Dallas to Houston High-Speed Rail
Final Environmental Impact Statement

Appendix K:
Agency Specific Reports

Set 1 of 2

Federal Railroad
Administration

U.S. Department of Transportation

Federal Railroad Administration

Dallas to Houston High-Speed Rail Biological Assessment

Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, Waller, and Harris Counties, Texas

November 2019

Revision 1 – January 2020

Revision 2 – April 2020

Revision 3 – May 2020

Federal Railroad Administration

Dallas to Houston High-Speed Rail
Biological Assessment

By

U.S. Department of Transportation
Federal Railroad Administration

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ABSTRACT

The Biological Assessment (BA) has been completed in support of the National Environmental Policy Act (NEPA) evaluation initiated by the Federal Railroad Administration (FRA) for the Texas Central High-Speed Railway, LLC's (TCRR) and its affiliates' proposal to construct and operate a high-speed passenger railroad on entirely new track between Dallas and Houston, Texas (Project). The purpose of the Project is to provide the public with reliable and safe high speed passenger rail transportation between Dallas and Houston. TCRR identified the Dallas to Houston corridor as an ideal location and distance to implement high speed intercity passenger rail that is financially sustainable, constructible and connects two of the largest urban centers in the country.

To comply with NEPA, FRA is preparing an Environmental Impact Statement (EIS) to evaluate the Project's three Houston Terminal Station Options and six end-to-end Build Alternatives (Alternatives A through F), which cross portions of Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, Waller, and Harris counties. For analytical purposes, the Build Alternatives were divided into eight segments (1, 2A, 2B, 3A, 3B, 3C, 4, and 5). In December 2017, FRA released the Draft EIS and identified Alternative A as the Preferred Alternative, which consists of Segments 1, 2A, 3A, 4, and 5 and is considered the Project's Action Area. This BA evaluates the effects of the proposed action on listed species and an analysis of any cumulative effects.

FRA obtained the official protected species lists for the counties intersected by the Project from the U.S. Fish and Wildlife Service (USFWS) on July 25, 2019. Federally listed endangered or threatened species considered in this BA include the West Indian manatee (*Trichechus manatus*), golden-cheeked warbler (*Setophaga chrysoparia*), interior least tern (*Sterna antillarum*), whooping crane (*Grus americana*), Houston toad (*Anaxyrus houstonensis*), large-fruited sand verbena (*Abronia marcocarpa*), Navasota ladies'-tresses (*Spiranthes parksii*), and Texas prairie dawn (*Hymenoxys texana*). The Texas fawnsfoot (*Truncilla macrodon*) was assessed but no determination made based on its status as a candidate species. The piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) were included on the species list but not considered in this BA as USFWS states these species should only be considered for wind energy projects. A desktop analysis was conducted for each species to search for Element of Occurrence Records (EORs) and potential for suitable habitat. There is no designated or proposed critical habitat within the Project's Action Area.

The West Indian manatee, golden-cheeked warbler, and Texas fawnsfoot were dismissed from further analysis because suitable habitat was not identified within the Project's Action Area, which resulted in a determination of "No effect" for these species. The interior least tern and whooping crane have potential to be affected by the project; however, avoidance and minimization measures would help insure the species are not impacted as a result of the Project (see **3.3 Conservation and Mitigation Measures**), therefore resulting in an effects determination of "May affect, but not likely to adversely affect" for these species. Habitat suitability modeling was carried out for the Houston toad and the three plant species, the large-fruited sand verbena, Navasota ladies'-tresses, and Texas prairie dawn. Based on the model results, no suitable habitat was identified for the Texas prairie dawn, therefore resulting in an effects determination of "No effect" for the species.

Table i. Species Considered		
Species	**Status**	**Determination of Effect**
West Indian Manatee	Threatened	No Effect
Golden-cheeked Warbler	Endangered	No Effect
Interior Least Tern	Endangered	May Affect, Not Likely to Adversely Affect
Whooping Crane	Endangered	May Affect, Not Likely to Adversely Affect
Houston Toad	Endangered	May Affect, Not Likely to Adversely Affect
Texas Fawnsfoot	Candidate	No Effect Determination Warranted for Candidate Species
Large-fruited Sand Verbena	Endangered	May Affect, Likely to Adversely Affect
Navasota Ladies' Tresses	Endangered	May Affect, Likely to Adversely Affect
Texas Prairie Dawn	Endangered	No Effect

Results from the habitat model did indicate suitable habitat for the Houston toad, large-fruited sand verbena, and Navasota ladies'-tresses. Per USFWS protocol, three years of presence/absence surveys were then carried out for these species within modeled suitable habitat on properties where right-of-entry was granted. These surveys resulted in no Houston toads within 3.1 miles (5 kilometers [km]) of the Action Area, no large-fruited sand verbena within the Action Area, and 25 Navasota ladies'-tresses within the Action Area.

A determination of "May affect, but not likely to adversely affect" was determined for the Houston toad because while suitable habitat may be present, the Project would not reduce the likelihood of the recovery and survival of these species by the implementation of measures outlined in **3.3 Conservation and Mitigation Measures**. For the large-fruited sand verbena and Navasota Ladies'-tresses, a determination of "May affect, and likely to adversely affect" was determined as the Project may result in effects to an individual since presence/absence surveys could not be conducted on the acres of suitable habitat within the Action Area for which right-of-entry was not granted.

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

1.1 Introduction

This Biological Assessment (BA) and the supporting documents were completed in support of the National Environmental Policy Act (NEPA) evaluation initiated by the Federal Railroad Administration (FRA) for the Texas Central High-Speed Railway, LLC's (TCRR) and its affiliates' proposal to construct and operate a high-speed passenger railroad between Dallas and Houston, Texas (Project). FRA, as the lead agency, is preparing a Final Environmental Impact Statement (EIS) for compliance with the NEPA, in cooperation with the United States Environmental Protection Agency (EPA), the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the Surface Transportation Board (STB), the United States Army Corps of Engineers (USACE), and the United States Fish and Wildlife Service (USFWS). FRA has broad authority to prescribe regulations and issue orders, as necessary, for every area of railroad safety (49 U.S.C. § 20101 et seq.; 49 C.F.R. § 1.89, Parts 200-299). FRA's existing regulations do not adequately address the safety concerns and operational characteristics of the HSR system proposed by TCRR. Therefore, FRA has proposed minimum Federal safety standards through an RPA (regulations that apply to a specific railroad or a specific type of operation), to ensure the TCRR's proposed system is operated safely. This regulatory action constitutes a major federal action and triggers the environmental review under NEPA. Additionally, TCRR (including its affiliated companies) may pursue financial assistance from DOT, including, but not limited to, a direct loan under the Railroad Rehabilitation and Improvement Financing (RRIF) Loan Program (45 U.S.C. 821 et seq.), credit assistance under the Transportation Infrastructure Finance and Improvement Act of 1998 (TIFIA) (23 U.S.C. 601-609) or other federal assistance to finance a portion of the Project. Should DOT provide credit or other financial assistance, such activity would also constitute a major federal action.

As the lead federal agency, FRA must initiate consultation with the U.S. Fish and Wildlife Service (USFWS) in accordance with Section 7 of the Endangered Species Act (ESA) due to the potential for listed, proposed to be listed, or candidate species to occur and be impacted in the Action Area. The Action Area for the Project is considered the Limits of Disturbance (LOD) of the Preferred Alternative, Build Alternative A as defined in **Table 1.2-1**. The LOD is comprised of the permanent operational and the temporary construction footprint of the Preferred Alternative as described in more detail below.

- The LOD includes the rail infrastructure, access roads, drainage swales and ancillary facilities (e.g., stations [Dallas Terminal Station, Brazos Valley Intermediate Station and Houston Northwest Mall Terminal Station], TMF and MOW facilities, TPSSs, maintenance roads and signal houses). For planning purposes, the proposed footprints for stations, maintenance and ancillary facilities were estimated to the maximum size to ensure the system would not be capacity constrained under the ultimate buildout of the system. These areas comprise the proposed permanent HSR ROW or the permanent footprint of the Project.

- In addition to the proposed permanent HSR ROW, construction of the Project would include the permanent relocation or alteration of existing utilities and easements (i.e., underground pipelines, aboveground electrical transmission lines, or existing roads). These activities, including the proposed footprint of relocated roads, are also included the LOD. The LOD includes potential indirect impacts from proposed new electrical transmission lines to meet the traction power demand of the Project from the existing power grid. These potential transmission line routes have been developed by TCRR through coordination with electrical transmission providers (i.e., Oncor and CenterPoint).

- The LOD also includes areas that would be used temporarily to construct the Project. These Project-specific locations designated by TCRR would be used temporarily or short-term during the construction period of the Project (e.g., construction laydown areas, workspace areas and modifications to existing utility easements [e.g., pole adjustments of electrical utilities or cathodic protection]). It is anticipated that, in most cases, these areas would require temporary construction easements.

This BA details the extent to which the Project may adversely affect endangered, threatened, and candidate wildlife and/or plant species that may occur within the Action Area. The information provided herein has been prepared in accordance with Section 7 of the ESA (Section 7) [16 United States Code (U.S.C.) 1536 (c)] and 50 CFR 402.12. FRA prepared this BA and EIS consistent with 40 CFR §1506.5(c) and guidance issued by the Council on Environmental Quality (46 FR 18026).

Due to the linear length of the Project and limited access to private property, compliance with Section 7 is being completed through a phased approach, as agreed upon in informal consultation with the USFWS. Parcels where access has not been granted may require additional surveys or biological monitoring for species and habitat considered in this BA once a Record of Decision (ROD) and right-of-entry (ROE) have been obtained.

1.2 Project Description

The Project includes the deployment of an electric-powered, high speed passenger rail system based on the Japanese N700-Series Tokaido Shinkansen technology. In coordination with the FRA Office of Railroad Safety, the train technology would be adapted to meet the regulatory requirements and environmental conditions between Dallas and Houston, as established by an FRA Rule of Particular Applicability or other regulatory action(s) to ensure the Project would operate safely. To minimize risk and enhance passenger safety, the Project is proposed to be operated in a closed corridor. The lack of crossings and other non-high-speed rail (HSR) traffic would enable trains to safely achieve speeds not exceeding 205 miles per hour (mph) and attain an approximate 90-minute travel time between Dallas and Houston. The HSR ROW would vary in width with an average width of 328 feet and a minimum ROW of 100 feet that would include the track, overhead catenary system (catenary), access roads and security fencing. Based on existing infrastructure (e.g. roadways, well pads, transmission lines, etc.) and changes in topography, combined with the need to minimize vertical changes along the HSR line, the double-track system would be constructed using a combination of at-grade/embankment, retained fill, retained cut and a bridge-like structure, called viaduct. Approximately 55 percent of the HSR line would be constructed on viaduct. When on viaduct, the Project would allow for movement underneath the rail.

The Project would extend approximately 240 miles (386 kilometers [km]) in length and intersect the Texas counties of Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, Waller, and Harris (see **Figure 1.1-1**). TCRR is proposing three stations as part of the Project: two terminal stations (Dallas and Houston) and one intermediate Brazos Valley Station in Grimes County. FRA studied multiple potential corridor and alignment alternatives between Dallas and Houston for the Project, and six end-to-end Build Alternatives (Alternatives A through F) are evaluated in the EIS. For analytical purposes, the Build Alternatives are divided into eight segments (see **Figure 1.1-1; Table 1.2-1**). In December 2017, FRA released the Draft EIS and identified Alternative A as the Preferred Alternative, which consists of Segments 1, 2A, 3A, 4, and 5.

Table 1.2-1: Build Alternatives A Through F Segment Sequences

Build Alternative	Segment Sequences
Alternative A (Preferred Alternative)	1, 2A, 3A, 4, 5
Alternative B	1, 2A, 3B, 4, 5
Alternative C	1, 2A, 3C, 5
Alternative D	1, 2B, 3A, 4, 5
Alternative E	1, 2B, 3B, 4, 5
Alternative F	1, 2B, 3C, 5

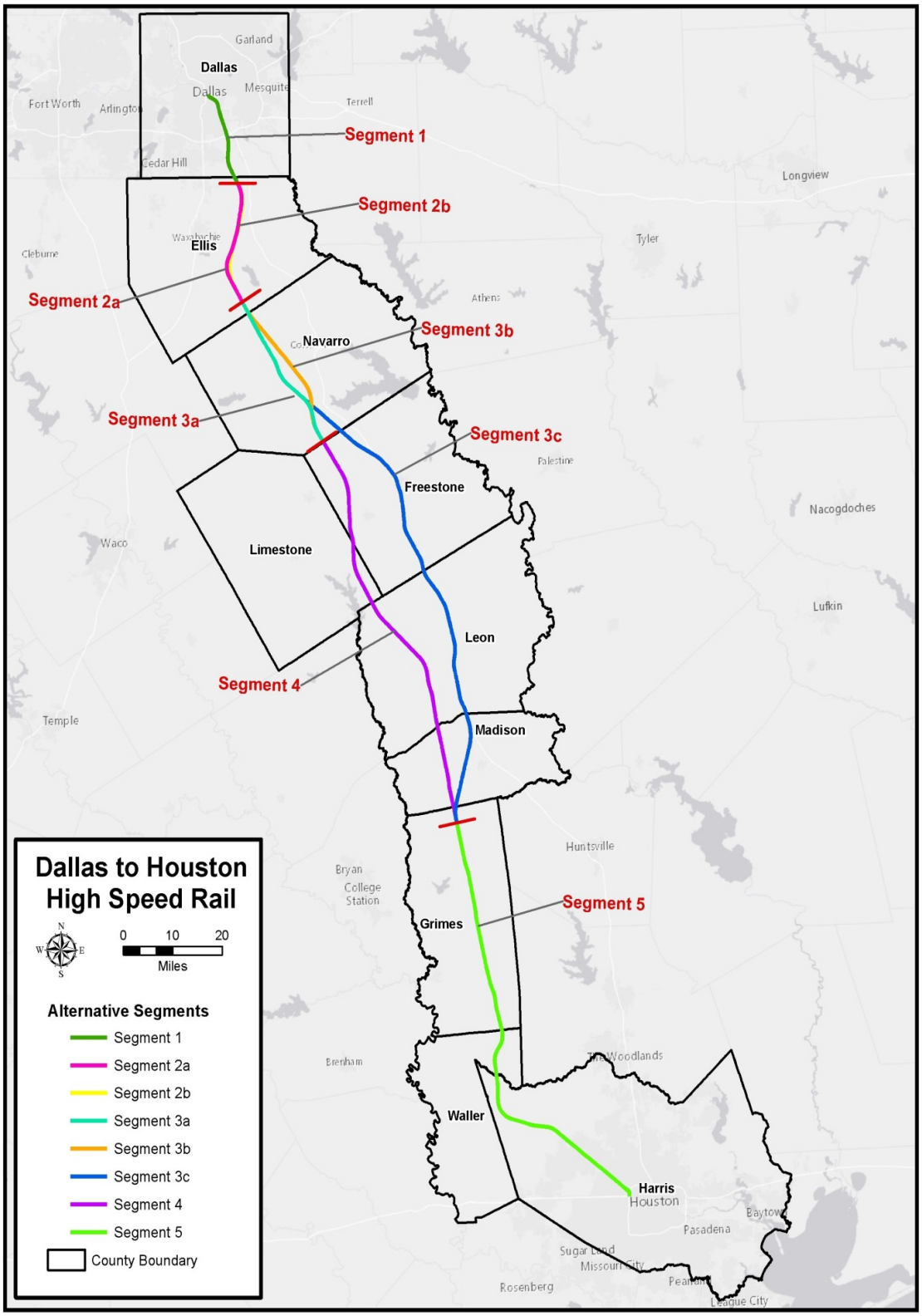

Figure 1.2-1. Route Alternatives, showing Segment Locations

1.2.1 Segment 1

Segment 1 is located in Dallas County. The alignment begins on the south side of downtown Dallas near IH-30 and Lamar Street and parallels the existing UPRR freight line towards IH-45. It parallels the west side of IH-45 as it crosses the Trinity River, running between the existing BNSF freight line and the highway as it crosses E. Illinois Avenue, Loop 12 and Simpson Stuart Road. South of Simpson Stuart Road, Segment 1 separates from IH-45 and generally follows the BNSF freight line, crossing IH-20, N. Lancaster/Hutchins Road, E. Pleasant Run Road and E. Beltline Road. South of E. Beltline Road, Segment 1 extends west of Lancaster Airport before turning towards the southwest to enter Ellis County and cross Farm to Market (FM) road 664. Segment 1 terminates approximately 1.5 miles (2.4 km) south of the Ellis County border.

1.2.2 Segment 2A

Segment 2A is located in Ellis County. Segment 2A begins approximately 1.5 miles (2.4 km) south of the Ellis County line, crossing FM 983 and Wester Road. Near the City of Palmer, Segment 2A parallels the west side of the utility easement and crosses West Jefferson Street, FM 879 and SH 287 and FM 34. It crosses FM 984 north of Rankin and is rejoined by Segment 2B 4 miles (6.4 km) south of Bardwell (approximately 2 miles [3.2 km] north of the Navarro County line).

1.2.3 Segment 2B

Segment 2B is located in Ellis County. Segment 2B begins approximately 1.5 miles (2.4 km) south of the Ellis County line. Near the City of Palmer, Segment 2B deviates to the east of the utility easement and crosses West Jefferson Street, FM 879, SH 287 and FM 34. It crosses FM 984 north of Rankin and rejoins Segment 2A 4 miles (6.4 km) south of Bardwell.

1.2.4 Segment 3A

Segment 3A is located in Ellis and Navarro counties. Segment 3A begins 2 miles (3.2 km) north of the Navarro County line and deviates from Segment 3b just south of FM 985 before it would cross into Navarro County. Segment 3A continues south towards Barry, passes to the east of Barry and crosses FM 22. The alignment continues southeast, crossing FM 744 and SH 31 west of Corbet. Segment 3C diverts from Segment 3A at this point. As Segment 3A continues, it crosses Bonner Avenue and FM 1394 before Segment 3B rejoins it 3.5 miles (5.6 km) northeast of Wortham at the Navarro – Freestone County line.

1.2.5 Segment 3B

Segment 3B is located in Ellis and Navarro counties. Two miles (3.2 km) north of the Navarro County line, Segment 3B veers to the east of Barry and crosses FM 22 and 744. It crosses SH 31 near Oak Valley, east of FM 2452. After crossing Bonner Avenue, Segment 3B heads southwest towards Segment 3A, crossing Segment 3C. After crossing FM 1394, Segment 3B rejoins Segment 3A 3.5 miles (5.6 km) northeast of Wortham at the Navarro – Freestone County line.

1.2.6 Segment 3C

Segment 3C is located in Navarro, Freestone, Leon, Madison and Grimes counties. West of Corbet, after crossing SH 31, Segment 3C deviates to the east away from Segment 3A and crosses Bonner Avenue, Segment 3B and FM 1394 following the utility easement. It crosses FM 1051 and 1101 before reaching IH-45 just south of FM 833. It travels along the western side of the highway passing Fairfield as it travels through Freestone County. It enters Leon County and passes Buffalo,

Centerville and Fort Boggy State Park. After crossing Waldrip Road, the alignment moves west crossing FM 978 and SH 190 near Cottonwood and rejoins Segment 3A in Grimes County north of FM 1696.

1.2.7 Segment 4

Segment 4 is located in Freestone, Limestone, Leon, Madison and Grimes counties. Segment 4 begins at the Freestone County line and travels southeast crossing over FM roads 246, 27 and 1366. As it runs parallel to FM 80, it crosses FM 930 and SH 84. It travels through an oil and gas field and crosses FM 1365 west of Teague. It crosses into Limestone County just east of Browns Lake and travels south, tracking east of Personville and crossing East Yeagua Street and continues south, passing east of Lake Limestone. The alignment crosses into Leon County west of Lynn Creek and crosses FM 1512 and 1469 before crossing U.S. 79. It continues south crossing FM 391 as it travels towards Concord and crosses Hwy 7 and veers south to parallel the utility easement. It crosses into Madison County northeast of Normangee and continues south crossing FM 2289, 978 and 1452 before crossing SH 190 west of Cottonwood. The alignment crosses FM 1372 and crosses into Grimes County just north of FM 1696.

1.2.8 Segment 5

Segment 5 is located in Grimes, Waller and Harris counties. Segment 5 continues south along the utility easement, crossing FM roads 155 and 39, before crossing SH 30 just west of Roans Prairie, and the Proposed Brazos Valley Station. It crosses several additional FM roads before crossing SH 105 as it reaches Waller County. The alignment veers southwest away from the utility easement and crosses Joseph Road west of Kickapoo Road and then parallels Kickapoo Road as it continues south. It crosses SH 6 and US 290/Hempstead Road and then curves southeast skirting south of Hockley. It crosses Warren Ranch Road and travels east to cross Grand Parkway/SH 99. It joins Hempstead road near Cypress and parallels US 290/Hempstead Road into Houston. It continues along Hempstead Road to the Northwest Mall area just south of IH-610 and US 290 where the alignment terminates.

1.2.9 Project Development and Refinement

As detailed within FRA's EIS, many routes between Dallas and Houston were evaluated by the FRA and published for public review on FRA's Project website (https://railroads.dot.gov/current-environmental-reviews/dallas-houston-high-speed-rail/dallas-houston-high-speed-rail). These routes were documented in: 1) the Project EIS - Scoping Report, published April 29, 2015, 2) HSR Corridor Alternatives Analysis Technical Report, published August 10, 2015; and 3) HSR Alignment Alternatives Analysis Report, published November 6, 2015. The analysis in the HSR Alignment Alternatives Analysis Report identified the eight segments (1, 2A, 2B, 3A, 3B, 3C, 4, and 5) that created the six end-to-end Build Alternatives (A through F) evaluated in the FRA's EIS, as depicted in Figure 1.1-1.

Throughout the NEPA process, TCRR has continually refined the design of the Build Alternatives to reduce the Project footprint and avoid or minimize impacts to the socioeconomic, natural, cultural and physical environment. These refinements were based on environmental and engineering surveys, stakeholder engagement, public input, design development, and the findings of FRA's environmental analyses and resulted in modifications to the alignment alternatives as well as the overall Action Area. Therefore, the alignment alternatives depicted in the Final EIS

have evolved from the alignment alternatives originally developed in the FRA Scoping Report. Design modifications made by TCRR since the Draft EIS resulted in approximately 17.5 percent of the track centerline being shifted to an area outside of a previous LOD. Also, as a result of these design modifications, the overall footprint of the Build Alternatives evaluated was reduced by approximately 23 percent.

Based on input received by TCRR through their stakeholder engagement efforts, these refinements resulted in the use of viaduct on approximately 55 percent of the Build Alternatives, which would allow for greater movement around and under the HSR system. Additionally, TCRR designed 48 percent of the Build Alternatives adjacent to existing infrastructure, which typically includes areas that have previously been disturbed by previous development. This design approach would minimize impacts to more environmentally sensitive areas and potentially reduce the fragmentation of existing habitat.

TCRR has proposed an approximate 5-year construction and testing schedule in their **TCRR Final Constructability Report**, which has been included as Appendix F of the Final EIS. As the schedule shows construction beginning in mid-2020, it should be used as a representative schedule and will be finalized upon having necessary environmental permits in place. Construction throughout the entire length of the project is anticipated to occur over a five-year timeframe. While the length of the 240-mile project would not be actively under construction at the same time, it is reasonable to assume that construction would proceed along multiple locations at the same time and tie-in. Exact construction schedule and sequencing has not yet been determined at this time.

1.3 Purpose and Need

The purpose of the privately proposed Project is to provide the public with reliable and safe high-speed passenger rail transportation between Dallas and Houston. TCRR identified the Dallas to Houston corridor as an ideal location and distance to implement high speed intercity passenger rail that would be financially sustainable, constructible and connects two of the largest urban centers in the country. To achieve TCRR's financial and ridership objectives, TCRR has identified the following functional criteria for the Project:

- Technological: bullet train vehicle and operating procedures based on the N-700-Series Tokaido Shinkansen system
- Operational: approximate 90-minute travel time between Dallas and Houston, with achievable speeds not exceeding 205 mph in a closed corridor
- Environmental: minimal impacts to the natural and built environments by maximizing adjacency to existing infrastructure ROW

FRA's mission, "to enable the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future," supports the development of safe and reliable intercity passenger rail. FRA's objectives for the Project are to:

- Ensure that the system operates safely in accordance with federal requirements
- Provide safe connectivity to existing transportation modes (i.e., heavy rail, light rail and bus) present throughout the Dallas-Fort Worth (DFW) Metroplex and the greater Houston area
- Ensure the Project does not preclude future rail expansion opportunities on adjacent corridors

- Avoid, minimize and mitigate impacts to the human and natural environment

The need for HSR as an alternative transportation mode is supported by several factors including population growth, congestion of the state transportation system and safety. Travel demand is increasing and the existing transportation infrastructure is not able to accommodate this growing demand between Dallas and Houston. Current transportation options between Dallas and Houston are limited to vehicular and air travel. Due to increasing congestion on IH-45, automobile travel times between the two regions are projected to increase as travel speeds decrease. Flight time between the two regions is relatively short; however, the overall trip duration when considering pre-arrival time more than doubles. Additionally, flights are sensitive to inclement weather and other delay-causing events from inside and outside of Texas.

In order to meet the needs of growing travel demand spurred by population growth and a decrease in the level of service of existing transportation systems, both cities are addressing much needed infrastructure improvements. Intercity and intracity transportation infrastructure will require significant expansion and maintenance in the future; a reliable multimodal option to alleviate the strain on this existing infrastructure would be needed to accommodate growing demand.

Previous passenger rail studies completed by FRA and TxDOT support the need for reliable multimodal transportation alternatives to promote congestion relief strategies. One of these strategies identified in the State Rail Plan included the potential implementation of HSR within the Dallas to Houston corridor. A reliable transportation alternative would also need to operate safely. The HSR system would not include grade crossings, which would remove any interactions between passenger vehicles and the HSR system. This separation would add more stringent security measures compared to traditional freight rail.

After completing its own analysis, TCRR identified an opportunity to develop a profitable, privately financed and operated HSR system for this corridor. The Project would transport thousands of passengers every day and provide an alternative transportation mode for travelers between the two cities, consistent with previous plans and studies.

2.0 HABITAT AND SPECIES CONSIDERED

2.1 Ecoregions

The LOD is located within four different Level III Ecoregions and seven Level IV Ecoregions (**Figure 2.1-1** and **Table 2.1-1**). These ecoregions are described below.

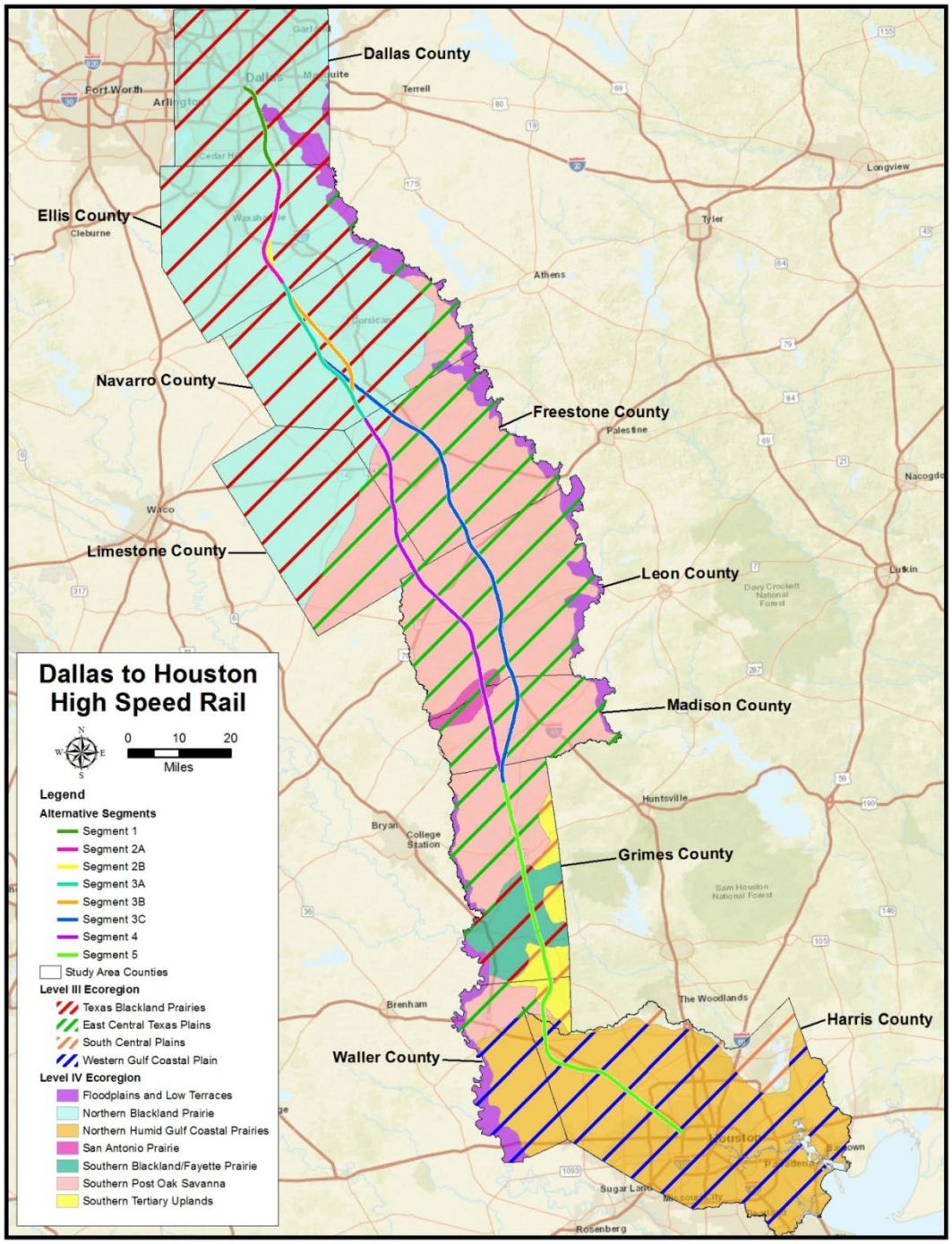

Figure 2.1-1. Ecoregions Within the High-Speed Rail Project

Table 2.1-1: Ecoregions within the LOD			
County	**Segment**	**Level III Ecoregion**	**Level IV Ecoregion**
Dallas	1	Texas Blackland Prairies	Floodplains and Low Terraces
			Northern Blackland Prairie
Ellis	1	Texas Blackland Prairies	Northern Blackland Prairie
	2A	Texas Blackland Prairies	Northern Blackland Prairie
	2B	Texas Blackland Prairies	Northern Blackland Prairie
	3A	Texas Blackland Prairies	Northern Blackland Prairie
	3B	Texas Blackland Prairies	Northern Blackland Prairie
	3C	Texas Blackland Prairies	Northern Blackland Prairie
Navarro	3A	Texas Blackland Prairies	Northern Blackland Prairie
	3B	Texas Blackland Prairies	Northern Blackland Prairie
	3C	Texas Blackland Prairies	Northern Blackland Prairie
Freestone	3A	Texas Blackland Prairies	Northern Blackland Prairie
	3B	Texas Blackland Prairies	Northern Blackland Prairie
	3C	East Central Texas Plains	Southern Post Oak Savanna
		Texas Blackland Prairies	Northern Blackland Prairie
	4	East Central Texas Plains	Southern Post Oak Savanna
		Texas Blackland Prairies	Northern Blackland Prairie
Limestone	4	East Central Texas Plains	Southern Post Oak Savanna
Leon	3C	East Central Texas Plains	Southern Post Oak Savanna
	4	East Central Texas Plains	San Antonio Prairie
			Southern Post Oak Savanna
Madison	3C	East Central Texas Plains	Southern Post Oak Savanna
	4	East Central Texas Plains	San Antonio Prairie
			Southern Post Oak Savanna
Grimes	3C	East Central Texas Plains	Southern Post Oak Savanna
	4	East Central Texas Plains	Southern Post Oak Savanna
	5	East Central Texas Plains	Southern Post Oak Savanna
		South Central Plains	Southern Tertiary Uplands
		Texas Blackland Prairies	Southern Blackland/Fayette Prairie
Waller	5	East Central Texas Plains	Southern Post Oak Savanna
		South Central Plains	Southern Tertiary Uplands
		Western Gulf Coastal Plain	Northern Humid Gulf Coastal Prairie
Harris	5	Western Gulf Coastal Plain	Northern Humid Gulf Coastal Prairie

Source: Griffith et al, 2007

Eastern Central Texas Plains Level III Ecoregion

Historically, vegetative cover of the East Central Texas Plains Level III Ecoregion was predominantly post oak (*Quercus stellata*) savanna when compared to the open prairie regions to the north, south and west and the pine forests in the east. Much of the underlying region has a thick clay pan which alters water movement and moisture for plant growth. Today, the majority of the region is utilized for pasture and range.[1]

Within the LOD, there are two Level IV ecoregions within the East Central Texas Plains Level III Ecoregion: San Antonio Prairie and Southern Post Oak Savanna.

[1] Griffith, Glenn E., Sandra A. Bryce, James M. Omerik, and Anne C. Rogers. *Ecoregions of Texas.* Austin: Texas Commission on Environmental Quality, 2007.

- **San Antonio Prairie Level IV Ecoregion -** The San Antonio Prairie Level IV Ecoregion is named for the belt of blackland prairie running northeast to southwest along both sides of State Highway – Old San Antonio Road (SH OSR). It is described as treeless grassland within a post oak savanna. This area attracted settlement and crops such as cotton (*Gossypium* sp.), corn (*Zea mays*) and small grains were frequently grown in this ecoregion. Today, it is a mosaic of woodland, improved pasture, rangeland and some cropland. Typical vegetation includes little bluestem (*Schizachyrium scoparium*), yellow Indiangrass (*Sorghastrum nutans)*, switchgrass (*Panicum virgatum*), purpletop (*Tridens flavus*), sunflowers (*Helianthus* spp.), coreopsis (*Coreopsis* spp.), goldenrods (*Solidago* spp.) and phloxes (*Phlox* spp.).[2]
- **Southern Post Oak Savanna Level IV Ecoregion -** The landscape of the Southern Post Oak Savanna Level IV Ecoregion is comprised of woods and forest primarily consisting of hardwoods. Post oak savannas historically occurred as the dominant land cover in this ecoregion. Today, post oak woods, pasture and rangeland make up the region, as well as some invasive mesquite (*Prosopis* sp.) regions to the south. Other areas also consist of yaupon (*Ilex* sp.) and eastern red cedar (*Juniperus virginiana*). Soils are mostly acidic with sand and sandy loam surface textures. However, clay and clay loams are found in low areas. A thick clay pan underlies all soils in the region. Characteristic vegetation of the region includes oak savannas or oak-hickory forest consisting of post oak, blackjack oak (*Quercus marilandica*), black hickory (*Carya texana*) interspersed with grasses like little bluestem, purpletop, curly threeawn (*Aristida desmantha*) and yellow Indiangrass. Yaupon, eastern red cedar, winged elm (*Ulmus alata*), American beautyberry (*Callicarpa americana*) and farkleberry (*Vaccinium arboreum*) are the dominant understory species.[3]

South Central Plains Level III Ecoregion

The South Central Plains Level III Ecoregion, also known as the piney woods, occurs at the western boundary of the southern coniferous forest belt. Today, it consists of mostly loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) plantations. Historically, it was a mix of pine and hardwood forest. The soils of this region are typically acidic sands and sandy loams. Within the LOD, there is one Level IV ecoregion within the South Central Plains Level III Ecoregion: Southern Tertiary Uplands.

- **Southern Tertiary Uplands Level IV -** The Southern Tertiary Uplands Level IV Ecoregion within this Level III Ecoregion represents the remaining longleaf pine range north of the Flatwoods. Historical vegetation types consisted of longleaf pine-bluestem woodlands as the dominate type with a variety of other forest types present. Today, it is comprised mostly of pine forest and pastureland instead of oak-pine forest. This ecoregion is also known for bogs with pitcher plants and orchids (*Orchis* spp.).[4]

[2] Griffith, Glenn E., Sandra A. Bryce, James M. Omerik, and Anne C. Rogers. *Ecoregions of Texas.* Austin: Texas Commission on Environmental Quality, 2007.
[3] Ibid.
[4] Griffith, Glenn E., Sandra A. Bryce, James M. Omerik, and Anne C. Rogers. *Ecoregions of Texas.* Austin: Texas Commission on Environmental Quality, 2007.

Texas Blackland Prairies Level III Ecoregion

The Texas Blackland Prairies Level III Ecoregion is distinguished from surrounding regions by predominantly prairie vegetation and is named for the deep, fertile black soils that characterize the area. The prairie soils support grasses including little bluestem, big bluestem (*Andropogon gerardii*), yellow Indiangrass and switchgrass. This region now contains a higher percentage of cropland than adjacent regions; pasture and forage production for livestock is common. Large areas of the region have been converted to urban and industrial uses.[5] Within the LOD, there are three Level IV ecoregions within the Texas Blackland Prairies Level III Ecoregion: Northern Blackland Prairie, Southern Blackland Prairie and Floodplains and Low Terraces.

- **Northern Blackland Prairie Level IV Ecoregion -** The Northern Blackland Prairie Level IV Ecoregion was historically a vast expanse of tallgrass prairie. Frequent fire and grazing suppressed woody species. The region was dominated by little bluestem, big bluestem, yellow Indiangrass and tall dropseed (*Sporobolus compositus*). While a few small remnants of grassland remain, virtually all of the native Blackland Prairie communities are gone.[6]
- **Southern Blackland Prairie Level IV Ecoregion -** The Southern Blackland Prairie Level IV Ecoregion, also known as the Fayette Prairie, hosts less extensive areas of cropland than surrounding regions and land cover is a more complex mosaic with more post oak woods and pasture. Historically, this is tall grass prairie with big bluestem, brownseed paspalum (*Paspalum plicatulum*), little bluestem, yellow Indiangrass and tall dropseed. Forbs present include prairie bluet (*Coenagrion angulatum*) and black-eyed susan (*Rudbeckia hirta*) and riparian forests contain bur oak (*Quercus macrocarpa*), Shumard oak (*Quercus shumardii*), sugar hackberry (*Celtis laevigata*), elm (*Ulmus spp*.), ash (*Fraxinus spp*.), eastern cottonwood (*Populus deltoides*) and pecan (*Carya illinoinensis*). Small knolls and shallow depressions present as a result of the clay soils can influence the composition of plant communities.[7]
- **Floodplains and Low Terraces Level IV Ecoregion -** The Floodplains and Low Terraces Level IV Ecoregion of the Texas Blackland Prairies includes only the broadest floodplains, i.e., those of the Trinity, Brazos and Colorado rivers. As these main stem rivers cross the Level III ecoregions, however, the surrounding characteristics can be quite different from region to region. The bottomland forests contained bur oak, Shumard oak, sugar hackberry, elm, ash, eastern cottonwood and pecan, but most have been converted to cropland and pasture. The remaining fragments of riverine forest provide some habitat for white-tailed deer (*Odocoileus virginianus*), squirrels (*Sciurus* spp.), common raccoon (*Procyon lotor*), common gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), Virginia opossum (*Didelphis virginiana*) and a variety of birds.[8]

Western Gulf Coastal Plain Level III Ecoregion

The Western Gulf Coastal Plain Level III Ecoregion is relatively flat, generally 50 to 90 miles (80.5 to 144.8 km) wide and adjacent to the Gulf of Mexico. The principal distinguishing characteristics of this ecoregion are its relatively flat topography and natural vegetation of mainly grassland.

[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] Ibid.

Inland from this region the plains are older, more irregular and have mostly forest or savanna-type vegetation. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Rice (*Oryza sativa*), grain sorghum (*Sorghum* spp.), cotton and soybeans (*Glycine max*) are the principal crops. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.[9] Within the LOD, there is one Level IV ecoregion: Northern Humid Gulf Coastal Prairie.

- **Northern Humid Gulf Coastal Prairie Level IV Ecoregion -** Within the prairies on the gently sloping, mostly flat, coastal plains, the Northern Humid Gulf Coastal Prairie Level IV Ecoregion exhibits generally poor drainage and soils that remain wet for parts of the year. The historical vegetation was mostly tallgrass grasslands with a few clusters of oaks, known as oak mottes or maritime woodlands. Little bluestem, yellow Indiangrass, brownseed paspalum, gulf muhly (*Muhlenbergia capillaris*) and switchgrass were the dominant grassland species in a mixture with hundreds of other herbaceous species across these prairies. These coastal prairies had some similarities to the grasslands of the Texas Blackland Prairies. Some post oak savannas occurred along the boundary where coastal prairie and inland savannas intergrade. Some loblolly pine occurs in the northern part of the region. Riparian area vegetation begins a change from the north part of the region, where it is generally similar to the floodplain forests to the northeast. To the south, fewer bottomland oaks and hickories are present and pecan, sugar hackberry, ash, southern live oak (*Quercus virginiana*) and cedar elm (*Ulmus crassifolia*) become the important overstory species. Cane brakes (*Arundinaria gigantea*) may also have occurred along some creeks and rivers in this region.[10]

2.2 Vegetation

The vegetation types within the LOD as defined by the Texas Parks and Wildlife Department (TPWD) Ecological Mapping System of Texas (EMST) were evaluated over the entirety of the LOD including all counties and segments. Of the 47 vegetation types present, four types comprise 70 percent or the total LOD acreage. The four main vegetation types are as follows:

- Blackland Prairie: Disturbance or Tame Grassland – these grasslands are assumed to consist primarily of disturbance or non-native grasses as very little intact Blackland prairie remains. Non-native grasses such as bermudagrass (*Cynodon dactylon*) and Johnsongrass (*Sorghum halepense*) are common. Native grasses present may include little bluestem, Indiangrass and hairy grama (*Bouteloua hirsuta*). Other species generally present include common broomweed (*Amphiachyris dracunculoides*), honey mesquite (*Prosopis glandulosa)* and huisache (*Vachellia farnesiana*). Blackland Prairie: Disturbance or Tame Grassland comprises approximately 18 percent of the LOD.
- Post Oak Savanna: Post Oak Motte and Woodland – This vegetation type generally represents a deciduous woodland component. The typical occurrence is dominated by post oak, with blackjack oak. Black hickory may be a large component of the overstory, particularly on deep sands. The shrub layer includes species such as American beautyberry, possumhaw (*Ilex decidua*), yaupon (*Ilex vomitoria*), gum bumelia

[9] Griffith, Glenn E., Sandra A. Bryce, James M. Omerik, and Anne C. Rogers. *Ecoregions of Texas.* Austin: Texas Commission on Environmental Quality, 2007.
[10] Ibid.

(*Sideroxylon lanuginosum*), saw greenbrier (*Smilax bona-nox*), coral berry (*Symphoricarpos orbiculatus*), farkleberry and Hercules' club (*Zanthoxylum clava-herculis*). Herbaceous components are often represented by components of the surrounding prairies. Post Oak Savanna: Post Oak Motte and Woodland comprises approximately 12 percent of the LOD.

- Post Oak Savanna: Savanna Grassland – This vegetation type represents the herbaceous expression of the overall system, which is a mosaic of woody and herbaceous cover types as suggested by reference to a savanna. These grasslands are often dominated by mid- and tallgrass species often present in the understory. Dominant species include little bluestem, Indiangrass and switchgrass. Post Oak Savanna: Savanna Grassland comprises approximately 24 percent of the LOD.
- Row Crops – this includes all cropland where fields are fallow for some portion of the year. Crops that are present year-round are generally mapped as grassland. Row crops comprise approximately 16 percent of the LOD.

2.3 Species Considered

Species considered below were included in the official list provided by USFWS on July 25, 2019 and included in **Appendix C**. The piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) were not considered in this BA as USFWS states these species should only be considered for wind energy projects.

2.3.1 West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is listed by USFWS as federally threatened in Texas and has potential to occur in Harris County. Critical habitat is designated for the West Indian manatee but is located outside of the Action Area. This species is a large marine mammal that can be found in estuarine and freshwater environments. They can reach nine feet in length and weigh up to 1,000 pounds. West Indian manatees have seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are typically grey in color and the muzzle is covered in coarse whiskers. Suitable habitat for this species typically occurs along coastlines, including coastal tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs and vegetated bottoms.[11]

2.3.2 Golden-cheeked Warbler

The golden-cheeked warbler (*Setophaga* [=*Dendroica*] *chrysoparia*) is listed by both USFWS and TPWD as federally and state endangered in Texas and is known to occur in Dallas County. No critical habitat has been designated by the USFWS (**Appendix C**). Golden-cheeked warblers are generally black, gray and white with a yellow face. Males have a black throat and bib, black eyeline, and two white wing bars. Females appear similar; however, they lack the black bib and throat, with less overall color contrast than males. Suitable nesting habitat for this species occurs in well-established juniper-oak woodlands, often on hill sides, including mature junipers which the species uses the peeling bark for nesting material. Suitable habitat also requires broad-leafed trees, usually *Quercus spp*., for foraging. Golden-cheeked warblers return to the same territory or

[11] USFWS. "West Indian Manatee (*Trichechus manatus*) 5-Year Review: Summary and Evaluation." Jacksonville, Florida: U.S. Fish and Wildlife Service, 2007.

one nearby, year after year, nesting from March to early summer. The species' breeding range is restricted to the Edwards Plateau and Cross Timbers regions in central and north central Texas.[12]

2.3.3 Interior Least Tern

The interior populations of least terns (*Sterna antillarum*) are listed by both USFWS and TPWD as federally and state endangered in Texas including Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, Waller, and Harris Counties. On October 24, 2019 the USFWS proposed to remove the interior least tern from the Federal List of Endangered and Threatened Wildlife.[13] No final rule has been published as of April 2020. The interior least terns are smaller than similar tern species with slender wings, short tail, and a large bill. The interior least tern has historically nested in Texas on sandbars of the Colorado River, Red River and Rio Grande River. Only small breeding populations exist at isolated locations within the species' historic range, although its winter range includes the entire Texas Gulf Coast. The interior least tern's preferred nesting habitat is non-vegetated, frequently flooded sand flats, salt flats, sand and gravel bars; and sand, shell and/or gravel beaches.[14, 15] The species is also known to utilize man-made disturbance areas such as mines, rooftops, and gravel covered locations near a large water source utilized for foraging. This species is believed to generally follow major river basins to their confluence and then south or southeast to the Gulf of Mexico during fall migration.[16]

2.3.4 Whooping Crane

The whooping crane (*Grus americana*) is a crane species listed by both USFWS and TPWD as federally and state endangered in Texas including Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, and Waller Counties. USFWS-designated critical habitat is located outside of the Action Area (**Appendix C**). The whooping crane winters on the central Texas Gulf Coast, where it inhabits the oak savannas, salt marshes, and bays of the Aransas National Wildlife Refuge. This species uses a variety of habitats during migration including croplands, palustrine wetlands of varying sizes, and other riverine habitats.[17] Migrants have been found, often with sandhill cranes (*Grus canadensis*), just west and east of the traditional migration route located throughout much of the Great Plains of North America.[18] Whooping cranes opportunistically use stopover habitat and may not use the same stopover locations each year. They will typically stop wherever they happen to be late in the day or when they find conditions no longer suitable for migration.[19] This can make for an unreliable estimation of stopover use.

[12] USFWS. "Golden-cheeked Warbler (*Setophaga chrysoparia*) 5-Year Review: Summary and Evaluation." Austin, Texas: U.S. Fish and Wildlife Service, 2014.
[13] Federal Register Vol. 84, No. 206, 56977-56991. Available online: https://www.regulations.gov/document?D=FWS-R4-ES-2018-0082-0001
[14] Campbell, Linda. 1995. *Endangered and Threatened Animals of Texas: Their Life History and Management*. Austin, Texas: Texas Parks and Wildlife Press.
[15] Lockwood, Mark and Brush Freeman. 2014. *The Texas Ornithological Society Handbook of Texas Birds*. College Station: Texas A&M University Press.
[16] USFWS. "Interior Least Tern (*Sternula antillarum*) 5-Year Review: Summary and Evaluation." Albuquerque, New Mexico: U.S. Fish and Wildlife Service, 2013.
[17] U.S. Fish and Wildlife Service. 2007. *International Recovery Plan Whooping Crane (Grus americana) Third Revision.*
[18] Lockwood, Mark and Brush Freeman. 2014. *The Texas Ornithological Society Handbook of Texas Birds*. College Station: Texas A&M University Press.
[19] USFWS. 2009. Whooping Cranes and Wind Development-An Issue Paper. Retrieved September 9, 2019 from https://tethys.pnnl.gov/sites/default/files/publications/USFWS_2009.pdf

2.3.5 Houston Toad

The Houston toad (*Anaxyrus houstonensis*) is a federal and state-listed endangered species and has historically occurred in nine Texas counties, including Austin, Bastrop, Burleson, Colorado, Lavaca, Lee, Leon, Milam and Robertson Counties. The Houston toad has federally designated critical habitat that is located outside of the Action Area (**Appendix C**). It typically averages 2 to 3.5 in (5 to 9 cm) long and has a light mid-dorsal stripe, a pale underside often with small, dark spots and varies in overall coloration from light brown to gray or purplish gray occasionally displaying green patches. The Houston toad is a close relative of the American toad (*Anaxyrus americanus*) that resembles it in call and morphology. Houston toads have thickened cranial ridges especially behind the eyes. Their call is a musical trill, higher pitched than the American toad but with the same trill rate (approximately 32 pulses per second) and lasts 4-11 seconds.[20]

The Houston toad has varying habitat requirements for its different life stages, but loose, deep sandy soils, and high canopy cover with an open understory of mainly bunch grasses and still or flowing waters for breeding are typically identified as necessary components.[21] Populations of Houston toads in Bastrop County are found in pine or mixed deciduous forested areas and historically populations known in Harris County were found in coastal prairie.[22] The common characteristic between these habitats is the presence of deep sandy soils necessary for burrowing. Houston toads can use flooded puddles in roads, ponds, and even lakes as potential breeding sites.[23]

The Houston toad is typically inactive during the coldest months and when it is hot and dry.[24] The breeding season for the Houston toad lasts from January to June, with a typical year's peak in March and April.[25] Calling, breeding, and spawning activity is apparently initiated by heavy rains with warm temperatures from mid-February to early June.[26]

2.3.6 Texas Fawnsfoot

The Texas fawnsfoot (*Truncilla macrodon*), a species of freshwater mussel species, is currently a federal candidate for listing by the USFWS and a current state-listed threatened species by the TPWD. This species does not have federally designated critical habitat due to its candidate status. It was historically found in the Colorado, Trinity, and Brazos River drainages of Central Texas. Preferred substrates for this species have not been extensively documented; however, an individual was found on a sandy shore of the Colorado River.[27]

[20] Conant, Roger and Joseph T. Collins. 1998. *Peterson Field Guide: Reptiles and Amphibians (Eastern/Central North America).*
[21] Forstner, Michael R. J. and James R. Dixon. 2011. "Houston Toad (*Bufo houstonensis*) 5-year Review: Summary and Evaluation. Final Report for Section 6 Project E-101." Austin: Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service.
[22] Ibid.
[23] Ibid.
[24] USFWS. "Houston Toad (*Bufo houstonensis*) 5-year Review: Summary and Evaluation." Austin, TX: U. S. Fish and Wildlife Service, 2011.
[25] Ibid.
[26] Dixon, James R. *Amphibians and Reptiles of Texas.* College Station: Texas A&M University Press, 2013.
[27] Howells, Robert G., Raymond W. Neck and Harold D. Murray. 1996. *Freshwater Mussels of Texas*. Austin, Texas: University of Texas Press.

The Texas fawnsfoot is a thin-shelled freshwater mussel that can grow to 2.4 in (60 millimeters [mm]) in length but is usually smaller.[28] The shell is oval with external coloration that varies from yellowish- or orangish-tan, brown, reddish-brown, to green with a pattern of fragmented rays or irregular blotches.[29] The inside of the shell is bluish-white or white and iridescent.

Texas fawnsfoot was not found alive for years, so little information is available about its preferred habitat. Historically, Texas fawnsfoot shells and some dead individuals were occasionally found along rivers following drought-related dewatering or bank deposition after major flooding events. These shells and dead individuals indicated that the Texas fawnsfoot occurs in flowing water of large and major rivers, as it was never found in ponds, lakes, or reservoirs, suggesting that it is intolerant of deep, low-velocity waters created by artificial impoundments.[30]

2.3.7 Large-fruited Sand Verbena

Large-fruited sand verbena (LFSV, *Abronia macrocarpa*) is an endemic federally and state-listed forb that primarily occurs in the post oak savannah ecological region of east-central Texas. There is no federally designated critical habitat for this species (**Appendix C**). This species is listed in two Texas counties within the Action Area, including Freestone and Leon Counties. Primary threats to LFSV are habitat destruction and modification, non-native plant species, and fire suppression. LFSV is a glandular herbaceous perennial with stems reaching approximately 20 in (50 centimeters [cm]) tall.[31] The maximum depth LFSV taproots have been detected was at 4.7 in (12 cm) below the surface.[32] Leaves are pubescent, simple, oppositely arranged, with ovate to elliptical blades measuring approximately 0.8-2.0 in (2-5 cm) long. Flowers are formed in bracted capitate heads approximately 1.6-2.8 in (4-7 cm) wide and containing 20-75 flowers. The corollas are magenta, approximately 0.7-1.3 in (18-32 mm) long, funnelform, approximately 0.2-0.5 in (5-12 mm) wide, and 5-lobed. The fruit is a papery anthocarp, 0.3-0.6 in (8-15 mm) long, 0.2-0.5 in (5-12 mm) wide, with a conic beak and five prominent wings. It is differentiated from other *Abronia* species by geography and by its large fruit. *Glandularia* sp such as Rose Vervain (*Glandularia canadensis*) can be confused for LFSV in rare circumstances but are easily distinguishable based on their leaves.[33]

LFSV has the highest germination rates in the fall and winter and the lowest germination rate was documented from May to September. LFSV produces rosettes or leaves above ground from October to February, flower and fruit from February until May, and persists as perennial underground taproots from May to September at a depth of 0-4.7 in (0-12 cm). Flowering begins as early as February with anthesis and fruiting in April and May. Senescence occurs from mid-May to October. LFSV flowers for the first time at 2-3 years of age.[34] LFSV is primarily moth-pollinated with flowers opening from 3:00-4:00 pm until 9:00-10:00 am or noon on overcast days. The

[28] Howells, R. G. 2010. *Texas fawnsfoot (Truncilla macrodon): summary of selected biological and ecological data for Texas.* BioStudies
[29] Ibid.
[30] Ibid.
[31] Poole, Jackie M., William R Carr, Dana M. Price, and Jason R. Singhurst. *Rare Plants of Texas*. College Station, Texas: Texas A&M University Press, 2007.
[32] Williamson, P.S. Final Report, Project 44: *Large-fruited sand-verbena monitoring and management study*. 1996. Section 6 grant no. E-3-1.
[33] Poole, Jackie M., William R Carr, Dana M. Price, and Jason R. Singhurst. *Rare Plants of Texas*. College Station, Texas: Texas A&M University Press, 2007.
[34] Williamson, P.S. Final Report: *Response to disturbance by large-fruited sand-verbena (Abronia macrocarpa).* 1998. (USFWS Cooperative Agreement No. 14-16-0002-91-284).

species relies on sexual fertilization between unrelated individuals and is thought to be pollinated by three moth species belonging to the family *Sphingoidea* and family *Noctuidae*. Diurnal, incidental pollination is suspected to occur due to bees belonging to the *Bombus* and *Apis* genera. LFSV anthocarps are wind-dispersed; however, the majority of them fall within approximately 11.8 in (30 cm) of the parent plant which leads to a "clumped-contagious" distribution. This means that the presence of one individual can indicate a high probability that there are more nearby.[35]

LFSV is an endemic species, occurring in the Post Oak Savannah Ecological Region of east-central Texas. It is primarily found in sparse, herbaceous vegetation clearings within post oak savannah, often within sandy blowouts. Common herbaceous associates include slimspike threeawn (*Aristida longespica*), healing croton (*Croton argyranthemus*), Illinois flatsedge (*Cyperus grayioides*), silver pygmycudweed (*Evax candida*), Georgia frostweed (*Helianthemum georgianum*), variable-leaf evening primrose (*Oenothera heterophylla*), Drummond's nailwort (*Paronychia drummondii*), scarlet penstemon (*Penstemon murrayanus*), annual phlox (*Phlox drummondii*), large clammyweed (*Polanisia erosa*), little bluestem, Pickering's dawnflower (*Stylisma pickeringii*), and Reverchon's spiderwort (*Trandescantia reverchonii*).[36]

2.3.8 Navasota Ladies'-Tresses

The Navasota ladies'-tresses (NLT, *Spiranthes parksii*) is a federally listed, endangered species and has been listed in 13 Texas counties by USFWS, including Freestone, Limestone, Leon, Madison, and Grimes counties. Currently there is no federally designated critical habitat for this species (**Appendix C**). NLT is a perennial orchid reaching approximately 8 to 15 in (20-38 cm) in height. It produces rosettes or leaves above ground from February to May but persists as underground tubers from May to September. NLT yields cream-colored flowers which grow in a loose spiral along the uppermost 2 in (5.1 cm) of the stalk. It is differentiated from other *Spiranthes* species by the short, rounded petals with a green stripe in the center, the oval lip and the green bracts with white tips.[37] Flowering begins as early as September, but generally peaks in October and November. However, the species does not characteristically flower every year and individuals may be present for several years without producing either rosettes or flowering stems. Seed dispersal occurs in December.[38] Maximum depth of root tubers has been recorded at 3.5 in (9 cm) below the surface.[39]

NLT is similar in morphology to several other *Spiranthes* species, particularly the woodlands, open flowered form of nodding ladies'-tresses (*S. cernua*). In fact, there is some debate within the scientific community as to whether or not NLT is a unique species. While NLT is thought to be pollinated by various bee species, the orchid is known to reproduce primarily via apomixis (asexual

[35] USFWS. *Large-Fruited Sand-Verbena (Abronia macrocarpa) Galloway 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2010.
[36] Poole, Jackie M., William R Carr, Dana M. Price, and Jason R. Singhurst. *Rare Plants of Texas*. College Station, Texas: Texas A&M University Press, 2007.
[37] Liggio, J. and A. O. Liggio. *Wild Orchids of Texas.* University of Texas Press, Austin, 1999.
[38] Wonkka, C. L., W. E. Rogers, F. E. Smeins, J. R. Hammons, S. J. Haller, and M. C. Ariza. "Biology, ecology, and conservation of Navasota ladies' tresses (Spiranthes parksii Correll), an endangered terrestrial orchid of Texas." *Native Plants Journal* 13, no.3 (2012): 236-243.
[39] Hammons, J. R., F. E. Smeins, and W. E. Rogers. "Transplant methods for Spiranthes parksii." *Native Plants Journal* 16, no. 1 (2010): 38-46.

seed formation).[40] This apomictic development of polyembrionic seeds and the tetraploid chromosome number indicates that NLT is a member of the *S. cernua* complex. The *S. cernua* complex consists of three species with diploid chromosome numbers and three tetraploid species, including *S. cernua* and NLT. With its limited distribution, mostly in the post oak savannah region of east-central Texas, NLT could be considered a local form of *S. cernua*. However, distinctive morphological characteristics such as small flower size and upturned lateral sepal apices are unique characteristics of NLT not seen in *S. cernua*.[41]

USFWS concluded in 2009 that not enough evidence existed to rule out NLT as a valid species and that further research in areas such as differential gene expression may be warranted in order to determine the genetic pathways responsible for the observed phenotypic differences.[42] A petition to delist the endangered NLT was submitted to USFWS in July 2015, but was again determined by USFWS to lack substantial information, indicating that the NLT should remain federally listed as endangered.[43,44]

NLT is an endemic species, occurring in the post oak savannah ecological region of east-central Texas.[45] It is found primarily in small grassland clearings within upland post oak savannah, often along streambanks or ephemeral seeps with sandy soils.[46,47] Common canopy and shrub species include black jack oak, farkleberry, yaupon, and American beautyberry. Associated herbaceous species can include rosemary frostweed (*Helianthemum rosmarinifolium*), St Andrews cross (*Hypericum hypericoides*), pinkscale blazing star (*Liatrus elegans*), bluet (*Houstonia pusilla*), yellow hedge hyssop (*Gratiola flava*), long bract wild indigo (*Baptisia bracteata var. leucophaea*), Nuttall's rayless goldenrod (*Bigelowia nuttallii*), Arkansas least daisy (*Chatopappa asteroides*), silkgrass (*Pityopsis graminofolia*), slender ladies'-tresses (*S. lacera* var. *gracilis*), nodding ladies'-tresses (*S. cernua*), splitbeard bluestem (*Andropogon ternarius*) and little bluestem.[48,49] The woodland form of *S. cernua* is also sympatric (occurring in the same area) with NLT.[50]

[40] Catling, P. M., and K. L. McIntosh. "Rediscovery of Spiranthes parksii Correll." *Sida* 8 (1979): 188-193.
[41] Sheviak, C. J. and P. M. Brown. "Spiranthes – Spiranthes parksii." *Flora of North America* 26 (2002): 541. Accessed December 13, 2016, http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101962.
[42] USFWS. *Navasota Ladies'-Tresses (Spiranthes parksii) 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2009.
[43] SWCA, "Petition to Delist the Navasota Ladies'-tresses (*Spiranthes parksii*) in Accordance with Section 4 of the Endangered Species Act of 1973," May 2015.
[44] USFWS. "Endangered and Threatened Wildlife and Plants; 90-Day Findings on 29 Petitions." *Federal Register* 81 (2016): 14058-14072.
[45] USFWS. *Navasota Ladies'-Tresses (Spiranthes parksii) 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2009.
[46] Wonkka, C. L., W. E. Rogers, F. E. Smeins, J. R. Hammons, S. J. Haller, and M. C. Ariza. "Biology, ecology, and conservation of Navasota ladies' tresses (Spiranthes parksii Correll), an endangered terrestrial orchid of Texas." *Native Plants Journal* 13, no.3 (2012): 236-243.
[47] Poole, J. M., W. R. Carr, D. M. Price, and J. R. Singhurst, "Spiranthes parksii." In *Rare Plants of Texas: A Field Guide*, 465-466. College Station: Texas A&M University Press, 2008.
[48] Liggio, J. and A. O. Liggio. *Wild Orchids of Texas.* University of Texas Press, Austin, 1999.
[49] USFWS. *Navasota Ladies'-Tresses (Spiranthes parksii) 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2009.
[50] Ibid.

Known NLT populations have shown a strong association with the Arol, Burlewash, Shirol and Singleton soil series of the Manning and Wellborn geologic formations.[51] These soils are strongly acidic and composed of approximately 50-90 percent sand and 0-20 percent clay.[52] NLT elevations range between 197-361 feet (60-110 m) above mean sea level.[53]

2.3.9 Texas Prairie Dawn

The Texas prairie dawn (TXPD, *Hymenoxys texana*) is endemic to the Texas Gulf Coastal Plain and has been listed as endangered in three Texas counties by USFWS, including Harris County. There is no federally designated critical habitat for this species (**Appendix C**). It is an herbaceous, branching annual that grows up to approximately 7 in (17.8 cm) tall with 1-7 stems. Flowers are pale yellow to deep yellow in color and flowering occurs between March and April. Its leaves are spoon-shaped, basal, alternate, and narrow.

It occurs only in poorly drained, sparsely vegetated areas (slick spots) at the base of mima, or pimple mounds, in open grasslands or almost barren areas on slightly saline soils that are sticky when wet and almost powdery when dry.[54] Mima mounds are circular or elliptical domes or shield-like mounds, often with flat tops, composed of sandy loam soils coarser than, and distinct from, the surrounding less coarse, often clayey soil. Mima mounds range from 1 to 30 m diameter and attain heights from about 10 cm to over 2 m.[55] Common soil series associated with TXPD consist of primarily of Gessner Complex (Ge) and Katy Find Sandy Loam (Ka or Kf). Soils where TXPD grows is typically covered with blue-green algae.[56]

[51] Wonkka, C. L., W. E. Rogers, F. E. Smeins, J. R. Hammons, S. J. Haller, and M. C. Ariza. "Biology, ecology, and conservation of Navasota ladies' tresses (Spiranthes parksii Correll), an endangered terrestrial orchid of Texas." *Native Plants Journal* 13, no.3 (2012): 236-243.

[52] USDA. *Official Soil Series Descriptions*. USDA-NRCS. n.d.

[53] Wonkka, C. L., W. E. Rogers, F. E. Smeins, J. R. Hammons, S. J. Haller, and M. C. Ariza. "Biology, ecology, and conservation of Navasota ladies' tresses (Spiranthes parksii Correll), an endangered terrestrial orchid of Texas." *Native Plants Journal* 13, no.3 (2012): 236-243.

[54] Poole, Jackie M., William R Carr, Dana M. Price and Jason R. Singhurst. 2007. *Rare Plants of Texas*. College Station, Texas: Texas A&M University Press.

[55] Johnson, D.L., and J. L. Horwath Burnham. 2012. *Introduction: Overview of concepts, definitions, and principles of soil mound studies.* Special Paper 490, The Geological Society of America.

[56] USFWS. Texas Prairie Dawn, 2013. Retrieved from http://www.fws.gov/southwest/clearlakees/PDF/TexasPrairieDawn.pdf

3.0 EFFECTS ANALYSIS

3.1 Methodology

Based on informal coordination with the USFWS in 2015, FRA determined the effects analysis methodology for the below referenced species. For all species, FRA conducted a desktop analysis to determine suitable habitat and the potential for impacts to the species or individuals. Where warranted and feasible (i.e., defined habitat parameters or not a migratory species), FRA conducted habitat suitability analyses to determine the potential and extent of suitable habitat and the need to conduct presence/ absence surveys. For those species which warranted presence/absence surveys, the surveys were conducted were right-of-entry was obtained in accordance with USFWS approved methods as described below.

3.1.1 West Indian Manatee

FRA conducted a desktop analysis which included reviewing literature, TPWD Texas Natural Diversity Database (TXNDD) data, U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) data, and U.S. Department of Agriculture's (USDA) 2016 National Agriculture Imagery Program (NAIP) aerial imagery. No habitat suitability analyses, or presence/absence surveys were conducted for the West Indian manatee due to a lack of coastlines, coastal tidal rivers and streams, mangrove swamps, and salt marshes within or near the Action Area.

3.1.2 Golden-cheeked Warbler

FRA conducted a desktop analysis which included reviewing literature, TPWD EMST vegetation data, TPWD TXNDD data, USGS topographic maps, and 2016 NAIP aerial imagery. Suitable habitat was not identified for the golden-cheeked warbler within the Action Area. Therefore, no presence/absence surveys were conducted for the golden-cheeked warbler. For more information regarding results from the desktop analysis, see **Section 3.2.2** below..

3.1.3 Interior Least Tern

FRA conducted a desktop analysis based on TPWD TXNDD data, NHD data, 2016 NAIP aerial imagery and information obtained through the Texas Railroad Commission (RRC). The RRC provided information for the Jewett Mine, operated by the Texas Westmoreland Coal Company, due to known EORs on the property.[57,58] These resources were used in the effects analysis to assess the potential for occurrence and suitable nesting habitat for this species within the Action Area.[59] Suitable nesting habitat was identified where interior least terns have historically nested. Access to these areas was denied at these locations. No additional suitable least tern nesting habitat, including gravel, sand, or shell bars, beaches and otherwise sparsely vegetated areas within or near rivers or large waterbodies, was identified within the Action Area. No presence/absence surveys were completed for the interior least tern because no suitable nesting habitat was identified outside of the historical nesting locations. For more detailed results from the effects analysis, see **Section 3.2.3** below.

[57] TPWD. "Texas Natural Diversity Database." 2019. Austin: Texas Parks and Wildlife Department, Wildlife Diversity Branch.
[58] Per. Comm. Texas Westmoreland Coal Company. Interior Least Tern Monitoring at Jewett Mine. Received April 4, 2019.
[59] USGS. 2018. *National Hydrography Dataset*. Retrieved January 28, 2019 from http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd

3.1.4 Whooping Crane

FRA conducted a desktop analysis based on TPWD TXNDD, USGS NHD, USFWS National Wetland Inventory (NWI), and TPWD EMST data.[60] NAIP aerial imagery (2016) and USFWS information on this species were also used in the effects analysis to determine areas of suitable stopover habitat, including open areas near a water source or wetlands. Temporary and permanent impacts to emergent wetlands were calculated using NWI data mapped along the Action Area within the nine counties listed for whooping crane. These values represent the anticipated temporary and permanent impacts to whooping crane stopover habitat within the Action Area. No presence/absence surveys were completed for the whooping crane due to the location of the Action Area outside of known nesting and wintering ranges and the unpredictable pattern of this species' use of stopover habitat during migration.[61] See **Section 3.2.4** below for more detailed results of the effects analysis of the whooping crane.

3.1.5 Houston Toad

FRA conducted a desktop analysis for the Houston toad which included reviewing published literature, TPWD TXNDD data, and identifying habitat. In addition, per informal coordination with the USFWS, FRA developed a habitat suitability model using data derived from the USDA NRCS soil data viewer, 2016 NAIP imagery, field delineated water sources, USGS NHD, and USFWS NWI to identify suitable Houston toad habitat for presence/absence surveys.[62] The following variables were included in the Houston toad habitat suitability model:

- Soils consisting of 60% or greater sand to a depth of 24 in (0.6 m) or greater[63]
- 60% or greater canopy cover[64]
- Distance to water source[65]
    - 0-330 ft (0-100 m) from water source would receive a 1 ranking
    - 331-2550 ft (100-777 m) from water source would receive a 0.75 ranking
    - 2,551-4,921 ft (777-1500 m) feet from water source would receive a 0.5 ranking
    - 4,922-16,404 ft (1,500-5,000 m) feet from water source would receive a 0.25 ranking
    - >16,404 ft (>5,000 m) feet from water source would receive a 0 ranking

Parameters representing soils, canopy cover, and distance to water source were combined in GIS to produce a Houston toad habitat suitability model. The resulting habitat suitability model provided suitability on a scale of low suitability (0 percent) to high suitability (100 percent). For the purposes of this Project, areas of 60 percent suitability or greater were modeled to allow for one habitat parameter (soil, canopy cover, or water source) to be absent, resulting in the presence of both optimal and marginal habitat within the final delineation. This allowed for

[60] USFWS. 2019. National Wetland Inventory. Retrieved January 28, 2019 from http://www.fws.gov/wetlands/Wetlands-Mapper.html
[61] USFWS. 2009. Whooping Cranes and Wind Development-An Issue Paper. Retrieved September 9, 2019 from https://tethys.pnnl.gov/sites/default/files/publications/USFWS_2009.pdf
[62] AECOM Austin Ecology and Water Resources Team, memorandum to TCR Project Management Team, December 22, 2016.
[63] USFWS. 2010. Houston Toad *(Bufo houstonensis*) 5-Year Review: Summary and Evaluation
[64] Buzo. 2008. A GIS Model for Identifying Potential Breeding Habitat for the Houston Toad (*Bufo houstonensis*). Biology, Department of Theses and Dissertations-Biology. Texas State University
[65] Ibid.

dispersal habitats and some native prairies to be included within the modeled suitable habitat. The results of the habitat suitability model were then reviewed against 2016 NAIP aerial imagery to eliminate areas that had been previously developed as well as large areas void of canopy cover and determine potential areas for Houston toad presence/absence surveys. The methodology and output of the Houston toad habitat model were discussed and confirmed with USFWS during an informal meeting on February 16, 2017.

3.1.6 Texas Fawnsfoot

FRA conducted a desktop analysis for the Texas fawnsfoot which included reviewing published literature, TPWD TXNDD data, and identifying impacted suitable habitat. Very little occurrence data exists for this species. The presence of large or major rivers that intersect the Action Area was investigated. No species-specific aquatic surveys were completed for the Texas fawnsfoot due to access limitations. Additionally, per TPWD protocol, [66] surveys for this species must be completed closer to construction and relocated, if found, under a TPWD permit.

3.1.7 Large-fruited Sand Verbena

FRA conducted a desktop analysis for the LFSV which included reviewing published literature, TPWD TXNDD data, and identifying habitat. In addition, per informal coordination with the USFWS, FRA developed a habitat suitability model using data derived from the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) soil data viewer, the USGS 250k Grid of Texas Geologic Formations, and the TPWD EMST to identify suitable LFSV habitat.[67] The following variables were included in the LFSV habitat suitability model:

- Post oak woodlands vegetation
- Soils comprised of 70-100 percent sand and 0-15 percent clay at depths of 0-4.7 in (0-12 cm)
- Soils with a pH of 4.8-6.6 at depths of 0-4.7 in (0-12 cm)
- Areas over the Carrizo Sand, Sparta Sand, and Queen City Sand geologic formations

The results of the habitat suitability model were then reviewed against 2016 NAIP aerial imagery to eliminate areas that had been previously developed and determine potential areas for LFSV presence/absence surveys. The methodology of the LFSV habitat model and presence/absence surveys were shared with Amber Bearb with USFWS in a meeting on February 6, 2017 and in a letter on March 13, 2017.

3.1.8 Navasota Ladies'-Tresses

FRA conducted a desktop analysis for the NLT which included reviewing published literature, TPWD TXNDD data, and identifying habitat. In addition, per informal coordination with the USFWS, FRA developed a habitat suitability model using data derived from the USDA NRCS soil data viewer, the USGS 3D Elevation Program (USGS 3DEP), and TPWD EMST to identify suitable NLT habitat for presence/absence surveys.[68] The following parameters were included in the NLT habitat suitability model:

[66] Texas Parks & Wildlife. 2017. Kills and Spills Team Freshwater Mussel Survey and Relocation Protocols. Retrieved April 10, 2020 at https://tpwd.texas.gov/publications/pwdpubs/media/pwd_lf_t3200_1957.pdf
[67] AECOM Austin Ecology and Water Resources Team, memorandum to TCR Project Management Team, February 6, 2017.
[68] AECOM Austin Ecology and Water Resources Team, memorandum to TCR Project Management Team, August 26, 2016.

- Post oak woodlands vegetation
- Soils comprised of 50-90 percent sand at depths of 0-3.54 in (0-9 cm)
- Soils comprised of 0-20 percent clay at depths of 0-3.54 in (0-9 cm)
- Soils with a pH of 5.1-6.5 at depths of 0-3.54 in (0-9 cm)
- Areas with elevations between 197-361 feet (60-110 m) above mean sea level

The results of the habitat suitability model were then reviewed against 2016 NAIP aerial imagery to eliminate areas that had been previously developed and determine potential areas for NLT presence/absence surveys. The methodology and output of the NLT habitat model were discussed and confirmed with USFWS during informal meetings on August 29, 2016, September 4, 2019, and September 11, 2019.

3.1.9 Texas Prairie Dawn

FRA conducted a desktop analysis for the TXPD which included reviewing published literature, TPWD TXNDD data, and identifying habitat. In addition, per informal coordination with the USFWS, FRA developed a habitat suitability model for this species to determine areas suitable for presence/absence surveys. Creating a habitat suitability model is difficult for the TXPD due to the lack of research regarding the species' habitat requirements.[69] To determine areas of potential occurrence for the species, two habitat parameters, soil and vegetation, were considered. With vegetation data acquired from the EMST, areas of urban development were removed from the analysis. Using the NRCS soil data viewer, areas consisting of the Gessner Complex or Katy fine sandy loam soil associations were modeled due to the TXPD's association with these soil associations.[70] Using ArcMap 10.1, the two layers were intersected to modeled areas with a high probability for occurrence. In addition, TXPD have been known to occur on low sloping portions at the base of mima mounds, which are circular domes or mounds with flat tops composed of sandy loam soils, distinct from surrounding clay soils.[71,72,73] Due to the association between TXPD and mima mounds, the Action Area was further investigated for the occurrence of these mounds using historical aerial imagery to find small, white photographic signatures that may indicate that mima mounds are present.[74] Any suspect areas identified were checked with 2016 NAIP aerial imagery and field investigation, when accessible during wetland delineations. The methodology of the TXPD habitat model was based on methodology used in previously issued Biological Assessments and Biological Opinions.[75][76]

3.2 Results

3.2.1 West Indian Manatee

This species has USFWS-designated critical habitat located outside of the Action Area (**Appendix C)**. No EORs were reported by the TPWD TXNDD within counties traversed by the Action Area. In

[69] USFWS. Texas prairie dawn (*Hymenoxys texana*) 5-year review. 2015.
[70] Ibid.
[71] Poole, Jackie M., William R Carr, Dana M. Price and Jason R. Singhurst. 2007. *Rare Plants of Texas*. College Station, Texas: Texas A&M University Press.
[72] USFWS. *Hymonoxys texana* Recovery Plan." Albuquerque, New Mexico: U.S. Fish and Wildlife Service, 1990.
[73] USFWS. Texas prairie dawn (*Hymenoxys texana*) 5-year review. 2015.
[74] AECOM. Hunting Bayou Federal Flood Control Project Biological Assessment. Harris County Flood Control District. 2010.
[75] HCFCD (Harris County Flood Control District). Hunting Bayou Federal Flood Control Project biological Assessment, 2010
[76] USFWS. FHA (Federal Highway Administration) West Greens Road from SH 249 to Cutten Road Biological Opinion, 2005.

addition, the Action Area is not located in the vicinity of the coastline or any large waterbody connected to the coast to provide suitable habitat for the West Indian manatee. There is no potential for this species to occur within the Action Area. Therefore, no direct or indirect effects from construction and operation of the HSR are anticipated.

3.2.2 Golden-cheeked Warbler

No critical habitat has been designated for the golden-cheeked warbler by the USFWS (**Appendix C**). As shown in **Table 2.1-1**, the Action Area is not located within the Edwards Plateau or Cross Timbers Level III Ecoregions. Furthermore, no EMST vegetation types associated with Ashe juniper-oak woodlands were identified within the Action Area. In Dallas County, golden-cheeked warblers temporarily occupied habitat near Cedar Hill State Park, including the Dogwood Canyon Audubon Center, in 2001 and 2002 (see **Appendix A1**).[77] This area contains the only known golden-cheeked warbler observations in Dallas County.[78] The disjunct habitat in this area contains juniper-oak woodlands in the vicinity of Joe Pool Lake and is surrounded by vegetation typically associated with the Blackland Prairies Level III Ecoregion. Based on aerial imagery, this record is located approximately 11 miles southwest of the Action Area. According to the Dogwood Canyon Audubon Center, confirmed sightings of this species have not been recorded for at least 10 years.[79] In addition, as of March 2019 no golden-cheeked warbler EORs were reported by the TPWD TXNDD within counties intersecting the Action Area. Based on this information, aerial imagery, and USGS topographic maps, suitable golden-cheeked warbler nesting habitat was not identified within the Action Area. There is no potential for this species to occur within the Action Area. Therefore, no direct or indirect effects from construction and operation of the HSR are anticipated.

3.2.3 Interior Least Tern

Currently, this species is known to breed along the Red River to Hall County, along the Canadian River to Roberts County, locally in north-central Texas and at reservoirs around San Angelo, Tom Green County; Lake Amistad, Val Verde County; and Falcon Reservoir, Zapata County.[80] No critical habitat for the interior least tern has been designated by the USFWS (**Appendix C**). According to the TPWD TXNDD, for this species there are two EORs within 5 miles (8.1 km) of the Action Area in Dallas County, two EORs within 5 miles (8.1 km) of the Action Area in Freestone County, and one EOR within 1 mile of the Action Area in Leon County (**Appendix A2**).[81] The interior least tern EORs in Dallas, Freestone, and Leon counties are for breeding/nesting populations. The EOR for interior least tern in Leon County was recorded within Segment 4 of the Action Area at the Jewett Mine property. An additional EOR for interior least tern was recorded at the Jewett Mine within Freestone County, last observed in 2006. The other EOR for this species in Freestone County was recorded adjacent to Fairfield Lake State Park, last observed in 2016. The EOR in Dallas County was recorded along the Trinity River, last observed in 2000 (**Appendix A2**).

[77] Lockwood, Mark and Brush Freeman. 2014. *The Texas Ornithological Society Handbook of Texas Birds*. College Station: Texas A&M University Press.
[78] Per. Comm. Dogwood Canyon Audubon Center. Telephone correspondence on April 7, 2020.
[79] Ibid.
[80] Thompson, Bruce C.; Jackson, Jerome A.; Burger, Joanna; Kirsch, Eileen M.; Atwood, Jonathan L. 1997. *The Birds of North America.* Philadelphia: The Academy of Natural Sciences.
[81] TPWD. "Texas Natural Diversity Database. Annotated County Lists of Rare Species by County." 2019. Austin: Texas Parks and Wildlife Department, Wildlife Diversity Branch.

The Texas RRC provided contact information for the operator of the Jewett Mine located along the Leon-Freestone county line. Based on information from observations recorded at the Jewett Mine between 1994 and 2018, interior least terns were recorded nesting throughout permitted portions of the mine property, with the exception of 2008, 2016, 2017, and 2019.[82] In 2018, interior least terns were also observed foraging in various ponds located throughout the mine property. After reviewing information provided by the Jewett Mine operator, a portion of the EOR that intersects Segment 4 corresponds to recorded interior least tern nesting in 2001. Although the EOR intersects the Action Area, the location of nests recorded in 2001 are approximately 0.25 miles (0.40 km) east of the Action Area. No known nest locations exist within or west of the Action Area. The next closest nesting location was recorded approximately 0.66 miles (1.06 km) northeast of the Action Area in 2006. Nests recorded in 2015 occurred approximately 10 miles (16 km) east of the Action Area. The mine also recorded the species nesting near IH 45 in 2007 and 2009, approximately 11 miles northeast of Segment 4. One nesting area was recorded at the Jewett Mine in 2018, including 10 individual nests observed near FM 39, approximately 3.5 miles (5.6 km) east of Segment 4. No nesting individuals were identified in 2019.

Based on this information (and the abovementioned EORs reported by TPWD TXNDD), the interior least tern has moderate potential to nest adjacent to the Action Area in Leon, Freestone, and Dallas counties. No direct effects to the Interior least tern are anticipated based on the species not being present within the Action Area. However, there is potential for indirect effects related to water quality during both construction and operation. Other indirect effects include construction noise and artificial light during construction and operation. Potential indirect effects from contaminants during construction may occur without appropriate avoidance and minimization measures. Implementation of avoidance and mitigation measures outlined in **Section 3.3.1** will reduce the potential for take to discountable as a result of construction and operation of the Project.

3.2.4 Whooping Crane

The whooping crane has USFWS-designated critical habitat located outside of the Action Area (**Appendix C**). In addition, no EORs were reported by the TPWD TXNDD for the whooping crane within affected counties of the Action Area. The Action Area is not within range of this species' wintering or nesting habitats. However, suitable stopover habitat for this species may be present in emergent wetlands and adjacent, relatively open habitats found within the Action Area. In addition, the Action Area occurs within the eastern portion of the whooping crane's 95 percent migration corridor (see **Appendix A3**) which extends from the panhandle eastward to the east-central portion of the state.[83] NWI data indicate a total of 20.15 acres (0.08 km^2) of temporary impacts and 4.84 acres (0.02 km^2) of permanent impacts to whooping crane suitable stopover habitat (emergent wetlands only) for the Action Area. Therefore, there is potential for this species to occur as a migrant/transient within suitable stopover habitat throughout the Action Area.

Direct effects to the whooping crane is related to alteration of suitable stopover habitat. This effect, alteration of suitable habitat, is not expected to adversely affect the species. . However, there is potential for indirect effects related to water quality during both construction and

[82] Per. Comm. Texas Westmoreland Coal Company. Interior Least Tern Monitoring at Jewett Mine. Received April 4, 2019.
[83] Dunn, Jon L., and Jonathan Alderfer. 2006. *National Geographic Field Guide to the Birds of North America.*

operation. Other indirect effects include construction noise and artificial light during construction and operation. Potential indirect effects from contaminants during construction may occur without appropriate avoidance and minimization measures. Implementation of avoidance and mitigation measures outlined in **Section 3.3.2** will reduce the potential for take to discountable as a result of construction and operation of the Project.

3.2.5 Houston Toad

The Houston toad has USFWS-designated critical habitat located outside of the Action Area (**Appendix C**). As mentioned in **Section 3.1.5**, a habitat suitability analysis was conducted in Leon County due to known Houston Toad observations within the county. The habitat suitability model was designed to determine areas of suitable habitat within the Action Area for Houston toad presence/absence surveys. Based on the results of the model, the majority of modeled suitable habitat was found throughout Leon County and in the southern portion of Grimes County (**Appendix A4**). While no historical records of Houston toads have been recorded from Grimes County it was included in the model as part of TCRR FRA's evaluation as recommended by USFWS. The USFWS recommended including Grimes County due to its proximity to Brazos County, which has a confirmed historical record of Houston toad located on the Navasota River which forms the border of Brazos and Grimes counties. Additionally, USFWS indicated that suitable habitat could be present in the southern portion of the county.

Following the habitat suitability analysis, FRA developed methodologies for Houston toad presence/absence surveys in conjunction with the USFWS during informal coordination efforts and conducted three consecutive years of surveys (2017-2019) as described below. Monitoring locations and habitat suitability results are shown on mapping in **Appendix A4**.

Nocturnal surveys were conducted from February to May 2017 at 120 points located near ponds and wetlands (85 in Leon County and 35 in Grimes County) within or directly adjacent to modeled Houston toad habitat up to 3.1 miles (5 km) from the LOD, as recommended by the USFWS. Similarly, nocturnal surveys were conducted from February to May 2018 and 2019 at 90 points located near ponds and wetlands (54 in Leon County and 36 in Grimes County) within or directly adjacent to modeled Houston toad habitat up to 3.1 miles (5 km) from the Action Area. Surveys were conducted from public roadways including roads near properties where permissions were not granted to access the property. These surveys were conducted during times when weather parameters were considered optimal, which meant temperatures above 55°F (12.8°C), winds below 15 mph (24 kmph), humidity above 50 percent and a predicted barometric pressure drop. Pressure drops are considered the best predictor of Houston toad activity[84] and likely holds the most weight in combination with temperature and low wind for optimal hearing conditions. However, surveys may be conducted if humidity and pressure are not optimal. The goal of surveying was to record a minimum of 12 optimal nights (all four parameters met). Based on the USFWS recommendations, an average of 20 surveys per observation point were conducted during the toad's active season.

Starting in February 2017, FRA deployed a total of 24 acoustic monitors throughout the project alignment. Each deployment consisted of a Wildlife Acoustics Song Meter SM4 automated recording unit (ARU) with the exception of detector T10, which was a Wildlife Acoustics Song

[84] Personal Communication with Mike Forstner (Regent's Professor at Texas State University)

Meter SM3BAT ARU. T10 (SM3BAT) was replaced with T25 (SM4) on May 9, 2017. Each ARU was programmed to record for the first 10 minutes of every hour, beginning at sunset and ending at sunrise. All SM4 ARUs made recordings in stereo and all SM3BAT recordings were made in mono. Sampling rates were set to 16 kilohertz (kHz), preamps were set to 24 decibels (dB), and no high-pass filters were used. All ARUs were operated on D cell batteries, which were regularly replaced during the course of the study. Deployment timeframes and detector county locations are presented below in **Table 3.2.5-1**, as well as in **Appendix A4**, Houston Toad Acoustic Monitor Locations.

Table 3.2.5-1: Acoustic Monitor Information for the 2017 Survey Season

Monitor	County	Deploy Start	Deploy End	Total Nights Recorded
T01	Grimes	2/9/2017	6/30/2017	141
T02	Leon	2/17/2017	6/30/2017	133
T03	Grimes	2/9/2017	6/30/2017	141
T04	Leon	2/17/2017	6/28/2017	131
T05	Leon	2/9/2017	6/29/2017	140
T06	Grimes	2/9/2017	6/30/2017	141
T07	Leon	2/9/2017	6/28/2017	139
T08	Grimes	2/9/2017	6/30/2017	141
T09	Leon	2/9/2017	6/28/2017	139
T10&T25	Grimes	2/9/2017	6/30/2017	141
T12	Grimes	2/9/2017	5/9/2017	90
T13	Leon	2/17/2017	6/28/2017	131
T14	Leon	2/17/2017	6/28/2017	131
T15	Leon	2/17/2017	6/28/2017	131
T16	Grimes	2/17/2017	6/30/2017	133
T17	Grimes	2/17/2017	6/30/2017	133
T18	Grimes	2/28/2017	6/30/2017	120
T19	Grimes	2/28/2017	6/30/2017	120
T20	Grimes	3/1/2017	6/30/2017	119
T21	Grimes	3/18/2017	6/30/2017	102
T22	Grimes	3/1/2017	6/30/2017	119
T23	Leon	3/16/2017	6/28/2017	102
T24	Leon	3/16/2017	6/28/2017	102
T25	Grimes	5/9/2017	6/30/2017	51
Total Detector-nights				2,971

Starting in January 2018, FRA deployed a total of 23 acoustic monitors throughout the Action Area including the 3.1 mile (5 km) buffer. All ARUs were operated on D cell batteries, which were replaced March 19-22, 2018. Due to site access restrictions resulting in the inability to change out SD cards, ARU T22 did not record past May 25, 2018 (**Table 3.1.7-2**). Deployment timeframes and detector county locations are presented below in **Table 3.1.7-2**, as well as on Figure 3 and Figure 4, respectively.

Table 3.2.5-2: Acoustic Monitor Information for the 2018 Survey Season				
Monitor	**County**	**Deploy Start**	**Deploy End**	**Total Nights Recorded**
T01	Grimes	1/26/2018	7/2/2018	157
T02	Leon	1/25/2018	7/2/2018	158
T03	Grimes	1/25/2018	7/2/2018	158
T04	Leon	1/25/2018	7/2/2018	158
T05	Leon	2/1/2018	7/2/2018	151
T06	Grimes	1/26/2018	7/3/2018	158
T07	Leon	1/25/2018	7/2/2018	158
T08	Grimes	1/26/2018	7/3/2018	158
T09	Leon	1/25/2018	7/2/2018	158
T10	Grimes	1/26/2018	7/2/2018	157
T13	Leon	2/1/2018	7/2/2018	151
T14	Leon	2/1/2018	7/2/2018	151
T15	Leon	1/25/20187	6/28/2017	131
T16	Grimes	2/17/2017	6/30/2017	133
T17	Grimes	2/17/2017	6/30/2017	133
T18	Grimes	2/28/2017	6/30/2017	120
T19	Grimes	1/26/2018	7/3/2018	158
T20	Grimes	1/26/2018	7/2/2018	157
T21	Grimes	1/26/2018	7/2/2018	157
T22	Grimes	1/26/2018	5/25/2018	119
T23	Leon	1/25/2018	7/2/2018	158
T24	Leon	1/25/2018	7/2/2018	158
T25	Grimes	1/26/2018	7/3/2018	158
Total Detector-nights				3,563

Starting in December 2019, FRA deployed a total of 22 acoustic monitors throughout the project alignment. All ARUs were operated on D cell batteries, which were replaced February 26-27 and May 13-14, 2019. Due to site access restrictions resulting in removal of two units, ARU T13 and T14 did not record past February 26, 2019 (**Table 3.1.7-3**). Another unit, T21, was stolen from a deployment location and data only up to May 14, 2019 was available for analysis. Deployment timeframes and detector county locations are presented below in **Table 3.1.7-3**, as well as on Figure 3 and Figure 4, respectively.

Table 3.2.5-3: Acoustic Monitor Information for the 2019 Survey Season				
Monitor	**County**	**Deploy Start**	**Deploy End**	**Total Nights Recorded**
T01	Grimes	12/19/2018	7/1/2019	194
T02	Leon	12/17/2018	7/2/2019	197
T03	Grimes	12/19/2018	7/1/2019	194
T04	Leon	12/18/2018	7/2/2019	196
T05	Leon	12/17/2018	7/2/2019	197
T06	Grimes	12/18/2018	7/2/2019	196
T07	Leon	12/18/2018	7/2/2019	196
T08	Grimes	12/19/2018	7/1/2019	194
T09	Leon	12/17/2018	7/2/2019	197
T10	Grimes	12/18/2018	7/1/2019	195

Table 3.2.5-3: Acoustic Monitor Information for the 2019 Survey Season				
T13	Leon	12/18/2018	2/26/2019	70
T14	Leon	12/18/2018	2/26/2019	70
T15	Leon	12/18/2018	7/2/2019	196
T16	Grimes	12/18/2018	7/2/2019	196
T17	Grimes	12/18/2018	7/2/2019	196
T18	Grimes	12/17/2018	7/2/2019	197
T19	Grimes	12/19/2018	7/1/2019	194
T20	Grimes	12/19/2018	7/1/2019	194
T21	Grimes	12/19/2018	5/14/2019	136
T23	Leon	12/17/2018	7/2/2019	197
T24	Leon	12/17/2018	7/2/2019	197
T25	Grimes	12/18/2018	7/2/2019	196
Total Detector-nights				3,995

FRA utilized a classifier for identifying potential Houston toad calls with Wildlife Acoustics Kaleidoscope Pro Version 4.3.2, using the cluster analysis mode. The following signal parameters were used: limiting the signal of interest to 1-3 kilo Hertz (kHz), with a duration of 6-12 seconds (s), a maximum inter-syllable gap of 0.05 s, FFT Window of 2.67 milliseconds (ms) (128 at 0-24 kHz), 12 maximum states, 0.5 maximum distance to cluster center, and 500 maximum clusters. A subset of the field dataset, plus 22 known reference calls of Houston toads were analyzed in order to create a cluster dataset[85], these recordings were then manually classified and re-scanned in order to create the updated classifier. This classifier was then run against the entire field dataset to scan data for potential Houston toad calls.

This documentation was provided to USFWS per their Houston toad survey protocol as part of yearly Houston Toad Technical Reports delivered on December 15, 2017, November 7, 2018, and August 7, 2019.

During the 2017, 2018 and 2019 survey seasons, a total of 1,763, 2,466 and 1,841 individual nocturnal audio surveys were conducted, respectively. No Houston toads were identified within the Action Area. After scanning the acoustic monitor data from all three survey seasons against the Houston toad classifier, scans resulted in several calls identified as potential Houston toads. Manual inspection found these to be gulf coast toads (*Bufo nebulifer*) with overlapping but short calls and/or mole crickets, often occurring at the beginning or end of a recording file. After manual inspection, no calls were identified as potential Houston toad vocalizations.

Based on three consecutive years of surveying, through nocturnal audio surveys and acoustic monitoring, a finding of "no presence" was determined for up to 3.1 miles (5 km) from the Action Area in Leon and Grimes counties per USFWS recommendations.

No direct effects to the Houston Toad are anticipated based on the species not being present within the Action Area. However, there is potential for indirect effects to water quality during both construction and operation. Additionally, potential indirect effects from contaminants during construction may occur without appropriate avoidance and minimization measures.

[85] The Macauley Library by The Cornell Lab of Ornithology

Implementation of voidance and monitoring measures outlined in **Section 3.3.3** will help reduce the potential for take to discountable as a result of construction and operation of the Project.

3.2.6 Texas Fawnsfoot

The TPWD TXNDD search did not report any EORs for this species within or immediately surrounding the Action Area.[86] The nearest EOR was recorded approximately 14 miles (22.5 km) from the Action Area within the Navasota River in Grimes County. The species could occur in Freestone, Grimes, Navarro, Madison and Waller counties within the Navasota, Brazos, and Trinity river basins. [87,88] The Texas fawnsfoot is known from the mainstem of the Brazos River from southeast Waco to Southwest Houston, including Waller County. The presumptive range of the Texas fawnsfoot within the Trinity River Basin that is crossed by the Action Area is limited to Dallas, Ellis, and Navarro counties (**Appendix A5**). Within these counties, the Action Area will have excavation impacts to only 10 perennial streams (see **Final EIS Chapter 3.7 Waters of the U.S., Section 3.7.5 Environmental Consequences** for further detail). While sandy substrates are present within perennial streams within the Action Area; there is no potential for this species to occur since the only major river crossed by the Project is in Dallas County where the species is not known to occur.[89] TCRR's proposed crossing of the Trinity River in Dallas County would be a long span concrete bridge with a 275 feet span width (see **Final EIS, Appendix F, TCRR Final Constructability Report**) so that piers would not be place within the riverbed. Additionally, the Project does not cross any other large or major river stems such as the Navasota or Brazos Rivers. Therefore, there is no potential for this species to occur within the Action Area.

3.2.7 Large-fruited Sand Verbena

There are nine documented wild populations of LFSV that occur within 49.7 mi (80 km) of each other.[90] LFSV is known to occur where sandy soils of the Arenosa, Silstead-Padina, Pickton, and Wolfpen series lie 31 to 50 in (79 to 127 cm) deep over sandy clay loam.[91] These soils are acidic to slightly acidic (4.8 – 6.6 pH) and composed of approximately 70-100 percent sand and 0-15 percent clay at a depth of 0-4.7 in (0-12 cm).[92] Known LFSV populations have been associated with soils derived from the Carrizo Sand, Sparta Sand, and Queen City Sand geologic formations.[93] No critical habitat for Large-fruited Sand Verbena has been designated by the USFWS (**Appendix C**).The TPWD TXNDD search reported three EORs for LFSV within Leon and Freestone counties.[94]

[86] Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs. 2019. TPWD County Lists of Protected Species and Species of Greatest Conservation Need. [Dallas, Ellis, Freestone, Grimes, Harris, Leon, Limestone, Madison, Navarro, Waller, accessed December 16, 2015, January 11, 2016, and February 26, 2019].

[87] Federal Register Vol. 76, No. 194 October 6, 2011: 62166-62212.

[88] Randklev, Charles, R., Kentaro Inouse, Michael Hart, and Anna Pieri. 2017. Assessing the Conservation Status of Native Freshwater Mussels (Family: Unionidae) in the Trinity River Basin. Final Report to Texas parks and Wildlife Department. Texas A&M University, College Station, TX.

[89] USFWS. Texas mussel distribution maps, accessed September 13, 2019 from http://www.fws.gov/southwest/es/austintexas/esa_sp_mussel.html

[90] USFWS. *Large-Fruited Sand-Verbena (Abronia macrocarpa) Galloway 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2010.

[91] Williamson, P.S. Final Report, Project 44: *Large-fruited sand-verbena monitoring and management study*. 1996. Section 6 grant no. E-3-1.

[92] USDA n.d.

[93] USFWS. *Large-Fruited Sand-Verbena (Abronia macrocarpa) Galloway 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2010.

[94] TPWD. "Texas Natural Diversity Database." 2019. Austin: Texas Parks and Wildlife Department, Wildlife Diversity Branch. Accessed February 26, 2019].

While no EORs for LFSV were reported within the Action Area, the nearest EOR was recorded approximately 3 miles (4.8 km) west of Segment 4 within Leon County. However, the TXNDD reported that this population was last observed in 1994. An EOR was also reported approximately 18.0 miles (29.0 km) east of Segment 4 within Freestone County. Another EOR was reported for a reference population observed at a property in Hilltop Lakes approximately 7.8 miles (12.6 km) west of Segment 4 within Leon County. This reference property at Hilltop Lakes is owned and managed by Hilltop Lakes Water Supply Corporation. In addition to the EORs, Dr. Paula Williamson identified an additional three wild populations of LFSV in Leon and Freestone Counties. [95]

As described in **Section 3.1.7**, a habitat suitability model was designed for the LFSV to identify areas of suitable habitat within the Action Area. Based on the results of the model, approximately 873 acres (353 ha) within the Project LOD (across all alternatives at the time) were ultimately identified as potentially suitable habitat for LFSV. However, after further investigation of the modeled suitable habitat in 2017, removal of approximately 439 (178 ha) of the 873 acres was recommended due to dense canopy cover that contributed to a lack of habitat suitability. This was accomplished using the National Land Cover Database (NLCD) 2011 U.S. Forest Service Tree Canopy raster file to identify areas with 40 percent or less canopy and intersect those areas with the habitat model initial findings. These removed areas were also field-verified and characterized as "dense canopy cover" or "dense canopy cover with thick understory." This effort was appropriate for the modeling of LFSV habitat according to Dr. Paula Williamson (University Distinguished Professor at Texas State University- San Marcos).[96,97]

Following the further refinement of the habitat model results, FRA developed methodologies for LFSV presence/absence surveys in conjunction with the USFWS during informal coordination efforts and conducted three consecutive years of surveys (2017-2019) as described below.

Prior to conducting surveys each year, surveyors visited the Hilltop Lakes reference population site in Leon County on March 18, 2017, March 30, 2017, April 3, 2017, March 19, 2018, and March 11, 2019, and took representative photos of LFSV to help verify the blooming period and aid LFSV identification for the survey teams (**Appendix B**). Surveyors also counted the individual LFSV present at the reference site and collected representative GPS locations at the center of grouped LFSV. In 2017, 419 individual LFSV were counted at the reference site in sandy blowout areas and along the edges of these blowouts. Other vegetation found at the reference site included annual phlox, Reverchon's spiderwort, little bluestem, and threeawn (*Aristida* spp.). No LFSV were observed under any canopy or shaded areas. In 2017 and 2018, the observed LFSVs were in various stages of blooming and fruiting. Some smaller individuals were not blooming or fruiting but easily identified by their pubescent leaves. In 2019, there appeared to be less LFSV individuals than in previous years. This might be due to extreme weather that altered the sandy blowout. However, several individuals were identified blooming and not yet fruiting.

Due to design changes potentially affecting the Action Area, presence/absence surveys were conducted on nearby, accessible parcels containing modeled LFSV habitat. **Table 3.2.7-1** below provides LFSV habitat information for the Action Area that was surveyed for three consecutive

[95] USFWS. 2010. Large-Fruited Sand-Verbena *Abronia macrocarpa* Galloway 5-Year Review: Summary and Evaluation
[96] Williamson, P.S. per. Comm. Email received: September 13, 2017
[97] Williamson, P.S. Final Report: Protection on Private Lands and Research for Recovery of Large-fruited Sand-verbena. 2008. (USFWS Contract Number 146696)

years. Survey permission forms signed by landowners allowing access for field surveys are on file and can be provided to the USFWS upon request.

Table 3.2.7-1: LFSV Habitat by Segment for the Action Area				
Year	**Segment**	**Total Modeled Suitable Habitat Acreage to be Impacted**	**Surveyed Acreage**	**Un-surveyed Acres**
2017	4	445	64	381
2018	4	144	23	121
2019	4	129	13	116

LFSV presence/absence surveys were conducted in accordance with the USFWS LFSV Survey Protocol, as provided by the USFWS on February 15, 2017, during the peak flowering season of March-April using pedestrian methods within areas Action Area identified by the habitat suitability model and accessible via landowner-granted right-of-entry. /FRA surveyed 64 acres (25.9 ha) of accessible, modeled suitable LFSV habitat from March 30-April 4, 2017; 23 acres (9.3 ha) of accessible, modeled suitable LFSV habitat from March 18-19, 2018 and March 30, 2018; and 13 acres (5.3 ha) of accessible, modeled suitable LFSV habitat from March 11-14, 2019 (**Appendix A6**). Of the 129 acres of modeled LFSV habitat within the Action Area, 13 acres were surveyed for three consecutive years. Documentation of these survey efforts was provided to the USFWS per their LFSV Survey Protocol as part of FRA's annual LFSV Technical Reports delivered on April 21, 2017, July 6, 2018, and May 3, 2019.

During 2017, 2018 and 2019 survey efforts, no LFSVs or the sandy blowouts associated with this species were observed on the surveyed parcels. One bare sandy area that appeared to be artificially maintained as a gun range on private property was identified in Freestone County (**Appendix B**); however, the property appeared to be heavily grazed and no LFSV plant individuals were identified. While no LFSV individuals or sandy blowouts were identified on surveyed parcels, approximately 116 acres (46.9 ha) were not surveyed for the species within the Action Area. Therefore, there is potential for this species to occur within the 116 unsurveyed acres of the Action Area. The implementation of measures outlined in **3.3 Conservation and Mitigation Measures** to address the modeled suitable habitat identified on these unsurveyed acres will ensure that the Project would not reduce the recovery and survival of the species.

3.2.8 Navasota Ladies'-Tresses

Based on the TPWD TXNDD search, no EORs were reported for NLT within the Action Area. In addition, no critical habitat for this species has been designated by the USFWS (**Appendix C**). The results of the habitat suitability model as described in **Section 3.1.8** included optimal (meets all habitat parameters) and marginal (meets all except one habitat parameter) for survey purposes and were reviewed against 2016 NAIP aerial imagery to eliminate urban and otherwise developed areas. Additionally, suitable habitat was edited based on field verification. This included removing habitat of very dense pine forests and disturbed or developed areas where land was accessible. Additionally, some habitat that appeared to be suitable during surveys was added as a result of field verification. Of the 1,054 acres ultimately identified as modeled suitable habitat within the Action Area in 2016, FRA was able to access (via landowner-granted right-of-entry) and survey a total of 470 acres (190 ha) within the Action Area from October 31 — November 15, 2016.

Of the 1,059 acres (428.6 ha) of the modeled suitable NLT habitat in 2017, FRA was able to access (via landowner-granted right-of-entry) and survey a total of 570 acres (230.7 ha) within the Action Area from October 23 – November 3, 2017. Due to changes in the LOD following the 2017 surveys, approximately 953 acres (385.7 ha) were identified as modeled suitable NLT habitat within the Action Area for 2018 survey efforts. From October 15-26, 2018, FRA was able to access and survey a total of 475 of the 953 acres (192.2 ha). Following the 2018 NLT survey efforts, further changes to the LOD occurred which resulted in approximately 957 acres (387.7 ha) of suitable NLT habitat within the Action Area. **Table 3.2.8-1** below provides NLT habitat information by segment for the 2019 LOD within the Action Area. Survey permission and land access changed each year during survey efforts. Survey permission forms signed by landowners allowing access for field surveys are on file and can be provided to USFWS upon request.

Table 3.2.8-1: Modeled NLT Habitat by Segment for the Action Area

Consecutive Years Surveyed	Segment	Habitat Suitability*	Total Modeled Suitable Habitat Acreage to be Impacted	Surveyed Acreage	Unsurveyed Acres
3	4	Optimal	144	65	79
	4	Marginal	297	102	195
	5	Optimal	152	64	88
	5	Marginal	364	156	208
		Total	**957**	**387**	**570**

*Optimal habitat includes areas where all habitat parameters are present. Marginal habitat allows for one habitat parameter to be absent.
Out of the 387 acres of surveyed modeled suitable habitat, 25 individuals were found on a single parcel consisting of 6 acres (1.5% of surveyed acreage) of optimal modeled suitable habitat.

Surveys were conducted by FRA with the assistance of Mr. Joe Liggio an NLT expert and author of "Wild Orchids of Texas."[98] Presence/absence surveys were conducted in accordance with the USFWS NLT Survey Protocol using pedestrian methods within areas modeled by the habitat suitability model that were accessible for Segments 4 and 5, and during the peak flowering season, October-November. Timing of surveys was coordinated with Dr. Fred Smeins (Professor at Texas A&M University) and USFWS to ensure that surveys were conducted while reference populations were in bloom. Photos of *Spiranthes* individuals were then analyzed by Mr. Joe Liggio and Dr. Fred Smeins to determine species. On properties where no *Spiranthes* species were observed, photographic documentation was gathered to confirm that surveys were conducted.

Per USFWS survey protocol, if NLTs were observed, documentation was provided to the USFWS including a map that clearly identified the location with written landowner consent, aerial photos with date and property information, photos of NLT individuals with corresponding GPS points, descriptions of the observed habitat, and descriptions of the populations including size and number of plants, and age structure of population. If *Spiranthes* species were observed, field personnel recorded the observations by noting detailed descriptions of each individual occurrence and gathering photographic and GPS documentation. This documentation was

[98] Liggio, J.L and A.O. *Wild Orchids of Texas*, 1999. University of Texas Press. Austin, TX.

provided to USFWS per their NLT Survey Protocol as part of yearly NLT Technical Reports delivered on February 15, 2017, December 12, 2017, and February 1, 2019.

During 2016 survey efforts, no NLTs were observed; however, hundreds of nodding ladies' tresses or *Spiranthes cernua* (*S. cernua*) were present in the survey area. The closed flower peloric form of nodding ladies' tresses were by far the most abundant and the typical open flowered woodland form of *S. cernua* was much less common. In addition to *S. cernua*, a few individuals of the earlier flowering *S. lacera* var. *gracilis* were also noted.

During 2017 surveys, three NLT were identified on parcel TX-MA-043.000 on Segment 4. Photos of the individuals were sent to Dr. Fred Smeins for confirmation. The locations of these individuals are available in **Table 3.2.8-2** and **Appendix A7**. Photos of the individuals and their habitat are provided in **Appendix B**. A subsequent visit to parcel TX-MA-043.000 was conducted on November 10, 2017, by Joe Liggio and FRA to obtain additional photos of the NLT individuals with the flower more open. During this visit an additional NLT individual was identified on the parcel (Individual 4). However, Individuals 1 and 2 were not found during the November 10, 2017 visit. The NLT expert suggested that they succumbed to predation by fire ants that were identified near the plants during the initial visit.

Table 3.2.8-2: NLT Locations in Action Area

Individual	County	Segment	Date Observed
1	Madison	4	11/1/2017
2	Madison	4	11/1/2017
3	Madison	4	11/1/2017
4	Madison	4	11/10/2017
5	Madison	4	11/2/2018
6	Madison	4	11/2/2018
7	Madison	4	11/2/2018
8	Madison	4	11/2/2018
9	Madison	4	11/2/2018
10	Madison	4	11/2/2018
11	Madison	4	11/2/2018
12	Madison	4	11/2/2018
13	Madison	4	11/2/2018
14	Madison	4	11/2/2018
15	Madison	4	11/2/2018
16	Madison	4	11/2/2018
17	Madison	4	11/2/2018
18	Madison	4	11/2/2018
19	Madison	4	11/2/2018
20	Madison	4	11/2/2018
21	Madison	4	11/2/2018
22	Madison	4	11/2/2018
23	Madison	4	11/2/2018
24	Madison	4	11/2/2018
25	Madison	4	11/2/2018

During the 2018 survey season a parcel on Segment 4 in Madison County was surveyed three times. During the initial visit on October 17, 2018, biologists identified several *Spiranthes* sp. on the property; however, not all were blooming and a species could not be determined for some. A subsequent visit to the parcel was conducted on October 24, 2018. Again, not all were blooming and a species could not be determined for some. A third visit to this parcel was conducted on November 2, 2018, by Mr. Joe Liggio and other biologists to obtain photos of the NLT individuals with the flowers more open. During this visit, 21 NLT individuals were identified within optimal suitable habitat and recorded.

During the three years of survey efforts (2016, 2017, and 2018), 25 NLT individuals were found on a single parcel in the Action Area (Segment 4) in Madison County, TX.

Habitat on the parcel where 25 individuals were identified in the Action Area included other species such as bahiagrass (*Paspalum notatum*), bermuda grass, hogwort (*Croton capitatus*), yankee weed (*Eupatorium compositifolium*), late flowering boneset (*Eupatorium serotinum*), long bract wild indigo, and nodding ladies 'tresses (*S. cernua*) within the maintained transmission line right-of-way where the NLT individuals were found. An ephemeral stream was present on the southern portion of the property; however, the NLT individuals were not found directly adjacent to the stream. NLT individuals were found within 12 feet (4 m) of a roadway ditch south of FM 978 which acts as an artificial ephemeral stream. The closest NLT was approximately 12 feet (4 m) south of the drainage ditch. The individuals were all approximately 4 in (10.2 cm) tall and blooming age. The location of the parcel can be observed in **Appendix A7** and a representative photo can be observed in **Appendix B**.

Given the adequate amounts of rainfall prior to the flowering season, blooming reference populations, and the high occurrence of nodding ladies'-tresses (a known sympatric species), it can be deduced that an increased chance of detecting NLT during the 2016-2018 field survey efforts would be likely. However it is important to note that plants that flower one year have a low probability of flowering the following year, and it has been found that even in ideal years, it is unlikely that all of the viable plants will flower.[99] Three consecutive years of surveys were therefore conducted to support a "no presence" determination on the surveyed parcels.

Due to the known presence of the species within the Action Area, measures to avoid impacting observed population are outlined in Section 3.3.5. Additionally, since access to survey the entire 957 acres of modeled suitable habitat was not granted, mitigation measures are also outlined in **Section 3.3.5** to mitigation adversely affecting the species.

3.2.9 Texas Prairie Dawn

According to the TXNDD, 26 EORs for this species exist within 5 miles (8.1 km) of the Action Area in Harris County. [100] Twelve of these EORs occurred outside of the areas identified as suitable habitat based on the habitat suitability model as discussed in **Section 3.1.9**; nine of which were recorded prior to the year 2000 and, based on aerial imagery, these areas are now developed. As discussed in **Section 3.1.9**, due to the association between TXPD and mima mounds, the Action

[99] USFWS. *Navasota Ladies'-Tresses (Spiranthes parksii) 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2009.
[100] TPWD. "Texas Natural Diversity Database." 2019. Austin: Texas Parks and Wildlife Department, Wildlife Diversity Branch.

Area was investigated for the occurrence of these mounds using historical aerial imagery and field investigations. During wetland delineations, no TXPD, associated species such as whorled dropseed (*Sporobolus pyramidatus),* Texas willkommia *(Willkommia texana* var.*texana),* Texas windmill grass *(Chloris texensis),* Houston camphor daisy *(Rayjacksonia aurea),* and threeflower snakeweed (*Thurovia triflora)*, or TXPD's typical habitat, mima mounds, were observed. Based on current aerial imagery, all areas where historical aerial imagery indicated possible mounds were determined to be developed or plowed for crops (**Appendix A8**). Additionally, the TXNDD reports that many of the historical sites have disappeared due to development.

No suitable habitat was identified through reviewing historical and current aerial imagery and access was limited for ground surveys to verify the absence of suitable habitat. There is no potential for this species to occur within the Action Area. Therefore, no direct or indirect effects from construction and operation of the HSR are anticipated.

3.3 Conservation and Mitigation Measures

No suitable habitat was identified within the Action Area for the West Indian manatee, golden-cheeked warbler, Texas fawnsfoot, or Texas Prairie Dawn. FRA conducted three consecutive years of presence/absence surveys for the Houston toad, NLT, and LFSV beginning in October 2016 and concluding in June 2019. Plans for avoiding, conserving, and minimizing impacts for the remaining species are described below and will begin after right-of-entry is obtained by TCRR. TCRR may conduct surveys for the presence of multiple threatened or endangered species and their habitat concurrently when possible. Additionally, some species, such as the Houston toad, may require surveyors or biologists to hold a federal recovery permit for surveys or biological monitoring of the species. Lastly, construction performed within the Action Area will be done in compliance with measures identified in the Final EIS, including **WW-CM#4: Clean Water Act Section 404, Individual Permit** and thus any impacts to Waters of the U.S. will further be considered by the USACE. The measures below for species not yet surveyed are to support the overall determination of effects. Should surveys or findings during biological monitoring efforts (as discussed below) reveal new information on effects of the action that may affect listed species in a manner or to an extent not previously considered, FRA would reinitiate coordination with USFWS.

3.3.1 Interior Least Tern

As discussed in **Section 3.2.3**, based on TPWD TXNDD and monitoring information provided by the Jewett Mine operators, the interior least tern has moderate potential to nest within and adjacent to the Action Area in Dallas, Freestone, and Leon counties. Additionally, the interior least tern is federally listed for Dallas, Navarro, Ellis, Freestone, Limestone, Leon, Madison, Grimes, Waller, and Harris counties. The interior least tern is currently proposed for de-listing; however, as part of the delisting (when final rule is published) the USFWS will be required to implement a monitoring plan for a minimum of five years to ensure the stability of the population.[101] Additionally, when delisted the species will be protected under the Migratory Bird Treaty Act. Below are general conservation measures to avoid and minimize direct and indirect effects to the interior least tern within suitable habitat:

[101] USFWS Least Tern (Interior Population) *Sterna antillarum* Fact Sheet, available online: https://www.fws.gov/midwest/endangered/birds/leasttern/IntLeastTernFactSheet.html

- ***BA 1. Coordination and Inspection for Suitable Habitat and Nesting Interior Least Terns in all counties.*** Prior to the start of construction activities, TCRR will hire a qualified biologist with experience in identifying avian species to inspect all suitable habitats and open sand bars or gravel areas during the species breeding season, defined as April 1 through August 31. TCRR will coordinate with USFWS to ensure appropriate timing, frequency, and duration of surveys. Inspections will occur by a qualified biologist/environmental inspector immediately prior to construction to determine the presence or absence of nesting interior least terns. If nesting interior least terns are identified during inspections, FRA will contact USFWS to determine species avoidance measures. Due to the Jewett Mine occurring within Segment 4 of the Preferred Alternative, where interior least terns have been documented to nest, prior to and throughout construction, TCRR will coordinate with the Jewett Mine operators to obtain the latest data on known nesting locations to avoid impacts to this species.
- ***BA 2. Interior Least Tern Site Training.*** Site training will occur prior to and during construction. TCRR will hire a qualified biologist to develop appropriate environmental awareness training that TCRR will administer to all site personnel before beginning work on the Project. The training will include the definition of "take" relative to protected species, the potential presence of protected species, reporting requirements, and measures to be taken to minimize impacts to the natural environment. TCRR will also hire staff to train all site personnel on identification of the interior least tern prior to starting work within interior least tern habitat. TCRR will document training activities and retain documentation for the duration of construction. The documentation will include names of site personnel undergoing training, names of trainers, name of qualified biologist that developed the curriculum, dates and duration of training, and curriculum materials.
- ***BA 3. Interior Least Tern Sensitive Habitat Areas.*** Prior to vegetation clearing, TCRR will hire a qualified biologist to determine the placement of flagging and/or fencing of sensitive habitats and install signs signaling the need for avoidance of these areas to avoid unnecessary adverse impacts and preclude construction impacts from occurring within the area. Sensitive habitats are areas intended to be avoided by the Project and may include:
    - Areas identified that provide habitat for protected species.
    - Areas adjacent to habitats of protected species.
    - Areas where shorebird rookeries and nests are located.
    - All lakes, wetlands, estuaries, lagoons, streams and rivers.
    - Riparian corridors.
    - When feasible, areas that include TXNDD EORs.
- ***BA 4. Construction and Nesting Season*****.** FRA in coordination with USFWS will determine an appropriate buffer distance to avoid impacting nesting interior least terns. TCRR will avoid construction activities within this buffer during interior least tern breeding and nesting season (April 1 through August 31).

In addition to the avoidance and minimization measures above, the Project will be required to meet various general compliance measures specific to water quality and contamination regulations. These include obtaining or having in place a Section 401 Water Quality Certification, General Construction Permit (TXR150000) and Multi-sector General Permit (TXR050000), and Stormwater Management/Stormwater Pollution Prevention Plan. These measures are designed

to prevent degradation of waterways that may supply important foraging habitat components for the Interior least tern (see **Final EIS Chapter 3.3 Water Quality, Section 3.3.6 Avoidance, Minimization, and Mitigation** for further detail). Additionally, implementation of a Hazardous Materials Management Plan and Spill Prevention Control and Countermeasure Plan will be used to address both potential construction and operational impacts to water quality and sensitive habitats (see **Final EIS Chapter 3.5 Hazardous Materials, Section 3.5.6 Avoidance, Minimization, and Mitigation** for further detail).

Other potential indirect effects include construction noise and artificial light at night during construction and operation. The implementation of a Construction Noise Control Plan, while designed for reducing impacts to human receptors, will also benefit the Interior least tern if present at the Jewett Mine. Other operational noise monitoring and mitigation will also have the added benefit to the Interior least tern (see **Final EIS Chapter 3.4 Noise and Vibration, Section 3.4.6 Avoidance, Minimization, and Mitigation** for further detail). Artificial light may indirectly impact the Interior least tern during construction and operation. Artificial lighting during construction will be limited at night to the degree that work can be safely completed. Similarly, lighting will be focused downward to lessen the impact to migratory birds including the Interior least tern (see **Final EIS Chapter 3.6 Natural Resources, Section 3.6.6 Avoidance, Minimization, and Mitigation** for further detail).

Lastly, there is the potential for collision with operational trains. **Section 1.2** of this document describes the HSR facility and its design of security fencing and catenary system that is likely to discourage the Interior least tern from flying within the HSR tracks. Strikes with trains are extremely unlikely to occur. In the unlikely event of the strike of an identified Interior least tern with a train, USFWS shall be contacted and available data provided (including carcass, if available) throughout operation of the HSR system. However, to monitor any strike occurrences with wildlife in general, **during** the operation any obvious wildlife/bird mortality will be recorded and documented for a period of five years as detailed in the **Final EIS, NR-MM#7: Wildlife Mortality Recording Forms**. Inspections will occur at each terminal station after each arrival. Additionally, records of any obvious wildlife electrocutions/mortality related to the overhead catenary system will be recorded and documented for a period of five years after initial operation. Data would be available to the USFWS upon request.

3.3.2 Whooping Crane

As discussed in **Section 3.2.4 Whooping Crane**, TXNND records and desktop data did not report individual whooping cranes within the Action Area. The Action Area occurs within the eastern portion of the whooping crane's 95 percent migration corridor and stopover habitat is present within Segment 4 of the Action Area. Therefore, there is potential for this species to occur as a migrant/transient within suitable stopover habitat throughout the Action Area. Construction cannot be solely completed outside of the whooping crane migration season (October 15 to April 15); therefore, the following measures are proposed to avoid and minimize direct and indirect effects to the whooping crane within suitable habitat:

- ***BA 5. Suitable Habitat Ground Surveys for Whooping Cranes.*** TCRR will hire a qualified biologist with experience in identifying avian species to inspect all suitable migratory stopover habitats that may be impacted, including palustrine and emergent wetlands,

and adjacent cropland prior to vegetation clearing during the species migration season, defined as March 1 through April 30 and September 1 through November 30. This qualified biologist/environmental inspector will have "stop work" authority. Inspections shall also occur by a qualified biologist/environmental inspector immediately prior to construction to determine the presence or absence of whooping cranes in suitable stopover habitat. If migrating whooping cranes are detected using stopover habitat within 1,000 feet of the Action Area, then construction near that location would be directed to cease work by the qualified biologist/environmental inspector until the whooping crane vacates the area and is no longer within 1,000 feet, unless otherwise agreed to by FRA and USFWS.

- ***BA 6. Whooping Crane Site Training.*** Site training will occur prior to and during construction. TCRR will hire a qualified biologist to develop appropriate environmental awareness training that TCRR will administer to all site personnel before beginning work on the Project. The training will include the definition of "take" relative to protected species, the potential presence of protected species, reporting requirements, and measures to be taken to minimize impacts to the natural environment. TCRR will hire staff to train all site personnel on identification of the whooping crane within whooping crane stopover habitat before site personnel can begin work on the Project. TCRR will document training activities and retain documentation for the duration of construction. The documentation will include names of site personnel undergoing training, names of trainers, name of qualified biologist that developed the curriculum, dates and duration of training, and curriculum materials.
- ***BA 7. Whooping Crane Sensitive Habitat Areas.*** Prior to vegetation clearing, TCRR will hire a qualified biologist to determine the placement of flagging and/or fencing of appropriate sensitive whooping crane stopover habitats and install signs signaling the need for avoidance of these areas to avoid unnecessary adverse impacts and preclude construction impacts from occurring within the area. Sensitive whooping crane stopover habitats are areas intended to be avoided by the Project and may include lakes, emergent wetlands, streams, rivers, and adjacent open upland habitats including agricultural areas.
- **BA 8**. **Equipment Storage During Construction**. Equipment, such as a mechanical crane, when not in use will be laid down to its lowest position at night and during periods of inclement weather. If any equipment cannot be lowered below 15 feet above ground, then it will be marked or flagged to alert migrating whooping cranes of its position to avoid collisions.

In addition to the avoidance and minimization measures above, the Project will be required to meet various general compliance measures specific to water quality and contamination regulations. These include obtaining or having in place a Section 401 Water Quality Certification, General Construction Permit (TXR150000) and Multi-sector General Permit (TXR050000), and Stormwater Management/Stormwater Pollution Prevention Plan. These measures are designed to prevent degradation of waterways that may supply important stopover foraging habitat components for the whooping crane (see **Final EIS Chapter 3.3 Water Quality, Section 3.3.6 Avoidance, Minimization, and Mitigation** for further detail). Additionally, implementation of a Hazardous Materials Management Plan and Spill Prevention Control and Countermeasure Plan will be used to address both potential construction and operational impacts to water quality and

sensitive habitats (see **Final EIS Chapter 3.5 Hazardous Materials, Section 3.5.6 Avoidance, Minimization, and Mitigation** for further detail).

Other potential indirect effects include construction noise and artificial light at night during construction and operation. The implementation of a Construction Noise Control Plan while designed for reducing impacts to human receptors, will also benefit the whooping crane, if present, if they stopover near the Project. Artificial light may indirectly impact the whooping crane during construction and operation. Artificial lighting during construction will be limited at night to the degree that work can be safely completed. Similarly, lighting will be focused downward to lessen the impact to migratory birds including the whooping crane (see **Final EIS Chapter 3.6 Natural Resources, Section 3.6.6 Avoidance, Minimization, and Mitigation** for further detail).

Lastly, there is the potential for collision with operational trains. Section 1.2 of this document describes the HSR facility and its design of security fencing and catenary system that is likely to discourage the whooping crane from flying within the HSR tracks. Strikes with trains are extremely unlikely to occur. In the unlikely event of the strike of an identified whooping crane with a train, USFWS shall be contacted and available data provided (including carcass, if available) throughout operation of the HSR system. However, to monitor any strike occurrences with wildlife in general, during the operation any obvious wildlife/bird mortality will be recorded and documented for a period of five years, as detailed in the **Final EIS, NR-MM#7: Wildlife Mortality Recording Forms**. Inspections will occur at each terminal station after each arrival. Additionally, records of any obvious wildlife electrocutions/mortality related to the overhead catenary system will be recorded and documented for a period of five years after initial operation. Data would be available to the USFWS upon request.

3.3.3 Houston Toad

As discussed in **Section 3.2.5**, FRA did not identify individual Houston toads during nocturnal audio surveys within 3.1 miles (5 km) of the Action Area or recorded on acoustic monitors in Leon or Grimes counties. This species is only listed by USFWS and known to occur in Leon County so avoidance measures for the species are for Leon County only.

Below are avoidance and minimization measures to prevent direct and indirect effects to Houston toad within the Action Area in Leon County, Texas.

- ***BA 9. Avoid Transporting Nonnative Seed.*** During vegetation clearing and construction, TCRR will ensure off-road vehicles and equipment are free of plant debris and seeds before entering and leaving worksites in Leon County, to avoid transport of nonnative seed to construction areas. TCRR will restore sites with native seed mixes certified as "weed free." If native seeds cannot be used, then the area will be left bare. If left bare, the areas would be stabilized by other appropriate control measures in compliance with the TPDES permit requirements.
- ***BA 10. Construction Monitoring for Houston Toad.*** Prior to and during construction, TCRR will hire a qualified biologist that holds federal and state permits for the Houston Toad to survey, capture, transport, relocate and monitor suitable habitat for the species.

TCRR will coordinate with USFWS to ensure appropriate timing, frequency, and duration of monitoring to ensure no lethal take occurs.

- ***BA 11. Exclusion of Houston Toad During Construction in Leon County.*** TCRR will erect physical exclusion (silt fence or other physical barrier to anurans) at the boundary of work areas located within Houston toad habitat to exclude entry by Houston toads. Daily monitoring by the permitted biologist and maintenance of this perimeter is necessary to ensure integrity of exclusion measures. Active monitoring and trapping (e.g., pitfall traps and cover boards) should continue within the exclusion barrier and particularly following precipitation events. Within 24 hours following rain events, cumulatively of 2 inches (5.1 cm) or more, a qualified biologist will inspect the site before work can resume. TCRR will deploy a qualified biologist to monitor construction activities within all areas identified as Houston toad habitat within Leon County. This qualified biologist inspector will have "stop work" authority. During construction, should an unexpected Houston toad be encountered, TCRR will be directed to cease work in that area immediately by the qualified biologist. The permitted biologist will secure the area containing the Houston toad and consult FRA and USFWS. The permitted biologist will hold an appropriate USFWS recovery permit to survey, capture, transport, relocated, and monitor Houston toads.
- ***BA 12. Houston Toad Site Training.*** Site awareness training will occur prior to and during construction. TCRR will hire a qualified biologist to develop appropriate environmental awareness training that TCRR will administer to all site personnel before beginning work on the Project. The training will include the definition of "take" relative to protected species, the potential presence of protected species, reporting requirements, and measures to be taken to minimize impacts to the natural environment. Prior to and during construction, TCRR will hire staff to train all site personnel on identification of the Houston toad prior to starting work within Houston toad habitat. TCRR will document training activities and retain documentation for the duration of construction and provide copies to USFWS upon request. The documentation will include names of site personnel undergoing training, names of trainers, name of qualified biologist that developed the curriculum, dates and duration of training, and curriculum materials.
- ***BA 13. Cover Open Trenches.*** During construction, TCRR will ensure that open trenches are covered overnight and/or inspected every morning by a permitted biologist to ensure that no Houston toads or other wildlife are trapped. During construction, TCRR will ensure that escape ramps are placed in any open trenches when needed to ensure that wildlife, including Houston toads, can escape. Should wildlife become trapped, a qualified biologist hired by TCRR will free the wildlife before construction can resume. The permitted biologist will hold an appropriate USFWS recovery permit to survey, capture, transport, relocated, and monitor Houston toads.
- ***BA 14. Downed Tree, Log and Stump Removal within Houston Toad Habitat in Leon County.*** The qualified biologist hired by TCRR will inspect downed trees and logs to be moved, removed to a staging area, mulched, disturbed by a falling tree that is scheduled to be cut, or otherwise disturbed to determine if any Houston toads are sheltering beneath, per USFWS guidance. In addition, during removal of any stumps the qualified biologist shall inspect the area prior to removal and monitor the activity during removal.
- ***BA 15. Mowing Height Restriction within Houston Toad Habitat in Leon County.*** During operation and maintenance of the HSR within Leon County, TCRR will set any mowing equipment used for clearing grass, forbs and small-diameter woody vegetation to a height

of at least 5 inches (12.7 cm) above the ground to minimize the loss of cover for the Houston toad and other anurans.

In addition to the avoidance and minimization measures above, the Project will be required to meet various general compliance measures specific to water quality and contamination regulations. These include obtaining or having in place a Section 401 Water Quality Certification, General Construction Permit (TXR150000) and Multi-sector General Permit (TXR050000), and Stormwater Management/Stormwater Pollution Prevention Plan. These measures are designed to prevent degradation of wetland and streams that are important habitat components to the Houston Toad (see **Final EIS Chapter 3.3 Water Quality, Section 3.3.6 Avoidance, Minimization, and Mitigation** for further detail). Additionally, implementation of a Hazardous Materials Management Plan and Spill Prevention Control and Countermeasure Plan will be used to address both potential construction and operational impacts to water quality and sensitive habitats (see **Final EIS Chapter 3.5 Hazardous Materials, Section 3.5.6 Avoidance, Minimization, and Mitigation** for further detail).

3.3.4 Large-fruited Sand Verbena

As discussed in **Section 3.2.7**, FRA did not find individual LFSVs or sandy blowouts on any surveyed parcels in Leon or Freestone counties. As previously noted, access was limited for the three-year survey effort. A total of 116 acres of modeled suitable habitat was not accessible during the three-year surveys within the Action Area. The FRA and TCRR, in coordination with the USFWS, are currently working together to identify appropriate measures to mitigate for these unsurveyed areas of suitable habitat of the LFSV. These measures may include, but are not limited to, the conservation of existing unprotected populations of LFSV or other measures not yet identified. The FRA, the USFWS, and TCRR are actively pursuing options that are beneficial to the species and its recovery and appropriate to the scale of impact. Once suitable mitigation is identified, the USFWS will provide a Biological Opinion (BO) with updated offset language while referencing an updated version this BA. The USFWS's BO will be incorporated into the FRA's Record of Decision (ROD).

3.3.5 Navasota Ladies'-Tresses

As discussed in **Section 3.2.8**, access was limited for the three-year survey effort. A total of 570 acres of modeled suitable habitat was not accessible during the three year survey period within the Action Area. Of these 570 acres, 167 acres were modeled as optimal habitat and 403 acres marginal habitat. Proposed compensatory mitigation would include preservation at a ratio of 1 : 1 for the 167 acres of modeled optimal habitat and 1 : 0.5 for the 403 acres of modeled marginal habitat.[102] The FRA and TCRR, in coordination with the USFWS, are currently working together to identify appropriate measures to mitigate for these unsurveyed areas of suitable habitat of the NLT. These measures may include, but are not limited to, the conservation of existing unprotected populations of NLT or other measures not yet identified. The FRA, the USFWS, and TCRR are actively pursuing options that are beneficial to the species and its recovery and appropriate to the scale of impact. Once suitable mitigation is identified, the USFWS will provide

[102] This ratio is consistent with TxDOT projects "TxDOT. Widening of US Hwy 79", "TxDOT Construction of 9.6 miles of SH6", "TxDOT. Widening of 15.8 miles of SH21 and US Hwy 190", "TxDOT, New 8.3-mile 4-lane US Hwy 79", and "TxDOT. Improvements to CR169 (road approaches to two new bridges on Mathis Creek)". USFWS. *Navasota Ladies'-Tresses (Spiranthes parksii) 5-Year Review: Summary and Evaluation.* Austin, Texas: U.S. Fish and Wildlife Service, 2009.

a BO with updated offset language while referencing an updated version this BA. The USFWS's BO will be incorporated into the FRA's ROD.

As discussed in **Section 3.2.8**, 25 individual NLTs were found on a single parcel within the Action Area in Madison County in a transmission line Right-of-Way (ROW).

To ensure that NLT individuals are not directly impacted during construction, TCRR will place exclusion fencing, prior to construction, around the avoidance area to ensure site personnel do not come in direct contact with the population. No construction activities would occur within the avoidance area. The avoidance area is depicted in full on **Figure 3.3.5-1** and also shown in part with a detailed map of the population on the in **Appendix A7, NLT Locations**. At the time of this BA the Project schedule has not been defined to a level to identify when these potential activities would specifically occur outside of the avoidance area of this specific NLT population, however they will not coincide with the blooming period of the NLT (September-November). The design and construction of the reroute will not affect the current drainage into and out of the NLT avoidance area.

Indirect or secondary effects to the population as a result of dust and sedimentation control will be avoided based on Project-wide mitigation criteria, further defined below. Additionally, by maintaining the existing tree line around the population, indirect or secondary impacts to the population would be avoided through the preservation of approximately 9.25 acres (3.7 ha) including approximately 3.4 acres (1.4 ha) of forested area and 80 feet of tree line on both sides of the transmission line ROW. Furthermore, the existing road segment would be abandoned in place north of the population to avoid disturbance to the NLTs.

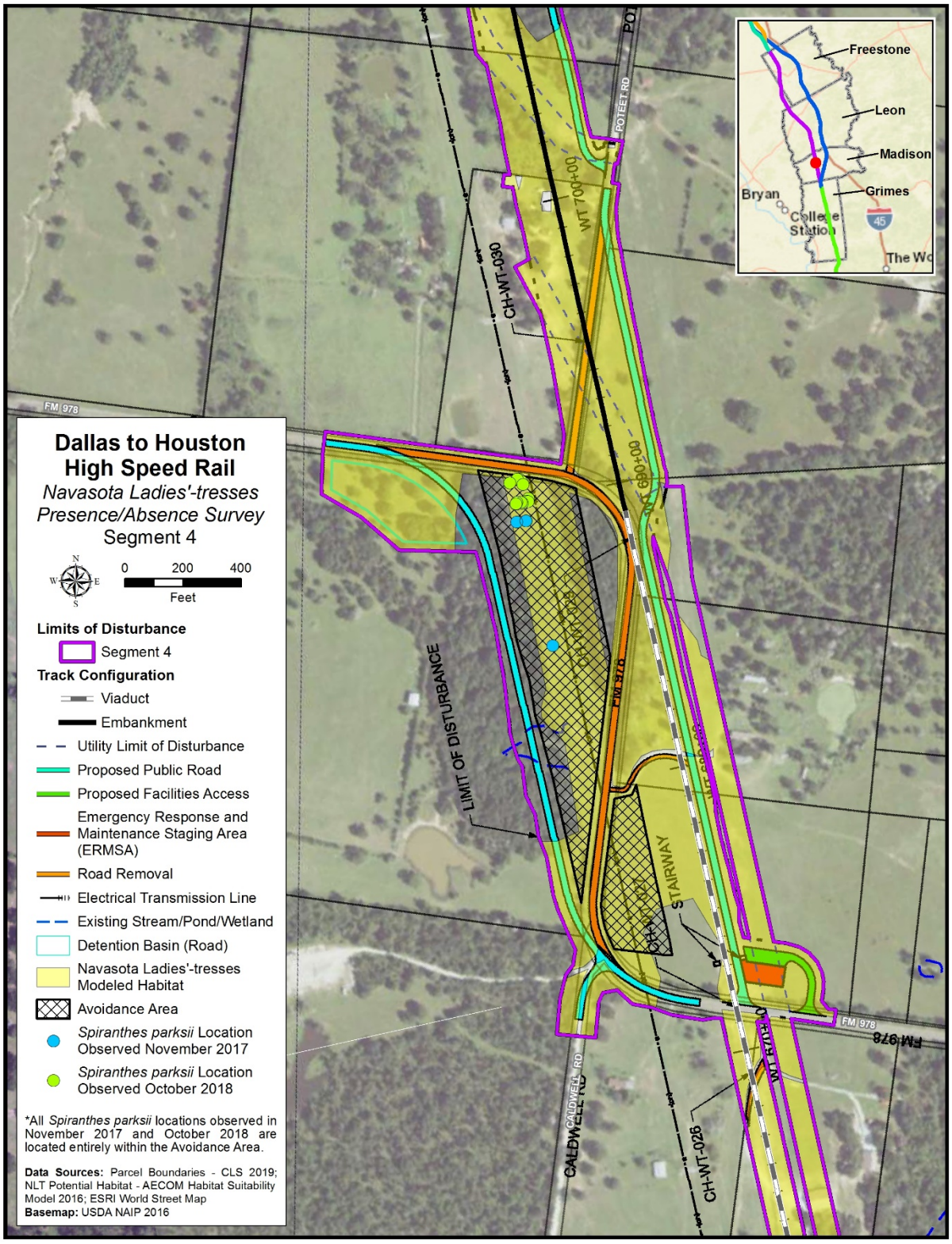

Figure 3.3.5-1. Construction Activities near NLT Population

Following construction, the necessary removal of trees and other vegetation that have the potential to interfere with the safe and reliable operation of the HSR would be performed during routine maintenance activities. This ground disturbance would also provide opportunities for establishment and/or spread of non-native or invasive species. Opportunistic species, such as mesquite and numerous grasses, can be introduced through dispersal methods including wind, being tracked in on vehicles, or spread by wildlife. In addition, increased soil compaction can inhibit the establishment of desirable native species. However, for some protected plant species such as Navasota ladies'-tresses, which has been observed in maintained ROWs and disturbed areas, a maintained ROW could help prevent the encroachment and competition of woody species.

This NLT population was found in a maintained transmission line ROW and the electric company (CenterPoint Energy) will be engaged and informed about the population so that they can help maintain and preserve the population post-construction.

Below are avoidance and minimization measures to prevent direct and indirect impacts to identified individual NLT within the Action Area in Madison County, Texas.

- ***BA 16. Avoid Transporting Nonnative Seed.*** During vegetation clearing and construction, TCRR will ensure off-road vehicles and equipment are free of plant debris and seeds before entering and leaving worksites in Madison County, to avoid potential transport of nonnative seed to construction areas.
- ***BA 17. Navasota Ladies'-Tresses Site Training.*** Site training will occur prior to and during construction. TCRR will hire a qualified biologist to develop appropriate environmental awareness training that TCRR will administer to all site personnel before beginning work on the Project The training will include the definition of "take" relative to protected species, the potential presence of protected species, reporting requirements, and measures to be taken to minimize impacts to the natural environment. Prior to and during construction, TCRR will hire staff to train all site personnel to avoid fenced areas of the known NLT individuals. TCRR will document training activities and retain documentation for the duration of construction. The documentation will include names of site personnel undergoing training, names of trainers, name of qualified biologist that developed the curriculum, dates and duration of training, and curriculum materials.
- ***BA 18. Minimize Limits of Disturbance.*** During construction, TCRR will minimize disturbance to vegetation by using previously disturbed areas when feasible for staging and equipment storage and limiting driving speeds in sensitive areas. In addition, TCRR will ensure disturbed ground is rehabilitated with native vegetation as soon as possible following construction activities to minimize exposure of bare ground susceptible to colonization by nonnative plants.
- ***BA 19. Dust suppression techniques.*** During construction, TCRR will cover and/or treat disturbed areas with dust suppression techniques, including but not limited to soil binders, sprinkling, watering and/or chemical stabilizer/suppressants. This will also include effectively controlling fugitive dust emissions by the application of water, presoaking, or other dust suppression technique during all clearing, grubbing, scraping, excavation, grading, cut and fill, and demolition activities. If winds are greater than 25

mph (40 kmph), TCRR will either soak the exposed work area or suspend dust-generating activities.

3.4 Cumulative Effects Analysis

3.4.1 Cumulative Effects Background

Cumulative effects include the effects of future state, local, private, or tribal actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the Proposed Project are not considered in this section because they would be subject to separate consultation pursuant to Section 7 of the ESA.

Range-wide habitat loss, fragmentation, and degradation, which affects a variety of plant and animal species are the primary threats to the species considered in the BA. Habitats may be lost or degraded as a result of several activities including road and utility construction and maintenance, overgrazing, agricultural expansion, invasive species immigration, and water irrigation and storage projects. In addition to habitat loss, pressures due to urbanization include contamination of air and water, increased predation, and competition from non-native species associated with human development. Additionally, activities that may impact listed species, such as land conversion, pest control, industrial developments such as oil and gas developments, and housing developments may occur without consultation with or authorization by USFWS. In most cases, recordation and acquisition of background data are tied to geopolitical boundaries. In many cases, information required for cumulative effects analyses must be inferred from a variety of secondary sources, such as the inference that significant developments result in a loss of habitat.

3.4.1.1 Urbanization

When considering cumulative effects, there are two species with mapped potential occupied habitat that occur within the Action Area which may be adversely affected by the Project. The LFSV and NLT may occur in five counties traversed by the Project: Freestone, Limestone, Leon, Madison, and Grimes counties. According to the US Census, population growth has been less than 1 percent in Freestone, Leon, and Limestone counties from 2010 to 2018.[103] Freestone County has decreased its population during this time range. Grimes and Madison counties have grown 6.6 and 5.5 percent, respectively. See **Table 3.4.1-1**.

Table 3.4.1-1: US Census Population, Permits, and Housing Units Data

County	County Population			Building Permits	Housing Units
	2018	2010	2000	2018	2013-2017
Freestone	19,808	19,816	17,867	5	9,385
Limestone	23,519	23,384	22,051	2	10,635
Leon	17,270	16,801	15,335	0	9,668
Madison	14,422	13,664	12,940	11	5,228
Grimes	28,360	26,604	23,552	106	11,138
Total	**103,379**	**100,269**	**91,745**	**124**	**46,054**

Source: US Census - https://www.census.gov/quickfacts/fact/table/grimescountytexas,madisoncountytexas,limestonecountytexas,freestonecountytexas,leoncountytexas,leoncountyflorida/PST045218

[103] 2018 population estimated by US Census.

Additionally, US Census data regarding issued building permits in each county suggest that urbanization based on new housing is slow and not likely a factor in these counties (Table 3.4.1-1). While Grimes County did have 106 issued building permits in 2018, this is low compared to the number of housing units within the county (Table 3.4.1-1).

Considering the land area within each county and the acreage of impact from the Proposed Project shows that less than 0.01 and 0.04 percent of land available in these counties are impacted for the LFSV and NLT, respectively. Therefore, habitat loss due to urbanization is not likely to cumulatively affect the LFSV or NLT.

3.4.1.2 Agriculture Expansion

Agriculture is a primary industry in Texas. In 2017 agricultural production and related items accounted for $26.14 billon. Gleaton and Robinson (2018)[104] documented the status of farming in Texas based on the agricultural census of the state. Results showed that, overall, agriculture throughout Texas has changed very little. There are some expansions and contractions that are near 1 to 6 percent, but overall the industry is stable. Based on this information, agricultural expansion is not likely to cumulatively affect the LFSV or NLT.

3.4.1.3 Projects Considered

Other project types include roadway construction/expansion, solar development, and oil and gas development. The Texas Department of Transportation (TXDOT) governs statewide road construction at federal, state, and local levels. Road construction and maintenance within the action area is expected to be minimal due to the nature of the Project as well as the limited access to the Project right of way. Surveys for federally listed species considered where roadway reroutes would occur as a result of the Project. Only one population of NLT was observed within an area of a reroute. That area will be protected during construction and the roadway adjusted to avoid this population (see Section 3.3.5).

Similar to roadway right-of-way, electric transmission generally has maintenance and clearing activities in select location were adjacent trees and vegetation threaten to damage lines. A population of NLT identified in the Action Area was associated with an electric transmission line right-of-way (see Section 3.3.5). This location will be protected during construction in order to maintain a viable population.

Energy development such as that of Mid-South Synergy Solar Power Generation is aimed at providing green energy to Mid-South Synergy customers in rural parts of Grimes, Walker, Madison, Montgomery, Brazos and Waller counties. These developments may potentially impact habitat for listed species assessed in this BA. These potential developments may not always be required to consult with the USFWS regarding potential impacts to listed species. Similarly, oil and gas pipelines that may be planned for crossing the Action Area may also lack requirements for assessing federally listed species.

[104] https://agecoext.tamu.edu/wp-content/uploads/2018/09/AgFacts2018-FullReport.pdf

3.4.2 Contributions of this Project to Cumulative Effects

Three of the species considered in this BA are not expected to be impacted by the Project. Those species include West Indiana manatee (**Section 3.2.1**), golden-cheeked warbler (**Section 3.2.2**), and Texas prairie dawn (**Section 3.2.9**). These species are not known to occur within the Action Area and/or the Action Area being important to their continued recovery and existence.

3.4.2.1 Interior Least Tern

The interior least tern population has historically declined base on a variety of factors including climate change, habitat loss, decline of fish prey and other factors that include nest destruction from natural and human causes (i.e., flooding, off-road vehicles, depredation).[105] Overall, the interior least tern population is increasing to the point of recovery. On October 24, 2019 the USFWS proposed removal of the interior least tern from the Federal list of Endangered and Threatened Wildlife.[106] A final rule has not been issued at the time of this BA. No individuals are known to nest or inhabit that Action Area. However, there are EOR records at the Jewett Mine and also the Trinity River near the Dallas terminus (**Appendix A2**).

Interior least tern populations in Texas have been exploiting anthropogenic resources such as gravel pits and reservoirs for some time and have been increasing in numbers. Periodic flooding and depredation from predators probably consist of the primary reason for mortality. Because of the specific habitat type for this species, urbanization and agricultural expansion are limited in their effects to the interior least tern. Although adjacent to known records of the species, the Action Area does not traverse any suitable habitat or occupied sites. Therefore, this project will not contribute to cumulative effects for this species.

3.4.2.2 Whooping Crane

The whooping crane population is primarily most vulnerable on its nesting grounds and wintering grounds where habitat destruction/alteration, shooting, and human interaction are the primary factors in limiting recovery of the species. Impacts to migratory habitat include loss and degradation of migratory stopover habitat, construction of additional power lines, and threat of chemical spills.[107]

Threats to the whooping crane in Texas are primarily associated with the coastal wintering grounds and interactions with humans directly and indirectly by habitat loss and degradation. Within the Action Area, the Project will temporarily impact approximately 20 acres (0.08 km^2) of emergent wetlands and approximately five acres (0.02 km^2) permanently impacts to whooping crane suitable stopover habitat (emergent wetlands only) for the Action Area. These impacts are considered minor and construction of the project are not expected to appreciably add to the cumulative effects associated with habitat loss and degradation statewide. The Project has been designed (including identification of the Preferred Alternative) based on consideration for minimizing impacts to Waters of the U.S. (i.e., important habitat for whooping crane) and those impacts will be mitigated appropriately during the Clean Water Act permitting process (see in the Final EIS, **WW-CM#4: Clean Water Act Section 404, Individual Permit)**.

[105] Interior Least Tern (*Sternula antillarum*) 5-Year Review: Summary and Evaluation. USFWS 2013
[106] FR 84(206), October 24, 2019/proposed rule: FWS-R4-ES-2018-0082-0001.pdf
[107] Canadian Wildlife Service and U.S. Fish and Wildlife Service. 2007. International recovery plan for the whooping crane. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and U.S. Fish and wildlife Service, Albuquerque, New Mexico. 162 p.

3.4.2.3 Houston Toad

According to USFWS, habitat loss, fragmentation, and degradation are a primary cause of decline.[108] The current distribution of the Houston toad is thought to be naturally restricted based on specific habitat requirements for breeding and development.

Houston toad was not found during extensive multi-year surveys in appropriate habitat along the Action Area in Leon and Grimes counties. Based upon the results of these surveys the Project is not expected to contribute to the cumulative effects for this species.

3.4.2.4 Large-fruited Sand Verbena

The USFWS indicates that the threats to this species include clearing of vegetation for residential development, petroleum exploration, conversion of native grassland to improved pastures and woodlands, fires suppression, off highway vehicles, livestock and deer browsing.[109]

Extensive surveys following USFWS protocols were conducted on modeled suitable habitat within the Action Area. During surveys, activities that are known to threaten this species were observed including overgrazed pastures and improved pastures. **Section 3.4.1.1** indicates that there are few pressures resulting from urbanization. Agriculture, including livestock grazing, are the primary pressures in the counties where the Action Area occurs. However, no individuals were found within the Action Area during surveys. Modeled suitable habitat for LFSV for Leon and Freestone counties totaled 102,118 acres while modeled suitable habitat within the Action Area in these two counties totaled 126 acres. After surveys of these modeled suitable habitat only 116 acres remained within the Action Area; therefore, the Action Area will affect approximately 0.11 percent of modeled suitable habitat within these two counties. Based upon the results of these surveys the Project is not expected to contribute meaningfully to the cumulative effects for this species.

3.4.2.5 Navasota Ladies'-tresses

The USFWS 5-Year Review of the NLT indicated that the primary threats to the species are habitat loss and modification.[110] The USFWS 5-Year Review indicates that there are populations of NLT to the east and west of the Action Area in Madison and Grimes counties.

However, the modeled suitable habitat was surveyed during multiple years with no NLT observed within the Action Area with exception of the location in Madison County. This location, however, is outside of the proposed HSR operational limits and in a powerline right of way. This location will be avoided during construction in order to avoid direct impacts. Over the five counties where modeled suitable habitat was identified for the NLT (approximately 847,820 acres) only 957 were situated within the Action Area. After extensive multi-year surveys where entry permission was granted only a total 570 acres remain unsurveyed. This is approximately 0.067 percent of habitat available within the counties traversed by the Action Area. Based upon the results of these surveys and the percentage of unsurveyed modeled suitable habitat

[108] Houston Toad 5-Year Review: Summary and Evaluation, 2011: https://ecos.fws.gov/docs/five_year_review/doc3957.pdf
[109] Large-Fruited Sand-Verbena 5-Year Review: Summary and Evaluation, 2010:
https://www.fws.gov/southwest/es/Documents/R2ES/Large-fruited_sand-verbena_5-year_Review.pdf
[110] Navasota Ladies'-Tresses 5-Year Review: Summary and Evaluation, 2009:
https://ecos.fws.gov/docs/five_year_review/doc4356.pdf

remaining the Project is not expected to contribute meaningfully to cumulative effects for this species.

4.0 CONCLUSIONS AND DETERMINATION OF EFFECTS

4.1 Determination Effects

4.1.1 West Indian Manatee

Due to the absence of large or major waterbodies with connection to the Gulf Coast, as outlined in **Section 3.2.1 West Indian Manatee**, the Project will have "No effect" on the West Indian manatee. The Project would not directly or indirectly reduce the likelihood of the recovery and survival of West Indian manatees in the wild by reducing their reproduction, numbers, or distribution.

4.1.2 Golden-cheeked Warbler

Due to the absence of suitable nesting habitat, as outlined in **Section 3.2.2 Golden-cheeked Warbler**, the Project will have "No effect" on the golden-cheeked warbler. The Project would not directly or indirectly reduce the likelihood of the recovery and survival of golden-cheeked warblers in the wild by reducing their reproduction, numbers, or distribution.

4.1.3 Interior Least Tern

With the implementation of measures outlined in **Section 3.3.1 Interior Least Tern,** the Project "May affect, but is not likely to adversely affect" interior least tern.

4.1.4 Whooping Crane

With the implementation of measures outlined in **Section 3.3.2 Whooping Crane,** the Project "May affect, but is not likely to adversely affect" whooping crane.

4.1.5 Houston Toad

With the implementation of measures outlined in **Section 3.3.3 Houston Toad**, and based on survey efforts resulting in no presence, the Project "May affect, but is not likely to adversely affect" the Houston toad.

4.1.6 Texas Fawnsfoot

A species effects determination is not provided for the Texas Fawnsfoot, as it is not listed by the USFWS at this time. If listed in the near future, the information provided can be used to aid in an effect's determination specific to the Project.

4.1.7 Large-fruited Sand Verbena

Even with the implementation of measures outlined in Section **3.3.4 Large-Fruited Sand Verbena,** the Project "May affect, and is likely to adversely affect" large-fruited sand verbena. While no LFSV individuals or sandy blowouts were identified on surveyed parcels, approximately 116 acres (46.9 ha) of modeled suitable habitat were not surveyed for the species within the Action Area due to a lack of right-of-entry access. Therefore, there is potential for this species to occur within the unsurveyed 116 acres within the Action Area. Implementation measures outlined in **3.3 Conservation and Mitigation Measures** to address the assumed presence on these unsurveyed acres will ensure that the Project would not reduce the recovery and survival of the species.

4.1.8 Navasota Ladies'-Tresses

Even with the implementation of measures outlined in Section **3.3.5 Navasota Ladies'-Tresses,** the Project "May affect, and is likely to adversely affect" Navasota ladies'-tresses. The Project would impact 167 acres of optimal modeled suitable habitat and 403 acres of marginal modeled suitable habitat for the species that was not surveyed due to lack of right-of-entry access. Implementation measures outlined in **3.3 Conservation and Mitigation Measures** to address the assumed presence on these unsurveyed acres will ensure that the Project would not reduce the recovery and survival of the species.

4.1.9 Texas Prairie Dawn

With the lack of suitable habitat within the Action Area the Project will have "No effect" on TXPD individuals. The Project would not directly or indirectly reduce the likelihood of the recovery and survival of TXPD in the wild by reducing their reproduction, numbers, or distribution.

5.0 LIST OF CONTACTS AND PREPARERS

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AECOM
Erin Lee (Project Manager): Project Manager, Senior Review
Amanda Hargrave (Ecologist): Preparer of BA, Task Lead for T&E surveys, Houston Toad Permittee
Joseph Jandle (Ecologist): Technical, Acoustic Analysis for Houston Toad, Houston Toad Permittee
Jeff Brown (Ecologist): Senior Review

Blanton & Associates
Clifton Ladd (Subconsultant): Sub-lead for Nocturnal Houston Toad Surveys

Michael Forstner, Ph.D., Texas State University: Houston Toad expert

Fred Smeins, Ph.D., Texas A&M University: Navasota Ladies'-tresses/Texas Prairie Dawn expert

Paula Williamson, Ph.D., Texas State University: Large-fruited Sand Verbena expert

Joe Liggio (Retired from TxDOT, Subconsultant): Navasota ladies'-tresses expert

Booz Allen
Katie Hite (FRA MTAC Support): BA Review
Barbara Bottiger (FRA MTAC Support): Review

US Fish and Wildlife Service (USFWS)
Amber Bearb USFWS lead and contact
Moni Belton (Species Expert and Lead Biologist): Navasota ladies'-tresses
Jeff Hill (Species Expert and Lead Biologist): Houston toad
Amber Bearb (Species Expert and Lead Biologist): Large-fruited sand verbena

Westmoreland Jewett Mining LLC
Michael G. Altavilla (Operations Manager): Interior least tern mine monitoring

APPENDIX A – MAPS

A1 – Golden Checked Warbler Locations

A2 – Interior Least Tern Nesting Locations

A3 – Whooping Crane Migration Corridor

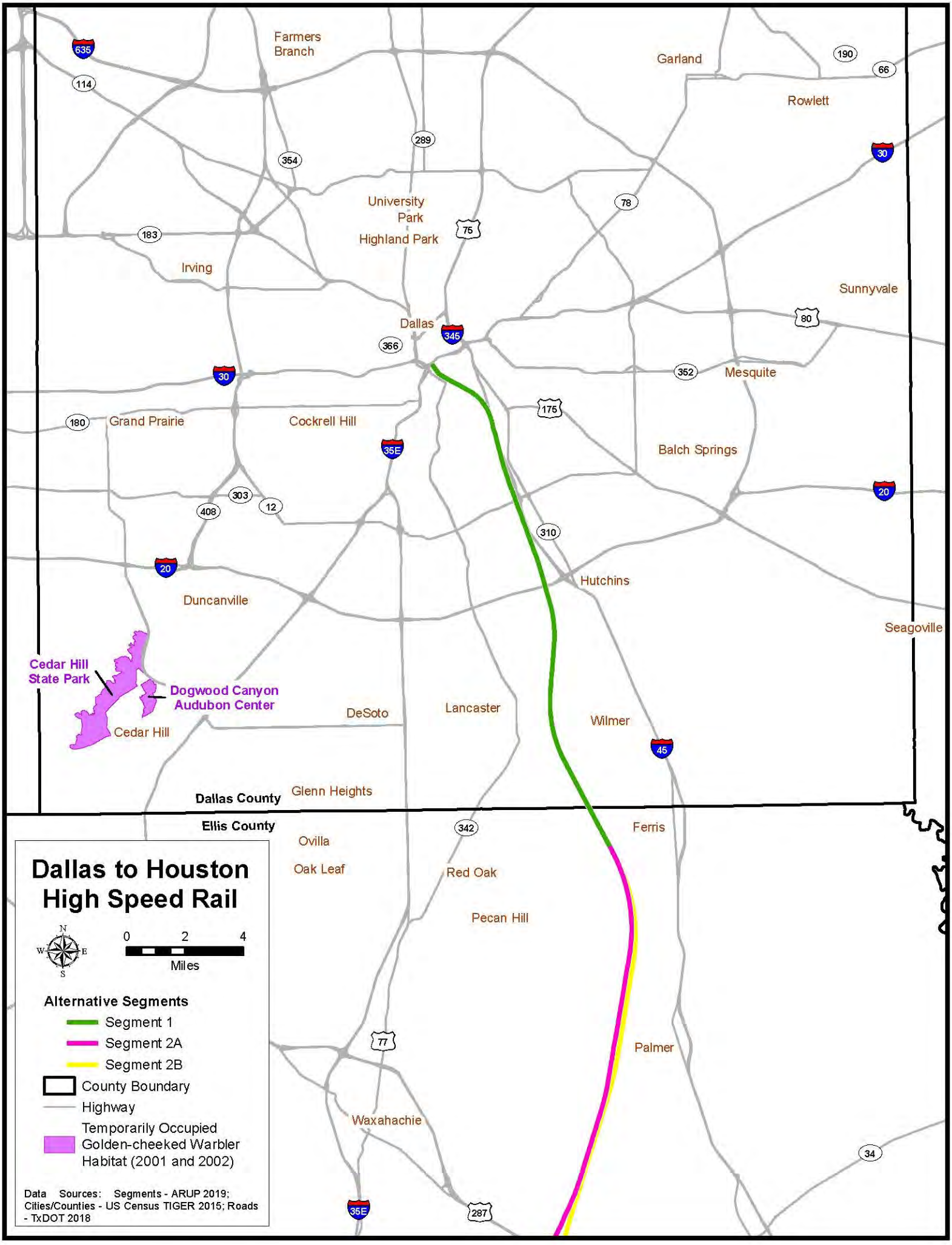
A4 – Houston Toad Acoustic Monitor Locations,
Houston Toad Leon County Road Survey Points
Houston Toad Grimes County Road Survey Points

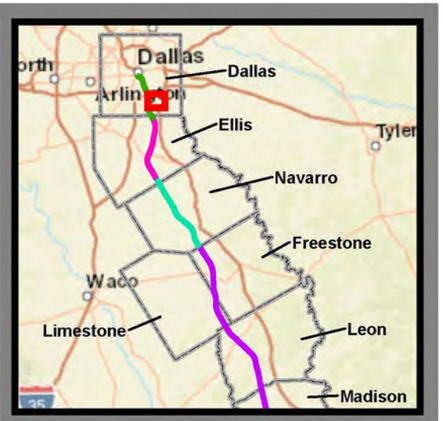
A5 – Texas Fawnsfoot Locations

A6 – Large Fruited Sand Verbena Presence/Absence Survey

A7 – Navasota Ladies'-tresses Presence/Absence Survey
Large Fruited Sand Verbena Locations

A8 - Texas Prairie Dawn 2016 Imagery
Texas Prairie Dawn Historical Imagery


Farmers Branch
Garland
Rowlett
University Park
Highland Park
Irving
Sunnyvale
Dallas
Mesquite
Grand Prairie
Cockrell Hill
Balch Springs
Duncanville
Hutchins
Seagoville
Cedar Hill State Park
Dogwood Canyon Audubon Center
Cedar Hill
DeSoto
Lancaster
Wilmer
Dallas County
Glenn Heights
Ellis County
Ovilla
Oak Leaf
Red Oak
Ferris
Pecan Hill
Palmer
Waxahachie
635
114
289
354
190
66
30
78
75
183
80
345
366
352
175
180
35E
303
408
12
310
20
45
342
77
287
34
Dallas to Houston High Speed Rail
N
W
E
S
0
2
4
Miles
Alternative Segments
Segment 1
Segment 2A
Segment 2B
County Boundary
Highway
Temporarily Occupied Golden-cheeked Warbler Habitat (2001 and 2002)
Data Sources: Segments - ARUP 2019; Cities/Counties - US Census TIGER 2015; Roads - TxDOT 2018



Dallas to Houston
High-Speed Rail Project
Interior Least Tern Locations
Segment 1
Dallas County

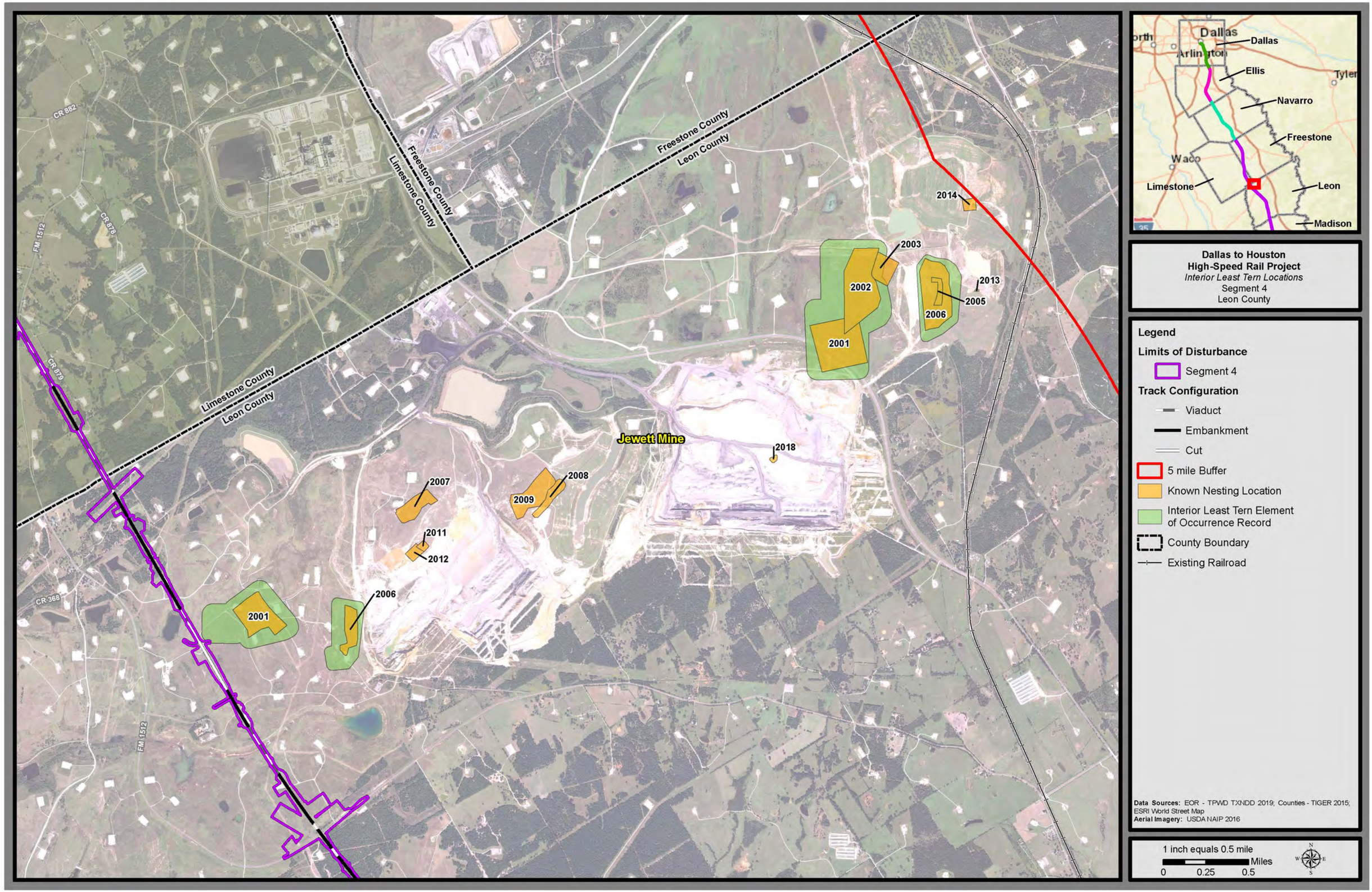
Legend

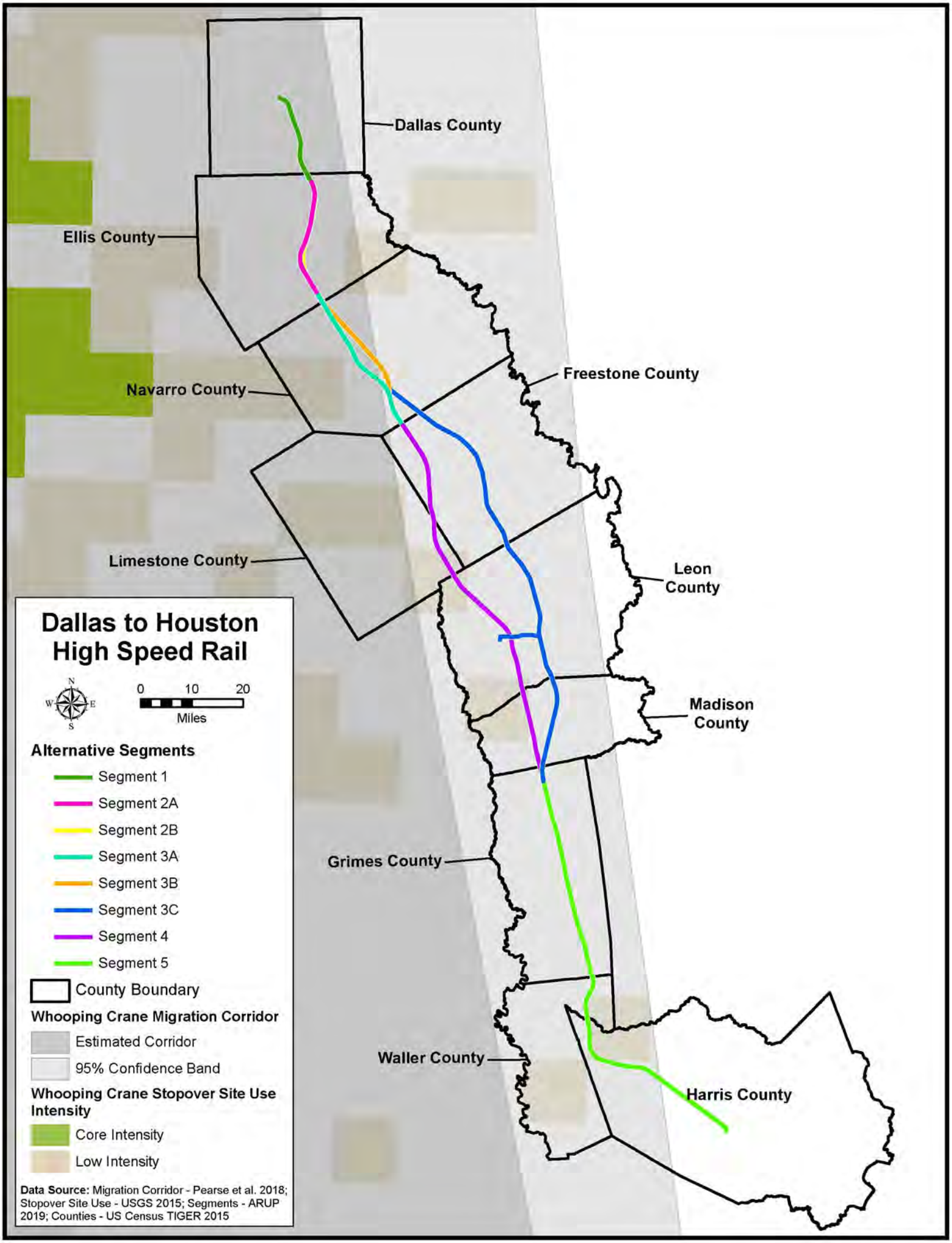
Limits of Disturbance
- Segment 1

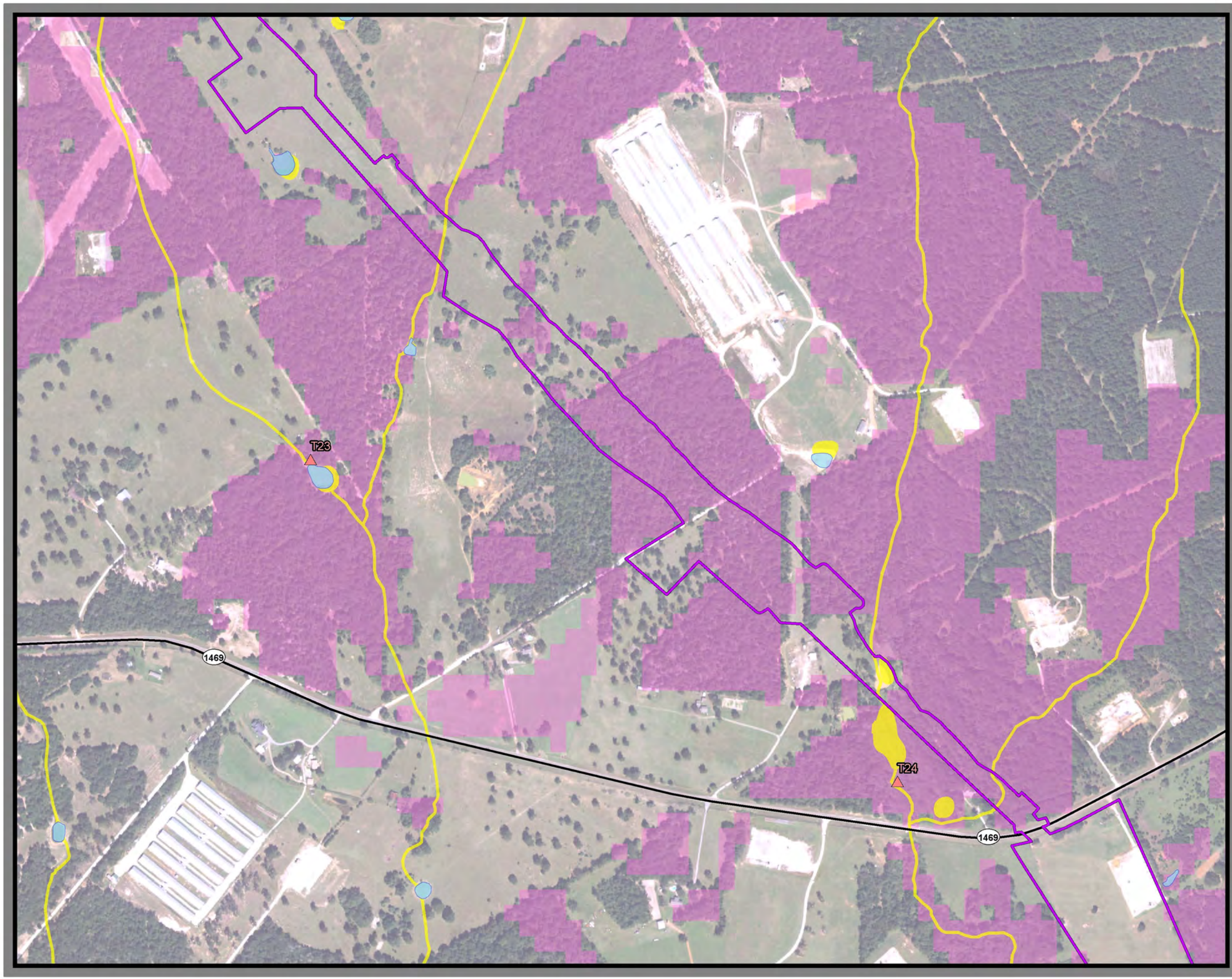
Track Configuration
- Viaduct
- Embankment
- 5 mile Buffer
- Known Nesting Location
- Interior Least Tern Element of Occurrence Record
- County Boundary
- Existing Railroad

Data Sources: EOR - TPWD TXNDD 2019; Counties - TIGER 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch equals 0.6 mile
Miles
0 0.3 0.6


Freestone County
Limestone County
Leon County
Limestone County
Leon County
Freestone County
CR 882
FM 1512
CR 878
CR 879
CR 368
FM 1512
Jewett Mine
2001
2002
2003
2005
2006
2007
2008
2009
2011
2012
2013
2014
2018
Dallas
Dallas
Arlington
Ellis
Tyler
Navarro
Freestone
Waco
Limestone
Leon
Madison
Dallas to Houston
High-Speed Rail Project
Interior Least Tern Locations
Segment 4
Leon County
Legend
Limits of Disturbance
Segment 4
Track Configuration
Viaduct
Embankment
Cut
5 mile Buffer
Known Nesting Location
Interior Least Tern Element of Occurrence Record
County Boundary
Existing Railroad
Data Sources: EOR - TPWD TXNDD 2019; Counties - TIGER 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016
1 inch equals 0.5 mile
Miles
0
0.25
0.5
N
W
E
S


Dallas County
Ellis County
Navarro County
Freestone County
Limestone County
Leon County
Madison County
Grimes County
Waller County
Harris County
Dallas to Houston High Speed Rail
N
W
E
S
0
10
20
Miles
Alternative Segments
Segment 1
Segment 2A
Segment 2B
Segment 3A
Segment 3B
Segment 3C
Segment 4
Segment 5
County Boundary
Whooping Crane Migration Corridor
Estimated Corridor
95% Confidence Band
Whooping Crane Stopover Site Use Intensity
Core Intensity
Low Intensity
Data Source: Migration Corridor - Pearse et al. 2018; Stopover Site Use - USGS 2015; Segments - ARUP 2019; Counties - US Census TIGER 2015



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 1 of 13

Legend

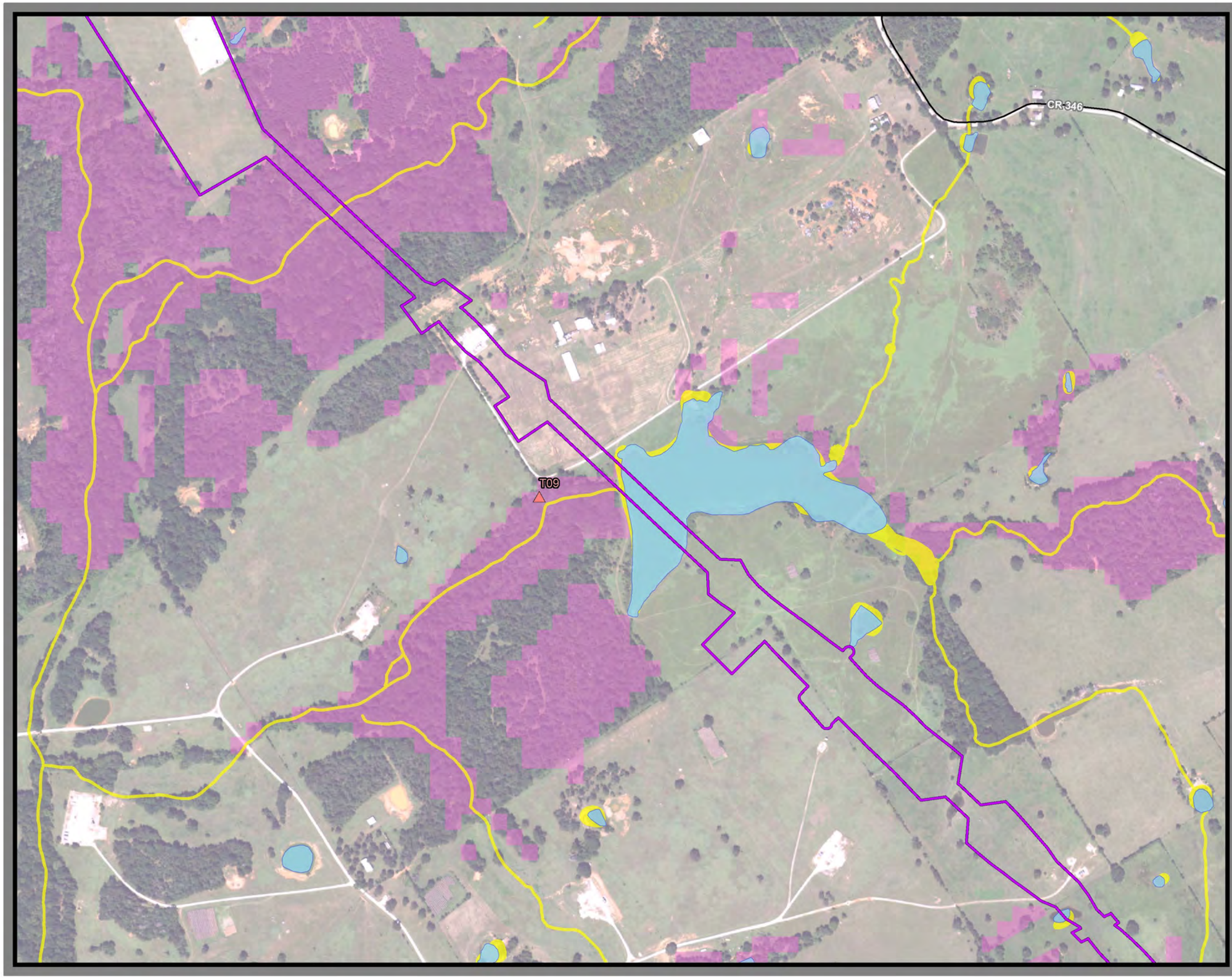
Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet

0 300 600 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 2 of 13

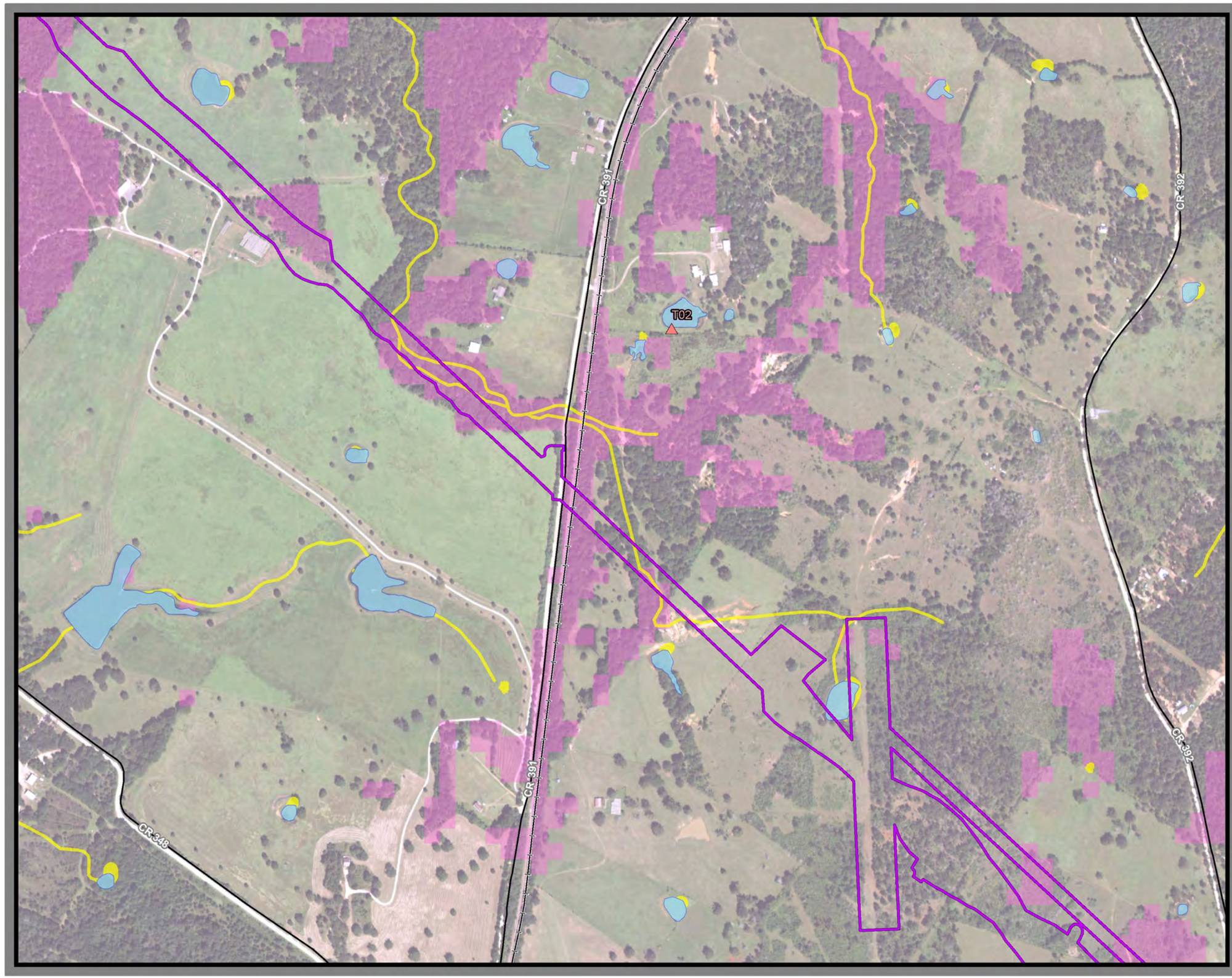
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 3 of 13

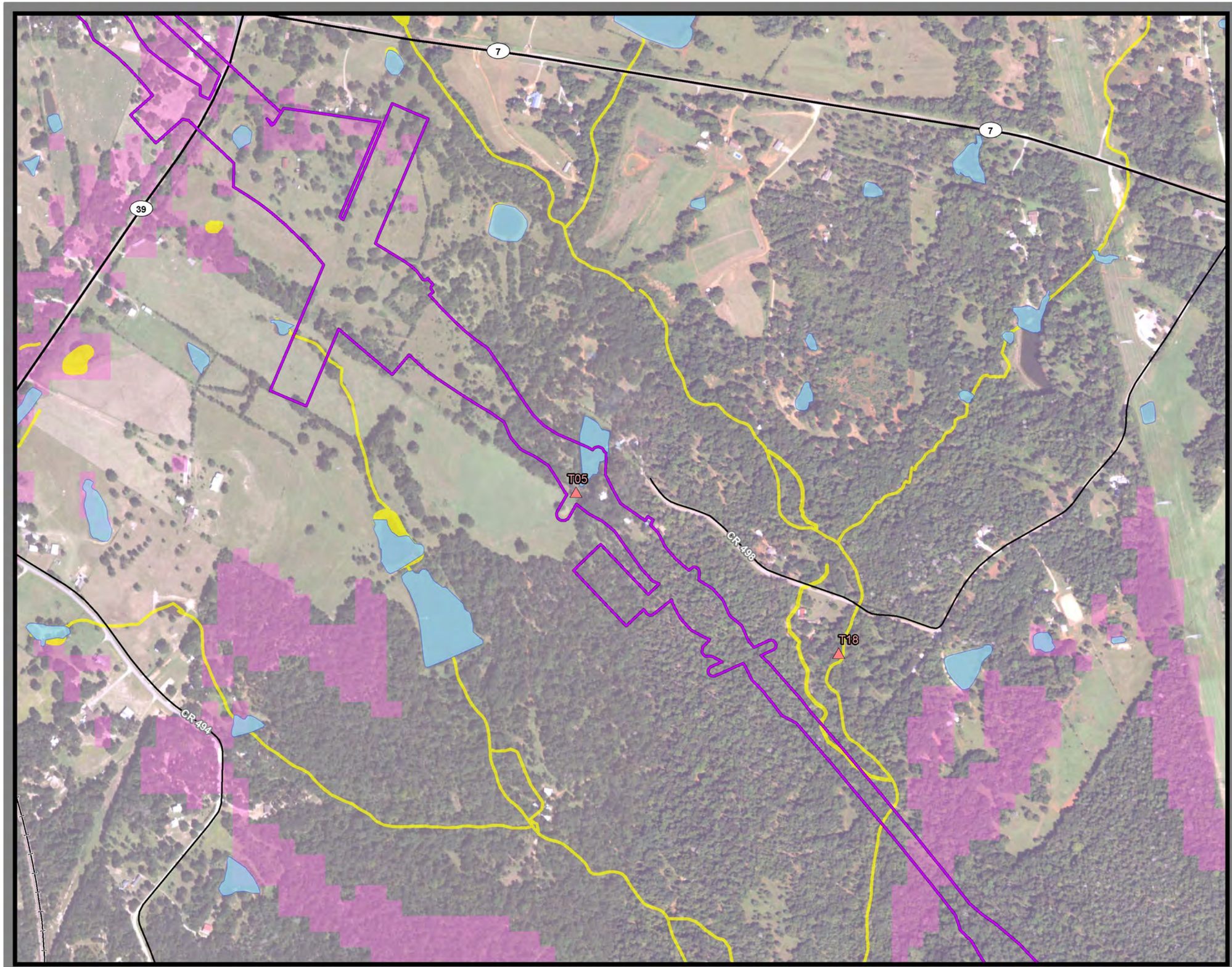
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
Feet
0 300 600

N W E S



Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 4 of 13

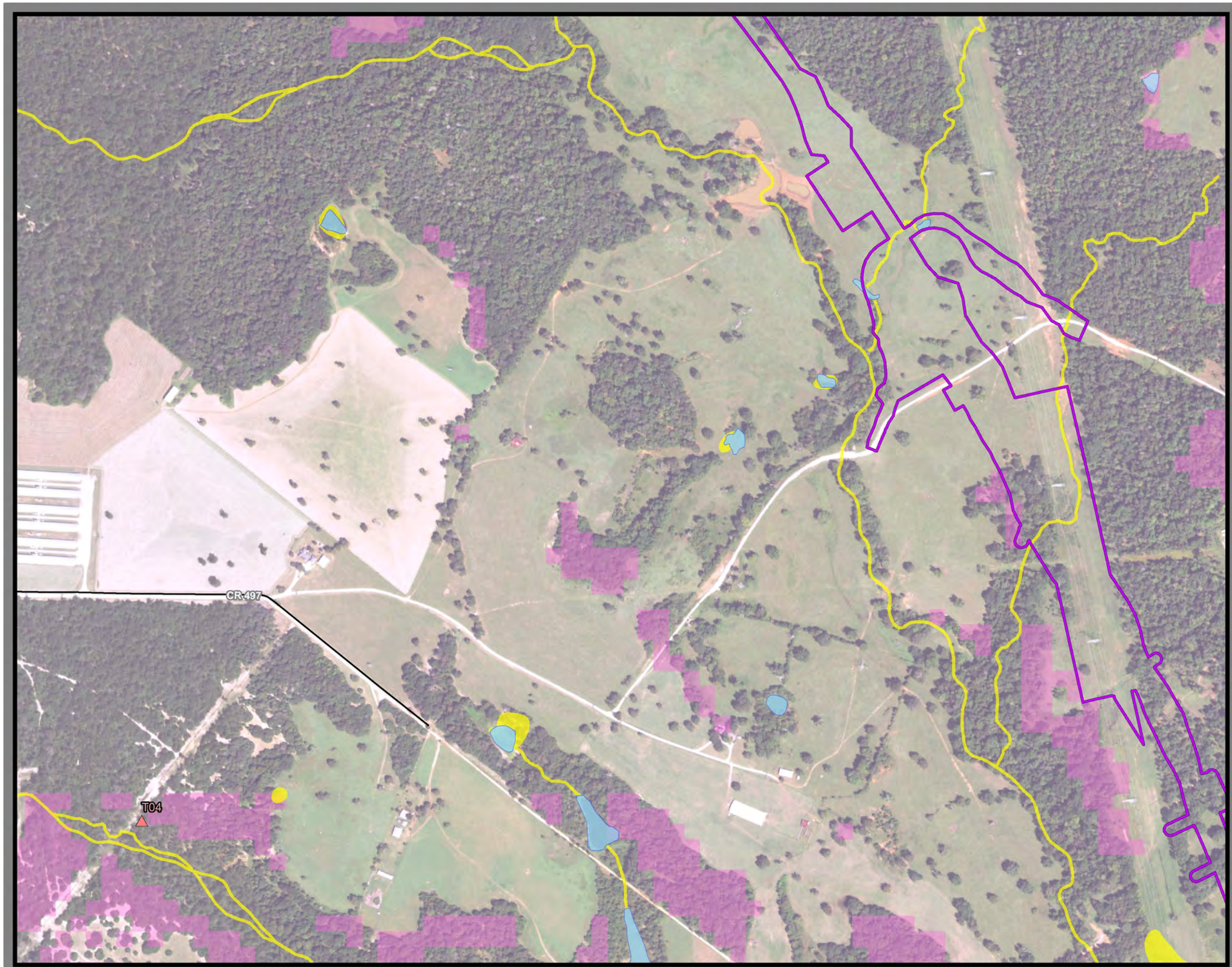
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 5 of 13

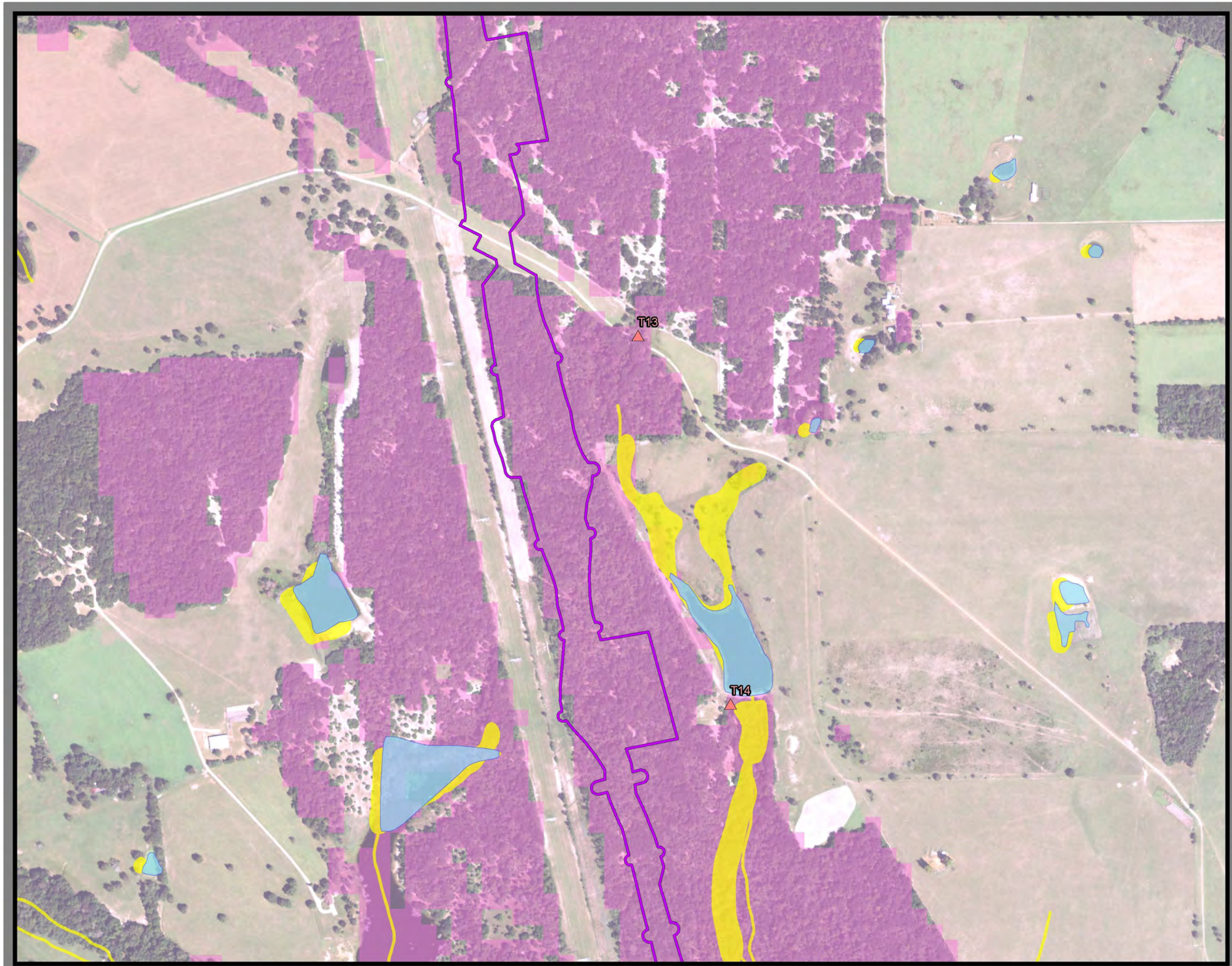
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 6 of 13

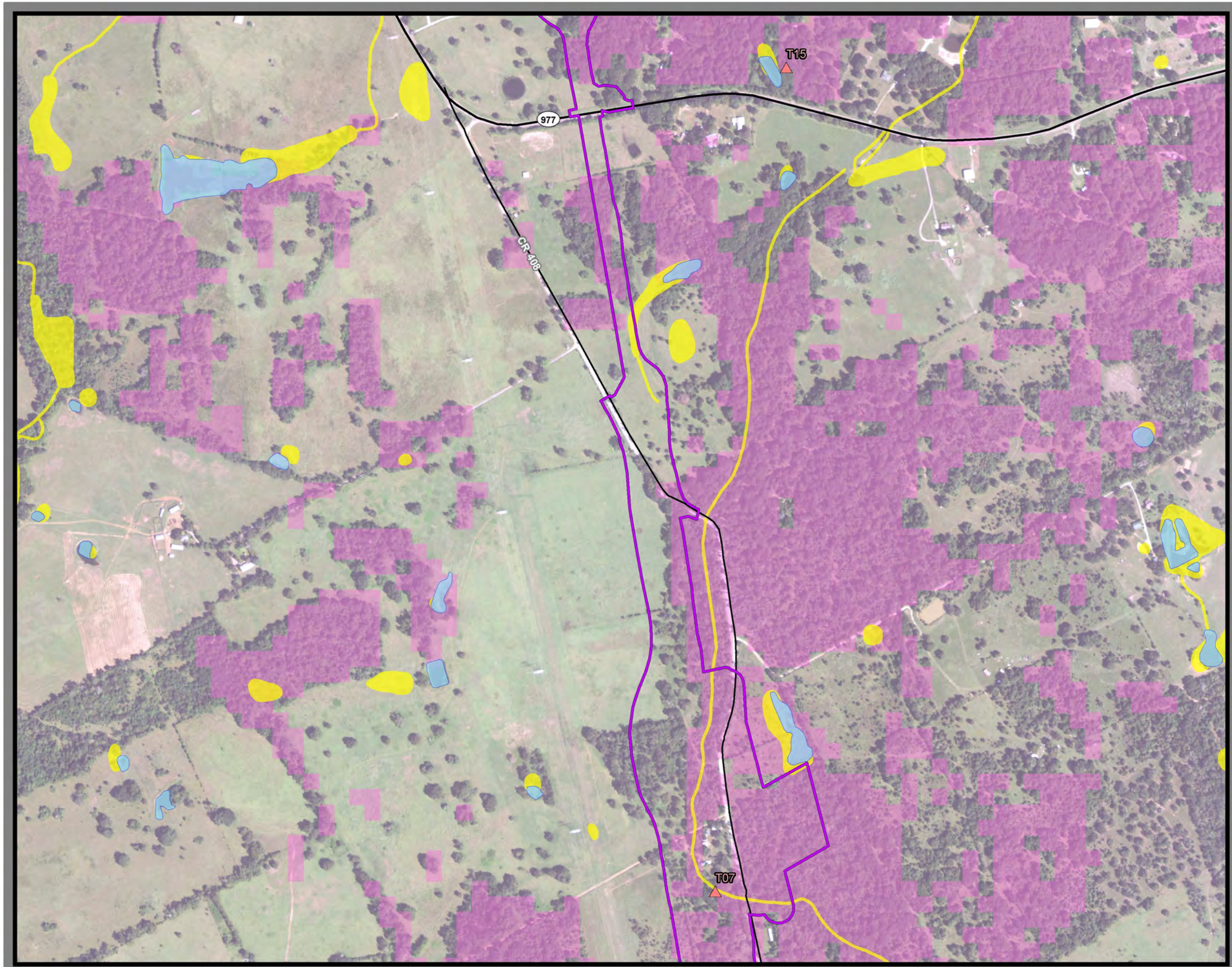
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
Feet
0 300 600

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 4
Sheet 7 of 13

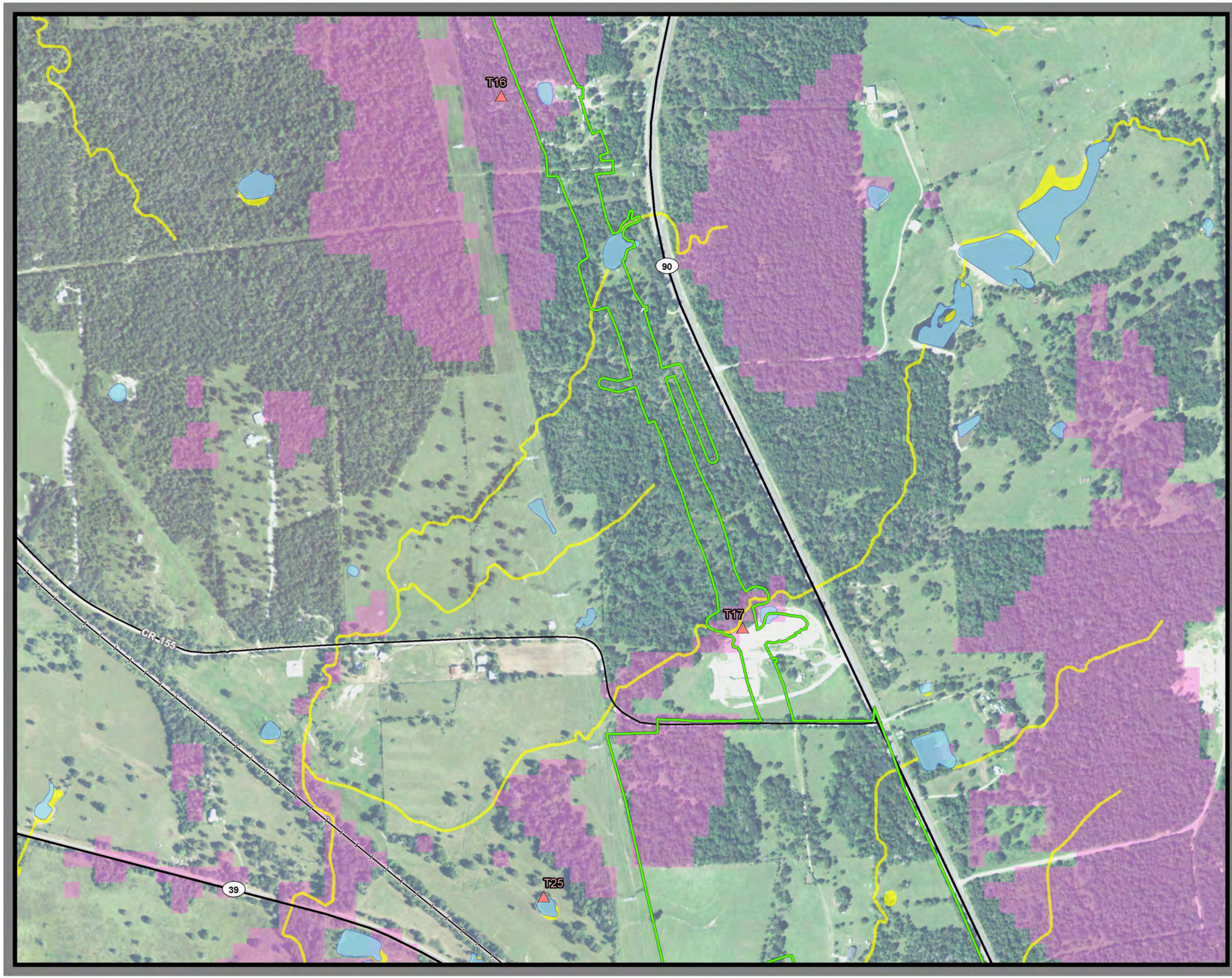
Legend

Limits of Disturbance
- Segment 4
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 8 of 13

Legend

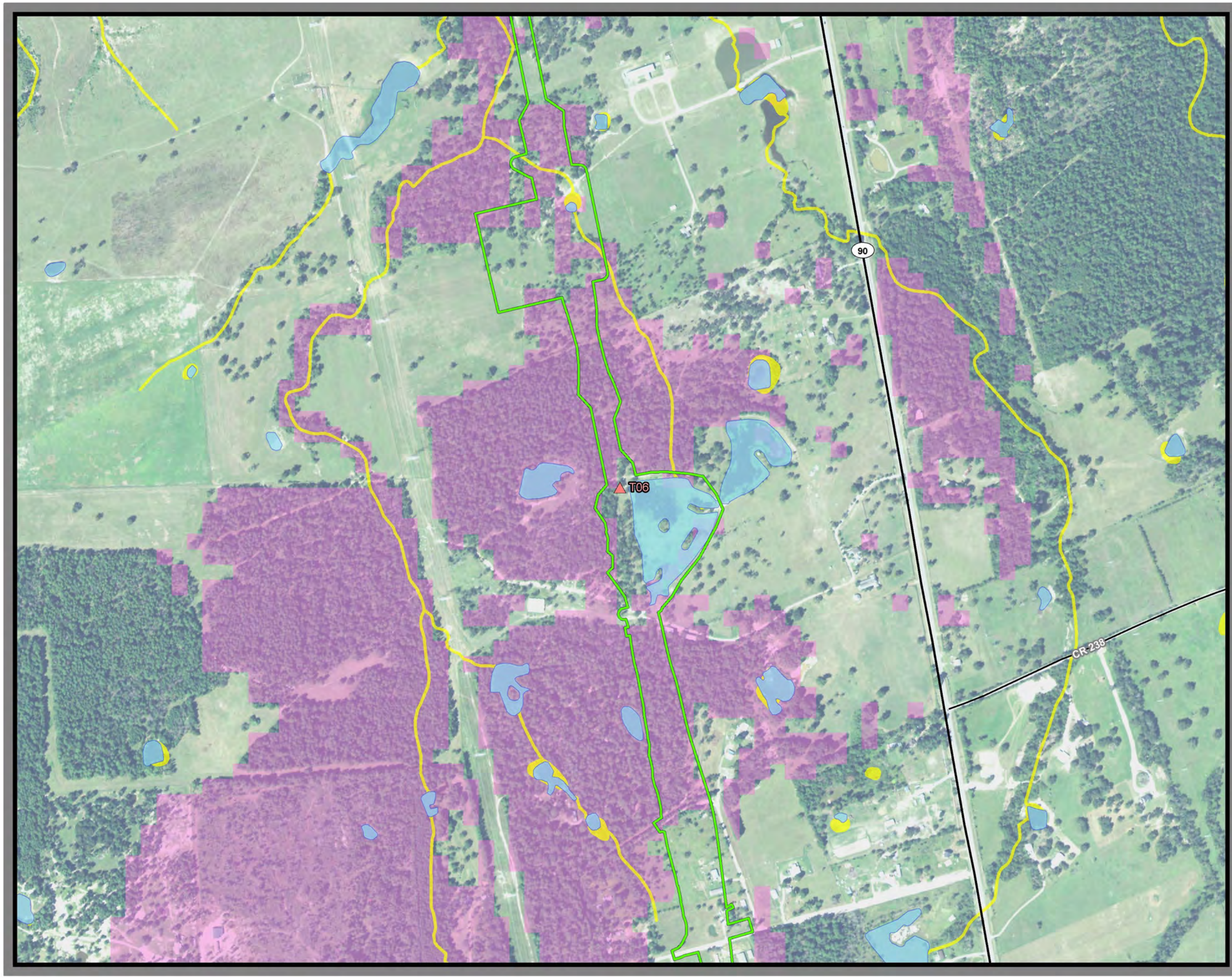
Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet

0 300 600 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 9 of 13

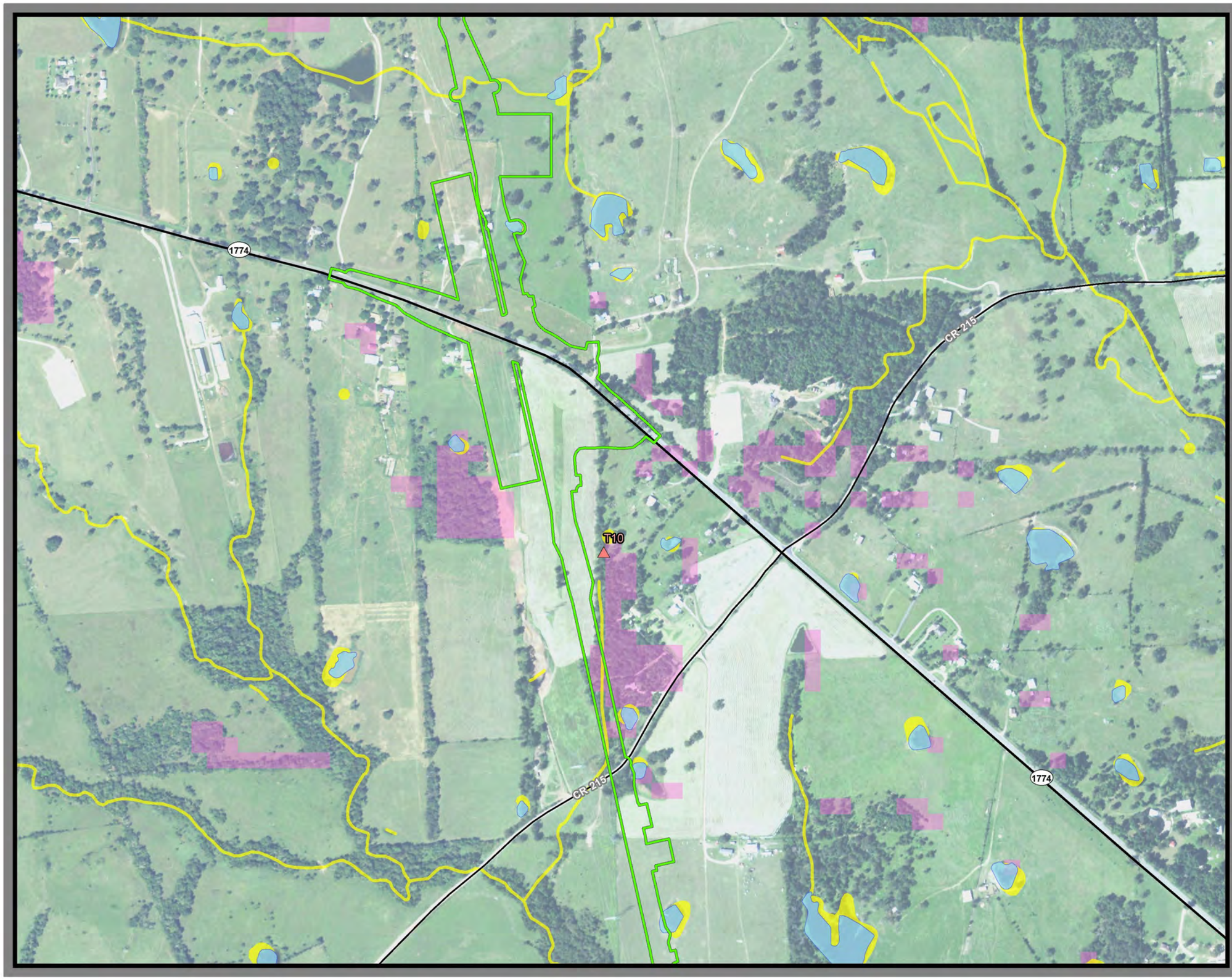
Legend

Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
Feet
0 300 600

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 10 of 13

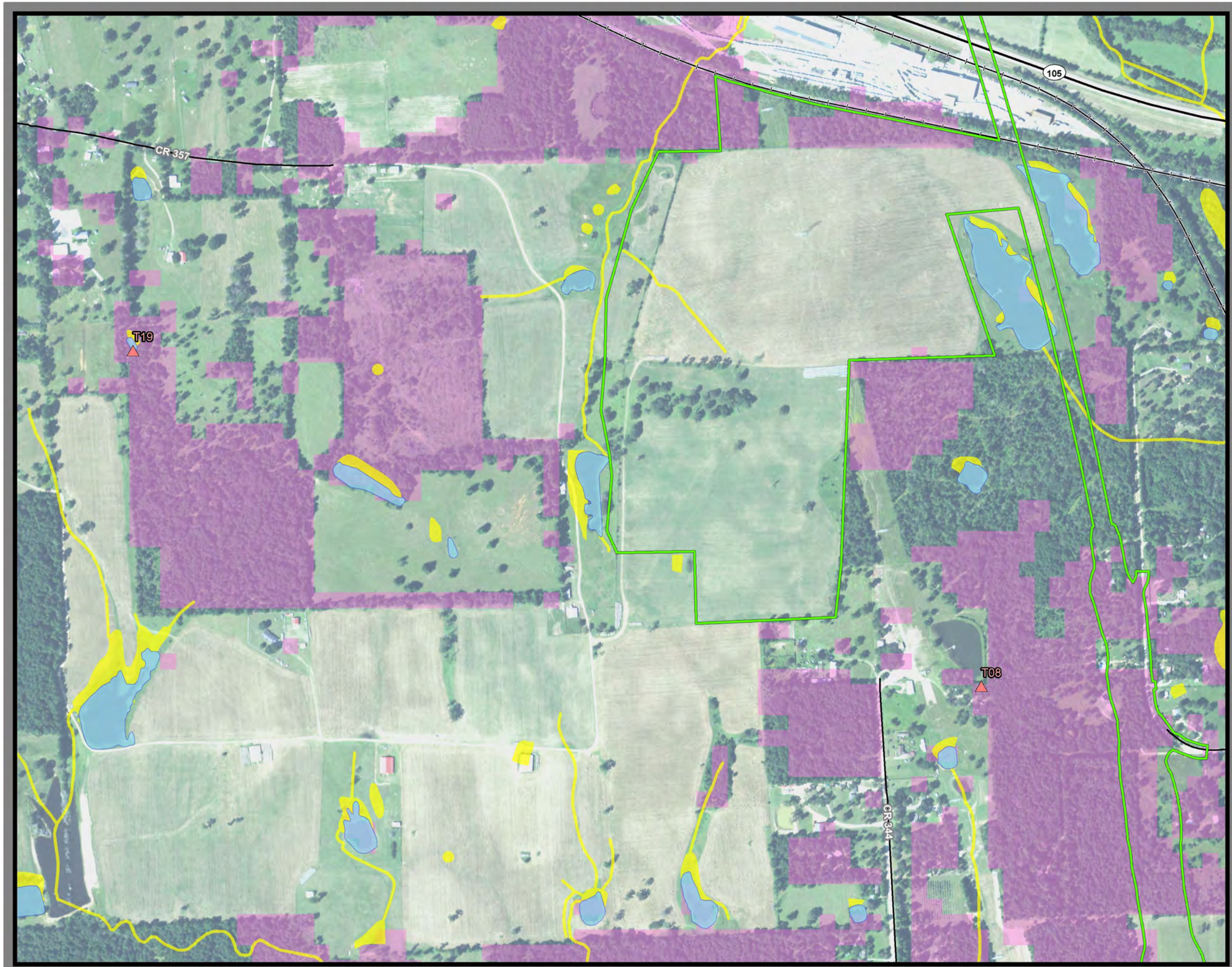
Legend

Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 11 of 13

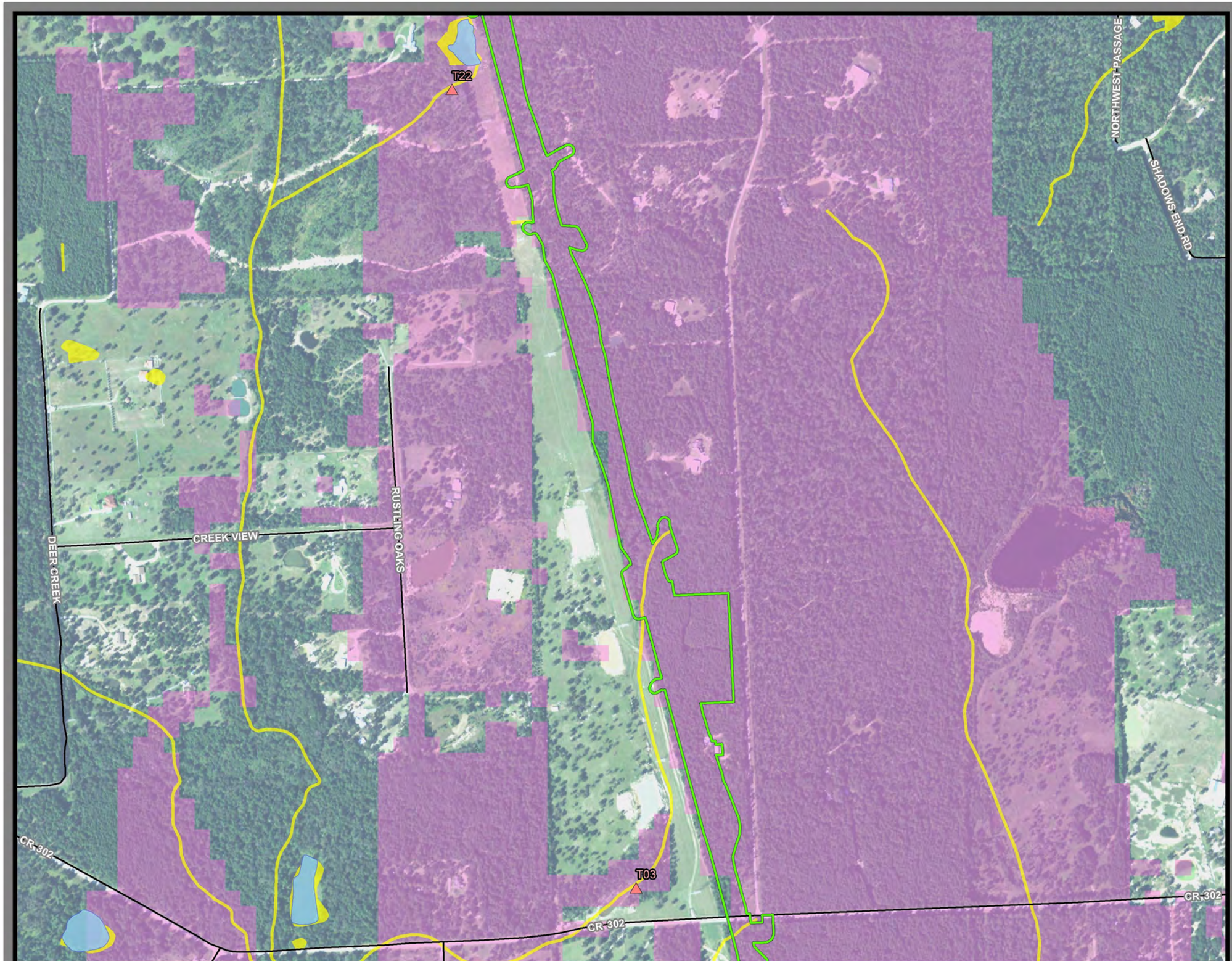
Legend

Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet

N W E S



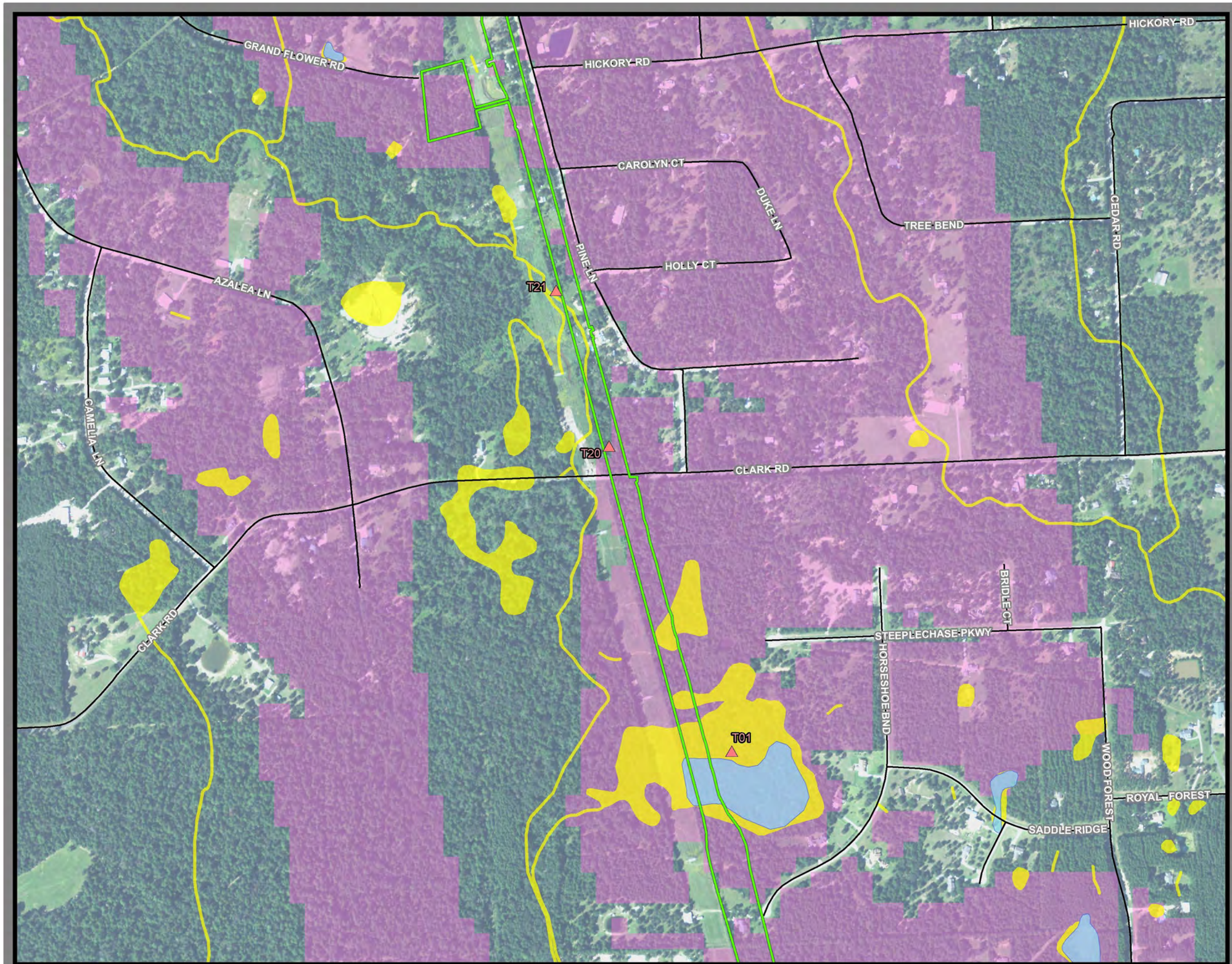
Dallas to Houston High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 12 of 13

Legend

Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
Feet
0 300 600



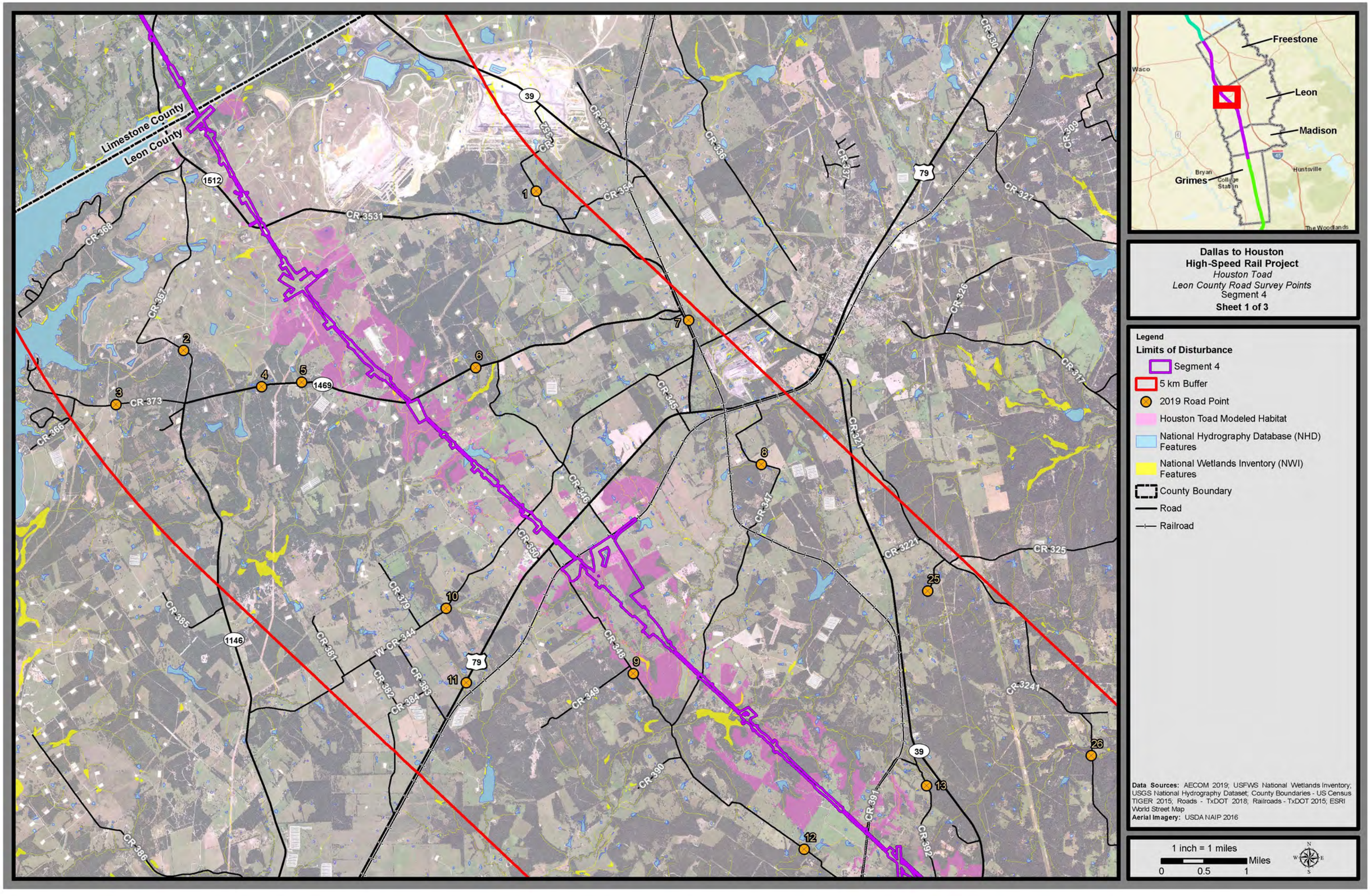
Dallas to Houston
High-Speed Rail Project
Houston Toad
Acoustic Monitor Locations
Segment 5
Sheet 13 of 13

Legend

Limits of Disturbance
- Segment 5
- 2019 Monitor Location
- Houston Toad Modeled Habitat
- National Hydrography Dataset (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
Feet
0 300 600



Dallas to Houston High-Speed Rail Project
Houston Toad
Leon County Road Survey Points
Segment 4
Sheet 1 of 3

Legend

Limits of Disturbance
- Segment 4
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles
Miles
0 0.5 1

Dallas to Houston
High-Speed Rail Project
Houston Toad
Leon County Road Survey Points
Segment 4
Sheet 2 of 3

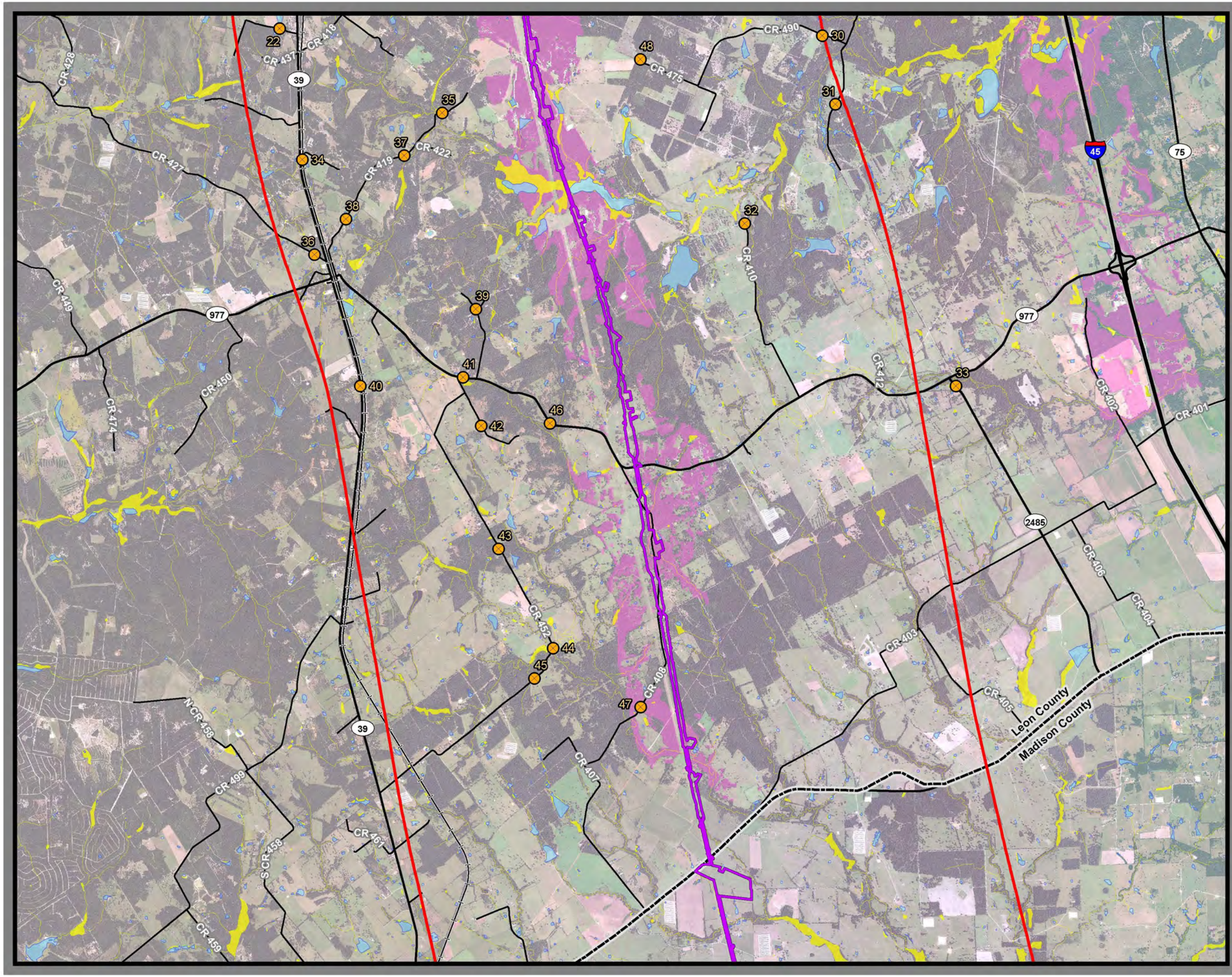
Legend

Limits of Disturbance

- Segment 4
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles
Miles
0 0.5 1



Dallas to Houston High-Speed Rail Project
Houston Toad
Leon County Road Survey Points
Segment 4
Sheet 3 of 3

Legend

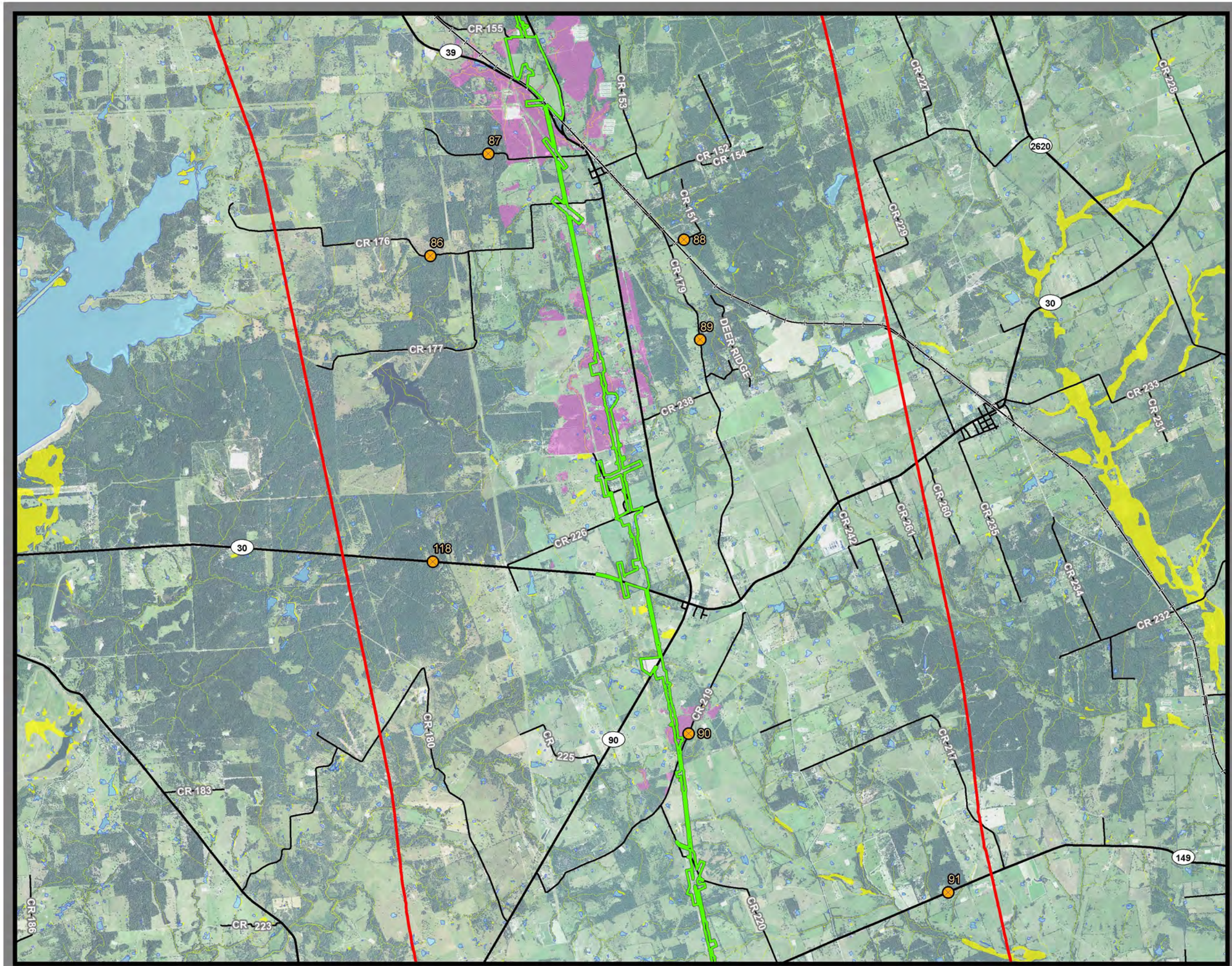
Limits of Disturbance

- Segment 4
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles

0 0.5 1 Miles



Dallas to Houston High-Speed Rail Project
Houston Toad
Grimes County Road Survey Points
Segment 5
Sheet 1 of 3

Legend

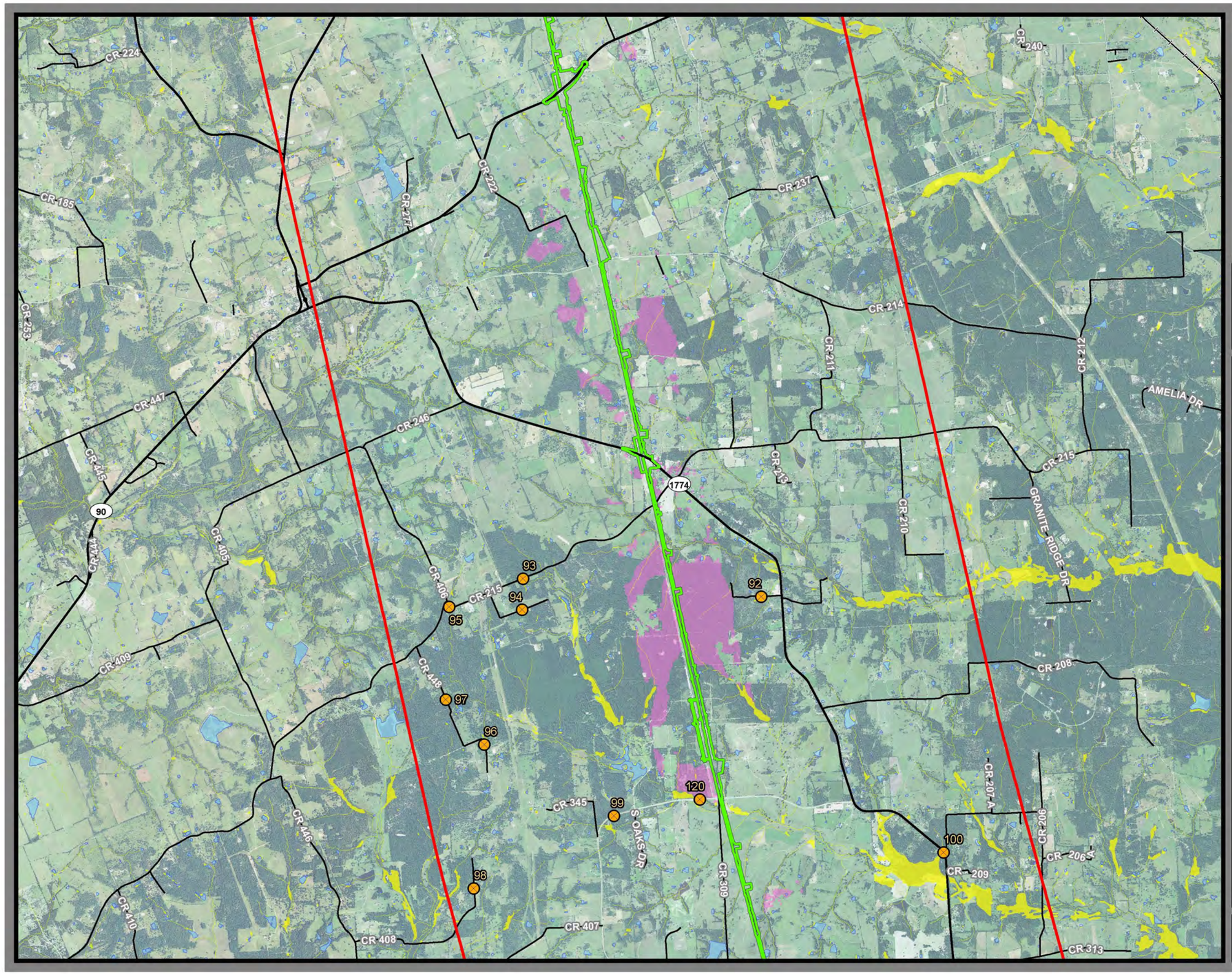
Limits of Disturbance
- Segment 5
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles

0 0.5 1 Miles

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Grimes County Road Survey Points
Segment 5
Sheet 2 of 3

Legend

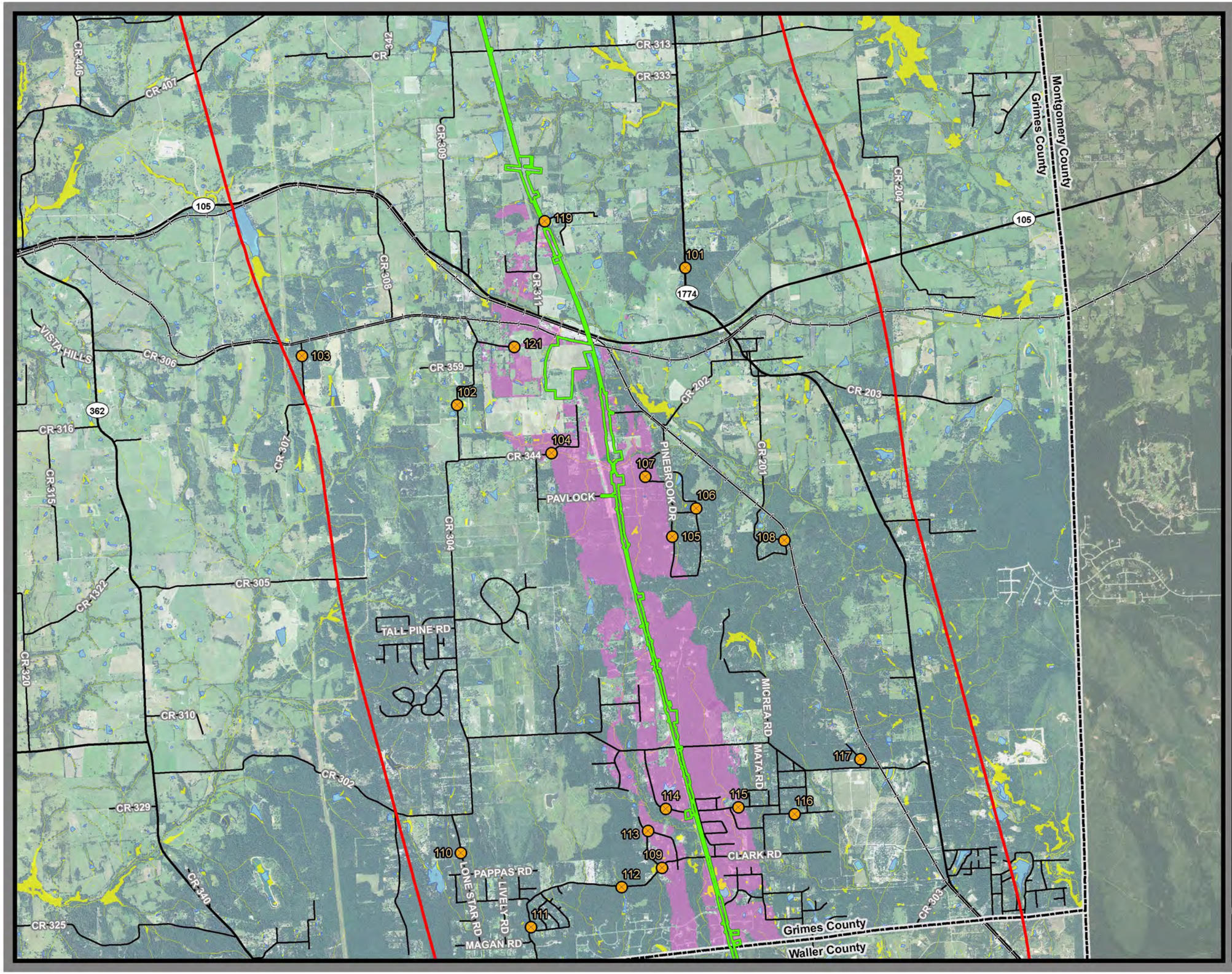
Limits of Disturbance
- Segment 5
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles

0 0.5 1 Miles

N W E S



Dallas to Houston High-Speed Rail Project
Houston Toad
Grimes County Road Survey Points
Segment 5
Sheet 3 of 3

Legend

Limits of Disturbance

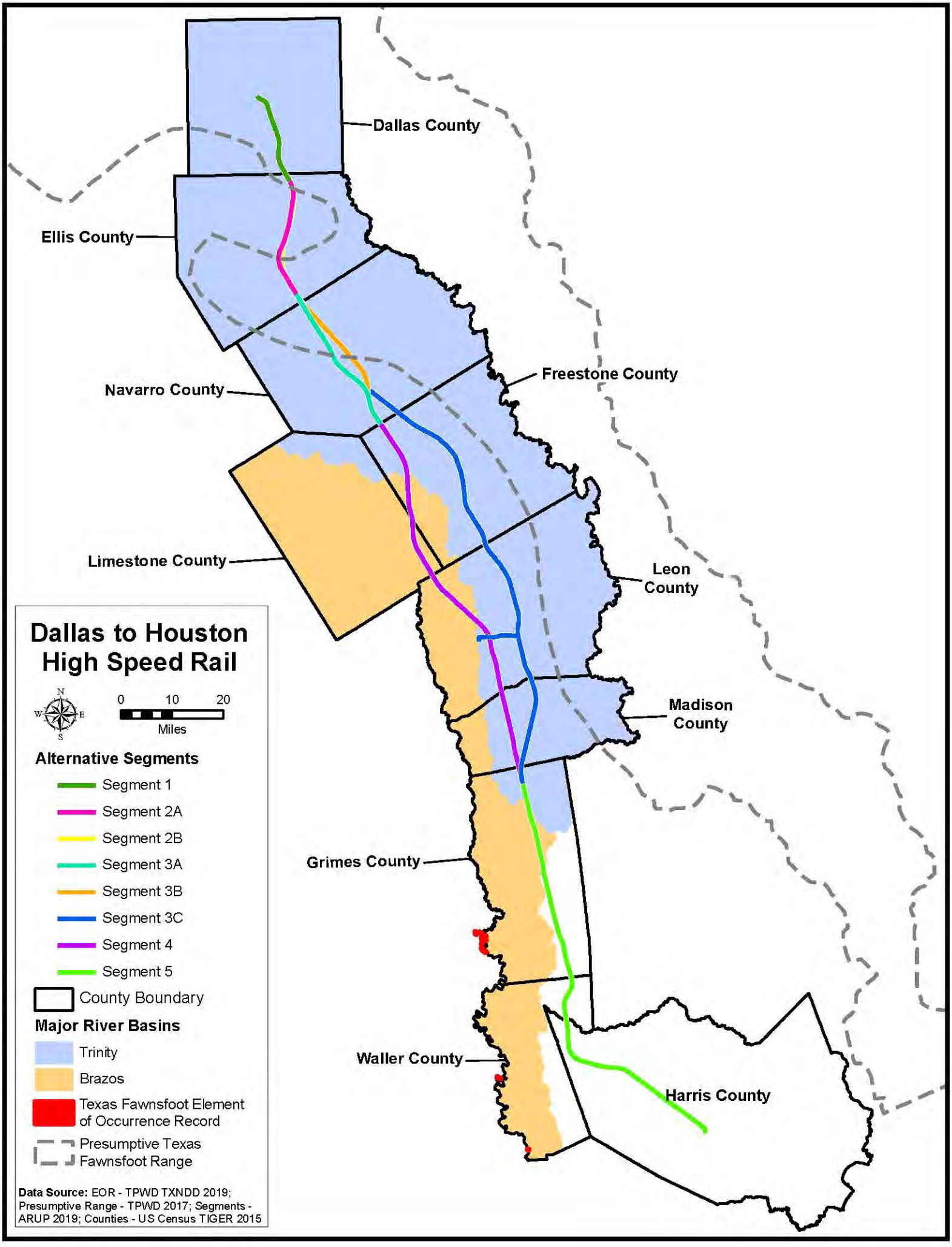
- Segment 5
- 5 km Buffer
- 2019 Road Point
- Houston Toad Modeled Habitat
- National Hydrography Database (NHD) Features
- National Wetlands Inventory (NWI) Features
- County Boundary
- Road
- Railroad

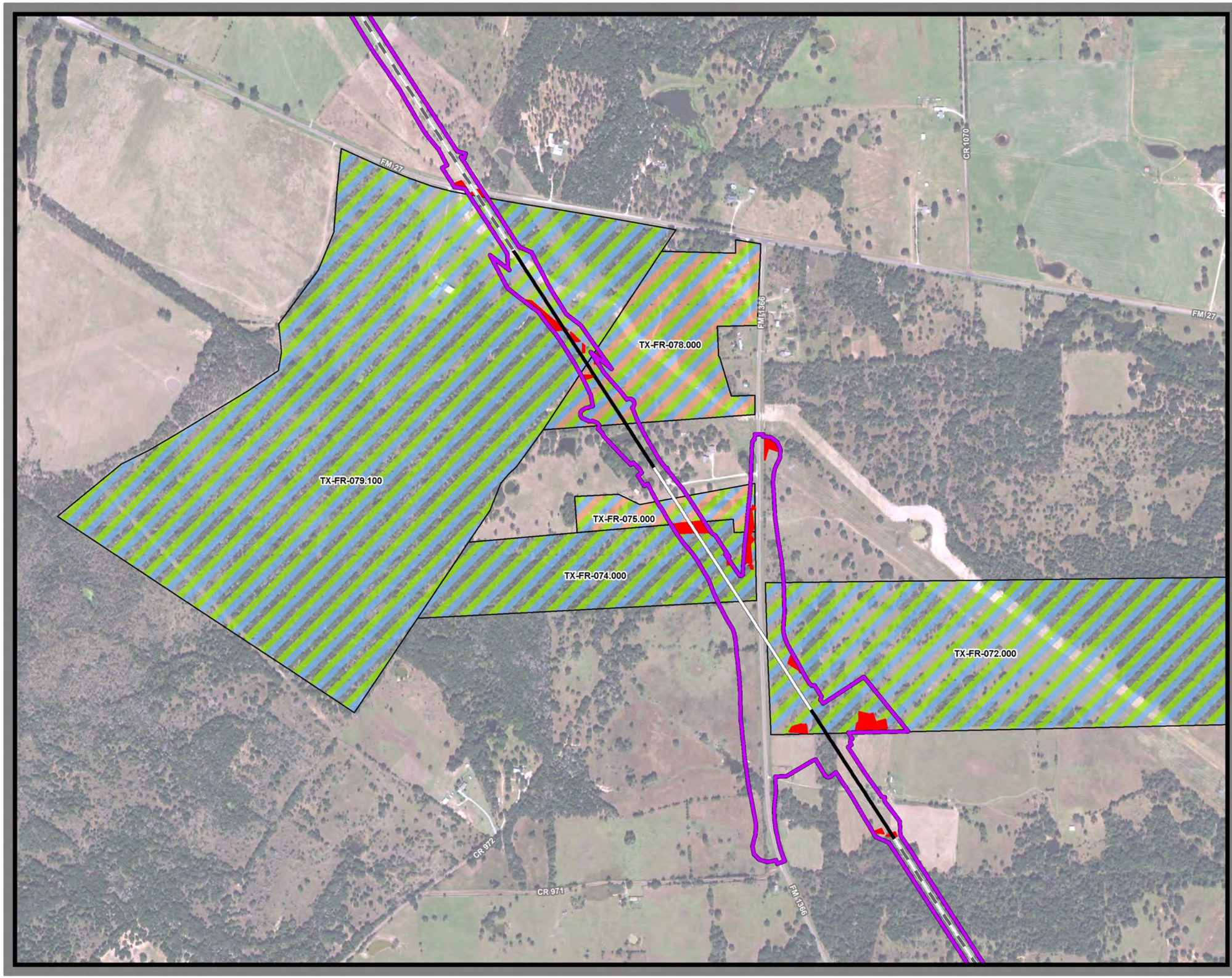
Data Sources: AECOM 2019; USFWS National Wetlands Inventory; USGS National Hydrography Dataset; County Boundaries - US Census TIGER 2015; Roads - TxDOT 2018; Railroads - TxDOT 2015; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 1 miles

0 0.5 1 Miles

N W E S


Dallas County
Ellis County
Navarro County
Freestone County
Limestone County
Leon County
Madison County
Grimes County
Waller County
Harris County
Dallas to Houston High Speed Rail
N
W
E
S
0
10
20
Miles
Alternative Segments
Segment 1
Segment 2A
Segment 2B
Segment 3A
Segment 3B
Segment 3C
Segment 4
Segment 5
County Boundary
Major River Basins
Trinity
Brazos
Texas Fawnsfoot Element of Occurrence Record
Presumptive Texas Fawnsfoot Range
Data Source: EOR - TPWD TXNDD 2019; Presumptive Range - TPWD 2017; Segments - ARUP 2019; Counties - US Census TIGER 2015



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 1 of 24

Legend

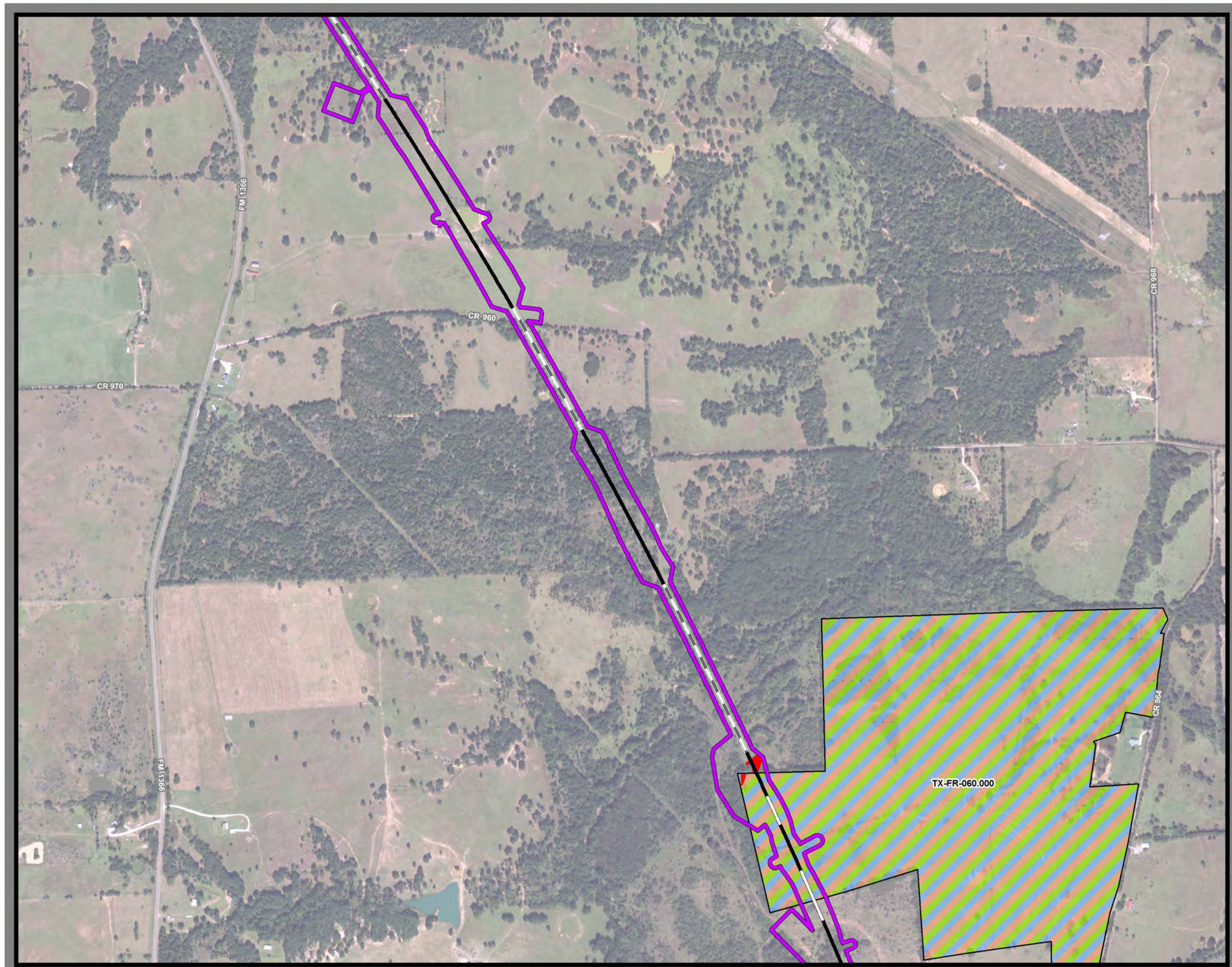
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 156 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 2 of 24

Legend

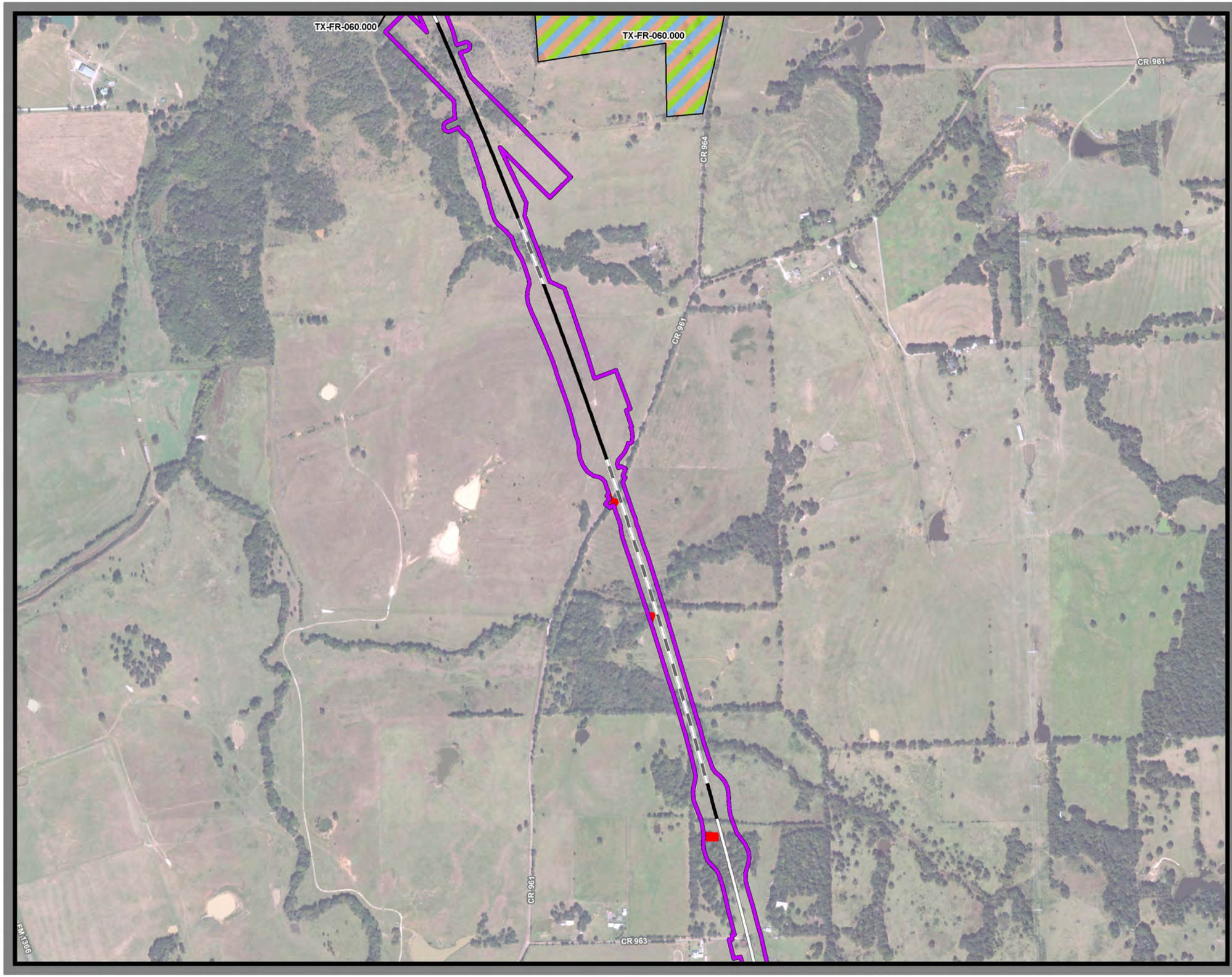
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 157 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 3 of 24

Legend

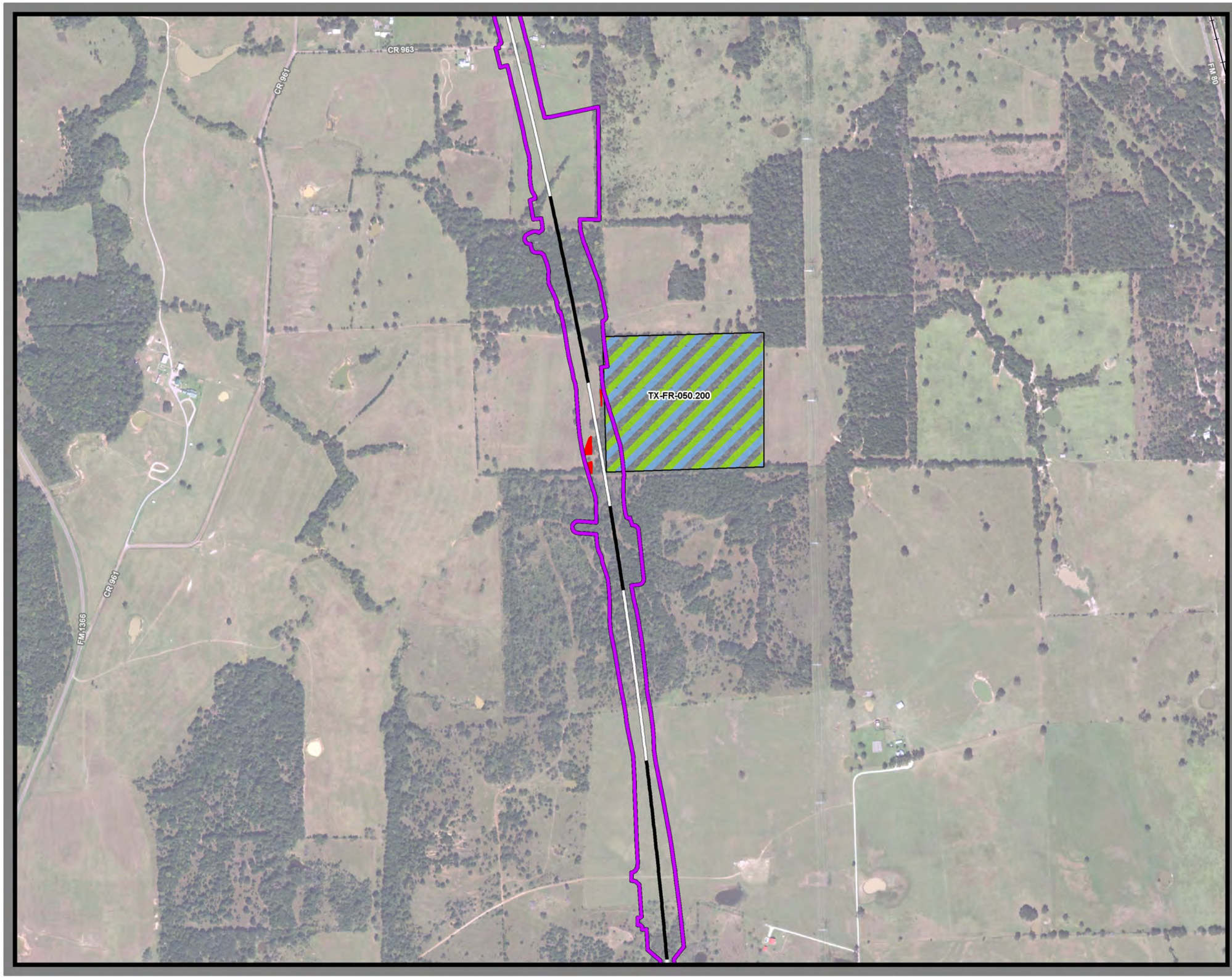
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 158 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 4 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

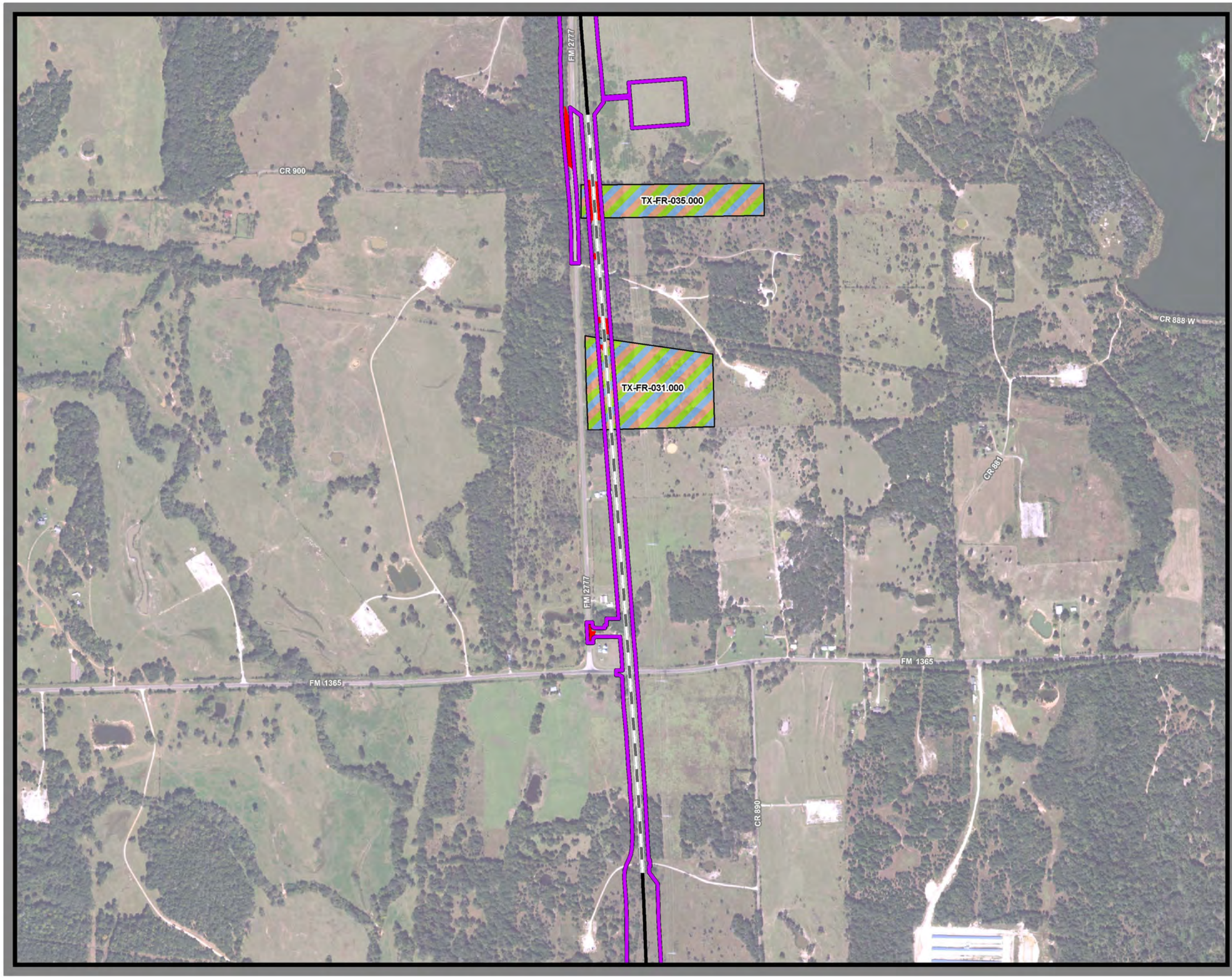
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 159 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 5 of 24

Legend

Track Configuration
- Viaduct
- Embankment

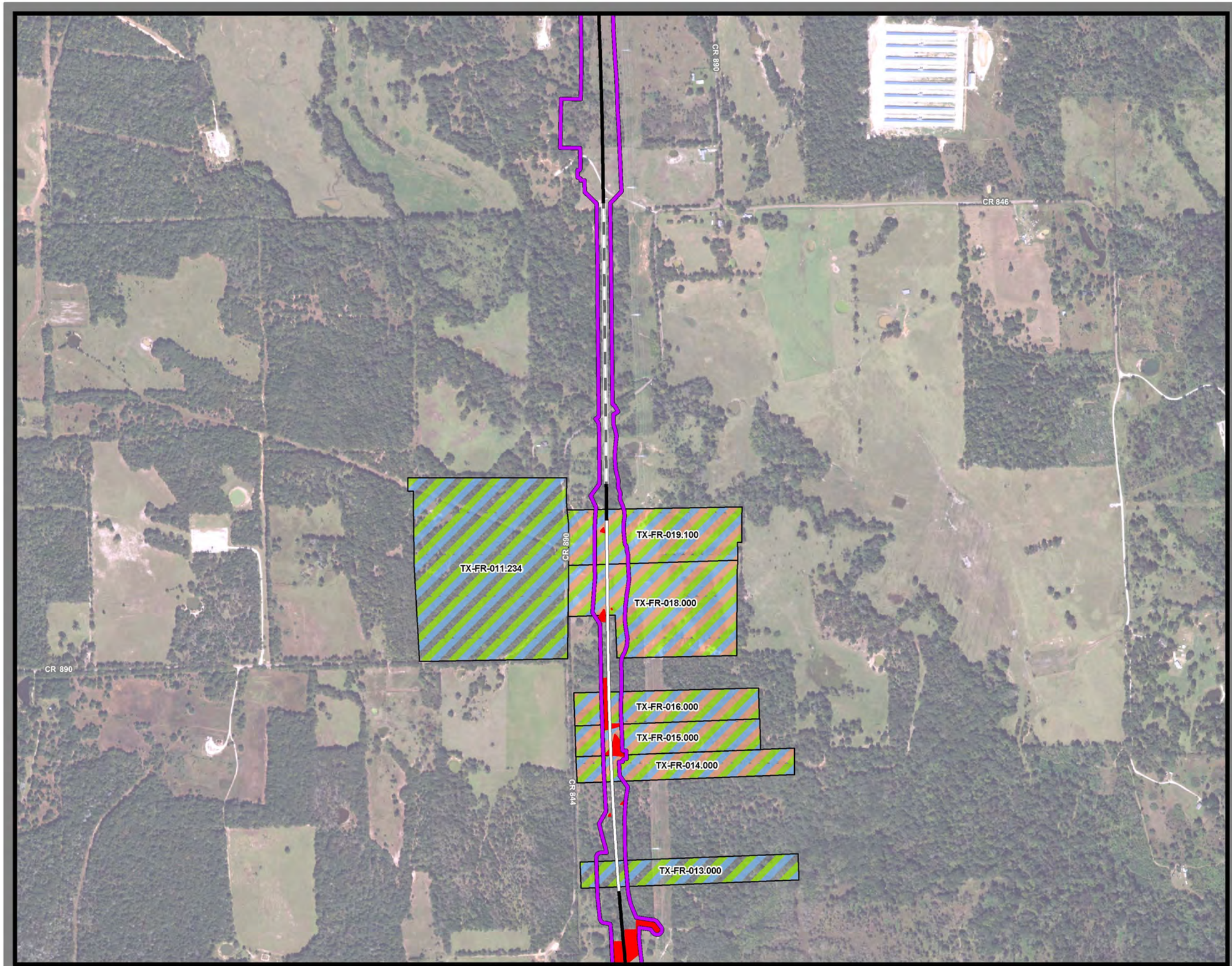
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 162 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 6 of 24

Legend

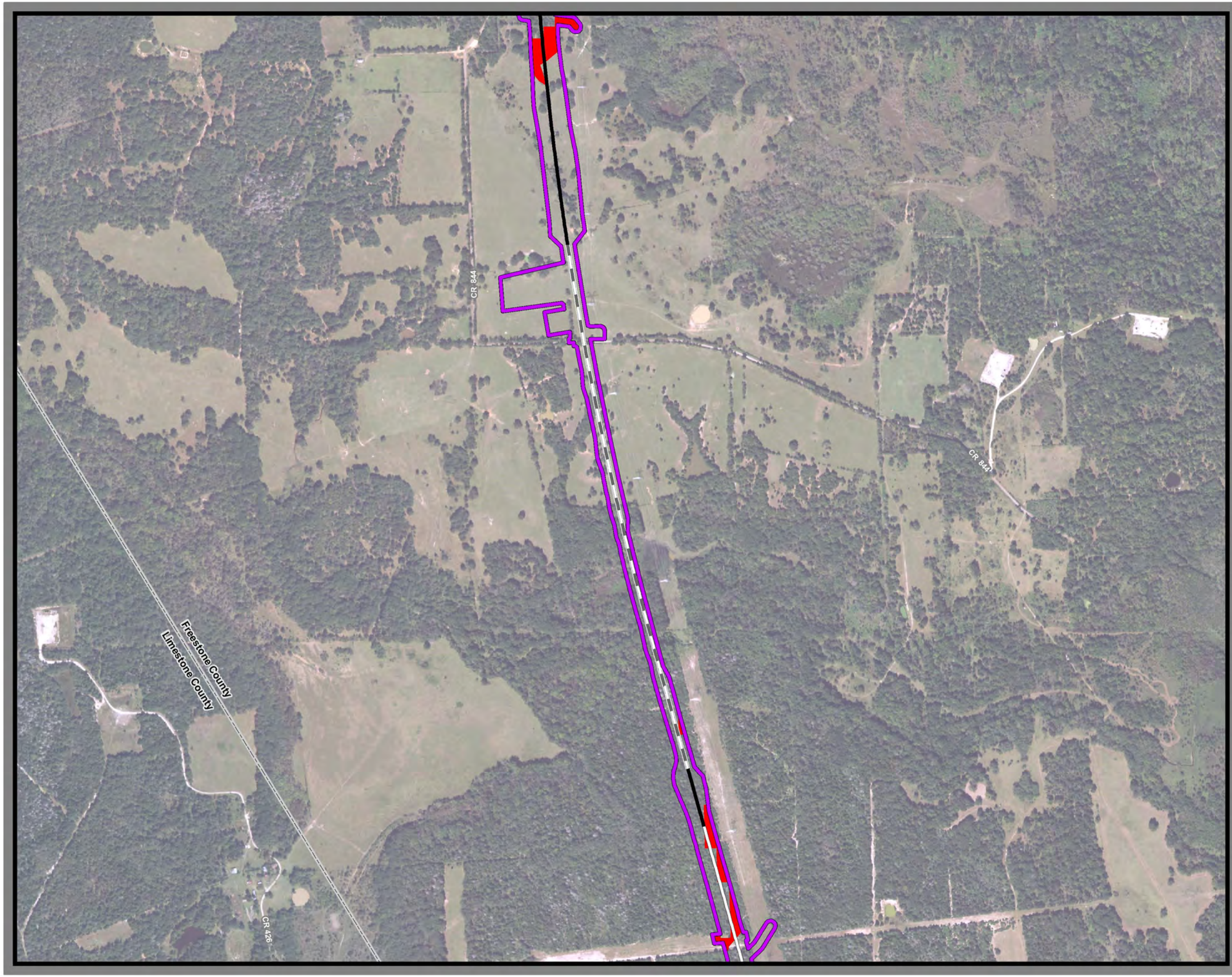
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 163 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 7 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

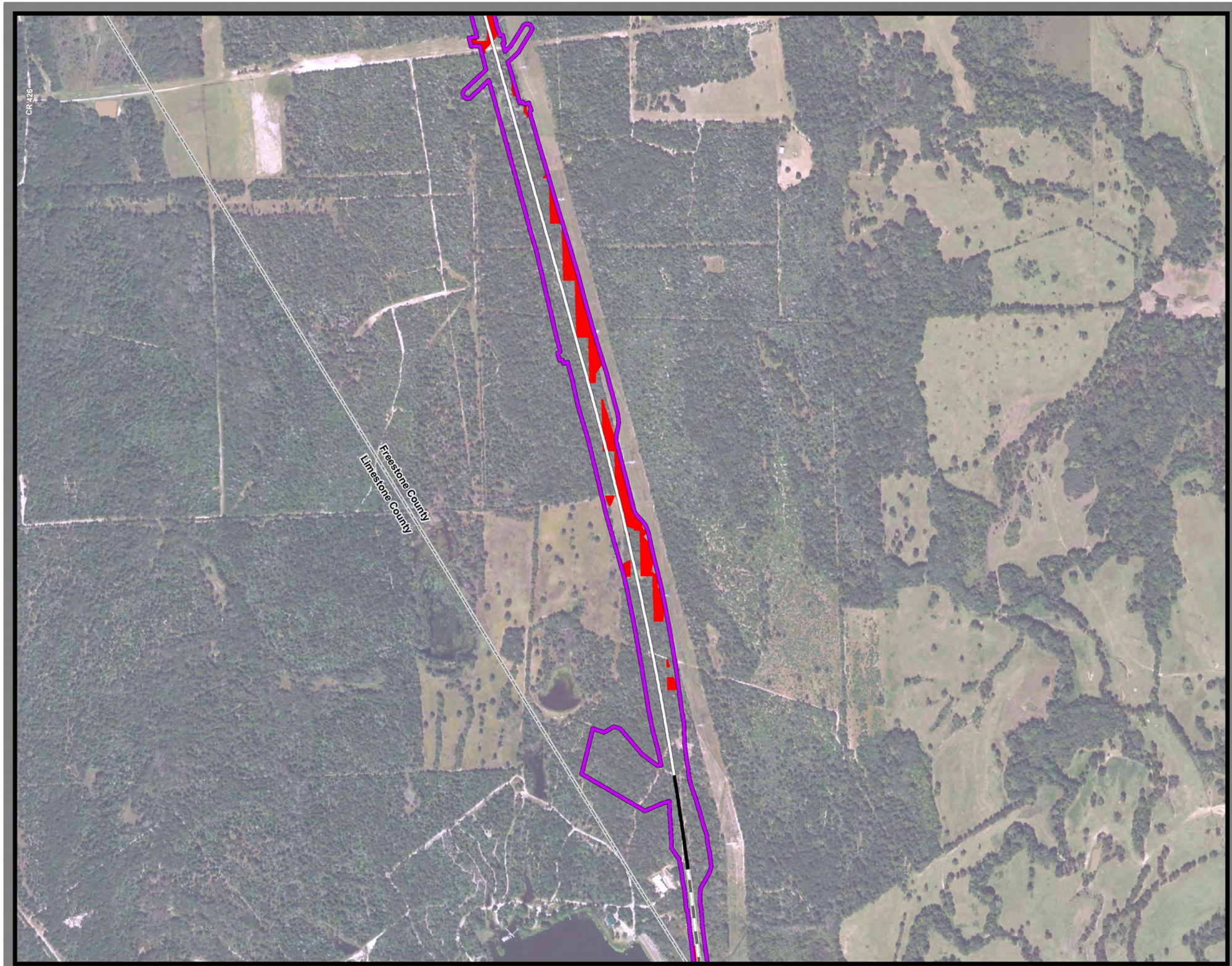
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 164 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 8 of 24

Legend

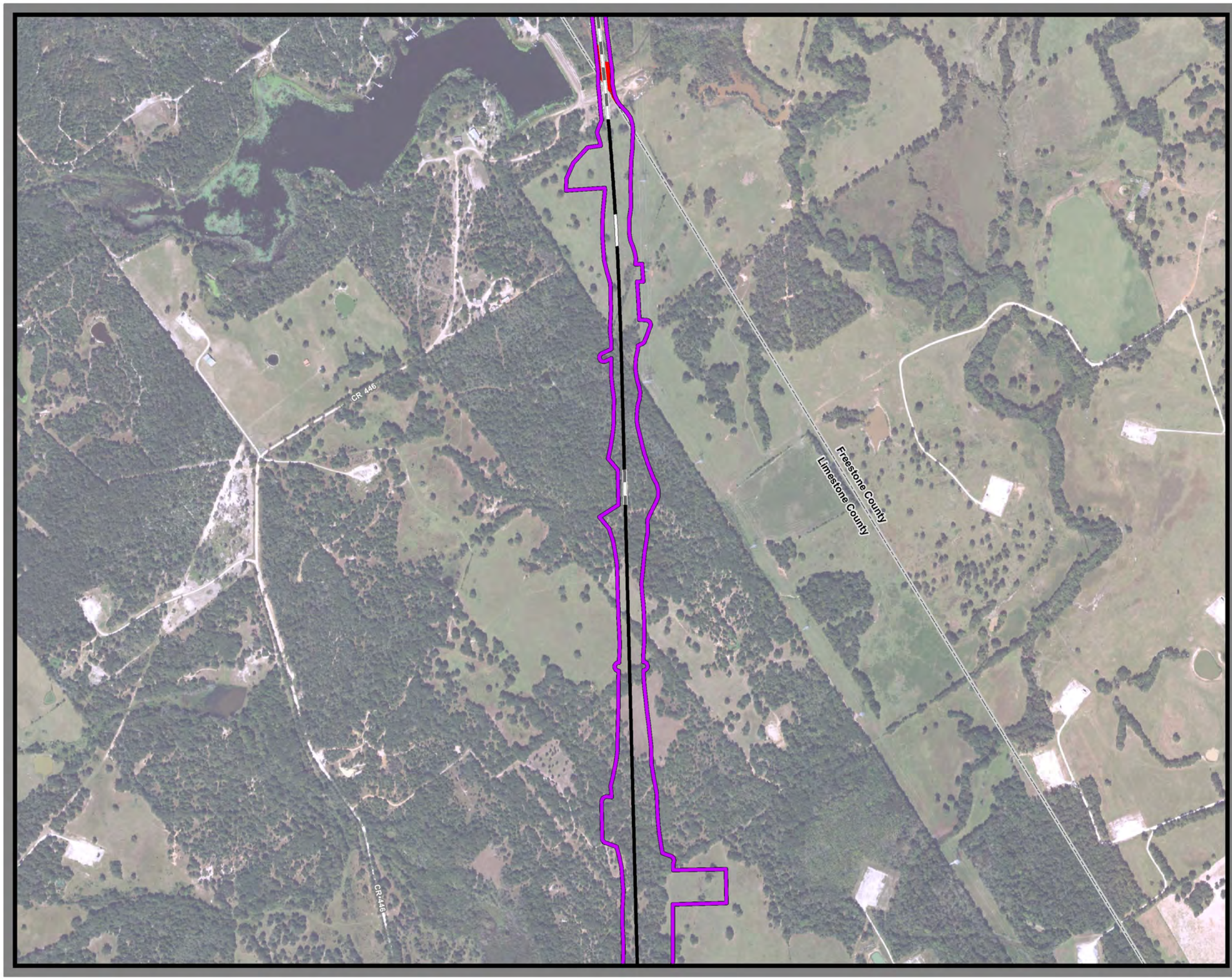
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 165 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 9 of 24

Legend

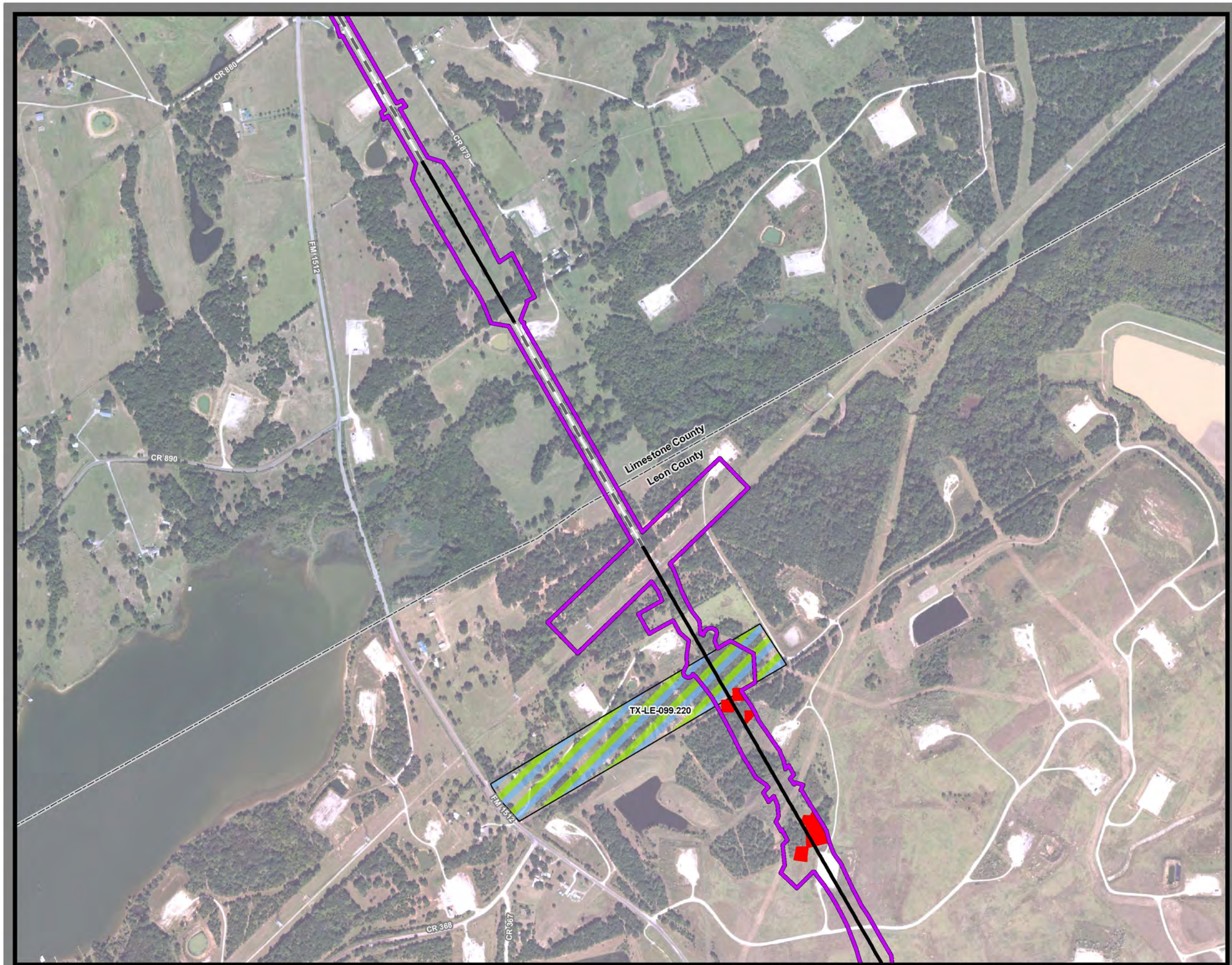
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 166 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 10 of 24

Legend

Track Configuration
- Viaduct
- Embankment

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 173 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 11 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

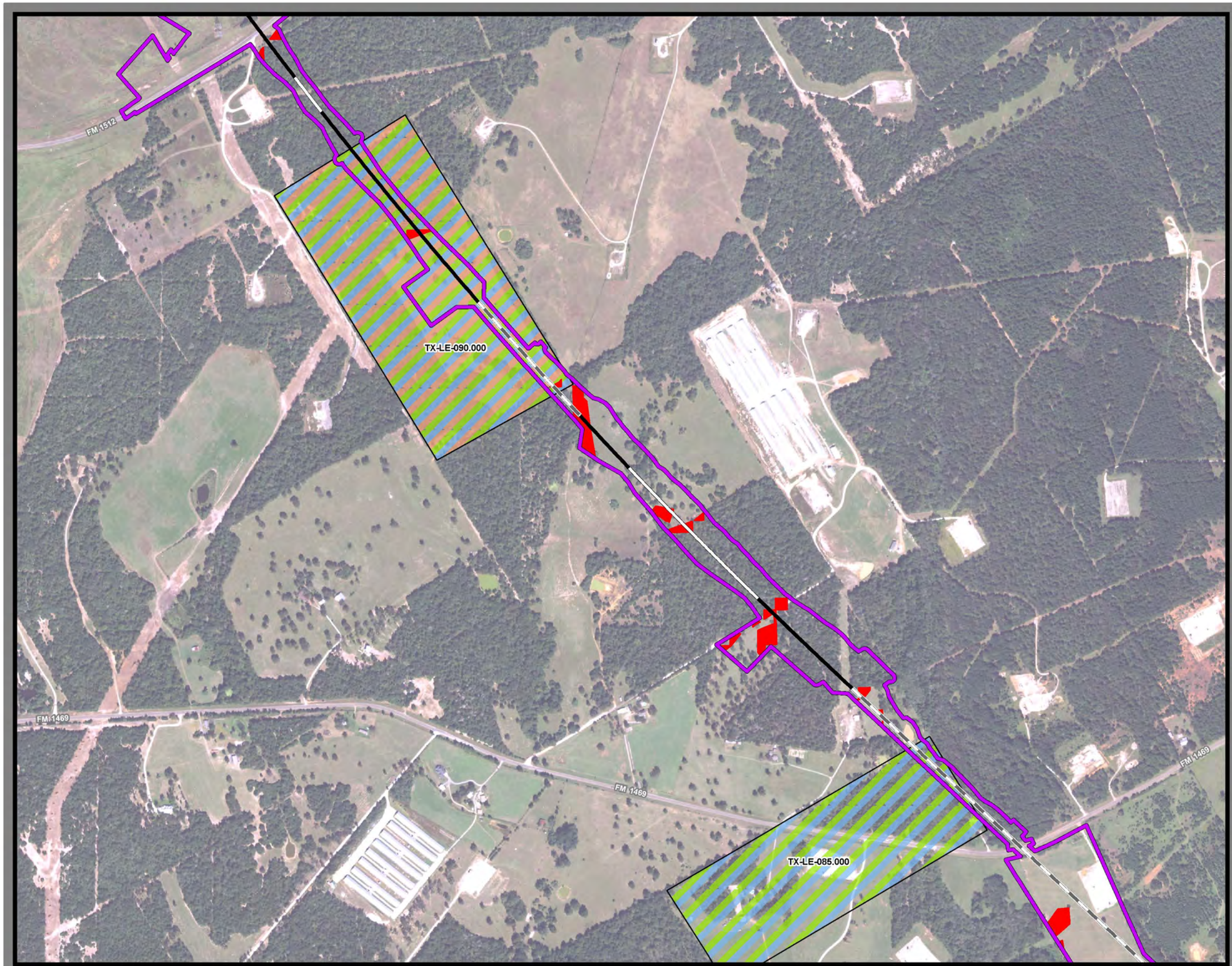
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 174 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 12 of 24

Legend

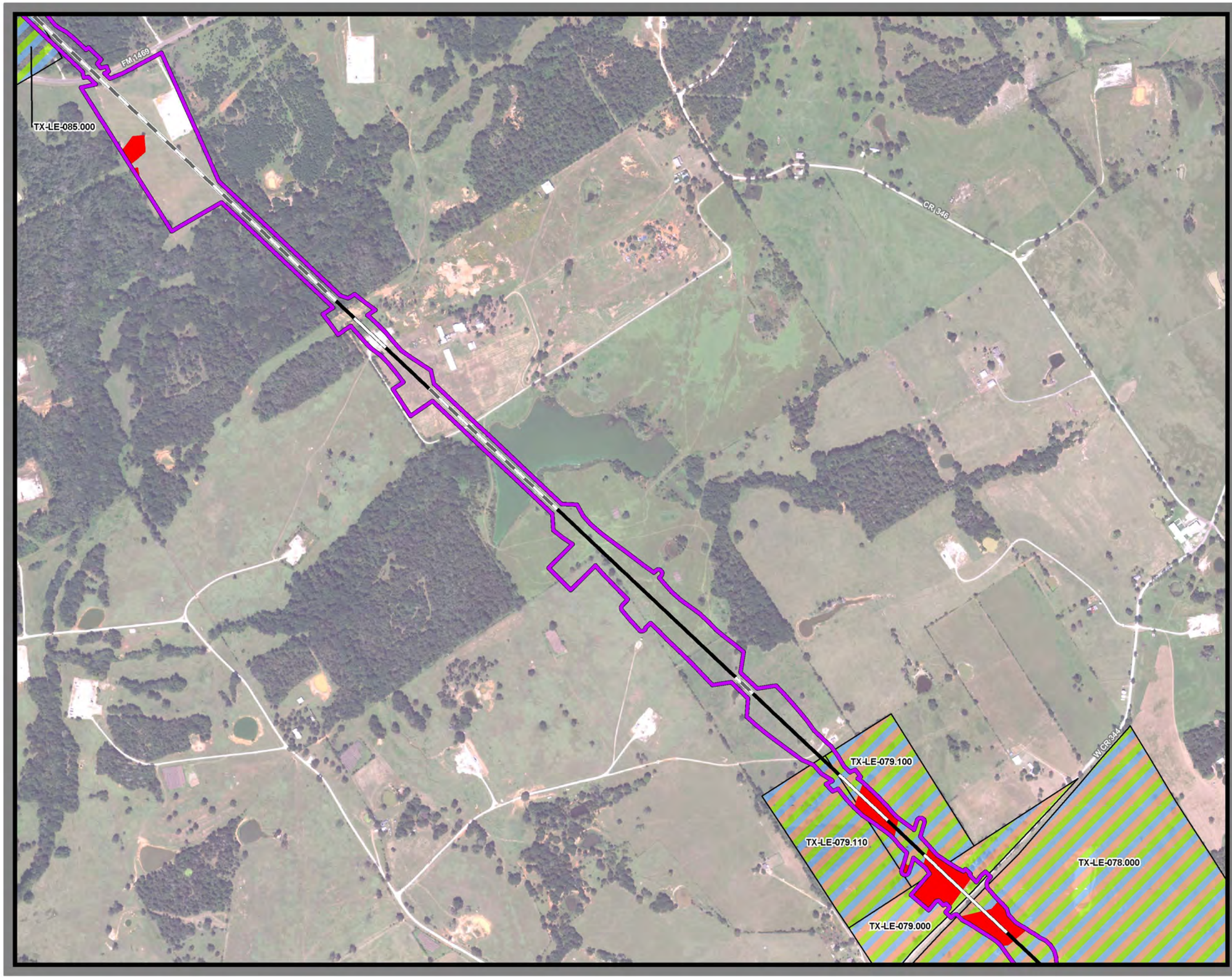
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 175 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 13 of 24

Legend

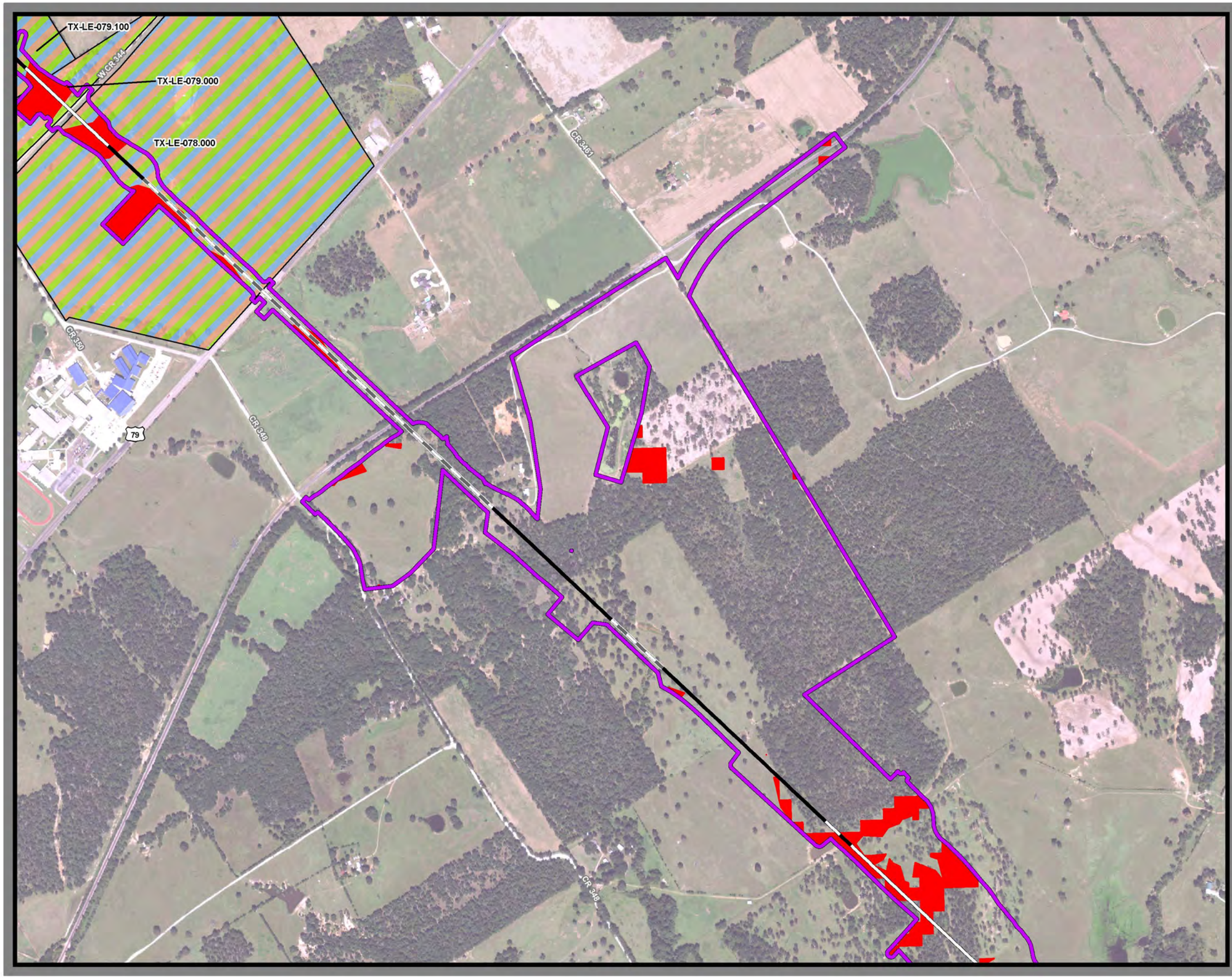
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 176 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 14 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

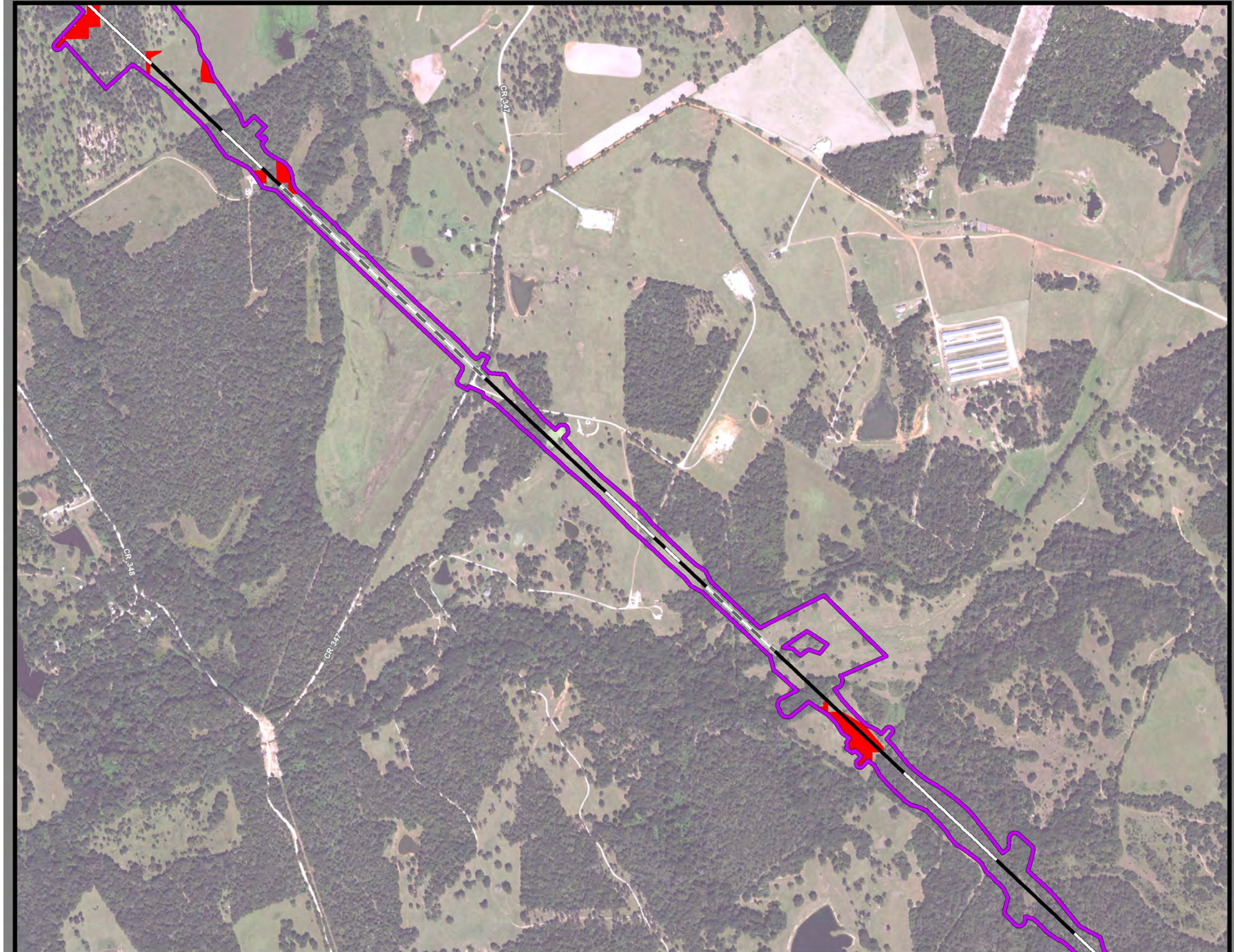
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 177 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 15 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

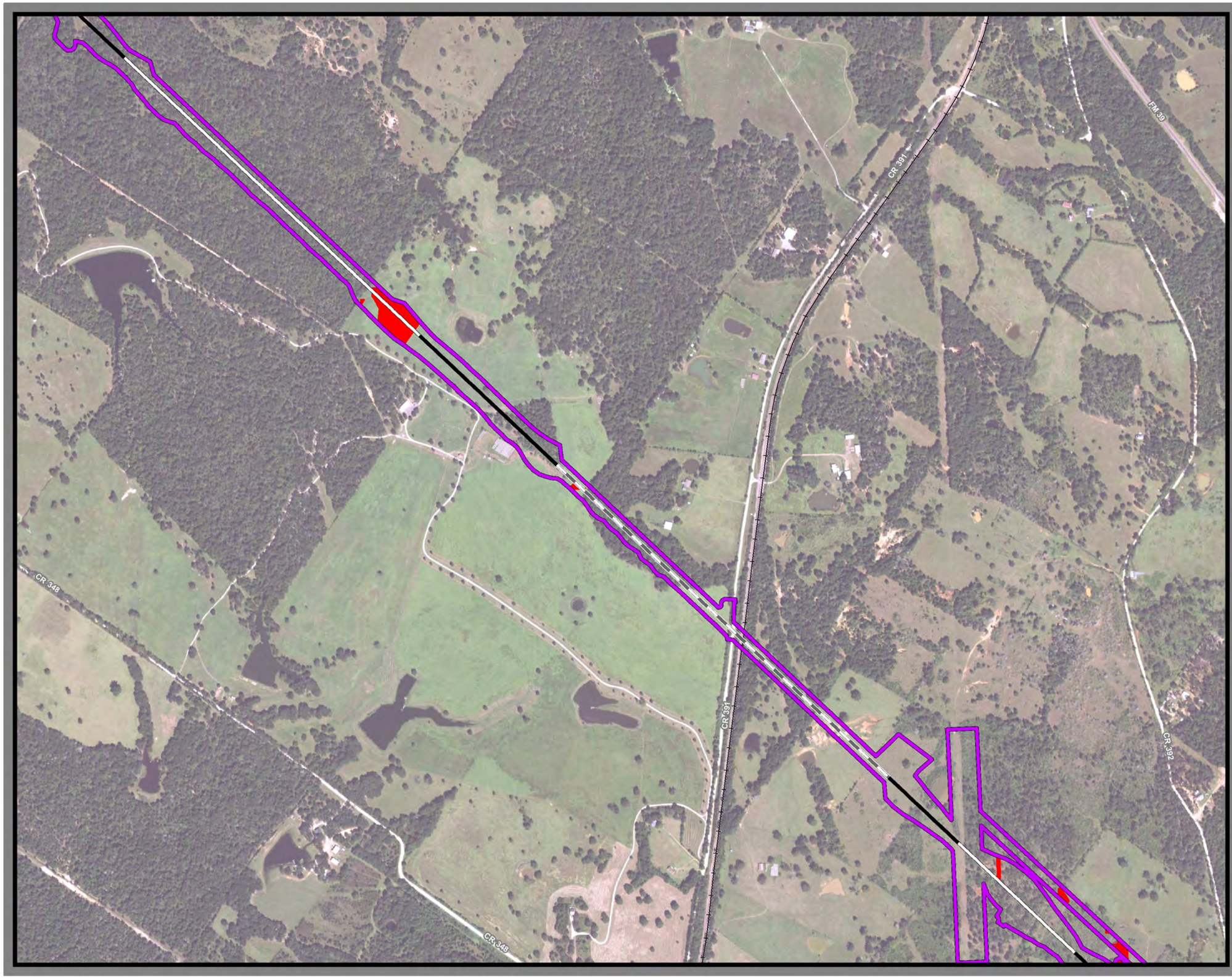
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 178 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 16 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

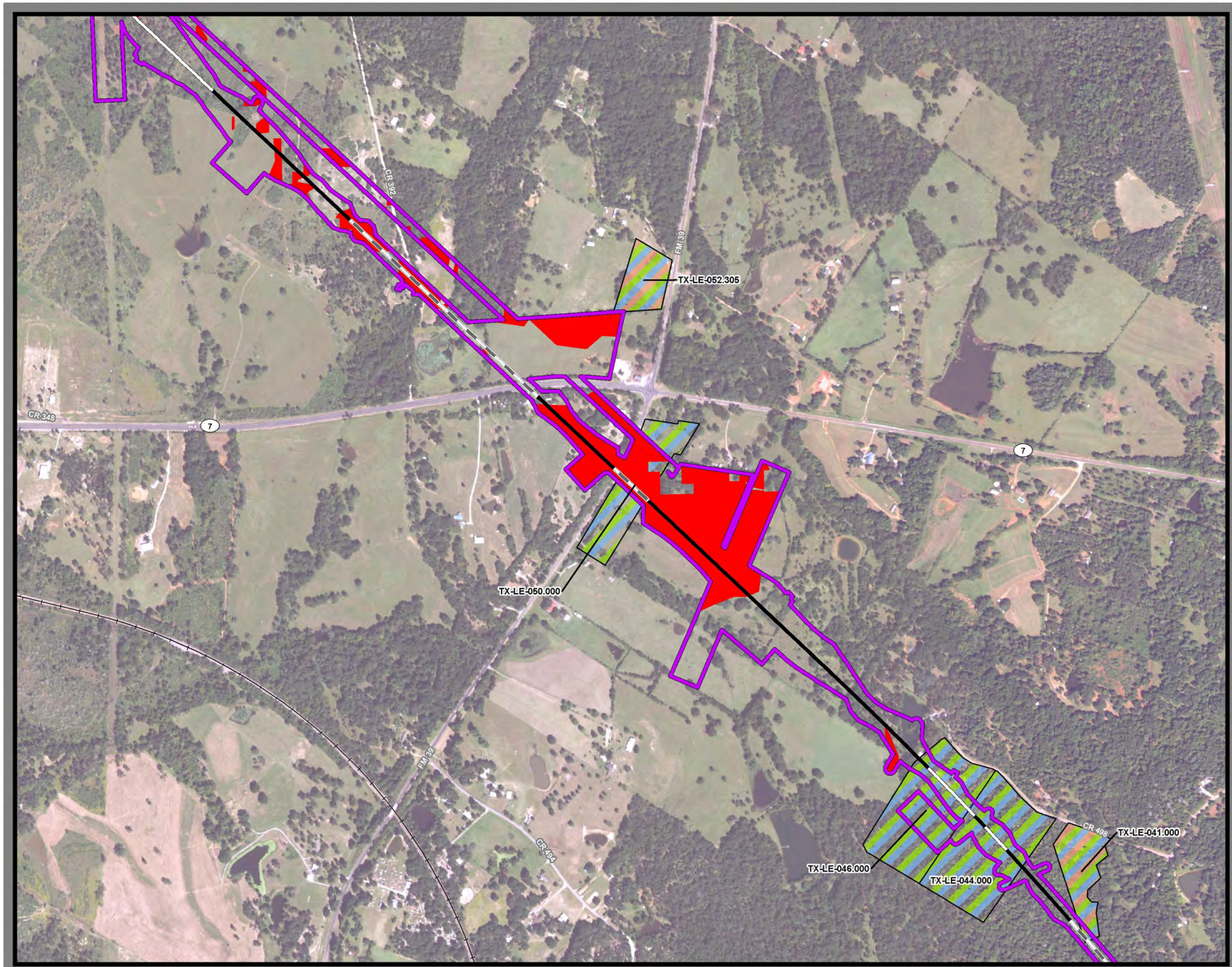
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 179 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 17 of 24

Legend

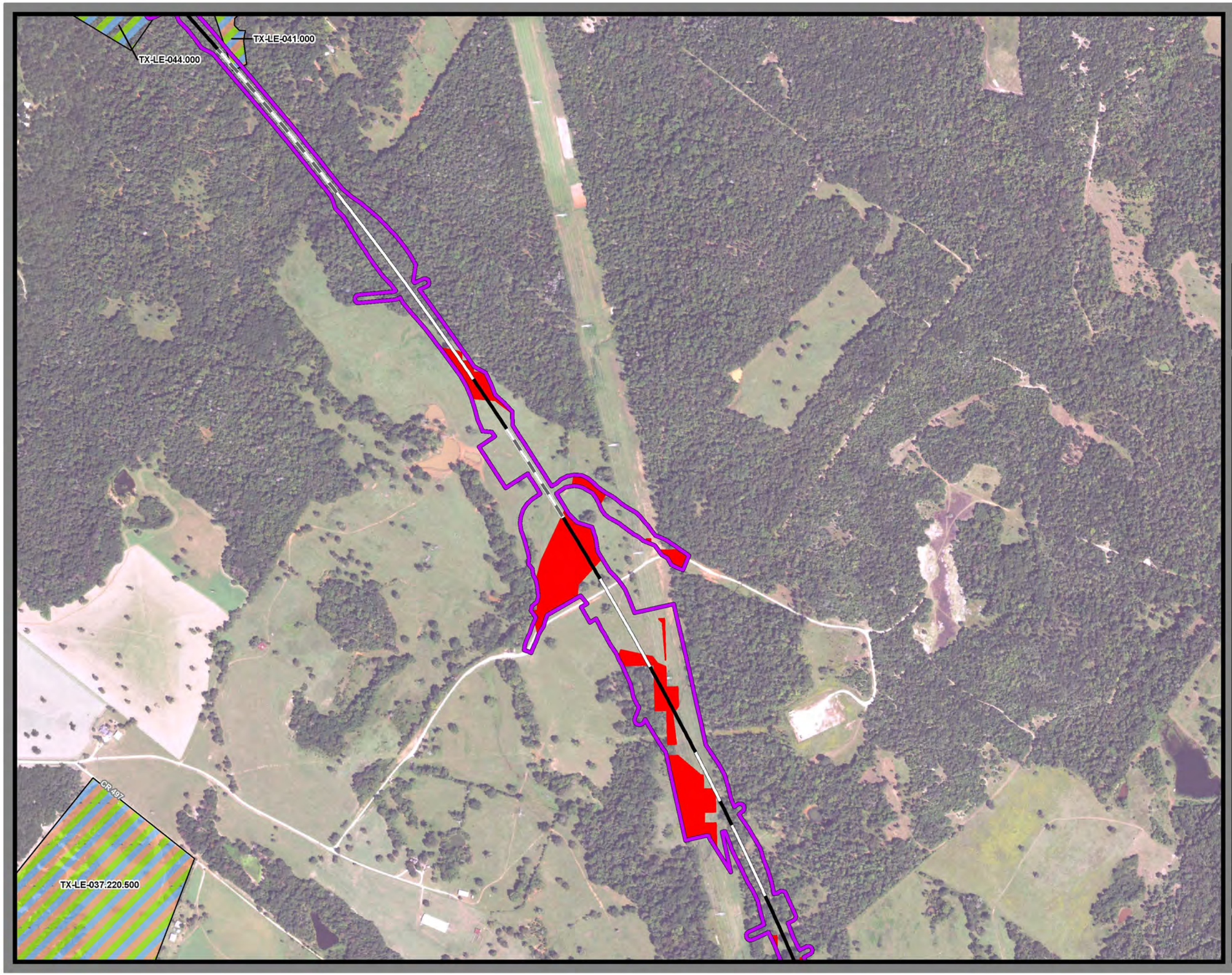
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 180 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 18 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

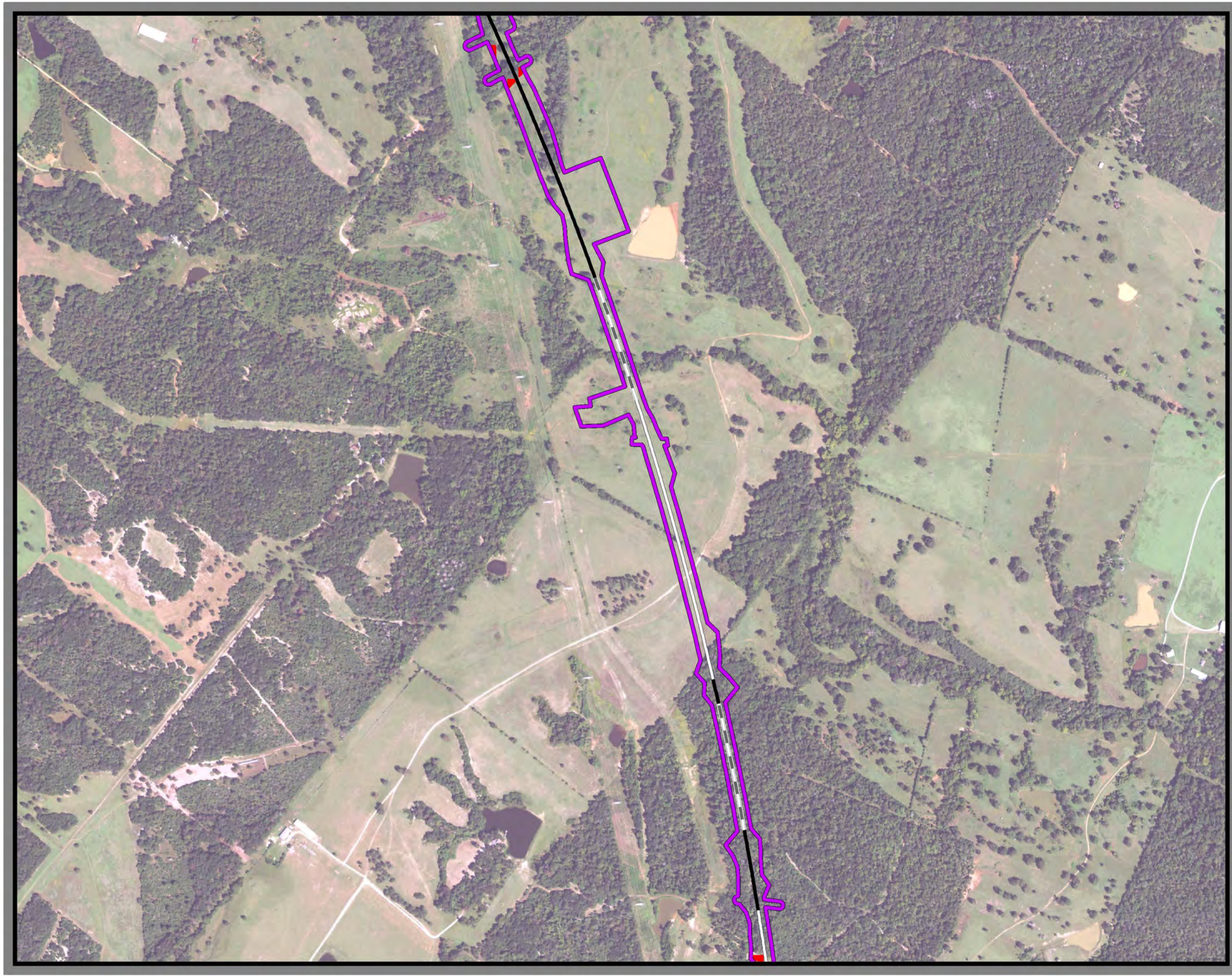
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2019 Surveyed Parcel
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 181 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Large-fruited Sand Verbena
Presence/Absence Survey
Segment 4
Sheet 19 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

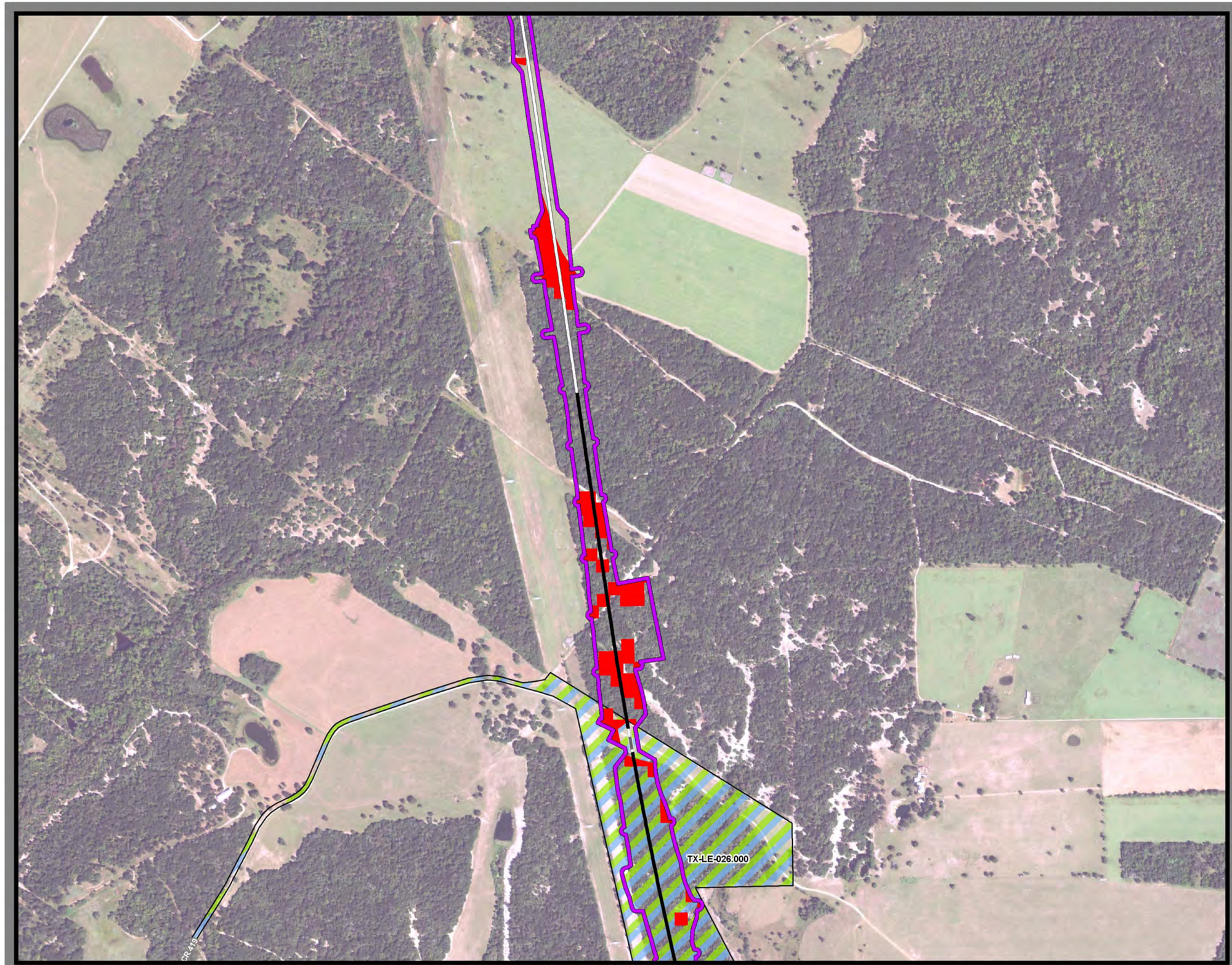
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 182 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 20 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

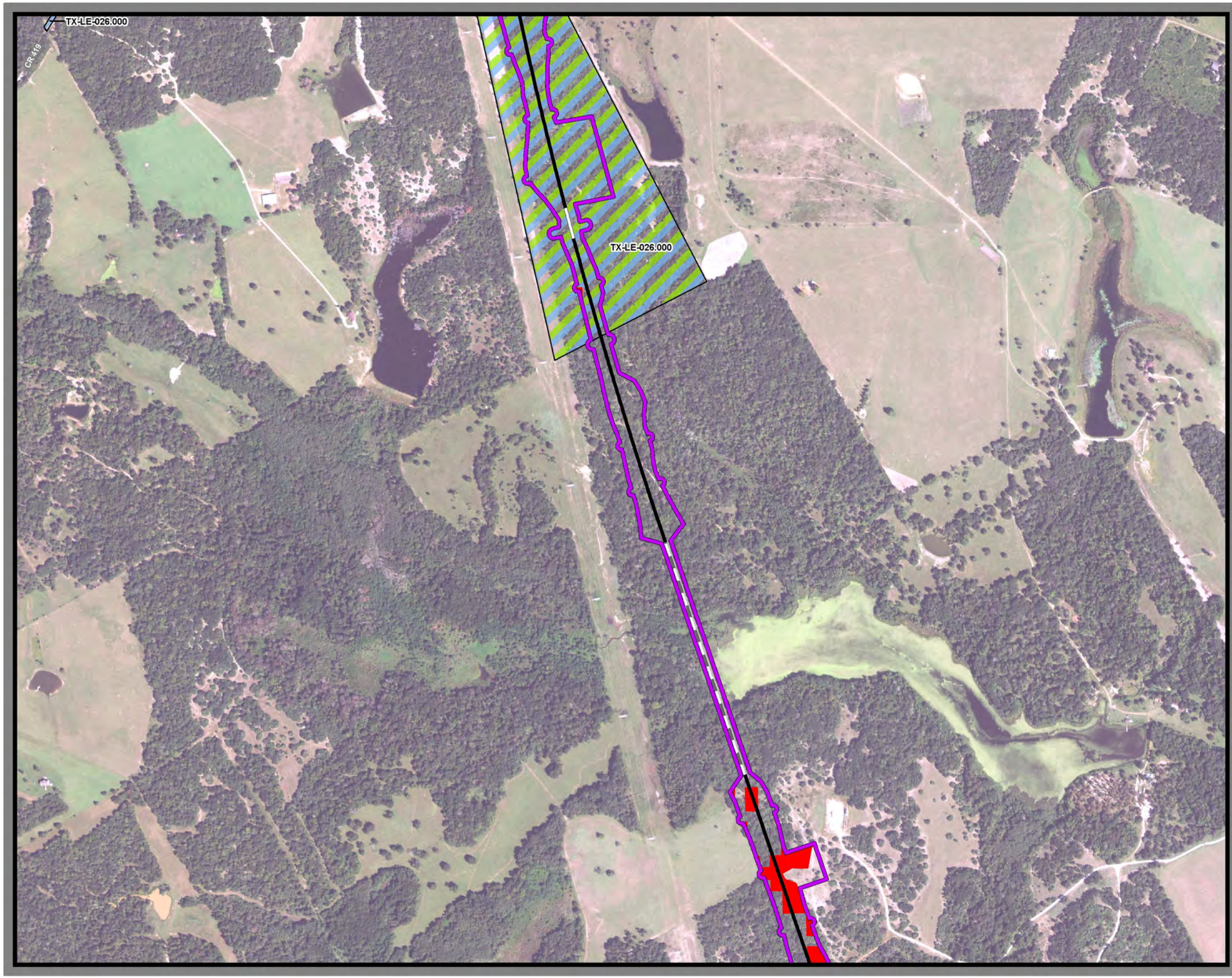
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 183 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 21 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

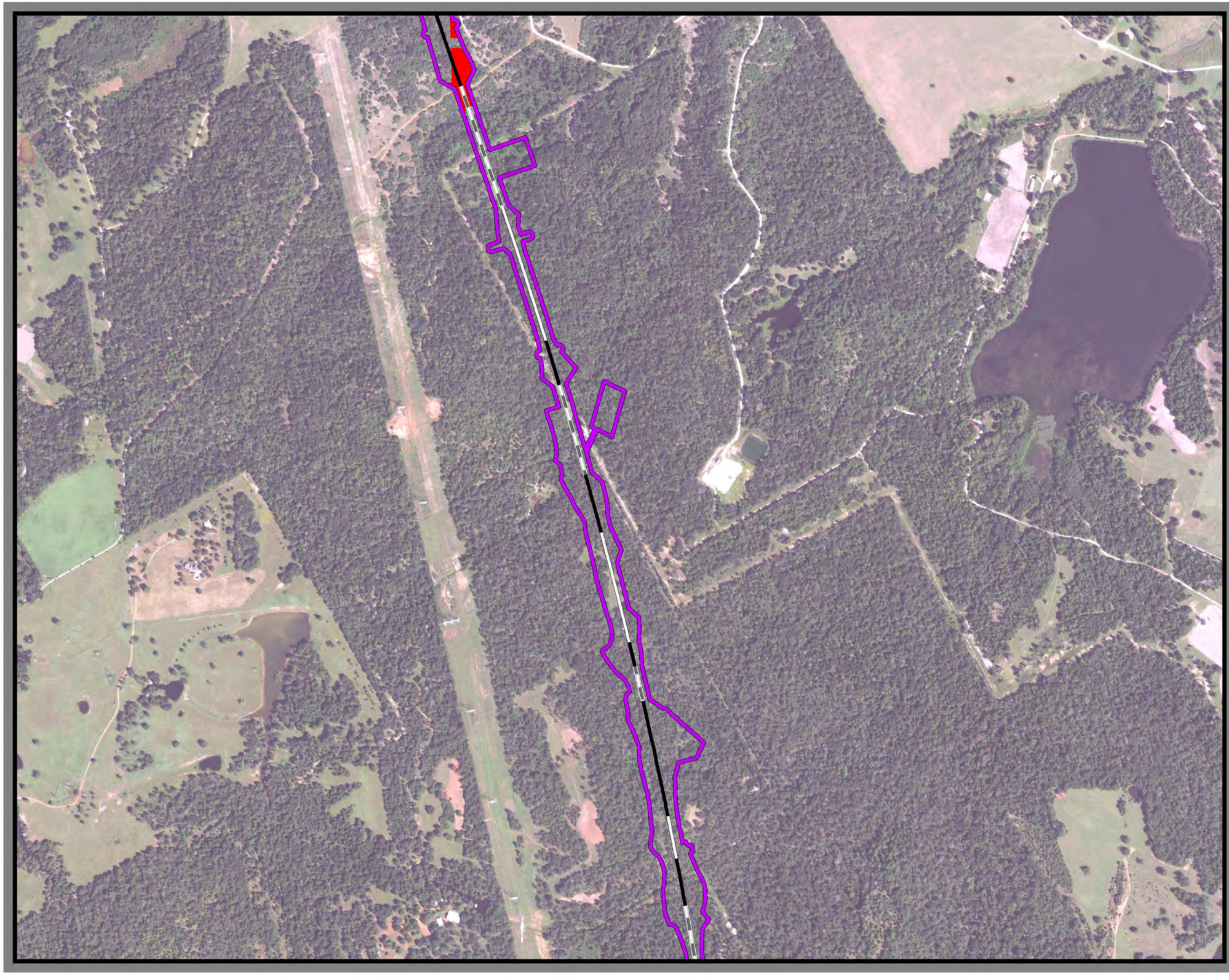
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 184 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 22 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

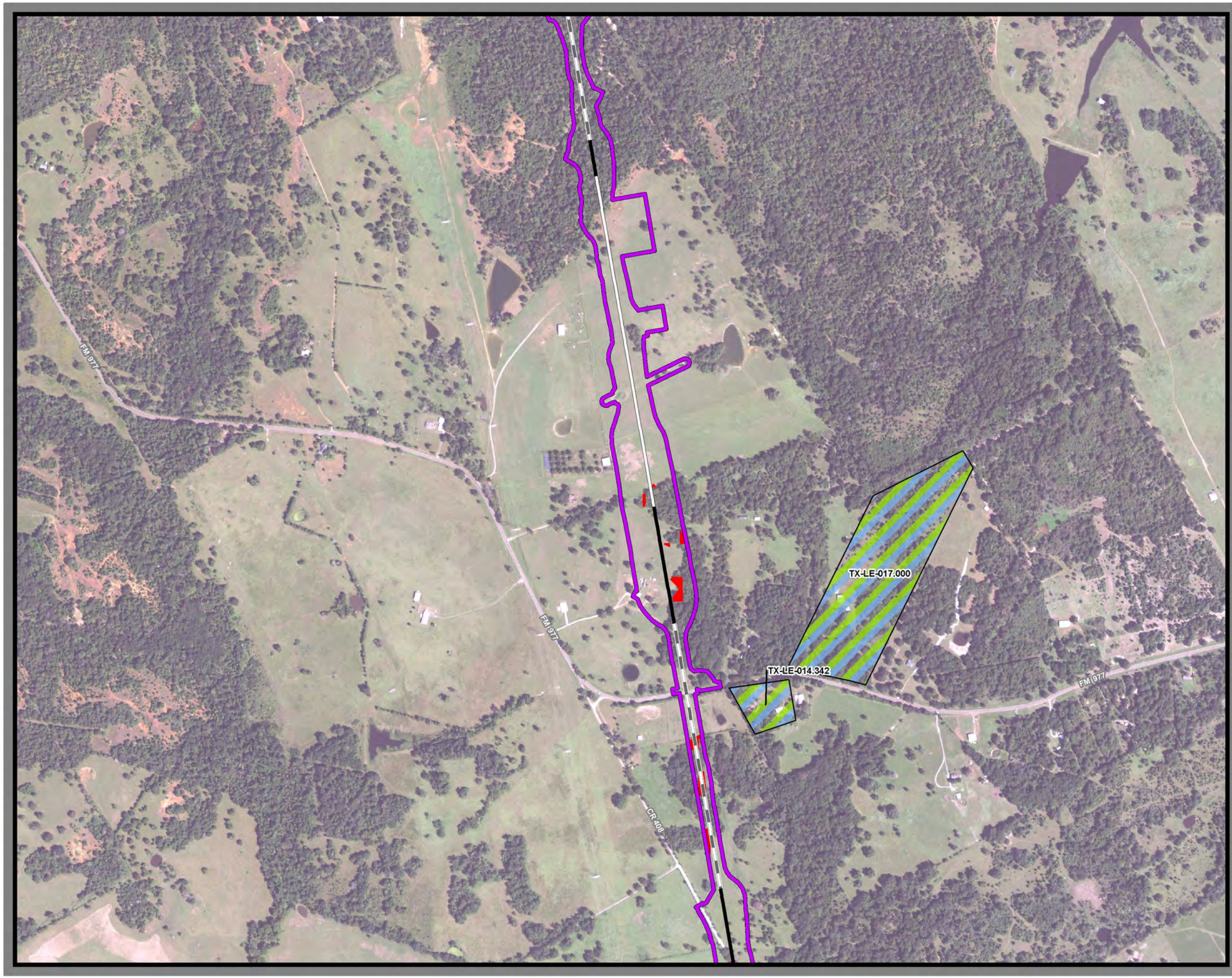
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 185 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 23 of 24

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat
- 2018 Surveyed Parcel
- 2017 Surveyed Parcel

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 186 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S

Dallas to Houston High-Speed Rail Project
Large-fruited Sand Verbena Presence/Absence Survey
Segment 4
Sheet 24 of 24

Legend

Track Configuration
- Viaduct
- Embankment

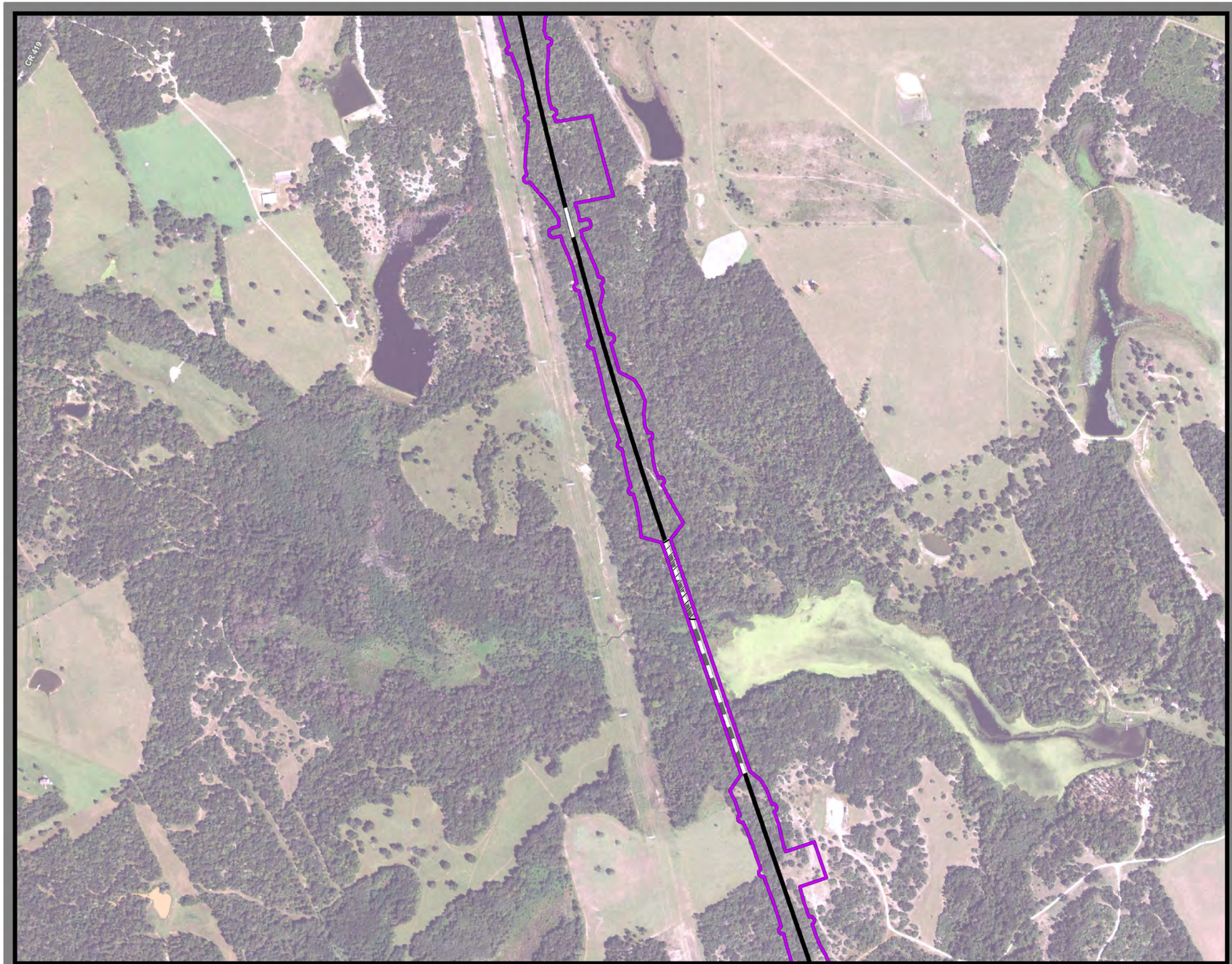
Limits of Disturbance
- Segment 4
- County Boundary
- Large-fruited Sand Verbena Modeled Habitat

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 187 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; LFSV Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 1 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

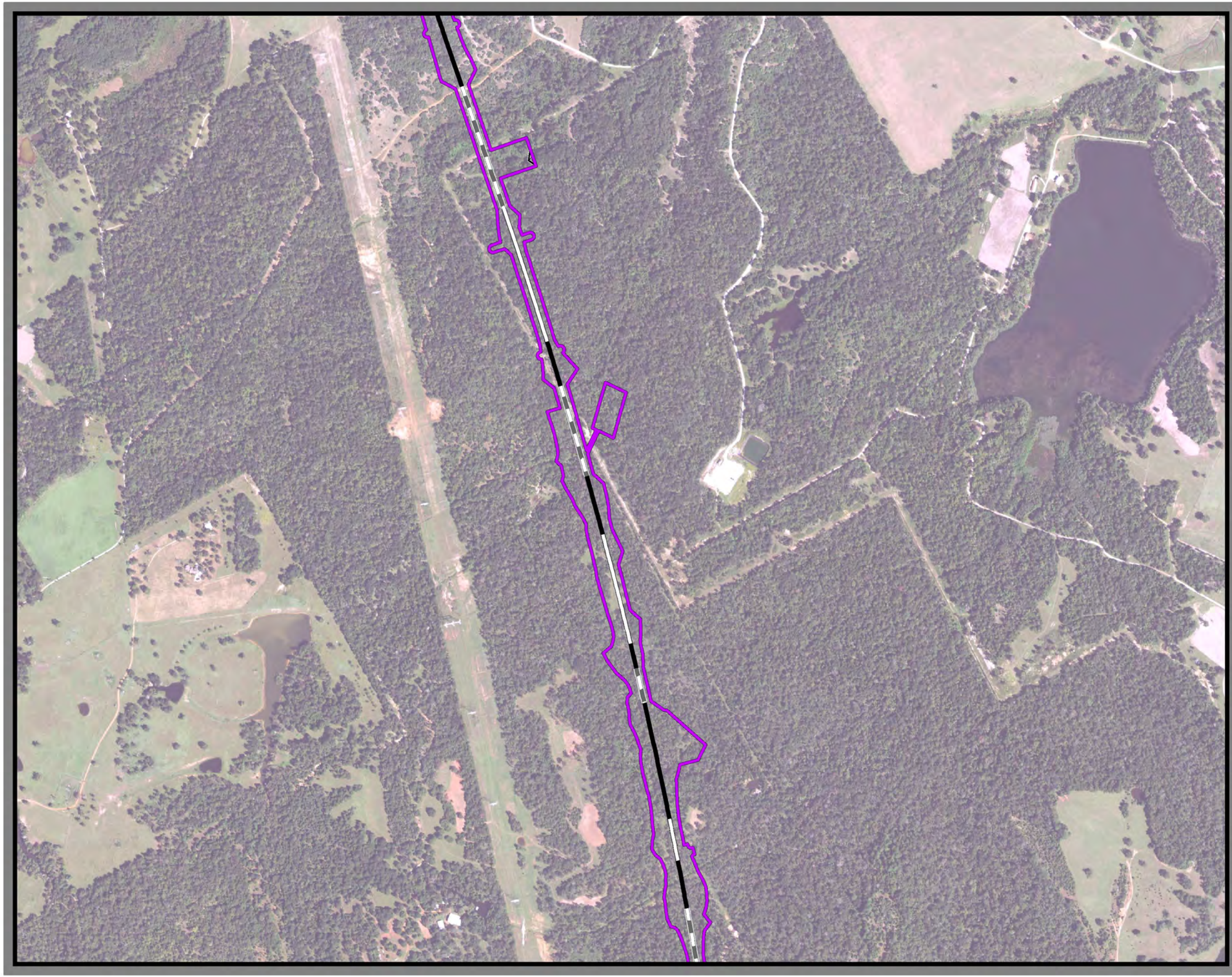
Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 184 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 2 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 185 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 3 of 38

Legend

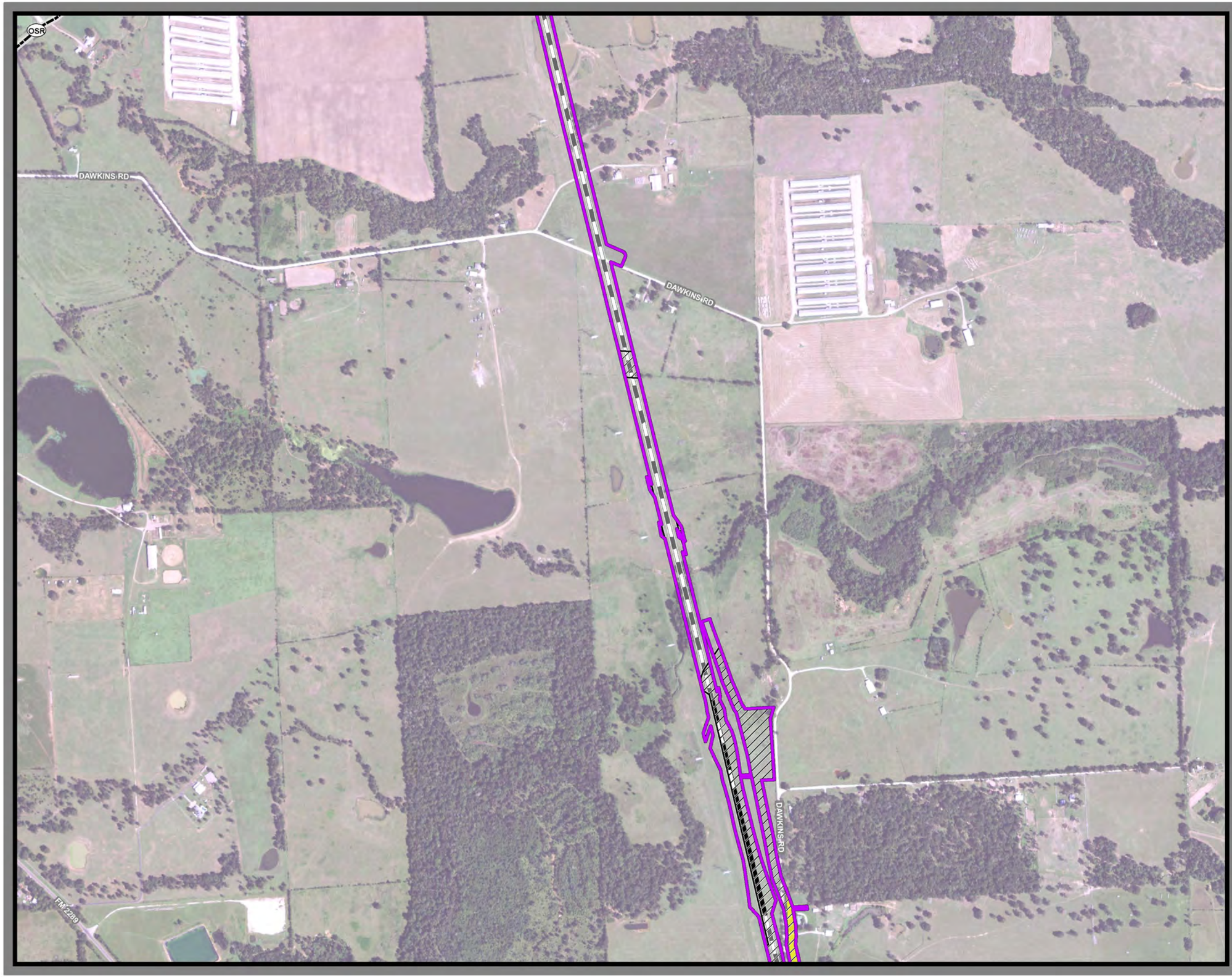
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 188 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 4 of 38

Legend

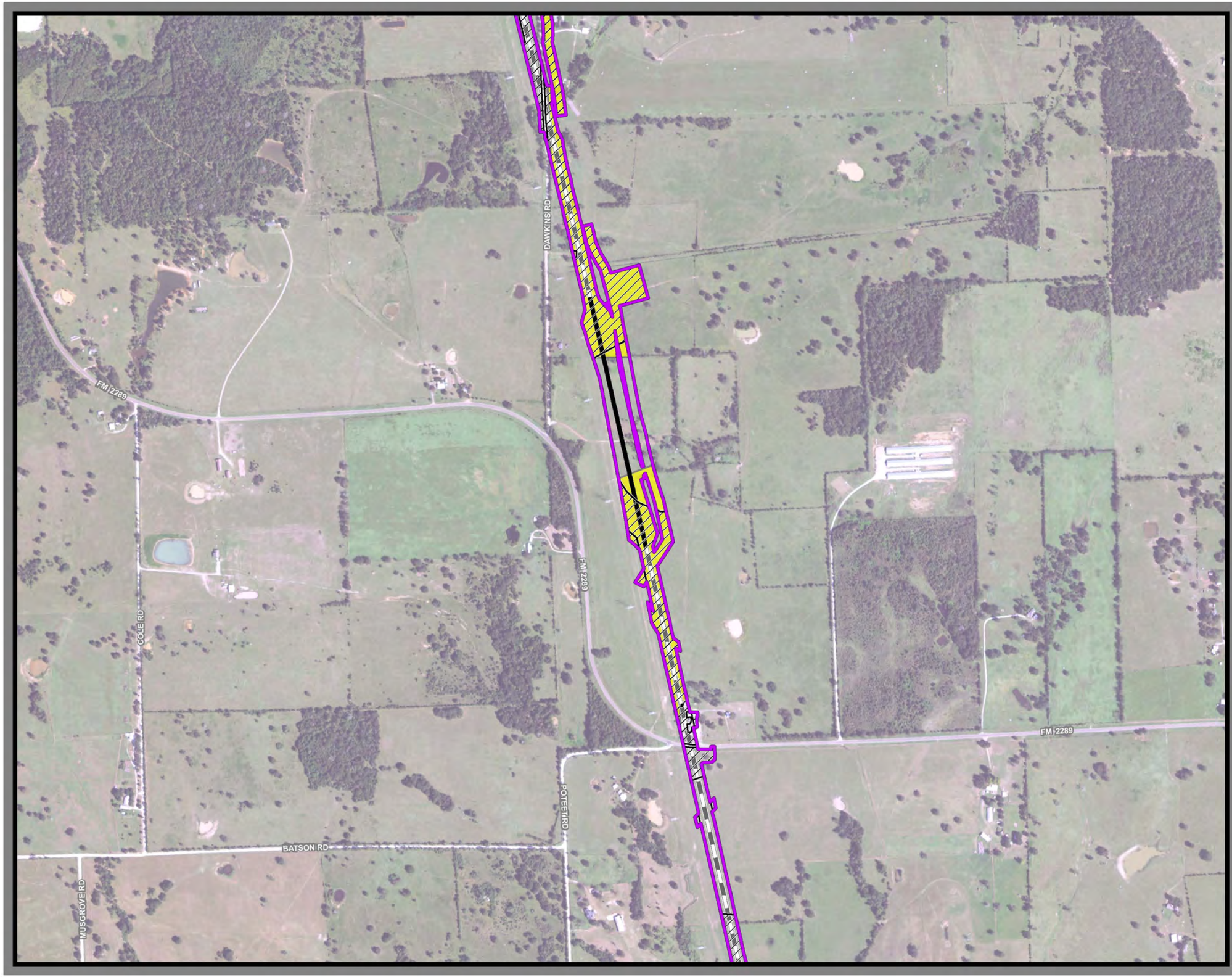
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 190 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 5 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 191 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 6 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 192 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 7 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- Spiranthes parksii Location Observed November 2017
- Spiranthes parksii Location Observed October 2018
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 193 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 8 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 194 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 9 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

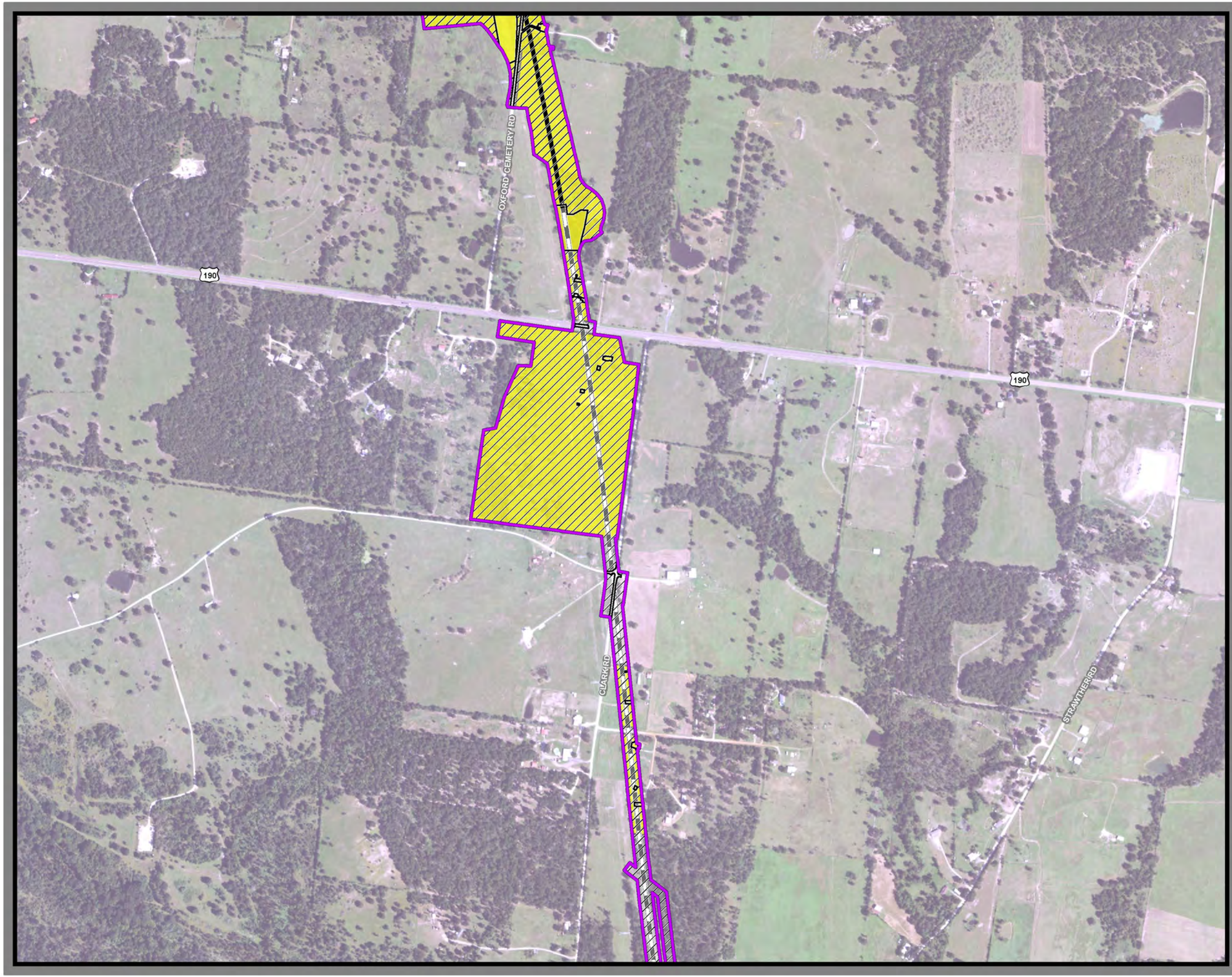
Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 195 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 10 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 196 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 11 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

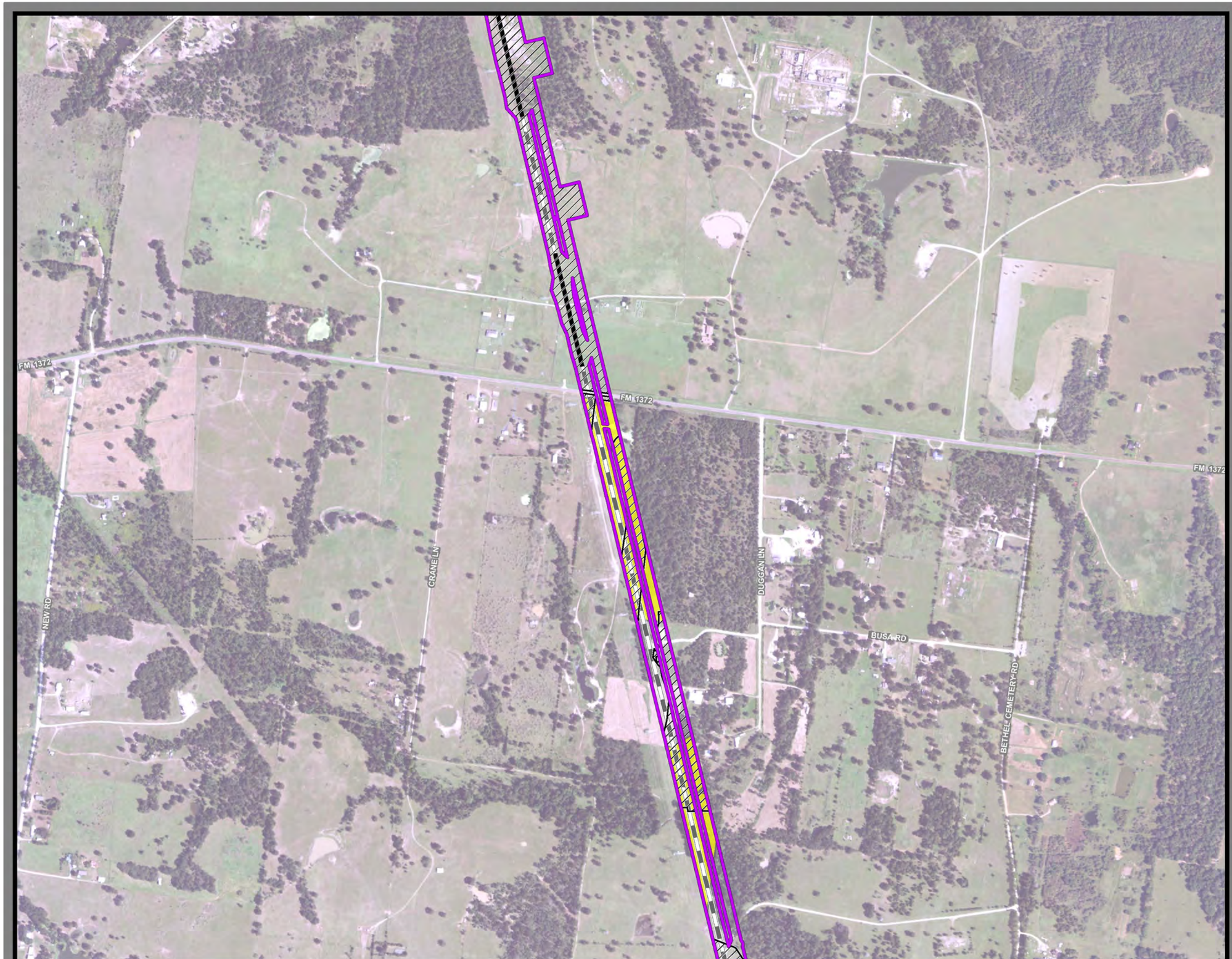
Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 197 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 12 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 198 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 13 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

*****This Sheet only depicts Segment 4; Segment 3C is also located in this same area and can be referenced on Sheet 150.*****

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 199 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4
Sheet 14 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 4
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

*****This Sheet only depicts Segment 4; Segment 3C is also located in this same area and can be referenced on Sheet 151.*****

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 200 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 4, 5
Sheet 15 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

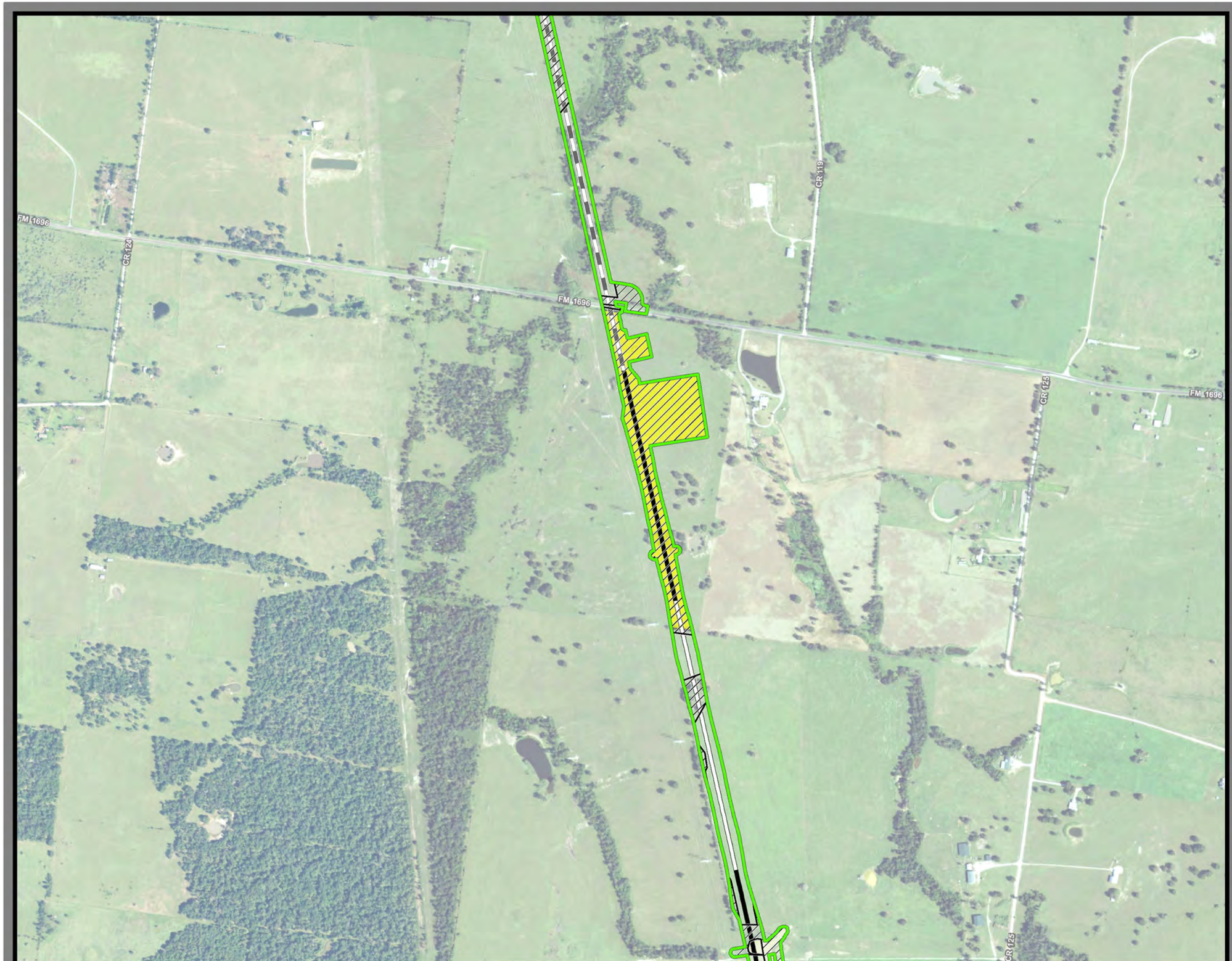
Limits of Disturbance
- Segment 4
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

*****This Sheet only depicts Segments 4 & 5; Segment 3C is also located in this same area and can be referenced on Sheet 152.*****

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 201 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 16 of 38

Legend

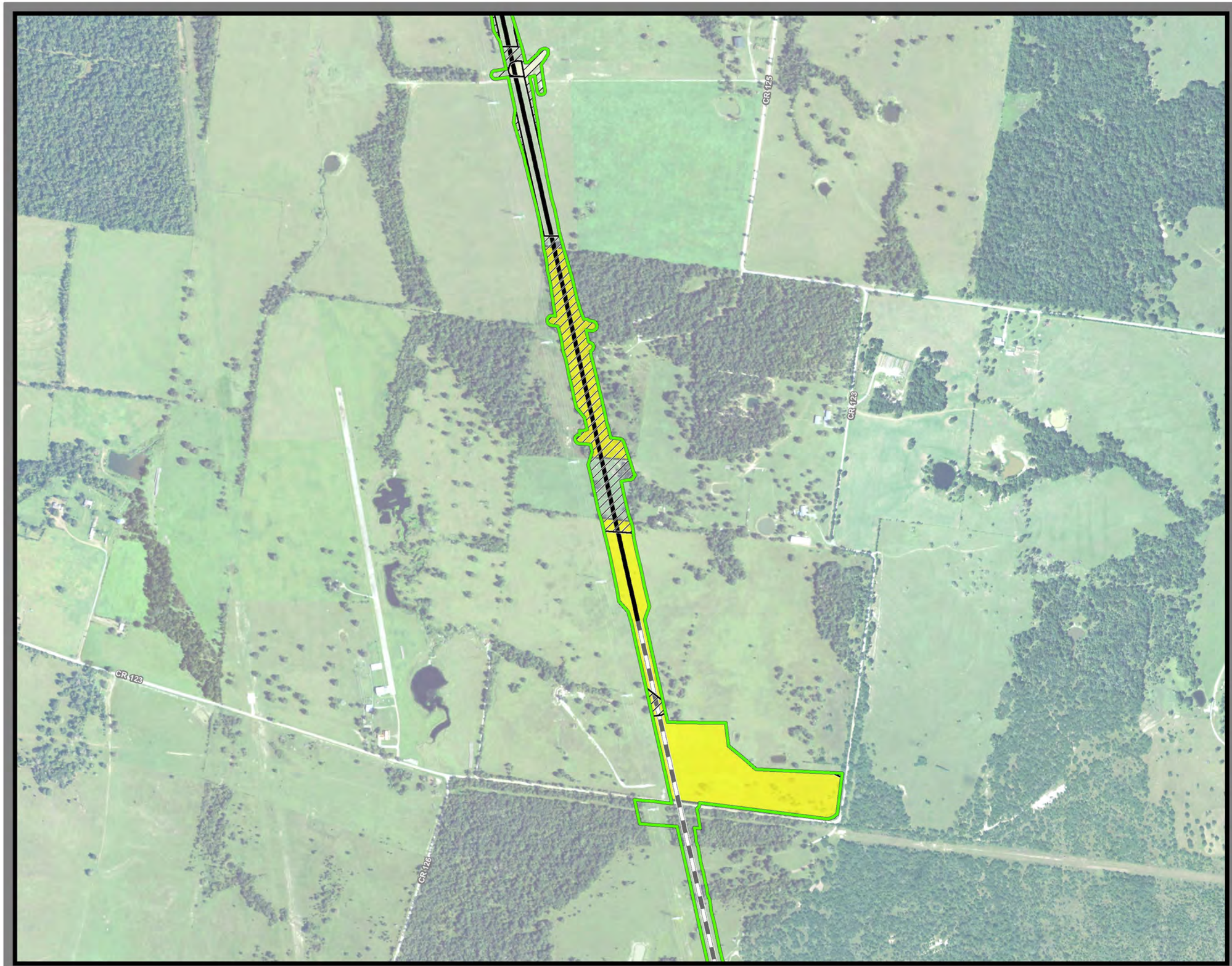
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 202 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston High-Speed Rail Project

Navasota Ladies'-tresses Presence/Absence Survey

Segment 5

Sheet 17 of 38

Legend

Track Configuration

- Viaduct
- Embankment
- Cut

Limits of Disturbance

- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 203 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map

Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 18 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

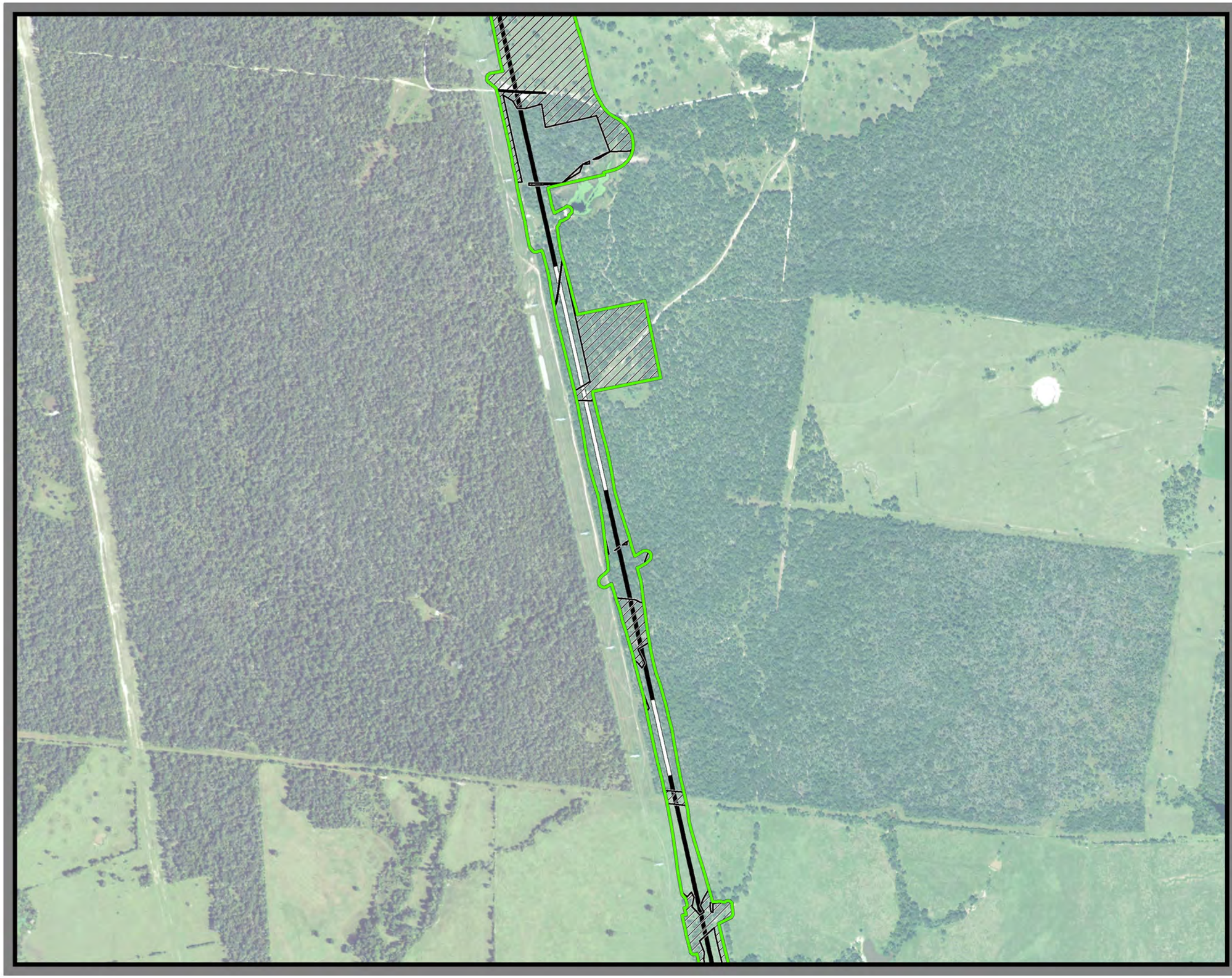
***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 204 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 19 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

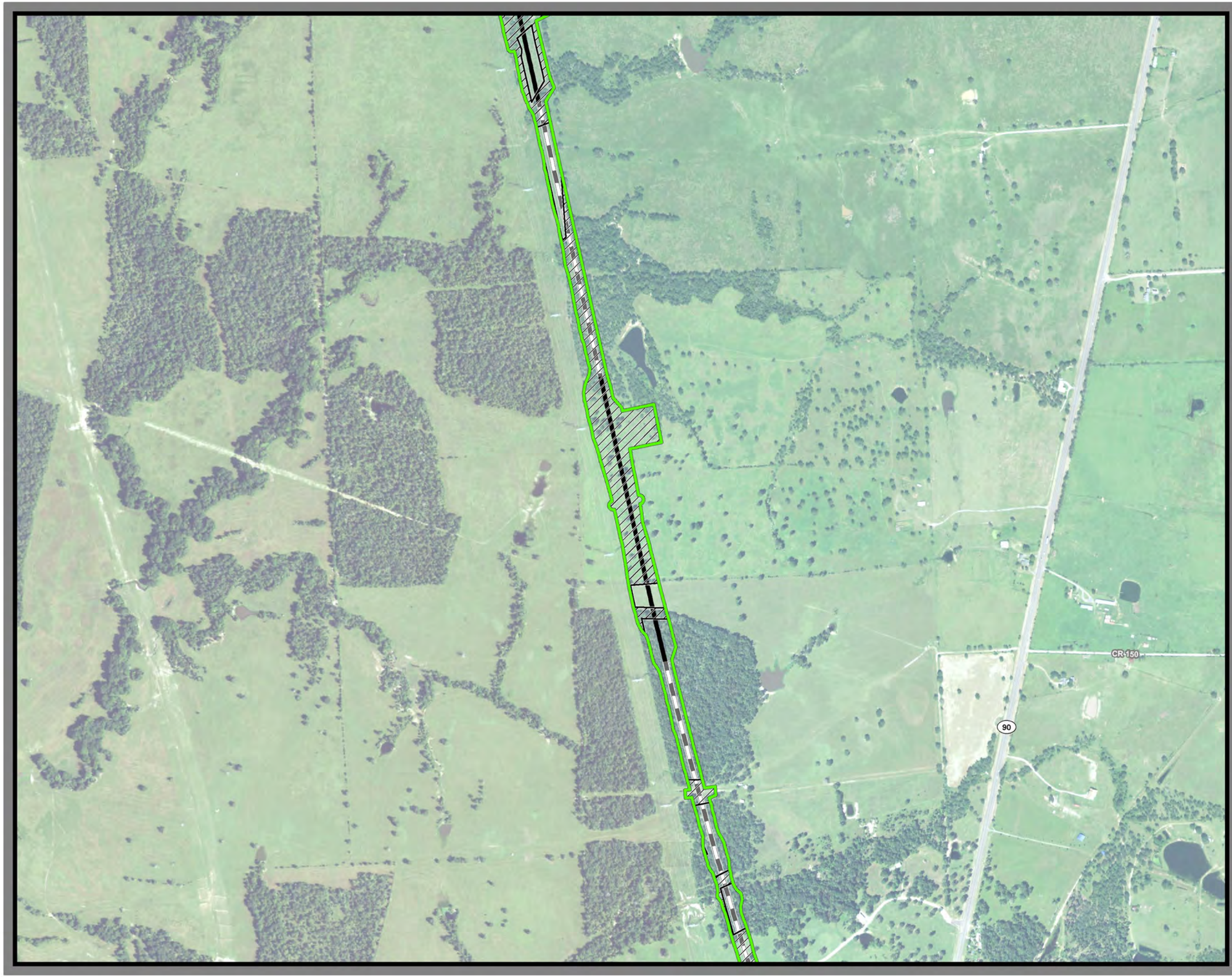
***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 205 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 20 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

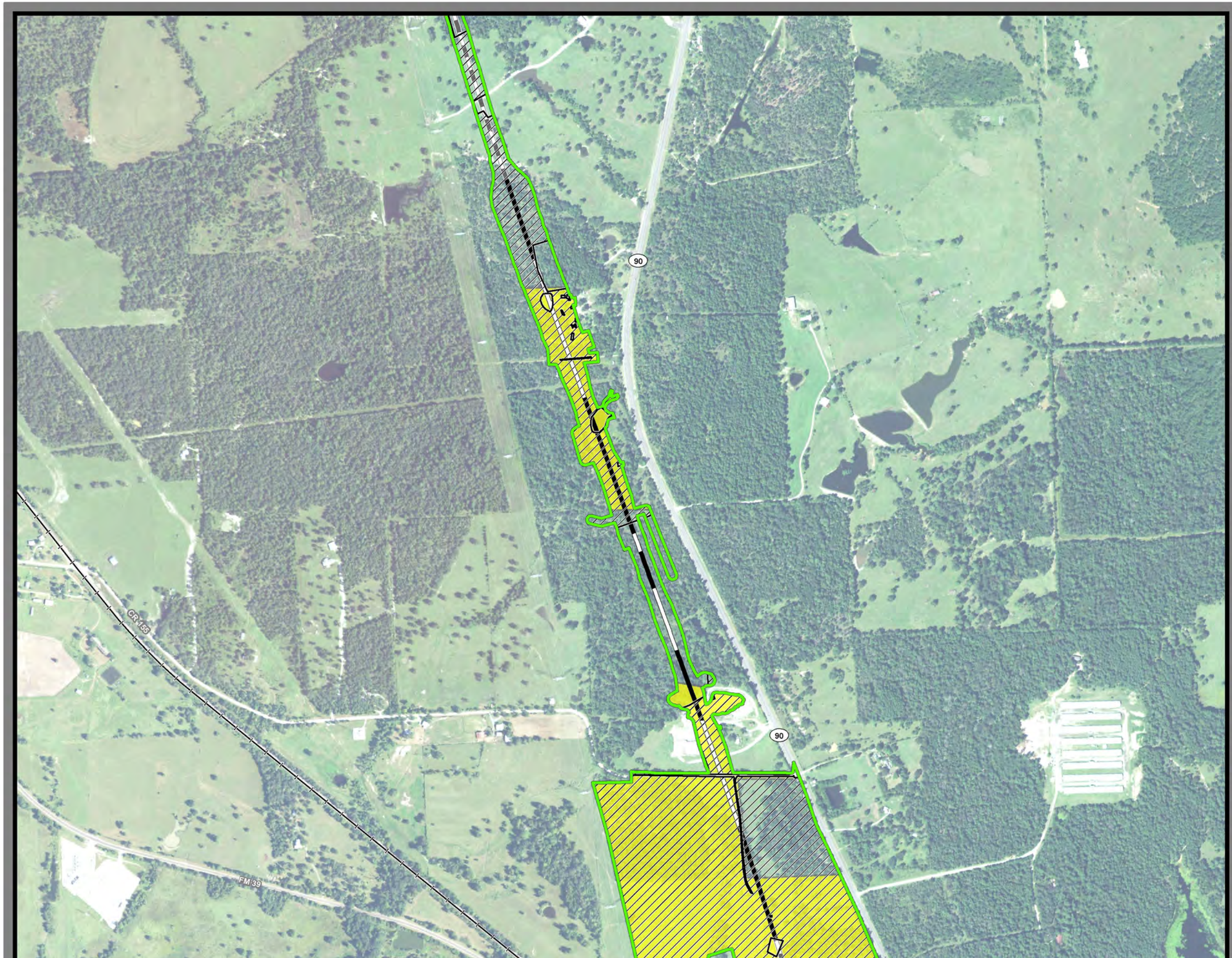
***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 206 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 21 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

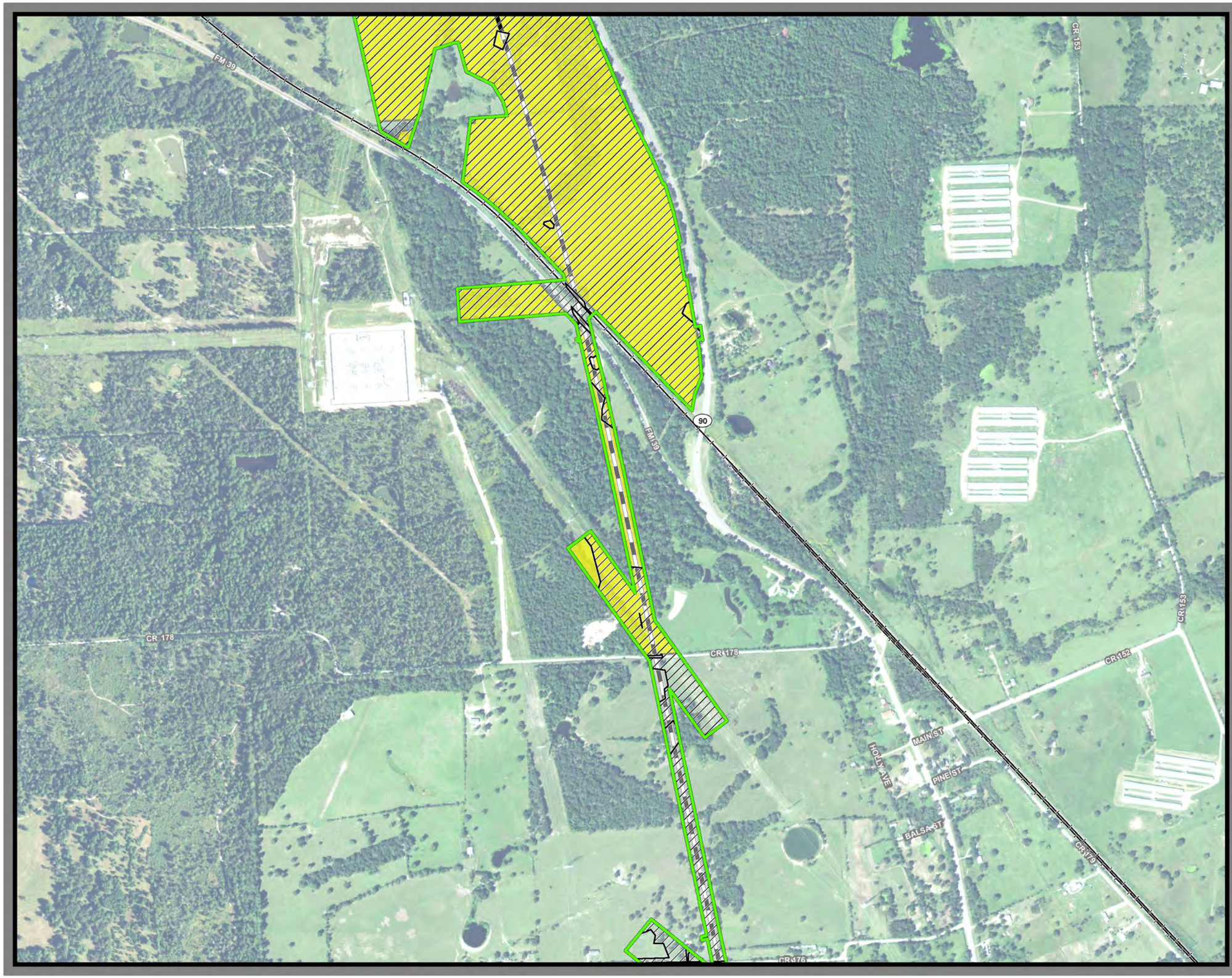
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 207 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 22 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

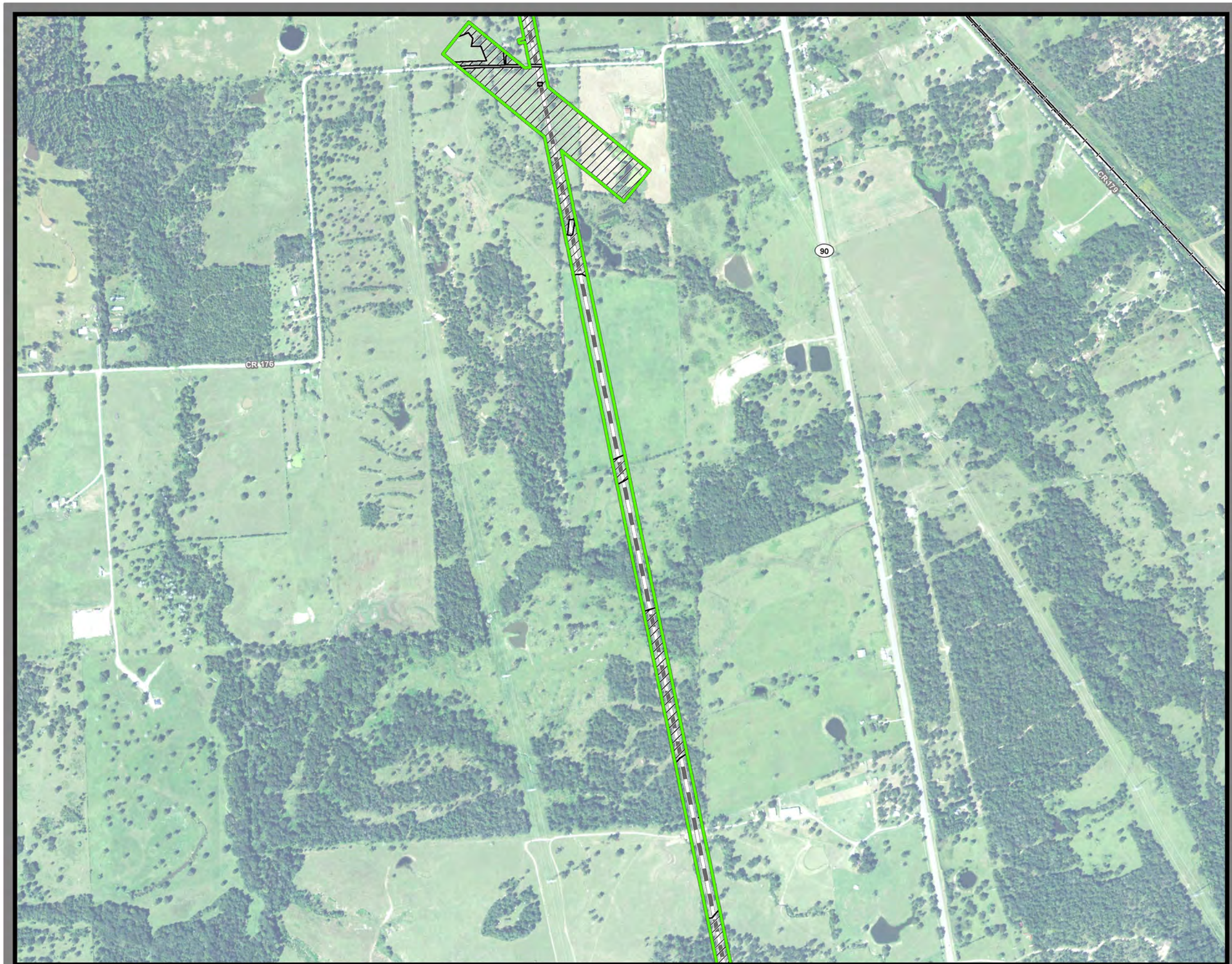
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 208 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 23 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

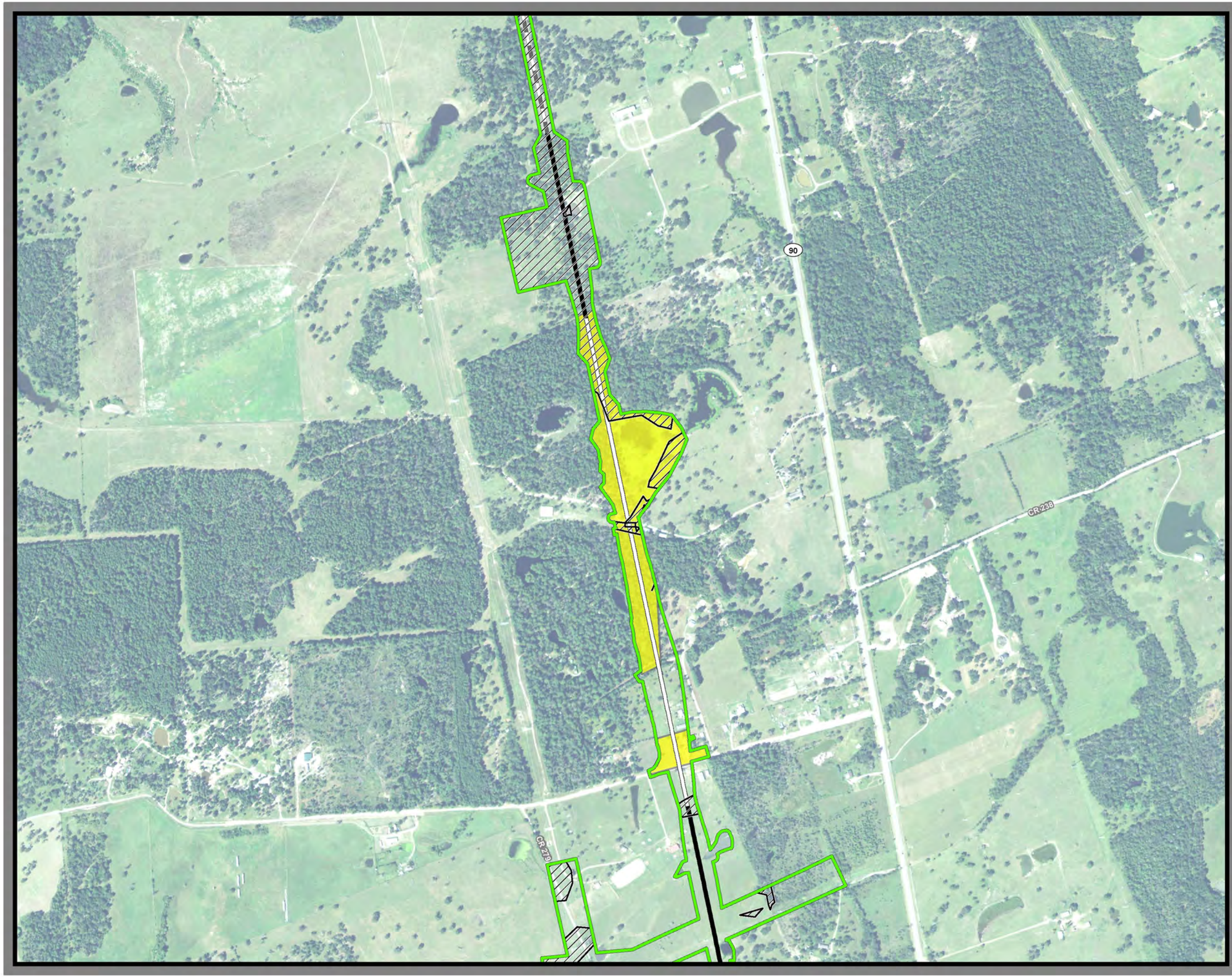
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 209 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 24 of 38

Legend

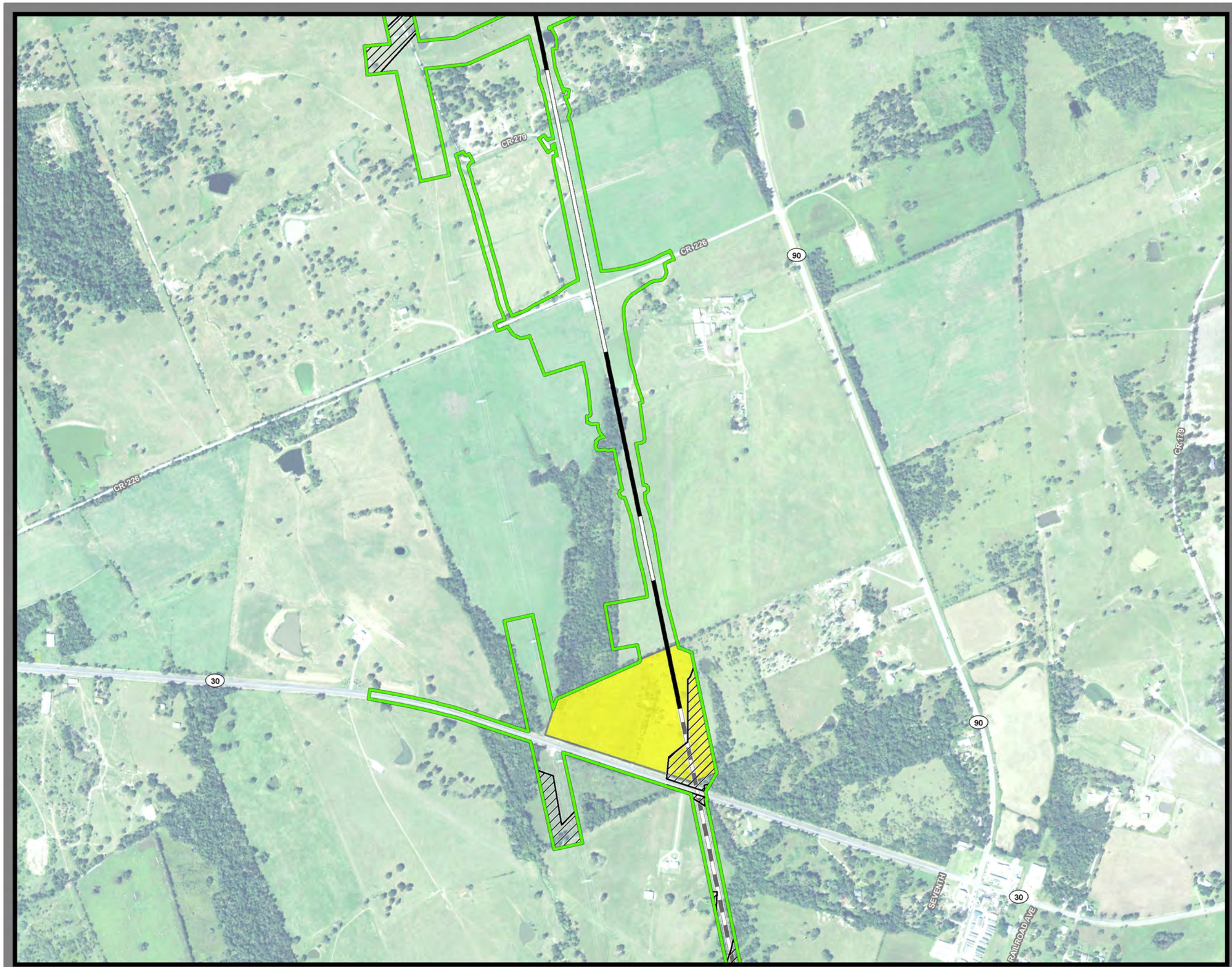
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 210 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5, Brazos Valley Intermediate Station
Sheet 25 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

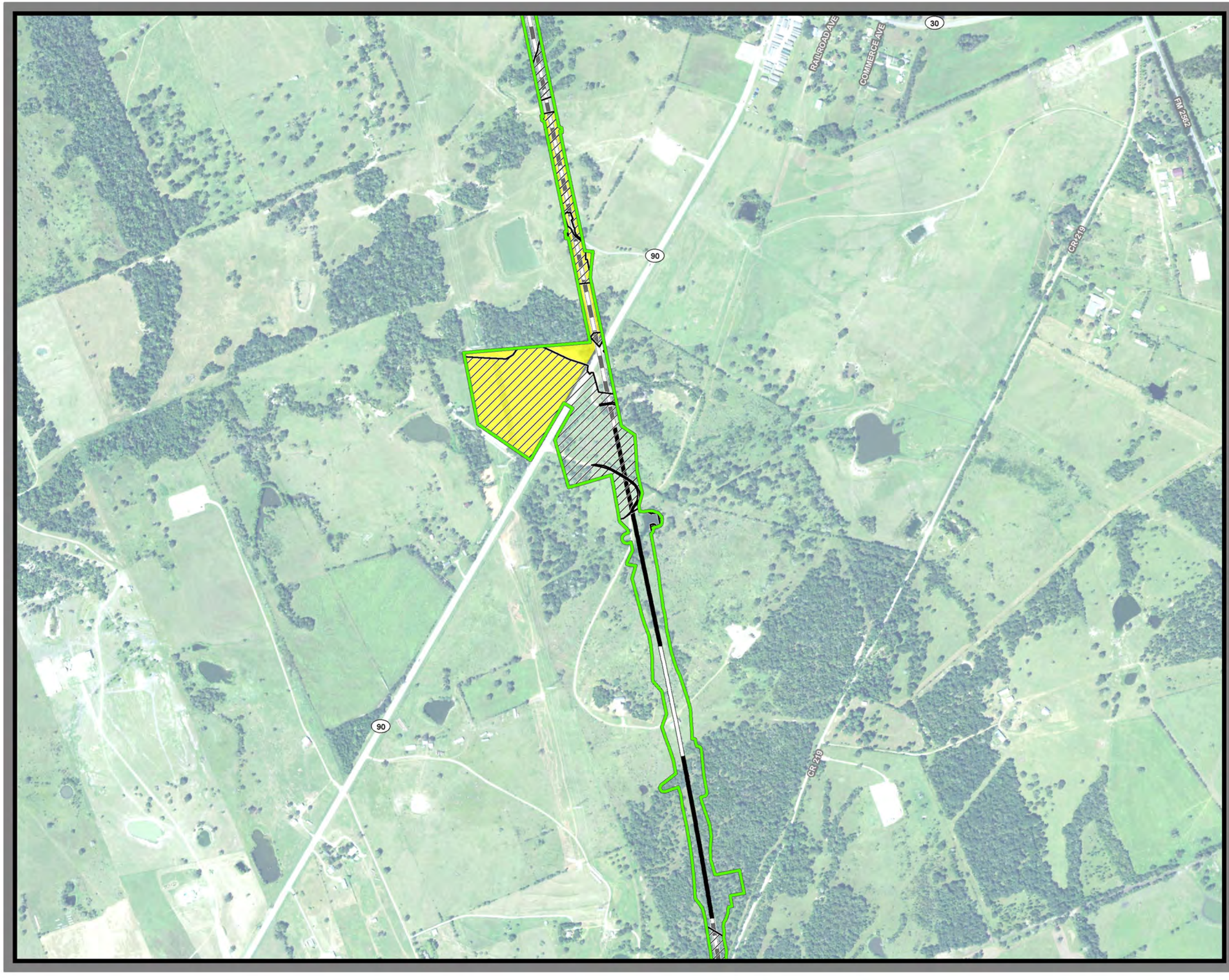
***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 211 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 26 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 212 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 27 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 213 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 28 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 217 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 29 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 218 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 30 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 219 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 31 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

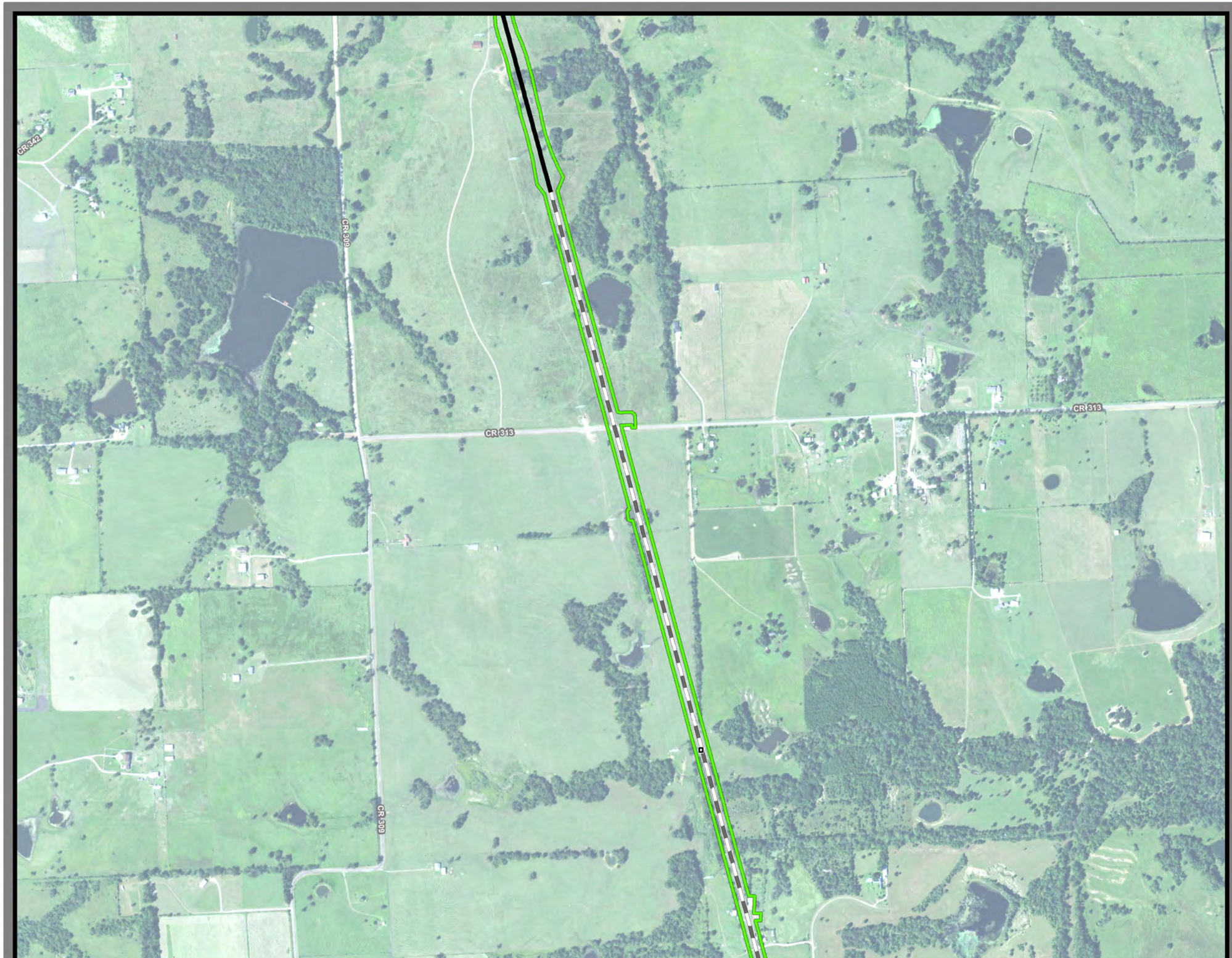
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 220 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 32 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

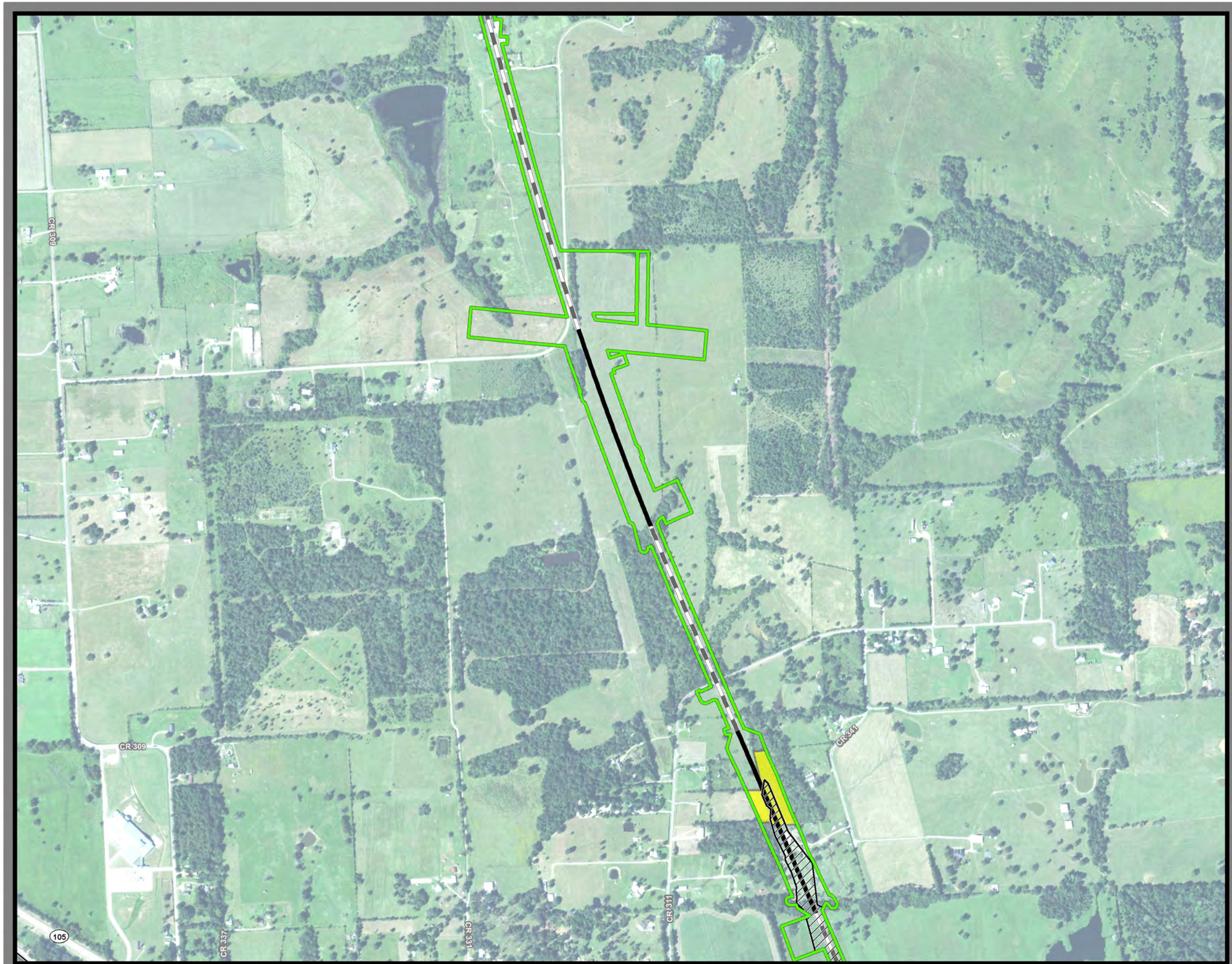
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 221 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 33 of 38

Legend

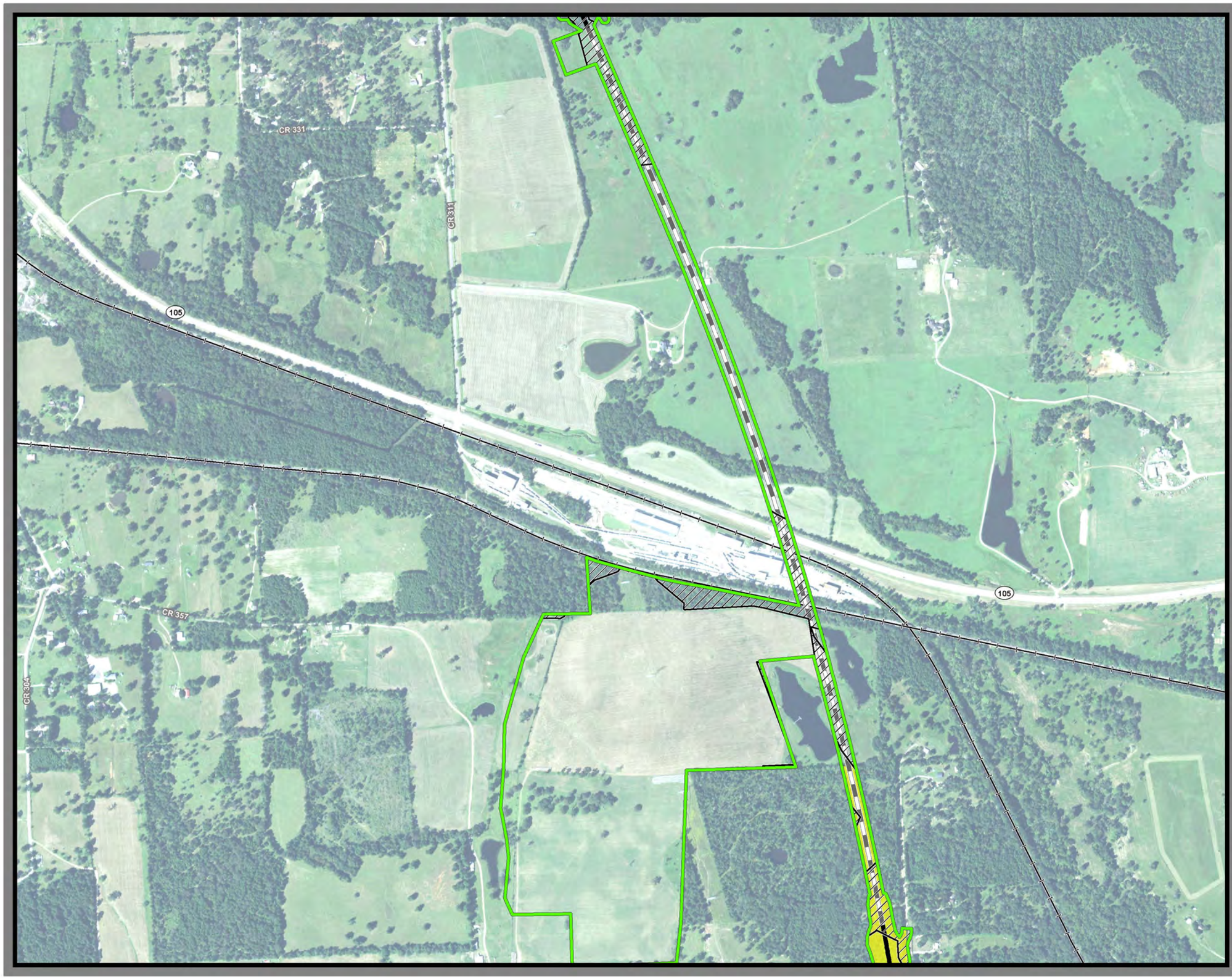
Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 222 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 34 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

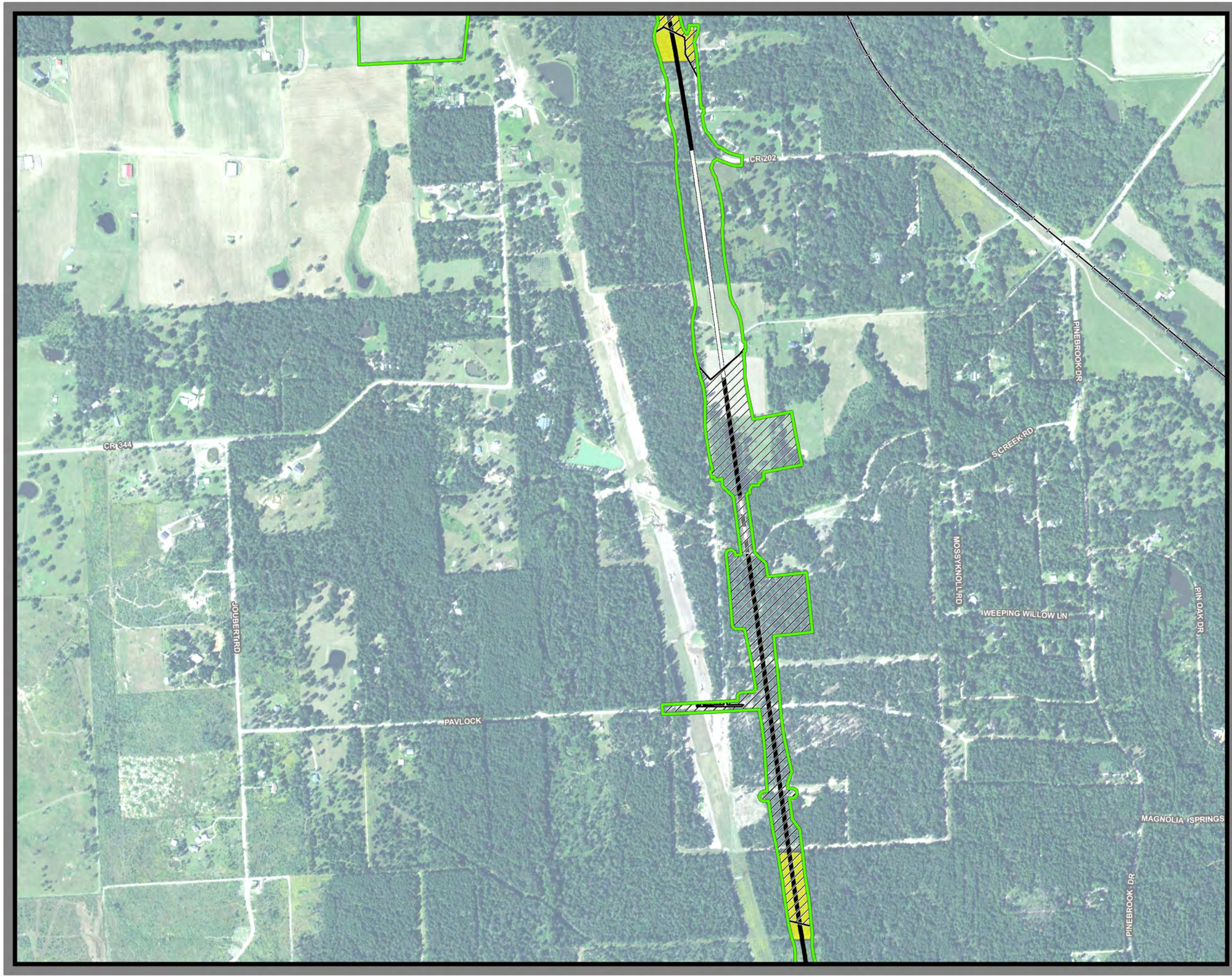
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 223 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 35 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary
- Existing Railroad

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 224 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 36 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 225 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet

0 400 800 Feet

N W E S

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 37 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 226 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
Feet
0 400 800

Dallas to Houston
High-Speed Rail Project
Navasota Ladies'-tresses Presence/Absence Survey
Segment 5
Sheet 38 of 38

Legend

Track Configuration
- Viaduct
- Embankment
- Cut

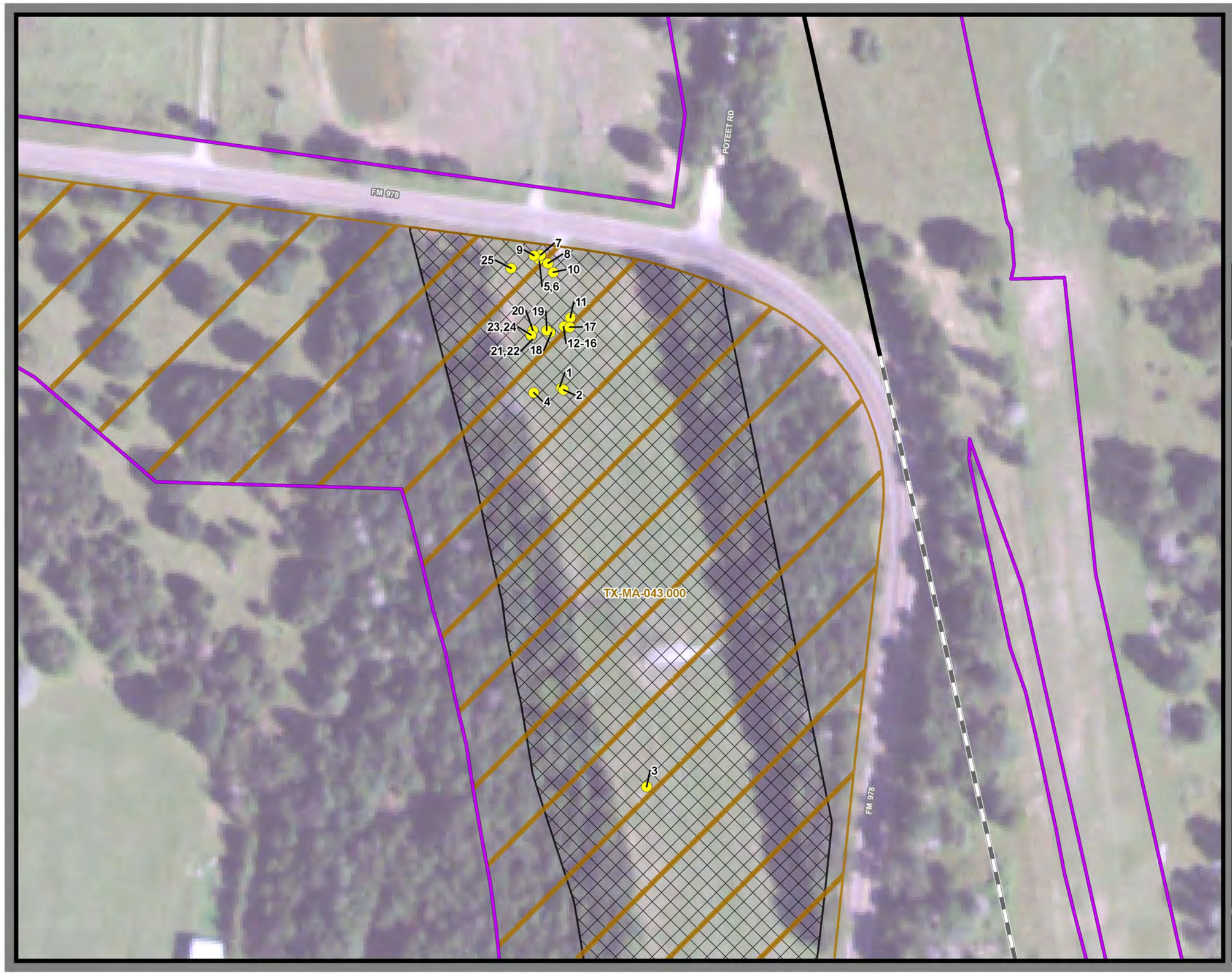
Limits of Disturbance
- Segment 5
- Navasota Ladies'-tresses Modeled Habitat
- Surveyed Parcel
- County Boundary

***This map book is a modified subset of the Natural Resources Mapbook in Appendix D of the EIS. This sheet corresponds with Sheet 227 of 257.

Data Sources: County Boundaries - US Census TIGER 2015; Parcel Boundaries - CLS 2018; NLT Potential Habitat - AECOM Habitat Suitability Model 2016; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 800 feet
0 400 800 Feet

N W E S



Dallas to Houston High-Speed Rail Project
Navasota Ladies'-tresses Locations
Segment 4
Sheet 1 of 1

Legend

Limits of Disturbance
- Segment 4

Track Configuration
- Viaduct
- Embankment
- Navasota Ladies'-tresses Location
- Parcel Boundary
- Avoidance Area

Data Sources: Parcel Boundaries - CLS 2018; NLT Locations - AECOM Field Surveys 2017/2018; ESRI World Street Map
Aerial Imagery: USDA NAIP 2016

1 inch = 100 feet
Feet
0 50 100