Noise Technical Report

State Highway (SH)114

CSJ: 0353-03-100
Fort Worth District, Tarrant County

August 2019

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

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1.0 Project Description

The Fort Worth District of the Texas Department of Transportation proposes to add continuous two-lane frontage roads along State Highway (SH) 114 from Farm-to-Market Road (FM) 1938 (Davis Blvd) to Dove Rd to increase connectivity along this travel corridor, located in the City of Southlake, Town of Westlake, and Town of Trophy Club, Tarrant County, Texas. Additionally, the proposed project includes the reversal of the existing entrance and exit ramps from the "Diamond Configuration" to an "X Configuration" to increase mobility and safety along the SH 114 mainlanes and frontage roads. Along with these improvements, U-Turn lanes will be added along SH 114 for both eastbound and westbound directions at Kirkwood Blvd and on the west side of Dove Road.

Additional right-of-way will be needed along certain areas of the project, and it is anticipated that the needed right-of-way will be dedicated by the City of Southlake. In other areas, the project will be designed such that no additional right-of-way will be needed. In total the proposed project is located on 113.23 acres of existing right-of-way, 4.64 acres of proposed right-of-way, and 5.70 acres of temporary construction easements.

2.0 Noise Analysis

2.1 Background and Methodology

This analysis was accomplished in accordance with TxDOT's Federal Highway Administration (FHWA)-approved *Guidelines for Analysis and Abatement of Roadway Traffic Noise* (April 2011). Traffic volume data approved by TxDOT's Transportation Planning and Programming division used in this analysis can be found in **Appendix 2**.

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."

Dominant noise sources within the proposed project area include traffic on existing roads and various kinds of local activity.

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; and
- Consideration and evaluation of measures to reduce noise impacts.

FHWA has established the Noise Abatement Criteria (NAC) listed in **Table 1** 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: Noise Abatement Criteria

Activity Category	FHWA (dB(A) Leq)		Description of Land Use Activity Areas
A	57 (exterior)		Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67 (exterior)		Residential
C	67 (exterior)		Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)		Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or 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

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

- Absolute criterion: the predicted noise level at a receiver approaches, equals or exceeds the NAC. "Approach" is defined as one dB(A) below the FHWA NAC. For example: a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dB(A) or above.
- Relative criterion: the predicted noise level substantially exceeds the existing noise level at a receiver even though the predicted noise level does not approach, equal or exceed the NAC. “Substantially exceeds” is defined as more than 10 dB(A). For example: a noise impact would occur at a Category B residence if the existing level is 54 dB(A) and the predicted level is 65 dB(A).

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.

The FHWA traffic noise modeling software (version 2.5) was used to calculate existing and predicted (2040) 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.

2.2 Consideration of Future Noise Impacts

Existing and predicted traffic noise levels were modeled at receiver locations (**Table 2** and **Figure 2**) 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. An existing 14-foot barrier adjacent to the Lake Forest Village neighborhood (R1-R16) was included in the model.

Table 2: Traffic Noise Levels dB(A) Leq						
Receiver	**NAC Category**	**NAC Level**	**Existing 2020**	**Predicted 2040**	**Change (+/-)**	**Noise Impact**
R1	B (Residential)	67	62	64	+2	No
R2	B (Residential)	67	54	56	+2	No
R3	B (Residential)	67	57	59	+2	No
R4	B (Residential)	67	59	61	+2	No
R5	B (Residential)	67	59	61	+2	No
R6	B (Residential)	67	59	62	+3	No
R7	B (Residential)	67	60	62	+2	No
R8	B (Residential)	67	61	63	+2	No
R9	B (Residential)	67	60	62	+2	No
R10	B (Residential)	67	60	63	+3	No
R11	B (Residential)	67	60	62	+2	No
R12	B (Residential)	67	59	62	+3	No
R13	B (Residential)	67	58	60	+2	No
R14	B (Residential)	67	58	60	+2	No
R15	B (Residential)	67	55	57	+2	No
R16	B (Residential)	67	56	58	+2	No
R17	C (Church)	67	57	60	+3	No
R18	B (Residential)	67	64	66	+2	**Yes**
R19	B (Residential)	67	71	73	+2	**Yes**
R20	B (Residential)	67	70	73	+3	**Yes**
R21	B (Residential)	67	74	76	+2	**Yes**
R22	B (Residential)	67	70	72	+2	**Yes**
R23	B (Residential)	67	73	76	+3	**Yes**
R24	B (Residential)	67	70	73	+3	**Yes**
R25	B (Residential)	67	74	76	+2	**Yes**
R26	B (Residential)	67	70	73	+3	**Yes**
R27	B (Residential)	67	74	75	+1	**Yes**
R28	B (Residential)	67	72	73	+1	**Yes**
R29	B (Residential)	67	74	75	+1	**Yes**
R30	D (Hospital)	52	44	45	+1	No
R31	D (Hospital)	52	45	46	+1	No
R32	E (Restaurant)	72	71	72	+1	**Yes**
R33	C (Amphitheater)	67	60	63	+3	No
R34	B (Residential)	67	73	75	+2	**Yes**
R35	B (Residential)	67	70	72	+2	**Yes**
R36	B (Residential)	67	67	69	+2	**Yes**
R37	B (Residential)	67	64	66	+2	**Yes**
R38	B (Residential)	67	63	66	+3	**Yes**
R39	B (Residential)	67	63	66	+3	**Yes**
R40	B (Residential)	67	64	66	+2	**Yes**
R41	B (Residential)	67	64	67	+3	**Yes**

Table 2: Traffic Noise Levels dB(A) Leq						
Receiver	**NAC Category**	**NAC Level**	**Existing 2020**	**Predicted 2040**	**Change (+/-)**	**Noise Impact**
R42	B (Residential)	67	64	66	+2	**Yes**
R43	B (Residential)	67	65	67	+2	**Yes**
R44	B (Residential)	67	62	64	+2	No
R45	B (Residential)	67	65	67	+2	**Yes**
R46	B (Residential)	67	64	66	+2	**Yes**
R47	B (Residential)	67	62	65	+3	No
R48	B (Residential)	67	61	64	+3	No
R49	B (Residential)	67	58	60	+2	No

As indicated in **Table 2**, the proposed project would result in a traffic noise impact, and the following noise abatement measures were considered: traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise walls.

Before any abatement measure can be proposed for incorporation into the project, it must be both feasible and reasonable. In order to be "feasible," the abatement measure must be able to reduce the noise level at greater than 50% of impacted first row receivers by at least five dB(A); and to be "reasonable," it must not exceed the cost-effectiveness criterion of $25,000 for each receiver that would benefit by a reduction of at least five dB(A), and the abatement measure must be able to reduce the noise level for at least one impacted first row receiver by at least seven dB(A).

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

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 walls - This is the most commonly used noise abatement measure. Noise walls were evaluated for each of the impacted receiver locations with the following results (Note: barrier costs are calculated at $18 per square foot to determine cost effectiveness as per TxDOT guidelines. Actual costs may be higher):

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

R18-R29: These receivers represent 22 balconies and patios facing the roadway at the Vineyards of Trophy Club apartments, all of which would be impacted by traffic noise (**Figure 2a**). Based on preliminary calculations, a noise barrier 865 feet in length and 16 feet high, beginning east of the complex driveway, would reduce noise levels by at least 5dB(A) for 12 benefited receivers at a total cost of $249,120 or $20,760 for each benefited receiver. A barrier segment west of the driveway was examined as part of the analysis, but was not included due to site constraints (topographic changes, utility conflicts, and an existing concrete traffic barrier near the edge of pavement).

Table 3: Noise Barrier Proposal (Preliminary)

Barrier	Receivers	Total # Benefited	Length (Feet)	Height (Feet)	Barrier Cost	$/Benefited Receiver
1	R18-R29	12	865	16	$249,120	$20,760

Any subsequent project design changes may require a reevaluation of this preliminary noise barrier proposal. The final decision to construct the proposed noise barrier will not be made until completion of the project design, utility evaluation and polling of adjacent property owners.

Noise barriers would not be feasible and reasonable for the following impacted receivers and, therefore, are not proposed for incorporation into the project:

R32: This receiver represents the outdoor seating area at the Bread Winners Cafe on the east side of SH 114. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal would exceed the reasonable, cost-effectiveness criterion of $25,000.

R34-R45: These receivers represent a row of 11 homes in the planned Southlake Meadows development, west of SH 114 and north of Dove Road. A noise wall 20 feet high was modeled at this location and would not achieve the minimum feasible reduction of 5 dB(A).

R46: This receiver represents an individual residence west of SH 114 and south of Dove Road. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal would exceed the reasonable, cost-effectiveness criterion of $25,000.

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 (2040) noise impact contours. **Table 4** provides approximate predicted distances to noise contours for undeveloped areas adjacent to the project.

Table 4: Land Use Contours for Undeveloped Land		
NAC Category B & C	66 dB(A)	380 feet
NAC Category E	71 dB(A)	157 feet

2.3 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. The receiver is not 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.

3.0 Conclusions

As indicated in **Table 2 and Table 3**, the proposed project would result in a traffic noise impact. Noise abatement measures were examined at each of the impacted receivers and noise walls were found to be both reasonable and feasible at one location and is therefore recommended for inclusion in the proposed project.

4.0 Local Officials Statement

A copy of this traffic noise analysis will be made available to local officials to ensure, to the maximum extent possible, future developments are planned, designed, and programmed in a manner that would avoid traffic noise impacts. On the date of approval of this document (Date of Public Knowledge), FHWA and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the project.

Appendix 1

Figures

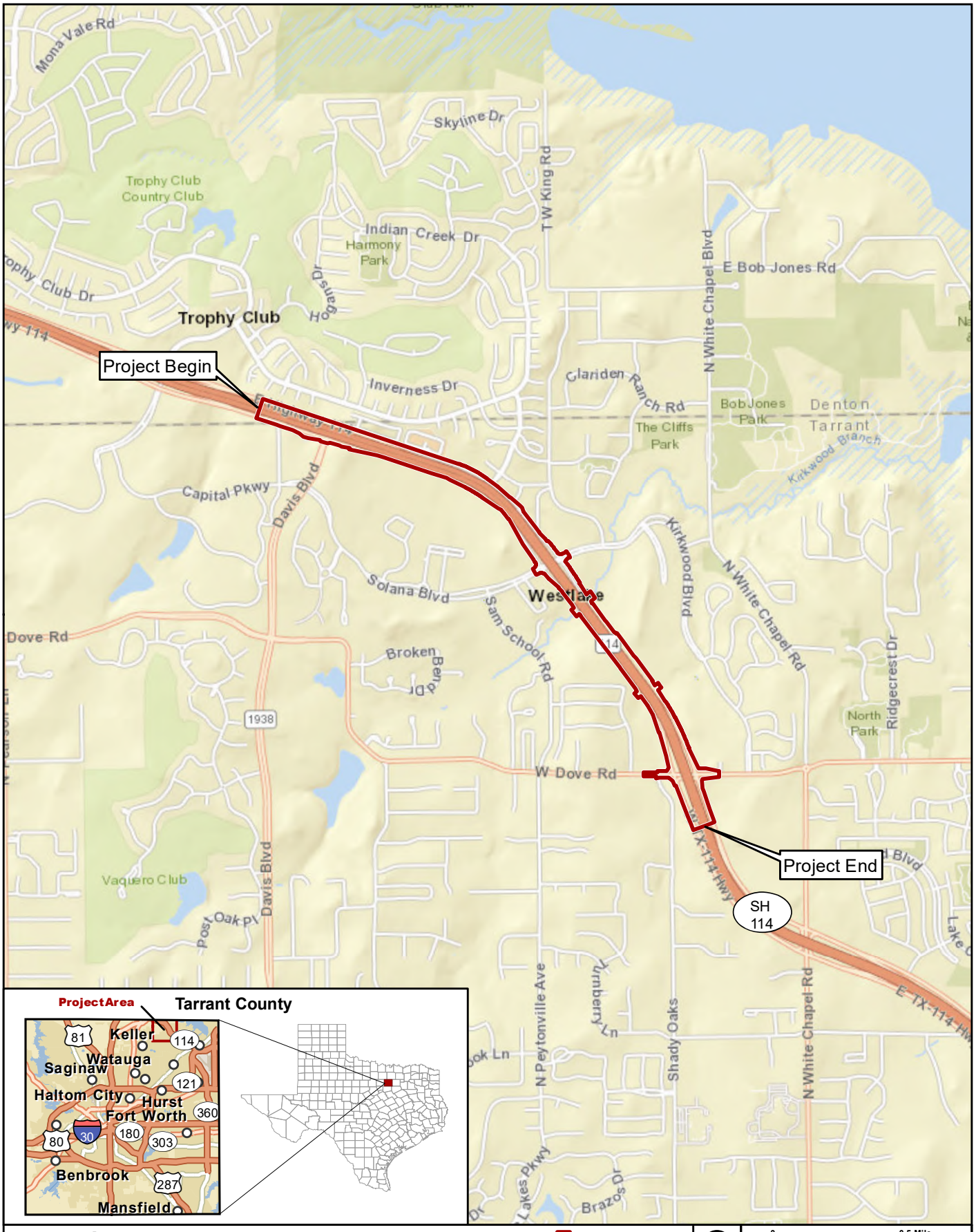

Figure 1

Project Location (Road Base)

SH 114 from FM 1938 to Dove Rd

Basemap Source: ESRI (2018)

Prepared for: TxDOT	1 in = 0.5 mile
	Scale: 1:31,680
CSJ: 0353-03-100	Date: 12/12/2018

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Figure 2a

Location of Noise Receivers

SH 114 from FM 1938 to Dove Rd

Project Location
Benefited Receiver
Non-impacted Receiver
Impacted Receiver
Existing Wall
Proposed Wall

Data Sources: CMEC (2019)
Aerial Source: Google (2018)

0 500 Feet
0 150 Meters

Prepared for: TxDOT	1 in = 500 feet
	Scale: 1:6,000
CSJ: 0353-03-100	Date: 4/24/2019

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Figure 2b

Location of Noise Receivers

SH 114 from FM 1938 to Dove Rd

Project Location
Non-impacted Receiver
Impacted Receiver
Proposed Wall

Data Sources: CMEC (2019)
Aerial Source: Google (2018)

0 500 Feet
0 150 Meters

Prepared for: TxDOT	1 in = 500 feet
	Scale: 1:6,000
CSJ: 0353-03-100	Date: 4/24/2019

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Figure 2c

Location of Noise Receivers

SH 114 from FM 1938 to Dove Rd

Project Location
Non-impacted Receiver
Impacted Receiver

Data Sources: CMEC (2019)
Aerial Source: Google (2018)

0 500 Feet
0 150 Meters

Prepared for: TxDOT	1 in = 500 feet
	Scale: 1:6,000
CSJ: 0353-03-100	Date: 4/24/2019

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Appendix 2

Traffic Analysis for Highway Design and Anticipated Average Daily Traffic and Turning Movement Schematics

Texas Department of Transportation

MEMO

June 17, 2019

To: Loyl C. Bussell, P.E., District Engineer
Attention: Ricardo Gonzalez, P.E., Director of TPD

Through: William E. Knowles, P.E.
Traffic Analysis Section Director, TPP

From: Tammye A. Fontenot
Planner, TPP

Subject: Traffic Data
CSJ: 0353-03-100
SH 114
From: FM 1934 (Davis Blvd.)
To: Dove Road

Tarrant County

Attached are revised consultant provided diagrams depicting forecasted 2020, 2040 and 2050 average daily traffic volumes and turning movements along SH 114 from FM 1934 to Dove Rd for Build Conditions. Also attached are tabulations developed to show traffic analysis based on revised assumptions made by the proposed Westlake Entrada and Ameritrade Developments as requested by the District. The analysis is for highway design for the 2020 to 2040 twenty-year period and the 2020 to 2050 thirty-year period for the described limits of the route. Also included are tabulations showing data for use in air and noise analysis.

This data supersedes the information for the project provided to your office May 8, 2019.

Please refer to your original emails dated April 23, 2019 and May 31, 2019.

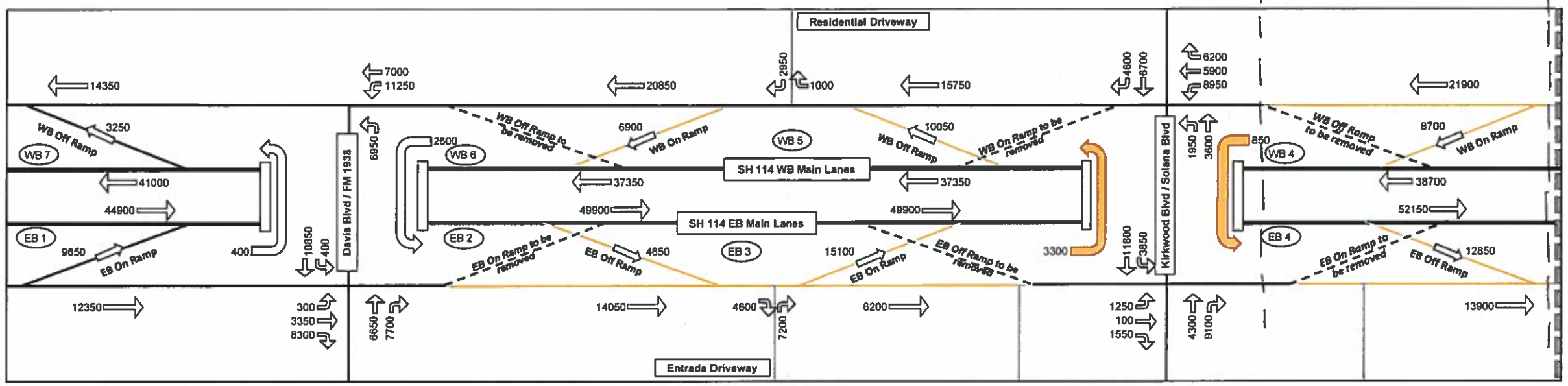
If you have any questions or need additional information, please contact Tammye Fontenot at (512) 486-5108.

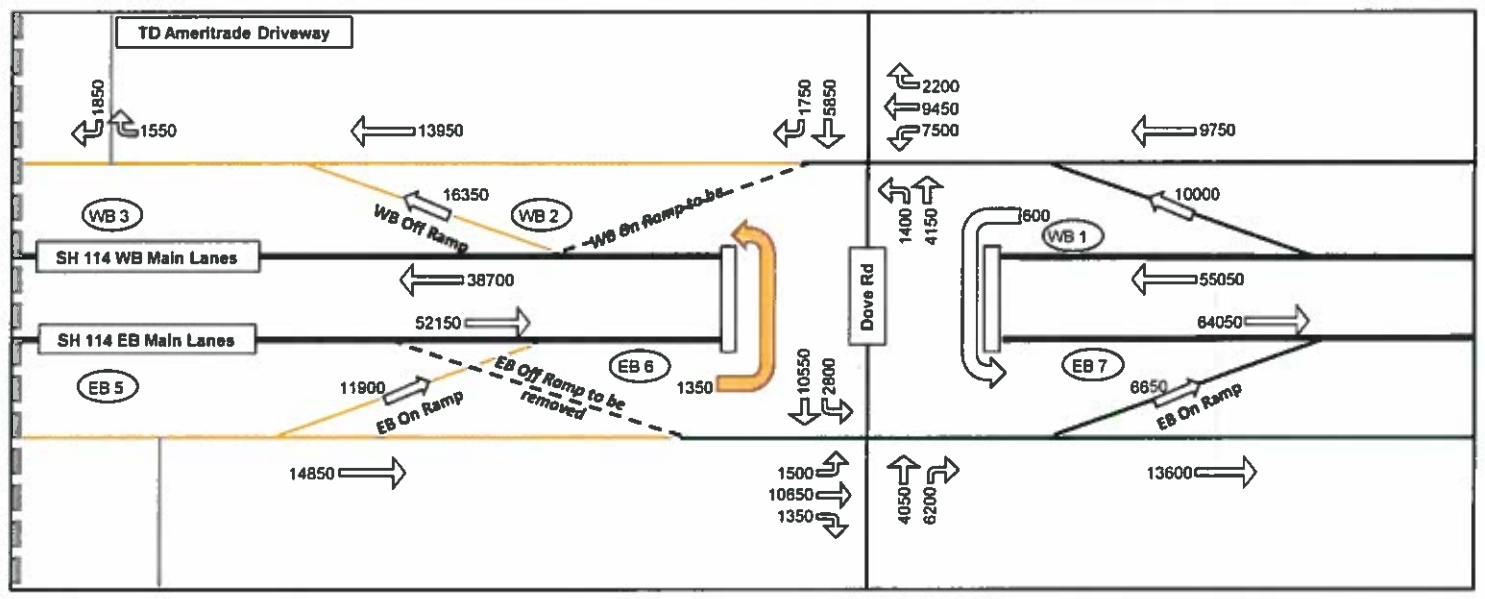
Attachments

CC: Thomas Marquardt, P.E., Transportation Engineer, Fort Worth District
Design Division

ESALs MLs & Frtg

ESALs Frtg Only





Kimley»Horn

State Highway 114 Frontage Roads (FM 1938 to Dove Rd)
CSJ: 0353-03-100

Southlake, TX | Westlake, TX | Trophy Club, TX
March 2019

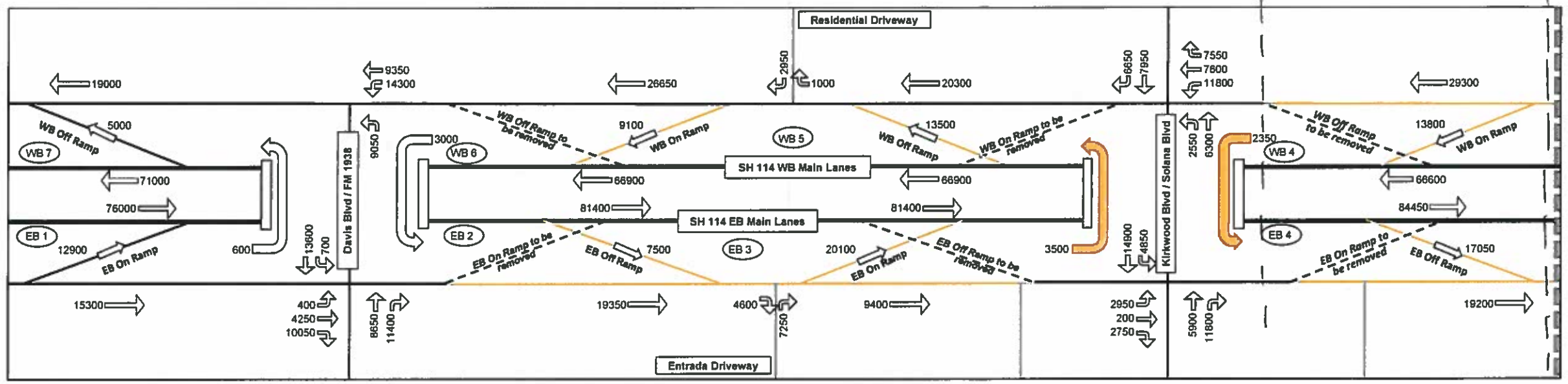
Total Traffic Volumes - 2020 ADT
(based on TPP Volumes, TD Ameritrade Site Traffic, and Entrada Site Traffic)

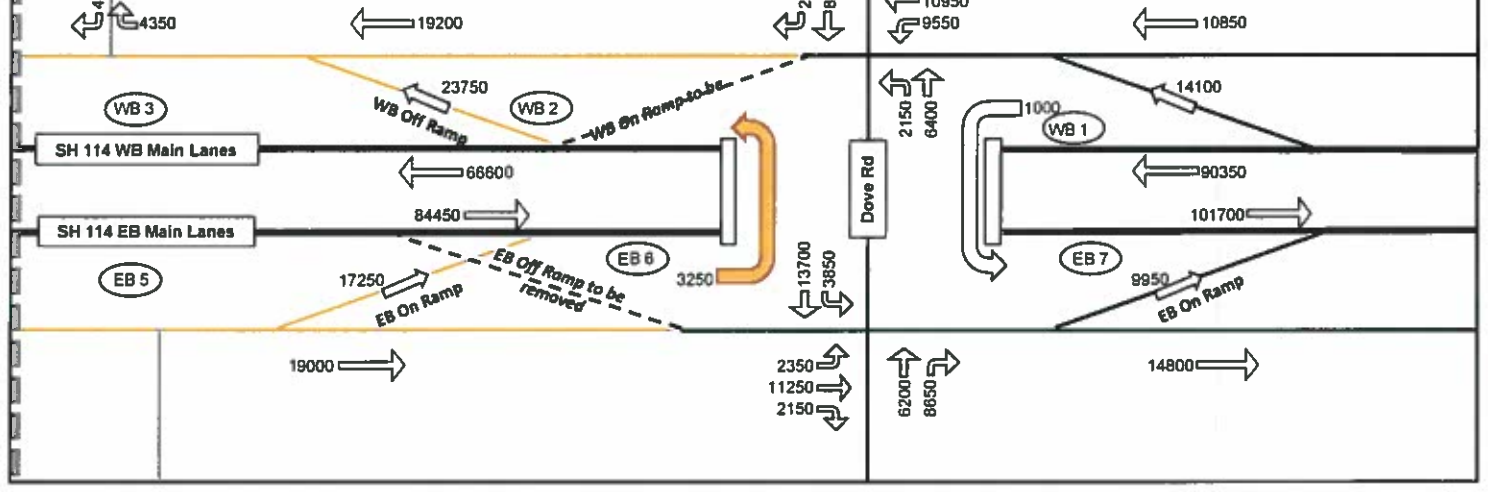
Legend
- = Average Daily Traffic
- = Proposed Network Additions
- = Ramp to be Removed
- = Driveways
- XX = Freeway Segment

Exhibit 6

ESALs
MLs & Frtg

ESALs
Frtg Rds Only





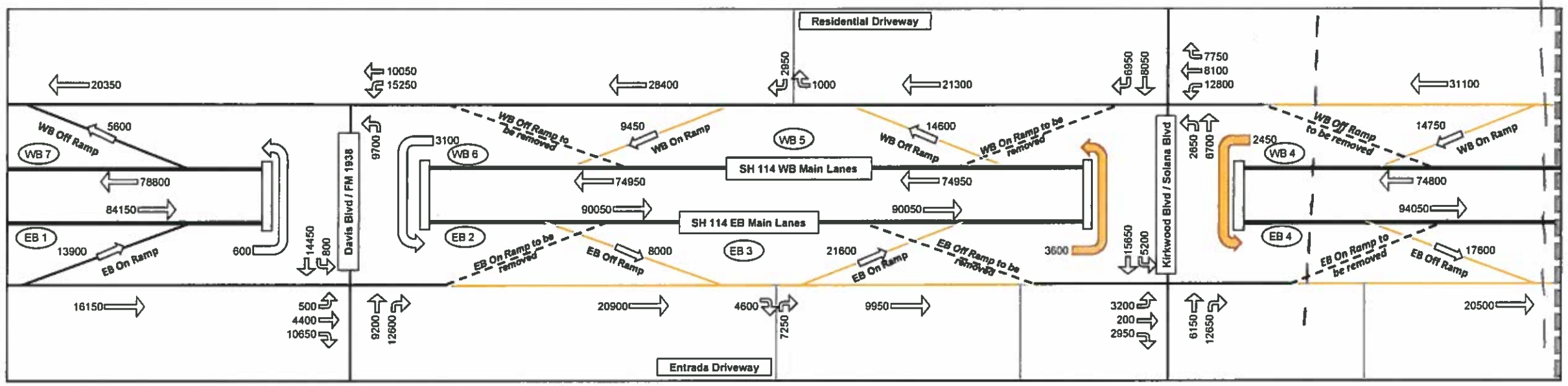
Kimley»Horn	State Highway 114 Frontage Roads (FM 1938 to Dove Rd) CSJ: 0353-03-100 Southlake, TX | Westlake, TX | Trophy Club, TX March 2019	Total Traffic Volumes - 2040 ADT (based on TPP Volumes, TD Ameritrade Site Traffic, and Entrada Site Traffic)	Legend = Average Daily Traffic = Proposed Network Additions = Ramp to be Removed = Driveways XX X = Freeway Segment

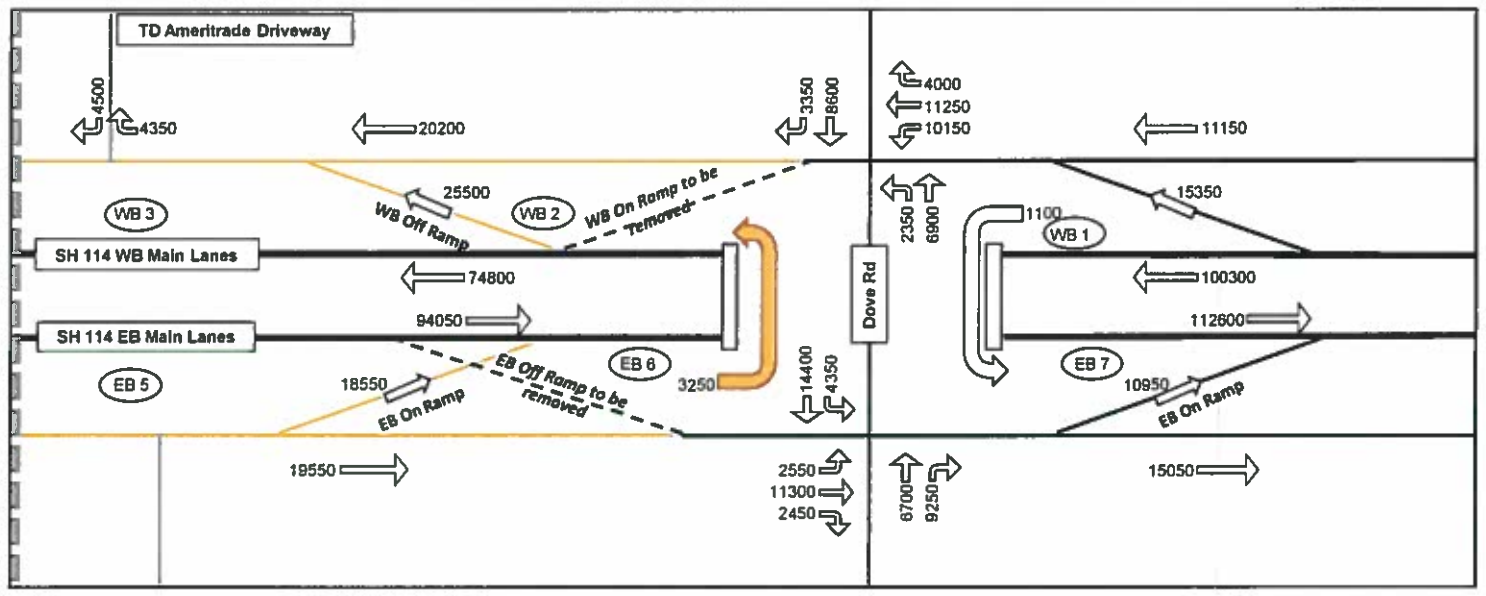
NTS

Exhibit 8

ESALs MLs: Frtg

ESALs Frtg Only





Kimley»Horn	State Highway 114 Frontage Roads (FM 1938 to Dove Rd) CSJ: 0353-03-100 Southlake, TX | Westlake, TX | Trophy Club, TX April 22, 2019	2050 Average Daily Traffic (based on TPP Volumes, TD Ameritrade Site Traffic, and Entrada Site Traffic) Build	Legend = Average Daily Traffic = Proposed Network Additions = Ramp to be Removed = Driveways XX = Freeway Segment	Figure 1

NTS

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E
Serial Number 94704

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Fort Worth District

June 17, 2019

Description of Location	Average Daily Traffic 2020	Average Daily Traffic 2040	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 (2020 to 2040) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 114 (Mainlanes and Frontage Roads) From FM 1938 (Davis Blvd.) To Dove Road Tarrant County	148,200	230,400	54 - 46	9.4	7.3	4.8	13,200	30	45,370,000	3	61,928,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	92.7	95.2
Medium Duty	2.3	1.5
Heavy Duty	5.0	3.3

Description of Location	Average Daily Traffic 2020	Average Daily Traffic 2050	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 (2020 to 2050) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 114 (Mainlanes and Frontage Roads) From FM 1938 (Davis Blvd.) To Dove Road Tarrant County	148,200	252,800	54 - 46	9.4	7.3	4.8	13,200	30	72,085,000	3	98,393,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Fort Worth District

June 17, 2019

Description of Location	Average Daily Traffic 2020	Average Daily Traffic 2040	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 (2020 to 2040) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 114 (Frontage Roads Only) From FM 1938 (Davis Blvd.) To Dove Road Tarrant County	57,350	79,350	54 - 46	9.4	2.4	1.8	11,600	30	4,286,000	3	5,288,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	97.6	98.2
Medium Duty	0.8	0.6
Heavy Duty	1.6	1.2

Description of Location	Average Daily Traffic 2020	Average Daily Traffic 2050	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 (2020 to 2050) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 114 (Frontage Roads Only) From FM 1938 (Davis Blvd.) To Dove Road Tarrant County	57,350	83,950	54 - 46	9.4	2.4	1.8	11,600	30	6,645,000	3	8,199,000	8"

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E
Serial Number 84704