance from the footprint of the project and would therefore be considered an encroachment alteration impact on community resources. Displacement of community facilities could result in encroachment alteration impacts to individuals or groups of individuals within the AOI. Loss of these facilities or disruption of services could result in adverse impacts on populations who are dependent on services provided by these facilities; however, if these facilities and service providers are able to relocate within their current neighborhoods, with assistance, then adverse impacts may be limited in terms of duration. Encroachment alteration impacts due to relocations and displacements could include a reduction in the supply of affordable housing, changes in residential and commercial property values due to the proposed increase in access and mobility, changes in the local tax base due to the anticipated displacements and impacts to employees (such as potential increased commuting time) who could be displaced by the proposed project. Residential and commercial properties located near the project area that are not physically impacted by the proposed project may experience a change in market value, either positive or negative.	Communities are not declining per se although affordable housing is a concern; also see environmental justice summary for details related to communities of concern.	Yes. The cumulative effects to neighborhoods and community facilities are analyzed in the cumulative impacts analysis because the Preferred Alternative would have primarily direct and some indirect impacts. In addition, community cohesion, displacements and relocations, aspects of transportation, economics, parks, open space, visual resources, and traffic noise are discussed as components of community resources.

Resource	Direct Impacts	Indirect Impacts (Induced Growth and Encroachment Alteration)	Is the Resource in Poor or Declining Health?	Included in the Cumulative Impacts Analysis? Reason for Inclusion/Exclusion
Community Facilities: Environmental Justice	Numerous single-family and multi-family residential displacements would occur; socioeconomic data presented in detail in the *Community Impacts Assessment Technical Report* indicate that the project area largely comprises minority and/or low-income communities. Displacements or relocations of the following community organizations or businesses utilized by environmental justice populations are listed below. ▪ Displacement of AVANCE Training Center, a non-profit organization that assists low-income and at-risk families with workforce training and family therapy ▪ Displacement of Texas Department of Health and Human Services, which serves low-income communities ▪ Displacement and Relocation of Loaves and Fishes Magnificat Houses Ministries, SEARCH Homeless Services, and Fatima House, which all service low-income and homeless populations ▪ Displacement of medical offices that serve low-income and high-minority communities ▪ Displacement of 2 places of worship and 1 school that serve Spanish-speaking populations ▪ Displacement of 3 places of worship with predominantly African American members and the Helping Hands Charity (operated by Sloan Memorial United Methodist Church), an organization that supports children and other low-income individuals in the surrounding community ▪ Parking impacts at a variety of facilities ▪ Construction-phase effects ▪ Impacts to various entities that serve sensitive populations (such as Limited English Proficiency populations) Additional community outreach was initiated to reach out to the facilities mentioned above or in the general area of the proposed project. Mitigation for impacted residences, organizations and businesses is being coordinated on a site-by-site basis, as discussed in Section 6.0 in the *Community Impacts Assessment Technical Report* (TxDOT 2019b). TxDOT would continue to coordinate with organizations and businesses that provide services to environmental justice populations. Although numerous noise barriers are proposed for residential areas where minority and low-income populations reside, there could be some areas where barriers are not feasible or reasonable in accordance with TxDOT's FHWA-approved Guidelines for Analysis and Abatement of Roadway Traffic Noise. TxDOT has also committed to utilize longitudinally tined pavement on the mainlanes and frontage roads, which is quieter than traditional concrete pavement. Numerous aesthetic walls have been proposed adjacent to environmental justice areas. These walls, along with possible aesthetic improvements, would be discussed with the community members who may benefit from them. Multiple bus stops located in high-minority and low-income Census areas could require relocation. TxDOT will coordinate with METRO to facilitate timely planning for bus stop relocations and bus route detours. TxDOT will coordinate with METRO for review of the 30-percent design plans, and additional follow-up meetings would be conducted as requested by METRO. METRO would notify riders at least one week in advance of any temporary bus stop relocations or closures and bus route changes. METRO would install temporary bus stops out of the proposed ROW as close as possible to the original bus stop locations. In addition to adverse impacts, the proposed project would also provide benefits such as decreased congestion and improved traffic safety on both community and regional levels.	Environmental Justice individuals/populations could be adversely impacted by increased traffic noise, permanent and temporary visual impacts due to roadway design, construction activities, and displacement of homes, businesses, and places of worship in their communities. The proposed project would result in numerous displacements, including residences of members of minority and low-income communities, businesses, and community facilities that primarily serve environmental justice individuals/populations. To the extent that the services provided by these community facilities and public housing organizations could be relocated within their original service area, it is possible that these services would only be lost temporarily and could be replaced to again serve their original populations as well as persons in surrounding communities. If not, services to environmental justice populations may be reduced in the community. The degree to which encroachment alteration impacts could occur to environmental justice communities of concern is tied to the effectiveness of any mitigation efforts employed to reduce direct adverse impacts to community members and those served by the community facilities that would be directly affected.	Yes. Environmental Justice populations are vulnerable populations and include minorities and low-income persons. Executive Order 12898 and Title VI provide protections for environmental justice populations. Data collected for direct impacts indicated the presence of environmental justice populations in the Census profile areas for the Preferred Alternative.	Yes. The cumulative effects to environmental justice populations are analyzed in the cumulative impacts analysis because the Preferred Alternative would have direct and indirect impacts.

1 Source: *Cumulative Impacts Technical Report*

6.4.2 RESOURCE STUDY AREA AND TEMPORAL BOUNDARIES FOR ANALYSIS

The Community Resources Resource Study Area (RSA) is shown in Appendix A. The areas where direct effects would occur were the focus of defining an appropriate RSA. "Super neighborhoods" surrounding the alignment of the Preferred Alternative were used for consistency with the analysis in the Community Impacts Assessment Technical Report (TxDOT 2019b). The super neighborhoods that are represented within the Community Resources RSA include:

- Acres Home
- Downtown
- Fourth Ward
- Greater Greenspoint
- Greater Heights
- Greater Third Ward
- Greater Fifth Ward
- Hidden Valley
- Independence Heights
- MacGregor
- Museum Park
- Near Northside
- Neartown-Montrose
- Northside/Northline
- Second Ward
- University Place
- Washington Avenue Coalition/Memorial Park

The Community Resources RSA boundary is also reflective of management districts (MDs). The MDs located within the Community Resources RSA include:

- Airline Improvement District
- Aldine North Expansion Tract 3
- Aldine Public Improvement District (PID)
- East Downtown MD
- East End MD
- Greater Greenspoint MD
- Greater Northside MD
- Greater Southeast MD
- Houston Downtown

- Midtown MD
- Montrose MD

Zip code boundaries were considered, and a boundary was delineated where either a super neighborhood or MD geographic boundary did not exist (specifically, zip code 77038 was used to capture an area between Greater Greenspoint and Acres Home). The resulting RSA is an area presumed to include the basic service areas for services provided by the community facilities that would be displaced by the Preferred Alternative, along with the neighborhoods within which other displacements would occur. Both public outreach and mitigation considerations are important concepts for assessing cumulative impacts to community resources, and this RSA allows for the analysis to focus on those factors as well. Finally, this is an area within which past, present, and reasonably foreseeable future actions may be ascertained. The total acreage of the Community Resources RSA is approximately 86,087 acres.

6.4.3 TEMPORAL BOUNDARIES

TxDOT's guidance also requires the setting of general temporal boundaries to better define the time period considered. The temporal boundary for the community resources cumulative impacts analysis is from 1970 to 2040. The year 1970 was chosen to include a full decennial population Census, it was the year after NEPA was enacted, and it preceded the creation of the Houston-Galveston Area Council (H-GAC), the metropolitan planning organization.

This timeframe captures a period of substantial population and residential growth surrounding the Houston metropolitan area that has been a result of residential, commercial, and transportation-based development. This timeframe captures the 2040 planning horizon for the H-GAC's 2040 RTP (H-GAC 2016).

6.4.4 CONDITIONS AND TRENDS

The *Cumulative Impacts Technical Report* includes detailed discussion of past trends, particularly regarding population growth. From 1970 to 2010, Houston rose from the 6th largest urban area in the U.S. to the 4th largest with a population of more than two million in the City of Houston and more than four million in Harris County.

One current condition in the RSA is the prevalence of environmental justice communities of concern. This consideration is a major focus of analysis in the *Community Impacts Assessment Technical Report*, along with the *Cumulative Impacts Technical Report*. Major portions of the Preferred Alternative traverse predominantly environmental justice communities of concern.

Planned highway expansions and proposed transit investments within the Community Resources RSA could result in both beneficial and adverse impacts to communities. Adverse impacts could include displacements at the project level, such as would occur from the Preferred Alternative, but also beneficial impacts, such as access to employment centers, hospitals, and institutions of higher education along with congestion reduction and mobility benefits.

Current conditions and trends discussed in detail in the *Cumulative Impacts Technical Report* include the activities of various planning entities in the growing urban area. Planning entities such as the H-GAC have

tracked population and employment growth and use that data to help plan for infrastructure needs in the future. Data sets from various H-GAC documents are discussed in the technical report to describe current conditions. Planning efforts such as the Livable Centers studies reflect neighborhood-scale efforts to make communities more walkable, compact, and accessible. These studies are important for understanding the "health" of the Community Resources RSA.

A detailed discussion of housing affordability issues in Houston is part of the conditions and trends discussion in the technical report. Hurricane Harvey struck in August of 2017, causing massive amounts of damage to communities and homes in the area. This exacerbated the challenge of finding affordable housing; several recovery programs have been funded and are in progress. See both the *Community Impacts Assessment Technical Report* and *Cumulative Impacts Technical Report*s for more detail.

6.5 Step 2: Direct and Indirect Effects on Each Resource from the Proposed Project

Table 1 in the *Cumulative Impacts Technical Report* summarizes the potential direct and indirect effects to the community resources (neighborhoods and public facilities/environmental justice) and Historic Resources. The table was used as a screening tool to identify resources studied in detail in this cumulative analysis. Steps 3 through 5 focus on the resources identified.

6.6 Step 3: Other Actions — Past, Present, and Reasonably Foreseeable — and Their Effects on Each Resource

The past actions section of the *Cumulative Impacts Technical Report* discusses the history of the project area, with reference to the Historic Resources Survey Report. The transportation component of the discussion focused on the various highway loops in central Houston. Highways have been built in segments as economic conditions allow, but generally, construction started on the I-610 loop in the 1950s, the Beltway 8 loop in the 1980s, and Grand Parkway in the 1990s. These infrastructure projects continue to define the shape and character of Houston.

The present actions and reasonably foreseeable actions provide data about population and employment growth from the H-GAC data. By 2045, population is projected to be approximately 10.8 million people and the area is projected to have 4.8 million jobs.

Planned transportation projects within the Community Resources RSA are depicted in the *Cumulative Impacts Technical Report* on GIS-based graphics depicting data from the City of Houston and TxDOT. Between 1984 and 2017, TxDOT let 92 projects and between 2018 and 2032, TxDOT plans reflect letting 30 additional projects reflecting several billion dollars in investments.

Current and projected land use data is presented in the *Cumulative Impacts Technical Report*. In the 86,087-acre RSA, in the planning horizon out to 2045, only 757 acres of land will be developable in the RSA, which constitutes less than one percent of the total RSA. Over the planning horizon, development is expected to continue and densify. Parks and open space land are expected to remain preserved.

Major projects in the Community Resources RSA are shown in Table 6 of the technical report. These projects were based on feedback provided during interviews with local land use experts conducted by project team members during the preparation of the *Indirect Impacts Technical Report*. In particular, the City of Houston's Planning and Development department compiled a number of substantial developments within the AOI, focusing on hospitals and schools, which indicate significant capital improvements occurring in the area. These major projects include a mix of commercial, office, industrial, residential, and community facility developments. In general, these projects represent signs of healthy economic growth and land use development in an urban city.

Additional research identified a number of affordable housing developments in the Community Resources RSA. The Houston area is adding developments to the affordable housing stock due in part to funding from the Low-Income Housing Tax Credit (LIHTC), a federal program which provides financial incentives for private developers to build and preserve rental housing that will be reserved and kept affordable for low-income residents. The LIHTC is an effective incentive for private developers because it allows them to reduce their federal income taxes by one dollar for every dollar received in tax credit. Information obtained from the Texas Department of Housing and Community Affairs in 2019 provided a property inventory of the developments that have applied and been approved for LIHTC from 2015–2018. Based on this information, shown in Table 7 of the technical report, approximately 872 affordable housing units are under construction or newly available in the RSA that could partially meet the needs associated with displacements associated with current or future development projects in the RSA.

6.7 Step 4: The Overall Effects of the Proposed Project Combined with Other Actions

6.7.1 Community Resources

Within the temporal analysis timeframe, there have been trends of infrastructure growth and development, the initiation of planning and regulatory compliance, the emergence of community activism to mitigate substantial effects of infrastructure projects, economic downturns and upswings, and cycles of disinvestment and reinvestment in Downtown. While displacements have occurred from infrastructure development over time, there has also been an increase in community engagement that followed the inception of the NEPA process and subsequent federal Executive Orders such that environmental justice communities of concern are now routinely identified and included in the project development process. While affordable housing concerns have continued to rise, planning initiatives and non-profit activities are currently addressing those issues. The efforts toward more sustainable development patterns that have emerged as a result of air quality regulation and livable cities initiatives call for multi-modal transportation options, better access to jobs, and walkable environments that may better serve residents, including low-income and/or zero car households. Both positive and negative trends are observable in the Community Resources RSA.

Throughout the Community Resources RSA, transportation projects are expected to continue but with additional emphasis on transit projects. Land use development and redevelopment projects are underway and expected to progress with or without the proposed NHHIP. Where development projects are proposed, depending on the funding mechanism involved, those projects may require their own

environmental compliance processes. There is a regulatory framework in place with mitigation requirements that may apply to at least some of the reasonably foreseeable development projects within the RSA.

Residential Resources: As discussed in detail in the *Community Impacts Assessment Technical Report*, more than 1,000 total residential displacements would occur in Northside/Northline, Independence Heights, Near Northside, Greater Heights, Downtown, Midtown, Second Ward, Greater Third Ward, Greater Fifth Ward, and Museum Park super neighborhoods. Among these residential displacements are two public housing developments—Clayton Homes and Kelly Village—which are part of the limited affordable housing supply for extremely low-income populations. Temenos Place Apartments II and Midtown Terrace Suites are two other housing facilities that would be affected by the project, resulting in a reduction of affordable housing supply. In response to these concerns, TxDOT would facilitate the relocations and provide assistance with allocating adequate replacement housing, subsidized or unsubsidized, in accordance with federal regulations. TxDOT is working closely with HHA to develop new housing to help address displacements at Clayton Homes and a portion of Kelly Village.

Within the temporal analysis timeframe, Houston has seen a continued trend of population and economic growth that has generated infrastructure construction and urban development. Such development prompted the gradual mobilization of community activism in opposition to past unjust development practices and inequitable infrastructure projects. Additionally, while affordable housing concerns have continued to rise, planning initiatives and non-profit activities are currently focused on addressing those issues. The efforts toward more sustainable development patterns have emerged as a result of federal regulation, disaster recovery and resiliency, and regional and local policies. Relevant policies include the livable cities and complete communities initiatives, which call for multi-modal transportation options; better access to schools, jobs, and essential services; and walkable environments that may better serve residents, including low-income and/or zero car households.

In combination, the past, present, and reasonably foreseeable future projects have had and would continue to have adverse impacts on residential resources. However, those impacts have been and will continue to be at least partially mitigated by the planning initiatives and non-profit activities mentioned above, as well as TxDOT's efforts to develop new housing with HHA and other efforts described in the Community Impacts Technical Report.

Commercial Resources: Multiple negative and positive effects would result from construction of the proposed project. Approximately 344 businesses would potentially be displaced, and the employment loss analysis estimated that between 4,840 to 13,713 jobs could be affected. The analysis presented in the *Community Impacts Assessment Technical Report* revealed that the availability of existing properties for sale or lease within ZIP codes near the project corridor is not sufficient to accommodate the relocation of all potential business displacements; however, redevelopment of commercial properties does have the potential to accommodate those businesses interested in relocating. The planned commercial developments have the potential to help accommodate displacements; these developments are discussed below.

With regards to benefits, the proposed NHHIP would improve access to employment centers while also reducing congestion, enhancing mobility, and improving safety.

Houston's ongoing trend of economic growth suggests that increased commercial development and employment opportunities are expected to continue in the region. Additionally, as H-GAC has projected, job growth over the temporal analysis timeframe is expected to be substantial.

In combination, the past, present, and reasonably foreseeable future projects would have limited adverse impacts on commercial resources. For this project, TxDOT would comply with the Uniform Relocation Act for potentially displaced businesses. TxDOT is also committed to facilitating opportunities to promote hiring individuals from local communities for general employment and project construction, such as through job fairs. TxDOT will research opportunities to invest funds in a local workforce development program aimed at job readiness training prior to construction. Additional mitigation to consider could involve a partnership with the Texas Workforce Commission and the appropriate Workforce Solutions affiliate, Gulf Coast Workforce Board, to mitigate the potential employment impacts associated with the NHHIP improvements. See Section 6.0 of the *Cumulative Impacts Technical Report* for more details.

Parks, Trails and Open Space: The Preferred Alternative would reduce some open space along parks and the bayou greenways. The Preferred Alternative would not result in a use of or adverse impact to any Section 4(f) park properties. Visibility and open space along the greenways would be improved in other locations where the freeway overpasses are eliminated. TxDOT would utilize proposed storm water detention areas as green spaces where possible. TxDOT would also accommodate or replace existing trails that are impacted by the proposed project, as well as allow for future planned hike and bike trails as a recreational resource. The City of Houston has a Parks and Open Space Ordinance; Buffalo Bayou Partnership has launched several initiatives in the RSA; and the City has a long-term bikeway vision plan. Based on this information, it can be reasonably assumed that the development of new parks, trails, and open space would continue to occur within the Community Resources RSA, and the cumulative impacts to parks, trails, and open space as a result of this project would be minimal given TxDOT's effort to create, coordinate, and provide opportunities for more parks, trails, and open space in the development of this project.

Transportation and Mobility: With regard to transportation resources as a component of community resources, the NHHIP project would impact transportation facilities, travel patterns, and accessibility and would also temporarily reroute or redirect existing rail lines and infrastructure. The relocation of bus stops and changes in routes could affect populations that do not have access to automobiles or that are dependent on public transportation. Route deviation during construction and relocations of bus stops would temporarily affect bus circulation and travel times. TxDOT would coordinate with METRO to facilitate timely planning for bus stop relocations and bus route detours. TxDOT would also continue to coordinate with METRO during design and construction to minimize impacts to existing transit operations. Route deviation could also affect individuals who use bicycle and pedestrian facilities for mobility. See Appendix A, Table A-2 for more specific information about coordination between TxDOT and METRO regarding mitigation.

Visual Resources: The visual impacts of the Segments 1 and 2 Preferred Alternatives are expected to be neutral. The project would be developed under TxDOT's Green Ribbon Program, which allocates funds for trees and plants within roadway ROW. The overall visual quality impact would be neutral for Segment 3. The visual quality would be reduced for viewer groups north of Downtown and for some residential and other viewers outside of Downtown with views of the skyline; however, the majority of viewsheds in the Segment 3 area would have improved views or neutral visual impacts as a result of the proposed project, and visual quality would remain moderate. Specific areas where adverse impacts could occur (North Downtown) could be mitigated to minimize the impact (see TxDOT's Green Ribbon Program). Additionally, the form and materials of the proposed project would remain compatible with the existing environment. Mitigation to improve the visual and aesthetic qualities of the project area could be utilized and is discussed in detail in the *Visual Resources Technical Report*.

Floodplains: In 2018, NOAA released revised precipitation-frequency data, termed Atlas 14 data, that incorporated updated historical rainfall depth information, including rainfall from Hurricane Harvey. The City of Houston and HCFCD now require that all projects (including this project) use the Atlas 14 data when designing and constructing drainage features. These ongoing regulatory requirements will protect against the cumulative impacts of flooding in the area. As discussed in Sections 3.8.3 and 5.2 of this document, TxDOT's analysis clarifies that the direct and indirect impacts of the project will not increase flood risks. Thus, cumulative effects should be minimized because reasonably foreseeable projects will need to comply with local flooding regulations.

TxDOT has performed drainage studies for Segments 2 and 3 that will be used to determine the appropriate drainage features that the local regulatory authorities will require to mitigate flooding risks. TxDOT will perform a detailed drainage study for Segment 1 for that same purpose. The models that are used to design drainage systems based on Atlas 14 rainfall data within Harris County are still being updated as of the date of this Final EIS; thus, TxDOT will continue to update its studies as appropriate in the future to ensure that the latest flooding data are used for designing and constructing the project.

Community Facilities: In this discussion, community facilities are non-profit organizations, places of worship, schools, community centers, and other entities that serve the community. Past actions in the Community Resources RSA were previously discussed as trends (rather than with regard to specific community facilities) and include major construction of infrastructure in Downtown areas that may have created adverse impacts on community facilities. In the Community Resources RSA, along with other construction (development and redevelopment), community facilities have been established to benefit the present-day community. The need for community facilities is the result of previous patterns of infrastructure development; the challenges of homelessness and housing affordability run parallel to the establishment of community facilities, service organizations, and public agencies working to address those challenges.

The impacts of past, present, and reasonably foreseeable future projects are tied closely to TxDOT's documented commitment to mitigate direct impacts to community facilities. With regard to direct impacts in the project area, direct impacts to community facilities (and indirect impacts, including community cohesion) are substantial and are discussed in detail in the *Community Impacts Assessment*

Technical Report. Table 8 in Section 6.1 of the *Cumulative Impacts Technical Report* summarizes direct impacts and mitigation within super neighborhoods in the context of the RSA.

To determine impacts of past, present, and reasonably foreseeable future construction projects on community facilities, known direct impacts are reviewed with respect to whether or not those community facilities would relocate within their service area within the Community Resources RSA. Due to extensive outreach efforts and one-on-one communications with TxDOT project staff and community facility representatives, efforts are underway to help support community facilities facing displacement. Particular attention has been given to community facilities that provide services for environmental justice populations. Detailed information is found in Appendix C of the *Cumulative Impacts Technical Report* (Appendix Q to the Final EIS) as well as the *Community Impacts Assessment Technical Report* (Appendix F to the Final EIS).

6.8 Step 5: Mitigation Measures and Regulatory Framework

Specific mitigation is planned for the direct impacts to community resources due to the proposed project. Tables A-1, A-2, and A-3 in Appendix A of this document present the detailed mitigation commitments.

Direct impacts to community facilities and corresponding proposed mitigation were further analyzed as a measure of the overall health of community resources. Tables A-1, A-2, and A-3 in Appendix A of this document show community facility and service provider displacements by super neighborhood by segment and briefly summarizes mitigation commitments made to date. Exhibit 7 in the *Cumulative Impacts Technical Report* shows community facilities that would be displaced. For these sites, customized mitigation plans are underway to help ensure they are able to relocate within the RSA. The table also provides some information about other community facilities that may provide similar services nearby while displaced community facilities transition to new locations, although efforts are being made to reduce or eliminate interruptions to services provided.

The proposed NHHIP would not displace community facilities in several super neighborhoods. Most of the community facilities displacements would occur in a few of the super neighborhoods. The most impacts would occur in **Northside/Northline**; this is a fairly large super neighborhood on the east side of I-45 north of I-610. **Downtown** (along US 59 in the city center), several community facilities that specialize in providing essential services to homeless populations would be displaced. **Greater Fifth Ward** would be impacted by the displacement of two community facilities. **Independence Heights** would have one community facility displaced; representatives were proactively engaged and working closely with TxDOT to develop a plan to minimize adverse effects in their super neighborhood. As discussed in Table 8, customized mitigation to ensure these community facilities are treated equitably, are allowed to remain in operation until they move, and have financial and logistical support for relocation has been designed to minimize adverse cumulative impacts to super neighborhoods and to the RSA as a whole.

Taken together, past, present, and reasonably foreseeable future projects have had and may continue to have limited adverse impacts on community resources. A concerted effort is underway by TxDOT to ensure that community facilities — particularly the ones that provide services to environmental justice communities — would be able to relocate within the service area to reduce the incremental effects from

the project. In addition, commitments have been made by TxDOT to avoid inhibiting operations during the construction phase.

Based on this analysis, direct impacts from the project would be mitigated for sensitive populations. Adverse indirect impacts (encroachment alteration and induced development) could result from the proposed project. Other past, present, and reasonably foreseeable projects would continue to contribute to the local and regional trends of development within the Community Resources RSA. Such development is expected to continue, accompanied by the continuing and parallel socioeconomic challenges of homelessness and housing affordability that established agencies and organizations are working to address.

6.9 Conclusion

This analysis considered community resources (specifically neighborhoods/community facilities and environmental justice populations), discussed the health of these resources and relevant trends, and identified a specific RSA boundary and appropriate temporal boundary for the analysis. Direct and potential indirect impacts were summarized for this resource. Past, present, and reasonably foreseeable future actions were identified through research, interviews, and cartographic analysis. The construction of the proposed project was considered in conjunction with these other actions to consider cumulative impacts. This analysis provided detailed information about community resources within the RSA for the proposed NHHIP project and described the extensive public and private activities that have evolved over time to help protect these resources.

Mitigation of direct adverse impacts from the proposed project substantially reduces the project's incremental contribution to adverse cumulative impacts on community resources. The proposed project maintains urban development trends that result in both beneficial and adverse impacts to community resources from large infrastructure projects; these trends are not likely to be substantially changed by this project.

7 ENVIRONMENTAL PERMITS, ISSUES, AND COMMITMENTS

7.1 Introduction

Efforts have been made in the planning process to avoid adverse impacts to the natural and human environment. When impacts are unavoidable, steps are taken to minimize and mitigate impacts, as required under NEPA, FHWA, and TxDOT guidelines. According to CEQ regulations (40 CFR 1508.20), mitigation efforts include:

- Avoiding an impact altogether;
- Minimizing the impact by limiting the degree or magnitude of the action;
- Rectifying the impact by repairing, rehabilitating, or restoring the resource;
- Reducing or eliminating the impact over time by preservation and maintenance activities; and
- Compensating for the impact by replacing or providing substitutes to the impacted resource.

Substantial efforts were made when identifying the Preferred Alternative to avoid or minimize adverse effects where possible. Where impacts to resources would require coordination and permitting, processes in accordance with state and federal regulations would be followed with the appropriate jurisdictional agency. See the project technical reports for detailed discussions of efforts to avoid, minimize, and mitigate impacts to environmental resources from the Preferred Alternative.

The following sections identify mitigation and permitting that would be required for the implementation of the Preferred Alternative.

7.2 Community Resources

Mitigation discussions and commitments for impacts to community resources are presented in Tables A-1, A-2, and A-3 in Appendix A of this document and are discussed in detail in the *Community Impacts Assessment Technical Report* (Appendix F to the Final EIS).

Environmental justice mitigation measures are in development to reduce the potential for short-term construction dust and/or noise impacts and to monitor for near-road air emissions during construction. To mitigate for potential short-term construction dust and/or noise impacts, TxDOT is developing a program to provide weatherization and energy efficiency for qualifying low-income single-family residences. Weatherization refers to improvements to a residence to make it more resistant to certain outdoor elements.

In order to further assess emissions in the near-road environment, TxDOT is proactively developing a program to conduct air monitoring on the corridor for PM2.5, NO2, CO, and priority MSAT for a minimum of five years during construction. At least two near-road locations will be monitored during this time period. TxDOT is in discussion with HISD for potentially locating the monitors at schools abutting or within 200 feet of the corridor. Monitoring results will be provided on a publicly accessible website with an option for members of the public to receive monitor data notifications. Monitoring results will be

compared to health-based NAAQS limits and EPA air toxics health risk thresholds. TxDOT is consulting with TCEQ and EPA on the development of this program, including risk controls, if needed.

Aesthetic walls are also proposed to offset impacts to communities. These aesthetic walls are proposed in EJ communities where federal noise criteria was not met but which would be impacted by traffic noise. The aesthetic walls would screen affected receivers from the highway.

7.3 Pedestrian and Bicycle Paths

In accordance with the federal Policy Statement on Bicycle and Pedestrian Accommodations Regulations and Recommendations by the USDOT (2010), TxDOT is including bicycle and pedestrian accommodations in the proposed project, taking into consideration existing and anticipated bicycle and pedestrian facility systems and needs, and linkages to transit stops and corridors, including future changes to METRO transit systems.

The Preferred Alternative will provide continuity of sidewalks and shared-use lanes along the frontage roads by adding sidewalks and pathways in areas as needed. All intersections will be designed in compliance with the ADA per federal requirements. TxDOT will coordinate with the City of Houston, Independent School Districts, and METRO during project design to minimize the temporary and permanent impacts to bicycle and pedestrian facilities. Additionally, TxDOT will accommodate or replace existing trails that are impacted by the proposed project, as well as allow for planned future trails as shown on the City of Houston Bike Plan.

In the instance of any modifications to existing or proposed hike and bike facilities, TxDOT will coordinate with the City of Houston, Houston Parks Board, and other agencies or organizations to have the same level connectivity as the existing and planned future facilities provide.

7.4 Displacements and Relocations

A substantial portion of the mitigation activities proposed for this project are intended to address displacements and relocations. TxDOT is committing an amount of no less than $27 million toward developing affordable housing in the neighborhoods most affected by the proposed project, which include EJ neighborhoods. TxDOT is currently working on developing appropriate partnerships and mechanisms to apply this funding in the most efficient and effective manner. Additional details on this program are expected to be available at the time TxDOT issues the Record of the Decision for the project. Mitigation discussions and commitments for impacts to community resources are presented in Tables A-1, A-2, and A-3 in Appendix A of this document and are discussed in detail in the *Community Impacts Assessment Technical Report* (Appendix F to the Final EIS). (See also Tables 5-15, 5-16, 6-1, 6-2, and 6-3 in the technical report which list specific residential, commercial, office, community facility, and other entities that would be affected by the Preferred Alternative.)

7.5 Transportation Facilities

TxDOT would continue to coordinate with the City of Houston and METRO during project design to minimize the temporary and permanent impacts to transportation, pedestrian, and bicycle facilities to

provide an acceptable level of connectivity. Sidewalks, shared-use paths, and ADA compliance requirements have been addressed during the design process. Bus routes will not be discontinued and TxDOT will give METRO notice of construction so they can establish new stops near displaced stops. Detailed communication commitments between TxDOT and METRO are described in Section 3.4. TxDOT has previously coordinated with HB&T, BNSF, and UPRR representatives, and TxDOT does not anticipate permanently affecting current operations and rail locations.

7.6 Air Quality

During the construction phase of this project, temporary increases in PM and MSAT emissions may occur from construction activities. The primary construction-related emissions of PM are fugitive dust from site preparation, and the primary construction-related emissions of MSAT are diesel PM from diesel powered construction equipment and vehicles.

The potential impacts of PM emissions will be minimized by using fugitive dust control measures contained in standard specifications, as appropriate. The Texas Emissions Reduction Plan (TERP) provides financial incentives to reduce emissions from vehicles and equipment. TxDOT encourages construction contractors to use this and other local and federal incentive programs to the fullest extent possible to minimize diesel emissions. Information about the TERP program can be found on TCEQ's TERP website[11].

However, considering the temporary and transient nature of construction-related emissions, the use of fugitive dust control measures, the encouragement of the use of TERP, and compliance with applicable regulatory requirements; it is not anticipated that emissions from construction of this project will have any significant impact on air quality in the area. See also Section 7.2 above regarding community impacts.

7.7 Traffic and Construction Noise

Noise barriers are proposed as abatement measures for predicted traffic noise impacts, where reasonable and feasible. In all, 76 noise barriers are proposed for the Preferred Alternative: 7 barriers in Segment 1, 12 barriers in Segment 2, and 57 barriers in Segment 3.

The final decision to construct proposed noise barriers will not be made until completion of the proposed NHHIP design, utility evaluation, and polling of adjacent property owners. Noise contours were established for undeveloped land. A copy of the traffic noise analysis will be made available to local officials. On the date of approval of the Record of Decision (Date of Public Knowledge), FHWA and TxDOT would no longer be responsible for providing noise abatement for new development adjacent to the project. In addition to noise mitigation by way of noise barriers, BMPs that will be implemented to reduce noise levels of the project include the use of longitudinally tined pavement, which creates shallow grooves in the roadway surface running lengthwise and decreases noise compared to transverse tining. The tined pavement will be used on non-elevated structures. However, since FHWA does not currently consider pavement as a formal noise abatement measure, potential noise reduction from tined pavement is not

[11]See: https://www.tceq.texas.gov/airquality/terp.

quantified in the Traffic Noise Technical Report. Such reduction would be in addition to the noise mitigation quantified in the Traffic Noise Technical Report.

During the construction phase of this project, temporary increases in noise may result from construction activities. Noise associated with construction of the project is difficult to predict. Heavy machinery, the major sources of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receivers would be expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities would not be expected.

Provisions would be included in the construction 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.

7.8 Water Resources

7.8.1 GROUNDWATER

During final design of the proposed project, measures such as minor alignment shifts to minimize or avoid impacts to public or private water wells would be evaluated. Water wells directly impacted by the Preferred Alternative would be plugged during project construction according to the TCEQ regulations. A storm water management plan would be developed to reduce the risk of contaminating local aquifers. Storm water BMPs, which may include silt fencing, temporary berms, inlet protection barriers, hay bales, seeding or sodding of bare areas, or other suitable methods of containment, would be implemented during construction to minimize the potential introduction of erosion and sedimentation materials, particulates, and contaminants from affecting regional groundwater resources. Storm water drainage improvements, including in-line and off-line facilities (e.g., detention basins), would be constructed as part of the proposed project and would minimize the potential degradation of groundwater quality in the area of the proposed improvements.

7.8.2 SURFACE WATER

Water quality impacts of the proposed project would include highway and bridge runoff, construction-related impacts, and maintenance-related impacts. Long-term operational effects on surface water quality would include an increase in the volume of storm water runoff and constituents carried in the runoff. Storm water runoff from the proposed project could contain sediment or pollutants in quantities that could impact water quality. To offset potential adverse impacts, storm water BMPs (e.g., in-line detention within upsized storm sewers and off-line detention basins) would be implemented to mitigate the changes in storm water runoff. The combination of BMPs implemented for the proposed project would minimize adverse effects of storm water runoff to surface water quality. The detention systems would be sized such that the proposed roadway improvements would result in no adverse impact to the existing drainage conditions for storm events up to an including the 100-year storm event.

The proposed project would disturb more than 1 acre of land, thereby requiring the preparation of a storm water pollution prevention plan (SW3P). In addition, because the proposed project would disturb more

than 5 acres, a NOI for coverage under the TPDES CGP would also be required. Once construction has been completed, a Notice of Termination would be filed per permit requirements. Guidance documents, such as the TxDOT *Storm Water Management Guidelines for Construction Activities*, discuss temporary erosion control measures to be implemented to minimize impacts to water quality during construction (TxDOT 2018a). TxDOT will coordinate with the City of Houston regarding construction of the proposed project within the City's MS4 boundary.

The contractor would take appropriate measures to prevent or minimize harm and control hazardous material spills in the construction assembly area. Removal and disposal of waste materials by the contractor would be in compliance with applicable federal and state guidelines and laws.

Discharges of dredged or fill material into waters of the United States regulated by the USACE would require authorization through evaluation of a Department of the Army permit. Under Section 401 of the CWA, the TCEQ regulates water quality for waters of the state. Permit applications for USACE-regulated waters are joint applications with the TCEQ for evaluation of project impacts to water quality. Therefore, potential impacts to water quality would be reviewed by the TCEQ during evaluation of the Department of the Army permit submitted to the USACE for the proposed project.

TxDOT will coordinate with the TCEQ during the review and evaluation of the proposed project relative to the TCEQ's 303(d) List of impaired water bodies occurring within the proposed project area that could potentially be impacted by construction and operation of the proposed project.

7.8.3 PUBLIC DRINKING WATER SYSTEMS

Water wells within the proposed project area ROW would be plugged during construction according to TCEQ regulations to eliminate potential impacts to groundwater resources. Implementation of a storm water management plan and BMPs for construction and operation of the proposed project would avoid storm water runoff from entering groundwater aquifers at wellheads.

7.8.4 COASTAL ZONE MANAGEMENT PLAN AND ESSENTIAL FISH HABITAT

A portion of the Texas Coastal Management Zone associated with Buffalo Bayou traverses east-west through Segment 3. Construction activities of the Preferred Alternative requiring permit authorization from the USACE would necessitate formal coordination between TxDOT and the General Land Office regarding consistency with the Texas Coastal Management Program, thereby minimizing impacts to the coastal zone.

The proposed project would traverse Buffalo Bayou and a portion of White Oak Bayou, which are identified in the TCEQ's Texas Water Quality Inventory as tidal waters. Construction of bridge or culvert crossings of Buffalo Bayou or White Oak Bayou may potentially impact EFH. Coordination with the NMFS will be conducted. Impacts to the tidal waters of Buffalo Bayou and White Oak Bayou within the new ROW of the proposed project would be avoided to the extent practicable; however, should potentially adverse impacts to EFH be identified, additional coordination with the NMFS would be conducted as part of the required coordination process.

7.8.5 COASTAL BARRIERS

As stated in Section 3.7, no coastal barriers occur within the proposed project area. Therefore, no mitigation for coastal barriers would be required.

7.8.6 WILD AND SCENIC RIVERS

As stated in Section 3.13, no wild and scenic rivers listed in the National Inventory of the National Wild and Scenic Rivers System occur within the proposed project area. Therefore, no mitigation for wild and scenic rivers would be required.

7.9 Floodplains

Section 60.3 (d)(3) of the NFIP regulations states that a community is to "prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base (100-year) flood discharge" (FEMA 2000).

Based on NFIP regulations, prior to issuance of any construction permits involving activities in a regulated floodway, an engineering or "no-rise" certification would be obtained (FEMA 2019b). The request for certification must be supported by technical data stating that construction of the proposed project would not impact the base flood elevations, floodway elevations, or floodway data widths that are present prior to construction. A hydraulic analysis to the more stringent of City of Houston, HCFCD, and FEMA floodplain standards, defined at the time of the study, would be performed for the proposed project to obtain a letter of no objection from the local authorities.

7.10 Wetlands and Other Waters of the United States

During continued evaluation of the Preferred Alternative alignment, efforts would be made to avoid impacts to waters of the United States. Based on the proposed design, approximately 29 acres of aquatic resources, including approximately 19,150 linear feet of streams, are present within the existing and proposed new ROWs of the Preferred Alternative. Of the 29 total acres of identified aquatic resources, approximately 26 acres are preliminarily assessed as being potentially jurisdictional waters of the United States subject to regulatory authority. An identification and delineation of waters of the United States has been performed for the existing project ROW and the portions of the Preferred Alternative ROW where right-of-entry was authorized. Reports documenting the identification and delineation of waters of the United States will be submitted to the USACE for verification of the water bodies and wetlands regulated by the USACE. Discharges of dredged or fill material impacting jurisdictional waters of the United States or work or structures constructed within navigable waters of the United States would require authorization from the USACE and the USCG, as appropriate.

After USACE verification of the limits and jurisdictional status of the identified waters of the United States in the project area, an assessment of impacts to jurisdictional waters of the United States, including wetlands, would be performed for each water body and wetland occurring within the existing ROW and

proposed new ROW of the Preferred Alternative. Dependent on the findings of the verification from the USACE and the level of impacts to jurisdictional waters of the United States, an individual or nationwide permit pre-construction notification(s) would be prepared and submitted to the USACE for evaluation and processing. Proposed project activities may be authorized through the USACE's nationwide permit program, which allows for the authorization of fill activities having minor impacts on the aquatic environment. Project activities exceeding the threshold limits as established in the nationwide permit program would likely require authorization through a standard (i.e., individual) permit. A compensatory mitigation plan would be prepared as appropriate for the level of impact determined for project impacts and permitting (individual or nationwide) to compensate for unavoidable adverse impacts to jurisdictional waters of the United States, including wetlands. The USACE's wetland and stream functional assessment procedures would be used to identify wetland and stream functions and services, which would serve as the basis to develop compensatory mitigation to be considered as part of the permit review and evaluation. Mitigation for wetland or stream impacts would likely be accomplished through the purchase of wetland or stream credits from an approved mitigation bank. Natural resource agencies would be involved in the review of the permit application and the proposed compensatory mitigation plan(s). Water quality certification, as required by Section 401 of the CWA, would be assessed by the TCEQ as part of the Department of the Army permit review process.

7.11 Vegetation and Wildlife

All landscaping that would be implemented as part of the proposed project would be in accordance with EO 13112 on Invasive Species and the April 26, 1994, Executive Memorandum on Beneficial Landscaping. 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
- Reduce fertilizer and pesticide use
- Implement water-efficient and runoff-reduction practices
- Create outdoor demonstration projects employing the above measures and practices

Where possible, the ROW of the Preferred Alternative would be revegetated upon completion of roadway construction. Open areas would be revegetated and maintained according to standard TxDOT practices. Other landscape measures may include tree and shrub plantings.

In accordance with EO 13112 on Invasive Species, the Executive Memorandum on Beneficial Landscaping, and the 1999 FHWA guidance on invasive species, all revegetation within the Preferred Alternative alignment would, to the extent practicable, use only native species. Upon completion of earthwork activities, disturbed areas would be reseeded according to TxDOT specifications and in compliance with EO 13112, where applicable.

Impacts to non-rare fish and wildlife would be minimized through initial project design considerations and through the avoidance and minimization of vegetation removal and stream channel disturbance. Construction activities would disturb only that which is necessary to construct the proposed project, including minimizing disturbance to inert microhabitats (e.g., snags, brush piles). The removal of native vegetation would be avoided to the greatest extent practicable, and BMPs would be utilized to avoid impacts to fish and wildlife within the project area during construction activities. Construction activities that require the temporary diversion of water or dewatering of construction areas would require an Aquatic Resource Relocation Permit from TPWD and would be coordinated with the TPWD Kills and Spills Team (KAST) prior to construction.

7.12 Threatened and Endangered Species

In accordance with the *Best Management Practices Programmatic Agreement* between TxDOT and TPWD under the 2013 MOU, BMPs have been defined for implementation by TxDOT in order to minimize impacts to federally and state-listed species and SGCNs. Table 7-1 summarizes those BMPs related to species that have suitable habitat within the proposed project area. There are no TPWD-approved BMPs for the SGCN plant species.

Table 7-1: Best Management Practices for State-listed Species and Species of Greatest Conservation Need

Species	BMP
Plains spotted skunk*	Contractors will be advised of potential occurrence in the project area, to avoid harming the species if encountered, and to avoid unnecessary impacts to dens.
Southeastern myotis bat Rafinesque's big-eared bat	All bat surveys and other activities that include direct contact with bats shall comply with TPWD-recommended white-nose syndrome protocols located on the TPWD Wildlife Habitat Assessment Program website under "Project Design and Construction." The following survey and exclusion protocols should be followed prior to commencement of construction activities. For the purposes of this document, structures are defined as bridges, culverts (concrete or metal), wells, and buildings. ▪ For activities that have the potential to impact structures or trees; a qualified biologist will perform a habitat assessment and occupancy survey of the feature(s) with roost potential as early in the planning process as possible or within one year before project letting. ▪ For roosts where occupancy is strongly suspected but unconfirmed during the initial survey, revisit feature(s) at most four weeks prior to scheduled disturbance to confirm absence of bats. ▪ If bats are present or recent signs of occupation (i.e., piles of guano, distinct musky odor, or staining and rub marks at potential entry points) are observed, take appropriate measures to ensure that bats are not harmed, such as implementing non-lethal exclusion activities or timing or phasing of construction. ▪ Exclusion devices can be installed by a qualified individual between September 1 and March 31. Exclusion devices should be used for a minimum of seven days when minimum nighttime temperatures are above 50°F and minimum daytime temperatures are above 70°F. Prior to exclusion, ensure that alternate roosting habitat is available in the immediate area. If no suitable roosting habitat is available, installation of alternate roosts is recommended to replace the loss of an occupied roost. If alternate roost sites

Species	BMP
	are not provided, bats may seek shelter in other inappropriate sites, such as buildings, in the surrounding area. ▪ If feature(s) used by bats are removed as a result of construction, replacement structures should incorporate bat-friendly design or artificial roosts should be constructed to replace these features, as practicable. ▪ Large hollow trees, snags (dead standing trees), and trees with shaggy bark should be surveyed for colonies and, if found, should not be disturbed until the bats are no longer occupying these features. Post-occupancy surveys should be conducted by a qualified biologist prior to tree removal from the landscape. ▪ Retain mature, large-diameter hardwood forest species and native/ornamental palm trees where feasible. ▪ In all instances, avoid harm or death to bats. Bats should only be handled as a last resort and after communication with TPWD.
Louisiana pigtoe Sandbank pocketbook Texas pigtoe	▪ When work is in the water; survey project footprints for state-listed species where appropriate habitat exists. ▪ When work is in the water and mussels are discovered during surveys; relocate state-listed and SGCN mussels under TPWD authorization and implement Water Quality BMPs. ▪ When work is adjacent to the water; Water Quality BMPs implemented as part of the SW3P for a CGP or any conditions of the 401 water quality certification for the project will be implemented. ▪ Water Quality BMPs: • Minimize the use of equipment in streams and riparian areas during construction. When possible, equipment access should be from banks, bridge decks, or barges. • When temporary stream crossings are unavoidable, remove stream crossings once they are no longer needed and stabilize banks and soils around the crossing.
American eel Creek chubsucker*	▪ For projects within the range of a SGCN or state-listed fish and work is adjacent to water: Water Quality BMPs. ▪ For projects within the range of a SGCN or state-listed fish, and work is in the water: TPWD coordination required. (TPWD coordination was completed on 12/1/2016).
Alligator snapping turtle	Minimize impacts to wetland and riverine habitats. Apply Amphibian and Aquatic Reptile BMPs: ▪ Unless absence of the species can be demonstrated, assume presence in suitable habitat and implement the following BMPs. Absence can only be demonstrated using TPWD-approved survey efforts (contact TPWD for minimum survey protocols for species and project site conditions). ▪ For projects within one mile of a known occupied location or observation of the species recorded from 1980 until the current year and suitable habitat is present, coordinate with TPWD. ▪ For new location roadway projects, coordinate with TPWD. (TPWD coordination was completed on 12/1/2016). ▪ For projects within existing ROW when work is in water or will permanently impact a water feature and potential habitat exists for the target species complete the following:

Species	BMP
	• Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered. • Minimize impacts to wetland, temporary and permanent open water features, including depressions, and riverine habitats. • Maintain hydrologic regime and connections between wetlands and other aquatic features. • Use barrier fencing to direct animal movements away from construction activities and areas of potential wildlife-vehicle collisions in construction areas directly adjacent, or that may directly impact, potential habitat for the target species. • Apply hydromulching and/or hydroseeding in areas for soil stabilization and/or revegetation of disturbed areas where feasible. If hydromulching and/or hydroseeding are not feasible due to site conditions, using erosion control blankets or mats that contain no netting, or only contain loosely woven natural fiber netting is preferred. Plastic netting should be avoided to the extent practicable. • PSLs proposed within state-owned ROW should be located in uplands away from aquatic features. • When work is directly adjacent to the water, minimize impacts to shoreline basking sites (e.g., downed trees, sand bars, exposed bedrock) and overwinter sites (e.g., brush and debris piles, crayfish burrows) where feasible. • Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter, which may be refugia for terrestrial amphibians, where feasible. • If gutters and curbs are part of the roadway design, where feasible install gutters that do not include the side box inlet and include sloped (i.e., mountable) curbs to allow small animals to leave roadway. If this modification to the entire curb system is not possible, install sections of sloped curb on either side of the storm water drain for several feet to allow small animals to leave the roadway. Priority areas for these design recommendations are those with nearby wetlands or other aquatic features. ▪ For projects that require acquisition of additional ROW and work within that new ROW is in water or will permanently impact a water feature, implement the items listed above plus the items listed below, where applicable: • For sections of roadway adjacent to wetlands or other aquatic features, install wildlife barriers that prevent climbing. Barriers should terminate at culvert openings in order to funnel animals under the road. The barriers should be of the same length as the adjacent feature or 80 feet long in each direction, or whichever is the lesser of the two. • For culvert extensions and culvert replacement/installation, incorporate measures to funnel animals toward culverts such as concrete wingwalls and barrier walls with overhangs. • When riprap or other bank stabilization devices are necessary, their placement should not impede the movement of terrestrial or aquatic wildlife through the water feature. Where feasible, biotechnical streambank stabilization methods using live native vegetation, or a combination of vegetative and structural materials should be used.

Species	BMP
Timber rattlesnake	Terrestrial Reptile BMPs ▪ Apply hydromulching and/or hydroseeding in areas for soil stabilization and/or revegetation of disturbed areas where feasible. If hydromulching and/or hydroseeding are not feasible due to site conditions, using erosion control blankets or mats that contain no netting or contain loosely woven, natural fiber netting is preferred. Plastic netting should be avoided to the extent practicable. ▪ For open trenches and excavated pits, install escape ramps at an angle of less than 45 degrees (1:1) in areas left uncovered. Visually inspect excavation areas for trapped wildlife prior to backfilling. ▪ Inform contractors that if reptiles are found on project site allow species to safely leave the project area. ▪ Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter where feasible. ▪ Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered.
Wood Stork	Bird BMPs In addition to complying with the MBTA, perform the following BMPs: ▪ Prior to construction, perform daytime surveys for nests including under bridges and in culverts to determine if they are active before removal. Nests that are active should not be disturbed. ▪ Do not disturb, destroy, or remove active nests, including ground nesting birds, during the nesting season. ▪ Avoid the removal of unoccupied, inactive nests, as practicable. ▪ Prevent the establishment of active nests during the nesting season on TxDOT owned and operated facilities and structures proposed for replacement or repair. ▪ Do not collect, capture, relocate, or transport birds, eggs, young, or active nests without a permit.

Source: Best Management Practices Programmatic Agreement between TxDOT and TPWD Under the 2013 MOU. Reapproved in 2017.
*Note: BMPs for the plains spotted skunk and the creek chubsucker have been retained due to their inclusion in TPWD coordination in 2016; however, they are no longer listed as rare species on the Harris County list.

In addition to the BMPs discussed above for state-listed species, TxDOT commits to conducting a bat presence/absence survey for all structures — that have been determined to contain suitable bat roost habitat — prior to construction at these locations.

7.13 Soils and Geology

Specifications and design criteria used for the Preferred Alternative would address issues related to various soils, topographic or geologic conditions and limitations associated with the Preferred Alternative. Management of soil and dust to avoid and minimize erosion in compliance with applicable federal and state regulations and guidelines and in conformance with specific requirements of project permits.

7.14 Archeological Resources

In the event that unanticipated archeological deposits are encountered during construction, work in the immediate area shall cease, and TxDOT archeological staff (key contact: Dr. Jason Barrett,

Jason.barrett@txdot.gov, 713-802-5804) shall be contacted immediately to initiate post-review discovery procedures.

7.15 Historic Resources

7.15.1 Design Refinements

TxDOT made design refinements throughout project development and design to avoid and minimize impacts to historic properties. Design refinements have included narrowing roadway ROW widths and changing design of interchanges and elevated structures. For instance, along the Pierce Elevated section of I-45 on the west and south side of Downtown Houston, construction will be limited to the current freeway footprint, removing several historic properties from the NHHIP APE. Several historic properties in the Houston Warehouse Historic District are similarly no longer in the NHHIP APE because the alignment of I-10/I-45 was shifted to the northern edge of the historic district at this location. Following discovery of additional historically significant properties in the project APE in the Germantown Historic District, TxDOT modified I-45 frontage road and ramp placement to avoid adverse effects to historic properties at that location. Similar examples of design modifications are present elsewhere in the project APE. As a result of design refinements, TxDOT avoided or minimized impacts to numerous historic properties.

7.15.2 Design-Build Prescriptives

Portions of NHHIP would be delivered under design-build contracts. For these types of projects, TxDOT provides the schematics to the bidding contractor with restrictions and special commitments, referred to as "prescriptives". Several prescriptives regarding treatment and consideration for historic properties have been documented in Section 12.7 of the "Special Provision to Item 12: Environmental" document to be included in the design-build contract specifications. The contractor must commit to building the project according to the NHHIP schematic design as shown in the Final EIS. See Appendix R, Programmatic Agreement. The design-build office will notify TxDOT ENV of any changes to these schematics in the vicinity of historic properties so that proper coordination with consulting parties and Texas SHPO occurs as warranted. A copy of the design-build contract and the prescriptives contained therein for historic properties will be provided to the Texas SHPO.

The design-build prescriptives were considered when making determinations of effects to historic properties. These prescriptives mandate that:

- New ROW or easements cannot be obtained within 300 feet of identified historic properties without coordination with the THC. A list of these historic properties is attached as part of the Special Provision to Item 12 design-build specification. The list corresponds to NRHP-listed and NRHP-eligible properties identified in the September 2019 *Historical Resources Survey Report — Update* (Appendix H to the Final EIS). (Item 12.7)
- A "no-work zone" will be established on construction plans and in the contract documents within 300 feet of historic property boundaries. A "no-work zone" for a historic property is an area where any potentially damaging project activities such as storage yards, waste disposal, borrow pits, staging areas, or other related activities shall not be permitted. (Item 12.7)

- The contractor must limit vibration from equipment, prepare a vibration study, conduct a pre and post-construction survey, and monitor vibration near the Cheek-Neal Coffee Company Building and several buildings in the Warehouse District: San Jacinto Warehouse (1125 Providence Street), Carlisle Plastics Warehouse, south building (1133 Providence Street/1110 Naylor Street), Walter's Downtown/Bottling Works (1120 Naylor), and METRO Warehouse (1116 Naylor Street). (Item 12.7.1.)
- The contractor must conduct a traffic study along St. Emanuel Street between Texas Avenue and Commerce Street to assess the potential for additional vibratory impacts from conversion of St. Emanuel Street to one-way traffic during and following construction. (Item 12.7.1.1.1)
- The contractor must provide written notice to TxDOT when the Reader's Warehouse and Carlisle buildings are acquired and tenants have been relocated. The contractor must also provide a demolition plan for the Reader's Warehouse building and the metal-clad structure of the Carlisle Building to demonstrate that demolition and associated debris removal do not adversely impact or cause damage to surrounding buildings in the Warehouse District. Visual monitoring of adjacent buildings will be performed throughout demolition and debris removal. (Item 12.7.2)
- New bridge columns and foundations must be located within project ROW. New columns must be located at least 20 feet from any above ground portion of buildings in the Warehouse District that are located outside the project ROW. Associated foundations must be located at least 15 feet from any above ground portion of buildings in the Warehouse District that are located outside the project ROW. (Item 12.7.3)
- All elements of the Strauss-Bascule Railroad Bridge, including the counterweight and associated historical marker, are to be protected and the contractor must provide a protection plan detailing protective measures to the resource. Protective measures must include a protective cage to prevent construction debris from damaging the bridge or associated historical marker. (Item 12.7.4)
- The ornamental rail on the south approach to the Judge Hernandez Tunnel will be protected during project work and must not be damaged. (Item 12.7.5)
- The contractor will notify TxDOT prior to demolition of the Rossonian Cleaners building so that documentation of the building may take place. The contractor will also provide a demolition plan for the Rossonian Cleaners building to demonstrate that demolition and associated debris removal do not adversely impact or cause damage to surrounding buildings. (Unnumbered item between Items 12.7.5 and 12.7.6)
- The contractor will develop a demolition plan for the I-45 Pierce Elevated Bridge structures and associated road, drainage, and utility facilities. The demolition plan must demonstrate control procedures that avoid damage to adjacent structures and provide for dust and debris containment measures. The plan will specifically identify protective measures for identified historic properties that could potentially be damaged by the demolition of the Pierce Elevated Bridge structures and associated facilities, and by debris removal associated with the demolition. Damage caused must be repaired by the contractor. (Item 12.7.6.)

- The identified historic properties in the vicinity of the I-45 Pierce Elevated structure are:
  - Condominiums, 2016 Main Street
  - Sacred Heart Cathedral, 1111 Pierce Street
  - 500 Jefferson Building, 500 Jefferson Street
  - Sam Houston Park, 1000 Bagby Street
- The contractor will develop a demolition plan for the I-10 mainlanes, frontage roads, and ramps between Milam Street and McKee Street. The demolition plan must demonstrate control procedures that avoid damage to adjacent structures and provide for dust and debris containment measures. The plan will specifically identify protective measures for identified historic properties that could potentially be damaged by the demolition of I-10 between Milam Street and McKee Street, and by debris removal associated with the demolition. Damage caused must be repaired by the contractor. (Item 12.7.7.)

The identified historic properties are:

- Tony's Barber Shop, 1204 Nance Street
- Henke's Ward Grocery, 1200 Nance Street
- 5th Ward Hotel, 1206 Nance Street
- San Jacinto Warehouse, 1125 East Freeway (1125 Providence Street)
- Gulf Coast Implement Building, 1021 N. San Jacinto Street

- Project roadway lighting within the viewshed of identified residential historic properties shall be designed and constructed to minimize the dispersion of light beyond the highway ROW and include current industry techniques and systems. (Item 12.7.8.)
- Noise barriers and aesthetic walls constructed near the Germantown, Near Northside, and Third Ward historic districts must use aesthetic treatments as directed by TxDOT based on coordination with the Texas SHPO. Noise barriers and aesthetic walls must be constructed in project ROW. Noise abatement measures will be designed and implemented utilizing current industry methods (such as innovative pavement designs, bridge decks and joints, berms, noise barriers, and landscaping) to minimize noise effects on historic properties. (Item 12.7.9).
- Photographs must be provided for an identified list of historic properties, as part of pre-construction record surveys. (Item 12.7.10)

The identified historic properties are:

- Judge Hernandez Tunnel, North Main Street at Daly Place
- Myers-Spalti Manufacturing Plant, 2115 Runnels Street
- Gribble Stamp Company, 121 St. Emanuel Street
- Houston Water Works, 27 Artesian Street
- Navigation Underpass, Navigation Boulevard at Commerce Street
- City Hall Plaza, 900 Bagby Street

- Strauss-Bascule Railroad bridge, former railroad ROW underneath US 59 near Race Street
- Cheek-Neal Coffee Building, 2017 Preston Street
- Downtown Houston Post Office, 401 Franklin Street
- Hollywood Cemetery, 3506 North Main Street
- Apartments, 2016 Main Street
- Sacred Heart Cathedral, 1111 Pierce Street
- 500 Jefferson Building, 500 Jefferson Street
- Tony's Barber Shop, 1204 Nance Street
- Henke's 5th Ward Grocery, 1200 Nance Street
- 5th Ward Hotel, 1206 Nance Street
- Union Transfer and storage, 1113 Vine Street
- Gulf Coast Implement Company, 1021 N San Jacinto Street
- Historic Districts:
  - Germantown Historic District
    - 1212 Wrightwood Street
  - Near Northside Historic District
    - 109 Carl Street
  - Houston Warehouse Historic District Warehouse
    - 1125 Providence Street (San Jacinto Warehouse)
    - 1120 Naylor Street (Walter's Downtown/Bottling Works)
    - 1133 Providence St (Carlisle Plastics south building)

- Streetscape improvements in the APE such as landscaping, tree plantings, ornamental street lighting, fencing, curbing, pavements, sidewalks, traffic calming, or other similar work will be specified in the design-build contract plans. Any work of this type within 150 feet of historic properties must be coordinated with TxDOT and the Texas SHPO.

7.15.3 MITIGATION

Adverse effects to historic resources as a result of this project have been minimized with careful planning and will be mitigated. TxDOT is developing programmatic approaches to mitigation, including a historic resources survey of East Downtown as mitigation for the adverse effect to the Houston Warehouse Historic District and the Cheek-Neal Coffee Company Building. Measures to mitigation for adverse effects to historic properties are shown in Table 7-2 below.

Table 7-2: Mitigation Measures for Adverse Effects to Historic Properties.

Resource #	Property Name/Address	Mitigation
No number	Houston Warehouse Historic District	Windshield-level survey and other documentation of East Downtown Houston warehouse area, allowing future preservation enhancements by private owners or City of Houston Certified Local Government (CLG) program.
024	Readers Distributors Warehouse (1201 Naylor Street) — individually NRHP eligible and contributing to historic district	Historic American Buildings Survey (HABS)-like Level I/Level II archival documentation of property, possibly including interior.
029	Carlisle Plastics Building, north building (1133 Providence Street) — contributing resource to historic district	HABS-like Level I/Level II archival documentation of property, possibly including interior.
016	Cheek-Neal Coffee Company (2017 Preston Avenue)	Windshield-level survey and other documentation of the East Downtown warehouse area, allowing future preservation enhancements by private owners or City of Houston CLG program.
590	Rossonian Cleaners (3921 Almeda Road)	HABS-like Level I/Level II archival documentation of property prior to demolition. Reconnaissance-level survey of Almeda Road commercial corridor of Houston, allowing future preservation enhancements by private owners or City of Houston CLG program. Possible retention of 1920s portion of Rossonian Cleaners building, pending engineering analysis and owner acceptance.

7.15.4 PROGRAMMATIC AGREEMENT

Because final design will be contingent upon subsequent processes by a design-build contractor to be selected in 2021, TxDOT has executed a project-level PA for historic properties with the Texas SHPO and the ACHP (see Appendix R). The PA for historic properties sets procedures and practices in place designed to mitigate for known adverse effects such as demolition and buffers other historic properties in the APE and adjacent to the APE from unanticipated additional adverse effects. The PA for historic properties includes the design prescriptives and mitigation commitments as described in this section.

7.16 Hazardous Materials

If hazardous constituents are unexpectedly encountered in the soil and/or shallow groundwater during construction operations, appropriate measures for the proper assessment, remediation, and management of the contamination would be initiated in accordance with applicable federal, state, and local regulations. In the event of an accidental spill of hazardous materials, TxDOT would work with other agencies and its contractors to secure the scene and implement appropriate spill response measures. Standard spill response procedures are outlined in 30 T.A.C. Chapter 327. The following general recommendations were made relating to the project corridor.

- An ASTM-conforming Phase I environmental site assessment would be conducted prior to property acquisition.
- All construction contractors would be instructed to immediately stop all subsurface activities in the event that potentially hazardous materials are encountered, an odor is identified, or significantly stained soil is visible. Contractors and maintenance personnel would be instructed to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process.
- Special provisions or contingency language would be included in the proposed project's Plans, Specifications, and Estimate to handle hazardous materials and/or petroleum contamination according to applicable state, federal, and local regulations per TxDOT Standard Specifications. Hazardous items that require special handling would be removed only by certified and licensed abatement contractors having documentation of prior acceptable work.
- Further analysis of identified potential sites of concern and their proximity in the project area would occur during design development.

7.17 Visual and Aesthetic Qualities

As indicated by FHWA's Guidelines for the Visual Impact Assessment of Highway projects (January 2015), design-related mitigation considerations often occur during the design process rather than during NEPA but may result from input received on the project during the public involvement process. Additionally, FHWA's regulations prohibit final design activities until the NEPA process is complete (23 CFR 771.113(a)). Some types of specific design elements and specific details regarding design elements cannot be determined until the project enters the final design phase, after completion of the NEPA process. However, certain elements intended to mitigate the visual impacts of the project were considered during the NEPA process, as discussed below.

Where practicable, mitigation measures include: Landscape plantings and revegetation per TxDOT's Green Ribbon Landscape Improvement Program, which allocates funds for trees and plants within roadway ROW; promoting roadside native wildflower planting programs; noise barriers; providing adequate signage and easy access to roadway facilities; treatment of the side surfaces and columns of the project using façade materials of varying texture, color, etc.

Proposed detention areas are being evaluated as potential green spaces. The detention areas will not be parks. TxDOT will coordinate with local groups and agencies to accommodate enhancements to standard landscaping and recreational use of green space in and around storm water detention areas, where feasible. Wet bottom detention basins will be considered if a partner entity agrees to maintain them.

Miscellaneous aesthetic improvements along Heights Bike Trail between Taylor Street and Main Street will be provided (coordinated by TxDOT with Houston Parks Board and other entities).

Landscaping would include regionally native plants for landscaping and implementing design and construction practices that minimize adverse effects on the natural habitat. To the extent possible, the

proposed project would be designed to create an aesthetically and visually pleasing experience for both roadway users and roadway viewers.

The project would substantially reduce the highway footprint in the area of Sam Houston Park and Buffalo Bayou, creating opportunities for additional greenspace. There are opportunities for aesthetic enhancements under elevated sections of the highways. The Mayor of Houston has appointed a committee to oversee the potential designs and funding options for uses for the open space areas in Segment 3 and TxDOT will consider its recommendations.

All lighting would be in accordance with the Texas Health and Safety Code Title 5 425.002 regarding light pollution. To the extent possible, outdoor lighting fixtures would only be installed and operated if the purpose of the lighting cannot be achieved by the installation of reflective road markers, lines, warning, or informational signs, or other effective passive methods.

Additionally, full consideration would be given to energy conservation, reduction of glare, minimizing light pollution, and preserving the natural light environment. An example of commonly used lighting meeting these considerations is the use of high-pressure sodium lamps equipped with glare shields.

7.18 Section 4(f) Resources

Table 7-2 in Section 7.15 describes mitigation measures for historic resources that would be adversely affected under Section 106 of the NHPA.

There are no feasible and prudent avoidance alternatives to the use of Section 4(f) properties: Warehouse Historic District, Readers Distributors Warehouse, Carlisle Plastics, Cheek-Neal Coffee Company Building, and Rossonian Cleaners. The project includes all possible planning to minimize harm to the Section 4(f) properties. The project complies with other related laws, including Section 6(f) of the Land and Water Conservation Fund Act and Chapter 26 of the TPW Code, when applicable.

Due to extensive efforts to avoid direct impacts and uses to park resources, there are no direct impacts to parks. The Preferred Alternative would not result in a use of or adverse impact to any Section 4(f) park properties. Although there would be no use and no adverse impact to Sam Houston Park, it bears mentioning for beneficial impacts. The proposed action would substantially reduce the highway footprint in the area of Sam Houston Park. With the proposed project, noise levels are predicted to decrease by 3 decibels at approximately the center of the park.

For additional information on 4(f) properties and TxDOT's commitments, refer to Appendix O: *Individual Section 4(f) Evaluation* in this document.

8 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

During the agency coordination and public involvement for the NHHIP, TxDOT has ensured adherence to all regulatory guidelines and policies in compliance with federal and state statutes and sound public involvement practice. TxDOT has solicited and encouraged involvement of all stakeholders during the planning process and incorporated input received in the various planning activities. During the project, TxDOT has provided accurate and timely information, proactively sought early and continuing public input and involvement, and has been responsive to inquiries and suggestions. Input from all stakeholders has been reviewed and considered. TxDOT has addressed proactive efforts to ensure meaningful opportunities for public participation including activities to increase low-income and minority participation.

A selection of agency coordination documents is attached to this Final EIS as Appendix M. See also technical reports for the various resource categories summarized in this Final EIS.

This section summarizes the activities and methods utilized to communicate with project stakeholders. In 2011, TxDOT initiated the preliminary design and environmental document preparation phase to develop and evaluate alternatives to meet the highway transportation goals in the study area. The NOI to prepare an EIS was published in the State and Federal Registers in October 2011. At that time, TxDOT and FHWA were joint lead agencies for the EIS. On December 16, 2014, TxDOT assumed responsibility from FHWA for reviewing and approving certain assigned NEPA environmental documents including the NHHIP Draft and Final EISs. The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by TxDOT pursuant to 23 U.S.C. 327 and an MOU dated December 16, 2014 and renewed on December 9, 2019, and executed by FHWA and TxDOT.

To facilitate public and agency input in the development of the project, an Agency Coordination and Public Involvement Plan was developed for the project (see the 2015 document on the project website at http://ih45northandmore.com/docs/18_NHHIP%20ACPIP%20Combined%20042015.pdf). The plan was initially developed by TxDOT and FHWA to facilitate and document the structured interaction with the public and other agencies and to inform the public and other agencies how the coordination would be accomplished. The Agency Coordination and Public Involvement Plan promotes early and continuous involvement from stakeholders, agencies, and the public, and describes the proposed project, the roles of the agencies and the public, the project need and purpose, schedule, level of detail for alternatives analysis, methods to be used in the environmental analysis, and the proposed process for coordination and communication. The plan was updated several times during the EIS process.

Scoping meetings were held to discuss project goals and objectives, define the project need and purpose, identify potential issues of concern, and present the alternatives screening process and initial project alternatives. Public meetings were held to present and solicit comments on the alternatives evaluation and the Reasonable Alternatives, including the Proposed Recommended Alternative. The Public Hearing was held to present the schematic design and Draft EIS document and solicit comments from the general

public as well as agencies and elected officials. In addition, hundreds of stakeholder meetings were held to discuss project design, operation, impacts, issues of concern and other topics.

Additionally, the following communication tools were used to assist with delivering a consistent and thorough message to the public and stakeholders.

8.1 Website

Updated information was posted periodically on the project website, www.ih45northandmore.com. The updates consisted of text, graphics, videos, 3D visualizations of the Proposed Recommended Alternatives, project newsletter, the Draft EIS, draft technical reports for the Final EIS, the schematic designs of the Preferred Alternative, public involvement events, and other information. The visualizations included geometric features, including number of lanes, intersections, ramps, and bridges. Agencies and the public were able to review project materials, meeting information, agency coordination and public involvement activities, schedules, and responses to comments received; check on the status of the project; and submit comments and questions on the "Comments/Contact Us" tab.

8.2 Media Releases

Media releases were sent to the media prior to the public meetings, the Public Hearing, and other meetings; and when study documents were posted on the website.

8.3 Early Coordination for North Houston Transportation Studies

In 2001, METRO, TxDOT, and the H-GAC began a study to evaluate alternatives for transit and highway improvements for a corridor from Downtown Houston to SH 242, principally in the area between I-45 and Hardy Toll Road in Harris County, Texas. The North-Hardy Planning Studies were conducted in partnership with the elected officials representing the North-Hardy Corridor's constituency; the various public agencies responsible for transportation system planning and operation; a diverse group of stakeholders that lived or worked in the North-Hardy Corridor; and numerous individual, interested citizens. During the studies, the sponsoring agencies conducted public meetings and other community stakeholder meetings. The North-Hardy Corridor Alternatives Analysis Report was completed in 2003 and recommended that the transit alternatives be examined prior to detailed evaluation of highway alternatives. The assessment of transit alternatives was completed in February 2004 and the assessment of highway alternatives was completed in November 2005. The North-Hardy Planning Studies were conducted with extensive community outreach and consensus-building including 15 formal stakeholder meetings, 12 public meetings, and 104 small group or one-on-one meetings.

8.4 Coordination Since 2011

When TxDOT began the subsequent project development process to evaluate alternatives for highway improvements in the corridor in more detail, the development of the initial mailing list of stakeholders for the NHHIP started with those on the mailing list from the North-Hardy Planning Studies, which included over 2,800 individuals and interested citizens. For the NHHIP mailing list, elected officials, government

agencies, local organizations, civic groups, businesses, landowners and interested citizens were added and updated. The notifications for the first scoping meeting for the NHHIP were mailed to 4,805 mailing addresses, and over time the list has been updated to include attendees at meetings, commenters and others, and the list currently has 5,700 mailing addresses. TxDOT also maintains a project email list, and TxDOT sends project information and news to approximately 6,751 email addresses.

TxDOT has conducted continuous public involvement and agency coordination for the NHHIP for more than eight years, including public and neighborhood meetings in the most directly impacted neighborhoods. In 2011, TxDOT began preparation of the EIS. When the EIS process was imitated in October 2011, TxDOT created the project website http://ih45northandmore.com/ to provide project information early in the study process and throughout the development and analysis of the project, as discussed in more detail below and in Section 2 of the Final EIS. Public involvement and agency coordination for the EIS included scoping meetings, public meetings, a Public Hearing, and more than 300 meetings with stakeholders along the project corridor. The project purpose and need, alternatives, and mitigation have been refined as a result of feedback from communities, local government and other agencies, and other stakeholders.

During the study process, TxDOT has provided accurate and timely information, proactively sought early and continuing public input and involvement, and has been responsive to inquiries and suggestions. Input from all stakeholders has been reviewed and considered. TxDOT has addressed proactive efforts to ensure meaningful opportunities for public participation including activities to increase low-income and minority participation. Meeting with stakeholders is an important activity during the project development process and is particularly important for public involvement efforts across such a large and diverse community study area. Stakeholders can identify potential issues and concerns related to the project design and operation. Based on comments received on the Draft EIS, including at the May 2017 Public Hearing, the Proposed Recommended Alternative presented in the Draft EIS was revised and is presented as the Preferred Alternative in the Final EIS. In response to the numerous meetings with stakeholders, agencies, and other groups, modifications to the project were made that reduced impacts to the various communities along the study corridor and several examples of these are discussed in Section 2 Alternatives.

8.4.1 COOPERATING AND PARTICIPATING AGENCIES

As part of the project development process, a number of federal, state, and local government agencies were consulted prior to and during the preparation of the EIS. Some of these agencies are categorized as participating or cooperating agencies. Cooperating agencies are classified as agencies with jurisdiction by law or special expertise that are invited to serve as cooperating participants in the preparation and review of the EIS. Participating agencies are involved with coordination and review of the project and were invited to participate in agency meetings with the project team prior to public meetings and the Public Hearing. The FHWA and the federal and non-federal agencies currently designated as cooperating and/or participating agencies are listed in Table 8-1. In addition to the meetings discussed in Section 8.2.2, TxDOT attended other meetings with many of these agencies.

Table 8-1: Agency Roles

Agency	Role
Federal Agencies	
Advisory Council on Historic Preservation	Participating Agency
Federal Highway Administration	Conformity determination and assistance with interpretation of federal law and policy
Federal Transit Administration	Cooperating Agency Participating Agency
U.S. Army Corps of Engineers	Cooperating Agency Participating Agency
U.S. Coast Guard	Cooperating Agency Participating Agency
U.S. Environmental Protection Agency	Cooperating Agency Participating Agency
U.S. Fish and Wildlife Service	Cooperating Agency Participating Agency
State Agencies	
Texas Commission on Environmental Quality	Participating Agency
Texas Department of Transportation	Lead Agency
Texas General Land Office Coastal Coordination Council	Participating Agency
Texas Historical Commission	Participating Agency
Texas Parks and Wildlife Department	Participating Agency
Texas Railroad Commission	Participating Agency
Local Agencies	
Airline Improvement District	Participating Agency
City of Houston	Participating Agency
East Downtown Management District	Participating Agency
Greater East End Management District	Participating Agency
Greater Northside Management District	Participating Agency
Greater Southeast Management District	Participating Agency
Metropolitan Transit Authority of Harris County, Texas	Cooperating Agency Participating Agency
Harris County	Participating Agency
Harris County Flood Control District	Participating Agency
Harris County Toll Road Authority	Participating Agency
Houston-Galveston Area Council	Participating Agency

Agency	Role
Houston Downtown Management District (HDMD)	Participating Agency
Midtown Management District	Participating Agency
Montrose Management District	Participating Agency
North Houston District (formerly Greenspoint District)	Participating Agency

8.4.2 AGENCY MEETING SUMMARIES

This section discusses the agency meetings held with Cooperating and Participating agencies at the time of the 2011 and 2012 scoping meetings, 2013 and 2015 public meetings, and the 2017 Public Hearing. Other meetings with agencies are discussed below.

8.4.2.1 November 14, 2011 — Agency Scoping Meeting

Two agency scoping meetings were held on Monday, November 14, 2011, at TxDOT, Houston District Office, 7600 Washington Avenue, Houston, Texas. Invitations were mailed to 13 participating agencies and four cooperating agencies on October 11, 2011. Seven individuals representing three agencies (METRO, H-GAC, and HCFCD) attended the morning meeting for participating agencies. One individual from METRO attended the afternoon meeting for cooperating agencies. Meeting attendees were provided an agenda, exhibit packet, informational handout, survey form, comment form, and a project map. Reference materials were also available, including a project area map, aerial map, the draft Need and Purpose Statement and the draft Agency Coordination and Public Involvement Plan. An open discussion followed the scoping meeting presentation. No written comments were submitted at the meeting. All information presented at the agency meeting was the same information as was presented at the public meeting and is described below in the discussion of the public meeting.

8.4.2.2 October 10, 2012 — Agency Scoping Meeting

Two agency scoping meetings were held on Wednesday, October 10, 2012 at the TxDOT, Houston District Office, 7600 Washington Avenue, Houston, Texas. Invitations were mailed to 17 participating agencies and six cooperating agencies on September 18, 2012. Six individuals representing three agencies (HCFCD, City of Houston, and HDMD/Central Houston, Inc.) attended the morning meeting for participating agencies. Seven individuals representing four agencies (METRO, H-GAC, FHWA, and USACE) attended the afternoon meeting for cooperating agencies. Meeting attendees were provided an informational handout, survey form, and comment form. Reference materials were also available including the exhibits from the first public scoping meeting, the *North-Hardy Planning Studies, Alternatives Analysis Report (Highway Component*), a summary of the first public scoping meeting, a glossary of common terms, the draft Need and Purpose Statement, and the Agency Coordination and Public Involvement Plan. An open discussion followed the scoping meeting presentation. No written comments were submitted at the meeting. All information presented at the agency meeting was the same information as was presented at the public meeting and is described below in the discussion of the public meeting.

8.4.2.3 November 13 and 14, 2013 — Agency Meeting #3

Two agency meetings were held in November 2013 at the TxDOT Houston District office, 7600 Washington Avenue, Houston, Texas. The meeting for participating agencies was on Wednesday, November 13. The meeting for cooperating agencies was on Thursday, November 14. Invitations were mailed to 13 participating and six cooperating agencies on November 1, 2013 and October 11, 2013, respectively. There were 14 individuals representing seven agencies (Greater Northside Management District, H-GAC, City of Houston, Harris County Public Infrastructure Department, HDMD, TPWD, FHWA) in attendance at the meeting for the participating agencies. Four individuals representing two agencies (USACE and METRO) attended the meeting for the cooperating agencies.

Meeting attendees were provided an informational handout, survey form, and comment form. Reference materials were also available, including the exhibits from the first and second public scoping meetings; the *North-Hardy Planning Studies, Alternatives Analysis Report (Highway Component)*; a summary from the first and second public scoping meetings; a glossary of common terms; the Need and Purpose Statement; and the Agency Coordination and Public Involvement Plan. An open discussion followed the public meeting presentation. No written comments were submitted at the meeting. All information presented at the agency meeting was the same information as was presented at the public meeting and is described below in the discussion of the public meeting.

8.4.2.4 April 22, 2015 — Agency Meeting #4

Two agency scoping meetings were held on Wednesday, April 22, 2015, at the TxDOT, Houston District Office, 7600 Washington Avenue, Houston, Texas. Twenty-one invitations were mailed to participating agencies on March 24, 2015. There were 14 individuals representing nine agencies (Airline Improvement District, Central Houston Inc., East Downtown Management District, Greater East End Management District, Greater Northside Management District, HCFCD, HCTRA, H-GAC, and HDMD) in attendance at the meeting for the participating agencies. Six invitations were mailed to cooperating agencies on March 20, 2015. No agency representatives attended the meeting for the cooperating agencies.

TxDOT provided agency meeting attendees with an informational handout and comment form. A narrated presentation and the public meeting exhibits were displayed on-screen. A three-dimensional (3D) visualization video of the Proposed Recommended Alternative was shown. Reference materials were also available, including the North-Hardy Planning Studies, Alternatives Analysis Report (Highway Component); meeting summaries of the first three public meetings; a glossary of common terms; the Need and Purpose Statement; and the Agency Coordination and Public Involvement Plan. An open discussion followed the presentation. No written comments were submitted at the meeting. All information presented at the agency meeting was the same information as was presented at the public meeting and is described below in the discussion of the public meeting.

8.4.2.5 May 8, 2017 — Agency Meeting

Two agency meetings were held on May 8, 2017 at the TxDOT Houston District office, 7600 Washington Avenue, Houston, Texas. Invitations were mailed to 27 participating agencies and seven cooperating

agencies on April 28, 2017. Eight agency representatives attended the meeting for participating agencies. No agency representatives attended the meeting for the cooperating agencies.

TxDOT provided agency meeting attendees with an update on study activities since the April 2015 agency meetings. The Public Hearing schedule, informational handout, comment form, and Draft EIS were presented and discussed. A narrated presentation and the Public Hearing exhibits were displayed on-screen. An open discussion followed the presentation. No written comments were submitted at the meeting. All information presented at the agency meeting was the same information as was presented at the Public Hearing and is described below in the discussion of the Public Hearing.

8.4.3 PUBLIC MEETING SUMMARIES

8.4.3.1 November 15 and 17, 2011: Public Meeting #1: Scoping

One round of public meetings was held at two different locations. The meeting was held in an open house format. The purpose of the meetings was to invite the public to help define the study area, the draft Need and Purpose Statement, and the goals and objectives for the project, and to identify issues to be evaluated during the environmental review process. Summary information from the *North-Hardy Planning Studies, Alternatives Analysis Report (Highway Component)* was presented. Copies of the draft Agency Coordination and Public Involvement Plan, and the draft Need and Purpose Statement were available for review. Comment forms allowed the public to provide their comments on the draft Need and Purpose Statement and the draft Agency Coordination and Public Involvement Plan, and to prioritize project concerns. Comments were also accepted after the meeting during the specified comment period via letters and email.

Notification of the public scoping meetings included notices published in the Federal Register and Texas Register; legal advertisements (English and Spanish) published in newspapers and online; letters mailed to elected officials; postcards (English and Spanish) mailed to elected officials, government agencies, local organizations, civic groups, businesses, landowners and interested citizens; and website postings; and dynamic messaging signs.

The public scoping meetings were held at Jefferson Davis High School (November 15, 2011) and Aldine Senior High School (November 17, 2011). A total of 311 people attended the public scoping meetings. A total of 172 people (including agencies and the public) submitted written comments during the comment period. The written comments were submitted at the scoping meetings, and by mail and email. Topics that were more prevalent among the comments were project alternatives, modes of transportation, neighborhood quality of life, impacts to neighborhoods, homes, and businesses, noise and vibration, flooding and drainage, visual impacts, project goals, design themes and landscaping, project would benefit suburban areas, and adversely affect City of Houston residents, connect Hardy Toll Road to Downtown Houston, historic resources and cemeteries, double-decked roadways, and the Draft Need and Purpose and Draft Agency Coordination and Public Involvement Plan.

All comments received were considered as the Study Team developed and evaluated roadway alternatives for the project. The Public Meeting Summary Report, which included comments and responses to

comments, was posted on the project website. Comments on the Draft Need and Purpose and Draft Agency Coordination and Public Involvement Plan were considered by as the documents were finalized.

8.4.3.2 October 9 and 11, 2012: Public Meeting #2: Scoping

A second round of public scoping meetings was held at two separate locations in an open house format to present the Universe of Alternatives and the initial screening process used to select six Preliminary Alternatives for further study. The proposed secondary screening process was presented that would be applied to the six Preliminary Alternatives to select three Reasonable Alternatives, which would be presented at Public Meeting #3. Exhibits were presented, and copies of the final Agency Coordination and Public Involvement Plan and final Statement of Need and Purpose were available. The screening matrix of the Universe of Alternatives was available for review and discussion during Public Meeting #2. Also available for review were a study area environmental constraints map; the project need, purpose, goals, and objectives; the study process and methods; a proposed project schedule; and contact information. Comment forms were provided to allow the public to provide comments on the information presented. Comments were accepted after the meeting during the specified comment period via letters and email.

Notification of the public scoping meetings included legal advertisements (English and Spanish) published in newspapers and online; letters mailed to elected officials; postcards (English and Spanish) mailed to elected officials, government agencies, local organizations, civic groups, businesses, landowners and interested citizens; website postings; and dynamic messaging signs.

The public scoping meetings were held at Jefferson Davis High (October 9, 2012) and Aldine Ninth Grade School (October 11, 2012) A total of 235 people attended the public scoping meetings. A total of 640 people (including agencies and the public) submitted written comments during the comment period. Of the comments received, 237 were a signed petition. The Public Meeting Summary Report, which included comments and responses to comments, was posted on the project website. Two commenters asked about additional Spanish-language information. In response to the request, TxDOT provided additional information in Spanish at the subsequent public and agency meetings and did conduct a bilingual Public Hearing. TxDOT ensured that Spanish-speaking project team members were present and available at all public meetings and provides a Spanish-speaking contact at the TxDOT Public Information Office.

8.4.3.3 November 14 and 19, 2013: Public Meeting #3

A third round of public meetings was held at two separate locations in an open house format to present the three Reasonable Alternatives selected from the six Preliminary Alternatives. The screening process that was used for the three Reasonable Alternatives was presented. The screening process that would be applied to select the Proposed Recommended Alternative from among the three Reasonable Alternatives was presented. The Proposed Recommended Alternative would be presented at Public Meeting #4. A study area environmental constraints map; the project need, purpose, goals, and objectives; the study process and methods; a proposed project schedule; and contact information were also presented. Exhibits were presented and copies of the Agency Coordination and Public Involvement Plan and the Statement of Need and Purpose were available. Comment forms were provided to allow the public to provide

comments on the information presented. Comments were accepted after the meeting during the specified comment period via letters and email.

Notification of the public meetings included legal advertisements (English and Spanish) published in newspapers and online; letters mailed to elected officials; postcards (English and Spanish) mailed to elected officials, government agencies, local organizations, civic groups, businesses, landowners, and interested citizens.; website postings; emails; online messaging by TxDOT (Twitter and Facebook); and dynamic messaging signs.

The public meetings were held at Aldine Ninth Grade School (November 14, 2013) and at Jefferson Davis High School (November 19, 2013). A total of 322 people attended the public meetings. A total of 199 people (including agencies and the public) submitted written comments during the comment period. All comments received were considered as the Study Team developed and evaluated roadway alternatives for the project. The Public Meeting Summary Report, which included comments and responses to comments, was posted on the project website.

8.4.3.4 April 23, 28, and 30, 2015: Public Meeting #4

A fourth round of public meetings was held at three separate locations in an open house format to present the Proposed Recommended Alternative selected from the three Reasonable Alternatives. Exhibits showing the Proposed Recommended Alternative were available for review. The public meeting included a narrated presentation describing the need for and purpose of the project, the study process, the Proposed Recommended Alternative, and how to provide comments. A 3D visualization video of the Proposed Recommended Alternative was shown during the meeting. Comment forms were provided for the public to submit written comments during or after the meeting. All attendees were informed that written comments could also be submitted after the meeting via mail, email, or on the project website by the end of the comment period.

Notification of the public meetings included legal advertisements (English and Spanish) published in newspapers and online; letters mailed to elected officials; postcards (English and Spanish) mailed to adjacent property owners, local businesses, city, state, and federal officials, homeowner associations, and local organizations and institutions; website postings; emails; online messaging by TxDOT (Twitter and Facebook); and dynamic messaging signs.

The public meetings were held at Aldine Ninth Grade School (April 23, 2015), Houston Community College Central Campus (April 28, 2015), and Jefferson Davis High School (April 30, 2015). A total of 540 people registered their attendance at the public meetings, including 8 media representatives and 7 elected officials. More than 500 comments (in comment forms, letters, or emails) were received during the comment period from agencies, elected officials, organizations (including businesses), and the public.

The Public Meeting Summary Report, which included comments and responses to comments, was posted on the project website. Specific comments and questions about the alternatives and project design, potential project impacts, public involvement, and other issues identified in the comments were evaluated by TxDOT and the Study Team and considered during the project development process.

Of the comments received, 90 were submitted on comment forms that were provided at the public and agency meetings. Of the commenters who submitted the forms, 39 supported the project, 28 did not support the project, 18 were undecided, and five did not respond.

8.4.4 PUBLIC HEARING SUMMARY

The Draft EIS was released in April 2017. The Public Hearing was held in May 2017 to present the proposed improvements along the I-45 corridor and to receive public comments on the Reasonable Alternatives (including the Proposed Recommended Alternative) presented in the Draft EIS. Proposed design changes for the Proposed Recommended Alternative (as compared to the one documented in the Draft EIS) were also presented at the Public Hearing. The Public Hearing was held at St. Pius X High School (May 9, 2017) and the Houston Community College Central Campus (May 11, 2017). A total of 514 people attended the Public Hearing (at the two locations). Notification of the Public Hearing included legal advertisements (English and Spanish) published in newspapers and online; letters mailed to elected officials and agencies; postcards (English and Spanish) mailed to adjacent property owners, local businesses, city, state, and federal officials, homeowner associations, and local organizations and institutions; website postings; emails; online messaging by TxDOT (Twitter and Facebook); and dynamic messaging signs.

Due to construction at Northside High School (former Jefferson Davis High School), and lack of another suitable facility in the area, a third venue/date for the hearing was not initially identified by TxDOT. For a Public Hearing that TxDOT expected would be attended by hundreds of people, TxDOT prefers, at minimum, auditorium seating or other chairs for the comfort of attendees; large areas for exhibits, tables (registration, environmental, ROW, find-your-home station); access and accommodations that meet ADA requirements; and suitable parking. At the request of elected officials, TxDOT did identify an alternate venue and conducted an additional meeting on May 15, 2017 at St. Arnold Brewing Company to provide an additional opportunity for public comment in the vicinity of the Near Northside and Greater Fifth Ward neighborhoods. This meeting was held in the same format as a Public Hearing, and the same information from the Public Hearing was presented. A total of 232 people attended the meeting. Although held in a non-traditional venue, where attendees sat at picnic tables in the tasting room in the building, TxDOT was able to successfully accommodate attendees, present project information, receive comments, and have good discussions with attendees. Notification of the additional meeting included announcements at the Public Hearings; website postings; emails; online messaging by TxDOT (Twitter and Facebook); and dynamic messaging signs.

At the request of elected officials and other stakeholders, TxDOT extended the original Draft EIS comment period to allow additional time for review of the Draft EIS and preparation and submission of comments. The original 45-day comment period was extended 30 days, from June 27, 2017, to July 27, 2017. Comments were accepted at the Public Hearing, by mail and email, at the TxDOT Houston District office, and on the project website.

Based on public and agency comments received during and after the comment period, the Study Team revised the Proposed Recommended Alternative that was presented at the Public Hearing, and design changes were incorporated into the Preferred Alternative included in the Final EIS. Section 2 of the Final EIS describes and illustrates the design changes. Responses to Comments are included in Volume III.

8.4.5 OTHER STAKEHOLDER ENGAGEMENT EFFORTS

Between July 2013 and August 2019, TxDOT attended over 300 stakeholder meetings, presenting project information and seeking input on the project need and purpose; environmental, engineering, and other constraints; other issues of concern; alternatives evaluation criteria; schematic design alternatives; results of the impact analyses conducted the study process; impact minimization and mitigation strategies; and other topics.

TxDOT and the Study Team held meetings with individual stakeholders and had meetings with a collaboration of several stakeholder representatives. Information received during stakeholder meetings was taken into consideration as project alternatives were developed and refined and was incorporated into the Preferred Alternative to the extent possible. TxDOT shared project information including presentations, display boards, and handouts at most meetings. These stakeholders include:

- Management Districts[12] and Chambers of Commerce
- Super Neighborhoods, Neighborhood Associations, and Civic Clubs
- Agencies
- Tax Increment Reinvestment Zone (TIRZ) and Redevelopment Authorities
- Local, State, and National Officials
- Organizations and Associations
- Corporations
- Businesses and Property Owners
- Other Stakeholders

Table 8-2 provides a summary of the stakeholder meetings conducted from July 2013 through August 2019, excluding the agency and public meetings and the Public Hearing discussed above.

Table 8-2: Stakeholder Meeting Summary (July 2013 through August 2019)

Stakeholder	Number of Meetings
Management Districts and Chambers of Commerce	
Houston Downtown Management District	30
East Downtown Management District	11
East End Cultural District	2
Greater Northside Management District	10
Greater Southeast Management District (Houston Southeast)	4

[12] The management districts listed are special districts created by the Texas legislature, and are empowered to promote, develop, encourage and maintain employment, commerce, transportation, housing, tourism, recreation, arts, entertainment, economic development, safety, and the public welfare in specific geographic areas.

Stakeholder	Number of Meetings
North Houston District (formerly Greater Greenspoint Management District)	2
Houston Northwest Chambers of Commerce	1
Midtown Management District	2
Super Neighborhoods*, Neighborhood Associations, and Civic Clubs	
Super Neighborhood No. 24 — Montrose/Neartown	1
Super Neighborhood No. 55 — Greater Fifth Ward	1
Super Neighborhood No. 62 — Midtown	1
Super Neighborhood No. 64 — Greater Eastwood	2
Super Neighborhood No. 66 — Museum Park	1
Super Neighborhood Alliance Advisory Board	2
First Montrose Commons Neighborhood Association	1
Avenue Place Civic Club	1
East Bayou District Civic Club	2
Eastwood Civic Association	1
Hidden Valley	1
Lindale Park Civic Club	2
Near Northside Civic Club	2
Pleasantville Civic League	1
Greater Third Ward (Complete Communities Initiative)	1
Second Ward (Complete Communities Initiative)	1
Near Northside (Complete Communities Initiative)	1
Old Spanish Trail Community Partnership	1
Riverside Civic Association	1
Independence Heights Neighborhood	1
Other Community Stakeholder meetings	4
Agencies	
Aldine Independent School District	1
City of Houston (Mayor's Office and various departments)	37
Federal Highway Administration	1
H-GAC (Houston-Galveston Area Council)	10
Houston First Corporation	5
METRO (Metropolitan Transit Authority of Harris County)	9
Harris County Toll Road Authority	1
Harris County Flood Control District	3

Stakeholder	Number of Meetings
Houston Coalition for the Homeless	1
Houston Housing Authority	6
Houston Independent School District	2
Gulf Coast Rail District	5
Harris County — Houston Sports Authority	1
Texas Health and Human Services	1
U. S. Army Corps of Engineers	1
Texas Historical Commission	5
Tax Increment Reinvestment Zones and Redevelopment Authorities	
TIRZ No. 2 — Midtown Redevelopment Authority	1
TIRZ No. 3 — Main Street-Market Square Redevelopment Authority	1
TIRZ No. 5 — Memorial Heights Reinvestment Zone	1
TIRZ No. 7 — Old Spanish Trail/Almeda	1
TIRZ No. 13 — Old Sixth Ward	1
TIRZ No. 14 — Fourth Ward	1
TIRZ No. 15 — East Downtown Redevelopment Authority/TIRZ No. 15	3
TIRZ No. 21 — Hardy/Near Northside Redevelopment Authority	1
TIRZ No. 23 — Harrisburg Redevelopment Authority	1
Independence Heights Redevelopment Council	2
Local, State, and National Officials	
Senator Sylvia Garcia	2
Representative Jessica Farrar	2
Representative Garnet Coleman	4
Representative Carol Alvarado	2
Mayor Sylvester Turner	2
Houston Councilmember Karla Cisneros	3
Houston Councilmember Robert Gallegos	2
Houston Councilmember Jerry Davis	1
Texas Transportation Commissioner Laura Ryan	3
Texas Transportation Commissioner Victor Vandergriff	3
Organizations and Associations	
Air Alliance Houston	1
American Institute of Architects	1
American Society of Civil Engineers	1

Stakeholder	Number of Meetings
Associated General Contractors	1
Bike Houston	2
Buffalo Bayou Partnership	3
Coalition of Organizations	4
Houston Parks Board	4
Kinder Foundation	1
North Houston Association	1
I-45 Coalition	1
Rice Design Alliance	1
Risk Management Association	1
South Main Alliance	3
University of Houston-Downtown	5
Corporations	
Central Houston, Inc.	3
Houston Astros	1
Houston Dynamo	1
Gensler (George R. Brown Convention Center Operations)	4
Lovett Commercial (Downtown Post Office Developer)	2
TranSystems Corporation	2
Union Pacific Railroad	4
Business and Property Owners	
City View Terrace	1
Ecclesia Church	1
United Methodist Church	1
Goodwill Missionary Baptist Church	1
Huynh Vietnamese Restaurant	1
Reader's Warehouse	1
Yen Huong Bakery	1
Toute Suite	1
Warehouse Property Owners	1
Cheek-Neal Coffee Building	4
Midway Developers	2
St. Arnold Brewery	1
Bethlehem Baptist Church	1

Stakeholder	Number of Meetings
Eaton Vance Real Estate Management	1
Chenevert Condominiums	1
Loaves and Fishes Magnificat Houses Ministries	2
Midtown Terrace Suites	1
Temenos Place Apartments II	1
SEARCH Homeless Services	3
Gallery Furniture	1
Northline Commons Mall	1
Macey Family Properties	1
Mexican Consulate	4
Universal Church	3
Culinary Institute LeNotre	1
Greater Mount Olive Missionary Baptist Church	4
Unity Spirit Missionary Worship Center	1
Centro Cristiano Church	1
Noise meetings with property owners	5
Other Stakeholders	
Individuals	7

Source: NHHIP Study Team 2019
Note: * The communities assessed along the project corridor are referred to as "super neighborhoods", which are geographically designated areas that are divided by major physical features and share common characteristics.

8.4.6 COMMUNITY OUTREACH: 2017–2019

As roadway alignment alternatives became more developed, the estimated ROW impacts to specific properties and individuals became clearer. In order to identify and address environmental justice concerns, TxDOT began to carry out more direct outreach in early 2017 to present the details of the updated design of the Preferred Alternative as a step toward more focused engagement with specific properties and individuals.

The Study Team began additional outreach to representatives of community facilities, organizations, and some businesses that serve or assist low-income, disabled, senior, children, minority, and LEP populations. This phase of public outreach was initially targeted those located within or near the proposed ROW of the Reasonable Alternatives for the proposed project. Following the May 2017 Public Hearing, outreach focus shifted toward those located within or near the proposed ROW of the Preferred Alternative. Many of these individuals and organizations have been continuously involved throughout the evaluation of the Preferred Alternative. Some individuals and organizations have been involved as early as the North-Hardy Planning Studies, building upon email lists and other contact information in order to maintain involvement

throughout a multi-year effort. Other entities were established only after publication of the Draft EIS, reinforcing the need for the project team to consistently reassess project design, impacts to affected communities, and stakeholders.

Communication methods included mailed letters, phone calls, emails, surveys, and questionnaires, many of which were followed by in-person site visits or meetings to achieve full and fair participation. The Study Team found that meeting people where they are — attending a meeting at their local community center or other gathering place — to be a simple and effective strategy that accommodates scheduling issues and other barriers often faced by environmental justice communities. When meeting representatives were invited to specific organizations it also encourages input for those who may not feel comfortable participating in the more formalized Public Hearings and meetings that TxDOT holds, which also allows the audience to set the agenda and focus on the more specific areas of interest regarding the proposed project.

Community outreach focused on facilities such as:

- Schools
- Places of worship
- Service providers — Including those that serve minority, low-income, homeless, veterans or other traditionally underserved populations
- Medical care facilities for low-income or LEP populations, and those providing services unique to the project area
- Businesses that specifically serve minority or LEP populations
- Low-income housing
- Cemeteries
- Housing for seniors and disabled populations
- Community centers
- Multi-family housing communities

The *Community Impacts Assessment Technical Report: Appendix F* provides more detailed information about coordination meetings that were either requested by community groups, open meetings concerning environmental justice issues, or resulted in considerable project design changes.

8.4.7 ENGAGEMENT EFFORTS

February 2017: TxDOT offered to meet to discuss the project and potential impacts to the property and/or services provided, in addition to providing additional information. TxDOT sent coordination letters to community organizations/facilities adjacent to or within the proposed ROW. The letter described the proposed project, included a project area map and diagram of the Segment 3 Proposed Recommended Alternative, and indicated whether the letter recipient was located within or near the project ROW. The outreach letters and mailing lists are included in the *Community Impacts Assessment Technical Repor*t, Appendix F.

September 2017: TxDOT sent a second coordination letter to those who had not responded to the February 2017 letter and were still within or near the ROW of the Preferred Alternative for the proposed project. This follow-up letter reiterated that TxDOT was available to discuss the proposed project and potential impacts to the property and/or services provided. TxDOT sent a similar coordination letter to additional community facilities and organizations that were newly identified within the proposed ROW of the Preferred Alternative. These letters and mailing lists are included in the *Community Impacts Assessment Technical Report*, Appendix F.

December 2017–July 2018: Because of nonresponse issues from many of the coordination letters from 2017, the Study Team reached out with phone calls and emails beginning in December 2017. Although no community centers would be directly impacted by the proposed project, five community centers that are near the project corridor were also contacted. Questionnaires were developed to assist with the discussion and understanding of potential project impacts to the facility, organization, or business and their clients, customers, or members. The Study Team contacted all of these entities by phone and sent questionnaires with varying success at engagement; some did not return the phone call, others were contacted by phone and then were emailed a questionnaire that was not returned, and some provided responses by email.

Several organizations requested a meeting, which TxDOT arranged to ensure awareness of the project and opportunities for participation. This was the case for many of these meetings; when a community group requested a meeting, TxDOT agreed to go to the area with project briefing materials to receive input.

8.4.7.1 Additional Community Outreach

Impact-specific questions were developed for — and distributed directly to — schools, service providers, places of worship, and businesses for widespread awareness of the proposed project. The questions generally focused on:

- Respondent's knowledge of the proposed project
- Demographic information
- Customers/clients served
- Locations where clients/customers reside
- Length of time the entity has operated or been at the current address
- Number of full and part-time employees
- If they are displaced, would they like to remain in the same area
- Specialized needs to relocate
- How they feel the proposed project would affect their customers and clients

The majority of respondents explained that they primarily serve or otherwise include environmental justice populations as part of their normal operations. This indicated that these locations are environmental justice facilities and ought to be considered as such in the analysis. This broadened the Study Team's understanding from Census data, which only provides demographic information for those

who live within the study area, potentially overlooking many of those that travel to environmental justice facilities for work, worship, attend school, or other services.

Nearly all who answered the question concerning relocation stated that they would prefer to relocate within the same area, either because they are well established within the surrounding communities or offer services unique to the area. Specific questions for each type of environmental justice questionnaire and the responses received are included in the *Community Impacts Assessment Technical Report*, Appendix F.

8.4.7.2 Advance Acquisition Notice and Site Visits

June 2018: TxDOT sent another letter to selected community organizations and businesses located with the proposed project ROW, advising them that they could apply for advance acquisition of the property. The advance acquisition notification letter and mailing list is included in Appendix N. lists those to which TxDOT sent an advance acquisition letter. Advance acquisition is TxDOT's ability to legally purchase ROW prior to environmental clearance or before a determination is made that the property is needed for a particular transportation project. Details on the early acquisition process can be found in TxDOT's ROW Acquisition Manual (Revised January 2019), on TxDOT's website.

It is important to note that the level of follow-up varies because some organizations (e.g., Mexican Consulate) were already coordinating with TxDOT for advance acquisition of their property. Where it was determined that some of these organizations would either not impacted directly, or minimal indirect impacts are anticipated, outreach was limited to letters and contact by phone.

July 2018: To overcome low response rates, and design changes that would impact other property owners, site visits were conducted by the NHHIP Study Team to attempt to contact some of the entities. If a person was not available at a location, a notice was left on the door or mailbox. Many of the places of worship could not be contacted during the site visits but later requested meetings by phone or in-person. Organizations and businesses provided feedback about how the proposed project could affect their customers/clients, and some met with TxDOT to discuss the project. Resources for further information were offered at the end of meetings, in addition to contact information for follow-up if requested.

November 2018–May 2019: Additional outreach to places of worship, schools and service providers located within the proposed project ROW was conducted by phone interview and/or email to discuss any additional concerns or needs due the proposed project. The interview included a question about clarification of relocation procedures and benefits. Many staff or volunteers at these organizations asked that the TxDOT Right of Way Division provide additional detail about relocation procedures and benefits, and other asked for meetings with TxDOT. Many of the organizations contacted requested advance acquisition of their properties, which TxDOT is actively reviewing and following the procedures under its guidelines.

8.4.7.3 Housing and Affordability

Housing affordability within the NHHIP project area was frequently raised in conversations with the public. Long-term, low-income, and minority households all face an increased risk of involuntary displacement as

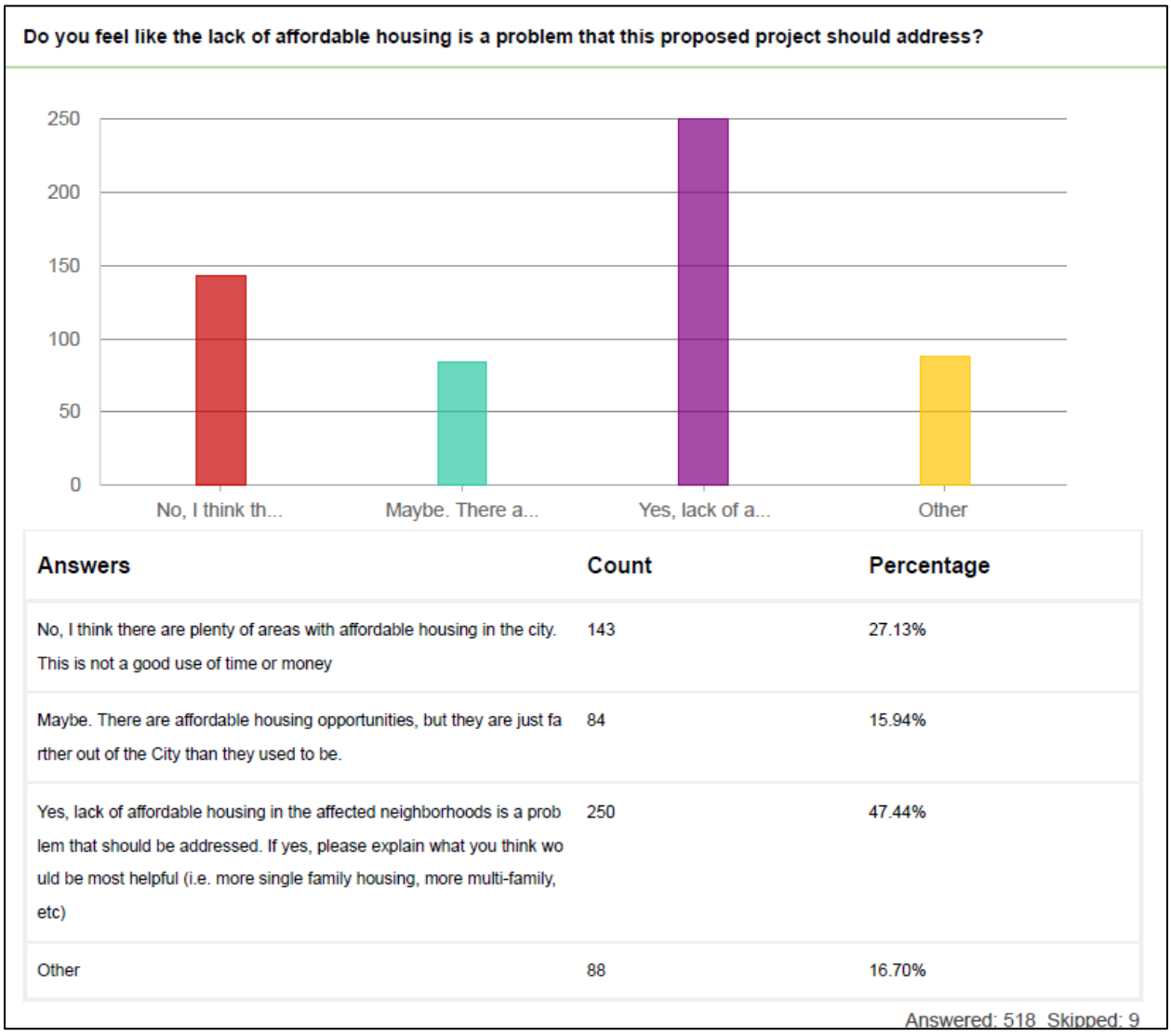
a result of increasing housing/property tax costs and other gentrification pressures. Transportation systems have associations with both of these issues, providing connections between housing and employment centers and other opportunities is one example. For this reason, along with the level of community concern over this issue regarding this project in particular, TxDOT included the question below on the mitigation survey (Figure 8-1). Results show general support from survey respondents on the need for NHHIP to address this problem, and TxDOT has committed to a number of mitigation strategies. See Tables A-1, A-2, and A-3 in Appendix A.

TxDOT has coordinated with HHA consistently throughout project development. Discussions focused on updates on planned relocation for housing, addressing new concerns or needs of HHA or residents, and additional suggestions or information needed for inclusion in this analysis.

Public and low-income housing units are approximately 60 percent of the housing displacements in Segment 3. The Preferred Alternative would displace public and low-income housing units at Clayton Homes, Kelly Village, Midtown Terrace Suites, and the Temenos Place Apartments II. The Temenos Place Apartments II is managed under a non-profit organization that offers affordable housing for low-income individuals, homeless individuals, and persons with disabilities. The Temenos Place Apartments II were constructed during the analysis of the Draft EIS; therefore, this development was not included in the previous study as a potential displacement.

In general, HHA does not have sufficient housing supply to meet the current demand for public housing units. The average wait period for public housing (public housing that is not specifically for elderly or disabled persons) is 18 months to two years. For one-bedroom apartments, the wait period is typically longer than two years. The average wait period for senior living communities is six to nine months (HHA 2016).

Figure 8-1: Housing Question on Mitigation Survey



Answers	Count	Percentage
No, I think there are plenty of areas with affordable housing in the city. This is not a good use of time or money	143	27.13%
Maybe. There are affordable housing opportunities, but they are just fa rther out of the City than they used to be.	84	15.94%
Yes, lack of affordable housing in the affected neighborhoods is a prob lem that should be addressed. If yes, please explain what you think wo uld be most helpful (i.e. more single family housing, more multi-family, etc)	250	47.44%
Other	88	16.70%

Answered: 518 Skipped: 9

Notes: The survey was available from August 6 through September 19, 2019. It was distributed in hard copy format and available on iPads at public involvement events held in August of 2019. It was also available via Survey 123 in ArcGIS Online, and the link to the survey was distributed via the project email distribution list. Approximately 540 people completed the survey.

TxDOT has held four meetings to date with HHA staff to discuss potential impacts to Clayton Homes and Kelly Village. TxDOT is coordinating with the HHA for advance acquisition of the Clayton Homes property and a portion of Kelly Village property and more detailed information regarding mitigation is found in Tables A-1, A-2, and A-3 in Appendix A.

8.4.7.4 Homelessness

A Meeting with the City of Houston Mayor's Office for Homeless Initiatives was held in December 2018. The meeting focused on addressing potential impacts to homeless populations that live in encampments in the proposed project ROW. Such meetings resulted in recommendations for specific groups and initiatives to partner with for relocation, such as "The Way Home", which has a goal to provide support

services and housing for people experiencing homelessness within the City of Houston. TxDOT met with the City of Houston Mayor's Office for Homeless Initiatives and the Coalition for the Homeless of Houston/Harris County, which is the lead agency for obtaining and managing federal and other funding and serves as the lead agency for "The Way Home" Continuum of Care program. At these meetings, the potential impact of the project to homeless persons was discussed. TxDOT will continue to coordinate with the City of Houston and other local homeless services providers to develop a plan to assist in the relocation of the homeless population in a safe and appropriate manner.

8.4.7.5 Schools of Concern

In May 2019, TxDOT met with representatives of HISD and Aldine ISD. TxDOT discussed the proposed project and potential positive and negative impacts to schools within 500 feet of the proposed project. These schools are predominately minority students, many of whom are economically disadvantaged or otherwise vulnerable. During these meetings, TxDOT offered to meet with additional school representatives to discuss specific concerns and issues, such as the timing of the relocation process and how it could interrupt or impact class schedules, and safe school crossings.

A follow-up meeting with school representatives from Houston Independent School District (HISD)'s Jefferson Elementary took place on June 6, 2019. Topics discussed included history of the school, student transportation to/from the school, and school priorities. TxDOT is continuing to coordinate with HISD and Aldine Independent School District. TxDOT has commitments that include ongoing public coordination with schools.

In June 2019, TxDOT met with representatives of Alpha and Omega Christian Academy which is affiliated with Centro Cristiano Church. The school and church would be displaced as a result of the proposed project. Alpha and Omega Academy has an enrollment of approximately 40 students from Pre-K through 12th grade, most of whom speak Spanish. TxDOT is coordinating for advance acquisition of the property, which would allow the school to rebuild a new school prior to displacement and without disruption to classes. Centro Cristiano Church is affiliated and would relocate along with Alpha and Omega Academy.

8.4.7.6 Multi-Family Communities

TxDOT conducted phone interviews or in-person meetings in May and June 2019 with staff or property owners at multi-family apartment communities that would be partly or entirely displaced by the proposed project. Sixteen multi-family communities were contacted, including five that are already working with TxDOT for advance acquisition of property. The remaining properties were contacted by phone and/or through in-person interviews. Seven facilities were contacted, four through phone interviews and three through in-person interviews. Four properties were visited but no contact with a leasing office, property owner, or resident occurred because two properties did not have a leasing office, and two properties were unoccupied. The Study Team recognizes that most of these residents should be assumed to be renters and has therefore considered them as such in the potential displacements analysis.

Completed questionnaire responses and other comments are summarized in the *Community Impacts Assessment Technical Report*, Appendix F.

8.5 Recent Public Involvement

8.5.1 Noise Meetings — 2019

TxDOT is proactively responding to community concerns about potential traffic noise impacts by holding informational noise meetings with adjacent affected property owners. These meetings occurred earlier than the typical noise workshop process to both provide information to residents, and to receive feedback on proposed traffic noise mitigation. The noise meetings also served as opportunities to provide general project information as discussion topics included concerns beyond traffic noise barriers, such as flooding and drainage. Meetings for proposed barriers in Segment 3 were held in 2019 due to the construction schedule for that segment. Those dates are listed below:

- June 4th — Young Women's College Preparatory Academy
- July 16th — Yellowstone Academy
- August 6th — Fifth Ward Multi-Service Center
- August 15th — Baker Ripley Leonel Castillo Community Center
- August 20th — Third Ward Multi-Service Center

A *Noise Meeting Summary Report* is available for review at the Houston District Office. Noise workshops, where property owners and residents officially vote for or against a proposed abatement measure, will still be held after environmental clearance for the project.

8.5.2 City of Houston and Mayor's Steering Committee

In June 2019, the City of Houston and TxDOT co-hosted two public meetings (June 20 and 26) to provide an overview and status update of the project, and to inform the public about the City-led engagement process for NHHIP. Mayor Turner initiated a Steering Committee to direct a series of meetings among various stakeholders within the project area, including TxDOT. The process is intended to gather information and further input to ultimately provide recommendations to the Mayor's Office. The City of Houston Office of the Mayor sent project recommendations to TxDOT (letter dated May 12, 2020), and TxDOT responded (letter dated May 20, 2020).

Although TxDOT has met with many of these stakeholders previously, efforts such as this are helpful to address the challenges in reaching residents that have been historically underrepresented in government decision making. Environmental justice populations often experience unique barriers to participation in the standard process of state agencies. Partnerships with HHA, City of Houston, and other stakeholders helps overcome these barriers by working through existing relationships and well-established communication methods. TxDOT executed an Interlocal Agreement with the City of Houston (July 2019) that documents the public participation process, the City's plan for summarizing public input and presenting recommendations to TxDOT, and cooperation between the agencies (TxDOT 2019b). TxDOT will continue discussions with the Mayor's office throughout the development of the project.

8.5.3 OTHER COMMUNITY OUTREACH EVENTS IN 2019

TxDOT has also hosted and participated in public involvement events coinciding with the beginning of City of Houston engagement during the summer of 2019 (Table 8-3). TxDOT hosted meetings with super neighborhood representatives, elected officials, and other invitees to provide an update about the proposed project, including updates about community impacts and proposed and potential mitigation measures. At the National Night Out and Back-to-School events, TxDOT provided project newsletters and solicited feedback about potential mitigation measures via a survey (see section below for more information).

Table 8-3: Community Outreach: June–August 2019

Event	Date	Location	Attendance
Residential and Community Interface Meeting	June 6, 2019	Houston Community College Central Campus	20
Residential and Community Interface Meeting	June 8, 2019	Leonel Castillo Community Center	58
Residential and Community Interface Meeting	June 11, 2019	Partnership Tower	22
Residential and Community Interface Meeting	June 13, 2019	Empowerment Community Center	18
Independence Heights Super Neighborhood Meeting	June 18, 2019	Independence Heights Community Center	15–25
Third Ward Super Neighborhood Meeting (includes Greater Third Ward Super Neighborhood leadership and committee leaders)	July 18, 2019	Third Ward Multi-Service Center	17
National Night Out — Precincts 1, 2 & 6 (Near Northside/5th Ward/East Downtown/East End)	August 6, 2019	Constable Precinct 6 Office	30+
Fifth Ward Super Neighborhood Meeting with State Senator Boris L. Miles: District 13*	August 7, 2019	Fifth Ward Multi-Service Center	100+
Near Northside Back-to-School Event	August 9, 2019	Castillo Community Center	63 Adults, 172 Children
Fifth Ward Super Neighborhood Workshop with Senator Miles	August 28, 2019	Fifth Ward Multi-Service Center	62

Note: *Given the high turnout at this meeting, TxDOT again worked with Senator Miles' office to co-host a second meeting at the same venue on August 28. The format was changed to a three-hour, come-and-go workshop to facilitate the most one-to-one interactions.

TxDOT's public involvement methods have expanded and become more flexible in response to the observed limitations of standard procedures. The intent is to increase the cross section of participants to meaningfully involve environmental justice and other vulnerable populations. The high rate of attendance at the initial meeting co-hosted with Senator Miles is likely due to the sharing of the event with the Senator's established district networks. These community workshops and other additional opportunities

for input as part of the Mayor's Steering Committee have already provided valuable insight to TxDOT, as concerns and suggestions have developed alongside the project itself.

8.5.4 MITIGATION FEEDBACK — 2019

As mitigation options are developed, TxDOT is making sure that the current options included are feasible and relevant to the area in question, and that it builds upon and addresses priority concerns as identified by the community in previous public involvement efforts. Community members were surveyed on topics based on feedback gathered since the publication of the Draft EIS. The survey was intentionally designed to be brief, thus avoiding time investment as a potential barrier for environmental justice communities. The Study Team also attended two back-to-school events in August to conduct intercept surveys with mobile tablets for respondents to quickly complete surveys. These annual resource fairs are well attended by minority households and people with low to moderate incomes. TxDOT also attended the August National Night Out community building event at for Precincts 1, 2, and 6 (covering the Near Northside, 5th Ward, East Downtown and East End neighborhoods). At all of these events, Study Team members distributed the project newsletter and handout with the survey URL code, in both English and Spanish. Spanish-speaking Study Team members were able to speak with the people with LEP or who preferred to speak Spanish. Some attendees completed the survey at the events and others took the URL handout to complete the survey later.

The survey was promoted in a newsletter email distribution sent to more than 6,500 subscribers who previously indicated interest in receiving project updates, and considerably increased responses.

The survey closed on September 20, 2019, after being live for six weeks. Information collected at these established community events likely resulted in more exposure and survey responses from underrepresented populations than traditional outreach methods. In addition to strengthening the overall validity of the survey and further refining mitigation options, the Study Team is able to better understand who lives in the project area, along with their concerns and hopes for the project. However, what proves to be effective for one community might not be as effective in another, which is one of the reasons for including a question about which neighborhood the respondent lives or does business in. Because Houston is one of the most diverse cities in the country, working with groups that have connections within specific communities is one of the most practical ways to quickly and effectively engage the public, especially environmental justice populations. This has included coalitions of concerned citizens, nonprofits, management districts, neighborhood associations, Complete Communities coordination meetings, and many others. TxDOT is committed to continuing to work with local leaders and representatives of community facilities, housing, and businesses used by environmental justice communities of concern to support the implementation of drafted mitigation measures.

The participation of environmental justice communities in the planning process aims to ensure that their priorities are addressed from the system-planning stage through the project development stage. Nearly all invitations from interested parties to present NHHIP briefings or more specific project information were answered by Study Team staff in some capacity. Current project design features are a direct result of changes implemented based on coordination with and input from stakeholders.

8.6 Limited English Proficiency and Accessibility

As a recipient of federal assistance, TxDOT complies with various nondiscrimination laws and regulations, including Title VI of the Civil Rights Act of 1964 and EO 13166: Improving Access to Services for Persons with LEP, to promote inclusive public involvement. TxDOT has conducted public involvement and the project development process in consideration of soliciting participation from and providing benefits to all project stakeholders, regardless of race, religion, color, national origin, sex, age, or disability. Primary methods for identifying LEP and Title VI populations have included:

- Review of U.S. Census data
- Review of data on languages spoken by residents
- Review of City of Houston neighborhood profiles
- Review of H-GAC mapping of minority areas
- Review of data on area schools
- Field reconnaissance to view communities and community resources such as medical service providers
- Input at public and other stakeholder meetings

Techniques for reaching out to LEP and Title VI populations have included:

- Provided notices and meeting materials in Spanish
- Provided Spanish speakers at all meetings
- Provided simultaneous Spanish translation during the Public Hearing
- Offered to provide additional language assistance, if requested
- Sent meeting notifications and newsletter to neighborhood civic clubs, places of worship, community centers, service providers, schools, businesses, and others, including in areas where minority populations were identified
- Conducted meetings in locations with adequate public parking, accessible entries, and compliant with the ADA

To help identify and engage stakeholders, TxDOT provides accommodations for LEP individuals during project development, along with opportunities to request further language assistance and other accessibility accommodations. Throughout the project area, Spanish is the main language spoken by those who reported speaking English “less than very well” according to Census data. As a matter of best practice, TxDOT translates essential materials where the Spanish LEP population is known to be substantial, such as the Houston District. NHHIP project documents are routinely bilingual (e.g. presentations, comment forms, exhibit boards and informational pamphlets related to ROW acquisition and relocation assistance). Many of these documents are also made available on the project website to both provide adequate notice, and to ensure continual access to updated project information for LEP populations. The mitigation survey completed in 2019 was also available in Spanish and included four respondents from this language group.

For the formal TxDOT public meetings and hearing discussed below, notices were published in English and Spanish in local newspapers including the Houston Chronicle, Defender, and La Voz (a Spanish-language newspaper). Bilingual public meeting notices were mailed to adjacent landowners, community organizations, elected officials, government officials, civic groups, and published on the project website to ensure sufficient opportunities for community input in the NEPA process and provide information on how citizens could request language interpreters. The project team included bilingual staff during both public meetings and the hearing to assist those that may be uncomfortable communicating in English. Although no advance requests for language assistance were received, some meeting attendees preferred speaking Spanish and were assisted by project team members fluent in Spanish. Simultaneous Spanish translation was provided during the hearing as well. TxDOT displayed 3D visualizations of the Preferred Alternative to make complex engineering information more understandable in general, and clearly convey major changes resulting from the project.

In May 2017, the HHA organized informational meetings for the culturally and linguistically diverse residents of Clayton Homes and Kelly Village. The first meeting, held on May 17, 2017, at Kelly Village, was attended by approximately 30 residents and staff from TxDOT and HHA. Interpretation in Swahili was performed, providing LEP residents with information on the overall project, units that would be impacted (including portions of the park), relocation services, and housing resources. The meeting also included time for residents to ask questions directly after the presentation in order to address any specific concerns.

The second meeting was held on May 18, 2017, at Clayton Homes and approximately 60 residents attended along with staff from TxDOT and HHA. Interpretation was provided in Swahili, Spanish and Haitian Creole, which provided residents with information on the overall project, and that all units would be impacted. A question and answer session was also included in this meeting to address specific concerns raised, such as the relocation of the Head Start Program. Both of these on-site meetings were held to help ensure awareness of the proposed project, in addition to demonstrating that accommodations are available for LEP participation as the project develops.

Site visits were conducted in order to verify and supplement LEP data described in the Community Profile section. Primarily within Segment 1, several businesses and places of worship have Spanish-language names or signs. In Segment 3, a few businesses with Asian-language names are located on the east side of Downtown, including a bakery and restaurants that would be displaced. During community outreach, attempts were made to talk with these businesses to discuss the project and get input on potential impacts from these organizations and business owners (discussed in the *Community Impacts Assessment Technical Report*).

Select businesses and churches with names in languages other than English include Centro Cristiano Church, which has been continuously in contact with project staff. After directly discussing their interests and concerns, this facility applied for advance acquisition of their property. The Study Team also met with the owners of Yen Huong Bakery, which makes specialty deserts and pastries for the Vietnamese and Chinese community. This culturally specific business is owned by an Asian property owner who speaks limited English. TxDOT met with the owner and English-speaking brother to discuss the option of applying

for advance acquisition of the property, among other topics. Detailed outreach to these businesses and places of worship are discussed in Section 6 of the *Community Impacts Assessment Technical Report*.

TxDOT will continue to comply with EO 13166 by offering to meet the needs of persons requiring special communication or accommodations in all public involvement activities and notices. Public involvement is conducted in a manner such that all interested parties are given an opportunity to provide further input on the proposed project.

8.7 Additional Public Involvement Requirements

Federal assistance requirements also mandate TxDOT undertake public involvement specific to historic properties potentially affected by a project. TxDOT is complying with regulations promulgated by the ACHP implementing Section 106 of the NHPA provide that "[t]he agency official shall seek and consider the views of the public in a manner that reflects the nature and complexity of the undertaking and its effects on historic properties, the likely interest of the public in the effects on historic properties, confidentiality concerns of private individuals and businesses, and the relationship of the federal involvement to the undertaking." 36 CFR 800.2(d)(1). Pursuant to the TxDOT–FHWA MOU (referenced above), TxDOT has sought and considered the views of the public in a manner that reflects the nature and complexity of the undertaking and its effects on historic properties, and the likely interest of the public in the effects on historic properties. ACHP's regulations provide that the agency official may use the agency's procedures for public involvement under NEPA or other program requirements to satisfy these requirements. 36 CFR 800.2(d)(3). For this project, potential impacts to historic properties were disclosed in the Draft EIS that was presented at the Public Hearing and subject to public notice and comment.

Chapter 26 of Title 3, Parks and Wildlife Code (PWC) section 26.001 outlines Public Hearing notice requirements for projects that take public lands designated and used as parklands, recreational areas, scientific areas, wildlife refuges or historic sites (3 PWC 26.001). The Public Hearing in May 2017 complied with the notice requirements of Chapter 26 because, at the time of the Draft EIS, it was envisioned that the project would use property from two public parks. However, the project has been redesigned to avoid those two public parks; therefore, there will be no use or taking of any public lands protected by Chapter 26.

8.8 Concurrent Outreach for the 2040 Regional Transportation Plan

As part of the planning process for developing the 2040 RTP, H-GAC conducted public outreach beginning in early 2013. The 2040 RTP is a guide for maintaining and improving the current transportation system and identifies priority transportation investments in the eight central counties of the 13-county H-GAC region. The proposed NHHIP was included in the Draft 2040 RTP and presented along with other proposed transportation investments in the region. H-GAC conducted a comprehensive public outreach process designed to achieve broad-based input. Public outreach sessions targeted the following groups:

- Elected and Appointed Officials
- Business, chamber of commerce, and transportation organizations

- Under-served or environmental justice populations, including low-income households, members of minority groups, zero-automobile households, elderly persons, persons with limited educational attainment, and persons with LEP.

A summary of public outreach by H-GAC is in Appendix J of the 2040 RTP, viewable at:

http://www.h-gac.com/regional-transportation-plan/2040/documents/Appendix%20J%20Public%20Outreach%20Summary.pdf

EJ-specific public outreach by H-GAC is also discussed in Appendix B of the 2040 RTP, viewable at:

http://www.h-gac.com/regional-transportation-plan/2040/documents/Appendix%20B%20Environmental%20Justice.pdf

When developing the 2040 RTP, H-GAC considered input received via the outreach efforts. The NHHIP is included in the 2040 RTP, which was approved and adopted in 2016.

The NHHIP is also in the 2045 RTP, which was released in May 2019. The 2045 RTP includes the proposed NHHIP as one of the recommended highway investments in the Houston-Galveston region to support the significant growth in regional travel (H-GAC 2019). Appendix D of the 2045 RTP includes details of the proposed project, including reconstruction of interchanges, reconstruction and widening of mainlanes and frontage roads, and increasing the number of managed lanes on I-45 from I-10 to Beltway 8. Guided by H-GAC's Public Participation Plan, H-GAC implemented a broad-based public outreach program in the development of the 2045 RTP. A variety of strategies were used to encourage participation by the traditionally underserved population, included in environmental justice communities.

A summary of public outreach by H-GAC is in Chapter 7 of the 2045 RTP, viewable at:

http://2045rtp.com/documents/plan/Chapter-7-Public-Involvement.pdf

8.9 Outreach During Construction

Since the hearing on the Draft EIS, more than 2,400 concerns and other comments have been considered in Final EIS documentation, but this does not signal the end of TxDOT's public involvement activities. Because public interest in transportation projects is usually at its highest during construction, TxDOT will continue outreach efforts with as much advance notice as possible. When construction timelines are established, TxDOT will work to accurately and thoroughly communicate important information such as alternative routes, detours, and the maintenance of property access during construction. This includes safe and efficient connections to and through neighborhoods during construction for all modes of transportation, including bicycles and pedestrians. TxDOT will provide a public website that will disclose the monitoring data compared to NAAQS limits and EPA and/or TCEQ air toxics health risk thresholds. The website will have an early warning alert system using the EPA and TCEQ Air Quality Index triggers.

Outreach efforts will be developed with partners such as METRO to inform the public about transit changes. Rider alerts and other media advisories will communicate new routing information, the potential for service delays and more crowded buses, and mitigation measures to anticipate and address these

impacts. Coordination with local government programs and bicycle/pedestrian groups will also be used to circulate information about construction activities using a variety of proven techniques such as changeable message signs, maintaining a project web page, email newsletters, traditional and social media, and broadly distributed flyers with a commitment to specific/impact populations.

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11 REFERENCES

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VOLUME II: FINAL EIS APPENDICES

(UNDER SEPARATE COVER)

Appendix A:	Final EIS Exhibits
Appendix B:	Preferred Alternative Schematic and Typical Sections
Appendix C:	Air Quality Technical Report (including the Mobile Source Air Toxics Technical Report and Carbon Monoxide Traffic Air Quality Analysis)
Appendix D:	Archeological Survey Report and Coordination
Appendix E:	Biological Resources Technical Report
Appendix F:	Community Impacts Assessment Technical Report
Appendix G:	Hazardous Materials Technical Report
Appendix H:	Historical Resources Survey Report — Update
Appendix I:	Traffic Noise Technical Report
Appendix J:	Water Resources Technical Report
Appendix K:	Waters of the United States Technical Report
Appendix L:	Visual Impact Assessment Technical Report
Appendix M:	Agency Coordination Documentation
Appendix N:	Public Involvement
Appendix O:	Individual Section 4(f) Evaluation
Appendix P:	Indirect Impacts Technical Report
Appendix Q:	Cumulative Impacts Technical Report
Appendix R:	Programmatic Agreement

VOLUME III: COMMENTS AND RESPONSES

(UNDER SEPARATE COVER)