Dallas to Houston High-Speed Rail
Final Environmental Impact Statement

Appendix E:
Combined Tech Memos Set 1 of 2

TMF Alternatives Analysis Technical Memorandum
Air Quality Technical Memorandum
Noise and Vibration Technical Memorandum
Hazardous Materials Initial Site Assessment Report
Wildlife Crossings Technical Memorandum
Waters of the U.S. Technical Memorandum
Impacts to USACE Projects Technical Memorandum

Federal Railroad
Administration

Dallas to Houston High-Speed Rail
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TABLE OF TECHNICAL MEMORANDA

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TECHNICAL MEMORANDUM

To: Kevin Wright, FRA

From: Erin Lee, AECOM

Date: November 8, 2019

RE: **Dallas to Houston High-Speed Rail Project – Trainset Maintenance Facility Alternatives Analysis**

INTRODUCTION

The United States Department of Transportation's (DOT) Federal Railroad Administration (FRA) has prepared an Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) (42 U.S.C. § 4231 et seq) to assess the potential beneficial and detrimental effects of implementing the proposed Dallas to Houston High-Speed Rail Project (Project). The EIS documents FRA's evaluation of Texas Central High-Speed Railway's, LLC (TCRR) and its affiliates' proposal to construct and operate a 240-mile, for-profit, high-speed passenger rail (HSR) system connecting Dallas and Houston based on the Japanese N700-Series Tokaido Shinkansen technology.

As part of the development of the EIS, FRA completed an alternatives analysis on Trainset Maintenance Facility (TMF) locations in Dallas and Harris counties (see **Figures 1-10**). TMFs serve as dedicated maintenance facilities to repair and maintain the HSR trainset and track. TCRR based the program, layout and sizing of these facilities on similar systems located in Japan. For the Project, TMFs would be located in proximity to the terminal stations to serve as cleaning and maintenance facilities of the HSR trainsets. The TMFs would provide for all periodic inspections, scheduled maintenance and unexpected repairs, as well as serve as the location for delivery and assembly of the trainsets. Each facility would accommodate the final operating scenario and occupy approximately 100 acres. Each TMF would include sidings for train storage, paint shop, train sheds, wash facilities and other facilities. The Dallas TMF would house the Operations Control Center for the system.

TCRR proposed two TMF locations in Dallas County, the Dallas North TMF and Dallas South TMF. The Dallas North TMF site would be located north of Interstate Highway (IH) 20 within the City of Dallas, about 7.5 miles from the Dallas Terminal Station. The Dallas South TMF site would be located north of Belt Line Road, approximately 12 miles from the Dallas Terminal Station. The Dallas South TMF would require an additional MOW between the TMF and the Dallas terminal station, while the Dallas North TMF site would not. For the Draft EIS, FRA evaluated these Dallas locations. However, TCRR's ongoing coordination with stakeholders indicated that the Dallas International Intermodal Terminal and related developments in south Dallas have continued to progress since the release of the Draft EIS. Because of these ongoing developments, TCRR determined that the Dallas South TMF site was not a viable option for the Project as indicated in **Section 2.5.4, Alternatives Considered, Engineering Refinements**. Both the Dallas North and South TMF sites based on TCRR's updated project LOD are assessed in this memorandum.

TCRR also proposed two TMF locations in Harris County prior to the Draft EIS. The Houston North TMF site would be located near U.S. Highway (U.S.) 290 and Katy Hockley Road, approximately 27 miles from the Houston Terminal Station Options. The Houston South TMF site would be located east of Beltway 8 and south of Hempstead Road, approximately 8.5 miles from the Houston Terminal Station Options. In the Draft EIS, FRA evaluated the Houston North and Houston South TMF sites. However, due to ongoing stakeholder outreach and engineering design updates detailed in **Section 2.5.4, Alternatives Considered, Engineering Refinements**, and subsequent to the publication of the Draft EIS, TCRR proposed a third location for the Houston TMF, the Harris North TMF site on Castle Road. The Harris North TMF site would be located on Castle Road in northern Harris County, approximately 34 miles from the Houston Terminal Station Options. Therefore, FRA reevaluated in this analysis all three Harris County TMF sites based on TCRR's updated project LOD assessed in the Final EIS. The Harris North TMF site and the Houston North TMF site would require an additional MOW between the TMF and the Houston terminal station, while the Houston South TMF site would not.

Since the Dallas South, Harris North and Houston North TMF sites are located more than 10 miles from the Terminal Station Options, if one of those TMF sites was selected, an additional Maintenance-of-Way (MOW) facility would also be required to support the operations of the HSR system. Each MOW facility would be approximately 20 acres and have sidings for equipment and sweeper vehicles and additional tracks for shunting MOW equipment. The Dallas North and Houston South TMF sites are located within 10 miles from the Terminal Station Options, and therefore no additional MOW sites would be required. Therefore, the requirement for an additional MOW facility resulted in an evaluation of in total two TMFs locations, one MOW location and the associated common mainline track within Dallas County, as well as three TMF location, two MOW locations and the associated common mainline track in Harris County.

This TMF alternatives analysis documents FRA's evaluation of the five TMF sites and associated track and facilities and identifies one TMF site in Dallas County and one TMF site in Harris County to be carried forward for detailed evaluation as part of the LOD assessed in the Final EIS.

METHODOLOGY

FRA completed an alternatives analysis using 19 environmental criteria to determine areas of potential environmental impact. A similar approach was used to evaluate the Project's alignment alternatives that resulted in six end-to-end Build Alternatives carried forward for detailed evaluation in the EIS. The environmental criteria included prime farmland, wetlands and floodplains, community facilities, historical properties, threatened and endangered species, and road crossings. This analysis was based on desktop level research and data collection. No field surveys or site verification was conducted to complete this analysis. Fieldwork, modeling and detailed technical evaluation in accordance with NEPA and FRA's procedures has been completed as part of the EIS on the TMF site alternatives identified in this analysis.

Each criterion was weighted equally and the scoring for the environmental evaluation criteria was based on the lowest score having the least potential to create an environmental impact (best). Environmental criteria that were equal (same level of impact or showed no impact) were removed from consideration because they did not provide a meaningful comparison between alternatives.

In addition to the environmental criteria assessed, FRA also considered engineering design constraints and stakeholder engagement conducted by TCRR.

For the purposes of the TMF analysis, the Limits of Disturbance (LOD) or permanent footprint for each TMF site and associated facilities (e.g. MOW, if necessary), as well as the entire mainline track alignment between the TMF options was evaluated using the 19 criteria. Multiple sets of data were calculated for each county to compare the potential impacts of the appropriate combination of facility and associated mainline track to one another. This combination allowed FRA to compare the potential environmental impacts of one TMF location to another. The evaluation data is included in **Appendix A**.

RESULTS

Dallas County

The following criteria did not differentiate between the Dallas North TMF site and the Dallas South TMF site because there were no potential impacts related to those criteria:

- Community facilities
- Physical impact to a cemetery
- Ecology
- Hazardous materials

The following criteria did not help differentiate between the two sites because the potential impacts related to those criteria were the same for both sites:

- Physical impacts to historic properties
- Visual impacts to historic properties
- Parks
- Adjacency to existing infrastructure
- Visual impact to a cemetery

Table 1 summarizes the findings for the remaining environmental criteria. The highlighted cells show the least potentially impactful site for each criterion.

Table 1 – Dallas TMF Results

	Land Use	Structures	Parcel Takes	Prime Farmland	Wetlands	Waterways	Floodplains	Road Crossings	Population below poverty	Minority population
	Acres	**No.**	**No.**	**Acres**	**Acres**	**No.**	**Acres**	**No.**	**No.**	**No.**
North TMF Site	511.82	31	58	166.96	21.86	13	89.91	48	17	19
South TMF Site	462.00	35	62	202.91	18.80	11	74.66	60	19	21
Net Difference	49.82	4	4	35.96	3.36	2	15.26	**12**	2	2

The biggest potential impact associated with land use would be the conversion of the land to a transportation use. Currently, the largest three land use categories (agriculture, commercial or transportation) account for almost 87 percent of the land use in the study areas for both Dallas County TMF sites. Due to the overall difference in size and layout of the two sites, the Dallas South TMF site would convert overall less acreage, but would convert more agricultural land, most of which is also classified as prime farmland. The Dallas South TMF site would convert less commercial land to transportation. Additional land use classifications include industrial, park, residential, rural, utilities and vacant and do not represent an appreciable difference between the sites. The Dallas North TMF Site would have fewer road crossings, however, road crossings would be mitigated by either rerouting or regrading roads, so this potential impact does not differentiate between the sites. The Dallas North TMF site would be located within fewer block groups that contain minority and/or low income populations, and the overall number of impacts to structures by acquisition and displacement would be less than the

Dallas South TMF site. No minority and/or low income communities would be impacted by either TMF site.

FRA further examined the potential for acquisition and displacement of structures (identified in **Table 1** as 'Structures'), potential impacts to wetlands, waterway crossings, and floodplains to determine if a more detailed analysis would reveal differences between the sites.

The acquisitions and displacements of the Dallas North TMF would impact fewer residential and commercial structures, and fewer parcels. This indicates that the Dallas South TMF site has the potential to displace more taxable property compared to the Dallas North TMF sites. Additionally, because of ongoing developments at the International Intermodal Terminal, TCRR determined that the Dallas South TMF site was not a viable option for the Project as indicated in **Section 2.5.4, Alternatives Considered, Engineering.**

The wetlands data was broken down by types of wetlands – forested, emergent, riverine, and pond. **Table 2** summarizes the types of wetlands impacted by the two TMF sites in Dallas County. The highlighted section would be the least potentially impactful option for each criterion.

Table 2 – Wetlands (Acres)

	Forested/Shrub	Emergent	Riverine	Pond
Dallas North TMF	6.12	7.12	1.44	7.19
Dallas South TMF	5.96	5.49	1.28	6.08

Waterway crossings were categorized by streams, canals, and artificial paths (i.e. manipulated drainages). A total length (in feet) of the waterway within the LOD is also included. **Table 3** summarizes the detailed data. The highlighted section would be the least potentially impactful option for each criterion.

Table 3 – Waterways

	Stream/River		Canal/Ditch		Artificial Path	
	Number	Length (feet)	Number	Length (feet)	Number	Length (feet)
Dallas North TMF	10	3,637.16	3	942.00	0	0.00
Dallas South TMF	9	3,277.35	2	687.80	0	0.00

Floodplains were categorized by zones. **Table 4** summarizes the data. The highlighted section would be the least potentially impactful option for each criterion.

Table 4 – Floodplains Zones (Acres)

	AE	X
Dallas North TMF	89.92	421.91
Dallas South TMF	74.66	387.35

Note:
Zone AE: An area inundated by 100-year flooding, for which Base Flood Zone Elevations have been determined.
Zone X: Area of moderate flood hazard, usually the area between the limits of the 100- year and 500-year floods

Harris County

The following criteria did not differentiate between the three Harris County TMF sites because there were no potential impacts related to those criteria:

- Community facilities
- Physical impacts to historic properties
- Visual impacts to historic properties
- Cemeteries
- Ecology
- Hazardous materials – High Risk Sites

The following environmental criteria did not help differentiate between the three sites because the potential impacts related to those criteria were the same for each site:

- Parks
- Adjacency to existing infrastructure
- Population below Poverty
- Minority Populations

Table 5 summarizes the findings for the remaining environmental criteria. The highlighted cells show the least potentially impactful site for each criterion.

Table 5 – Houston TMF Results

	Land Use	Structures	Parcel Takes (30%)	Prime Farmland	Wetland	Waterway	Floodplain	Road Crossings	Hazardous Materials Sites	
	Acres	No.	No.	Acres	Acres	No.	Acres	No.	Low Risk	Moderate Risk
Harris North TMF	1,655.06	224	103	1,021.15	136.18	67	39.90	124	1	1
Houston North TMF	1,674.09	224	100	1,040.17	137.55	69	39.90	124	0	0
Houston South TMF	1,607.68	239	108	933.38	134.36	66	44.18	128	3	0
Net Difference	66.41	15	8	106.79	3.19	3	3.19	4	3	1

The greatest potential impact associated with land use would be the conversion of the land use to a transportation use. Currently, the largest three land use categories (agriculture, commercial, civic or vacant) account for almost 89 percent of the land use for both. Due to the overall difference in size and layout of the three sites, the Harris North TMF site would convert overall less acreage, including commercial to transportation use. However, the Houston South TMF would have the least amount of conversion of prime farmland to transportation use. Additional land use classifications include industrial, park, residential, rural, utilities and vacant and do not represent an appreciable difference between the sites. Road crossings would be mitigated by either rerouting or regrading roads, so this potential impact does not differentiate between the sites. The hazardous materials sites identified in the analysis are comparable and all are either low risk or moderate sites; therefore, there would be minimal differentiation between the TMF sites based on potential impacts to hazardous materials sites.

FRA further examined the potential for acquisition and displacement of structures (identified in **Table 5** as 'Structures'), potential impacts to wetlands, waterway crossings, and floodplains to determine if a more detailed analysis would reveal differences between the sites.

The acquisitions and displacements of the three sites would impact similar numbers of residential structures (146/147) while the Houston South TMF site would impact 16 more commercial structures than either the Harris North or Houston North TMF sites. Additionally, the Houston North TMF Site would potentially acquire fewer parcels. This indicates that the Houston South TMF site has the potential to displace more taxable property compared to the Harris and Houston North TMF sites.

The wetlands data was broken down by types of wetlands – forested, emergent, riverine, pond and other. **Table 6** summarizes the types of wetlands impacted by the three TMF sites in Harris County. The highlighted section would be the least potentially impactful option for each criterion.

Table 6 – Wetlands (Acres)					
	Forested/Shrub	Emergent	Pond	Riverine	Other
Harris North TMF	8.92	43.54	13.78	9.88	60.07
Houston North TMF	18.26	38.98	6.34	11.26	62.71
Houston South TMF	19.18	39.15	6.41	9.55	60.07

Waterway crossings were categorized by streams, canals, connectors and other artificial paths. A total length (in feet) of the waterway within the LOD is also included. **Table 7** summarizes the detailed data. The highlighted section would be the least potentially impactful option for each criterion.

Table 7 – Waterways								
	Stream/River		Canal/Ditch		Connector		Artificial Path	
	No.	Length (feet)	No.	Length (feet)	No.	Length (feet)	No.	Length (feet)
Harris North TMF	17	6,870.63	45	22,875.28	2	1,596.13	3	1,285.33
Houston North TMF	16	6,576.03	49	28,653.87	2	1,596.13	2	357.86
Houston South TMF	17	6,983.62	45	22,881.37	2	1,596.13	2	357.86

Floodplains were categorized by zones. **Table 8** summarizes the detailed the data. The highlighted section would be the least potentially impactful option for each criterion.

Table 8 – Floodplain Zones (Acres)			
	A	AE	X
Harris North TMF	**0.01**	**39.89**	**1615.16**
Houston North TMF	**0.01**	**39.89**	**1634.19**
Houston South TMF	**3.91**	**40.27**	**1563.50**

Note:
Zone A: An area inundated by 100 year flooding, for which no Base Flood Zone Elevations have been established.
Zone AE: An area inundated by 100-year flooding, for which Base Flood Zone Elevations have been determined.
Zone X: Area of moderate flood hazard, usually the area between the limits of the 100- year and 500-year floods

FINDINGS

Only one TMF site for Dallas County and one TMF site for Harris County was identified for evaluation with the Final EIS.

Based on the above data, the Dallas North TMF Site would impact fewer structures, parcels, prime farmland and roads. The Dallas South TMF site would impact fewer wetlands, waterways, and floodplains compared to the Dallas North TMF site. However, because of ongoing developments at the International Intermodal Terminal, TCRR determined that the Dallas South TMF site was not a viable option for the Project as indicated in **Section 2.5.4, Alternatives Considered, Engineering** and the Dallas South TMF site was eliminated from further consideration.

The more detailed desktop analysis indicated that the Harris North TMF site would create fewer environmental impacts to wetlands and waterways compared to the Houston TMF sites. Overall, the Houston South TMF site would impact fewer floodplains. However, as detailed in **Section 2.5.4, Alternatives Considered, Engineering Refinements,** due to planned developments, land ownership changes, and to account for the raised HSR profile to allow for the Houston Major Thoroughfare and Freeway Plan, the Houston TMF location was shifted north along the Castle Road Realignment. Therefore due to their potential to create greater environmental impacts (including acquisition for the Houston South TMF Site) and engineering design constraints detailed in **Section 2.5.4, Alternatives Considered, Engineering Refinements**, the Houston North and South TMF sites were eliminated from further consideration.

Therefore, the Dallas North TMF and Harris North TMF sites were carried forward for further FRA review including fieldwork, modeling and detailed technical evaluation as part of the overall Project LOD in **Chapter 3.0, Affected Environment and Environmental Consequences** of the Final EIS**.**

Figure 1 – Dallas County TMF and MOW Locations

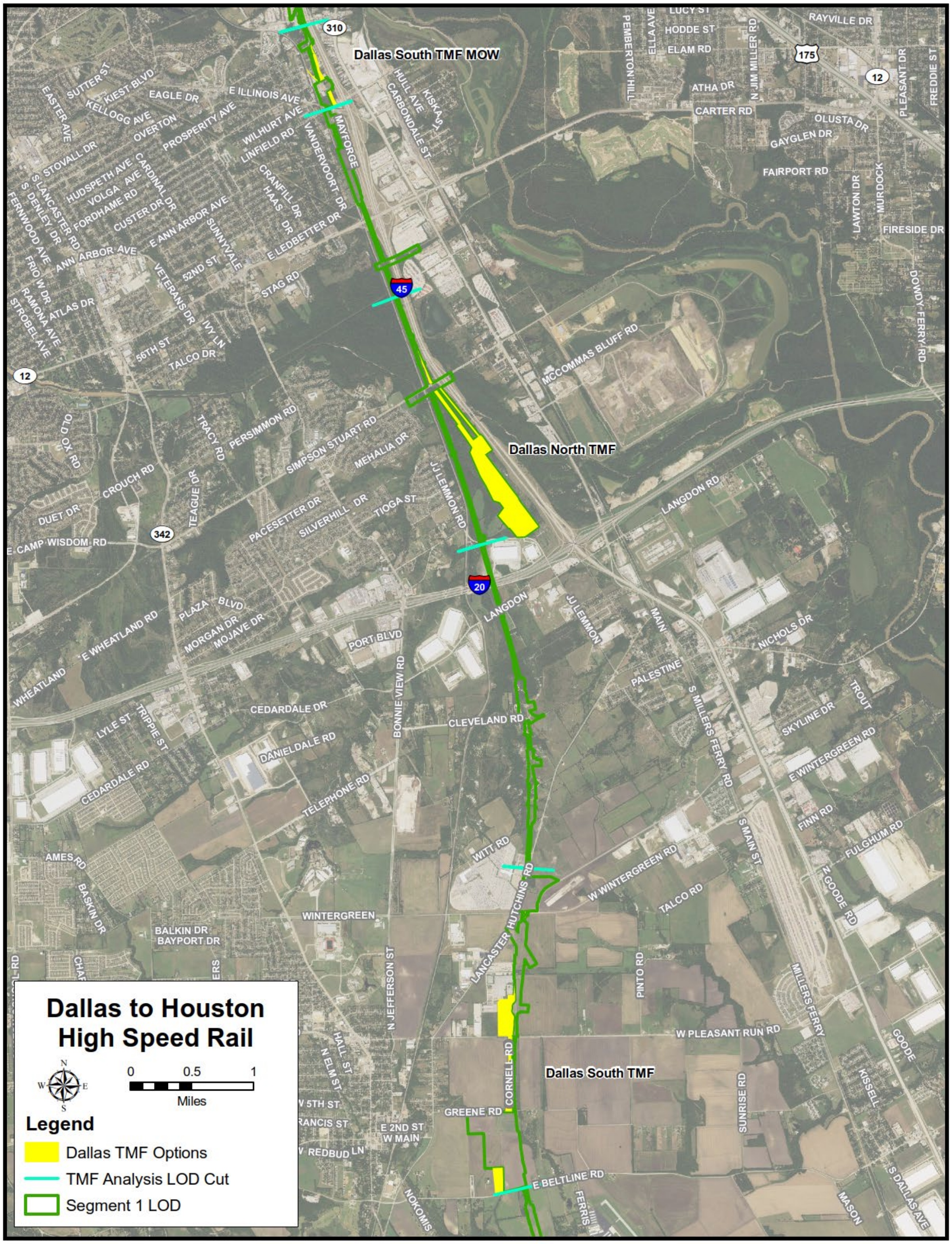


Figure 2 – Dallas MOW Site

Figure 3 – Dallas North TMF Site

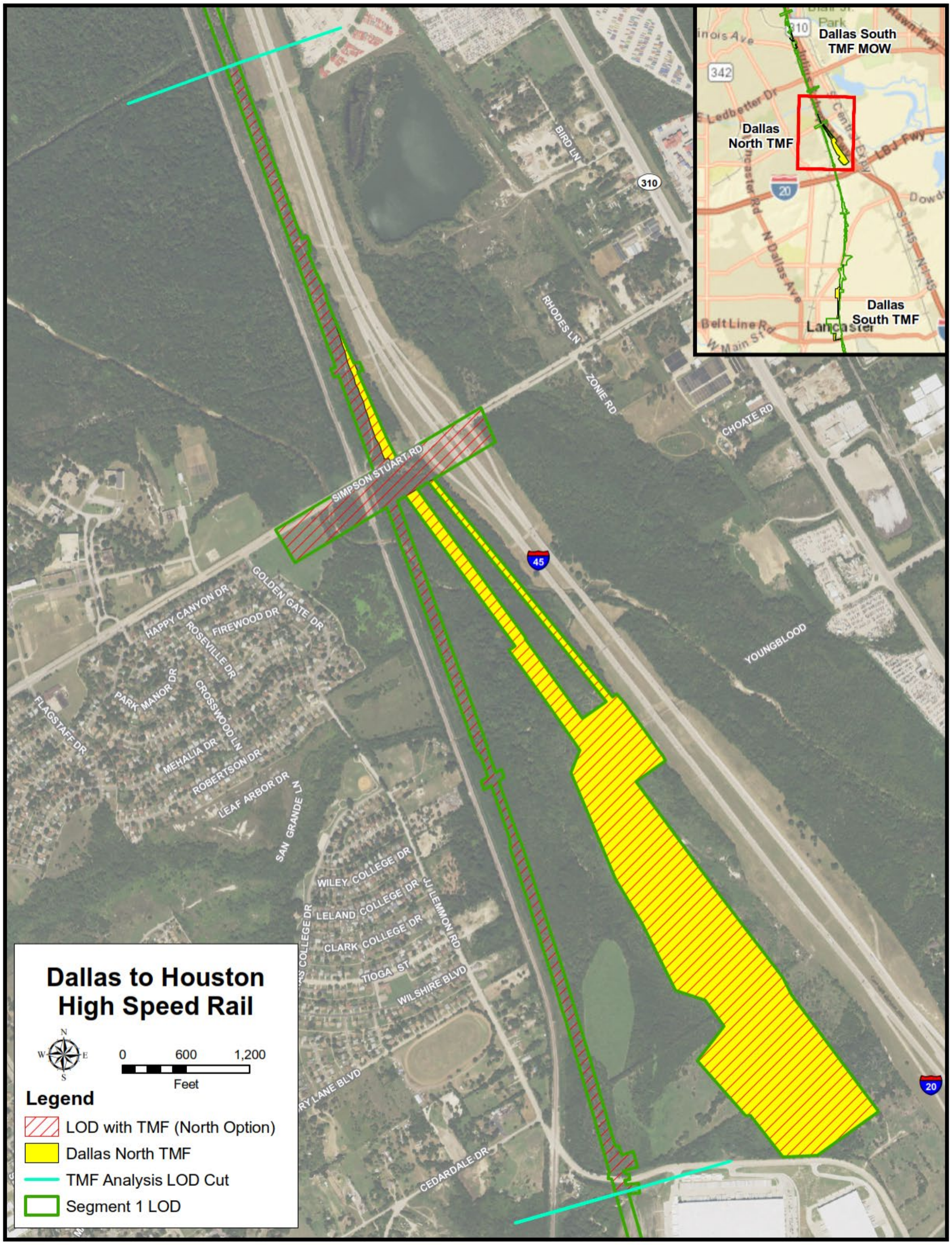


Figure 4 – Dallas South TMF Site

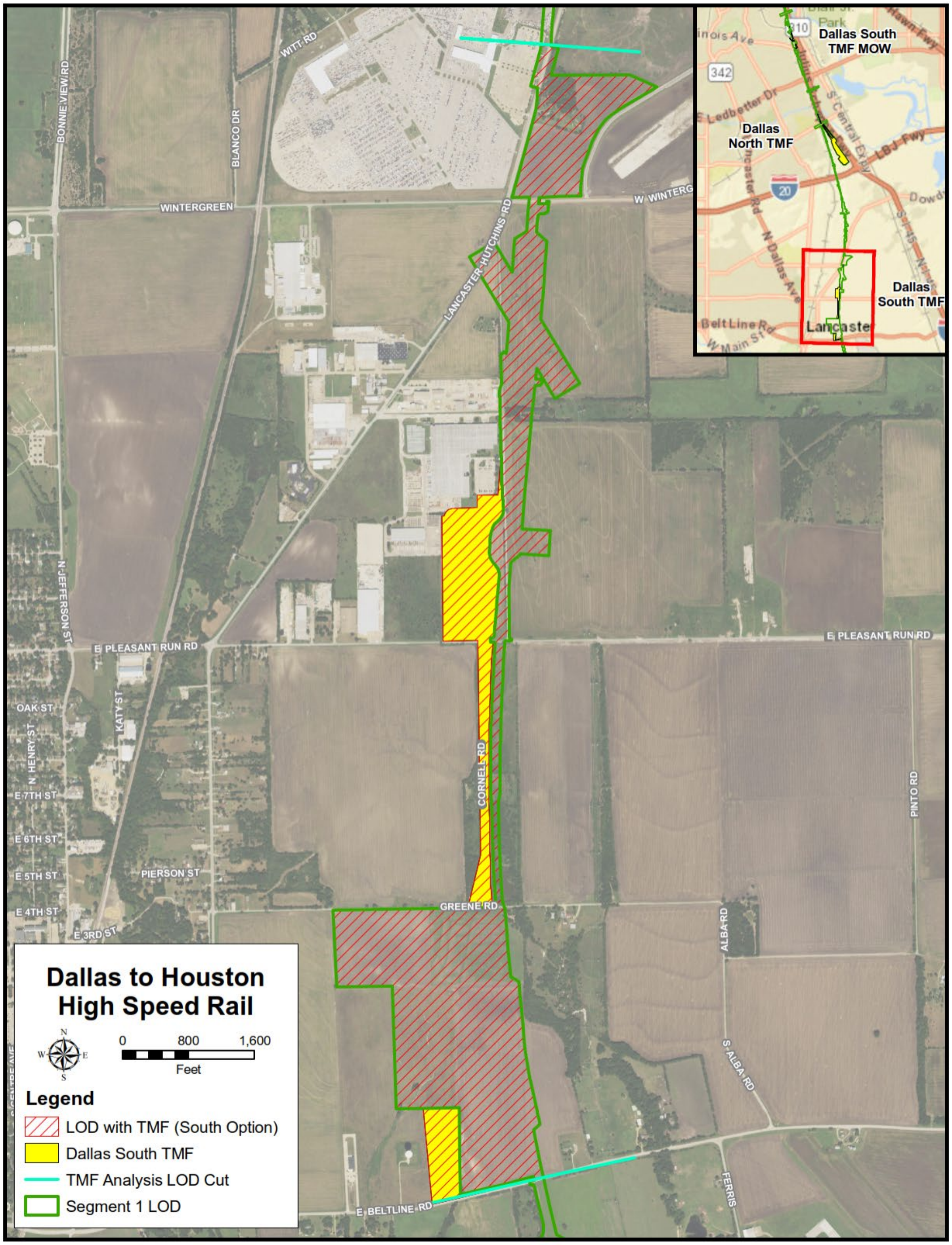


Figure 5 – Houston TMF and MOW Locations

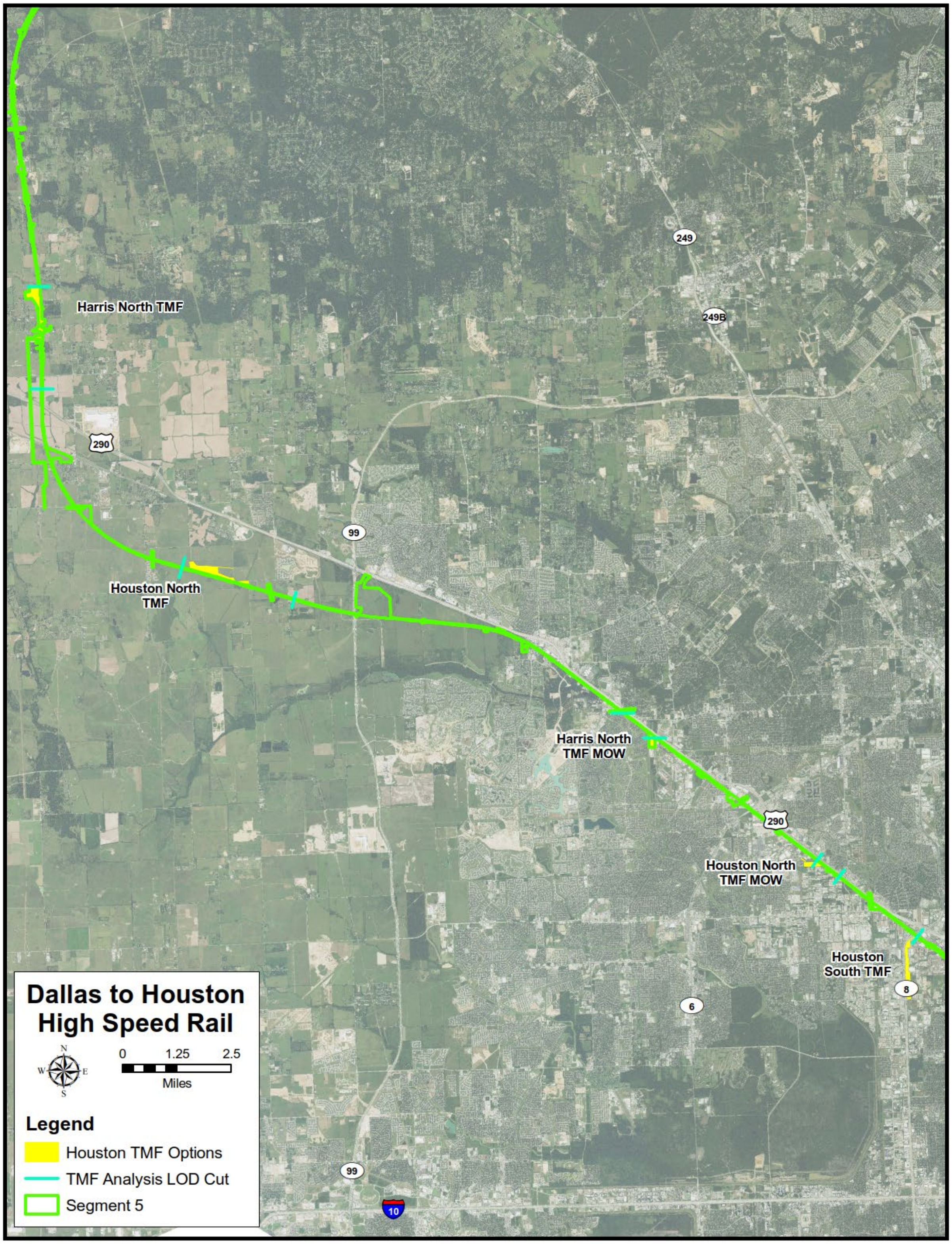


Figure 6 – Harris North TMF Site

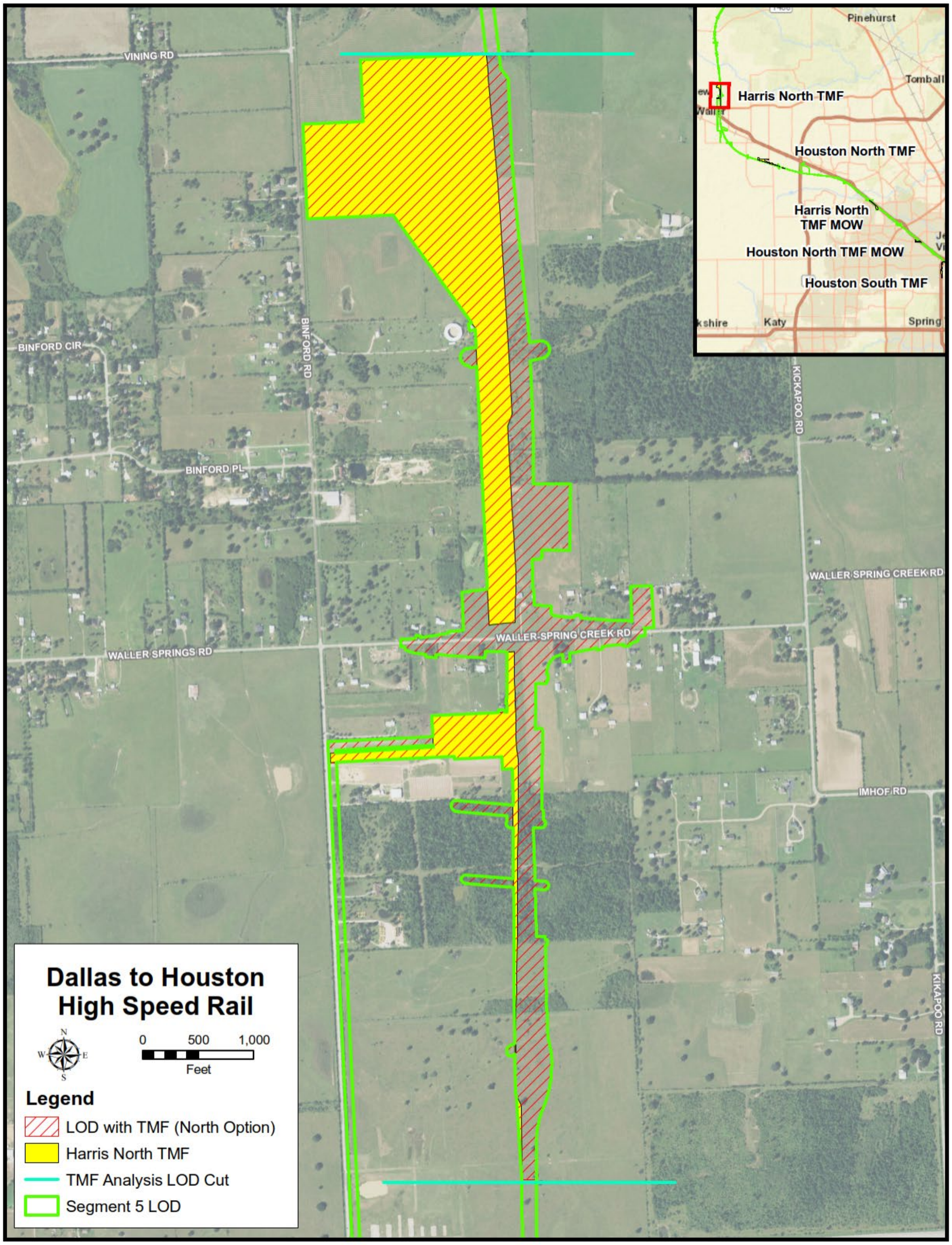


Figure 7 – Houston North TMF Site

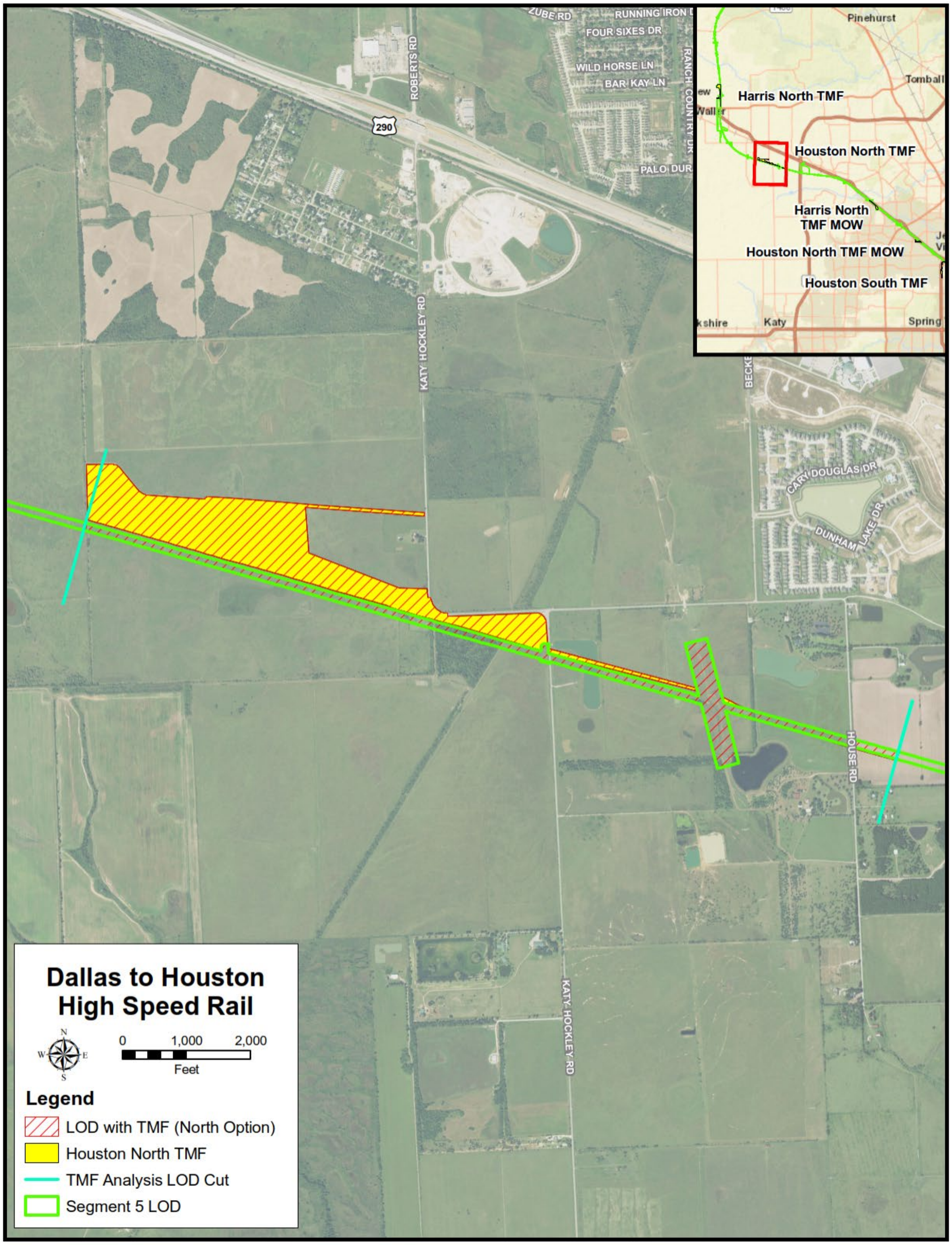


Figure 8 – Harris North MOW Site

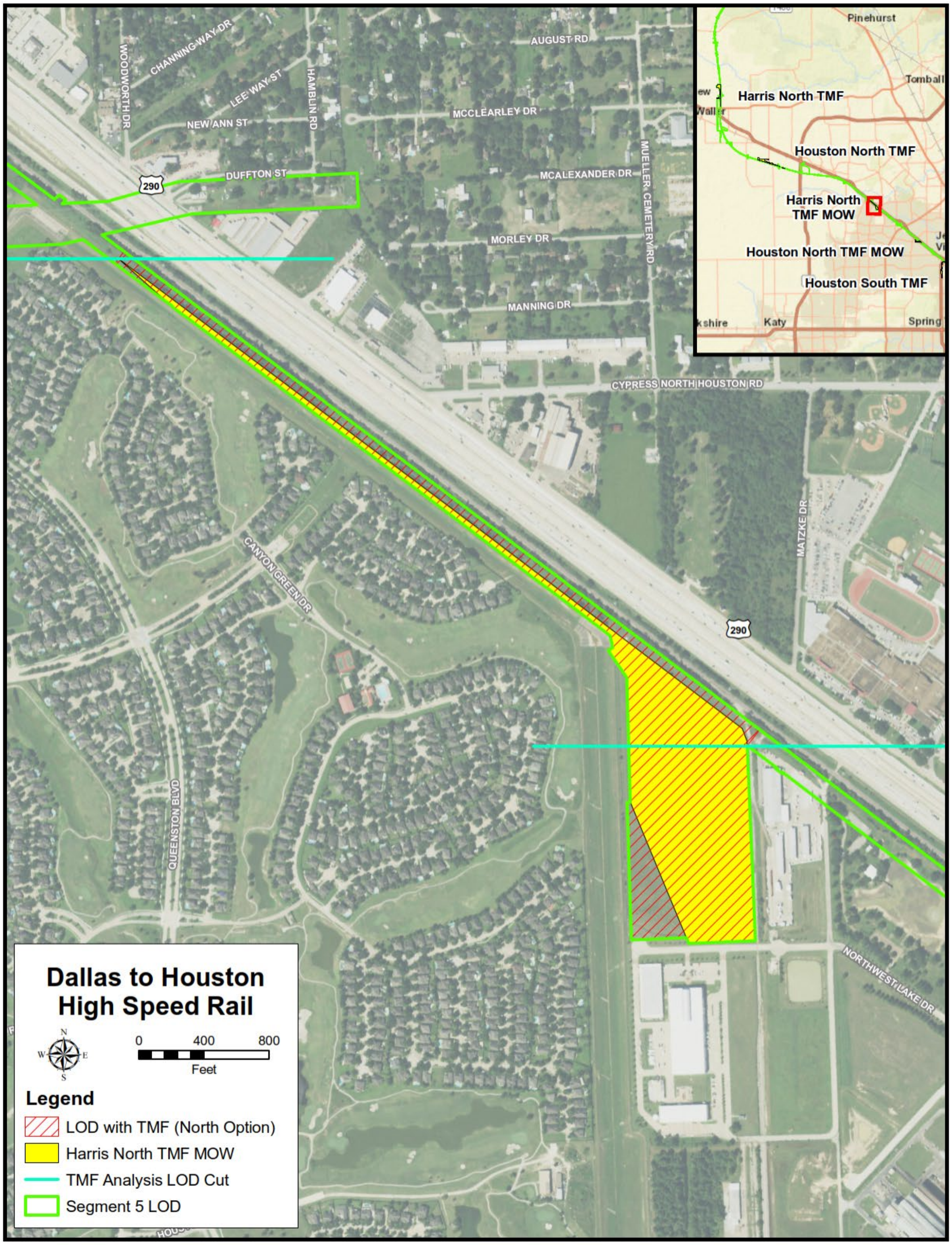


Figure 9 – Houston North MOW Site

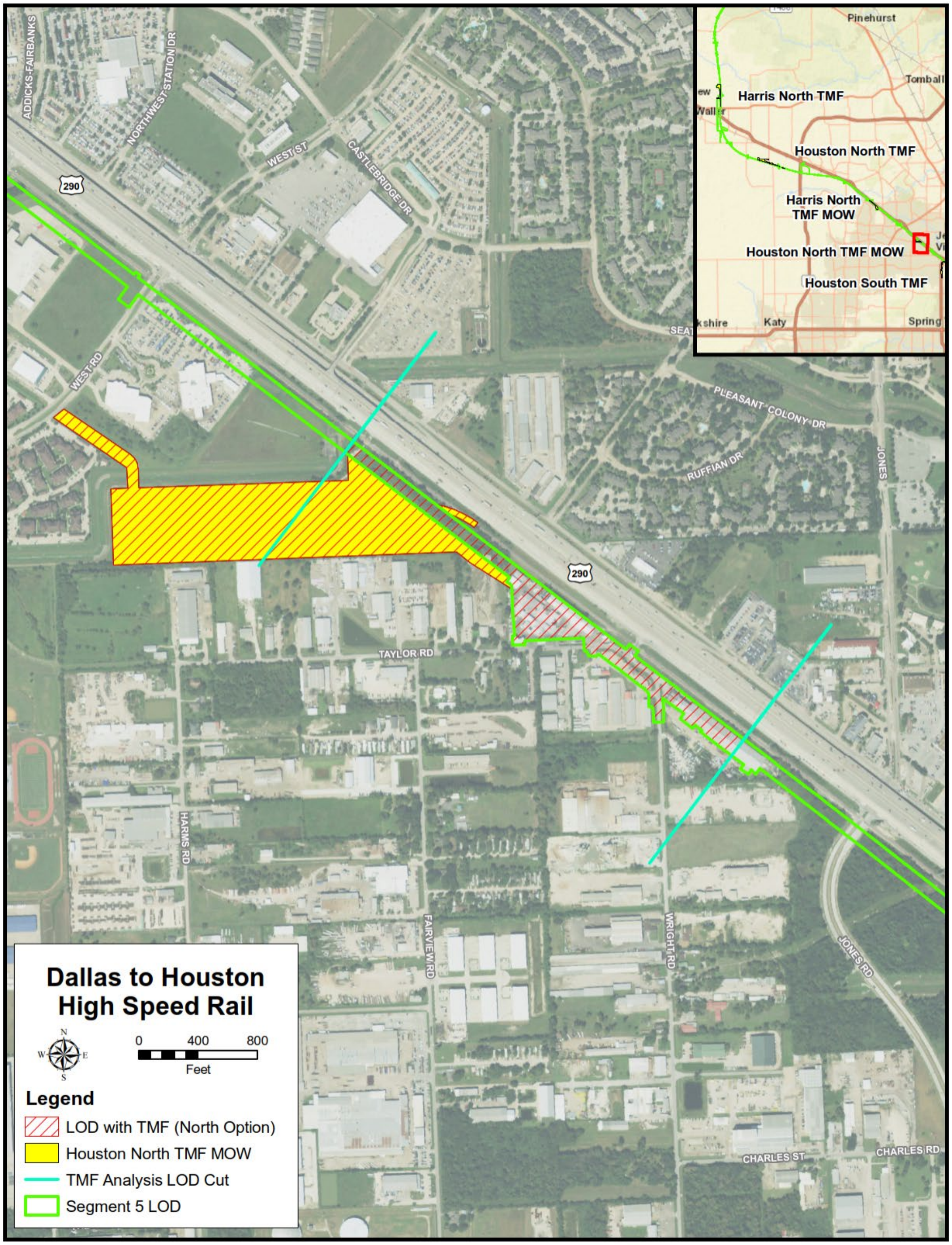
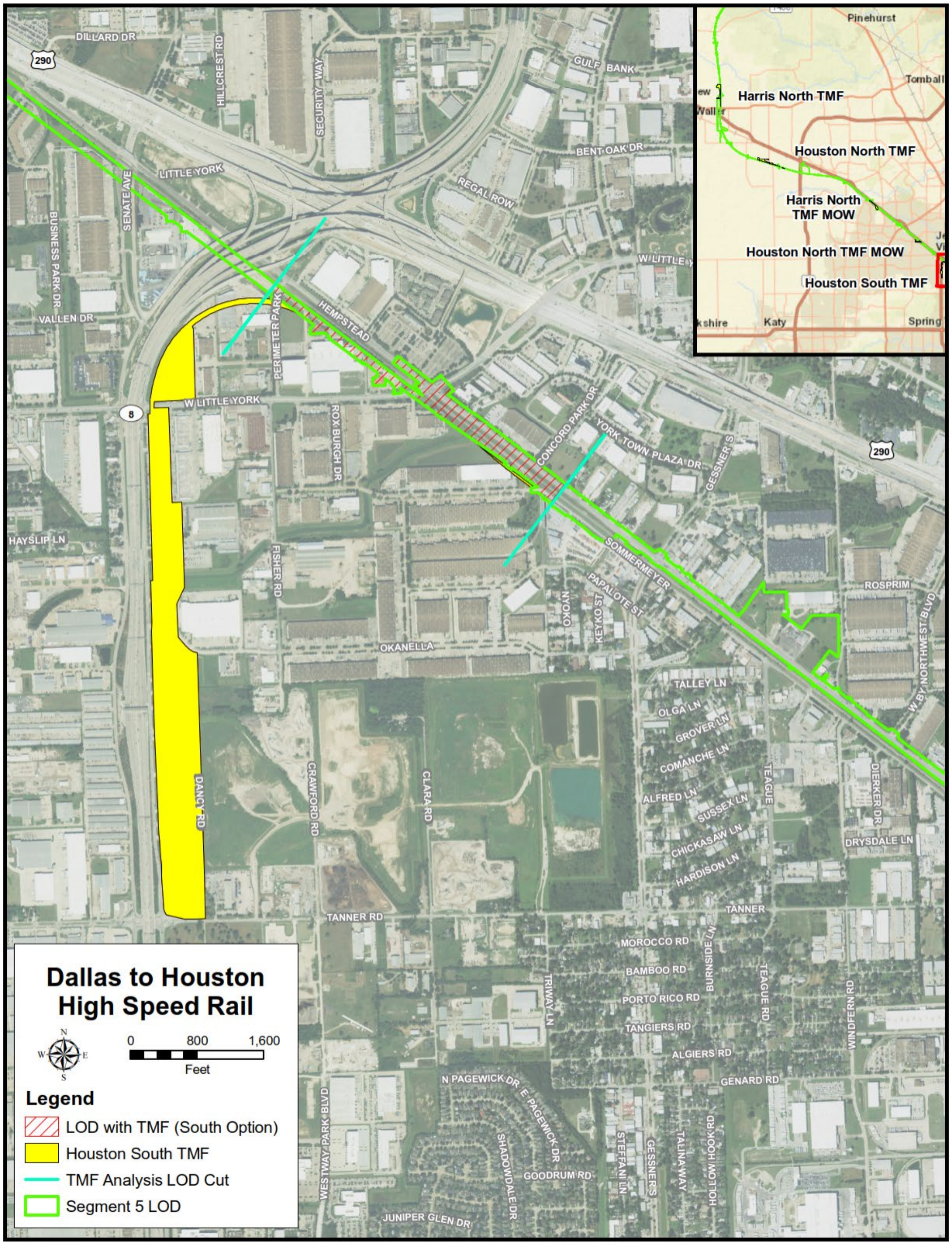


Figure 10 – Houston South TMF Site



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Appendix A – Level I and II Evaluation Data

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	Alignment Area (acre)	Alignment Length (mi.)	Urban Land Cover (Acres)									
Scoring (Dallas North TMF)			Agriculture	Commercial	Industrial	Park	Residential	Rural	Transportation	Utilities	Vacant	Acres
Permanent	315.67	9.74	107.74	140.57	13.69	0.30	2.28	21.92	18.22	1.83	9.12	315.67
Temporary	196.15	0.00	134.61	15.00	18.56	0.00	2.25	0.01	14.29	7.63	3.79	196.15
Indirect	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scoring (Dallas South TMF)												
Permanent	265.85	9.74	124.87	65.99	15.87	0.30	2.30	21.92	23.06	1.83	9.71	265.85
Temporary	196.15	0.00	134.61	15.00	18.56	0.00	2.25	0.01	14.29	7.63	3.79	196.15
Indirect	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dallas North TMF	**511.82**	**9.74**	**242.34**	**155.57**	**32.25**	**0.31**	**4.53**	**21.93**	**32.51**	**9.46**	**12.92**	**511.82**
Dallas South TMF	**462.00**	**9.74**	**259.47**	**80.98**	**34.43**	**0.31**	**4.55**	**21.93**	**37.35**	**9.46**	**13.51**	**462.00**
Net Difference	**-49.82**	**0.00**	**17.13**	**-74.58**	**2.18**	**0.00**	**0.02**	**0.00**	**4.84**	**0.00**	**0.59**	**-49.82**

	Structures	Parcel Takes	Community Facilities	Historic Properties (Physical Impacts)	Historic Properties (Visual Impacts)	Parks	Prime Farmland	Wetlands*	Waterways*	Floodplains	Road Crossings
Scoring (Dallas North TMF)	Number	Number (30%)	Number	Number	Number	Acreage	Acreage	Acreage	Number	Acreage	Number
Permanent	27	40	0	0	0	0.35	66.02	17.45	9	65.29	38
Temporary	4	18	0	1	1	0.00	100.94	4.41	4	24.63	10
Indirect	0	0	0	0	0	0.00	0.00	0.00	0	0.00	0
Scoring (Dallas South TMF)											
Permanent	31	44	0	0	0	0.35	101.97	14.39	7	50.03	50
Temporary	4	18	0	1	1	0.00	100.94	4.41	4	24.63	10
Indirect	0	0	0	0	0	0.00	0.00	0.00	0	0.00	0
Dallas North TMF	**31**	**58**	**0.00**	**1.00**	**1.00**	**0.35**	**166.96**	**21.86**	**13**	**89.91**	**48**
Dallas South TMF	**35**	**62**	**0.00**	**1.00**	**1.00**	**0.35**	**202.91**	**18.80**	**11**	**74.66**	**60**
Net Difference	**4**	**4**	**0.00**	**0.00**	**0.00**	**0.00**	**35.96**	**-3.07**	**-2**	**-15.26**	**12**

	Infrastructure Adjacency	Population below Poverty	Minority Population*	Cemeteries (Physical Impact)		Cemeteries (Visual Impact)		Ecology (TXNDD)	Hazardous Materials Sites		
Scoring (Dallas North TMF)	Percent	Number	Number	Number	Acres	Number	Acres	Acres	Low Risk	Moderate Risk	High Risk
Permanent	64%	7	8	0	0.00	1.00	3.56	0.00	0.00	0.00	0.00
Temporary	0%	10	11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indirect	0%	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scoring (Dallas South TMF)											
Permanent	64%	9	10	0	0.00	1.00	3.56	0.00	0.00	0.00	0.00
Temporary	0%	10	11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indirect	0%	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dallas North TMF	**0.64**	**17**	**19**	**0.00**	**0.00**	**1.00**	**3.56**	**0.00**	**0.00**	**0.00**	**0.00**
Dallas South TMF	**0.64**	**19**	**21**	**0.00**	**0.00**	**1.00**	**3.56**	**0.00**	**0.00**	**0.00**	**0.00**
Net Difference	**0.00**	**2**	**2**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

*Duplicate data within wetlands and waterway crossings

Criteria that showed no impact

Criteria that showed the same level of impact

More detailed analysis completed

		Structures		Wetlands				Waterways*						Floodplain*			
		Commercial	Residential	Forested/ Shrub	Emergent	Riverine	Pond	Stream/River		Canal/Ditch		Artificial Path		A	AE	AO	X
		(Number)	(Number)	(Acre)	(Acre)	(Acre)	(Acre)	(Number)	(Acre)	(Number)	(Acre)	(Number)	(Acre)	(Acre)	(Acre)	(Acre)	(Acre)
Dallas North TMF	Permanent	9	18	2.75	7.00	0.52	7.19	7	2125.23	2	579.99	0	0.00	0.00	65.29	0.00	250.38
	Temporary	2	2	3.38	0.12	0.92	0.00	3	1511.93	1	362.02	0	0.00	0.00	24.63	0.00	171.52
	Indirect	0	0	0.00	0.00	0.00	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00	0.00
Dallas South TMF	Permanent	12	19	2.59	5.37	0.36	6.08	6	1765.42	1	325.78	0	0.00	0.00	50.03	0.00	215.82
	Temporary	2	2	3.38	0.12	0.92	0.00	3	1511.93	1	362.02	0	0.00	0.00	24.63	0.00	171.52
	Indirect	0	0	0.00	0.00	0.00	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00	0.00
Dallas North TMF		11	20	6.12	7.12	1.44	7.19	10	3637.16	3	942.00	0	0.00	0.00	89.92	0.00	421.91
Dallas South TMF		14	21	5.96	5.49	1.28	6.08	9	3277.35	2	687.80	0	0.00	0.00	74.66	0.00	387.35
	Net Difference	**3**	**1**	**-0.16**	**-1.63**	**-0.16**	**-1.11**	**-1**	**-359.81**	**-1**	**-254.20**	**0**	**0.00**	**0.00**	**-15.26**	**0.00**	**-34.56**

*100-year floodplain impacts analyzed

Criteria that showed no impact

Criteria that showed the same level of impact

		Alignment Area (acre)	Alignment Length (mi.)	Urban Land Cover									Structures	Parcel Takes	Community Facilities	Historic Properties (Physical Impacts)	Historic Properties (Visual Impacts)	Parks	Prime Farmland	Wetlands**	Waterways**	Floodplains	Road Crossings	Infrastructure Adjacency	Population below Poverty	Minority Population*	Cemeteries		Ecology (TXPD)	Ecology (TXNDD)	Hazardous Materials Sites		
Scoring (Harris North TMF)				Agriculture	Civic	Commercial	Industrial	Residential	Transportation	Unclassified	Vacant		Number	Number (30%)	Number	Number	Number	Acreage	Acreage	Acreage	Number	Acreage	Number	Percent	Number	Number	Number	Acres	Acres	Acres	Low Risk	Moderate Risk	High Risk
	Permanent	611.07	28.20	376.23	41.69	52.02	18.18	16.90	34.47	0.86	70.72	611.07	106	42	0	0	0	1.93	311.81	71.59	30	19.82	51	49%	1	8	0	0.00	0.00	0.00	1	1	0
	Temporary	1003.17	0.00	730.53	61.44	59.79	18.61	14.92	47.89	16.41	53.58	1003.17	118	61	0	0	0	6.93	671.29	63.28	32	20.08	63	0%	2	16	0	0.00	0.00	0.00	1	0	0
	Indirect	40.82	0.00	29.98	0.00	2.18	0.00	0.89	6.26	0.00	1.63	40.92	0	0	0	0	0	0.00	38.05	1.31	5	0.00	10	0%	0	1	0	0.00	0.00	0.00	0	0	0
Scoring (Houston North TMF)																																	
	Permanent	630.10	28.20	395.11	65.28	52.60	18.20	14.15	36.61	0.86	47.28	630.10	106	39	0	0	0	1.93	330.82	72.96	32	19.82	51	49%	1	8	0	0.00	0.00	0.00	1	0	0
	Temporary	1003.17	0.00	730.53	61.44	59.79	18.61	14.92	47.89	16.41	53.58	1003.17	118	61	0	0	0	6.93	671.29	63.28	32	20.08	63	0%	2	16	0	0.00	0.00	0.00	1	0	0
	Indirect	40.82	0.00	29.98	0.00	2.18	0.00	0.89	6.26	0.00	1.63	40.92	0	0	0	0	0	0.00	38.05	1.31	5	0.00	10	0%	0	1	0	0.00	0.00	0.00	0	0	0
Scoring (Houston South TMF)																																	
	Permanent	563.69	28.20	288.92	39.80	110.59	18.18	12.68	38.39	0.86	54.26	563.69	121	47	0	0	0	1.93	224.04	69.77	29	24.10	55	49%	1	8	0	0.00	0.00	0.00	3	0	0
	Temporary	1003.17	0.00	730.53	61.44	59.79	18.61	14.92	47.89	16.41	53.58	1003.17	118	61	0	0	0	6.93	671.29	63.28	32	20.08	63	0%	2	16	0	0.00	0.00	0.00	1	0	0
	Indirect	40.82	0.00	29.98	0.00	2.18	0.00	0.89	6.26	0.00	1.63	40.92	0	0	0	0	0	0.00	38.05	1.31	5	0.00	10	0%	0	1	0	0.00	0.00	0.00	0	0	0
	Harris North TMF	**1655.06**	**28.20**	**1136.73**	**103.13**	**113.99**	**36.79**	**32.71**	**88.62**	**17.27**	**125.93**	**1655.16**	**224**	**103**	**0**	**0**	**0**	**8.86**		**136.18**	**67**	**39.90**	**124**	**0.49**	**3.00**	**25.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**1.00**	**0.00**
	Houston North TMF	**1674.09**	**28.20**	**1155.61**	**126.72**	**114.57**	**36.81**	**29.96**	**90.75**	**17.27**	**102.49**	**1674.19**	**224**	**100**	**0**	**0**	**0**	**8.86**		**137.55**	**69**	**39.90**	**124**	**0.49**	**3.00**	**25.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**0.00**	**0.00**
	Houston South TMF	**1607.68**	**28.20**	**1049.43**	**101.25**	**172.56**	**36.79**	**28.49**	**92.54**	**17.27**	**109.46**	**1607.78**	**239**	**108**	**0**	**0**	**0**	**8.86**		**134.36**	**66**	**44.18**	**128**	**0.49**	**3.00**	**25.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**0.00**	**0.00**
	Net Change	**66.41**	**0.00**	**106.19**	**25.48**	**58.57**	**0.02**	**4.22**	**3.92**	**0.00**	**23.44**	**66.41**	**15**	**8**	**0**	**0**	**0**	**0.00**	**1,021.15 106.79 1,040.17**	**3.19**	**3**	**4.28**	**4**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**1.00**	**0.00**
																			933.38														

*For both of the Houston South TMF option and baseline the roadway enters 2 Minority EJ communities, however, this was only limited to the roadway so it was removed from the calculations.

**Duplicate data within wetlands and waterway

Criteria that showed no impact

Criteria that showed the same level of impact

More detailed analysis completed

	Structures		Wetlands					Waterways								Floodplain*			
	Commercial	Residential	Forested/ Shrub	Emergent	Pond	Riverine	Other	Stream/River		Canal/Ditch		Connector		Artificial Path		A	AE	AO	X
Scoring (Harris North TMF)	Number	Number	Acre	Acre	Acre	Acre	Acre	Number	Length	Number	Length	Number	Length	Number	Length	Acre	Acre	Acre	Acre
Permanent	36	70	4.06	23.42	10.31	3.75	30.03	8	1635.13	20	10237.29	1.00	798.07	1	927.47	0.01	19.82	0.00	591.25
Temporary	41	77	4.09	20.05	3.47	5.64	30.03	8	5109.31	21	11199.93	1.00	798.07	2	357.86	0.01	20.08	0.00	983.09
Indirect	0	0	0.77	0.06	0.00	0.49	0.00	1	126.19	4	1438.05	0.00	0.00	0	0.00	0.00	0.00	0.00	40.82
Scoring (Houston North TMF)																			
Permanent	36	70	13.41	18.87	2.87	5.14	32.68	7	1340.53	24	16015.88	1.00	798.07	0	0.00	0.01	19.82	0.00	610.27
Temporary	41	77	4.09	20.05	3.47	5.64	30.03	8	5109.31	21	11199.93	1.00	798.07	2	357.86	0.01	20.08	0.00	983.09
Indirect	0	0	0.77	0.06	0.00	0.49	0.00	1	126.19	4	1438.05	0.00	0.00	0	0.00	0.00	0.00	0.00	40.82
Scoring (Houston South TMF)																			
Permanent	52	69	14.33	19.04	2.94	3.43	30.03	8	1748.12	20	10243.39	1.00	798.07	0	0.00	3.91	20.19	0.00	539.59
Temporary	41	77	4.09	20.05	3.47	5.64	30.03	8	5109.31	21	11199.93	1.00	798.07	2	357.86	0.01	20.08	0.00	983.09
Indirect	0	0	0.77	0.06	0.00	0.49	0.00	1	126.19	4	1438.05	0.00	0.00	0	0.00	0.00	0.00	0.00	40.82
Harris North TMF	**77**	**147**	**8.92**	**43.54**	**13.78**	**9.88**	**60.07**	**17**	**6870.63**	**45**	**22875.28**	**2**	**1596.13**	**3**	**1285.33**	**0.01**	**39.89**	**0.00**	**1615.16**
Houston North TMF	**77**	**147**	**18.26**	**38.98**	**6.34**	**11.26**	**62.71**	**16**	**6576.03**	**49**	**28653.87**	**2**	**1596.13**	**2**	**357.86**	**0.01**	**39.89**	**0.00**	**1634.19**
Houston South TMF	**93**	**146**	**19.18**	**39.15**	**6.41**	**9.55**	**60.07**	**17**	**6983.62**	**45**	**22881.37**	**2**	**1596.13**	**2**	**357.86**	**3.91**	**40.27**	**0.00**	**1563.50**
Net Change	**16**	**1**	**10.26**	**4.56**	**7.44**	**1.71**	**2.64**	**1**	**407.60**	**4**	**5778.59**	**0**	**0.00**	**1**	**927.47**	**3.90**	**0.37**	**0.00**	**70.69**

*100-year floodplain impacts analyzed

Criteria that showed no impact

Criteria that showed the same level of impact

AECOM

TECHNICAL MEMORANDUM

AIR QUALITY

To: Kevin Wright, FRA

From: Bill Tillar/Carl Sepulveda, AECOM

Date: March 09, 2020

RE: **DALLAS TO HOUSTON HSR – Air Quality Technical Memorandum and Construction Emissions Air Quality Analysis**

Construction emissions account for emissions from construction equipment on site, employee trips to the construction site, delivery of construction materials (hauling by both trucks and rail) to the material storage yards and to the construction sites, and emissions from other on-road vehicles used during construction activities.

Included in this technical memorandum are:

- A summary of on-site construction elements and annual NOx, VOC, SO2, and GHG CO2 emissions.
- Construction material quantities used in the emissions calculations
- Locomotive line-haul emissions calculations.
- Truck hauling emissions calculations.
- On-road (non-hauling) vehicle emission calculations.
- Equipment lists by construction activity.
- Detailed construction phase equipment quantities.
- Detailed construction emissions calculations for track, stations, TMFs, and MOWs.
- Detailed construction GHG emissions calculations for track, stations, TMFs, and MOWs.

Table E3.1-1: Maximum Construction Period Emissions (tons/year)[a]						
Construction Activity	**Construction Year**	**DFW NAA[b]**		**HGB NAA[c]**		**FRE NAA**
		NO_x (tons)	**VOC (tons)**	**NO_x (tons)**	**VOC (tons)**	**SO_2 (tons)**
Off-Road Construction Equipment	1	14.39	1.31	14.75	1.34	0.001
	2	14.39	1.31	14.75	1.34	0.001
	3	43.14	4.07	39.33	3.71	0.001
	4	50.17	4.75	42.85	4.05	0.001
	5	21.60	2.05	21.96	2.08	0.001
On-Road Construction Vehicles	1	9.85	1.99	7.98	1.83	0.007
	2	9.85	1.99	7.98	1.83	0.007
	3	11.19	2.46	9.28	2.30	0.007
	4	11.49	2.57	9.57	2.41	0.007
	5	10.48	2.22	8.59	2.06	0.007
Locomotive Hauling	Year 1 – 5 (per year	1.68	0.09	2.52	0.13	0
Total	**1**	**25.92**	**3.39**	**25.24**	**3.30**	**0.008**
	2	**25.92**	**3.39**	**25.24**	**3.30**	**0.008**
	3	**56.01**	**6.62**	**51.13**	**6.14**	**0.008**
	4	**63.34**	**7.41**	**54.94**	**6.59**	**0.008**
	5	**33.76**	**4.36**	**33.07**	**4.27**	**0.008**

Source: AECOM, 2020

Notes:

a These construction emissions were estimated for Alternative C, which is used as a proxy to estimate construction emissions for all other alternatives. Total construction emissions of NO_x, VOC, and SO_2 from all other alternatives would be lower and are estimated to differ from Alternative C by less than 1.9 percent.

b The applicable DFW nonattainment area counties are Dallas and Ellis counties.

c The applicable HGB nonattainment area counties are Harris and Waller counties.

Table E3.1-2: Maximum Annual Construction-Related GHG Emissions [a]	
Construction Activity	**CO_2e (metric tons)**
Off-Road Construction Equipment	52,301
On-Road Construction Vehicles	63,914
Locomotive Hauling	8,690
Total	**124,905**

Source: AECOM, 2019

Notes:

a The construction GHG emissions were estimated for the HSR Alternative C, which is used as a proxy to estimate construction emissions for all other alternatives. Total construction GHG emissions from all other alternatives would be lower and are estimated to differ from Alternative C by less than 1.9%.

Table E3.1-3: Construction Material Quantities			
Item	**Unit**	**Revised End to End Alignment C**	**Notes**
Total Length	miles	241.09	
Drill Shafts	CY	2,052,266	
Column	CY	1,477,796	
Cap	CY	553,815	
Beams	CY	0	
Deck/Girder	CY	3,326,978	
Drainage	CY	250,000	
Systems	CY	135,000	
Electrical	CY	20,000	
Stations	CY	330,000	
Misc Other	CY	221,534	Assume concrete for catenary poles included here
Total Concrete	CY	8,367,389	
Cement	Ton	1,673,478	Assume 20% delivered by rail and 80% by truck
Sand	Ton	3,346,955	Assume 20% delivered by rail and 80% by truck
Gravel	Ton	3,346,955	Assume 20% delivered by rail and 80% by truck
Reinforcement	lbs	2,091,847,178	
Structural Steel	lbs	13,453,067	stations, parking structures, trainset maintenance facilities, and catenary poles
Sub-Ballast	CY	837,394	
Ballast	CY	1,812,753	
Concrete Ties	Each	1,406,516	
Rail	TF	2,681,695	
Excavation	CY	7,857,546	
Filling	CY	26,585,082	
Trainset Maintenance Facility	Each	2	
Maintenance-of-Way Facility	Each	5	
Data Taken from Project Descriptions or Provided			
Estimated Values			
Data Used in Calculations			

Notes:
Assume water available at batching/precasting sites
Assume 1 delivery of ballast every two weeks via locomotive
Assume 1 delivery of cement, sand, and gravel every two weeks via locomotive

Table E3.1-4a: HSR Material Hauling Locomotive Emissions								
Source Geography	Material Hauled	Total Quantity[1]	Units	Total Quantity	Units	Possible Material Location[2]	Average Distance Traveled within NAA by rail (1-way mi)	Duration of Activity (Years)
HSR Alternative C Construction by Rail in DFW NAA per year								
Dallas Rail Connection	Sub-Ballast	15,215	cy	31,951	tons	C. Texas	30.9	5
Dallas Rail Connection	Ballast	32,936	cy	69,165	tons	C. Texas	30.9	5
	Sand			12,162	tons	C. Texas	30.9	5
	Gravel			12,162	tons	C. Texas	30.9	5
	Cement			6,081	tons	C. Texas	30.9	5
	Steel Reinforcing			19,003	tons	Out of State	30.9	5
	Steel Structural			122	tons	Out of State	30.9	5
	Rail			1,023	tons	Out of State	30.9	5
Ellis Rail Connection	Sub-Ballast	15,215	cy	31,951	tons	C. Texas	15.3	5
Ellis Rail Connection	Ballast	32,936	cy	69,165	tons	C. Texas	15.3	5
	Sand			12,162	tons	C. Texas	15.3	5
	Gravel			12,162	tons	C. Texas	15.3	5
	Cement			6,081	tons	C. Texas	15.3	5
	Steel Reinforcing			19,003	tons	Out of State	15.3	5
	Steel Structural			122	tons	Out of State	15.3	5
	Rail			1,023	tons	Out of State	15.3	5
HSR Alternative C Construction by Rail in HGB NAA per year								
HGB Rail Connection	Sub-Ballast	32,584	cy	68,426	tons	C. Texas	32.3	5
HGB Rail Connection	Ballast	70,536	cy	148,126	tons	C. Texas	32.3	5
	Sand			26,047	tons	C. Texas	32.3	5
	Gravel			26,047	tons	C. Texas	32.3	5
	Cement			13,023	tons	C. Texas	32.3	5
	Steel Reinforcing			40,698	tons	Out of State	32.3	5
	Steel Structural			262	tons	Out of State	32.3	5
	Rail			2,191	tons	Out of State	32.3	5
Total Alignment Length - (mi)		240.96						
DFW NAA Alignment Length (mi)		43.78	18.17%					
HGB NAA Alignment Length (mi)		46.88	19.46%					
Total Sub-Ballast (cy - total 4 yrs)		837,394						
Total Ballast (cy - total 4 yrs)		1,812,753						
Total Sand (tons - total 4 yrs)[3]		669,391						
Total Gravel (tons - total 4 yrs)[3]		669,391						

Table E3.1-4a: HSR Material Hauling Locomotive Emissions								
Source Geography	**Material Hauled**	**Total Quantity[1]**	**Units**	**Total Quantity**	**Units**	**Possible Material Location[2]**	**Average Distance Traveled within NAA by rail (1-way mi)**	**Duration of Activity (Years)**
Total Cement (tons - total 4 yrs)[3]		334,696						
Total Reinforing Steel (tons - total 4 yrs)		1,045,923						
Total Structural Steel (tons - total 4 yrs)		6,726						
Total Rail (tons - total 4 yrs)		56,316						
Total Gravel (tons - total 4 yrs)[3]		669,391						

Data Taken from Project Descriptions or Provided

Estimated Values

Data Used in Calculations

Notes:

(1) Total quantities was obtained from Construction Quantities and Construction Equipment list for Alignment C.

(2) Most of the aggregates would come from quarries within Texas per TCRR as noted in **Appendix F, TCRR Final Conceptual Engineering** Report. The Project does anticipate the need to purchase some aggregates from out-of-state quarries with emissions accounted for in the Locomotive Emissions spreadsheet.

(3) Number shown assumes 20% of total Sand, Cement, and Gravel delivered to precast yards by locomotive.

(4) Distance travelled by rail calculated for travel in NAA only.

(5) Density of ballast and sub-ballast was assumed to be 2.1 tons/cubic yard (based on California HSR calculations)

(6) Total rail = 2,681,695 TF. Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

Table E3.1-4b: HSR Alternative C Construction Rail Hauling – Total Quantities (tons)							
Material	**DFW (Construction Period)**	**HGB (Construction Period)**	**(50% to Dallas rail connection, 50% to Ellis Co. rail connection)**				
Sub-Ballast	63,901	68,426					
Ballast	138,331	148,126					
Sand	24,324	26,047					
Gravel	24,324	26,047					
Cement	12,162	13,023					
Steel Reinforcing	38,007	40,698					
Steel Structural	244	262					
Rail	2,046	2,191					
Emission Factors	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
Rail (g/gal)[1]	5.408	26.624	102.96	0.094	3.744	3.63168	10217
Rail (g/ton-mile)[2]	0.011	0.056	0.218	0.0002	0.008	0.008	21.6
Data Taken from Project Descriptions or Provided							
Estimated Values							
Data Used in Calculations							

Notes:

(1) Emission factors based on Tier 2 line-haul locomotive emission factors as listed in the EPA Report "Emission Factors for Locomotives - Large Line Haul", USEPA Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Grams per gal calculations based on a 20.8 bhp-hr/gal conversion factor as listed in the same EPA report.

(2) The conversion factor of 473 ton-mile/gallon based on the report by the American Association of Railroads "The Environmental Benefits of Moving Freight by Rail, April 2016.

(3) Tier 2 rail emission factors were used for all years.

(4) for DFW: Assume 50% to Dallas rail connection, 50% to Ellis Co. rail connection

Table E3.1-4c: HSR Alternative C Construction Rail Hauling Emissions per Year								
	tons	Miles	VOC ER g/ton-mile	VOC g/yr	VOC tons/yr	NOx ER g/ton-mile	NOx	NOx
Dallas Railroad Connection (Sta 100310+00)								
Sub-Ballast	31,951	30.9	0.011	11,288	0.012	0.218	214,905	0.237
Ballast	69,165	30.9	0.011	24,436	0.027	0.218	465,216	0.513
Sand	12,162	30.9	0.011	4,297	0.005	0.218	81,804	0.090
Gravel	12,162	30.9	0.011	4,297	0.005	0.218	81,804	0.090
Cement	6,081	30.9	0.011	2,148	0.002	0.218	40,902	0.045
Steel Reinforcing	19,003	30.9	0.011	6,714	0.007	0.218	127,819	0.141
Steel Structural	122	30.9	0.011	43	0.00005	0.218	822	0.001
Rail	1,023	30.9	0.011	361	0.000	0.218	6,882	0.008
					0.059			1.125
Ellis Railroad Connection (Sta 80650+00)								
Sub-Ballast	31,951	15.3	0.011	5,589	0.006	0.218	106,409	0.117
Ballast	69,165	15.3	0.011	12,099	0.013	0.218	230,350	0.254
Sand	12,162	15.3	0.011	2,128	0.002	0.218	40,505	0.045
Gravel	12,162	15.3	0.011	2,128	0.002	0.218	40,505	0.045
Cement	6,081	15.3	0.011	1,064	0.001	0.218	20,253	0.022
Steel Reinforcing	19,003	15.3	0.011	3,324	0.004	0.218	63,289	0.070
Steel Structural	122	15.3	0.011	21	0.000	0.218	407	0.000
Rail	1,023	15.3	0.011	179	0.0002	0.218	3,408	0.004
					0.029			0.557
Houston Railroad Connection (Sta 11250+00)								
Sub-Ballast	68,426	32.3	0.011	25,270	0.028	0.218	481,096	0.530
Ballast	148,126	32.3	0.011	54,703	0.060	0.218	1,041,455	1.148
Sand	26,047	32.3	0.011	9,619	0.011	0.218	183,131	0.202
Gravel	26,047	32.3	0.011	9,619	0.011	0.218	183,131	0.202
Cement	13,023	32.3	0.011	4,810	0.005	0.218	91,566	0.101
Steel Reinforcing	40,698	32.3	0.011	15,030	0.017	0.218	286,142	0.315
Steel Structural	262	32.3	0.011	97	0.000	0.218	1,840	0.002
Rail	2,191	32.3	0.011	809	0.001	0.218	15,407	0.017
					0.132			2.517
Data Taken from Project Descriptions or Provided								
Estimated Values								
Data Used in Calculations								

Notes:
1) pounds per gram = 0.0022046
2) tons per pound = 0.0005

Totals (tons)	
DFW VOC	0.09
DFW NOx	1.68
HGB VOC	0.13
HGB NOx	2.52

Table E3.1-5a: Material Hauling Truck Emissions

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations
Truck Capacity
20 cy/truck
30 tons/truck

Material Hauled	Total Quantity[1]	Units	Possible Origin Location	Duration of Activity (years)
From RR Connection / Precast Yard				
Sub-Ballast	837,394	CY	from rail connection yard	5
Ballast	1,812,753	CY	from rail connection yard	5
Concrete Rail Ties	1,406,516	Each	batch plant to construction site	5
Total Concrete	8,367,389	CY	batch plant to construction site	5
Rail	2,681,695	TF	Out of state	5
Excavation	7,857,546	CY	within alignment	5
Fill	26,585,082	CY	within alignment	5
Structural Steel	6,726	Ton	from rail connection yard	5
Reinforcing Steel	1,045,923	Ton	from rail connection yard	5
Construction Waste - Concrete	58,572	CY	within alignment	5
Construction Waste - Rebar	15,688	Ton	within alignment	5
To Precast Yard[2]				
Sand	2,677,564	Ton	Texas	5
Cement	1,338,782	Ton	Texas	5
Gravel	2,677,564	Ton	Texas	5

Notes:
(1) Information about total quantities was obtained from HSR Construction Quantities and Equipment Estimates (Alt C).
(2) Number shown assumes 80% of total Sand, Cement, and Gravel delivered to precast yards by truck.
(3) Truck hauling emissions were calculated using a standard truck capacity of 20 cubic yards or 30 tons per truck, and by multiplying the emission factor by the anticipated distance traveled and the amount of material hauled per trip for each hauling method.

Table E3.1-5b: HSR Material Hauling Truck Calculations				
Material Hauled	**Total Truck Hauling Trips Alternative C**	**No. Trucks Trips HGB**	**No. Trucks Trips DAL**	**No. Trucks Trips Ellis/Freestone Co.**
From RR Connection / Precast Yard				
Sub-Ballast	41,870	8,374	8,374	8,374
Ballast	90,638	18,128	18,128	18,128
Concrete Rail Ties	23,442	4,688	4,688	4,688
Total Concrete	418,369	83,674	83,674	83,674
Rail	1,877	375	375	375
Excavation	392,877	78,575	78,575	78,575
Fill	1,329,254	265,851	265,851	265,851
Structural Steel	224	45	45	45
Reinforcing Steel	34,864	6,973	6,973	6,973
Construction Waste - Concrete	2,929	586	586	586
Construction Waste - Rebar	523	105	105	105
To Precast Yard				
Sand	89,252	17,850	17,850	17,850
Cement	44,626	8,925	8,925	8,925
Gravel	89,252	17,850	17,850	17,850

Assumptions:
Weight of average concrete railway tie is 1,000 pounds
No. of trucks allocated based on ratio of railroad connection / precasting yards to total (5 total, 1 in Dal, 1 in Ellis Co. and 1 in Hou (20% each))
Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

HSR Material Hauling Mileage Calcuations								
Material Hauled	No. Trucks HGB	HGB Annual Miles	No. Trucks DAL	DAL Annual Miles	No. Trucks ELLIS	ELLIS Annual Miles	FRE Annual Miles	Total Project Annual Miles
From RR Connection / Precast Yar								
Sub-Ballast	8,374	38,520	8,374	28,471	8,374	21,772	8,374	125,609
Ballast	18,128	83,387	18,128	61,634	18,128	47,132	18,128	271,913
Concrete Rail Ties	4,688	21,567	4,688	15,941	4,688	12,190	4,688	70,326
Total Concrete	83,674	384,900	83,674	284,491	83,674	217,552	83,674	1,255,108
Rail	375	1,727	375	1,276	375	976	375	5,632
Excavation	78,575	361,447	78,575	267,157	78,575	204,296	78,575	1,178,632
Fill	265,851	1,222,914	265,851	903,893	265,851	691,212	265,851	3,987,762
Structural Steel	45	206	45	152	45	117	45	673
Reinforcing Steel	6,973	32,075	6,973	23,708	6,973	18,129	6,973	104,592
Construction Waste - Concrete	586	2,694	586	1,991	586	1,523	586	8,786
Construction Waste - Rebar	105	481	105	356	105	272	105	1,569
To Precast Yard								
Sand	17,850	203,495	17,850	221,345	17,850	117,813	17,850	696,167
Cement	8,925	101,747	8,925	110,673	8,925	58,906	8,925	348,083
Gravel	17,850	203,495	17,850	221,345	17,850	117,813	17,850	696,167
Total	**511,999**	**2,658,655**	**511,999**	**2,142,433**	**511,999**	**1,509,703**	**511,999**	**8,751,018**

Assumptions:
Distance traveled is estimated based on the origin of the material being delivered.
Average R/T Distance from Rail Connection Yard: HGB = 23 miles, Average R/T Distance DAL = 17 miles, Average R/T Distance Ellis Co = 13 miles, Average R/T Distance Freestone Co = 5 miles
Average roadway R/T distance within NAA to Rail Precast Yard: HGB = 57 miles, DAL = 62 miles, Ellis Co = 33 miles, Freestone Co. = 5 miles
Material haul: quantities will be delivered over a five-year time frame for use in the construction phase (as per schedule).
Assume concrete will be hauled in support of concrete batch plant operations.

Data from MOVES2014b	**Long Haul Truck Emissions in Grams per Mile**		
	NOx	**VOC**	**SO2**
Ellis	**1.625**	**0.208**	
Dallas	**1.620**	**0.208**	
Freestone Co			**0.009**
Harris	1.555	0.208	
Waller	1.556	0.208	
Average HGB Emissions	**1.556**	**0.208**	

Note:
Emissions averaged for Harris and Waller Counties

Table E3.1-6a: HSR Material Hauling Emissions - HGB		
	Long Haul Truck Emissions (Tons/Year)	
Year	**NOx**	**VOC**
Annual Emissions	4.56	0.610

Notes:
1) pounds per gram = 0.0022046
2) tons per pound = 0.0005

Table E3.1-6b: HSR Material Hauling Emissions - DAL		
	Long Haul Truck Emissions (Tons/Year)	
Year	**NOx**	**VOC**
Annual Emissions	3.83	0.49

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

Table E3.1-6c: HSR Material Hauling Emissions – Ellis Co		
	Long Haul Truck Emissions (Tons/Year)	
Year	**NOx**	**VOC**
Annual Emissions	**2.70**	**0.35**

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

Table E3.1-6d: HSR Material Hauling Emissions – Annual Emissions		
	NOx	**VOC**
DFW NAA (Dallas and Ellis counties)	6.530	0.837
HGB NAA (Harris and Waller counties)	4.559	0.610
HSR Material Hauling Emissions - Freestone Co.		
	Long Haul Truck Emissions (Tons/Year)	
Year	SO2	
Annual Emissions	0.005	

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005
3) assume same emissions for all five years

Table E3.1-7a: HSR Material Hauling Truck Emissions Track Construction Mileage Calculation

Legend
Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - TMF	On-Road (Non-Haul) Trucks		No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	Average R/T Distance	Total Miles Per Year	Total Miles Per Year	Total Miles Per Year	Total Miles Per Year
		No. TMF in County	1	0	1	0	(miles)	Dallas Co	Ellis Co	Harris Co	Waller Co
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks									
Light Commercial Truck	Flatbed F350	24					**20**				
	Flat Bed F700	18									
	Total	**42**	**2.9**	**5.0**	**6.6**	**1.5**	Light Commercial Truck	**36,707**	**62,831**	**82,749**	**19,300**
Passenger Truck	Mechanics Truck (small)	29									
	Pick-up 1/2 Ton	595									
	Pick-up 3/4 Ton	382									
	Worker Trips	5620									
	Total	**6626**	**464.0**	**794.3**	**1,046.0**	**243.9**	Passenger Truck	**5,790,954**	**9,912,348**	**13,054,662**	**3,044,737**
Single-Unit Short Haul	Fuel Truck	44									
	Water Truck 4000 gal	24									
		68	**4.8**	**8.1**	**10.7**	**2.5**	Single-Unit Short Haul	**59,430**	**101,726**	**133,975**	**31,247**
Single-Unit Long Haul	Semi Tractor	0									
		0	**0**	**0**	**0**	**0**	Single-Unit Long Haul	**0**	**0**	**0**	**0**

Table E3.1-7b: HSR Material Hauling Truck Emissions Track Construction by County							
Emission Rates	**Ellis Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.065	2.183	0.061	0.012	0.003	0.172	433.1
Light Commercial Truck	0.063	2.318	0.062	0.012	0.003	0.172	436.6
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.969	1327.2
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.625	1229.4
Emission Rates	**Dallas Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.062	2.060	0.061	0.012	0.003	0.169	434.7
Light Commercial Truck	0.060	2.188	0.061	0.012	0.003	0.169	438.2
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.964	1332.9
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.620	1234.9
Emission Rates	**Harris Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.063	2.089	0.060	0.012	0.003	0.165	440.31
Light Commercial Truck	0.062	2.237	0.061	0.012	0.003	0.166	443.89
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.884	1352.38
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.555	1253.55
Emission Rates	**Waller Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.078	2.536	0.061	0.012	0.003	0.205	438.0
Light Commercial Truck	0.073	2.600	0.061	0.012	0.003	0.194	441.5
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.885	1344.1
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.556	1245.6

Table E3.1-7c: HSR Material Hauling Truck Emissions Track Construction (Tons)							
Emission Rates	**Ellis Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.004	0.160	0.004	0.001	0.000	0.012	30.2
Light Commercial Truck	0.709	23.803	0.665	0.131	0.033	1.875	4722.1
Single Unit Short-Haul Truck	0.027	0.101	0.033	0.014	0.001	0.220	148.5
County Total	0.740	24.064	0.703	0.146	0.034	2.108	4900.8
Emission Rates	**Dallas Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.088	0.002	0.000	0.000	0.007	17.695
Light Commercial Truck	0.395	13.122	0.389	0.076	0.019	1.077	2769.175
Single Unit Short-Haul Truck	0.016	0.059	0.019	0.008	0.001	0.128	87.138
County Total	0.413	13.270	0.411	0.085	0.020	1.212	2874.0
Emission Rates	**Harris Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.006	0.204	0.006	0.001	0.000	0.015	40.4
Light Commercial Truck	0.905	29.998	0.862	0.172	0.043	2.369	6322.9
Single Unit Short-Haul Truck	0.035	0.134	0.044	0.019	0.001	0.278	199.3
County Total	0.946	30.335	0.911	0.192	0.045	2.662	6562.6
Emission Rates	**Waller Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.055	0.001	0.000	0.000	0.004	9.4
Light Commercial Truck	0.261	8.494	0.204	0.040	0.010	0.687	1466.8
Single Unit Short-Haul Truck	0.008	0.031	0.010	0.004	0.000	0.065	46.2
County Total	0.271	8.580	0.216	0.045	0.010	0.755	1522.4

Table E3.1-7c: HSR Material Hauling Truck Emissions Track Construction (Tons) – Cont'd							
Emission Rates	**Freestone Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.000	0.002	0.000	0.000	0.000	0.000	0.3
Light Commercial Truck	0.056	2.005	0.045	0.009	0.002	0.148	317.5
Single Unit Short-Haul Truck	0.002	0.007	0.002	0.001	0.000	0.015	9.9
County Total	0.058	2.013	0.047	0.010	0.002	0.163	327.6
Emission Rates	**All Counties**						
Truck Category							
							Total No.
Passenger Truck							254.6
Light Commercial Truck							39836.9
Single Unit Short-Haul Truck							1254.7
County Total							41346.2
Truck Emissions (TPY)	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Dallas County	0.413	13.270	0.411	0.085	0.020	1.212	2874.0
Ellis County	0.740	24.064	0.703	0.146	0.034	2.108	4900.8
Harris County	0.946	30.335	0.911	0.192	0.045	2.662	6562.6
Waller County	0.271	8.580	0.216	0.045	0.010	0.755	1522.4
Freestone County	0.058	2.013	0.047	0.010	0.002	0.163	327.6
Regional Truck Emissions - Track (tons/year)							
DFW	1.153	37.334	1.113	0.231	0.054	3.319	7774.796
HGB	1.217	38.915	1.127	0.237	0.055	3.418	8084.967
FRE	0.058	2.013	0.047	0.010	0.002	0.163	327.616

Table E3.1-8a: Construction Emissions - Non-Road Engines (Stations)												
Description	**Equipment category based on NONROAD classification**	**SCC [1]**	**Fuel Type**	**Engine Technology Type**	**Equipment HP**	**Number of Equipment**	**Total Days**	**Total Weeks**	**Total Months**	**Usage Rate**	**Hours per Week per Engine**	**Total Working hrs**
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		90	4		48		0.4	50	3,840
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		105	2		48		0.4	50	1,920
Cat D3	Crawler Tractor	2270002069	Diesel		70	4		48		0.4	50	3,840
Cat D6N	Crawler Tractor	2270002069	Diesel		165	2		48		0.4	50	1,920
Cat 320BL Backhoe	Excavators	2270002036	Diesel		135	2		48		0.5	50	2,400
Cat 325BL Backhoe	Excavators	2270002036	Diesel		180	2		48		0.5	50	2,400
Cat 330BL Backhoe	Excavators	2270002036	Diesel		240	2		48		0.5	50	2,400
Cat 140G Grader	Graders	2270002048	Diesel		150	1		48		0.25	50	600
60Ton R/T Crane	Cranes	2270002045	Diesel		250	1		48		0.1	50	240
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		210	1		48		0.5	50	1,200
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		160	2		48		0.4	50	1,920
Bobcat 743	Skid Steer Loaders	2270002072	Diesel		40	1		48		0.5	50	1,200
30' Aerial Lift	Aerial Lifts	2270003010	Diesel		50	1		48		0.2	50	480
60' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	1		48		0.2	50	480
80' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	1		48		0.2	50	480
Cat 433 CS Roller	Roller	2270002015	Diesel		105	1		48		0.25	50	600
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel		145	1		48		0.25	50	600
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel		145	1		48		0.25	50	600
PS 130Pneumatic Compactor	Roller	2270002015	Diesel		230	1		48		0.4	50	960
Air Compressors	Air Compressor	2270006015	Diesel		75	2		48		0.6	50	2,880
Generators	Generator Sets	2270006005	Diesel		5	2		48		0.6	50	2,880
Grout Pump	Pumps	2270006010	Diesel		15	1		48		0.6	50	1,440
Walk behind roller	Rollers	2270002015	Diesel		7	1		48		0.6	50	1,440
Small Vac Sweeper	Sweepers	2270003030	Diesel		150	1		48		0.6	50	1,440
All Welders	Welders	2270006025	Diesel		50	1		48		0.6	50	1,440

Table E3.1-8b: Construction Emissions - Non-Road Engines (Track)												
Description	**Equipment category based on NONROAD classification**	**SCC [1]**	**Fuel Type**	**Engine Technology Type**	**Equipment HP**	**Number of Equipment**	**Total Days**	**Total Weeks**	**Total Months**	**Usage Rate**	**Hours per Week per Engine**	**Total Working hrs**
Cat 416 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		70	3		48		0.4	50	2,880
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		90	23		48		0.4	50	22,080
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		105	3		48		0.4	50	2,880
Cat D3	Crawler Tractor	2270002069	Diesel		70	5		48		0.4	50	4,800
Cat D6N	Crawler Tractor	2270002069	Diesel		165	27		48		0.4	50	25,920
Cat 320BL Backhoe	Excavators	2270002036	Diesel		135	1		48		0.5	50	1,200
Cat 325BL Backhoe	Excavators	2270002036	Diesel		180	3		48		0.5	50	3,600
Cat 330BL Backhoe	Excavators	2270002036	Diesel		240	5		48		0.5	50	6,000
Cat 140G Grader	Graders	2270002048	Diesel		150	24		48		0.25	50	14,400
60Ton R/T Crane	Cranes	2270002045	Diesel		250	61		48		0.1	50	14,640
80Ton RT Crane	Cranes	2270002045	Diesel		300	4		48		0.1	50	960
110 Ton Crawler Crane	Cranes	2270002045	Diesel		330	4		48		0.1	50	960
150 Ton Crawler Crane	Cranes	2270002045	Diesel		350	3		48		0.1	50	720
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel		400	7		48		0.1	50	1,680
230 Ton Crawler Crane / 888	Cranes	2270002045	Diesel		400	2		48		0.1	50	480
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		210	5		48		0.5	50	6,000
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		160	4		48		0.4	50	3,840
Bobcat 743	Skid Steer Loaders	2270002072	Diesel		40	2		48		0.5	50	2,400
30' Aerial Lift	Aerial Lifts	2270003010	Diesel		50	1		48		0.2	50	480
60' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	56		48		0.2	50	26,880
80' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	10		48		0.2	50	4,800
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel		350	1		48		0.1	50	240
Cat 433 CS Roller	Roller	2270002015	Diesel		105	4		48		0.25	50	2,400
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel		145	3		48		0.25	50	1,800
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel		145	19		48		0.25	50	11,400
PS 130Pneumatic Compactor	Roller	2270002015	Diesel		230	1		48		0.4	50	960
Cat RM 500 Reclaimer	Paving Equipment	2270002021	Diesel		450	2		48		0.1	50	480
Air Compressors	Air Compressor	2270006015	Diesel		75	85		48		0.6	50	122,400
Generators	Generator Sets	2270006005	Diesel		5	5		48		0.6	50	7,200
Grout Pump	Pumps	2270006010	Diesel		15	9		48		0.6	50	12,960
Walk behind roller	Rollers	2270002015	Diesel		7	10		48		0.6	50	14,400
Small Vac Sweeper	Sweepers	2270003030	Diesel		150	2		48		0.6	50	2,880
All Welders	Welders	2270006025	Diesel		50	3		48		0.6	50	4,320
Bidwell Deck Finishers	Paving Equipment	2270002021	Diesel		50	1		48		0.1	50	240

Table E3.1-8c: TMF Construction Emissions - Non-Road Engines												
Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		90	4		48		0.4	50	3,840
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		105	2		48		0.4	50	1,920
Cat D3	Crawler Tractor	2270002069	Diesel		70	4		48		0.4	50	3,840
Cat D6N	Crawler Tractor	2270002069	Diesel		165	2		48		0.4	50	1,920
Cat 320BL Backhoe	Excavators	2270002036	Diesel		135	4		48		0.5	50	4,800
Cat 325BL Backhoe	Excavators	2270002036	Diesel		180	2		48		0.5	50	2,400
Cat 330BL Backhoe	Excavators	2270002036	Diesel		240	4		48		0.5	50	4,800
Cat 140G Grader	Graders	2270002048	Diesel		150	3		48		0.25	50	1,800
60Ton R/T Crane	Cranes	2270002045	Diesel		250	1		48		0.1	50	240
80Ton RT Crane	Cranes	2270002045	Diesel		300	1		48		0.1	50	240
110 Ton Crawler Crane	Cranes	2270002045	Diesel		330	1		48		0.1	50	240
150 Ton Crawler Crane	Cranes	2270002045	Diesel		350	1		48		0.1	50	240
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel		400	1		48		0.1	50	240
300 Ton Crawler Crane	Cranes	2270002045	Diesel		450	1		48		0.1	50	240
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		210	1		48		0.5	50	1,200
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		160	4		48		0.4	50	3,840
Bobcat 743	Skid Steer Loaders	2270002072	Diesel		40	1		48		0.5	50	1,200
120' Aerial Lift	Aerial Lifts	2270003010	Diesel		75	1		48		0.2	50	480
30' Aerial Lift	Aerial Lifts	2270003010	Diesel		50	1		48		0.2	50	480
60' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	4		48		0.2	50	1,920
80' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	1		48		0.2	50	480
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel		350	2		48		0.1	50	480
Cat 433 CS Roller	Roller	2270002015	Diesel		105	2		48		0.25	50	1,200
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel		145	2		48		0.25	50	1,200
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel		145	2		48		0.25	50	1,200
PS 130Pneumatic Compactor	Roller	2270002015	Diesel		230	1		48		0.4	50	960
Air Compressors	Air Compressor	2270006015	Diesel		75	6		48		0.6	50	8,640
Generators	Generator Sets	2270006005	Diesel		5	4		48		0.6	50	5,760
Grout Pump	Pumps	2270006010	Diesel		15	5		48		0.6	50	7,200
Walk behind roller	Rollers	2270002015	Diesel		7	3		48		0.6	50	4,320
Small Vac Sweeper	Sweepers	2270003030	Diesel		150	2		48		0.6	50	2,880
All Welders	Welders	2270006025	Diesel		50	2		48		0.6	50	2,880

Table E3.1-8d: MOW Construction Emissions - Non-Road Engines												
Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		90	2		48		0.4	50	1,920
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel		105	1		48		0.4	50	960
Cat D3	Crawler Tractor	2270002069	Diesel		70	2		48		0.4	50	1,920
Cat D6N	Crawler Tractor	2270002069	Diesel		165	1		48		0.4	50	960
Cat 320BL Backhoe	Excavators	2270002036	Diesel		135	2		48		0.5	50	2,400
Cat 325BL Backhoe	Excavators	2270002036	Diesel		180	1		48		0.5	50	1,200
Cat 330BL Backhoe	Excavators	2270002036	Diesel		240	2		48		0.5	50	2,400
Cat 140G Grader	Graders	2270002048	Diesel		150	2		48		0.25	50	1,200
60Ton R/T Crane	Cranes	2270002045	Diesel		250	1		48		0.1	50	240
80Ton RT Crane	Cranes	2270002045	Diesel		300	1		48		0.1	50	240
110 Ton Crawler Crane	Cranes	2270002045	Diesel		330	1		48		0.1	50	240
150 Ton Crawler Crane	Cranes	2270002045	Diesel		350	1		48		0.1	50	240
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel		400	1		48		0.1	50	240
300 Ton Crawler Crane	Cranes	2270002045	Diesel		450	1		48		0.1	50	240
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		210	1		48		0.5	50	1,200
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel		160	2		48		0.4	50	1,920
Bobcat 743	Skid Steer Loaders	2270002072	Diesel		40	1		48		0.5	50	1,200
120' Aerial Lift	Aerial Lifts	2270003010	Diesel		75	1		48		0.2	50	480
30' Aerial Lift	Aerial Lifts	2270003010	Diesel		50	1		48		0.2	50	480
60' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	2		48		0.2	50	960
80' Aerial Lift	Aerial Lifts	2270003010	Diesel		65	1		48		0.2	50	480
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel		350	1		48		0.1	50	240
Cat 433 CS Roller	Roller	2270002015	Diesel		105	1		48		0.25	50	600
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel		145	1		48		0.25	50	600
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel		145	1		48		0.25	50	600
PS 130Pneumatic Compactor	Roller	2270002015	Diesel		230	1		48		0.4	50	960
Air Compressors	Air Compressor	2270006015	Diesel		75	3		48		0.6	50	4,320
Generators	Generator Sets	2270006005	Diesel		5	2		48		0.6	50	2,880
Grout Pump	Pumps	2270006010	Diesel		15	3		48		0.6	50	4,320
Walk behind roller	Rollers	2270002015	Diesel		7	2		48		0.6	50	2,880
Small Vac Sweeper	Sweepers	2270003030	Diesel		150	1		48		0.6	50	1,440
All Welders	Welders	2270006025	Diesel		50	1		48		0.6	50	1,440

Table E3.1-9a: Track Total Construction Emissions (Entire Project)								
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**	**GHG - CO2e (metric tons)**
Non-Road Year 1	6.89	35.29	5.39	5.23	0.161	75.78	21,366.49	19,383.35
Non-Road Year 2	6.89	35.29	5.39	5.23	0.161	75.78	21,366.49	19,383.35
Non-Road Year 3	6.89	35.29	5.39	5.23	0.161	75.78	21,366.49	19,383.35
Non-Road Year 4	6.89	35.29	5.39	5.23	0.161	75.78	21,366.49	19,383.35
Non-Road Year 5	6.89	35.29	5.39	5.23	0.161	75.78	21,366.49	19,383.35
Total Project	**34.46**	**176.45**	**26.96**	**26.15**	**0.80**	**378.89**	**106,832.46**	**96,916.75**

Table E3.1-9b: Dallas-Fort Worth Ozone Nonattainment Area (Dallas and Ellis Counties) Track Construction Emissions							
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**
Non-Road Year 1	1.31	6.70	1.02	0.99	0.03	14.39	4,057.49
Non-Road Year 2	1.31	6.70	1.02	0.99	0.03	14.39	4,057.49
Non-Road Year 3	1.31	6.70	1.02	0.99	0.03	14.39	4,057.49
Non-Road Year 4	1.31	6.70	1.02	0.99	0.03	14.39	4,057.49
Non-Road Year 5	1.31	6.70	1.02	0.99	0.03	14.39	4,057.49
Total Project (DFW)	**6.54**	**33.51**	**5.12**	**4.97**	**0.15**	**71.94**	**20,287.47**

Table E3.1-9c: Houston-Galveston-Brazoria Ozone Nonattainment Area (Harris and Waller Counties) Track Construction Emissions							
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**
Non-Road Year 1	1.34	6.87	1.05	1.02	0.03	14.75	4,159.84
Non-Road Year 2	1.34	6.87	1.05	1.02	0.03	14.75	4,159.84
Non-Road Year 3	1.34	6.87	1.05	1.02	0.03	14.75	4,159.84
Non-Road Year 4	1.34	6.87	1.05	1.02	0.03	14.75	4,159.84
Non-Road Year 5	1.34	6.87	1.05	1.02	0.03	14.75	4,159.84
Total Project (HGB)	6.71	34.35	5.25	5.09	0.16	73.74	20,799.21

Note: 60-month construction schedule.

Table E3.1-10a: Construction Emissions Summary - Stations								
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**	**GHG - CO2e (metric tons)**
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 3	0.74	3.75	0.62	0.60	0.020	7.21	2,700.18	2,449.56
Non-Road Year 4	0.74	3.75	0.62	0.60	0.020	7.21	2,700.18	2,449.56
Non-Road Year 5	0.74	3.75	0.62	0.60	0.020	7.21	2,700.18	2,449.56
Total Project	**2.22**	**11.25**	**1.85**	**1.80**	**0.06**	**21.63**	**8,100.54**	**7,348.68**

Note: Totals shown per station, 36-month construction schedule.

Table E3.1-10b: Construction Emissions Summary - TMF								
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**	**GHG - CO2e (metric tons)**
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 3	1.24	6.12	1.00	0.97	0.034	13.21	4,656.40	4,224.21
Non-Road Year 4	1.24	6.12	1.00	0.97	0.034	13.21	4,656.40	4,224.21
Non-Road Year 5	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Total Project	**2.48**	**12.24**	**2.00**	**1.94**	**0.07**	**26.42**	**9,312.80**	**8,448.43**

Note: Totals shown per TMF, 24-month construction schedule.

Table E3.1-10c: Construction Emissions Summary - MOW								
	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**	**GHG - CO2e (metric tons)**
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 3	0.39	1.92	0.31	0.30	0.011	4.16	1,464.80	1,328.84
Non-Road Year 4	0.73	3.55	0.58	0.56	0.020	7.67	2,704.25	2,453.25
Non-Road Year 5	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Total Project	**1.12**	**5.47**	**0.89**	**0.87**	**0.03**	**11.83**	**4,169.06**	**3,782.11**

Notes:
Totals shown per MOW facility.
One MOW each located in Dallas, Ellis, and Harris Counties.
18-Month construction schedule.

Table E3.1-11a: HSR Material Hauling Locomotive GHG Emissions

Legend
Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

HSR Alternative C Construction by Rail in DFW NAA per year

Source Geography	Material Hauled	Total Quantity[1]	Units	Total Quantity	Units	Possible Material Location	Average Distance Traveled	Duration (Years)
Rail Connections	Sub-Ballast	167,479	cy	351,705	tons	C. Texas	240.96	5
Rail Connections	Ballast	362,551	cy	761,356	tons	C. Texas	240.96	5
	Sand			133,878	tons	C. Texas	240.96	5
	Gravel			133,878	tons	C. Texas	240.96	5
	Cement			66,939	tons	C. Texas	240.96	5
	Steel Reinforcing			209,185	tons	Out of State	240.96	5
	Steel Structural			1,345	tons	Out of State	240.96	5
	Rail			11,263	tons	Out of State	240.96	5
Total Alignment Length - (mi)		240.96						
DFW NAA Alignment Length (mi)		43.78	18.17%					
HGB NAA Alignment Length (mi)		46.88	19.46%					
Freestone County SO2 NAA Alignment Length (mi)		0	0.00%					
Total Sub-Ballast (cy - total 5 yrs)		837,394						
Total Ballast (cy - total 5 yrs)		1,812,753						
Total Sand (tons - total 5 yrs)		669,391						
Total Gravel (tons - total 5 yrs)		669,391						
Total Cement (tons - total 5 yrs)		334,696						
Total Reinforcing Steel (tons - total 5 yrs)		1,045,923						
Total Structural Steel (tons - total 5 yrs)		6,726						
Total Rail (tons - total 5 yrs)		56,316						
Total Cement (tons - total 5 yrs)		334,696						

Notes:
(1) Total quantities was obtained from Construction Quantities and Construction Equipment list.
(2) Number shown assumes 20% of total Sand, Cement, and Gravel delivered to precast yards by locomotive.
(3) Distance travelled by rail calculated for length of Alt. C alignment.
(4) Density of ballast and sub-ballast was assumed to be 2.1 tons/cubic yard (based on California HSR calculations)
(5) Total rail = 2,681,695 TF. Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

Table E3.1-11b: HSR Alternative C Construction Rail Hauling - Total Quantities (tons)							
Material		**Construction Period**					
Sub-Ballast		351,705					
Ballast		761,356					
Sand		133,878					
Gravel		133,878					
Cement		66,939					
Steel Reinforcing		209,185					
Steel Structural		1,345					
Rail		11,263					
Emission Factors - Rail (g/gal)[1]							
	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
	5.408	26.624	102.96	0.094	3.744	3.63168	10217

Notes:
(1) Emission factors based on Tier 2 line-haul locomotive emission factors as listed in the EPA Report "Emission Factors for Locomotives - Large Line Haul", USEPA Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Grams per gal calculations based on a 20.8 bhp-hr/gal conversion factor as listed in the same EPA report.
(2) The conversion factor of 473 ton-mile/gallon based on the report by the American Association of Railroads "The Environmental Benefits of Moving Freight by Rail, April 2016.
(3) Tier 2 rail emission factors were used for all years.
(4) for DFW: Assume 50% to Dallas rail connection, 50% to Ellis Co. rail connection

Table E3.1-11c: HSR Alternative C Construction Rail Hauling Emissions - per year											
	tons	**miles**	**VOC ER g/ton-mile**	**VOC g/yr**	**VOC tons/yr**	**NOx ER g/ton-mile**	**NOx g/yr**	**NOx tons/yr**	**CO2 ER g/ton-mile**	**CO2 g/yr**	**CO2 tons/yr**
Sub-Ballast	351,705	240.96	0.011	968,946	1.068	0.218	18,447,244	20.334	21.6	1,830,570,007	2,017.8
Ballast	761,356	240.96	0.011	2,097,531	2.312	0.218	39,933,766	44.019	21.6	3,962,735,907	4,368.1
Sand	133,878	240.96	0.011	368,834	0.407	0.218	7,022,022	7.740	21.6	696,814,327	768.1
Gravel	133,878	240.96	0.011	368,834	0.407	0.218	7,022,022	7.740	21.6	696,814,327	768.1
Cement	66,939	240.96	0.011	184,417	0.203	0.218	3,511,016	3.870	21.6	348,407,684	384.0
Steel Reinforcing	209,185	240.96	0.011	576,302	0.635	0.218	10,971,905	12.094	21.6	1,088,771,931	1,200.2
Steel Structural	1,345	240.96	0.011	3,706	0.004	0.218	70,557	0.078	21.6	7,001,548	7.7
Rail	11,263	240.96	0.011	31,030	0.034	0.218	590,760	0.651	21.6	58,622,708	64.6
					5.070			96.528			9,578.699
	Totals (tons)										
VOC	5.07		**Totals (metric tons)**								
NOx	96.53										
CO2	9,579	CO2	8,690								

Table E3.1-12a: HSR Material Hauling Truck GHG Emissions
Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations
Truck Capacity
20 cy/truck
30 tons/truck

Material Hauled	Total Quantity[1]	Units	Possible Origin Location	Duration of Activity (years)
From RR Connection / Precast Yard				
Sub-Ballast	837,394	CY	from rail connection yard	5
Ballast	1,812,753	CY	from rail connection yard	5
Concrete Rail Ties	1,406,516	Each	batch plant to construction site	5
Total Concrete	8,367,389	CY	batch plant to construction site	5
Rail	2,681,695	TF	Out of state	5
Excavation	7,857,546	CY	within alignment	5
Fill	26,585,082	CY	within alignment	5
Structural Steel	6,726	Ton	from rail connection yard	5
Reinforcing Steel	1,045,923	Ton	from rail connection yard	5
Construction Waste - Concrete	58,572	CY	within alignment	5
Construction Waste - Rebar	15,688	Ton	within alignment	5
To Precast Yard[2]				
Sand	2,677,564	Ton	Texas	5
Cement	1,338,782	Ton	Texas	5
Gravel	2,677,564	Ton	Texas	5

Notes:

(1) Information about total quantities was obtained from HSR Construction Material Quantities and Equipment Estimates (Alt Alignment C).

(2) Number shown assumes 80% of total Sand, Cement, and Gravel delivered to precast yards by truck.

(3) Truck hauling emissions were calculated using a standard truck capacity of 20 cubic yards or 30 tons per truck, and by multiplying the emission factor by the anticipated distance traveled and the amount of material hauled per trip for each hauling method.

Table E3.1-12b: HSR Material Hauling Mileage Calculations		
Material Hauled	**No. Trucks Total**	**Total Annual Miles**
From RR Connection / Precast Yard		
Sub-Ballast	41,870	167,479
Ballast	90,638	362,551
Concrete Rail Ties	23,442	93,768
Total Concrete	418,369	1,673,478
Rail	1,877	7,509
Excavation	392,877	1,571,509
Fill	1,329,254	5,317,016
Structural Steel	224	897
Reinforcing Steel	34,864	139,456
Construction Waste - Concrete	2,929	11,714
Construction Waste - Rebar	523	2,092
To Precast Yard		
Sand	89,252	1,071,026
Cement	44,626	535,513
Gravel	89,252	1,071,026
Total	2,559,997	12,025,033

Assumptions:
Weight of average concrete railway tie is 1,000 pounds
Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)
Distance traveled is estimated based on the origin of the material being delivered.
Average R/T Distance from Rail Connection Yard: 20 miles.
Average R/T Distance to Rail Connection Yard: 60 miles.
Material haul: quantities will be delivered over a five-year time frame for use in the construction phase (as per schedule).
Assume concrete will be hauled in support of concrete batch plant operations.

Table E3.1-12c: HSR Material Hauling Truck GHG Emissions Total			
Data from MOVES2014b	**Long Haul Truck Emissions in Grams per Mile**		
	NOx	**VOC**	**CO2E**
Ellis	1.625	0.208	1,229.4
Dallas	1.620	0.208	1,234.9
Freestone	1.609	0.208	1,228.4
Harris	1.555	0.208	1,253.6
Waller	1.556	0.208	1,245.6
Average HGB Emissions	**1.556**	**0.208**	**1,249.6**

HSR Material Hauling Emissions - Total			
	Long Haul Truck		
	Emissions (Tons/Year)		
Year	**CO2E**	**CO2E (metric tons)**	
Annual Emissions (Construction Period)	12,092.1	10,969	

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

Table E3.1-13a: Material Hauling Truck GHG Emissions - Track Construction					
Data Taken from Project Descriptions or Provided					
Estimated Values					
Data Used in Calculations					
Truck Emissions - Track	**On-Road (Non-Haul) Trucks**	**County distance ratio to overall alignment**	**1**	**Average R/T Distance**	**Total Miles Per Year**
Non-Haul Truck Category	**Trucks**	**Total Number of Non-Haul Trucks**	**HSR Material Hauling**		
Light Commercial Truck	Flatbed F350	24	Data Taken from Project Descriptions or Provided	**40**	
	Flat Bed F700	18			
	Total	**42**	**42**	Light Commercial Truck	**524,160**
Passenger Truck	Mechanics Truck (small)	29			
	Pick-up 1/2 Ton	595			
	Pick-up 3/4 Ton	382			
	Worker Trips	5620			
	Total	**6626**	**6626**	Passenger Truck	**82,692,480**
Single-Unit Short Haul	Fuel Truck	44			
	Water Truck 4000 gal	24			
		68	**68**	Single-Unit Short Haul	**848,640**

Notes:
(1) Assume 312 working days per year.
(2) Number of trucks shown for entire Alternative C alignment.
Worker Trips: Assume 47 mob and demob sites (30 vehicles/site) and 20 sites each for demo, land clearing, earth moving, road crossings, track at-grade, track elevated, and structures (20 vehicles/site)

Table E3.1-13b: HSR Material Hauling Truck GHG Emissions Track Construction by County							
Emission Rates	**Ellis Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.065	2.183	0.061	0.012	0.003	0.172	433.1
Light Commercial Truck	0.063	2.318	0.062	0.012	0.003	0.172	436.6
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.969	1327.2
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.625	1229.4
Emission Rates	**Dallas Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.062	2.060	0.061	0.012	0.003	0.169	434.7
Light Commercial Truck	0.060	2.188	0.061	0.012	0.003	0.169	438.2
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.964	1332.9
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.620	1234.9
Emission Rates	**Harris Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.063	2.089	0.060	0.012	0.003	0.165	440.31
Light Commercial Truck	0.062	2.237	0.061	0.012	0.003	0.166	443.89
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.884	1352.38
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.555	1253.55
Emission Rates	**Waller Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.078	2.536	0.061	0.012	0.003	0.205	438.0
Light Commercial Truck	0.073	2.600	0.061	0.012	0.003	0.194	441.5
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.885	1344.1
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.556	1245.6
Emission Rates	**Freestone Co**						
Truck Category	**2020 Composite Efs (g/mi)**						
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.083	2.688	0.061	0.012	0.003	0.215	432.8
Light Commercial Truck	0.077	2.755	0.062	0.012	0.003	0.204	436.3
Single Unit Short-Haul Truck	0.239	0.906	0.298	0.127	0.01	1.949	1326.1
Single Unit Long-Haul Truck	0.208	0.784	0.294	0.109	0.009	1.609	1228.4

Table E3.1-13c: HSR Material Hauling Truck GHG Emissions Track Construction (Tons)							
Emission Rates	**Ellis Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.004	0.160	0.004	0.001	0.000	0.012	30.2
Light Commercial Truck	0.709	23.803	0.665	0.131	0.033	1.875	4722.1
Single Unit Short-Haul Truck	0.027	0.101	0.033	0.014	0.001	0.220	148.5
County Total	0.740	24.064	0.703	0.146	0.034	2.108	4900.8
Emission Rates	**Dallas Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.088	0.002	0.000	0.000	0.007	17.695
Light Commercial Truck	0.395	13.122	0.389	0.076	0.019	1.077	2769.175
Single Unit Short-Haul Truck	0.016	0.059	0.019	0.008	0.001	0.128	87.138
County Total	0.413	13.270	0.411	0.085	0.020	1.212	2874.0
Emission Rates	**Harris Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.006	0.204	0.006	0.001	0.000	0.015	40.4
Light Commercial Truck	0.905	29.998	0.862	0.172	0.043	2.369	6322.9
Single Unit Short-Haul Truck	0.035	0.134	0.044	0.019	0.001	0.278	199.3
County Total	0.946	30.335	0.911	0.192	0.045	2.662	6562.6
Emission Rates	**Waller Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.055	0.001	0.000	0.000	0.004	9.4
Light Commercial Truck	0.261	8.494	0.204	0.040	0.010	0.687	1466.8
Single Unit Short-Haul Truck	0.008	0.031	0.010	0.004	0.000	0.065	46.2
County Total	0.271	8.580	0.216	0.045	0.010	0.755	1522.4

Table E3.1-13c: HSR Material Hauling Truck GHG Emissions Track Construction (Tons) – Cont'd							
Emission Rates	**Freestone Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.000	0.002	0.000	0.000	0.000	0.000	0.3
Light Commercial Truck	0.056	2.005	0.045	0.009	0.002	0.148	317.5
Single Unit Short-Haul Truck	0.002	0.007	0.002	0.001	0.000	0.015	9.9
County Total	0.058	2.013	0.047	0.010	0.002	0.163	327.6
Emission Rates	**All Counties**						
Truck Category							
							Total No.
Passenger Truck							254.6
Light Commercial Truck							39836.9
Single Unit Short-Haul Truck							1254.7
County Total							41346.2
Truck Emissions - Track (tons/year)							
All Counties							**41,346.2**

Table E3.1-14a: Material Hauling Truck Annual GHG Emissions - Station Construction					
Data Taken from Project Descriptions or Provided					
Estimated Values					
Data Used in Calculations					
Truck Emissions - Station	**On-Road (Non-Haul) Trucks**				
		No. of Stations in County	**1**	**1**	**1**
Non-Haul Truck Category	**Trucks**	**Total Number of Non-Haul Trucks**	**No Trucks Dal Co**	**No Trucks Harris Co**	**No Trucks Central Co**
Light Commercial Truck	Flatbed F350	3			
	Flat Bed F700	2			
	Total	**5**	**5**	**5**	**5**
Passenger Truck	Mechanics Truck (small)	1			
	Pick-up 1/2 Ton	8			
	Pick-up 3/4 Ton	8			
	Worker Trips	500			
	Total	**517**	**517**	**517**	**517**
Single-Unit Short Haul	Fuel Truck	1			
	Water Truck 4000 gal	1			
		2	**2**	**2**	**2**
Single-Unit Long Haul	Semi Tractor	2			
		2	**2**	**2**	**2**
Average R/T Distance	Total Miles Per Year				
(miles)	per County				
20					
Light Commercial Truck	**31,200**				
Passenger Truck	**3,226,080**				
Single-Unit Short Haul	**12,480**				
Single-Unit Long Haul	**12,480**				

Notes:
(1) Assume 312 working days per year.
(2) Stations would be located in Dallas, Harris, and a centrally located county only.

Table E3.1-14b: HSR Material Hauling Truck GHG Emissions Station Construction (Tons)							
Emission Rates	**Ellis Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							
Emission Rates	**Dallas Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.075	0.002	0.000	0.000	0.006	15.0
Light Commercial Truck	0.220	7.310	0.216	0.043	0.011	0.600	1542.7
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.027	18.3
County Total	0.225	7.398	0.223	0.045	0.011	0.632	1576.0
Emission Rates	**Harris Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.077	0.002	0.000	0.000	0.006	15.2
Light Commercial Truck	0.224	7.413	0.213	0.043	0.011	0.586	1562.5
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.026	18.6
County Total	0.229	7.502	0.219	0.045	0.011	0.617	1596.3
Emission Rates	**Waller Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							

Table E3.1-14b: HSR Material Hauling Truck GHG Emissions Station Construction (Tons) – Cont'd							
Emission Rates	**Freestone Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							
Truck Emissions – Stations (tons)							
Years 3-5							
DFW							1,576.017
HGB							1,596.319
Intermediate Station							1,596.319

Table E3.1-15a: Material Hauling Truck Annual GHG Emissions – TMF Construction				
Data Taken from Project Descriptions or Provided				
Estimated Values				
10a				
Truck Emissions - TMF	**On-Road (Non-Haul) Trucks**			
		No. of TMFs in County	1	1
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Dal Co	No Trucks Harris Co
Light Commercial Truck	Flatbed F350	3		
	Flat Bed F700	2		
	Total	**5**	**5**	**5**
Passenger Truck	Mechanics Truck (small)	1		
	Pick-up 1/2 Ton	8		
	Pick-up 3/4 Ton	8		
	Worker Trips	250		
	Total	**267**	**267**	**267**
Single-Unit Short Haul	Fuel Truck	1		
	Water Truck 4000 gal	1		
		2	**2**	**2**
Single-Unit Long Haul	Semi Tractor	2		
		2	**2**	**2**
Average R/T Distance	Total Miles Per Year			
(miles)	per County			
20				
Light Commercial Truck	**31,200**			
Passenger Truck	**1,666,080**			
Single-Unit Short Haul	**12,480**			
Single-Unit Long Haul	**12,480**			

Notes:
(1) Assume 312 working days per year.
(1) Assume two TMFs, one each in Dallas and Harris counties.

Table E3.1-15b: HSR Material Hauling Truck GHG Emissions TMF Construction (Tons)							
Emission Rates	**Ellis Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							
Emission Rates	**Dallas Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.075	0.002	0.000	0.000	0.006	15.0
Light Commercial Truck	0.114	3.775	0.112	0.022	0.005	0.310	796.7
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.027	18.3
County Total	0.119	3.863	0.118	0.024	0.006	0.342	830.0
Emission Rates	**Harris Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.002	0.077	0.002	0.000	0.000	0.006	15.2
Light Commercial Truck	0.115	3.828	0.110	0.022	0.005	0.302	806.9
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.026	18.6
County Total	0.121	3.918	0.116	0.024	0.006	0.334	840.7
Emission Rates	**Waller Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							

Table E3.1-15b: HSR Material Hauling Truck GHG Emissions TMF Construction (Tons) – Cont'd							
Emission Rates	**Freestone Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							
Truck Emissions – TMF (tons)							
Year 3							
DFW							830.041
HGB							840.749
Year 4							
DFW							830.041
HGB							840.749

Table E3.1-16a: Material Hauling Truck Annual GHG Emissions - MOW Construction

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - MOW	**On-Road (Non-Haul) Trucks**						
		No. MOW Facilities in County	1	1	2	0	1
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	No Trucks Other Co
Light Commercial Truck	Flatbed F350	2					
	Flat Bed F700	1					
	Total	3	3	3	6	0	3
Passenger Truck	Mechanics Truck (small)	1					
	Pick-up 1/2 Ton	4					
	Pick-up 3/4 Ton	4					
	Worker Trips	250					
	Total	259	259	259	518	0	259
Single-Unit Short Haul	Fuel Truck	1					
	Water Truck 4000 gal	1					
		2	2	2	4	0	2
Single-Unit Long Haul	Semi Tractor	1					
		1	1	1	2	0	1

Notes:
(1) Assume five stand-alone MOW facilities.
(2) Assume 312 working days per year.

Average R/T Distance (miles)	Total Miles Per Year Per County
20	
Light Commercial Truck	**18,720**
Passenger Truck	**1,616,160**
Single-Unit Short Haul	**12,480**
Single-Unit Long Haul	**6,240**

Table E3.1-16b: HSR Material Hauling Truck GHG Emissions MOW Construction (Tons)							
Emission Rates	**Ellis Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.001	0.048	0.001	0.000	0.000	0.004	9.0
Light Commercial Truck	0.116	3.881	0.108	0.021	0.005	0.306	769.9
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.027	18.2
County Total	0.120	3.941	0.114	0.023	0.006	0.336	797.1
Emission Rates	**Dallas Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.001	0.045	0.001	0.000	0.000	0.003	9.0
Light Commercial Truck	0.110	3.662	0.108	0.021	0.005	0.300	772.8
Single Unit Short-Haul Truck	0.003	0.012	0.004	0.002	0.000	0.027	18.3
County Total	0.115	3.720	0.114	0.023	0.006	0.331	800.2
Emission Rates	**Harris Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck	0.003	0.092	0.003	0.000	0.000	0.007	18.3
Light Commercial Truck	0.224	7.428	0.213	0.043	0.011	0.587	1565.5
Single Unit Short-Haul Truck	0.007	0.025	0.008	0.003	0.000	0.052	37.1
County Total	0.233	7.545	0.224	0.047	0.011	0.645	1621.0
Emission Rates	**Waller Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							

Table E3.1-16b: HSR Material Hauling Truck GHG Emissions MOW Construction (Tons) – Cont'd							
Emission Rates	**Freestone Co**						
Truck Category							
	VOC	**CO**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO2e**
Passenger Truck							
Light Commercial Truck							
Single Unit Short-Haul Truck							
County Total							
Truck Emissions – MOW (tons)							
Year 3							
DFW							865.193
HGB							878.017
Year 4							
DFW							1597.279
HGB							1620.954

AIR QUALITY AND GREENHOUSE GAS OPERATIONAL EMISSIONS CALCULATIONS

Operational emissions of the proposed action would occur from power plants supplying electricity to operate the HSR ("train operation emissions"), which would represent an increase in emissions, and from reduction in vehicle travel ("vehicle emissions reduction"), due to HSR use, which would represent a decrease in emissions. The calculation of air quality and greenhouse (GHG) gas emissions were done using the same models, methodology, and assumptions described below because emissions factors for GHGs are available from the same sources and models as those for air quality criteria pollutants. Therefore, the details of calculations are presented together. The following subsections describe the modeling and estimate of these emissions.

TRAIN OPERATION EMISSIONS

Power Consumption

Emissions due to the power consumption, trains and stations were calculated using power consumption information supplied by the engineering firm retained by Texas Central Railway Partners to design the HSR. The following steps summarize the procedure:

- Calculate daily power consumption from train traction, station, maintenance facilities and signaling using consumption rates from project engineers
- Calculate annual power consumption based on operational assumptions for train, station, and maintenance facilities from project engineers
- Calculate power transmission and transformation losses using statewide average loss derived from Energy Information Agency (EIA) data for Texas
- Calculate annual total power consumption (including losses)
- Extract power generation emissions factors (EF) from EPA Emissions & Generation Resource Integrated Database (eGRID) database and National Renewable Energy Laboratory (NREL) data for the Electric Reliability Council (ERCOT) of Texas power sub-region.
- Calculate emissions using power consumption and EFs

Daily power consumption information was provided for initial service at an interim level of ridership, and full service at the full assumed level of ridership. Initially, the full-service level was used, since it represented the maximum level of train activity and associated emissions. However, the initial service level (ISL) was also used due to concern that although the train activity would be lower, the power generation emissions factors would be higher than in 2040 because the projected change would be less, due to a shorter time elapsed during the projected downward trend of these emissions factors. Therefore, an initial service scenario was also calculated in case it resulted in higher net emissions. Train power consumption included the power used for traction (i.e. locomotion), onboard services (e.g. lights, controls, public address, etc.). Electricity generated due to regenerative braking was indicated by project engineers to be returned to the train's power demand and accounted for in the power consumption provided. **Table E3.2-1** below provides the details of the consumption, operational assumptions provided by TCRR, and the calculated total daily demand. Because the service will be assumed to be provided 365 days a year, yearly power consumption was calculated assuming this. The power consumption of Alternative A is shown, because it is the longest track-length alternative with the highest power consumption, although the difference with the alternative consuming the least power (Alternative E) is negligible at 1 percent.

The EIA is an agency under the U.S. Department of Energy that collects statistics on energy including power generation (in megawatt-hours [MWh] or gigawatt-hours [GWh]) nationwide and by state. Data is obtained through surveys submitted by power management regions like ERCOT, and analysis of submitted data. The data includes an estimate of power lost through transmission and transformers. Power is lost in transmission as heat generated by the resistance of power line conductors, and in transformers mainly as heat also due to conductor resistance and due to other electrical effect losses. It is not practical to estimate losses at the project transmission line level due to the variability in what plant specifically would supply power, and necessary design detail has not yet been developed. Annual loss data for Texas from 1996 to 2016 (latest data available) was used to calculate a rate of loss as a percentage of power generated[1]. The percentage was observed to decline through this period with the rate steadying in the last few years. Advances in technology and power management have resulted in significantly increasing system efficiency, which explains this decline. The average in the last few years has been approximately 5 percent, which is consistent with nationwide data[2]. The loss percentage of 5 percent was assumed.

Table E3.2-1: Train Traction Power Consumption

Train Consumption		
Train Assumed	N700-series Tokaido Shinkansen	
Operational Scenario	Initial Service Level	Full Service Level
Traction energy (MWh) consumed per round trip (each trainset)	6.2	7.7
Power consumption conditions		
Regenerative braking efficiency:	included	
On-board services consumption:	included	
Number of train trips per day	68	80
Total daily train power demand (MWh)	419	618

Source: Power consumption provided by TCRR 2019.

[1] Energy Information Agency. 2018. Table 10. Supply and disposition of electricity, 1990 through 2016. *Texas Electricity Profile*. Online date available at https://www.eia.gov/electricity/state/Texas/ (accessed December 4, 2018).

[2] Jackson, Roderick, Omer C. Onar, Harold Kirkham, Emily Fisher, Klaehn Burkes, Michael Starke, Olama Mohammed and George Weeks. 2015. Opportunities for Energy Efficiency Improvements in the U.S. Electricity Transmission and Distribution System. Oak Ridge National Laboratory (ORNL) Report ORNL/TM-2015/5. National Technical Information Service, Springfield, VA.

Table E3.2-2: Station and Facilities Power Consumption			
Station Consumption	**No. of Facilities**	**Total daily power consumption (MWh)**	**% Total Daily Demand**
Major Stations (Houston, Dallas)	2	178.3	13%
Brazos Valley Station	1	30.4	2%
Maintenance Facility Consumption			
Train Maintenance Facilities and additional MOW	2	127.1	9%
Maintenance of way (MOW) facility	7	90.0	6%
Traction Power for TMF		80.0	6%
Switching and Substations			
Switching, subswitching, and substations	36	69.2	5%
Signaling Consumption			
Communication House	44	43.5	3.1%
Sub-Signal House	2	2.4	0.2%
Signaling House (MSCH)	10	31.4	2%
Signaling House (ISCH)	5	9.0	1%
Total Daily Station & Facility Consumption (MWh)		661.3	48%

Source: Power consumption provided by TCRR 2019.

Table E3.2-3: Total Train Operations Power Consumption		
Operational Scenario	ISL	FSL
Total daily train power demand (MWh)	511.3	726.5
Total Daily Station & Facility Consumption (MWh)	661	661
Total Daily Operating Power Consumption (MWh)	1,173	1,388
Transmission & Transformer Losses		
Percentage lost	5%	5%
Power lost (MWh)	58	69
Total Daily Power + Losses (MWh)	1,231	1,457
Operating days/year	365	365
Total Electric Power Consumed per Year (MWH)	447,250	531,867

Source: Power consumption provided by TCRR 2019.

Emissions Factors

The power grid in Texas is interconnected throughout the state to meet demand. The ERCOT power subregion is the entity that manages and regulates the power grid for most of Texas, including the project corridor. Because there is no certain set of power plants designated or dedicated to providing electricity the HSR, power generation and distribution are interconnected statewide and primarily controlled by ERCOT, emissions from power supplied to the HSR were determined using ERCOT data.

The EPA's eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States[3]. It is based on a yearly compilation of power plant-reported information on power generation, and emissions estimation. eGRID provides aggregation of this data by plant, power sub-region, and state. Emissions factors for the ERCOT subregion were used. Power in any subregion such as ERCOT is supplied by various sources such as natural gas, coal, nuclear, and to a smaller degree, renewable sources (e.g. wind, solar). The emissions factors for ERCOT reflect

[3] U.S. Environmental Protection Agency (EPA). 2018. eGRID. Online database available at https://www.epa.gov/energy/egrid (Accessed December 4, 2018)

the blend of power generation of this subregion. Factors were available for NO_x, SO_2 and GHGs. Source emissions rates used in the calculation and reporting by sub-regions typically rely on those published in the EPA's AP-42, *Compilation of Air Pollutant Emission Factors*.

The eGRID data did not include VOC, CO, or PM_{10} emissions factor. These emissions factors were derived from a study of source energy and emission factors for energy use in buildings conducted by the NREL that included emissions from power[4]. Similar to eGRID, data was reported by power sub-region, including ERCOT. The emissions factors in this study were derived from the NREL's Life Cycle Inventory (LCI) database for combustion of each fuel type in utility boilers and electricity and on the fuel totals used for electricity generation reported to EIA. The LCI also uses emission rates from AP-42. For VOC, the NREL study provided an emission factor for total non-methane organic compounds (TNMOC). In air monitoring, TNMOC is a group of organic compounds sampled and analyzed by a similar but more inclusive method than that used for VOC measured by standard gas chromatography, which is normally used for CAA standards comparison. Studies comparing measurement by both methods indicate that TNMOC can be 1 to almost 2 times the VOC result, and therefore are conservatively assumed to represent VOCs in air emissions inventories[5,6]. Therefore, the TNMOC emission factor was assumed to represent VOC. The ERCOT emissions factors for VOC, CO, and PM_{10} were used and reflect the Year 2004 data. No later comparable data was available. However, the use of earlier year factors is conservative, because emissions factors have been decreasing as time progresses, as discussed in the **Future Year Train Emissions Adjustment** section below.

The emission factor for combustion effects was used. Regional emissions factors expressed as mass of pollutant per unit power reflect the pollutant contribution and generated power amounts from combustion (e.g. gas, coal) and non-combustion (e.g. wind, nuclear) generation. Because non-combustion power generation does not contribute pollutants, it has the effect of diluting the overall regional emission factor. Because the NREL emissions factors only reflected combustion generation, it was necessary to adjust them to reflect the contribution of non-combustion power to give overall emissions rates that reflect the total regional power mix. This was calculated using the percent of non-combustion power, using eGRID data for 2004 to be consistent with the NREL emissions factors, which were for 2004. eGRID did not begin explicitly listing combustion vs non-combustion generation distribution until 2005, but the 2004 distribution data for hydroelectric, nuclear, solar, and wind generation, which comprise the non-combustion portion, was used. More detail on combustion and non-combustion power and emissions factors, and their calculation is provided in the **Future Year Train Emissions Adjustment** section below.

Future Year Train Emissions Adjustment

Because the available power generation and emissions factor data used to calculate train operation emissions only reflect current and historical data and practices, they do not incorporate the

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[4] Deru, M. and P. Torcellini. Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007

[5] Maris, Christophe, Myeong Chung, Udo Krischke, Richard Meller and Suzanne Paulson. An Investigation of the Relationship Between Total Non-Methane Organic Carbon and the Sum of Speciated Hydrocarbons and Carbonyls Measured by Standard GC/FID: Measurements in the South Coast Air Basin. Presentation given at the Air Resources Board (ARB) Research Seminar, June 17, 2002, California EPA Headquarters, 1001 "I" Street, Sacramento, CA. Department of Atmospheric Sciences, University of California at Los Angeles. Available at http://www.arb.ca.gov/research/seminars/paulson/paulson.htm (Accessed 5/10/2016)

[6] U.S. Department of the Interior (USDOI) Bureau of Ocean Energy Management (BOEM). 2015. Gulf of Mexico Air Emissions Calculations Instructions and PRA Statement. Office of Management and Budget (OMB) Form OMB Control No. 1010-0151, BOEM Instructions for Form 0138.

improvements to emissions controls that vehicle emissions models account for in future years, and they do not reflect the increasing percentage of power from renewable or non-fossil fuel energy.

Electric power generation in Texas comes from 1) combustion sources such as natural gas and coal, and minor sources such as oil and biomass, and 2) non-combustion sources such as wind, nuclear, solar, and hydroelectric generation. Only the combustion sources produce criteria pollutants. EIA state-level data for power generation by source was used to calculate the non-combustion portions[7]. This data indicates a strong trend between 1990 and 2016 of an increasing percentage of power by non-combustion sources, changing from 6 percent to 22 percent. **Figure E3.2-1** below shows this trend in black markers and plot line. This trend means that an increasing portion of power generated would not produce emissions, and the overall emission rate per power generated should have dropped. The eGRID data by state corroborates this, indicating a Year 2000 NOx emission rate of 2.308 lbs/MWh and a Year 2016 rate of 0.605 lbs/MWh, a decrease of 74 percent.

The increasing percentage of non-combustion power reflects the significant increase in renewable energy, most notably, wind power in Texas. The decrease in the NO_x emission rate reflects the increasing non-combustion power, but also the improvements in plant emissions controls and shifts to lower NO_x fossil fuel generation such as natural gas. Two methods were used to project this trend to the future years of 2026 and 2040: using the 1990-2016 simple average annual rate of change of 0.59 percent (orange markers and line) and inserting a linear-fit trend line and extending it to 2040 (thin black line). This resulted in projections of non-combustion power in 2026 constituting between 23 percent and 27 percent of total power generated, and in 2040 constituting between 30 percent and 37 percent of total power generated. The more conservative trend line values of 22 percent and 30 percent for 2026 and 2040 were selected. These rates would be used to estimate an effect on the future year overall NO_x rate. The change in non-combustion power percentage was predicted using state-level data which will differ slightly from ERCOT, as the state statistics include the small portions of Texas outside of ERCOT. However, checks of the eGrid ERCOT data between 2005 and 2012 indicate that the ERCOT non-combustion percent power is 1 to 3 percent higher for the same years. Therefore, using state-level data is a conservative projection of the change in non-combustion percent power.

Overall emissions factors or rates per unit of power generated for subregions such as ERCOT are derived from the emissions produced by the combustion sources divided by the sum of all (combustion plus non-combustion) power generated, as shown in the following example for NO_x:

$$\frac{lbs_{NOx}}{(megawatt\text{-}hours_{Combust} + megawatt\text{-}hours_{Noncombust})} = EF_{NOx\text{-}TOTAL} \qquad \{1\}$$

eGRID calculates and lists related emission rates and quantities for combustion sources only, which is shown in the following example for NOx:

$$\frac{lbs_{NOx}}{(megawatt\text{-}hours_{Combust})} = EF_{NOx\text{-}Combust} \qquad \{2\}$$

[7] Energy Information Agency. "Table 5. Electric power industry generation by primary energy source, 1990 through 2016" Texas Electricity Profile. 2018. https://www.eia.gov/electricity/state/Texas/. (accessed December 4, 2018)

The equations above follow general calculations of combustion and non-combustion power emissions rates that can be found in eGRID and NREL technical documentation[8,9]. Equation 1 can be rewritten using Equation 2 as follows:

$$\frac{EF_{NOx\text{-}Combust} \times megawatt\text{-}hours_{Combust}}{(megawatt\text{-}hours_{Combust} + megawatt\text{-}hours_{Noncombust})} = EF_{NOx\text{-}TOTAL} \qquad \{3\}$$

The megawatt-hour terms collectively are equivalent to the percent of total power generation that combustion power generation comprises. Therefore, Equation 4 becomes:

$$EF_{NOx\text{-}Combust} \times \%\, power\, generation_{Combust} = EF_{NOx\text{-}TOTAL} \qquad \{4\}$$

Expressing the percent power generation from combustion using the non-combustion percentage, Equation 4 becomes:

$$EF_{NOx\text{-}Combust} \times (1 - \%\, power\, generation_{Noncombust}) = EF_{NOx\text{-}TOTAL} \qquad \{5\}$$

As long as the combustion EF remains constant, the overall NOx emission factor can be calculated using the change in percent of non-combustion power. However, as shown before, the NO_x emission rate has decreased substantially with some of that decrease attributable to reduction of combustion emission rates. eGRID only began tracking subregion combustion emission rates since 2005. This data indicates an average decrease of the combustion NO_x EF of 6 percent per year[10]. Available eGRID information was used to project the change in combustion emission rates of NO_x, SO_2, and the GHGs (CO_2, CH_4, N_2O) to estimate emissions based on the emission rates change indicated by the data[11]. The eGRID data was used to project future $EF_{combust}$ using the average rate of change or percent change calculated with the 2004-2016 data and applied to extrapolate future values in 2026 and 2040.

One modification to using the average rate was done for CH_4. Between the eGRID 2012 and 2014, a five-fold increase in the CH_4 combustion emissions rate and total CH_4 emissions was noted, despite no associated similar increases in CO_2 or N_2O, which would be expected if it was a true change in plant-generated power quantities or methods. This was not explained in the eGRID technical documentation

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[8] Deru, M. and P. Torcellini. Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007

[9] Abt Associates. 2015. The Emissions and Generation Resource Integrated Database Technical Support Document for eGRID with Year 2012 Data. Technical report prepared for Clean Air Markets Division, Office of Atmospheric Programs, U.S. Environmental Protection Agency Washington, DC. Abt Associates, Bethesda, MD.

[10] U.S. Environmental Protection Agency (EPA). 2018. eGRID. Online database available at https://www.epa.gov/energy/egrid

[11] ibid

for either year.[12,13] This was investigated by downloading and examining the plant-level data via database queries for both years. It was found that 16 coal-fired plants accounted for the five-fold jump in estimated CH_4 emissions despite no commensurate increase in CO_2, N_2O or MWh generated. Other than one plant that became fully commercially operational in 2013 (Sandy Creek Energy Station), changes in power generated varied from a 25% decrease to 84% increase. The emissions factor of these plants had primarily increased approximately ten-fold, typically from the twenties of lbs per GigaWatt-hour (lb/GWh) to the two-hundreds of lb/GWh. Because there was no commensurate increase in CO_2, N_2O or MWh generated, and the changes were all for coal-fired plants, the change in $EF_{combust}$ for CH_4 was deemed attributable to a correction or update in the source EF used, and not any inherent change in plant fuel, technology, or operation. There was no such abrupt change between 2014 and 2016 data. Therefore, the average rate of change was calculated with changes occurring from 2004-2012, and 2014-2016, eliminating the anomalous change between 2014-2016.

The annual change used is compounding, and therefore follows the general Equation 6 below for value growth of a compounded rate of change, similar to calculating future value in financial calculations. The projections for NO_x, SO_2, and the GHGs are shown in **Figures E3.2-4** through **6**. The projected $EF_{combust}$ was then used in Equation 5 to calculate the overall EF_{total} for power generation in ERCOT in the Year 2040 for NO_x, SO_2, and the GHGs. The resultant EF_{total} are shown in **Table E3.2-4** below.

$$FV = PV(1 + r)^n \qquad \{6\}$$

Where:

FV = future value

PV = present value

r = annual rate of change

n = time period

[12] U.S. Environmental Protection Agency (EPA). October 2015. eGRID2012 Technical Support Document. Clean Air Markets Division Office of Atmospheric Programs, EPA, Washington, DC 20460.

[13] U.S. Environmental Protection Agency (EPA). February 2017. eGRID2014 Technical Support Document. Clean Air Markets Division Office of Atmospheric Programs, EPA, Washington, DC 20460.

Table E3.2-4: eGRID ERCOT Current and Projected Emissions Rates

	Combustion Emissions Rates ($EF_{combust}$)									
	NO_x		SO_2		CO_2		CH_4		N_2O	
Year	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/GWH)	Avg. Annual Change	(lb/GWH)	Avg. Annual Change
2016	0.726	-6%	1.38	-13%	1,344	-3%	102	-1%	14.0	-3%
2026	0.388	-	0.35	-	994	-	91.5	-	9.9	-
2040	0.162	-	0.05	-	652	-	78.6	-	6.1	-
Calculated Overall Emissions Rates (EFtotal)										
2026	0.299	-	0.272	-	766	-	0.070	-	0.008	-
2040	0.113	-	0.037	-	456	-	0.055	-	0.004	-

Source: Data sourced from USEPA eGRID database available at https://www.epa.gov/energy/egrid

The eGRID data did not track VOC, PM_{10} or CO historically; therefore, it could not be used to estimate the change in the combustion emissions rates for those pollutants. The EPA maintains and aggregates data from the National Emissions Inventory (NEI) which is a comprehensive and detailed estimate of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants from major air emissions sources. The state average annual emissions trends data contains aggregation of the NEI emissions by Tier 1 categories[14]. As of 2018, the trend data released in 2016, which covers trends from 1990 to 2014, is the most current.[15] National inventories typically follow IPCC tiered categorization of emissions and factors by sources, and Tier 1 is the most basic level. Tier 1 categories include fuel combustion by electric utilities and track VOC, PM_{10}, and CO by year. The Texas annual emissions (in thousands of tons) for this category were used. To maintain consistency with projections for the other pollutants from eGRID, the available data from 2004 and forward was used. By pairing this emissions data with power generation (i.e. MWh) for equivalent categories from the EIA data discussed in the Power Consumption section above, a relative change in the emissions rates per unit of power generated could be estimated to assess whether combustion power plants were improving emissions for these pollutants too. State EIA data for combustion-generated power for electric utilities and independent producers of electricity (i.e. privatized power providers) was used, as this most closely matches the Tier 1 category for electric utilities[16]. The annual emissions for each pollutant were divided by the total category power generated to provide annual emissions rate for state electric utilities.

These state-level emissions rates were not used directly for EF calculations and projections, but rather to estimate the rate of improvement of power plant emissions of these pollutants in Texas and ERCOT. The most current year ERCOT EFs for VOC, PM_{10}, and CO sourced from NREL were more consistent with eGRID estimations used for the other pollutants. Even though the estimate of improvements are state-level, Texas is dominated by ERCOT power, and improvements in emissions would be largely reflective of improvements within ERCOT. **Figures E3.2-7** through **9** show the NEI-based emissions rates for VOC, PM_{10}, and CO which show gradual downward trends. The average percent change from this data was then used to project changes in the NREL-based $EF_{combust}$ factors for VOC, PM_{10}, and CO for the Year 2012 (conservatively assumed the same as 2004) to forecast these factors for the Years 2016 (to bring it to

[14] EPA. 2016. Air Pollutant Emissions Trends Data. Online data available at https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data (Accessed May 30, 2016)

[15] ibid

[16] EIA. 1990-2014 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923) (Revised: November 2015). Online data available at https://www.eia.gov/electricity/data/state/

the same year as the latest data for eGRID ERCOT factors), 2026 and 2040. The projection was conducted in the same manner as NO_x, SO_2, and the GHGs. **Table E3.2-5** summarizes the percent change calculated and the projected 2026 and 2040 $EF_{combust}$ factors. The projected $EF_{combust}$ was then used in Equation 5 to calculate the overall EF_{total} for power generation in ERCOT in the Years 2026 and 2040 for VOC, $PM_{10,}$ and CO. The resultant EF_{total} are shown in **Table E3.2-5**.

Table E3.2-5: NREL ERCOT Current and Projected Emissions Rates

Combustion Emissions Rates ($EF_{combust}$)						
	VOC		PM_{10}		CO	
Year	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change
2016	0.0473	-2.5%	0.0684	-5.4%	0.3565	-2.9%
2026	0.0368	-	0.0391	-	0.2655	-
2040	0.0259	-	0.0178	-	0.176	-
Overall Emissions Rates (EF_{total})						
2026	0.028	-	0.030	-	0.204	-
2040	0.019	-	0.013	-	0.128	-

Source: Baseline 2012 data from Deru, M. and P. Torcellini, Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007. Projected Data estimated using average change derived from EPA NEI data in Air Pollutant Emissions Trends Data, available online at https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data

The 2026 and 2040 EF_{total} for all pollutants were then multiplied by the train operations annual power consumption to calculate the train operations emissions in tons per yecar. These results are shown in **Table E3.2-6** below.

Table E3.2-6: Train Operations Emissions in the Years 2026 and 2040

Emissions (tons per year)								
NO_x	VOC	PM_{10}	SO_2	CO	CO_2	CH_4	N_2O	$CO_{2equivalent}$
Year 2026 (Initial Service Level)								
67.2	6.4	6.8	61.0	45.9	172,035	15.8	1.7	172,941
Year 2040 (Future Service Level)								
30.1	4.8	3.3	9.7	32.7	121,329	14.6	1.1	122,032

Source: AECOM, 2019

VEHICLE EMISSIONS REDUCTION

The shift in travel mode due to the HSR from passenger vehicles to high-speed rail use would result in passenger vehicles no longer making the trip from Dallas to Houston and vice versa. This would eliminate the emissions from those vehicles. This section presents the estimate of emissions from these vehicles.

Reduction in Vehicle Miles Traveled

Ridership and travel mode information from the July, 2019 report *Texas Central Dallas to Houston High-Speed Rail Final Conceptual Engineering Report* provided in **Appendix F, TCRR Final Conceptual Engineering Report** (hereafter referred to as the "2019 TCRR FCE Report") and the May 15, 2017 report *Texas Central Dallas to Houston High-Speed Rail Final Draft Conceptual Engineering Report*, provided in the Draft EIS (hereafter referred to as the "2017 TCRR FDCE Report"), provided by ARUP, Texas Central Partners, and Freese and Nichols, Inc. were used to derive the expected numbers of cars no longer making the trip between Dallas and Houston. These documents contained projections and assumptions of ridership and travel mode being used to plan station capacities, including vehicles expected, and parking requirements.

Although TCRR provided updated ridership estimates of 6.4M in 2029 and 9.9M in 2040 in the 2019 TCRR FCE Report, the original ridership estimates used in the Draft EIS of 4.4M in 2026 and 7.2M in 2040 have been carried forward by FRA in the Final EIS to conduct conservative analyses in the Final EIS. The 2017 TCRR FDCE Report assumed an annual ridership of 7,200,000 passengers for the 2040 FSL, and the 2019 TCRR FCE Report contained an estimate of existing and projected travel mode share of people traveling between Dallas and Houston from a planning forecast report provided for the project. These assumptions are displayed in the calculations shown below. The estimated 2017 mode share represents the existing percentage of passengers expected to use either cars, airplanes, or bus to make the Dallas-Houston trip, in the absence of the HSR project. This mode share and the annual ridership were used to calculate the number of passengers that would be using cars to travel between Houston and Dallas on IH-45.

The 2019 TCRR FCE Report also contained an assumption of average passenger occupancy of cars, which was 1.2 passengers per car that was used to derive the numbers of cars that would now be expected to show up at HSR stations. This was used to derive the number of cars expected from the passengers estimated using this mode. This information was used to calculate the number of passengers traveling by car as follows:

Table E3.2-7: Existing and Projected Mode Share of People Traveling Between Dallas and Houston

Trip Type	2017 Market	2029 Market
Car	94%	69%
HSR	-	29%
Air	5.6%	2%
Bus	0.4%	0%

Source: TCRR. Memorandum, Station Area Guidance for EIS Documentation, January 14, 2016

2026 Calculation:

4,400,000 passengers/year X 94% car share = 4,136,000 passengers using car

4,136,000 passengers/1.2 passengers/car = 3,446,667 cars/year

2040 Calculation:

7,200,000 passengers/year X 94% car share = 6,768,000 passengers using car

6,768,000 passengers/1.2 passengers/car = 5,640,000 cars/year

The projections of rates of ground transportation activity into the stations generated from park and ride, passenger drop off, rental car, etc. in terms of vehicles per hour for the Dallas and Houston stations were used to derive trip distributions. The distribution of trips originating in Dallas versus Houston was assumed to reflect the proportion between these ground activity rates; that is the more active station would have a larger share of the 3.4 million or 5.6 million passenger car trips calculated. **Table E3.2-8** shows the distribution of trips and **Table E3.2-9** provides the resulting annual numbers of cars inferred for each city from this distribution.

Table E3.2-8: Distribution of Trips Between Dallas and Houston

Metro Area	No. Ground Transport Vehicles Arriving and Departing Station (vehicles/hr)		Inferred Trip Balance	
	Low	High	Low	High
Dallas	1320	1610	47%	47%
Houston	1500	1830	53%	53%

Source: Vehicles/hour from TCRR. Memorandum, Station Area Guidance for EIS Documentation, January 14, 2016

Table E3.2-9: Number of Cars Originating from Each City Assuming Inferred Trip Balance

Operating Scenario	ISL	FSL	Percentage (%)
Total cars/year	3,446,667	5,640,000	
Dallas	1,613,120	2,639,651	47%
Houston	1,833,547	3,000,349	53%

Source: AECOM, 2016

City center origin travel was assumed for simplicity, and because the origin of car trips going to Dallas from Houston, and vice versa, would be anticipated to come from all around the respective urban cores to connect to IH-45. This would include major metropolitan areas north and south of city centers that would tend to average out shorter and longer distances past the city centers. Also, since the proposed Dallas and Houston stations are relatively close to city centers and IH-45 is relatively centered east-west in both of these cities, car trips from outlying east or west areas would still travel inward to connect to or use IH-45 in the absence of the HSR, and with the HSR, would still travel close to the city center to the proposed stations. Therefore, trip distance along IH-45 was assumed to average out to trip lengths from the city centers. Assumption of city center Highway centerline geospatial data from TxDOT was used to calculate a city center-to-city center distance of 239 miles between Houston and Dallas.

Consistent with the average length of stay assumption of 1 and 3 days in the 2019 TCRR FCE Report, it would be expected that travel between Houston and Dallas using HSR would primarily be temporary travel for business, tourism, or visitation, and not supplant travel for one-way moves, etc. Since Dallas and Houston are already major airline hubs, use of HSR to connect from one city to the other to catch connecting flights to other destinations would be anticipated to be negligible. The projection of passenger numbers was initially assumed to represent singular passengers who would engage in business or visits over the aforementioned average stay of 1 to 3 days and then return to their originating location, which would represent passengers who would have otherwise taken a round trip by car or other means. However, this assumption was verified with TCRR, who indicated the numbers represented passenger numbers taking a one-way trip from station to another. Considering this, the passenger numbers were assumed to represent passengers who would have otherwise engaged in one-way trips from either Houston or Dallas. Therefore, this one-way distance was assumed.

Table E3.2-10: Assumed Trip Distances	
Trip	**Distance (miles)**
City center-City-Center	239
Assume one-way trip	239

Source: AECOM, 2016

The one-way trip distance and calculated cars/year were used to calculate the vehicle miles traveled (VMT) that would have been traveled in the absence of the HSR as follows:

One-way trip distance X cars/year = VMT

Table E3.2-11: Calculated VMT		
Metro Share of VMT	**VMT**	
	ISL	**FSL**
Dallas VMT	385,535,754	630,876,628
Houston VMT	438,217,659	717,083,372
Total VMT avoided	823,753,413	1,347,960,000

Source: AECOM, 2016

Emissions Factors

The MOVES2014b was used to derive emissions factors[17]. Because the HSR stations that would generate the majority of the HSR travel are located in Houston and Dallas, vehicles that would have otherwise used IH-45 to travel between Houston and Dallas would overwhelmingly be expected to originate in the counties of these two metropolitan areas. For consistency with the construction emissions estimated, the NAA counties in the project corridor were used with MOVES2014b to define vehicle characteristics. National default data were used for the relevant NAA counties to derive the county specific MOVES2014b emission factors. Emissions were developed for the years 2026 and 2040 to match the ISL and FSL years.

The modeling assumed a rural restricted road type which is defined for rural highways that can only be accessed by an on-ramp. Though IH-45 is an urban highway within the Dallas and Houston metropolitan areas (including the 30-mile length north of BW-8 in Houston to Conroe) most of the length through the project corridor is highway in a rural area with access primarily through on-ramps from service or frontage roads. From an emissions reduction standpoint, this is a conservatively low assumption, given that the metropolitan segments are not modeled as urban highways, which would result in greater vehicle emissions calculated that would otherwise be avoided through HSR use.

The vehicle speed assumed was an average speed of 40 miles per hour (MPH) which was the average speed (39 MPH rounded up) projected by TxDOT in 2035 for IH-45 travel between DFW and Houston, contained in the Project Planning Documentation for the State's funding application for the High-Speed Intercity Passenger Rail (HSIPR) Program[18]. This speed reflects a decrease from the 2002 average of 59

[17] U.S. Environmental Protection Agency. 2016. MOVES (Motor Vehicle Emission Simulator). Air quality emissions modeling system available at https://www3.epa.gov/otaq/models/moves/ (Accessed February 2016)

[18] Texas Department of Transportation. 2011. Section 5: Planning Documentation, TxDOT Narrative Application Form for the High-Speed Intercity Passenger Rail (HSIPR) Program March 2011 Notice of Funding Availability (NOFA)

MPH, commensurate with the increasing traffic volume trend observed in traffic data, and the exceedance of the highway's design capacity in future years.

Because the large majority of passengers that would use HSR for Dallas-Houston travel would be those using passenger vehicles (and not commercial light or heavy-duty trucks), emissions factors for passenger cars and trucks were calculated. Emissions avoided for travel by bus and aircraft were not calculated as they represent a relatively minor portion of the projected travel mode shift. On a relative basis, shifting to HSR from bus travel would result in some reduction of criteria pollutants. One study showed that per passenger mile traveled; operational NO_x emissions from some transit rail systems including Massachusetts Green Line light rail and CAHSR would be approximately an order of magnitude (12X to 35X) lower than those from bus and for PM, approximately 7 times lower[19]. Given the small percentage (2%) of bus travel mode shift, the reductions would be minor.

Emissions

The resultant emissions factors generated for the DFW and HGB NAA counties in the project area were averaged to provide emission factors for each of the NAA areas for the criteria pollutants, expressed as grams per mile (g/mile) and converted to pounds per mile (lbs/mile) shown in **Tables E3.2-12a** and **b,** and **Tables E3.2-13a** and **b**. The total annual VMT avoided and emission factors were used to calculate the emissions that would have occurred in the absence of the HSR as shown in **Tables E3.2-14a** and **b**.

Table E3.2-12a: HGB Passenger Vehicle Emissions Factors – 2026

County/Month	HGB Emissions Factors(g/mile)						
Harris	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
	1.171	0.037	0.019	0.034	0.007	0.002	261.4
Waller							
	1.422	0.044	0.022	0.035	0.007	0.002	260.1
HGB Project Avg.	**1.297**	**0.041**	**0.021**	**0.035**	**0.007**	**0.002**	**260.8**
	Converted to lb/mile						
HGB Project Avg.	**0.0029**	**9.04E-05**	**4.63E-05**	**7.72E-05**	**1.54E-05**	**4.41E-06**	**0.575**

Source: Factors derived from EPA MOVES2014b modeling.

Table E3.2-12b: HGB Passenger Vehicle Emissions Factors – 2040

County/Month	HGB Emissions Factors(g/mile)						
Harris	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
	0.609	*0.016*	*0.012*	*0.033*	*0.006*	*0.001*	*201.5*
Waller							
	0.723	*0.018*	*0.013*	*0.033*	*0.006*	*0.001*	*200.5*
HGB Project Avg.	**0.666**	**0.017**	**0.013**	**0.033**	**0.006**	**0.001**	**201.1**
	Converted to lb/mile						
HGB Project Avg.	**0.0015**	**3.75E-05**	**2.87E-05**	**7.27E-05**	**1.32E-05**	**2.20E-06**	**0.443**

Source: Factors derived from EPA MOVES2014b modeling.

[19] Chester, Mikhail, and Arpad Horvath. "Life-Cycle Environmental Assessment of California High Speed Rail." Access, 2010: 5.

Table E3.2-13a: DFW Passenger Vehicle Emissions Factors – 2026							
County/Month	**DFW Emissions Factors(g/mile)**						
Dallas	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
	1.171	0.038	0.019	0.035	0.007	0.002	258.2
Ellis							
	1.242	0.039	0.019	0.035	0.007	0.002	257.3
DFW Project Avg.	**1.297**	**0.039**	**0.019**	**0.035**	**0.007**	**0.002**	**257.8**
	Converted to lb/mile						
DFW Project Avg.	**0.0029**	**8.60E-05**	**4.19E-05**	**7.72E-05**	**1.54E-05**	**4.41E-06**	**0.568**

Source: Factors derived from EPA MOVES2014b modeling.

Table E3.2-13b: DFW Passenger Vehicle Emissions Factors – 2040							
County/Month	**DFW Emissions Factors(g/mile)**						
Dallas	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
	0.609	*0.016*	*0.012*	*0.033*	*0.0060*	*0.001*	*199.1*
Ellis							
	0.651	*0.016*	*0.012*	*0.033*	*0.006*	*0.001*	*198.4*
DFW Project Avg.	**0.630**	**0.016**	**0.012**	**0.033**	**0.006**	**0.001**	**198.8**
	Converted to lb/mile						
DFW Project Avg.	**0.0014**	**3.53E-05**	**2.64E-05**	**7.27E-05**	**1.32E-05**	**2.20E-06**	**0.438**

Source: Factors derived from EPA MOVES2014b modeling.

Table E3.2-14a: 2026 Passenger Vehicle Emissions Reduction							
Emissions (TPY)							
VMT	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
Houston Trip Emissions							
438,217,659	635.4	19.8	10.1	16.9	3.4	1.0	125,988
Dallas Trip Emissions							
385,535,754	559.0	16.6	8.1	14.9	3.0	0.9	109,492
TOTAL	1,194.4	36.4	18.2	31.8	6.3	1.8	235,480

Source: AECOM, 2020.

Table E3.2-14b: 2040 Passenger Vehicle Emissions Reduction							
Emissions (TPY)							
VMT	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
Houston Trip Emissions							
717,083,372	537.8	13.4	10.3	27.7	4.7	0.8	158,834
Dallas Trip Emissions							
630,876,628	441.6	10.9	8.3	24.4	4.2	0.7	138,162
TOTAL	979.4	24.3	18.6	52.0	8.9	1.5	296,996

Source: AECOM, 2020.

NET OPERATIONAL EMISSIONS

The train operation emissions represent increases in emissions due to the proposed action. The vehicle emissions reduction represents emissions reduced by the proposed action. The vehicle VMT reduction emissions were subtracted from the train operation emissions to calculate the net emissions due to the proposed action. **Table E3.2-15** below shows the results using the 2026 and 2040 train operations emissions factors and the 2026 and 2040 passenger vehicles emissions reductions calculated above.

Table E3.2-15: Net Operational Emissions (TPY)					
NO_x	VOC	PM_{10}	SO_2	CO	$CO_{2eq.}$
Year 2026 (Initial Service Level)					
30.8	(11.8)	(25.0)	59.2	(1,148)	(62,539)
Year 2040 (Future Service Level)					
5.8	(13.8)	(48.7)	8.2	(947)	(174,964)

Source: AECOM, 2019.

As shown, there are net reductions of all the estimated criteria pollutants except NO_x and SO_2. This is commonly the case in other high-speed rail projects, comparing train power consumption emissions vs vehicle emissions[20,21,22]. The net increase in SO_2 occurs because electric power generation from coal produces significantly more SO_2 than other forms of power generation and passengers vehicles produce very little SO_2 due to the nature of the fuel, its refinement, and car emission controls. Even in places where coal constitutes a small percentage of power generation, such as California, power consumption for traction and station power still produces more SO_2 than vehicles eliminated by travel mode shift[23]. One county (Freestone) in the air quality Study Area is in nonattainment of the SO_2 standard and emissions would be below *de minimis* as discussed in Section 3.2.5.2.6, and the Build Alternatives would result in net reduction of all the other pollutants. The emissions are relatively small, only one county in the project area is in nonattainment of the SO_2 standard, and the proposed action results in net reduction of all the other pollutants except NO_x. The net result of the proposed action is that emissions for most pollutants would be reduced over the long term.

GENERAL CONFORMITY OPERATIONAL EMISSIONS

The conformity analysis focuses on the criteria pollutants for which nonattainment is designated, and for the NAAs at both ends of the project alignment (HGB and DFW) and the one in the middle (Freestone-Anderson). Not all of the proposed project length is located in an NAA. Therefore, the emissions attributable to the NAAs in the project had to be estimated. The following describes the estimate of the portion of operational emissions that would occur in the HGB, DFW and Freestone-Anderson NAAs. It should be noted that the project only traverses through the Freestone County portion of the Freestone-Anderson NAA.

Train General Conformity Emissions

The general conformity (GC) regulations in 40 CFR 93, states at Rule 93.153(d)(1) that the portion of an action that includes major or minor new or modified stationary sources that require a permit under the new source review (NSR) program or the prevention of significant deterioration program of the CAA, is exempt from the GC rules. Power plants are permitted as stationary sources under these programs and emissions from them would, therefore, be exempt. Therefore, power plant emissions from electricity demand by the HSR train would be exempt. However, the operational analysis included the power plant

[20] California High-Speed Rail Authority and USDOT Federal Railroad Administration. 2012. FINAL California High-Speed Train Project Environmental Impact Report/Environmental Impact Statement, Merced to Fresno Section Project EIR/EIS

[21] Florida High-Speed Rail Authority and USDOT Federal Railroad Administration. 2005. Final Environmental Impact Statement. Florida High Speed Rail Tampa to Orlando.

[22] USDOT Federal Railroad Administration. 2011. Final Environmental Impact Statement and Final Section 4(f) Evaluation for the Proposed DesertXpress High-Speed Passenger Train Victorville, California to Las Vegas, Nevada

[23] California High-Speed Rail Authority and USDOT Federal Railroad Administration 2012

emissions for demonstration, even though they do not technically apply to determining GC applicability. The emissions due to train and station power consumption of electricity from the power grid are relatively indirect effects spatially since they occur at distant power plants located away from the proposed project. These emissions would occur at the power plants meeting the operational demand at any particular time that the trains and stations are operating, which can be any number of regional power plants connected to the ERCOT grid. The interconnectivity and power demand management across the ERCOT sub-region make it impractical to identify or directly attribute the HSR power demand throughout the year to any particular set of power plants within ERCOT. The proposed substations would also be distributed along the HSR alignment across the 10 project counties, further complicating attribution to specific power plants.

However, assumptions can be made and analyzed about the fraction of power used by HSR operations being supplied by power plants in the NAA counties. The EPA eGRID database contains plant-level statistics by subregion that was used to calculate the fractions under two basic assumptions. The most current data (2012) was used.[24] The following summarizes those assumptions and the resulting effect on NAA NO_x, VOC, and SO_2 emissions.

Assumption 1: Uniform Demand on ERCOT Plants – This assumes the entire HSR operation draws power from the ERCOT grid uniformly, and the proportion of HSR power drawn from plants in the NAA reflects the percentage of annual power generated that the NAA plants generate compared to total ERCOT annual power generation. For this assumption, generation from the plants in all 8 HGB counties was used for the HGB percent, generation in the Freestone county power plant, and generation from all 10 DFW counties was used for the DFW percent. Drawing from NAA-wide plants was assumed because plants and power distribution to demand areas within the NAAs tend to be more regionally spread rather than concentrated in individual counties, larger plants that meet higher demands tend to be located in less populated counties, and such indirect emissions in non-project counties would still occur within the NAA. The emissions were calculated using the current and projected 2040 EFs, for comparison. The results are provided in **Table E3.2-16** below:

Table E3.2-16: Assumption 1 Train Operation General Conformity Emissions

Region	Annual Generated (MWh)	% of ERCOT MWh	Portion of Annual HSR Power Consumption	Annual Emissions (tons)					
				Current EFs			2026 EFs		
ERCOT	**360,221,517**			**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**
DFW NAA	28,859,992	8%	35,832	9.8	0.9		5.4	0.5	
HGB NAA	76,009,178	21%	94,373	25.7	2.5		14.1	1.3	
Freestone NAA (SO_2 only)	12,593,140	3%	15,636	-	-	8			2.1

Source: AECOM, 2019.

[24] U.S. Environmental Protection Agency (EPA). 2016. eGRID. Online database available at https://www.epa.gov/energy/egrid (Accessed February 2016)

Table E3.2-16b: Assumption 1 Train Operation General Conformity Emissions - 2040									
Region	Annual Generated (MWh)	% of ERCOT MWh	Portion of Annual HSR Power Consumption	Annual Emissions (tons)					
				Current EFs			2040 EFs		
ERCOT	360,221,517			NOx	VOC	SO_2	NOx	VOC	SO_2
DFW NAA	28,859,992	8%	42,612	12	1		2	0.4	
HGB NAA	76,009,178	21%	112,227	31	3		6	1.0	
Freestone NAA (SO_2 only)	12,593,140	3%	18,594	-	-	10			0.3

Source: AECOM, 2019.

Assumption 2: Station and TMF on Location, Traction Along Alignment – This assumes that the traction power of the HSR operation draws power uniformly from plants along the alignment evenly. However, the station, TMFs, and a maintenance-of-way (MOW) facility associated with each TMF, which comprise 28% of the daily demand, are assumed to draw from plants in their respective locations. The major stations in Houston and Dallas, which are in NAAs comprise 17% of the FSL daily demand, while the mid-point station in Grimes, representing 2% of the daily demand is not in an NAA. There ae no stations in the Freestone NAA. The TMFs which together comprise 11% of the FSL daily demand are at the Dallas and Houston ends of the project. The other train components, such MOW facilities along the alignment, and signaling houses comprise 14% of FSL daily demand, are evenly distributed along the alignment, and are included with traction power in the calculation and apportionment. The percentages of daily demand for the ISL scenario are very similar to those for the FSL. The results are provided in **Table E3.2-17** below.

Table E3.2-17: Assumption 2 Train Operation General Conformity Emissions				
Component	ISL		FSL	
	% Daily Demand	Portion of Annual HSR Power Consumption	% Daily Demand	Portion of Annual HSR Power Consumption
Traction	44%	196,893	53%	279,552
MOW	8%	34,658	7%	34,632
Switching & subs	6%	26,148	5%	26,128
Signaling	7%	31,577	6%	31,554
Totals	64%	289,276	70%	371,866

Source: AECOM, 2019.

Table E3.2-17b: Distribution on Plants Along Alignment				
			Portion of Trackside Consumption	
County	**NAA**	**%**	**ISL**	**FSL**
Dallas	DFW	17%	48,213	61,978
Ellis	DFW	17%	48,213	61,978
Freestone	FRE	17%	48,213	61,978
Limestone	-	17%	48,213	61,978
Grimes	-	17%	48,213	61,978
Harris	HGB	17%	48,213	61,978
	Totals	100%	289,276	371,866
		DFW Total	96,425	123,955
		HGB Total	48,213	61,978
		FRE Total	48,213	61,978

Source: AECOM, 2019

Table E3.2-17c: Station and Maintenance Facilities			
Facility	**NAA**	**% Daily Demand**	**Portion of Annual HSR Power Consumption**
ISL (Year 2026)			
Dallas Station	DFW	7.6%	34,331
Houston Station	HGB	7.6%	34,331
Grimes Station	-	3%	11,707
Dallas TMF + 1 MOW	DFW	5.4%	24,472
Houston TMF + 1 MOW	HGB	5.4%	24,472
	Totals	29%	129,313
DFW Total			58,803
HGB Total			58,803
FSL (Year 2040)			
Dallas Station	DFW	6.4%	34,305
Houston Station	HGB	6.4%	34,305
Grimes Station	-	2%	11,698
Dallas TMF + 1 MOW	DFW	4.6%	24,454
Houston TMF + 1 MOW	HGB	4.6%	24,454
	Totals	24%	129,217
DFW Total			58,759
HGB Total			58,759

Source: AECOM, 2019.

Table E3.2-17d: DFW and HGB NAA Total Trackside, Station, & TMF Power and Emissions					
		Portion of Annual HSR Power Consumption	Annual Emissions (tons)		
			NOx	VOC	SO_2
ISL (Year 2026)					
Current Emissions Factors	DFW	155,228	42.3	4.1	
	HGB	107,016	29.2	2.8	
	FRE	48,213			25.0
2026 EFs	DFW	155,228	23.2	2.2	
	HGB	107,016	16.0	1.5	
	FRE	48,213			6.5
FSL (Year 2040)					
Current Emissions Factors	DFW	182,715	49.8	4.8	
	HGB	120,737	32.9	3.2	
	FRE	61,978			42.7
2040 EFs	DFW	182,715	10.3	1.7	
	HGB	120,737	6.8	1.1	
	FRE	61,978			1.1

Source: AECOM, 2019.

As shown, in none of the assumptions of distribution or assumptions of emissions factors do the annual NO_x and VOC emissions apportioned to the DFW or HGB NAAs exceed the *de minimis* thresholds of 50 tons for a serious NAA, nor do those apportioned to the Freestone SO_2 NAA exceed the *de minimis* thresholds of 100 tons for its nonattainment designation. Texas power plants in the future would continue to improve emissions and derive a greater percentage of power from non-combustion sources; therefore, they would more closely reflect the projected 2026 and 2040 emissions than emissions with current EFs. Even absent of the improvements, train operation emissions would not be expected to exceed *de minimis* thresholds for NO_x, VOC, or SO_2.

Vehicle Emissions Reduction General Conformity Emissions

Since vehicle emissions are directly tied to the vehicle travel producing the emissions, those emissions occurring in NAAs can be more readily estimated geographically than power plant emissions. The segments of IH-45 within the DFW, HGB and FRE NAAs used to conduct the city center-to-city center trips would be the location where such emissions would take place. These are emissions within the NAAs that would have occurred in the absence of the HSR. The geospatial data used in the vehicle emissions reduction analysis was used to calculate the segment lengths in the HGB NAA, in the DFW NAA, and in the FRE NAA. IH-45 passes through the counties listed in **Tables E3.2-18a** through **f** below. Conceptually, the vehicle activity in each NAA would be comprised of local cars leaving the NAA and visiting cars arriving at the NAA through the associated lengths of IH-45 for the HGB and DFW NAAs. For the FRE NAA, conceptually, the vehicle activity would be comprised of cars passing through Freestone County from Dallas going to Houston and vice versa. The segment lengths, arriving/leaving assumptions and numbers of annual vehicles from **Table E3.2-9**, were used to calculate the VMT. The same EFs and methodology described in Vehicle Emissions Reduction section were then used to calculate the emissions. **Tables E3.2-18a** through **f** below provides the results of the estimated emissions.

Table E3.2-18a: DFW NAA IH-45 Miles and VMT		
Dallas County miles	17.9	
Ellis County miles	23.5	
Total length in NAA	41.4	
Dallas vehicle travel miles leaving for Houston	41.4	
	ISL	**FSL**
Dallas no. of vehicles	1,613,120	2,639,651
Dallas vehicle VMT	66,750,918	109,228,765
Houston vehicle miles arriving	41.4	
Total Houston vehicle trip miles	41.4	
	ISL	**FSL**
Houston no. of vehicles	1,833,547	3,000,349
Houston vehicle VMT	75,872,162	124,154,435
DFW NAA VMT	142,623,080	233,383,200

Source: AECOM, 2019.

Table E3.2-18b: DFW NAA Vehicle Emissions Reduction	
Emissions (TPY)	
NOx	**VOC**
ISL (2026)	
6.13	2.99
FSL (2040)	
4.12	3.09

Source: AECOM, 2020.

Table E3.2-18c: HGB NAA IH-45 Miles and VMT		
Montgomery County miles	27.9	
Harris County miles	26.8	
Total length in NAA	54.6	
Houston vehicle miles leaving for Dallas	54.6	
	ISL	**FSL**
Houston no. of vehicles	1,833,547	3,000,349
Houston vehicle VMT	100,148,320	163,879,053
Dallas vehicle miles arriving	54.6	
	ISL	**FSL**
Dallas no. of vehicles	1,613,120	2,639,651
Dallas vehicle VMT	88,108,631	144,177,747
HGB NAA VMT	188,256,952	308,056,800

Source: AECOM, 2019.

Table E3.2-18d: HGB NAA Vehicle Emissions Reduction	
HGB Emissions (TPY)	
NOx	**VOC**
ISL (2026)	
8.51	4.36
FSL (2040)	
5.77	4.41

Source: AECOM, 2020.

Table E3.2-18e: FRE NAA IH-45 Miles and VMT		
Freestone County miles	31.9	
Dallas veh. miles heading for Houston	31.9	
	ISL	**FSL**
Dallas no. vehicles	1,613,120	2,639,651
Dallas vehicle VMT	51,458,538	84,204,872
Houston veh. miles heading for Dallas	31.9	
	ISL	**FSL**
Houston # veh.	1,833,547	3,000,349
Houston veh. VMT	58,490,139	95,711,128
FRE NAA VMT	109,948,677	179,916,000

Source: AECOM, 2019.

Table E3.2-18f: FRE NAA Vehicle Emissions Reduction
FRE Emissions SO_2 (TPY)
ISL (2026)
0.24
FSL (2040)
0.20

Source: AECOM, 2020.

Net General Conformity Emissions

Using the 2026 and 2040 train operation emissions and vehicle emissions reduction for each NAA, the net operational emissions within each NAA was calculated with the two assumptions of train power draw on the power grid discussed above. The results are provided in **Table E3.2-19** and **Table E3.2-20** below. Under the assumption that the train draws uniformly from the ERCOT power grid, there would be net reductions in all pollutants, except for NO_x in HGB and SO_2 in the FRE NAA for the same reasons explained for the net operational emissions above regarding the nature of passenger car vehicle emissions compared to electricity generation that includes coal-fired power plants. Under the assumption that the train draws power from stations along the track evenly and stations and TMFs draw from plants in the counties of their location, net reductions in all pollutants except NO_x in the DFW and HGB NAAs, and SO_2 in the FRE NAA were estimated. In all cases, the increase in NO_x is comparatively negligible and well below the current serious nonattainment de minimis threshold of 50 TPY. The increase in SO_2 is also comparatively negligible and well below the applicable nonattainment de minimis threshold of 100 TPY. Considering these results, operational emissions of the regulated pollutants in NAAs due to the proposed action are below *de minimis* thresholds.

Table E3.2-19: Net General Conformity Emissions – 2026 (ISL)

	Train Operation Emissions (tons)			**Vehicle Emissions Reduction (TPY)**			**Net Emissions (TPY)**		
NAA	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**
Assumption 1 – Uniform ERCOT Power									
DFW	5.0	0.5		-6.1	-3.0		-1.1	-2.5	
HGB	13.1	1.2		-8.5	-4.4		4.6	-3.2	
FRE			2.0			-0.24			1.7
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	23.2	2.2		-6.1	-3.0		17.1	-0.8	
HGB	16.0	1.5		-8.5	-4.4		7.5	-2.9	
FRE			6.5			-0.24			6.3

Source: AECOM, 2020.

Table E3.2-20: Net General Conformity Emissions – 2040 (FSL)									
	Train Operation Emissions (tons)			Vehicle Emissions Reduction (TPY)			Net Emissions (TPY)		
NAA	NOx	VOC	SO_2	NOx	VOC	SO_2	NOx	VOC	SO_2
Assumption 1 – Uniform ERCOT Power									
DFW	2.3	0.4		-4.1	-3.1		-1.8	-2.7	
HGB	6.0	1.0		-5.8	-4.4		0.2	-3.4	
FRE			0.3			-0.20			0.01
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	10.3	1.7		-4.1	-3.1		6.2	-1.4	
HGB	6.8	1.1		-5.8	-4.4		1.0	-3.3	
FRE			1.1			-0.20			0.9

Source: AECOM, 2020.

SENSITIVITY OF OPERATIONAL EMISSIONS TO VEHICLE OCCUPANCY

One component in calculating the offsetting emissions reductions of reduced VMT is the vehicle occupancy, discussed earlier in the section titled “VEHICLE EMISSIONS REDUCTION”. The vehicle occupancy of 1.2 passengers per car used, was discussed in that section and came from the project-specific occupancy expected for passenger cars projected for traffic demand used for station planning. The number reflects the average number of train passengers expected to arrive by this mode of travel to the station. For the EIS analysis, conceptually this would reflect the numbers of passengers dropped off that would otherwise be using cars without the HSR. Because it was a project-specific projection, it was used.

Some public comments received on the DEIS asserted or implied that this vehicle occupancy was low, or some other higher-value alternate should have been used. At the time of the preparation of the DEIS, the occupancy was consistent with what was used in state transportation planning (1.25).[25,26] Actual surveyed vehicle occupancy in the state had fallen below 1.2 and leveled off by the 1990s, including in the Dallas-Fort Worth area according to State transportation planning documents that used the similar value for vehicle occupancy.[27,28] A newer state-specific vehicle occupancy rate was recommended and published in late 2017, after issuance of the DEIS was initiated.[29] This information, used for estimating roadway user delay costs, recommended a revision of the previous rate of 1.25 to 1.5 based on newer National Household Travel Survey data. In response to the public comments, a sensitivity analysis was performed with the recent published recommended state rate of 1.5. Although the occupancy of 1.2 is a project-specific value expected to be more reflective of the particular traveler profile of the targeted ridership, the sensitivity analysis was performed to see if the state-wide value would change conclusions about adverse air quality impacts for NEPA purposes.

[25] Thomas A. Williams, AICP, Byron Chigoy, Jeff Borowiec, Ph.D., Brianne Glover, J.D. Methodologies Used to Estimate and Forecast Vehicle Miles Traveled (VMT). July 2016. Texas A&M Transportation Institute (TTI), College Station, Texas. TTI Publication PRC 15-40 F.

[26] North Central Texas Council of Governments (NCTCOG). Mobility 2030: The Metropolitan Transportation Plan for the Dallas-Fort Worth Area, 2009 Amendment. 2009. NCTCOG, Arlington, Texas.

[27] ibid.

[28] Federal Highway Administration, Texas Department of Transportation, and North Texas Tollway Authority. Supplemental Draft Environmental impact Statement and Draft Section 4(f) Evaluation, Trinity Parkway, from IH-35E/SH-183 to US-175/SH-310, Dallas County, Texas. February 2009.

[29] Phil Lasley, PhD. Change in Vehicle Occupancy Used in Mobility Monitoring Efforts. August 2017. TTI Mobility Analysis Program, College Station, Texas.

The calculation methods for vehicle emissions discussed earlier in the section titled "VEHICLE EMISSIONS REDUCTION" were used, except that vehicle occupancy was changed to 1.5 passengers per vehicle. The change directly affects the numbers of vehicles making trips that would be assumed to be replaced by HSR use and therefore changes the VMT reduced. The resulting VMT and emissions are shown in **Tables E3.2-21a and b**. The train emissions are not affected by this change, and therefore, the previous results shown in **Table E3.2-6** were used to calculate the net emissions. The resulting net emissions are provided in **Table E3.2-21c**. In both the initial and future service level cases, there would continue to be reductions in all pollutants except NO_x and SO_2. The largest increase was to NO_x emissions since that pollutant is most influenced by car traffic increasing it from 30.8 TPY to 38.1 TPY in 2026 and 5.8 TPY to 10.5 TPY in 2040. However, total NO_x emissions would continue to be less than the de minimis threshold in both the DFW and HGB NAAs.

Table E3.2-21a: Vehicle Occupancy Sensitivity Analysis – 2026 Passenger Vehicle Emissions Reduction

Emissions (TPY)							
VMT	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
Houston Trip Emissions							
350,574,178	501.2	15.8	8.1	13.5	2.7	0.8	100,756
Dallas Trip Emissions							
308,428,648	410.0	13.3	6.5	11.9	2.4	0.7	87,639
TOTAL	911.2	29.1	14.6	25.4	5.1	1.5	188,395

Source: AECOM, 2020.

Table E3.2-21b: Vehicle Occupancy Sensitivity Analysis – 2040 Passenger Vehicle Emissions Reduction

Emissions (TPY)							
VMT	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
Houston Trip Emissions							
573,666,698	421.1	10.7	8.2	20.9	3.8	0.6	127,098
Dallas Trip Emissions							
504,701,302	350.5	8.9	6.7	18.4	3.3	0.6	110,551
TOTAL	771.6	19.6	14.9	39.3	7.1	1.2	237,649

Source: AECOM, 2020.

Table E3.2-21c: Vehicle Occupancy Sensitivity Analysis – Net Operational Emissions (TPY)

NO_x	**VOC**	**PM_{10}**	**SO_2**	**CO**	**$CO_{2eq.}$**
Year 2026 (Initial Service Level)					
38.1	(8.2)	(18.6)	59.5	(865.3)	(15,454)
Year 2040 (Future Service Level)					
10.5	(10.1)	(36.0)	8.5	(738.9)	(115,617)

Source: AECOM, 2020.

The same methods described in the section "Vehicle Emissions Reduction General Conformity Emissions" were also used to recalculate general conformity emissions assuming the occupancy of 1.5 passengers/vehicle. The resulting emissions are shown in **Tables E3.2-22a** through **c**. The vehicle emissions that can be eliminated are moderately reduced from when the 1.2 passenger/vehicle occupancy was used. As previously discussed, the train emissions are not affected by this change, and therefore, the previous results shown in **Tables E3.2-16** and **17** were used to calculate the net emissions under the two train power consumption assumptions. Results are provided in **Table E3.2-22d**. The conclusions are the same as those when the 1.2 passenger/ vehicle occupancy is used. Assuming the train draws uniformly from the ERCOT power grid, there would be net reductions in all pollutants, except for SO_2 in the FRE NAA. Assuming the train draws power from stations along the track evenly and stations and TMFs draw from plants in the counties of their location, net reductions in all pollutants except NO_x in the DFW NAA, and SO_2 in the FRE NAA were estimated. The increase in NO_x and SO_2 are again, comparatively negligible and well below the nonattainment thresholds of 50 TPY (NO_x) and 100 TPY (SO_2). Considering these results, the conclusions for impacts on NAA emissions are not sensitive to the vehicle occupancy.

Table E3.2-22a: Vehicle Occupancy Sensitivity Analysis – DFW NAA Vehicle Emissions Reduction

Emissions (TPY)	
NOx	**VOC**
ISL (2026)	
13.26	6.46
FSL (2040)	
8.90	6.68

Source: AECOM, 2020.

Table E3.2-22b: Vehicle Occupancy Sensitivity Analysis – HGB NAA Vehicle Emissions Reduction

HGB Emissions (TPY)	
NOx	**VOC**
ISL (2026)	
15.84	8.12
FSL (2040)	
10.75	8.22

Source: AECOM, 2020.

Table E3.2-22c: Vehicle Occupancy Sensitivity Analysis – FRE NAA Vehicle Emissions Reduction

FRE Emissions SO_2 (TPY)
ISL (2026)
0.48
FSL (2040)
0.40

Source: AECOM, 2020.

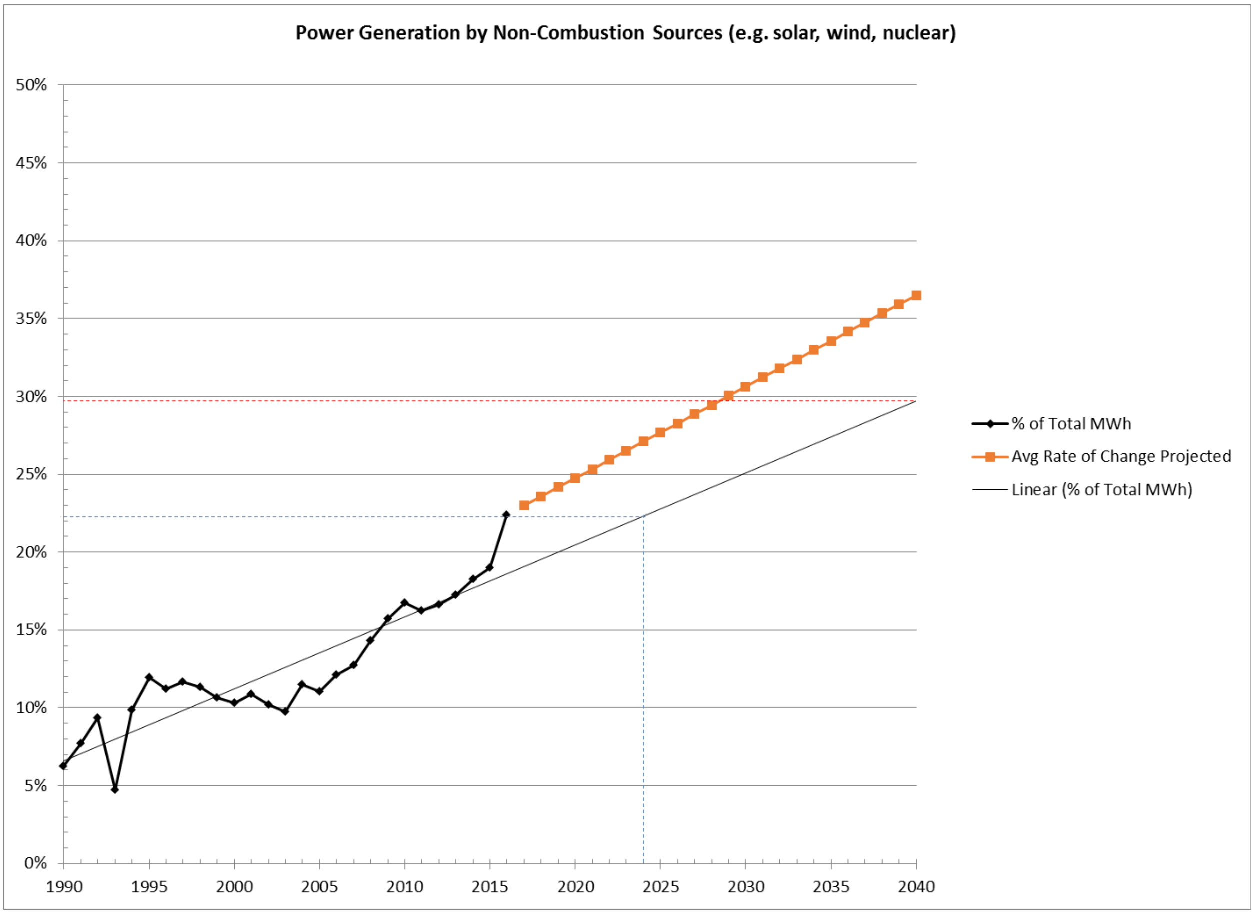
Table E3.2-22d: Vehicle Occupancy Sensitivity Analysis – Net General Conformity Emissions – 2026 (ISL)									
	Train Operation Emissions (tons)			Vehicle Emissions Reduction (TPY)			Net Emissions (TPY)		
NAA	NOx	VOC	SO_2	NOx	VOC	SO_2	NOx	VOC	SO_2
Assumption 1 – Uniform ERCOT Power									
DFW	5.0	0.5		-13.3	-6.5		-8.3	-6.0	
HGB	13.1	1.2		-15.8	-8.1		-2.7	-6.9	
FRE			4.0			-0.48			3.5
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	23.2	2.2		-13.3	-6.5		9.9	-4.3	
HGB	16.0	1.5		-15.8	-8.1		-0.2	-6.6	
FRE			6.5			-0.48			6.0

Source: AECOM, 2020.

Table E3.2-22e: Vehicle Occupancy Sensitivity Analysis – Net General Conformity Emissions – 2040 (FSL)									
	Train Operation Emissions (tons)			Vehicle Emissions Reduction (TPY)			Net Emissions (TPY)		
NAA	NOx	VOC	SO_2	NOx	VOC	SO_2	NOx	VOC	SO_2
Assumption 1 – Uniform ERCOT Power									
DFW	2.3	0.4	0	-8.9	-6.7		-6.6	-6.3	
HGB	6.0	1.0	0	-10.8	-8.2		-4.8	-7.2	
FRE	-	-	0.3			-0.40			-0.1
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	10.3	1.7	0	-8.9	-6.7		1.4	-5.0	
HGB	6.8	1.1	0	-10.8	-8.2		-4.0	-7.1	
FRE	-	-	1.1			-0.40			0.7

Source: AECOM, 2020.

Figure 1: Texas Power Generation by Non-Combustion Sources



Source: EIA, Table 5 Electric power industry generation by primary energy source, 1990 through 2016 for State of Texas

Figure 2

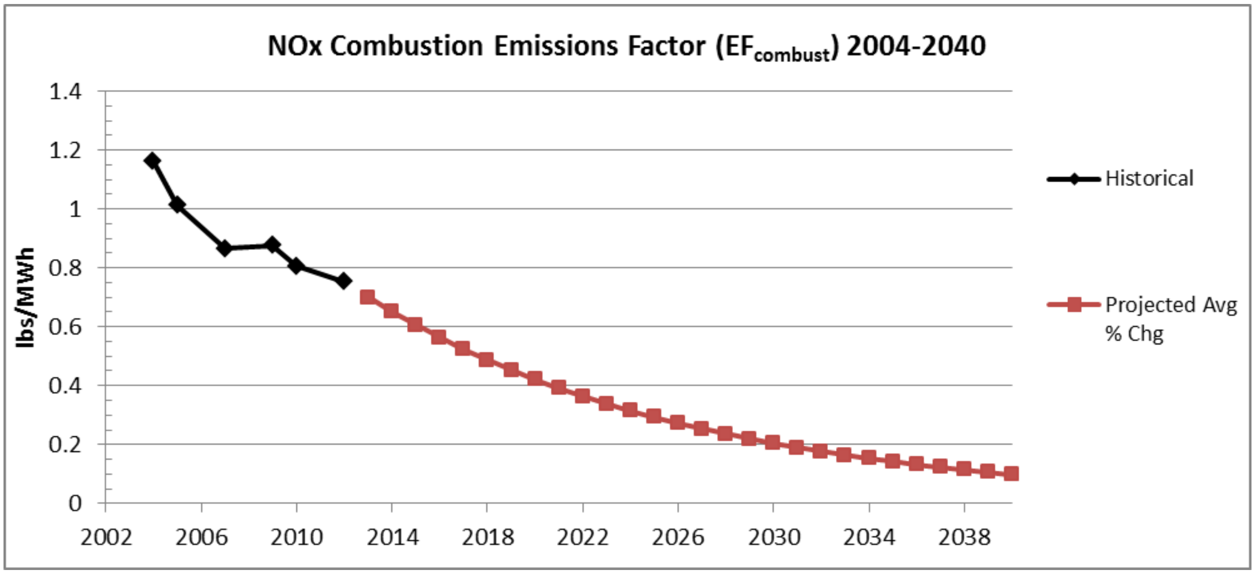


Figure 3

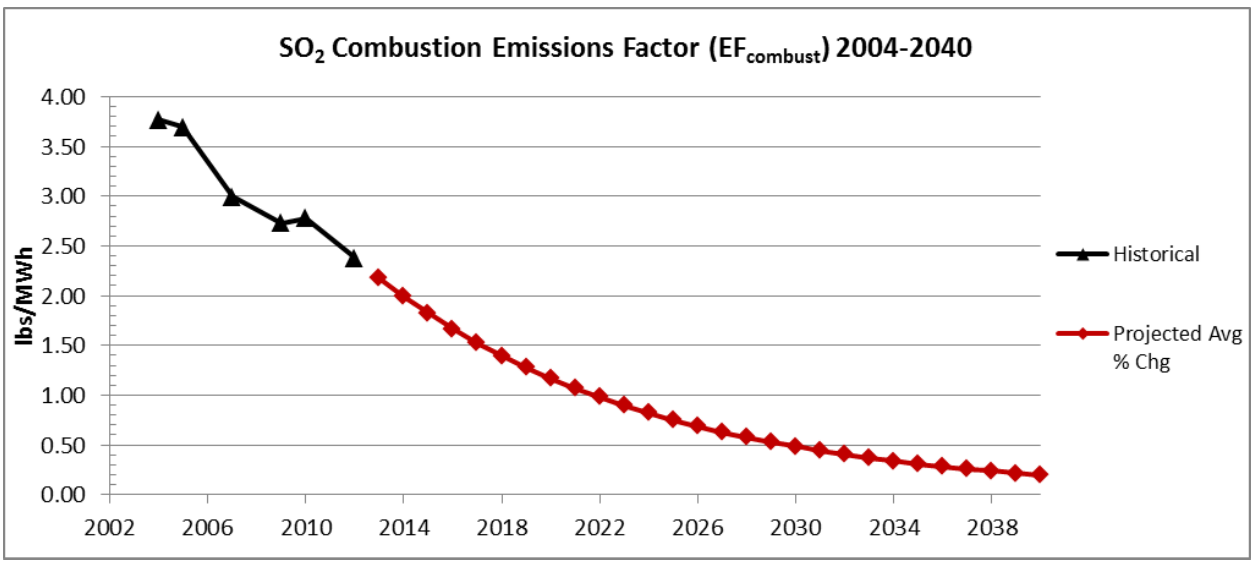


Figure 4

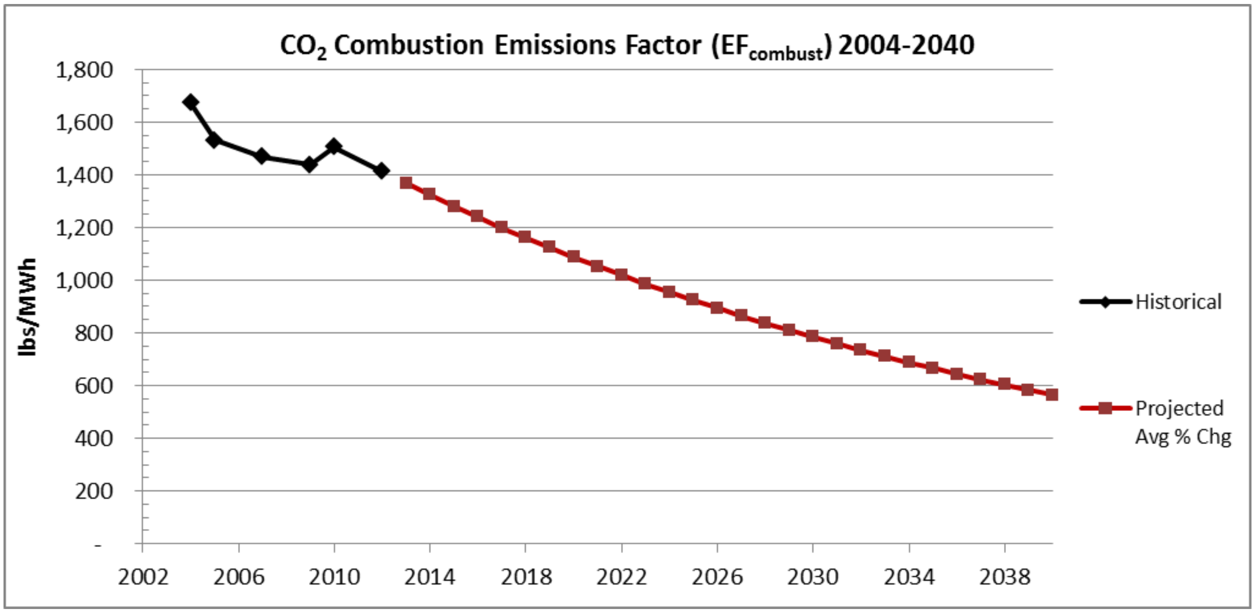


Figure 5

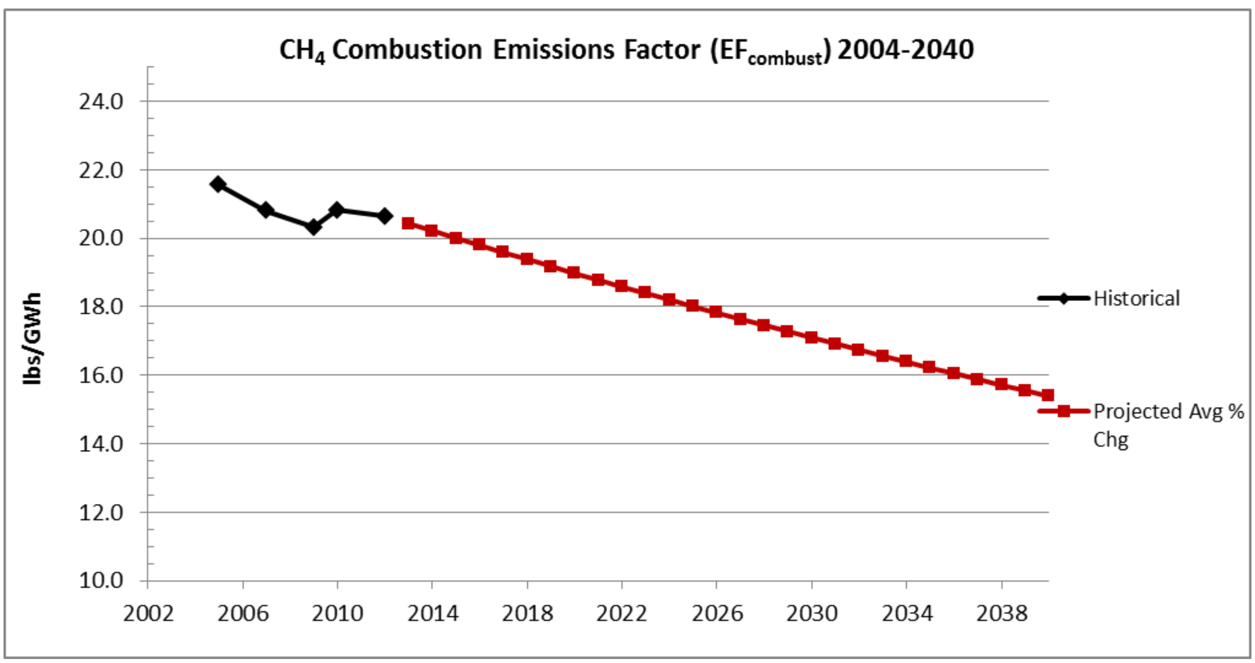


Figure 6

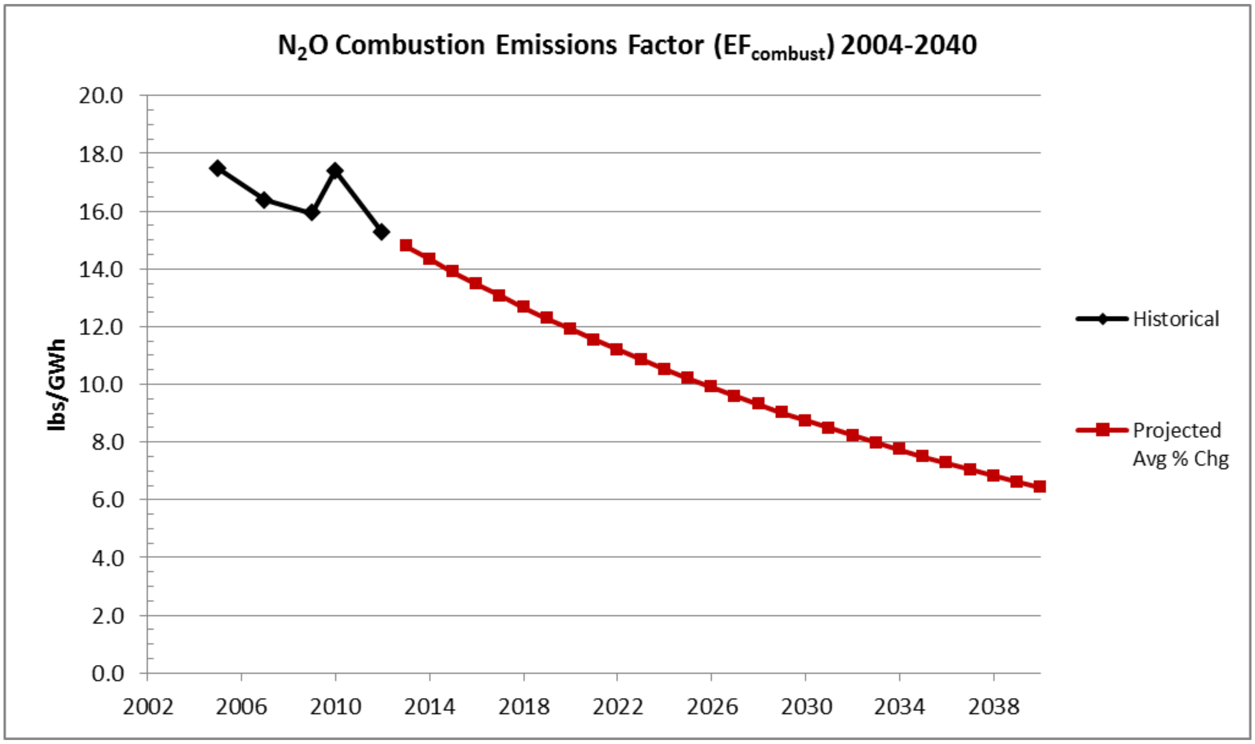


Figure 7

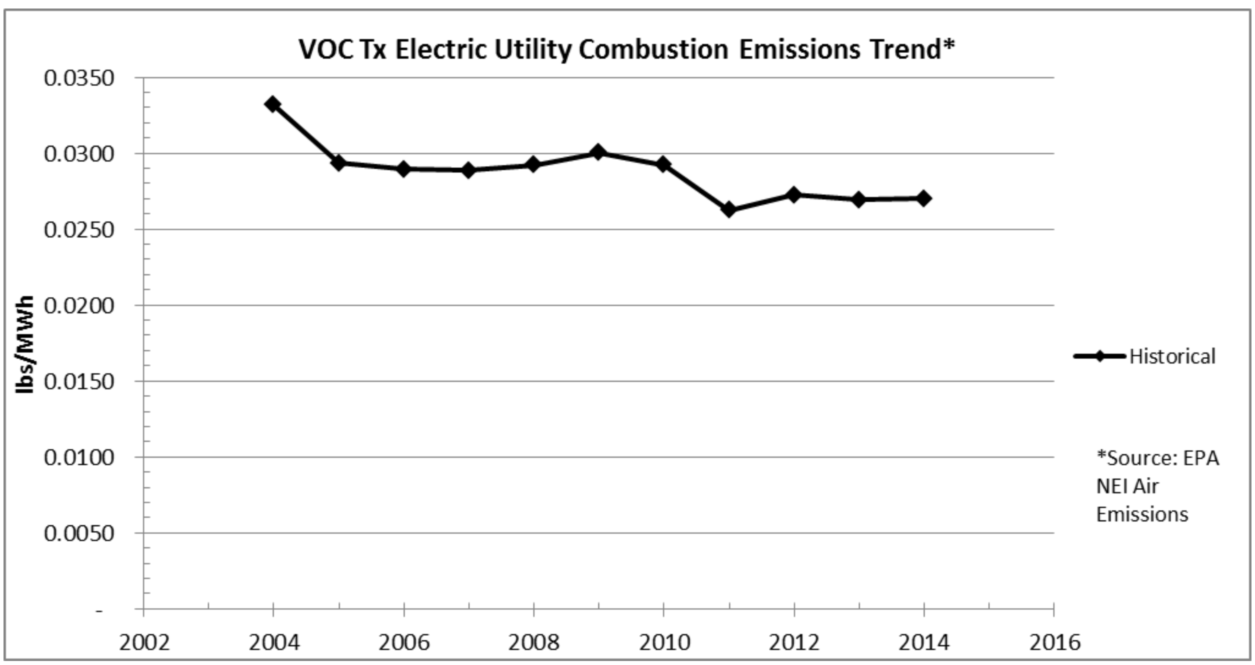


Figure 8

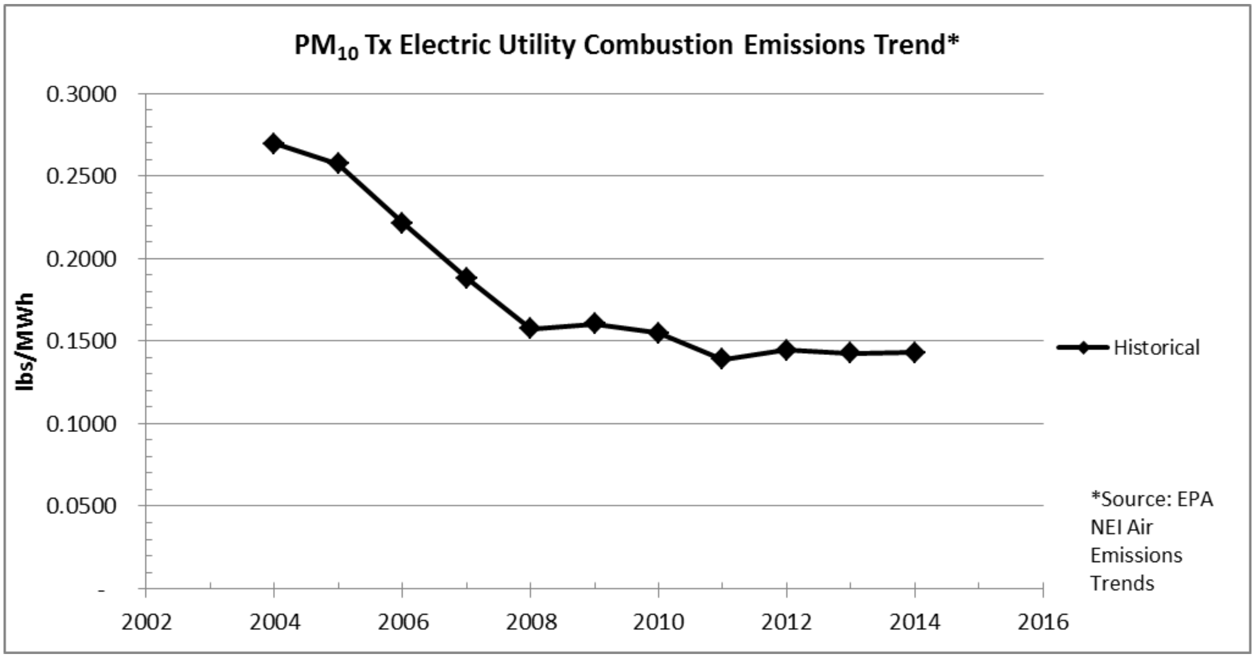
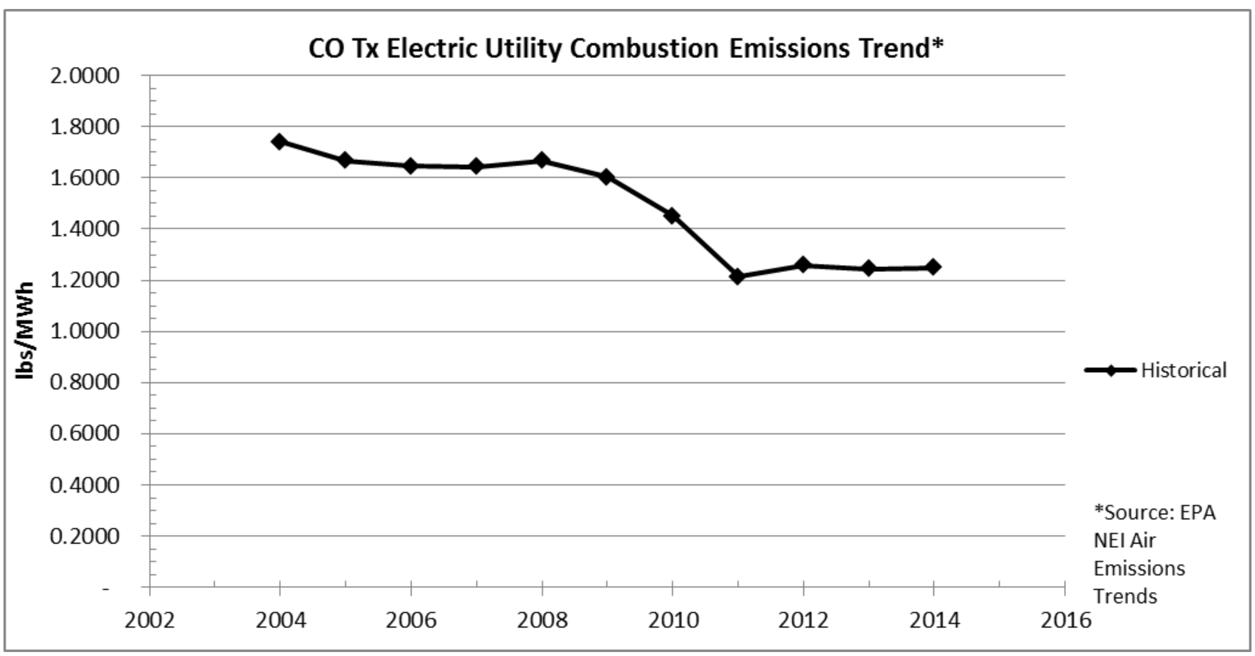


Figure 9



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AECOM

TECHNICAL MEMORANDUM
NOISE AND VIBRATION

To: Kevin Wright, FRA

From: Lance Meister and David Towers, Cross Spectrum Acoustics

Date: December 17, 2019

RE: Dallas to Houston HSR –Noise and Vibration

---

1 INTRODUCTION

This technical report describes the existing noise and vibration conditions and impact analysis for operation and construction of the Dallas to Houston High-Speed Rail (HSR) Project along six alternative routes (A-F) through ten counties between Dallas and Houston, TX. Sensitive receptors or receivers along these routes include residential and institutional sites.

1.1 Regulatory Context

Several federal laws and guidelines are relevant to the assessment of ground transportation noise impacts:

- FRA Railroad Noise Emission Compliance Regulations (49 C.F.R.§ 210) prescribes minimum compliance regulations for enforcement of the Railroad Noise Emission Standards established by the Environmental Protection Agency in 40 C.F.R. Part 201
- The Noise Control Act of 1972 (42 U.S.C.§ 4910) was the first comprehensive statement of national noise policy. It declared "it is the policy of the U.S. to promote an environment for all Americans free from noise that jeopardizes their health or welfare."
- HUD Environmental Standards (24 C.F.R. Part 51) establishes standards for noise exposure used to assess the suitability of sites for new residential development
- OSHA Occupational Noise Exposure; Hearing Conversation Amendment (FR 48 (46), 9738—9785) establishes noise exposure limits in the workplace
- EPA Railroad Noise Emission Standards (40 C.F.R. Part 201) establishes standards for noise emissions from railroads

For vibration, federal standards for safe vibration levels for residential buildings are limited to the safe blasting levels established by the U.S. Bureau of Mines (USBM RI 8507).

There are no state-wide noise or vibration regulations that apply to transportation systems. The TxDOT *Guidelines for Analysis and Abatement of Roadway Traffic Noise* applies to vehicular traffic. Texas does not have separate guidance for rail noise and vibration.

Local noise and vibration regulations are contained in city ordinances and general plans. Although noise and vibration from transportation systems are typically exempt from local regulations, noise and vibration from project construction activities and stationary sources (e.g., traction power substations) shall comply with the following local regulations:

1.1.1 City of Dallas

Ordinance No. 19455 in Part II of the Dallas Development Code (Chapter 51A, Article VI) includes environmental performance standards for both noise and vibration. Section 51A-6.102 of the ordinance specifies noise limits based on zoning district and time of day in terms of Leq averaged over an eight-minute period of time. For residential districts, the limits are 56 dBA during daytime hours (7 AM – 10 PM) and 49 dBA during nighttime hours (10 PM – 7 AM) on the bounding lot line, which would apply to stationary sources. Although there are no specific noise limits for construction activities, Chapter 30 of the Dallas Code of Ordinances restricts construction activity to the hours between 7 AM and 7 PM, Monday through Friday, and between 8 AM and 7 PM on Saturdays and legal holidays. In addition, Section 51A-6.105 of Ordinance 19455 includes property-line vibration standards based on frequency and ground displacement that could be applied to construction activities.

1.1.2 City of Lancaster

Ordinance #2006-04-13 of the Lancaster Development Code includes environmental performance standards for both noise and vibration. Section 14.704 of the ordinance specifies noise limits of 56 dBA during daytime hours (7 AM – 7 PM) and 49 dBA during nighttime hours (7 PM – 7 AM) near property lines, which could be applied to stationary sources. Although there are no specific noise limits for construction activities, such noise is restricted to the hours between 6 AM and 9 PM. In addition, Section 14.708 of the ordinance includes property-line vibration standards based on frequency and ground displacement that could be applied to construction activities.

1.1.3 City of Wilmer

Section 8.06 of the Wilmer Code of Ordinances includes property-line limits on environmental sound levels from stationary sources in terms of A-weighted, statistical percentile noise metrics measured over a 10-minute to 30-minute period. These metrics include the L_1 (level exceeded 1 percent of the period), the L_{10} (level exceeded 10 percent of the period) and the L_{90} (level exceeded 90 percent of the period). The L_1 (near maximum) noise level from stationary sources is limited to 15 dBA above the ambient L_{90} (background) noise level. There are also L_{10} and L_{90} limits based on land use and time of day. For residential land use, the L_{10} and L_{90} limits are 65 dBA and 55 dBA, respectively, during daytime hours (7AM – 10 PM) and 60 dBA and 50 dBA, respectively, during nighttime hours (10 PM – 7 AM). For construction work, the L_{10} and L_{90} limits are 85 dBA and 75 dBA, respectively, at any time.

1.1.4 City of Houston

Chapter 30 of the City of Houston Code of Ordinances specifies noise limits of 65 dBA and 58 dBA at residential property lines for daytime and nighttime periods, respectively. However, noise from railroad equipment on railroad ROWs is exempted. Noise from construction between the hours of 7 AM and 8 PM is also exempted, provided the noise levels do not exceed 85 dBA at residential property lines.

1.2 Overview

For the No Build Alternative, existing sources throughout the study area (e.g. highways and freight trains) would continue to generate noise and vibration in the future. In addition, noise and vibration levels may increase, depending on changes in highway and rail traffic as well as the construction of any new transportation facilities unrelated to the Project. While there is insufficient information currently available to determine if there would be any noise or vibration impacts in the future from these and other sources, any significant projects that might be included in the No Build Alternative would have a separate environmental assessment to determine noise or vibration impacts and potential mitigation measures, if required.

As a summary of the assessment for the Build Alternatives with no mitigation, **Table 1-1** provides a comparison of the projected noise and vibration impacts from HSR operations by Build Alternative and land use. As shown in the table, HSR operations are projected to result in severe noise impacts at 9-12 residences and moderate noise impacts at 275-295 residences, depending on the route. In addition, moderate noise impact is predicted at one institutional site for all alternatives. No vibration impact is predicted from HSR operations for any of the Build Alternatives, and no noise or vibration impacts are anticipated due to activities at any of the proposed train station locations.

Table 1-1: Comparison of Noise and Vibration Impacts by Build Alternative

Type of Impact		Alt A	Alt B	Alt C	Alt D	Alt E	Alt F
Severe Noise Impact	Residential	10	12	10	9	11	9
	Institutional	0	0	0	0	0	0
Moderate Noise Impact	Residential	280	290	275	285	295	280
	Institutional	1	1	1	1	1	1
Vibration Impact	Residential	0	0	0	0	0	0
	Institutional	0	0	0	0	0	0

Source: Cross-Spectrum Acoustics, 2019

With regard to the effects of noise from passing trains on animals, noise impact would be expected to occur only within about 15 feet from the tracks for HSR trains operating on viaduct at the maximum speed of 205 mph. Because no animals would be this close to the tracks, noise impact on wildlife is not anticipated. Similarly, increased annoyance due to the startle effect of noise from rapidly passing trains at the maximum train speed of 205 mph would only occur within about 45 feet from the tracks, which is within the ROW. Therefore, increased noise annoyance due to startle should not be an issue.

In terms of HSR noise mitigation, the results of the assessment indicate that that the impact locations tend to be scattered geographically such that the use of sound barriers as a practical mitigation measure may be limited. However, the application of sound barriers at specific locations will be investigated as the engineering design advances and the alternatives are refined. Where sound barriers are not practical, building sound insulation would be the most likely noise mitigation alternative.

The results of the vibration impact assessment indicate that no impacts are projected from HSR operations. Therefore, no operational vibration mitigation is required.

During Project construction, the potential for noise impact at residential sites would extend to distances of 40-200 feet from daytime construction and to distances of 125-630 feet from nighttime construction, depending on the activity. Although some activities may cause noticeable ground-borne vibration, it is unlikely that such activities would occur close enough to buildings to have significant damage effects.

However, where activities such as pile driving and vibratory compaction would occur very close to underground utilities, TCRR would coordinate with the utilities to identify where mitigation measures (e.g. relocation and/or encasement of pipelines) would be needed to avoid damage and would then compensate the utilities. Otherwise, there is the potential for vibration annoyance or interference with the use of sensitive equipment at locations up to 500 from certain construction activities. To mitigate potential construction noise and vibration impacts, construction activities will be carried out in compliance with all applicable local regulations and appropriate mitigation measures will be applied.

2 NOISE AND VIBRATION CONCEPTS

This section describes the characteristics of transportation-related noise and vibration and the associated noise and vibration metrics.

2.1 Noise

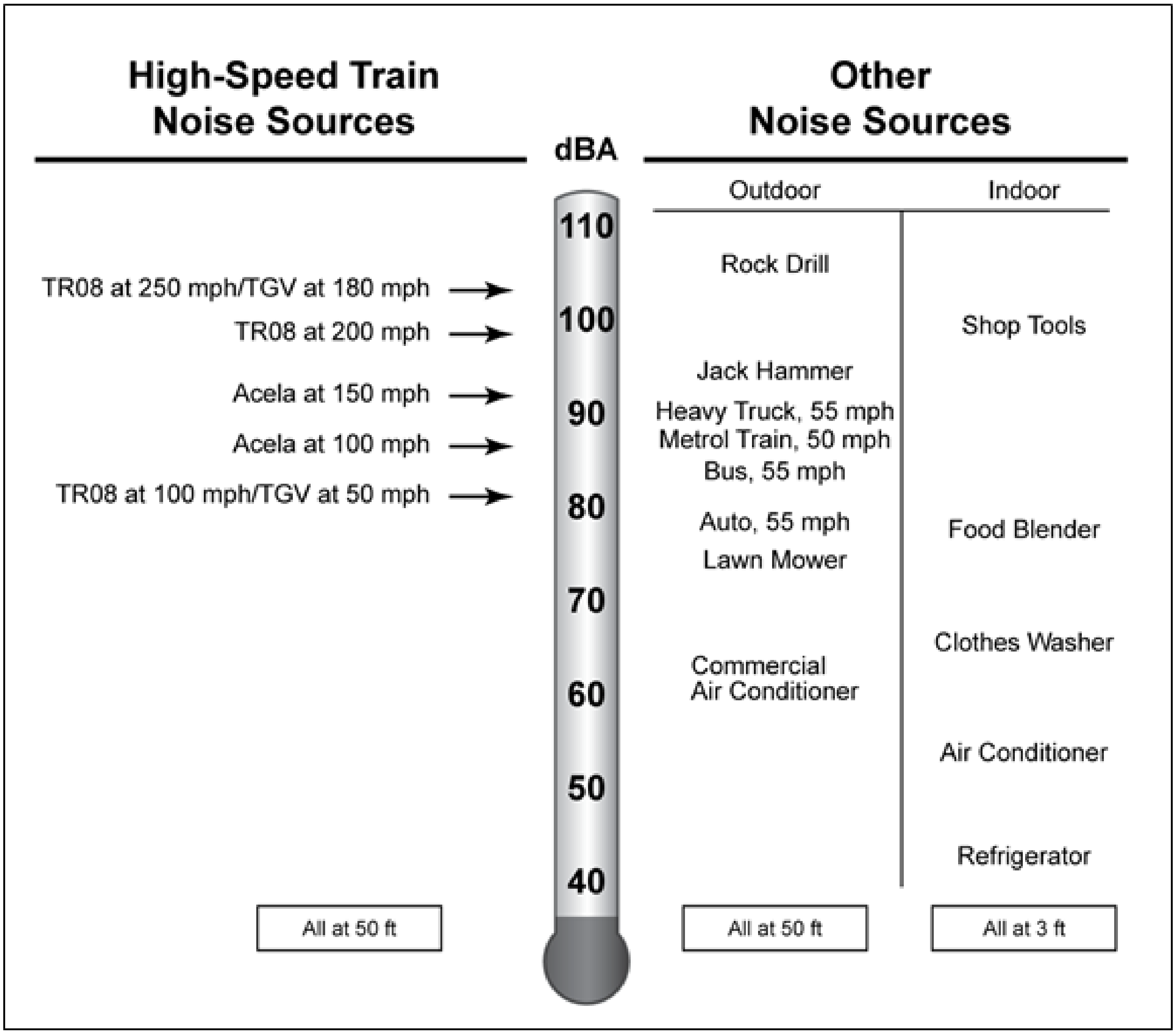
2.1.1 Noise Fundamentals and Descriptors

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally defined as unwanted or excessive sound. Environmental noise sources may include traffic, aircraft, industrial activities, other human activity, or sounds in nature. Distant sources of noise combine to create background noise. Background noise may be fairly constant from moment to moment and varies gradually from hour to hour as the activity levels of the distant noise sources change. Superimposed on the background noise is a succession of identifiable noisy events of relatively brief duration that are either near to a receiver or are of sufficiently high amplitude to dominate the noise environment at a location. Examples include the passing of a train, the over-flight of an airplane, the sound of a horn or siren, the barking of a dog, landscape maintenance activities, or the screeching of brakes. The descriptors used in the measurement of noise environments are summarized below.

Sound can vary in intensity by over one million times within the range of human hearing. Because the range of actual sound pressures is so large (e.g. the sound pressure of a painful sound can be over one million times the sound pressure of the quietest sound that a human can hear), sound intensity is normally presented in a more manageable range by using the ratio between the sound pressure of the source of interest (e.g., passenger and freight trains) or background noise and a reference pressure (which approximates the quietest sound that a human can hear), and expressing this ratio in logarithmic form. The basic unit for measuring environmental sound levels is the decibel (dB).

Sound is characterized by both its amplitude and frequency (or pitch). The human ear does not hear all frequencies equally. In particular, the ear deemphasizes low and very high frequencies. In the 1930s, acoustical scientists studied the way that humans hear various sounds and developed response characteristics to represent the sensitivity of a typical ear. The “A” curve or “A-weighting scheme” represents the sensitivity of the human ear to various frequencies of environmental noise. A-weighting tends to deemphasize sounds of very low or very high frequencies and emphasize sound at middle frequencies. Sound levels that have been weighted according to the A-curve are expressed as A-weighted decibels (dBA). On this scale, the human range of hearing extends from approximately 3 dBA to around 140 dBA. **Figure 2–1** presents examples of A-weighted sound levels from high-speed train sources and common indoor and outdoor sounds.

Figure 2-1: Typical A-Weighted Sound Levels



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

As noted above, sounds in the environment constantly change. Various noise descriptors have been developed to allow the comparison of different types of environmental noise and to define noise emissions. The descriptors used in this report are described below:

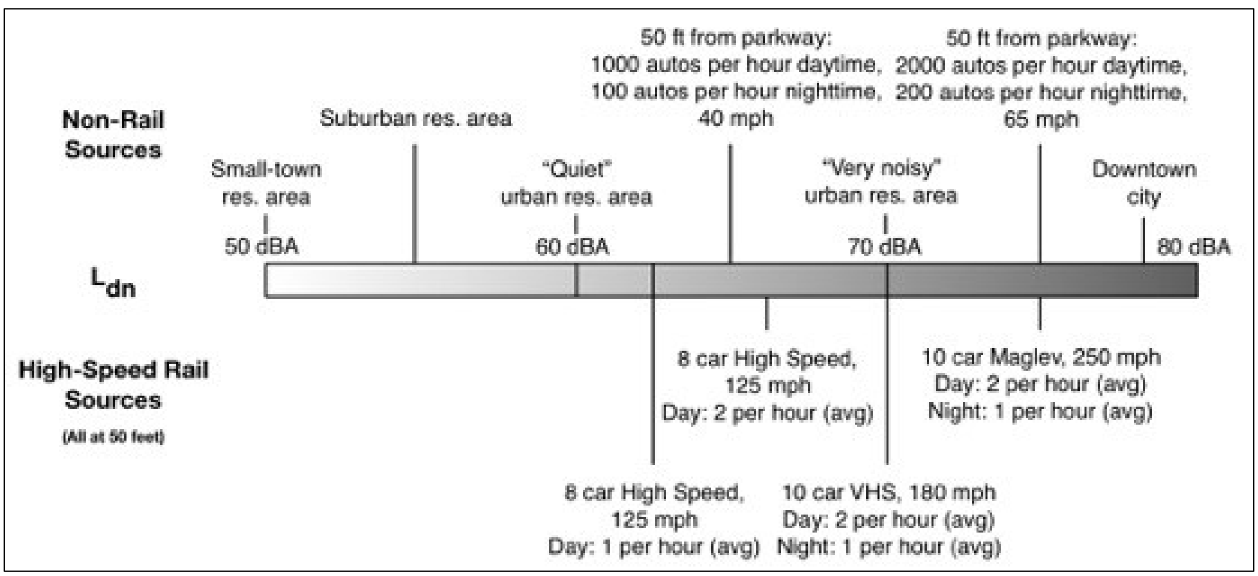
Maximum Sound Level (Lmax): The Lmax is the highest noise level achieved during a noise event or measurement period. Standard sound level meters have two settings, FAST and SLOW, which represent different time constants. For trains, Lmax measured using the FAST setting will typically be 1 to 3 dB greater than Lmax using the SLOW setting. Lmax values expressed in this report refer to the SLOW setting, which uses a time constant of 1 second.

Sound Exposure Level (SEL): The SEL describes a receiver's cumulative noise exposure from a single noise event. It is represented by the total A-weighted sound energy during the event, normalized to a one-second interval. It is the primary descriptor for low- and high-speed rail vehicle noise emissions and is also a useful intermediate quantity for estimating the Leq and Ldn due to train pass-bys.

Equivalent Sound Level (Leq): Leq describes a receptor's cumulative noise exposure from noise events that occur during a specified period of time. It is sometimes referred to as the energy-average sound level. The Leq represents a constant sound that, over a specified period, has the same sound energy as the time-varying sound. The Hourly Equivalent Sound Level, Leq(h), is a measure of the accumulated sound exposure over a full hour. The Federal Highway Administration (FHWA) uses the peak traffic Leq(h) as the metric for establishing highway noise impact. The Federal Railroad Administration (FRA) uses Leq(h) to evaluate potential noise impacts to institutional land uses and to land uses where serenity and quiet are essential.

Day-Night Sound Level (Ldn): Ldn describes the cumulative noise exposure from those noise events that occur within a 24-hour period, with noise levels between 10 p.m. and 7 a.m. increased by 10 dB to account for greater nighttime sensitivity to noise. The effect of the penalty is that, when calculating Ldn, any event that occurs during the nighttime is equivalent to 10 of the same events during the daytime. Ldn is the most common measure of total community noise over a 24-hour period and is used by the Federal Railroad Administration (FRA) to evaluate potential noise impacts from proposed high-speed train projects at residential locations. Typical Ldn values for high-speed rail and non-rail sources are shown in **Figure 2-2**.

Figure 2-2: Typical Ldn Values

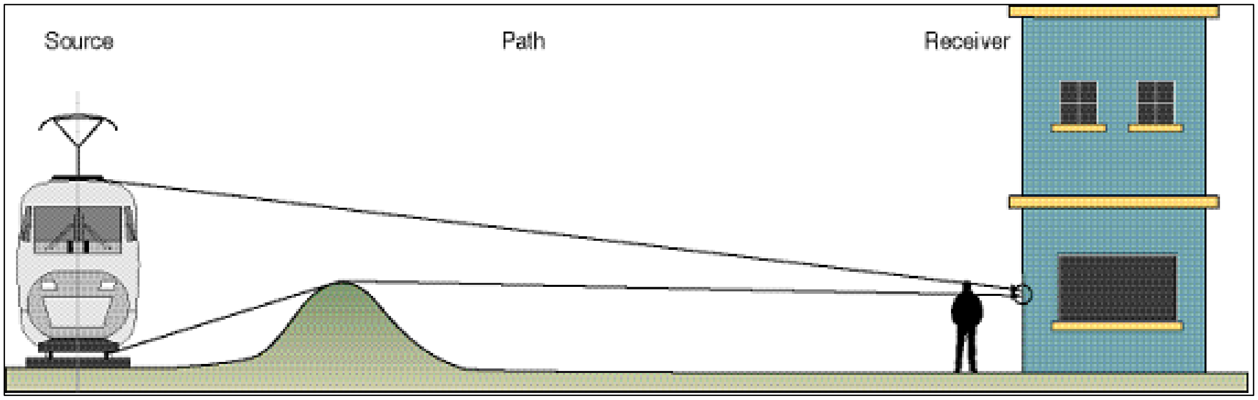


Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

2.1.2 Transportation Noise

Highways and rail lines tend to be the most dominant noise sources when located in a typical community environment. Each source has distinctive noise characteristics with regard to both pitch and amplitude. Within the project area, areas along both sides of the proposed alignment would be exposed to existing highway and rail noise. Noise from a source can be evaluated in terms of a Source-Path-Receiver framework, as illustrated in **Figure 2–3**, in which the source of noise is a train moving on its tracks. The path describes the intervening course between the source and the receiver, wherein the noise levels are reduced by distance, topographical and man-made obstacles, reflections from surfaces, atmospheric effects, and other factors. At each receiver, the noise from all sources and source paths combines and comprises the noise environment at that location.

Figure 2-3: Source-Path-Receiver



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

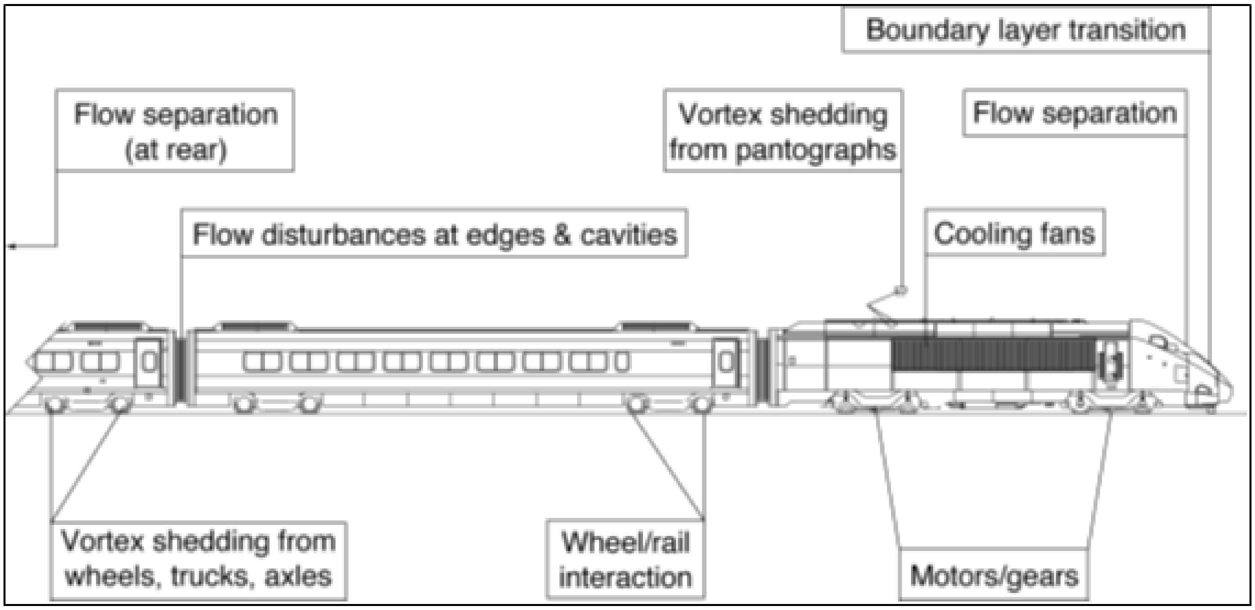
The noise from a train moving on its tracks is produced by several individual noise-generating mechanisms, each with its own characteristics (in terms of location, intensity, frequency content, directivity, and speed dependence) that depend on the train type. The most common train types include freight, commuter rail, light rail and high-speed rail. Conventional train noise sources would include locomotives, wheel/rail interaction, and audible warning devices at grade crossings, including train horns and warning bells.

For high speed rail, train noise characteristics are speed-dependent. For speeds below about 40 miles per hour (mph), referred to as Regime I by FRA guidance, noise emissions are dominated by the propulsion units, cooling fans, and under-car and top-of-car auxiliary equipment, such as compressors and air conditioning units.

In the speed range from 60 mph to about 150 mph, referred to as Regime II, mechanical noise, resulting from wheel/rail interaction and structural vibrations, dominates the noise emission from trains. In the project area, existing trains seldom exceed 79 mph; therefore, this speed range is the top end of noise characteristics for trains with which most people are familiar.

The aerodynamic noise component begins to be an important factor when the train speed exceeds about 160 mph (referred to as Regime III). Aerodynamic noise is generated from high-velocity airflow over the train. For a conventional steel-wheeled train, the components of aerodynamic noise are generated by unsteady flow separations at the front and rear of the train and on structural elements of the train (mainly in the regions encompassing the trucks, the pantograph, inter-coach gaps, and discontinuities along the surface), and a turbulent boundary layer generated over the entire surface of the train. The distribution of noise sources on a typical high-speed train is shown in **Figure 2–4**.

Figure 2-4: High-Speed Train Noise Sources



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Noise from trains also depends on the type and configuration of the track structure. Typical noise levels refer to conventional rail operations at grade on ballast and tie track. For trains on elevated structures, train noise is increased, partially due to the loss of sound absorption by the ground and partially due to extra sound radiation from the bridge structure. Moreover, the sound from trains on elevated structures spreads about twice as far as it does from at-grade operations of the same train, because the sound source is higher above the ground and, therefore, is less affected by ground attenuation and shielding.

Horns are an example of a train noise source that is dominant at any train speed. Audible warning devices at grade crossings, including train horns and warning bells, are a common feature of conventional trains and a vital safety component of railroad operations. Persons living near railroad tracks often find horns to be annoying.

Another source of potential annoyance is wheel squeal that is produced by wheel-rail interaction, particularly on a curve where the radius of curvature is smaller than 100 times the truck length. According to the predecessor to FTA, a typical truck length for freight trains of about 5-1/2 feet (1.7 meters) and radius of curvature greater than 560 feet (170 meters) would not be expected to produce wheel squeal. Wheel squeal is normally an issue with transit systems where small-radius curves often occur. Freight trains and modern high-speed train tracks are typically designed to minimize this occurrence by limiting track curvature and incorporating design features such as canting at the curve to reduce wheel flange contact with the rail.

Noise from road traffic is generated by a wide variety of vehicle types, makes, and models. In general, the noise associated with highway vehicles can be divided into three vehicle classes: automobiles, medium trucks, and heavy trucks. Each class has its own noise characteristics depending on vehicle type, speed, and the condition of the roadway surface. These noise characteristics have been documented by FHWA. The noise from nearby and distant arterial streets and highways is a major source of background sound in an urban/suburban environment.

2.2 Ground-borne Vibration

2.2.1 Vibration Fundamentals and Descriptors

Ground-borne vibration from trains refers to the fluctuating or oscillatory motion experienced by persons on the ground and in buildings near railroad tracks. Vibration can be described in terms of displacement, velocity, or acceleration. Displacement is the easiest descriptor to understand. For a vibrating floor, the displacement is simply the distance that a point on the floor moves away from its static position. Velocity represents the instantaneous speed of the floor movement, and acceleration is the rate of change of the speed. Although displacement is easier to understand, the response of humans, buildings, and equipment to vibration is more accurately described using velocity or acceleration.

Two methods are used for quantifying vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV often is used in monitoring of blasting vibration, since it is related to the stresses experienced by buildings.

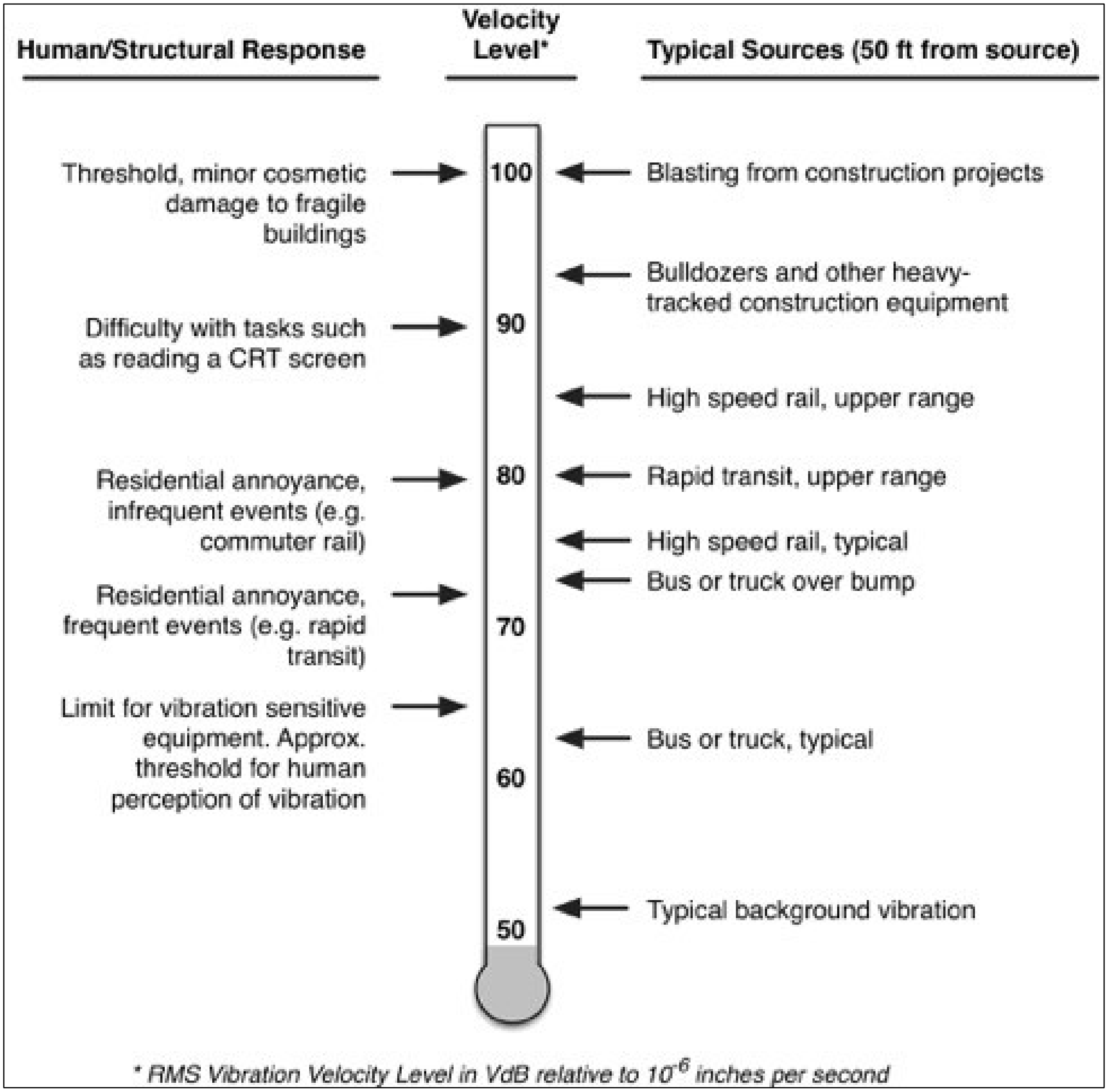
Although PPV is appropriate for evaluating the potential of building damage, it is not suitable for evaluating human response. It takes some time for the human body to respond to vibration impulses. In a sense, the human body responds to an average of the vibration amplitude. Because the net average of a vibration signal is zero, the root mean square (RMS) amplitude is used to describe the "smoothed" vibration amplitude.

PPV and RMS velocities are normally described in inches per second in the U.S. and in meters per second in the rest of the world. Although it is not universally accepted, decibel notation is in common use for vibration. Decibel notation compresses the range of numbers required to describe vibration. Vibration levels in this report are referenced to 1 x 10-6 inches per second (in/sec). Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Common vibration sources and human and structural response to ground-borne vibration are illustrated in **Figure 2-5**. Typical vibration levels can range from below 50 VdB to 100 VdB (0.000316 in/sec to 0.1 in/sec). The human threshold of perception is approximately 65 VdB.

Ground-borne noise is a low-volume, low-frequency rumble inside buildings, resulting when ground vibration causes the flexible walls of the building to resonate and generate noise. Ground-borne noise is normally not a consideration when trains are elevated or at grade. In these situations, the airborne noise usually overwhelms ground-borne noise, so the airborne noise level is the major consideration. However, ground-borne noise becomes an important consideration where there are sections of the corridor that are in a tunnel or where sensitive interior spaces are well-isolated from the airborne noise. In these situations, airborne noise is not a major path and ground-borne noise becomes the most important path into the building. Ground-borne noise may also need to be considered in cases where the airborne noise from a project is mitigated by a sound wall.

Figure 2-5: Typical Levels of Ground-borne Vibration



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

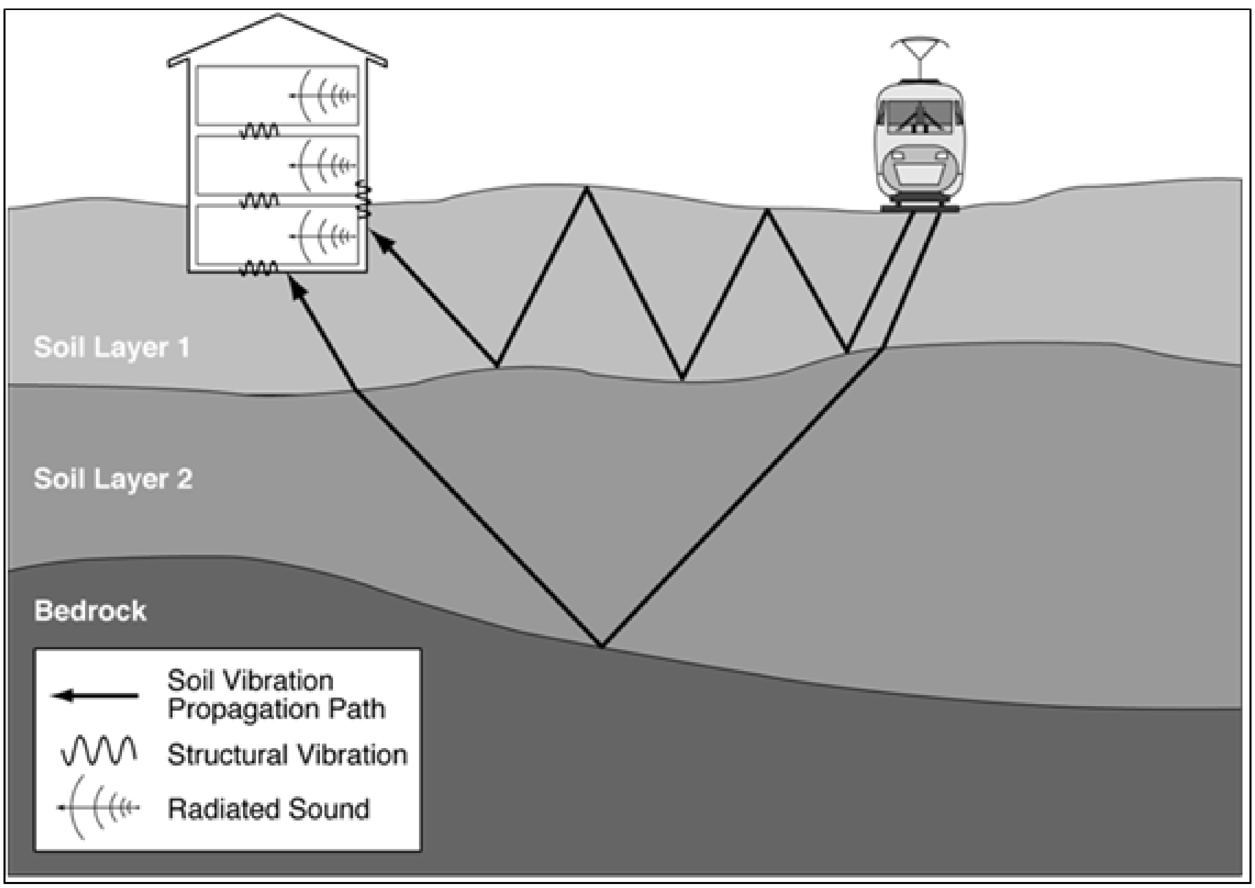
2.2.2 Transportation Vibration

The interaction of steel wheels rolling on steel rails causes vibration that is transmitted through the ground and into nearby buildings. Of concern to many building occupants is that the resulting building vibration could damage the building structure. In fact, the vibration from steel wheel/steel rail systems is almost always well below the vibration thresholds used to protect even fragile historic buildings from minor cosmetic damage. However, there are several different ways in which the building vibration may be intrusive and annoying to building occupants. First, the vibratory motion of room surfaces may be felt. Second, the vibration may cause rattling of dishes and bric-a-brac on shelves, items hanging on walls, or windows. Third, the surfaces put into motion by ground-borne vibration will radiate sound that may be audible as a low-frequency rumbling noise that sometimes is akin to distant thunder.

The amount of energy generated by the wheels rolling on the track and then transmitted into the ground depends on factors such as the smoothness of the wheels and rails, the vehicle suspension system, and the track support system. The same speed-dependent vibration generation mechanisms are common to conventional and high-speed trains. Vibration levels increase with speed although the rate of the increase varies. A common assumption for high-speed trains is that the vibration levels are proportional to 20 times the logarithm of speed. For example, when train speed increases from 75 mph to 125 mph, the expected increase in ground-borne vibration is 4.4 VdB if all other conditions are the same.

As with noise, a source-path-receiver relationship exists for vibration. Vibration experienced at the receiver is a function of the magnitude of the source and the path that the vibration takes to get to the receiver, as shown in **Figure 2-6**. High-frequency vibration decays more rapidly than low-frequency vibration as the vibrational energy passes through the ground. Soil conditions have a strong influence on the attenuation of ground-borne vibration. For the purposes of high-speed rail assessments, vibration is reported in terms of vibration velocity level or VdB, which is the maximum RMS vibration velocity level using a decibel reference of 1µin/sec (1×10−6 in/sec).

Figure 2-6: Typical Vibration Propagation Paths



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

3 NOISE AND VIBRATION CRITERIA

Noise and vibration impact guidelines have been adopted by the FRA that prescribe methods for analyzing and assessing noise and vibration impacts. The impact criteria are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect. The FRA guidance manual provides noise and vibration criteria for both construction and operation as described below.

3.1 Construction Noise Impact Criteria

Table 3-1 presents the FRA general assessment criteria for construction noise. The criteria are given in terms of 1-hour Leq for residential, commercial and industrial land use. The 1-hour Leq is estimated by combining the noise levels from the two noisiest pieces of equipment, assuming they both operate at the same time during a one-hour period. The construction noise limits are normally assessed at the noise-sensitive receiver property line.

Table 3-1: FRA General Assessment Criteria for Construction Noise

Land Use	1-Hour Leq (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

3.2 Construction Vibration Impact Criteria

Guidelines in the FRA guidance manual provide the basis for the construction vibration assessment. FRA provides construction vibration criteria designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period. The FRA criteria include two ways to express vibration levels: (1) root-mean-square (RMS) VdB for annoyance and activity interference, and (2) peak particle velocity (PPV), which is the maximum instantaneous peak of a vibration signal used for assessments of damage potential.

To avoid temporary annoyance to building occupants during construction or construction interference with vibration-sensitive equipment inside special-use buildings, such as a magnetic resonance imaging (MRI) machine, FRA recommends using the long-term vibration criteria provided in **Table 3-5** and **pendolino** below in the section on operational vibration impact criteria.

Table 3-2 shows the FRA building damage criteria for construction activity; the table lists PPV limits for four building categories. These limits are used to estimate potential impacts that would require mitigation during construction.

Table 3-2: Construction Vibration Damage Criteria		
Building Category	**PPV (inch/sec)**	**Approximate L_v^***
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

S* RMS vibration velocity level in VdB relative to 1 micro-inch/second.
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

3.3 Operational Noise Impact Criteria

The U.S. Department of Transportation has published guidelines that establish procedures for analyzing and assessing noise and vibration impacts from rail projects. Noise impact criteria have been adopted by the Federal Transit Administration (FTA) to assess the contribution of noise from conventional rail systems to the existing environment and by the Federal Railroad Administration (FRA) to assess the contribution of noise from high-speed rail systems to the existing environment. These guidelines include impact criteria that are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect. The noise exposure is measured in terms of the Day-Night Sound Level (Ldn) for residential land uses or in terms of the hourly equivalent sound level (Leq(h)) for other land uses.

Ldn depends on the number of events during the day and night separately – and also on each event's duration, which is affected by vehicle speed. The FRA and FTA have adopted Ldn as the measure of cumulative noise impact for residential land uses (those involving sleep), because:

- L_{dn} correlates well with the results of attitudinal surveys of residential noise impact,
- L_{dn} increases with the duration of transit events, which is important to people's reaction,
- L_{dn} takes into account the number of transit events over the full 24 hours, which is also important to people's reaction,
- L_{dn} takes into account the increased sensitivity to noise at night when most people are asleep,
- L_{dn} allows composite measurements to capture all sources of community noise combined,
- L_{dn} allows quantitative comparison of transit noise with other types of community noises,
- L_{dn} is the designated metric of choice of other Federal agencies such as the Department of Housing and Urban Development (HUD), the Federal Aviation Administration (FAA), and the Environmental Protection Agency (EPA), and
- L_{dn} has wide international acceptance.

Hourly Leq is adopted by FRA and FTA as the measure of cumulative noise impact for non-residential land uses (those not involving sleep) because:

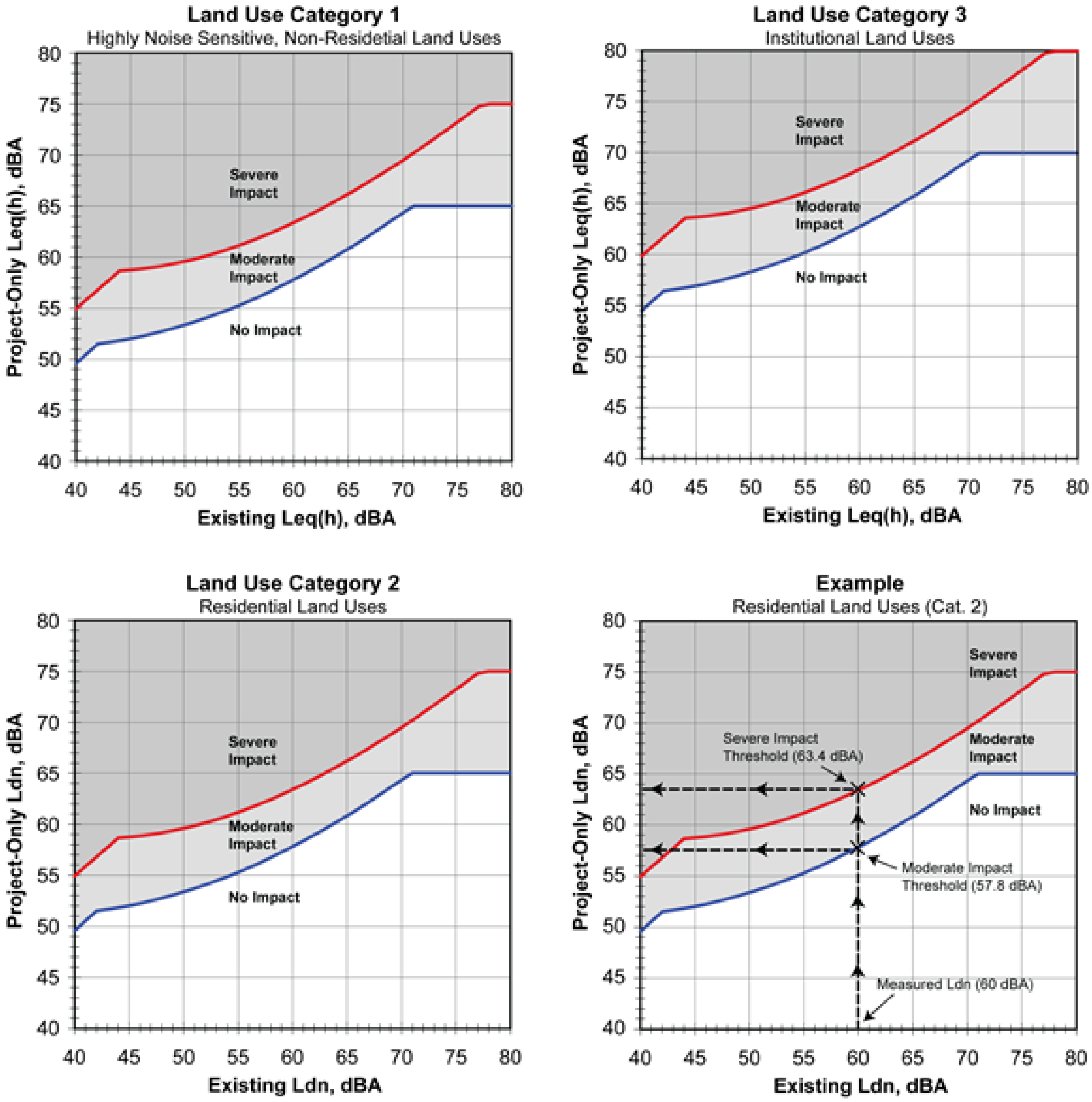
- L_{eq} correlates well with speech interference in conversation and on the telephone – as well as interruption of TV, radio, and music enjoyment,
- L_{eq} increases with the duration of events, which is important to people's reaction,
- L_{eq} takes into account the number of events over the hour, which is also important to people's reaction, and
- L_{eq} is used by the Federal Highway Administration in assessing highway-traffic noise impact.

Thus, the hourly Leq noise descriptor can be used to compare and contrast modal alternatives such as highway versus rail. Leq is computed for the loudest facility hour during noise-sensitive activity at each particular non-residential land use.

The noise impact criteria are defined by the two curves shown in **Figure 3-**1. These criteria are based on change in noise exposure using a sliding scale. Although higher project noise levels are allowed in areas with high levels of existing noise, smaller increases in total noise exposure are allowed with increasing levels of existing noise. Furthermore, the criteria curves incorporate a maximum limit for project noise. The FRA noise impact criteria include the following three levels of impact, as shown in **Figure 3-1**:

- **No Impact:** In this range, the proposed project is considered to have negligible impact since, on average, the introduction of the project will result in an insignificant increase in the number of people highly annoyed by the new project noise.
- **Moderate Impact:** At the moderate impact range, changes in the cumulative noise level are noticeable to most people, but may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation, such as the existing level, predicted increase over existing noise levels and the types and numbers of noise-sensitive land uses affected.
- **Severe Impact:** At the severe impact range, a significant percentage of people would be highly annoyed by the new project noise. Severe noise impacts are considered to be “significant” under NEPA, and should be avoided if possible. Noise mitigation should be applied for severe impacts where feasible.

Figure 3-1: Noise Impact Criteria for Transit and High-Speed Rail Projects



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

The magnitude of impact is assessed by comparing the project noise exposure to the existing noise exposure for three land use categories. Descriptions of these categories are given in **Table 3–3**. The noise exposure is measured in terms of Ldn for residential land uses and in terms of Leq(h) for other land uses. The exterior noise criteria are to be applied outside the building locations for residential land use and at either the property line or the nearest point of use for parks and other significant outdoor use. It is important to note that the criteria specify a comparison of future project noise with existing noise and not with projections of future "no-build" noise exposure.

Table 3–3: Federal Railroad Administration Land Use Categories and Metrics for High-Speed Train Noise Impact Assessments		
Land Use Category	**Noise Metric (dBA)**	**Land Use Category**
1	Outdoor $L_{eq}(h)^*$	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals where nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)^*$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

* Leq for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

The process of determining impact severity is to first determine land use from **Table 3–3**. The land use category determines the noise metric that should be used to determine level of impact (Ldn for Category 2, and Leq(h) for Category 1 and Category 3 land uses). The next step is to draw a vertical line at the value of the existing exterior noise exposure (including existing train traffic and all other community noise sources) for the property from the bottom axis of **Figure 3–1**. The impact thresholds are where the vertical line intersects the moderate and severe impact threshold curves.

The concept of a sliding scale for noise impact is difficult to grasp and may be clarified by the example illustrated in the bottom right graph in **Table 3–1**. Assume that the existing noise has been measured to be 60 dBA Ldn. This is the total noise from all existing noise sources over a 24-hour period: traffic, aircraft, lawn mowers, children playing, birds chirping, etc. Starting at 60 dBA on the horizontal axis, follow the vertical line up to where it intersects the moderate and severe impact curves. Then refer to the left axis to read off the impact thresholds. As shown in the example, an existing noise level of 60 dBA Ldn gives thresholds of 57.8 dBA Ldn for moderate impact and 63.4 dBA Ldn for severe impact. Note that the values are given in tenths of a decibel to avoid confusion from rounding off; in reality it is not possible to perceive a tenth of a decibel change in sound level.

The thresholds of 57.8 dBA and 63.4 dBA are for the project noise. If the predicted project noise is greater than 57.8 dBA Ldn, then there is moderate impact and noise mitigation must be considered. If the predicted project noise exceeds 63.4 dBA Ldn, then there is severe impact and, as discussed above, noise mitigation must be included in the project unless there are compelling reasons why mitigation is unfeasible.

To supplement the noise impact criteria in **Figure 3-1**, FRA provides guidelines for identifying noise-sensitive locations where increased annoyance can occur due to the sudden increase in noise (the startle effect) from the rapid approach of high-speed trains. This effect depends on the train speed and is confined to an area very close to the tracks. For example, 200 mph train operations would have the potential for increased annoyance within about 40 feet of the track centerline. Thus, the area where rapid onset rates of train noise may cause startle is typically within the right-of-way limits of the rail corridor.

FRA also addresses impacts on wildlife (mammals and birds) and domestic animals (livestock and poultry). Noise exposure limits for each are an SEL of 100 dBA from passing trains, as shown in **Table 3-4**.

Table 3-4: FRA Interim Criteria for Train Noise Effects on Animals			
Animal Category	**Class**	**Noise Metric**	**Noise Level (dBA)**
Domestic	Mammals (Livestock)	SEL	100
	Birds (Poultry)	SEL	100
Wild	Mammals	SEL	100
	Birds	SEL	100

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

3.4 Operational Vibration Impact Criteria

FRA vibration impact levels, expressed in terms of the maximum root-mean-square (RMS) vibration level, are affected by the receptor land-use category and the number of vibration events per day. The impact level also depends on the type of analysis being conducted (i.e., ground-borne vibration or ground-borne noise).

The FRA manual states that the vibration impact thresholds are based on the maximum vibration level (Lmax) as a train passes. Lmax is defined to be the maximum average vibration level over a 1-second interval using RMS averaging. Most studies of train vibration report the RMS average vibration level over the period when trains are passing the measurement position. A more rigorous definition is the RMS average vibration level between the points where the vibration level is greater than Lmax-3, which are also defined as the "3 dB down points." The RMS average vibration level is defined as Lplateau.

FRA provides guidelines to assess the human response to different levels of ground-borne noise and vibration. These are shown in **Table 3–5**. In addition, the guidelines provide criteria for special buildings that are sensitive to ground-borne noise and vibration. The impact criteria for these special buildings are shown in **Table 3–6**. The criteria depend on land use category as well as the frequency of the vibration events (e.g. train pass-bys). "Frequent Events" is defined as more than 70 vibration events per day, "Occasional Events" is defined as 30-70 vibration events per day while "Infrequent Events" is defined as less than 30 vibration events per day.

Table 3-5: Ground-borne Vibration and Noise Impact Criteria						
Land Use Category	**Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch /sec)**			**Ground-Borne Noise Impact Levels (dBA re 20 micro Pascals)**		
	Frequent Events	**Occasional Events**	**Infrequent Events**	**Frequent Events**	**Occasional Events**	**Infrequent Events**
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB*	65 VdB*	65 VdB*	N/A**	N/A**	N/A**
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

* This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. For equipment that is more sensitive, a Detailed Vibration Analysis must be performed.
** Vibration-sensitive equipment is generally not sensitive to ground-borne noise.
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Table 3-5 and **Table 3-6** include separate FRA criteria for ground-borne noise (the "rumble" that radiates from the motion of room surfaces in buildings from ground-borne vibration). Although the criteria are expressed in dBA, which emphasizes the more audible middle and high frequencies, the criteria are significantly lower than airborne noise criteria to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for above-ground (i.e., at-grade or elevated) alignments, ground-borne noise criteria apply primarily to operations in a tunnel, where airborne noise is not a factor, and to buildings with sensitive interior spaces that are well insulated from exterior noise.

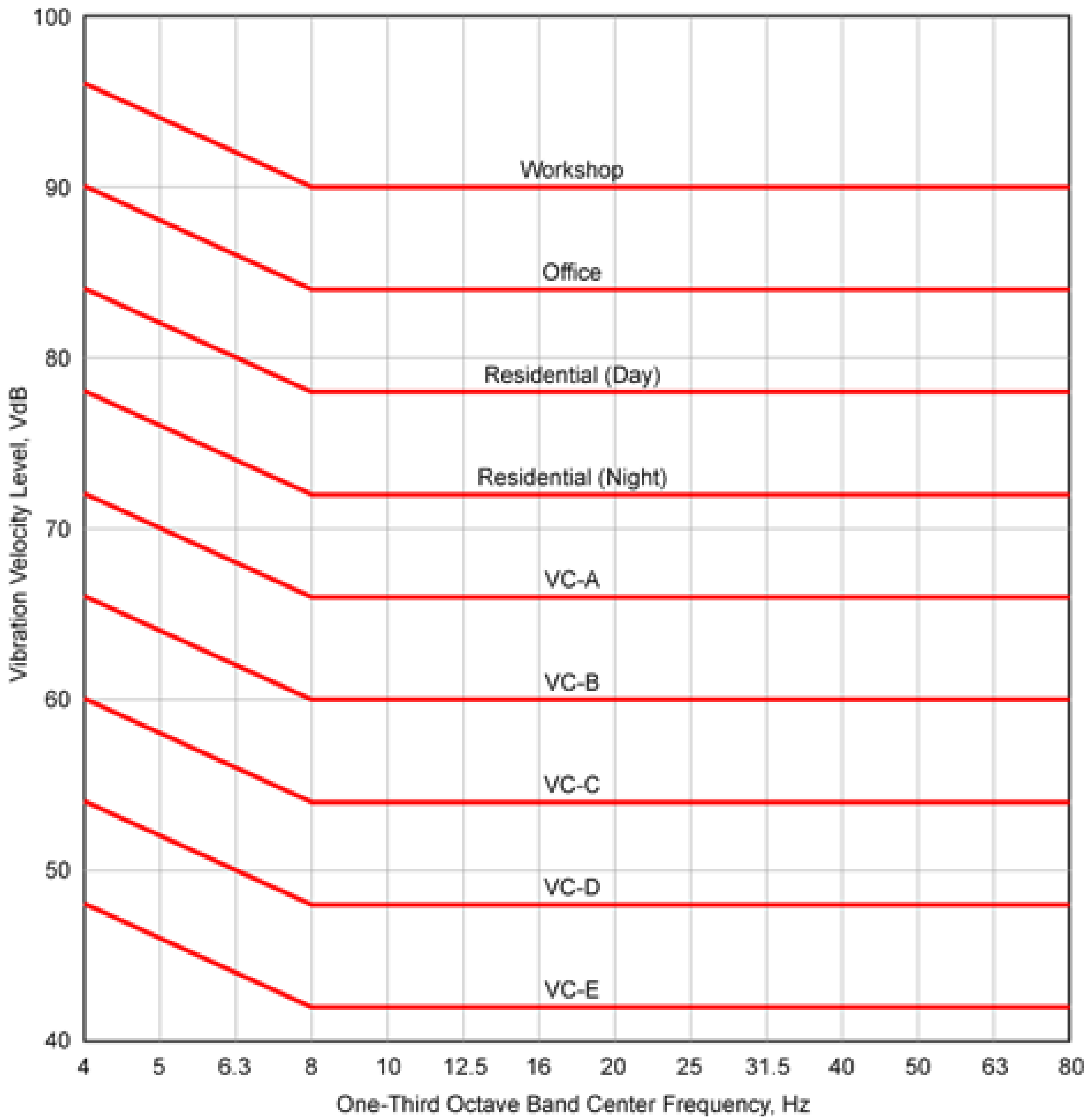
Table 3-6: Ground-borne Vibration and Noise Impact Criteria for Special Buildings				
Type of Building or Room	**Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)**		**Ground-Borne Noise Impact Levels (dBA re 20 micro-Pascals)**	
	Frequent Events	**Occasional or Infrequent Events**	**Frequent Events**	**Occasional or Infrequent Events**
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Specification of mitigation measures requires more detailed information and more refined impact criteria using the frequency distribution, or spectrum of the vibration energy. A detailed vibration analysis uses impact criteria in terms of the 1/3-octave band frequency spectrum. A detailed vibration analysis has been conducted for the Dallas to Houston High-Speed Rail assessment. **Figure 3-2** shows the FRA detailed ground-borne vibration impact criteria used in assessing this project's impacts.

The criteria in **Figure 3-2** are based on exceedances of the 1/3-octave band vibration levels over the frequency range of 8 to 80 Hz. For example, if the vibration levels in any frequency band from a high-speed train exceed the Residential (Night) line in **Figure 3-2** at a residential location, a vibration impact would be assessed. In addition, the detailed criteria are used to assess vibration impact at highly sensitive locations using the VC-A through VC-E thresholds shown in the figure. Descriptions of the curves are shown in **Table 3-7**.

Figure 3-2: FRA Detailed Ground-Borne Vibration Impact Criteria



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Table 3-7: Interpretation of Vibration Criteria for Detailed Analysis		
Criterion Curve (See Figure 3-4)	**Max Lv (VdB)[1]**	**Description of Use**
Workshop	90	Distinctly feelable vibration. Appropriate to workshops and non-sensitive areas.
Office	84	Feelable vibration. Appropriate to offices and non-sensitive areas.
Residential Day	78	Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes (up to 20X).
Residential Night, Operating Rooms	72	Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity.
VC-A	66	Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment.
VC-B	60	Adequate for high-power optical microscopes (1000X), inspection and lithography equipment to 3-micron line widths.
VC-C	54	Appropriate for most lithography and inspection equipment to 1-micron detail size.
VC-D	48	Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability.
VC-E	42	The most demanding criterion for extremely vibration-sensitive equipment.

[1] As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

4 EXISTING NOISE AND VIBRATION

This section includes a description of the noise and vibration sensitive land use within the Study Area, as well as the noise and vibration measurements conducted to characterize the existing conditions for the Project.

4.1 Existing Noise Conditions

Noise-sensitive land use within the Study Area was identified based on Geographic Information System (GIS) data, aerial photography, drawings, plans and a field survey. Based on the information from these sources, a noise measurement program was developed and carried out as described below.

4.1.1 Noise Measurement Procedures and Equipment

To document the existing noise conditions for the Project, a series of noise measurements were conducted in January 2016 and May 2017 along the routes for the Build Alternatives. Because the thresholds for impact in the FRA noise criteria are based on the existing noise levels, measuring the existing noise and characterizing noise levels at sensitive locations is an important step in the impact assessment. The noise measurements included both long-term (24-hour) and short-term (one hour) monitoring of the A-weighted sound level at noise-sensitive locations within the Study Area.

The noise measurements were performed with NTi Audio model XL2 noise monitors and Larson Davis model 820 noise monitors that conform to American National Standard Institute (ANSI) standards for Type 1 (precision) sound measurement equipment. Calibrations, traceable to the National Institute of Standards and Technology (NIST) were conducted before and after each measurement. The noise monitors were set to continuously monitor and record multiple noise level metrics, as well as obtain audio recordings, where appropriate, during the measurement periods.

At each site, the measurement was conducted at the approximate set back of the building or buildings relative to the Project alignment. The measurement microphones were protected with windscreens and positioned approximately 5 feet above the ground and at least 10 feet away from any major reflecting surface.

4.1.2 Noise Measurement Locations and Results

Table 4-1 summarizes the results of the existing noise measurement program and **Figures 4-1 through 4-4** show the locations of the 26 long-term noise monitoring sites (LT) and 19 short-term noise monitoring sites (ST) for the Project. These monitoring sites were selected at representative locations along the project alternative segments, and the results of the existing noise measurements at these sites were sufficient to characterize the existing noise levels at all noise-sensitive locations within the Study Area. **Appendix A** includes photographs of the noise measurement sites and **Appendix B** provides detailed noise measurement data.

Descriptions of the noise-sensitive land uses, as well as the associated noise measurement sites and sources, are provided below by county and segment.

Table 4-1: Summary of Existing Noise Measurements

Site No.	Measurement Location	County	Seg	Measurement Start		Meas. Dur. (hr)	Noise Level (dBA)	
				Date	Time		Leq	Ldn
LT-1	4019-4099 Bulova St, Dallas (Residences)	Dallas	1	1/21/2016	14:00	24	75	72
LT-1A	5125 Cleveland Rd, Dallas (Residences)	Dallas	1	5/11/2017	11:20	3**	50	53
LT-1B	1345 E Belt Line Rd, Lancaster (Residences)	Dallas	1	5/12/2017	2:49	3**	68	70
LT-1C	1786 Nail Dr, Lancaster (Residences)	Dallas	1	5/11/2017	14:00	3**	44	45
LT-2	911 FM 813, Palmer (Residence)	Ellis	2A	1/21/2016	9:09	24	62	55
LT-3	508 Old Waxahachie Rd, Waxahachie (Residence)	Ellis	2A	1/20/2016	16:00	24	58	53
LT-4	NW Co Rd 1320, Ennis (Residence)	Navarro	3A	1/20/2016	11:00	24	48	36
LT-5	SW 2120, Richland (Residence)	Navarro	3C	1/19/2016	15:17	24	50	46
LT-6	FM 1366, Wortham (Residential Parcel)	Freestone	4	1/19/2016	14:07	24	44	43
LT-7	132-264 CR 890, Teague (Ranch House)	Freestone	4	1/19/2016	14:00	24	49	42
LT-8	N Fwy Service Rd, Teague (Ranch)	Freestone	3C	1/18/2016	12:23	24	58	50
LT-9	633 LCR 882, Jewett (Ranch House)	Limestone	4	1/18/2016	12:00	24	52	48
LT-10	Beddingfield Rd, Marquez (Residence)	Leon	4	1/18/2016	11:00	24	53	42
LT-11	N Fwy Service Rd, Buffalo (Ranch)	Leon	3C	1/18/2016	10:00	24	63	55
LT-12	534 FM 39 (Residence)	Leon	4	1/18/2016	14:00	24	60	62
LT-13	2076-2765 W Feeder Rd (Residence)	Leon	3C	1/18/2016	16:00	24	53	55
LT-14	7652 Greenbriar Rd (Residence)	Madison	3C	1/18/2016	13:00	24	63	65

Table 4-1: Summary of Existing Noise Measurements								
Site No.	Measurement Location	County	Seg	Measurement Start		Meas. Dur. (hr)	Noise Level (dBA)	
				Date	Time		Leq	Ldn
LT-15	1977 Poteet Rd (Residence)	Madison	4	1/18/2016	17:00	24	48	50
LT-16	6113 FM 1696 (Residence)	Grimes	5	1/19/2016	14:00	24	45	47
LT-17	10735 TX-90 (Ranch)	Grimes	5	1/20/2016	16:00	24	47	49
LT-18	5126 FM 1774 (Residence)	Grimes	5	1/19/2016	20:00	24	60	62
LT-19	119 Plantation Drive, Todd Mission (Residence)	Waller	5	1/22/2016	12:39	24	47	49*
LT-20	21512 Binford Rd (Residence)	Harris	5	1/22/2016	10:56	24	49	51*
LT-21	1218 Canyon Arbor Way (Residence)	Harris	5	1/20/2016	19:00	24	67	69*
LT-22	14812 Hempstead Rd (Residence)	Harris	5	1/19/2016	21:00	24	44	46*
LT-23	11217 Todd St., Houston (Residence)	Harris	5	1/21/2016	14:00	24	47	49
ST-1	1213 Coleman Ave, Dallas (Residence)	Dallas	1	1/22/2016	11:40	1	63	61
ST-2	4412 Kolloch Dr, Dallas (Residence)	Dallas	1	1/21/2016	15:00	1	62	60
ST-3	6350 J. J. Lemmon Rd, Dallas (College Park Baptist Church)	Dallas	1	1/21/2016	17:10	1	54	52
ST-4	2607 Ferris Rd, Lancaster (Residence)	Ellis	2A	1/22/2016	10:00	1	52	50
ST-5	369 Farmer Rd, Ennis (Residential Area)	Ellis	2B	1/20/2016	16:31	1	62	60
ST-6	SW 1000, Corsicana (Residence)	Navarro	3B	1/20/2016	11:00	1	41	39
ST-7	117-123 CR 1041, Wortham (Residential Area)	Freestone	3C	1/19/2016	17:30	1	31	29
ST-8	N Fwy Service Rd & CR 1090, Streetman (Residential Area)	Freestone	3C	1/19/2016	16:00	1	54	52
ST-9	Old Mexia-Fairfield Rd, Fairfield (Parcel Adjacent to Several Hotels)	Freestone	3C	1/18/2016	13:50	1	70	68
ST-10	164 & FM 39, Groesbeck (Residential Area)	Limestone	4	1/18/2016	15:30	1	63	61
ST-11	N Fwy Service Rd & CR 306, Buffalo (Parcel Adjacent to Several Hotels)	Leon	3C	1/18/2016	17:00	1	68	66
ST-12	20559 I-45 Frontage Rd (Residence)	Leon	3C	1/19/2016	9:06	1	61	59
ST-13	5192 Dawkins Rd (Residence)	Madison	4	1/19/2016	11:12	1	54	52
ST-14	3159 Clark Rd (Residence)	Madison	4	1/20/2016	12:00	1	56	54
ST-15	15619 TX-90 (Residence)	Grimes	5	1/20/2016	14:47	1	53	51
ST-16	CR 341, Plantersville (Residence)	Grimes	5	1/21/2016	9:20	1	50	48
ST-17	31205 Hegar Rd (Residence)	Waller	5	1/21/2016	9:11	1	47	45
ST-18	6734 Limestone St (Residence)	Harris	5	1/21/2016	15:17	1	57	55
ST-19	20710 May Showers Circle (Residence)	Harris	5	1/21/2016	17:23	1	61	59

*Measurements were interrupted before 24 hours due to a noise monitor battery connection problem. Ldn was estimated using methods contained in the FRA guidance manual.

**Due to limited access, three one hour measurements were made at these sites. The Ldn was estimated using methods contained in the FRA guidance manual.

Source: Cross-Spectrum Acoustics, 2016.

Figure 4-1: Existing Noise Measurement Locations (Sheet 1 of 4)

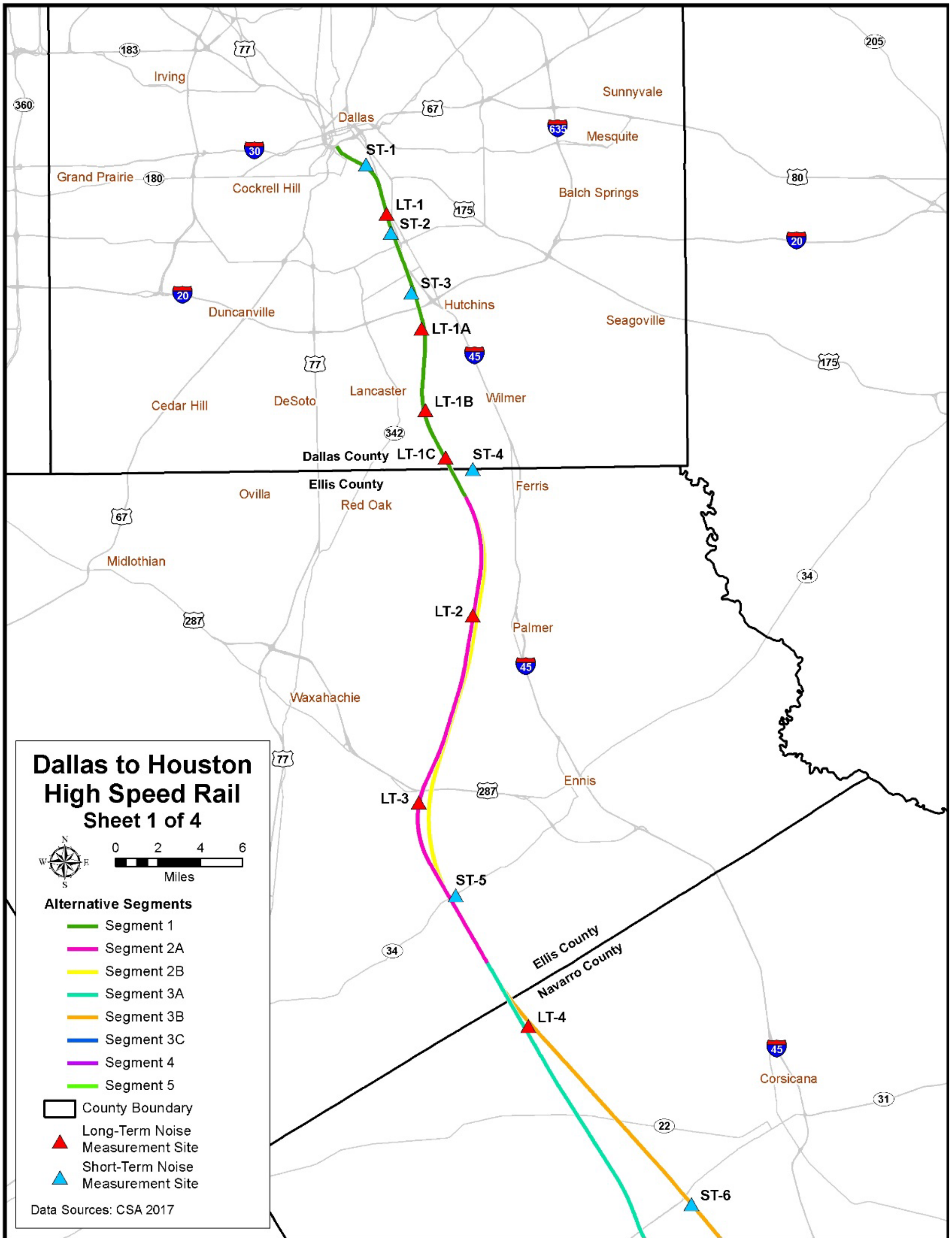


Figure 4-2: Existing Noise Measurement Locations (Sheet 2 of 4)

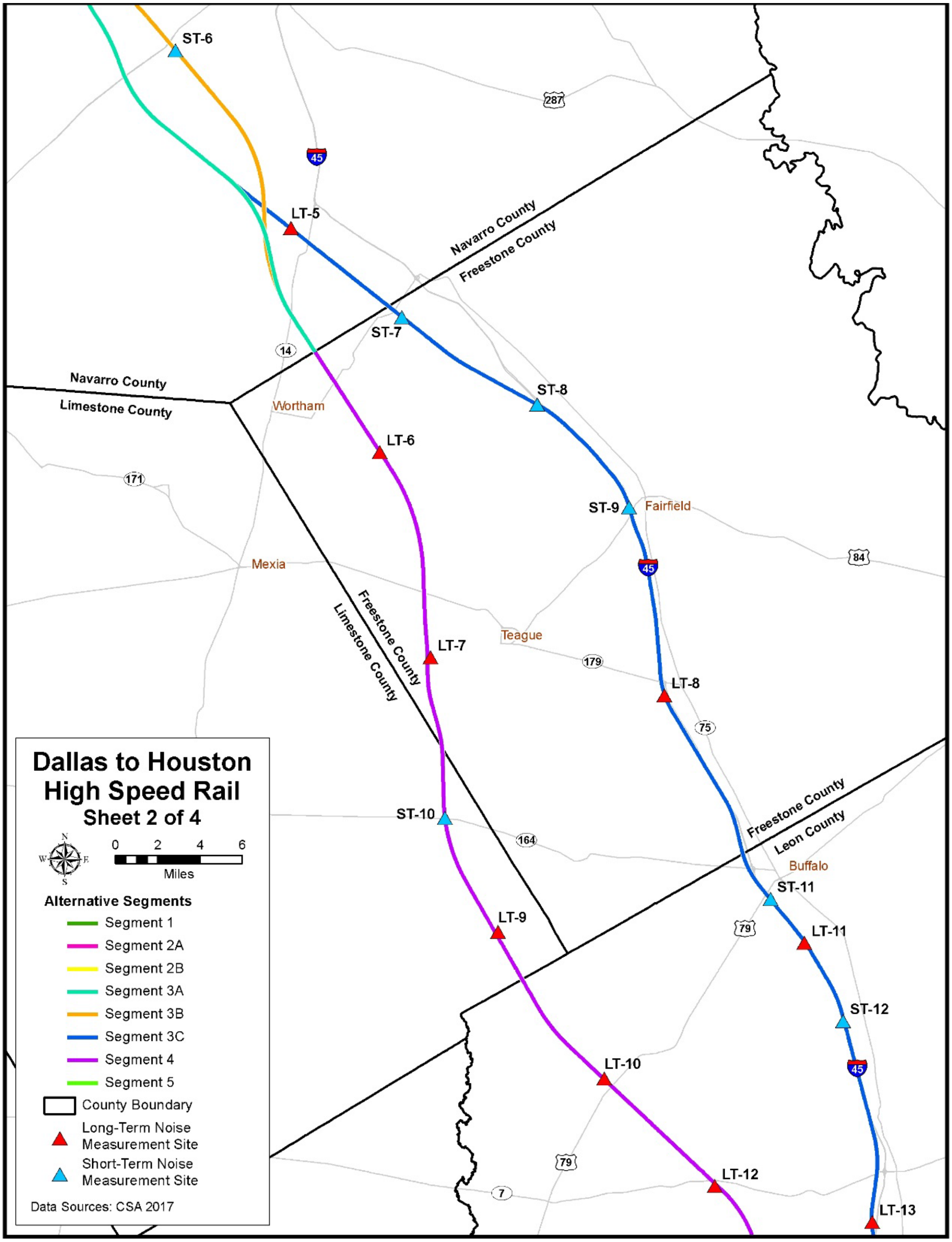


Figure 4-3: Existing Noise Measurement Locations (Sheet 3 of 4)

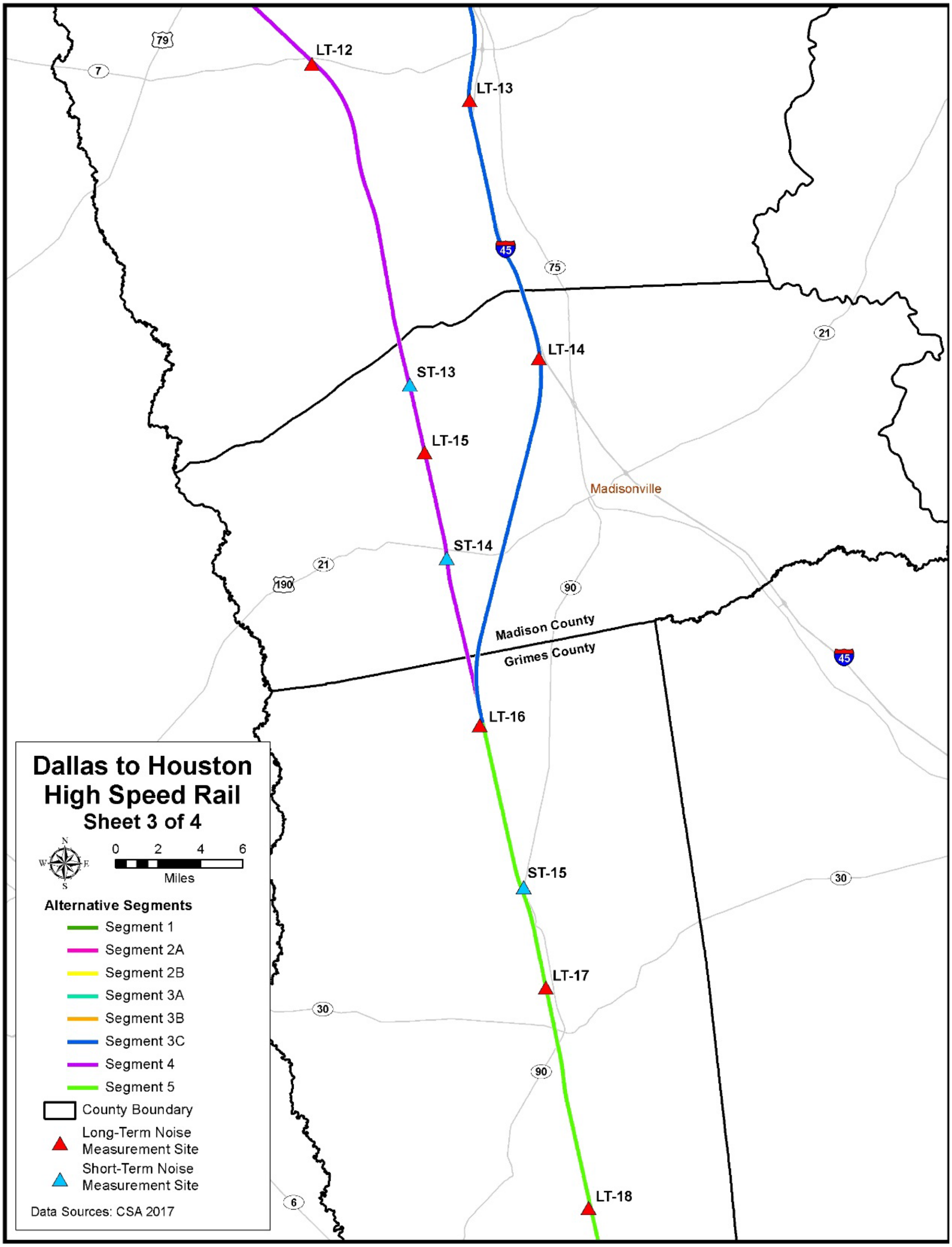
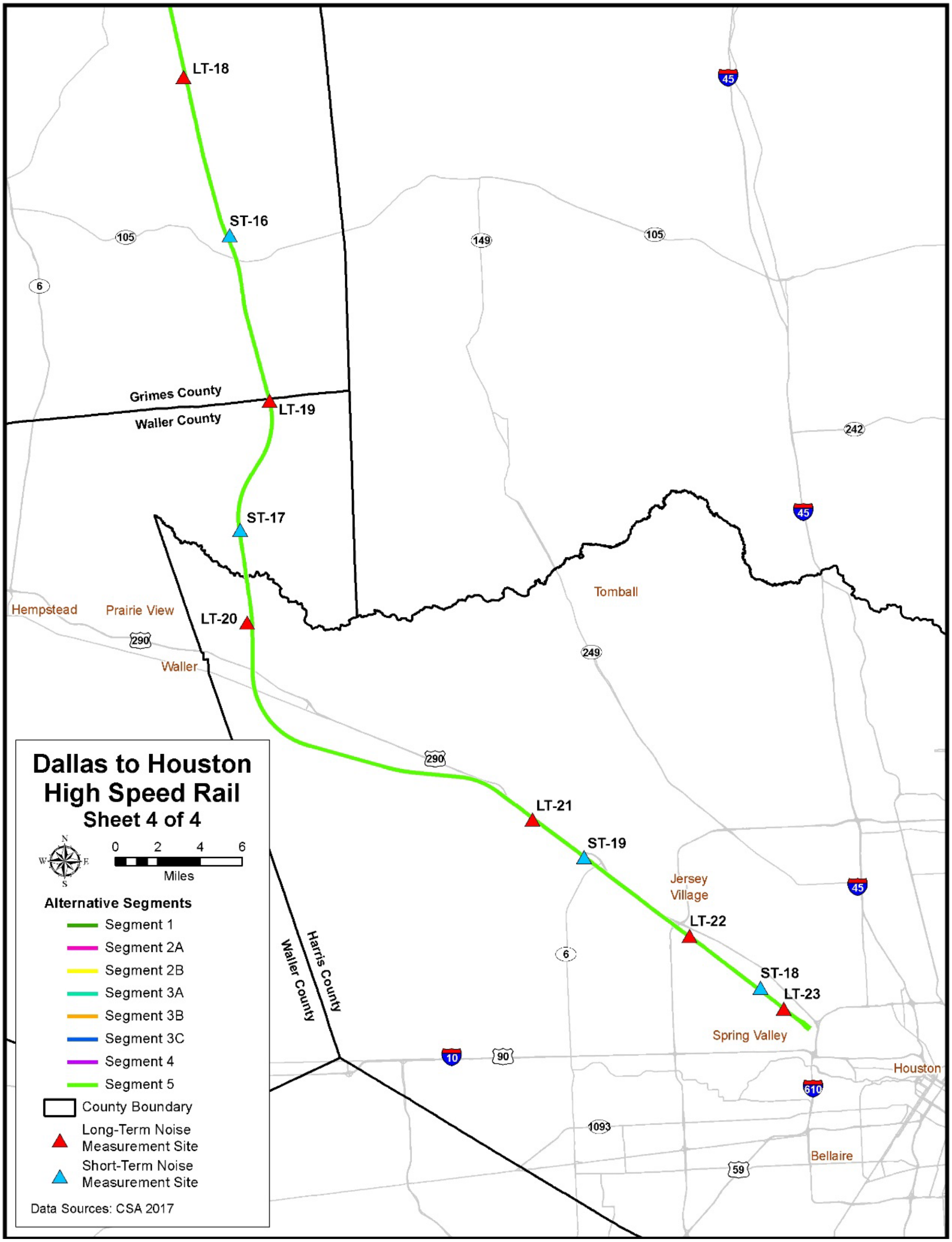


Figure 4-4: Existing Noise Measurement Locations (Sheet 4 of 4)



4.1.2.1 Dallas County

4.1.2.1.1 Segment 1

The noise-sensitive land use along the proposed alignment in Dallas County from the northern terminus to Route 12 (South Great Trinity Forest Avenue) is typically dense, urban commercial/industrial land use along the existing freight tracks and IH-45. Several urban residential neighborhoods are located in the areas north of South Lamar Street, along Kolloch Drive from East Illinois Avenue to Route 12, and along Le May and Le Forge Avenues. Multi-family residential complexes are located near East Overton Rd and Southern Oaks Boulevard and at Kolloch Drive and Linfield Road.

The Imperial Institute of America, a school with institutional land use, is located on Mayforge Drive near East Illinois Avenue. South of Route 12 to IH-20, the proposed alignment runs parallel to existing freight tracks and IH-45 through a largely wooded area with a few dense suburban residential neighborhoods to the west along Golden Gate Drive and J.J. Lemmon Road. Several parks and churches are located in this suburban area as well. South of IH-20 to the Dallas/Ellis County line is typically rural farmland with scattered single-family residences along the proposed alignment.

Descriptions of the noise measurements conducted along Segment 1 in Dallas are as follows:

Site LT-1: 4019-4099 Bulova Street, Dallas. The Ldn measured at this location was 72 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for 24 hours near the gate to this parcel.

Site LT-1A: 5125 Cleveland Rd, Dallas. The Ldn measured at this location was 53 dBA. The dominant noise sources were rural sounds and local traffic. Noise levels were measured during three separate one hour periods throughout the day along Cleveland Rd in front of the property.

Site LT-1B: 1345 E. Beltline Road, Lancaster. The Ldn measured at this location was 70 dBA. The dominant noise source was traffic on E Beltline Rd. Noise levels were measured during three separate one hour periods throughout the day along E Beltline Rd in front of the property.

Site LT-1C: 1786 Nail Drive, Lancaster. The Ldn measured at this location was 45 dBA. The dominant noise source was rural sounds. Noise levels were measured during three separate one hour periods throughout the day along Nail Drive in front of the property.

Site ST-1: 1213 Coleman Avenue, Dallas. The Leq measured at this location was 63 dBA. The dominant noise sources were traffic on Lamar Street, traffic on Cedar Crest Boulevard and freight train activity. Noise levels were measured for one hour on the side of the road within the public right-of-way (ROW).

Site ST-2: 4412 Kolloch Drive, Dallas. The Leq measured at this location was 62 dBA. The dominant noise sources were traffic on IH-45 and freight train activity. Noise levels were measured for one hour in the side yard of this residence.

Site ST-3: 6350 J.J. Lemmon Road, Dallas (College Park Baptist Church). The Leq measured at this location was 54 dBA. The dominant noise sources were traffic on J.J. Lemmon Road and distant traffic on IH-45. Noise was measured for one hour in the rear parking area of the church.

4.1.2.2 Ellis County

4.1.2.2.1 Segment 2A

The noise and vibration sensitive land use along the proposed Segment 2A in Ellis County is typically rural farmland with scattered single-family residences. Descriptions of the noise measurements conducted along Segment 2A in Ellis County are as follows:

Site LT-2: FM 813, Palmer. The Ldn measured at this location was 55 dBA. The dominant noise source was local community traffic. Noise levels were measured for 24 hours in the back yard of this residence.

Site LT-3: 508 Old Waxahachie Road, Waxahachie. The Ldn measured at this location was 53 dBA. The dominant noise sources were local traffic on Old Waxahachie Road and distant traffic on Route 287. Noise levels were measured for 24 hours in the front yard of the residence.

Site ST-4: 2607 Ferris Road, Lancaster. The Leq measured at this location was 52 dBA. The dominant noise sources were wind and livestock. Noise levels were measured for one hour in the field behind the residence.

Site ST-5: 369 Farmer Rd, Ennis. The Leq measured at this location was 62 dBA. The dominant noise source was traffic on Route 34. Noise levels were measured for one hour on the side of the road within the public ROW.

4.1.2.2.2 Segment 2B

The noise-sensitive land use along the proposed Segment 2B in Ellis County is typically rural farmland with scattered single-family residences. The noise measurement sites used to characterize Segment 2B in Ellis County are the same as those used for Segment 2A.

4.1.2.3 Navarro County

4.1.2.3.1 Segment 3A

The noise-sensitive land use along the proposed Segment 3A in Navarro County is typically rural farmland with scattered single-family residences. A description of the noise measurement conducted along Segment 3A in Navarro County is as follows:

Site LT-4: NW County Road 1320, Ennis. The Ldn measured at this location was 36 dBA. The dominant noise sources were distant traffic and livestock. Noise levels were measured for 24 hours in the front yard of the residence.

4.1.2.3.2 Segment 3B

The noise-sensitive land use along the proposed Segment 3B in Navarro County is typically rural farmland with scattered single-family residences. A description of the noise measurement conducted along Segment 3B in Navarro County is as follows:

Site ST-6: SW 1000, Corsicana. The Leq measured at this location was 41 dBA. The dominant noise source was traffic from Route 31. Noise levels were measured for one hour in the back yard of the residence.

4.1.2.3.3 <u>Segment 3C</u>

The noise-sensitive land use along the proposed Segment 3C in Navarro County is typically rural farmland with scattered single-family residences. A description of the noise measurement conducted along Segment 3C in Navarro County is as follows:

Site LT-5: SW 2120, Richland. The Ldn measured at this location was 46 dBA. The dominant noise sources were farm activity and distant freight trains/horns. Noise levels were measured for 24 hours in the field behind the ranch house.

4.1.2.3.4 <u>Segment 4</u>

The noise-sensitive land use along the proposed Segment 4 in Navarro County is typically rural farmland with scattered single-family residences.

The noise measurement site used to characterize Segment 4 in Navarro County is the same as for Segment 3C.

4.1.2.4 Freestone County

4.1.2.4.1 <u>Segment 3C</u>

The noise-sensitive land use along the proposed Segment 3C in Freestone County is typically rural farmland with scattered single-family residences. Segment 3C runs parallel to IH-45 from just south of FM 833 until the Freestone/Leon County line. This area remains typically rural farmland until the City of Fairfield, where the land use becomes slightly denser and largely commercial/industrial. South of Fairfield, the land use returns to rural farmland and oil fields with scattered single-family residences. Descriptions of the noise measurements conducted along Segment 3C in Freestone County are as follows:

Site LT-8: N Fwy Service Road, Teague. The Ldn measured at this location was 50 dBA. The dominant noise sources were traffic on IH-45 and farm activity. Noise levels were measured for 24 hours adjacent to the pond on this ranch.

Site ST-7: 117-123 County Road 1041, Wortham. The Leq measured at this location was 31 dBA. The dominant noise source was distant wildlife. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-8: N Freeway Service Road at County Road 1090, Streetman. The Leq measured at this location was 54 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-9: N Freeway Service Road at Old Mexia-Fairfield Road, Fairfield. The Leq measured at this location was 70 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

4.1.2.4.2 <u>Segment 4</u>

The noise-sensitive land use along the proposed Segment 4 in Freestone County is typically rural farmland with scattered single-family residences. Descriptions of the noise measurements conducted along Segment 4 in Freestone County are as follows:

Site LT-6: FM 1366, Wortham. The Ldn measured at this location was 43 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the back house on this parcel.

Site LT-7: Approx. 132-264 CR 890, Teague. The Ldn measured at this location was 42 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the ranch house.

4.1.2.5 Limestone County

4.1.2.5.1 Segment 4

The noise-sensitive land use along the proposed Segment 4 in Limestone County is typically rural farmland/oil fields with scattered single-family residences. Descriptions of the noise measurements conducted along Segment 4 in Limestone County are as follows:

Site LT-9: 633 Local County Road 882, Jewett. The Ldn measured at this location was 48 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the ranch house.

Site ST-10: FM 39 at East Yeagua Street, Groesbeck. The Leq measured at this location was 63 dBA. The dominant noise sources were traffic on FM 39 and traffic on East Yeagua Street. Noise levels were measured for one hour on the side of the road within the public ROW.

4.1.2.6 Leon County

4.1.2.6.1 Segment 3C

The noise-sensitive land uses for Segment 3C in Leon County include mostly rural areas with single-family residences and the cities of Buffalo and Centerville. The City of Buffalo is a mixture of single-family houses and commercial areas with a church close to the proposed route. Descriptions of the noise measurements conducted along Segment 3C in Leon County are as follows:

Site LT-11: N Freeway Service Road, Buffalo. The Ldn measured at this location was 55 dBA. The dominant noise sources were traffic on IH-45 and distant freight trains/horns. Noise levels were measured for 24 hours adjacent to the driveway of this ranch.

Site LT-13: 2076-2765 West Feeder Road. The measured Ldn at this location was 53 dBA. This 24-hour measurement was taken at the southern edge of the property facing a small pond. The dominant noise sources were local traffic from West Feeder Road, IH-45 and neighborhood activity.

Site ST-11: N Freeway Service Road at County Road 306, Buffalo. The Leq measured at this location was 68 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-12: 20559 IH-45 Frontage Road. The measured Leq at this location was 61 dBA. The dominant noise sources were local traffic from the frontage road and IH-45. Noise levels were measured in the front yard of the property for a period of one hour.

4.1.2.6.2 Segment 4

The noise-sensitive land uses for Segment 4 in Leon County include scattered single-family residences. This segment also includes Leon High School. Descriptions of the noise measurements conducted along Segment 4 in Leon County are as follows:

Site LT-10: Beddingfield Road, Marquez. The Ldn measured at this location was 42 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours in the back yard of the residence.

Site LT-12: 534 FM 39. The measured Ldn at this location was 60 dBA. The dominant noise source was distant local traffic. Noise levels were measured for 24 hours on the north side of a dirt road that accesses the property.

4.1.2.7 Madison County

4.1.2.7.1 Segment 3C

The noise-sensitive land uses for Segment 3C in Madison County include rural areas with scattered single-family residences. A description of the noise measurement conducted along Segment 3C in Madison County is as follows:

Site LT-14: 7652 Greenbrier Road. The measured Ldn at this location was 63 dBA. Noise levels were measured for 24 hours. This measurement was taken in the front yard of the property. The major noise sources were local traffic on IH-45, farming activity and noise from the manufacturing facility located at the northern edge of the property.

4.1.2.7.2 Segment 4

The noise-sensitive land uses for Segment 3C in Madison County include rural areas with scattered single-family residences. Descriptions of the noise measurements conducted along Segment 4 in Madison County are as follows:

Site LT-15: 1977 Poteet Road. The measured Ldn at this location was 48 dBA. The dominant noise source was local traffic on Poteet Road. Noise levels were measured for 24 hours on the south side of the property facing a corral.

Site ST- 13: 5192 Dawkins Road. The measured Leq at this location was 54 dBA. The dominant noise source was local traffic. Noise levels were measured in front of the residence by the gate facing Dawkins Road for a period of one hour.

Site ST-14: 3159 Clark Road. The measured Leq at this location was 56 dBA. The dominant noise sources were local traffic on Clark Road, wind, farming activities and electrical noise from power lines. Noise levels were measured at the main gate for a period of one hour.

4.1.2.8 Grimes County

4.1.2.8.1 Segment 3C

The noise-sensitive land uses for Segment 3C in Grimes County include rural areas with scattered single-family residences. A description of the noise measurement conducted along Segment 3C in Grimes County is as follows:

Site LT-16: 6113 FM 1696. The Ldn measured at this location was 45 dBA. Noise levels were measured for 24 hours and the measurement was performed at northeast edge of the property overlooking at the power lines. The dominant noise sources were wind and farming activities.

4.1.2.8.2 Segment 4

The noise-sensitive land uses for Segment 4 in Grimes County include rural areas with scattered single-family residences. The noise measurement sites used to characterize Segment 4 in Grimes County are the same as those used for Segment 3C.

4.1.2.8.3 Segment 5

The noise-sensitive land uses for Segment 5 in Grimes County include rural areas with scattered single-family residences and the Town of Singleton. Singleton is a mixture of single-family residences and commercial and industrial areas. Descriptions of the noise measurements conducted along Segment 5 in Grimes County are as follows:

Site LT-17: 10735 Route 90. The Ldn measured at this location was 47 dBA. Noise levels were measured for 24 hours and the measurement was conducted at the eastern side of the property at a distance of about 150 feet from a metallic shed. The dominant noise source was distant local traffic.

Site LT-18: 5126 FM 1774. The measured Ldn at this location was 60 dBA. The dominant noise sources were barking dogs and local traffic from FM 1774. Noise levels were measured for 24 hours on the northern side of the property at a distance of 150 feet from FM 1774.

Site ST-15: 15619 TX-90. The measured Leq at this location was 53 dBA. The dominant noise source was local traffic from TX 90, livestock and other farm animals and farming activities. Noise levels were measured in front of the house near the driveway for a period of one hour.

Site ST-16: County Road 341, Plantersville. The measured Leq at this location was 50 dBA. The dominant noise source was local traffic from County Road 341. Noise levels were measured at the back of the property near a shed for a period of one hour.

4.1.2.9 Waller County

4.1.2.9.1 Segment 5

The noise-sensitive land uses for Segment 5 in Waller County include rural areas with scattered single-family residences. Descriptions of the noise measurements along Segment 5 in Waller County are as follows:

Site LT-19: 119 Plantation Drive, Todd Mission. The measured Ldn at this location was 47 dBA. Noise levels were measured for 24 hours at the front northern edge of the property. The dominant noise sources were local traffic from Plantation Drive and neighborhood activity.

Site ST-17: 31205 Hegar Road. The measured Leq at this location was 47 dBA. The major noise sources were local traffic from Hegar Road and Joseph Road. Noise levels were measured in the front yard of the residence for a period of one hour.

4.1.2.10 Harris County

4.1.2.10.1 Segment 5

The noise-sensitive land uses for Segment 5 in Harris County include some rural areas, industrial and commercial areas and residential neighborhoods. Between the county's northern boundaries where the proposed route crosses SH 99, the land use is mostly rural with scattered single-family residences. Between SH 99 and Fry Road, the segment runs through a mostly rural area with scattered single-family residences and commercial uses.

Between Fry Road and SH 6 North, both sides of the proposed route include a mixture of commercial and industrial areas with residential neighborhoods. The neighborhoods have both single and multi-family residences. Within this vicinity are four churches and Cy-Fair High School. Between SH 6 North and the West Sam Houston Parkway, there is a mix of commercial and residential areas north of the proposed route. The residential areas are a mixture of single- and multi-family housing. South of the route is a mixture of industrial and commercial usage. There are also two churches along this stretch of the segment.

Between the West Sam Houston Parkway and IH-610, the land use around the segment is mostly commercial and industrial with a few residential areas with single-family houses. Also, within this section are six places of worship and Bane Elementary School. Along IH-610, the route passes through a mixture of industrial and commercial areas.

Descriptions of the noise measurements conducted along Segment 5 in Harris County are as follows:

Site LT-20: 21512 Binford Road. The measured Ldn at this location was 49 dBA. Noise levels were measured for 24 hours at the northern edge of the property at the setback distance of the residence. Traffic noise from Binford Road was not significant during the measurement period.

Site LT-21: 12118 Canyon Arbor Way. The measured Ldn at this location was 67 dBA. Noise levels were measured for 24 hours at the northern edge of the property near a residence. The dominant noise source was local traffic from US-290.

Site LT-22: 14812 Hempstead Road. The measured Ldn at this location was 44 dBA. Noise levels were measured for 24 hours at the front yard of the property facing Hempstead Road. The dominant noise sources were local traffic on Hempstead Road and Union Pacific trains, located parallel to Hempstead Road.

Site LT-23: 11217 Todd Street. The measured Ldn at this location was 47 dBA. The dominant noise sources were local traffic on Todd Street, Harland Drive and Hempstead Road, plus Union Pacific trains. Noise levels were measured for 24 hours on the northern edge of the property.

Site ST-18: 6734 Limestone Street. The measured Leq at this location was 57 dBA. The dominant noise source was local traffic on Limestone Street and Hempstead Road. Noise levels were measured in front of the residence for a period of one hour.

Site ST-19: 20710 May Showers Circle. The measured Leq at this location was 61 dBA. The major noise sources were local traffic on Hempstead Road, Huffmeister Road and residential activities in May Showers Circle. Noise levels were measured in the front yard of the property for a period of one hour.

4.2 Existing Vibration Conditions

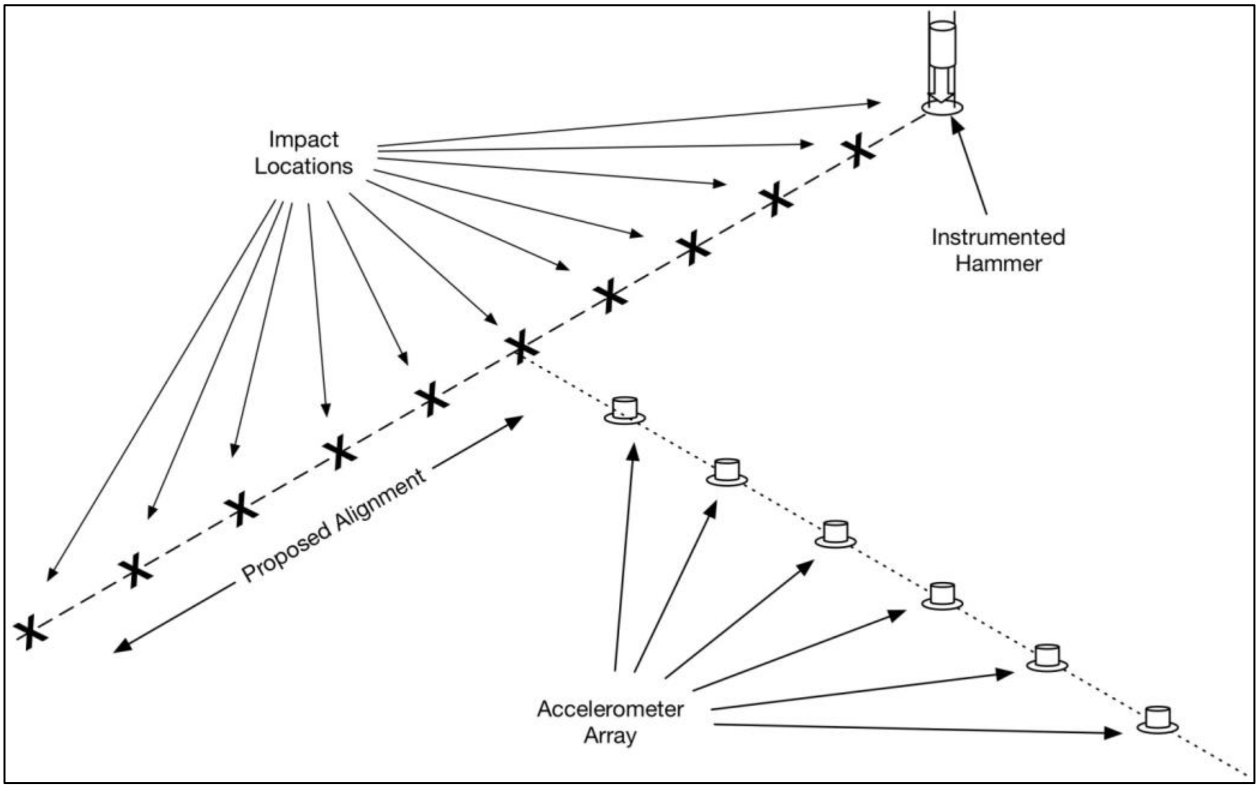
4.2.1 Vibration Measurement Procedures and Equipment

Vibration-sensitive land use for the project was identified based on GIS data, aerial photography, drawings, plans and a field survey. Except for parks and other exterior areas, the vibration sensitive land uses along the routes of the Build Alternatives are the same as described above in **Section 4.1** (Existing Noise Conditions).

Vibration propagation measurements were conducted in the Study Area during January 2016 to determine the vibration response characteristics of the ground near vibration-sensitive locations. A custom-built instrumented hammer was used to impart an impulsive force to the ground. The magnitude of the force was calculated based on the acceleration and mass of the falling hammer. The resulting vibration signals were measured using high-sensitivity accelerometers (PCB Model 393C and 393B05) mounted in a vertical direction on pavement or on steel spikes driven into the ground. The signals from the hammer and accelerometers were recorded using Data Translation DT9837A digital acquisition hardware. Data Translation's QuickDAQ software, running on a laptop computer, was used to review the measurement data.

The vibration propagation test procedure is shown schematically in **Figure 4-5**. The instrumented hammer was used to generate impulses at specific locations spaced 15 feet apart along a line on or parallel to the proposed HSR alignment. A line of accelerators was placed perpendicular to the line of impacts as shown in the figure. The relationship between the input force and the resulting vibration measured by the accelerometers, called the transfer mobility (TM), was calculated using proprietary software in the Cross-Spectrum Acoustics (CSA) laboratory. The transfer mobility represents the vibration propagation characteristics of the ground at the measurement site and at other sites with similar geology. Vibration levels from an HSR vehicle were estimated by mathematically combining the force generated by a train (the force density) with the transfer mobility as described in the Detailed Vibration Assessment methodology provided in the FRA guidance manual.

Figure 4-5: Vibration Propagation Measurement Schematic



Source: Cross-Spectrum Acoustics, 2016.

For the laboratory analysis, the following steps were used to calculate the transfer mobility at each measurement site:

- Narrow-band transfer functions for each accelerometer/force pair were computed using custom CSA software. Signal processing and averaging techniques were used to maximize the signal-to-noise ratio for each measurement. Numerical integration was used to convert the acceleration data into velocity.
- The narrowband data were converted to one-third-octave band data.
- Numerical integration was used to convert the measured point source transfer mobility (PSTM) data into line source transfer mobilities (LSTM).
- For each one-third-octave band, linear or quadratic regression was used to determine smoothed estimates for each line source transfer mobility as a function of distance from the source.

The FRA manual provides more details regarding the propagation test and analysis procedures.

4.2.2 <u>Vibration Measurement Locations</u>

Table 4-2 and **Figures 4-6 through 4-9** describe the locations of the eleven vibration measurement sites. Photographs of each site are included in Appendix A.

Table 4-2: Summary of Vibration Propagation Measurement Sites				
Site No.	Measurement Location	County	Segments	Date
V-1	4360 Kolloch Drive, Dallas (Church)	Dallas	1	1/18/2016
V-2	103 Coffee Rd.	Ellis	2A, 2B	1/18/2016
V-3	710 FM 2100	Navarro	3A, 3B, 3C	1/19/2016
V-4	N Fwy Service Rd., Fairfield	Freestone	3C, 4	1/19/2016
V-5	LCR 828, Personville	Limestone	4	1/20/2016
V-6	6734 FM 977 (Residence)	Leon	4	1/20/2016
V-7	10290 Greenbriar Rd. (Residential Parcel)	Madison	3C	1/20/2016
V-8	10063 CR 311 (Residence)	Grimes	5	1/21/2016
V-9	Plantation Dr., Todd Mission	Waller	5	1/21/2016
V-10	Josey Ranch Rd., Houston	Harris	5	1/22/2016
V-11	21610 U.S. 290 Frontage Rd., Houston	Harris	5	1/22/2016

Source: Cross-Spectrum Acoustics, 2016.

Descriptions of the vibration measurement sites and the areas they represent are provided below by county and segment.

4.2.2.1 Dallas County

4.2.2.1.1 Segment 1

Site V-1: 4360 Kolloch Dr. The vibration propagation measurement was conducted in the parking lot of Friendship Missionary Baptist Church. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the I-45 corridor in Dallas between S Lamar St. and the I-20 junction along Segment 1.

4.2.2.2 Ellis County

4.2.2.2.1 Segment 2A

Site V-2: 103 Coffee Rd. The vibration propagation measurement was conducted along Coffee Rd. with the sensors placed in the adjacent field. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use west of I-45 from Hutchins to Bardwell along both Segments 2A and 2B.

4.2.2.2.2 Segment 2B

The vibration measurement results used to characterize the vibration propagation conditions along Segment 2B in Ellis County are the same as those used for Segment 2A.

Figure 4-6: Vibration Propagation Measurement Locations (Sheet 1 of 4)

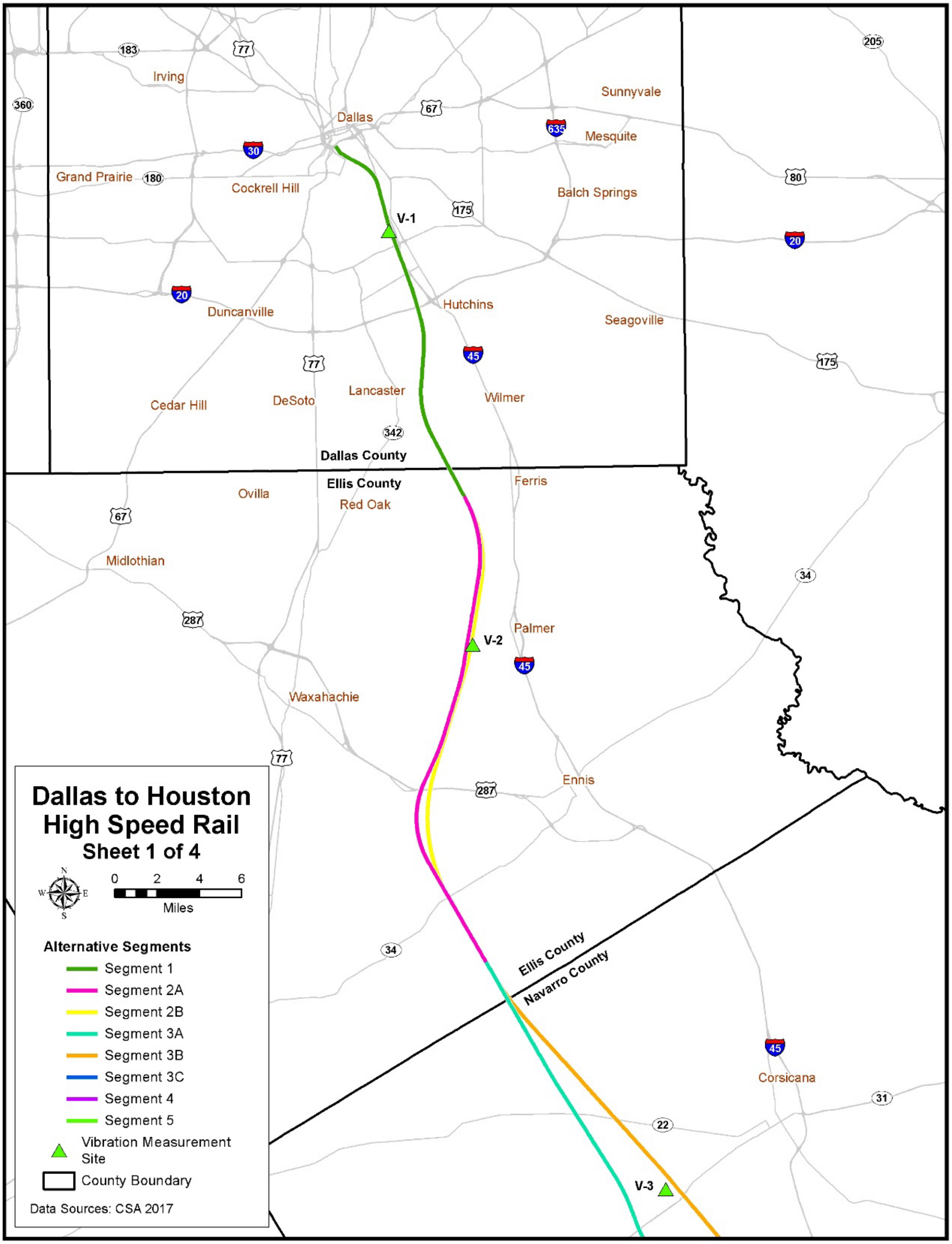


Figure 4-7: Vibration Propagation Measurement Locations (Sheet 2of 4)

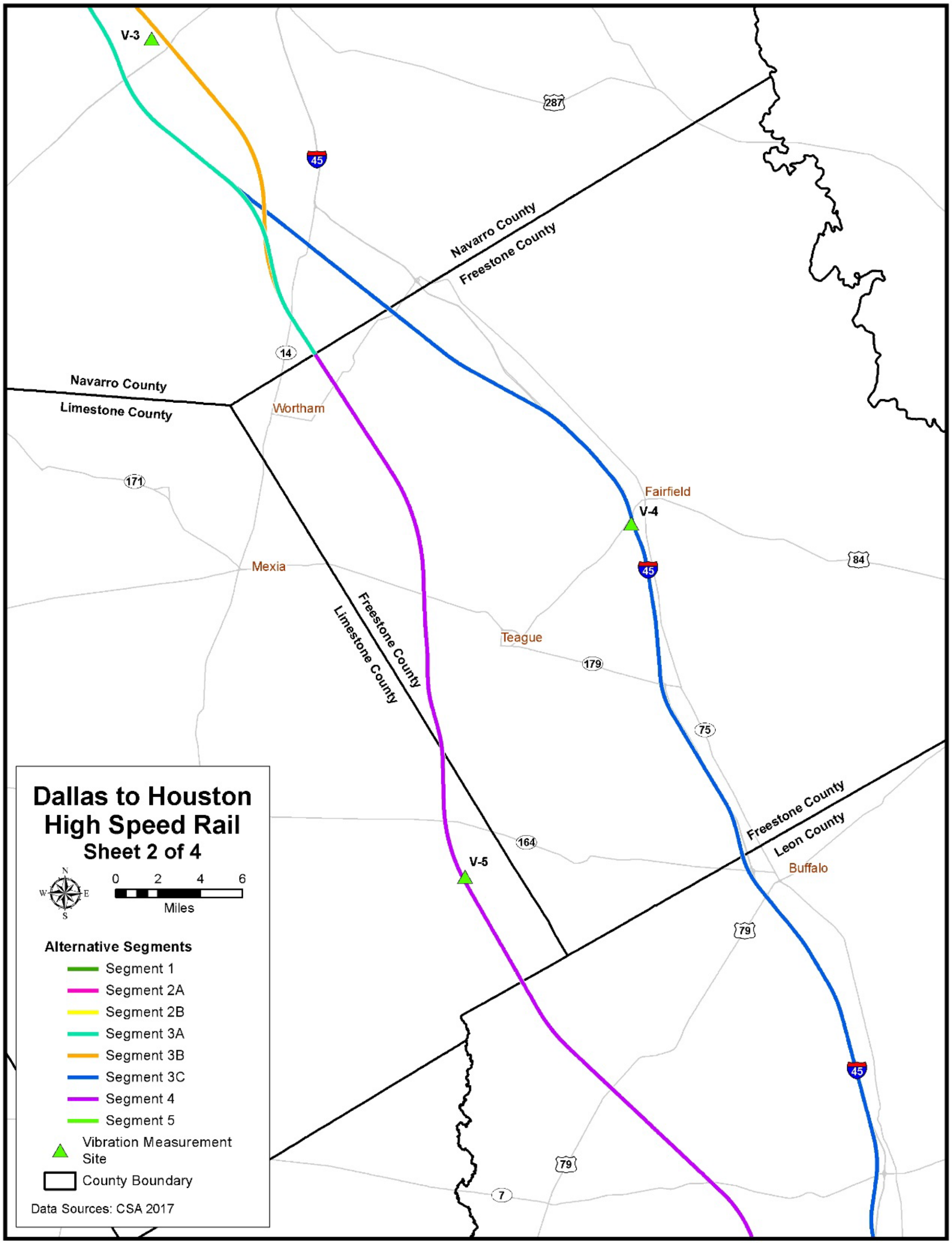


Figure 4-8: Vibration Propagation Measurement Locations (Sheet 3 of 4)

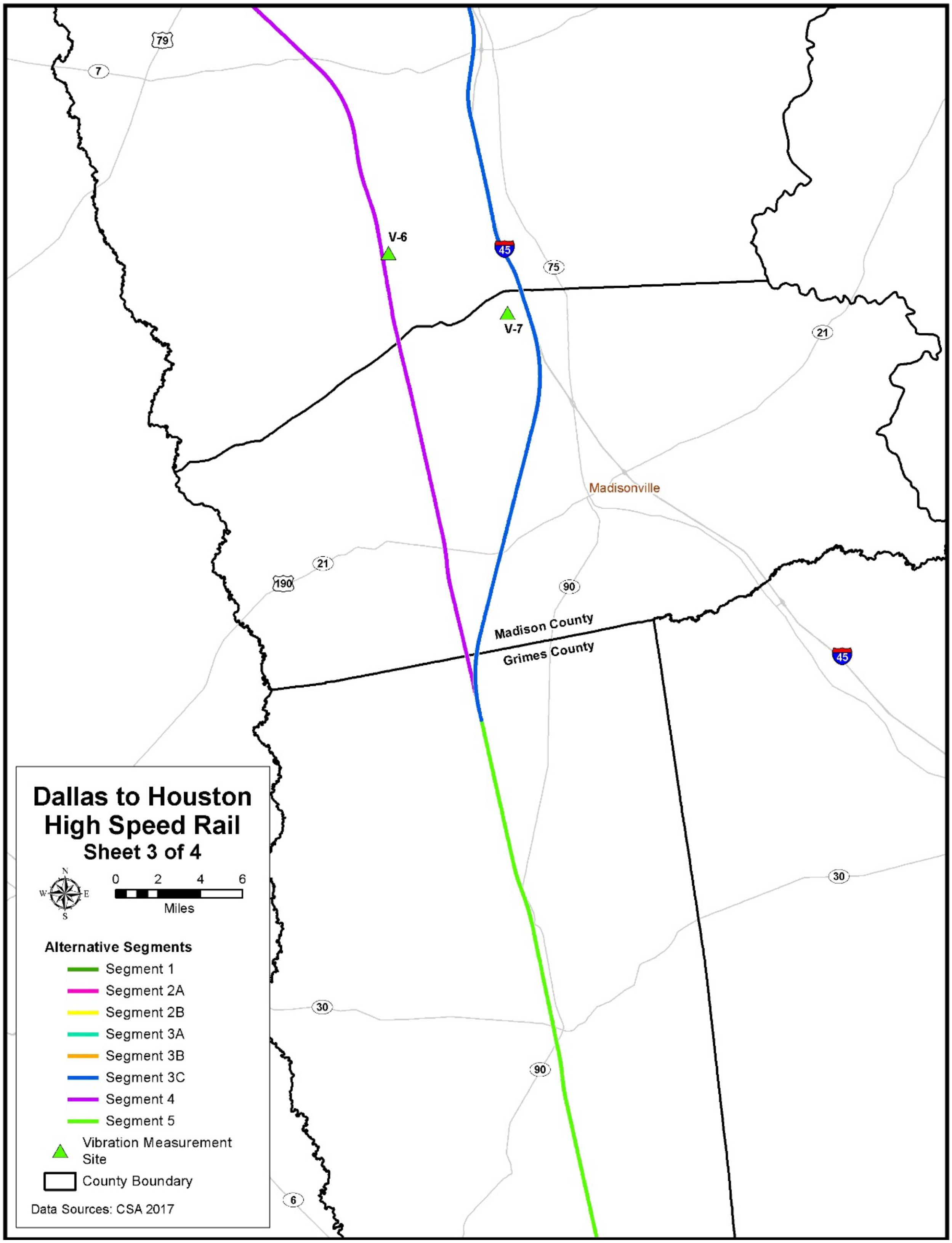
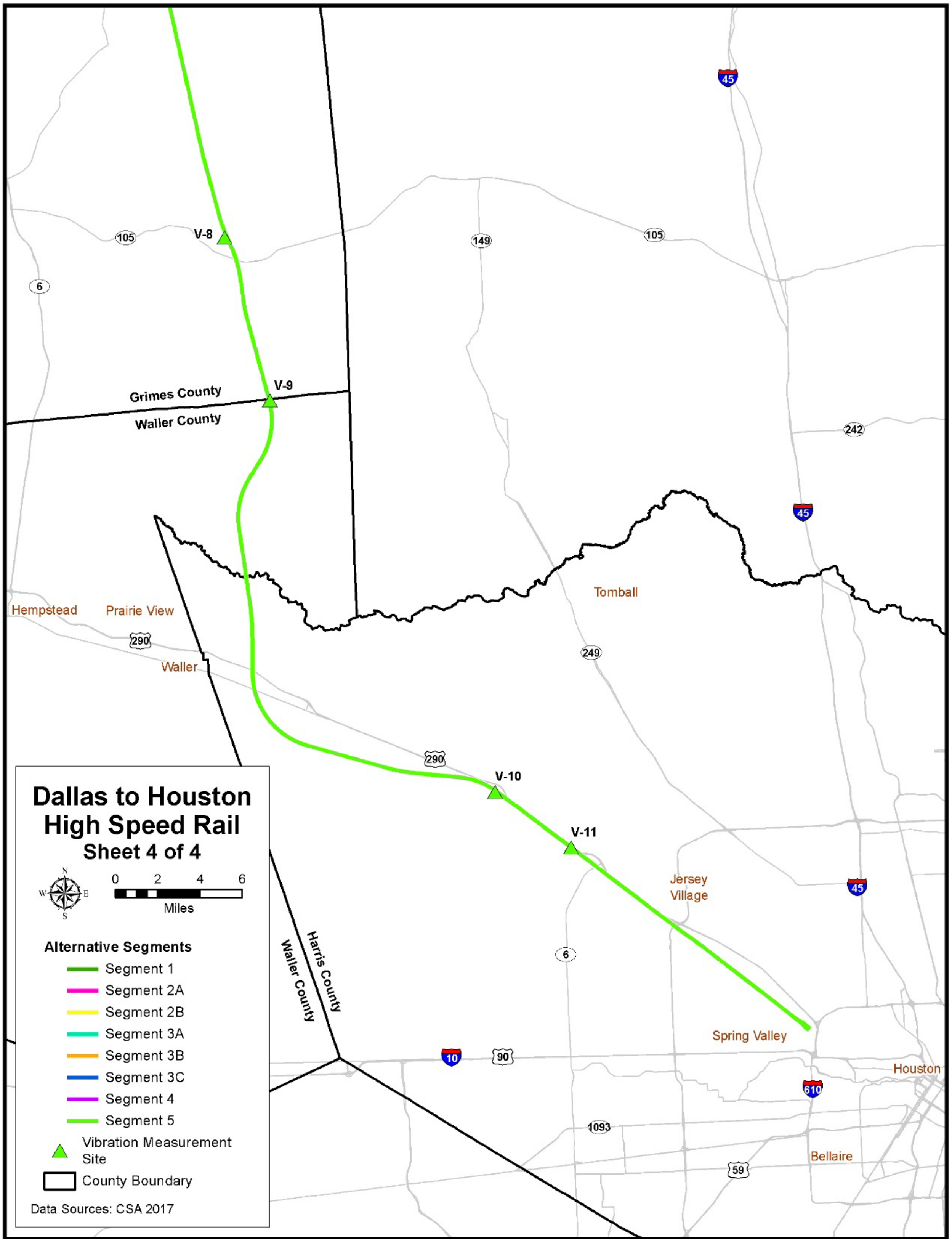


Figure 4-9: Vibration Propagation Measurement Locations (Sheet 4 of 4)



4.2.2.3 Navarro County

4.2.2.3.1 Segment 3A

Site V-3: 710 FM 2100. The vibration propagation measurement was conducted along FM 2100 with the sensors in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use in Navarro County along the northern portions of Segments 3A, 3B, 3C and 4 including the towns of Barry and Oak Valley.

4.2.2.3.2 Segment 3B

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3B in Navarro County are the same as those used for Segment 3A.

4.2.2.3.3 Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Navarro County are the same as those used for Segment 3A.

4.2.2.3.4 Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Navarro County are the same as those used for Segment 3A.

4.2.2.4 Freestone County

4.2.2.4.1 Segment 3C

Site V-4: N Fwy Service Rd., Fairfield. The vibration propagation measurement was conducted along the western edge of the gas field with the sensors in the adjoining field. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use between Fairfield and Teague in Freestone County following Route 179 on the east and Segment 4 on the west.

4.2.2.4.2 Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Freestone County are the same as those used for Segment 3C.

4.2.2.5 Limestone County

4.2.2.5.1 Segment 4

Site V-5: LCR 828, Personville. The vibration propagation measurement was conducted in the front pasture of the property along the driveway. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 4 west of the towns of Donie and Jewett.

4.2.2.6 Leon County

4.2.2.6.1 Segment 3C

Site V-7: 10290 Greenbriar Rd. The vibration propagation measurement was conducted along Greenbriar Rd. with the sensors located in the field to the north of the house. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the southern part of Segment 3C in south Leon County and north Madison County, including the towns of Centerville and Leona.

4.2.2.6.2 Segment 4

Site V-6: 6734 FM 977. The vibration propagation measurement was conducted in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the southern part of Segment 4 in southern Leon County and northern Madison County.

4.2.2.7 Madison County

4.2.2.7.1 Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Madison County are the same as those used for Segment 3C in Leon County.

4.2.2.7.2 Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Madison County are the same as those used for Segment 4 in Leon County.

4.2.2.8 Grimes County

4.2.2.8.1 Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Grimes County are the same as those used for Segment 3C in Leon County.

4.2.2.8.2 Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Grimes County are the same as those used for Segment 4 in Leon County.

4.2.2.8.3 Segment 5

Site V-8: 10063 CR 311. The vibration propagation measurement was conducted along CR 311 with the sensors located in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 5 in Grimes co. from Roans Prairie to State Highway 105.

4.2.2.9 Waller County

4.2.2.9.1 Segment 5

Site V-9: Plantation Dr., Todd Mission. The vibration propagation measurement was conducted along Plantation Dr. with the sensors located in an empty lot. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 5 in south Grimes County and north Waller County.

4.2.2.10 Harris County

4.2.2.10.1 Segment 5

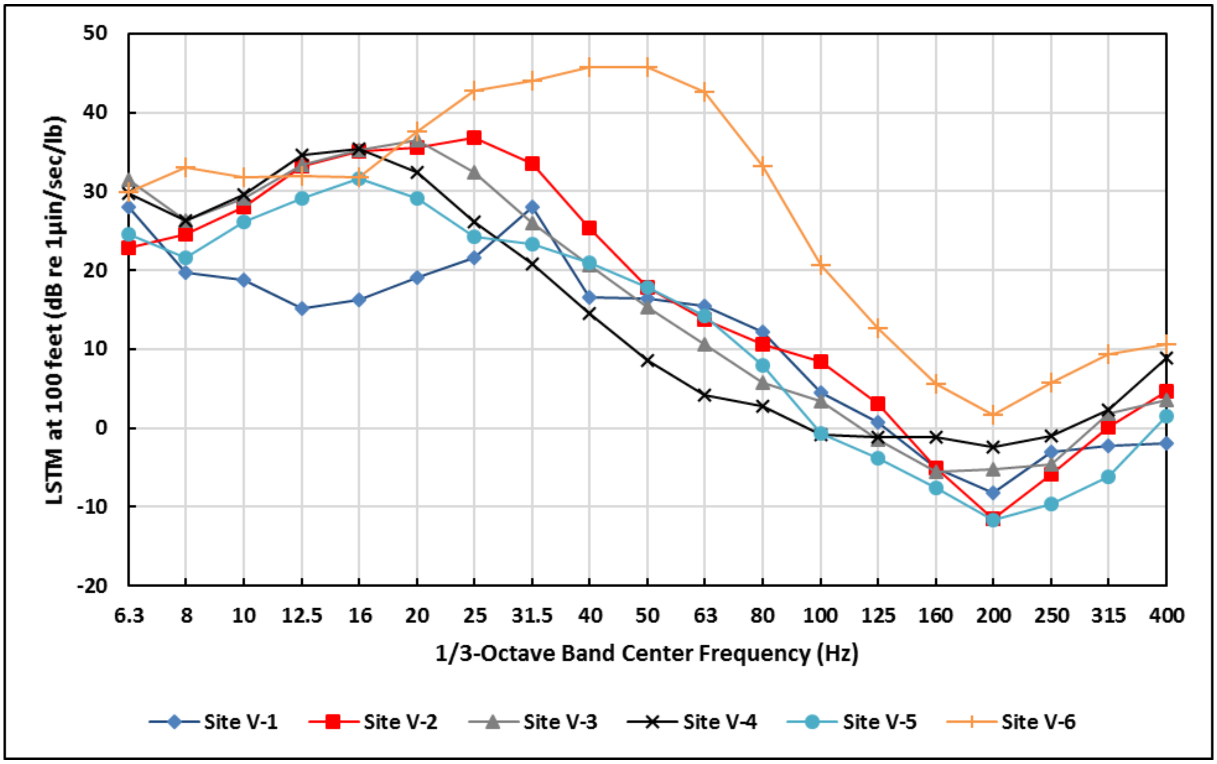
Site V-10: Josey Ranch Rd., Houston. The vibration propagation measurement was conducted along Josey Ranch Rd. with the sensors located in the field to the west. The results at this measurement site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along US 290 close to Fry Rd for Segment 5.

Site V-11: 21610 U.S. 290 Frontage Rd. The vibration propagation measurement was conducted in the field northeast of the train tracks. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along U.S. 290 between Lee Way Dr. and Huffmeister Rd. in Houston.

4.3 Vibration Measurement Results

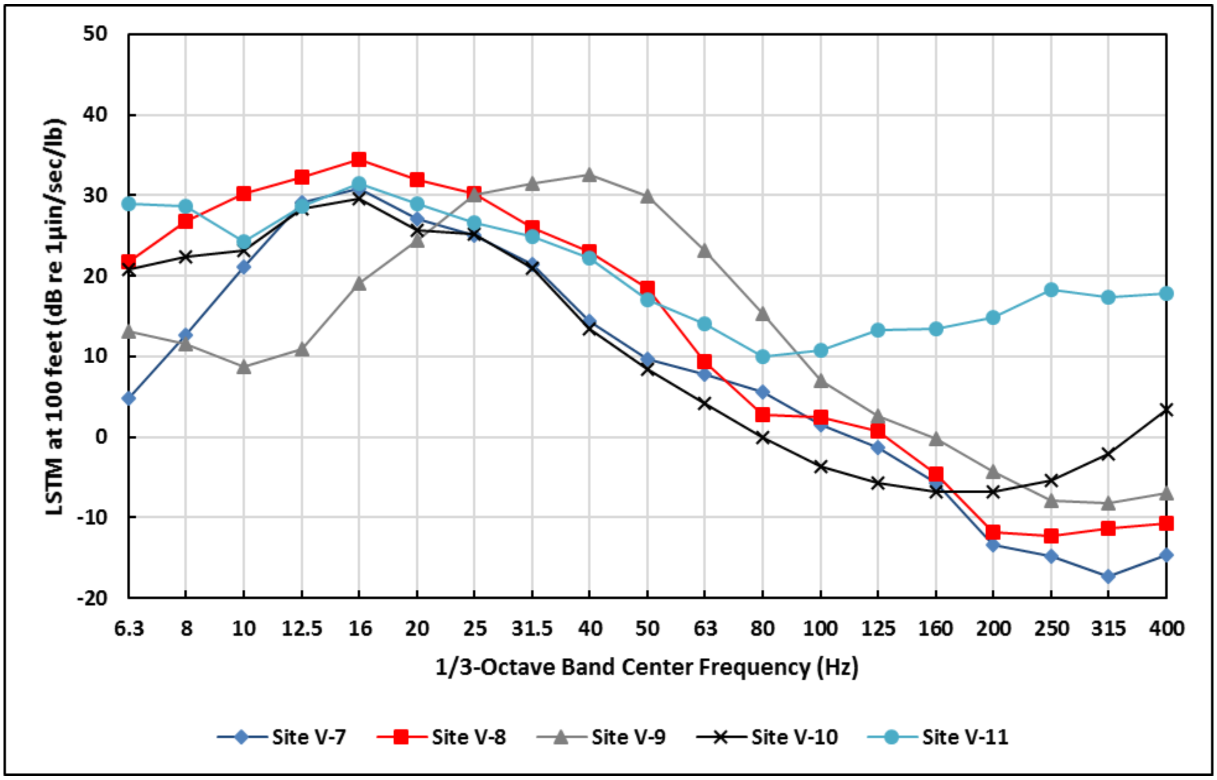
Representative results of the vibration propagation tests are shown in **Figure 4-10** (for Sites V-1 through V-6) and in **Figure 4-11** (for Sites V-7 through V-11) in terms of the measured LSTM as a function of vibration frequency at a distance of 100 feet. Higher LSTM levels in these figures indicate more efficient vibration propagation. Detailed vibration propagation data are provided in Appendix C.

Figure 4-10: Vibration Propagation Test Data (Sites V-1 through V-6)



Source: Cross-Spectrum Acoustics, 2016.

Figure 4-11: Vibration Propagation Test Data (Sites V-7 through V-11)



Source: Cross-Spectrum Acoustics, 2016.

5 NOISE AND VIBRATION PREDICTION METHODOLOGY

Noise and vibration impacts due to the Project construction and operation were analyzed by using the methodology contained in the FRA and FTA guidance manuals. The FRA Guidance Manual was used as the primary source of guidance for analysis of high-speed rail noise and vibration impacts and mitigation and the FTA guidance was used to supplement the FRA guidance for non-high speed rail sources of noise and vibration. The following sections provide additional details regarding the methodology for the noise and vibration impact assessments.

5.1 Airborne Noise

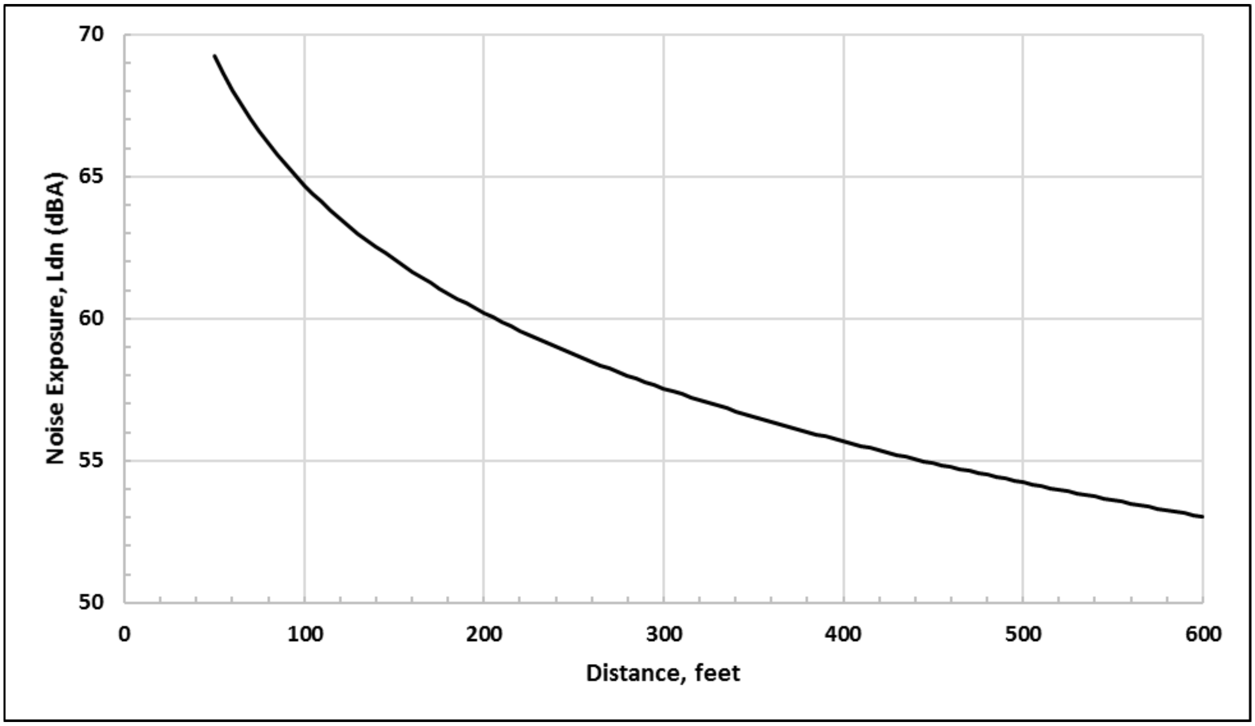
5.1.1 Operational Noise

Noise levels from HSR operations were projected based on sound data gathered by Texas Central Railroad (TCRR) in Japan for the Tokaido Shinkansen N700-A train, the proposed project's operating plan and the general noise assessment methods included in the FRA guidance manual (Chapter 4, Initial Noise Evaluation). Significant factors are summarized below:

- Based on TCRR measurement data for the Tokaido Shinkansen N700-A train, the predictions assume a Reference Sound Exposure Level (SEL) of 87 dBA at a distance of 50 feet from the track centerline in all speed regimes. Although the HSR system operations will be based on the Shinkansen N700-Series train, this remodeled train is not yet in service and sound data for this train are not yet available. However, because the N700-Series will have new features which reduce air resistance and noise compared to the N700-A model, the current noise assessment should be conservative (i.e. the noise impacts will not be greater than and are likely to be less than currently projected).
- For the Final Operating Scenario (FOS) in the analysis year (2040), it is assumed that trains will run every 10 to 15 minutes in each direction between 05:30 and 23:30, with the last trains departing from Dallas and Houston at 22:00.
- It is assumed that the trainsets will be 8-car EMU fixed consists with a length of 204.7 meters.
- It is assumed that the trains will operate at a maximum speed of 205 mph along most of the route, except in the vicinity of the stations.

As an example, the projected noise exposure (Ldn) from HSR operations under worst-case conditions (i.e. on viaduct at the maximum speed of 205 mph, without shielding from intervening terrain or structures) is shown in **Figure 5-1** as a function of distance from the near track centerline. These projections are based on actual noise measurements of the Shinkansen N700A trainset along with the proposed train schedule and consists, using the methodology in the FRA guidance manual.

Figure 5-1: Projected HSR Noise Exposure (on Viaduct, 205 mph, no shielding)

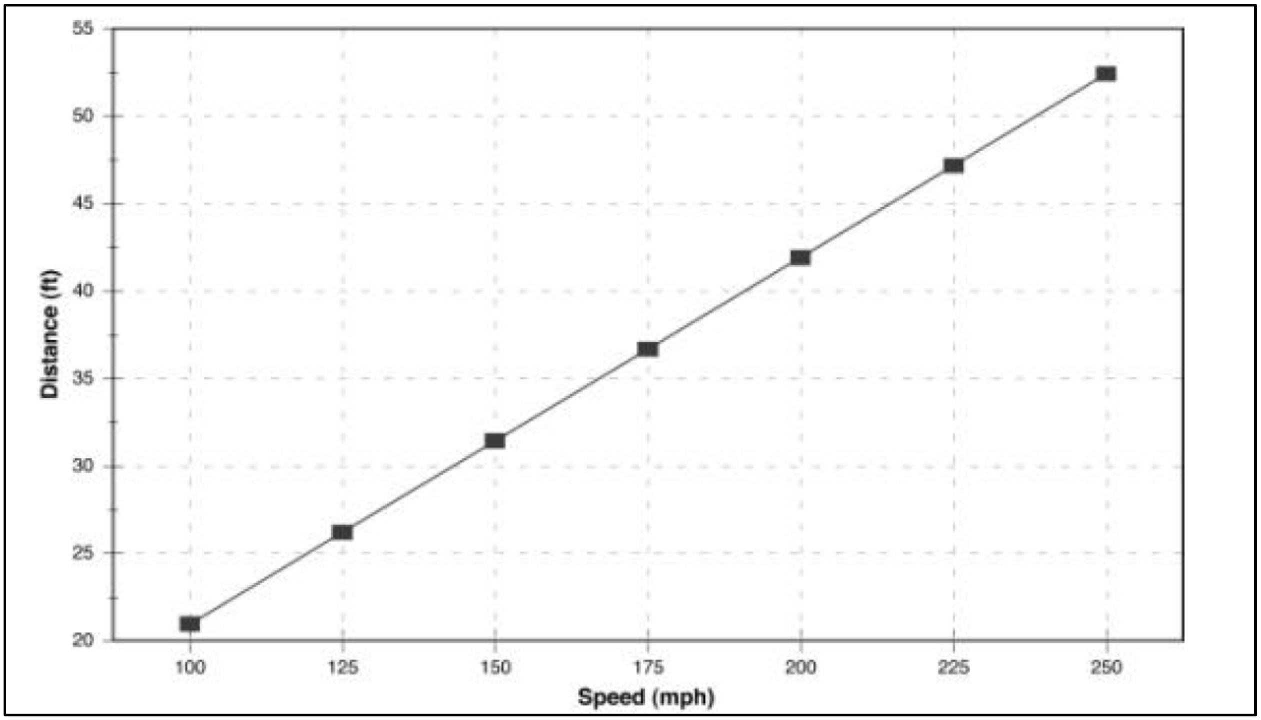


Source: Cross-Spectrum Acoustics, 2016.

5.1.1.1 Startle Due to Rapid Onset Rates

Rapid onset rates (very rapid changes in noise level) due to high speed train noise may cause startle effects at distances very close to the proposed tracks. The onset rate is defined as the rate of change of increasing noise level in decibels per second during a noise event. The duration of such an event is short (typically a few seconds for high-speed trains). For a given speed, onset rates will decrease as the distances from the trains to the noise-sensitive receivers increase. **Figure 5-2** shows the distance from the tracks versus speed relationship for rapid onset rates. This figure from the FRA guidance manual is included for reference, but it is not anticipated that noise levels that can cause startle will be present at distances of more than 45 feet from the track centerline.

Figure 5-2: Distance from Tracks within which Startle Can Occur for HSR



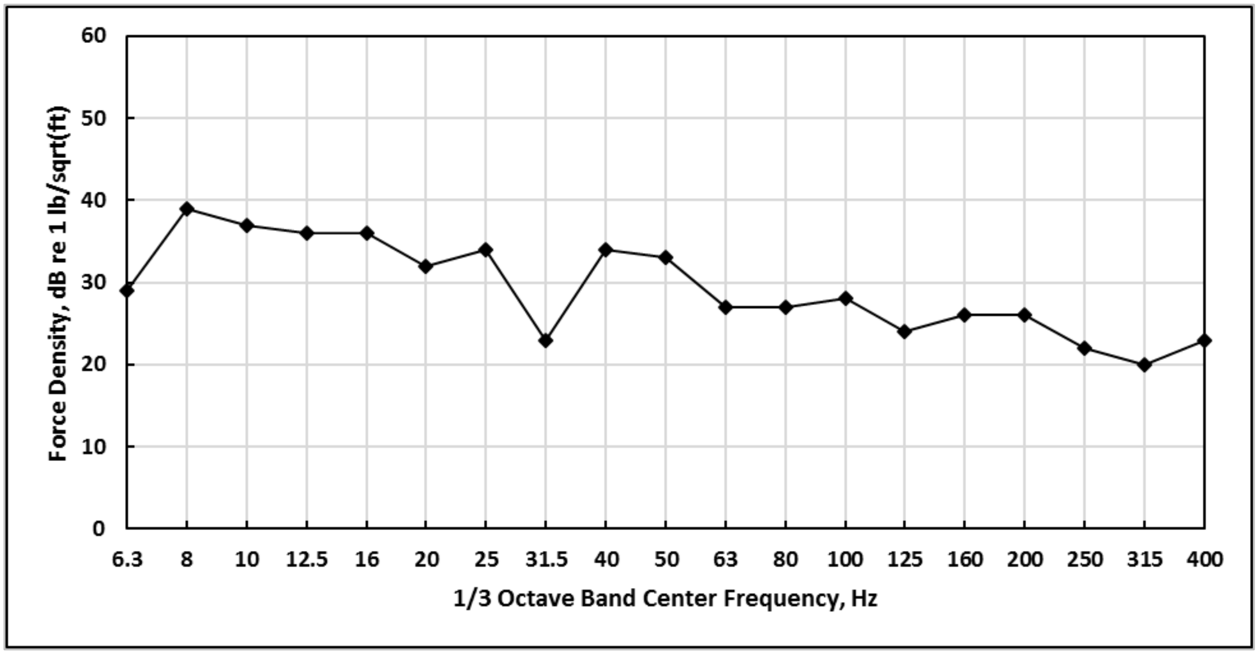
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

5.2 Ground-borne Vibration

Ground-borne vibration levels from HSR operations were projected using the detailed vibration assessment prediction methods included in the FRA guidance manual (Chapter 9, Detailed Vibration Assessment). Significant factors are summarized below:

- Because vibration source data for the Shinkansen N700-Series train that operations will be based on for the HSR system are not available, the train vibration source level was based on the Force Density Level for the Pendolino EMU high-speed train as reported in Figure 9-5 of the FRA guidance manual and shown below in **Figure 5-3**. The Pendolino and Shinkansen trainsets are both of the Electric Multiple Unit (EMU) type and should have similar vibration characteristics.
- It is assumed that the trains will operate at a maximum speed of 205 mph along most of the route, except in the vicinity of the stations.
- It is assumed that ground-borne noise would be masked by airborne noise from HSR operations at typical structures along the alternative routes and thus ground-borne noise impacts were not assessed.

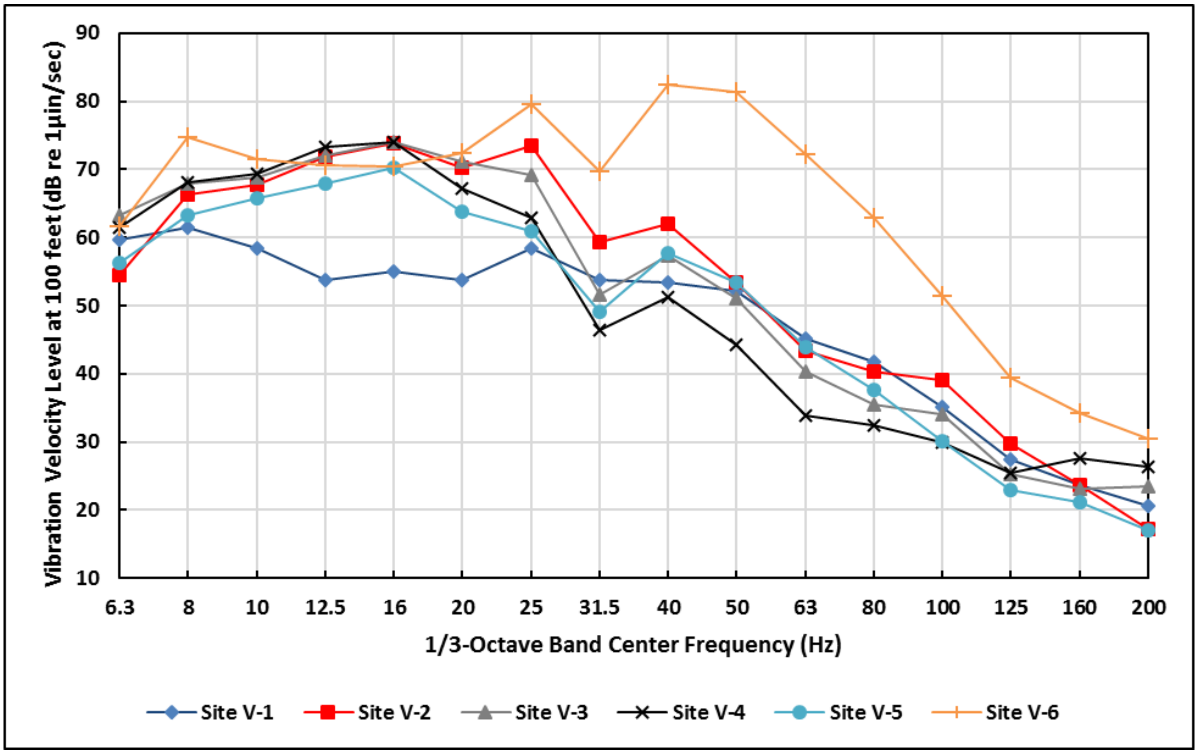
Figure 5-3: Force Density for Pendolino EMU High-Speed Train at 150 mph



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

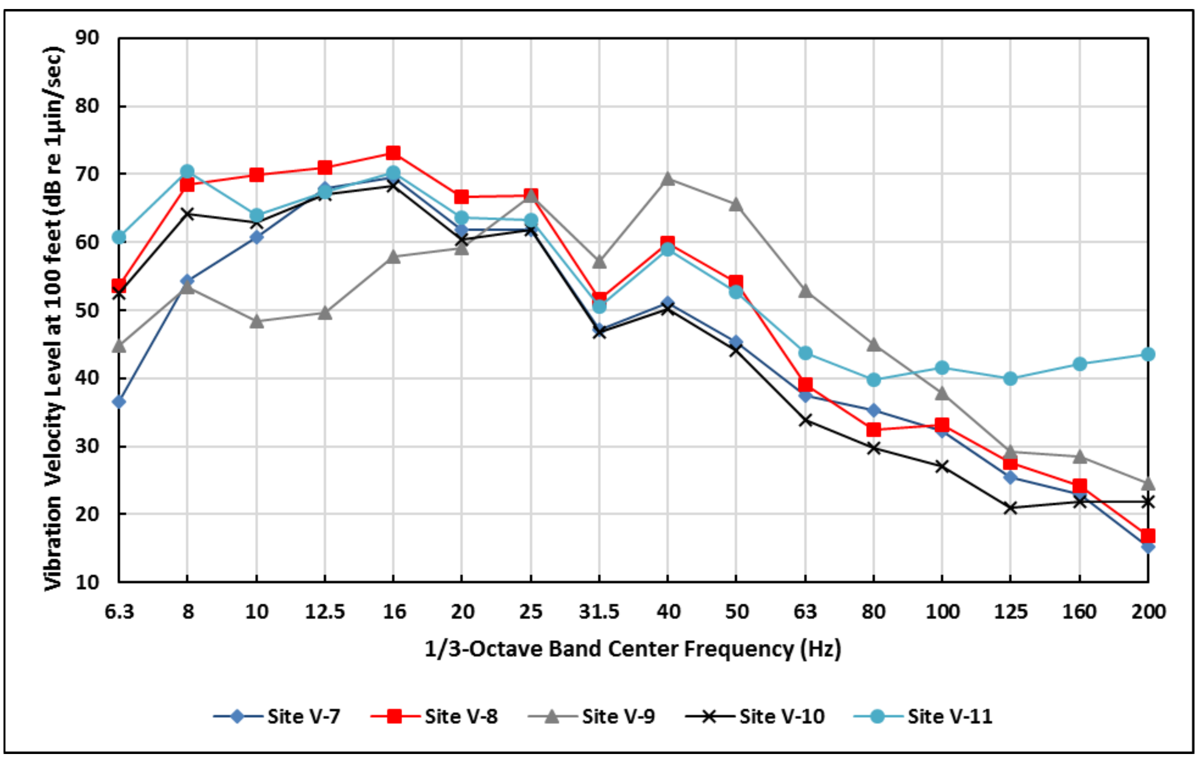
The above force density spectrum was combined with the LSTM data at each vibration measurement site to project ground vibration levels from future HSR operations using the FRA detailed vibration analysis methodology. As an example of the results, the projected ground vibration level spectra from HSR operations at a distance of 100 feet from the near track under worst-case conditions (i.e. at grade and at the maximum speed of 205 mph) are shown in **Figure 5-4** (for Sites V-1 through V-6) and in **Figure 5-5** (for Sites V-7 through V-11). These results suggest that HSR ground vibration levels at 100 feet from the tracks will marginally exceed the FRA vibration criterion of 72 VdB for residential land use in the areas represented by Sites V-2, V-3, V-4 and V-8, but will significantly exceed this criterion in the area represented by Site V-6.

Figure 5-4: Maximum HSR Ground Vibration at 100 feet (Sites V-1 through V-6)



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Figure 5-5: Maximum HSR Ground Vibration at 100 feet (Sites V-7 through V-11)



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

5.3 Construction Noise and Vibration

Construction noise and impacts are assessed using a combination of the methods and construction source data contained in the FRA Manual and the FHWA Roadway Construction Noise Model (RCNM). Typical noise levels generated by representative pieces of equipment are listed in **Table 5-1**.

The noise exposure at a receiver location may be calculated using decibel addition of all operating construction equipment using the following equation:

$$Leq(n) = Lmax + 10 \times Log(U.F.) - 20 \times Log(D/50) - Ashielding$$

where:

- Leq(n) = noise exposure at a receiver resulting from the operation of a single piece of equipment over n hours,
- Lmax = noise emission level of the particular piece of equipment at the reference distance of 50 feet (taken from **Table 5-1**),
- Ashielding = shielding provided by barriers, building, or terrain,
- D = distance from the receiver to the piece of equipment in feet, and
- U.F. = usage factor that accounts for the fraction of time that the equipment is in use over the specified time period. For Leq(1) assume a U.F. equal to 100% and for 8 hours or more use the values in **Table 5-1**.

The combination of noise from several pieces of equipment operating during the same time period is obtained from decibel addition of the Leq of each single piece of equipment calculated using the above equations.

Construction vibration is assessed for areas where there is potential for impact from construction activities. Such activities include blasting, pile driving, demolition, and drilling or excavation in close proximity to sensitive structures. Typical vibration levels generated by representative pieces of equipment are listed in **Table 5-2**.

Table 5-1: Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level (dBA) 50 ft from Source	Usage Factor (U.F.), %
Air Compressor	80	40
Backhoe	80	40
Ballast Equalizer	82	50
Ballast Tamper	83	50
Compactor	82	20
Concrete Mixer	85	40
Concrete Pump	82	20
Concrete Vibrator	76	20
Crane, Derrick	88	16
Crane, Mobile	83	16
Dozer	85	16
Generator	82	50
Grader	85	40
Impact Wrench	85	50
Jack Hammer	88	20
Loader	80	40
Paver	85	50

Table 5-1: Construction Equipment Noise Emission Levels		
Equipment	**Typical Noise Level (dBA) 50 ft from Source**	**Usage Factor (U.F.), %**
Pile Driver (Impact)	101	20
Pile Driver (Vibratory)	95	20
Pneumatic Tool	85	50
Pump	77	50
Rail Saw	90	20
Rock Drill	85	20
Roller	85	20
Saw	76	20
Scarifier	83	20
Scraper	85	40
Shovel	82	40
Spike Driver	77	20
Tie Cutter	84	20
Tie Handler	80	20
Tie Inserter	85	20
Truck	84	40

Sources: (1) FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012 and (2) FHWA, "Construction Noise Handbook, Final Report FHWA-HEP-06-015, August 2006.

Table 5-2: Vibration Source Levels for Construction Equipment			
Equipment		**PPV at 25 ft (in/sec)**	**Approximate Lv † at 25 ft**
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (vibratory)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory roller		0.210	94
Hoe ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

† RMS velocity in decibels (VdB) re 1 µinch/second
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

For damage assessment the following equation is used:

$$PPV_{equip} = PPV_{ref} \times [(25/D)]^{1.5}$$

where:

- PPVequip = the peak particle velocity in in/sec of the equipment adjusted for distance
- PPVref = the reference vibration level in in/sec at 25 feet from **Table 5-2**, and
- D = the distance from the equipment to the receiver in feet.

For annoyance assessment the following equation is used:

$$Lv(D) = Lv(25\ ft) - 30 \times \log(D/25)$$

where:

- Lv(D) = RMS vibration level at distance D
- Lv(25 ft) = RMS vibration level at 25 ft from **Table 5-2**, and
- D = the distance from the equipment to the receiver in feet.

6 NOISE AND VIBRATION IMPACT ASSESSMENT

6.1 Station Noise Assessment

The proposed station locations include one site in Dallas, one site near College Station and three site options in Houston. Excluding noise impacts from train operations (addressed below), sources of potential noise impact in the vicinity of train stations includes auto and bus traffic associated with access roads and parking facilities. For these sources, FTA guidance suggests impact screening distances in the range of 100-225 feet. For the station sites under consideration, however, it does not appear that there is any noise-sensitive land use within these distances. Thus, noise impacts are not anticipated due to HSR station activities.

6.2 Maintenance Facility Noise Impacts

There are two proposed Trainset Maintenance Facilities (TMF) and five Maintenance-of-Way Facilities (MOWF) along each build alternative. For maintenance facilities, FTA guidance (Chapter 3 of the FTA Guidance Manual)[1] suggests an impact screening distance of 1,000 feet from the center of the facility. If no sensitive receptors are found within that distance, no further noise analysis is required. For all the TMF and MOWF facilities, there are no noise-sensitive land uses within this distance. Thus, noise impacts are not anticipated due to TMF or MOWF operations.

6.3 Operational Noise Assessment

The assessment of noise impacts from HSR operations is summarized by county and segment in **Table 6-1** for FRA Category 2 (residential) land use and in **Table 6-2** for FRA Category 3 (institutional) land use. The results include a tabulation of location information for each sensitive receptor group, the existing noise levels, the projections of future noise levels, the impact criteria, and whether there will be noise impacts. The tables also show the total number of moderate and severe noise impacts for each location, without mitigation.

[1] FTA, "Transit Noise and Vibration Impact Assessment Manual," FTA Report No. 0123, September 2018.

Table 6-1: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Dallas (1)	Dallas Station to IH-20	NB	225-415	72	53-57	65	71	0	0	--
				53		54	60	0	0	--
Dallas (1)	Dallas Station to IH-20	SB	348-1001	72	48-54	65	71	0	0	--
				53		54	60	0	0	--
Dallas (1)	IH-20 to Bluff Springs Rd	NB	300-793	53	47-54	54	60	0	0	--
				70		64	69	0	0	--
				45		52	59	3	0	10-11
Dallas (1)	IH-20 to Bluff Springs Rd	SB	223-970	53	46-55	54	60	0	0	--
				70		64	69	0	0	--
				45		52	59	1	0	11
Ellis (1)	IH-20 to Bluff Springs Rd	NB	183-910	45	48-59	52	59	8	0	11-12
Ellis (1)	IH-20 to Bluff Springs Rd	SB	122-914	45	48-61	52	59	10	2	11-12
Ellis (2A)	Bluff Springs Rd to FM 813	NB	176-982	45	46-59	52	59	0	1	14
				55		55	61	0	0	--
Ellis (2A)	Bluff Springs Rd to FM 813	SB	199-777	45	49-58	52	59	2	0	14-15
				55		55	61	2	0	14-15
Ellis (2A)	FM 813 to TX 287	NB	824-896	55	49	55	61	0	0	--
				53		55	61	0	0	--
Ellis (2A)	FM 813 to TX 287	SB	163-989	55	47-60	55	61	2	0	18
				53		55	61	0	0	--
Ellis (2A)	TX 287 to TX 34	NB	712-908	53	47-50	55	61	0	0	--
				52		54	60	0	0	--
Ellis (2A)	TX 287 to TX 34	SB	289-957	53	46-56	55	61	1	0	22
				52		54	60	0	0	--
Ellis (2A)	TX 34 to TX 22	NB	947	53	46	55	61	0	0	--
				36		50	55	0	0	--
Ellis (2A)	TX 34 to TX 22	SB	No noise sensitive receptors.							--
Ellis (2B)	Bluff Springs Rd to FM 813	NB	338-988	55	46-55	55	61	0	0	--
				45		52	59	2	0	29
Ellis (2B)	Bluff Springs Rd to FM 813	SB	325-901	55	49-55	55	61	0	0	--
				45		52	59	1	0	30
Ellis (2B)	FM 813 to TX 287	NB	154-947	55	48-60	55	61	2	0	33
				53		55	61	0	0	--

Table 6-1: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Ellis (2B)	FM 813 to TX 287	SB	660	55	49	55	61	0	0	--
				53		55	61	0	0	--
Ellis (2B)	TX 287 to TX 34	NB	183-757	53	50-59	55	61	4	0	39-40
				60		58	63	0	0	--
Ellis (2B)	TX 287 to TX 34	SB	191-945	53	48-59	55	61	3	0	38-40
				60		58	63	0	0	--
Ellis (2B)	TX 34 to TX 22	NB	947	53	46	55	61	0	0	--
Ellis (2B)	TX 34 to TX 22	SB	No noise sensitive receptors.							--
Ellis (3A)	TX 34 to TX 22	NB	No noise sensitive receptors.							--
Ellis (3A)	TX 34 to TX 22	SB	No noise sensitive receptors.							--
Ellis (3B)	TX 34 to TX 22	NB	857	36	49	50	55	0	0	--
Ellis (3B)	TX 34 to TX 22	SB	No noise sensitive receptors.							--
Ellis (3C)	TX 34 to TX 22	NB	No noise sensitive receptors.							--
Ellis (3C)	TX 34 to TX 22	SB	No noise sensitive receptors.							--
Navarro (3A)	TX 34 to TX 22	NB	665-982	36	47-49	50	55	0	0	--
Navarro (3A)	TX 34 to TX 22	SB	908-958	36	47-48	50	55	0	0	--
Navarro (3A)	TX 22 to TX 31	NB	294-637	39	48-54	50	55	2	0	51
				36		50	55	0	0	--
Navarro (3A)	TX 22 to TX 31	SB	237-873	39	48-55	50	55	2	0	51
				36		50	55	0	0	--
Navarro (3A)	TX 31 to FM 3194	NB	No noise sensitive receptors.							--
Navarro (3A)	TX 31 to FM 3194	SB	430	46	53	52	59	1	0	52
Navarro (3A)	FM 3194 to Navarro County Line	NB	240	46	58	52	59	1	0	58
Navarro (3A)	FM 3194 to Navarro County Line	SB	889	46	47	52	59	0	0	--
Navarro (3B)	TX 34 to TX 22	NB	794-848	36	48-49	50	55	0	0	--
Navarro (3B)	TX 34 to TX 22	SB	175-976	36	46-59	50	55	4	1	64-66
Navarro (3B)	TX 22 to TX 31	NB	261-996	46	48-56	52	59	1	0	70
				39		50	55	0	0	--
Navarro (3B)	TX 22 to TX 31	SB	324-759	46	49-55	52	59	2	0	70
Navarro (3B)	TX 31 to Bonner Ave	NB	340-1001	46	43-54	52	59	1	0	73
Navarro (3B)	TX 31 to Bonner Ave	SB	280-1017	46	42-54	52	59	1	0	70
				39		50	55	4	0	70

Table 6-1: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA) HSR	FRA Criteria Mod.	FRA Criteria Sev.	Number and Type of Impacts Mod.	Number and Type of Impacts Sev.	Mapbook Page
Navarro (3B)	Bonner Ave to Navarro County Line	NB	142-751	46	49-60	52	59	2	1	73-77
Navarro (3B)	Bonner Ave to Navarro County Line	SB	398	46	52	52	59	1	0	77
Navarro (3C)	TX 34 to TX 22	NB	665-982	36	46-49	50	55	0	0	--
Navarro (3C)	TX 34 to TX 22	SB	908-958	36	47-48	50	55	0	0	--
Navarro (3C)	TX 22 to TX 31	NB	294-637	36	48-54	50	55	0	0	--
				39		50	55	2	0	89
Navarro (3C)	TX 22 to TX 31	SB	237-873	39	48-55	50	55	2	0	89
Navarro (3C)	TX 31 to TX 14	NB	352-1017	46	47-55	52	59	1	0	94
Navarro (3C)	TX 31 to TX 14	SB	430	46	53	52	59	1	0	94
Navarro (3C)	TX 14 to Navarro County Line	NB	176-1000	46	46-59	52	59	1	0	95
Navarro (3C)	TX 14 to Navarro County Line	SB	194-940	46	46-56	52	59	1	0	96
Freestone (3C)	Navarro County Line to FM 1090	NB	177-885	29	46-59	50	55	3	1	99-100
Freestone (3C)	Navarro County Line to FM 1090	SB	568-989	29	46-49	50	55	0	0	--
Freestone (3C)	FM 1090 to US 84	NB	No noise sensitive receptors.							--
Freestone (3C)	FM 1090 to US 84	SB	257-511	52	50-56	54	60	2	0	103-104
				68		63	68	0	0	--
Freestone (3C)	US 84 to TX 179	NB	No noise sensitive receptors.							--
Freestone (3C)	US 84 to TX 179	SB	366-452	50	51-52	53	60	0	0	--
				68		63	68	0	0	--
Freestone (3C)	TX 179 to Freestone County Line	NB	No noise sensitive receptors.							--
Freestone (3C)	TX 179 to Freestone County Line	SB								--
Freestone (4)	Navarro County Line to FM 930	NB	306-905	42	46-54	52	57	1	0	160
				43		52	58	1	0	156
Freestone (4)	Navarro County Line to FM 930	SB	739	43	50	52	58	0	0	--
Freestone (4)	FM 930 to Freestone County Line	NB	812-989	42	47-49	52	57	0	0	--
Freestone (4)	FM 930 to Freestone County Line	SB	166-993	42	48-59	52	57	4	1	160-163
Limestone (4)	Limestone County	NB	345-862	48	49-53	53	59	1	0	173
Limestone (4)	Limestone County	SB	452-832	48	49-53	53	59	0	0	--
Leon (3C)	Freestone County Line to CR 3051	NB	No noise sensitive receptors.							--

Table 6-1: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria Mod.	FRA Criteria Sev.	Mod.	Sev.	
Leon (3C)	Freestone County Line to CR 3051	SB	322-503	55	50-55	55	61	0	0	--
Leon (3C)	CR 3051 to TX 7	NB	221-333	55	53-55	55	61	1	0	126
Leon (3C)	CR 3051 to TX 7	SB	271-428	55	51-55	55	61	0	0	--
Leon (3C)	TX 7 to FM 977	NB	500	55	52	55	61	0	0	--
Leon (3C)	TX 7 to FM 977	SB	No noise sensitive receptors.							--
Leon (4)	Limestone County Line to US 79	NB	708	42	48	51	57	0	0	--
Leon (4)	Limestone County Line to US 79	SB	833	42	46	51	57	0	0	--
Leon (4)	US 79 to TX 7	NB	296-885	42	46-53	51	57	1	0	177
Leon (4)	US 79 to TX 7	SB	124-519	42	50-61	51	57	0	0	--
				62		59	64	1	0	180
Leon (4)	TX 7 to FM 977	NB	439-797	42	47-51	51	57	0	0	--
				62		59	64	0	0	--
Leon (4)	TX 7 to FM 977	SB	211-843	62	48-58	59	64	0	0	--
				52		54	60	0	0	--
Leon (4)	FM 977 to FM 2289	NB	243-745	52	49-55	54	60	1	0	187
Leon (4)	FM 977 to FM 2289	SB	386-907	52	46-52	54	60	0	0	--
Madison (3C)	FM 977 to Waldrip Rd	NB	No noise sensitive receptors.							--
Madison (3C)	FM 977 to Waldrip Rd	SB	190-379	65	54-58	61	66	0	0	--
Madison (3C)	Waldrip Rd to FM 1452	NB	338	50	55	53	60	1	0	144
Madison (3C)	Waldrip Rd to FM 1452	SB	532-640	50	50	53	60	0	0	--
Madison (3C)	FM 1452 to FM 1696	NB	787-970	54	46-49	55	61	0	0	--
Madison (3C)	FM 1452 to FM 1696	SB	No noise sensitive receivers.							--
Madison (4)	FM 977 to FM 2289	NB	279-480	52	51-56	54	60	2	0	190
Madison (4)	FM 977 to FM 2289	SB	338-982	52	46-53	54	60	0	0	--
Madison (4)	FM 2289 to US 190	NB	353-714	50	49-54	53	60	0	0	--
				54		55	61	0	0	--
Madison (4)	FM 2289 to US 190	SB	456-693	50	48-53	53	60	0	0	--
Madison (4)	US 190 to FM 1696	NB	182-909	54	48-59	55	61	2	0	196-197
Madison (4)	US 190 to FM 1696	SB	436-990	54	46-53	55	61	0	0	--
Grimes (5)	FM 1696 to FM 39	NB	235-404	47	51-55	52	59	0	0	--
				49		53	59	1	0	207
Grimes (5)	FM 1696 to FM 39	SB	No noise sensitive receptors.							--

Table 6-1: Summary of Noise Impacts for Residential Land Use										
County/ Segment	**Location**	**Side of Track**	**Near Track Dist. (ft)**	**Existing Noise Level (Ldn)**	**Project Noise Levels – Ldn (dBA)**			**Number and Type of Impacts**		**Mapbook Page**
					HSR	**FRA Criteria**				
						Mod.	**Sev.**	**Mod.**	**Sev.**	
Grimes (5)	FM 39 to TX 90	NB	313-942	49	46-55	53	59	2	0	211-212
Grimes (5)	FM 39 to TX 90	SB	225-852	49	49-57	53	59	2	0	209-211
Grimes (5)	TX 90 to CR 215	NB	207-952	49	43-56	53	59	0	0	--
Grimes (5)	TX 90 to CR 215	SB	392-798	49	44-52	53	59	0	0	--
Grimes (5)	CR 215 to TX 105	NB	395-850	48	48-52	53	59	0	0	--
Grimes (5)	CR 215 to TX 105	SB	414-873	48	46-53	53	59	0	0	--
Grimes (5)	TX 105 to Grimes County Line	NB	157-972	49	44-60	53	59	7	1	227
				48		53	59	0	0	--
Grimes (5)	TX 105 to Grimes County Line	SB	563-992	49	43-49	53	59	0	0	--
Waller (5)	Waller County	NB	196-994	45	46-58	52	59	3	0	231-232
				49		53	59	10	0	228
Waller (5)	Waller County	SB	113-1000	45	46-60	52	59	11	1	231-232
				49		53	59	5	1	228-229
Harris (5)	Harris County Line to Old Hwy 290	NB	664-971	51	46-50	54	60	0	0	--
Harris (5)	Harris County Line to Old Hwy 290	SB	238-992	51	46-57	54	60	1	0	234
Harris (5)	Old Hwy 290 to Grand Pkwy	NB	147-918	51	48-60	54	60	2	1	238-240
Harris (5)	Old Hwy 290 to Grand Pkwy	SB	210-994	51	48-58	54	60	11	0	239
Harris (5)	Grand Pkwy to TX 6	NB	502	59	52	57	63	0	0	--
				69		64	69	0	0	--
Harris (5)	Grand Pkwy to TX 6	SB	132-520	59	52-61	57	63	3	0	246-247
				69		64	69	0	0	--
Harris (5)	TX 6 to Blalock Rd	NB	340-493	46	52-55	52	59	2	0	247-250
Harris (5)	TX 6 to Blalock Rd	SB	No noise sensitive receptors.							--
Harris (5)	Blalock Rd to Houston Station	NB	156-510	55	52-60	55	64	22	0	251-252
				46		52	59	2	0	251
				49		53	59	61	2	252-253
Harris (5)	Blalock Rd to Houston Station	SB	227-524	55	52-57	55	64	81	0	251-252
				49		49	56	5	0	252-253

Source: Cross-Spectrum Acoustics, 2019.

Table 6-2: Summary of Noise Impacts for Institutional Land Use												
County	Seg.	Location	Side of Track	Near Track Dist. (ft.)	Speed (mph)	Existing Noise Level Leq (dBA)	TX HSR Noise Levels – Leq (dBA)			Type and # of Impacts		Mapbook Page
							TX HSR Project	FTA Criteria				
								Mod.	Sev.	Mod.	Sev.	
Dallas	1	Friendship Missionary Baptist Church	SB	311	205	75	54	70	78	0	0	4
Dallas	1	The Church of Revelation	SB	357	205	75	53	70	78	0	0	4
Dallas	1	College Park Baptist Church	SB	670	205	50	49	58	65	0	0	6
Dallas	1	Full Faith Deliverance Church	SB	463	205	50	52	58	65	0	0	6
Ellis	2B	Palmyra Studios	NB	963	205	62	47	64	70	0	0	31
Freestone	4	Furney-Richardson School	NB	837	205	49	48	58	64	0	0	162
Grimes	5	Shiloh Church Cemetery	SB	988	205	45	47	57	64	0	0	202
Harris	5	St. Aidan's Episcopal Church	SB	487	205	67	51	67	72	0	0	244
Harris	5	Fairbanks United Methodist Church	NB	451	205	44	52	57	67	0	0	250
Harris	5	Christian Family Church	NB	177	205	44	58	57	64	1	0	250

Source: Cross-Spectrum Acoustics, 2019.

The noise impact locations are shown graphically in **Appendix D, Cultural Resources and Community Facilities Mapbook** and the projected noise impacts are described below by county and segment. The projected impacts are generally due to HSR operations where the existing noise levels are low.

6.3.1 Dallas County

6.3.1.1 Segment 1

- **I-20 to Bluff Springs Rd (NB) (Mapbook Page 6-12):** There are three single-family residences along the northbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate noise impacts.
- **I-20 to Bluff Springs Rd (SB) (Mapbook Page 6-12):** There is one single-family residence along the southbound side of the proposed alignment between Interstate-20 and the Bluff Springs Rd along Segment 1 projected to have a moderate noise impact.

6.3.2 Ellis County

6.3.2.1 Segment 1

- **I-20 to Bluff Springs Rd (NB) (Mapbook Page 6-12):** There are eight single-family residences along the northbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate or severe noise impacts.
- **I-20 to Bluff Springs Rd (SB) (Mapbook Page 6-12):** There are twelve single-family residences along the southbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate or severe noise impacts.

6.3.2.2 Segment 2A

- **Bluff Springs Rd to FM 813 (NB) (Mapbook Page 12-16):** There is one single-family residence along the northbound side of the proposed alignment between the Bluff Springs Rd and Farm to Market 813 along Segment 2A projected to have a severe noise impact.
- **Bluff Springs Rd to FM 813 (SB) (Mapbook Page 12-16):** There are four single-family residences along the southbound side of the proposed alignment between the Bluff Springs Rd and Farm to Market 813 along Segment 2A projected to have moderate noise impacts.
- **FM 813 to TX 287 (SB) (Mapbook Page 16-22):** There are two single-family residences along the southbound side of the proposed alignment between Farm to Market 813 and TX 287 along Segment 2A projected to have moderate noise impacts.
- **TX 287 to TX 34 (SB) (Mapbook Page 22-25):** There is one single-family residence along the southbound side of the proposed alignment between TX 287 and TX 34 along Segment 2A projected to have a moderate noise impact.

6.3.2.3 Segment 2B

- **Bluff Springs Rd to FM 813 (NB) (Mapbook Page 28-32):** There are two single-family residences along the northbound side of the proposed alignment between Bluff Springs Rd and Farm to Market 813 along Segment 2B projected to have moderate noise impacts.
- **Bluff Springs Rd to FM 813 (SB) (Mapbook Page 28-32):** There is one single-family residence along the southbound side of the proposed alignment between Bluff Springs Rd and Farm to Market 813 along Segment 2B projected to have a moderate noise impact.

- **FM 813 to TX 287 (NB) (Mapbook Page 32-38):** There are two single-family residences along the northbound side of the proposed alignment between Farm to Market 813 and TX 287 along Segment 2B projected to have moderate noise impacts.
- **TX 287 to TX 34 (NB) (Mapbook Page 38-41):** There are four single-family residences along the northbound side of the proposed alignment between TX 287 and TX 34 along Segment 2B projected to have moderate noise impacts.
- **TX 287 to TX 34 (SB) (Mapbook Page 38-41):** There are three single-family residences along the southbound side of the proposed alignment between TX 287 and TX 34 along Segment 2B projected to have moderate noise impacts.

6.3.3 Navarro County

6.3.3.1 Segment 3A

- **TX 22 to TX 31 (NB) (Mapbook Page 48-52):** There are two residences along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3A projected to have moderate noise impacts.
- **TX 22 to TX 31 (SB) (Mapbook Page 48-52):** There are two residences along the southbound side of the proposed alignment between TX 22 and TX 31 along Segment 3A projected to have moderate noise impacts.
- **TX 31 to FM 3194 (SB) (Mapbook Page 52-57):** There is one residence along the southbound side of the proposed alignment between TX 31 to Farm to Market 3194 along Segment 3A in Navarro County projected to have a moderate noise impact.
- **FM 3194 to Navarro County Line (NB) (Mapbook Page 52-57):** There is one residence along the northbound side of the proposed alignment between TX 31 to Farm to Market 3194 along Segment 3A in Navarro County projected to have a moderate noise impact.

6.3.3.2 Segment 3B

- **TX 34 to TX 22 (SB) (Mapbook Page 63-67):** There are five residences along the southbound side of the proposed alignment between TX 34 and TX 22 along Segment 3B projected to have moderate or severe noise impacts.
- **TX 22 to TX 31 (NB) (Mapbook Page 67-70):** There is one residence along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3B projected to have a moderate noise impact.
- **TX 22 to TX 31 (SB) (Mapbook Page 67-70):** There are two residences along the southbound side of the proposed alignment between TX 22 and TX 31 along Segment 3B projected to have moderate noise impacts.
- **TX 31 to Bonner Ave (NB) (Mapbook Page 70-73):** There are two single-family residences along the northbound side of the proposed alignment between TX 31 and Bonner Ave along Segment 3B projected to have moderate noise impacts.
- **TX 31 to Bonner Ave (SB) (Mapbook Page 70-73):** There are five single-family residences along the southbound side of the proposed alignment between TX 31 and Bonner Ave along Segment 3B projected to have moderate noise impacts.
- **Bonner Ave to Navarro County Line (NB) (Mapbook Page 73-80):** There are two single-family residences along the northbound side of the proposed alignment between Bonner Ave and Navarro County Line along Segment 3B projected to have moderate or severe noise impacts.

- **Bonner Ave to Navarro County Line (SB) (Mapbook Page 73-80):** There is one single-family residence along the southbound side of the proposed alignment between Bonner Ave and Navarro County Line along Segment 3B projected to have moderate noise impact.

6.3.3.3 Segment 3C

- **TX 22 to TX 31 (NB) (Mapbook Page 86-90):** There are two single-family residences along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3C projected to have moderate noise impacts.
- **TX 22 to TX 31 (SB) (Mapbook Page 86-90):** There are two single-family residences along the southbound side of the proposed alignment between TX 22 and TX 31 along Segment 3C projected to have moderate noise impacts.
- **TX 31 to TX 14 (NB) (Mapbook Page 90-95):** There is one single-family residence along the northbound side of the proposed alignment between TX 31 and the TX 14 along Segment 3C projected to have a moderate noise impact.
- **TX 31 to TX 14 (SB) (Mapbook Page 90-95):** There is one single-family residence along the southbound side of the proposed alignment between TX 31 and the TX 14 along Segment 3C projected to have a moderate noise impact.
- **TX 14 to Navarro County Line (NB) (Mapbook Page 95-97):** There is one single-family residence along the northbound side of the proposed alignment between TX 14 and the Navarro County Line along Segment 3C projected to have a moderate noise impact.
- **TX 14 to Navarro County Line (SB) (Mapbook Page 95-97):** There is one single-family residence along the southbound side of the proposed alignment between TX 14 and the Navarro County Line along Segment 3C projected to have a moderate noise impact.

6.3.4 Freestone County

6.3.4.1 Segment 3C

- **Navarro County Line to FM 1090 (NB) (Mapbook Page 97-102):** There are four single-family residences along the northbound side of the proposed alignment between the Navarro County Line to Farm to Market 1090 projected to have moderate or severe noise impacts.
- **FM 1090 to US 84 (SB) (Mapbook Page 102-105):** There are two single-family residences along the southbound side of the proposed alignment between Farm to Market 1090 and US 84 projected to have moderate noise impacts.

6.3.4.2 Segment 4

- **Navarro County Line to FM 930 (NB) (Mapbook Page 153-160):** There are two residences along the northbound side of the proposed alignment between the Navarro County Line and Farm to Market 930 to have moderate noise impacts.
- **FM 930 to Freestone County Line (SB) (Mapbook Page 160-166):** There are five residences along the southbound side of the proposed alignment between Farm to Market 930 and the Freestone County Line projected to have moderate or severe noise impacts.

6.3.5 Limestone County

6.3.5.1 Segment 4

- **NB (Mapbook Page 166-173): There is one residence along the northbound side of the proposed alignment in Limestone County projected to have a moderate noise impact.**

6.3.6 Leon County

6.3.6.1 Segment 3C

- **CR 3051 to TX 7 (NB) (Mapbook Page 121-126):** There is one residence along the northbound side of the proposed alignment between County Road 3051 and TX 7 projected to have a moderate noise impact.

6.3.6.2 Segment 4

- **US 79 to TX 7 (NB) (Mapbook Page 177-180):** There is one residence along the northbound side of the proposed alignment between US 79 and TX 7 projected to have a moderate noise impact.
- **US 79 to TX 7 (SB) (Mapbook Page 177-180):** There is one residence along the southbound side of the proposed alignment between US 79 and TX 7 projected to have a moderate noise impact.
- **FM 977 to FM 2289 (NB) (Mapbook Page 186-189):** There is one single-family residences along the northbound side of the proposed alignment between Farm to Market 977 and Farm to Market 2289 along Segment 4 projected to have a moderate noise impact.

6.3.7 Madison County

6.3.7.1 Segment 3C

- **Waldrip Rd to FM 1452 (NB) (Mapbook Page 140-145):** There is one single-family residence along the northbound side of the proposed alignment between Waldrip Rd and Farm to Market 1452 projected to have a moderate noise impact.

6.3.7.2 Segment 4

- **FM 977 to FM 2289 (NB) (Mapbook Page 189-191):** There are two single-family residences along the northbound side of the proposed alignment between Farm to Market 977 and Farm to Market 2289 projected to have a moderate noise impact.
- **US 190 to FM 1696 (NB) (Mapbook Page 196-201):** There are two single-family residences along the northbound side of the proposed alignment between US 290 and Farm to Market 1696 projected to have moderate noise impacts.

6.3.8 Grimes County

6.3.8.1 Segment 5

- **FM 1696 to FM 39 (NB) (Mapbook Page 201-208):** There is one single-family residence along the northbound side of the proposed alignment between Farm to Market 1696 and Farm to Market 39 projected to have a moderate noise impact.
- **FM 39 to TX 90 (NB) (Mapbook Page 208-212):** There are two single-family residences along the northbound side of the proposed alignment between Farm to Market 39 and TX 90 projected to have moderate noise impacts.
- **FM 39 to TX 90 (SB) (Mapbook Page 208-212):** There are two single-family residences along the southbound side of the proposed alignment between Farm to Market 39 and TX 90 projected to have moderate noise impacts.
- **TX 105 to Grimes County Line (NB) (Mapbook Page 223-228):** There are eight single-family residences along the northbound side of the proposed alignment between TX 105 and Grimes County Line that are projected to have moderate or severe noise impacts.

6.3.9 Waller County

6.3.9.1 Segment 5

- **NB (Mapbook Page 228-233):** There are 13 single-family residences along the northbound side of the proposed alignment in Waller County projected to have moderate noise impacts.
- **SB (Mapbook Page 228-233):** There are 18 single-family residences along the southbound side of the proposed alignment in Waller County projected to have moderate or severe noise impacts.

6.3.10 Harris County

6.3.10.1 Segment 5

- **Harris County Line to Old Hwy 290 (SB) (Mapbook Page 233-237):** There is one single-family residence along the southbound side of the proposed alignment between the Harris County line and Old Hwy 290 projected to have a moderate noise impact.
- **Old Hwy 290 to Grand Pkwy (NB) (Mapbook Page 237-242):** There are three single-family residences along the northbound side of the proposed alignment between Old Hwy 290 and Grand Pkwy projected to have moderate or severe noise impacts.
- **Old Hwy 290 to Grand Pkwy (SB) (Mapbook Page 237-242):** There are eleven single-family residences along the southbound side of the proposed alignment between Old Hwy 290 and Grand Pkwy projected to have moderate noise impacts.
- **Grand Pkwy to TX 6 (SB) (Mapbook Page 242-247):** There are three single-family residences along the southbound side of the proposed alignment between Grand Pkwy and TX 6 projected to have moderate noise impacts.
- **TX 6 to Blalock Rd (NB) (Mapbook Page 247-251):** There is one single-family residence and one hotel along the northbound side of the proposed alignment between TX 6 and Blalock Rd projected to have moderate noise impacts.
- **Blalock Rd to Houston Station (NB) (Mapbook Page 251-257):** There are 87 single and multi-family residences along the northbound side of the proposed alignment between Blalock Rd to the Houston Station projected to have moderate or severe noise impacts.

- **Blalock Rd to Houston Station (SB) (Mapbook Page 251-257):** There are 86 single and multi-family residences along the southbound side of the proposed alignment between Blalock Rd and the Houston Station projected to have moderate noise impacts.
- **Christian Family Church (Mapbook Page 250):** The Christian Family Church is projected to have a moderate noise impact.

With regard to potential increased annoyance due to the startle effect of noise from passing trains, at the maximum train speed of 205 mph this effect would only occur within about 45 feet from the tracks which is within the ROW. Therefore, increased noise annoyance due to startle should not be an issue.

Finally, with regard to the effects of noise from passing trains on animals, the FRA noise exposure criterion limit is a Sound Exposure Level (SEL) of 100 dBA. For the TX HSR trains operating on viaduct at the maximum speed of 205 mph, this limit would only be exceeded within about 15 feet from the tracks and within the HSR ROW. Because no animals would be this close to the tracks, noise impact on wildlife is not anticipated.

6.4 Operational Vibration Assessment

As indicated in the tables in this section below, HSR train vibration levels will be well below the thresholds for damage to structures, including underground utilities, which are 90 VdB or greater. Therefore, the vibration impact assessment focused on potential annoyance effects.

Based on a Detailed Vibration Analysis, the assessment of vibration impacts from HSR operations is summarized by county and segment in **Table 6-3** for FRA Category 2 (residential) land use and in **Table 6-4** for FRA Category 3 (institutional) land use. The results include a tabulation of location information for each sensitive receptor group, the projections of future vibration levels, the impact criteria, and whether there will be vibration impacts.

Table 6-3: Summary of Vibration Impacts for Residential Land Use

County	Segment	Location	Side of Track	Near Track Distance (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
DALLAS	1	Dallas Station to I-20	NB	225-415	205	42	72	0	1-6
DALLAS	1	Dallas Station to I-20	SB	348-1001	205	37	72	0	1-6
DALLAS	1	IH-20 to Bluff Springs Rd	NB	300-793	205	48	72	0	6-12
DALLAS	1	IH-20 to Bluff Springs Rd	SB	223-970	205	52	72	0	6-12
ELLIS	1	IH-20 to Bluff Springs Rd	NB	183-910	205	44	72	0	6-12
ELLIS	1	IH-20 to Bluff Springs Rd	SB	122-914	205	49	72	0	6-12
ELLIS	2A	Bluff Springs Rd to FM 813	NB	176-982	205	66	72	0	12-16
ELLIS	2A	Bluff Springs Rd to FM 813	SB	199-777	205	66	72	0	12-16
ELLIS	2A	FM 813 to TX 287	NB	824-896	205	54	72	0	16-22
ELLIS	2A	FM 813 to TX 287	SB	163-989	205	67	72	0	16-22
ELLIS	2A	TX 287 to TX 34	NB	712-908	205	64	72	0	22-25
ELLIS	2A	TX 287 to TX 34	SB	289-957	205	67	72	0	22-25
ELLIS	2A	TX 34 to TX 22	NB	947	205	68	72	0	25-27
ELLIS	2A	TX 34 to TX 22	SB	No sensitive receptors.					--
ELLIS	2B	Bluff Springs Rd to FM 813	NB	338-988	205	67	72	0	28-32
ELLIS	2B	Bluff Springs Rd to FM 813	SB	325-901	205	58	72	0	28-32
ELLIS	2B	FM 813 to TX 287	NB	154-947	205	66	72	0	32-38
ELLIS	2B	FM 813 to TX 287	SB	660	205	65	72	0	32-38
ELLIS	2B	TX 287 to TX 34	NB	183-757	205	61	72	0	38-41
ELLIS	2B	TX 287 to TX 34	SB	191-945	205	68	72	0	38-41
ELLIS	2B	TX 34 to TX 22	NB	947	205	68	72	0	41-43
ELLIS	2B	TX 34 to TX 22	SB	No sensitive receptors.					--
ELLIS	3A	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3A	TX 34 to TX 22	SB	No sensitive receptors.					--
ELLIS	3B	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3B	TX 34 to TX 22	SB	857	205	54	72	0	62-63
ELLIS	3C	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3C	TX 34 to TX 22	SB	No sensitive receptors.					--
NAVARRO	3A	TX 34 to TX 22	NB	665-982	205	64	72	0	43-48
NAVARRO	3A	TX 34 to TX 22	SB	908-958	205	64	72	0	43-48
NAVARRO	3A	TX 22 to TX 31	NB	294-637	205	67	72	0	48-52
NAVARRO	3A	TX 22 to TX 31	SB	237-873	205	68	72	0	48-52
NAVARRO	3A	TX 31 to FM 3194	NB	No sensitive receptors.					--

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Distance (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
NAVARRO	3A	TX 31 to FM 3194	SB	430	205	55	72	0	52-57
NAVARRO	3A	FM 3194 to Navarro County Line	NB	240	205	58	72	0	57-61
NAVARRO	3A	FM 3194 to Navarro County Line	SB	889	205	64	72	0	57-61
NAVARRO	3B	TX 34 to TX 22	NB	794-848	205	64	72	0	63-67
NAVARRO	3B	TX 34 to TX 22	SB	175-976	205	67	72	0	63-67
NAVARRO	3B	TX 22 to TX 31	NB	261-996	205	58	72	0	67-70
NAVARRO	3B	TX 22 to TX 31	SB	324-759	205	57	72	0	67-70
NAVARRO	3B	TX 31 to Bonner Ave	NB	340-1001	205	66	72	0	70-73
NAVARRO	3B	TX 31 to Bonner Ave	SB	280-1017	205	67	72	0	70-73
NAVARRO	3B	Bonner Ave to Navarro County Line	NB	142-751	205	61	72	0	73-80
NAVARRO	3B	Bonner Ave to Navarro County Line	SB	398	205	66	72	0	73-80
NAVARRO	3C	TX 34 to TX 22	NB	665-982	205	64	72	0	82-86
NAVARRO	3C	TX 34 to TX 22	SB	908-958	205	64	72	0	82-86
NAVARRO	3C	TX 22 to TX 31	NB	294-637	205	67	72	0	86-90
NAVARRO	3C	TX 22 to TX 31	SB	237-873	205	68	72	0	86-90
NAVARRO	3C	TX 31 to TX 14	NB	352-1017	205	64	72	0	90-95
NAVARRO	3C	TX 31 to TX 14	SB	430	205	55	72	0	90-95
NAVARRO	3C	TX 14 to Navarro County Line	NB	176-1000	205	66	72	0	95-97
NAVARRO	3C	TX 14 to Navarro County Line	SB	194-940	205	69	72	0	95-97
FREESTONE	3C	Navarro County Line to FM 1090	NB	177-885	205	56	72	0	97-102
FREESTONE	3C	Navarro County Line to FM 1090	SB	568-989	205	58	72	0	97-102
FREESTONE	3C	FM 1090 to US 84	NB	No sensitive receptors.					--
FREESTONE	3C	FM 1090 to US 84	SB	257-511	205	58	72	0	102-105
FREESTONE	3C	US 84 to TX 179	NB	No sensitive receptors.					--
FREESTONE	3C	US 84 to TX 179	SB	366-452	205	60	72	0	105-111
FREESTONE	3C	TX 179 to Freestone County Line	NB	No sensitive receptors.					--
FREESTONE	3C	TX 179 to Freestone County Line	SB						--
FREESTONE	4	Navarro County Line to FM 930	NB	306-905	205	61	72	0	153-160
FREESTONE	4	Navarro County Line to FM 930	SB	739	205	46	72	0	153-160
FREESTONE	4	FM 930 to Freestone County Line	NB	812-989	205	55	72	0	160-166
FREESTONE	4	FM 930 to Freestone County Line	SB	166-993	205	62	72	0	160-166
LIMESTONE	4	Limestone County	NB	345-862	205	60	72	0	166-173
LIMESTONE	4	Limestone County	SB	452-832	205	49	72	0	166-173

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Distance (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
LEON	3C	Freestone County Line to CR 3051	NB	No sensitive receptors.					--
LEON	3C	Freestone County Line to CR 3051	SB	322-503	205	58	72	0	116-121
LEON	3C	CR 3051 to TX 7	NB	221-333	205	72	72	0	121-126
LEON	3C	CR 3051 to TX 7	SB	271-428	205	70	72	0	121-126
LEON	3C	TX 7 to FM 977	NB	500	205	58	72	0	126-136
LEON	3C	TX 7 to FM 977	SB	No sensitive receptors.					--
LEON	4	Limestone County Line to US 79	NB	708	205	56	72	0	173-177
LEON	4	Limestone County Line to US 79	SB	883	205	55	72	0	173-177
LEON	4	US 79 to TX 7	NB	296-885	205	66	72	0	177-180
LEON	4	US 79 to TX 7	SB	124-519	205	68	72	0	177-180
LEON	4	TX 7 to FM 977	NB	439-797	205	69	72	0	180-186
LEON	4	TX 7 to FM 977	SB	211-843	205	67	72	0	180-186
LEON	4	FM 977 to FM 2289	NB	243-745	205	71	72	0	186-189
LEON	4	FM 977 to FM 2289	SB	386-907	205	69	72	0	186-189
MADISON	3C	FM 977 to Waldrip Rd	NB	No sensitive receptors.					--
MADISON	3C	FM 977 to Waldrip Rd	SB	190-379	205	47	72	0	136-140
MADISON	3C	Waldrip Rd to FM 1452	NB	338	205	34	72	0	140-145
MADISON	3C	Waldrip Rd to FM 1452	SB	532-640	205	37	72	0	140-145
MADISON	3C	FM 1452 to FM 1696	NB	787-970	205	28	72	0	145-152
MADISON	3C	FM 1452 to FM 1696	SB	No sensitive receptors.					--
MADISON	4	FM 977 to FM 2289	NB	279-480	205	61	72	0	189-191
MADISON	4	FM 977 to FM 2289	SB	338-982	205	57	72	0	189-191
MADISON	4	FM 2289 to US 190	NB	353-714	205	35	72	0	191-196
MADISON	4	FM 2289 to US 190	SB	456-693	205	37	72	0	191-196
MADISON	4	US 190 to FM 1696	NB	182-909	205	48	72	0	196-201
MADISON	4	US 190 to FM 1696	SB	436-990	205	33	72	0	196-201
GRIMES	5	FM 1696 to FM 39	NB	235-404	205	65	72	0	201-208
GRIMES	5	FM 1696 to FM 39	SB	No sensitive receptors.					--
GRIMES	5	FM 39 to TX 90	NB	313-942	205	62	72	0	208-212
GRIMES	5	FM 39 to TX 90	SB	225-852	205	60	72	0	208-212
GRIMES	5	TX 90 to CR 215	NB	207-952	205	65	72	0	212-218
GRIMES	5	TX 90 to CR 215	SB	392-798	205	61	72	0	212-218
GRIMES	5	CR 215 to TX 105	NB	395-850	205	61	72	0	218-223

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Distance (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
GRIMES	5	CR 215 to TX 105	SB	414-873	205	60	72	0	218-223
GRIMES	5	TX 105 to Grimes County Line	NB	157-972	205	54	72	0	223-228
GRIMES	5	TX 105 to Grimes County Line	SB	563-992	205	55	72	0	223-228
WALLER	5	Waller County	NB	196-994	205	50	72	0	228-233
WALLER	5	Waller County	SB	113-1000	205	66	72	0	228-233
HARRIS	5	Harris County Line to Old Hwy 290	NB	664-971	205	38	72	0	233-237
HARRIS	5	Harris County Line to Old Hwy 290	SB	238-992	205	46	72	0	233-237
HARRIS	5	Old Hwy 290 to Grand Pkwy	NB	147-918	205	55	72	0	237-242
HARRIS	5	Old Hwy 290 to Grand Pkwy	SB	210-994	205	52	72	0	237-242
HARRIS	5	Grand Pkwy to TX 6	NB	502	205	47	72	0	242-247
HARRIS	5	Grand Pkwy to TX 6	SB	132-520	205	55	72	0	242-247
HARRIS	5	TX 6 to Blalock Rd	NB	340-493	205	50	72	0	247-251
HARRIS	5	TX 6 to Blalock Rd	SB	No sensitive receptors.					--
HARRIS	5	Blalock Rd to Houston Station	NB	156-510	205	57	72	0	251-257
HARRIS	5	Blalock Rd to Houston Station	SB	227-524	205	61	72	0	251-257

Source: Cross-Spectrum Acoustics, 2019.

Table 6-4: Summary of Vibration Impacts for Institutional Land Use									
County	Segment	Location	Side of Track	Near Track Dist. (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
DALLAS	1	Friendship Missionary Baptist Church	SB	311	205	38	78	0	4
DALLAS	1	The Church of Revelation	SB	357	205	37	78	0	4
DALLAS	1	College Park Baptist Church	SB	670	205	31	78	0	6
DALLAS	1	Full Faith Deliverance Church	SB	463	205	34	78	0	6
ELLIS	2B	Palmyra Studios	NB	963	205	54	65	0	31
FREESTONE	4	Furney-Richardson School	NB	837	205	45	78	0	162
GRIMES	5	Shiloh Church Cemetery	SB	988	205	18	78	0	202
HARRIS	5	St. Aidan’s Episcopal Church	SB	487	205	47	78	0	244
HARRIS	5	Fairbanks United Methodist Church	NB	451	205	48	78	0	250
HARRIS	5	Christian Family Church	NB	177	205	55	78	0	250

Source: Cross-Spectrum Acoustics, 2019.

As shown in **Table 6-3** and **Table 6-4**, HSR operations will result in no vibration impacts.

6.5 Construction Assessment

Construction noise and vibration assessment criteria were taken from the 2012 FRA guidance manual, "High Speed Ground Transportation Noise and Vibration Impact Assessment". The impact criteria are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect, and FRA's construction vibration criteria are designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period.

6.5.1 Construction Noise

By using the FRA criteria provided in **Table 3-1** and the construction equipment noise emission levels in **Table 5-1**, and assuming that construction noise is reduced by 6 dB for each doubling of distance from the center of the work site, it is possible to estimate the screening distances for potential construction noise impact at residential locations for various construction activities. These estimates, shown in **Table 6-5**, suggest that the potential for construction noise impact at residential sites would extend to distances of 40-200 feet from daytime construction and to distances of 125-630 feet from nighttime construction, depending on the activity. The greater impact distances apply to those construction activities that include pile driving. Descriptions of the types of equipment that would be used for each construction activity are provided below.

Table 6-5: Construction Noise Impact Screening Distances for Residences

Construction Activity	1-Hr Leq at 50 feet (dBA)	Residential Noise Impact Screening Distance (feet)	
		Daytime (90 dBA Limit)	Nighttime (80 dBA Limit)
Clearing and Grubbing	88	40	125
Demolition	91	55	175
Earthworks	88	40	125
Highways/Roadways	88	40	125
Drainage	88	40	125
Structures	102	200	630
Utility Relocations	88	40	125
Trackwork	88	40	125
Stations	102	200	630
MOW Facilities	102	200	630
Trainset Maintenance	102	200	630

Source: Cross-Spectrum Acoustics, 2016

6.5.2 Clearing and Grubbing

Clearing and grubbing will involve the use of backhoes, loaders, dozers, excavators, manlifts, trucks, air compressors and generators. The two noisiest items will be dozers and excavators, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA at 50 feet. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.1 Demolition

Demolition will involve the use of hydraulic hammers, dozers, excavators, graders, loaders, cranes, manlifts, trucks, air compressors, generators and welders. The noisiest items will be the hydraulic hammers, with a noise emission level of 90 dBA at 50 feet, followed by dozers, excavators and graders, with noise emission levels of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 91 dBA at 50 feet for the two noisiest equipment items operating together. It is estimated that residences within a distance of 55 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 175 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.2 Earthworks

Earthworks construction will involve the use of backhoes, loaders, dozers, excavators, graders, manlifts, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.3 Highways/Roadways

Highway and roadway construction will involve the use of backhoes, loaders, dozers, excavators, graders, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.4 Drainage

Drainage construction will involve the use of backhoes, dozers, excavators, graders, cranes, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.5 Structures

The construction of structures will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.6 Utility Relocations

The relocation of utilities will involve the use of backhoes, dozers, excavators, graders, cranes, manlifts, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.7 Trackwork

Trackwork construction will involve the use of backhoes, dozers, excavators, graders, cranes, loaders, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.8 Stations

Station construction will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.9 MOW Facilities

The construction of MOW facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.10 Trainset Maintenance

The construction of trainset maintenance facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

6.5.2.11 Construction Vibration

During construction, some activities may cause perceptible ground-borne vibration, most notably pile driving for structures and vibratory compaction for ground improvements. Where these activities occur in very close proximity to underground utilities, TCRR would coordinate with the utilities to identify where mitigation measures (e.g. relocation and/or encasement of pipelines) would be needed to avoid damage and would then compensate the utilities. Otherwise, potential vibration impacts would be limited to annoyance effects or interference with the use of sensitive equipment. **Table 6-6** provides the approximate distances within which receivers could experience construction-related vibration annoyance effects. Descriptions of the types of construction equipment that would generate the highest levels of ground-borne vibration for each construction activity are provided below.

Table 6-6: Construction Vibration Impact Screening Distances

Construction Activity	Maximum Vibration Level at 25 feet (VdB)	Vibration Impact Screening Distance (feet)		
		Category 1 (65 VdB Limit)	Category 2 (72 VdB Limit)	Category 3 (75 VdB Limit)
Clearing and Grubbing	87	135	80	65
Demolition	87	135	80	65
Earthworks	94	230	135	105
Highways/Roadways	94	230	135	105
Drainage	94	230	135	105
Structures	104	500	290	230
Utility Relocations	94	230	135	105
Trackwork	94	230	135	105
Stations	104	500	290	230
MOW Facilities	104	500	290	230
Trainset Maintenance	104	500	290	230

Source: Cross-Spectrum Acoustics, 2016

6.5.2.12 Clearing and Grubbing

Clearing and grubbing will involve the use of backhoes, loaders, dozers, excavators, manlifts, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are backhoes, dozers and excavators, each with a vibration source level of 87 VdB at 25 feet. It is estimated that receivers within distances of 135 feet, 80 feet and 65 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.13 Demolition

Demolition will involve the use of hydraulic hammers, dozers, excavators, graders, loaders, cranes, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are hydraulic hammers, backhoes, dozers and excavators, each with a vibration source level of 87 VdB at 25 feet. It is estimated that receivers within distances of 135 feet, 80 feet and 65 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.14 Earthworks

Earthworks construction will involve the use of backhoes, loaders, dozers, excavators, graders, manlifts, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.15 Highways/Roadways

Highway and roadway construction will involve the use of backhoes, loaders, dozers, excavators, graders, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.16 Drainage

Drainage construction will involve the use of backhoes, dozers, excavators, graders, cranes, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.17 Structures

The construction of structures will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.18 Utility Relocations

The relocation of utilities will involve the use of backhoes, dozers, excavators, graders, cranes, manlifts, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.19 Trackwork

Trackwork construction will involve the use of backhoes, dozers, excavators, graders, cranes, loaders, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.20 Stations

Station construction will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.21 MOW Facilities

The construction of MOW facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

6.5.2.22 Trainset Maintenance

The construction of trainset maintenance facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground-borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

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A. APPENDIX: NOISE AND VIBRATION MEASUREMENT SITE PHOTOGRAPHS

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Figure A-1: Noise Measurement Site LT-1 – 4019-4099 Bulova St, Dallas; Dallas County; Segment 1

Figure A-2: Noise Measurement Site LT-1A – 5125 Cleveland Rd, Dallas; Dallas County; Segment 1

Figure A-3: Noise Measurement Site LT-1B – 1345 E Belt Line Rd, Lancaster; Dallas County; Segment 1

Figure A-4: Noise Measurement Site LT-1C – 1786 Nail Dr, Lancaster; Dallas County; Segment 1

Figure A-5: Noise Measurement Site LT-2 – 911 FM 813, Palmer; Ellis County; Segment 2C

Figure A-6: Noise Measurement Site LT-3 – 508 Old Waxahachie Rd, Waxahachie; Ellis County; Segment 2A

Figure A-7: Noise Measurement Site LT-4 – NW Co Rd 1320, Ennis; Navarro County; Segment 3A

Figure A-8: Noise Measurement Site LT-5 – SW 2120, Richland; Navarro County; Segment 3C

Figure A-9: Noise Measurement Site LT-6 – FM 1366, Wortham; Freestone County; Segment 4

Figure A-10: Noise Measurement Site LT-7 – 132-264 CR 890, Teague; Freestone County; Segment 4

Figure A-11: Noise Measurement Site LT-8 – N Fwy Service Rd, Teague; Freestone County; Segment 3C

Figure A-12: Noise Measurement Site LT-9 – 633 LCR 882, Jewett; Limestone County; Segment 4

Figure A-13: Noise Measurement Site LT-10 -- Beddingfield Rd, Marquez; Leon County; Segment 4

Figure A-14: Noise Measurement Site LT-11 – N Fwy Service Rd, Buffalo; Leon County; Segment 3C

Figure A-15: Noise Measurement Site LT-12 – 534 FM 39; Leon County; Segment 4

Figure A-16: Noise Measurement Site LT-13 – 2076-2765 W Feeder Rd; Leon County; Segment 3C

Figure A-17: Noise Measurement Site LT-14 – 7652 Greenbriar Rd; Madison County; Segment 3C

Figure A-18: Noise Measurement Site LT-15 – 1977 Poteet Rd; Madison County; Segment 4

Figure A-19: Noise Measurement Site LT-16 – 6113 FM 1696; Grimes County; Segment 5

Figure A-20: Noise Measurement Site LT-17 – 10735 TX-90; Grimes County; Segment 5

Figure A-21: Noise Measurement Site LT-18 – 5126 FM 1774; Grimes County; Segment 5

Figure A-22: Noise Measurement Site LT-19 – 119 Plantation Dr; Waller County; Segment 5

Figure A-23: Noise Measurement Site LT-20 – 21512 Binford Rd; Harris County; Segment 5

Figure A-24: Noise Measurement Site LT-21 –1218 Canyon Arbor Way; Harris County; Segment 5

Figure A-25: Noise Measurement Site LT-22 –14812 Hempstead Rd; Harris County; Segment 5

Figure A-26: Noise Measurement Site LT-23 – 11217 Todd St; Harris County; Segment 5

Figure A-27: Noise Measurement Site ST-1 – 1213 Coleman Ave, Dallas; Dallas County; Segment 1

Figure A-28: Noise Measurement Site ST-2 –4412 Kolloch Dr, Dallas; Dallas County; Segment 1

Figure A-29: Noise Measurement Site ST-3 – 6350 J. J. Lemmon Rd, Dallas; Dallas County; Segment 1

Figure A-30: Noise Measurement Site ST-4 –2607 Ferris Rd, Lancaster; Ellis County; Segment 2A

Figure A-31: Noise Measurement Site ST-5 –369 Farmer Rd, Ennis; Ellis County; Segment 2B

Figure A-32: Noise Measurement Site ST-6 – SW 1000, Corsicana; Navarro County; Segment 3B

Figure A-33: Noise Measurement Site ST-7 – 117-123 CR 1041, Wortham; Freestone County; Segment 3C

Figure A-34: Noise Measurement Site ST-8 – N Fwy Service Rd & CR 1090, Streetman; Freestone County; Segment 3C

Figure A-35: Noise Measurement Site ST-9 – Old Mexia-Fairfield Rd, Fairfield; Freestone County; Segment 3C

Figure A-36: Noise Measurement Site ST-10 – 164 & FM 39, Groesbeck

Figure A-37: Noise Measurement Site ST-11 – N Fwy Service Rd & CR 306, Buffalo; Leon County; Segment 3C

Figure A-38: Noise Measurement Site ST-12 – 20559 I-45 Frontage Rd; Leon County; Segment 3C

Figure A-39: Noise Measurement Site ST-13 – 5192 Dawkins Rd; Madison County; Segment 4

Figure A-40: Noise Measurement Site ST-14 – 3159 Clark Rd; Madison County; Segment 4

Figure A-41: Noise Measurement Site ST-15 – 15619 TX-90; Grimes County; Segment 5

Figure A-42: Noise Measurement Site ST-16 – CR 341, Plantersville; Grimes County; Segment 5

Figure A-43: Noise Measurement Site ST-18 – 6734 Limestone St; Harris County; Segment 5

Figure A-44: Noise Measurement Site ST-19 –20710 May Showers Circle; Harris County; Segment 5

Figure A-45: Vibration Propagation Measurement Site V-1 – 4360 Kolloch Drive; Dallas County; Segment 1

Figure A-46: Vibration Propagation Measurement Site V-2 – 103 Coffee Road; Ellis County; Segments 2A and 2B

Figure A-47: Vibration Propagation Measurement Site V-3 – 710 FM 2100; Navarro County; Segments 3A, 3B and 3C

Figure A-48: Vibration Propagation Measurement Site V-4 – N Fwy Service Road, Fairfield; Freestone County; Segments 3C and 4

Figure A-49: Vibration Propagation Measurement Site V-5 – LCR 828, Personville; Limestone County; Segment 4

Figure A-50: Vibration Propagation Measurement Site V-6 – 6734 FM 977; Leon County; Segment 4

Figure A-51: Vibration Propagation Measurement Site V-7 – 10290 Greenbriar Road; Madison County; Segment 3C

Figure A-52: Vibration Propagation Measurement Site V-8 – 10063 CR 311; Grimes County; Segment 5

Figure A-53: Vibration Propagation Measurement Site V-9 – Plantation Drive, Todd Mission; Waller County; Segment 5

Figure A-54: Vibration Propagation Measurement Site V-10 – Josey Ranch Road, Houston; Harris County; Segment 5

Figure A-55: Vibration Propagation Measurement Site V-11 – 21610 U.S. 290 Frontage Road, Houston; Harris County; Segment 5

B. APPENDIX: NOISE MEASUREMENT DATA

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Figure B-1: Long-Term Noise Measurement Data – Site LT-1

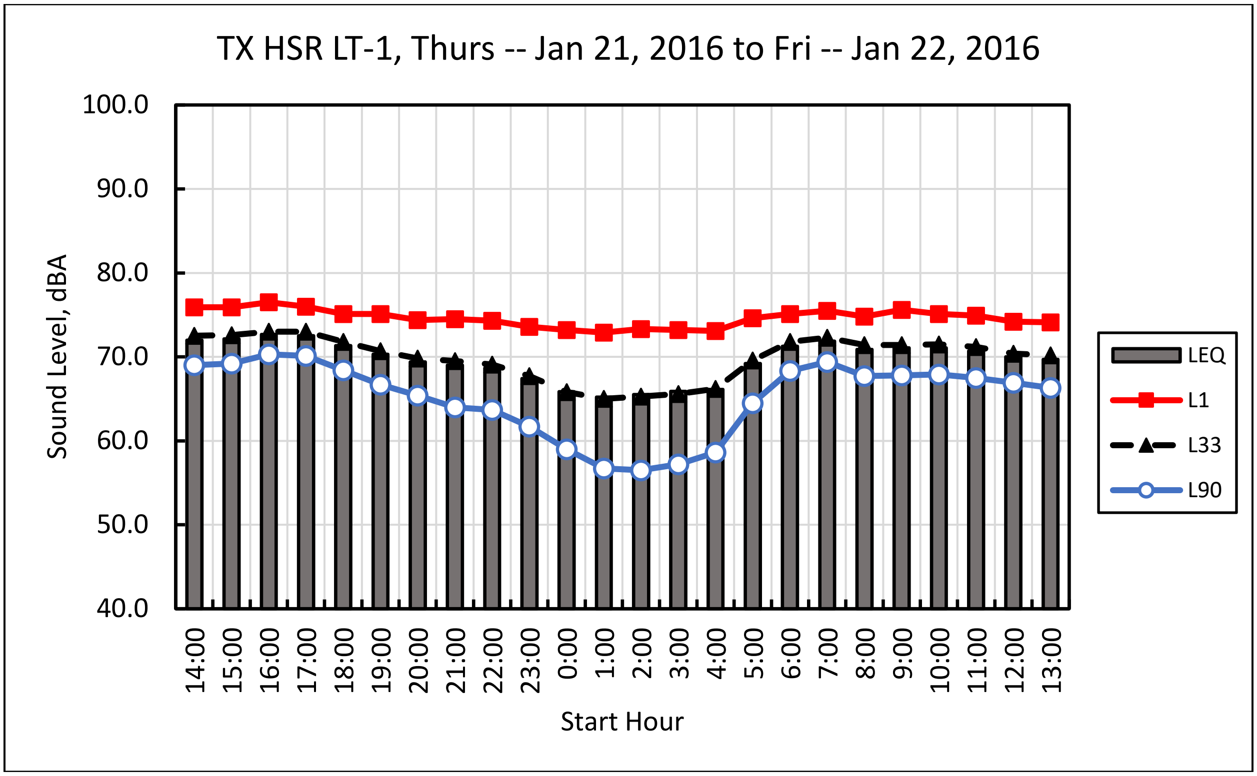


Figure B-2: Long-Term Noise Measurement Data – Site LT-2

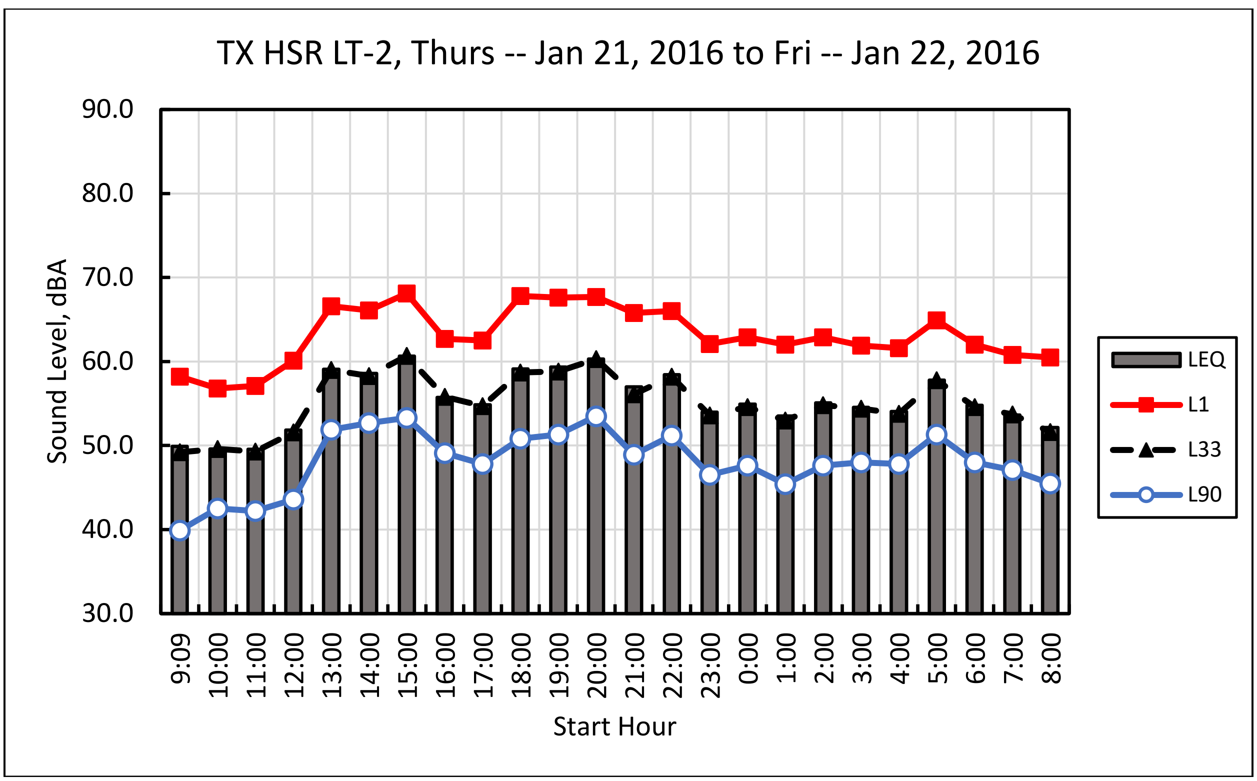


Figure B-3: Long-Term Noise Measurement Data – Site LT-3

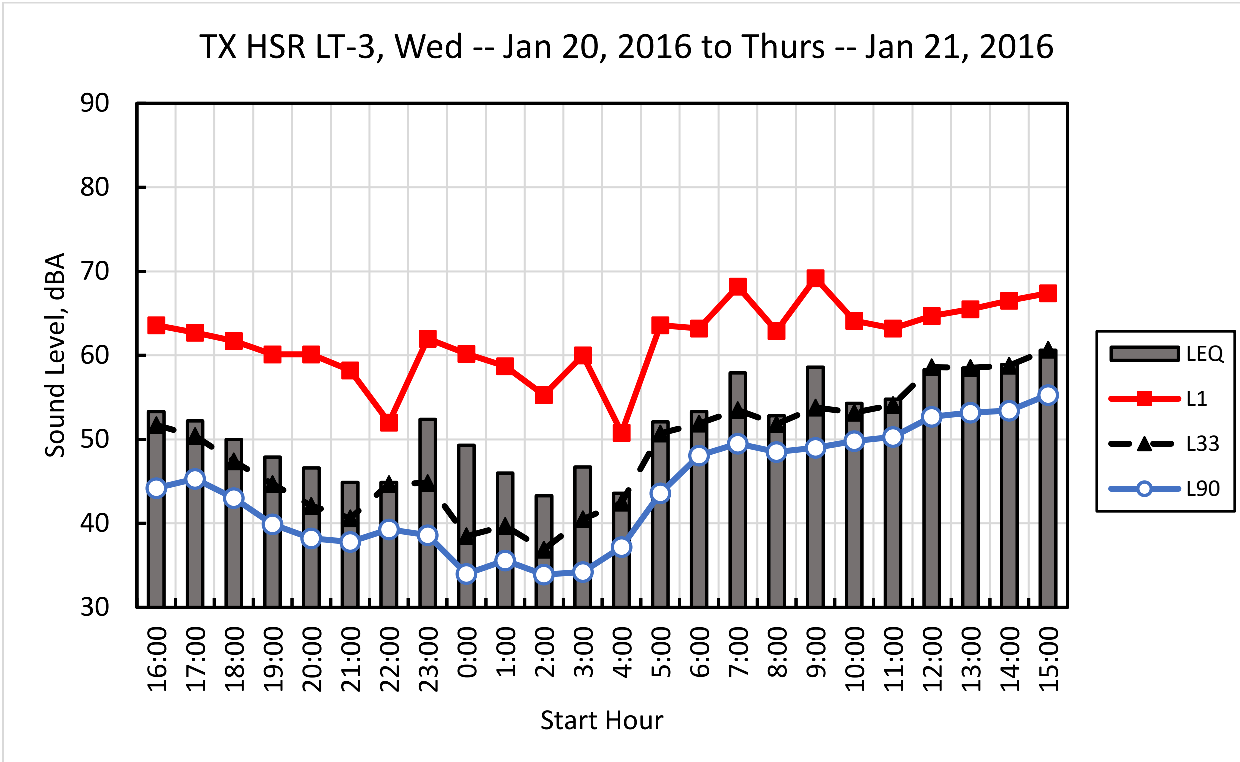


Figure B-4: Long-Term Measurement Data – Site LT-4

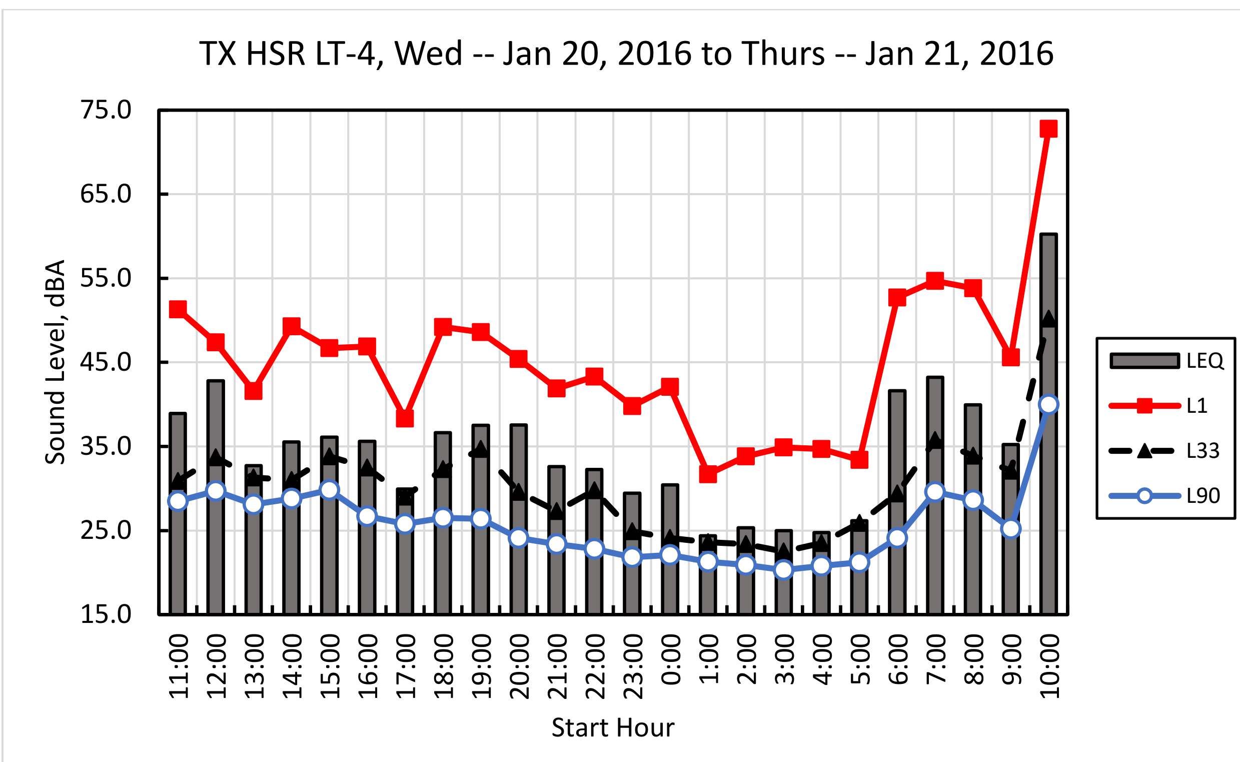


Figure B-5: Long-Term Measurement Data – Site LT-5

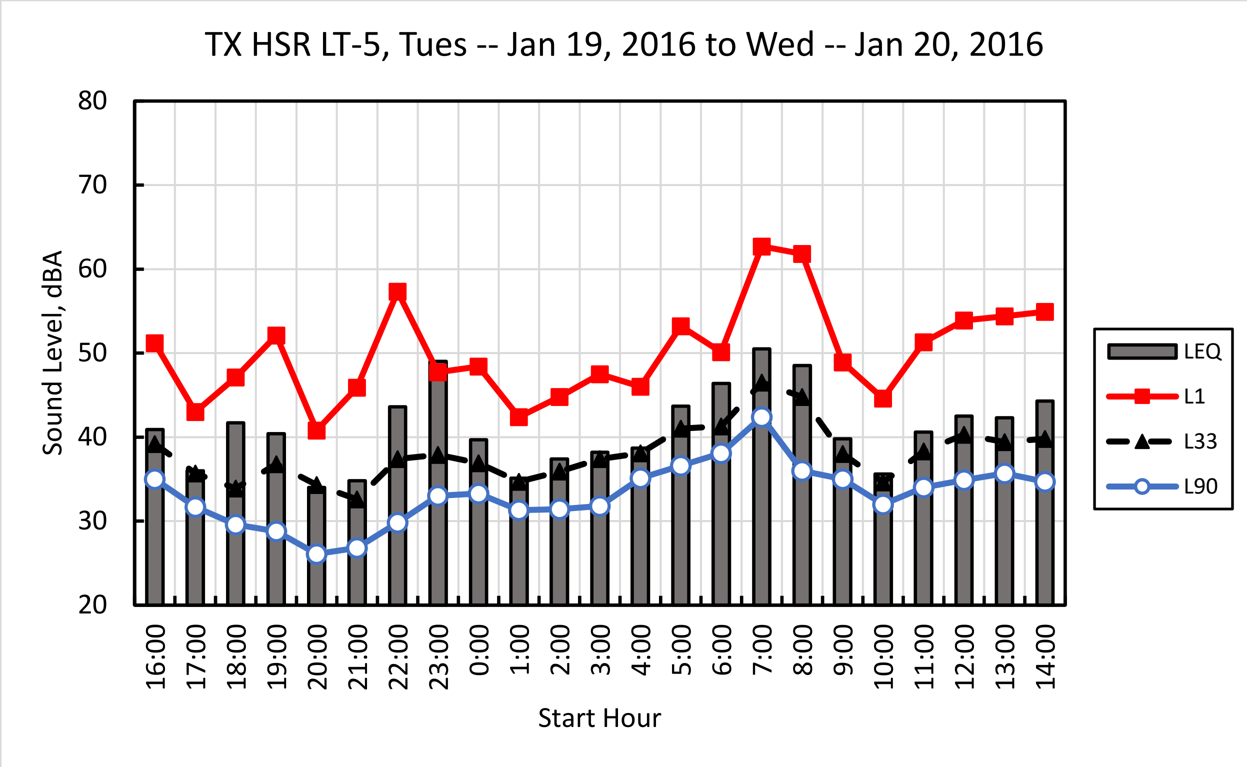


Figure B-6: Long-Term Measurement Data – Site LT-6

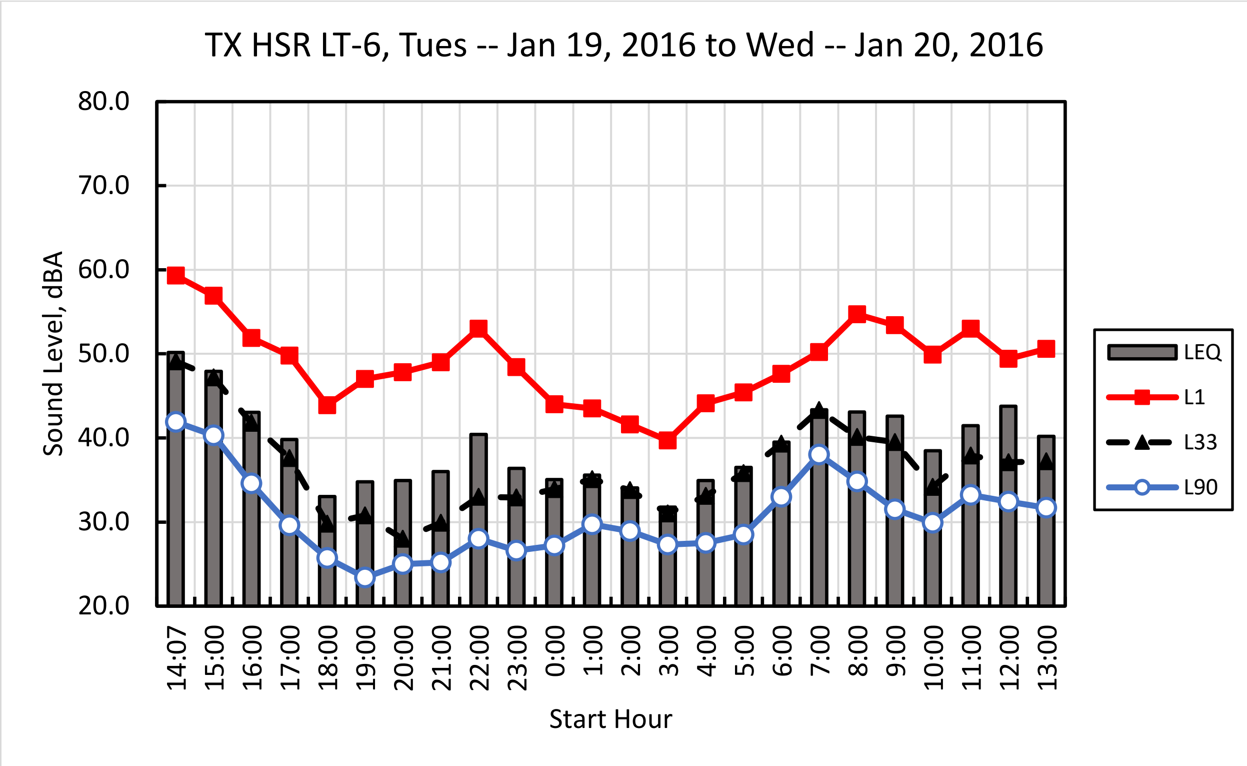


Figure B-7: Long-Term Measurement Data – Site LT-7

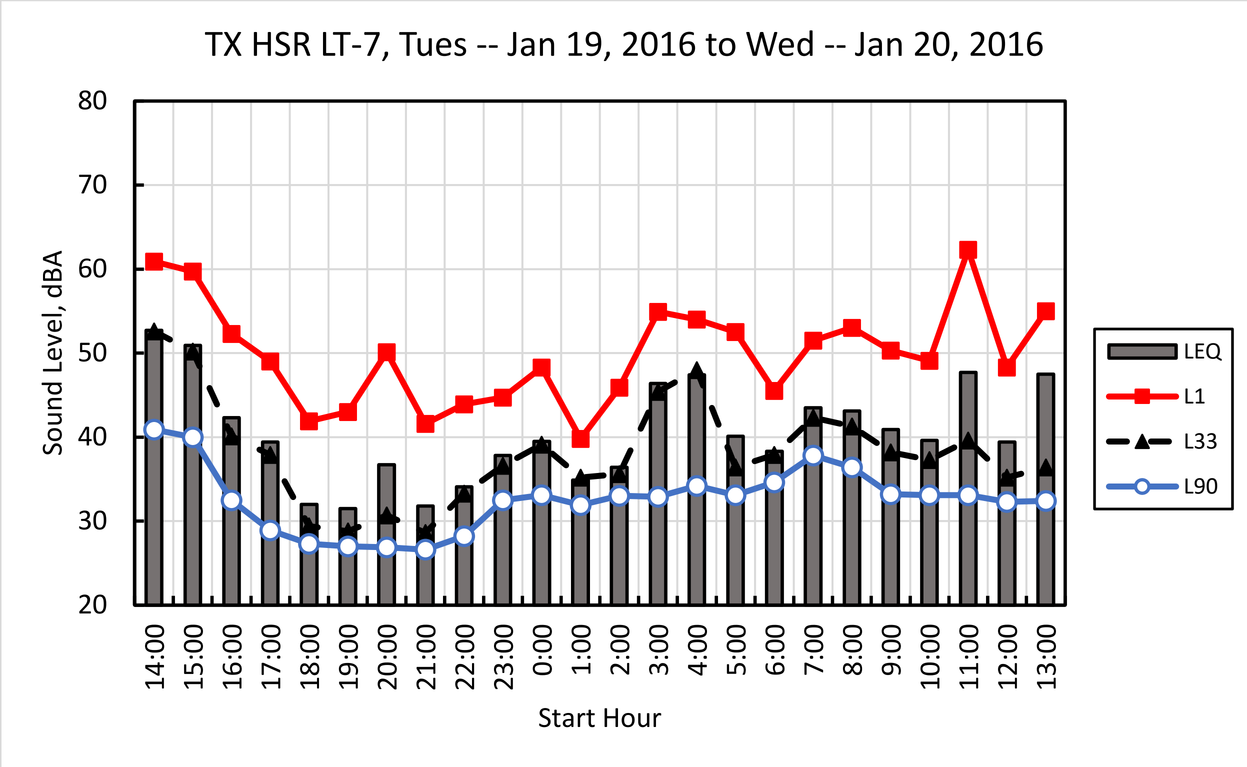


Figure B-8: Long-Term Measurement Data – Site LT-8

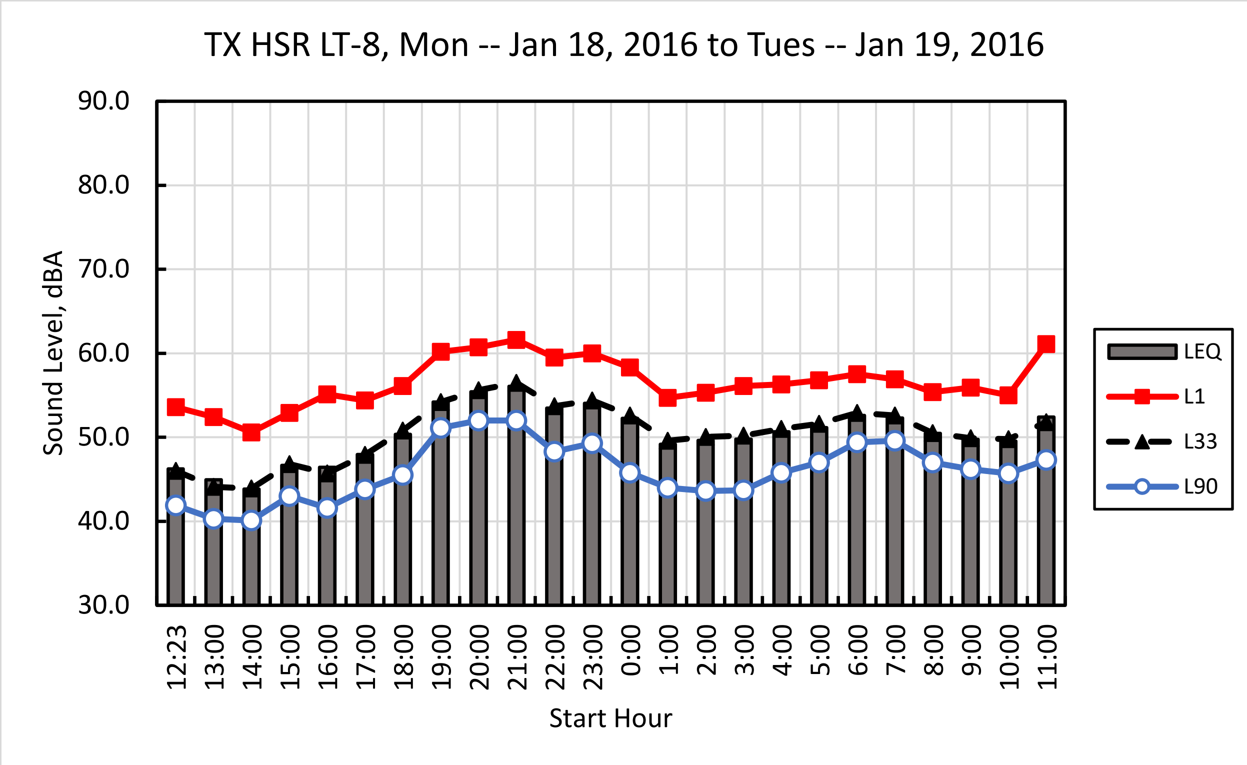


Figure B-9: Long-Term Measurement Data – Site LT-9

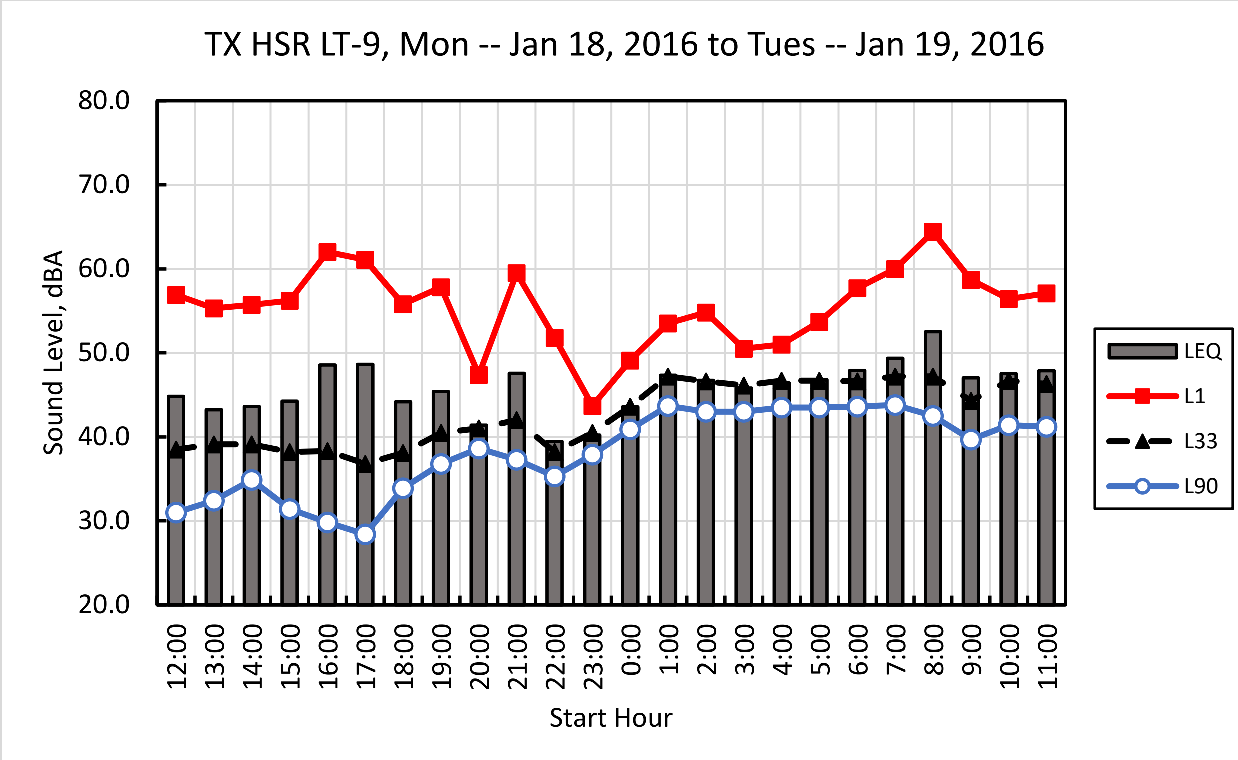


Figure B-10: Long-Term Measurement Data – Site LT-10

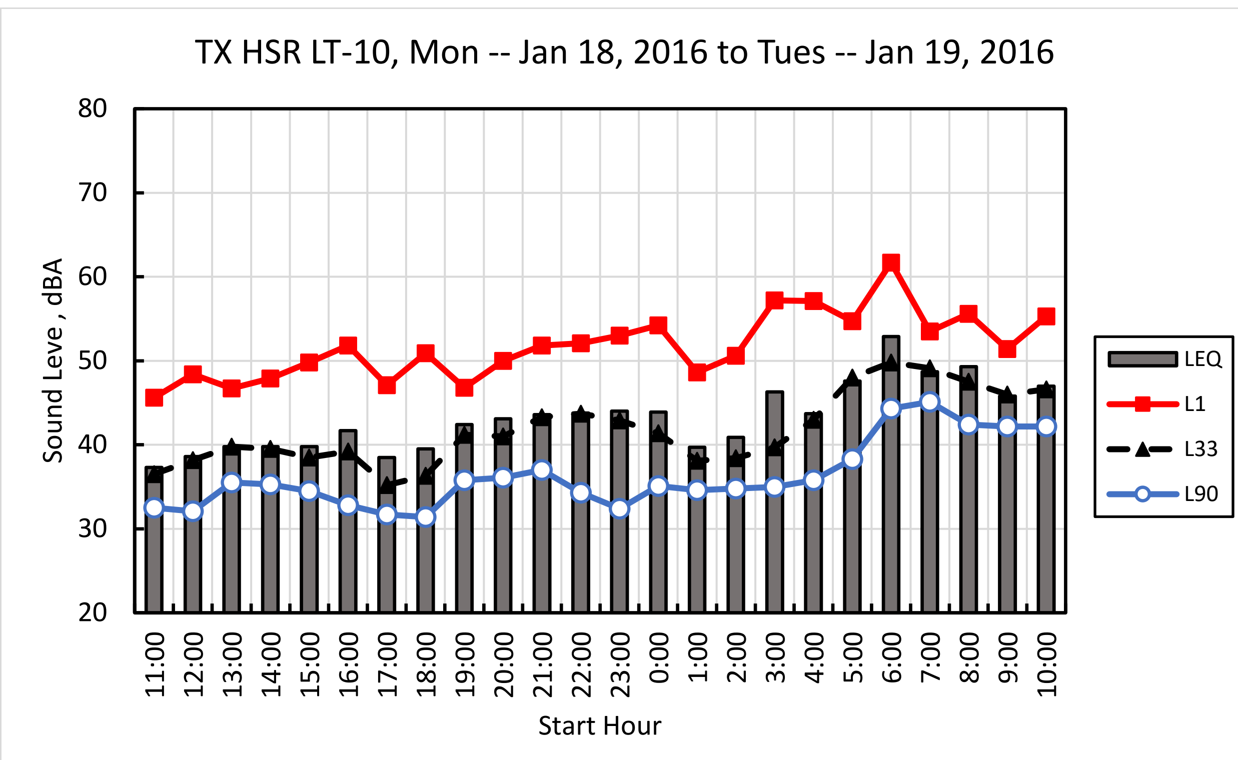


Figure B-11: Long-Term Measurement Data – Site LT-11

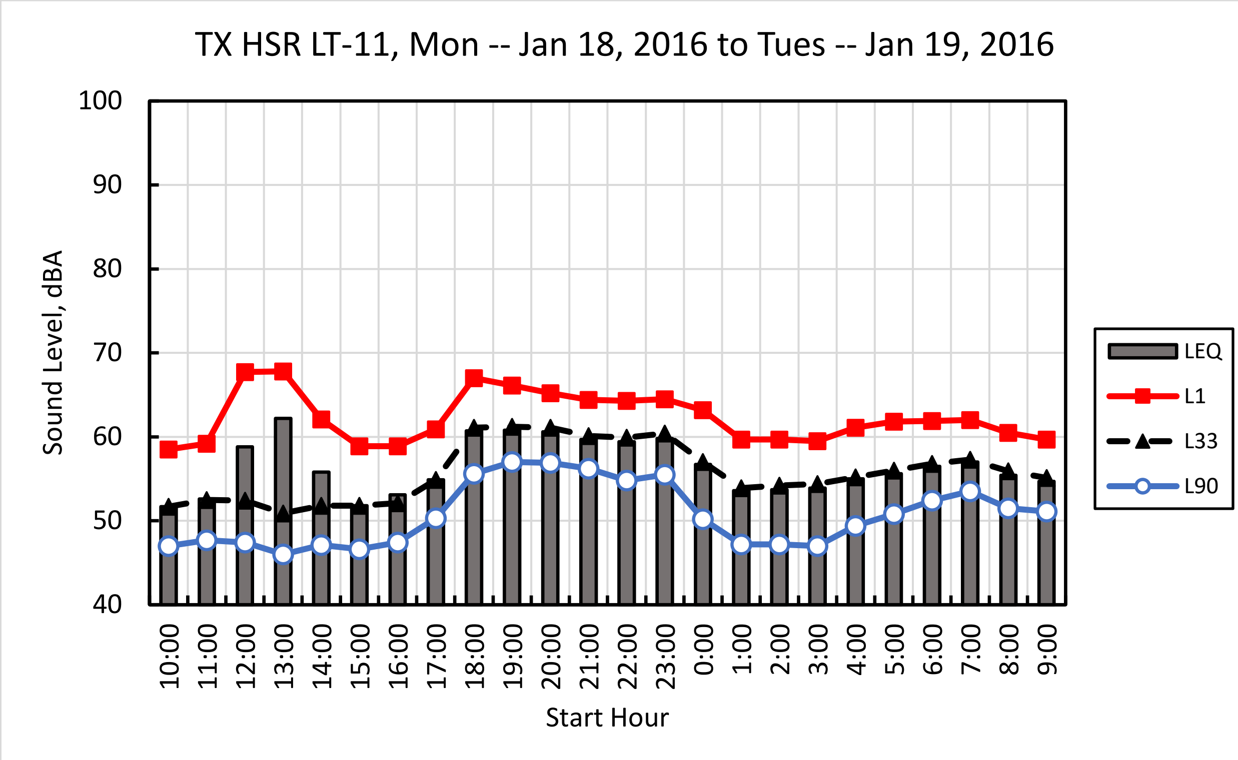


Figure B-12: Long-Term Measurement Data – Site LT-12

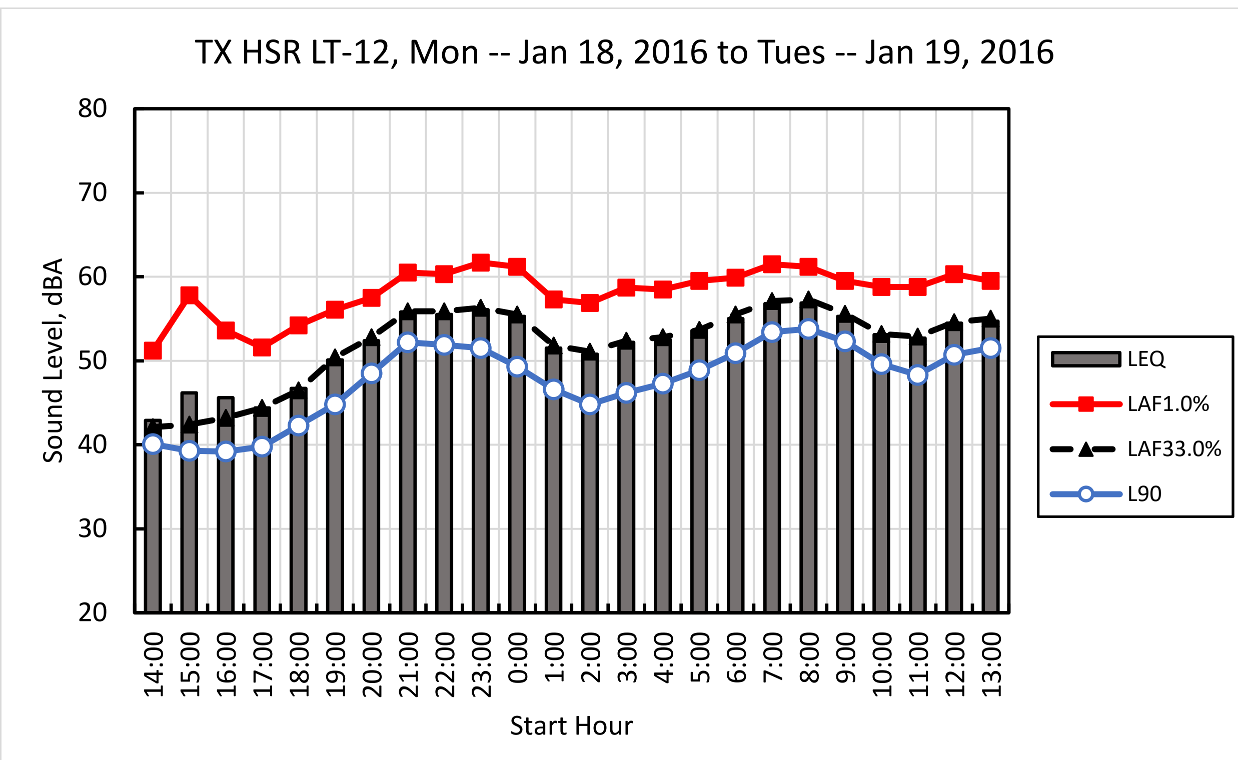


Figure B-13: Long-Term Measurement Data – Site LT-13

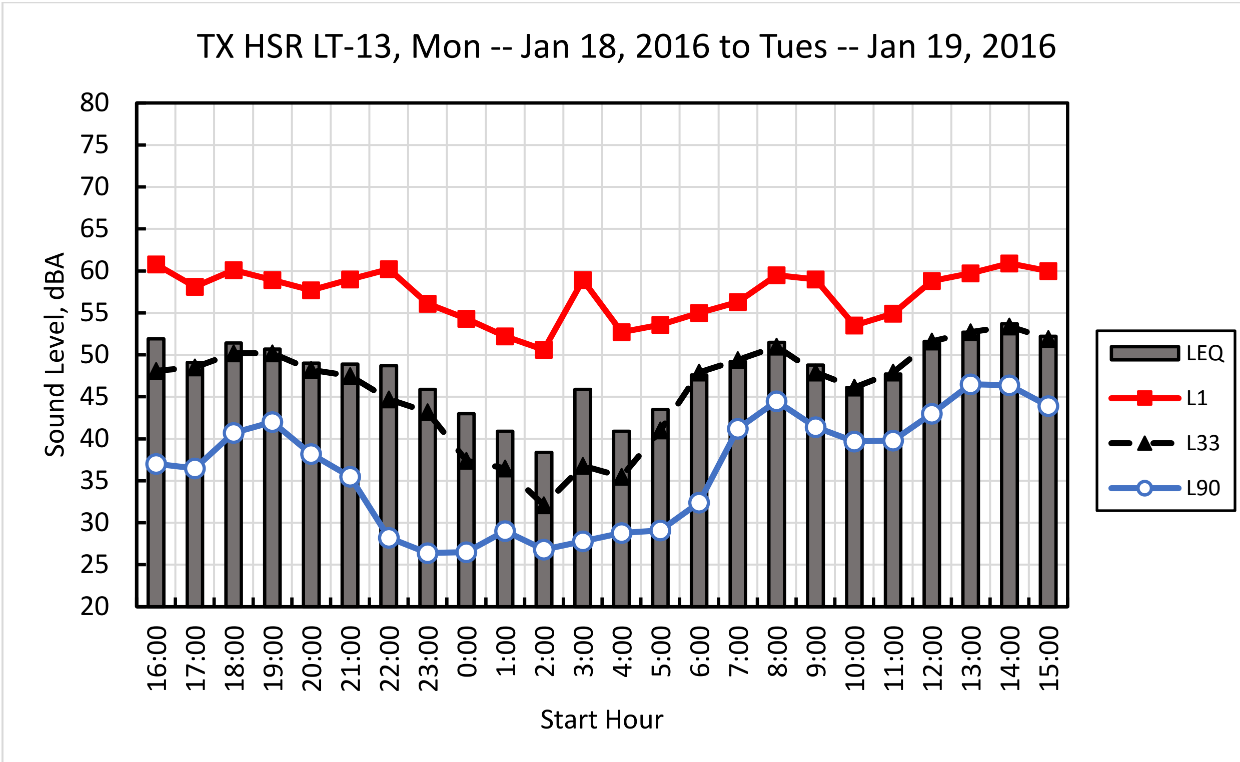


Figure B-14: Long-Term Measurement Data – Site LT-14

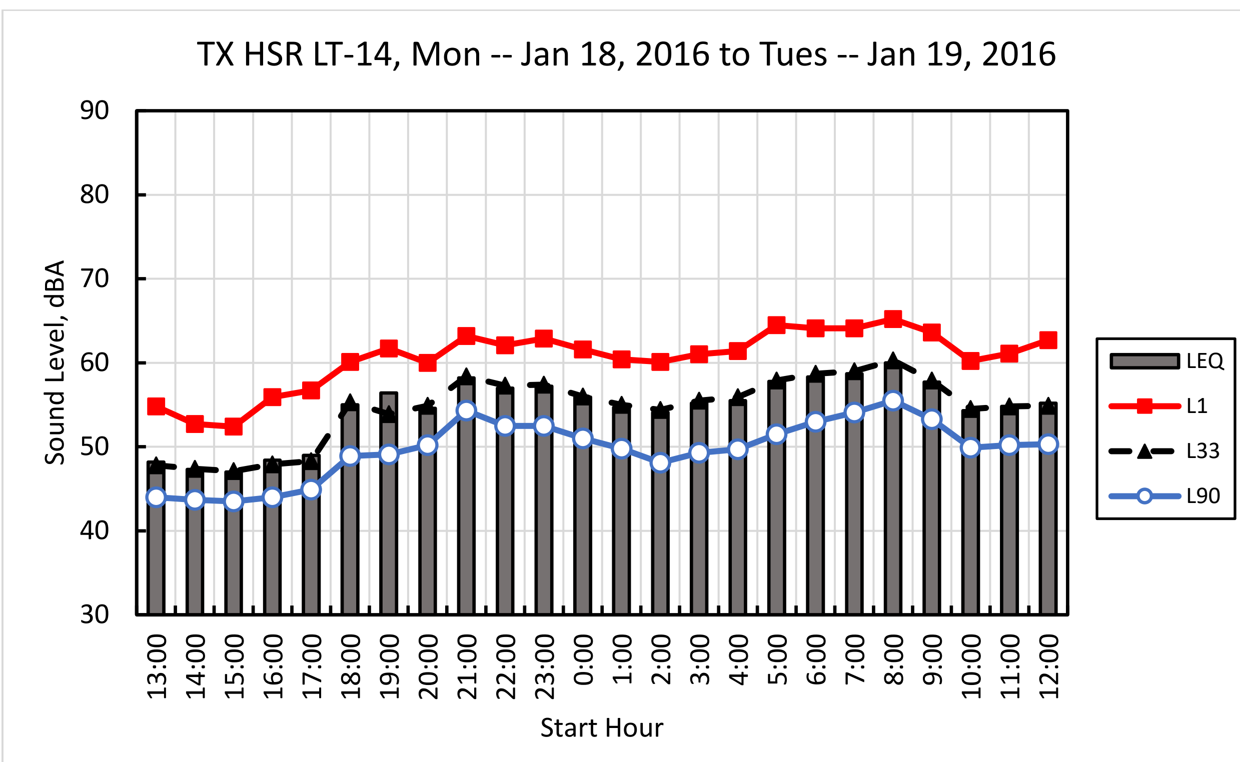


Figure B-15: Long-Term Measurement Data – Site LT-15

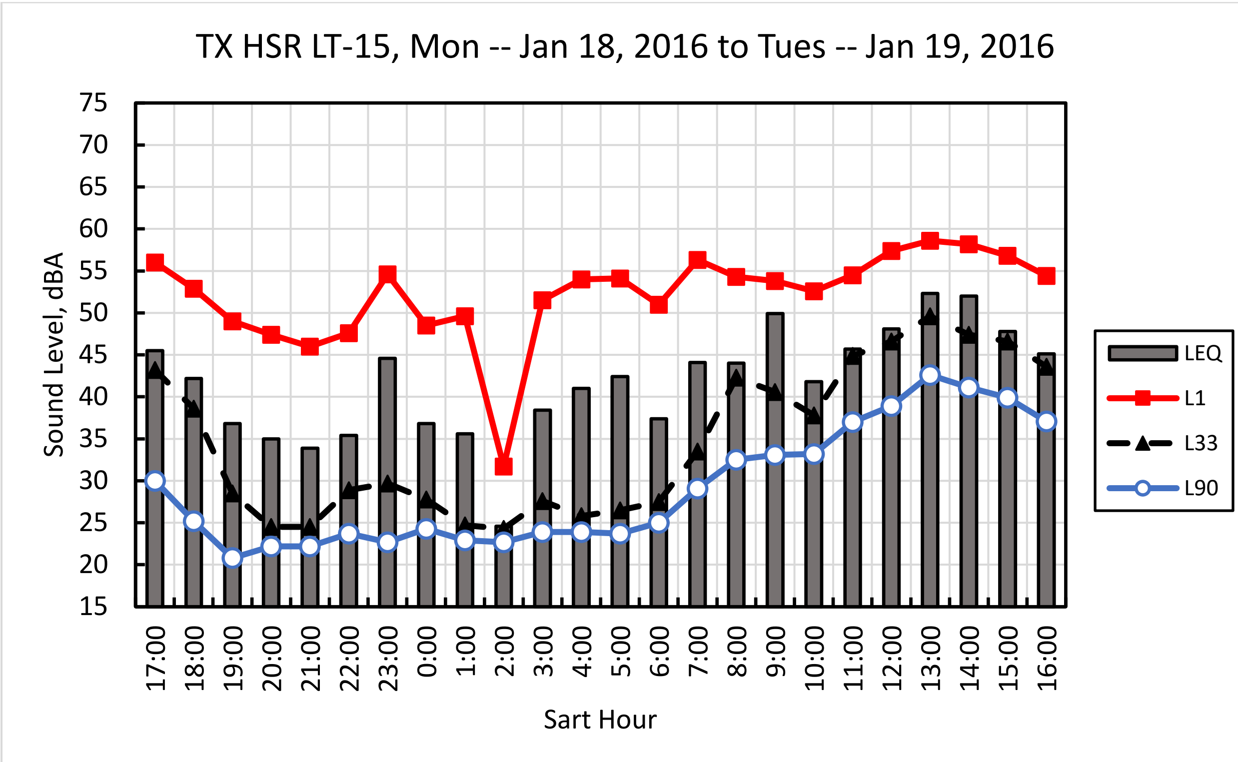


Figure B-16: Long-Term Measurement Data – Site LT-16

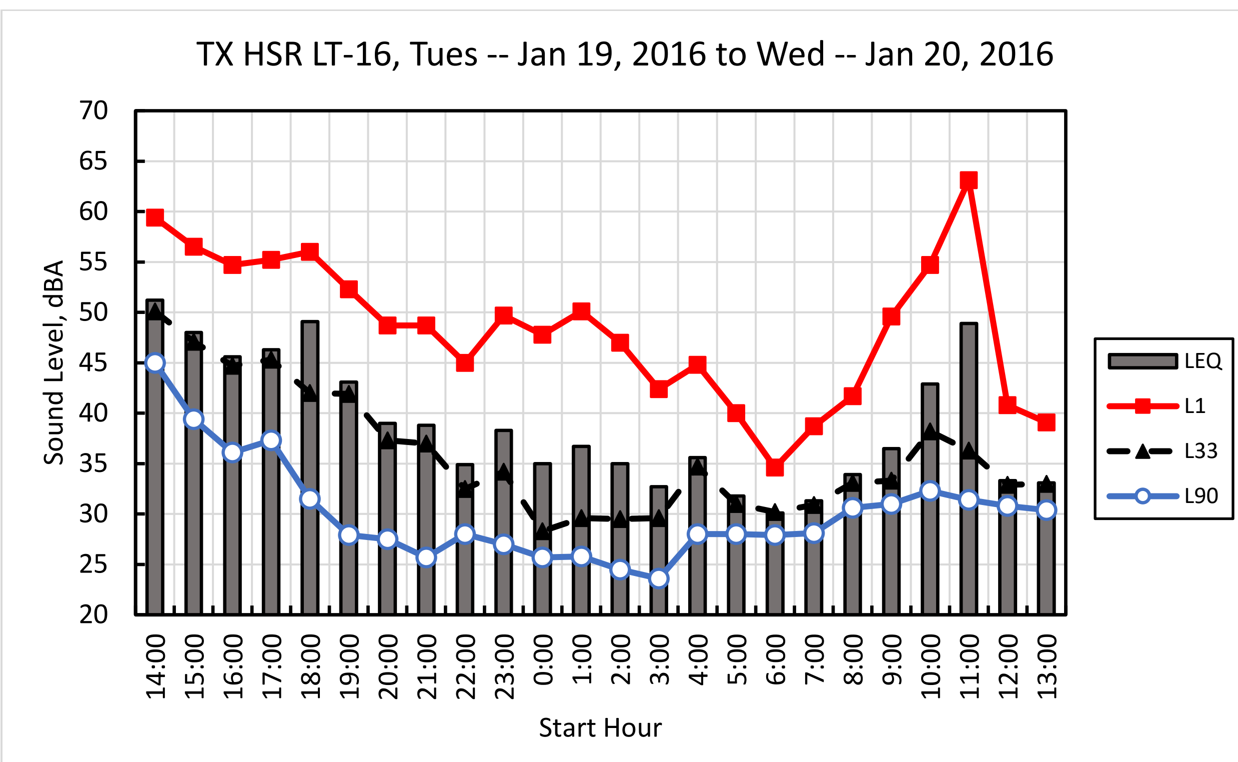


Figure B-17: Long-Term Measurement Data – Site LT-17

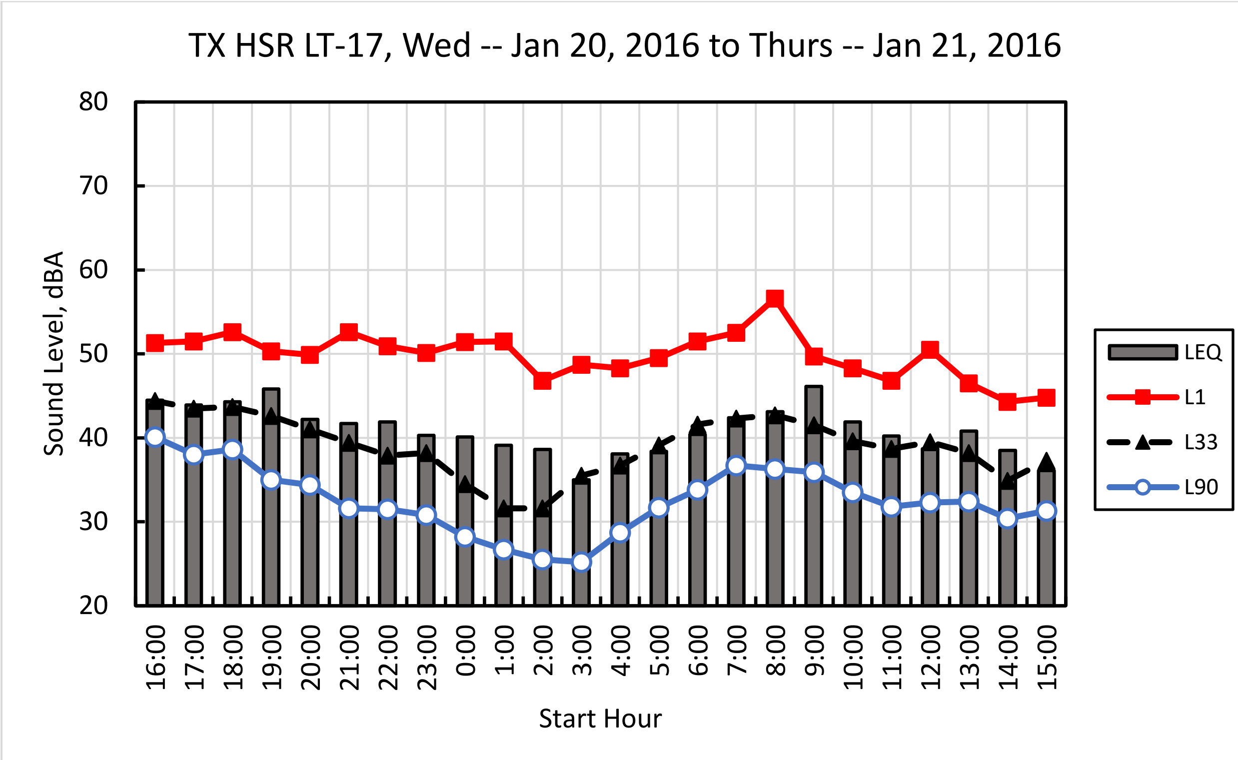


Figure B-18: Long-Term Measurement Data – Site LT-18

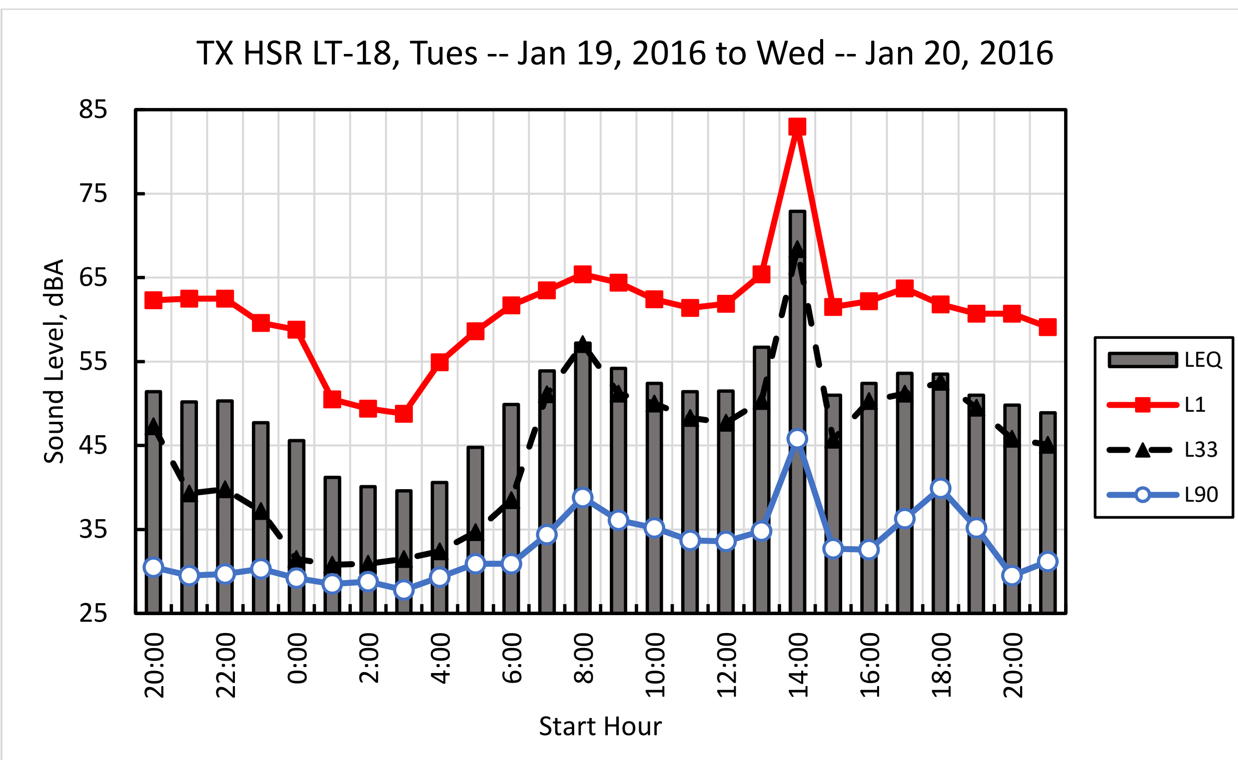
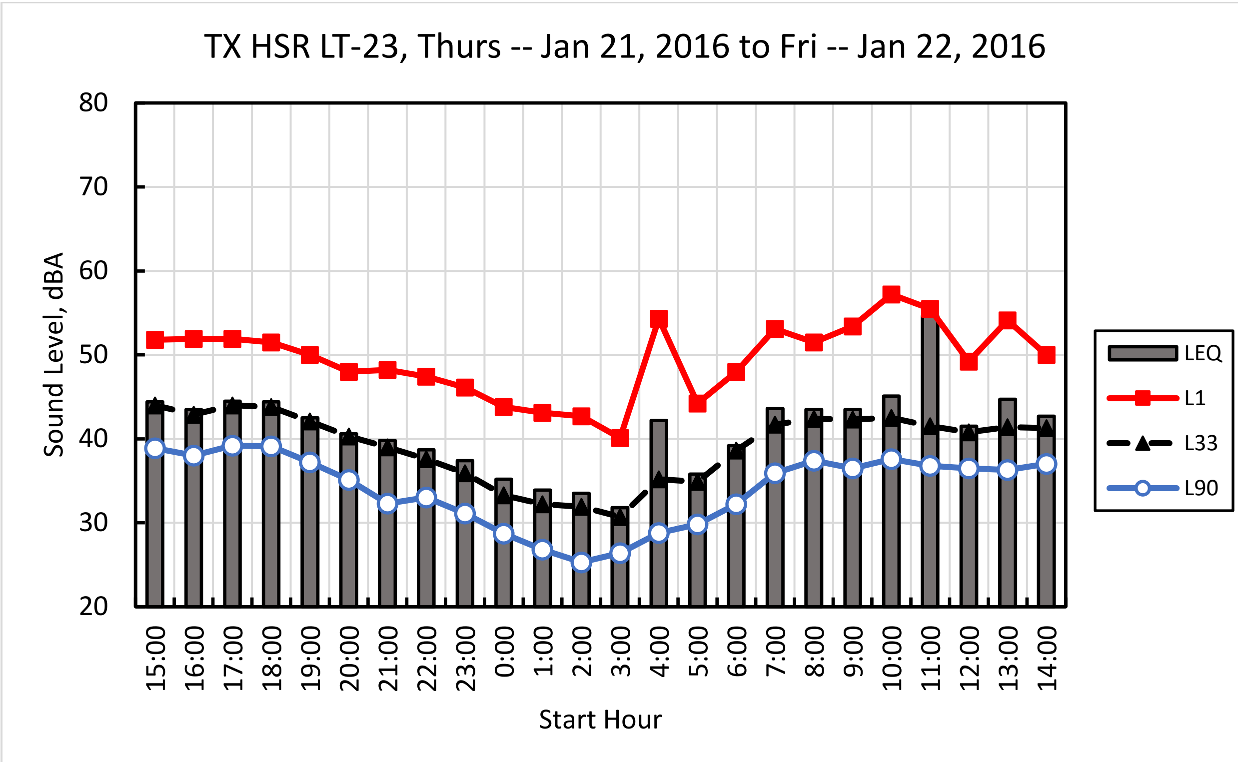


Figure B-19: Long-Term Measurement Data – Site LT-23



D. APPENDIX: VIBRATION MEASUREMENT DATA

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Site V-1

Figure C-1: 1/3-Octave Band Transfer Mobility Coefficients – Site V-1

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	76.4	76.0	69.5	4.0	58.0	39.6	63.6	74.0	137.3	105.8	99.2	99.6	58.3	91.9	78.2	65.7
B	24.2	-28.1	-25.4	43.1	-20.8	-0.1	-21.0	-23.0	-78.6	-44.7	-41.8	-43.7	7.0	-45.6	-41.6	-36.9
C	0.0	0.0	0.0	-18.8	0.0	-5.1	0.0	0.0	9.1	0.0	0.0	0.0	-16.9	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-2: Line Source Transfer Mobility – Site V-1

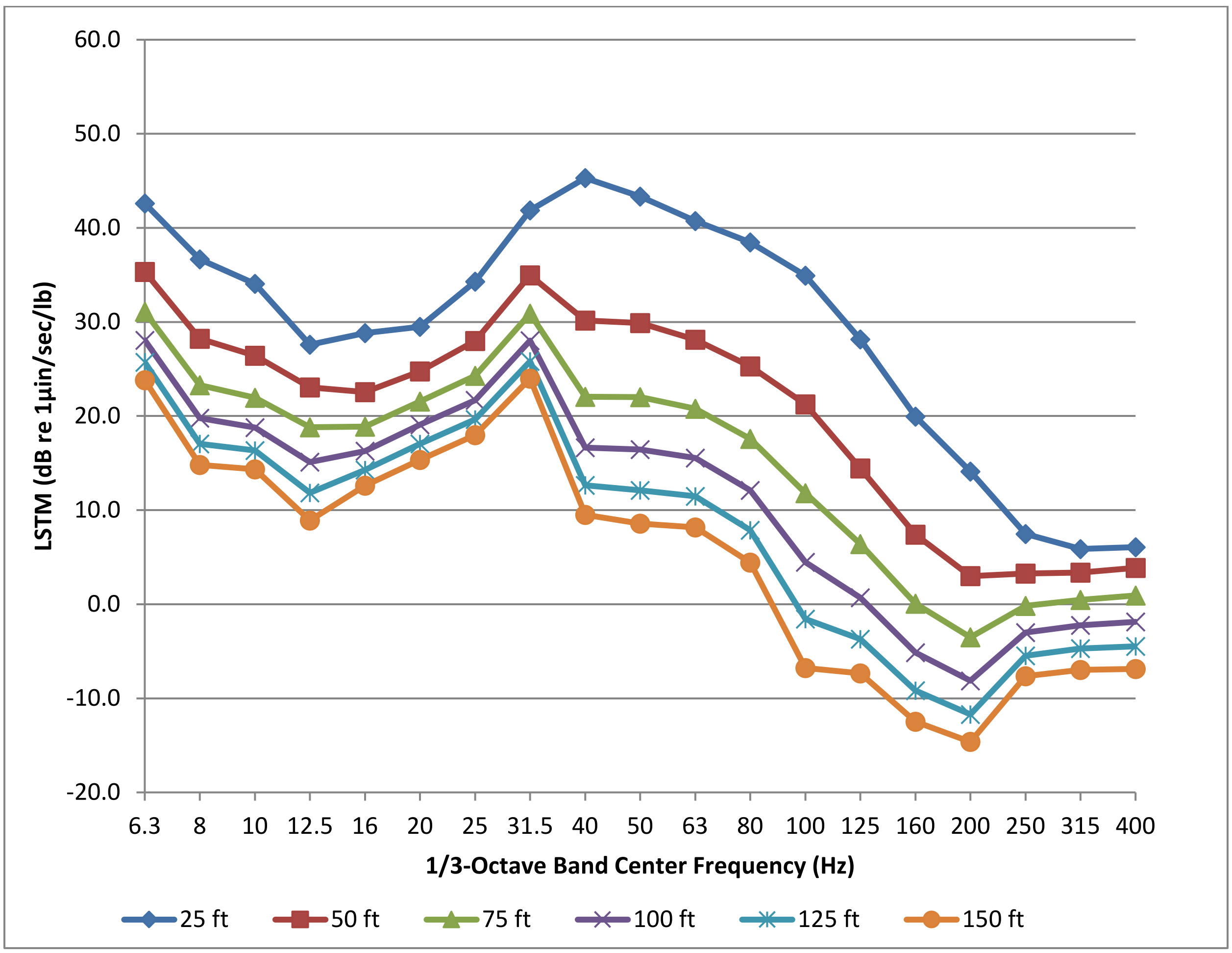
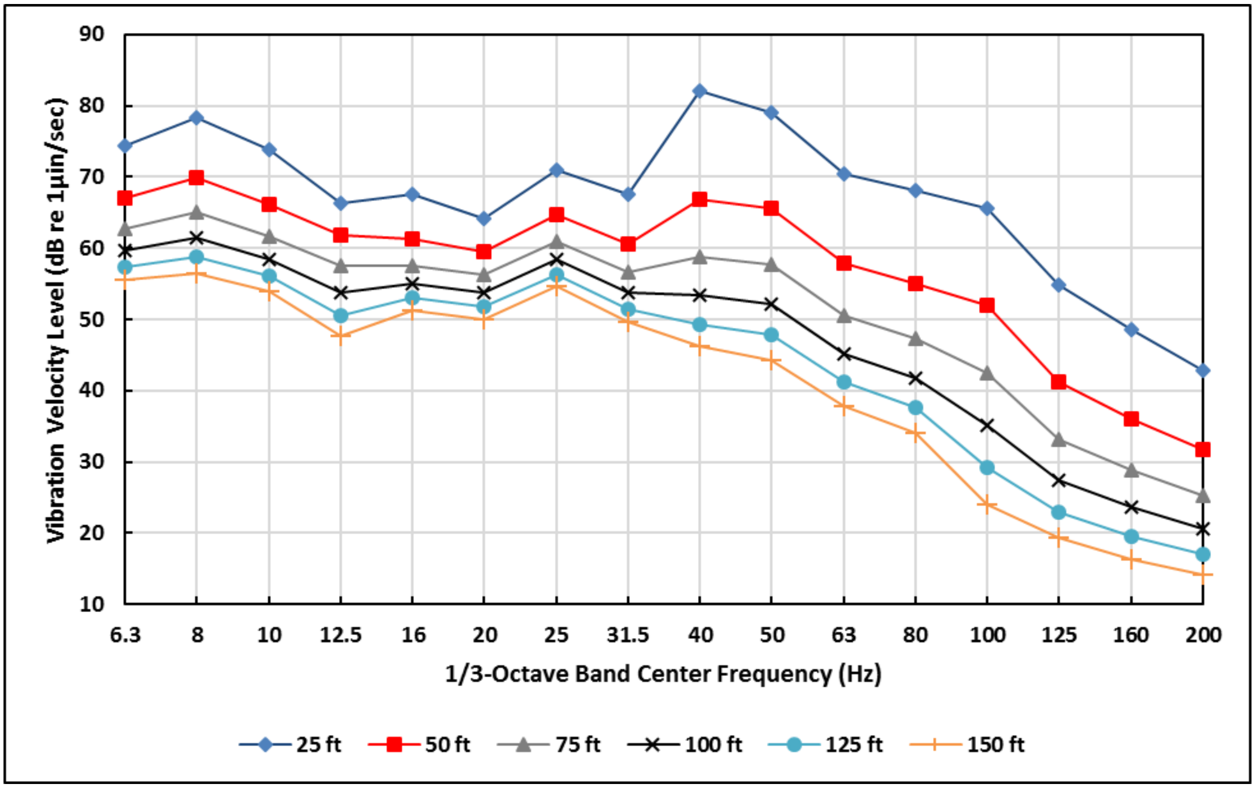


Figure C-3: Projected HSR Ground Vibration Levels – Site V-1



Site V-2

Figure C-4: 1/3-Octave Band Transfer Mobility Coefficients – Site V-2

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	75.7	45.7	55.6	50.1	56.5	71.4	88.9	70.6	107.0	123.7	104.3	93.4	52.4	39.4	20.5	29.4
B	26.5	-10.5	-13.8	-8.4	-10.7	-17.9	-26.1	-2.8	-45.4	-61.8	-45.3	-41.4	-9.4	0.1	11.0	-3.6
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.8	2.3	4.4	0.0	0.0	-6.3	-9.2	-11.9	-8.4

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-5: Line Source Transfer Mobility – Site V-2

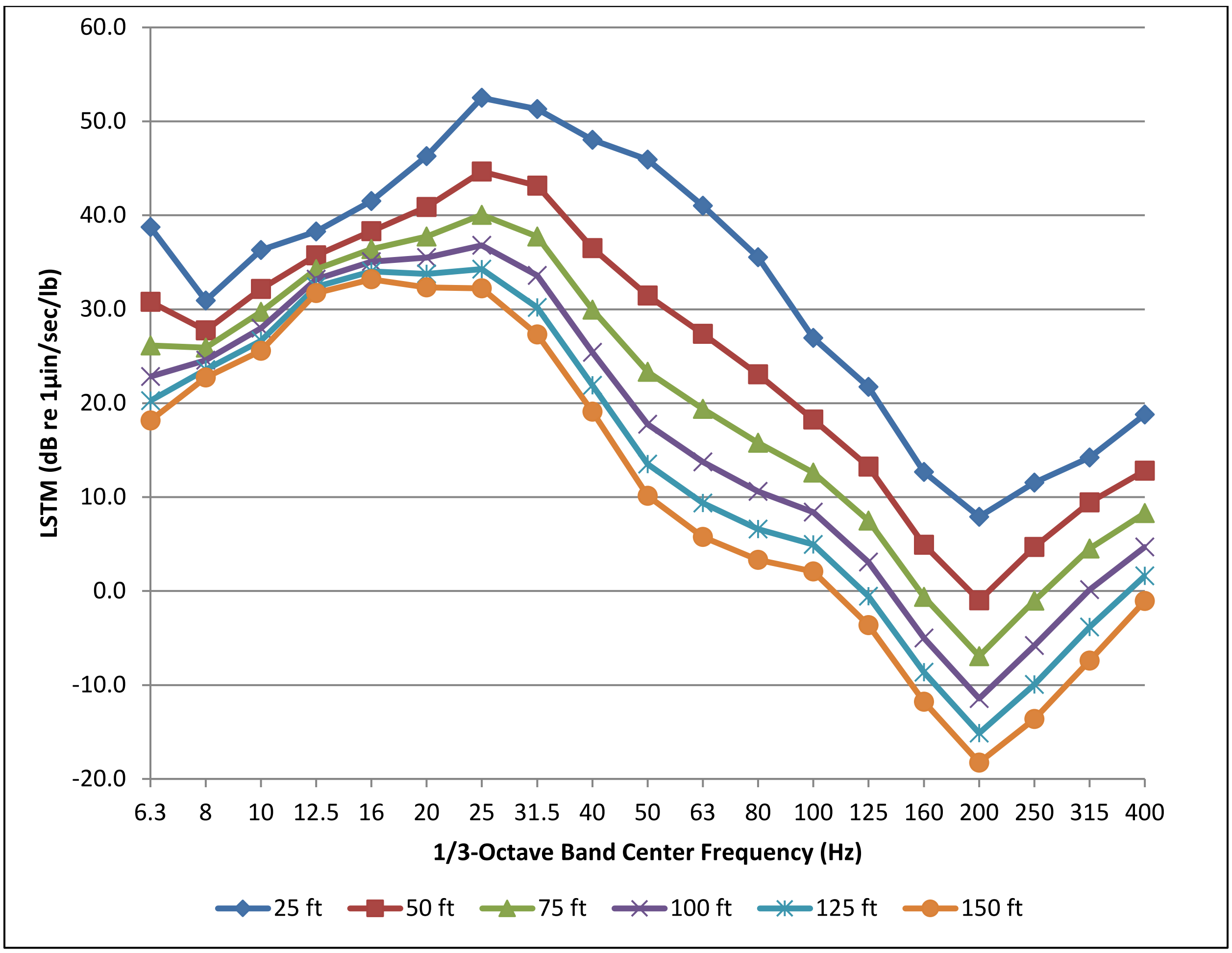
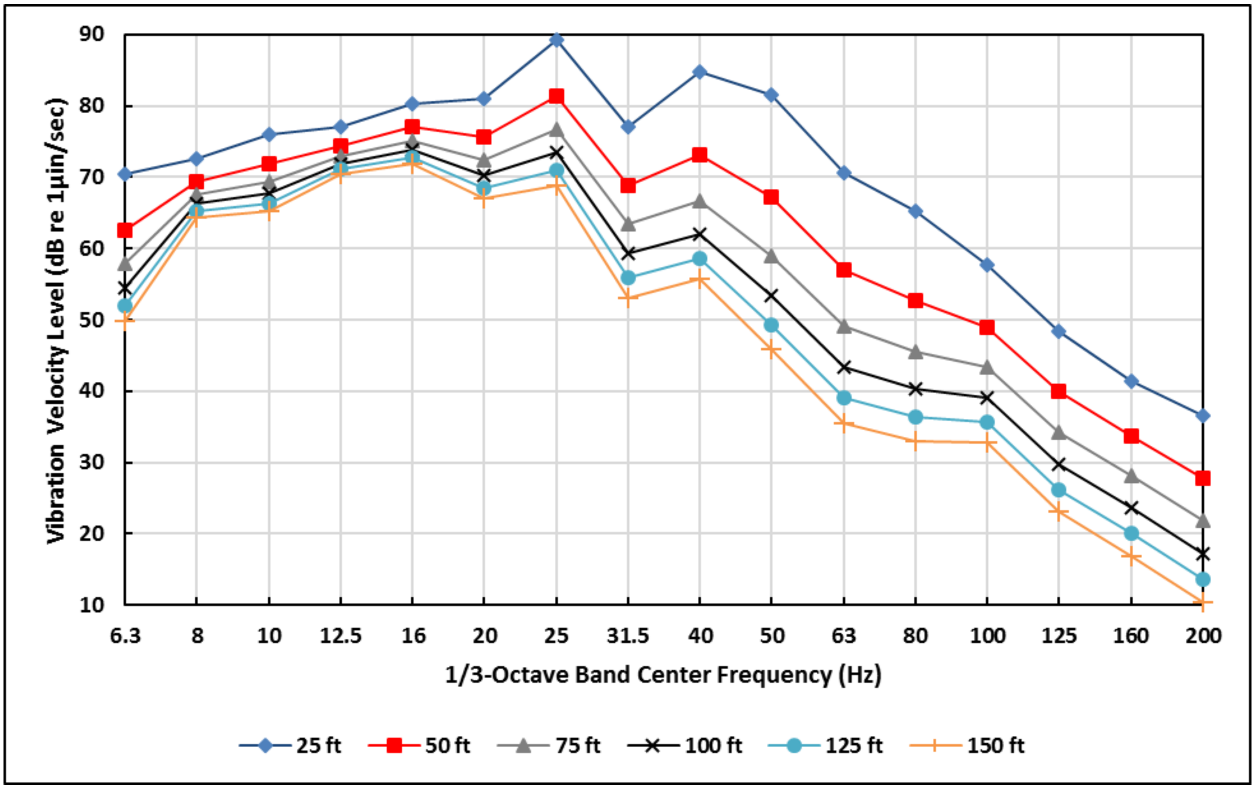


Figure C-6: Projected HSR Ground Vibration Levels – Site V-2



Site V-3

Figure C-7: 1/3-Octave Band Transfer Mobility Coefficients – Site V-3

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	30.5	49.1	63.0	57.9	76.9	-41.5	95.2	111.0	49.9	109.6	96.4	81.6	54.2	37.2	15.2	-0.7
B	0.5	-11.4	-16.9	-13.6	-20.8	122.8	-31.4	-42.5	25.0	-47.1	-42.9	-37.9	-25.4	-19.3	-10.4	-2.2
C	0.0	0.0	0.0	0.7	0.0	-41.9	0.0	0.0	-19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-8: Line Source Transfer Mobility – Site V-3

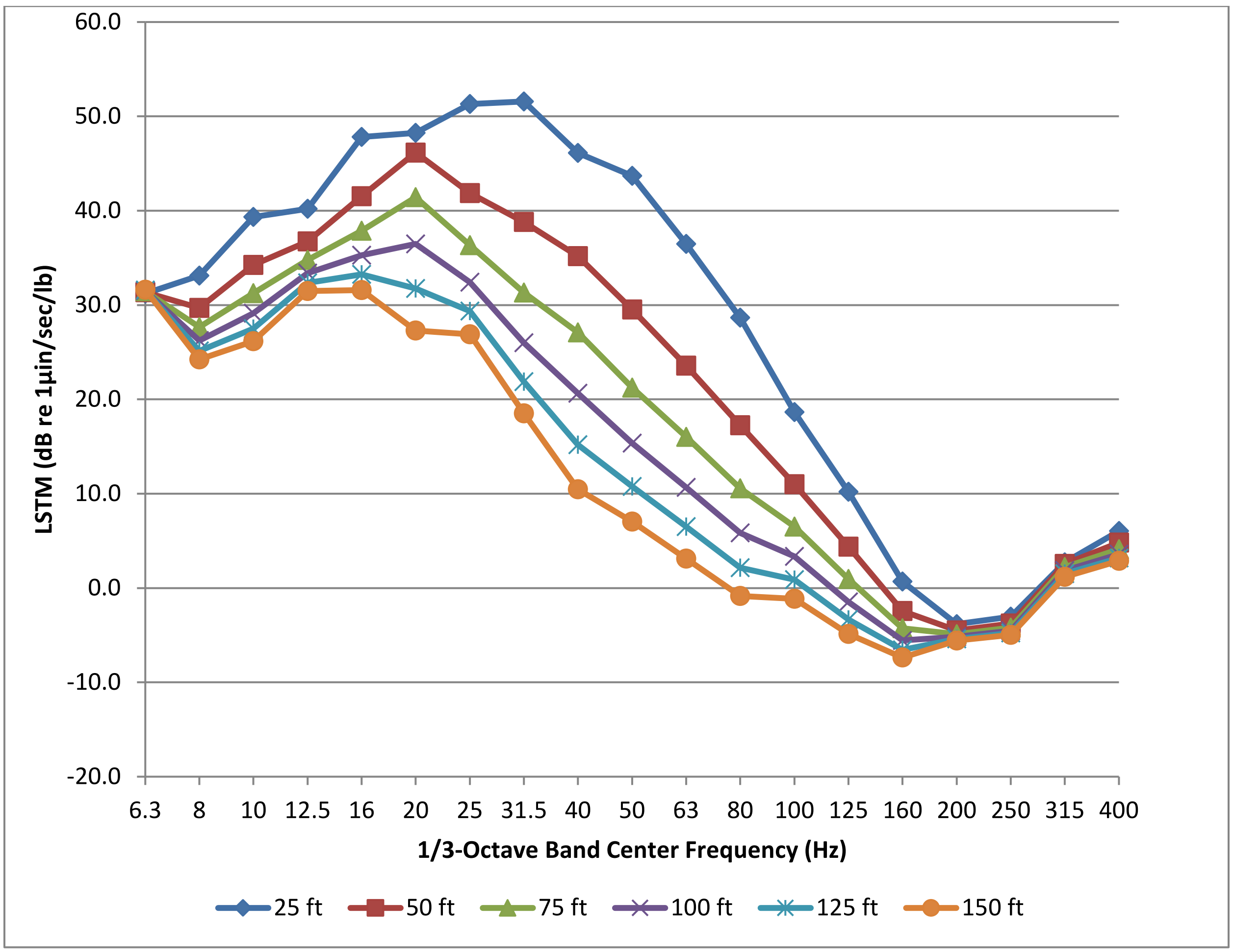
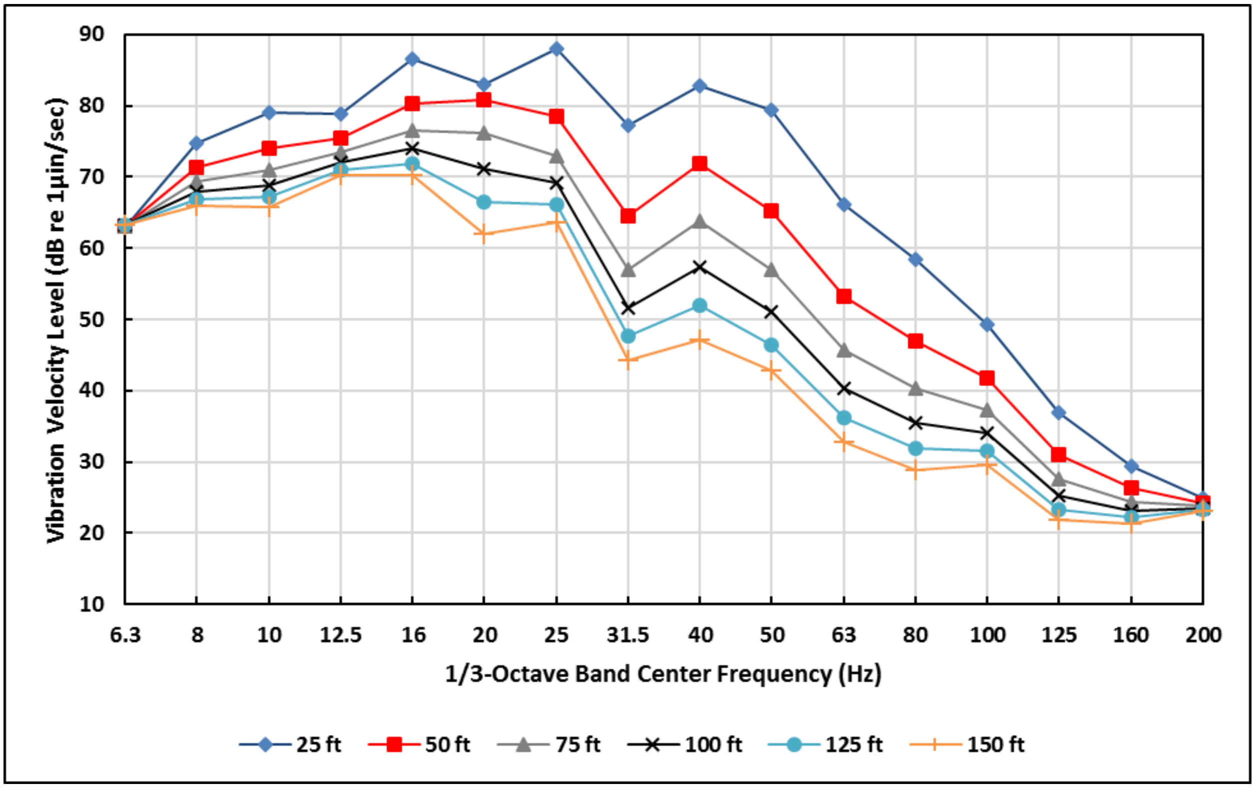


Figure C-9: Projected HSR Ground Vibration Levels – Site V-3



Site V-4

Figure C-10: 1/3-Octave Band Transfer Mobility Coefficients – Site V-4

Coefficients	6.3 Hz		8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	61.4		53.6	67.4	-44.0	-38.9	-47.3	-40.5	-22.9	42.3	121.2	125.8	114.1	105.3	99.5	88.9	76.2
B	15.8		-13.6	-18.9	118.1	122.6	136.4	133.6	114.8	37.5	-56.3	-60.8	-55.7	-53.1	-50.3	-45.0	-39.3
C	0.0		0.0	0.0	-39.4	-42.7	-48.3	-50.2	-46.5	-25.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-11: Line Source Transfer Mobility – Site V-4

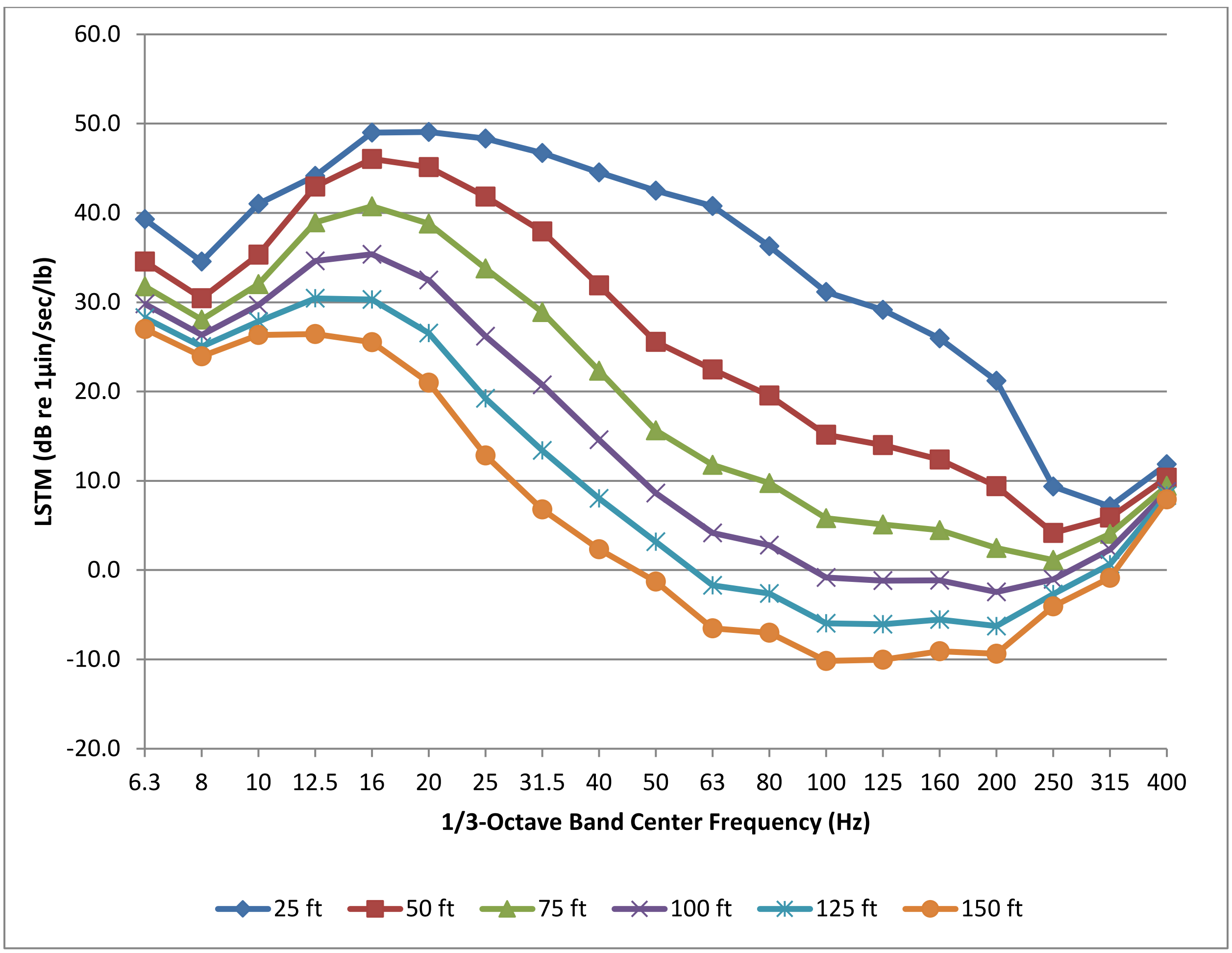
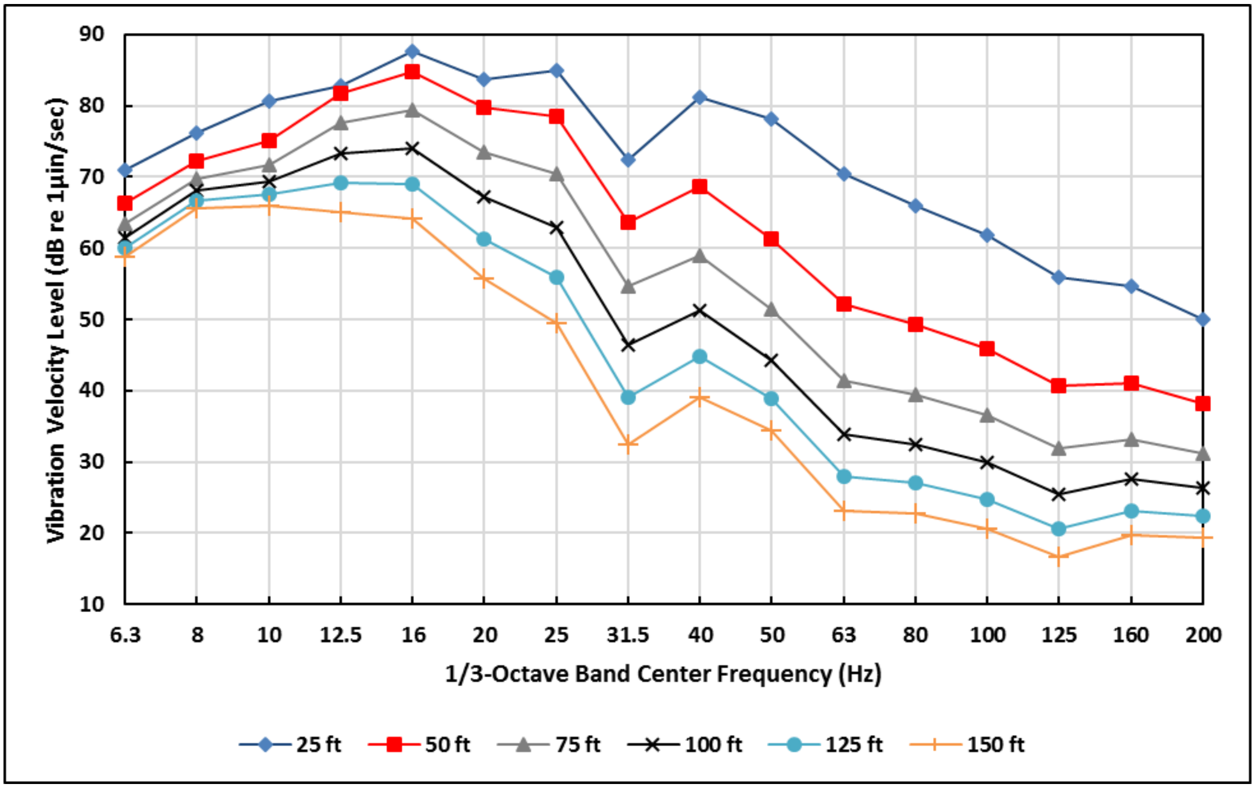


Figure C-12: Projected HSR Ground Vibration Levels – Site V-4



Site V-5

Figure C-13: 1/3-Octave Band Transfer Mobility Coefficients – Site V-5

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-37.3	21.4	46.0	57.0	3.3	-37.6	-6.5	42.7	85.6	25.5	-56.4	-29.3	113.1	94.8	93.4	72.6
B	121.6	23.1	2.0	-13.9	53.1	106.6	68.2	29.6	-11.1	60.4	161.1	126.1	-37.6	-49.3	-50.5	-42.1
C	-45.3	-11.5	-6.0	0.0	-19.5	-36.6	-26.4	-19.7	-10.6	-32.2	-62.9	-53.7	-9.6	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-14: Line Source Transfer Mobility – Site V-5

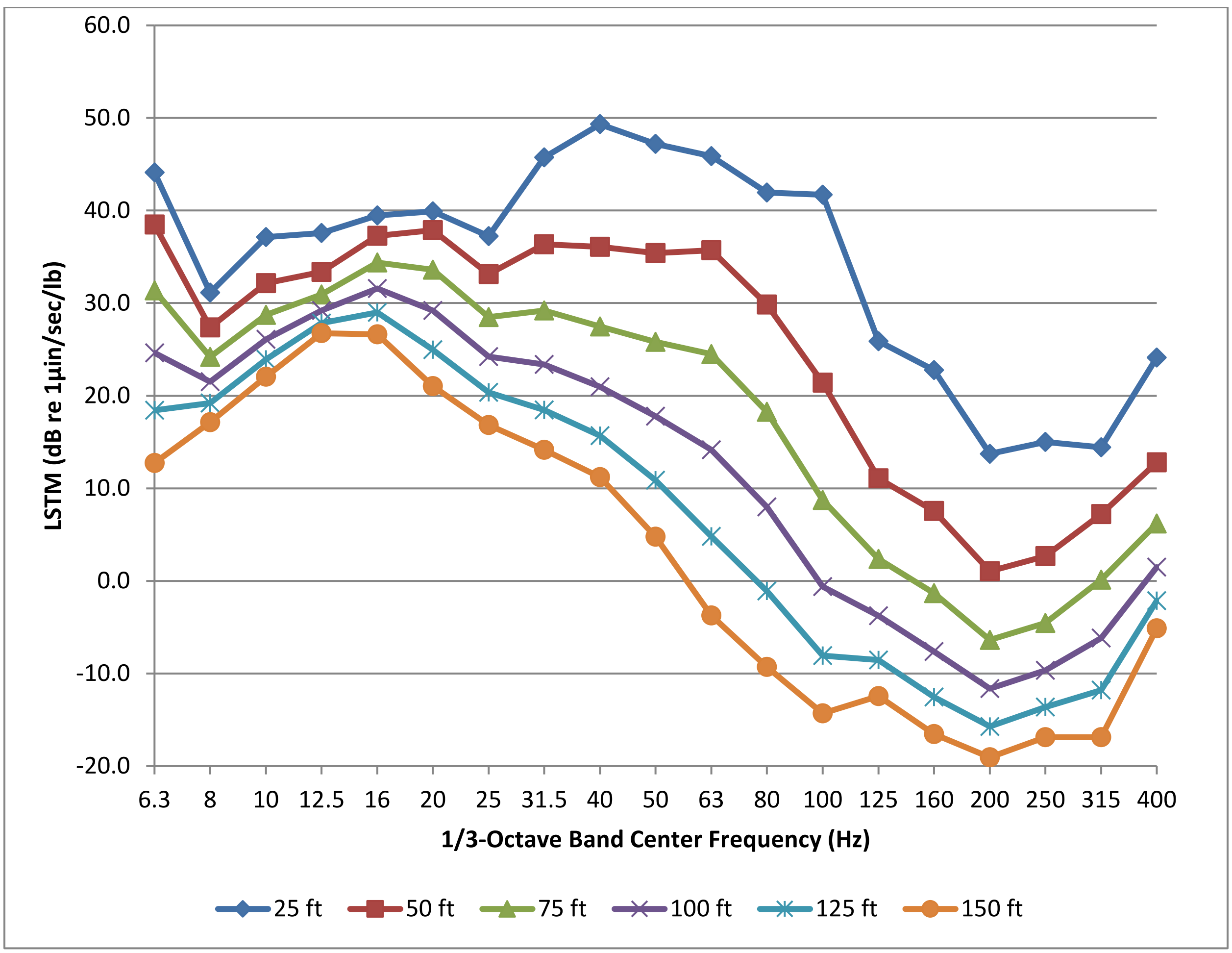
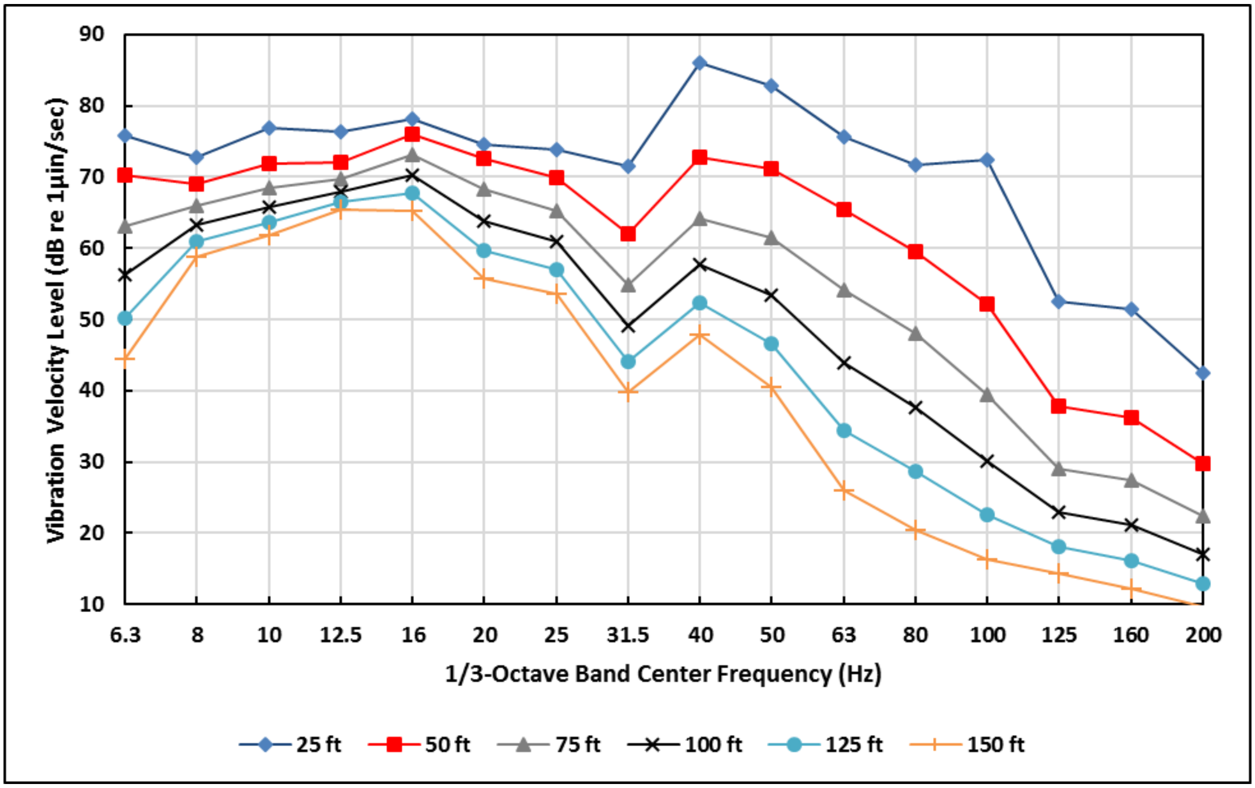


Figure C-15: Projected HSR Ground Vibration Levels – Site V-5



Site V-6

Figure C-16: 1/3-Octave Band Transfer Mobility Coefficients – Site V-6

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	52.4	52.1	15.0	24.2	56.5	4.0	79.4	32.1	16.0	55.1	31.5	107.6	47.8	97.3	72.8	89.4
B	-11.2	-9.5	33.5	22.4	-9.1	66.7	-6.9	54.0	72.6	28.4	57.2	-37.2	32.0	-31.1	-7.5	-43.8
C	0.0	0.0	-12.5	-9.3	-1.6	-24.9	-5.7	-24.0	-28.8	-16.6	-25.8	0.0	-22.8	-5.6	-13.0	0.0

$$TM = A + B * \log(dist) + C * \log{(dist)}^2$$

Figure C-17: Line Source Transfer Mobility – Site V-6

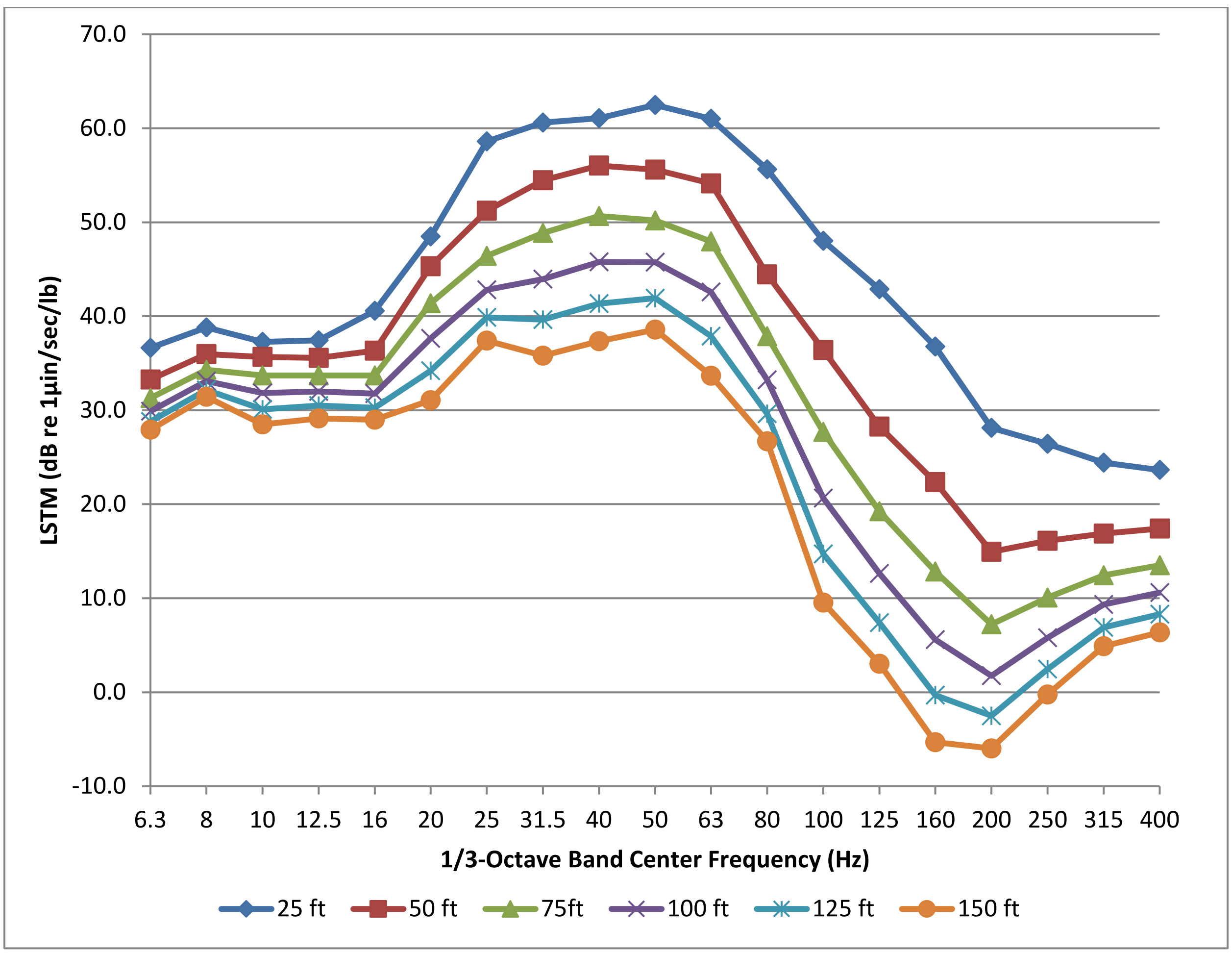
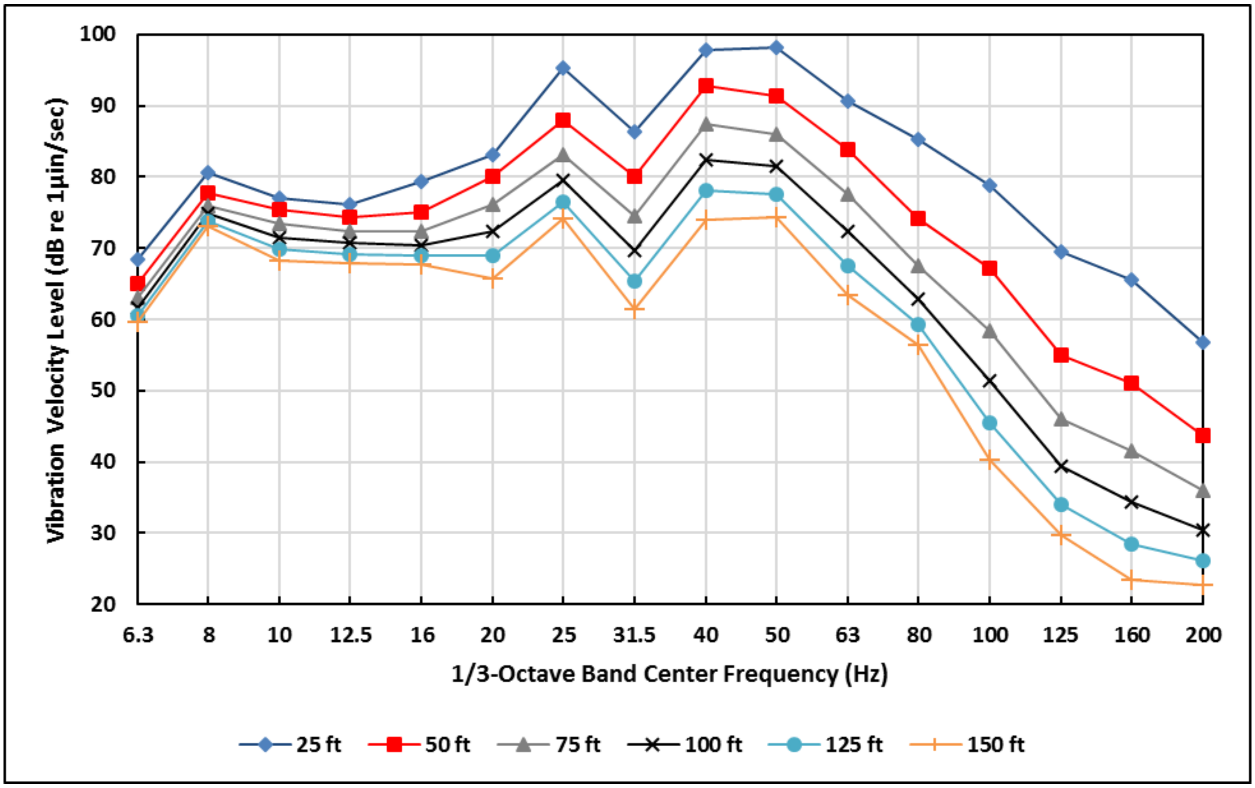


Figure C-18: Projected HSR Ground Vibration Levels – Site V-6



Site V-7

Figure C-19: 1/3-Octave Band Transfer Mobility Coefficients – Site V-7

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	24.1	21.9	-14.7	-17.7	-25.4	96.1	-42.4	2.1	64.7	109.6	77.4	104.8	99.9	80.2	66.5	57.4
B	17.6	15.9	58.3	77.9	99.5	-34.5	135.1	103.6	32.7	-29.0	-4.9	-49.6	-49.2	-40.7	-36.1	-35.4
C	-13.6	-10.3	-20.2	-27.2	-35.7	0.0	-50.7	-46.9	-28.9	-10.5	-15.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-20: Line Source Transfer Mobility – Site V-7

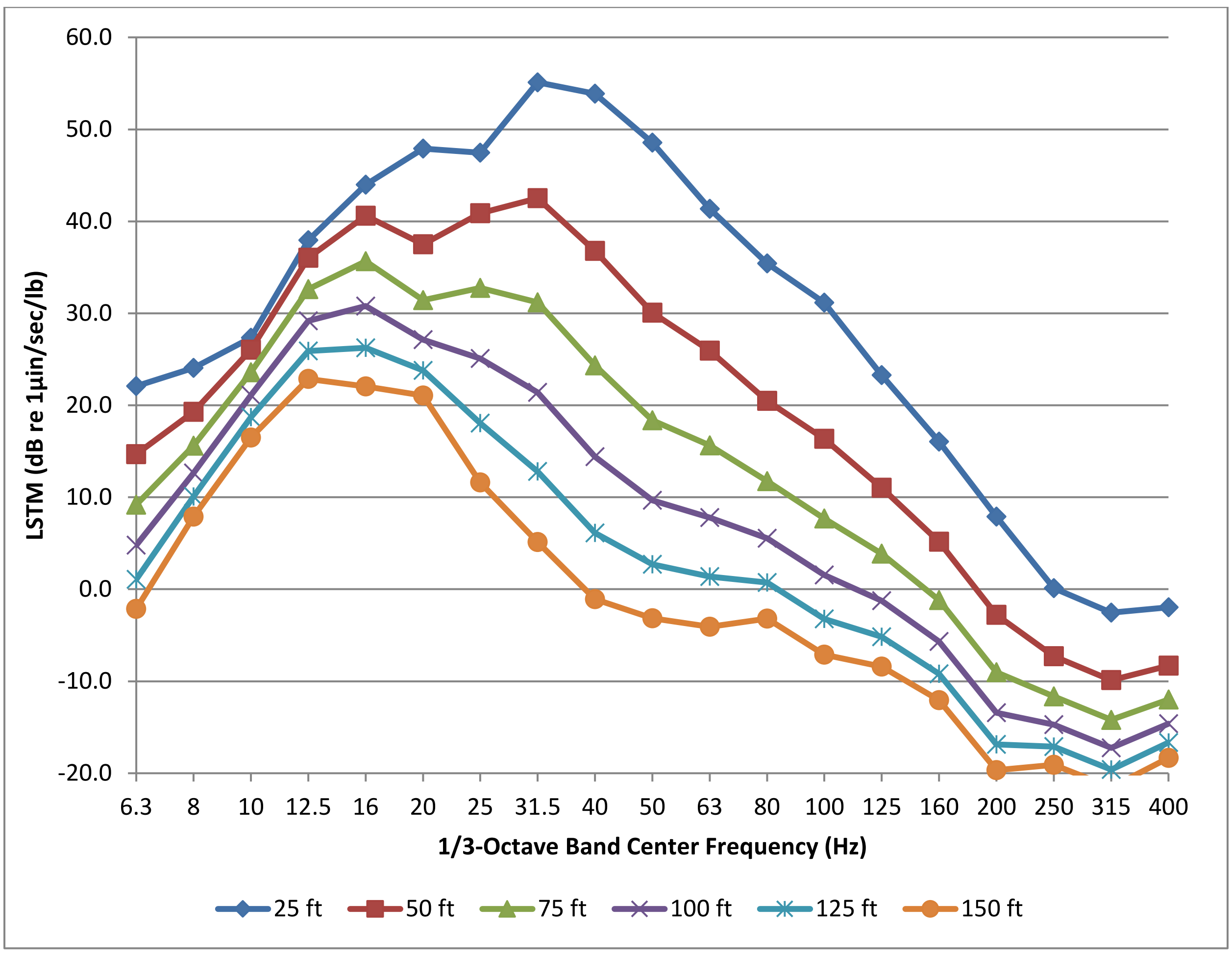
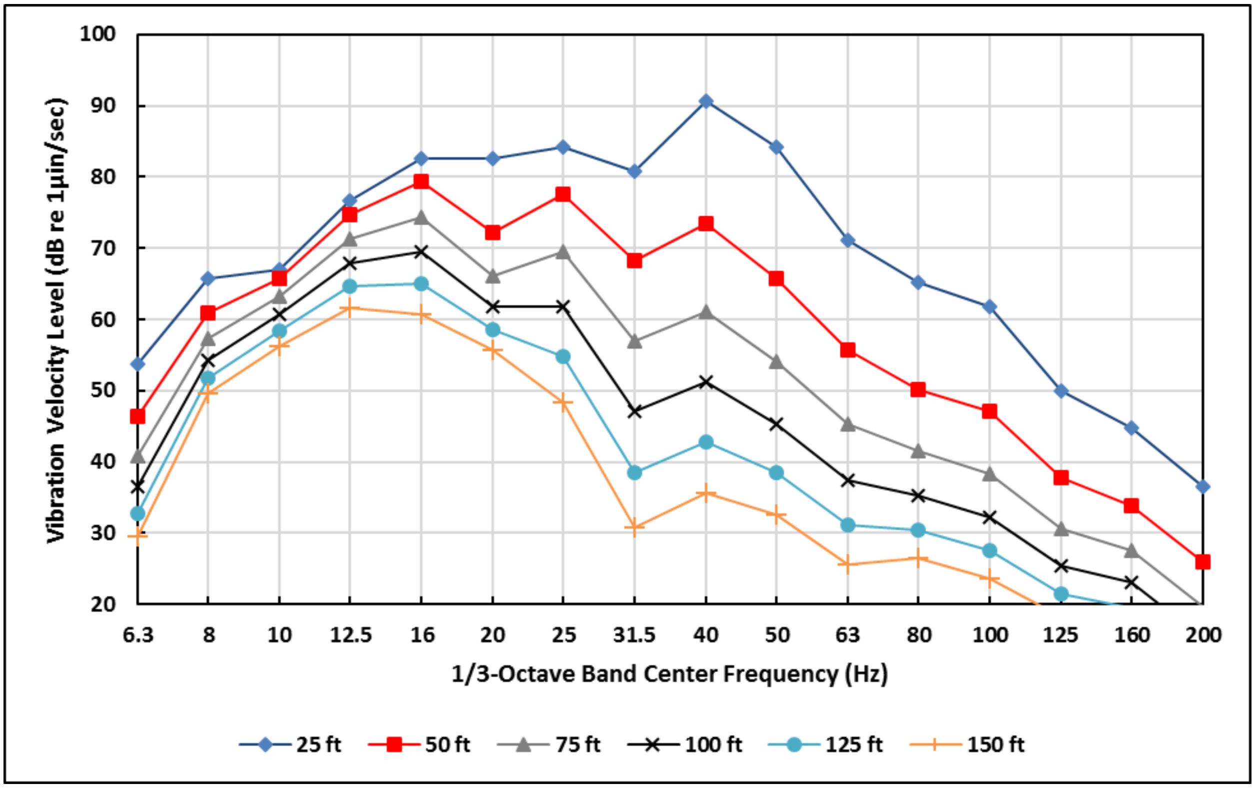


Figure C-21: Projected HSR Ground Vibration Levels – Site V-7



Site V-8

Figure C-22: 1/3-Octave Band Transfer Mobility Coefficients – Site V-8

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-4.1	4.6	34.9	-18.5	14.3	71.4	20.8	-10.1	-2.4	108.1	-45.2	-34.3	0.8	45.4	44.7	48.1
B	43.5	41.0	8.1	74.9	42.6	-19.7	39.7	82.5	71.3	185.8	117.2	96.4	44.4	-22.3	-24.7	-30.0
C	-15.3	-15.0	-5.2	-24.8	-16.2	0.0	-17.5	-32.2	-29.3	-61.3	-44.9	-39.0	-21.8	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-23: Line Source Transfer Mobility – Site V-8

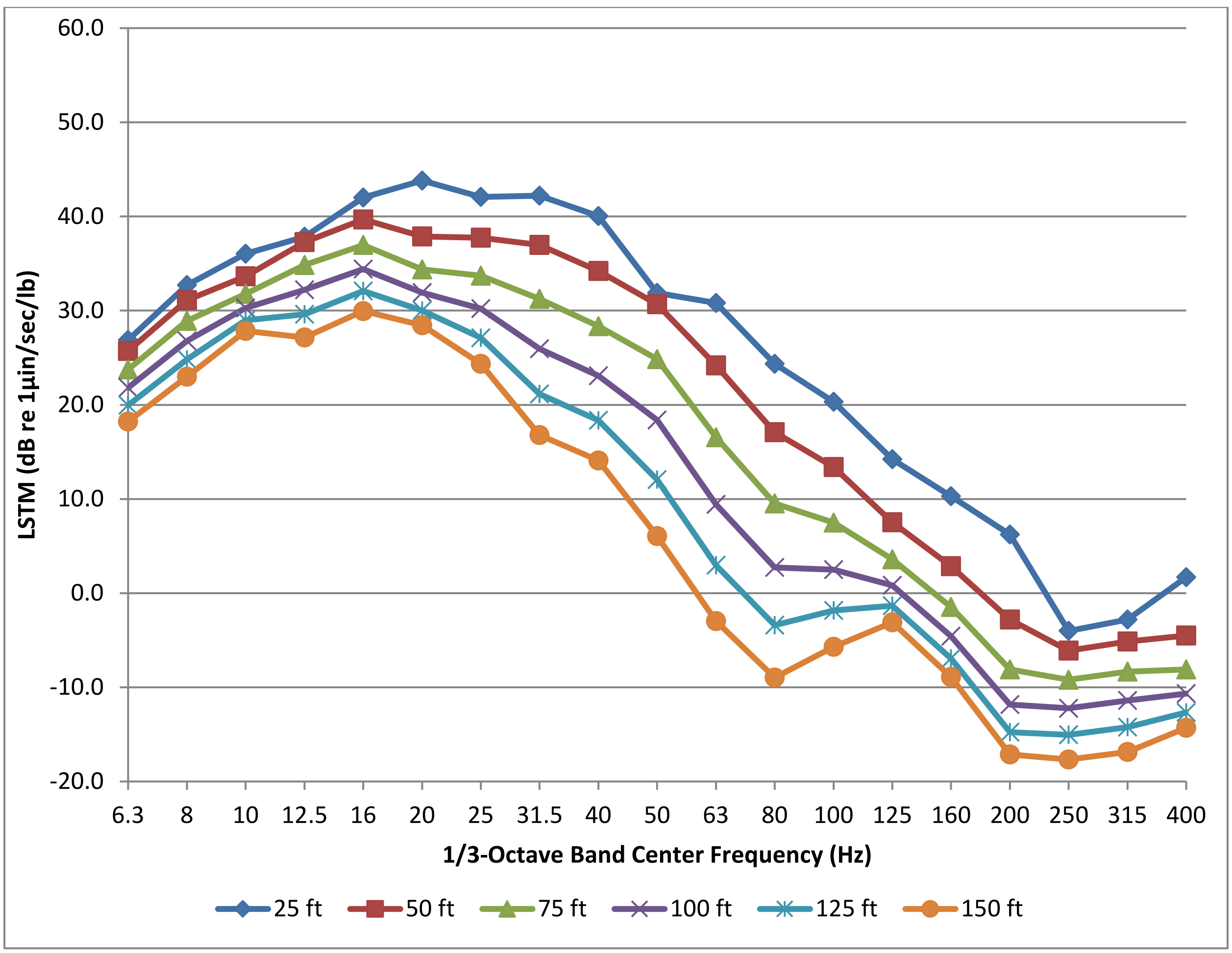
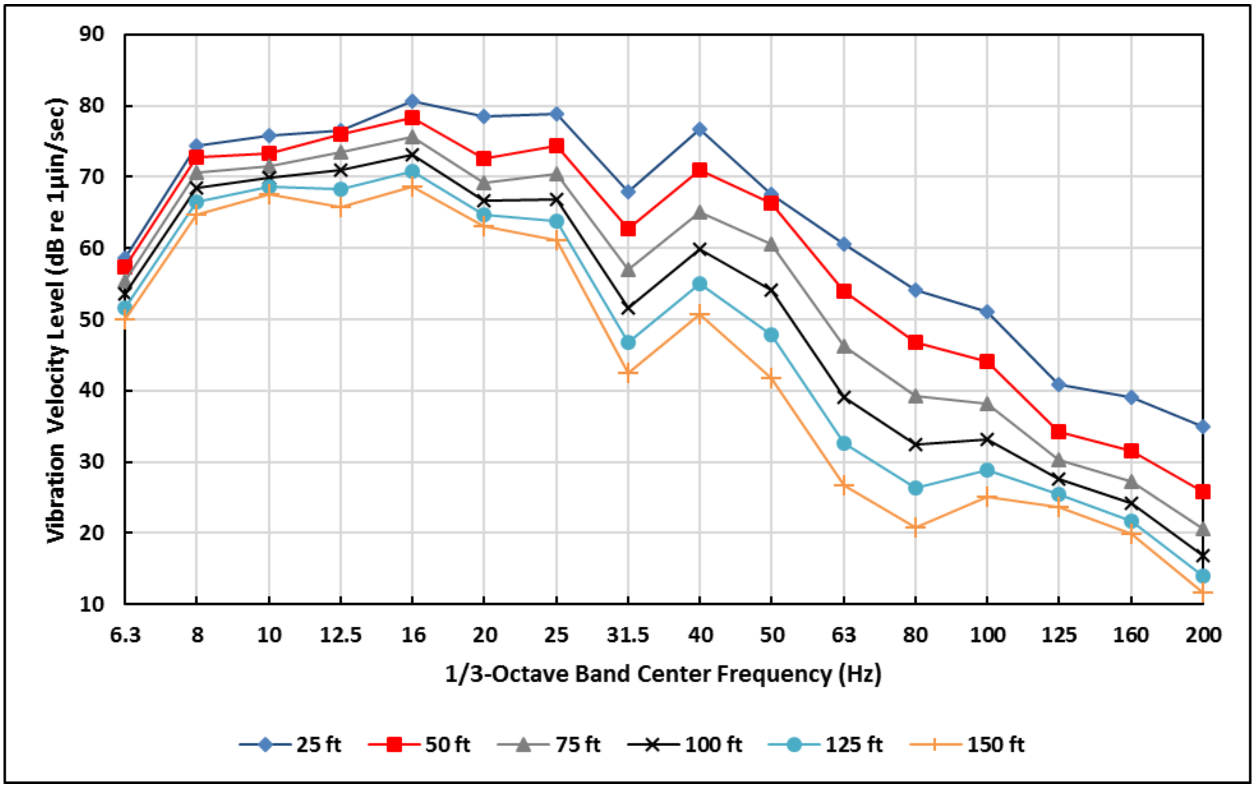


Figure C-24: Projected HSR Ground Vibration Levels – Site V-8



Site V-9

Figure C-25: 1/3-Octave Band Transfer Mobility Coefficients – Site V-9

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-46.1	-28.9	41.8	51.7	59.9	72.8	22.3	-35.3	-27.5	-60.1	139.3	-97.2	-0.6	106.9	85.1	-25.1
B	93.1	73.2	-9.7	-20.4	-20.4	-24.2	39.5	110.0	111.0	149.7	238.0	189.3	78.0	-52.2	-42.7	59.5
C	-31.8	-26.5	-3.4	0.0	0.0	0.0	-17.8	-38.3	-40.4	-52.3	-78.4	-66.5	-37.1	0.0	0.0	-24.5

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-26: Line Source Transfer Mobility – Site V-9

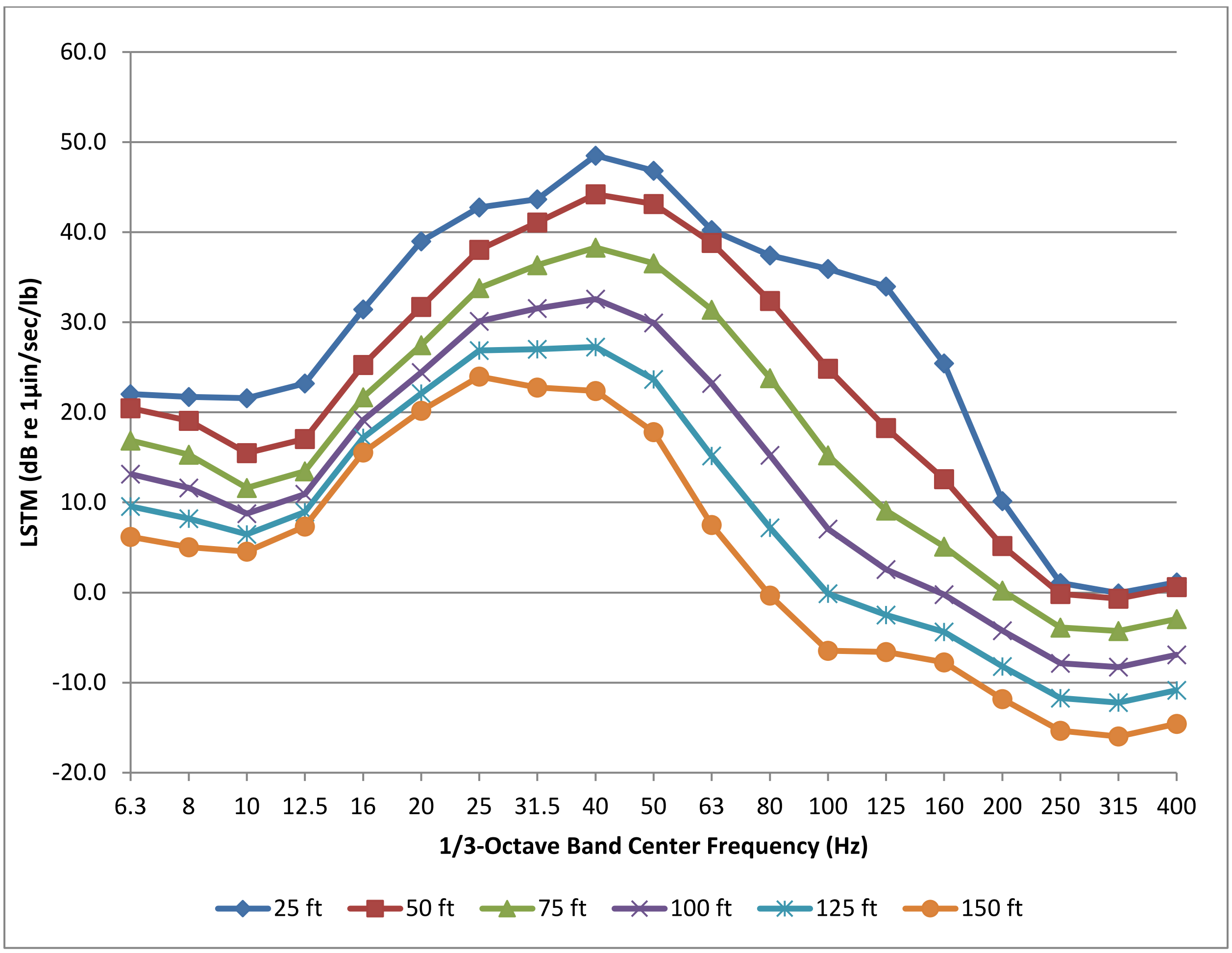
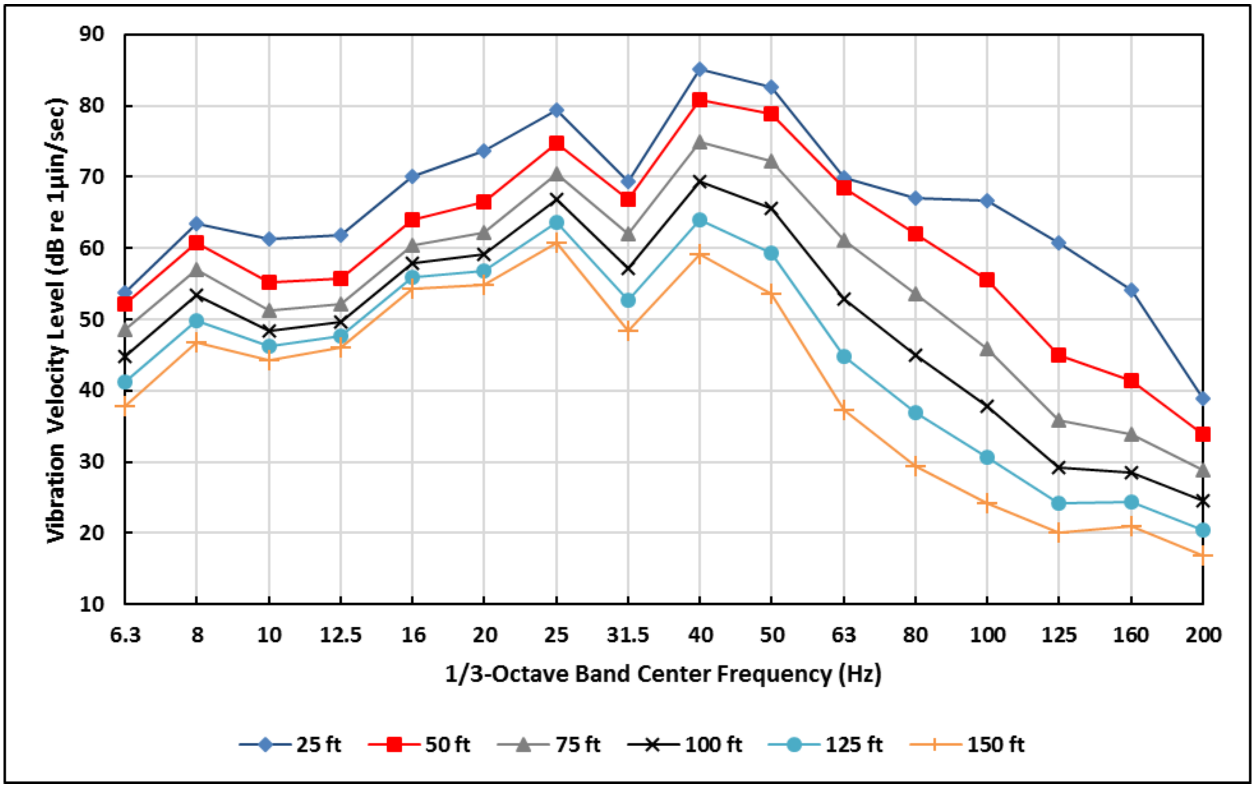


Figure C-27: Projected HSR Ground Vibration Levels – Site V-9



Site V-10

Figure C-28: 1/3-Octave Band Transfer Mobility Coefficients – Site V-10

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-29.1	-76.4	71.3	58.8	78.1	87.3	-43.1	17.9	62.5	78.4	102.5	135.6	111.3	68.6	45.8	22.2
B	80.8	142.0	-31.5	-15.2	-24.3	-30.8	122.9	60.4	21.1	1.5	-27.5	-67.8	-57.5	-37.1	-26.3	-14.5
C	-27.9	-46.3	3.7	0.0	0.0	0.0	-44.4	-29.5	-22.8	-18.2	-10.8	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-29: Line Source Transfer Mobility – Site V-10

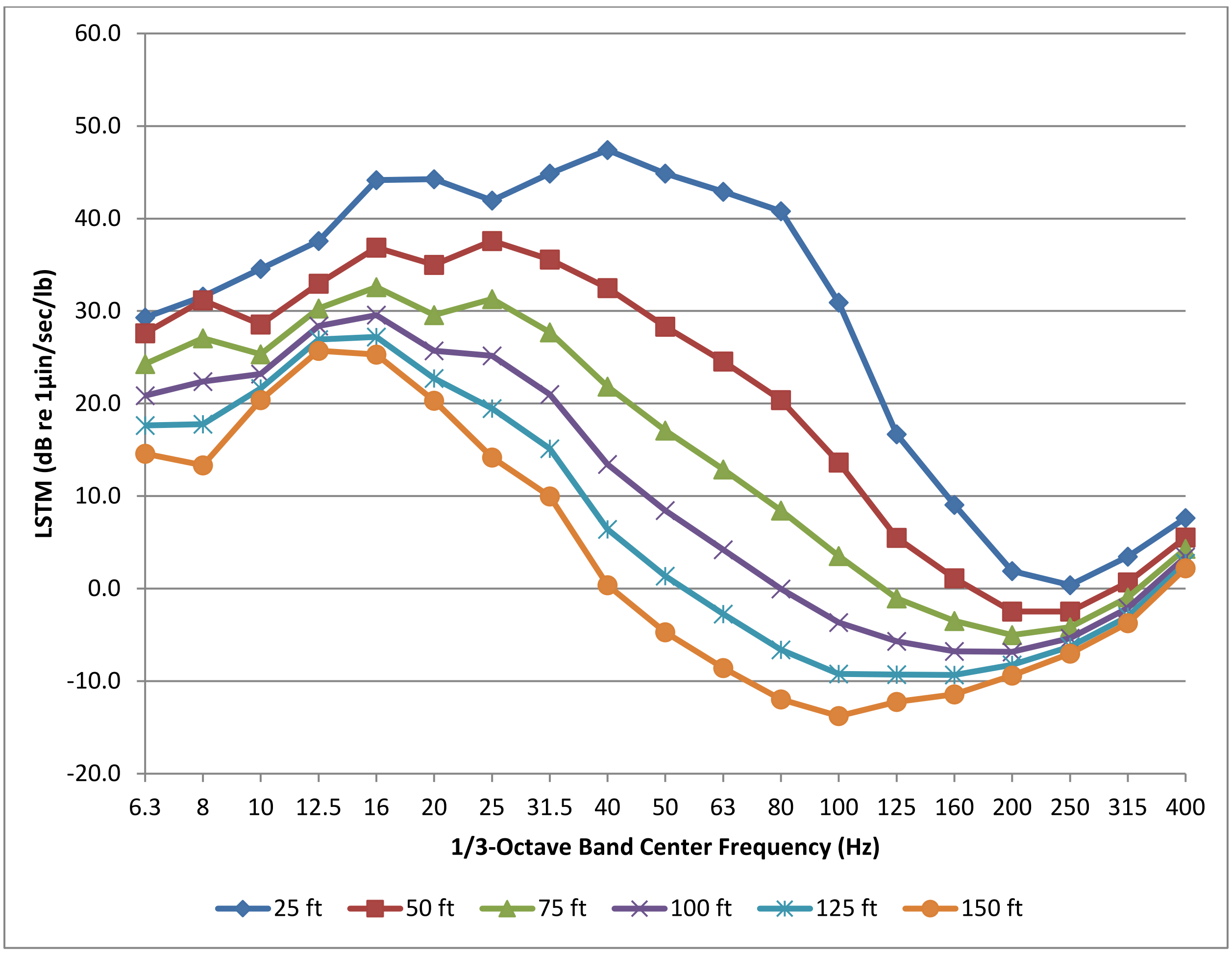
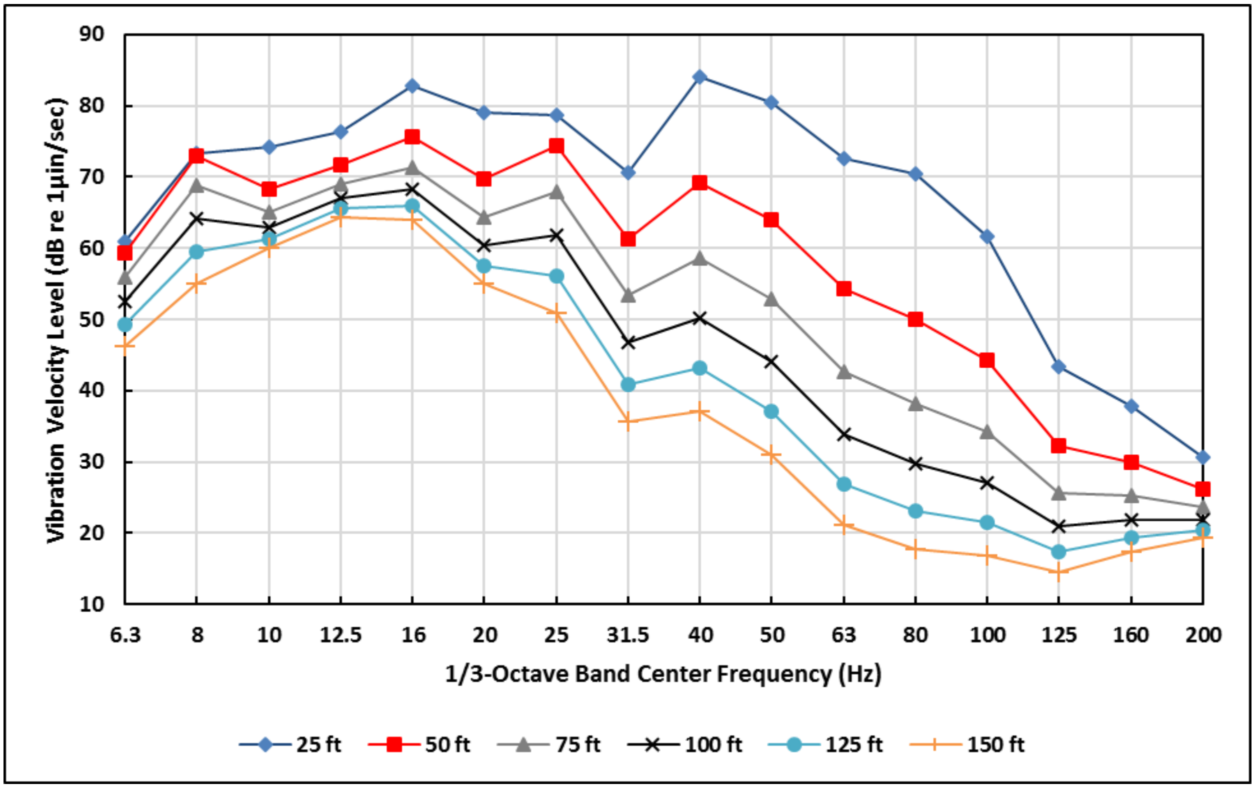


Figure C-30: Projected HSR Ground Vibration Levels – Site V-10



Site V-11

Figure C-31: 1/3-Octave Band Transfer Mobility Coefficients – Site V-11

Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	53.5	69.1	59.7	62.7	69.8	92.4	8.0	25.7	115.4	125.3	116.4	78.6	37.0	20.4	23.9	27.9
B	-12.2	-20.2	-17.7	-17.1	-19.1	-31.7	76.9	57.7	-46.6	-54.2	-51.2	-34.3	-16.7	-3.5	-5.3	-6.5
C	0.0	0.0	0.0	0.0	0.0	0.0	-33.8	-29.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Figure C-32: Line Source Transfer Mobility – Site V-11

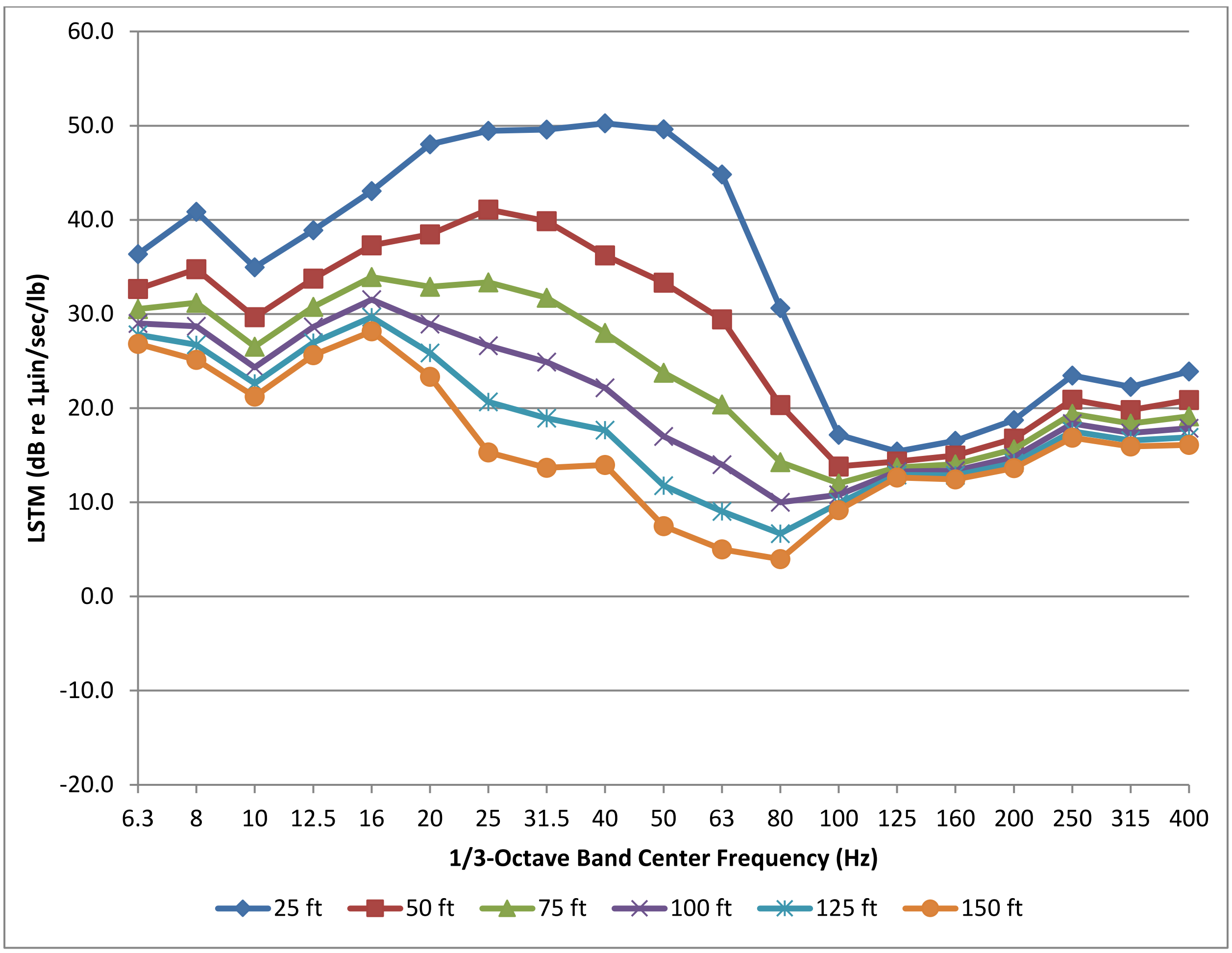
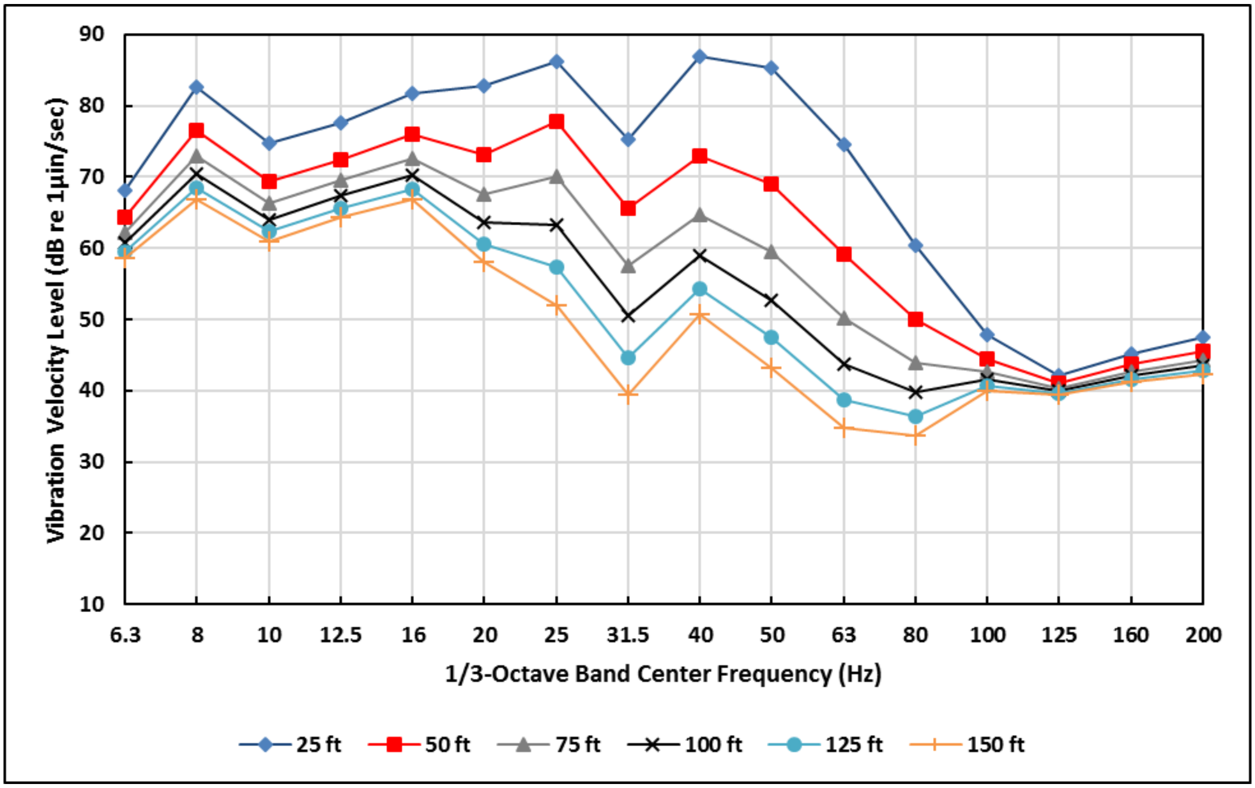


Figure C-33: Projected HSR Ground Vibration Levels – Site V-11



TECHNICAL MEMORANDUM
HAZARDOUS MATERIALS INITIAL SITE ASSESSMENT REPORT

To: Jerry Smiley, AICP, AECOM

From: Huda Shihada, AECOM

Date: November 1, 2017

RE: Dallas to Houston HSR – Hazmat Initial Site Assessment

This technical memorandum includes the following sections:

- Hazardous Materials Initial Site Assessment (ISA) Report
- Photographic Log

Hazardous Materials Initial Site Assessment (ISA) Report

TxDOT Environmental Affairs Division
Effective Date: 12/2014
510.02.DS
Version 3

Hazardous Materials Initial Site Assessment (ISA) Report

Completion of the ISA complies with the Federal Highway Administration's (FHWA's) policy dealing with hazardous materials discussed in FHWA's *Supplemental Hazardous Waste Guidance* (January 16, 1997) located at http://www.environment.fhwa.dot.gov/guidebook/vol1/doc7b.pdf.

This FHWA policy emphasizes three objectives: 1) the need to identify and assess potentially contaminated sites early in project development, 2) to coordinate early with federal/ state/ local agencies to assess the contamination and the cleanup needed; and 3) to determine and implement measures early to avoid or minimize involvement with substantially contaminated properties.

In addition, completion of the ISA will reduce construction delays that result from unexpected hazardous material discoveries and reduce the department's liability associated with the purchase of contaminated right of way.

Maintain a copy of the completed ISA report with all applicable attachments in the project administrative record.

For additional information, refer to TxDOT's online manual: *Hazardous Materials in Project Development:* http://onlinemanuals.txdot.gov/txdotmanuals/haz/index.htm

Abbreviations and Acronyms

ACM	Asbestos Containing Material
ASTs	Aboveground Storage Tanks
ASTM	American Society for Testing and Materials
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
COG	Council of Government
ECOS	Environmental Compliance Oversight System
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
IIR	Issues Identification and Resolution Form in ECOS
ISA	Initial Site Assessment
LPST	Leaking Petroleum Storage Tank
MSWLF	Municipal Solid Waste Landfill
NPL	National Priorities List
PST	Petroleum Storage Tank
RCRA	Resource Conservation and Recovery Act
ROW	Right of Way
RPST	Registered Petroleum Storage Tank
TCEQ	Texas Commission on Environmental Quality
TRC	Texas Railroad Commission
TSD	Treatment Storage and Disposal Facility
USGS	United States Geological Survey
UST	Underground Storage Tank
VCP	Voluntary Cleanup Program

TxDOT Hazardous Materials Initial Site Assessment (ISA) Report

Project Information			
CSJ No:N/A	City:Dallas to Houston	Zip Code:N/A	County:Dallas, Ellis, Navarro, Grimes, Leon, Madision, Waller, Harris, Limestone, and Freestone
HWY:Various Roads between Dallas and Houston Texas	Limits:Dallas to Houston Texas		

Section 1: Identify Previously Completed Environmental Site Assessments, Known Hazmat Conditions, Preliminary Project Design and Right-of-Way Requirements	
Yes/No	**Obtain information/comments from design, right of way, and/or environmental staff. Attach maps and/or details as appropriate.**
☐ Yes ☒ No	Has a Phase I Environmental Site Assessment (ESA) been prepared for this project? If one or more Phase I ESAs have been prepared for this project, please use applicable information from the Phase I ESA(s) to help complete the ISA.
☐ Yes ☒ No ☐ Unknown	Are there any previous environmental assessments, testing or studies performed within the proposed project area related to contamination issues? If yes, explain here if there are any concerns to the proposed project:
☐ Yes ☒ No	Are preliminary plans detailed enough to show excavation, ROW features, pipelines, utilities and storm sewer details? If no, explain here what information is limited or unavailable:

Section 2: Demolition and Renovation Information	
☒Yes ☐No	Are there proposed bridge or building demolition or renovation operations for this project?
If yes, describe the bridge or building locations, anticipated demolitions and/or renovations here:Assuming several instances where roads and structures associated with roads will need to be re-routed in order to complete construction	
If yes, record asbestos and/or lead-in-paint concerns or testing needs on an IIR form in ECOS. Detailed instructions for completing an ECOS IIR Form are located in the Non-Project Documentation section of ECOS under the heading Hazmat. Contact the ECOS help desk for assistance preparing the IIR Form, if necessary.	
Note: ACM inspections are required for all bridge and building renovation and demolition projects. Refer to the guidance found at TxDOT's *Environmental Compliance Toolkit* web page for additional information. **Note:** Contact ENV-HMM staff for assistance with lead-in-paint issues.	

Section 3: Identify Project Activities	
3.1 Yes/No	**Using the preliminary design and ROW information for this project, determine if the project includes any of the activities listed below.**
☒ Yes ☐ No	**Project Excavations:** Will the work consist of substantial excavation operations. Substantial excavation includes, but is not necessarily limited to: • Underpass construction, • Storm sewer installations, • Trenching or tunneling that would require temporary or permanent shoring.
☐ Yes ☒ No	**Dewatering:** Are there proposed de-watering operations. If yes, what is the estimated depth to groundwater?

☒ Yes ☐ No	**Utility Adjustments:** Are there proposed pipeline and underground utility installation or adjustments?
☒ Yes ☐ No	**Encroachments:** Are there known or potential encroachments into the project area? Encroachments include soil and groundwater contamination, dump sites, tanks, and other issues in the ROW.
☒ Yes ☐ No	**ROW and Easements:** Are there any acquisitions of new ROW, easements, temporary construction easements planned for the project?

3.2 Complete the appropriate box below:

☒ If Section 3.1 contains any "Yes" answers, please proceed to Section 4.

☐ If Section 3.1 contains all "No" answers, proceed to Section 6, Site Survey. Please perform a site survey documenting the results in Section 6 and then mark the appropriate box below. If a Phase I ESA has been prepared for this project, you may use the applicable site survey information from the Phase I ESA.

☐ The site survey did not identify evidence of any environmental concerns listed in Section 6. The ISA is complete. Complete section 10 and maintain a copy of the ISA and all applicable attachments in the administrative record.

☐ The site survey identified evidence of environmental concerns listed in Section 6. Continue with Section 4.

Reviewed?	Review and assess current and past land use (up to 50 years) in the project area. Document and attach sources that were reviewed.		
	Review and assess current and past land use (up to 50 years) in the project area. Document and attach sources that were reviewed. If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA.		
☒Yes ☐ No ☐ Not Available ☐ Not Applicable	**4.1 Review Current and if possible Past USGS 7.5 Minute Topographic Maps of the project area:** Look for oil & gas pipelines, tanks, landfills or other industrial features. Describe any concerns:Observed on the 1970 Satsuma topo map was a location that used to be a tank farm area. The 1970 Hedwig Village topo showed an area that used to be a sewage disposal pond, and the 1967 Houston Heights topo displayed an area that was a pond in past years.		
	List Topo Maps Reviewed:	Dates:	Comments:
	All available 7.5 minute, 15 minute, and 30 minute maps that were available and not duplications.	Various years through 1891-2013	The time frame listed for topographic coverage does not include a complete coverage of the entire project area for any given year. Coverage was obtained for areas for years available.
☒Yes ☐ No ☐ Not Available ☐ Not Applicable	**4.2 Review Current Aerial Photographs and if possible Past Aerial Photographs of the project area:** Look for oil & gas pipelines, tanks, landfills or other industrial features. Describe any concerns:Aerials displayed areas where former manufacturing site were located that are no longer there or now inactive including a tank farm, metal processsing site, and other non-identifiable manufacting facilties. Also observed serveral medium sized ponds located in the Houston area in 1971.		
	List All Aerial Photos Reviewed:	Photo Dates:	Comments:

<table>
<tr><th colspan="4">Section 4: Current and Past Land Use Information</th></tr>
<tr><td>Reviewed?</td><td colspan="3">Review and assess current and past land use (up to 50 years) in the project area. Document and attach sources that were reviewed. If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA.</td></tr>
<tr><td></td><td>Obtainable Aerials from EDR</td><td>1938, 1939, 1942, 1944, 1952, 1953, 1960, 1961, 1962, 1963, 1964, 1965, 1968, 1972, 1973, 1977, 1978, 1981, 1982, 1983, 1989, 1996, 2004, and 2014</td><td>The years listed do not represent an entire coverage of the project area for each year listed.</td></tr>
<tr><td rowspan="3">☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.3 Review Current and Past Right-of-Way Maps/Files: Look for oil & gas pipelines, tanks, landfills, or other industrial features.
Describe any concerns:</td></tr>
<tr><td>List Maps/ Files & Dates Reviewed:</td><td colspan="2">Comments:</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">☒Yes
☐ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.4 Review Sanborn Fire Insurance Maps/Files: Look for tanks, oil & gas pipelines, landfills, or other industrial features.
Describe any concerns:Concerns with certain types of industriess adjacent or in the LOD are Mosher Manufacturing Co-Foundry and Machine Shpo, Trinity Cotton Oil Company, Dallas Cotton Mills, Armstrong Packing Company, Guiberson Corporation Manufacture of Oil, City of Dallas Garbage and Incenerator, Texas Pipeline Company, Brown Brick Compnay, Proctor and Gamble Company Vegetable Oil Refinery and Soap Factory.</td></tr>
<tr><td>List Maps/ Files & Dates Reviewed:</td><td colspan="2">Comments:</td></tr>
<tr><td>Dallas Maps from 1921 and 1922</td><td colspan="2"></td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.5 Review TxDOT As-Built Plans:
Any concerns identified during previous work within the project limits?
If yes, explain:
If known, what is the previous Project CSJ:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.6 Review TxDOT Geotechnical Soil Boring Logs:
Any concerns noted on the boring logs such as unusual odors, visible contamination, trash, waste or debris?
If yes explain:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.7 Review TxDOT Temporary Use ROW Agreements (permits issued by the district to entities to occupy a portion of the ROW):
Any concerns such as monitor wells or treatment systems within the ROW?
If yes, explain:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.8 Review Notifications of Contamination to TxDOT (These are typically letters from TCEQ or third parties explaining the presence of contamination on TxDOT ROW):
Any concerns regarding contamination of ROW from off-site sources?
If yes, explain:</td></tr>
</table>

Section 5: Complete a Regulatory Records Review (Database Search)

Note: The purpose of the database search is to obtain and review standard sources of environmental information from government agency records that will help identify potential hazardous material issues within the project limits and surrounding properties. A list of standard databases of environmental information from government agency records is included in Section5.1.

To enhance and supplement the standard sources of environmental information, other information such as local records and/or additional state records should be reviewed when, in the judgment of the environmental professional, such additional records are (1) reasonably ascertainable, and (2) are sufficiently useful, accurate, and complete in light of the objective of the regulatory records review.

Standard database source information or other record information from government agencies may be obtained directly from appropriate government agencies or from commercial services.

If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA.

Mark the appropriate box below:

☐ A Database search was conducted through a contracted service. Indicate in Section 5.1, and if applicable, Section 5.2, the regulatory records searched and make any comments if potential environmental concerns are identified. A complete copy of the database search findings (contractor's report deliverable) should be maintained in the project administrative record with the ISA.

☒ A Database search was conducted in-house. Include in Section 5.1 the regulatory records searched and make any comments if potential environmental concerns are identified. For in-house database searches, not all databases need to be reviewed for each project, but at a minimum the databases listed in Section 5.1 marked in bold with a star must be reviewed. Include database records that list potential issues in the project administrative record with the ISA. It is not necessary to include records of negative findings in the project administrative record.

Most state and federal databases are located at the following websites:
Federal EPA databases link: http://www.epa.gov/enviro/.
Texas TCEQ databases link: http://www15.tceq.texas.gov/crpub/

Section 5.1 Standard Database Sources of Environmental Information from Government Agency Records

Regulatory Record	Reviewed	Recommended Minimum Search Distance from Project Limits (miles)	Comment Field: Provide any comments related to potential issues discovered within the database.
NPL list*	☒ Yes	1.0	See Table 3.5-2 in Section 3.5 of EIS
Federal Delisted *NPL* list*	☒ Yes	0.5	No findings have been identified within one mile of the Project Area
Federal CERCLIS list*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Federal CERCLIS No Further Remedial Action Planned (NFRAP) site list*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Federal RCRA Corrective Action (CORRACTS) list	☐ Yes ☒ No	1.0	
Federal RCRA non-CORRACTS Treatment Storage Disposal (TSD) facilities list	☐ Yes ☒ No	0.5	

Federal Institutional Controls/ Engineering Controls Registry http://www.epa.gov/ictssw07/public/export/regionalReport/REGION6.HTM	☐ Yes ☒ No	0.5	
Federal RCRA generators	☒ Yes ☐ No	*property* and *adjoining properties*	See Table 3.5-2 in Section 3.5 of EIS.
Federal ERNS	☐ Yes ☒ No	*property* only	
TCEQ Industrial Hazardous Waste (IHW) Corrective Action sites*	☒ Yes ☐ No	1.0	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Superfund sites*	☒ Yes	1.0	No findings have been identified within one mile of the Project Area
Closed and abandoned municipal solid waste landfill sites* **http://www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw-data**	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ leaking petroleum storage tank remediation lists (LPST)*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ registered petroleum storage tank lists (PST)*	☒ Yes	*property* and *adjoining properties*	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ voluntary cleanup program (VCP) sites*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Innocent Owner/ Operator (IOP) sites	☒ Yes ☐ No	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Dry Cleaners Remediation Database*	☒ Yes ☐ No	0.5	No findings have been identified within one mile of the Project Area
TCEQ Brownfields Database	☒ Yes ☐ No	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Texas Railroad Commission VCP sites* http://www.rrc.state.tx.us/oil-gas/environmental-cleanup-programs/site-remediation/voluntary-cleanup-program/	☒ Yes	0.5	No findings have been identified within one mile of the Project Area

Section 5.2 List below other records reviewed such as local records and/or additional state records	
Record source	Environmental Concerns (If Yes describe)
TCEQ Central File Registry	☒ YesSee Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located in or adjacent to the project area. ☐ No
EPA Envirofacts website	☒ YesSee Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located in or adjacent to the project area. ☐ No

Section 6: Complete a Project Site Survey
Note: Document site survey and findings. Describe location, size of concern. Attach site maps and photographs as appropriate. If a Phase I ESA has been prepared for this project, you may use the applicable site survey information from the Phase I ESA.
Site Survey Date(s):1/18 through 1/29 2016

6.1 Current Land Use Type: ☒ Undeveloped to light commercial (agricultural, residential, offices, retail, light commercial). ☒ Developed/commercial (automotive repair, gas stations, manufacturing, dry cleaners, military base, waste collection and handling facilities, other industrial sites). Describe: Areas in and surrounding the project area consist of a variety activities including, undeveloped, gas stations, oil/gas facilities, quarry, industrial, and commercial	
Evidence? (Yes/No)	**6.2 Specific Concerns Identified (as necessary provide a description for each "Yes" checked).**
☒Yes ☐No	• underground storage tanks.
☐Yes ☒No	• vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground.
☒Yes ☐No	• aboveground storage tanks.
☐Yes ☒No	• electrical and transformer equipment storage or evidence of release.
☐Yes ☒No	• injection wells, cisterns, sumps, dry wells. Added information may be attained from the oil/gas section of the DEIS
☒Yes ☐No	• groundwater monitoring wells and/or groundwater treatment systems. located at active LPST sites
☐Yes ☒No	• flooring, drains, or walls stained by substances other than water or emitting foul odors.
☒Yes ☐No	• vats, 55-gallon drums (labeled/unlabeled), canisters, barrels, bottles, etc.
☒Yes ☐No	• stockpiling, storage of material.
☐Yes ☒No	• evidence of liquid spills.
☒Yes ☐No	• surface dumping of trash, garbage, refuse, rubbish, debris half exposed/buried, etc. Witness several areas where dumping was being done along the ROW or adjacent to the ROW
☐Yes ☒No	• damaged or discarded automotive or industrial batteries.
☐Yes ☒No	• stained, discolored, barren, exposed or foreign (fill) soil.
☐Yes ☒No	• dead, damaged or stressed vegetation.
☐Yes ☒No	• oil sheen or films on surface water, seeps, lagoons, ponds, or drainage basins.
☐Yes ☒No	• pits, ponds, or lagoons associated with waste treatment or waste disposal.
☐Yes ☒No	• changes in drainage patterns from possible fill areas.
☒Yes ☐No	• security fencing, protected areas, placards, warning signs.
☐Yes ☒No	• dead animals (fish, birds, etc.) possibly due to contamination.
☐Yes ☒No	• other concerns.
6.3 Describe adjoining properties and any visible hazardous material concerns. List adjacent businesses, factories, abandoned sites, etc. that may be the source of hazardous materials concerns. A variety of commercial, industrial, and manufacturing facilities exists along the route adjacent to the project area. Examples would be gas stations, quarries, oil/gas facilities, auto repair, etc.	
6.4 Describe Concerns Observed in the Site Survey. Indicate whether the concern is associated with existing ROW, proposed ROW acquisition or easements. As necessary, provide additional information about the evidence identified; include photographs as an attachment to the ISA. Several locations are inactive/vacant facilities that were identified in one or more of the databases reviewed for contmination or are existing facilities that deal with hazadous materials and wastes. Several facilties are located inside the LOD or directly adjacent to the LOD.	

Section 7: Interviews		
Section 7.1 Were interviews conducted? ☐Yes ☒No Possible interviewees include: local residents, TxDOT staff, fire department personnel, city or county department of health/environmental staff; city or county planning staff; TCEQ staff; TRC staff; current and former property owners or operators. If one or more Phase I ESAs were prepared for this project, please use applicable interview information from the Phase I ESAs to help complete this section of the ISA.		
Section 7.2 Interview Summary: Complete this section if interviews were conducted. Add additional rows as needed. Attach record of communications to the ISA.		
Name:	Title:	Date:
Describe any potential concerns:		
Name:	Title:	Date:
Describe any potential concerns:		
Name:	Title:	Date:
Describe any potential concerns:		

Section 8: Identified Hazardous Material Concerns
On the list below, indicate Yes or No whether the hazardous material concern was identified. If Yes, record the hazardous material concern on an Issues Identification and Resolution (IIR) Form in ECOS. If the ISA preparer is unsure how to complete the IIR Form, the responsibility to complete the Hazmat IIR may be assigned within ECOS to ENV Hazmat Staff. *Detailed instructions for completing an ECOS IIR Form are located in the Non-Project Documentation section of ECOS under the heading Hazmat. Contact the ECOS help desk for assistance preparing the IIR Form if necessary.* Hazardous materials concerns identified below will require additional assessment work. In most cases, resolution to the concerns should be completed prior to project letting. For additional information regarding scheduling considerations, internal/external coordination and recommended practices for resolving hazmat issues please refer to TxDOT's *Environmental Tool Kit* web site. Contact ENV Pollution Prevention and Abatement (PPA) for additional assistance.

8.1 Identify the Hazardous Material Concerns		
Concern Identified?	**Type of Concern** Record the hazardous material concerns on an Issues Identification and Resolution (IIR) Form in ECOS.	
☒**Yes** ☐**No** ☐**NA**	**Current or Past Land Use Concern:** This concern is associated with hazardous material issues identified in Section 4. Note: *On the ECOS IIR, the Available Contaminated Media would be "Other".*	
	☒Yes ☐No	One or more concerns identified in Section 4.
	☐Yes ☒No	No obvious concerns were identified but additional research is needed as a result of unique or unusual current or past land use. Request additional assistance from ENV.
☒**Yes** ☐**No**	**Site Visit Concerns:** This is associated with any hazardous material issues discovered following the completion of Section 6. On the *ECOS* IIR, the Available Contaminated Media would be "Other".	
	☒Yes ☐No	One or more concerns identified.
	☐Yes ☒No	No listed concerns identified but additional research is needed as a result of unique or

8.1 Identify the Hazardous Material Concerns		
Concern Identified?	**Type of Concern** Record the hazardous material concerns on an Issues Identification and Resolution (IIR) Form in ECOS.	
		unusual project site conditions. Request assistance from ENV.
☐Yes ☐No ☒NA	**Interview Concerns:** This concern is associated with any hazardous material issues discovered during an interview listed in Section 7. In the IIR, the Available Contaminated Media would be “Other”.	
	☐Yes ☐No	One or more concerns identified after completing interviews.
	☐Yes ☐No	No listed concerns identified but additional research is needed as a result of unique or unusual project site conditions. Request assistance from ENV.
☒Yes ☐No	**Asbestos and/or Lead in Paint Concerns:** The following are related to ACM and LBP identified in Section 2. Select below all that apply.	
	☐Yes ☒No	Bridge Demolition/ Renovation without Steel Structures
	☐Yes ☒No	Bridge Demolition/ Renovation with Steel Structures
	☒Yes ☐No	ROW Structure(s) Demolition
	☐Yes ☐No	Enhancement Project Demolition/Renovation
	☐Yes ☐No	Other- Describe
☒Yes ☐No	**Petroleum Storage Tank Concerns:** PSTs can be any underground or aboveground storage tanks that are used to store petroleum based fluids. Typically, these are gasoline and diesel refueling facilities. Select below all that apply.	
	☒Yes ☐No	ROW acquisition or partial acquisition of a parcel with one or more PSTs.
	☐Yes ☒No	Other- Describe:
☒Yes ☐No	**Leaking Petroleum Storage Tank (LPST) Concerns:** An LPST parcel will only need to be identified once in the following list. LPST sites are PSTs that have caused or suspected to have caused a release to the environment.	
	☐Yes ☒No	Additional Research is needed or uncertain of impacts from an LPST. Request assistance from ENV.
	☒Yes ☐No	Acquisition of a Parcel with an LPST.
	☒Yes ☐No	An LPST is located within 0.25 miles of the project.
	☐Yes ☒No	Other- Describe

☒Yes ☐No	**Oil and Gas Production Activity Concerns**: TxDOT is concerned with the acquisition of oil and gas production wells (and ancillary equipment). Typically, these are oil/gas wells, piping, ancillary production equipment, pipelines, etc. Select below all that apply.	
	☒Yes ☐No	Additional Research needed or uncertain of impacts. Request assistance from ENV.
	☐Yes ☒No	Database search identified TRC VCP Site within 0.5 miles of project.
	☒Yes ☐No	Oil/ Gas Wells within future ROW.
	☒Yes ☐No	Pipelines requiring adjustment.
	☒Yes ☐No	Other- Describe:
☒Yes ☐No	**Non-LPST Source Contamination Concerns**: These parcels or locations have a potential for soil and/or groundwater contamination. Typically, they are contaminated locations (even potentially contaminated locations) that are not associated with LPST sites. Select below all that apply.	
	☐Yes ☒No	Additional Research is needed or uncertain of impacts from a Non-LPST site. Request assistance from ENV.
	☐Yes ☒No	Database search identified a CERCLA NPL(s) site within 1 mile of project.
	☒Yes ☐No	Database search identified CERCLA (to include NFRAP) within 0.5 miles of project.
	☐Yes ☒No	Database search identified RCRA Corrective Action(s) site within 1 mile of project.
	☐Yes ☒No	Database search identified RCRA TSD Facilities within 0.5 miles of project.
	☒Yes ☐No	Database search identified TCEQ IHW Corrective Action Sites within 1 mile.
	☐Yes ☒No	Database search identified TCEQ Superfund Sites within 1 mile of project.
	☒Yes ☐No	Database search identified TCEQ VCP Sites within 0.5 miles of project.
	☒Yes ☐No	Database search identified TCEQ IOP Sites within 0.5 miles of project.
	☐Yes ☒No	Other- Describe:
☒Yes ☐No	**Landfills/ Waste Pits/ Dump Site Concerns:** This is associated with any known or unknown (based on visual observations) landfills, dump sites, or waste pits. Typically, the local Council of Governments (COG) should maintain a list of all closed and open landfills in your project area. Select below all that apply.	
	☐Yes ☒No	Additional research is needed or uncertain of impacts. Request assistance from ENV.
	☒Yes ☐No	Database search identified active/closed/abandoned MSW landfill sites within .5 miles of the project.
	☐Yes ☒No	Other- Describe

8.2 Did the ISA identify any potential Hazardous material concerns?

☐ No hazardous materials concerns were identified as a result of the ISA performed for the proposed action. No further hazardous materials action is required. The ISA is complete for this project. Any unanticipated hazardous materials impacts encountered during the project construction phase will be addressed in accordance with regulatory requirements. No further assessment is required. Complete Sections 9 and 10 and maintain a copy of the ISA and all applicable attachments in the project administrative record.

☒ Yes, the ISA identified one or more hazardous materials concerns for this project. An IIR form has been completed in ECOS. Complete Sections 9 and 10 and maintain a copy of the ISA and all applicable attachments in the project administrative record.

Section 9: Reference Materials Utilized (Identify any referenced materials attached to this ISA)			
Referenced Materials Used	☐ Project Map	☐ USGS Topo Maps	☐ Aerial Photographs
	☐ ROW Maps/Files	☐ Sanborn Fire Insurance Maps	☐ Temporary Use Agreements
	☐ TxDOT As-Built Plans	☐ Notifications	☒ Photographs
	☐ Record of Communications	☐ Regulatory Database	☐ Record of Interviews
	☒ Other:Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located within the study area.		

Section 10: Contact/Completed by		
Name:	Josh Orr	**Tel: 512-571-8662**
Title:	Environmental Scientist	
Firm (District Section):	AECOM	
Address:	9400 Amberglen Blvd. Austin, TX 78729	
Signature:		**Date:6/14/2016**

Appendix A

The following table shows the revision history for this guidance document.

Revision History	
Effective Date Month, Year	**Reason for and Description of Change**
4/2014	Version 1 released in May 2014.
8/2014	Version 2 released in August 2014. Removed introductory note describing ISA threshold criteria. Note was removed because the ISA threshold criteria are located in other TxDOT guidance.
12/2014	Version 3 released in December 2014. Modifications to Section 2: Clarified this section to better define what asbestos and lead-in-paint concerns are. Changes were made due to numerous comments from the end-user. An additional note was added to this section. This note directs end-users to ENV-HMM for further assistance related to lead-in-paint issues. Modifications to Section 3: The question concerning Project Excavations in Section 3.1 was modified to match the definition used in *Scoping Procedure for Categorically Excluded TxDOT Projects* for Hazardous Materials found in the NEPA and Project Development Toolkit. Modifications to Section 5: Web links were modified based on changes made by regulatory agency websites. Modifications to 8.2: Clarified the “Yes” answer in 8.2 to remove the need for additional assessments for all identified hazardous materials concerns. The question was modified due to comments by the end-user.

Attachment 1

Photographic Log

![AECOM]

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 1 | **Date:** January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 18 River Liquor store and parking lot

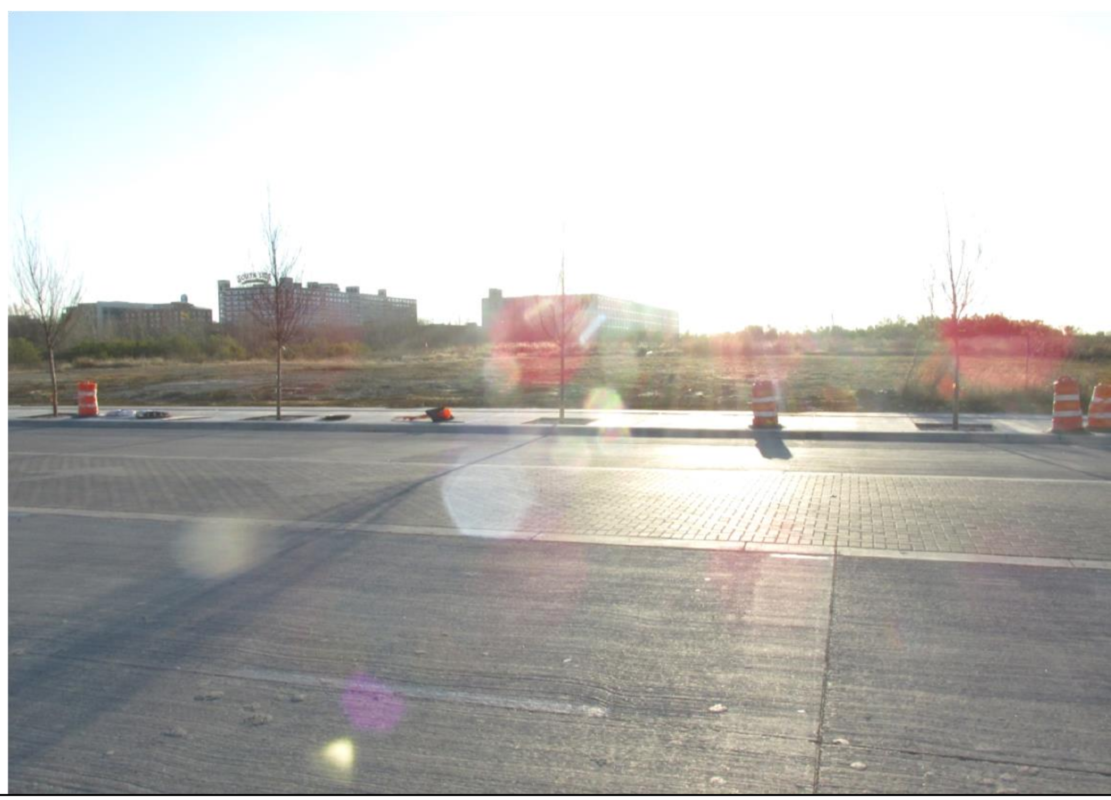
Photo No. 2 | **Date:** January 18, 2016

Direction Photo Taken:

South

Description:

Map ID 20 vacant tract of land formerly Jacks Service station



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 3

Date: January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 19 vacant tract of land, formerly Alford Refrigerated Warehouses

Photo No. 4

Date: January 18, 2016

Direction Photo Taken:

Northeast

Description:

Map ID 21 abandoned building

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 5	**Date:** January 18, 2016
Direction Photo Taken: Northeast	
Description: Map ID 26 vacant property, formerly Refrigerated Transport.	

Photo No. 6	**Date:** January 18, 2016
Direction Photo Taken: North	
Description: Map ID 33 active storage yard for demo equipment.	

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 7

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 36 Quick Stop Liquor store and parking lot

Photo No. 8

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 37 active gas station

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 9

Date: January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 38 active ASTs on property

Photo No. 10

Date: January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 43 active scrap metal yard entrance

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
11	January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 45 entrance gate to active concrete plant

Photo No.	Date:
12	January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 46 active site yard

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
13	January 18, 2016

Direction Photo Taken:

South

Description:

Map ID 48 entrance of active site

Photo No.	Date:
14	January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 49 entrance to active concrete plant

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **15a**

Date: January 18, 2016

Direction Photo Taken:

Southwest

Description:

Map ID 52 active OxyChem facility

Photo No. **15b**

Date: March 15, 2016

Direction Photo Taken:

West

Description:

Map ID 52 active OxyChem facility. Soil staining/discoloration at southeastern side of facility

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **15c**

Date: March 15, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 52 active OxyChem facility. Spill/release at southeastern side of facility

Photo No. **16**

Date: January 18, 2016

Direction Photo Taken:

South

Description:

Map ID 53 fenced-in property from northern edge

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 17

Date: January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 54 entrance to active metals recycling site

Photo No. 18

Date: January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 66 front gate of property

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
19	January 18, 2016

Direction Photo Taken:

Southeast

Description:

Map ID 67 active fueling station

Photo No.	Date:
20	January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 68 entrance to current property.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 21

Date: January 18, 2016

Direction Photo Taken:

East

Description:

Map ID 86 vacant tract of land from west edge.

Photo No. 22

Date: January 18, 2016

Direction Photo Taken:

East

Description:

Map ID 90 vacant lot from west edge

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 23

Date: January 18, 2016

Direction Photo Taken:

Northeast

Description:

Map ID 93 security fence and on-site building

Photo No. 25

Date: January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 95 current residential tract of land

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
27	January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 98 Royal Food and Beverage.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
28a	January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 99 Penneco Bardwell Site.

Photo No.	Date:
28b	May 12, 2016

Direction Photo Taken:

East

Description:

Map ID 99 Penneco Bardwell Site.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 29

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 100 Former Jack Herod Trucking.

Photo No. 30

Date: January 25, 2016

Direction Photo Taken:

East

Description:

Map ID 103 Lone Star Aggregates.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 31

Date: January 25, 2016

Direction Photo Taken:

West

Description:

Possible Location of Map ID 105.

Photo No. 32

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 107 Coopers Farm Country Store.

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 33

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 108 and 118 I-45 Shell Truck Stop and Halliburton Energy Services.

Photo No. 34

Date: January 25, 2016

Direction Photo Taken:

West

Description:

Map ID 110 Professional Wireline Rental Fairfield Facility.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
35	January 25, 2016

Direction Photo Taken:

West

Description:

Map ID 112 Loves Country Store 288.

Photo No.	Date:
36	January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 114 Coles One Stop.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 37	**Date:** January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 120 Jet Travel Plaza.

Photo No. 38	**Date:** January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 121 Dew Truck Stop One.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **39**

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 122 Lucky J's Travel Center.

Photo No. **40**

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 129 Triangle Petroleum.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 41

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 130 Woody's Smokehouse 1.

Photo No. 42

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID's 131 and 132 Exxon RS 63615 and Texan Food Mart.

AECOM

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 43

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map Id 133 Ryder Oil now Alli Oil Co.

Photo No. 44

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map Id 134 Centerville Asphalt Plant.

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 45

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 138 HC Chandler and Son Inc.

Photo No. 46

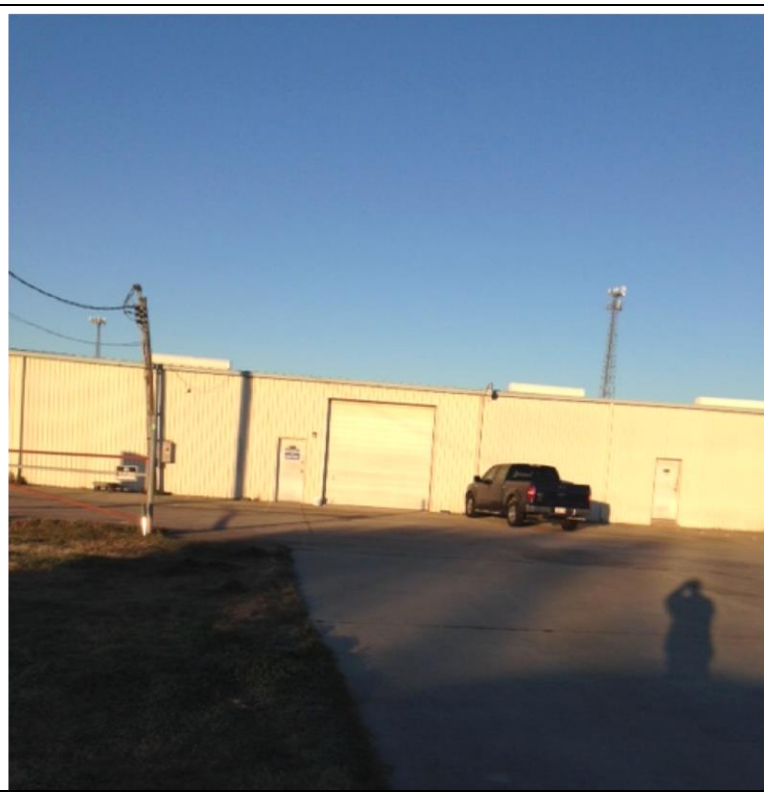
Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 144 APD Holdings III Cypress.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
47	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 145 Timewise Exxon 823.

Photo No.	Date:
48	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 146 Hewlett-Packard Company.

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
49	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 147 Plant 11.

Photo No.	Date:
50	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 152 Wyman Gordon Forgings.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 51

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 158 SPX Flow Control Houston.

Photo No. 52

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 162 West End Lumber.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **53**

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 169 Varn Products now Akzonobel.

Photo No. **54**

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 174 Eldridge Fast Stop Shell and now Lone Star Chevrolet.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 55	**Date:** January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 176 Fabmark now Sparkle Sign.

Photo No. 56	**Date:** January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 178 Jones Road Exxon 69395.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 57

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 181 Concrete Batch Plant Houston 539 and United Rentals.

Photo No. 58

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 184 Guardsman and Cytex Industries now CSE W-Industries.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 59

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 191 Elg Ireland Alloys, Inc. now Versa Tech.

Photo No. 60

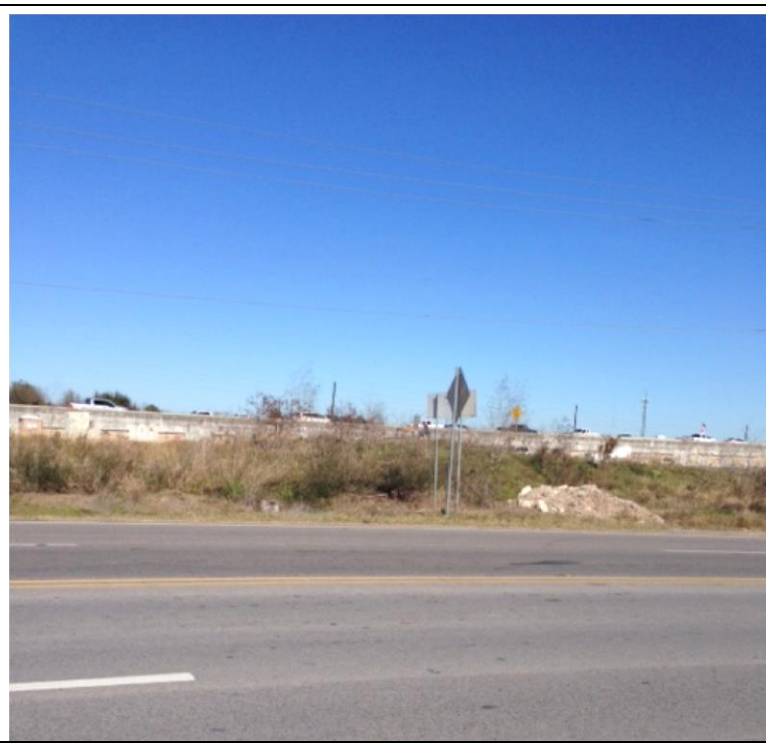
Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 199 Texaco Service Station/Star Enterprise.



AECOM **PHOTOGRAPHIC LOG**

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 61	**Date:** January 28, 2016
Direction Photo Taken: South	
Description: Map ID 202 former Shell station.	

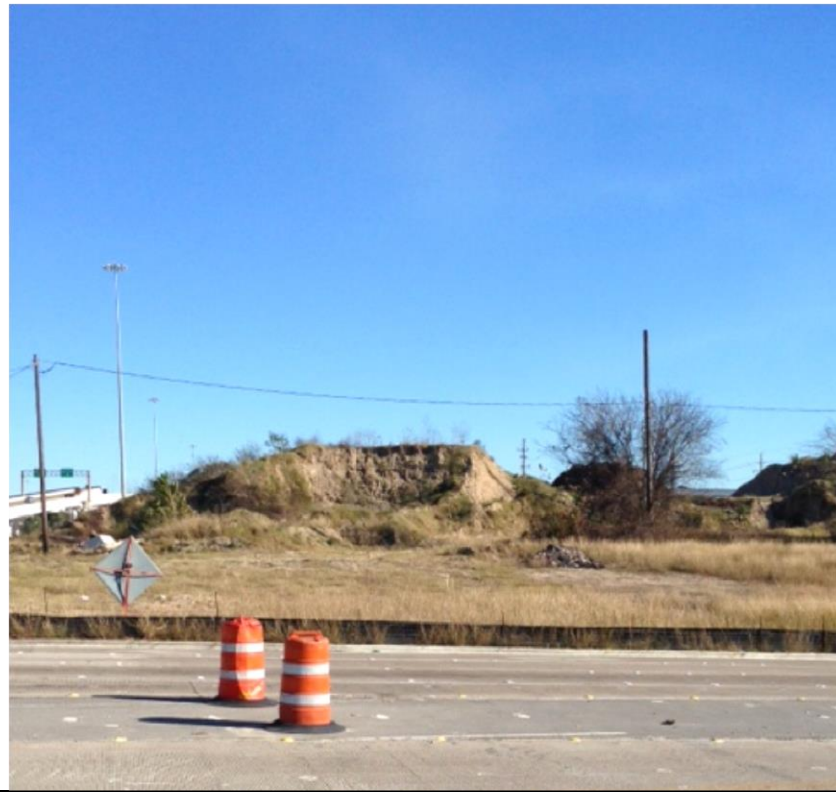


Photo No. 62	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map Id 204 former SPM Houston Mfg.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 63

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 205 Houston 2 US Army Reserve Center.

Photo No. 64

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 210 AMSA 4.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
66	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 215 Gavlon Industries.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
67	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 216 Sunbelt Steel Texas.

Photo No.	Date:
68	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 218 Living Earth Technologies.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
69	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 224 BJ Stringer.

Photo No.	Date:
70	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 235 City of Houston Transfer Station Facility.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 71

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 236 Matthew-Price Industries.

Photo No. 72

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 241 CY Fair Tire.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
73	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 246 Teague Water Maintenance.

Photo No.	Date:
74	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 258 Midwest Paint and Body now Coastal Metal Recycling.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 75

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 263 Los Gas and Diesel LPST 112333 now vacant lot.

Photo No. 76

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 283 Bio Energy Landscape Maintenance.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **77**	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 297 Sandvik Rock Tools Facility.	

Photo No. **78**	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map ID 299 Chamdal Food Mart.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
79	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 319 Rectorseal.

Photo No.	Date:
80	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 332 American Door Products.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
81	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 337 Penske Truck Leasing.

Photo No.	Date:
82	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 391 Southern Pacific Transport.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
83	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 400 Firestone Master Care Center now Northwest Mall.

Photo No.	Date:
84	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 401 Electro Welding.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **85**

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 403 Lunsford Estate Property/V&G.

Photo No. **86**

Date: January 28, 2016

Direction Photo Taken:

North

Description:

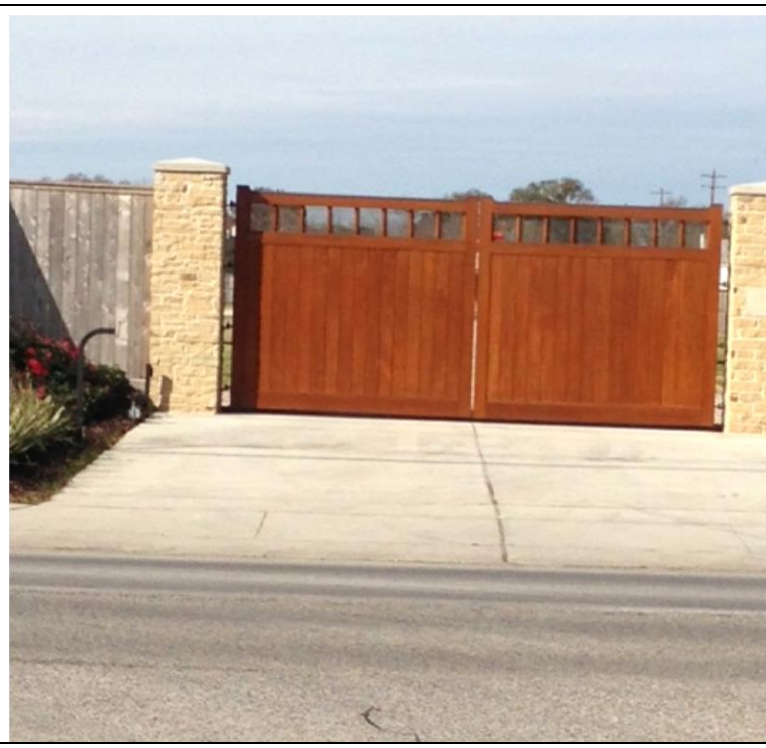
Map ID 405 Tex-Tube.

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 87	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map ID 406 Wheel World.	

Photo No. 88	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map ID 407 South Texas Equipment.	



PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 89

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 408 Bergen Brunswig Drug now Prologis.

Photo No. 90

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 410 Celotex The Houston Plant.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 91

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 412, 413, and 415 Fant Children's Trust Property now New Process Steel.

Photo No. 92

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 414 Amber Booth.

AECOM	PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 93	**Date:** January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 419 and 440 McKinley Paper and Patrick Media Group of Houston.

Photo No. 94	**Date:** January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 423 Zenneca and Former Stauffer Management.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 95

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 428 Hughes MPD.

Photo No. 96

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 430 Southline Metal Products.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 97	**Date:** January 29, 2016
Direction Photo Taken: East	
Description: Map ID 431 Kennametal Firth Sterling.	

Photo No. 98	**Date:** January 29, 2016
Direction Photo Taken: North	
Description: Map ID 432 Kvaener Oilfield Products-Western Plume now North Post Oak Lofts.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 99

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 434 West Loop 6 & 7 now Strip Center.

Photo No. 100

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 439 Malibu Grand Prix.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **101**	**Date:** January 29, 2016

Direction Photo Taken:

East

Description:

Map ID 438 Graebel Houston Movers.

Photo No. **102**	**Date:** January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 437 A Division of Cummins Southern Plains no is feeder road construction with parking lot.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **103**

Date: January 29, 2016

Direction Photo Taken:

West

Description:

Map ID 441 Post Oak Memorial Office Park.

Photo No. **104**

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 444 MTSO now Pitney Bowes Management Services.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
105	January 29, 2016

Direction Photo Taken:

South

Description:

Map ID 443 Malibu Grand Prix now TxDOT concrete batch plant.

Photo No.	Date:
106	January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 447 and 449 Duratherm Inc. /Bird Environmental and Business Park.

AECOM	PHOTOGRAPHIC LOG	
Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 107	**Date:** January 29, 2016
Direction Photo Taken: North	
Description: Map ID 450 Laroche Industries.	

Note:
Photos #24, #26 and #65, that correspond to Map IDs 94, 96 and 214 were removed from the hazardous materials sites list based on revisions to the LOD.

AECOM

TECHNICAL MEMORANDUM

WILDLIFE CROSSINGS

To: Kevin Wright, FRA

From: Jennifer Oakley, AECOM

Date: December 11, 2019

RE: **DALLAS TO HOUSTON HSR – WILDLIFE CROSSINGS**

Linear transportation projects can create movement barriers for many wildlife species, including amphibians, reptiles and small and large mammals, resulting in impacts to individual species and ecosystems. In addition, indirect effects to wildlife species from habitat fragmentation as a result of linear transportation projects can include interrupting migration corridors resulting in potentially lowered reproductive success rates from restricted gene flow. Fragmentation can also divide existing populations into subpopulations, potentially increasing predation on small animals due to lack of cover and general disturbance of wildlife communities.[1]

To mitigate such impacts as a result of the Dallas to Houston High-Speed Rail Project (Project), the preferred alternative (Build Alternative A) would include design features to avoid impacts to wildlife corridors to the maximum extent practicable. Minimization of potential impacts will include the use of viaducts and incorporating wildlife crossings at a frequency to minimize direct and indirect impacts to wildlife. Proposed wildlife crossings will provide permanent structures integrated into the landscape to reduce fragmentation and limit the impacts of wildlife movement barriers. Other mitigation design elements include elevated tracks, underpasses, and specific structures for wildlife crossings which could allow for unimpeded wildlife movement.

This technical memorandum details proposed wildlife crossing design considerations and recommendations for the Project preferred alternative based on currently available scientific literature. Due to the average lifespan of wildlife crossing structures (approximately 70 to 80 years), the proposed locations and design of the crossings takes into consideration the changing dynamics of habitat and climatic conditions and the target species populations over time. Target species include native species with the potential to occur along the preferred alternative, such as white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*) as well as threatened and endangered species. Build Alternative A has been identified in the Draft EIS and the Final EIS as the preferred alternative. As proposed in **Appendix F, TCRR Final Conceptual Engineering Design Report** general considerations for wildlife crossings have been incorporated into the preliminary design, including culverts to provide not only for passage of water, but also for wildlife crossings.[2] Final construction design plans will be further refined based upon

[1] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[2] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report-FCE*," July 1, 2019.

field studies[3] and close coordination with landowners, wildlife agencies and species-specific experts. The final construction design plans will identify optimal wildlife-friendly crossing locations to maintain or enhance crossings, dispersal, and migration opportunities for wildlife across the preferred alternative. TCRR will be responsible for initiating coordination with landowners, wildlife agencies and species-specific experts; ensuring correct construction and placement of all wildlife crossings; post construction monitoring; and maintenance of all wildlife crossings.

General Design Considerations

The potential impacts to wildlife movement would be dependent on the permeability of the preferred alternative (i.e., the presence of elevated or viaduct structures, road crossings or wildlife crossings), the amount of non-urban land within and adjacent to the preferred alternative and identified habitat linkages and corridors within and adjacent to the corridor. A detailed understanding of the wildlife and associated habitats with the potential to occur within the corridor is important to determine specific characteristics of individual wildlife crossing locations and specifications in order to minimize and mitigate impacts to wildlife movements. Corridor-wide considerations focus on the permeability and connectivity of the landscape along the preferred alternative including topography, locations of threatened and/or endangered species, migration corridors, unfragmented areas of wildlife habitat, watersheds and other similar concerns. Frequency and placement of wildlife crossings should support habitat connectivity and be tailored to any target species. Research suggests that the design of a wildlife crossing can be just as important as the crossing location.[4, 5, 6]

A general summary of wildlife crossing design considerations and recommendations based on a review of available literature is provided below. These recommendations would be incorporated into more detailed designs, as appropriate, and as required to mitigate potential impacts identified by the FRA analyses.[7, 8, 9]

- Include key project stakeholders along with researchers and professionals familiar with wildlife and ecology in the Study Area in design development to address local concerns.
- Utilize publicly available data, including National Wetlands Inventory (NWI), National Hydrography Data (NHD), Ecological Mapping Systems of Texas (EMST) and Natural Resources Conservation Service (NRCS) soils data in the determination of optimum placement of wildlife crossings.
- Integrate wildlife crossings into the natural landscape and take advantage of existing wildlife corridors when deciding on the placement of wildlife crossings.
- Ensure that wildlife crossings connect to and from larger regional corridor networks to address habitat fragmentation (division of a particular habitat) and avoid ecological dead-ends (a connection that fails to connect to similar habitat).

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[3] At the time of the Final EIS, field assessments completed by FRA were conducted on property where access was granted, as such the entire LOD was not accessible for field assessment, and approximately 42 percent of Build Alternative A LOD was surveyed by FRA for waters of the U.S.

[4] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report-FCE*," July 1, 2019.

[5] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[6] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[7] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019.

[8] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[9] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

- Incorporate a variety of styles of crossings to ensure opportunities for all species present in the corridor (for example, amphibians need tunnels that are wet and cool, while small mammals need cover in the form of logs, rocks and bushes).
- Place crossings in areas with limited noise and human activity, such as away from cities and towns, to the greatest extent applicable.
- Locate crossings away from highways and other hazard areas to prevent wildlife mortality due to exposure to traffic or other threats, unless studies or expertise from researchers and professionals indicate a high mortality along certain areas necessitating placement of wildlife crossings in such locations.
- Ensure adequate provision and effective design of wildlife crossings to prevent wildlife from crossing adjacent roadways and threatening driver safety after project implementation including areas that the preferred alternative parallel adjacent roadway corridors.
- In areas where the preferred alternative parallels existing roadway corridors, place wildlife crossings in locations with high road mortality, as these areas are considered population sinks and known wildlife corridors.
- Protect both sides of wildlife crossings with long-term conservation easements, particularly at larger crossings.
- Create a straight line of sight within the wildlife crossings to encourage use of the crossings by wildlife species.
- Consider long-term maintenance requirements of passages and fencing to ensure effectiveness of wildlife crossings, especially the bottom of passages in riparian areas and holes in fencing.
- Limit wildlife crossings in highly urbanized areas, namely in the City of Dallas and Houston, due to anticipated low wildlife populations.

General Wildlife

To provide a basis for detailed design of wildlife crossings for the Final EIS stage of the Project, the project team used information gathered during the review of drainage and infrastructure elements to target preliminary locations for wildlife crossings. In addition, areas were identified for further investigation based on proposed embankment length, proximity to water resources, surrounding fragmentation, proximity to viaduct crossings and vegetation type and cover as shown in **Appendix D, Mapbooks, Wildlife Crossing Mapbook**. These preliminary locations were identified and mapped in GIS considering the following basic assumptions: [10]

- Viaduct sections would allow "free movement" and not require wildlife crossings.
- Embankment sections, stations and large maintenance facilities would "constrict movement" and require wildlife crossings.
- Wildlife crossings would be moved, as appropriate, to take advantage of proposed drainage design features (i.e. culverts).
- Wildlife crossings would be placed regardless of frequency to accommodate special situations (i.e. fenced stations or maintenance facilities and large road crossings).
- Wildlife crossings in highly urbanized areas, namely in the City of Dallas and Houston, would be limited due to anticipated low wildlife populations.

[10] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019

In order for a crossing to be effective for a target species, it would be critical to determine the minimum structure size necessary through environmental analysis. Recommendations for sizing and specifications of wildlife crossings based on current available literature include:[11, 12, 13]

- Wildlife crossings designed to accommodate small to large wildlife should utilize microhabitat complexity and escape cover (e.g. logs, rock piles) to encourage use by the smaller wildlife. In addition, to encourage use by smaller wildlife, incorporating tunnel sub compartments within the larger wildlife crossings should be considered.
- To encourage use of all wildlife crossings by amphibians and reptiles, natural ponds and riparian habitats should be incorporated into the crossing design. In addition, crossings should maintain existing riparian vegetation, soil moisture and natural light at crossings, where applicable.
- If a closed bottom (i.e. concrete floor) is incorporated into a wildlife crossing, it is recommended that a soil substrate of at least six inches be applied to the interior of the crossing.
- For wildlife crossings designed for small- to medium-sized wildlife, ensure that sufficient cover and protection is incorporated into the crossing design. These crossings should be placed in known routes of seasonal migration, dispersal or other movement events for target amphibians and reptiles to encourage use by these species.
- The recommended dimension of a wildlife crossing underpass for small to large mammals is 32 feet wide and greater than 13 feet high, with a minimum recommendation of 10 feet wide and 12 feet high.
- The minimum recommended dimension of a wildlife crossing underpass incorporated into large creek culvert crossings is greater than 10 feet wide and greater than 13 feet high, with a minimum of 6.5 feet wide and 10 feet high. This size could be used for small to large mammals as well as amphibians and reptiles. For smaller modified culverts, the recommended dimension for small- to medium-sized mammals and amphibians and reptiles is greater than three feet wide and greater than four feet high with a minimum of 1.5 feet wide and greater than three feet high.
- For wildlife crossings designed for small to medium-sized mammals, the recommended size is one to four feet wide and one to four feet high or a diameter of one to four feet.
- For areas constrained by engineering design requirements, wildlife crossings would be reduced in height to six feet (medium animal) or two to four feet (small animal).
- Amphibian and reptile tunnel dimensions would vary depending on target species. The recommended size range for tunnels is one to three feet in diameter.
- Tunnels installed for the passage of amphibians and reptiles should be placed between upland habitat and wetland breeding grounds, or between isolated wetlands. The tunnels should be placed to allow for migration of adults to travel from breeding grounds, migration of adults returning to upland habitat, and the emigration of metamorphs from breeding ponds.

Riparian and Flooding Areas

Wildlife corridors are generally associated with riparian habitats; therefore, wildlife crossings placed in riparian areas can be desirable for the free movement of wildlife. If the riparian habitat would be retained or cover would be provided along the walls of underpasses, small and medium-sized wildlife

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[11] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[12] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[13] Roads & Ecological Infrastructure: Concepts and Applications for Small Animals, Edited by Kimberly M. Andrews, Priya Nanjappa, and Seth P. D. Riley, The Wildlife Society, 2015, Chapter 6: The Current Planning and Design Process

are more likely to utilize wildlife crossings placed in these areas. In addition, these types of crossings can be easily adapted for amphibians and reptiles.[14] Of the current 160 proposed wildlife crossings, 102 would be placed in association or in conjunction with creek crossings within the Study Area. These creek corridors are often the only sufficiently vegetated areas in otherwise predominantly agricultural or developed areas. They frequently serve as wildlife travel corridors and as foraging and resting habitat for wildlife.

Where the Project track configuration would be on an embankment, creeks would be carried through culverts. These culverts would be designed to accommodate the 100-year flood with three feet of freeboard. Culverts would be used by some species during dry periods to cross the alignment, but during heavy rain events these crossings may be flooded. However, additional culvert design features should be considered to allow safe passage for wildlife at these crossings during flood events. In areas where culvert placement or structure does not allow for these additional design features, the design team would review the need for additional crossings at higher elevations.

Build Alternative A has been identified in the Draft EIS and the Final EIS as the preferred alternative for preliminary design. As detailed design progresses, the considerations and recommendations below would be as appropriate.[15, 16, 17]

- Culverts for wildlife crossings should be placed near those used to convey stormwater, but at an elevation above the design flood elevation. Travel routes to these wildlife crossing culverts would also need to be above the 100-year flood elevations and should have appropriate cover.
- Wildlife crossings incorporated into culvert design should include minimal clearing widths to reduce impacts on existing vegetation. Where practicable, open designs should be considered to provide ample natural lighting to allow for natural vegetative growth.
- Wildlife crossings incorporated into culvert design should consider specifications to accommodate amphibians and reptiles as well as small to large mammals.
- Even in riparian zones, culverts should be built with dry ledges for use by water-shy wildlife, and ledges should be located above the design flood elevation.
- Where wildlife crossings are incorporated into creek culverts, specific size specifications for each crossing should be based on the results of the environmental analyses, as well as coordination with local land owners, trained biologists, and wildlife agencies (minimum size recommendations are provided above in **General Wildlife**).
- Avoid importation of soils from outside the Study Area.
- Escape cover should be provided for small to medium wildlife to avoid predation and encourage use.
- Box culverts have been found effective in both riparian and upland situations, especially when used in conjunction with fencing to guide (or "funnel") animals into the culvert and should be used when practicable.
- Selection of the substrate in the floor of the culvert has been demonstrated to be important and should be the same or similar to the substrate in the surrounding habitat.
- Long-term monitoring and maintenance of the culverts should be considered to maintain effectiveness, especially following precipitation events.

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[14] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[15] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019

[16] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[17] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

- Boulders, riprap, or other coarse materials should not be used to maintain the aprons on culverts used for passage by small-bodied animals since rough materials may be difficult to navigate for small and hoofed wildlife unless a smooth pathway is provided.

Frequency of Wildlife Crossings

Factors that influence landscape connectivity (the degree to which the landscape facilitates or impedes wildlife movement and ecological flows) include terrain, habitat type, levels of human activity and climate. Therefore, in order to determine optimum frequency, spacing and placement of wildlife crossings along the preferred alternative, considerations include the variability of landscape, population densities, species movement data, biology for target species and the juxtaposition of wildlife habitat, including critical habitat that intersects the limits of disturbance (LOD) and the connectivity requirements for the target species. In general, landscapes that are highly fragmented with little natural habitat would require fewer wildlife crossings as compared to relatively intact, less fragmented landscapes.[18] In addition, habitat suitability models would be created for target species including previously mentioned factors as well as land cover, elevation, topographic position, slope, aspect, proximity to water resources and soil characteristics. Habitat utilization is influenced by, but not limited to, food resource availability, mating and nesting sites, avoidance of predators, and hazards and competition with other species.[19]

The design team coordinated with the environmental analysis team to develop impact mitigation standards, which would prescribe a minimum crossing density (crossings/mile) based on the biology of the target species (large vs. small vs. amphibian/reptilian), habitat fragmentation (highly fragmented vs. largely intact), habitat types, and construction type (i.e. viaduct vs. embankment). Individual wildlife crossing needs identified for any target species found within the corridor that are federally listed as threatened or endangered, and considered the species' home range and habitat suitability models.[20, 21]

Additional recommendations and considerations for frequency and spacing of wildlife crossings based on current available literature include determining land use within and adjacent to the LOD based on aerial photography and EMST data to identify areas considered urban vs. non-urban.[22, 23, 24]

The final number, types and spacing of wildlife crossings would be based upon the results of the environmental analyses, coordination with wildlife agencies and local subject matter experts once as final design is conducted.

Land Use and Ownership

Land use and property ownership would be considered when determining the placement and design of wildlife crossings. Communication and coordination with land owners would aid in identifying potential

[18] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[19] Corridor Design. "Conceptual steps for designing wildlife corridors." http://corridordesign.org/designing_corridors. 2013. Accessed July 28, 2016

[20] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019

[21] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[22] Ibid.

[23] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[24] Jochimsen, Denim M.; Peterson, Charles R.; Andrews, Kimberly M.; and Gibbons, J. Whitfield. A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize those Effects. Idaho Fish and Game Department, 2004.

issues related to unwanted wildlife movement onto or off of their property. As appropriate to mitigate impacts, existing rural fences that would allow wildlife species to pass through would be improved.[25]

During design, wildlife crossings would generally be placed on larger tracts of land with suitable habitat where ingress and egress are confined to the same property. If ingress and egress to the wildlife crossing are located on separate properties, special arrangements such as conservation easements would likely be necessary and coordinated with individual landowners.[26]

Project-Specific Considerations

Embankment Sections

Wildlife crossings would be integrated along embankment sections at sufficient intervals along the preferred alternative in order to facilitate wildlife movement and prevent wildlife movement barriers. These crossings would typically be integrated with culvert crossings for drainage, employing wildlife-friendly designs such as catwalk sections [27], and could be used by some species during dry periods to cross the preferred alternative. Additional information regarding these types of crossings is provided above in the **Riparian and Flooding Areas** section. Based on the number and frequency of culvert crossings and proximity to viaduct sections reported in **Appendix G, TCRR Final Conceptual Engineering Plans and Details**, it is recommended that a minimum of 160 wildlife crossings be constructed along the approximately 129 miles of embankment sections as shown in **Appendix D, Mapbooks, Wildlife Crossing Mapbook**. Approximately 39 miles of embankment were identified for further investigation based on embankment length, proximity to water resources, amount or lack of habitat fragmentation, distance to viaduct crossings and vegetation cover (woodland, grassland and agricultural) as shown in **Appendix D, Mapbooks, Wildlife Crossing Mapbook**. For the total number of proposed wildlife crossings and the miles identified for further investigation by segment, refer to **Table 1**. Additional typical details for culverts and wildlife crossings have been included in **Appendix G, TCRR Final Conceptual Engineering Plans and Details**.

Table 1: Comparison by Segment

Segments	Miles on Embankment	# of Potential Minimum Wildlife Crossings	Miles for Further Investigation
Segment 1	3.7	3	0
Segment 2A	9.9	4	3.3
Segment 2B	5.8	0	1.9
Segment 3A	11.0	12	10.2
Segment 3B	11.1	15	1.6
Segment 3C	35.3	22	11.7
Segment 4	35.9	61	5.0
Segment 5	20.6	43	5.0

Source: TCRR, 2019 and AECOM, 2019

The location, frequency, size and monitoring of wildlife crossings shall be incorporated into final Project design and determined in coordination with the Texas Parks and Wildlife Department (TPWD), United States Fish and Wildlife Service (USFWS) and landowners; through field investigations by trained biologists; and largely based on species' biology, such as home range size, and habitat.

[25] Ibid.
[26] Ibid.
[27] Andrews, K.M., P. Nanjappa, and S.P.D. Riley. Roads and Ecological Infrastructure. Johns Hopkins Press. Baltimore, Maryland. 2015.

Viaduct Sections

Approximately 55 percent of the HSR line would be constructed on an elevated viaduct with overhead catenary. Corridor segments with viaducts would not require special considerations other than the placement of security fences or other barriers at transitional locations from to viaduct from embankment, to prevent access by wildlife to the track constructed on viaduct. It is anticipated that fences or other barriers would not be constructed within the areas below viaduct.

Viaducts are generally used where the track configuration would be located more than 20 feet (6.1 meters) above the surrounding grade. In addition, viaducts would be used to cross floodplains and large water resources, minimizing fill in those areas. Viaducts would be placed to minimize disturbance to habitats, vegetation and riparian areas, and designed wide enough to conserve riparian habitats and maintain local landform. Based on the current conceptual design, approximately 55 percent of the preferred alternative would be constructed on viaduct. For the total number of miles per segment and miles on viaduct per segment, refer to **Table 2**.

Table 2: Miles on Viaduct by Segment

Segments	Total Miles per Segment	Miles on Viaduct
Segment 1	18.3	14.0
Segment 2A	23.4	11.8
Segment 2B	23.2	15.6
Segment 3A	30.8	16.0
Segment 3B	31.1	15.9
Segment 3C	113.1	66.2
Segment 4	77.9	33.9
Segment 5	84.2	52.8

Source: TCRR, 2019 and AECOM, 2019

The viaducts would be constructed between approximately 4 and 80 feet from natural ground to the lowest elevation of the viaduct beam. The placement of viaducts along the preferred alternative provides unimpeded wildlife movement in floodplains and riparian areas where there would be significant wildlife habitat as well as other wildlife movement corridors.

Fencing

In order to further reduce the risk of wildlife collisions and ensure the safe operation of the HSR system, fencing would be used to divert or funnel wildlife into the wildlife crossings. Fencing for the entire Build Alternative and for all crossings would be securely designed and tamper-proof so that animals could not burrow, chew, climb or otherwise access the HSR line.[28] Standard fencing would consist of various sizes of page wire or similar material fencing at minimum of 12 feet high for large mammals and six feet high for small mammals. Fencing would be reinforced with dense, high-resistant wire mesh as applicable. Given propensity of the feral pig for cursorial (digging/rooting) behavior, protection of the HSR line from these animals would be a key consideration. High-strength buried fencing, or electrified fencing, would be required in areas with established pig populations and where the grade separation of the tracks and the natural ground is minimal. Typical details in the conceptual design for potential fencing types that could be employed at different locations along the preferred alternative is included in **Appendix G, TCRR Final Conceptual Engineering Plans and Details.** In addition, long-term monitoring and maintenance of fencing should be considered to maintain integrity and effectiveness following installation.

[28] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019

Wildlife Overpasses

Wildlife overpasses are typically employed along roadways to reduce traffic mortality for wildlife, provide safe passage for large-bodied mammals and improve roadway safety. However, given that the majority of the HSR line would be constructed on an embankment or on an elevated viaduct with overhead catenary, the use of overpasses is prohibitive except in select locations where the HSR is constructed using retained cut methods and is below existing grade (See **Figure 2-4** in **Section 2.2.1, Alternatives Considered, Technology** of the Final EIS).

The following are considerations and recommendations related to overpasses for wildlife crossings:[29, 30]

- Typically the highest cost option, wildlife overpasses are typically used over multi-lane roadways, roadways with high-density and fast-driving traffic, high-speed railway line in areas where wildlife/vehicle collisions are relatively frequent and result in severe injuries or fatalities, or when special status species or ungulates (e.g. white-tailed deer) and small to large mammals (e.g. bobcat and rabbits) are involved.
- The placement of wildlife overpasses should be oriented and sized to the occurrence and behavior of the target species. The overpass should be wide enough at its narrowest point to function as a habitat corridor. In general, the minimum width recommendation for wildlife overpasses is 130 to 165 feet.
- In general, larger wildlife requires wider overpasses than smaller wildlife. In addition, smaller wildlife tend to rely on special habitat features, such as vegetation for cover.
- To ensure performance and function, wildlife overpasses should be situated in areas with high landscape permeability, are known wildlife travel corridors, and have minimal human disturbance.
- Fencing and vegetation can be used to direct animals to the wildlife overpass.
- Substrate and vegetation on the wildlife overpass should match that of surrounding landscapes and provide cover and refuge for small to medium wildlife.
- Soil depth should be sufficient for water retention for plant growth and support trees, if applicable, while providing adequate drainage.
- Wildlife overpasses can be effectively used to maintain habitat connectivity, especially when used in conjunction with vegetation and fencing to guide animals to over-crossing. Overpasses themselves may serve as intermediate habitat for smaller-sized organisms.
- Vegetation is often used to provide a sight and sound barrier at edges of wildlife overpasses to encourage use by disturbance-shy animals.
- Long-term monitoring and maintenance of the structure and drainage system should be considered to maintain effectiveness and safety of the wildlife overpass.

Species-Specific Crossings

The effectiveness of the type of wildlife crossings utilized along the preferred alternative would differ based on the target species. A list of wildlife species with the potential to occur in the Study Area is provided in **Section 3.6, Natural Ecological Systems and Protected Species** in the Final EIS. For the purposes of identifying minimum recommended wildlife crossing width and heights, the target species are combined in to general groups consisting of large mammals (e.g. white-tailed deer), medium-sized

[29] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[30] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

mammals (e.g. bobcat, coyote [*Canis latrans*] and raccoon [*Procyon lotor*]), small mammals (e.g. ground squirrels and mice), and amphibians and reptiles (e.g. frogs, toads, snakes and lizards). As a general rule, wildlife crossings should be designed to allow for the movement of the greatest diversity of species.

As no standard design document is available for Texas-specific species, the project team would consult guidelines, successful designs, and Best Management Practices (BMPs) for wildlife crossings in other geographic areas, such as those by the California Department of Transportation (Caltrans) and the Arizona Game and Fish Department (AZGFD) as identified in **Appendix F, TCRR Final Conceptual Engineering Design Report**, and the Federal Highway Administration (FHWA) and European Commission. Guidance from these and similar sources would be adapted to create successful design approaches for species specific to the Study Area during final design.

Design Development Approach for Wildlife Crossings

The level of detail developed for the design and placement of wildlife crossings would increase through the planning and design process. Examples of typical details and proposed approaches to mitigation of impacts have been provided with the **Appendix G, TCRR Final Conceptual Engineering Plans and Details** to support the Final EIS. Location-specific treatments and more advanced typical details would be provided in support of the Final EIS following input from the FRA, USFWS and TPWD.

In addition to the literature review, engineers and biologists from the project team have initiated planning-level design development to identify opportunities for wildlife crossings along the preferred alternative. The planning level efforts completed to date in preparation of the Final Conceptual Engineering include:[31]

- Drainage Design – Identified existing creek corridors along the preferred alternative and bridge underpasses or culvert crossings required to meet drainage needs.
- Infrastructure Type Selection – Selected the proposed infrastructure type, namely embankment versus viaduct section; selection largely driven by track configuration and constructability considerations but identified opportunities for wildlife crossing locations.
- Species List for Wildlife Crossings along the Preferred Alternative (identified as Build Alternative A in the Draft and Final EIS) – Developed a list of species within the Study Area that would require some type of crossing to prevent interruptions to normal migrations patterns or require special considerations due to their protected status (i.e., threatened or endangered).
- Maps of Wildlife Crossing Areas – Performed a desktop analysis to identify the following:
    - Viaduct areas = free wildlife crossing, no special considerations
    - Highly urbanized areas where wildlife crossings would be low priority
    - Crossing locations along embankment sections at a specified interval (for purposes of this exercise, spacing would follow recommendations for white tailed deer)
- Typical Sections for Wildlife Crossings and Fencing – Identified typical wildlife crossing and fencing details that could be modified for the preferred alternative to meet the requirements of target species (i.e. white-tailed deer) and HSR safety needs.

[31] TCRR, "*Texas Central Partners Texas High Speed Rail Final Conceptual Engineering Report- FCE*," July 1, 2019

Considerations and recommendations that should be incorporated into future design along with the planning level efforts mentioned above include the following:[32, 33]

- While highly urbanized areas were considered low priority during the initial planning level efforts, it is recommended that areas along roadway corridors, including IH-45, consider placing wildlife crossings in locations with high road mortality and known wildlife corridors while avoiding funneling wildlife toward the roadways.
- Preliminary wildlife crossings were based on a frequency of every one-half mile. While this spacing is adequate for general wildlife crossings to allow for safe passage of small to large wildlife species, tunnels should be placed every 100 feet to allow for the safe passage of amphibians and reptiles and increase acceptance of the tunnels.
- All bridges and culverts along existing roadways should be mapped and cataloged to assist in optimal placement of wildlife crossings.

The project team used GIS, design plans and aerial photography to analyze existing creek corridors along the preferred alternative and bridge underpasses, or culvert crossings required to meet drainage needs. This information was compared to the proposed infrastructure type to identify and compare those locations where wildlife migration across the preferred alternative would be impacted by design. In general, the project team considered viaduct sections with bridge overpasses to be areas of "free movement" for wildlife, where all species within the corridor would be able to easily navigate the corridor without special crossing considerations.

During final design, mitigation measures incorporated in the Final EIS would continue to be defined, including site-specific crossing treatments. The level of detail required would be refined through coordination with regulatory bodies during the final design, but it is expected that the following actions could be incorporated:[34]

- Field Survey – The Study Area would be surveyed by qualified biologists to determine habitat suitability of crossings proposed in the planning-level design
  - Additional studies in areas identified for further investigation as shown in **Appendix D, Mapbooks, Wildlife Crossing Mapbook**, would be conducted to determine the need and placement of additional crossings. Approximately 39 miles of the embankment sections were identified for further investigation. For the total number of proposed wildlife crossings and the miles identified for further investigation by segment refer to **Table 1**.
  - In addition, areas identified as listed species habitat would require further investigation to determine the need for additional crossings in those areas
- Develop Site-Specific Crossing Treatments – Document requirements for wildlife treatments (fencing and crossings) based on site-specific habitats and target species. Identify treatments proposed at each location along the preferred alternative.
- Property Impacts – Identify any additional right-of-way (ROW) requirements associated with provision of wildlife crossings, such as the purchase of conservation easements in the vicinity of wildlife crossings. Wildlife crossing designs would consider property ownership on either side of the crossing to minimize the need for special arrangements and conservation easements.

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[32] Jochimsen, Denim M.; Peterson, Charles R.; Andrews, Kimberly M.; and Gibbons, J. Whitfield. A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize those Effects. Idaho Fish and Game Department, 2004.

[33] Roads & Ecological Infrastructure: Concepts and Applications for Small Animals, Edited by Kimberly M. Andrews, Priya Nanjappa, and Seth P. D. Riley, The Wildlife Society, 2015, Chapter 6: The Current Planning and Design Process

[34] Roads & Ecological Infrastructure: Concepts and Applications for Small Animals, Edited by Kimberly M. Andrews, Priya Nanjappa, and Seth P. D. Riley, The Wildlife Society, 2015, Chapter 6: The Current Planning and Design Process.

- Engage Local Subject Matter Experts – The location and design of wildlife crossings would be informed by local subject matters experts and resource agencies during design as appropriate.

Conclusion and Limitations

This technical memorandum identifies proposed wildlife crossing areas requiring further investigation, considerations, and recommendations for frequency and dimensions for wildlife crossings. The following includes limitations of this technical memorandum:

- The information presented is broad and meant to provide considerations and recommendations for the largest diversity of species possible.
- The considerations and recommendations are based on current literature and not based on agency or landowner coordination or field analysis which is essential when determining optimum placement, type, and frequency of wildlife crossings.
- Specific locations of potential existing wildlife crossings incorporated into existing roadways was not known when determining potential placement of wildlife crossings and areas for further investigation along the Study Area. Therefore, coordination with transportation agencies to determine exact locations of existing wildlife crossings, if any, should be conducted.
- Home ranges and habitat suitability models for target species is not included in publicly available data and was not mapped by the project team at the time that this technical memorandum was prepared.
- Crossings associated with NHD and NWI data relies upon accuracy of those publicly available databases and should be field verified.

The minimum potential wildlife crossings presented in the technical memorandum is subject to change based on further environmental analysis and coordination.

TECHNICAL MEMORANDUM
WATERS OF THE U.S.

To: Kevin Wright, FRA

From: Jennifer Oakley, AECOM

Date: May 23, 2019

RE: Dallas to Houston HSR – Waters of the U.S.

This technical memorandum identifies the streams, wetlands and waterbodies that occur within the Dallas to Houston HSR Study Area. The tables provided in this memorandum include streams, wetlands and waterbodies based on the U.S. Geological Survey's National Hydrography Dataset (NHD), U.S. Fish and Wildlife Services' National Wetland Inventory (NWI) and field collected data (as of June 1, 2018), construction type (access road, rail, stormwater drainage, facility, station and temporary fill), crossing type (fill, excavation, viaduct, culvert, overhead and conversion) and acres of estimated impacts at each crossing. For additional information on waters of the U.S. and descriptions of the crossing types, refer to **Section 3.7, Waters of the U.S**. of the Final EIS.

Dallas County

Table 1: Estimated Stream Impacts – Dallas County						
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					linear feet	
1	Unnamed	Perennial	Viaduct	Access Road	5.5	0.00
1	Unnamed	Perennial	Viaduct	Access Road	134.8	0.00
1	NCB2S7	Intermittent	Overhead	Overhead Utilities	25.1	0.00
2	NCB2S1	Perennial	Viaduct	Rail	189.0	0.00
2	Trinity River	Artificial Path	Viaduct	Rail	110.7	0.00
2	NCB2S1	Perennial	Excavation	Stormwater Drainage	0.00	55.0
3	NCB2S202	Intermittent	Overhead	Overhead Utilities	174.1	0.00
3	NCB2S3	Perennial	Overhead	Overhead Utilities	225.1	0.00
3	NCB2S8	Intermittent	Viaduct	Rail	452.3	0.00
4	Unnamed	Perennial	Overhead	Overhead Utilities	269.8	0.00
4	Unnamed	Perennial	Overhead	Overhead Utilities	27.7	0.00
4	NCC2S1	Intermittent	Overhead	Overhead Utilities	607.2	0.00
4	NCC2S4	Ephemeral	Overhead	Overhead Utilities	130.0	0.00
4	Honey Springs Branch	Intermittent	Viaduct	Rail	142.0	0.00
4	NCC2S1	Intermittent	Viaduct	Rail	134.3	0.00
5	Unnamed	Artificial Path	Fill	Maintenance Facility	0.00	126.8
5	Unnamed	Perennial	Overhead	Overhead Utilities	125.3	0.00
5	Unnamed	Artificial Path	Overhead	Overhead Utilities	84.2	0.00
5	NCC3S1	Perennial	Overhead	Overhead Utilities	291.1	0.00
5	NCC3S8	Ephemeral	Overhead	Overhead Utilities	169.3	0.00
5	NCC3S1	Perennial	Viaduct	Rail	384.4	0.00
5	NCC3S5	Ephemeral	Viaduct	Rail	10.1	0.00
5	NCC3S7	Perennial	Viaduct	Rail	155.7	0.00
6	NCC3S3	Perennial	Viaduct	Rail	460.8	0.00
6	Newton Creek	Perennial	Viaduct	Rail	132.8	0.00
6	Whites Branch	Perennial	Viaduct	Rail	118.9	0.00
10	NCE3S12	Perennial	Overhead	Overhead Utilities	346.7	0.00
10	Tenmile Creek	Perennial	Overhead	Overhead Utilities	177.7	0.00
10	NCE3S12	Perennial	Viaduct	Rail	146.7	0.00
10	NCE3S14	Ephemeral	Viaduct	Rail	118.9	0.00
11	Unnamed	Intermittent	Overhead	Overhead Utilities	777.8	0.00
11	Unnamed	Intermittent	Culvert	Rail	50.2	0.00
11	NCE3S10	Intermittent	Culvert	Rail	154.8	0.00
11	NCE3S15	Intermittent	Culvert	Rail	85.2	0.00

Table 1: Estimated Stream Impacts – Dallas County						
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					linear feet	
11	NCE3S13	Ephemeral	Viaduct	Rail	168.1	0.00
11	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	46.4
11	NCE3S10	Intermittent	Excavation	Stormwater Drainage	0.00	34.5
				Total	**6,586.1**	**262.8**

Source: USGS, 2018; FNI, 2018
*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 2: Estimated Wetland Impacts – Dallas County						
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					acres	
1	NCB2EW99	Emergent	Overhead Utilities	Overhead	0.17	0.00
1	NCB2FW4	Forested	Overhead Utilities	Overhead	0.22	0.00
2	NCB2FW6	Forested	Rail	Conversion	0.00	0.01
2	NCB2FW6	Forested	Rail	Conversion	0.00	0.03
2	NCB2FW1	Forested	Rail	Conversion	0.00	0.08
2	NCB2FW6	Forested	Rail	Conversion	0.00	0.11
2	PFO1A	Forested	Rail	Conversion	0.00	0.13
2	NCB2SW1	Scrub/Shrub	Rail	Conversion	0.00	0.55
2	NCB2FW1	Forested	Rail	Conversion	0.00	4.2
2	NCB2FW1	Forested	Stormwater Drainage	Excavation	0.00	<0.01
2	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	<0.01
2	NCB2FW6	Forested	Stormwater Drainage	Excavation	0.00	0.03
2	NCB2EW2	Emergent	Stormwater Drainage	Excavation	0.00	0.03
2	NCB2FW6	Forested	Stormwater Drainage	Excavation	0.00	0.05
2	NCB2FW1	Forested	Stormwater Drainage	Excavation	0.00	0.05
2	NCB2EW200	Emergent	Stormwater Drainage	Excavation	0.00	0.08
2	NCB2EW2	Emergent	Rail	Viaduct	<0.01	0.00
2	NCB2EW2	Emergent	Rail	Viaduct	0.65	0.00
2	NCB2EW200	Emergent	Rail	Viaduct	1.0	0.00
3	NCB2FW2	Forested	Rail	Conversion	0.00	0.41
3	NCB2EW5	Emergent	Stormwater Drainage	Excavation	0.00	1.1
3	PFO1A	Forested	Overhead Utilities	Overhead	0.20	0.00
3	NCB2FW7	Forested	Overhead Utilities	Overhead	0.35	0.00
3	NCB2EW10	Emergent	Overhead Utilities	Overhead	1.7	0.00
3	NCB2FW8	Forested	Overhead Utilities	Overhead	2.0	0.00

Table 2: Estimated Wetland Impacts – Dallas County						
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 1**	
					Temp	**Perm**
					acres	
3	NCB2EW5	Emergent	Rail	Viaduct	1.2	0.00
3	NCB2EW5	Emergent	Rail	Viaduct	1.5	0.00
4	PFO1A	Forested	Overhead Utilities	Overhead	0.03	0.00
4	PSS1/EM1A	Scrub/Shrub	Overhead Utilities	Overhead	0.85	0.00
5	NCC3FW8	Forested	Rail	Conversion	0.00	0.04
5	NCC3SW4	Scrub/Shrub	Rail	Conversion	0.00	0.06
5	NCC3FW1	Forested	Rail	Conversion	0.00	0.14
5	NCC3FW99	Forested	Rail	Conversion	0.00	0.88
5	NCC3FW99	Forested	Utilities	Excavation	0.15	0.00
5	NCC3FW1	Forested	Maintenance Facility	Fill	0.00	0.06
5	NCC3SW3	Scrub/Shrub	Maintenance Facility	Fill	0.00	0.17
5	NCC3FW1	Forested	Maintenance Facility	Fill	0.00	0.61
5	NCC3SW4	Scrub/Shrub	Overhead Utilities	Overhead	0.01	0.00
5	NCC3FW8	Forested	Overhead Utilities	Overhead	0.03	0.00
5	NCC3SW3	Scrub/Shrub	Overhead Utilities	Overhead	0.09	0.00
6	NCC3FW98	Forested	Rail	Conversion	0.00	0.07
6	PFO1A	Forested	Rail	Conversion	0.00	0.60
7	PFO1C	Forested	Access Road	Fill	0.00	<0.01
10	PFO1C	Forested	Rail	Conversion	0.00	<0.01
10	PFO1A	Forested	Rail	Conversion	0.00	0.35
10	PFO1C	Forested	Overhead Utilities	Overhead	0.14	0.00
10	PFO1A	Forested	Overhead Utilities	Overhead	0.24	0.00
				Total	**10.6**	**9.8**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM – Emergent
SS1 - Broad-leaved Deciduous Scrub-Shrub
FO1 – Broad-leaved Deciduous Forested
EM1 - Persistent Emergent
A - Temporarily Flooded
C - Seasonally Flooded

Table 3: Estimated Waterbody Impacts – Dallas County						
Natural Resources Mapbook Page #	**Waterbody ID/ Name ***	**Waterbody Type**	**Construction Type**	**Crossing Type**	**Segment 1**	
					Temp	**Perm**
					acres	
1	NCB2PD99	Pond	Overhead Utilities	Overhead	0.08	0.00
1	NCB2PD11	Pond	Rail	Viaduct	0.00	0.00
2	NCB2PD6	Pond	Rail	Viaduct	0.06	0.00
2	NCB2PD5	Pond	Rail	Viaduct	0.16	0.00
2	NCB2PD5	Pond	Rail	Viaduct	0.16	0.00
2	NCB2PD5	Pond	Stormwater Drainage	Excavation	0.00	0.05
2	NCB2PD5	Pond	Stormwater Drainage	Excavation	0.00	0.08
3	NCB2PD18	Pond	Overhead Utilities	Overhead	0.01	0.00
3	NCB2PD8	Pond	Rail	Viaduct	0.01	0.00
3	NCB2PD8	Pond	Rail	Viaduct	1.82	0.00
3	NCB2PD8	Pond	Stormwater Drainage	Excavation	0.00	0.06
3	NCB2PD8	Pond	Stormwater Drainage	Excavation	0.00	0.18
3	NCB2PD8	Pond	Temporary Fill	Fill	<0.01	0.00
7	Unnamed	Pond	Rail	Fill	0.00	0.10
8	Mooreland Lake	Lake	Rail	Viaduct	2.11	0.00
9	Unnamed	Pond	Rail	Viaduct	0.13	0.00
11	Unnamed	Pond	Overhead Utilities	Overhead	0.02	0.00
11	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.03
				Total	**4.6**	**0.49**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Ellis County

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
12	Long Branch	Perennial	Viaduct	Rail	118.0	0	--	--	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	299.0	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	379.4	--	--	--	--	--	--	--	--
13	Unnamed	Artificial Path	Excavation	Access Road	--	--	--	--	0.00	299.0	--	--	--	--	--	--
13	Unnamed	Intermittent	Excavation	Rail	--	--	--	--	0.00	299.0	--	--	--	--	--	--
13	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	3.5	0.00	--	--	--	--	--	--
13	Bear Creek	Perennial	Viaduct	Rail	--	--	117.1	0.00	117.6	0.00	--	--	--	--	--	--
13	NCF3S2	Perennial	Viaduct	Rail	--	--	121.3	0.00	--	--	--	--	--	--	--	--
13	NCF3S3	Intermittent	Viaduct	Access Road	--	--	86.5	0.00	--	--	--	--	--	--	--	--
13	NCF3S3	Intermittent	Viaduct	Rail	--	--	137.8	0.00	--	--	--	--	--	--	--	--
13	NCF4S200	Ephemeral	Viaduct	Rail	--	--	38.0	0.00	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Access Road	--	--	10.5	0.00	--	--	--	--	--	--	--	--
13	Bear Creek	Perennial	Viaduct	Access Road	--	--	--	--	84.2	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	111.4	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	14.5	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	30.5	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	522.3	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	74.2	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	163.9	0.00	--	--	--	--	--	--
14	NCF4S1	Ephemeral	Viaduct	Rail	--	--	134.6	0.00	--	--	--	--	--	--	--	--
15	NCG3S200	Ephemeral	Overhead	Overhead Utilities	--	--	70.3	0.00	--	--	--	--	--	--	--	--
15	NCG3S3	Perennial	Overhead	Overhead Utilities	--	--	109.0	0.00	--	--	--	--	--	--	--	--
15	NCG3S2	Intermittent	Overhead	Overhead Utilities	--	--	151.1	0.00	--	--	--	--	--	--	--	--
15	NCG3S2	Ephemeral	Overhead	Overhead Utilities	--	--	372.3	0.00	--	--	--	--	--	--	--	--
15	NCG3S7	Ephemeral	Overhead	Overhead Utilities	--	--	449.9	0	--	--	--	--	--	--	--	--
15	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	3.5	0.00	--	--	--	--	--	--
15	NCF3S10	Perennial	Viaduct	Rail	--	--	105.2	0.00	--	--	--	--	--	--	--	--
15	NCG3S2	Ephemeral	Viaduct	Rail	--	--	148.9	0.00	--	--	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																		
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
15	NCG3S201	Ephemeral	Viaduct	Rail	--	--	94.3	0.00	--	--	--	--	--	--	--	--
15	NCG3S201	Ephemeral	Viaduct	Rail	--	--	112.8	0.00	--	--	--	--	--	--	--	--
15	NCG3S3	Perennial	Viaduct	Rail	--	--	75.3	0.00	--	--	--	--	--	--	--	--
15	NCG3S7	Ephemeral	Viaduct	Access Road	--	--	58.0	0.00	--	--	--	--	--	--	--	--
15	NCG3S7	Ephemeral	Viaduct	Rail	--	--	153.0	0.00	--	--	--	--	--	--	--	--
15	NCG3S8	Ephemeral	Viaduct	Rail	--	--	66.2	0.00	--	--	--	--	--	--	--	--
15	Unnamed	Intermittent	Viaduct	Rail	--	--	21.8	0.00	--	--	--	--	--	--	--	--
15	NCG3S3	Perennial	Viaduct	Rail	--	--	6.9	0.00	--	--	--	--	--	--	--	--
15	Brushy Creek	Intermittent	Viaduct	Access Road	--	--	--	--	50.9	0.00	--	--	--	--	--	--
15	Brushy Creek	Intermittent	Viaduct	Rail	--	--	--	--	151.4	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	157.7	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	347.0	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	248.5	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	161.4	0.00	--	--	--	--	--	--
16	NCG3S4	Perennial	Viaduct	Rail	--	--	193.3	0.00	--	--	--	--	--	--	--	--
16	Red Oak Creek	Perennial	Viaduct	Access Road	--	--	--	--	56.7	0.00	--	--	--	--	--	--
16	Red Oak Creek	Perennial	Viaduct	Rail	--	--	--	--	179.7	0.00	--	--	--	--	--	--
16	Unnamed	Artificial Path	Viaduct	Access Road	--	--	--	--	30.3	0.00	--	--	--	--	--	--
16	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	261.8	0.00	--	--	--	--	--	--
16	Unnamed	Artificial Path	Viaduct	Rail	--	--	--	--	122.7	0.00	--	--	--	--	--	--
17, 18	Bone Branch	Intermittent	Viaduct	Rail	--	--	121.6	0.00	97.7	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Rail	--	--	105.7	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Artificial Path	Viaduct	Rail	--	--	3.6	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Rail	--	--	156.2	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Artificial Path	Viaduct	Access Road	--	--	--	--	50.0	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	42.7	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	12.9	0.00	--	--	--	--	--	--
17	Unnamed	Artificial Path	Viaduct	Rail	--	--	--	--	11.6	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	131.8	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	132.8	0.00	--	--	--	--	--	--
18	Grove Creek	Intermittent	Viaduct	Rail	--	--	211.1	0.00	305.3	0.00	--	--	--	--	--	--
18	NCH3S13	Perennial	Viaduct	Rail	--	--	15.7	0.00	--	--	--	--	--	--	--	--
18	Unnamed	Intermittent	Viaduct	Rail	--	--	119.3	0.00	--	--	--	--	--	--	--	--
18	Unnamed	Intermittent	Viaduct	Rail	--	--	34.2	0.00	--	--	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	**Stream ID/ Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 1**		**Segment 2A**		**Segment 2B**		**Segment 3A**		**Segment 3B**		**Segment 3C**	
					Temp	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**		**linear feet**		**linear feet**		**linear feet**		**linear feet**	
18	Bone Branch	Intermittent	Viaduct	Access Road	--	--	--	--	11.7	0.00	--	--	--	--	--	--
18	Grove Creek	Intermittent	Viaduct	Access Road	--	--	--	--	189.3	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	21.3	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	31.5	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	181.5	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Culvert	Access Road	--	--	--	--	0.00	274.8	--	--	--	--	--	--
19	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	125.6	--	--	--	--	--	--
19	NCH3S6	Intermittent	Viaduct	Rail	--	--	128.5	0.00	--	--	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Rail	--	--	97.8	0.00	--	--	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Temporary Fill	--	--	2.3	0.00	--	--	--	--	--	--	--	--
19	Cottonwood Creek	Intermittent	Viaduct	Access Road	--	--	--	--	177.0	0.00	--	--	--	--	--	--
19	Cottonwood Creek	Intermittent	Viaduct	Rail	--	--	--	--	117.7	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	6.1	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	54.6	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	68.2	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	2.3	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Viaduct	Temporary Fill	--	--	--	--	2.3	0.00	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Viaduct	Rail	--	--	86.3	0.00	68.2	0.00	--	--	--	--	--	--
20	NCI3S1	Ephemeral	Viaduct	Rail	--	--	404.2	0.00	--	--	--	--	--	--	--	--
20	NCI3S2	Ephemeral	Viaduct	Rail	--	--	146.4	0.00	--	--	--	--	--	--	--	--
20	Unnamed	Intermittent	Viaduct	Rail	--	--	103.8	0.00	--	--	--	--	--	--	--	--
20	Unnamed	Intermittent	Viaduct	Rail	--	--	483.2	0.00	--	--	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Viaduct	Access Road	--	--	--	--	4.0	0.00	--	--	--	--	--	--
20	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	3.2	0.00	--	--	--	--	--	--
20	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	85.7	0.00	--	--	--	--	--	--
20	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	162.2	0.00	--	--	--	--	--	--
21	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	11.5	0.00	--	--	--	--	--	--
21	Unnamed	Artificial Path	Viaduct	Rail	--	--	--	--	171.7	0.00	--	--	--	--	--	--
21	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	249.8	0.00	--	--	--	--	--	--
21	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	263.3	0.00	--	--	--	--	--	--
22	Unnamed	Perennial	Overhead	Overhead Utilities	--	--	15.6	0.00	--	--	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	**Stream ID/ Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 1**		**Segment 2A**		**Segment 2B**		**Segment 3A**		**Segment 3B**		**Segment 3C**	
					Temp	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**		**linear feet**		**linear feet**		**linear feet**		**linear feet**	
22	Waxahachie Creek	Perennial	Overhead	Overhead Utilities	--	--	74.8	0.00	--	--	--	--	--	--	--	--
22	NCI3S7	Perennial	Overhead	Overhead Utilities	--	--	153.3	0.00	--	--	--	--	--	--	--	--
22	NCI3S5	Intermittent	Overhead	Overhead Utilities	--	--	305.7	0.00	--	--	--	--	--	--	--	--
22	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	592.9	0.00	--	--	--	--	--	--	--	--
22	NCI3S6	Ephemeral	Overhead	Overhead Utilities	--	--	1,195.9	0.00	--	--	--	--	--	--	--	--
22	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	910.8	0.00	--	--	--	--	--	--
22	Unnamed	Perennial	Overhead	Overhead Utilities	--	--	--	--	136.5	0.00	--	--	--	--	--	--
22	Waxahachie Creek	Perennial	Overhead	Overhead Utilities	--	--	--	--	487.8	0.00	--	--	--	--	--	--
22	NCI3S5	Intermittent	Viaduct	Rail	--	--	137.6	0.00	--	--	--	--	--	--	--	--
22	NCI3S7	Perennial	Viaduct	Rail	--	--	135.2	0.00	--	--	--	--	--	--	--	--
22	Waxahachie Creek	Perennial	Viaduct	Rail	--	--	131.1	0.00	--	--	--	--	--	--	--	--
22	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	97.7	0.00	--	--	--	--	--	--
22	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	646.8	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Excavation	Utilities	--	--	--	--	117.2	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Excavation	Utilities	--	--	--	--	229.6	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	91.0	0.00	--	--	--	--	--	--	--	--
23	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	172.5	0.00	--	--	--	--	--	--	--	--
23	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	104.2	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	5.8	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	295.6	0.00	--	--	--	--	--	--
23	Waxahachie Creek	Perennial	Overhead	Overhead Utilities	--	--	--	--	355.7	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Access Road	--	--	204.1	0.00	--	--	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Rail	--	--	58.6	0.00	--	--	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
23	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	6.9	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	2.7	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	6.5	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	2.7	0.00	--	--	--	--	--	--
23	Unnamed	Artificial Path	Viaduct	Rail	--	--	--	--	181.7	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	121.9	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	524.2	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	127.7	0.00	--	--	--	--	--	--
23	Waxahachie Creek	Perennial	Viaduct	Access Road	--	--	--	--	6.5	0.00	--	--	--	--	--	--
23	Waxahachie Creek	Perennial	Viaduct	Rail	--	--	--	--	123.3	0.00	--	--	--	--	--	--
24	NCJ3S10	Ephemeral	Culvert	Rail	--	--	0.00	103.1	--	--	--	--	--	--	--	--
24	NCJ3S9	Ephemeral	Culvert	Rail	--	--	0.00	319.8	--	--	--	--	--	--	--	--
24	NCJ3S10	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	244.7	--	--	--	--	--	--	--	--
24	NCJ3S9	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	84.5	--	--	--	--	--	--	--	--
24	Elm Branch	Intermittent	Viaduct	Access Road	--	--	--	--	157.1	0.00	--	--	--	--	--	--
24	Elm Branch	Intermittent	Viaduct	Rail	--	--	--	--	162.9	0.00	--	--	--	--	--	--
25	Unnamed	Intermittent	Viaduct	Access Road	--	--	19.1	0.00	--	--	--	--	--	--	--	--
25	Unnamed	Intermittent	Viaduct	Rail	--	--	390.4	0.00	--	--	--	--	--	--	--	--
25	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	390.4	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Fill	Maintenance Facility	--	--	--	--	0.00	177.4	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Rail	--	--	127.7	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Rail	--	--	7.8	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	180.7	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	2.5	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	127.7	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	4.3	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	7.8	0.00	--	--	--	--	--	--
27	Big Onion Creek	Perennial	Viaduct	Rail	--	--	119.8	0.00	119.8	0.00	--	--	--	--	--	--
27	Unnamed	Intermittent	Viaduct	Rail	--	--	129.5	0.00	--	--	--	--	--	--	--	--
27	Unnamed	Intermittent	Viaduct	Rail	--	--	109.2	0.00	--	--	--	--	--	--	--	--
27	Big Onion Creek	Perennial	Viaduct	Access Road	--	--	--	--	2.6	0.00	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	**Stream ID/ Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 1**		**Segment 2A**		**Segment 2B**		**Segment 3A**		**Segment 3B**		**Segment 3C**	
					Temp	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**		**linear feet**		**linear feet**		**linear feet**		**linear feet**	
27	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	129.5	0.00	--	--	--	--	--	--
27	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	109.2	0.00	--	--	--	--	--	--
44	Clear Creek	Artificial Path	Culvert	Access Road	--	--	--	--	--	--	0.00	57.0	0.00	57.0	0.00	57.0
44	Clear Creek	Artificial Path	Culvert	Rail	--	--	--	--	--	--	0.00	152.9	0.00	152.9	0.00	152.9
44	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	--	--	0.00	389.1	--	--	--	--
44	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	--	--	--	--	--	--	0.00	389.1
44	Clear Creek	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	--	--	0.00	176.0	0.00	176.0	0.00	176.0
44	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	--	--	0.00	96.9	--	--	--	--
44	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	--	--	--	--	0.00	65.2	--	--
44	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	--	--	--	--	--	--	0.00	96.9
44	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	--	--	--	--	21.2	0.00	--	--
44	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	--	--	--	--	65.2	0.00	--	--
				Total	**118.0**	**0.00**	**9,225.8**	**1,430.5**	**11,448.5**	**1,175.8**	**0.00**	**872.0**	**86.4**	**451.1**	**0.00**	**872.0**

Source: USGS, 2018; FNI, 2018

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' – not present

Table 5: Estimated Wetland Impacts – Ellis County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
13	PFO1C	Forested	Access Road	Conversion	0.00	0.02	--	--
13	PFO1C	Forested	Rail	Conversion	0.00	0.02	--	--
13	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--
13	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.02
13	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.02
13	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.03
13	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.03
16	NCG3EW2	Emergent	Rail	Viaduct	0.12	0.00	--	--
16	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.11
16	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.69
17	NCG3EW13	Emergent	Overhead Utilities	Overhead	0.08	0.00	--	--
17	NCG3EW16	Emergent	Overhead Utilities	Overhead	0.04	0.00	--	--
17	NCG3EW14	Emergent	Overhead Utilities	Overhead	0.05	0.00	--	--
17	NCG3EW15	Emergent	Overhead Utilities	Overhead	0.06	0.00	--	--
17	NCG3EW17	Emergent	Rail	Viaduct	0.24	0.00	--	--
17	PEM1Fh	Emergent	Rail	Viaduct	0.40	0.00	--	--
18	PFO1C	Forested	Rail	Conversion	0.00	0.07	--	--
18	PFO1C	Forested	Rail	Conversion	0.00	0.19	--	--
18	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.01
18	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.05
19	NCH3EW3	Emergent	Stormwater Drainage	Excavation	0.00	0.03	--	--
19	NCH3EW3	Emergent	Rail	Fill	0.00	0.03	--	--
19	NCH3EW2	Emergent	Rail	Viaduct	0.10	0.00	--	--
22	PFO1A	Forested	Rail	Conversion	0.00	0.03	--	--
22	PFO1A	Forested	Rail	Conversion	0.00	0.09	--	--
22	PFO1A	Forested	Overhead Utilities	Overhead	0.06	0.00	--	--
22	NCI3EW200	Emergent	Overhead Utilities	Overhead	0.10	0.00	--	--
22	PFO1A	Forested	Overhead Utilities	Overhead	1.9	0.00	--	--
22	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.10
22	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.46
22	PFO1C	Forested	Overhead Utilities	Overhead	--	--	0.85	0.00
22	PFO1A	Forested	Overhead Utilities	Overhead	--	--	3.3	0.00
23	NCI3EW99	Emergent	Rail	Fill	0.00	0.02	--	--
23	NCI3EW100	Emergent	Rail	Viaduct	0.15	0.00	--	--
27	PFO1C	Forested	Rail	Conversion	0.00	0.07	--	--
27	PFO1C	Forested	Access Road	Conversion	--	--	0.00	<0.01
27	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.07
				Total	**3.3**	**0.62**	**4.2**	**1.6**

Table 5: Estimated Wetland Impacts – Ellis County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
FO1 - Broad-leaved Deciduous Forested
A - Temporarily Flooded
h - Diked/Impounded
EM1 - Persistent Emergent
F - Semipermanently Flooded
C - Seasonally Flooded
'--' - not present

Table 6: Estimated Waterbody Impacts – Ellis County												
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3B	
					Temp	Perm	Temp	Temp	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet	
12	Unnamed	Pond	Rail	Viaduct	0.01	0.00	--	--	--	--	--	--
13	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.01	--	--
13	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01	--	--
13	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.30	--	--
13	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.19	0.00	--	--
13	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01	--	--	--	--
13	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.01	--	--	--	--
13	NCF3PD15	Pond	Rail	Viaduct	--	--	0.11	0.00	--	--	--	--
13	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.19	0.00	--	--	--	--
14	NCF3PD200	Pond	Rail	Viaduct	--	--	0.13	0.00	--	--	--	--
15	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.02	--	--
15	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.09	0.00	--	--
15	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.11	0.00	--	--
15	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--
15	NCG3PD3	Pond	Access Road	Viaduct	--	--	0.01	0.00	--	--	--	--
15	NCG3PD4	Pond	Rail	Viaduct	--	--	0.06	0.00	--	--	--	--
15	NCG3PD3	Pond	Rail	Viaduct	--	--	0.15	0.00	--	--	--	--
15	NCG3PD7	Pond	Overhead Utilities	Overhead	--	--	0.19	0.00	--	--	--	--
15	NCG3PD8	Pond	Overhead Utilities	Overhead	--	--	0.23	0.00	--	--	--	--
16	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.03	0.00	--	--
16	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.11	0.00	--	--
16	NCG3PD24	Pond	Rail	Viaduct	--	--	0.09	0.00	--	--	--	--
16	NCG3PD10	Pond	Rail	Viaduct	--	--	0.16	0.00	--	--	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.01	0.00	--	--
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.03	0.00	--	--
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.04	0.00	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.34	0.00	--	--
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	<0.01	0.00	--	--
17	NCG3PD16	Pond	Overhead Utilities	Overhead	--	--	0.01	0.00	--	--	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	0.03	0.00	--	--	--	--
17	NCG3PD13	Pond	Overhead Utilities	Overhead	--	--	0.09	0.00	--	--	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	0.90	0.00	--	--	--	--
18	NCH3PD5	Pond	Rail	Viaduct	--	--	0.05	0.00	--	--	--	--
19	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	1.0	--	--
19	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.29	0.00	--	--

Table 6: Estimated Waterbody Impacts – Ellis County												
Natural Resources Mapbook Page #	**Waterbody ID/Name ***	**Waterbody Type**	**Construction Type**	**Crossing Type**	**Segment 1**		**Segment 2A**		**Segment 2B**		**Segment 3B**	
					Temp	**Perm**	**Temp**	**Temp**	**Temp**	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**		**linear feet**		**linear feet**	
19	NCH3PD7	Pond	Rail	Viaduct	--	--	0.35	0.00	--	--	--	--
20	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.05	0.00	--	--
20	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	<0.01	0.00	--	--
20	NCI3PD3	Pond	Rail	Viaduct	--	--	0.01	0.00	--	--	--	--
20	NCI3PD1	Pond	Rail	Viaduct	--	--	0.01	0.00	--	--	--	--
20	NCI3PD2	Pond	Rail	Viaduct	--	--	0.01	0.00	--	--	--	--
22	Unnamed	Pond	Systems	Fill	--	--	--	--	0.00	0.65	--	--
22	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.01	0.00	--	--
22	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.16	0.00	--	--
22	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.31	0.00	--	--
22	NCI3PD100	Pond	Overhead Utilities	Overhead	--	--	0.02	0.00	--	--	--	--
22	NCI3PD100	Pond	Rail	Viaduct	--	--	0.06	0.00	--	--	--	--
22	NCI3PD99	Pond	Rail	Viaduct	--	--	0.15	0.00	--	--	--	--
22	NCI3PD101	Pond	Rail	Viaduct	--	--	0.17	0.00	--	--	--	--
22	NCI3PD101	Pond	Overhead Utilities	Overhead	--	--	0.23	0.00	--	--	--	--
22	NCI3PD99	Pond	Overhead Utilities	Overhead	--	--	0.59	0.00	--	--	--	--
23	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.16	--	--
23	NCI3PD5	Pond	Rail	Fill	--	--	0.00	0.01	--	--	--	--
23	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.25	--	--	--	--
23	Unnamed	Pond	Access Road	Excavation	--	--	0.00	<0.01	--	--	--	--
23	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.32	0.00	--	--	--	--
25	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.21	0.00	--	--
25	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	<0.01	0.00	--	--
25	Unnamed	Pond	Access Road	Viaduct	--	--	0.01	0.00	--	--	--	--
25	Unnamed	Pond	Rail	Viaduct	--	--	0.21	0.00	--	--	--	--
27	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.02	--	--
27	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	<0.01	--	--
27	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	<0.01	--	--
27	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.16	0.00	--	--
27	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	<0.01	0.00	--	--
27	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.02	--	--	--	--
27	Unnamed	Pond	Access Road	Excavation	--	--	0.00	<0.01	--	--	--	--
27	Unnamed	Pond	Rail	Viaduct	--	--	0.16	0.00	--	--	--	--
44	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	--	--	0.02	0.00
44	Unnamed	Pond	Rail	Viaduct	--	--	--	--	--	--	0.28	0.00
				Total	**0.01**	**0.00**	**4.7**	**0.30**	**2.1**	**2.2**	**0.30**	**0.00**

Table 6: Estimated Waterbody Impacts – Ellis County												
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3B	
					Temp	Perm	Temp	Temp	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet	

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determination to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' – Not Present

Navarro County

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
44	Unnamed	Intermittent	Viaduct	Rail	194.1	0.00	--	--	--	--
44	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	194.1	0.00
45	Chambers Creek	Artificial Path	Viaduct	Rail	135.7	0.00	283.6	0.00	135.7	0.00
45	Chambers Creek	Artificial Path	Viaduct	Access Road	--	--	24.9	0.00	--	--
45	Cryer Creek	Intermittent	Viaduct	Access Road	--	--	51.5	0.00	--	--
45	Cryer Creek	Intermittent	Viaduct	Rail	--	--	119.4	0.00	--	--
45	Unnamed	Perennial	Viaduct	Rail	117.1	0.00	--	--	--	--
45	Unnamed	Intermittent	Viaduct	Rail	118.6	0.00	--	--	--	--
45	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	53.1	--	--
45	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	527.9	--	--
45	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	124.4	--	--
45	Unnamed	Perennial	Viaduct	Access Road	--	--	21.2	0.00	--	--
45	Unnamed	Artificial Path	Viaduct	Access Road	--	--	11.4	0.00	--	--
45	Unnamed	Perennial	Viaduct	Rail	--	--	130.0	0.00	--	--
45	Unnamed	Intermittent	Viaduct	Rail	--	--	130.2	0.00	--	--
45	Unnamed	Perennial	Viaduct	Rail	--	--	--	--	117.1	0.00
45	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	118.6	0.00
46	Briar Creek	Intermittent	Overhead	Overhead Utilities	--	--	403.6	0.00	--	--
46	Briar Creek	Intermittent	Viaduct	Access Road	--	--	17.2	0.00	--	--
46	NCL4S4	Ephemeral	Culvert	Access Road	0.00	235.2	--	--	--	--
46	Unnamed	Intermittent	Culvert	Access Road	0.00	344.7	--	--	--	--
46	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	53.2	--	--	--	--
46	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	58.8	--	--
46	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	62.0	--	--
46	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	153.5	--	--
46	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	284.1	--	--
46	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	113.6	--	--
46	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	0.00	261.9	--	--
46	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	65.0	0.00	--	--
46	Unnamed	Intermittent	Culvert	Access Road	--	--	--	--	0.00	344.7
46	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	53.2
46, 53	Briar Creek	Intermittent	Viaduct	Rail	463.1	0.00	133.4	0.00	463.1	0.00
47	Unnamed	Intermittent	Viaduct	Rail	127.9	0.00	--	--	--	--
47	Unnamed	Intermittent	Viaduct	Rail	155.6	0.00	--	--	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
47	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	127.9	0.00
47	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	155.6	0.00
48	NCM5S5	Ephemeral	Overhead	Overhead Utilities	579.0	0.00	--	--	--	--
48	Unnamed	Intermittent	Culvert	Rail	0.00	373.9	--	--	--	--
48	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	89.8	--	--	--	--
48	Unnamed	Intermittent	Overhead	Overhead Utilities	192.8	0.00	--	--	--	--
48	Unnamed	Intermittent	Viaduct	Rail	472.5	0.00	--	--	--	--
48	Unnamed	Intermittent	Viaduct	Rail	152.0	0.00	--	--	--	--
48	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	373.9
48	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	89.8
48	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	192.8	0.00
48	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	472.5	0.00
48	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	152.0	0.00
49	Unnamed	Intermittent	Viaduct	Access Road	80.0	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Access Road	99.0	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Rail	2.0	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Rail	200.7	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Rail	1.1	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Rail	165.5	0.00	--	--	--	--
49	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	80.0	0.00
49	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	99.0	0.00
49	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	2.0	0.00
49	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	200.7	0.00
49	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	1.1	0.00
49	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	165.5	0.00
50	Unnamed	Intermittent	Culvert	Rail	0.00	248.3	--	--	--	--
50	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	118.7	--	--	--	--
50	Unnamed	Intermittent	Viaduct	Rail	124.0	0.00	--	--	--	--
50	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	248.3
50	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	118.7
50	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	124.0	0.00
52	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	73.0	--	--	--	--
52	Unnamed	Intermittent	Excavation	Rail	0.00	233.5	--	--	--	--
52	Unnamed	Intermittent	Overhead	Overhead Utilities	177.7	0.00	--	--	--	--
52	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	73.0
52	Unnamed	Intermittent	Excavation	Rail	--	--	--	--	0.00	233.5
52	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	177.7	0.00

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
53	Unnamed	Intermittent	Viaduct	Rail	245.6	0.00	--	--	--	--
53	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	245.6	0.00
54	Richland Creek	Intermittent	Viaduct	Rail	109.1	0.00	--	--	109.1	0.00
54	Unnamed	Intermittent	Viaduct	Rail	144.4	0.00	--	--	--	--
54	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	144.4	0.00
55	Pin Oak Creek	Intermittent	Viaduct	Rail	482.0	0.00	--	--	134.1	0.00
55	Pin Oak Creek	Intermittent	Viaduct	Access Road	--	--	--	--	50.8	0.00
55	Unnamed	Intermittent	Excavation	Access Road	0.00	186.1	--	--	--	--
55	Unnamed	Intermittent	Overhead	Overhead Utilities	303.1	0.00	--	--	--	--
55	Unnamed	Intermittent	Overhead	Overhead Utilities	51.6	0.00	--	--	--	--
55	Unnamed	Intermittent	Viaduct	Rail	120.8	0.00	--	--	--	--
55	Unnamed	Intermittent	Viaduct	Rail	108.3	0.00	--	--	--	--
55	Unnamed	Intermittent	Excavation	Access Road	--	--	--	--	0.00	186.1
55	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	303.1	0.00
55	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	7.0	0.00
55	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	18.6	0.00
55	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	117.0	0.00
55	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	108.3	0.00
56	Unnamed	Intermittent	Viaduct	Access Road	--	--	3.2	0.00	--	--
56	Unnamed	Intermittent	Viaduct	Rail	--	--	120.9	0.00	--	--
56	Unnamed	Intermittent	Culvert	Access Road	--	--	--	--	0.00	44.3
56	Unnamed	Intermittent	Culvert	Access Road	--	--	--	--	0.00	212.9
56	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	66.3
56	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	205.8
56	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	39.3
56	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	88.9
56	Unnamed	Intermittent	Fill	Temporary Fill	--	--	--	--	31.6	0.00
57	Unnamed	Intermittent	Viaduct	Rail	300.9	0.00	--	--	--	--
57	Unnamed	Intermittent	Viaduct	Access Road	--	--	141.9	0.00	--	--
57	Unnamed	Artificial Path	Viaduct	Rail	--	--	881.9	0.00	--	--
57	Unnamed	Artificial Path	Viaduct	Temporary Fill	--	--	34.4	0.00	--	--
58	NCQ7S2	Intermittent	Viaduct	Access Road	41.3	0.00	--	--	--	--
58	Unnamed	Intermittent	Culvert	Access Road	0.00	74.2	--	--	--	--
58	Unnamed	Intermittent	Culvert	Rail	0.00	95.8	--	--	--	--
58	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	136.5	--	--	--	--
58	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	380.2	0.00	--	--
58	Unnamed	Intermittent	Viaduct	Access Road	--	--	68.2	0.00	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
58	Unnamed	Intermittent	Viaduct	Access Road	--	--	35.6	0.00	--	--
58	Unnamed	Intermittent	Viaduct	Access Road	--	--	58.1	0.00	--	--
58	Unnamed	Intermittent	Viaduct	Rail	--	--	142.0	0.00	--	--
58	Unnamed	Intermittent	Viaduct	Rail	--	--	151.4	0.00	--	--
58	Unnamed	Intermittent	Viaduct	Rail	--	--	131.3	0.00	--	--
59	Little Pin Oak Creek	Intermittent	Viaduct	Access Road	--	--	212.9	0.00	10.0	0.00
59	Little Pin Oak Creek	Intermittent	Viaduct	Rail	--	--	3.3	0.00	--	--
59	NCQ7S200	Ephemeral	Culvert	Rail	0.00	213.3	--	--	--	--
59	NCQ7S4	Intermittent	Viaduct	Access Road	13.6	0.00	--	--	--	--
59	NCQ7S4	Intermittent	Viaduct	Rail	167.1	0.00	--	--	--	--
59	NCQ7S7	Intermittent	Culvert	Access Road	0.00	7.1	--	--	--	--
59	NCQ7S7	Intermittent	Culvert	Rail	0.00	346.3	--	--	--	--
59	NCQ7S7	Intermittent	Excavation	Stormwater Drainage	0.00	210.4	--	--	--	--
60	NCQ7S5	Ephemeral	Overhead	Overhead Utilities	90.8	0.00	--	--	--	--
60	NCQ7S6	Ephemeral	Overhead	Overhead Utilities	926.8	0.00	--	--	--	--
60	NCQ7S6	Ephemeral	Viaduct	Rail	135.6	0.00	--	--	--	--
60	NCQ7S6	Ephemeral	Viaduct	Access Road	5.4	0.00	--	--	--	--
61	Unnamed	Intermittent	Viaduct	Rail	294.1	0.00	--	--	--	--
61	Unnamed	Intermittent	Viaduct	Access Road	--	--	5.1	0.00	--	--
61	Unnamed	Intermittent	Viaduct	Rail	--	--	294.1	0.00	--	--
66	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	563.3	--	--
66	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	514.1	--	--
66	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	263.5	--	--
66	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	576.4	--	--
66	Unnamed	Intermittent	Viaduct	Access Road	--	--	32.4	0.00	--	--
66	Unnamed	Intermittent	Viaduct	Access Road	--	--	23.7	0.00	--	--
66	Unnamed	Intermittent	Viaduct	Rail	--	--	120.2	0.00	--	--
67	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	31.3	--	--
67	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	50.7	--	--
67	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	265.7	--	--
67	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	295.9	--	--
67	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	186.6	--	--
67	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	44.4	--	--
67	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	73.3	--	--
67	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	62.3	--	--
67	Unnamed	Intermittent	Viaduct	Access Road	--	--	20.3	0.00	--	--
67	Unnamed	Intermittent	Viaduct	Rail	--	--	228.3	0.00	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
68	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	78.2	--	--
68	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	457.2	--	--
68	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	636.9	--	--
68	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	161.6	--	--
68	Unnamed	Intermittent	Viaduct	Access Road	--	--	110.0	0.00	--	--
68	Unnamed	Intermittent	Viaduct	Access Road	--	--	306.8	0.00	--	--
68	Unnamed	Intermittent	Viaduct	Rail	--	--	138.1	0.00	--	--
68	Unnamed	Intermittent	Viaduct	Rail	--	--	95.2	0.00	--	--
68	Unnamed	Artificial Path	Viaduct	Rail	--	--	133.3	0.00	--	--
69	Cedar Creek	Intermittent	Culvert	Access Road	--	--	0.00	332.6	--	--
69	Cedar Creek	Intermittent	Viaduct	Access Road	--	--	8.2	0.00	--	--
69	Cedar Creek	Intermittent	Viaduct	Rail	--	--	121.2	0.00	--	--
69	Unnamed	Artificial Path	Culvert	Access Road	--	--	0.00	132.4	--	--
69	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	220.2	--	--
69	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	252.3	--	--
69	Unnamed	Intermittent	Viaduct	Access Road	--	--	35.1	0.00	--	--
69	Unnamed	Intermittent	Viaduct	Access Road	--	--	114.2	0.00	--	--
69	Unnamed	Intermittent	Viaduct	Access Road	--	--	9.1	0.00	--	--
69	Unnamed	Intermittent	Viaduct	Rail	--	--	131.7	0.00	--	--
69	Unnamed	Intermittent	Viaduct	Rail	--	--	155.2	0.00	--	--
69	Unnamed	Intermittent	Viaduct	Rail	--	--	140.3	0.00	--	--
69	Unnamed	Artificial Path	Viaduct	Rail	--	--	134.8	0.00	--	--
70	Unnamed	Intermittent	Viaduct	Access Road	--	--	21.1	0.00	--	--
70	Unnamed	Intermittent	Viaduct	Access Road	--	--	120.1	0.00	--	--
70	Unnamed	Intermittent	Viaduct	Rail	--	--	136.1	0.00	--	--
70	Unnamed	Intermittent	Viaduct	Rail	--	--	120.8	0.00	--	--
71	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	295.7	--	--
71	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	47.8	--	--
71	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	526.3	--	--
71	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	217.1	--	--
71	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	91.5	--	--
71	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	97.1	--	--
71	Unnamed	Intermittent	Viaduct	Access Road	--	--	144.3	0.00	--	--
71	Unnamed	Intermittent	Viaduct	Rail	--	--	330.2	0.00	--	--
72	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	86.2	--	--
72	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	517.7	--	--
72	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	298.9	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	**Stream ID/Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 3A**		**Segment 3B**		**Segment 3C**	
					Temp	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**		**linear feet**	
72	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	299.3	--	--
72	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	368.6	--	--
73	Richland Creek	Artificial Path	Viaduct	Access Road	--	--	75.7	0.00	--	--
73	Richland Creek	Artificial Path	Viaduct	Rail	--	--	127.8	0.00	--	--
73	Unnamed	Intermittent	Viaduct	Access Road	--	--	21.5	0.00	--	--
73	Unnamed	Intermittent	Viaduct	Rail	--	--	132.6	0.00	--	--
74	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	37.9	--	--
74	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	263.4	--	--
74	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	208.7	--	--
75	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	23.3	0.00
75	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	174.0	0.00
95	Little Pin Oak Creek	Intermittent	Overhead	Overhead Utilities	--	--	--	--	294.6	0.00
95	Little Pin Oak Creek	Intermittent	Viaduct	Rail	--	--	--	--	138.3	0.00
95	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	45.6	0.00
95	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--	80.9	0.00
95	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	8.7	0.00
95	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	595.6	0.00
95	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	130.4	0.00
96	Mesquite Creek	Intermittent	Viaduct	Access Road	--	--	--	--	241.9	0.00
96	Mesquite Creek	Intermittent	Viaduct	Rail	--	--	--	--	280.7	0.00
96	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	205.6
96	Unnamed	Intermittent	Excavation	Utilities	--	--	--	--	9.4	0.00
96	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	235.3	0.00
96	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	122.7	0.00
96	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	127.8	0.00
96	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	139.2	0.00
96	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	134.4	0.00
96	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	236.5	0.00
97	Unnamed	Intermittent	Culvert	Access Road	--	--	--	--	0.00	45.3
97	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	278.5
97	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	267.9
97	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	144.8	0.00
97	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	8.6	0.00
97	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	140.9	0.00
97	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	241.6	0.00
				Total	**7,098.7**	**3,040.0**	**7,344.2**	**10,194.3**	**7,814.2**	**3,176.0**

Source: USGS, 2018; FNI, 2018

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 8: Estimated Wetland Impacts – Navarro County										
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
45	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--	--	--
45	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.01	--	--
45	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.16	--	--
45	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.05
46	NCL4EW8	Emergent	Rail	Viaduct	0.04	0.00	--	--	--	--
46	NCL4EW10	Emergent	Rail	Viaduct	0.05	0.00	--	--	--	--
49	NCM5EW23	Emergent	Stormwater Drainage	Excavation	0.00	<0.01	--	--	--	--
49	NCM5EW23	Emergent	Rail	Excavation	0.00	0.04	--	--	--	--
49	NCM5EW22	Emergent	Rail	Fill	0.00	0.06	--	--	--	--
49	NCM5EW21	Emergent	Rail	Fill	0.00	0.24	--	--	--	--
50	NCM5EW24	Emergent	Rail	Fill	0.00	0.03	--	--	--	--
52	NCN5EW10	Emergent	Rail	Fill	0.00	1.4	--	--	--	--
52	NCN5EW15	Emergent	Temporary Fill	Fill	0.08	0.00	--	--	--	--
52	NCN5EW16	Emergent	Temporary Fill	Fill	1.2	0.00	--	--	--	--
52	NCN5EW12	Emergent	Access Road	Viaduct	0.01	0.00	--	--	--	--
52	NCN5EW12	Emergent	Rail	Viaduct	0.18	0.00	--	--	--	--
53	PFO1A	Forested	Rail	Conversion	0.00	0.05	--	--	--	--
53	PFO1C	Forested	Rail	Conversion	0.00	0.19	--	--	--	--
53	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.05
53	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.19
54	PFO1A	Forested	Rail	Conversion	0.00	4.7	--	--	--	--
54	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	4.7
55	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--	--	--
55	PFO1A	Forested	Rail	Conversion	0.00	0.64	--	--	--	--
55	PFO1C	Forested	Overhead Utilities	Overhead	0.02	0.00	--	--	--	--
55	PFO1C	Forested	Access Road	Conversion	--	--	--	--	0.00	<0.01
55	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.05
55	PFO1A	Forested	Access Road	Conversion	--	--	--	--	0.00	0.06
55	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	1.2
58	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.02	--	--
58	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.15	--	--
58	PFO1C	Forested	Overhead Utilities	Overhead	--	--	0.21	0.00	--	--
58	PEM1C	Emergent	Access Road	Viaduct	--	--	0.02	0.00	--	--
58	PEM1C	Emergent	Rail	Viaduct	--	--	0.06	0.00	--	--
59	NCQ7FW1	Forested	Rail	Conversion	0.00	0.04	--	--	--	--
60	NCQ8EW2	Emergent	Rail	Viaduct	0.02	0.00	--	--	--	--
61	NCQ8FW3	Forested	Rail	Conversion	0.00	0.06	--	--	--	--
66	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.01	--	--

Table 8: Estimated Wetland Impacts – Navarro County										
Natural Resources Mapbook Page #	**Wetland ID/Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 3A**		**Segment 3B**		**Segment 3C**	
					Temp	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**
					acres		**acres**		**acres**	
66	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.05	--	--
68	PEM1Fh	Emergent	Rail	Viaduct	--	--	0.62	0.00	--	--
69	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.04	--	--
69	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.89	--	--
69	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	0.00	0.11	--	--
69	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.01	--	--
69	PEM1C	Emergent	Access Road	Fill	--	--	0.00	0.12	--	--
69	PFO1A	Forested	Access Road	Fill	--	--	0.00	0.14	--	--
69	PEM1Ch	Emergent	Rail	Viaduct	--	--	0.17	0.00	--	--
70	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.01	--	--
70	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.05	--	--
70	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.05	--	--
70	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.07	--	--
71	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.35	--	--
71	PFO1A	Forested	Rail	Conversion	--	--	0.00	1.3	--	--
71	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	0.00	0.03	--	--
71	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.11	--	--
71	PFO1C	Forested	Rail	Fill	--	--	0.00	0.21	--	--
73	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.03	--	--
73	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.17	--	--
73	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.83	--	--
73	PFO1A	Forested	Overhead Utilities	Overhead	--	--	0.16	0.00	--	--
73	PEM1A	Emergent	Access Road	Viaduct	--	--	<0.01	0.00	--	--
73	PEM1A	Emergent	Rail	Viaduct	--	--	0.01	0.00	--	--
95	PFO1C	Forested	Access Road	Conversion	--	--	--	--	0.00	0.01
95	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.07
95	PFO1C	Forested	Overhead Utilities	Overhead	--	--	--	--	0.14	0.00
				Total	**1.6**	**7.5**	**1.2**	**5.0**	**0.14**	**6.3**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
h - Diked/Impounded
'--' - not present
EM - Emergent
FO - Forested
A - Temporarily Flooded
F – Semipermanently Flooded

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
45	Unnamed	Pond	Rail	Excavation	--	--	0.00	<0.01	--	--
46	Unnamed	Pond	Access Road	Excavation	--	--	0.00	0.03	--	--
46	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.04	--	--
46	Unnamed	Pond	Access Road	Excavation	--	--	0.00	0.05	--	--
46	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.47	--	--
46	NCL4PD20	Pond	Rail	Fill	0.00	<0.01	--	--	--	--
46	NCL4PD36	Pond	Access Road	Fill	0.00	0.10	--	--	--	--
46	NCL4PD19	Pond	Rail	Fill	0.00	0.21	--	--	--	--
46	NCL4PD20	Pond	Access Road	Fill	0.00	0.57	--	--	--	--
46	Unnamed	Pond	Rail	Fill	--	--	0.00	0.04	--	--
46	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.19	0.00	--	--
47	Unnamed	Pond	Temporary Fill	Fill	0.18	0.00	--	--	--	--
47	Unnamed	Pond	Temporary Fill	Fill	--	--	--	--	0.18	0.00
47	Unnamed	Pond	Rail	Viaduct	0.10	0.00	--	--	--	--
47	Unnamed	Pond	Rail	Viaduct	0.12	0.00	--	--	--	--
47	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.10	0.00
47	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.12	0.00
48	Unnamed	Pond	Overhead Utilities	Overhead	0.07	0.00	--	--	--	--
48	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.07	0.00
49	NCM5PD35	Pond	Rail	Excavation	0.00	0.55	--	--	--	--
49	NCM5PD31	Pond	Access Road	Fill	0.00	0.06	--	--	--	--
49	NCM5PD31	Pond	Rail	Fill	0.00	0.34	--	--	--	--
50	NCM5PD35	Pond	Stormwater Drainage	Excavation	0.00	0.74	--	--	--	--
50	NCM5PD36	Pond	Rail	Fill	0.00	0.31	--	--	--	--
51	NCN5PD5	Pond	Rail	Fill	0.00	0.24	--	--	--	--
51	Unnamed	Pond	Rail	Viaduct	0.33	0.00	--	--	--	--
51	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.33	0.00
52	Unnamed	Pond	Rail	Fill	0.00	0.03	--	--	--	--
52	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.03
53	Unnamed	Pond	Rail	Fill	0.00	0.12	--	--	--	--
53	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.12
54	Unnamed	Pond	Rail	Excavation	0.00	0.36	--	--	--	--
54	Unnamed	Pond	Access Road	Excavation	0.00	<0.01	--	--	--	--
54	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	<0.01
54	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.36
54	Unnamed	Pond	Rail	Viaduct	0.09	0.00	--	--	--	--
54	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.09	0.00

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
56	Unnamed	Pond	Rail	Excavation	0.00	0.29	--	--	--	--
56	Unnamed	Pond	Rail	Viaduct	0.02	0.00	--	--	--	--
56	Unnamed	Pond	Rail	Viaduct	0.05	0.00	--	--	--	--
56	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.03	0.00
57	Unnamed	Pond	Rail	Fill	--	--	0.00	0.08	--	--
57	Unnamed	Pond	Temporary Fill	Fill	--	--	0.15	0.00	--	--
57	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--	--	--
57	Unnamed	Pond	Rail	Viaduct	0.07	0.00	--	--	--	--
57	Unnamed	Pond	Rail	Viaduct	--	--	0.12	0.00	--	--
57	Unnamed	Pond	Rail	Viaduct	--	--	0.18	0.00	--	--
58	Unnamed	Pond	Access Road	Fill	0.00	0.22	--	--	--	--
58	Unnamed	Pond	Rail	Fill	0.00	0.39	--	--	--	--
58	Unnamed	Pond	Rail	Fill	--	--	0.00	0.12	--	--
58	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--	--	--
58	Unnamed	Pond	Access Road	Viaduct	--	--	0.02	0.00	--	--
58	Unnamed	Pond	Rail	Viaduct	--	--	0.07	0.00	--	--
59	NCQ7PD9	Pond	Stormwater Drainage	Excavation	0.00	0.16	--	--	--	--
59	NCQ7PD9	Pond	Rail	Fill	0.00	<0.01	--	--	--	--
59	NCQ7PD9	Pond	Access Road	Fill	0.00	0.08	--	--	--	--
59	NCQ7PD9	Pond	Rail	Fill	0.00	0.28	--	--	--	--
59	Unnamed	Pond	Rail	Fill	--	--	0.00	0.09	--	--
59	Unnamed	Pond	Rail	Fill	--	--	0.00	0.20	--	--
59	NCQ7PD13	Pond	Rail	Viaduct	0.21	0.00	--	--	--	--
59	Unnamed	Pond	Access Road	Viaduct	--	--	<0.01	0.00	--	--
59	Unnamed	Pond	Rail	Viaduct	--	--	<0.01	0.00	--	--
59	Unnamed	Pond	Rail	Viaduct	--	--	<0.01	0.00	--	--
59	Unnamed	Pond	Access Road	Viaduct	--	--	0.09	0.00	--	--
60	NCQ7PD14	Pond	Overhead Utilities	Overhead	0.11	0.00	--	--	--	--
60	NCQ7PD15	Pond	Overhead Utilities	Overhead	0.16	0.00	--	--	--	--
60	NCQ7PD15	Pond	Rail	Viaduct	0.01	0.00	--	--	--	--
60	Unnamed	Pond	Rail	Viaduct	0.05	0.00	--	--	--	--
60	Unnamed	Pond	Rail	Viaduct	--	--	<0.01	0.00	--	--
60	Unnamed	Pond	Rail	Viaduct	--	--	0.05	0.00	--	--
61	Unnamed	Pond	Rail	Viaduct	0.28	0.00	--	--	--	--
61	Unnamed	Pond	Access Road	Viaduct	--	--	<0.01	0.00	--	--
61	Unnamed	Pond	Rail	Viaduct	--	--	0.28	0.00	--	--
67	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	<0.01	--	--

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
68	Unnamed	Pond	Rail	Viaduct	--	--	0.04	0.00	--	--
68	Soil Conservation Service Site 138 Reservoir	Reservoir	Rail	Viaduct	--	--	1.7	0.00	--	--
69	Unnamed	Pond	Access Road	Excavation	--	--	0.00	<0.01	--	--
69	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.08	--	--
69	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.22	--	--
69	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.03	--	--
69	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05	--	--
69	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.06	--	--
69	Unnamed	Pond	Rail	Fill	--	--	0.00	0.29	--	--
69	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.39	--	--
70	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.17	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	<0.01	--	--
70	Unnamed	Pond	Rail	Fill	--	--	0.00	0.01	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.09	--	--
70	Unnamed	Pond	Rail	Fill	--	--	0.00	0.76	--	--
70	Unnamed	Pond	Rail	Viaduct	--	--	0.35	0.00	--	--
71	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.05	--	--
71	Unnamed	Pond	Rail	Fill	--	--	0.00	<0.01	--	--
71	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.45	--	--
71	Unnamed	Pond	Access Road	Viaduct	--	--	0.08	0.00	--	--
72	Unnamed	Pond	Access Road	Fill	--	--	0.00	<0.01	--	--
72	Unnamed	Pond	Rail	Fill	--	--	0.00	0.28	--	--
73	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.57	0.00	--	--
73	Unnamed	Pond	Access Road	Viaduct	--	--	0.01	0.00	--	--
73	Unnamed	Pond	Rail	Viaduct	--	--	0.02	0.00	--	--
73	Unnamed	Pond	Access Road	Viaduct	--	--	0.02	0.00	--	--
73	Unnamed	Pond	Rail	Viaduct	--	--	0.06	0.00	--	--
73	Unnamed	Pond	Rail	Viaduct	--	--	0.09	0.00	--	--
73	Unnamed	Pond	Rail	Viaduct	--	--	0.24	0.00	--	--
74	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.09	--	--
74	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.13	--	--
74	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.16	--	--
74	Unnamed	Pond	Rail	Fill	--	--	0.00	0.08	--	--
74	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.10	--	--
75	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.05	0.00

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
75	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.30	0.00
95	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.01	0.00
95	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.05	0.00
95	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.22	0.00
95	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.03	0.00
95	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.11	0.00
95	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.27	0.00
95	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.32	0.00
96	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.07	0.00
97	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.10
97	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.11
				Total	**1.9**	**5.0**	**4.3**	**4.7**	**2.4**	**0.70**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Freestone County

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
61	CER8S1	Intermittent	Viaduct	Rail	--	--	257.7	0.00
61	CER8S2	Perennial	Viaduct	Rail	--	--	126.3	0.00
61	CER8S3	Intermittent	Viaduct	Rail	--	--	270.4	0.00
98	Tehuacana Creek	Perennial	Viaduct	Access Road	173.7	0.00	--	--
98	Tehuacana Creek	Perennial	Viaduct	Rail	253.5	0.00	--	--
98	Unnamed	Intermittent	Culvert	Access Road	0.00	895.4	--	--
98	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	279.5	--	--
98	Unnamed	Intermittent	Excavation	Utilities	0.00	126.1	--	--
98	Unnamed	Intermittent	Overhead	Overhead Utilities	177.5	0.00	--	--
98	Unnamed	Intermittent	Viaduct	Access Road	140.0	0.00	--	--
98	Unnamed	Intermittent	Viaduct	Access Road	368.4	0.00	--	--
98	Unnamed	Intermittent	Viaduct	Rail	291.2	0.00	--	--
98	Unnamed	Intermittent	Viaduct	Rail	123.5	0.00	--	--
98	Unnamed	Intermittent	Viaduct	Rail	554.6	0.00	--	--
99	Little Tehuacana Creek	Intermittent	Viaduct	Access Road	18.7	0.00	--	--
99	Unnamed	Intermittent	Overhead	Overhead Utilities	235.0	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Access Road	27.0	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Access Road	55.8	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Access Road	23.3	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Rail	127.0	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Rail	149.3	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Rail	200.2	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Rail	126.8	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Temporary Fill	1,184.2	0.00	--	--
99	Unnamed	Intermittent	Viaduct	Temporary Fill	2,358.0	0.00	--	--
99,157	Little Tehuacana Creek	Intermittent	Viaduct	Rail	88.5	0.00	130.9	0.00
100	Dry Creek	Intermittent	Viaduct	Access Road	87.6	0.00	--	--
100	Dry Creek	Intermittent	Viaduct	Rail	84.1	0.00	--	--
100	Dry Creek	Intermittent	Viaduct	Rail	92.4	0.00	--	--
100	Unnamed	Intermittent	Culvert	Access Road	0.00	47.0	--	--
100	Unnamed	Intermittent	Culvert	Access Road	0.00	108.7	--	--
100	Unnamed	Artificial Path	Culvert	Rail	0.00	224.2	--	--

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
100	Unnamed	Intermittent	Culvert	Rail	0.00	212.2	--	--
100	Unnamed	Intermittent	Culvert	Rail	0.00	354.1	--	--
100	Unnamed	Artificial Path	Excavation	Stormwater Drainage	0.00	147.4	--	--
100	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	136.6	--	--
100	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	302.7	--	--
100	Unnamed	Intermittent	Viaduct	Access Road	23.4	0.00	--	--
100	Unnamed	Intermittent	Viaduct	Access Road	49.8	0.00	--	--
100	Unnamed	Intermittent	Viaduct	Rail	222.7	0.00	--	--
100	Unnamed	Intermittent	Viaduct	Rail	119.7	0.00	--	--
100	Unnamed	Intermittent	Viaduct	Rail	72.0	0.00	--	--
101	Caney Creek	Intermittent	Viaduct	Access Road	21.4	0.00	--	--
101	Caney Creek	Intermittent	Viaduct	Rail	378.0	0.00	--	--
101	Cedar Creek	Intermittent	Viaduct	Access Road	194.8	0.00	--	--
101	Cedar Creek	Intermittent	Viaduct	Rail	136.1	0.00	--	--
101	Unnamed	Intermittent	Viaduct	Access Road	42.3	0.00	--	--
101	Unnamed	Intermittent	Viaduct	Rail	178.7	0.00	--	--
102	Unnamed	Intermittent	Viaduct	Access Road	41.7	0.00	--	--
102	Unnamed	Intermittent	Viaduct	Access Road	14.6	0.00	--	--
102	Unnamed	Intermittent	Viaduct	Rail	46.3	0.00	--	--
102	Unnamed	Intermittent	Viaduct	Rail	118.6	0.00	--	--
103	Cottonwood Creek	Perennial	Viaduct	Rail	124.9	0.00	--	--
103	Unnamed	Intermittent	Viaduct	Access Road	91.4	0.00	--	--
103	Unnamed	Intermittent	Viaduct	Rail	118.2	0.00	--	--
104	Cottonwood Creek	Perennial	Viaduct	Access Road	51.3	0.00	--	--
104	Unnamed	Intermittent	Viaduct	Access Road	140.6	0.00	--	--
104	Unnamed	Intermittent	Viaduct	Rail	149.3	0.00	--	--
105	Unnamed	Intermittent	Viaduct	Access Road	98.4	0.00	--	--
105	Unnamed	Intermittent	Viaduct	Rail	198.2	0.00	--	--
106	Unnamed	Intermittent	Viaduct	Access Road	399.3	0.00	--	--
107	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	123.0	--	--
107	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	782.8	--	--
107	Unnamed	Intermittent	Viaduct	Access Road	294.9	0.00	--	--
107	Unnamed	Intermittent	Viaduct	Access Road	413.7	0.00	--	--
107	Unnamed	Intermittent	Viaduct	Rail	127.0	0.00	--	--
107	Unnamed	Intermittent	Viaduct	Rail	162.6	0.00	--	--
108	Unnamed	Intermittent	Viaduct	Access Road	36.5	0.00	--	--
108	Unnamed	Intermittent	Viaduct	Access Road	116.5	0.00	--	--

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
108	Unnamed	Intermittent	Viaduct	Rail	117.2	0.00	--	--
108	Unnamed	Intermittent	Viaduct	Rail	135.8	0.00	--	--
108	Upper Keechi Creek	Intermittent	Viaduct	Access Road	33.8	0.00	--	--
108	Upper Keechi Creek	Intermittent	Viaduct	Rail	117.5	0.00	--	--
109	Hog Creek	Intermittent	Viaduct	Access Road	40.9	0.00	--	--
109	Hog Creek	Intermittent	Viaduct	Rail	117.4	0.00	--	--
110	Unnamed	Intermittent	Viaduct	Access Road	41.3	0.00	--	--
110	Unnamed	Intermittent	Viaduct	Rail	117.5	0.00	--	--
112	Caroline Creek	Intermittent	Viaduct	Access Road	345.0	0.00	--	--
112	Caroline Creek	Intermittent	Viaduct	Rail	246.8	0.00	--	--
112	Unnamed	Intermittent	Viaduct	Access Road	17.3	0.00	--	--
112	Unnamed	Intermittent	Viaduct	Access Road	297.6	0.00	--	--
112	Unnamed	Intermittent	Viaduct	Access Road	121.2	0.00	--	--
112	Unnamed	Intermittent	Viaduct	Rail	121.4	0.00	--	--
112	Unnamed	Intermittent	Viaduct	Rail	117.1	0.00	--	--
113	Unnamed	Intermittent	Culvert	Access Road	0.00	153.2	--	--
113	Unnamed	Intermittent	Culvert	Rail	0.00	446.9	--	--
113	Unnamed	Intermittent	Culvert	Rail	0.00	86.2	--	--
113	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	81.4	--	--
113	Unnamed	Intermittent	Viaduct	Access Road	305.6	0.00	--	--
113	Wilkerson Spring Branch	Intermittent	Viaduct	Access Road	239.4	0.00	--	--
113	Wilkerson Spring Branch	Intermittent	Viaduct	Rail	489.2	0.00	--	--
114	Fulks Dugout	Intermittent	Viaduct	Access Road	246.9	0.00	--	--
114	Fulks Dugout	Intermittent	Viaduct	Rail	195.9	0.00	--	--
115	Unnamed	Intermittent	Viaduct	Access Road	6.1	0.00	--	--
115	Unnamed	Intermittent	Viaduct	Rail	193.6	0.00	--	--
115	Whitney Branch	Intermittent	Viaduct	Access Road	128.2	0.00	--	--
115	Whitney Branch	Intermittent	Viaduct	Rail	146.8	0.00	--	--
116	Buffalo Creek	Perennial	Viaduct	Rail	143.7	0.00	--	--
154	CER8S5	Ephemeral	Culvert	Rail	--	--	0.00	39.0
154	CER8S5	Intermittent	Excavation	Access Road	--	--	0.00	94.7
154	CER8S5	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	8.3
154	CER8S5	Intermittent	Viaduct	Rail	--	--	531.4	0.00
154	CER8S6	Ephemeral	Viaduct	Rail	--	--	36.5	0.00
154	CER8S8	Ephemeral	Culvert	Access Road	--	--	0.00	100.6

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
154	CER8S98	Ephemeral	Viaduct	Rail	--	--	144.0	0.00
154	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	248.9
154	Unnamed	Intermittent	Excavation	Access Road	--	--	0.00	125.9
154	Unnamed	Artificial Path	Fill	Maintenance Facility	--	--	0.00	17.8
154	Unnamed	Artificial Path	Viaduct	Rail	--	--	118.7	0.00
155	CER8S10	Ephemeral	Viaduct	Rail	--	--	360.8	0.00
155	CER8S11	Perennial	Viaduct	Access Road	--	--	44.7	0.00
155	CER8S11	Perennial	Viaduct	Rail	--	--	135.4	0.00
155	CER8S14	Ephemeral	Viaduct	Rail	--	--	160.4	0.00
156	CES8S1	Ephemeral	Culvert	Rail	--	--	0.00	211.0
156	CES8S1	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	106.5
156	CES8S2	Ephemeral	Excavation	Access Road	--	--	0.00	44.1
156	CES9S1	Ephemeral	Culvert	Rail	--	--	0.00	297.3
156	CES9S1	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	186.8
156	CES9S1	Ephemeral	Viaduct	Rail	--	--	200.1	0.00
156	CES9S2	Ephemeral	Culvert	Access Road	--	--	0.00	262.4
156	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	102.4
157	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	53.4
157	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	190.6
157	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	180.5
157	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	248.7
157	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	3.4	0.00
157	Unnamed	Intermittent	Viaduct	Rail	--	--	216.5	0.00
158	CES9S9	Intermittent	Viaduct	Access Road	--	--	83.1	0.00
158	CES9S9	Intermittent	Viaduct	Rail	--	--	230.1	0.00
158	Unnamed	Intermittent	Viaduct	Access Road	--	--	68.8	0.00
158	Unnamed	Intermittent	Viaduct	Access Road	--	--	33.3	0.00
158	Unnamed	Intermittent	Viaduct	Access Road	--	--	12.7	0.00
158	Unnamed	Intermittent	Viaduct	Rail	--	--	161.4	0.00
158	Unnamed	Intermittent	Viaduct	Rail	--	--	196.3	0.00
158	Unnamed	Intermittent	Viaduct	Rail	--	--	32.7	0.00
159	CET9S3	Ephemeral	Excavation	Access Road	--	--	0.00	50.4
159	CET9S3	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	32.1
159	CET9S3	Ephemeral	Excavation	Rail	--	--	0.00	262.8
159	CET9S4	Ephemeral	Culvert	Access Road	--	--	0.00	99.5
159	CET9S4	Ephemeral	Culvert	Rail	--	--	0.00	774.4
159	CET9S4	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	189.9

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	**Stream ID/Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 3C**		**Segment 4**	
					Temp	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**	
159	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	55.9
159	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	2.0
159	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	197.0
159	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	142.5
160	CET9S7	Ephemeral	Viaduct	Rail	--	--	693.8	0.00
160	Unnamed	Artificial Path	Viaduct	Rail	--	--	14.5	0.00
161	CET9S10	Ephemeral	Culvert	Access Road	--	--	0.00	80.6
161	CET9S10	Ephemeral	Overhead	Overhead Utilities	--	--	271.9	0.00
161	CET9S9	Ephemeral	Culvert	Access Road	--	--	0.00	44.4
161	CET9S9	Ephemeral	Culvert	Rail	--	--	0.00	314.9
161	CET9S9	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	27.6
161	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	129.4
162	CEU9S2	Ephemeral	Viaduct	Rail	--	--	143.5	0.00
162	Unnamed	Intermittent	Viaduct	Access Road	--	--	64.8	0.00
162	Unnamed	Intermittent	Viaduct	Access Road	--	--	6.7	0.00
162	Unnamed	Intermittent	Viaduct	Access Road	--	--	131.6	0.00
163	CEU9S5	Ephemeral	Viaduct	Access Road	--	--	25.4	0.00
163	CEU9S5	Ephemeral	Viaduct	Rail	--	--	97.2	0.00
163	Patton Creek	Intermittent	Viaduct	Rail	--	--	446.8	0.00
164	Perry Creek	Intermittent	Viaduct	Access Road	--	--	13.7	0.00
164	Perry Creek	Intermittent	Viaduct	Rail	--	--	95.0	0.00
166	Chambers Creek	Intermittent	Viaduct	Access Road	--	--	42.2	0.00
166	Chambers Creek	Intermittent	Viaduct	Rail	--	--	87.6	0.00
				Total	**15,206.8**	**4,507.5**	**5,690.4**	**4,922.4**

Source: USGS, 2018; FNI, 2018

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
61	CER8EW11	Emergent	Rail	Fill	--	--	0.00	<0.01
61	CER8EW17	Emergent	Rail	Fill	--	--	0.00	0.04
61	CER8EW10	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
61	CER8EW11	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
61	CER8EW9	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
99	PFO1C	Forested	Access Road	Conversion	0.00	0.01	--	--
99	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--
99	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--
99	PFO1A	Forested	Access Road	Conversion	0.00	0.10	--	--
99	PFO1A	Forested	Access Road	Conversion	0.00	0.12	--	--
99	PFO1A	Forested	Rail	Conversion	0.00	0.44	--	--
99	PFO1A	Forested	Rail	Conversion	0.00	0.60	--	--
99	PFO1C	Forested	Temporary Fill	Fill	0.76	0.00	--	--
99	PFO1A	Forested	Temporary Fill	Fill	1.8	0.00	--	--
99	PFO1C	Forested	Overhead Utilities	Overhead	0.14	0.00	--	--
100	PFO1C	Forested	Access Road	Conversion	0.00	0.04	--	--
100	PFO1C	Forested	Rail	Conversion	0.00	0.18	--	--
100	PEM1F	Emergent	Rail	Fill	0.00	0.11	--	--
101	PFO1C	Forested	Access Road	Conversion	0.00	0.09	--	--
101	PFO1C	Forested	Rail	Conversion	0.00	0.09	--	--
101	PSS1/EM1A	Scrub/Shrub	Access Road	Conversion	0.00	1.9	--	--
101	PSS1/EM1A	Scrub/Shrub	Rail	Conversion	0.00	2.6	--	--
101	PEM1Ch	Emergent	Access Road	Viaduct	0.37	0.00	--	--
104	PFO1A	Forested	Access Road	Conversion	0.00	0.05	--	--
104	PFO1A	Forested	Rail	Conversion	0.00	0.09	--	--
104	PEM1C	Emergent	Access Road	Viaduct	0.03	0.00	--	--
104	PEM1C	Emergent	Rail	Viaduct	0.06	0.00	--	--
111	PEM1A	Emergent	Rail	Viaduct	0.06	0.00	--	--
113	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	0.12	--	--
113	PFO1A	Forested	Access Road	Fill	0.00	0.07	--	--
115	PEM1C	Emergent	Access Road	Viaduct	0.05	0.00	--	--
115	PEM1C	Emergent	Rail	Viaduct	0.05	0.00	--	--
116	PFO1A	Forested	Access Road	Conversion	0.00	0.08	--	--
116	PFO1A	Forested	Rail	Conversion	0.00	2.6	--	--
154	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.05

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 3C**		**Segment 4**	
					Temp	**Perm**	**Temp**	**Perm**
					acres		**acres**	
154	PFO1C	Forested	Maintenance Facility	Fill	--	--	0.00	0.01
154	CER8SW1	Scrub/Shrub	Rail	Fill	--	--	0.00	0.02
154	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.17
154	CER8EW18	Emergent	Temporary Fill	Fill	--	--	<0.01	0.00
154	CER8EW8	Emergent	Temporary Fill	Fill	--	--	0.02	0.00
154	CER8EW4	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
154	CER8EW6	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
154	CER8EW7	Emergent	Temporary Fill	Fill	--	--	0.04	0.00
154	CER8EW5	Emergent	Temporary Fill	Fill	--	--	0.07	0.00
154	CER8EW3	Emergent	Temporary Fill	Fill	--	--	0.16	0.00
155	PFO1A	Forested	Access Road	Conversion	--	--	0.00	<0.01
155	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.01
155	CER8FW5	Forested	Rail	Conversion	--	--	0.00	0.06
155	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.07
155	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.93
155	CER8FW5	Forested	Utilities	Excavation	--	--	<0.01	0.00
155	CER8EW14	Emergent	Utilities	Excavation	--	--	0.02	0.00
155	CER8EW15	Emergent	Rail	Viaduct	--	--	<0.01	0.00
155	CER8EW16	Emergent	Access Road	Viaduct	--	--	0.01	0.00
155	CER8EW14	Emergent	Rail	Viaduct	--	--	0.01	0.00
155	CER8EW12	Emergent	Access Road	Viaduct	--	--	0.01	0.00
155	CER8EW15	Emergent	Access Road	Viaduct	--	--	0.01	0.00
155	CER8EW13	Emergent	Rail	Viaduct	--	--	0.02	0.00
155	CER8EW16	Emergent	Rail	Viaduct	--	--	0.05	0.00
155	CER8EW12	Emergent	Rail	Viaduct	--	--	0.06	0.00
156	CES8EW1	Emergent	Rail	Excavation	--	--	0.00	0.06
157	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.06
161	CEU9EW4	Emergent	Access Road	Fill	--	--	0.00	0.06
161	CEU9EW4	Emergent	Rail	Fill	--	--	0.00	0.12
162	CEU9EW3	Emergent	Access Road	Viaduct	--	--	0.01	0.00
162	CEU9EW3	Emergent	Rail	Viaduct	--	--	0.05	0.00
163	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.18
164	PFO1A	Forested	Access Road	Conversion	--	--	0.00	0.08
164	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.65
164	PEM1C	Emergent	Access Road	Viaduct	--	--	0.04	0.00
164	PEM1A	Emergent	Access Road	Viaduct	--	--	0.04	0.00

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
164	PEM1C	Emergent	Access Road	Viaduct	--	--	0.07	0.00
164	PEM1A	Emergent	Rail	Viaduct	--	--	0.28	0.00
164	PEM1C	Emergent	Rail	Viaduct	--	--	0.55	0.00
164	PEM1C	Emergent	Rail	Viaduct	--	--	0.61	0.00
				Total	**3.3**	**9.4**	**2.3**	**2.6**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM - Emergent
EM1 - Persistent Emergent
FO - Forested
FO1 - Broad-leaved Deciduous Forested
SS - Scrub-Shrub
SS1 - Broad-leaved Deciduous Scrub-Shrub
A - Temporarily Flooded
C - Seasonally Flooded
h – Diked/Impounded
'--' - not present

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
61	CER8PD1	Pond	Rail	Fill	--	--	0.00	0.16
61	CER8PD2	Pond	Temporary Fill	Fill	--	--	0.72	0.00
61	CER8PD3	Pond	Temporary Fill	Fill	--	--	0.04	0.00
61	CER8PD4	Pond	Temporary Fill	Fill	--	--	0.31	0.00
98	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--
98	Unnamed	Pond	Access Road	Fill	0.00	0.12	--	--
98	Unnamed	Pond	Rail	Fill	0.00	0.15	--	--
99	Unnamed	Pond	Temporary Fill	Fill	0.09	0.00	--	--
99	Unnamed	Pond	Temporary Fill	Fill	0.11	0.00	--	--
99	Unnamed	Pond	Temporary Fill	Fill	0.44	0.00	--	--
99	Unnamed	Pond	Temporary Fill	Fill	0.48	0.00	--	--
99	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--
100	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.08	--	--
100	Unnamed	Pond	Access Road	Fill	0.00	0.07	--	--
100	Unnamed	Pond	Rail	Fill	0.00	0.04	--	--
100	Unnamed	Pond	Rail	Fill	0.00	0.21	--	--
100	Unnamed	Pond	Access Road	Viaduct	<0.01	0.00	--	--
102	Unnamed	Pond	Access Road	Viaduct	0.18	0.00	--	--
102	Unnamed	Pond	Rail	Viaduct	0.12	0.00	--	--
102	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--
102	Unnamed	Pond	Rail	Viaduct	0.07	0.00	--	--
104	Unnamed	Pond	Utilities	Excavation	0.07	0.00	--	--
104	Unnamed	Pond	Rail	Fill	0.00	0.01	--	--
105	Unnamed	Pond	Access Road	Viaduct	0.01	0.00	--	--
106	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.09	--	--
107	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.10	--	--
107	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.12	--	--
107	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.67	--	--
107	Unnamed	Pond	Access Road	Viaduct	<0.01	0.00	--	--
107	Unnamed	Pond	Access Road	Viaduct	0.13	0.00	--	--
107	Unnamed	Pond	Access Road	Viaduct	0.16	0.00	--	--
107	Unnamed	Pond	Rail	Viaduct	0.14	0.00	--	--
109	Unnamed	Pond	Access Road	Fill	0.00	0.02	--	--
110	Unnamed	Pond	Access Road	Viaduct	0.03	0.00	--	--
110	Unnamed	Pond	Access Road	Viaduct	0.06	0.00	--	--
110	Unnamed	Pond	Access Road	Viaduct	0.06	0.00	--	--
110	Unnamed	Pond	Rail	Viaduct	0.08	0.00	--	--

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
154	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	0.03
154	CER8PD11	Pond	Rail	Fill	--	--	0.00	0.08
154	CER8PD6	Pond	Temporary Fill	Fill	--	--	0.22	0.00
154	CER8PD7	Pond	Temporary Fill	Fill	--	--	0.16	0.00
154	CER8PD8	Pond	Temporary Fill	Fill	--	--	0.22	0.00
154	CER8PD9	Pond	Temporary Fill	Fill	--	--	0.24	0.00
154	Unnamed	Pond	Rail	Viaduct	--	--	0.22	0.00
154	CER8PD9	Pond	Rail	Viaduct	--	--	<0.01	0.00
155	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01
155	Unnamed	Pond	Access Road	Fill	--	--	0.00	<0.01
155	Unnamed	Pond	Rail	Fill	--	--	0.00	0.03
155	Unnamed	Pond	Rail	Fill	--	--	0.00	0.18
155	CER8PD22	Pond	Access Road	Viaduct	--	--	0.02	0.00
155	CER8PD23	Pond	Access Road	Viaduct	--	--	0.03	0.00
155	CER8PD23	Pond	Access Road	Viaduct	--	--	0.11	0.00
155	CER8PD22	Pond	Rail	Viaduct	--	--	0.04	0.00
155	CER8PD23	Pond	Rail	Viaduct	--	--	0.07	0.00
155	CER8PD23	Pond	Rail	Viaduct	--	--	0.11	0.00
156	CES8PD3	Pond	Access Road	Excavation	--	--	0.00	0.02
156	CES9PD1	Pond	Access Road	Excavation	--	--	0.00	0.04
156	CES9PD1	Pond	Rail	Excavation	--	--	0.00	0.02
156	CES8PD2	Pond	Access Road	Fill	--	--	0.00	0.25
156	CES8PD2	Pond	Rail	Fill	--	--	0.00	0.47
157	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01
157	CES9PD5	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.05
157	Unnamed	Pond	Rail	Fill	--	--	0.00	0.15
157	CES9PD5	Pond	Rail	Fill	--	--	0.00	0.79
157	CES9PD4	Pond	Rail	Viaduct	--	--	0.10	0.00
158	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.03	0.00
158	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.08	0.00
159	CET9PD4	Pond	Access Road	Fill	--	--	0.00	0.05
159	CET9PD6	Pond	Access Road	Fill	--	--	0.00	0.42
159	CET9PD7	Pond	Access Road	Fill	--	--	0.00	0.07
159	CET9PD4	Pond	Rail	Fill	--	--	0.00	<0.01
159	CET9PD6	Pond	Rail	Fill	--	--	0.00	0.24
159	CET9PD7	Pond	Rail	Fill	--	--	0.00	0.05
160	Unnamed	Pond	Rail	Fill	--	--	0.00	0.09

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
160	Unnamed	Pond	Rail	Viaduct	--	--	0.06	0.00
160	Unnamed	Pond	Rail	Viaduct	--	--	0.07	0.00
160	CET9PD18	Pond	Rail	Viaduct	--	--	0.05	0.00
161	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.19
161	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.10
161	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.15
161	CET9PD20	Pond	Access Road	Fill	--	--	0.00	0.05
161	CET9PD20	Pond	Rail	Fill	--	--	0.00	0.24
162	CEU9PD5	Pond	Access Road	Viaduct	--	--	0.03	0.00
162	CEU9PD7	Pond	Access Road	Viaduct	--	--	0.01	0.00
162	Unnamed	Pond	Rail	Viaduct	--	--	0.02	0.00
162	CEU9PD5	Pond	Rail	Viaduct	--	--	0.06	0.00
162	CEU9PD7	Pond	Rail	Viaduct	--	--	0.01	0.00
163	CEU9PD11	Pond	Rail	Excavation	--	--	0.00	0.04
165	Unnamed	Pond	Access Road	Viaduct	--	--	0.06	0.00
165	Unnamed	Pond	Rail	Viaduct	--	--	0.07	0.00
165	Unnamed	Pond	Rail	Viaduct	--	--	0.08	0.00
				Total	**2.2**	**1.7**	**3.2**	**4.0**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Limestone County

Table 13: Estimated Stream Impacts – Limestone County						
Natural Resources Mapbook Page #	Stream ID/Stream Name*	Classification	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					linear feet	
166	Unnamed	Intermittent	Culvert	Access Road	0.00	45.8
166	Unnamed	Intermittent	Culvert	Rail	0.00	200.1
166	Unnamed	Intermittent	Culvert	Rail	0.00	661.5
166	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	110.1
166	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	184.7
166	Unnamed	Intermittent	Viaduct	Access Road	129.3	0.00
166	Unnamed	Intermittent	Viaduct	Rail	13.3	0.00
166	CEV9S12	Ephemeral	Viaduct	Rail	39.9	0.00
166	CEV9S7	Ephemeral	Viaduct	Rail	120.6	0.00
167	CEW9S13	Ephemeral	Culvert	Rail	0.00	125.3
167	Unnamed	Intermittent	Viaduct	Access Road	21.5	0.00
167	Unnamed	Intermittent	Viaduct	Access Road	16.7	0.00
167	Unnamed	Intermittent	Viaduct	Access Road	7.4	0.00
167	CEV9S10	Ephemeral	Viaduct	Access Road	43.9	0.00
167	CEW9S1	Intermittent	Viaduct	Access Road	2.8	0.00
167	Unnamed	Intermittent	Viaduct	Rail	133.4	0.00
167	Unnamed	Intermittent	Viaduct	Rail	125.3	0.00
167	CEV9S10	Ephemeral	Viaduct	Rail	49.0	0.00
167	CEW9S1	Intermittent	Viaduct	Rail	104.8	0.00
168	Unnamed	Intermittent	Culvert	Access Road	0.00	113.5
168	Unnamed	Intermittent	Culvert	Access Road	0.00	62.3
168	Unnamed	Intermittent	Culvert	Rail	0.00	319.8
168	Unnamed	Intermittent	Culvert	Rail	0.00	80.7
168	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	78.8
168	Unnamed	Artificial Path	Viaduct	Rail	57.8	0.00
168	Unnamed	Intermittent	Viaduct	Rail	21.0	0.00
168	CEW9S9	Perennial	Viaduct	Rail	191.4	0.00
169	CEW9S100	Ephemeral	Culvert	Rail	0.00	795.9
169	CEW9S100	Ephemeral	Excavation	Stormwater Drainage	0.00	223.0
169	CEW9S12	Intermittent	Viaduct	Access Road	64.7	0.00
169	CEW9S99	Ephemeral	Viaduct	Access Road	62.5	0.00
169	CEW9S12	Intermittent	Viaduct	Rail	186.6	0.00
169	CEW9S99	Ephemeral	Viaduct	Rail	279.9	0.00
170	Unnamed	Intermittent	Viaduct	Access Road	50.2	0.00

Table 13: Estimated Stream Impacts – Limestone County						
Natural Resources Mapbook Page #	Stream ID/Stream Name*	Classification	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					linear feet	
170	Unnamed	Intermittent	Viaduct	Rail	292.6	0.00
170	Unnamed	Intermittent	Viaduct	Rail	601.2	0.00
171	CEX10S10	Ephemeral	Viaduct	Access Road	49.1	0.00
171	Coots Branch	Intermittent	Viaduct	Access Road	13.9	0.00
171	Unnamed	Intermittent	Viaduct	Rail	109.8	0.00
171	CEX10S10	Ephemeral	Viaduct	Rail	167.9	0.00
171	Coots Branch	Intermittent	Viaduct	Rail	178.3	0.00
171	Sanders Creek	Intermittent	Viaduct	Rail	86.9	0.00
172	Unnamed	Intermittent	Viaduct	Rail	63.5	0.00
172	Lies Branch	Intermittent	Viaduct	Rail	115.4	0.00
173	Unnamed	Intermittent	Viaduct	Rail	132.3	0.00
173	Unnamed	Intermittent	Viaduct	Rail	253.9	0.00
173	Lambs Creek	Intermittent	Viaduct	Rail	230.4	0.00
				Total	**4,017.2**	**3,001.7**

Source: USGS, 2018; FNI, 2018

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 14: Estimated Wetland Impacts – Limestone County						
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
167	PFO1C	Forested	Access Road	Conversion	0.00	0.02
167	PFO1C	Forested	Rail	Conversion	0.00	0.08
168	PFO1A	Forested	Rail	Conversion	0.00	0.56
168	CEW9EW8	Emergent	Rail	Viaduct	0.01	0.00
168	CEW9EW13	Emergent	Rail	Viaduct	0.06	0.00
168	CEW9EW12	Emergent	Rail	Viaduct	0.41	0.00
168	CEW9EW14	Emergent	Rail	Viaduct	0.74	0.00
169	PFO1C	Forested	Access Road	Conversion	0.00	<0.01
169	CEW9FW99	Forested	Rail	Conversion	0.00	0.08
170	PFO1C	Forested	Access Road	Conversion	0.00	0.02
170	PFO1C	Forested	Rail	Conversion	0.00	0.27
170	PEM1C	Emergent	Rail	Viaduct	0.12	0.00

Table 14: Estimated Wetland Impacts – Limestone County						
Natural Resources Mapbook Page #	**Wetland ID/Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 4**	
					Temp	**Perm**
					acres	
171	PFO1C	Forested	Access Road	Conversion	0.00	0.01
171	PFO1C	Forested	Rail	Conversion	0.00	0.05
171	PFO1C	Forested	Rail	Conversion	0.00	0.06
171	CEX10EW2	Emergent	Access Road	Viaduct	0.01	0.00
172	PFO1C	Forested	Rail	Conversion	0.00	0.12
172	CEX10EW3	Emergent	Access Road	Viaduct	0.01	0.00
172	CEX10EW2	Emergent	Rail	Viaduct	0.07	0.00
172	CEY10EW1	Emergent	Rail	Viaduct	0.61	0.00
173	PFO1C	Forested	Rail	Conversion	0.00	0.05
				Total	**2.0**	**1.3**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type

P - Palustrine
FO – Forested
FO1 - Broad-leaved Deciduous Forested
C – Seasonally Flooded
EM - Emergent
EM1 – Persistent Emergent
A - Temporarily Flooded

Table 15: Estimated Waterbody Impacts – Limestone County						
Natural Resources Mapbook Page #	**Waterbody ID/Name ***	**Waterbody Type**	**Construction Type**	**Crossing Type**	**Segment 4**	
					Temp	**Perm**
					acres	
167	CEW9PD26	Pond	Rail	Fill	0.00	0.02
168	CEW9PD10	Pond	Rail	Viaduct	0.14	0.00
168	Unnamed	Pond	Rail	Viaduct	0.08	0.00
170	Unnamed	Pond	Rail	Fill	0.00	0.15
171	CEX10PD25	Pond	Access Road	Fill	0.00	0.03
171	CEX10PD25	Pond	Rail	Fill	0.00	0.05
171	Unnamed	Pond	Rail	Fill	0.00	0.03
171	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.11
172	CEX10PD26	Pond	Access Road	Viaduct	0.03	0.00
172	CEX10PD37	Pond	Access Road	Viaduct	0.04	0.00
172	CEY10PD3	Pond	Rail	Viaduct	<0.01	0.00
172	CEY10PD6	Pond	Rail	Viaduct	0.05	0.00
172	CEX10PD26	Pond	Rail	Viaduct	0.12	0.00
172	CEY10PD4	Pond	Rail	Viaduct	0.25	0.00
173	CEY10PD14	Pond	Rail	Viaduct	0.04	0.00
173	CEY10PD14	Pond	Utilities	Excavation	<0.01	0.00
				Total	**0.74**	**0.40**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Leon County

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
116	Unnamed	Intermittent	Viaduct	Access Road	62.7	0.00	--	--
116	Unnamed	Intermittent	Viaduct	Rail	169.4	0.00	--	--
117	Cane Branch	Intermittent	Viaduct	Access Road	61.9	0.00	--	--
117	Cane Branch	Intermittent	Viaduct	Rail	85.0	0.00	--	--
117	Cane Branch	Intermittent	Viaduct	Temporary Fill	50.4	0.00	--	--
117	Unnamed	Intermittent	Culvert	Rail	0.00	179.1	--	--
117	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	204.7	--	--
117	Unnamed	Intermittent	Viaduct	Access Road	8.6	0.00	--	--
117	Unnamed	Intermittent	Viaduct	Access Road	55.8	0.00	--	--
117	Unnamed	Intermittent	Viaduct	Access Road	239.9	0.00	--	--
117	Unnamed	Intermittent	Viaduct	Rail	36.2	0.00	--	--
117	Unnamed	Intermittent	Viaduct	Rail	83.1	0.00	--	--
117	Unnamed	Intermittent	Viaduct	Rail	178.0	0.00	--	--
118	Copper Creek	Intermittent	Viaduct	Access Road	107.8	0.00	--	--
118	Copper Creek	Intermittent	Viaduct	Rail	117.1	0.00	--	--
119	Bliss Creek	Perennial	Viaduct	Access Road	146.9	0.00	--	--
119	Bliss Creek	Perennial	Viaduct	Rail	129.3	0.00	--	--
119	Unnamed	Intermittent	Viaduct	Access Road	113.4	0.00	--	--
119	Unnamed	Perennial	Viaduct	Access Road	132.8	0.00	--	--
119	Unnamed	Intermittent	Viaduct	Access Road	185.6	0.00	--	--
119	Unnamed	Intermittent	Viaduct	Rail	148.8	0.00	--	--
119	Unnamed	Intermittent	Viaduct	Rail	125.1	0.00	--	--
120	Right Branch	Intermittent	Viaduct	Access Road	108.6	0.00	--	--
120	Right Branch	Intermittent	Viaduct	Rail	120.0	0.00	--	--
120	Unnamed	Intermittent	Viaduct	Access Road	464.9	0.00	--	--
120	Unnamed	Intermittent	Viaduct	Rail	133.4	0.00	--	--
121	Unnamed	Intermittent	Viaduct	Access Road	224.6	0.00	--	--
121	Unnamed	Intermittent	Viaduct	Access Road	166.2	0.00	--	--
121	Unnamed	Intermittent	Viaduct	Rail	127.4	0.00	--	--
121	Unnamed	Intermittent	Viaduct	Rail	123.2	0.00	--	--
122	Unnamed	Intermittent	Culvert	Access Road	0.00	280.0	--	--
122	Unnamed	Intermittent	Culvert	Access Road	0.00	115.9	--	--
122	Unnamed	Intermittent	Culvert	Access Road	0.00	108.6	--	--
122	Unnamed	Intermittent	Culvert	Rail	0.00	210.9	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
122	Unnamed	Intermittent	Culvert	Rail	0.00	139.3	--	--
122	Unnamed	Intermittent	Excavation	Access Road	0.00	108.8	--	--
122	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	0.01	--	--
122	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	107.7	--	--
122	Unnamed	Artificial Path	Overhead	Overhead Utilities	227.4	0.00	--	--
122	Unnamed	Intermittent	Overhead	Overhead Utilities	140.2	0.00	--	--
122	Unnamed	Intermittent	Viaduct	Access Road	212.4	0.00	--	--
122	Unnamed	Intermittent	Viaduct	Rail	130.3	0.00	--	--
123	Unnamed	Intermittent	Viaduct	Access Road	293.5	0.00	--	--
123	Unnamed	Intermittent	Viaduct	Rail	137.5	0.00	--	--
124	Lower Keechi Creek	Artificial Path	Viaduct	Access Road	168.7	0.00	--	--
124	Lower Keechi Creek	Artificial Path	Viaduct	Rail	163.2	0.00	--	--
124	Smith Branch	Intermittent	Viaduct	Access Road	746.0	0.00	--	--
124	Unnamed	Intermittent	Viaduct	Access Road	22.0	0.00	--	--
124	Unnamed	Intermittent	Viaduct	Access Road	117.5	0.00	--	--
124	Unnamed	Intermittent	Viaduct	Rail	142.6	0.00	--	--
125	Mill Branch	Intermittent	Viaduct	Access Road	95.6	0.00	--	--
125	Mill Branch	Intermittent	Viaduct	Rail	139.4	0.00	--	--
125	Tiger Branch	Intermittent	Excavation	Access Road	0.00	218.0	--	--
125	Tiger Branch	Intermittent	Excavation	Stormwater Drainage	0.00	66.0	--	--
125	Unnamed	Intermittent	Viaduct	Access Road	216.6	0.00	--	--
125	Unnamed	Intermittent	Viaduct	Rail	160.6	0.00	--	--
126	Bain Branch	Intermittent	Viaduct	Access Road	197.8	0.00	--	--
126	Bain Branch	Intermittent	Viaduct	Rail	119.1	0.00	--	--
126	Unnamed	Intermittent	Culvert	Access Road	0.00	351.8	--	--
126	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	64.6	--	--
126	Unnamed	Intermittent	Viaduct	Access Road	123.5	0.00	--	--
126	Unnamed	Intermittent	Viaduct	Rail	151.2	0.00	--	--
127	Beaver Creek	Perennial	Viaduct	Access Road	308.0	0.00	--	--
127	Beaver Creek	Perennial	Viaduct	Rail	242.6	0.00	--	--
127	Unnamed	Intermittent	Culvert	Rail	0.00	33.6	--	--
127	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	132.3	--	--
127	Unnamed	Intermittent	Viaduct	Access Road	466.0	0.00	--	--
127	Unnamed	Intermittent	Viaduct	Access Road	626.8	0.00	--	--
127	Unnamed	Intermittent	Viaduct	Rail	150.9	0.00	--	--
128	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	126.7	--	--
128	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	235.0	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
128	Unnamed	Intermittent	Viaduct	Access Road	130.5	0.00	--	--
128	Unnamed	Intermittent	Viaduct	Rail	121.6	0.00	--	--
129	Cedar Creek	Intermittent	Fill	Maintenance Facility	0.00	418.3	--	--
129	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	260.2	--	--
129	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	161.9	--	--
130	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	154.7	--	--
130	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	388.9	--	--
131	Spring Creek	Perennial	Fill	Maintenance Facility	0.00	217.8	--	--
131	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	185.1	--	--
131	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	518.4	--	--
131	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	180.1	--	--
131	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	160.4	--	--
131	Unnamed	Intermittent	Fill	Maintenance Facility	0.00	168.8	--	--
131	Unnamed	Intermittent	Viaduct	Rail	--	--	123.1	0.00
133	Unnamed	Intermittent	Viaduct	Rail	17.4	0.00	--	--
133	Unnamed	Intermittent	Viaduct	Rail	101.3	0.00	--	--
134, 184	Boggy Creek	Perennial	Viaduct	Rail	143.6	0.00	83.1	0.00
134	Boggy Creek	Perennial	Viaduct	Access Road	178.2	0.00	--	--
134	Unnamed	Intermittent	Viaduct	Access Road	262.5	0.00	--	--
134	Unnamed	Intermittent	Viaduct	Rail	119.5	0.00	--	--
135	Leona Branch	Intermittent	Viaduct	Access Road	129.8	0.00	--	--
135	Leona Branch	Intermittent	Viaduct	Access Road	282.1	0.00	--	--
135	Leona Branch	Intermittent	Viaduct	Rail	161.5	0.00	--	--
135	Unnamed	Artificial Path	Viaduct	Access Road	471.1	0.00	--	--
135	Unnamed	Intermittent	Viaduct	Rail	117.1	0.00	--	--
136	Unnamed	Intermittent	Viaduct	Access Road	330.4	0.00	--	--
136	Unnamed	Intermittent	Viaduct	Rail	136.8	0.00	--	--
137	Mustang Creek	Perennial	Viaduct	Access Road	440.5	0.00	--	--
137	Mustang Creek	Perennial	Viaduct	Rail	129.2	0.00	--	--
137	Spring Branch	Intermittent	Viaduct	Access Road	31.9	0.00	--	--
137	Spring Branch	Intermittent	Viaduct	Rail	117.8	0.00	--	--
138	Unnamed	Intermittent	Viaduct	Access Road	25.7	0.00	--	--
138	Unnamed	Intermittent	Viaduct	Access Road	33.4	0.00	--	--
138	Unnamed	Intermittent	Viaduct	Access Road	14.3	0.00	--	--
138	Unnamed	Intermittent	Viaduct	Rail	117.7	0.00	--	--
173	CEY10S7	Ephemeral	Culvert	Rail	--	--	0.00	285.9
173	CEY10S7	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	55.6

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
174	CEY10S8	Intermittent	Viaduct	Access Road	--	--	31.6	0.00
174	CEY10S8	Intermittent	Viaduct	Rail	--	--	120.6	0.00
174	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	155.5
175	CEZ11S2	Intermittent	Viaduct	Rail	--	--	166.7	0.00
176	CEZ11S8	Perennial	Viaduct	Rail	--	--	137.5	0.00
177	Cedar Creek	Intermittent	Viaduct	Access Road	--	--	117.3	0.00
177	Cedar Creek	Intermittent	Viaduct	Rail	--	--	261.1	0.00
177	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	109.2
177	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	640.7
177	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	0.00	75.5
177	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	112.6
177	Unnamed	Intermittent	Fill	Maintenance Facility	--	--	0.00	131.5
177	Unnamed	Intermittent	Fill	Maintenance Facility	--	--	0.00	421.9
177	Unnamed	Intermittent	Fill	Temporary Fill	--	--	949.7	0.00
177	Unnamed	Intermittent	Viaduct	Rail	--	--	298.0	0.00
177	Unnamed	Intermittent	Viaduct	Temporary Fill	--	--	465.2	0.00
178	Brushy Creek	Intermittent	Viaduct	Access Road	--	--	17.6	0.00
178	Brushy Creek	Intermittent	Viaduct	Rail	--	--	119.3	0.00
178	Little Brushy Creek	Intermittent	Culvert	Rail	--	--	0.00	253.5
178	Little Brushy Creek	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	358.9
178	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	64.1
178	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	374.4
178	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	410.3
178	Unnamed	Intermittent	Viaduct	Access Road	--	--	14.8	0.00
178	Unnamed	Intermittent	Viaduct	Rail	--	--	123.7	0.00
178	Unnamed	Intermittent	Viaduct	Rail	--	--	143.7	0.00
179	Little Brushy Creek	Intermittent	Viaduct	Access Road	--	--	83.8	0.00
179	Little Brushy Creek	Intermittent	Viaduct	Rail	--	--	1,142.1	0.00
179	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	15.8	0.00
180	CEAA13S10	Ephemeral	Excavation	Rail	--	--	0.00	80.7
180	CEAA13S11	Ephemeral	Culvert	Rail	--	--	0.00	153.2
180	CEAA13S11	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	24.9
180	CEAA13S12	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	155.5
180	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	262.3	0.00
180	Unnamed	Intermittent	Viaduct	Rail	--	--	94.5	0.00
181	Spring Creek	Perennial	Culvert	Access Road	--	--	0.00	79.9
181	Spring Creek	Perennial	Viaduct	Rail	--	--	380.1	0.00

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
181	Unnamed	Artificial Path	Culvert	Access Road	--	--	0.00	248.2
181	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	239.4
181	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	292.5
181	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	282.8
181	Unnamed	Intermittent	Excavation	Utilities	--	--	21.1	0.00
181	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	554.9	0.00
181	Unnamed	Intermittent	Viaduct	Access Road	--	--	378.8	0.00
181	Unnamed	Intermittent	Viaduct	Rail	--	--	127.3	0.00
184	Unnamed	Intermittent	Viaduct	Rail	--	--	101.6	0.00
185	Unnamed	Intermittent	Viaduct	Access Road	--	--	167.8	0.00
185	Unnamed	Intermittent	Viaduct	Access Road	--	--	210.9	0.00
185	Unnamed	Intermittent	Viaduct	Rail	--	--	137.1	0.00
185	Unnamed	Intermittent	Viaduct	Rail	--	--	124.5	0.00
185	Unnamed	Intermittent	Viaduct	Rail	--	--	154.5	0.00
185	Unnamed	Intermittent	Viaduct	Rail	--	--	135.9	0.00
186	Yellow Branch	Intermittent	Viaduct	Access Road	--	--	164.2	0.00
186	Yellow Branch	Intermittent	Viaduct	Rail	--	--	201.0	0.00
187	CEAD13S2	Intermittent	Culvert	Rail	--	--	0.00	666.2
187	CEAD13S2	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	397.2
187	CEAD13S5	Ephemeral	Culvert	Rail	--	--	0.00	56.6
187	CEAD13S5	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	31.9
187	CEAD13S7	Ephemeral	Culvert	Access Road	--	--	0.00	68.6
187	CEAD13S7	Ephemeral	Culvert	Rail	--	--	0.00	28.1
187	CEAD13S8	Ephemeral	Culvert	Rail	--	--	0.00	448.7
187	Copeland Branch	Intermittent	Culvert	Rail	--	--	0.00	73.0
187	Copeland Branch	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	27.5
188	East Caney Creek	Intermittent	Viaduct	Access Road	--	--	21.7	0.00
188	East Caney Creek	Intermittent	Viaduct	Rail	--	--	141.3	0.00
188	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	27.7
				Total	**12,819.5**	**5,497.9**	**7,793.9**	**6,832.1**

Source: USGS, 2018; FNI, 2018

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 17: Estimated Wetland Impacts – Leon County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
117	PEM1C	Emergent	Temporary Fill	Fill	0.02	0.00	--	--
117	PEM1C	Emergent	Access Road	Viaduct	0.03	0.00	--	--
117	PEM1C	Emergent	Rail	Viaduct	0.06	0.00	--	--
118	PFO1A	Forested	Access Road	Conversion	0.00	0.05	--	--
118	PSS1/EM1A	Scrub/Shrub	Access Road	Conversion	0.00	0.09	--	--
119	PFO1C	Forested	Access Road	Conversion	0.00	<0.01	--	--
119	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--
119	PEM1C	Emergent	Access Road	Viaduct	0.06	0.00	--	--
120	PEM1A	Emergent	Access Road	Viaduct	0.05	0.00	--	--
120	PEM1C	Emergent	Access Road	Viaduct	0.05	0.00	--	--
120	PEM1C	Emergent	Rail	Viaduct	0.06	0.00	--	--
124	PEM1C	Emergent	Rail	Viaduct	0.07	0.00	--	--
124	PEM1A	Emergent	Rail	Viaduct	0.26	0.00	--	--
124	PEM1C	Emergent	Access Road	Viaduct	0.59	0.00	--	--
124	PEM1A	Emergent	Access Road	Viaduct	1.1	0.00	--	--
127	PFO1C	Forested	Rail	Conversion	0.00	0.07	--	--
127	PFO1C	Forested	Access Road	Conversion	0.00	0.16	--	--
128	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.08	--	--
129	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.25	--	--
131	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.16	--	--
131	PEM1A	Emergent	Rail	Viaduct	--	--	0.23	0.00
133	PFO1C	Forested	Rail	Conversion	0.00	0.05	--	--
134	PFO1A	Forested	Access Road	Conversion	0.00	0.12	--	--
134	PFO1F	Forested	Access Road	Conversion	0.00	0.25	--	--
134	PFO/EM1F	Forested	Access Road	Conversion	0.00	0.59	--	--
134	PEM1C	Emergent	Access Road	Viaduct	<0.01	0.00	--	--
134	PEM1F	Emergent	Access Road	Viaduct	0.04	0.00	--	--
134	PEM1/FO1F	Emergent	Access Road	Viaduct	0.33	0.00	--	--
134	PEM1C	Emergent	Rail	Viaduct	0.35	0.00	--	--
134	PEM1F	Emergent	Rail	Viaduct	0.82	0.00	--	--
136	PFO1A	Forested	Access Road	Conversion	0.00	2.1	--	--
137	PSS1C	Scrub/Shrub	Access Road	Conversion	0.00	0.01	--	--
137	PSS1C	Scrub/Shrub	Rail	Conversion	0.00	0.05	--	--
137	PFO1C	Forested	Rail	Conversion	0.00	0.06	--	--
137	PFO1C	Forested	Access Road	Conversion	0.00	0.21	--	--
137	PFO1A	Forested	Rail	Conversion	0.00	0.25	--	--
175	CEZ11EW5	Emergent	Rail	Viaduct	--	--	<0.01	0.00

Table 17: Estimated Wetland Impacts – Leon County								
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 3C**		**Segment 4**	
					Temp	**Perm**	**Temp**	**Perm**
					acres		**acres**	
175	CEZ11EW5	Emergent	Access Road	Viaduct	--	--	0.03	0.00
176	CEZ11FW3	Forested	Rail	Conversion	--	--	0.00	0.03
177	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.06
177	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.11
178	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.02
178	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.06
178	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.11
178	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.18
178	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.23
178	PEM1A	Emergent	Rail	Fill	--	--	0.00	0.42
178	PEM1C	Emergent	Access Road	Viaduct	--	--	0.01	0.00
178	PEM1C	Emergent	Rail	Viaduct	--	--	0.08	0.00
179	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.22
180	CEAA12EW3	Emergent	Rail	Viaduct	--	--	0.11	0.00
180	CEAA12EW2	Emergent	Access Road	Viaduct	--	--	0.16	0.00
180	CEAA12EW2	Emergent	Rail	Viaduct	--	--	0.24	0.00
181	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.14
186	PEM1Ch	Emergent	Access Road	Viaduct	--	--	0.08	0.00
186	PEM1Ch	Emergent	Rail	Viaduct	--	--	0.37	0.00
187	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	0.00	0.01
187	CEAD13EW1	Emergent	Rail	Fill	--	--	0.00	0.02
187	PFO1C	Forested	Rail	Fill	--	--	0.00	0.03
188	PFO1C	Forested	Access Road	Conversion	--	--	0.00	0.01
188	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.06
				Total	**3.9**	**4.6**	**1.3**	**1.7**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
SS1 - Broad-leaved Deciduous Scrub-Shrub
C - Seasonally Flooded
h - Diked/Impounded

EM - Emergent
FO - Forested
SS - Scrub-Shrub
A - Temporarily Flooded
F – Semi-permanently Flooded
'--' - not present

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
119	Unnamed	Pond	Rail	Viaduct	0.04	0.00	--	--
119	Unnamed	Pond	Access Road	Viaduct	0.68	0.00	--	--
121	Unnamed	Pond	Access Road	Viaduct	0.19	0.00	--	--
121	Unnamed	Pond	Rail	Viaduct	0.25	0.00	--	--
121	Unnamed	Pond	Access Road	Viaduct	0.30	0.00	--	--
122	Unnamed	Pond	Access Road	Excavation	0.00	0.06	--	--
122	Unnamed	Pond	Access Road	Fill	0.00	0.04	--	--
122	Unnamed	Pond	Overhead Utilities	Overhead	0.07	0.00	--	--
122	Unnamed	Pond	Overhead Utilities	Overhead	0.44	0.00	--	--
124	Unnamed	Pond	Access Road	Viaduct	0.37	0.00	--	--
125	Unnamed	Pond	Access Road	Viaduct	0.12	0.00	--	--
126	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.07	--	--
126	Unnamed	Pond	Access Road	Fill	0.00	0.02	--	--
126	Unnamed	Pond	Rail	Viaduct	0.07	0.00	--	--
126	Unnamed	Pond	Access Road	Viaduct	0.22	0.00	--	--
127	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--
127	Unnamed	Pond	Rail	Fill	0.00	0.02	--	--
127	Unnamed	Pond	Access Road	Fill	0.00	0.09	--	--
128	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.12	--	--
129	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.09	--	--
134	Unnamed	Pond	Access Road	Viaduct	0.48	0.00	--	--
135	Unnamed	Pond	Access Road	Viaduct	<0.01	0.00	--	--
135	Unnamed	Pond	Access Road	Viaduct	0.05	0.00	--	--
136	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--
173	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.02	0.00
173	CEY10PD16	Pond	Overhead Utilities	Overhead	--	--	0.25	0.00
173	Unnamed	Pond	Rail	Viaduct	--	--	0.05	0.00
173	CEY10PD16	Pond	Rail	Viaduct	--	--	0.17	0.00
175	CEZ11PD2	Pond	Access Road	Viaduct	--	--	0.12	0.00
175	CEZ11PD2	Pond	Rail	Viaduct	--	--	0.15	0.00
176	CEZ11PD11	Pond	Rail	Fill	--	--	0.00	0.01
176	CEZ11PD6	Pond	Rail	Fill	--	--	0.00	0.07
176	CEZ11PD5	Pond	Rail	Fill	--	--	0.00	0.22
176	CEZ11PD4	Pond	Rail	Viaduct	--	--	0.16	0.00
176	CEZ11PD3	Pond	Rail	Viaduct	--	--	1.5	0.00
177	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.13
177	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	<0.01

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
177	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
177	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	0.31
177	CEZ11PD7	Pond	Access Road	Viaduct	--	--	0.08	0.00
177	CEZ11PD7	Pond	Rail	Viaduct	--	--	0.23	0.00
178	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.17
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.20
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.34
179	CEAA12PD6	Pond	Rail	Fill	--	--	0.00	0.04
179	CEAA12PD6	Pond	Overhead Utilities	Overhead	--	--	0.10	0.00
180	CEAA13PD14	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.13
180	CEAA13PD14	Pond	Rail	Fill	--	--	0.00	0.55
180	CEAA12PD7	Pond	Access Road	Viaduct	--	--	0.01	0.00
180	CEAA12PD9	Pond	Rail	Viaduct	--	--	0.02	0.00
180	CEAA13PD10	Pond	Rail	Viaduct	--	--	0.06	0.00
180	CEAA12PD7	Pond	Rail	Viaduct	--	--	0.27	0.00
180	CEAA13PD10	Pond	Access Road	Viaduct	--	--	0.32	0.00
181	Unnamed	Pond	Access Road	Viaduct	--	--	0.08	0.00
181	Unnamed	Pond	Access Road	Viaduct	--	--	0.09	0.00
184	Unnamed	Lake	Rail	Viaduct	--	--	1.5	0.00
186	Unnamed	Pond	Access Road	Excavation	--	--	0.00	0.08
186	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.11
187	CEAD13PD14	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.09
187	Unnamed	Pond	Rail	Fill	--	--	0.00	<0.01
187	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.04
187	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05
187	CEAD13PD15	Pond	Access Road	Fill	--	--	0.00	0.06
187	Unnamed	Pond	Rail	Fill	--	--	0.00	0.07
187	Unnamed	Pond	Rail	Fill	--	--	0.00	0.09
187	CEAD13PD15	Pond	Rail	Fill	--	--	0.00	0.15
187	CEAD13PD17	Pond	Rail	Viaduct	--	--	0.13	0.00
187	CEAD13PD17	Pond	Access Road	Viaduct	--	--	0.45	0.00
				Total	**3.3**	**0.54**	**5.8**	**3.0**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Madison County

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
139	Larrison Creek	Intermittent	Culvert	Access Road	0.00	1,369.1	--	--
139	Twomile Creek	Intermittent	Viaduct	Access Road	124.9	0.00	--	--
139	Twomile Creek	Intermittent	Viaduct	Rail	163.4	0.00	--	--
139	Unnamed	Intermittent	Viaduct	Access Road	95.2	0.00	--	--
139	Unnamed	Intermittent	Viaduct	Rail	122.3	0.00	--	--
140	Larrison Creek	Intermittent	Culvert	Access Road	0.00	181.2	--	--
140	Larrison Creek	Intermittent	Culvert	Rail	0.00	507.6	--	--
140	Unnamed	Intermittent	Culvert	Access Road	0.00	152.1	--	--
140	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	49.9	--	--
140	Unnamed	Intermittent	Viaduct	Access Road	115.3	0.00	--	--
140	Unnamed	Intermittent	Viaduct	Rail	121.5	0.00	--	--
141	Greenbriar Creek	Intermittent	Viaduct	Access Road	140.1	0.00	--	--
141	Greenbriar Creek	Intermittent	Viaduct	Rail	465.3	0.00	--	--
142	Unnamed	Artificial Path	Culvert	Rail	0.00	170.7	--	--
142	Unnamed	Artificial Path	Excavation	Stormwater Drainage	0.00	338.5	--	--
142	Unnamed	Intermittent	Viaduct	Access Road	95.6	0.00	--	--
142	Unnamed	Intermittent	Viaduct	Rail	348.4	0.00	--	--
143	Greenbriar Creek	Intermittent	Viaduct	Access Road	122.2	0.00	--	--
143	Greenbriar Creek	Intermittent	Viaduct	Rail	186.5	0.00	--	--
143	Unnamed	Intermittent	Viaduct	Access Road	124.9	0.00	--	--
143	Unnamed	Intermittent	Viaduct	Rail	145.8	0.00	--	--
144	Caney Creek	Intermittent	Viaduct	Access Road	51.3	0.00	--	--
144	Caney Creek	Intermittent	Viaduct	Rail	276.3	0.00	--	--
144	Ferry Branch	Intermittent	Viaduct	Access Road	23.7	0.00	--	--
144	Ferry Branch	Intermittent	Viaduct	Rail	140.5	0.00	--	--
144	Unnamed	Intermittent	Viaduct	Access Road	12.9	0.00	--	--
144	Unnamed	Intermittent	Viaduct	Rail	338.4	0.00	--	--
144	Unnamed	Intermittent	Viaduct	Rail	118.7	0.00	--	--
145	Unnamed	Intermittent	Viaduct	Access Road	12.6	0.00	--	--
145	Unnamed	Intermittent	Viaduct	Rail	541.1	0.00	--	--
146	Pooles Branch	Intermittent	Viaduct	Access Road	6.0	0.00	--	--
146	Pooles Branch	Intermittent	Viaduct	Rail	207.3	0.00	--	--
146	Unnamed	Intermittent	Culvert	Access Road	0.00	128.5	--	--
146	Unnamed	Intermittent	Culvert	Rail	0.00	59.2	--	--

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
147	Iron Creek	Intermittent	Viaduct	Access Road	34.6	0.00	--	--
147	Iron Creek	Intermittent	Viaduct	Rail	121.6	0.00	--	--
147	Unnamed	Intermittent	Viaduct	Access Road	18.9	0.00	--	--
147	Unnamed	Intermittent	Viaduct	Rail	173.4	0.00	--	--
148	Kickapoo Creek	Intermittent	Viaduct	Access Road	79.6	0.00	--	--
148	Kickapoo Creek	Intermittent	Viaduct	Rail	363.4	0.00	--	--
148	Unnamed	Intermittent	Viaduct	Access Road	5.1	0.00	--	--
148	Unnamed	Intermittent	Viaduct	Access Road	23.3	0.00	--	--
148	Unnamed	Intermittent	Viaduct	Rail	380.8	0.00	--	--
148	Unnamed	Intermittent	Viaduct	Rail	204.3	0.00	--	--
149	Unnamed	Artificial Path	Viaduct	Access Road	102.4	0.00	--	--
149	Unnamed	Intermittent	Viaduct	Access Road	47.4	0.00	--	--
149	Unnamed	Artificial Path	Viaduct	Rail	243.3	0.00	--	--
149	Unnamed	Artificial Path	Viaduct	Rail	96.2	0.00	--	--
150	Bedias Creek	Perennial	Excavation	Utilities	--	--	137.3	0.00
150	Bedias Creek	Perennial	Overhead	Overhead Utilities	--	--	396.4	0.00
150	Bedias Creek	Perennial	Viaduct	Access Road	5.5	0.00	--	--
150	Bedias Creek	Perennial	Viaduct	Rail	122.6	0.00	150.9	0.00
150	CEAH14S4	Perennial	Excavation	Utilities	--	--	109.0	0.00
150	CEAH14S4	Perennial	Overhead	Overhead Utilities	--	--	29.5	0.00
150	CEAH14S4	Perennial	Viaduct	Rail	--	--	225.6	0.00
150	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	362.9	0.00
150	Unnamed	Intermittent	Viaduct	Access Road	6.6	0.00	--	--
150	Unnamed	Intermittent	Viaduct	Rail	128.4	0.00	--	--
189	Unnamed	Intermittent	Viaduct	Rail	--	--	555.6	0.00
190	Caney Creek	Intermittent	Viaduct	Rail	--	--	154.6	0.00
190	Salt Creek	Intermittent	Viaduct	Rail	--	--	328.7	0.00
190	Unnamed	Artificial Path	Viaduct	Rail	--	--	216.0	0.00
191	CEAE14S5	Ephemeral	Excavation	Utilities	--	--	80.3	0.00
191	CEAE14S5	Ephemeral	Fill	Structure	--	--	0.00	27.0
191	CEAE14S5	Ephemeral	Viaduct	Rail	--	--	13.8	0.00
191	Unnamed	Intermittent	Viaduct	Rail	--	--	118.4	0.00
192	Brushy Creek	Intermittent	Viaduct	Rail	--	--	167.0	0.00
192	CEAE14S7	Intermittent	Excavation	Utilities	--	--	9.7	0.00
192	CEAE14S7	Intermittent	Viaduct	Rail	--	--	238.2	0.00
192	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	179.8
192	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	899.8

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
192	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	37.6
192	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	141.1
192	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	31.2
192	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	978.9	0.00
192	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	71.5	0.00
192	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	399.0	0.00
192	Unnamed	Intermittent	Viaduct	Access Road	--	--	194.3	0.00
192	Unnamed	Intermittent	Viaduct	Rail	--	--	132.5	0.00
193	CEAF14S10	Ephemeral	Viaduct	Rail	--	--	355.1	0.00
193	CEAF14S11	Ephemeral	Viaduct	Access Road	--	--	252.5	0.00
193	CEAF14S12	Ephemeral	Viaduct	Access Road	--	--	185.5	0.00
193	Unnamed	Intermittent	Excavation	Utilities	--	--	78.4	0.00
193	Unnamed	Intermittent	Excavation	Utilities	--	--	85.4	0.00
193	Unnamed	Intermittent	Viaduct	Rail	--	--	268.6	0.00
194	CEAF14S13	Ephemeral	Culvert	Rail	--	--	0.00	233.9
194	CEAF14S13	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	142.1
194	CEAF14S6	Ephemeral	Viaduct	Rail	--	--	136.9	0.00
194	CEAF14S7	Intermittent	Culvert	Rail	--	--	0.00	440.6
194	CEAF14S7	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	334.9
195	CEAF14S9	Intermittent	Viaduct	Rail	--	--	605.5	0.00
195	CEAG14S19	Ephemeral	Viaduct	Rail	--	--	268.1	0.00
195	CEAG14S20	Ephemeral	Excavation	Utilities	--	--	6.4	0.00
195	CEAG14S20	Ephemeral	Viaduct	Rail	--	--	85.9	0.00
195	CEAG14S21	Ephemeral	Viaduct	Rail	--	--	143.6	0.00
195	CEAG14S4	Intermittent	Viaduct	Rail	--	--	173.8	0.00
195	CEAG14S6	Ephemeral	Viaduct	Rail	--	--	77.9	0.00
195	CEAG14S7	Ephemeral	Culvert	Rail	--	--	0.00	769.4
195	CEAG14S7	Ephemeral	Excavation	Stormwater Drainage	--	--	0.00	57.5
195	Unnamed	Intermittent	Viaduct	Access Road	--	--	15.9	0.00
195	Unnamed	Intermittent	Viaduct	Rail	--	--	5.1	0.00
197	CEAG14S10	Intermittent	Excavation	Utilities	--	--	424.4	0.00
197	CEAG14S10	Intermittent	Viaduct	Access Road	--	--	0.3	0.00
197	CEAG14S10	Intermittent	Viaduct	Rail	--	--	147.1	0.00
197	CEAG14S18	Perennial	Excavation	Utilities	--	--	11.4	0.00
197	CEAG14S18	Perennial	Viaduct	Rail	--	--	290.5	0.00
197	Kickapoo Creek	Intermittent	Excavation	Utilities	--	--	121.9	0.00
197	Kickapoo Creek	Intermittent	Viaduct	Rail	--	--	40.6	0.00

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	**Stream ID/ Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 3C**		**Segment 4**	
					Temp	**Perm**	**Temp**	**Perm**
					linear feet		**linear feet**	
197	Unnamed	Intermittent	Excavation	Utilities	--	--	86.8	0.00
197	Unnamed	Intermittent	Excavation	Utilities	--	--	97.3	0.00
197	Unnamed	Intermittent	Viaduct	Rail	--	--	124.6	0.00
197	Unnamed	Intermittent	Viaduct	Rail	--	--	147.7	0.00
198	CEAH14S1	Ephemeral	Excavation	Utilities	--	--	193.7	0.00
198	CEAH14S1	Ephemeral	Viaduct	Rail	--	--	178.0	0.00
198	CEAH14S14	Ephemeral	Excavation	Utilities	--	--	78.2	0.00
198	CEAH14S2	Intermittent	Excavation	Utilities	--	--	79.7	0.00
198	CEAH14S2	Intermittent	Viaduct	Rail	--	--	220.3	0.00
198	Unnamed	Intermittent	Excavation	Utilities	--	--	267.9	0.00
198	Unnamed	Intermittent	Excavation	Utilities	--	--	129.4	0.00
198	Unnamed	Intermittent	Viaduct	Rail	--	--	118.1	0.00
198	Unnamed	Intermittent	Viaduct	Rail	--	--	170.7	0.00
				Total	**6,257.3**	**2,956.7**	**10,743.3**	**3,294.9**

Source: USGS, 2018; FNI, 2018

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those “unnamed”) indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 20: Estimated Wetland Impacts – Madison County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
139	PEM1C	Emergent	Access Road	Fill	0.00	0.44	--	--
142	PFO1C	Forested	Access Road	Conversion	0.00	0.07	--	--
142	PFO1C	Forested	Rail	Conversion	0.00	0.12	--	--
143	PFO1A	Forested	Access Road	Conversion	0.00	0.07	--	--
143	PFO1A	Forested	Rail	Conversion	0.00	0.11	--	--
143	PEM1C	Emergent	Utilities	Excavation	0.02	0.00	--	--
144	PEM1A	Emergent	Systems	Fill	0.00	1.3	--	--
144	PEM1C	Emergent	Access Road	Viaduct	0.01	0.00	--	--
144	PEM1C	Emergent	Rail	Viaduct	0.02	0.00	--	--
144	PEM1A	Emergent	Rail	Viaduct	0.08	0.00	--	--
146	PFO1A	Forested	Access Road	Conversion	0.00	<0.01	--	--
146	PFO1A	Forested	Rail	Conversion	0.00	0.09	--	--
147	PFO1A	Forested	Access Road	Conversion	0.00	<0.01	--	--
147	PFO1A	Forested	Rail	Conversion	0.00	0.06	--	--
148	PFO1A	Forested	Access Road	Conversion	0.00	0.28	--	--
148	PFO1A	Forested	Rail	Conversion	0.00	3.7	--	--
150	PFO1A	Forested	Access Road	Conversion	0.00	0.50	--	--
150	PFO1A	Forested	Rail	Conversion	0.00	6.6	--	--
150	PFO1A	Forested	Overhead Utilities	Overhead	0.49	0.00	--	--
150	PFO1A	Forested	Rail	Conversion	--	--	0.00	4.9
150	CEAH14FW13	Forested	Utilities	Excavation	--	--	0.00	0.17
150	PFO1F	Forested	Utilities	Excavation	--	--	0.00	0.19
150	PFO1A	Forested	Utilities	Excavation	--	--	0.00	3.1
150	CEAH14EW5	Emergent	Overhead Utilities	Overhead	--	--	<0.01	0.00
150	CEAH14FW15	Forested	Overhead Utilities	Overhead	--	--	0.03	0.00
150	CEAH14FW14	Forested	Overhead Utilities	Overhead	--	--	0.06	0.00
150	CEAH14EW19	Emergent	Overhead Utilities	Overhead	--	--	0.14	0.00
150	PFO1F	Forested	Overhead Utilities	Overhead	--	--	0.32	0.00
150	PFO1A	Forested	Overhead Utilities	Overhead	--	--	9.7	0.00
150	CEAH14EW5	Emergent	Rail	Viaduct	--	--	0.03	0.00
150	CEAH14EW4	Emergent	Rail	Viaduct	--	--	0.17	0.00
189	PFO1Fh	Forested	Rail	Conversion	--	--	0.00	0.04
189	PEM1C	Emergent	Rail	Viaduct	--	--	0.13	0.00
190	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.07
190	PFO1C	Forested	Rail	Conversion	--	--	0.00	0.10
190	PEM1C	Emergent	Rail	Viaduct	--	--	0.04	0.00
192	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.40

Table 20: Estimated Wetland Impacts – Madison County								
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 3C**		**Segment 4**	
					Temp	**Perm**	**Temp**	**Perm**
					acres		**acres**	
194	CEAF14EW3	Emergent	Rail	Fill	--	--	0.00	0.01
194	CEAF14EW4	Emergent	Rail	Fill	--	--	0.00	0.02
194	CEAF14EW2	Emergent	Rail	Fill	--	--	0.00	0.03
196	CEAG14EW9	Emergent	Rail	Viaduct	--	--	0.06	0.00
197	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.01
197	PFO1A	Forested	Utilities	Excavation	--	--	0.00	0.06
197	PEM1Ah	Emergent	Utilities	Excavation	--	--	0.00	0.23
198	CEAH14FW12	Forested	Rail	Conversion	--	--	0.00	0.01
198	CEAH14FW12	Forested	Utilities	Excavation	--	--	0.00	0.01
198	CEAH14EW20	Emergent	Utilities	Excavation	--	--	0.00	0.01
198	CEAH14EW21	Emergent	Utilities	Excavation	--	--	0.00	0.02
198	CEAH14EW18	Emergent	Utilities	Excavation	--	--	0.00	0.05
198	CEAH14EW3	Emergent	Rail	Viaduct	--	--	0.05	0.00
198	CEAH14EW18	Emergent	Rail	Viaduct	--	--	0.25	0.00
				Total	**0.62**	**13.4**	**11.0**	**9.4**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
h - Diked/Impounded
EM - Emergent
FO - Forested
A - Temporarily Flooded
F - Semipermanently Flooded
'--' - not present

Table 21: Estimated Waterbody Impacts – Madison County								
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
139	Unnamed	Pond	Access Road	Fill	0.00	0.26	--	--
140	Unnamed	Pond	Access Road	Excavation	0.00	<0.01	--	--
140	Unnamed	Pond	Rail	Excavation	0.00	0.06	--	--
140	Unnamed	Pond	Rail	Excavation	0.00	0.15	--	--
140	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.19	--	--
140	Unnamed	Pond	Access Road	Fill	0.00	0.06	--	--
141	Unnamed	Pond	Access Road	Fill	0.00	0.13	--	--
141	Unnamed	Pond	Rail	Viaduct	0.02	0.00	--	--
141	Unnamed	Pond	Access Road	Viaduct	0.28	0.00	--	--
142	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.04	--	--
142	Unnamed	Pond	Access Road	Fill	0.00	0.01	--	--
142	Unnamed	Pond	Rail	Fill	0.00	0.03	--	--
142	Unnamed	Pond	Rail	Fill	0.00	0.40	--	--
143	Unnamed	Pond	Access Road	Viaduct	0.05	0.00	--	--
144	Unnamed	Swamp	Systems	Fill	0.00	1.5	--	--
144	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--
144	Unnamed	Swamp	Rail	Viaduct	0.16	0.00	--	--
144	Unnamed	Pond	Rail	Viaduct	0.22	0.00	--	--
145	Unnamed	Pond	Access Road	Fill	0.00	0.01	--	--
145	Unnamed	Pond	Rail	Fill	0.00	0.13	--	--
145	Unnamed	Pond	Rail	Fill	0.00	0.18	--	--
146	Unnamed	Swamp	Access Road	Viaduct	0.02	0.00	--	--
146	Unnamed	Swamp	Rail	Viaduct	0.11	0.00	--	--
147	Unnamed	Pond	Access Road	Viaduct	0.01	0.00	--	--
147	Unnamed	Pond	Rail	Viaduct	0.03	0.00	--	--
147	Unnamed	Pond	Rail	Viaduct	0.15	0.00	--	--
147	Unnamed	Pond	Access Road	Viaduct	0.22	0.00	--	--
148	Unnamed	Pond	Rail	Excavation	0.00	0.02	--	--
149	Unnamed	Pond	Access Road	Viaduct	0.04	0.00	--	--
149	Unnamed	Pond	Rail	Viaduct	0.04	0.00	--	--
149	Unnamed	Pond	Access Road	Viaduct	0.11	0.00	--	--
149	Unnamed	Pond	Rail	Viaduct	0.15	0.00	--	--
149	Unnamed	Pond	Rail	Viaduct	0.67	0.00	--	--
150	CEAH14PD10	Pond	Overhead Utilities	Overhead	--	--	0.12	0.00
150	CEAH14PD10	Pond	Overhead Utilities	Overhead	--	--	0.34	0.00
150	CEAH14PD6	Pond	Rail	Viaduct	--	--	0.05	0.00
190	Unnamed	Pond	Rail	Viaduct	--	--	0.80	0.00
191	CEAE14PD8	Pond	Access Road	Viaduct	--	--	0.06	0.00

Table 21: Estimated Waterbody Impacts – Madison County								
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
191	CEAE14PD8	Pond	Rail	Viaduct	--	--	0.18	0.00
192	Unnamed	Pond	Overhead Utilities	Overhead	--	--	0.01	0.00
194	CEAG14PD23	Pond	Rail	Fill	--	--	0.00	0.02
195	CEAG14PD11	Pond	Rail	Viaduct	--	--	0.02	0.00
196	CEAG14PD6	Pond	Access Road	Viaduct	--	--	0.03	0.00
197	CEAG14PD29	Pond	Utilities	Excavation	--	--	0.00	0.02
197	Unnamed	Pond	Utilities	Excavation	--	--	0.00	0.04
197	CEAG14PD99	Pond	Rail	Viaduct	--	--	0.02	0.00
197	Unnamed	Pond	Rail	Viaduct	--	--	0.04	0.00
197	CEAG14PD24	Pond	Rail	Viaduct	--	--	0.08	0.00
198	CEAH14PD4	Pond	Utilities	Excavation	--	--	0.00	<0.01
				Total	**2.3**	**3.1**	**1.8**	**0.08**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Grimes County

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
150	CEAH14S10	Ephemeral	Viaduct	Rail	--	--	100.6	0.00	--	--
150	CEAH14S200	Intermittent	Viaduct	Rail	--	--	123.3	0.00	--	--
150	CEAH14S7	Ephemeral	Excavation	Utilities	--	--	26.5	0.00	--	--
150	CEAH14S7	Ephemeral	Viaduct	Rail	--	--	21.4	0.00	--	--
150	CEAH14S8	Ephemeral	Viaduct	Rail	--	--	263.3	0.00	--	--
150	Unnamed	Intermittent	Overhead	Overhead Utilities	--	--	--	--		
150	Unnamed	Intermittent	Viaduct	Access Road	3.9	0.00	--	--	--	--
150	Unnamed	Intermittent	Viaduct	Access Road	36.5	0.00	--	--	--	--
150	Unnamed	Intermittent	Viaduct	Rail	119.2	0.00	--	--	--	--
150	Unnamed	Intermittent	Viaduct	Rail	144.7	0.00	--	--	--	--
151	CEAH14S11	Intermittent	Viaduct	Rail	--	--	185.0	0.00	--	--
151	CEAI15S1	Ephemeral	Viaduct	Rail	--	--	205.1	0.00	--	--
151	CEAI15S2	Ephemeral	Viaduct	Access Road	--	--	57.8	0.00	--	--
151	CEAI15S2	Ephemeral	Viaduct	Rail	--	--	71.1	0.00	--	--
151	CEAI15S7	Ephemeral	Viaduct	Rail	--	--	27.0	0.00	--	--
151	Panky Creek	Intermittent	Excavation	Stormwater Drainage	0.00	71.7	--	--	--	--
151	Panky Creek	Intermittent	Viaduct	Access Road	35.3	0.00	--	--	--	--
151	Panky Creek	Intermittent	Viaduct	Rail	262.7	0.00	--	--	--	--
151	Unnamed	Artificial Path	Culvert	Access Road	0.00	37.1	--	--	--	--
151	Unnamed	Artificial Path	Culvert	Access Road	--	--	0.00	37.1	--	--
151	Unnamed	Artificial Path	Culvert	Rail	0.00	99.6	--	--	--	--
151	Unnamed	Artificial Path	Culvert	Rail	--	--	0.00	99.6	--	--
151	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	0.00	77.2	--	--
151	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	0.00	77.2	--	--
151	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	248.6	--	--	--	--
151	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	712.2	--	--	--	--
151	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	247.7	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Access Road	5.6	0.00	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Access Road	17.7	0.00	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Access Road	135.5	0.00	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Access Road	--	--	33.5	0.00	--	--
151	Unnamed	Intermittent	Viaduct	Rail	123.7	0.00	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Rail	140.0	0.00	--	--	--	--
151	Unnamed	Intermittent	Viaduct	Rail	176.1	0.00	--	--	--	--

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
152	Panky Creek	Intermittent	Viaduct	Rail	--	--	--	--	529.2	0.00
152	Unnamed	Intermittent	Culvert	Access Road	--	--	0.00	1.3	--	--
152	Unnamed	Intermittent	Culvert	Rail	--	--	0.00	1.3	--	--
152	Unnamed	Intermittent	Viaduct	Access Road	88.2	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Access Road	228.1	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Access Road	104.7	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Rail	49.9	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Rail	73.8	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Rail	--	--	49.9	0.00	--	--
152	Unnamed	Intermittent	Viaduct	Rail	--	--	73.8	0.00	--	--
152	Unnamed	Intermittent	Viaduct	Rail	175.2	0.00	--	--	--	--
152	Unnamed	Intermittent	Viaduct	Rail	--	--	175.2	0.00	--	--
152	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	226.6	0.00
203	CEAJ15S1	Ephemeral	Culvert	Rail	--	--	--	--	0.00	384.2
203	CEAJ15S1	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	158.0
203	CEAJ15S11	Ephemeral	Culvert	Rail	--	--	--	--	0.00	281.1
203	CEAJ15S11	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	7.7
203	CEAJ15S12	Ephemeral	Culvert	Rail	--	--	--	--	0.00	263.2
203	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	195.8
204	South Bedias Creek	Intermittent	Viaduct	Access Road	--	--	--	--	23.2	0.00
204	South Bedias Creek	Intermittent	Viaduct	Rail	--	--	--	--	133.9	0.00
204	Turkey Creek	Intermittent	Culvert	Access Road	--	--	--	--	0.00	91.2
204	Turkey Creek	Intermittent	Culvert	Rail	--	--	--	--	0.00	843.2
204	Turkey Creek	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	0.00	649.5
204	Turkey Creek	Intermittent	Fill	Maintenance Facility	--	--	--	--	0.00	891.9
204	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	27.7	0.00
204	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	218.3	0.00
205	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	264.8
205	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	133.6
205	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	159.6
205	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	223.3
205	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	0.00	242.1
205	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	156.4
205	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	97.8
206	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	442.2

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
206	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	39.7	0.00
206	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	14.7	0.00
206	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	11.5	0.00
206	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	11.0	0.00
206	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	42.4	0.00
206	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	66.4	0.00
206	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	117.7	0.00
206	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	147.2	0.00
206	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	112.3	0.00
207	CEAK15S17	Ephemeral	Fill	Temporary Fill	--	--	--	--	205.2	0.00
207	CEAK15S18	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	242.1
207	CEAK15S19	Ephemeral	Culvert	Access Road	--	--	--	--	0.00	25.5
207	CEAK15S19	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	84.6
207	CEAK15S21	Ephemeral	Culvert	Access Road	--	--	--	--	0.00	44.5
207	CEAK15S8	Ephemeral	Culvert	Rail	--	--	--	--	0.00	426.0
207	CEAK15S8	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	294.0
207	CEAK15S9	Ephemeral	Viaduct	Temporary Fill	--	--	--	--	790.0	0.00
207	Unnamed	Intermittent	Fill	Temporary Fill	--	--	--	--	15.8	0.00
207	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	290.0	0.00
207	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	126.2	0.00
208	CEAK15S10	Ephemeral	Viaduct	Access Road	--	--	--	--	177.8	0.00
208	CEAK15S10	Ephemeral	Viaduct	Rail	--	--	--	--	149.1	0.00
208	CEAK15S10	Ephemeral	Viaduct	Temporary Fill	--	--	--	--	1,093.0	0.00
208	CEAK15S100	Ephemeral	Fill	Structure	--	--	--	--	0.00	156.4
208	CEAK15S100	Ephemeral	Viaduct	Rail	--	--	--	--	237.4	0.00
208	CEAK15S100	Ephemeral	Viaduct	Temporary Fill	--	--	--	--	95.7	0.00
208	CEAK15S11	Perennial	Overhead	Overhead Utilities	--	--	--	--	215.6	0.00
208	CEAK15S11	Perennial	Viaduct	Rail	--	--	--	--	204.3	0.00
208	CEAK15S11	Perennial	Viaduct	Rail	--	--	--	--	535.2	0.00
208	CEAK15S12	Intermittent	Overhead	Overhead Utilities	--	--	--	--	100.3	0.00
208	CEAK15S12	Intermittent	Viaduct	Rail	--	--	--	--	310.6	0.00
208	CEAK15S14	Ephemeral	Viaduct	Rail	--	--	--	--	6.6	0.00
208	CEAK15S15	Ephemeral	Viaduct	Temporary Fill	--	--	--	--	276.6	0.00
208	CEAK15S16	Ephemeral	Viaduct	Temporary Fill	--	--	--	--	376.8	0.00
208	CEAK15S9	Ephemeral	Viaduct	Access Road	--	--	--	--	213.9	0.00
208	CEAK15S9	Ephemeral	Viaduct	Rail	--	--	--	--	263.5	0.00
208	Unnamed	Intermittent	Viaduct	Temporary Fill	--	--	--	--	0.6	0.00

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
209	Sulphur Creek	Intermittent	Viaduct	Rail	--	--	--	--	288.5	0.00
209	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	117.8	0.00
209	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	468.9	0.00
209	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	160.3	0.00
210	CEAL15S5	Ephemeral	Culvert	Rail	--	--	--	--	0.00	295.9
210	CEAL15S5	Ephemeral	Culvert	Rail	--	--	--	--	0.00	77.2
210	CEAL15S8	Ephemeral	Excavation	Access Road	--	--	--	--	0.00	254.2
211	CEAL15S7	Ephemeral	Fill	Station	--	--	--	--	0.00	265.7
211	Unnamed	Artificial Path	Culvert	Access Road	--	--	--	--	0.00	269.9
211	Unnamed	Artificial Path	Culvert	Rail	--	--	--	--	0.00	390.0
211	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	0.00	303.0
211	Unnamed	Artificial Path	Fill	Maintenance Facility	--	--	--	--	0.00	122.8
211	Unnamed	Intermittent	Fill	Station	--	--	--	--	0.00	77.8
212	CEAM16S13	Ephemeral	Viaduct	Rail	--	--	--	--	48.6	0.00
212	CEAM16S3	Intermittent	Viaduct	Rail	--	--	--	--	121.0	0.00
212	Rocky Creek	Intermittent	Viaduct	Rail	--	--	--	--	240.6	0.00
212	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	431.4
212	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	223.3
212	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	0.00	66.9
212	Unnamed	Artificial Path	Excavation	Stormwater Drainage	--	--	--	--	0.00	336.4
212	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	252.4
212	Unnamed	Artificial Path	Excavation	Rail	--	--	--	--	0.00	38.3
212	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	294.0	0.00
213	CEAM16S11	Intermittent	Viaduct	Rail	--	--	--	--	172.8	0.00
213	CEAM16S6	Intermittent	Viaduct	Rail	--	--	--	--	6.5	0.00
213	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	76.8	0.00
214	CEAM16S10	Ephemeral	Viaduct	Rail	--	--	--	--	298.4	0.00
214	CEAM16S9	Ephemeral	Viaduct	Rail	--	--	--	--	263.8	0.00
214	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	124.8	0.00
214	Unnamed	Artificial Path	Viaduct	Rail	--	--	--	--	119.9	0.00
215	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	262.8
215	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	156.4
215	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	145.7	0.00
217	Bums Creek	Intermittent	Excavation	Utilities	--	--	--	--	68.3	0.00
217	Bums Creek	Intermittent	Viaduct	Rail	--	--	--	--	237.3	0.00
217	CEAO16S1	Intermittent	Viaduct	Rail	--	--	--	--	252.6	0.00
217	CEAO16S2	Intermittent	Viaduct	Rail	--	--	--	--	577.6	0.00

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
217	CEAO16S9	Ephemeral	Viaduct	Rail	--	--	--	--	739.7	0.00
217	Unnamed	Intermittent	Culvert	Rail	--	--	--	--	0.00	315.2
217	Unnamed	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	81.7
218	Haynie Creek	Intermittent	Viaduct	Rail	--	--	--	--	145.8	0.00
218	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	130.0	0.00
218	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	302.9	0.00
220	Caney Creek	Intermittent	Viaduct	Rail	--	--	--	--	128.2	0.00
220	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	238.2	0.00
220	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	147.9	0.00
221	CEAP16S10	Intermittent	Viaduct	Rail	--	--	--	--	113.5	0.00
221	CEAP16S9	Intermittent	Viaduct	Rail	--	--	--	--	246.8	0.00
222	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	131.1	0.00
223	CEAQ17S12	Ephemeral	Viaduct	Rail	--	--	--	--	85.5	0.00
223	CEAQ17S13	Ephemeral	Viaduct	Rail	--	--	--	--	34.3	0.00
223	CEAQ17S6	Ephemeral	Viaduct	Rail	--	--	--	--	125.7	0.00
223	Hurricane Creek	Intermittent	Viaduct	Rail	--	--	--	--	247.3	0.00
224	Kickapoo Creek	Intermittent	Viaduct	Rail	--	--	--	--	134.5	0.00
224	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	181.5	0.00
225	CEAR17S10	Ephemeral	Culvert	Rail	--	--	--	--	0.00	43.4
225	CEAR17S15	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	55.6
225	CEAR17S15	Ephemeral	Excavation	Rail	--	--	--	--	0.00	69.5
225	CEAR17S8	Intermittent	Culvert	Rail	--	--	--	--	0.00	199.8
225	CEAR17S8	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	175.1
225	CEAR17S9	Ephemeral	Culvert	Rail	--	--	--	--	0.00	234.9
225	CEAR17S9	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	179.7
225	CEAR17S95	Ephemeral	Culvert	Rail	--	--	--	--	0.00	109.2
225	CEAR17S95	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	17.4
225	CEAR17S96	Ephemeral	Culvert	Rail	--	--	--	--	0.00	82.7
225	CEAR17S97	Intermittent	Culvert	Rail	--	--	--	--	0.00	128.0
225	CEAR17S97	Intermittent	Excavation	Stormwater Drainage	--	--	--	--	0.00	63.4
225	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	280.8	0.00
226	CEAR17S11	Ephemeral	Culvert	Rail	--	--	--	--	0.00	29.2
226	CEAR17S11	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	108.1
226	CEAR17S12	Ephemeral	Culvert	Rail	--	--	--	--	0.00	217.3
226	CEAR17S13	Ephemeral	Culvert	Rail	--	--	--	--	0.00	84.0
226	CEAR17S2	Ephemeral	Culvert	Rail	--	--	--	--	0.00	251.6
226	CEAR17S2	Ephemeral	Excavation	Stormwater Drainage	--	--	--	--	0.00	203.3

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
226	Unnamed	Intermittent	Viaduct	Access Road	--	--	--	--	20.1	0.00
226	Unnamed	Intermittent	Viaduct	Rail	--	--	--	--	127.0	0.00
227	CEAR17S4	Intermittent	Viaduct	Rail	--	--	--	--	501.9	0.00
227	CEAR17S7	Ephemeral	Viaduct	Rail	--	--	--	--	57.8	0.00
				Total	**1,920.8**	**1,416.9**	**1,413.6**	**293.7**	**15,610.5**	**13,232.0**

Source: USGS, 2018; FNI, 2018

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those “unnamed”) indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 23: Estimated Wetland Impacts – Grimes County										
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
150	PFO1A	Forested	Overhead Utilities	Overhead	0.05	0.00	--	--	--	--
150	CEAH14FW10	Forested	Rail	Conversion	--	--	0.00	0.39	--	--
150	PFO1A	Forested	Rail	Conversion	--	--	0.00	0.69	--	--
150	PFO1A	Forested	Utilities	Excavation	--	--	0.33	0.00	--	--
150	CEAH14EW17	Emergent	Rail	Viaduct	--	--	0.13	0.00	--	--
151	PFO1A	Forested	Access Road	Conversion	0.00	0.02	--	--	--	--
151	PFO1A	Forested	Rail	Conversion	0.00	0.08	--	--	--	--
151	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	0.06	--	--	--	--
151	CEAH15FW6	Forested	Rail	Conversion	--	--	0.00	0.04	--	--
151	CEAH14FW9	Forested	Rail	Conversion	--	--	0.00	0.29	--	--
151	CEAH14FW11	Forested	Rail	Conversion	--	--	0.00	0.35	--	--
151	CEAH15EW5	Emergent	Rail	Viaduct	--	--	0.27	0.00	--	--
151	CEAH14EW15	Emergent	Rail	Viaduct	--	--	0.44	0.00	--	--
152	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.23
207	CEAK15EW100	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.23
207	CEAK15EW5	Emergent	Access Road	Fill	--	--	--	--	0.00	0.02
208	CEAK15EW101	Emergent	Temporary Fill	Fill	--	--	--	--	0.04	0.00
209	PEM1F	Emergent	Rail	Viaduct	--	--	--	--	0.37	0.00
210	CEAL15EW5	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	<0.01
210	CEAL15EW3	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
210	CEAL15EW5	Emergent	Rail	Fill	--	--	--	--	0.00	0.02
210	CEAL15EW3	Emergent	Rail	Fill	--	--	--	--	0.00	0.03
210	CEAL15EW4	Emergent	Rail	Fill	--	--	--	--	0.00	0.10
211	PEM1A	Emergent	Rail	Viaduct	--	--	--	--	0.02	0.00
212	CEAM16EW2	Emergent	Rail	Viaduct	--	--	--	--	0.08	0.00
217	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.07
217	PFO1A	Forested	Utilities	Excavation	--	--	--	--	<0.01	0.00
218	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.13
219	CEAO16SW1	Scrub/Shrub	Access Road	Excavation	--	--	--	--	0.00	0.10
220	PEM1C	Emergent	Rail	Viaduct	--	--	--	--	0.08	0.00
220	PEM1A	Emergent	Rail	Viaduct	--	--	--	--	0.09	0.00
222	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.08
223	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.11

Table 23: Estimated Wetland Impacts – Grimes County										
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
223	CEAQ17FW4	Forested	Rail	Conversion	--	--	--	--	0.00	0.18
223	CEAQ17FW4	Forested	Rail	Conversion	--	--	--	--	0.00	0.52
223	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.43	0.00
223	CEAQ17EW4	Emergent	Rail	Viaduct	--	--	--	--	0.02	0.00
223	PEM1C	Emergent	Rail	Viaduct	--	--	--	--	0.05	0.00
224	PFO1A	Forested	Rail	Conversion	--	--	--	--	0.00	0.06
225	CEAR17EW99	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.04
225	CEAR17EW98	Emergent	Rail	Fill	--	--	--	--	0.00	0.01
227	CEAR17FW1	Forested	Access Road	Conversion	--	--	--	--	0.00	0.01
227	CEAR17FW1	Forested	Access Road	Conversion	--	--	--	--	0.00	0.01
227	CEAR17FW3	Forested	Rail	Conversion	--	--	--	--	0.00	0.11
227	PFO1C	Forested	Rail	Conversion	--	--	--	--	0.00	0.13
227	CEAR17FW1	Forested	Access Road	Conversion	--	--	--	--	0.00	0.13
227	CEAR17FW1	Forested	Rail	Conversion	--	--	--	--	0.00	0.14
227	CEAR17FW1	Forested	Rail	Conversion	--	--	--	--	0.00	0.57
227	PFO1A	Forested	Access Road	Excavation	--	--	--	--	0.00	<0.01
227	PFO1A	Forested	Rail	Excavation	--	--	--	--	0.00	0.17
227	CEAR17EW1	Emergent	Rail	Viaduct	--	--	--	--	0.04	0.00
227	CEAR17EW3	Emergent	Rail	Viaduct	--	--	--	--	0.16	0.00
				Total	**0.05**	**0.16**	**1.2**	**1.8**	**1.4**	**3.2**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
'--' - not present
EM - Emergent
FO - Forested
A - Temporarily Flooded
F - Semipermanently Flooded

Table 24: Estimated Waterbody Impacts – Grimes County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
150	Unnamed	Pond	Rail	Viaduct	0.20	0.00	--	--	--	--
150	CEAH14PD7	Pond	Rail	Viaduct	--	--	0.06	0.00	--	--
151	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.17	--	--	--	--
151	Unnamed	Pond	Access Road	Fill	0.00	0.14	--	--	--	--
151	Unnamed	Pond	Rail	Fill	0.00	0.24	--	--	--	--
151	Unnamed	Pond	Rail	Viaduct	<0.01	0.00	--	--	--	--
151	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.17	--	--
151	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.14	--	--
151	Unnamed	Pond	Rail	Fill	--	--	0.00	0.24	--	--
152	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--	--	--
152	Unnamed	Pond	Rail	Fill	0.00	0.30	--	--	--	--
152	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01	--	--
152	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.02	--	--
152	Unnamed	Pond	Rail	Fill	--	--	0.00	<0.01	--	--
152	Unnamed	Pond	Rail	Fill	--	--	0.00	0.30	--	--
202	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.29
202	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.39
203	Unnamed	Pond	Utilities	Excavation	--	--	--	--	0.02	0.00
204	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	<0.01
204	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.40
204	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.09
205	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.04
205	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.17
205	Unnamed	Pond	Maintenance Facility	Fill	--	--	--	--	0.00	0.04
205	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.07
205	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.11
207	CEAK15PD100	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.16
207	CEAK15PD2	Pond	Rail	Excavation	--	--	--	--	0.00	0.27
207	CEAK15PD4	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.99
207	CEAK15PD4	Pond	Rail	Fill	--	--	--	--	0.00	0.26
207	CEAK15PD100	Pond	Rail	Fill	--	--	--	--	0.00	0.38
207	CEAK15PD10	Pond	Temporary Fill	Fill	--	--	--	--	0.18	0.00
208	CEAK15PD5	Pond	Temporary Fill	Fill	--	--	--	--	<0.01	0.00
208	CEAK15PD5	Pond	Rail	Viaduct	--	--	--	--	0.08	0.00
208	CEAK15PD5	Pond	Access Road	Viaduct	--	--	--	--	0.14	0.00
208	CEAK15PD6	Pond	Rail	Viaduct	--	--	--	--	0.17	0.00
209	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.44	0.00

Table 24: Estimated Waterbody Impacts – Grimes County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
209	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.02	0.00
209	Unnamed	Reservoir	Rail	Viaduct	--	--	--	--	0.19	0.00
210	CEAL15PD10	Pond	Access Road	Excavation	--	--	--	--	0.00	0.01
210	CEAL15PD8	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.02
210	CEAL15PD14	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.10
210	CEAL15PD11	Pond	Rail	Excavation	--	--	--	--	0.00	0.10
210	CEAL15PD13	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.57
210	CEAL15PD9	Pond	Rail	Excavation	--	--	--	--	0.00	0.58
210	CEAL15PD9	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	1.3
210	CEAL15PD13	Pond	Rail	Fill	--	--	--	--	0.00	0.09
210	CEAL15PD8	Pond	Rail	Fill	--	--	--	--	0.00	0.28
210	CEAL15PD16	Pond	Rail	Fill	--	--	--	--	0.00	0.30
210	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.03	0.00
210	Unnamed	Pond	Overhead Utilities	Overhead	--	--	--	--	0.06	0.00
210	CEAL15PD17	Pond	Overhead Utilities	Overhead	--	--	--	--	0.15	0.00
211	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
211	Unnamed	Pond	Maintenance Facility	Fill	--	--	--	--	0.00	0.31
211	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.49
211	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.64
211	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.01	0.00
212	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.07
212	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.09
212	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.67
212	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.35
212	CEAM16PD5	Pond	Rail	Viaduct	--	--	--	--	0.21	0.00
213	CEAM16PD9	Pond	Rail	Fill	--	--	--	--	0.00	0.15
214	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.18
214	CEAN16PD14	Pond	Overhead Utilities	Overhead	--	--	--	--	0.23	0.00
214	CEAM16PD10	Pond	Rail	Viaduct	--	--	--	--	0.03	0.00
214	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.15	0.00
215	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.01
215	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.06
215	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.07
216	CEAN16PD12	Pond	Rail	Fill	--	--	--	--	0.00	0.08
216	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.03	0.00
216	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.05	0.00
217	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.04

Table 24: Estimated Waterbody Impacts – Grimes County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
217	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.11
217	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.02
217	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.01	0.00
218	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.04	0.00
218	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.04	0.00
219	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	<0.01
219	CEAO16PD10	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.03
219	CEAO16PD11	Pond	Access Road	Excavation	--	--	--	--	0.00	0.08
219	CEAO16PD11	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.17
219	CEAO16PD10	Pond	Access Road	Fill	--	--	--	--	0.00	<0.01
220	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.02
220	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.14
220	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.06	0.00
221	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.07
221	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.12	0.00
221	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.35	0.00
222	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.05
222	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.05	0.00
223	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.08	0.00
223	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.08	0.00
224	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
224	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.02
224	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.27
227	CEAR17PD12	Pond	Rail	Viaduct	--	--	--	--	0.02	0.00
227	CEAR17PD13	Pond	Rail	Viaduct	--	--	--	--	0.06	0.00
227	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.11	0.00
				Total	**0.20**	**0.87**	**0.06**	**0.88**	**3.2**	**11.2**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Waller County

Table 25: Estimated Stream Impacts – Waller County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
229	Unnamed	Artificial Path	Viaduct	Rail	183.9	0.00
229	Walnut Creek	Perennial	Viaduct	Rail	208.2	0.00
230	Brushy Creek	Intermittent	Viaduct	Access Road	147.0	0.00
230	Brushy Creek	Intermittent	Viaduct	Rail	230.6	0.00
231	Unnamed	Intermittent	Viaduct	Access Road	83.9	0.00
231	Unnamed	Intermittent	Viaduct	Rail	129.5	0.00
231	SCAT17S1	Perennial	Viaduct	Rail	82.5	0.00
232	Unnamed	Intermittent	Viaduct	Access Road	215.4	0.00
232	Unnamed	Intermittent	Viaduct	Rail	165.6	0.00
233	Unnamed	Intermittent	Culvert	Access Road	0.00	68.0
233	Unnamed	Intermittent	Culvert	Rail	0.00	229.6
233	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	365.0
233	Unnamed	Intermittent	Viaduct	Rail	178.5	0.00
233	Spring Creek	Intermittent	Viaduct	Rail	149.4	0.00
				Total	**1,774.3**	**662.6**

Source: USGS, 2018; FNI, 2018

*Stream ID # (S) indicates a specific feature recorded in the field whereas stream names (or those “unnamed”) indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 26: Estimated Wetland Impacts – Waller County						
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 5**	
					Temp	**Perm**
					acres	
228	SCAS17EW2	Emergent	Stormwater Drainage	Excavation	0.00	0.01
228	SCAS17EW4	Emergent	Stormwater Drainage	Excavation	0.00	0.01
228	SCAS17EW3	Emergent	Overhead Utilities	Overhead	0.08	0.00
228	SCAS17EW3	Emergent	Overhead Utilities	Overhead	0.72	0.00
228	SCAS17EW4	Emergent	Overhead Utilities	Overhead	0.89	0.00
228	SCAS17FW3	Forested	Overhead Utilities	Overhead	0.05	0.00
229	SCAS17EW100	Emergent	Rail	Viaduct	0.15	0.00
229	SCAS17FW100	Forested	Rail	Conversion	0.00	0.00
229	PFO1A	Forested	Rail	Conversion	0.00	0.08
229	PFO1C	Forested	Rail	Conversion	0.00	0.05
231	PFO1A	Forested	Access Road	Conversion	0.00	0.04
231	SCAT17FW1	Forested	Rail	Conversion	0.00	0.15
231	SCAT17FW1	Forested	Rail	Conversion	0.00	0.25
231	PFO1A	Forested	Rail	Conversion	0.00	0.05
232	PEM1A	Emergent	Access Road	Fill	0.00	0.23
232	PEM1A	Emergent	Rail	Fill	0.00	0.14
232	PEM1C	Emergent	Rail	Fill	0.00	0.08
232	PEM1C	Emergent	Rail	Viaduct	0.03	0.00
232	PFO1C	Forested	Access Road	Conversion	0.00	0.10
232	PFO1C	Forested	Rail	Conversion	0.00	0.05
232	PEM1A	Emergent	Overhead Utilities	Overhead	0.19	0.00
232	PFO1C	Forested	Overhead Utilities	Overhead	0.04	0.00
233	PEM1C	Emergent	Rail	Viaduct	0.02	0.00
233	PFO1C	Forested	Rail	Conversion	0.00	0.05
				Total	**2.2**	**1.3**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (S) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM - Emergent
EM1 - Persistent Emergent
FO - Forested
FO1 - Broad-leaved Deciduous Forested
A - Temporarily Flooded
C - Seasonally Flooded
F – Semi-permanently Flooded

Table 27: Estimated Waterbody Impacts – Waller County						
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					acres	
228	SCAS17PD4	Pond	Stormwater Drainage	Excavation	0.00	0.01
228	SCAS17PD99	Pond	Stormwater Drainage	Excavation	0.00	<0.01
228	SCAS17PD4	Pond	Stormwater Drainage	Excavation	0.00	0.04
228	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	<0.01
228	SCAS17PD4	Pond	Rail	Fill	0.00	0.02
228	SCAS17PD2	Pond	Overhead Utilities	Overhead	0.06	0.00
228	SCAS17PD2	Pond	Overhead Utilities	Overhead	0.02	0.00
228	SCAS17PD1	Pond	Access Road	Viaduct	0.01	0.00
228	SCAS17PD1	Pond	Rail	Viaduct	0.11	0.00
228	SCAS17PD2	Pond	Rail	Viaduct	0.01	0.00
228	SCAS17PD2	Pond	Rail	Viaduct	0.03	0.00
231	Unnamed	Pond	Utilities	Excavation	0.03	0.00
231	Unnamed	Pond	Rail	Viaduct	<0.01	0.00
232	SCAT17PD5	Pond	Access Road	Excavation	0.00	0.02
232	Unnamed	Pond	Rail	Excavation	0.00	0.08
232	Unnamed	Pond	Overhead Utilities	Overhead	0.16	0.00
233	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.06
				Total	**0.43**	**0.23**

Source: USGS, 2018; USFWS, 2018; FNI, 2018

*Waterbody ID # (S) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Harris County

Table 28: Estimated Stream Impacts – Harris County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
233	Spring Creek	Intermittent	Viaduct	Rail	0.66	0.00
234	Unnamed	Perennial	Viaduct	Rail	120.4	0.00
235	SCAU17S5	Intermittent	Culvert	Rail	0.00	187.6
235	Unnamed	Intermittent	Excavation	Stormwater Drainage	0.00	66.0
235	SCAU17S5	Ephemeral	Excavation	Stormwater Drainage	0.00	149.8
235	SCAU17S5	Ephemeral	Fill	Maintenance Facility	0.00	198.0
239	Unnamed	Artificial Path	Viaduct	Access Road	141.1	0.00
239	Unnamed	Artificial Path	Viaduct	Rail	166.1	0.00
239	Unnamed	Artificial Path	Viaduct	Rail	117.8	0.00
240	Unnamed	Artificial Path	Viaduct	Rail	123.2	0.00
240	Unnamed	Artificial Path	Viaduct	Rail	121.5	0.00
240	SCAW18S2	Ephemeral	Viaduct	Rail	126.7	0.00
240	SCAW18S3	Intermittent	Viaduct	Rail	121.4	0.00
241	Unnamed	Artificial Path	Overhead	Overhead Utilities	133.5	0.00
241	Unnamed	Artificial Path	Overhead	Overhead Utilities	894.1	0.00
241	Unnamed	Artificial Path	Viaduct	Rail	572.0	0.00
241	Unnamed	Intermittent	Viaduct	Rail	191.8	0.00
242	Unnamed	Intermittent	Viaduct	Rail	152.7	0.00
242	Unnamed	Intermittent	Viaduct	Rail	117.4	0.00
242	Unnamed	Artificial Path	Viaduct	Rail	121.9	0.00
242	Unnamed	Intermittent	Viaduct	Temporary Fill	3,901.8	0.00
243	SCAW19S5	Perennial	Viaduct	Rail	118.9	0.00
243	SCAW19S6	Intermittent	Viaduct	Rail	73.2	0.00
243	SCAW19S6	Intermittent	Viaduct	Rail	47.3	0.00
245	SCAX20S1	Ephemeral	Fill	Maintenance Facility	0.00	79.6
245	Unnamed	Artificial Path	Overhead	Overhead Utilities	208.6	0.00
245	SCAW20S3	Intermittent	Overhead	Overhead Utilities	355.7	0.00
245	SCAW20S1	Perennial	Viaduct	Rail	110.1	0.00
245	SCAW20S2	Ephemeral	Viaduct	Rail	1,907.4	0.00
246	SCAX20S1	Ephemeral	Excavation	Stormwater Drainage	0.00	77.6
246	Unnamed	Artificial Path	Excavation	Utilities	177.3	0.00
246	Unnamed	Artificial Path	Viaduct	Rail	2,227.8	0.00
246	SCAX20S2	Ephemeral	Viaduct	Rail	289.5	0.00
248	Unnamed	Artificial Path	Viaduct	Rail	112.3	0.00

Table 28: Estimated Stream Impacts – Harris County						
Natural Resources Mapbook Page #	**Stream ID/ Name***	**Classification**	**Construction Type**	**Crossing Type**	**Segment 5**	
					Temp	**Perm**
					linear feet	
248	Unnamed	Artificial Path	Viaduct	Rail	8.2	0.00
248	SCAX21S2	Intermittent	Viaduct	Rail	67.9	0.00
248	SCAX22S1	Perennial	Viaduct	Rail	93.3	0.00
249	SCAY22S1	Perennial	Fill	Structure	0.00	79.0
249	Cole Creek	Intermittent	Viaduct	Access Road	80.8	0.00
249	SCAY22S1	Perennial	Viaduct	Access Road	20.7	0.00
249	SCAY22S1	Perennial	Viaduct	Rail	104.4	0.00
249	Cole Creek	Intermittent	Viaduct	Temporary Fill	10.9	0.00
250	Unnamed	Intermittent	Viaduct	Access Road	53.6	0.00
250	Unnamed	Intermittent	Viaduct	Rail	48.7	0.00
250	Unnamed	Artificial Path	Viaduct	Temporary Fill	109.4	0.00
250	Unnamed	Intermittent	Viaduct	Temporary Fill	217.8	0.00
252	Unnamed	Artificial Path	Viaduct	Access Road	60.4	0.00
252	Unnamed	Artificial Path	Viaduct	Rail	50.6	0.00
252	Unnamed	Artificial Path	Viaduct	Temporary Fill	1.1	0.00
				Total	**13,680.0**	**837.6**

Source: USGS, 2018; FNI, 2018

*Stream ID # (S) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
233	PFO1A	Forested	Rail	Conversion	0.00	0.07	--	--
234	PEM1A	Emergent	Rail	Viaduct	0.20	0.00	--	--
235	PEM1A	Emergent	Stormwater Drainage	Excavation	0.00	0.01	--	--
235	PEM1C	Emergent	Access Road	Excavation	0.00	0.03	--	--
235	SCAU17EW7	Emergent	Access Road	Excavation	0.00	0.03	--	--
235	SCAU17EW8	Emergent	Stormwater Drainage	Excavation	0.00	0.07	--	--
235	PSS1A	Scrub/Shrub	Stormwater Drainage	Excavation	0.00	0.16	--	--
235	PEM1C	Emergent	Stormwater Drainage	Excavation	0.00	0.66	--	--
235	SCAU17EW8	Emergent	Rail	Fill	0.00	0.00	--	--
235	PEM1A	Emergent	Rail	Fill	0.00	0.01	--	--
235	PEM1C	Emergent	Maintenance Facility	Fill	0.00	0.04	--	--
235	SCAU17EW8	Emergent	Maintenance Facility	Fill	0.00	0.14	--	--
235	PEM1C	Emergent	Maintenance Facility	Fill	0.00	0.18	--	--
235	PEM1A	Emergent	Maintenance Facility	Fill	0.00	0.40	--	--
235	PEM1C	Emergent	Rail	Fill	0.00	0.64	--	--
235	PEM1A	Emergent	Maintenance Facility	Fill	0.00	3.0	--	--
236	PEM1C	Emergent	Stormwater Drainage	Excavation	0.00	0.36	--	--
236	PEM1C	Emergent	Access Road	Fill	0.00	0.02	--	--
236	PEM1C	Emergent	Rail	Fill	0.00	0.12	--	--
236	PEM1C	Emergent	Maintenance Facility	Fill	0.00	0.42	--	--
236	PEM1C	Emergent	Rail	Fill	0.00	1.6	--	--
236	PEM1Cx	Emergent	Rail	Viaduct	0.02	0.00	--	--
237	SCAV17EW10	Emergent	Rail	Viaduct	0.05	0.00	--	--
237	Pf	Other	Rail	Viaduct	1.1	0.00	--	--
238	Pf	Other	Access Road	Viaduct	0.03	0.00	--	--
238	SCAV17EW7	Emergent	Rail	Viaduct	0.07	0.00	--	--
238	SCAV17EW6	Emergent	Rail	Viaduct	0.08	0.00	--	--
238	Pf	Other	Rail	Viaduct	0.43	0.00	--	--
238	PEM1C	Emergent	Rail	Viaduct	1.3	0.00	--	--
238	PEM1A	Emergent	Rail	Viaduct	2.0	0.00	--	--
239	PEM1Cx	Emergent	Rail	Viaduct	0.06	0.00	--	--
239	PEM1Cx	Emergent	Access Road	Viaduct	0.06	0.00	--	--
239	Pf	Other	Rail	Viaduct	0.08	0.00	--	--
239	Pf	Other	Rail	Viaduct	0.09	0.00	--	--
239	SCAV17EW8	Emergent	Rail	Viaduct	2.4	0.00	--	--
239	SCAW17EW1	Emergent	Rail	Viaduct	2.8	0.00	--	--

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
240	Pf	Other	Rail	Viaduct	0.11	0.00	--	--
242	PEM1A	Emergent	Temporary Fill	Fill	0.10	0.00	--	--
242	PEM1Cx	Emergent	Temporary Fill	Fill	0.12	0.00	--	--
242	PEM1C	Emergent	Temporary Fill	Fill	0.26	0.00	--	--
242	PEM1C	Emergent	Temporary Fill	Fill	0.47	0.00	--	--
242	PEM1F	Emergent	Rail	Viaduct	0.00	0.00	--	--
242	PEM1Cx	Emergent	Rail	Viaduct	0.05	0.00	--	--
242	SCAW19EW6	Emergent	Rail	Viaduct	2.0	0.00	--	--
242	Pf	Other	Rail	Viaduct	4.6	0.00	--	--
243	Pf	Other	Rail	Viaduct	0.01	0.00	--	--
243	SCAW19EW8	Emergent	Rail	Viaduct	0.05	0.00	--	--
243	SCAW19EW7	Emergent	Rail	Viaduct	0.18	0.00	--	--
243	SCAW19EW9	Emergent	Rail	Viaduct	0.26	0.00	--	--
243	SCAW19EW6	Emergent	Rail	Viaduct	0.34	0.00	--	--
244	SCAW20SW2	Scrub/Shrub	Rail	Conversion	0.00	0.07	--	--
244	PEM1A	Emergent	Rail	Viaduct	0.10	0.00	--	--
244	PEM1F	Emergent	Rail	Viaduct	0.25	0.00	--	--
245	PEM1Cx	Emergent	Overhead Utilities	Overhead	0.18	0.00	--	--
245	SCAW20EW7	Emergent	Overhead Utilities	Overhead	0.55	0.00	--	--
245	SCAW20EW6	Emergent	Overhead Utilities	Overhead	0.56	0.00	--	--
245	SCAW20EW1	Emergent	Rail	Viaduct	0.05	0.00	--	--
246	PSS1A	Scrub/Shrub	Utilities	Excavation	0.00	0.00	--	--
246	SCAX21EW2	Emergent	Utilities	Excavation	0.01	0.00	--	--
246	SCAX20EW2	Emergent	Utilities	Excavation	0.02	0.00	--	--
246	PEM1C	Emergent	Utilities	Excavation	0.02	0.00	--	--
246	PEM1A	Emergent	Utilities	Excavation	0.03	0.00	--	--
246	PEM1Cx	Emergent	Utilities	Excavation	0.04	0.00	--	--
246	SCAX21EW3	Emergent	Rail	Viaduct	0.11	0.00	--	--
246	SCAX20EW2	Emergent	Rail	Viaduct	0.11	0.00	--	--
246	SCAX21EW2	Emergent	Rail	Viaduct	0.15	0.00	--	--
246	PEM1Cx	Emergent	Rail	Viaduct	2.0	0.00	--	--
247	PEM1Cx	Emergent	Utilities	Excavation	0.02	0.00	--	--
247	PEM1Cx	Emergent	Overhead Utilities	Overhead	0.16	0.00	--	--
247	PEM1Cx	Emergent	Overhead Utilities	Overhead	0.17	0.00	--	--
247	SCAX21EW4	Emergent	Rail	Viaduct	0.05	0.00	--	--
248	PFO1Ad	Forested	Access Road	Conversion	0.00	0.01	--	--

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	**Wetland ID/ Classification***	**Wetland Type**	**Construction Type**	**Crossing Type**	**Segment 5**		**Northwest Transit Center Terminal**	
					Temp	**Perm**	**Temp**	**Perm**
					acres		**acres**	
248	SCAX21SW1	Scrub/Shrub	Rail	Conversion	0.00	0.02	--	--
248	SCAX22FW2	Forested	Rail	Conversion	0.00	0.02	--	--
248	SCAX22EW2	Emergent	Rail	Viaduct	0.01	0.00	--	--
248	SCAX22EW1	Emergent	Rail	Viaduct	0.02	0.00	--	--
249	PFO1C	Forested	Rail	Conversion	0.00	0.02	--	--
249	PFO1C	Forested	Utilities	Excavation	0.19	0.00	--	--
249	PEM1A	Emergent	Building	Fill	0.03	0.00	--	--
249	SCAY22EW2	Emergent	Temporary Fill	Fill	0.25	0.00	--	--
249	PEM1Cx	Emergent	Rail	Viaduct	0.00	0.00	--	--
249	PEM1Cx	Emergent	Access Road	Viaduct	0.00	0.00	--	--
249	SCAY22EW2	Emergent	Rail	Viaduct	0.08	0.00	--	--
249	PEM1A	Emergent	Access Road	Viaduct	0.09	0.00	--	--
249	PEM1A	Emergent	Rail	Viaduct	0.38	0.00	--	--
249	SCAY22EW2	Emergent	Rail	Viaduct	0.47	0.00	--	--
250	PFO1A	Forested	Temporary Fill	Fill	0.01	0.00	--	--
253	SCAZ24EW1	Emergent	Overhead Utilities	Overhead	--	--	0.00	1.0
253	SCAZ24EW1	Emergent	Rail	Viaduct	--	--	0.55	0.00
				Total	**25.4**	**8.1**	**0.55**	**1.0**

Source: USFWS, 2018; FNI, 2018

*Wetland ID # (S) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
SS1 - Broad-leaved Deciduous Scrub-Shrub
C - Seasonally Flooded
d- Partly Drained/Ditched
x – Excavated

EM - Emergent
FO - Forested
SS - Scrub-Shrub
A - Temporarily Flooded
F - Semipermanently Flooded
f - Farmed
'--' - not present

Table 30: Estimated Waterbody Impacts – Harris County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Temp	Temp	Perm
					acres		acres	
235	SCAU17PD8	Pond	Access Road	Excavation	0.00	0.01	--	--
235	SCAU17PD7	Pond	Access Road	Excavation	0.00	0.24	--	--
235	Unnamed	Swamp	Stormwater Drainage	Excavation	0.00	0.54	--	--
235	SCAU17PD14	Pond	Maintenance Facility	Fill	0.00	0.04	--	--
235	Unnamed	Swamp	Maintenance Facility	Fill	0.00	0.14	--	--
235	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.19	--	--
235	Unnamed	Swamp	Rail	Fill	0.00	0.65	--	--
237	Unnamed	Pond	Rail	Viaduct	1.1	0.00	--	--
238	Unnamed	Swamp	Systems	Fill	0.00	0.13	--	--
238	Unnamed	Swamp	Temporary Fill	Fill	0.06	0.00	--	--
238	Unnamed	Swamp	Overhead Utilities	Overhead	1.6	0.00	--	--
238	Unnamed	Swamp	Access Road	Viaduct	0.07	0.00	--	--
238	SCAV17PD2	Pond	Rail	Viaduct	0.28	0.00	--	--
238	Unnamed	Swamp	Rail	Viaduct	0.85	0.00	--	--
241	Unnamed	Pond	Overhead Utilities	Overhead	0.34	0.00	--	--
241	Unnamed	Pond	Rail	Viaduct	0.20	0.00	--	--
244	Unnamed	Pond	Rail	Viaduct	0.17	0.00	--	--
245	Unnamed	Reservoir	Overhead Utilities	Overhead	0.61	0.00	--	--
245	SCAW20PD3	Pond	Access Road	Viaduct	0.07	0.00	--	--
245	SCAW20PD3	Pond	Rail	Viaduct	0.01	0.00	--	--
245	SCAW20PD4	Pond	Rail	Viaduct	0.19	0.00	--	--
247	SCAX21PD3	Pond	Utilities	Excavation	0.00	0.03	--	--
247	Unnamed	Pond	Utilities	Excavation	0.00	0.11	--	--
247	Unnamed	Pond	Utilities	Excavation	0.00	0.14	--	--
247	SCAX21PD3	Pond	Utilities	Excavation	<0.01	0.00	--	--
247	Unnamed	Pond	Rail	Viaduct	0.17	0.00	--	--
247	SCAX21PD3	Pond	Rail	Viaduct	1.0	0.00	--	--
250	Unnamed	Pond	Temporary Fill	Fill	0.09	0.00	--	--
253	SCAZ24PD2	Pond	Station	Fill	--	--	0.00	0.04
253	SCAZ24PD2	Pond	Rail	Viaduct	--	--	0.06	0.00
				Total	**6.8**	**2.2**	**0.06**	**0.04**

Source: USGS, 2018; USFWS, 2018; FNI, 2018
*Waterbody ID # (S) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.
'--' – Not Present

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AECOM

TECHNICAL MEMORANDUM

IMPACTS TO USACE PROJECTS

To: Kevin Wright, FRA

From: Jennifer Oakley, AECOM

Date: February 24, 2020

RE: **DALLAS TO HOUSTON HSR – Section 408 Impacts to USACE Projects**

As noted in **Section 3.7, Waters of the U.S.**, potential impacts to U.S. Army Corps of Engineers (USACE) projects are documented and would be approved through separate Section 408 permission and Section 404 permit authorization processes by the USACE – Fort Worth District. Authorization requests developed, reviewed, and submitted by Texas Central Railroad (TCRR), are not part of this Environmental Impact Statement (EIS). However, the USACE – Fort Worth District is a cooperating agency on the Dallas to Houston High-Speed Rail (HSR) Project and will use the EIS and its appendices as a base document for their review and supplemental analysis of USACE impacts. As part of that analysis, the USACE has requested specific data from FRA detailing estimated potential impacts to resources within USACE project boundaries subject to Section 408. In addition, the USACE has requested an assessment of potential impacts to waters of the U.S, water quality, floodplains, vegetation and cultural resources that may result from alterations to the Section 408 properties.

1 Section 408

The authority to grant permission to alter USACE federally authorized civil works projects is contained in Section 14 of the Rivers and Harbors Act of 1899 and codified in Title 33 Section 408 (Section 408). Current Section 408 policy can be found within Engineer Circular (EC) 1165-2-220, *Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Work Projects Pursuant to 33 U.S.C. 408.* Issuance of a Section 408 permission is a federal action and subject to NEPA and other environmental laws, executive orders, regulations, and policies. The approval under Section 408 is termed a *permission.* Non-USACE entities proposing to do the work are defined as *requesters*. An *alteration* is defined as, "…any action by any entity other than USACE that builds upon, alters, improves, moves, occupies, or otherwise affects the usefulness, or the structural or ecological integrity, of a USACE project." The proposed Dallas to Houston HSR Project would constitute an alteration of three USACE federally authorized civil works projects: the Dallas Floodway Extension, the Dallas Floodway and Bardwell Lake. These USACE projects are described below.

1.1 Dallas County

Segment 1 is located in Dallas County (**Appendix D of the FEIS, Project Footprint Mapbook, Sheets 1-24**). The alignment begins on the south side of downtown Dallas near Interstate Highway (IH)-30 and Lamar Street and parallels the existing Union Pacific Railroad (UPRR) freight line towards IH-45. It parallels the west side of IH-45 as it crosses the Trinity River, running between the existing Burlington Northern Santa Fe (BNSF) freight line and the highway as it crosses East Illinois Avenue.

USACE federally authorized civil works projects subject to Section 408 approval located within Dallas County include the Dallas Floodway Extension and the Dallas Floodway. These projects provide comprehensive flood risk management for the City of Dallas. This is achieved through the improvements and construction of floodway enhancements. Floodway enhancements as part of the Dallas Floodway and Dallas Floodway Extension projects that are intersected by the HSR Project corridor include:

- Dallas Floodway – East Dallas Levee Trinity Left Bank (LB)
- Dallas Floodway – Able Sump
- Dallas Floodway Extension – Central Wastewater Treatment Plant (CWWTP) Trinity Right Bank (RB) Levee
- Dallas Floodway Extension – Upper/Lower Chain of Wetlands
- Dallas Floodway Extension – future Lamar Levee

A description of each of the above-mentioned floodway enhancements is provided below and shown on the attached **Figure**, **Project Footprint in Association with USACE Projects Mapbook**. In addition, conclusions regarding potential impacts as a result of the Project are provided below.

The HSR Project corridor and affiliated structures will include alterations to two existing levees in the vicinity of the Trinity River, the existing Dallas Floodway East Levee and the CWWTP Trinity RB Levee as described below.

The Dallas Floodway East Dallas Levee Trinity LB was completed in 1932 and provides protection along the north side of the Trinity River. This levee begins along the Elm Fork of the Trinity River and terminates at Santa Fe Avenue. In the 1950s, the Dallas Floodway reconstruction project modified the East Levee to flatten the levee slope to 3:1, widen the crest, and improve the interior drainage system. These improvements were completed in 1958. In 2012, the Dallas Floodway East Dallas Levee Trinity LB was updated to include a soil-bentonite cutoff wall to address seepage related concerns.

The Dallas Floodway Able Sump is part of the Dallas Floodway interior drainage system. The Able Sump consists of a series of nine ponds located to the south, southeast and west of the proposed Dallas Terminal Station. These interconnected ponds receive water from the newly constructed Able Pump Station which replaced two smaller stations, Small Able and Large Able, built in 1932 and 1954, respectively.

The CWWTP Trinity RB Levee is located on the south side of the Trinity River and protects the CWWTP. The levee was constructed in the 1940s, encircles the facility, and provides protection from floodwaters (while not directly providing protection to the public). These levee embankments were improved by the City of Dallas in 1994 to increase the crest height and flatten the slopes.

The Upper/Lower Chain of Wetlands cells are interconnected ponds fed year-round by reclaimed water from the CWWTP. During flood events, the wetlands reduce flood risk by providing an efficient and second pathway to convey waters through the Dallas Floodway system. The wetlands project, which is part of the overall Dallas Floodway Extension, began in 2004 and was completed in 2018. The HSR Project is not anticipated to encroach on or alter the wetlands.

In addition, the HSR Project corridor and affiliated structures may potentially affect the future Lamar Levee USACE project in the vicinity of the Trinity River within the proposed Dallas Floodway Extension initiative as described below.

The Dallas Floodway Extension, an initiative jointly developed through the City of Dallas' partnership with the USACE, will eventually extend flood protection in the Trinity River corridor to the intersection of IH-20 and Dowdy Ferry Road. Once completed, this Project will include the construction of new levee facilities, including the future Lamar Street Levee (hereinafter the "future Lamar Levee"). The future Lamar Levee will connect the Dallas Floodway East Levee system to the Rochester Levee system and is currently designed to a conceptual level (35%).

1.1.1 Waters of the U.S.

As discussed in **Section 3.7, Waters of the U.S.** of the EIS, Section 404 of the Clean Water Act (CWA) regulates discharges of dredged or fill material into waters of the U.S. **Tables 1** through **3** provide estimated impacts to waters of the U.S. within the Dallas Floodway Extension USACE project. No streams, wetlands or waterbodies are located within the limits of disturbance (LOD) that intersects the Dallas Floodway.

Table 1: Estimated Stream Impacts – Dallas County

Classification	Crossing Type	Dallas Floodway Extension		
		# of Crossings*	Temp	Perm
			linear feet	
Artificial	Bridge/Viaduct	1	110.7	0.00
Intermittent	Overhead	2	199.2	0.00
Perennial	Bridge/Viaduct	1	189.0	0.00
	Excavation	1	0.00	55.1
	Overhead	1	225.1	0.00
Total		**6**	**724.0**	**55.1**

Source: USGS, 2018; FNI, 2018

*Number of crossings was determined based on a combination of NHD and field collected data. Not all features have been field-verified. Each crossing is included by type and includes where a single feature may be crossed multiple times within the LOD.

Table 2: Estimated Wetland Impacts – Dallas County				
Wetland Type	**Crossing Type**	**Dallas Floodway Extension**		
		# of Crossings*	**Temp**	**Perm**
			acres	
Emergent	Bridge/Viaduct	5	4.4	0.00
	Excavation	3	0.00	1.3
	Overhead	2	1.9	0.00
Forested	Conversion	7	0.00	4.9
	Excavation	5	0.00	0.13
	Overhead	4	2.8	0.00
Shrub/Scrub	Conversion	1	0.00	0.55
Total		**27**	**9.1**	**6.9**

Source: USFWS, 2018; FNI, 2018
*Number of crossings was determined based on a combination of NWI and field collected data. Not all features have been field-verified. Each crossing is included by type and includes where a single feature may be crossed multiple times within the LOD.

Table 3: Estimated Waterbody Impacts – Dallas County				
Waterbody Type	**Crossing Type**	**Dallas Floodway Extension**		
		# of Crossings*	**Temp**	**Perm**
			acres	
Freshwater Pond	Bridge/Viaduct	6	2.2	0.00
	Excavation	4	0.00	0.37
	Overhead	2	0.09	0.00
Total		**12**	**2.3**	**0.37**

Source: USGS, 2018; USFWS, 2018; FNI, 2018
*Number of crossings was determined based on a combination of NWI and field collected data. Not all features have been field-verified. Each crossing is included by type, and includes where a single feature may be crossed multiple times within the LOD

1.1.2 Water Quality

Segment 1 of the LOD in Dallas County is underlain by the Trinity Aquifer (major) and Woodbine Aquifer (minor). Impaired waterbodies located within the Dallas Floodway Extension project in Dallas County includes a section of the Upper Trinity River. This section is listed as impaired due to dioxin in edible tissue (5a). There are no impaired sections of the Trinity River located within the Dallas Floodway project. Additional details on water quality are provided in **Section 3.3, Water Quality**.

1.1.3 Floodplains

Table 4 identifies estimated impacts to floodplains for the USACE projects within Segment 1 of the LOD in Dallas County.

Table 4: Estimated Floodplain Impacts – Dallas County				
USACE Projects	**Floodplains**			
	100-Year		**500-Year**	
	Temp	**Perm**	**Temp**	**Perm**
	acres			
Dallas Floodway	<0.01	0.00	0.00	0.00
Dallas Floodway Extension	36.1	31.5	0.15	0.45
Total	**36.1**	**31.5**	**0.15**	**0.45**

Source: AECOM, 2019

1.1.4 Vegetation

Table 5 identifies estimated impacts to vegetation for the USACE projects within Segment 1 of the LOD in Dallas County based on Ecological Mapping System of Texas (EMST) data.

Table 5: Estimated Vegetation Impacts – Dallas County				
Vegetation Type	**Dallas Floodway**		**Dallas Floodway Extension**	
	Temp	**Perm**	**Temp**	**Perm**
	acres		**acres**	
Urban Low Intensity	<0.01	0.00	18.0	14.9
Central Texas: Floodplain Hardwood Forest	0.00	0.00	5.8	7.4
Urban High Intensity	0.00	0.00	12.0	2.8
Native Invasive: Deciduous Woodland	0.00	0.00	0.38	5.0
Open Water	0.00	0.00	0.00	1.8
Central Texas: Riparian Herbaceous Vegetation	0.00	0.00	0.00	<0.01
Total	**<0.01**	**0.00**	**36.2**	**31.9**

Source: TPWD, 2014

1.1.5 Cultural Resources

As noted in **Section 3.19, Cultural Resources**, there is one cultural resource site located within the Dallas Floodway and Dallas Floodway Extension USACE projects crossed by Segment 1 of the HSR Project that requires coordination with the USACE. **Resource DA.072** is the Trinity River Floodway Historic District that encompasses 3,554.20 acres along the Trinity River including the Dallas Floodway. The Dallas Floodway Historic District, as a single engineering system for flood control and reclamation, is a historic and cultural resource with locally significant historical associations with flood control and the history of city planning and community development in Dallas, and is a significant statewide example of an engineering system designed for flood control and development enhancement. The period of significance of the Dallas Floodway Historic District spans from 1928, when floodway construction started, to 1959, when the project was completed. The essential physical features of the Dallas Floodway Historic District are the levees, diversion channels, overbank and the Belleview Pressure Sewer, a contributing resource to the district. The Dallas Floodway Historic District retains all its essential physical features and its ability to convey its significance to the observer. The Dallas Floodway Historic District meets the NEPA definition of a significant historic and cultural resource that must be considered in assessment of environmental impacts as required under CEQ regulations Part 1502.16.

FRA has recommended this resource eligible for listing in the NRHP under Criterion A for community development. A narrow portion (approximately 140 feet wide) at the south end of the district crosses the LOD of Segment 1 in Dallas County, at the Santa Fe Railroad tracks. Previous coordination between the USACE and the Texas Historical Commission (THC) determined that due to the type of resource, some changes in the setting of the historic district must be expected and that it is anticipated that the construction of additional bridges across the floodway would not adversely affect the historic floodway if the Belleview Pressure Sewer will not be directly affected (THC Letter dated December 30, 2011). Therefore, it is recommended the HSR Project would have no adverse effect on Resource DA.072.

It should be noted that Section 405 (a) of Public Law 111-212 and USACE guidance, directs the USACE to not to make any determinations under the NHPA for Resource DA.072, the Dallas Floodway Historic District, or resources within the Dallas Floodway Historic District. However, USACE must still consider impacts to cultural resources under NEPA. For additional information on cultural resources, see **Section 3.19, Cultural Resources**.

The Texas Archeological Sites Atlas (TASA) was queried in order to identify previously conducted cultural resources surveys for the USACE intersecting the LOD of Segment 1 in Dallas County that are located within the Dallas Floodway Extension USACE project (**Table 6**). Four previous investigations were conducted between 1981 and 2013, undertaken in support of floodway and utilities infrastructure.

Table 6: Previously Conducted Cultural Resources Surveys that Intersect the Dallas Floodway Extension Project

Investigation Type	Date	Project Sponsor	Investigating Firm	Antiquities Permit No.
Linear	9/1981	USACE	Unknown	N/A
Linear	6/2001	USACE	Unknown	N/A
Areal	9/1981	USACE	Unknown	N/A
Areal	8/2013	USACE / Tarrant Regional Water District	AmaTerra	5826

Source: TASA, 2019

1.1.6 Permission Request Process

In response to these potential impacts to USACE projects, TCRR shall submit a Section 408 request to the USACE Fort Worth District. **All Build Alternatives (A through F) would require 408 authorizations from the USACE Fort Worth District in Dallas County**.

1.2 Ellis County

Segment 2A is located in Ellis County (**Appendix D, Project Footprint Mapbook, Sheets 24-55**). Segment 2A begins approximately 1.5 miles 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 south of Bardwell (also 2 miles north of the Navarro County line).

Segment 2B is located in Ellis County (**Appendix D of the FEIS, Project Footprint Mapbook, Sheets 56-87**). The alignment begins south of Farm-to-Market 664 approximately 2.2 miles west of Ferris, Texas and extends generally south transecting the central portion of Ellis County and ending 0.28 mile east of Rankin, Texas. USACE federally authorized civil works projects subject to Section 408 approval located within Ellis County include Bardwell Lake. A description of Bardwell Lake is provided below and it is shown on the attached Figure, **Project Footprint in Association with USACE Projects Mapbook**.

Bardwell Lake was constructed in 1965 to provide flood control and water conservation. The dam and lake control runoff from 178 square miles of drainage area. USACE holds flowage easements, or the right to occasionally flood private land in connection with operation of the reservoir, up to an elevation of 440 feet above mean sea level, and regulates construction below this level around the lake. Only structures that do not reduce flood storage capacity and are not meant for human habitation may be constructed on the flowage easements and must have prior written approval of the USACE District Engineer. Section 408 permission applications for construction must include detailed design plans including a map showing the location of the construction activities and the supporting analysis to prove that the Bardwell Lake storage capacity would not be reduced by Project implementation. The total fee acreage for the Bardwell Lake property is 7,488 acres with 675 acres of flowage easement land. The total storage capacity is 140,000 acre-feet.

Segment 2A does not intersect the fee property of Bardwell Lake. However, Segment 2A would cross 12.67 acres of flowage easements maintained by USACE.

Segment 2B intersects 24.81 acres of the Bardwell Lake fee property. Segment 2B would also cross an additional 5.33 acres of flowage easements maintained by USACE.

As discussed in **Section 3.7, Waters of the U.S.** of the EIS, Section 404 of the CWA regulates discharges of dredged or fill material into waters of the U.S. **Table 7** and **Table 8** provide estimated impacts to streams and wetlands within the Bardwell Lake USACE project. No waterbodies are located within the Bardwell Lake USACE project.

Table 7: Estimated Stream Impacts – Ellis County

Classification	Crossing Type	# of Crossings*	Temp	Perm
			linear feet	
Intermittent	Bridge/Viaduct	4	875.0	0.00
	Overhead	2	1,206.4	0.00
Perennial	Bridge/Viaduct	2	129.8	0.00
	Overhead	2	843.5	0.00
Total		**10**	**3,054.7**	**0.00**

Source: USGS, 2018; FNI, 2018

*Number of crossings was determined based on a combination of NHD and field collected data. Not all features have been field-verified. Each crossing is included by type and includes where a single feature may be crossed multiple times within the LOD.

Table 8: Estimated Wetland Impacts – Ellis County

Wetland Type	Crossing Type	# of Crossings*	Temp	Perm
			acres	
Forested	Conversion	2	0.00	0.32
	Overhead	2	3.5	0.00
Total		**4**	**3.5**	**0.32**

Source: USFWS, 2018; FNI, 2018

*Number of crossings was determined based on a combination of NWI and field collected data. Not all features have been field-verified. Each crossing is included by type and includes where a single feature may be crossed multiple times within the LOD.

1.2.1 Water Quality

Segment 2B of the LOD in Ellis County is underlain by the Trinity Aquifer (major) and Woodbine Aquifer (minor). There are no impaired waterbodies located within Segment 2B of the LOD in Ellis County. Additional details on water quality are provided in **Section 3.3, Water Quality**.

1.2.2 Floodplains

Table 9 identifies estimated impacts to floodplains for the Bardwell Lake USACE project within Segment 2B of the LOD in Ellis County.

Table 9: Estimated Floodplain Impacts – Ellis County

USACE Projects	100-Year		500-Year	
	Temp	Perm	Temp	Perm
	acres			
Bardwell Lake	14.8	9.4	0.00	0.00

Source: AECOM, 2019

1.2.3 Vegetation

Table 10 identifies estimated impacts to vegetation for the Bardwell Lake USACE project within Segment 2B of the LOD in Ellis County based on Ecological Mapping System of Texas (EMST) data.

Table 10: Estimated Vegetation Impacts – Ellis County

Vegetation Type	Temp	Perm
	acres	
Urban Low Intensity	0.02	0.47
Central Texas: Floodplain Hardwood Forest	9.9	5.3
Central Texas: Floodplain Deciduous Shrubland	1.2	1.5
Native Invasive: Deciduous Woodland	0.24	0.19
Central Texas: Floodplain Herbaceous Vegetation	3.5	2.0
Total	**14.9**	**9.5**

Source: TPWD, 2014

1.2.4 Cultural Resources

The TASA was queried in order to identify previously conducted cultural resources surveys for the USACE intersecting the LOD of Segment 2B in Ellis County that are located within the Bardwell Lake USACE project (**Table 11)**. One previous investigation was conducted in 1999, undertaken in support of floodway and utilities infrastructure.

Table 11: Previously Conducted Cultural Resources Surveys that Intersect the Bardwell Lake Project

Investigation Type	Date	Project Sponsor	Investigating Firm	Antiquities Permit No.
Linear	8/1999	USACE/Public Utilities Commission	Unknown	N/A

Source: TASA 2019

1.2.5 Permission Request Process

In response to these impacts to USACE projects, TCRR submitted a Section 408 request on October 12, 2017 to the USACE Fort Worth District. **All Build Alternatives (A through F) would require 408 authorizations from the USACE Fort Worth District in Ellis County** . Further coordination with USACE determined that per the USACE National Non-Recreation Outgrant Policy, Segment 2B would be denied and not carried forward in the USACE evaluation criteria as there is a viable alternative not on federal property. This would result in the removal of Build Alternatives D, E and F, which include Segment 2B, from further consideration**.**

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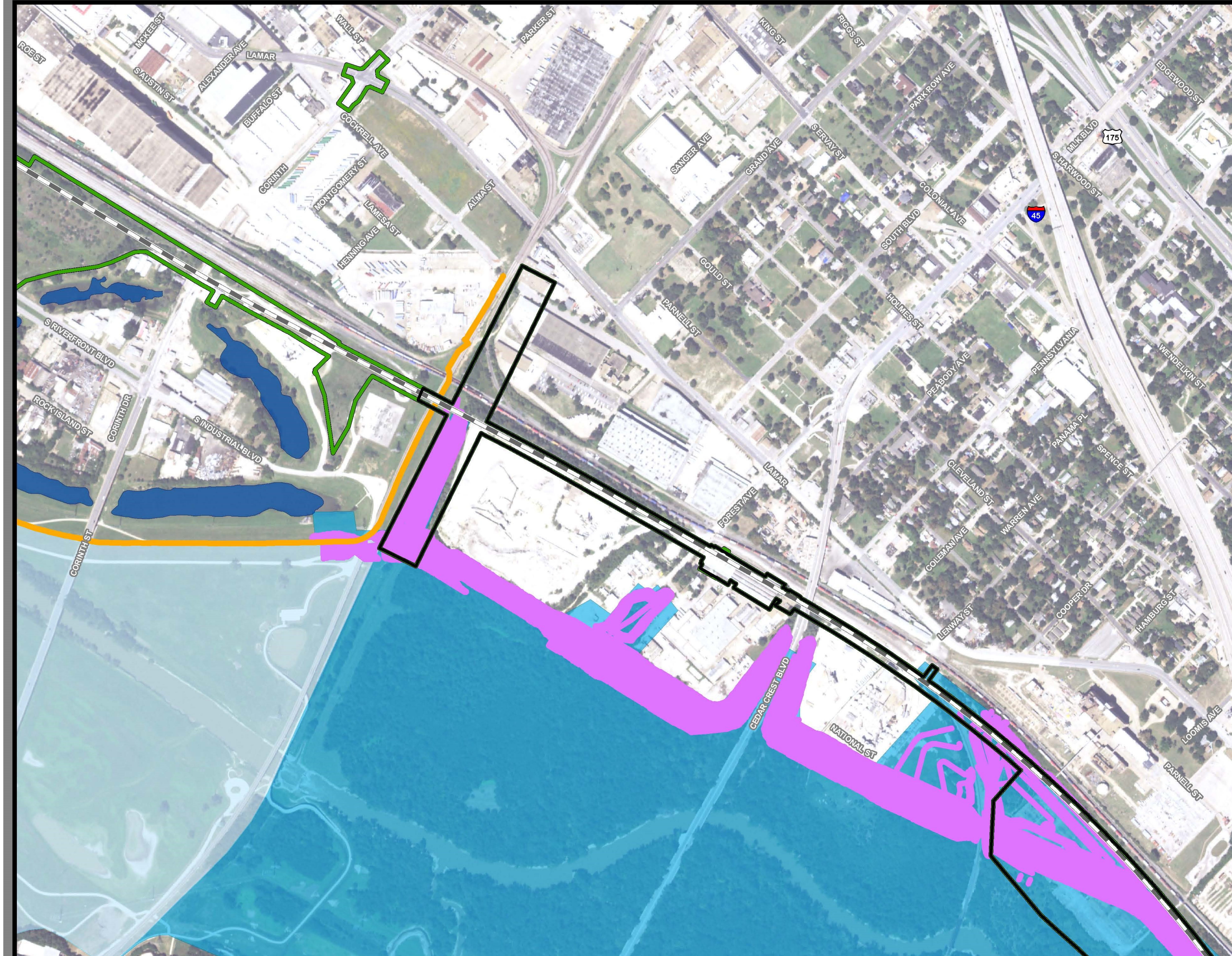
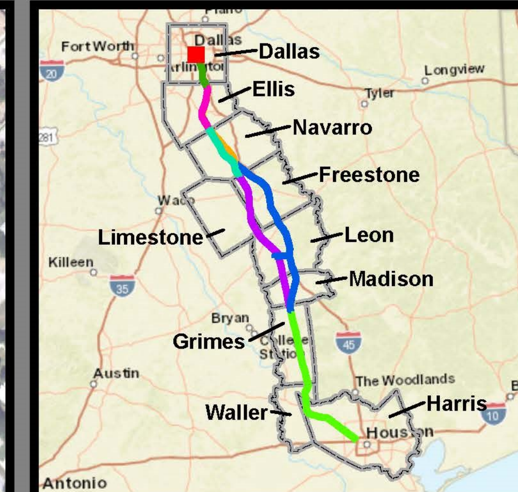




Dallas to Houston High-Speed Rail Project
Project Footprint
in Association with USACE Projects
Sheet 1 of 4

Legend

Track Configuration
- Viaduct

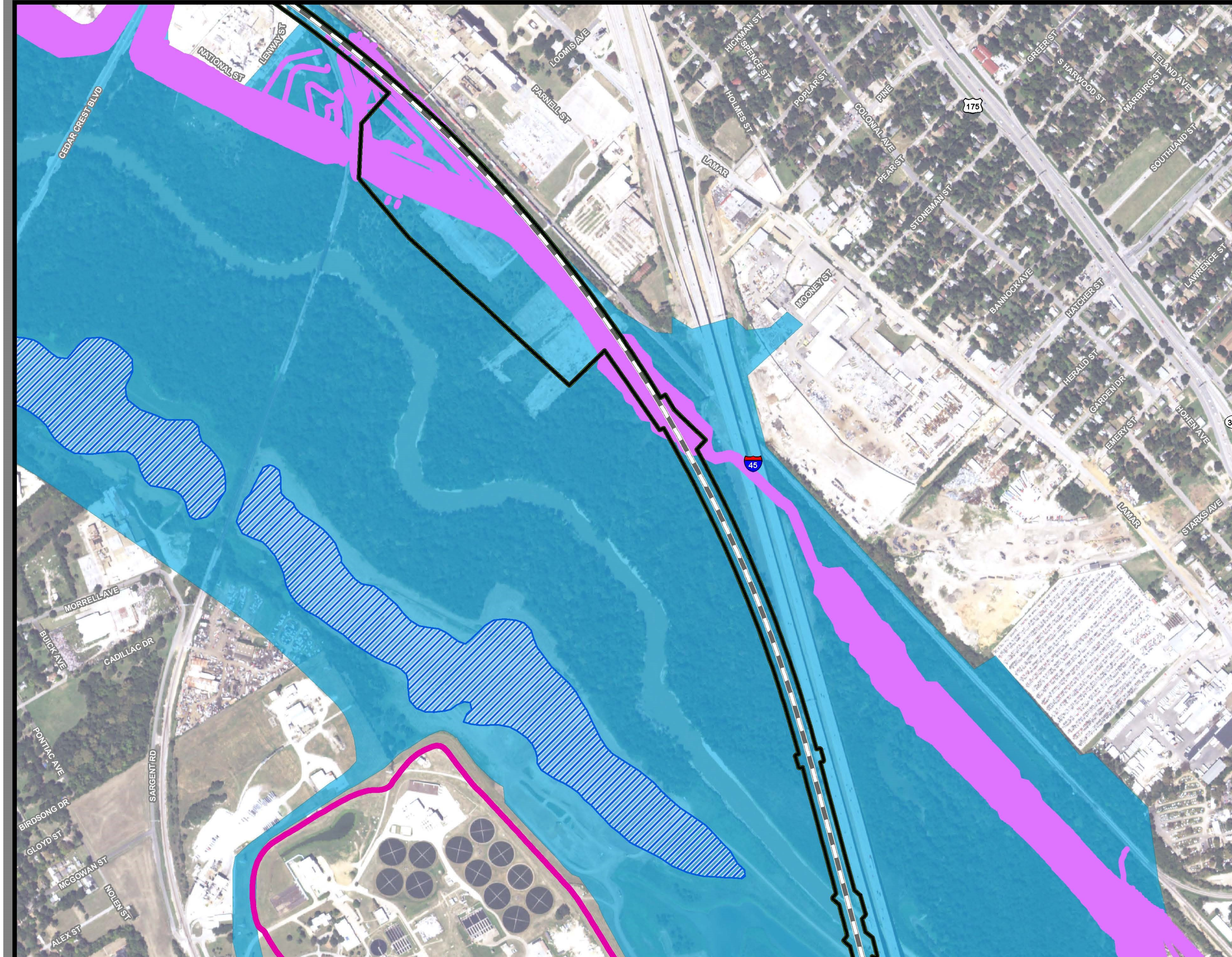
Limits of Disturbance (LOD)
- Segment 1
- LOD Located within 408 Boundary

Dallas Floodway
- East Dallas Levee Trinity LB
- Dallas Floodway
- Able Sump

Dallas Floodway Extension
- Future Lamar Levee
- Upper/Lower Chain of Wetlands
- Dallas Floodway Extension

Data Sources: USACE 2018, 2020
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet



Dallas to Houston High-Speed Rail Project

Project Footprint

in Association with USACE Projects

Sheet 2 of 4

Legend

Track Configuration

Viaduct

Limits of Disturbance (LOD)

Segment 1

LOD Located within 408 Boundary

Dallas Floodway Extension

Future Lamar Levee

Central WWTP Trinity RB

Upper/Lower Chain of Wetlands

Dallas Floodway Extension

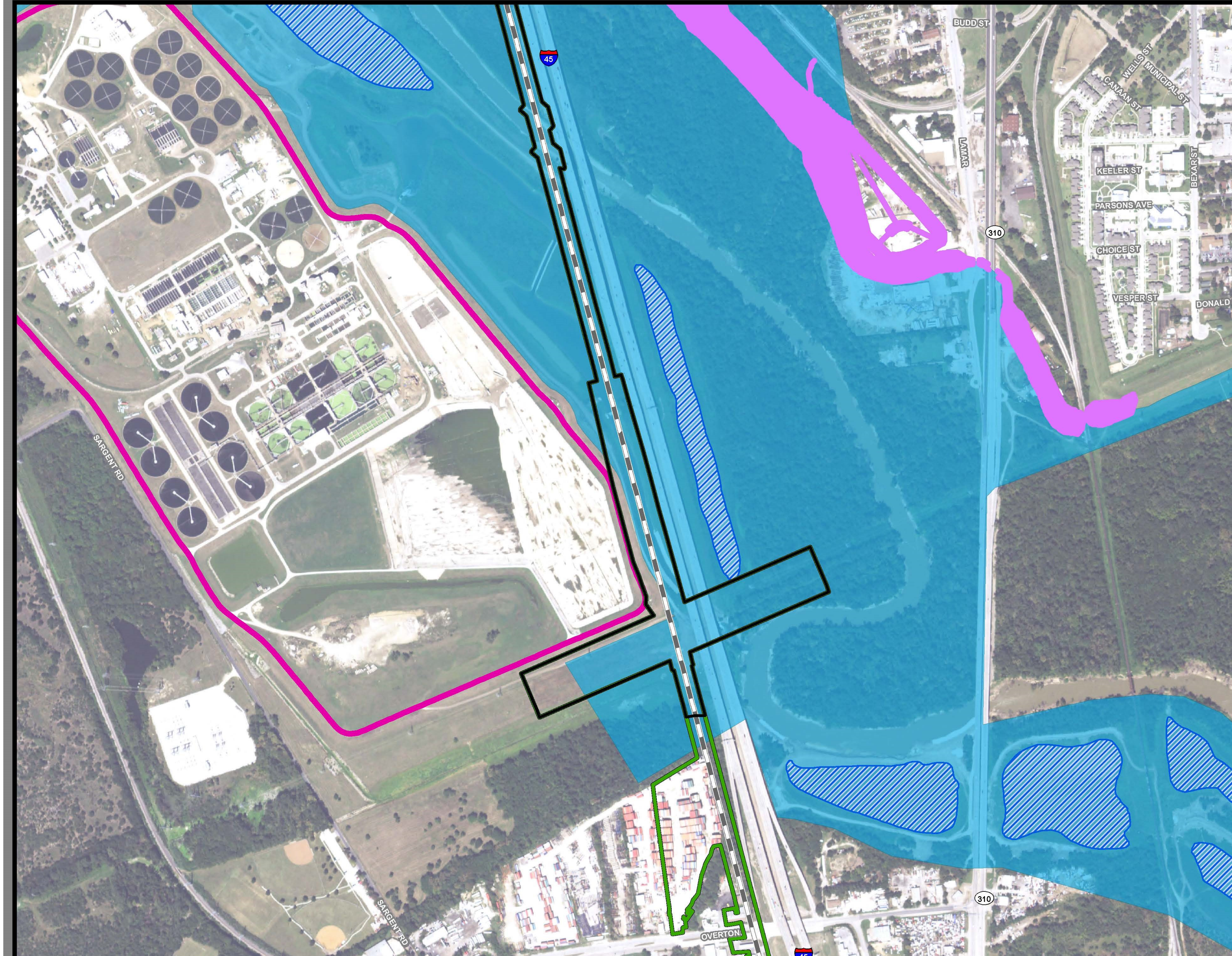
Data Sources: USACE 2018, 2020

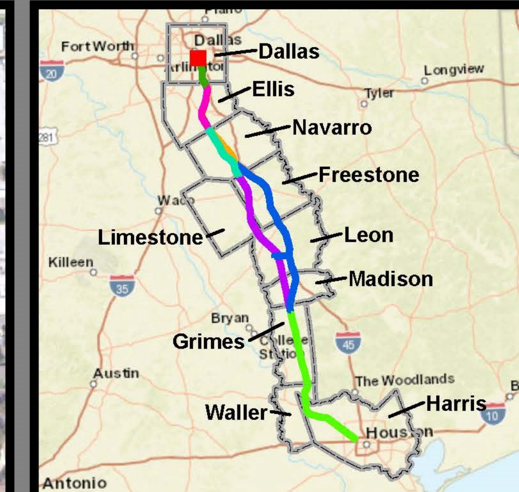
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet

0 300 600 Feet

N S E W





Dallas to Houston High-Speed Rail Project

Project Footprint

in Association with USACE Projects

Sheet 3 of 4

Legend

Track Configuration

Viaduct

Limits of Disturbance (LOD)

Segment 1

LOD Located within 408 Boundary

Dallas Floodway Extension

Future Lamar Levee

Central WWTP Trinity RB

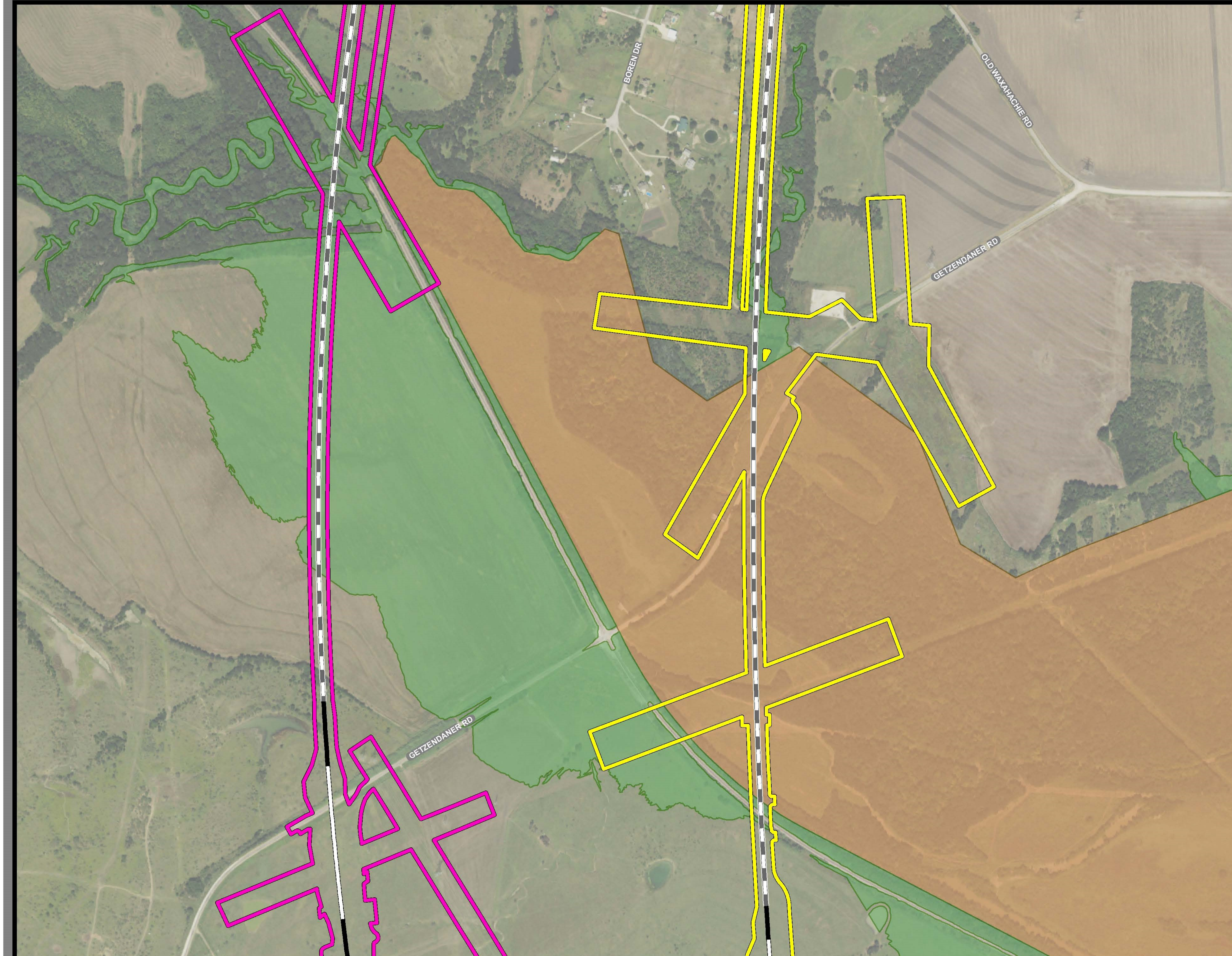
Upper/Lower Chain of Wetlands

Dallas Floodway Extension

Data Sources: USACE 2018, 2020
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet

0 300 600 Feet



Dallas to Houston High-Speed Rail Project
Project Footprint
in Association with USACE Projects
Sheet 4 of 4

Legend

Track Configuration

- Viaduct
- Embankment
- Cut

Limits of Disturbance (LOD)

- Segment 2A
- Segment 2B
- Bardwell Lake Easement
- Bardwell Lake Fee Property

Data Sources: USACE 2018, 2020
Aerial Imagery: USDA NAIP 2016

1 inch = 600 feet
0 300 600 Feet