Traffic Noise Analysis Report

FM 2931 from US 380 to FM 428

CSJ 2979-01-011
Dallas District

June 2022

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

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The Texas Department of Transportation (TxDOT) Dallas District proposes improvements to Farm-to-Market Road 2931 (FM 2931) from US Highway 380 to FM 428 in Denton County, Texas. The project is a Type I project as defined in 23 CFR 772.5, as it would result in the addition of new travel lanes. See the project description in the Environmental Compliance Oversight System (ECOS) and the project location maps in **Attachment A**.

Introduction

This analysis was accomplished in accordance with TxDOT's (Federal Highway Administration [FHWA]-approved) Traffic Noise Policy (2019).

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

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

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

The traffic noise analysis typically includes the following elements:

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

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

Table 1. FHWA Noise Abatement Criteria (NAC)

Activity Category	FHWA (dB(A) Leq)	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extra-ordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.

Activity Category	FHWA (dB(A) Leq)	Description of Land Use Activity Areas
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
F	--	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.
Source: Guidelines for Analysis and Abatement of Roadway Traffic Noise (TxDOT 2019)		

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

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

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

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

Analysis

The FHWA traffic noise modeling software (TNM 2.5) was used to calculate existing and predicted traffic noise levels. The model primarily considers the number, type and speed of vehicles; highway alignment and grade; cuts, fills and natural berms; surrounding terrain features; and the locations of activity areas likely to be impacted by the associated traffic noise.

The approved traffic data used in this analysis is included in **Attachment B**.

Validation

A validation study was performed in order to ensure that traffic noise is the main source of noise and to verify that the existing model accurately predicts existing traffic noise based on current conditions. Model validation compares field-collected sound level measurements to traffic noise levels calculated in an existing condition model that used field-collected traffic parameters. The difference between the measured and calculated levels for this project at the three validation sites was within the +/- 3 dB(A) tolerance allowed by FHWA. Therefore, the existing noise model is considered validated for this project. Additional information on the validation study is included in **Attachment C.**

Results

Existing and predicted traffic noise levels were modeled at receptor locations (see **Table 2** and **Figures 1-1** through **1-14** in **Attachment A**) that represent the land use activity areas adjacent to the proposed project that might be impacted by traffic noise and potentially benefit from feasible and reasonable noise abatement.

Table 2. Traffic Noise Levels dB(A) Leq

Representative Receptor	NAC Category	NAC Level	Existing	Predicted 2045	Change (+/-)	Noise Impact (Yes/No)
R-1 - Gas Station/Retail (Outdoor Seating)	E	72	61	64	+3	No
R-2 - Residence (Pool Area)	B	67	51	55	+4	No
R-3 - Apartment Balcony	B	67	53	58	+5	No
R-4 - School (Outdoor Seating)	C	67	58	61	+3	No
R-5 - Residence	B	67	64	67	+3	**Yes**
R-6 - Residence	B	67	64	67	+3	**Yes**
R-7 - Residence	B	67	57	61	+4	No
R-9 - Residence	B	67	66	68	+2	**Yes**
R-10 - Residence	B	67	64	64	+0	No
R-11 - Park (Playground Area)	C	67	54	56	+2	No
R-12 - Park (Ball Field)	C	67	57	58	+1	No
R-13 - School (Basketball Court)	C	67	55	57	+2	No
R-14 - Town Hall Interior	D	52	33	35	+2	No
R-15 - Residence (Outdoor Seating)	B	67	58	61	+3	No
R-16 - Residence	B	67	57	62	+5	No
R-17 - Residence	B	67	59	65	+6	No
R-18 - Residence	B	67	55	58	+3	No
R-19 - Residence	B	67	59	64	+5	No
R-20 - Residence	B	67	57	60	+3	No
R-20a - Residence	B	67	62	67	+5	**Yes**
R-21 - Residence	B	67	61	64	+3	No
R-22 - Church Interior	D	52	39	41	+2	No
R-23 - Residence	B	67	60	65	+5	No
R-24 - Residence	B	67	62	68	+6	**Yes**
R-25 - Trail HOA	C	67	62	67	+5	**Yes**
R-26 - Residence	B	67	62	67	+5	**Yes**
R-27 - Residence	B	67	60	65	+5	No
R-28 - Residence	B	67	60	63	+3	No
R-29 - Residence	B	67	62	66	+4	**Yes**
R-30 - Residence	B	67	62	66	+4	**Yes**
R-31 - Residence	B	67	60	66	+6	**Yes**
R-32 - Residence	B	67	61	66	+5	**Yes**
R-33 - Residence	B	67	51	57	+6	No
R-34 - Residence	B	67	58	64	+6	No
R-35 - Residence	B	67	51	57	+6	No
R-36 - Apartment Balcony	B	67	63	69	+6	**Yes**

Representative Receptor	NAC Category	NAC Level	Existing	Predicted 2045	Change (+/-)	Noise Impact (Yes/No)
R-37 - Residence	B	67	59	64	+5	No
R-38 - Residence	B	67	55	60	+5	No
R-39 - Residence	B	67	59	62	+3	No
R-40 - Residence	B	67	48	52	+4	No
R-41 - Residence	B	67	57	61	+4	No
R-42 - Residence	B	67	58	64	+6	No
R-43 - Residence	B	67	56	60	+4	No
R-44 - Residence	B	67	55	61	+6	No
R-45 - Church (Playground Area)	C	67	60	63	+3	No
R-46 - Residence	B	67	48	52	+4	No
Note: R-8 does not appear in this table, because it was removed from the analysis as a non-sensitive noise receptor. Abbreviations: NAC – noise abatement criteria; dB(a) A-weighted decibel; Leq – average/equivalent sound level						

As indicated in **Table 2**, the proposed project would result in traffic noise impacts at multiple receptors. Noise abatement measures were considered for the locations with predicted noise impacts.

Abatement Analysis

Before any abatement measure can be proposed for incorporation into the project, it must be both feasible and reasonable. Feasibility and reasonableness considerations include constructability, the predicted acoustic reductions provided by an abatement measure, a cost allowance, and whether the adjacent receptors desire abatement. Receptors associated with an abatement measure that achieve a noise reduction of five dB(A) or greater are called benefited receptors.

In order to be "feasible," the abatement measure must benefit a minimum of two impacted receptors AND reduce the predicted noise level by at least five dB(A) at greater than 50% of first-row impacted receptors.

In order to be "reasonable," the abatement measure must also reduce the predicted noise level by at least seven dB(A) for at least one benefited receptor (noise reduction design goal) and not exceed the standard barrier cost of 1,500 square feet per benefited receptor. In addition, an abatement measure may not be reasonable if the construction costs are unreasonably high due to site constraints, as determined through an alternate barrier cost assessment.

The following noise abatement measures were considered: traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise barriers.

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

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

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

Noise barriers – Noise barriers in the form of noise walls are the most commonly used noise abatement measures and were considered for this project. Noise barriers were evaluated for the impacted receptor locations with the following results:

R-20a – This receptor is an isolated residence that is not associated with a neighborhood or subdivision. Because a noise abatement measure must potentially benefit a minimum of two impacted receptors, noise abatement for this location is not feasible.

Proposed Abatement

Noise barriers would be feasible and reasonable for the following impacted receivers and are therefore proposed for incorporation into the project (see **Table 3**).

R5 and **R6** – These receivers represent 28 impacted receptors located in a subdivision in the town of Providence Village east of FM 2931 and south of Fishtrap Road. A barrier with two segments measuring 1,670 feet and a height of 10 feet was modeled at this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for 27 impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 16,698 square feet or 618 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

R9 – This receiver represents 20 impacted receptors located in a subdivision in the town of Providence Village east of the intersection of FM 2931 and Cape Cod Boulevard. A barrier with three segments measuring 2,015 feet and a height of 10 feet was modeled at this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for 20 impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 20,151 square feet or 720 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

R24 through **R27 –** These receivers represent 44 impacted receptors located north of FM 2931 between Silverado Parkway and Ike Byrom Road, including seven receptors associated with the walking trail around the pond using an average lot size of 0.16 acres. A barrier with five segments measuring 5,020 feet and a height of 8 feet was modeled at this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for 43 impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 40,161 square feet or 628 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

R29 and **R30** – These receivers represent 10 impacted receptors located in a new subdivision under construction (Enclave at Pecan Creek) along the east side of FM 2931 between Brewer Road and Ike Byrom Road. A barrier with four segments measuring 2,483 feet and a height of 10 feet was modeled in this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for eight impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 24,823 square feet or 1,182 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

R31 and **R32** – These receivers represent 16 impacted receptors located in a new subdivision under construction (Aspen Meadows) along the east side of FM 2931 north of Ike Byrom Road. A barrier with three segments measuring 1,820 feet and a height of 10 feet was modeled in this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for 15 impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 18,203

square feet or 1,011 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

R36 – This receiver represents 18 impacted receptors in a new apartment complex (EMLI at Pecan Creek) under construction on the west side of FM 2931 north of Ike Byrom Road. A barrier with two segments measuring 650 feet and a height of 14 feet was modeled in this location. This barrier would achieve the minimum feasible reduction of 5 dB(A) for 10 impacted, first-row receptors and would reduce noise levels by at least 7 dB(A) for at least one receptor. With a total area of abatement of 9,095 square feet or 268 square feet per benefitted receptor, this noise barrier is both reasonable and feasible and is proposed for incorporation into the project.

Table 3. Noise Barrier Proposal (preliminary)

Barrier	Representative Receivers	Total # Benefited	Length (feet)	Height (feet)	Total Sq. Ft.	Sq. Ft. per Benefited Receptor
A	R5 and R6	27	1,670	10	16,698	618
B	R9	28	2,015	10	20,151	720
C	R24-R27	64	5,020	8	40,161	628
D	R29-R30	21	2,483	10	24,823	1,182
E	R31 and R32	18	1,820	10	18,203	1,011
F	R36	34	650	14	9,095	268

Permit research was conducted using the best available online data from Denton County, the City of Aubrey, and the Town of Providence Village as of April 2022. This research was based on available online permit data and address information from the Denton Central Appraisal District database, as well as direct phone and email coordination with officials from Aubrey and Providence Village.

The final decision to construct the proposed noise barrier will not be made until completion of the project design, utility evaluation, and polling of all benefited and adjacent property owners and residents.

Noise Contours for Land Use Planning

To avoid noise impacts that may result from future development of properties adjacent to the project, local officials responsible for land use control programs must ensure, to the maximum extent possible, that no new activities are planned or constructed along or within the following predicted (2045) noise impact contours. The undeveloped areas identified below are based on field verification conducted in April 2022 and review of aerial photography.

Table 4. 2045 Predicted Noise Impact Contours

Undeveloped Area	Land Use	Impact Contour	Distance from Right of Way
West of FM 2931, North of Fishtrap Road	NAC Categories B & C	66 dB(A)	80 feet
	NAC Category E	71 dB(A)	15 feet
East of FM 2931, North of Gail Lane	NAC Categories B & C	66 dB(A)	80 feet
	NAC Category E	71 dB(A)	5 feet
South of FM 2931, West of Powell Road	NAC Categories B & C	66 dB(A)	48 feet
	NAC Category E	71 dB(A)	Within ROW
West of FM 2931, North of McNatt Road	NAC Categories B & C	66 dB(A)	20 feet
	NAC Category E	71 dB(A)	Within ROW
Note: The impact contours in Table 4 are one dB(A) lower than the NAC per category to reflect impacts that would occur as a result of approaching the NAC for the respective contours.			

Construction Noise

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

Local Official Notification and Date of Public Knowledge Statement

A copy of this traffic noise analysis will be available to local officials. On the date of the environmental decision for this project (Date of Public Knowledge), FHWA and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the project.

List of Attachments

A. Figures

B. Traffic Data

C. Existing Model Validation Study

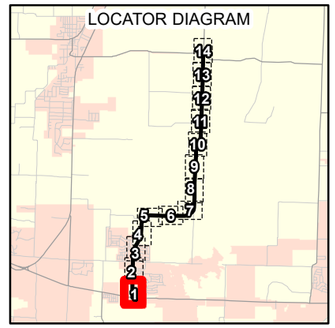
ATTACHMENT A

FIGURES

Figure 1-1

Traffic Noise Studies

FM 2931 from US 380 to FM 428
Denton County, Texas
CSJ: 2979-01-011



Key to Features

- Non-impacted Receptor
- Impacted Receptor
- Benefitted Receptor
- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

0 100 200
Feet

1 inch = 200 feet

Figure 1-2

Traffic Noise Studies

FM 2931 from US 380 to FM 428
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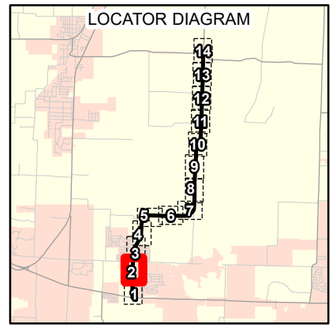

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0 100 200
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Figure 1-3

Traffic Noise Studies

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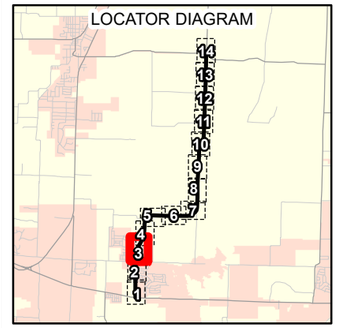

Key to Features

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- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

N

0 100 200
Feet

1 inch = 200 feet

Figure 1-4

Traffic Noise Studies

FM 2931 from US 380 to FM 428
Denton County, Texas
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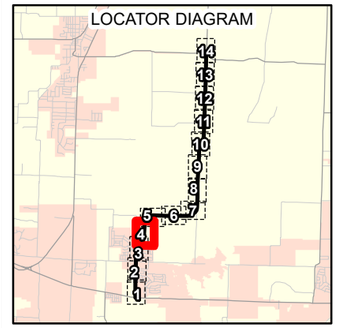

Key to Features

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N

0 100 200
Feet

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Figure 1-5

Traffic Noise Studies

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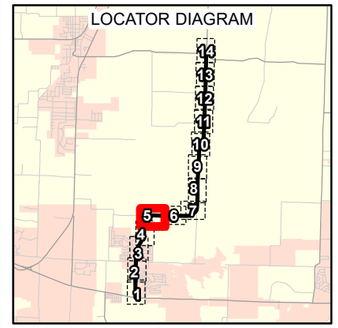

Key to Features

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N

0 100 200
Feet

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Figure 1-6

Traffic Noise Studies

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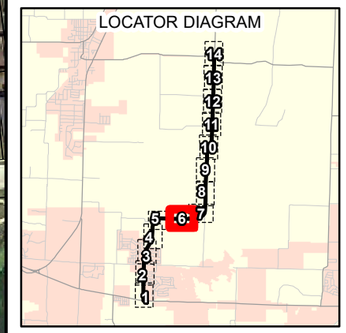

Key to Features

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- Existing ROW
- Proposed ROW
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- Parcel Boundary

N

0 100 200
Feet

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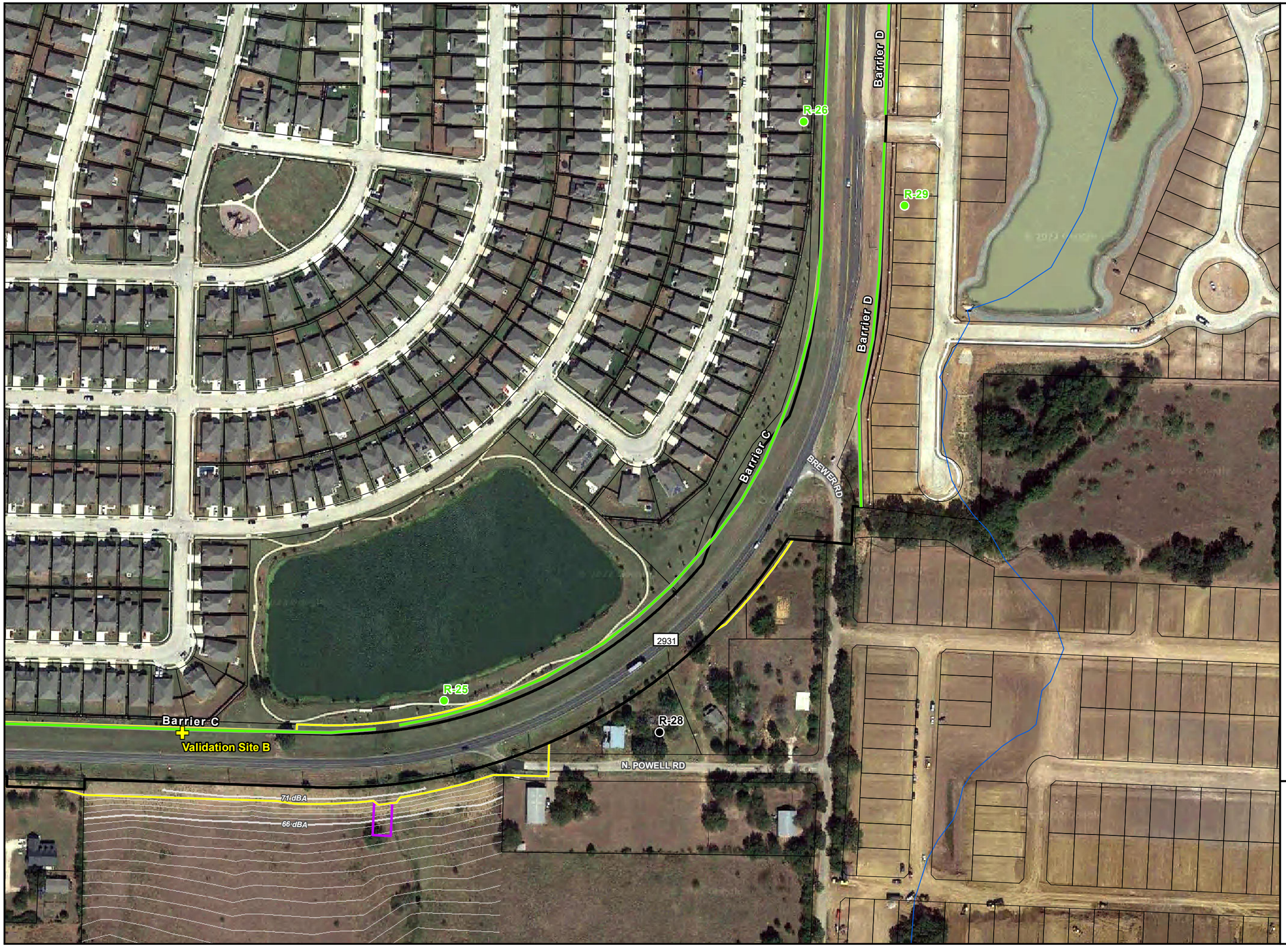

Figure 1-7

Traffic Noise Studies

FM 2931 from US 380 to FM 428
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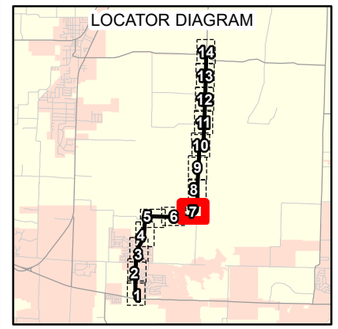

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N

0 100 200
Feet

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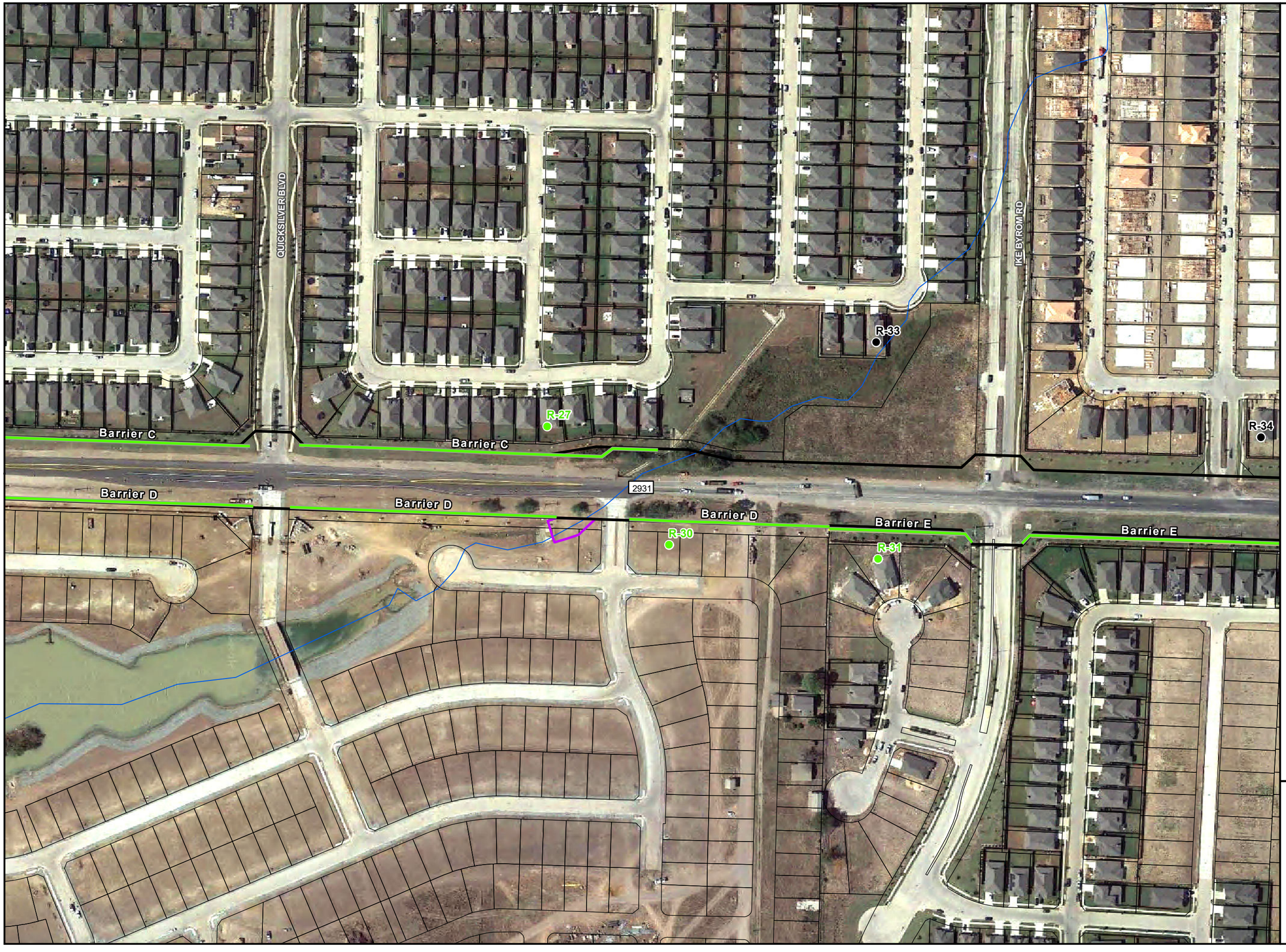

Figure 1-8

Traffic Noise Studies

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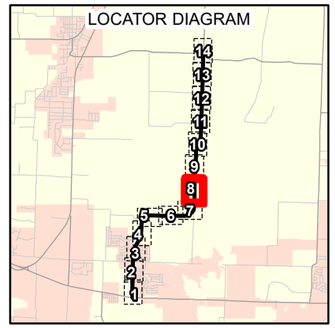

Key to Features

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Figure 1-9

Traffic Noise Studies

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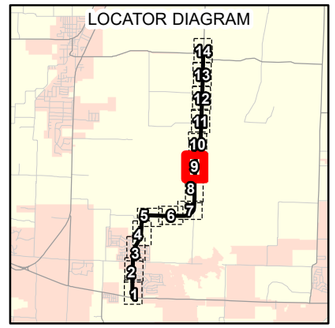

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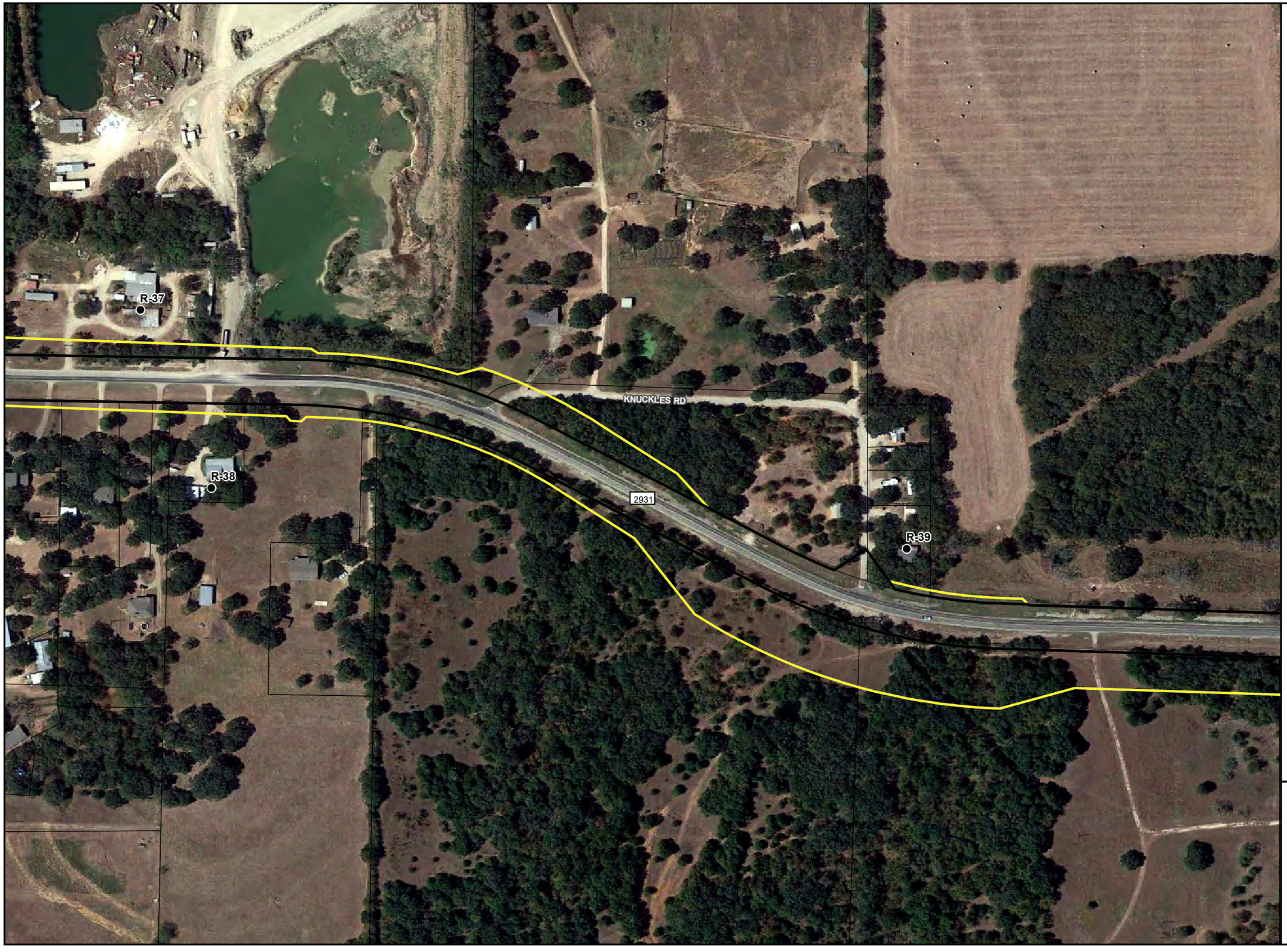

Figure 1-10

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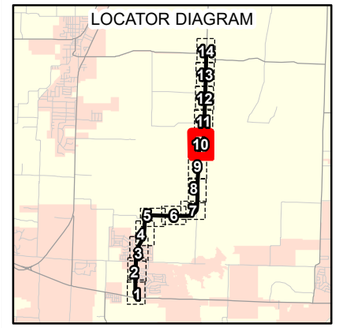

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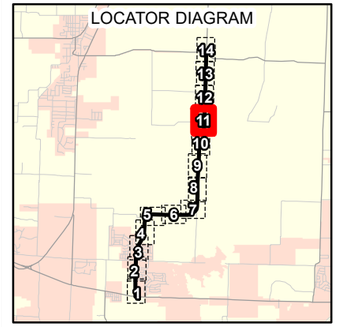
Denton County, Texas
CSJ: 2979-01-011



Key to Features

- Non-impacted Receptor
- Impacted Receptor
- Benefitted Receptor
- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

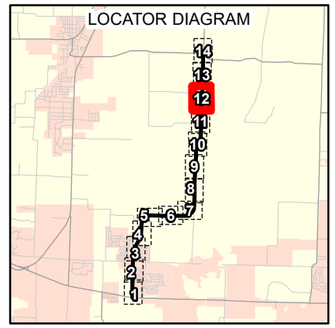
0 100 200
Feet

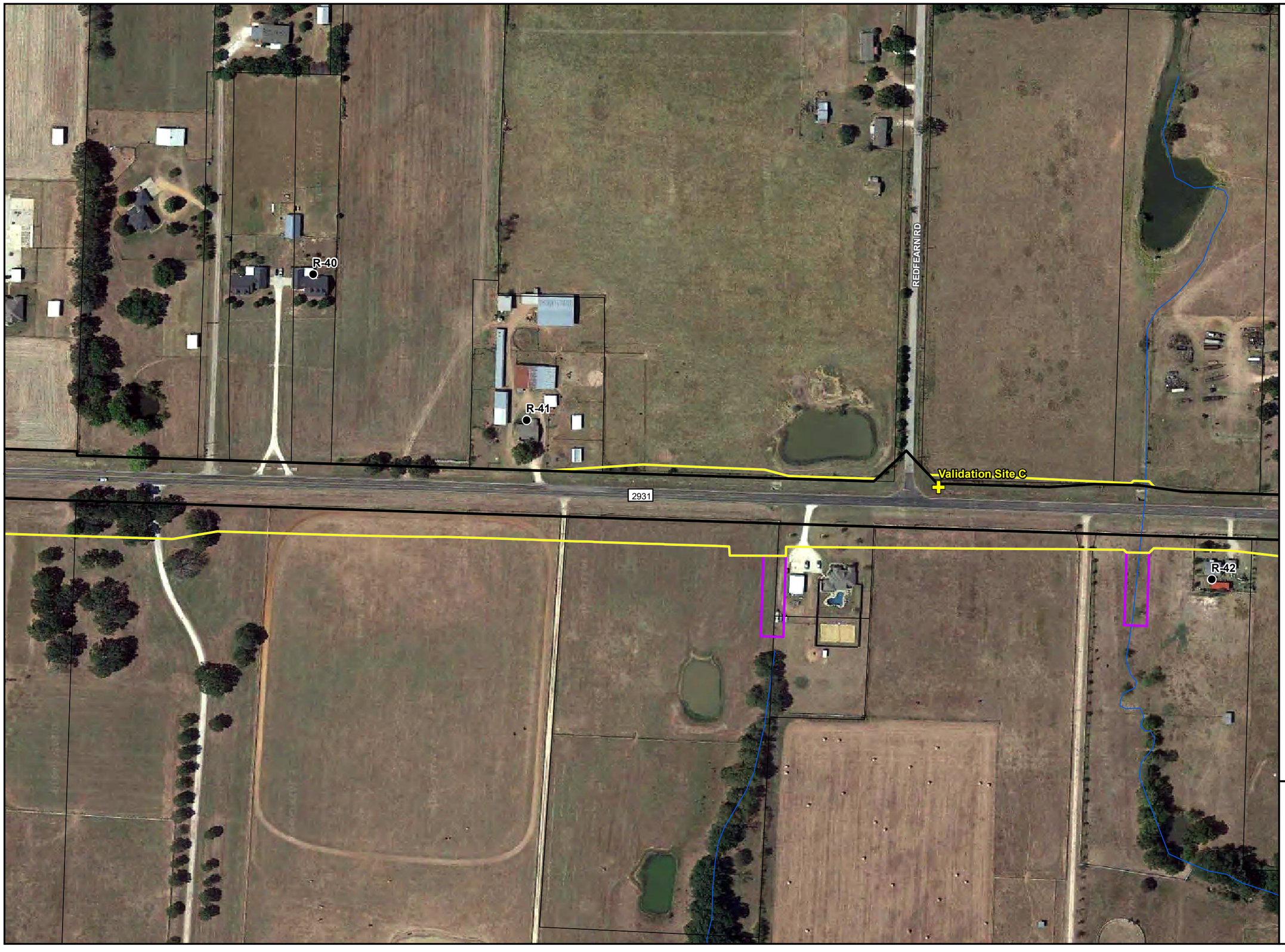
1 inch = 200 feet

Figure 1-12

Traffic Noise Studies

FM 2931 from US 380 to FM 428
Denton County, Texas
CSJ: 2979-01-011





Key to Features

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- Impacted Receptor
- Benefitted Receptor
- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

N

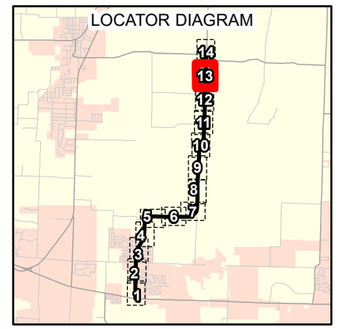
0 100 200
Feet

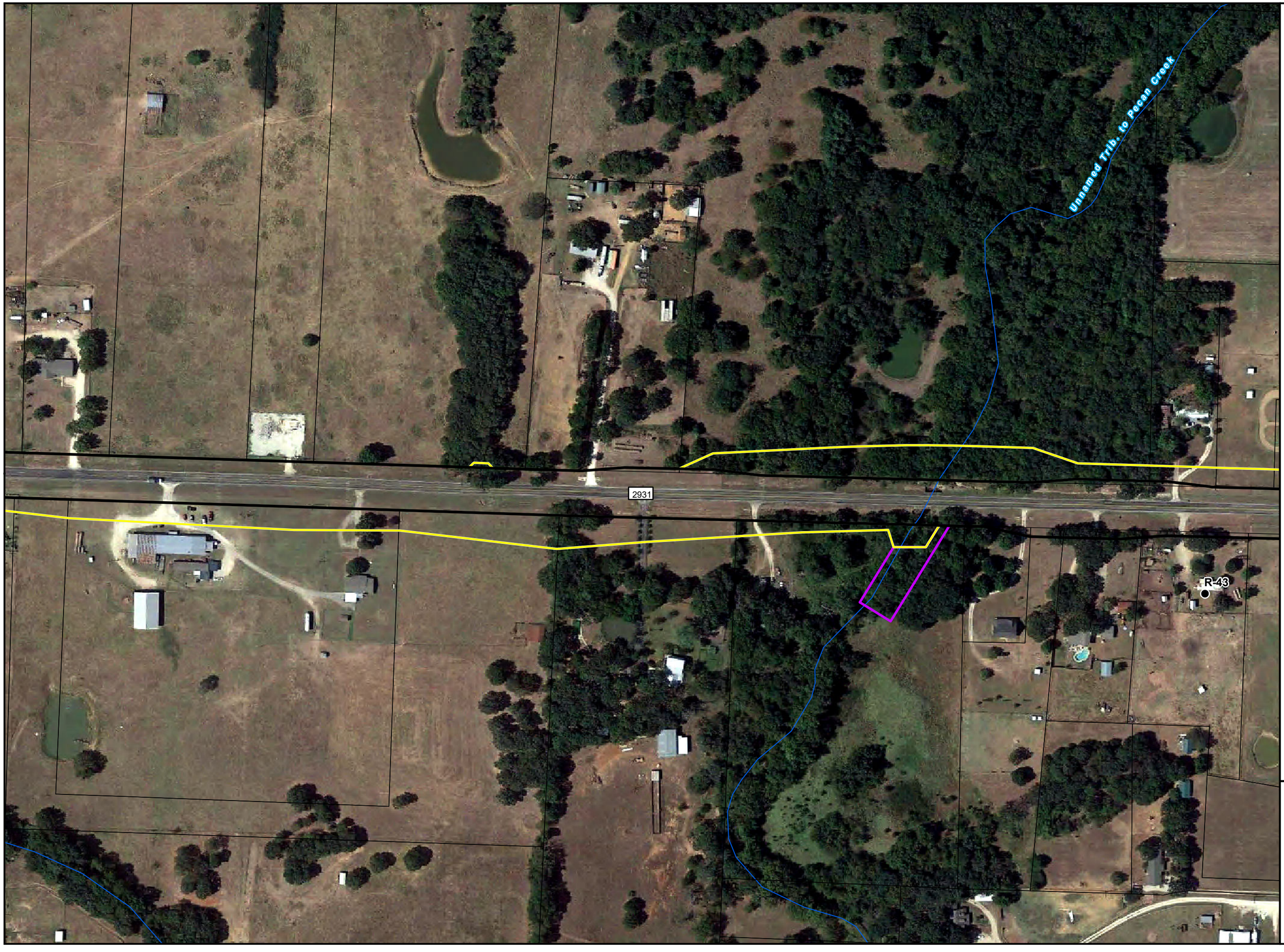
1 inch = 200 feet

Figure 1-13

Traffic Noise Studies

FM 2931 from US 380 to FM 428
Denton County, Texas
CSJ: 2979-01-011





Key to Features

- Non-impacted Receptor
- Impacted Receptor
- Benefitted Receptor
- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

N

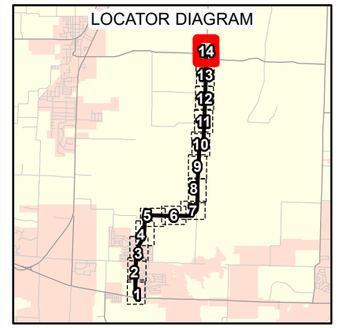
0 100 200
Feet

1 inch = 200 feet

Figure 1-14

Traffic Noise Studies

FM 2931 from US 380 to FM 428
Denton County, Texas
CSJ: 2979-01-011



Key to Features

- Non-impacted Receptor
- Impacted Receptor
- Benefitted Receptor
- Validation Site
- Proposed Barrier
- Stream (NHD)
- Existing ROW
- Proposed ROW
- Existing Easement
- Parcel Boundary

N

0 100 200
Feet

1 inch = 200 feet

ATTACHMENT B

TRAFFIC DATA

Texas Department of Transportation

MEMO

August 4, 2020

To: Transportation Planning & Programming Division
William E. Knowles, P.E.

Through: John Hudspeth, P.E.
Dallas Director of Transportation Planning and Development, TP&D

Through: Dan Perge, P.E.
Dallas District Environmental (DAL-ENV) Director

From: Lani Marshall, P.E.
Transportation Engineer Supervisor, PDO

Edra Brashear, P.E.
Project Manager, PDO

Subject: Traffic Request for ESALs (Option-C)
CSJ: 2979-01-011
FM 2931
From US 380 to FM 428

The attached traffic projections and traffic methodology were prepared by Jacobs Engineering Group Inc., and reviewed by TTI for QA/QC. The Dallas District approves the traffic methodology and line diagrams. The line diagrams depict 2025, 2045, and 2055 anticipated average daily traffic and turning movements for the proposed corridor improvements.

We request TPP to develop the noise, air and pavement data for this project.

If any additional information is needed, please contact Edra Brashear at (214)-320-6651 or Tim Wright at (214) 319-6477.

Attachments

CC: Edra Brashear, P.E.
Tim Wright, S.I.T.
C-5E, – (APD Traffic Data file, request date 2/24/2020

TECHNICAL MEMORANDUM (DRAFT)

Task Report # 8, Technical Assistance in the Environmental Process

TxDOT Project: QA/QC of Traffic Forecast Methodology for FM 2931 from US 380 to FM 428 in Denton County.

Project CSJ: 2979-01-011

DATE: June 23, 2020

TO: Edra Brashear, Project Manager, Project Delivery Office, TxDOT Dallas District

COPY TO: Dan Perge, Advance Project Development, TxDOT Dallas District

FROM: Sushant Sharma, Associate Research Scientist and John Overman, Research Scientist, Texas A&M Transportation Institute

FOR MORE INFORMATION:

Name: Sushant Sharma, John Overman
Phone: 817-462-0508, 817-462-0516
Email: s-sharma@tti.tamu.edu, JOVERM-C@txdot.gov

Executive Summary

The goal of this activity was to review traffic projection methodology and projected volumes. The Advance Project Development department at TxDOT's Dallas District requested quality assurance assistance from Texas A&M Transportation Institute (TTI) to evaluate the Traffic Forecast Methodology for FM 2931 from US 380 to FM 428 in Denton County.

The goal of this activity was to review traffic projection methodology and projected volumes. The Advance Project Development department at TxDOT's Dallas District requested quality assurance assistance from Texas A&M Transportation Institute (TTI) to evaluate the Traffic Forecast Methodology for FM 2931 from US 380 to FM 428 in Denton County.

Findings

- The Traffic Forecast Methodology report is consistent with guidelines in NCHRP 765 Report *(2), TxDOT's Traffic Data and Analysis Manual (3),* and *Roadway Design Manual (4)* and TPP Standard Operating Procedures *(5).*

- The growth rates adopted in the report are appropriate. The Traffic Forecast Methodology report recommends the growth rate of 3.9% and 2.9% pre-20 year pivot and 2.5% post-20 year pivot or long-term growth.

- Based on checks, the traffic project schematic numbers for the No-Build alternatives add correctly for the future years.

Conclusion

- Based on this re-review, the traffic projection methodology and projected volumes are complete, no more information or data is needed. This review is only for No-Build Condition.

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Introduction

The reviewed Traffic Forecast Methodology report is for the proposed for FM 2931 from US 380 to FM 428 in Denton County. Project is approximately 6.4 miles along FM 2931 and is primarily a two-lane undivided rural roadway and generally runs north to south with a section that runs east to west. The estimated traffic volumes were developed for the FM 2931 corridor and crossroads for 2025 (opening year), 2045 (design year), and 2055 (pavement design year).

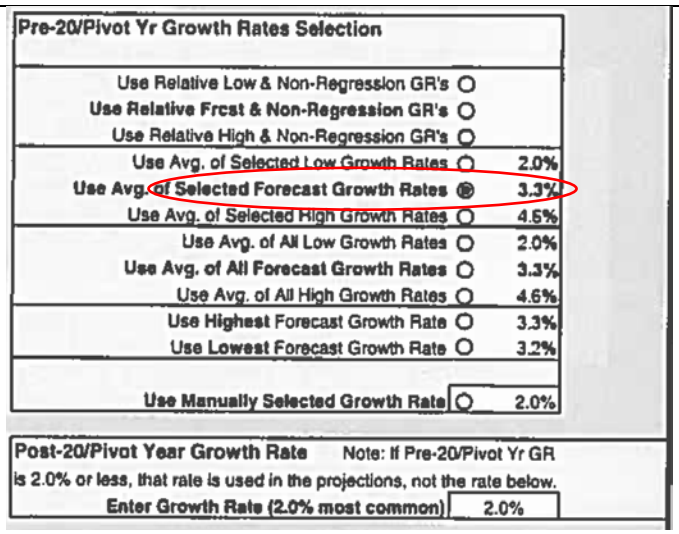
Estimated Growth Rates in Traffic Methodology Report

Data Sources

The traffic forecast methodology used the following data sources:

- TxDOT Traffic Count Database System (TCDS) website *(1)*.
- North Central Texas Council of Governments (NCTCOG) Travel Demand Model (TDM).
- Collected Existing Year 2020 Traffic Count

The Traffic Forecast Methodology report adopted a growth rate of 3.9% (2020−2025), 2.9% (2025−2045) for short-term growth, and 2.5% for long-term growth (2025−2055). According to the Traffic Forecast Methodology report, the TxDOT's Transportation Planning and Programming (TPP) Division Corridor Analysis Package provided to the consultant (dated March 26, 2019), the recommended short-term growth rate is 3.3%, and long-term growth rate is 2.0%. Figure 1 shows a screenshot of the growth rates that were provided in the TPP package.



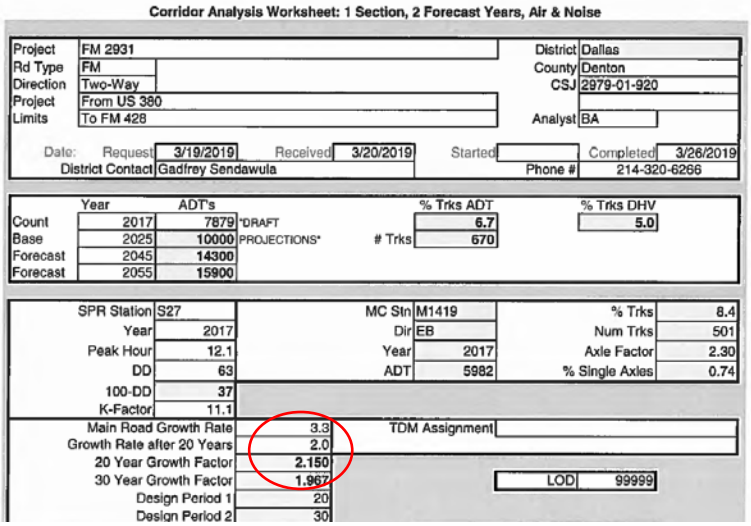
Pre-20/Pivot Yr Growth Rates Selection

Use Relative Low & Non-Regression GR's	○
Use Relative Frcst & Non-Regression GR's	○
Use Relative High & Non-Regression GR's	○
Use Avg. of Selected Low Growth Rates	○ 2.0%
Use Avg. of Selected Forecast Growth Rates	◉ 3.3%
Use Avg. of Selected High Growth Rates	○ 4.6%
Use Avg. of All Low Growth Rates	○ 2.0%
Use Avg. of All Forecast Growth Rates	○ 3.3%
Use Avg. of All High Growth Rates	○ 4.6%
Use Highest Forecast Growth Rate	○ 3.3%
Use Lowest Forecast Growth Rate	○ 3.2%
Use Manually Selected Growth Rate	○ 2.0%

Post-20/Pivot Year Growth Rate Note: If Pre-20/Pivot Yr GR is 2.0% or less, that rate is used in the projections, not the rate below.

Enter Growth Rate (2.0% most common) 2.0%

(a) From Traffic Volume Regression Worksheet in TPP Package



Corridor Analysis Worksheet: 1 Section, 2 Forecast Years, Air & Noise

Project	FM 2931			District	Dallas
Rd Type	FM			County	Denton
Direction	Two-Way			CSJ	2979-01-920
Project	From US 380				
Limits	To FM 428			Analyst	BA

Date: Request 3/19/2019 Received 3/20/2019 Started Completed 3/26/2019

District Contact Gadfrey Sendawula Phone # 214-320-6266

	Year	ADT's		% Trks ADT	% Trks DHV
Count	2017	7879	*DRAFT	6.7	5.0
Base	2025	10000	PROJECTIONS*	# Trks 670	
Forecast	2045	14300			
Forecast	2055	15900			

SPR Station	S27	MC Stn	M1419	% Trks	8.4
Year	2017	Dir	EB	Num Trks	501
Peak Hour	12.1	Year	2017	Axle Factor	2.30
DD	63	ADT	5982	% Single Axles	0.74
100-DD	37				
K-Factor	11.1				

Main Road Growth Rate	3.3	TDM Assignment	
Growth Rate after 20 Years	2.0		
20 Year Growth Factor	2.150		
30 Year Growth Factor	1.967	LOD	99999
Design Period 1	20		
Design Period 2	30		

(b) From Corridor Analysis Worksheet for Air& Noise Analysis in TPP Package

Figure 1. Estimated and Used Growth Rates in the Traffic Methodology Report and Provided in the TPP Package.

Background

Traffic forecasting is often an iterative process, involving assessment, corrections, or adjustments and retesting. Steps in this review range from data analysis to forecasting accuracy *(2)*. Traffic forecasts should be logical when compared with other studies and traffic forecasting work in the past, especially the recent past. Typically, the forecasts should be examined for scope, study area compatibility, forecast year, growth rates, assumptions used, quality of the tools used to develop the forecasts, and land-use changes. Resources that can be leveraged by the traffic forecaster can include state Department of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) planning studies, Traffic impact studies, Long-range transportation plans, and state DOTs Planning studies *(2)*. The common elements contained in a traffic forecast report include a table of contents, request for the forecast, project description/purpose of the forecast, data types and sources, forecasting parameters, discussion of tools and methods, results, supporting data/information, and glossary *(2)*.

Section 9 (Traffic Data and Forecast Request Procedures) and Chapter 3 (Project Level Traffic Data Development) of the TxDOT's *Traffic Data and Analysis Manual (3)* state that a request for a traffic feasibility study should include the information in Table 1. Table 1 lists the provided information from the Traffic Forecasting Methodology report for FM 2931 from US 380 to FM 428 in Denton County.

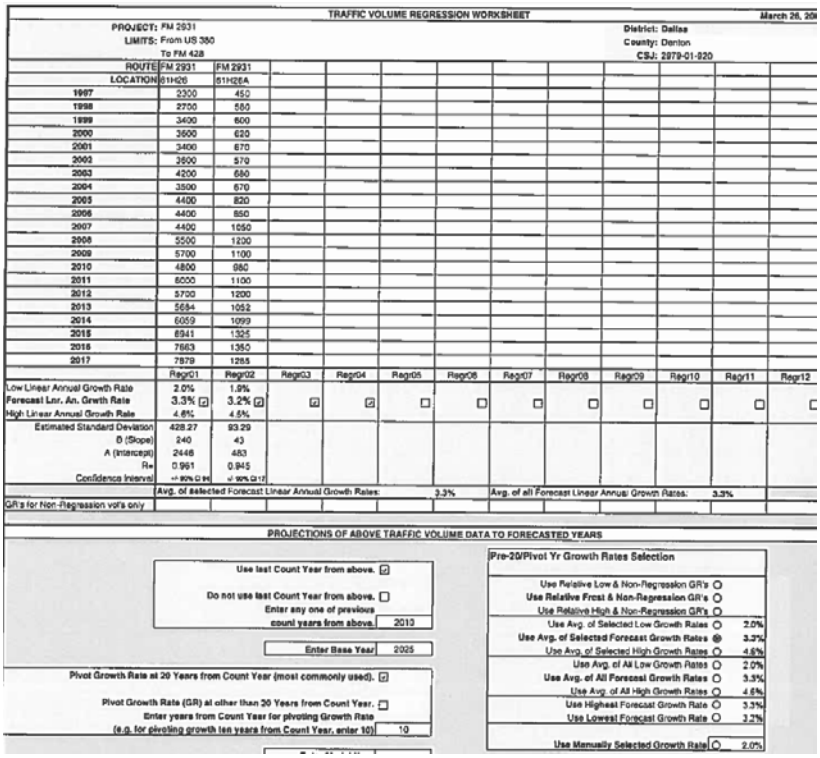
Table 1. Requirements for Traffic Feasibility Study *(3,4)*.

Requirements	Provided
Base year and design year for the project.	Yes
Current land use maps for the area surrounding the proposed project.	Yes
Location and type of major traffic generators.	Yes
Past and current traffic counts for an existing facility.	Yes
Major cross-streets.	Yes
Map giving general project alignment.	Yes
Identification of proposed facility type.	Yes
One- or two-way operation.	Yes
Number of lanes.	Yes
Preliminary schematic or straight-line map.	Yes
Length (in feet) for each link of the proposed facility (new location projects, only).	N.A.

Estimated and Recommended Growth Rates

The TPP Package presents forecasted linear annual growth rates on FM 2931 based on a 20-year historical data from nearby stations from TxDOT's Traffic Count Database System *(1).* Figure 2 shows the traffic data at two locations near the study corridor. The figure also shows low and high annual growth rates as well as a forecasted linear annual growth rate. The TPP recommended linear annual growth rate is 3.3% for pre 20-year/pivot year and a growth rate of 2% for post 20-year/pivot year growth. The growth rates adopted in the Traffic Methodology Report (3.9% (2020−2025), 2.9% (2025−2045) and 2.5% for long-term growth (2025−2055)) are consistent with TPP Corridor Analysis Standard Operating Procedures *(5)* that states:

"The 'Main Road Growth Rate' should never be less than 2% or more than 5%. Therefore, if the regression analysis determines the growth rate to be negative or under 2%, then 2% should be the entry. If the growth rate is over 5%, a default entry of 5% should be used."



TRAFFIC VOLUME REGRESSION WORKSHEET

PROJECT: FM 2931
LIMITS: From US 380 To FM 428
District: Dallas
County: Denton
CSJ: 2979-01-020

	ROUTE	FM 2931	FM 2931
	LOCATION	61H26	61H26A
1997		2300	450
1998		2700	550
1999		3400	600
2000		3600	620
2001		3400	670
2002		3500	570
2003		4200	680
2004		3500	670
2005		4400	820
2006		4400	850
2007		4400	1050
2008		5500	1200
2009		5700	1100
2010		4800	980
2011		6000	1100
2012		5700	1200
2013		5684	1052
2014		6059	1099
2015		6941	1325
2016		7663	1350
2017		7879	1265

	Regr01	Regr02	Regr03	Regr04	Regr05	Regr06	Regr07	Regr08	Regr09	Regr10	Regr11	Regr12
Low Linear Annual Growth Rate	2.0%	1.9%										
Forecast Lnr. An. Grwth Rate	3.3% ☑	3.2% ☑	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐
High Linear Annual Growth Rate	4.6%	4.5%										
Estimated Standard Deviation	428.27	93.29										
B (Slope)	240	43										
A (intercept)	2448	483										
R²	0.961	0.945										
Confidence Interval	+/- 90% CI H	+/- 90% CI L										

Avg. of selected Forecast Linear Annual Growth Rates: 3.3%
Avg. of all Forecast Linear Annual Growth Rates: 3.3%
GR's for Non-Regression vol's only

PROJECTIONS OF ABOVE TRAFFIC VOLUME DATA TO FORECASTED YEARS

Use last Count Year from above. ☑
Do not use last Count Year from above. ☐
Enter any one of previous count years from above: 2013
Enter Base Year: 2025

Pivot Growth Rate at 20 Years from Count Year (most commonly used). ☑
Pivot Growth Rate (GR) at other than 20 Years from Count Year. ☐
Enter years from Count Year for pivoting Growth Rate (e.g. for pivoting growth ten years from Count Year, enter 10): 10

Pre-20/Pivot Yr Growth Rates Selection

Use Relative Low & Non-Regression GR's	○
Use Relative Frcst & Non-Regression GR's	○
Use Relative High & Non-Regression GR's	○
Use Avg. of Selected Low Growth Rates	○ 2.0%
Use Avg. of Selected Forecast Growth Rates	◉ 3.3%
Use Avg. of Selected High Growth Rates	○ 4.6%
Use Avg. of All Low Growth Rates	○ 2.0%
Use Avg. of All Forecast Growth Rates	○ 3.3%
Use Avg. of All High Growth Rates	○ 4.6%
Use Highest Forecast Growth Rate	○ 3.3%
Use Lowest Forecast Growth Rate	○ 3.2%
Use Manually Selected Growth Rate	○ 2.0%

Figure 2. Data Used For Estimated and Recommended Growth Rates in TPP Package.

TxDOT Data

The linear regression models developed by the consultant (see Figure 3) using a 20-year historical data from TCDS has a robust coefficient of determination (R-square) for both stations (R-square of 0.89 and 0.87). The predicted average growth rate is 3.1% is reasonable. Further, the analysis using the recent data (2016-2020) provides an observed growth rate of 4.7%.

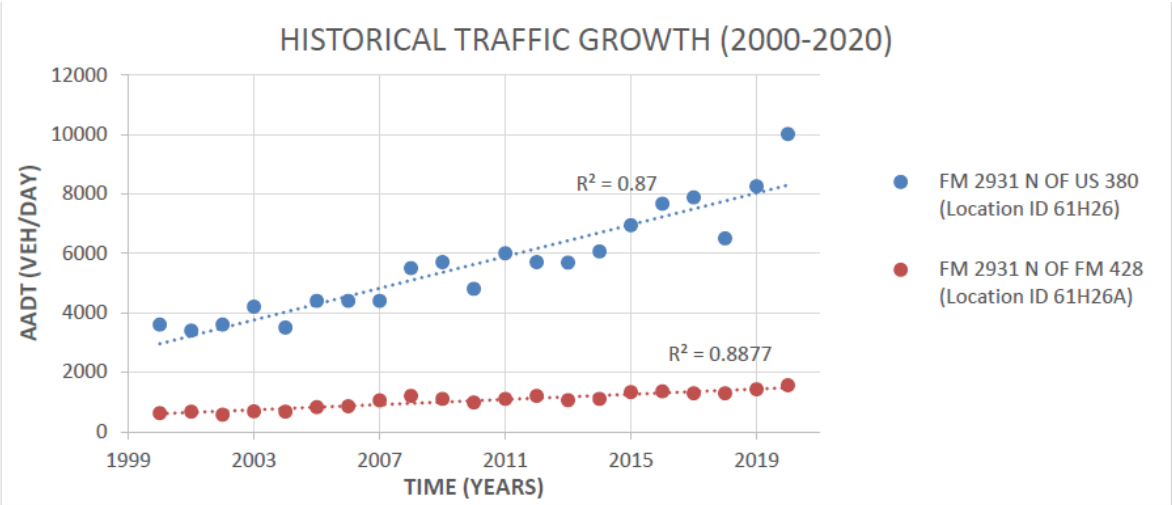


Figure 3. Linear Regression Models Developed by Consultant Using 20 Years of TCDS Data

NCTCOG Data

The Traffic Methodology Report also mentions the annual average growth rate estimated based on the NCTCOG TDM data. The average growth rates estimated from TDM traffic forecasts in the years 2020 to 2028 (8-year period), 2028 to 2045 (17-year period) and 2020 to 2045 (25-year period) are 4.6%, 6.9%, and 8.0% respectively. This information has been given low weight due to high percent difference in the traffic volume.

Table 2 compares the growth rates used in the Traffic Forecast Methodology report, the TPP recommends a linear growth rate of 3.3% for pre-20 year pivot and 2.0% for post-20 year pivot. The Traffic Methodology Report estimated the growth rates of 3.9% and 2.9% pre-20 year pivot and 2.5% post-20 year pivot using the linear regression model. TTI found the recommended annual growth rates as appropriate and well supported.

Table 2. Comparison of Reported and Estimated Growth Rates for 2025, 2045, 2055.

Year	Recommended Growth Rates	TPP TxDOT Avg. Forecasted Linear Growth Rate	NCTCOG Growth Rates	Rating of Proposed Growth Rate *(Low/Good/High)*
2025	**3.9%**	**3.3%**	**4.6%** [2020-2028]	**Good**
2045	**2.9%**	**2.0%** (Post-20/Pivot Year)	**6.9%** [2028-2045]	
2055	**2.5%**		**8.0%** [2020-2045]	

Traffic Volumes

Traffic projections on line schematic for the years 2025, 2045, and 2055 and No Build were randomly reviewed for accuracy to verify that turning and through movements add correctly. The traffic projections add up correctly (See Appendix A).

K Factor

The reviewed Traffic Forecast Methodology Report adopts a K factor or value of 11.1 percent as recommended in TPP corridor analysis information packet. TTI consulted *TxDOT's Roadway Design Manual (3)* that recommends following default values for K Factor (percentage of ADT representing the 30th highest hourly volume in the design year):

"For typical main rural highways, K factors generally range from 12 to 18 percent. For urban facilities, K factors are typically somewhat lower, ranging from 8 to 12 percent."

Based on the manual, the choice of K factor seems reasonable.

Conclusions

The goal of this activity was to review traffic projection methodology and projected volumes. The Advance Project Development department at TxDOT's Dallas District requested quality assurance assistance from Texas A&M Transportation Institute (TTI) to evaluate the Traffic Forecast Methodology for FM 2931 from US 380 to FM 428 in Denton County.

Findings

- The Traffic Forecast Methodology report is consistent with guidelines in NCHRP 765 Report *(2), TxDOT's Traffic Data and Analysis Manual (3),* and *Roadway Design Manual (4)* and TPP Standard Operating Procedures *(5).*

- The growth rates adopted in the report are appropriate. The Traffic Forecast Methodology report recommended the growth rate of 3.9% and 2.9% pre-20 year pivot and 2.5% post-20 year pivot or long-term growth.

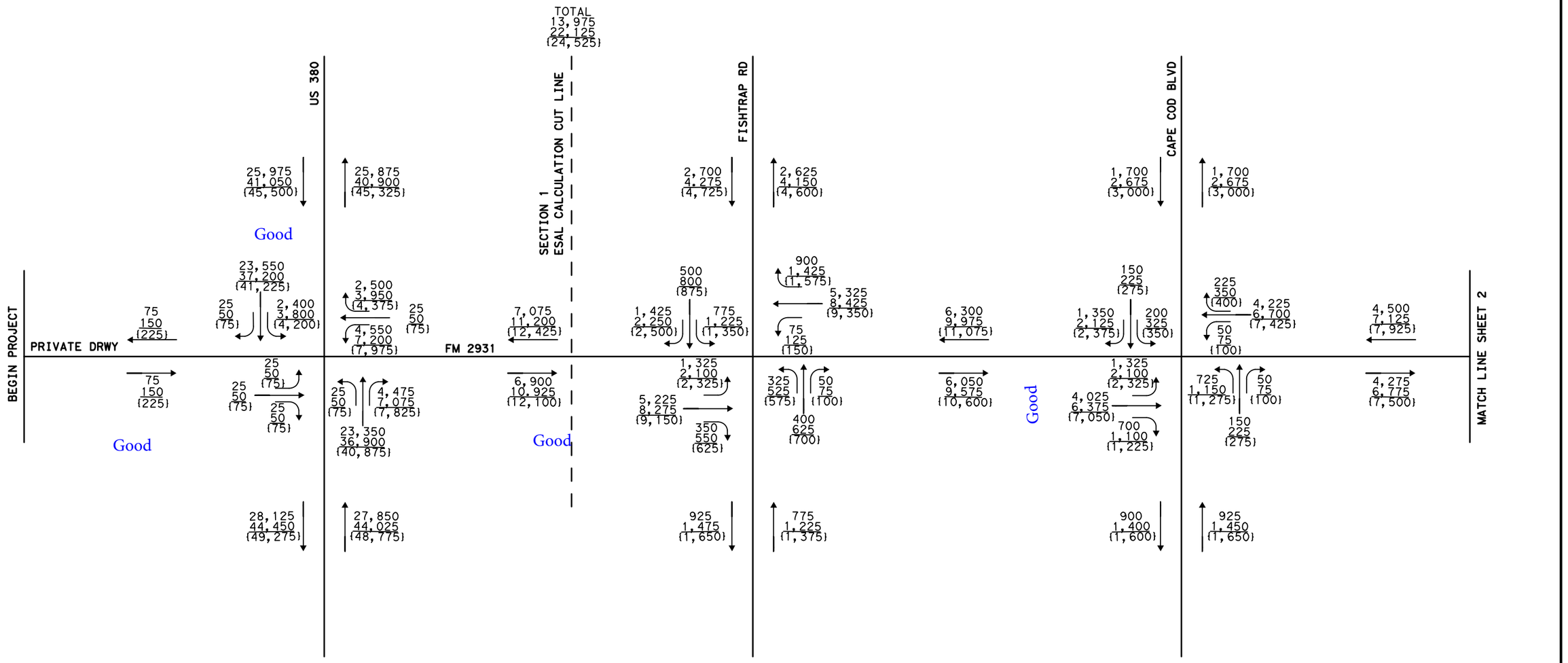
- Based on checks, the traffic project schematic numbers for the No-Build alternatives add correctly for the year 2040.

References

1. TxDOT, 2018 *Traffic Count Database System (TCDS): Statewide Traffic Analysis and Reporting System (STARS II). Accessed May 7, 2020* http://txdot.ms2soft.com/tcds/tsearch.asp?loc=Txdot&mod=
2. CDM Smith, Horowitz, A., Creasey, T., Pendyala, R., and Chen, M., 2014. *Analytical Travel Forecasting Approaches for Project-Level Planning and Design*, NCHRP Report 765, Project 08-83. http://www.trb.org/Main/Blurbs/170900.aspx Accessed April 2019.
3. TxDOT, 2001, *Traffic Data and Analysis Manual* http://onlinemanuals.txdot.gov/txdotmanuals/tda/tda.pdf Accessed May 9, 2020.
4. TxDOT, 2014, *Roadway Design Manual* http://onlinemanuals.txdot.gov/txdotmanuals/rdw/rdw.pdf Accessed May 9, 2019.
5. TxDOT, 2017a *Corridor Analysis Standard Operating Procedures Transportation* Planning and Programming Traffic Analysis Section (TPP). Published in May, 2017

Appendix A. Traffic Volume Verifications

This appendix contains the traffic volume verifications for the FM 2931



LEGEND

999-YEAR 2025 ADT
999-YEAR 2045 ADT
{999}-YEAR 2055 ADT

NOT TO SCALE

OTHON
CONSULTING ENGINEERS
F-1471 · HOUSTON · DALLAS
2140 Lake Park Boulevard | Richardson, Texas 75080
P: 214.340.7344 | F: 214.221.7411

NO BUILD TRAFFIC PROJECTIONS (ADT) FOR FM 2931 FROM US 380 TO FM 428

DATE: 4/3/2020	DN: JM	CK: AC	DW: JM	CK: SS
CSJ: 2979-01-011	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1

COUNTY	CONTROL	SECT	JOB	HIGHWAY
DENTON	2979	01	011	FM 2931

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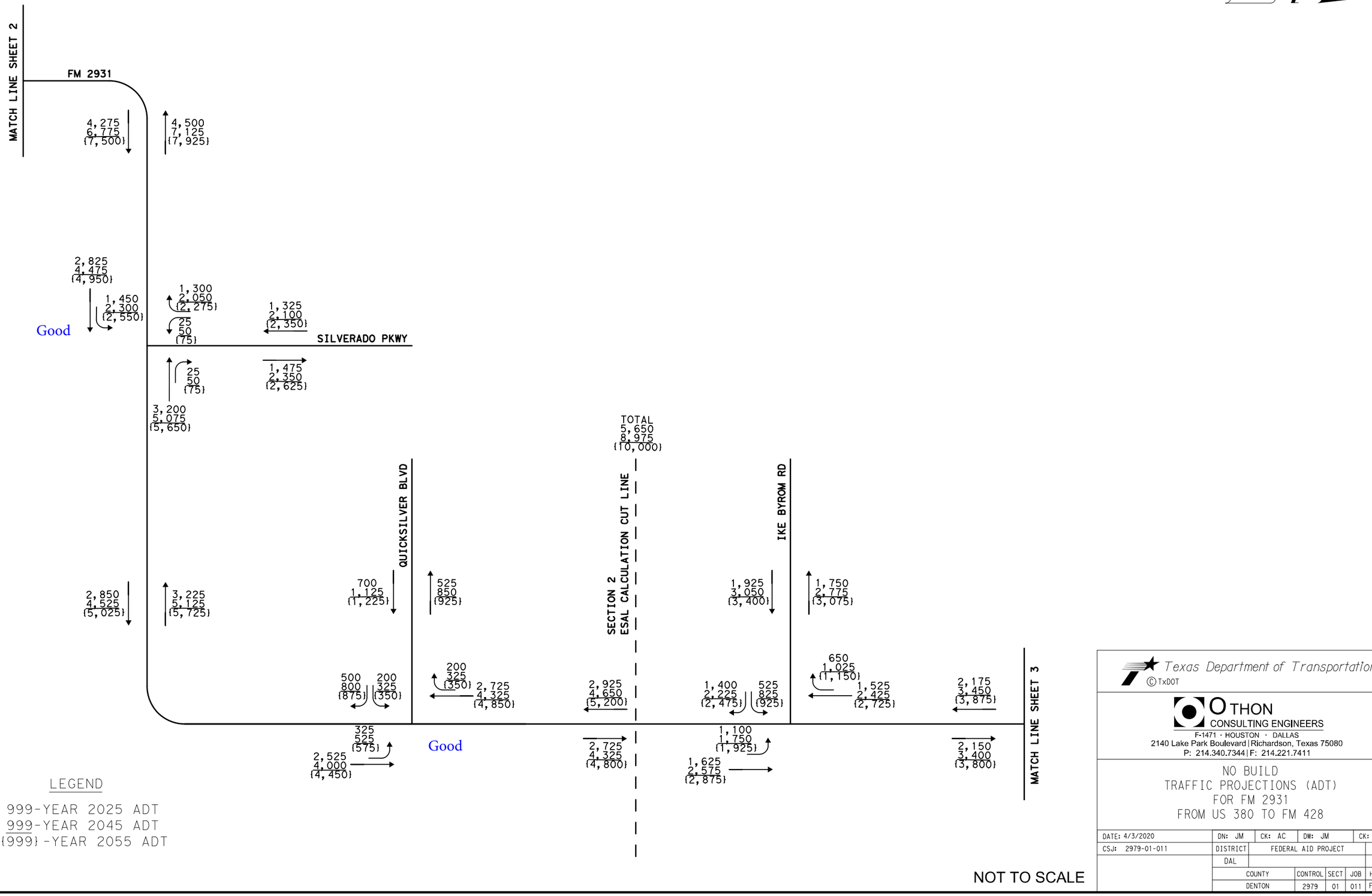

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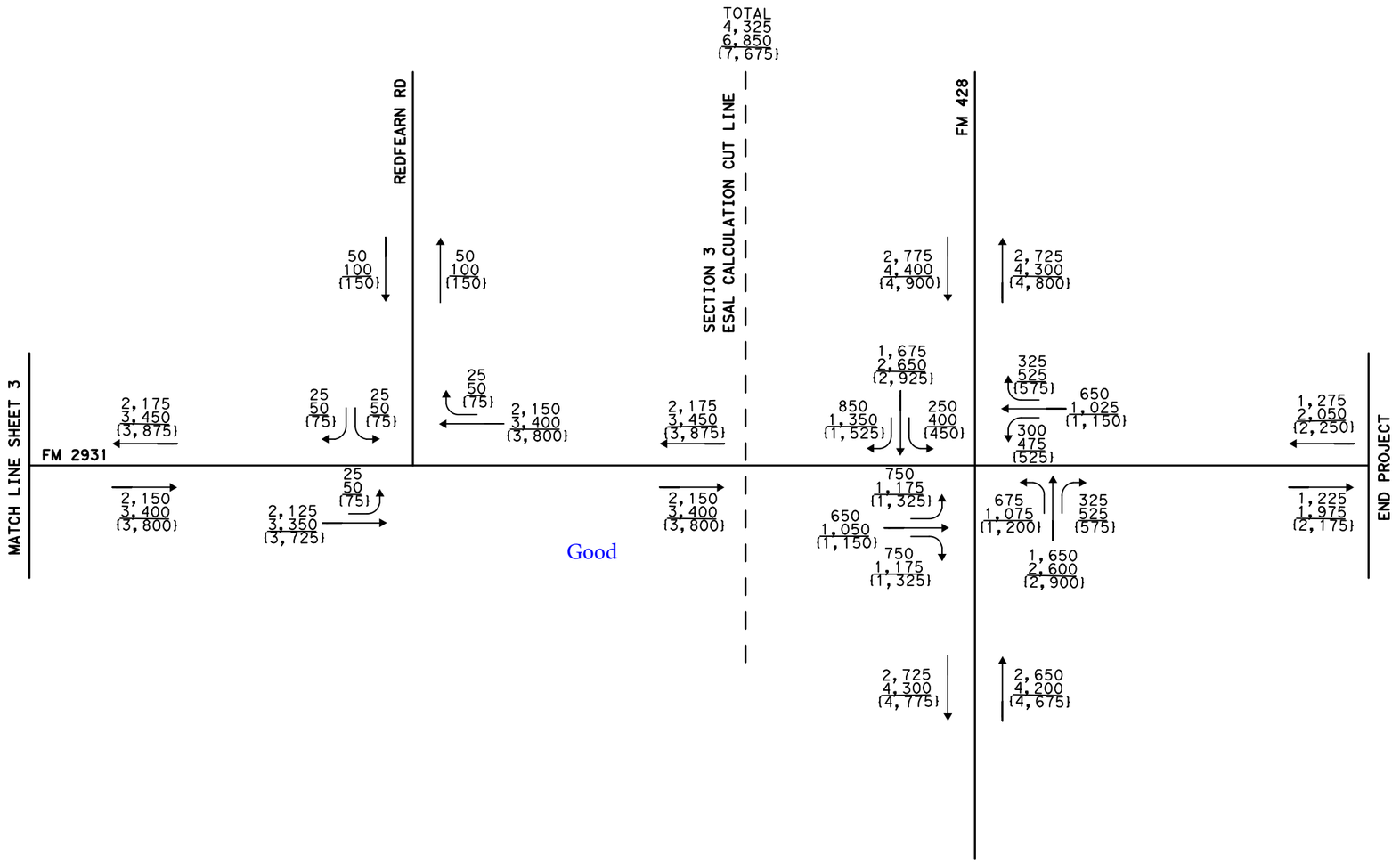
F-1471 · HOUSTON · DALLAS
2140 Lake Park Boulevard | Richardson, Texas 75080
P: 214.340.7344 | F: 214.221.7411

NO BUILD TRAFFIC PROJECTIONS (ADT) FOR FM 2931 FROM US 380 TO FM 428

DATE: 4/3/2020	DN: JM	CK: AC	DW: JM	CK: SS
CSJ: 2979-01-011	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON	2979	01	011	FM 2931



LEGEND

999-YEAR 2025 ADT
999-YEAR 2045 ADT
{999}-YEAR 2055 ADT

NOT TO SCALE

Texas Department of Transportation

OTHON
CONSULTING ENGINEERS
F-1471 · HOUSTON · DALLAS
2140 Lake Park Boulevard | Richardson, Texas 75080
P: 214.340.7344 | F: 214.221.7411

NO BUILD
TRAFFIC PROJECTIONS (ADT)
FOR FM 2931
FROM US 380 TO FM 428

DATE: 4/3/2020	DN: JM	CK: AC	DW: JM		CK: SS
CSJ: 2979-01-011	DISTRICT	FEDERAL AID PROJECT			SHEET
	DAL				3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON	2979	01	011	FM 2931

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TRAFFIC ANALYSIS FOR HIGHWAY DESIGN - (OPTION C)

Dallas District **August 28, 2020**

Description of Location	Base Year Average Daily Traffic 2025	Base Year Average Daily Traffic 2045	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2025 to 2045) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 1 From US 380 To Silverado Pkwy Denton County	13,975	22,125	59 - 41	11.1	6.0	4.5	11,200	30	2,606,000	3	3,153,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	94.0	95.5
Medium Duty	3.2	2.4
Heavy Duty	2.8	2.1

Description of Location	Base Year Average Daily Traffic 2025	Base Year Average Daily Traffic 2055	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2025 to 2055) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 1 From US 380 To Silverado Pkwy Denton County	13,975	24,525	59 - 41	11.1	6.0	4.5	11,300	30	4,169,000	3	5,043,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN - (OPTION C)

Dallas District **August 28, 2020**

Description of Location	Average Daily Traffic 2025	Average Daily Traffic 2045	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2025 to 2045) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 2 From Silverado Pkwy To Ike Byrom Rd Denton County	5,650	8,975	59 - 41	11.1	8.6	6.5	10,900	40	1,506,000	3	1,826,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	91.4	93.5
Medium Duty	4.6	3.5
Heavy Duty	4.0	3.0

Description of Location	Average Daily Traffic 2025	Average Daily Traffic 2055	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2025 to 2055) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 2 From Silverado Pkwy To Ike Byrom Rd Denton County	5,650	10,000	59 - 41	11.1	8.6	6.5	10,900	40	2,418,000	3	2,931,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN - (OPTION C)

Dallas District **August 28, 2020**

Description of Location	Base Year Average Daily Traffic 2025	Base Year Average Daily Traffic 2045	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2025 to 2045) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 3 From Ike Byrom Rd To FM 428 Denton County	4,325	6,850	59 - 41	11.1	10.0	7.5	10,900	40	1,336,000	3	1,621,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	90.0	92.5
Medium Duty	5.4	4.1
Heavy Duty	4.6	3.4

Description of Location	Base Year Average Daily Traffic 2025	Base Year Average Daily Traffic 2055	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2025 to 2055) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 2931 Section 3 From Ike Byrom Rd To FM 428 Denton County	4,325	7,675	59 - 41	11.1	10.0	7.5	10,900	40	2,152,000	3	2,611,000	8"

ATTACHMENT C

EXISTING MODEL VALIDATION STUDY

Existing Model Validation Study
FM 2931 from US 380 to FM 428
Denton County, TX
(CSJ: 2979-01-011)

A validation study was performed to verify that the existing model accurately predicts existing traffic noise based on current conditions and to ensure that traffic noise is the main source of noise. Model validation compares field-collected sound level measurements to traffic noise levels calculated in an existing condition model that used field-collected traffic parameters.

Three validation sites were selected along the project right of way after consultation with TxDOT District staff and ENV subject matter experts. The three field measurements were collected on September 30, 2020, between 9:38 AM and 11:57 AM. The weather was partly cloudy, with a light breeze. During the measurements, traffic was free-flowing and traveling at a relatively constant speed.

A 3M SoundPro DL 2-1/3 Octave dosimeter was used to measure sound levels in dB(A) Leq. The sound level meter was positioned on a tripod with the microphone facing the roadway and set at a height of five feet. The meter was calibrated before measurements were taken and at the end of the day.

Concurrently with the sound level measurement, traffic conditions for all existing travel lanes adjacent to the noise meter were video recorded. A laser speed detector was used to estimate average traffic speeds in both directions. Weather conditions were also recorded during the measurement period.

Upon return from the field, field data were reviewed to obtain traffic counts by vehicle classification (car, medium truck, and heavy truck). Because the noise modeling software uses a vehicle per hour input, vehicle counts for the 15-minute measurement interval were multiplied by four to convert the values to the hourly condition.

The FHWA traffic noise modeling software (TNM 2.5) was used to calculate existing traffic noise levels at the validation locations, based on the field-observed conditions. The validation model runs used the existing roadway parameters, observed hourly traffic counts, and observed speeds.

The traffic noise model validation results are shown in **Table C-1**.

Table C-1. Traffic Noise Model Validation

Validation Site	Field-Measured Level dB(A) Leq	Modeled Level dB(A) Leq	Difference (+/-)	Validated?
Validation Site A *SB FM 2931, at The Landing at Little Elm Apts.*	64.8	66.1	-1.3	Yes
Validation Site B *SB FM 2931, at Silverado neighborhood*	63.6	63.2	0.4	Yes
Validation Site C *SB FM 2931, approx. 60 feet north of Redfearn Rd.*	68.3	66.4	1.9	Yes

Differences between the measured and model-calculated sound levels at the validation site were within the +/- 3 dB(A) tolerance allowed by FHWA. Therefore, the model of existing noise is considered validated for this project.

Validation Study Site A FM 2931 (19429)

Denton County, TX

CSJ: 2979-01-011

Date of Study: 2020-09-30

Start Time of Study: 11:42 am

End Time of Study: 11:57 am

Duration: 15:10 minutes

Location: Along SB FM 2931 ROW on The Landing at Little Elm Apts. Across from Providence Elementary School

Dosimeter: SoundPro 2-1/3 Octave

Traffic Counter: Video was used

Speeds: Bushnell Radar Gun

Weather: Partly cloudy, light breeze

Notes: Typical bird and insect noise, light breeze, can hear traffic from HWY 380 to the south. Lawn mower can be seen to the north along SB FM 2931

Name	Field Observed dBA (leq)	TNM dBA	Difference
Validation Site A	64.8	66.1	-1.3

Hourly Vehicles for TNM Validation

Vehicle Type	Total SB Vehicles	Total NB Vehicles	SB Vehicles Divided by # of Lanes	NB Vehicles Divided by # of Lanes	Lanes
Light Duty	340	228	340	228	1
Medium Duty	16	8	16	8	1
Heavy Duty	32	36	32	36	1
Buses	0	0	0	0	1
Motorcycles	0	0	0	0	1

SB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	340	42
	Medium Duty	16	42
	Heavy Duty	32	42
	Buses	0	0
	Motorcycles	0	0

Recorded SB Speeds

41	42	46
42	39	51
40	42	
36	44	
34	50	
	Average	42.3

applied 42 mph for SB speeds

NB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	228	38
	Medium Duty	8	38
	Heavy Duty	36	38
	Buses	0	0
	Motorcycles	0	0

Recorded NB Speeds

39	50	32
35	34	36
24	40	38
41	44	
38	40	
	Average	37.8

applied 38 mph for NB speeds

Validation Study Site B FM 2931 (19429)

Denton County, TX

CSJ: 2979-01-011
Date of Study: 2020-09-30
Start Time of Study: 11:07 am
End Time of Study: 11:22 am
Duration: 15:20 minutes
Location: Along SB FM 2931 at Silverado Development approx. 2000 ft east Silverado Pkwy
Dosimeter: SoundPro 2-1/3 Octave
Traffic Counter: Video was used
Speeds: Bushnell Radar Gun
Weather: Partly cloudy, light breeze

Notes: Typical bird and insect noise, light breeze, dogs barking a few times, and can see a drone to the south but not very loud.

Name	Field Observed dBA (leq)	TNM dBA	Difference
Validation Site B	63.6	63.2	0.4

Hourly Vehicles for TNM Validation

Vehicle Type	Total SB Vehicles	Total NB Vehicles	SB Vehicles Divided by # of Lanes	NB Vehicles Divided by # of Lanes	Lanes
Light Duty	36	32	36	32	1
Medium Duty	12	4	12	4	1
Heavy Duty	8	20	8	20	1
Buses	0	0	0	0	1
Motorcycles	0	0	0	0	1

SB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	32	52
	Medium Duty	4	52
	Heavy Duty	20	52
	Buses	0	0
	Motorcycles	0	0

Recorded SB Speeds

50	64	
56	56	
52	48	
35	53	
54		
	Average	52

applied 52 mph for SB speeds

NB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	32	51
	Medium Duty	4	51
	Heavy Duty	20	51
	Buses	0	0
	Motorcycles	0	0

Recorded NB Speeds

37	51	
51	43	
48	55	
47		
52		
	Average	48

applied 51 mph for NB speeds

Validation Study Site C FM 2931 (19429)

Denton County, TX

CSJ: 2979-01-011
Date of Study: 2020-09-30
Start Time of Study: 9:38 am
End Time of Study: 9:53 pm
Duration: 15:21 minutes
Location: Along SB FM 2931 approx. 60 ft north of Redfearn Rd.
Dosimeter: SoundPro 2-1/3 Octave
Traffic Counter: Video was used
Speeds: Bushnell Radar Gun
Weather: Partly cloudy, light breeze
Notes: Typical bird and insect noise, light breeze, truck turned SB from Redfearn Rd at 9:46am

Name	Field Observed dBA (leq)	TNM dBA	Difference
Validation Site C	68.3	66.4	1.9

Hourly Vehicles for TNM Validation

Vehicle Type	Total SB Vehicles	Total NB Vehicles	SB Vehicles Divided by # of Lanes	NB Vehicles Divided by # of Lanes	Lanes
Light Duty	48	16	48	16	1
Medium Duty	0	4	0	4	1
Heavy Duty	12	16	12	16	1
Buses	0	0	0	0	1
Motorcycles	0	0	0	0	1

SB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	48	63
	Medium Duty	0	0
	Heavy Duty	12	63
	Buses	0	0
	Motorcycles	0	0

Recorded SB Speeds

60	58
61	
63	
65	
63	
Average	61.7

applied 63 mph for SB speeds

NB FM 2931 Traffic Data for TNM Input

Number of Lanes	Vehicle Type	Veh/hr	Speed (mph)
1	Light Duty	16	63
	Medium Duty	4	63
	Heavy Duty	16	63
	Buses	0	0
	Motorcycles	0	0

Recorded NB Speeds

47	56
49	55
63	60
51	
63	
Average	55.5

applied 63 mph for NB speeds