APPENDIX J
WATER RESOURCES TECHNICAL REPORT

Water Resources Technical Report

North Houston Highway Improvement Project

From US 59/I-69 at Spur 527 to I-45 at Beltway 8 North
CSJ 0912-00-146
Prepared by: TxDOT Houston District
Date: February 2017

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 a Memorandum of Understanding dated December 16, 2014 and executed by FHWA and TxDOT

Project Background

The Houston metropolitan region, which includes Harris, Fort Bend, Montgomery, Brazoria, Galveston, Liberty, Waller, and Chambers counties, is among the fastest-growing metropolitan areas in the United States. According to the 2010 U.S. Census, the 8-county region's population is projected to grow from 5.8 million residents in 2010 to 9.6 million residents by 2040. This represents an increase of 66 percent over 30 years, or 1.5 percent growth each year. With the increase in population, traffic is also expected to increase. Therefore, it is critical to have an efficient transportation system to sustain the mobility needs of the growing population, and to continue to foster economic growth in the region.

Interstate Highway 45 (I-45) serves as a critical regional corridor for the existing and future movement of traffic between Dallas and the Houston/Galveston area. It is one of the shortest of the primary interstates (approximately 285 miles), and is the only primary interstate to be entirely within one state. I-45 is also a major hurricane evacuation route for southeast Texas. The Texas Department of Transportation (TxDOT) proposes to construct improvements to I-45 in the northern portion of the City of Houston. The proposed project, referred to as the North Houston Highway Improvement Project (NHHIP), begins at the interchange of I-45 and Beltway 8 North and continues south along I-45 to Downtown Houston where it terminates at the interchange of U.S. Highway (US) 59/I-69 and Spur 527 south of Downtown Houston. The project area also includes portions of I-10 and US 59/I-69 near Downtown Houston. The proposed project is composed of three segments, Segments 1-3, for which reasonable alternatives are evaluated in the Draft Environmental Impact Statement (Draft EIS) (Exhibit 1).

This water resources technical report supports the Draft EIS that evaluates the social, economic, and environmental impacts potentially resulting from the proposed project.

Existing Facilities

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 frontage road lanes (two lanes in each direction), and a reversible high occupancy vehicle (HOV) lane in the middle, all within a variable right-of-way (ROW) of 250 to 300 feet. The existing posted speed limit along the general purpose lanes and reversible HOV lane is 60 miles per hour (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 347 acres.

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

I-45 within this segment primarily consists of eight at-grade general purpose lanes (four lanes in each direction), six frontage road lanes (three lanes in each direction), and a reversible HOV lane in the middle, all within a variable ROW 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 six frontage road lanes associated with the depressed section (three lanes in each direction) 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 south of Downtown Houston.

I-45 along the west side of Downtown Houston consists of six elevated general purpose lanes (three lanes in each direction) within an existing ROW of 205 feet. I-45 along the south side of Downtown Houston (the Pierce Elevated) consists of six elevated general purpose lanes (three lanes in each direction). I-10 north of Downtown Houston, between I-45 and US 59/I-69, consists of 10 general purpose lanes (five lanes in each direction) within an existing ROW of 420 feet. US 59/I-69 along the east side of Downtown Houston consists of six general purpose lanes (three lanes in each direction) within an existing ROW of 225 feet. 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 7.1 miles, and the existing ROW area is approximately 637 acres.

Proposed Alternatives

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 managed express (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 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 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. 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.

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.

Waters of the United States, including Wetlands

A separate technical report has been prepared that describes waters of the United States, including wetlands, in the proposed project area. The report is included as Appendix K of the NHHIP Draft EIS.

Surface Water

The TCEQ has developed surface water quality standards that apply to all surface waters in the state of Texas (Texas Administrative Code Title 30, Chapter 307). These standards were last amended in June 2010 and represent rules designed to establish goals for water quality throughout the state. However, during the following triennial review, the TCEQ revised and adopted the 2014 standards and submitted the package to the EPA. This means that the 2014 standards are in effect for non-federal programs unless specifically disapproved by the EPA while the entire package is under

review. 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 surface waters in the state have been individually defined and assigned a unique identification number. The major surface waters of the state are grouped by the TCEQ into 25 basins, with each basin being 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 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 are protected by the general standards and screening levels corresponding to that use designation until data is available or generated through a Use Attainability Analysis study or otherwise.

Unique 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. 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.

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. 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.

Within the boundaries of the project area, there are six surface waters, including bayous and other tributaries. Surface water segments within the project area are detailed in Table 3-1.

Table 3-1. Texas Surface Water Quality Water Segments within Project Area

Water Segment	Name and Location	NHHIP Crossing		Category
		Segment(s)	Alternative(s)	
1006D	Halls Bayou (unclassified water body): From Greens Bayou confluence upstream to Frick Rd.	1	4, 5, 7	4
1007	Houston Ship Channel/Buffalo Bayou Tidal: From point immediately upstream of Greens Bayou to point 100 meters upstream of US 59, including tidal portion of tributaries	3	11, 12	5
1013	Buffalo Bayou Tidal: From point 100m upstream of US 59 to point 400m upstream of Shepherd Dr. including the tidal portion of tributaries	2, 3	Seg 2 – 10, 11, 12 Seg 3 – 10, 11	4
1013A	Little White Oak Bayou (unclassified water body): From White Oak Bayou confluence to Yale St.	1, 2,	Seg 1 – 4, 5, 7 Seg 2 – 10, 11, 12	5
1016C	Unnamed Tributary of Greens Bayou (unclassified water body): From the confluence with Greens Bayou, east of Aldine Westfield Road, to the Hardy Toll Road	1	4, 5, 7	4
1017	White Oak Bayou Above Tidal: From point immediately upstream of confluence of Little White Oak Bayou to point 3kilometers (1.9 miles) upstream of FM 1960	2	10, 11, 12	4

Source: TCEQ Texas 303(d) List 2014

Segments 1007 and 1013A are Category 5 waters, and are included in the TCEQ 303(d) List. Segments 1006D, 1013, 1016C, and 1017are listed in TCEQ's Water Quality Index (WQI) as Category 4 waters. Category 4 waters are defined as impaired waters for which Total Maximum Daily Loads (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 2014a). Water quality concerns for the six water segments in the project area for the years 2002 through 2014 are presented in Table 3-2.

Table 3-2. Texas Water Quality Assessment Results for Potentially Affected Water Bodies (2002-2014): Water Quality Assessment/303(d) List Details by Year

Year	Seg ID	Segment Name	Parameter(s)
2002	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Polychlorinated biphenyls in fish tissue; dioxin in catfish and crab tissue; pesticides in fish tissue
	1013	Buffalo Bayou Tidal	Bacteria; copper (chronic) in water
	1013A	Little White Oak Bayou (unclassified water body)	Bacteria; depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria
2004	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	PCBs in fish tissue; chlordane in fish tissue; dieldrin in fish tissue; dioxin in catfish and crab tissue; heptachlor epoxide in fish tissue
	1013	Buffalo Bayou Tidal	Bacteria
	1013A	Little White Oak Bayou (unclassified water body)	Bacteria; depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria
2006	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Dioxin in edible tissue; PCBs in edible tissue; bacteria; toxicity in sediment
	1013	Buffalo Bayou Tidal	Bacteria
	1013A	Little White Oak Bayou (unclassified water body)	Bacteria; depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria

Year	Seg ID	Segment Name	Parameter(s)
2008	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Dioxin in edible tissue; PCBs in edible tissue; bacteria; toxicity in sediment
	1013	Buffalo Bayou Tidal	Bacteria
	1013A	Little White Oak Bayou (unclassified water body)	Bacteria; depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria
2010	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Dioxin in edible tissue; PCBs in edible tissue; bacteria; toxicity in sediment
	1013	Buffalo Bayou Tidal	Not listed
	1013A	Little White Oak Bayou (unclassified water body)	Depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Not listed
2012	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Dioxin in edible tissue; PCBs in edible tissue; bacteria; toxicity in sediment
	1013	Buffalo Bayou Tidal	Bacteria
	1013A	Little White Oak Bayou (unclassified water body)	Depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria

Year	Seg ID	Segment Name	Parameter(s)
2014	1006D	Halls Bayou (unclassified water body)	Bacteria
	1007	Houston Ship Channel/Buffalo Bayou Tidal	Dioxin in edible tissue; PCBs in edible tissue; bacteria; toxicity in sediment
	1013	Buffalo Bayou Tidal	Bacteria
	1013A	Little White Oak Bayou (unclassified water body)	Depressed dissolved oxygen
	1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Bacteria
	1017	White Oak Bayou Above Tidal	Bacteria

Source: TCEQ Texas 303(d) Lists 2002-2014

TCEQ will review the standards for one or more parameters before a management strategy is selected, including the possible revision of the water quality standards (TCEQ 2014a).

Short-term Water Quality Impacts

The Texas Pollutant Discharge Elimination System (TPDES) program implements the federal National Pollutant Discharge Elimination System program. TCEQ administers stormwater permits for construction projects disturbing at least 1 acre within the state. The proposed project would disturb more than 1 acre of land, thereby requiring the preparation of a Stormwater Pollution Prevention Plan (SW3P). In addition, because the proposed project would disturb more than 5 acres, a Notice of Intent (NOI) for coverage under the TPDES Construction General Permit (CGP) would also be required. Once construction has been completed, a Notice of Termination would be filed per permit requirements. Lastly, in accordance with Section 402 of the CWA, where stormwater runoff would discharge to a Municipal Separate Storm Sewer System (MS4), the MS4 permittee would be notified of the construction activity.

As noted, 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 2002). Temporary and permanent erosion control practices from TxDOT's *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* (TxDOT 2014) would be implemented for the proposed project. The practices would be in place prior to and during the construction period 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. 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. Mitigation for the impacts mentioned above would include TxDOT BMPs that have been designed to limit water quality degradation from construction activities. 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.

Long-term Water Quality Impacts

Long-term operational effects on surface water quality would include changes in the volume of rainfall runoff and constituents carried in the runoff. Generally, runoff would contain sediment or pollutants in quantities that could impact water quality. For example, runoff from paved surfaces would carry particulate matter from tire wear and oils and greases from vehicles, and would be expected to include urban litter, such as paper and plastic materials. There is also the possibility of collisions on any roadway, regardless of operating characteristics and traffic volumes. Collisions can contribute to pollutants being conveyed in stormwater runoff, as a minimal amount of spilled chemicals would run off or be flushed into adjacent drainageways.

Construction of the proposed project would result in an increase in the overall area of impervious cover, which would result in minor increases in localized runoff contributed by the proposed project compared to existing conditions. Stormwater runoff from the proposed project would likely have little adverse effect on area receiving waters, as the project area is in a highly urbanized part of the City of Houston, and proposed detention facilities would collect stormwater runoff from the project area before it enters receiving waters. The proposed detention facilities would promote the settling of suspended solids that may, for some constituents in stormwater runoff, lead to reduced pollutant concentrations. A reduction in the volume of pollutants would result in a reduced pollutant load potentially being conveyed with stormwater runoff into receiving waters.

Construction, operation, and maintenance activities associate with the proposed project would not adversely impact water quality in the proposed project area. BMPs implemented during construction and operation would reduce the introduction of pollutants into receiving waters. Construction of the proposed project would not result in contamination to or adverse effect on a public water supply, as potable water sources are typically obtained from underground aquifers or surface water sources located outside the 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.

No Build Alternative Impacts

The No Build Alternative would have no impacts to existing surface water quality conditions. The No Build Alternative would maintain current conditions for detention areas, protection measures, and BMPs that reduce impacts to existing water resources and water quality. Stormwater runoff would continue to flow into receiving waters within and near the project area.

Groundwater

The major aquifer in the Houston area is known as the Gulf Coast Aquifer and consists of complexly interbedded clays, silts, sands, and gravels of Cenozoic age, which 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 is comprised of 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 Formation, 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 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 included below is from Baker (1979).

http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/ch01_intro.pdf

Table 4-1. Description of Gulf Coast Aquifer System Components

Hydrologic Unit	Maximum Thickness in Houston Area (feet)	Geologic Formation (oldest to youngest)	Composition	Water-bearing Properties*
Chicot Aquifer	480	Willis Sand, Bentley and Montgomery Formation (aka Lissie Formation), Beaumont Clay, and Holocene Alluvium	Gravel, sand, silt, and clay. Sand constitutes about 50% of the aquifer. Gravel, very minor	Large yields of fresh water possible in areas with high rates of transmissivity within interconnected sand units
Evangeline Aquifer	1,900	Goliad Sand	Sand, gravel, silt, and clay. Gravel very minor. Sand constitutes about 30% to 50% of the unit	Large yields of fresh water possible in areas with high rates of transmissivity within interconnected sand units
Burkeville Confining System	450	Upper part of Fleming Formation/Lagarto Clay	Clay, silt, and sand. Sand constitutes from less than 10% - 20% of unit.	Would not transmit fresh water as the unit is a confining layer (aquitard or aquiclude)
Jasper Aquifer	2,400	Oakville Sandstone, Fleming Formation	Sand, silt, and clay. Sand constitutes from 30% - 40% of unit (fresh to slightly saline water)	Small to medium yields of fresh water possible in areas with relatively thicker and more transmissive sand units

Hydrologic Unit	Maximum Thickness in Houston Area (feet)	Geologic Formation (oldest to youngest)	Composition	Water-bearing Properties*
Catahoula Confining System		Frio Clay, Anahuac and Catahoula Tuff or Sandstone	Clay, sand and silt,	Would not easily transmit fresh water as the unit is a confining layer (aquitard or aquiclude)

*Small = less than 100 gpm; Moderate = 100 – 1,000 gpm; Large = more than 1,000 gpm
Source: Table adapted from Texas Water Development Board Report 72 and an updated report *Aquifers of the Gulf Coast of Texas* http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/R365_Composite.pdf.

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 (http://www.twdb.texas.gov/groundwater/aquifer/index.asp). 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 northern part of the project area (Segment 3) is the outcrop or recharge area of the Chicot Aquifer, the location of the Willis Sand and Lissie Formation. There is little to no Gulf Coast Aquifer recharge occurring the in the area of Segment 1 or 2. http://pubs.usgs.gov/wri/wri96-4018/pdf/wri96-4018.pdf.

Pumping from the Gulf Coast Aquifer between 1985 and 2000 ranged from around 1 million to 1.3 million acre-feet per year. Water level declines of up to 350 feet in Harris, Galveston, Fort Bend, Jasper, and Wharton counties have led to land-surface subsidence (Kasmarek and Robinson, 2004) (fig. 61 http://pubs.usgs.gov/ha/ha730/ch_e/E-text6.html. Since the establishment of the Harris-Galveston Subsidence District in 1975, groundwater use has decreased in an effort to address land subsidence. Surface water use has increased and is planned to continue to provide needed water supplies in the Houston area, although groundwater will continue to supply water for irrigation, public water needs, and industrial uses. However, large groundwater withdrawals in Harris County and adjacent areas have reduced the artesian pressure of the Gulf Coast Aquifer to cause water from clay beds in permeable zones to flow into sands. As the water flows out of the compressible clays, they become irreversibly compacted, causing permanent land surface subsidence. This subsidence has increased the risk of flood damage to residential and commercial properties and has activated faults that have caused structural damage in the Houston area. The natural, regional groundwater flow system in the Houston area has been profoundly altered by decades of substantial withdrawals of water from the Gulf Coast Aquifer. Large regional cones of depression have developed in the permeable areas of the Chicot and Evangeline aquifers. http://pubs.usgs.gov/wri/wri96-4018/pdf/wri96-4018.pdf

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. Potential impacts to shallow groundwater of the upper Gulf Coast Aquifer system could result from activities associated with the 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 potential result in impacts to groundwater or surface water quality; footing excavations for pier foundation 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 are associated with the dismantling and replacement of the existing bridges, roads, and road base, which may include discharges of waste material, accidental spills, and discharge or generation of impacted soils, impacts to surface water or to shallow groundwater in recharge areas.

The TCEQ administers the Texas Pollutant Discharge Elimination System (TPDES) and a TPDES Construction General Permit would be required to manage the discharge of storm water from the proposed project construction area. TxDOT has been issued a TPDES General Permit Number TXR150000 by the TCEQ related to storm water discharges associated with construction activities.

Construction work would include dredging, dewatering, concrete pouring, welding, paint and paint removal, and other activities that have the potential to impact water quality. Preventing these impacts may be difficult due to the complex site conditions, with limited space and several constraints. However, controls in the SWPPP would be used to minimize water quality effects to the maximum extent practicable. The SWPPP would have a plan for responding to and managing accidental spills during construction, a plan for the management of chemical and/or hazardous materials used during construction, a plan for management and performance of all construction activities conducted over water to minimize the potential for accidental releases, a plan for the management of excavation activities to minimize or eliminate the potential for groundwater contamination resulting from such activities, and a plan for the management and disposal of all pumped water and excavated or dredged materials. The SWPPP would also address overall management of the project, such as Best Management Practices for concrete pouring, the application of concrete curing compounds, material storage, equipment fueling, concrete washout, and stockpiles. The transport of materials and equipment use would also be covered.

The SWPPP would describe all erosion control measures to be taken by the contractor as well as Best Management Practices (BMPs) to be implemented to control and prevent to the Maximum Extent Practicable the discharge of pollutants to surface waters as well as groundwater. Erosion control measures may include, but not be limited to, the installation of silt fences on cut slopes, around drainage inlets, and any drainage path; placement of hay bales, mulching; erosion control blankets; and hydro-seeding. Roadway, bridge, and facility demolition work may also occur and may require a separate and specific SWPPP to address planned demolition activities including structures that may contain asbestos-containing materials or lead-based paint. The SWPPP will address specific dismantling activities and BMPs to be implemented to minimize the discharge of pollutants associated with these activities. Similar to the SWPPP prepared for the construction of new roadway and bridge structures, this SWPPP will have a plan for managing and responding to accidental spills and discharges of waste material.

The proposed project could include the construction of drilled shafts during bridge or other support structure construction. These excavation activities would 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 soils and/or groundwater management plans for activities within these areas would be developed.

Impacts on groundwater quality from the proposed project would be related to storm water discharges from both construction and operation. During construction, spills would be mainly limited to fuels (i.e., petrochemicals) and lubricants used for construction equipment. Impacts to groundwater quality because of surface spills would be minimized by the implementation of spill prevention measures. 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.

During construction, appropriate measures would be implemented to prevent, minimize, and/or control hazardous materials spills in construction assembly areas. Removal and disposal of materials by the contractor(s) would be conducted in accordance with applicable federal and state regulations and laws so as not to degrade groundwater quality. As stated previously, storm water control measures and BMPs would be implemented such that construction and operation of the proposed project would have minimal, if any, impact to regional groundwater resources.

No Build Alternative Impacts

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

Public Drinking Water Systems

The state's Source Water Protection Program (SWPP) 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 PWS 2014). 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 (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. No

PWSs within the project area were listed as participants in the Texas Source Water Protection Program (TCEQ TSWPP 2016).

The Water Utility Database of the TCEQ was searched for information pertaining to PWSs located in the proposed project area. There are 662 active community water utilities in Harris County (TCEQ TX Safe Drinking Water Information System (SDWIS) 2016). These utilities include municipalities, private corporations, and district ownership. There are 1,206 active PWSs in Harris County (TCEQ TX SDWIS 2016), and 11 of these are included in the EPA Safe Drinking Water Information System.

TWDB's groundwater database was searched for water wells located within the project area. A total of 15 registered water wells documented in the database were identified as being in the project area (Table 5-1). All wells were in the area of the Gulf Coast aquifer. Primary uses listed for the wells include commercial, domestic, industrial, public supply, and unused (TWDB 2016). Of the 15 water wells, 6 wells are listed as used for public water supply.

Table 5-1. Water Wells Within the Proposed NHHIP Right-of-Way

Water Well Primary Use	Segment 1 Alternatives			Segment 2 Alternatives	Segment 3 Alternatives		
	4	5	7		10	11	12
Commercial	1	1*	1*	0	0	0	0
Domestic	1	0	0	0	0	0	0
Industrial	1*	4*	0	0	0	0	0
Public	2	4**	2**	0	0	0	0
Stock	0	0	0	0	0	0	0
Unused	1	0	0	0	1	0	0
Alternative	6	9	3	0	1	0	0

*Indicates a single well occurring in more than one alternative
**Indicates two wells occurring in more than one alternative

Wells occurring within the project area that would be unavoidably impacted by the proposed project would be plugged and abandoned according to TCEQ regulations to eliminate the potential for impacts to groundwater resources.

Floodplains

Portions of the proposed project would traverse areas that are designated by the Federal Emergency Management Agency (FEMA) as special flood hazard areas (i.e., floodways, 100-year floodplains, and 500-year floodplains). FEMA Flood Insurance Rate Maps were reviewed for the project area (GIS Servers\Web Map Service NFHL on hazards.fema.gov). Map numbers, showing effective dates in parentheses, 48201C0460M (10/16/2013), 48201C0470L (6/18/2007), 48201C0660M (6/9/2014), 48201C0680L (6/18/2007), 48201C0670M (6/9/2014), 48201C0690M (6/9/2014), 48201C0860L (6/18/2007), and 48201C0880L (6/18/2007) show that a majority of the project area is outside of the one-percent annual exceedance probability (AEP) floodplain, or other flood hazard areas as determined by FEMA (See *Waters of the United States Technical Report* for exhibits and further detail). Areas adjacent to Drainage Ditch 113251901, Halls Bayou, Little White Oak Bayou, White Oak Bayou, and Buffalo Bayou are mapped as being within the one-percent AEP floodplain. Floodplain acreages within each project alternative for the three project segments are shown in Table 6-1.

Table 6-1. Floodplain Acreage Per Alternative Within Proposed NHHIP Right-of-Way

		Acreage
Segment 1	Existing ROW	262.3
	Alternative 4	93.4
	Alternative 5	56.8
	Alternative 7	40.8
Segment 2	Existing ROW	107.9
	Alternative 10	10.5
	Alternative 11	4.9
	Alternative 12	6.3
Segment 3	Existing ROW	130.2
	Alternative 10	48.2
	Alternative 11	36.6
	Alternative 12	58

A detailed 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 hydraulic study to verify that appropriate measures have been identified so as not to increase the flood risk to adjacent properties. Bridges, culverts, and cross-drainage structures would be designed to Federal Highway Administration (FHWA) and TxDOT standards to accommodate the 100-year storm event, periods of high flows, and sheetflow without impacting upstream or downstream areas. BMPs, such as the construction of detention/retention facilities, would be incorporated into the final design of the proposed project to offset increased flows from areas of impervious surface. Hydraulic design features incorporated into the proposed project would be in accordance with current FHWA and TxDOT design policies and standards. Construction of the proposed project would be in compliance with county and local floodplain guidelines and policies. The proposed project would be designed not to increase the risk of flooding by incorporating necessary drainage features, such as culverts and bridges, into the design.

TxDOT would comply with the regulatory requirements and processes related to floodplain management. Roadway development associated with the portions of the proposed project located within a Special Flood Hazard Area would require coordination with the Harris County floodplain administrator and Harris County Flood Control District. TxDOT will coordinate with the City of Houston Department of Public Works and Engineering, and HCFCD as needed, relative to regulatory floodplains and floodplain management during the evaluation and design of the proposed project.

Section 60.3 (d)(3) of the National Flood Insurance Program 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 program regulations, prior to issuance of any construction permits involving activities in a regulated floodway, an engineering or "no-rise" certification would be obtained. The request for certification must be supported by technical data stating that construction of the proposed project would not impact the base flood elevation, floodway elevations, or floodway data widths that are present prior to construction. A hydraulic analysis to current FEMA mapping standards for the proposed project would be performed to support a "no-rise" certification.

No Build Alternative Impacts

The No Build Alternative would result in no new encroachment on the 100-year floodplain and, therefore, would have no direct impacts on floodplains. However, land use changes in the vicinity of the project area could potentially impact floodplains. Any potential floodplain impacts would be regulated by floodplain policy.

Municipal Separate Storm Sewer Systems

Water quality impacts from development can be minimized through the implementation of a SW3P in compliance with TPDES requirements and a MS4 in conjunction with city improvements. Polluted stormwater runoff is often transported to MS4s and ultimately discharged into local rivers and streams without treatment. EPA's stormwater Phase II Rule establishes a MS4 stormwater management program that is intended to improve the Nation's waterways by reducing the quantity of pollutants that stormwater collects and carries into storm sewer systems during storm events. Common pollutants include oil and grease from roadways, pesticides from lawns, sediment from construction sites, and carelessly discarded trash, such as cigarette butts, paper wrappers, and plastic bottles. When deposited into nearby waterways through MS4 discharges, these pollutants can impair the waterways, thereby discouraging recreational use of the resource, contaminating drinking water supplies, and interfering with habitat for fish, other aquatic organisms, and wildlife.

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.

Coastal Zone Management Plan

The Coastal Zone Management Act of 1972 (as amended in 1996) provides for the preservation, protection, development, restoration, and enhancement (where feasible) of coastal zones in the United States. 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, federal program development and approval regulations, and the Texas Coastal Coordination Act. Requirements dictate that a state's coastal zone boundaries include four elements: an inland boundary, seaward boundary, interstate boundaries, and federal land excluded from the boundary.

As illustrated in Exhibit 2, the southern portion of the project area is within the coastal zone area.

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 under Section 10 of the Rivers and Harbors Act or Section 404 of the CWA for impacts to waters of the United States. Formal coordination with the General Land Office would be required to ensure consistency with the Texas Coastal Management Program, as a portion of the proposed project associated with the tidal waters of Buffalo Bayou is within the mapped Texas Coastal Management Zone. Additionally, a bridge permit or permit amendment from the U.S. Coast Guard would be required for the proposed project's crossing of the tidally-influenced Buffalo Bayou.

TxDOT will coordinate with the General Land Office regarding Texas Coastal Management Program consistency certification, as the proposed project is expected to require permit authorization from the USACE for unavoidable impacts to jurisdictional waters of the United States regulated under Section 404 of the CWA and/or Section 10 of the Rivers and Harbors Act.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (as amended on October 11, 1996) directs that all federal agencies proposing actions that would impact essential fish habitat consult with the National Marine Fisheries Service regarding potential adverse impacts. Although Halls Bayou, Buffalo Bayou, Little White Oak Bayou, and White Oak Bayou traverse the project area, according to the TCEQ's stream segments for the state of Texas, only a portion of Buffalo Bayou is identified as a tidal water. Otherwise, the water courses in the project area are not tidally influenced.

The National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat mapper was reviewed to determine if the proposed project area is within the NOAA Essential Fish Habitat. No Habitat Areas of Particular Concern (HAPC) or Essential Fish Habitat Areas Protected from Fishing (EFHA) were identified in the project area.

Bibliography

Federal Emergency Management Agency (FEMA). 2000. Section 60.3 of National Flood Insurance Program (NFIP) Regulations: Floodplain Management Criteria.

Texas Commission on Environmental Quality (TCEQ). 2014. Texas 303(d) List (November 19, 2015)<https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_303d.pdf > Accessed November 2016.

_____.2014a. Eight Total Maximum Daily Loads for Indicator Bacteria In Buffalo and Whiteoak Bayous and Tributaries.<https://ofmpub.epa.gov/waters10/attains_impaired_waters.show_tmdl_document?p_tmdl_doc_blobs_id=72799> Accessed November 29, 2016.

_____2016. Texas Safe Drinking Water Information System <http://dww2.tceq.texas.gov/DWW/> Accessed November 17, 2016

_____2016.Texas Source Protection Program. Geographical Informational Systems Data, Public Water System Wells.<https://www.tceq.texas.gov/assets/public/gis/metadata/pws_wells.pdf> .July 2016

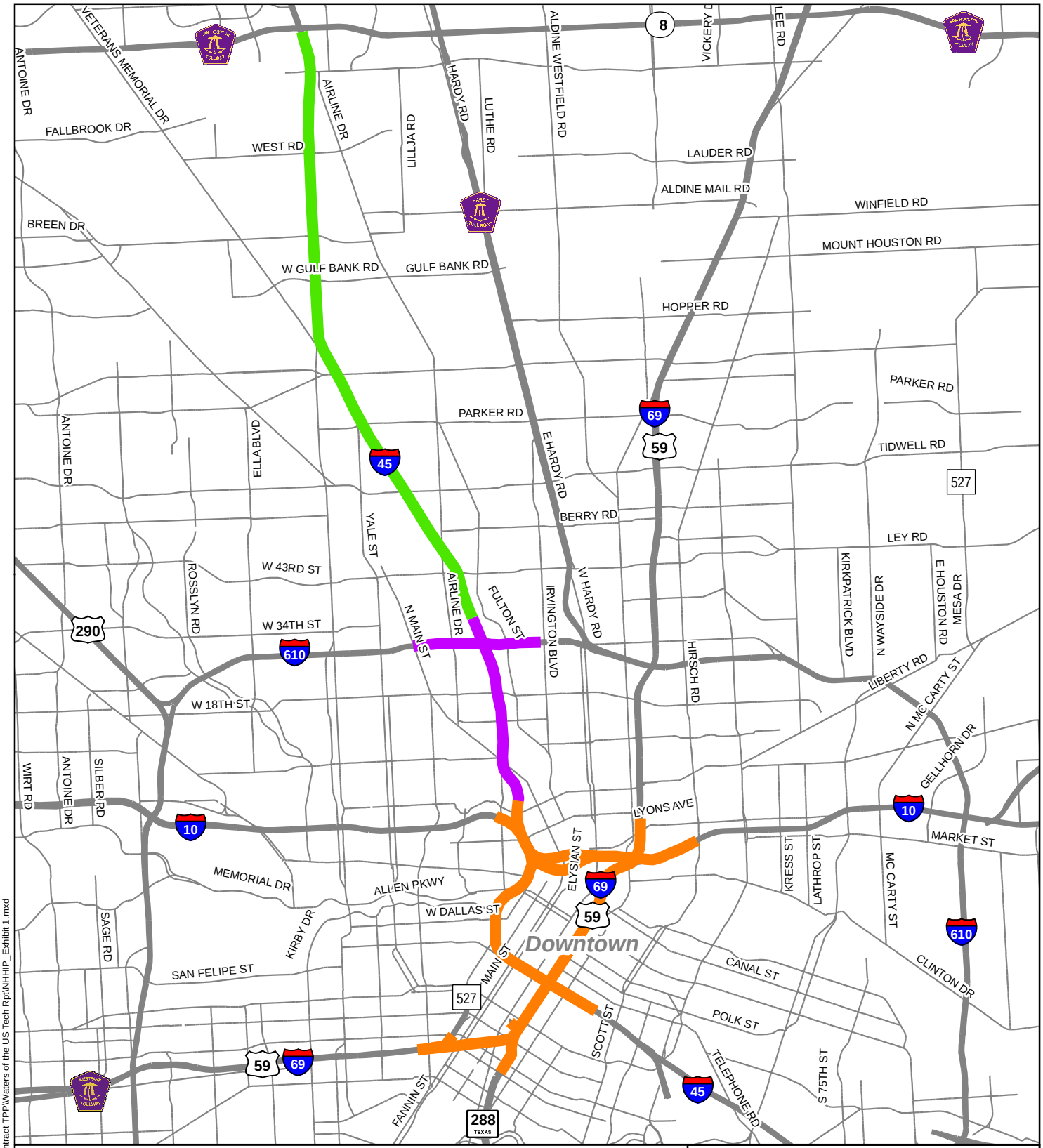
Texas Department of Transportation (TxDOT) 2002. TxDOT's Storm Water Management Guidelines for Construction Activities. July 2002.

_____2014. TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. November 1, 2014.

Texas Water Development Board. 2016. Geographical Information Systems Data. Well Locations from TWDB Groundwater Database (GWDB). <http://www.twdb.texas.gov/mapping/gisdata.asp> January 2016.

Appendix A

Exhibits



Legend

- Segment 1
- Segment 2
- Segment 3

N
W E
S

0 12,000 24,000 Feet

North Houston Highway Improvement Project

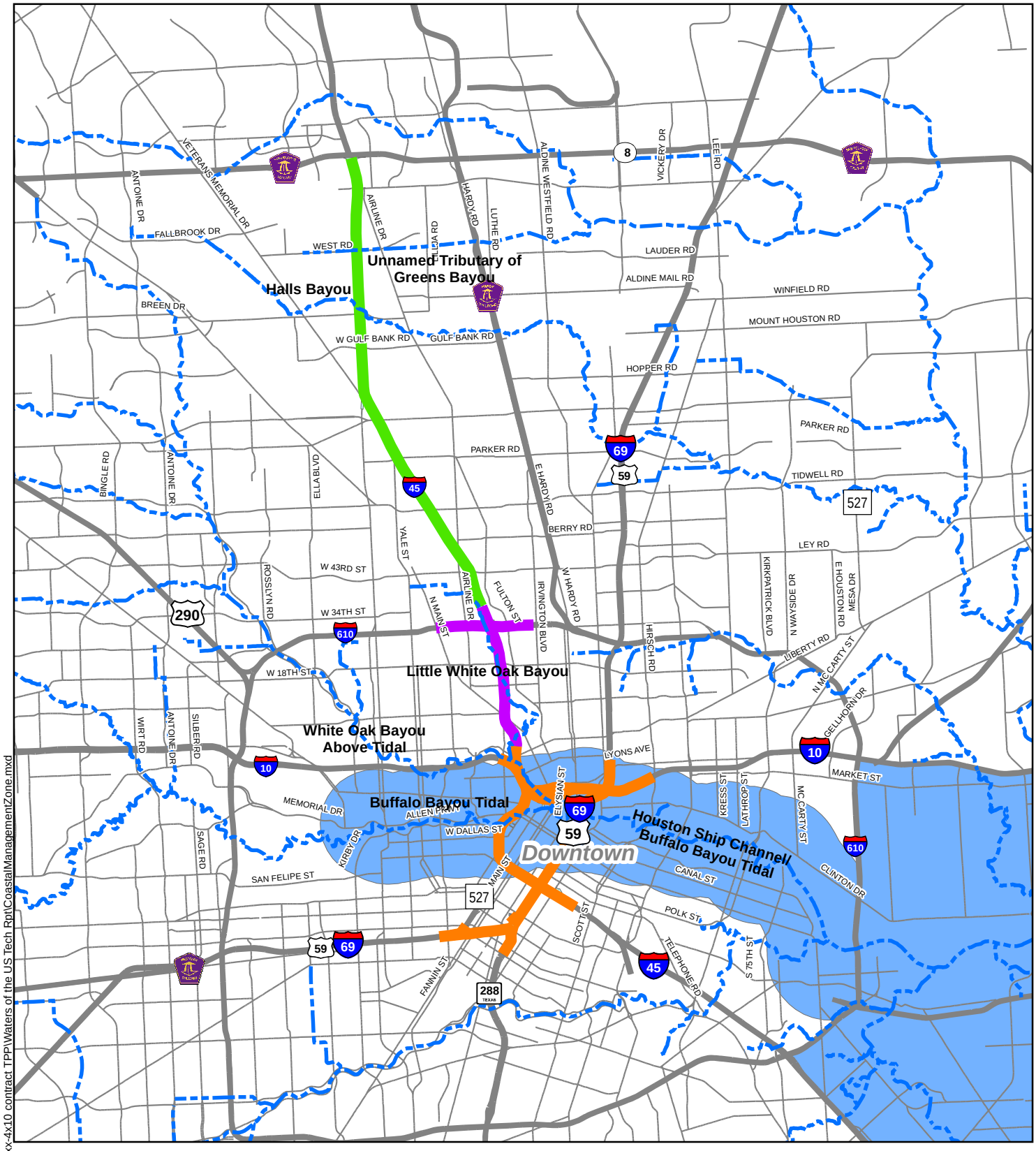
Vicinity Map

Texas Department of Transportation

Date: February 2017

Exhibit: 1

Document Path: P:_TRANSITxDOT\604xxxxx-4x10 contract TPP\Waters of the US Tech Rpt\NHHIP_Exhibit 1.mxd



Source: Texas General Land Office
Coastal Zone Boundary (2015)

N
W E
S

0 12,000 24,000 Feet

Legend

- TCEQ Impaired Segment
- Segment 1
- Segment 2
- Segment 3
- Coastal Zone Area

North Houston Highway Improvement Project

Coastal Zone Management Area

Texas Department of Transportation

Date: February 2017

Exhibit 2

Document Path: P:_TRANSITxDOT\604xxxx-4x10 contract TPP\Waters of the US Tech Rpt\CoastalManagementZone.mxd