APPENDIX

Executive Summary

Introduction

The TxDOT FM 407 Feasibility Study identified and evaluated road-related capacity, operational and geometric improvements along FM 407 in Denton County. In doing so, the study produced and recommended conceptual solutions to improve FM 407 travel conditions through Year 2045, namely Traffic Operations, Mobility, and Reliability improvements. Traffic operations assessments included current (near-term) and projected (long-term) traffic growth / travel demand along FM 407, and at each major cross-street which intersects FM 407.

Presented in **FIGURE 1**, the studied FM 407 study corridor is approximately 13 miles in length and spans from West of FM 156 (in the City of Justin) to FM 1830 (in the Town of Argyle). The FM 407 Study Area is located in Denton County and spans the municipalities of Argyle, Bartonville, Denton County, Dish, Draper, Flower Mound, Justin, and Northlake.

Figure 1: FM 407 Study Location Map

The FM 407 study team assembled by the TxDOT Dallas District coordinated the study aspects and solution pursuit and speculation process by conducting Public Meetings and agency-invited outreach meetings with the various FM 407 corridor stakeholders, namely:

- Denton County
- Town of Argyle
- Town of Bartonville
- Town of Dish
- Town of Draper
- Town of Flower Mound
- City of Justin
- Town of Northlake
- US Army Corps of Engineers (USACOE)

- North Central Texas Council of Governments (NCTCOG)
- Burlington Northern and Santa Fe Railway (BNSF RR)
- Union Pacific Railroad (UP RR)
- Multiple Utility Companies
- Multiple TxDOT Offices

The public and agency outreach conducted by the study team encouraged all-inclusive input to arrive at consensus solutions to improve the FM 407 corridor. This outreach included information-sharing results of the study and conceptual FM 407 Build Alternatives (improvement solutions), as well as a comparison No Build or Do Nothing Alternative.

Study Goal

The overriding study goal was to improve travel conditions along the FM 407 facility pertaining to safety, access, and mobility. The development of the Build Alternatives, and the resulting production of an ultimate Recommended Build Alternative, was guided by the following study actions:

- Comparison the No Build and Build Alternatives;
- Evaluation and production of forecasted Design Year 2045 FM 407 Traffic Volumes (Travel Demand) within the FM 407 corridor;
- Incorporation of current roadway design and safety standards;
- Evaluation of Traffic Safety aspects;
- Minimizing the Build Alternative near-term and long-term impacts; and
- Coordination with local municipalities and stakeholder agencies.

The study evaluation involved the need to minimize traffic congestion along FM 407, improve the FM 407 / cross-street intersection operations, maintain adjacent property site access to FM 407, and maintain the FM 407 connectivity to the major north-south transportation facilities which intersect FM 407 (FM 156, I-35W, US 377 and FM 1830).

Alternatives Evaluated

Based on the study purpose and study goals, the study's production and evaluation of the No Build Alternative and conceptual Build Alternatives factored in public and municipality / agency outreach and input. Described below, and presented at the study's initial advertised FM 407 Public Meeting conducted by TxDOT in March 2019, each alternative was assessed for compatibility with the regional Metropolitan Transportation Plan, known as *Mobility 2045*, local / municipal Thoroughfare Plans, and factored in environmental and design constraints and traffic operations and functionality.

No Build Alternative

FM 407 transportation improvements would not be constructed. This comparison alternative does not improve FM 407 beyond prior FM 407 improvement commitments and routine FM 407 road maintenance. The regional (*Mobility 2045*) improvements are assumed to be in place and operational with the exception of FM 407 improvements.

Green Build Alternative

This alignment predominately followed the existing FM 407 roadway centerline and spanned from Florance Road in Northlake eastward to the study's eastern study termini at FM 1830. This alignment also entailed two sub-options: intersecting the US 377 and UPRR at-grade, or bridging / overpassing the two facilities.

The following alternatives focused the City of Justin region of the studied corridor and each were intended to tie directly to the Green Alternative.

Blue Build Alternative

This northernmost new location alignment spanned from Florance Road on predominately new location westward / northwestward and tied directly to the west-east FM 1384 facility until it bypassed the City of Justin when it turned directly southward and eventually tied to existing FM 407 west of Justin / FM 156.

Brown Build Alternative

Located south of the Blue Alternative and within Justin, this westward new location alignment spanned from Florance Road on new location and terminated at the north-south FM 156 facility within Justin via entrance and exit vehicular access ramps to / from the Alternative and FM 156.

Red Build Alternative

Located south of the Brown Alternative and within Justin, this new location alignment spanned from Florance Road southwestward and was located to supplant or be located south of east-west 12th Street, and at the western limit of 12th Street, veered directly southward before it tied directly to existing FM 407 west of Justin / FM 156 / Boss Range Road.

One-Way Couplet Build Alternative

This alignment veered immediately southwestward from Florance Road on predominately new location and 1) the westbound travel lanes veered along the existing west-east segment of FM 407 (which is also signed locally within Justin as E. 5th Street), and 2) the eastbound travel lanes veered southwestward on new location and tied directly into the existing FM 407 facility within Justin (west of FM 156) and continuing westward to the study's western termini west of Boss Range Road.

Purple Build Alternative

This southernmost alignment veered immediately southwestward of Florance Road and followed the Couplet Alternative's eastbound travel lanes but did not align with E. 5th Street, and unlike the Couplet Alternative was a two-way facility.

Each studied build alternative could be implemented over different time periods based on localized congestion relief needs and construction funding availability. Another potential mobility improvement considered by the study to further alleviate the FM 407 travel conditions and traffic volume demand, as well as serve future, planned, ongoing development between FM 156 in Justin and I-35W, was to potentially supplement the ultimate build alternative. This supplemental option which is also presented on the **Build Alternative Alignment Concepts Diagrammatic** exhibit located in the **APPENDIX**, entailed a new location facility which spanned from FM 156 in Justin eastward along Downe Road and

proceeded further eastward and linked the Mulkey Lane facility and eventually linked the I-35E facility.

Data Collection

The study team collected data and corridor-related information from multiple entities including TxDOT, NCTCOG, Denton County, the City of Justin and the Towns of Argyle, Bartonville, Flower Mound and Northlake. Collecting this information was undertaken via a Study Kick-off Meeting conducted by the TxDOT Dallas District / Study Team, participating agencies, one-on-one town, city and county meetings, and publicly-accessible municipal and oversight agency websites.

One major, highlighted source of information collected and utilized by the Study were the county and municipal Thoroughfare Plans which served a prominent and guiding role in establishing and assessing the Build Alternatives according to conformance / accommodation of FM 407-related aspects involving each Thoroughfare Plan.

FM 407 traffic volume projections for the Design Year 2045 which were utilized for the Study's traffic evaluations were produced by the Study and approved by the Dallas District in association with the Texas Transportation Institute.

Study Process and Results

The Study investigations and evaluations focused high concept, high-level comparisons of the No-build and Build Alternative (presented at the March 2019 FM 407 Public Meeting) concepts which were each screened via standard and corridor-specific screening categories composed of quantitative and qualitative criteria. This Measure of Effectiveness matrix screening scrutinized and rated each alternative's functionality, benefits, disbenefits and impacts in order to determine an optimal recommended solution (alternative) which most adhered to the Study goal. The screening categories were Mobility, Safety, Travel Efficiency and Connectivity, Municipality Objectives, Engineering Considerations, Environmental Considerations, and Construction Cost Considerations and public and municipality feedback.

The potential environmental impacts resulting from the theorized construction of each Build Alternative were based on available public database information and field reconnaissance conducted by the study team along the FM 407 corridor. No detailed analysis was performed to analyze all the possible environmental impacts which may or may result from constructing each Build Alternative. Specific ROW impacts were assessed based on the FM 407 corridor aerial photography, *Google* imagery and field reconnaissance.

Each Build Alternative was scrutinized to gauge its effectiveness in providing a long-term (twenty-year) FM 407 travel demand and capacity solution which could satisfy the Design Year 2045 travel demand (traffic volume projections). The solution search not only involved the addition of travel lanes to the FM 407 corridor, but also improved the FM 407 / cross-street intersections, specifically alleviating the intersection congestion by improving the intersection traffic flow [Level of Service (LOS)], and grade-separating FM 407 over FM 156 and the BNSF Railway tracks. Design Year 2045 FM 407 traffic projections were therefore, evaluated and analyzed using Synchro software to determine the ability of each alternative to improve the LOS at each major existing and proposed (recommended) FM 407

intersection. The No-Build Alternative traffic analysis resulted in undesirable, failing LOSs through Design Year 2045 at multiple intersections. Whereas, the ultimate recommended solution to improve FM 407, and discussed in the following section, resulted in acceptable LOSs through Design Year 2045.

Conclusions and Recommendations

The FM 407 Feasibility Study performed various very high-level design alternative concepts, evaluations and analyses to produce a transportation solution ("Recommended Build Alternative") to improve travel and safety-related conditions along the FM 407 facility. Determination and selection of this Alternative was also based on input received from the FM 407 corridor municipalities, elected officials, and from the two advertised March 2019 and July 2020 FM 407 Public Meetings conducted for the Study by TxDOT.

Upon the completion of the Evaluation Matrix screening of the study's No Build and all the Build Alternatives, and upon further study team discussions with the stakeholders, municipalities and elected officials after the initial March 2019 FM 407 Public Meeting was conducted by the Study, a refined version of the original Red Route (in combination with the common Green Route and an at-grade FM 407 / US 377 intersection) presented at the same Public Meeting emerged as the study's Recommended Build Alterative.

The refinement included geometric / alignment modifications to the original Red Route to lessen building displacements and sensitive site impacts as much as possible. The refinement also factored in the public comments received at the March 2020 FM 407 Public Meeting.

In-depth traffic analysis during the refinement process also entailed LOS calculations which were produced to scrutinize and confirm the refined Red Route alternative would achieve acceptable LOSs through year 2045. Subsequently, the refined red Route was presented as the Recommended Build Alternative at the study's second and final July 2020 FM 407 Public Meeting which was conducted in a virtual format due to COVID-19 pandemic social distancing requirements and mandates which surfaced in the spring of 2020. At this Public Meeting, the Recommended Build Alternative was explained as a conceptual design solution which would be carried forward and processed as a formal post-Feasibility Study FM 407 improvement project and entail the production of FM 407 Roadway Design Schematics, Environmental Studies and further Public Involvement.

The overall Recommended Build Alternative is composed of three 12-foot wide travel lanes in each direction separated by a curbed median with left turn lane accommodation at major cross-street intersections. Drainage would be conveyed in curb and gutter inlets. The recommended alignment on the eastern portion of the corridor would follow the existing FM 407 alignment.

On the western portion of the corridor near Florance Road, the recommended alignment would be on new location and overpass the Denton Creek floodplain, FM 156 facility and adjacent BNSF Railway tracks. Access from FM 156 to and from the new location FM 407 alignment would be provided by access ramps. Further westward, the alignment would be located south of, and adjacent to the 12st Street ROW and continue southwesterly until merging with the existing FM 407 alignment west of Justin. The 12th Street facility would be separated from the FM 407 alignment by a curbed median

and therefore, would not be physically impacted by the alignment. The separation median is considered a potential landscaping and noise (wall) mitigation zone. However, the six residential structures located of 12th Street would be directly impacted by the alignment. The Alternative also includes a continuous sidewalk and a continuous Shared Use Path along the entire corridor. Coordination with the NCTCOG and local municipalities would be required on how best to locate and link the Shared Use Path with the envisioned Regional Veloweb routes which are planned/overseen by the NCTCOG.

Cost

The Recommended Build Alternative was preliminarily cost-estimated with the most recent available year 2020 construction unit costs. This estimate was based on the scenario of constructing the Alternative as one entire construction project. It is noted however, that potential future construction of the Alternative would likely let and be constructed as individual, timelier funded segments (individual construction projects).

The cost estimate includes TxDOT's standard Annual Scope & Estimate Documentation (ASED) cost estimation items (earthwork, subgrade / base, pavement, drainage, structures, and miscellaneous construction) for the Recommended Build Alternative elements: travel lanes/pavement, sidewalk and paved path, below-ground drainage lines, grading, and culverts and bridges.

TABLE 1 presents the preliminary construction cost estimate to construct the Recommended Build Alternative improvements.

Table 1: FM 407 Construction Cost Estimates (2020 Dollars)

Segment	ASED Cost	ROW Cost	Total	Cost / Mile
West of FM 156 to FM 1830	$211,038,784	$15,200,000	**$226,238,784**	$17,400,000

The cost estimates are based on the concept level Recommended Build Alternative Diagrammatic. The ROW cost portion of the estimates is based on Denton County Appraisal District valuations. Overall, the estimated costs are considered high-level estimates and do not account for inflation associated with the Recommended Build Alternative implementation exact timeline which is currently unknown.

The costs are presented in this Feasibility Report as a means to assist TxDOT and other FM 407 corridor municipal stakeholders in prioritizing the design, funding and construction of the Recommended Build Alternative or portions thereof. Therefore, this conceptual Alternative would need to be examined in further detail, holistically or partially, during a subsequent post-study Roadway Design Schematic and Environmental Studies phase.

Funding

No funding sources have been currently identified to construct the Recommended Build Alternative; however, funding could be identified from national, state, and local funding sources. Future pursuits to identify sources may include discussions with, or funding allocations involving, TxDOT, the NCTCOG, Denton County, FM 407 corridor municipalities, the Unified Transportation Plan (UTP), and the

Transportation Improvement program (TIP).

Timeline

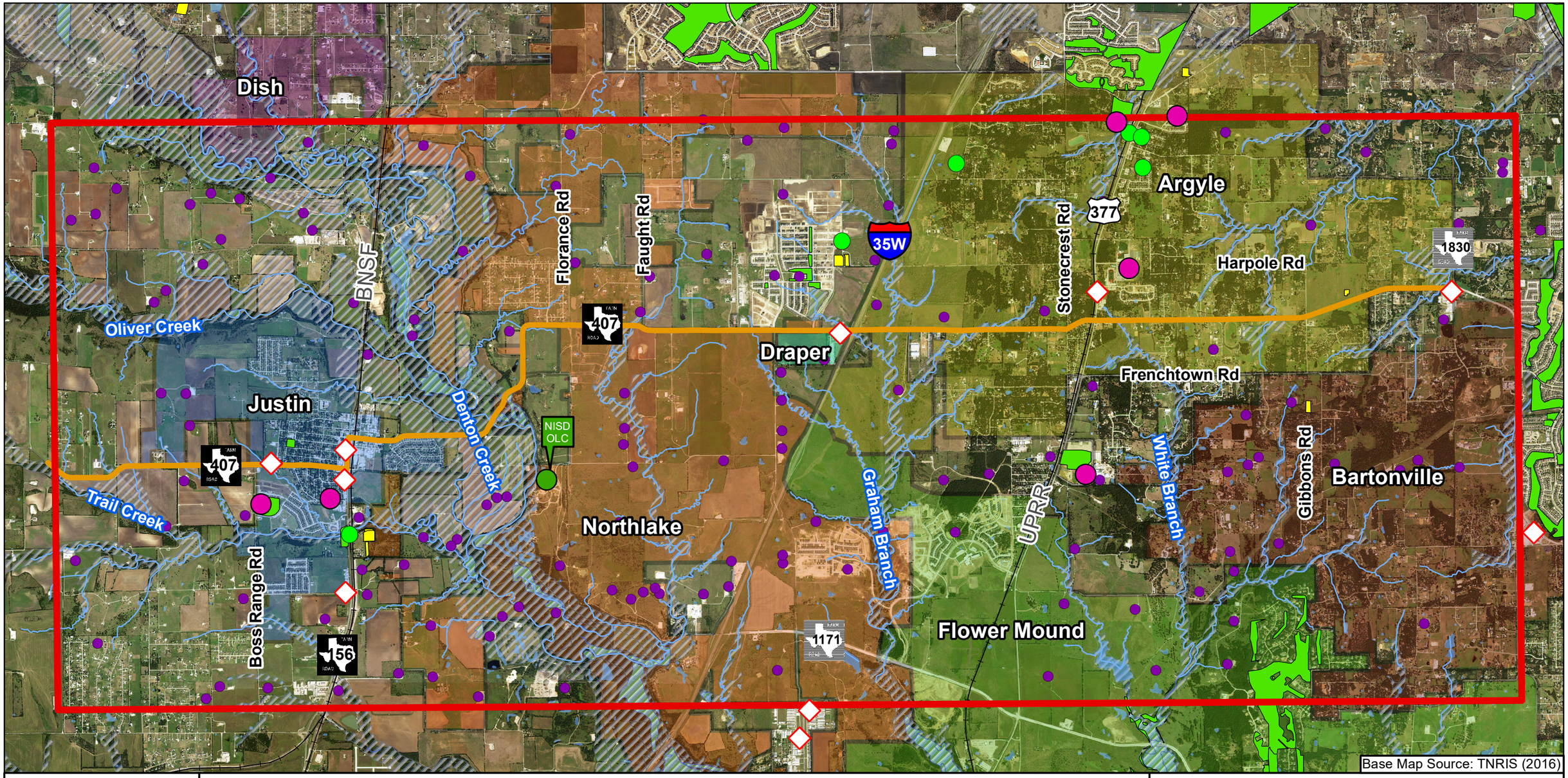
No definite or planned timeline has been established for the post-Study phase of developing the FM 407 Recommended Build Alternative. However, successive timeline phases currently envisioned by TxDOT are listed below and remain subject to change, particularly since no funding has been assigned to construct the Recommended Build Alternative.

- 2 to 4 years – FM 407 Roadway Schematic Design, Environmental Studies and Public Involvement (Public Meeting & Public Hearing)
- 5 to 8 years – FM 407 Final Design, Construction Plans and Utilities Coordination
- 9 to 11 years – Phased FM 407 Construction

After the future Roadway Schematic Design and Environmental Studies are finalized, and the Public Hearing is conducted, ROW preservation required to construct the Recommended Build Alternative should occur via land use planning and ROW acquisition.

APPENDIX

Constraints Map



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Legend

- Existing FM 407 Alignment
- Study Area
- Petroleum Storage Tank (TCEQ)
- Historical Marker (THC)
- School
- Cemetery (THC)
- Wetland (USFWS)
- Pond/Lake (USFWS)
- Park (NCTCOG)
- Stream (USCB)
- Railroad (DOT)
- 100 Yr. Flood Zone
- Oil/Gas Well

Environmental Constraints Map
FM 407
Feasibility Study

From West of FM 156
To FM 1830
Denton County, TX

APPENDIX

Traffic Forecasting Methodology Memorandum

OTHON

MEMORANDUM

Date: June 21, 2018

To: Stephen Endres, PE
Texas Department of Transportation (TxDOT)

Cc: Naser Abusaad, PE
Civil Associates, Inc.

From: Jignesh Thakkar, PE, PTOE
OTHON, Inc. Consulting Engineers

Subject: FM 407 Traffic Forecasting Methodology
(Contract No. 36-7IDP5033, WA 1)

PROJECT DETAILS

Project Limits (for Traffic Projections): FM 407 from West of FM 156 to FM 1830 (CSJ: 1310-01-145)

Project Length (Overall): Approximately 1 mile along W 1st St and FM 156, then 10 miles along FM 407

Project Description:

- FM 407 is primarily a two-lane undivided rural roadway within the project limits.
- FM 407 becomes E. 5th St when it bisects the City of Justin from the East, and continues to the West of the City of Justin as W. 1st St.
- The major intersections within the project limits along FM 407 include: FM 156 near downtown Justin, I-35W east and west frontage roads, US 377, and FM 1830.
- This project is being developed concurrently with two other adjacent corridor feasibility studies listed below:
    1. FM 1171 from FM 156 to I-35W in Denton County, TX (CSJ: 1311-01-055). OTHON is developing traffic projections for this adjacent project as well.
    2. I-35W from SH 170 to I-35E in Denton County, TX (CSJ 0081-13-050). Existing traffic volumes for FM 407 and I-35W NBFR/SBFR intersections will be obtained from this schematic project.
- Traffic projects will be developed for the main roadways, frontage roads, and ramps within the project limits.
- A project location map is provided for reference in the **Appendix**.

DATA COLLECTION

- Obtain existing and historical Average Daily Traffic (ADT) volumes where available from TxDOT Transportation Data Management System website and other local sources (City, Counties, NCTCOG, etc.).
- Collect existing year 2018 traffic counts (24-hour turning movement counts at intersections and road tube counts) along the project limits where necessary. Traffic data will be collected at the following locations:

24-Hour Intersection Turning Movement Counts

[NOTE: These counts will also include 24-hour roadway link volumes along main lanes, frontage roads, and cross-streets]

1. FM 407 @ Boss Range Rd
2. FM 407 @ FM 156 (South)
3. FM 407 @ FM 156 (North)
4. FM 407 @ I-35W West Frontage Rd
5. FM 407 @ I-35W East Frontage Rd
6. FM 407 @ US 377
7. FM 407 @ FM 1830

24-Hour Bi-Directional Volume Counts

1. FM 407 just east of Gibbons Rd
2. FM 407 just south of Smith Rd

[NOTE**:** Existing traffic counts were collected at the locations listed above on May 2 and May 17, 2018 and are summarized on an exhibit included in the **Appendix**. Detailed traffic volumes are also included with this submittal.]

- Coordinate with TxDOT to obtain TPP traffic analysis package to develop travel forecasts for the opening year, design year (opening year plus 20 years) and pavement design year (design year plus 10 years). The analysis package should include historical data along the corridor, the 20-year and the 30-year growth factors. [NOTE: TPP Corridor Analysis Package dated March 16, 2018 has been provided to OTHON by TxDOT/Civil Associates.]
- Collect all previous information for the project corridor, including any previous traffic forecasting performed for this project.

TRAFFIC PROJECTIONS

- Traffic projections will be developed in accordance with the guidelines provided in the Corridor Analysis Standard Operating Procedures (dated 02/13/17) developed by the Transportation Planning and Programming (TPP) division of TxDOT.

- Existing (year 2018) 24-hour traffic volumes and intersection turning movement counts will be collected at selected locations listed above.
- The existing year 2018 traffic data will be used to develop traffic projections for the project (main lanes and intersections within the project limits) for opening year 2025, design year 2045 (opening plus 20 years) and pavement design year 2055 (design year plus 10 years). [NOTE: No temporal factors will be applied to existing year 2018 traffic counts.]
- Respective growth factors previously obtained from the TPP package will then be applied to the existing 24-hour traffic volumes (main lanes, ramps, frontage roads, intersections and cross-streets) to calculate projected traffic data for opening year 2025, design year 2045, and pavement design year 2055 for pavement design calculations.
    - Year 2025 ADT (projected) = Existing 2018 Volumes * (1 + G1*7)
    - Year 2045 ADT (projected) = Year 2025 ADT (projected) * (1 + G2*20)
    - Year 2055 ADT (projected) = Year 2025 ADT (projected) * (1 + G3*30)

      [NOTE: G1 (2.4%), G2 (1.875%), and G3 (1.792%) are the growth factors obtained from the Corridor Analysis Worksheet included in the from TPP Corridor Analysis Package March 16, 2018.]
- ADT and the directional splits at the intersections will be be determined based on the existing turning movement counts (24-hour).
- Projected and approved traffic volumes from the adjacent projects FM 1171 from FM 156 to I-35W in Denton County, TX (CSJ: 1311-01-055), and I-35W from SH 170 to I-35E in Denton County, TX (CSJ 0081-13-050) will be compared, added (where applicable), and reconciled to ensure consistency in traffic data among adjacent projects.
- All ADT data including turning movements will be rounded off to the nearest 100's.
    - If a turning movement is not allowed, then the directional arrow will be removed. If a turning movement is not allowed in a previous year but is allowed starting in a forecast year, then it will be notified with a dash for the year(s) the movement is not open. All turning movements are required to have positive growth. All turning movements must be arithmetically correct.
- The projected traffic volumes obtained from the above steps will be adjusted to get a balanced network for both existing conditions, no-build conditions, and build conditions. [NOTE: It shall be verified that the 30-year growth should not have a higher growth factor than 20-year growth at cut lines].

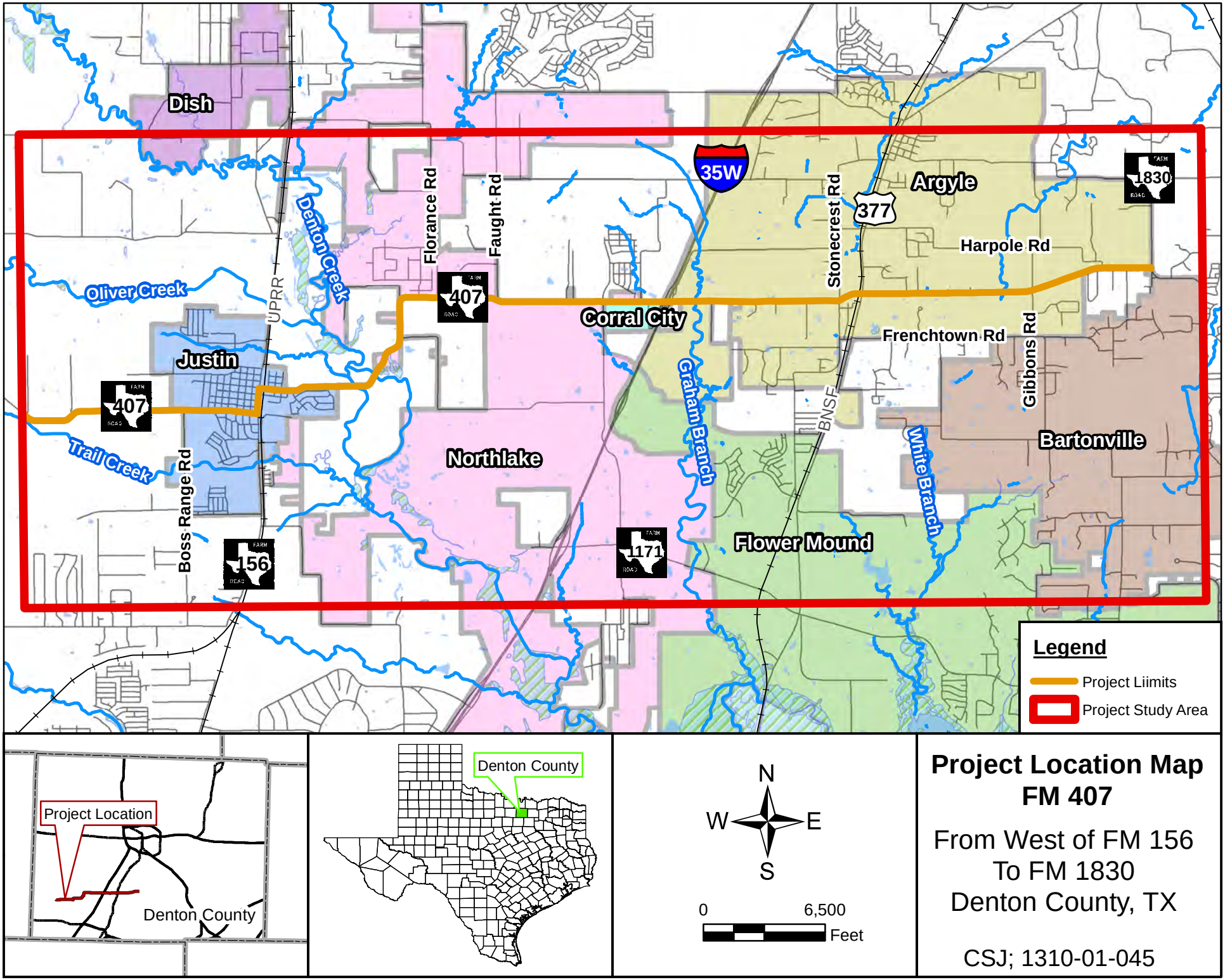
SUBMITTALS

- Line diagrams/schematics showing 2025, 2045, and 2055 ADT volumes for no-build conditions and build conditions will be submitted. The Traffic Analysis for Highway Design (TAHD) Sheet will also be submitted.

- The line diagrams/schematics and the TAHD Sheet will be submitted to TxDOT for a 90% pre-final review.
- After addressing TxDOT comments, a final submittal will be delivered to TxDOT within three weeks of receiving comments.

APPENDIX

Project Location Map



Project Location Map
FM 407

From West of FM 156
To FM 1830
Denton County, TX

CSJ; 1310-01-045

OTHON

MEMORANDUM

TPP Corridor Analysis Packet

Texas Department of Transportation

MEMO

March 16, 2018

To: James K. Selman, P.E., District Engineer
Attention: Ceason C. Clemens, P.E., Director of TPD

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

From: Bruce R. Uphaus
Planner, TPP

Subject: Traffic Data
CSJ: 1310-01-045
FM 407:
From West of FM 156
To FM 1830

Denton County

Attached is a corridor analysis package for the defined limits of the route.

Please refer to your original memorandum dated February 20, 2018.

If you have any questions or need additional information, please contact Bruce R. Uphaus at (512) 486-5104.

Attachments

CC: Godfrey Sendawula, Transportation Specialist, Dallas District

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Dallas District

March 14, 2018

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 407 (DRAFT) Denton County	8,000	11,000	54 - 46	11.1	11.2	8.4	0	0	0	3	0	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	88.8	91.6
Medium Duty	2.2	1.7
Heavy Duty	9.0	6.7

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 407 Section 1 (DRAFT) Denton County	8,000	12,300	54 - 46	11.1	11.2	8.4	0	0	0	3	0	8"

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

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Dallas District

March 14, 2018

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 407 Section 2 (DRAFT) Denton County	11,200	15,300	54 - 46	11.1	10.6	8.0	0	0	0	3	0	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	89.4	92.0
Medium Duty	2.1	1.6
Heavy Duty	8.5	6.4

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 407 Section 2 (DRAFT) Denton County	11,200	17,200	54 - 46	11.1	10.6	8.0	0	0	0	3	0	8"

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

Texas Department of Transportation

MEMO

February 20, 2018

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

From: Dan Perge, P.E.
Dallas District, Advance Project Development

Subject: Traffic Analysis Packet Request
CSJ: 1310-01-045
FM 407
From West of FM 156 to FM 1830

Denton County

Attached please find traffic data request form and a location map for the above subject project. Please provide our office with a Consultant Corridor Information Packet. If any additional information is needed, please contact Godfrey Sendawula at (214)320-6266.

Attachments

RECEIVED TPP
0093 FEB21 18

Request for Traffic Data

Date: 02/16/2018

District: DALLAS **County:** DENTON **CSJ:** 1310-01-045

Highway: FM 407

Limits: W of FM 156 to FM 1830

Texas Reference Marker System

From Marker: 558 From Displacement: +0.000 From DFO: 8.401

To Marker: 570 To Displacement: +0.593 To DFO: 21.032

Is it in the UTP: ☒ Yes ☐ No District Priority: Est. Letting Date: 10/01/2019

Existing Number of Lanes: 2

Proposed Number of Lanes: 6

District Contact Person: Stephen Endres, P.E.

Phone Number: 214-320-4469

Please attach an 8-1/2" x 11" location map and make note of any existing or proposed development that will be a traffic generator. NOTE:

The following to be completed (Please mark information to be provided):

☒ 1. Basic Highway Traffic Data for pavement design
(No line diagram analysis required)
- A. Base year/ Beginning year: 2025
- B. Forecasted 20 year: 2045
- C. Forecasted 30 year: 2055
- D. Directional Distribution
- E. K-factor
- F. Percent Trucks ADT/DHV
- G. Average Ten Heaviest Wheel Loads (ATHWLD)
- H. Percent Tandem Axles in the ATHWLD
- I. One Directional cumulative 18 KSA at the end of the 20 years/30 years
- J. Slab Thickness (8" unless otherwise specified):
- K. Structural Number (3 unless otherwise specified):

☒ 2. Vehicle classification for environmental studies (Air and Noise Analysis)

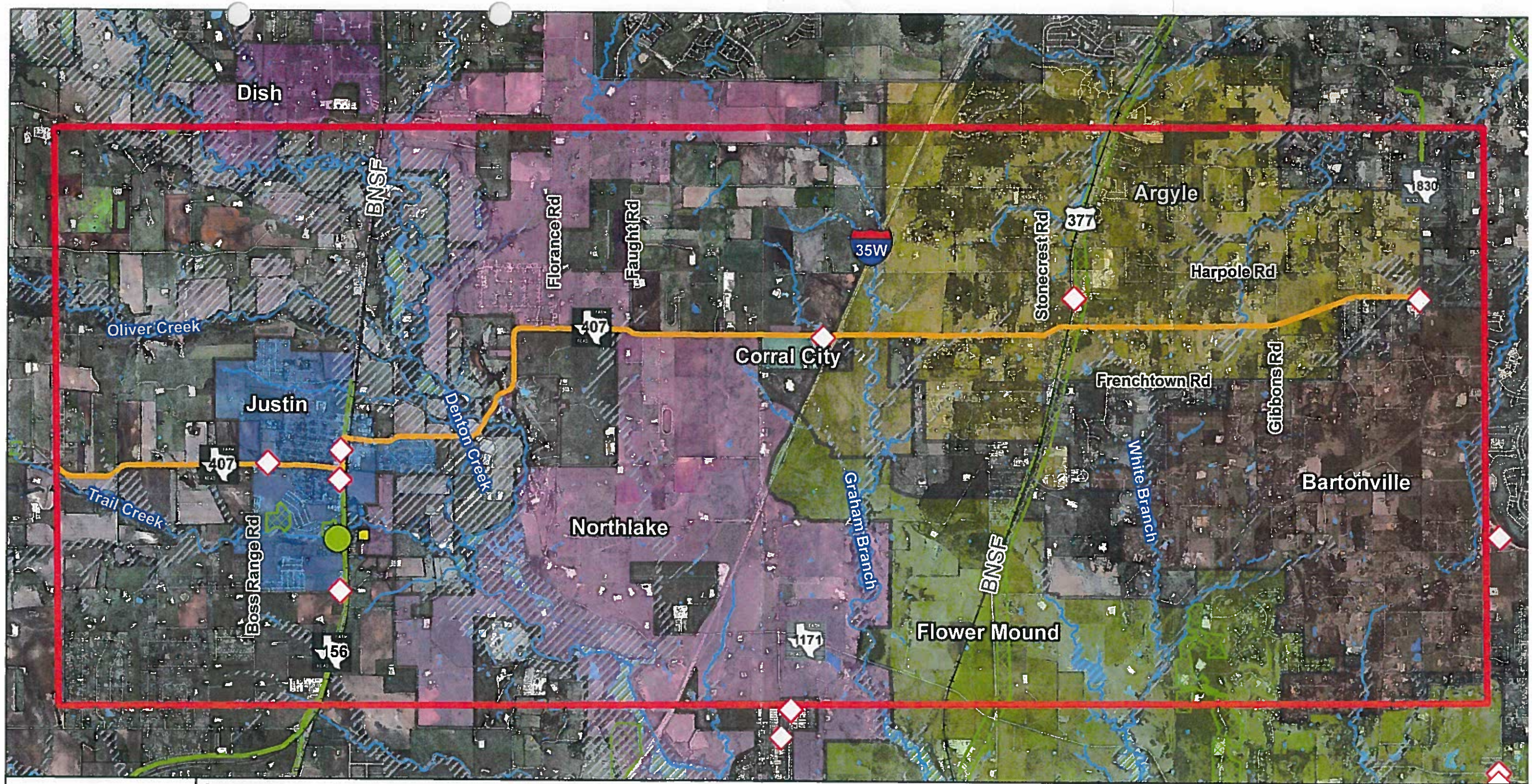
☐ 3. Line diagram analysis (straight line turning movements; please provide line diagram).

☐ 4. Complete Corridor Analysis (includes basic highway traffic data for pavement design, environmental studies and detailed schematic turning movements; *please provide detailed schematic*).

☒ 5. Consultant Corridor Information Packet

☐ 6. No build traffic analysis.
- ☐ EA
- ☐ EIS
- ☐ EA/EIS Reevaluation

Note: If complete corridor analysis is requested, please attach a traffic schematic diagram.



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Legend

- Existing FM 407 Alignment to FM 1830
- Study Area
- PST (TCEQ)
- Historical Marker (THC)
- Archeo Project Area (THC)
- Cemetery (THC)
- Wetland (USFWS)
- Pond/Lake (USFWS)
- Stream (USCB)
- Railroad (DOT)

Preliminary Constraints Map
FM 407

1310-01-045

From West of FM 156
To FM 1830
Denton County, TX

Texas Department of Transportation

MEMO

March 6, 2018

To: James K. Selman, P.E.
Attention: Ceason G. Clemens, P.E

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

Subject: Traffic Data Request

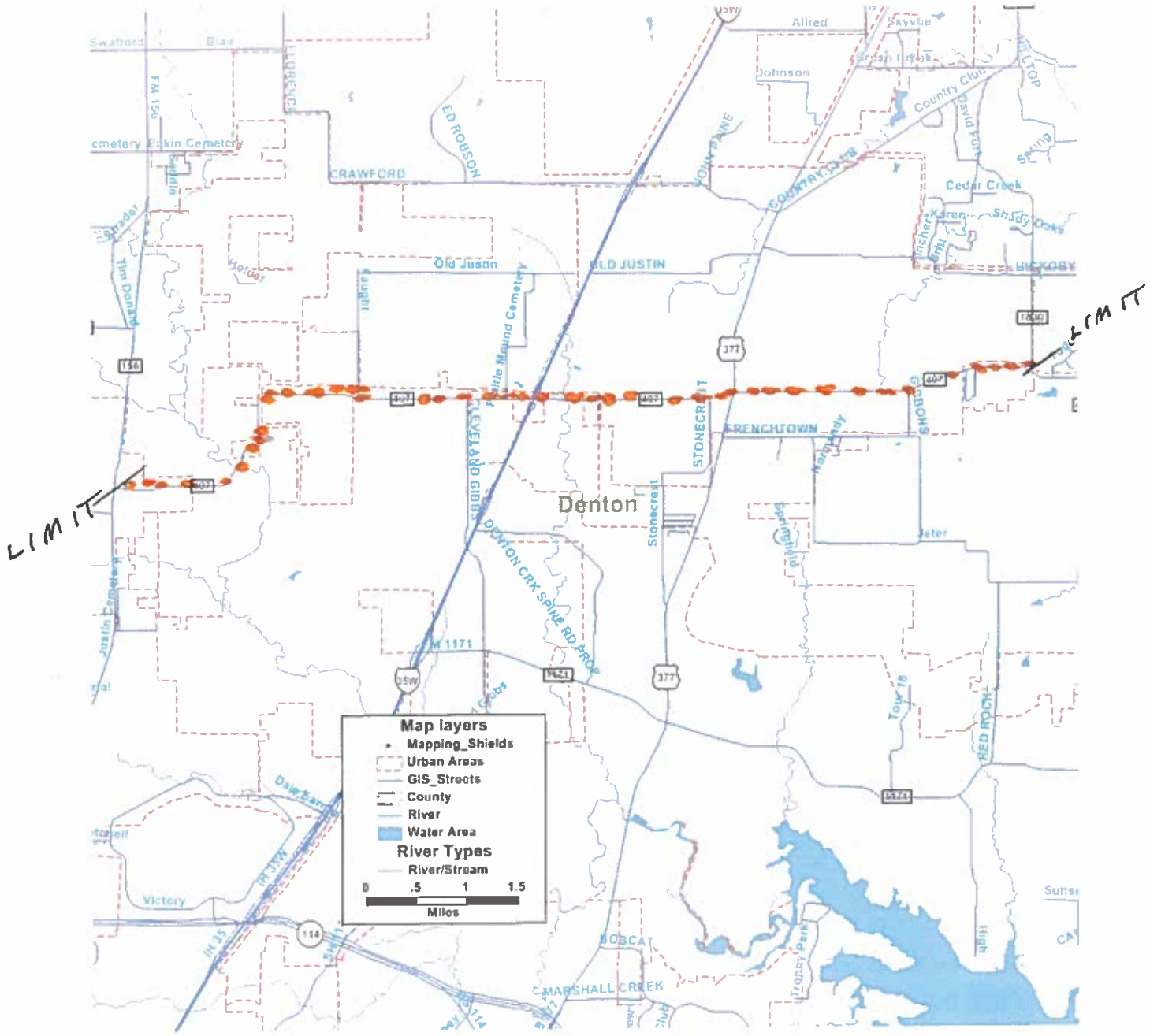
The Transportation Planning and Programming Division received the following request February 21, 2018

Request Date: February 21, 2018

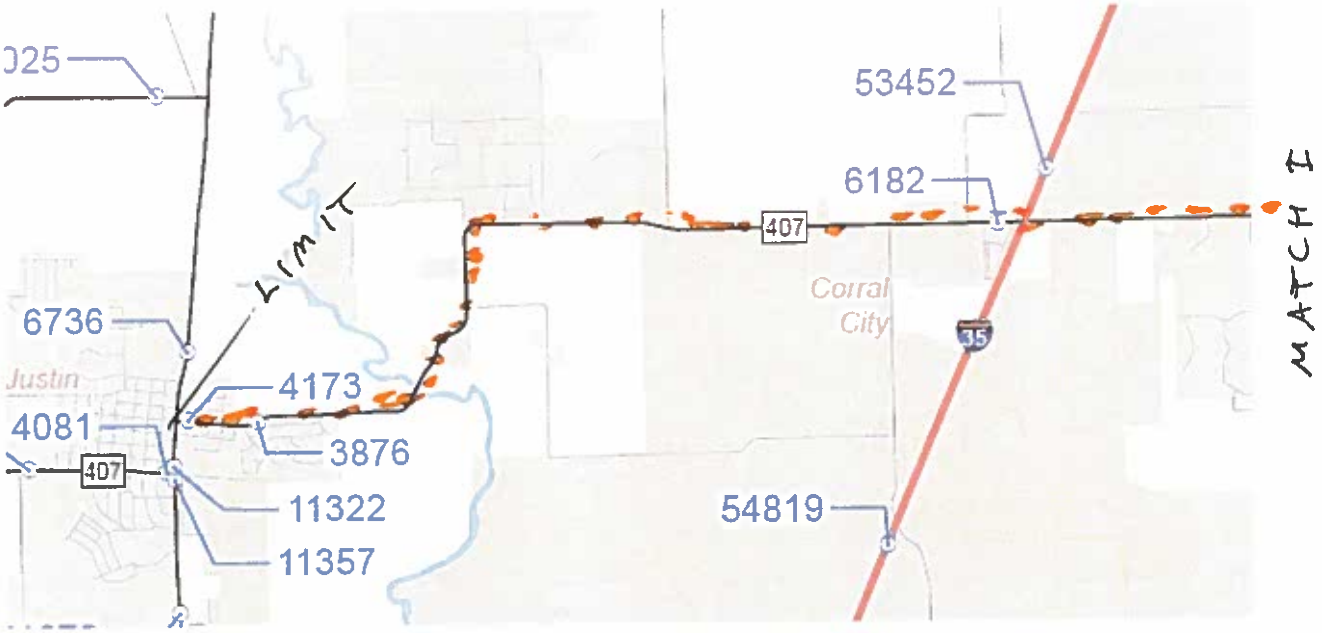
CSJ: 1310-01-045

Highway/Limits:
FM 407/W of FM 156 to FM 1830

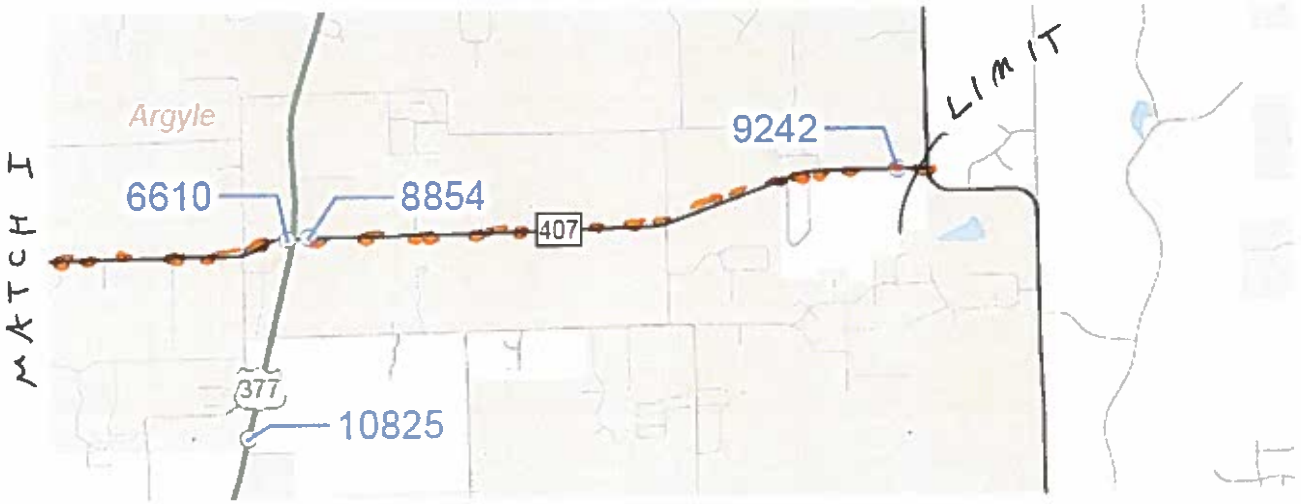
The project will be entered into our Project Priority List at the priority level requested by the district. If no priority was indicated in your request, this project will be entered as your district's last priority. You will be contacted by a member of our staff if additional information is needed.



Project Location Map

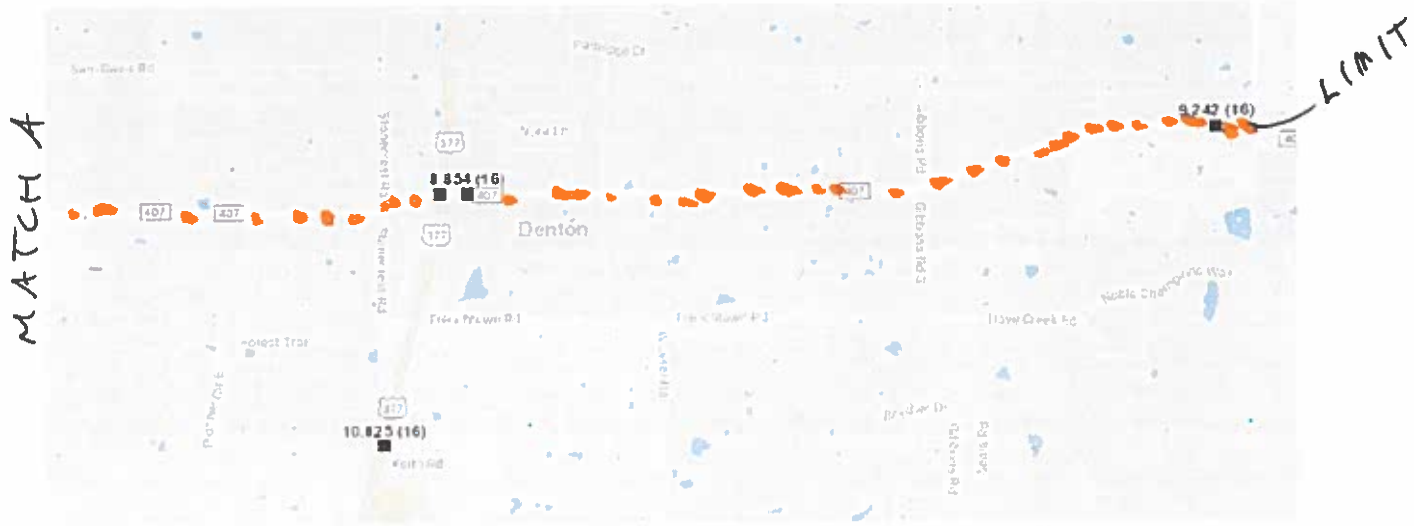


2016 District Traffic Map, FM 407 at FM 156



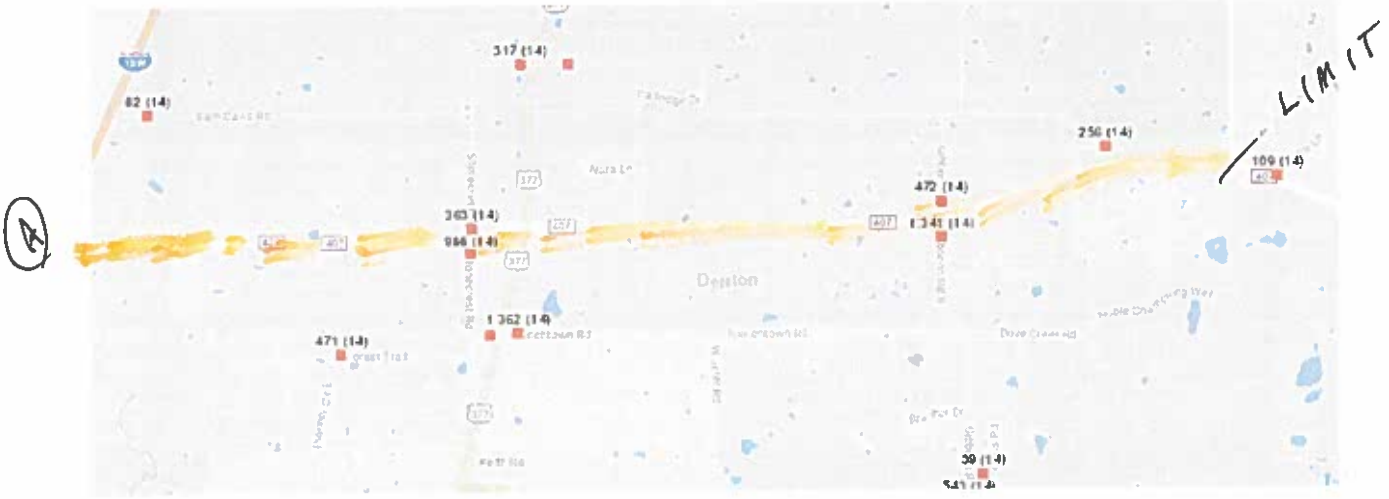
2016 District Traffic Map, FM 407 at FM 1830

2016 STARS II District Traffic Map at FM 156 limit



2016 STARS II District Traffic Map at FM 1830 limit

2014 Urban Saturation Map at western limit



2014 Urban Saturation Map at eastern limit

Corridor Analysis Worksheet: 2 Sections, 2 Forecast Years, Air & Noise

Project	FM 407	District	Dallas
Rd Type	FM	County	Denton
Direction	Two-Way	CSJ	1310-01-045
Limits	From West of FM 158 to FM 1830		
Section 1		Analyst	bru
Limits			
Section 2			
Limits			

Date: Request	2/20/2018	Received	2/21/2018	Started	3/13/2018	Completed	3/14/2018
District Contact	Godfery Sendawula				Phone #	214/320-6266	

	Year	ADT's			% Trks ADT		% Trks DHV	
Count	2016	6610	9242		11.2	10.6	8.4	8
Base	2025	8000	11200	# Trks	896	1187		
Forecast	2045	11000	15300	DRAFT				
Forecast	2055	12300	17200	PROJECTIONS				

SPR Station	S 77	MC Stn	M 935	% Trks	18.06
Year	2016	Dir	SW leg	Num Trks	353
Peak Hour	16.8	Year	2016	Axle Factor	2.81
DD	54	ADT	1955	% Single Axles	0.45
100-DD	46				
K-Factor	11.1				

TDM Assignment					
Main Road Growth Rate	2.4				
Growth Rate after 20 Years	2.0			LOD	
20 Year G.F. Sectn 1	1.875	Sectn 2	1.830	Design Period	20
30 Year G.F. Sectn 1	1.792	Sectn 2	1.786	Design Period	30

			# Lanes	
Structural Number (SN)	3		Existing	2
Slab Thickness (ST)	8		Proposed	6

Past Projects

Project	FM 407
From	At Denton Creek
To	
Date	7/31/2015
County	Denton
CSJ	1310-01-027

Items Done on This Project

Straight Line Turning Movements		Detailed Schematic Turning Movements	
Traffic Analysis for Highway Design	X	Field Trip	
Vehicle Mix		Travel Demand Model Used	
Manual Count Worksheet			

NOTES:

INPUT DATA FOR KIPS: AUTOMATIC

SN, ST	3, 8							
Section	Section 1		Section 2					
Des. Yr.	1st Yr	2nd Yr	1st Yr	2nd Yr				
Year 1	25	25	25	25				
Year 2	45	55	45	55				
ADT	8000	8000	11200	11200				
% Trks	11.2	11.2	10.6	10.6				
GR	1.875	1.792	1.830	1.786				
Years	20	30	20	30				
FacilType	C	C	C	C				
S.N.	3	3	3	3				
SLAB	8	8	8	8				
WeightSta	0	0	0	0				
A.F.	2.81	2.81	2.81	2.81				
S.A.	0.45	0.45	0.45	0.45				

DATA CALCULATIONS FOR USE IN AIR & NOISE ANALYSIS

FHWA Format Vehicle Class. Counts		
Light Duty Vehicles	Motorcycles	1
	Passenger	912
	Pickup or Van	689
Single Units	Buses	3
	Other 2 Axle	58
	3 Axles	7
	4 Axles or more	0
Truck Combs.	3-4 Axles	20
	5 Axles	258
	6 Axles or more	6
Semi-Trailer-Trailer	5 Axles or less	0
	6 Axles	0
	7 Axles or more	1

	Number	%
Light	1602	81.9
Medium	71	3.6
Heavy	282	14.4
Trucks	353	18.1

SECTION 1

FM

	ADT	DHV
Light	88.8	91.6
Medium	2.2	1.7
Heavy	9	6.7

SECTION 2

FM

	ADT	DHV
Light	89.4	92
Medium	2.1	1.6
Heavy	8.5	6.4

Total Vehicles	1955
Total Trucks	353
Total Singles	446.0
Total Tandems	547.0
AXLE FACTOR	2.81
SINGLE AX FACT	0.45

INPUT DATA FOR KIPS: AUTOMATIC

SN, ST				
Section				
Design Year				
Year 1				
Year 2				
ADT				
% Trks				
Growth Rate				
Years				
Facil Type				
S.N.				
SLAB				
WeightSta				
Axle Factor				
Single Axle				

OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST	3, 8			
Section	Section 1		Section 2	
Design Year	1st Yr	2nd Yr	1st Yr	2nd Yr
ATHWLD				
%T in ATHWLD				
FLEXIBLE				
RIGID				

OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST								
Section								
Design Year								
ATHWLD								
% T in ATHWLD								
FLEXIBLE								
RIGID								

TRAFFIC VOLUME REGRESSION WORKSHEET

March 13, 2018

PROJECT: FM 407
LIMITS: From FM 156
To FM 1830

District: Dallas
County: Denton
CSJ: 1310-01-045

ROUTE		FM 407		FM 407		FM 407		FM 407		FM 407		FM 407
LOCATION		T 37		H 119		H 118		H 107		H 106		H 88
1996		3100		2600		2600		2500		2500		2500
1997		2900		2800		2700		2800		2700		2700
1998		3800		3700		3900		3400		2800		2900
1999		4400		3500		3700		3900		3900		3900
2000		4700		3900		4000		4000		4500		4200
2001		4600		3800		4400		4000		4400		4100
2002		4600		3900		4500		4300		4900		4800
2003		5400		4900		4800		5200		5200		5500
2004		5300		4800		4400		5500		6500		6000
2005		5500		4520		5070		5350		5280		6650
2006		5400		4500		5600		5700		5900		7300
2007		5900		4800		5500		7600		8500		8500
2008		4600		4000		4900		6200		7300		7300
2009		5200		4400		4500		6100		8000		7500
2010		4800		4200		5000		7000		8800		8200
2011		5200		4200		5200		7500		11000		10000
2012		5300		4400		5600		7500		9800		9600
2013		5001		4456		5943		6675		8192		8174
2014		4877		4030		5462		7278		9715		9524
2015		3928		3446		5542		6578		8466		8763
2016		4173		3876		6182		6610		8854		9242
	Regr01	Regr02	Regr03	Regr04	Regr05	Regr06	Regr07	Regr08	Regr09	Regr10	Regr11	Regr12
Low Linear Annual Growth Rate		0.1%		0.1%		1.3%		1.8%		2.2%		2.2%
Forecast Lnr. An. Grwth Rate	☐	1.0% ☑	☐	0.9% ☑	☐	2.2% ☑	☐	3.0% ☑	☐	3.7% ☑	☐	3.7% ☑
High Linear Annual Growth Rate		1.9%		1.7%		3.2%		4.2%		5.2%		5.1%
Estimated Standard Deviation		709.93		549.78		451.16		676.59		967.63		744.81
B (Slope)		50		41		137		235		382		378
A (Intercept)		4198		3628		3365		3156		2710		2763
R=		0.401		0.417		0.884		0.907		0.926		0.953
Confidence Interval		+/- 90% CI 47		+/- 90% CI 37		+/- 90% CI 58		+/- 90% CI 98		+/- 90% CI 155		+/- 80% CI 149
	Avg. of selected Forecast Linear Annual Growth Rates:					2.4%		Avg. of all Forecast Linear Annual Growth Rates:		2.4%		
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. 2010

Enter Base Year 2020

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

Enter Model Year

Optional Input: SPR Station, Yr
Optional Input: K-Factor
Optional Input: Dir. Dist.

Enter Earliest Variable Year 2015
Enter Latest Variable Year 2025

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	○	1.3%
Use Avg. of Selected Forecast Growth Rates	◉	2.4%
Use Avg. of Selected High Growth Rates	○	3.6%
Use Avg. of All Low Growth Rates	○	1.3%
Use Avg. of All Forecast Growth Rates	○	2.4%
Use Avg. of All High Growth Rates	○	3.6%
Use Highest Forecast Growth Rate	○	3.7%
Use Lowest Forecast Growth Rate	○	0.9%
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%

ROUTE		FM 407		FM 407		FM 407		FM 407		FM 407		FM 407
LOCATION		T 37		H 119		H 118		H 107		H 106		H 88
20/PIVOT YR AN. GROWTH RATE		2.4%		2.4%		2.4%		2.4%		2.4%		2.4%
Count Year - 2016		4173		3876		6182		6610		8854		9242
Base Year - 2020		4600		4200		6800		7200		9700		10100
Ten Year Forecast - 2030		5600		5200		8300		8800		11800		12300
Twenty Year Forecast - 2040		6500		6000		9600		10300		13800		14400
Thirty Year Forecast - 2050		7300		6800		10900		11600		15600		16300
Forty Year Forecast - 2060		8200		7600		12100		13000		17400		18100
GR Pivot Year Forecast - 2036		6200		5700		9100		9800		13100		13700
Earliest Var Yr Frcst - 2015		4100		3800		6000		6500		8600		9000
Latest Var Yr Frcst - 2025		5100		4700		7500		8000		10800		11200
Model Year Forecast - Model Traffic Assignment												
Difference of Model Yr Forecast from Model Traffic Assignment												
Above Difference in DDHV												
% Difference of Model Yr Forecast from Model Traffic Assignment												

Classification Report

Location ID	M935_SW	**Located On**	SH 220	**County**	Erath
Counted By			At junction of US 67	**Community**	-
Start Date	Tue 4/19/2016	**Loc On Alias**		**Station**	M935_SW
Start Time	12:00:00 AM	**Direction**	SW	**Agency**	Texas DOT
Source		**Sensor Type**		**Owner**	Stacey.Lewis
Axle Factor	0.821	**Count Status**	Accepted		
Filename	M-935.16				

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Pick up	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	TOTAL
12:00 AM	0	7	2	0	0	0	0	0	6	0	0	0	0	0	0	15
1:00 AM	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	5
2:00 AM	0	3	1	0	1	0	0	0	3	0	0	0	0	0	0	8
3:00 AM	0	5	1	0	0	0	0	0	17	0	0	0	0	0	0	23
4:00 AM	0	7	3	0	1	0	0	0	7	0	0	0	0	0	0	18
5:00 AM	0	15	12	0	2	0	0	0	8	0	0	0	0	0	0	37
6:00 AM	0	22	25	1	0	1	0	2	17	0	0	0	0	0	0	68
7:00 AM	0	40	40	0	5	0	0	1	10	0	0	0	0	0	0	96
8:00 AM	0	36	33	0	4	1	0	1	12	1	0	0	0	0	0	88
9:00 AM	0	56	38	0	9	0	0	2	20	0	0	0	0	0	0	125
10:00 AM	0	59	43	0	6	0	0	2	15	0	0	0	0	0	0	125
11:00 AM	0	74	56	0	7	0	0	0	18	5	0	0	1	0	0	161
12:00 PM	0	57	48	0	6	0	0	1	14	0	0	0	0	0	0	126
1:00 PM	1	70	46	0	2	1	0	2	15	0	0	0	0	0	0	137
2:00 PM	0	77	56	0	4	0	0	2	10	0	0	0	0	0	0	149
3:00 PM	0	87	64	0	5	3	0	2	12	0	0	0	0	0	0	173
4:00 PM	0	74	52	1	4	1	0	0	10	0	0	0	0	0	0	142
5:00 PM	0	76	59	0	1	0	0	1	14	0	0	0	0	0	0	151
6:00 PM	0	51	51	1	0	0	0	0	12	0	0	0	0	0	0	115
7:00 PM	0	29	24	0	0	0	0	0	10	0	0	0	0	0	0	63
8:00 PM	0	23	14	0	1	0	0	2	5	0	0	0	0	0	0	45
9:00 PM	0	20	13	0	0	0	0	0	7	0	0	0	0	0	0	40
10:00 PM	0	14	5	0	0	0	0	1	8	0	0	0	0	0	0	28
11:00 PM	0	9	3	0	0	0	0	1	4	0	0	0	0	0	0	17
TOTAL	1	912	689	3	58	7	0	20	258	6	0	0	1	0	0	1955

MANUAL COUNT DESIGN DATA - FHWA FORMAT

Station Number M 935 **Direction** SW leg **Year** 2016

Optional Misc. Info. (loc., etc.)

Type of Truck		Number of Trucks	Single Axles Mult.		Tandem Axle Sets Mult.	
Single Units						
Buses	4	3	2	6	0	0
2-D	5	58	2	116	0	0
3-Axle	6	7	1	7	1	7
4-Axle	7	0	1	0	1	0
Single Trailer						
3-4-Axle	8	20	2.5	50.0	0.5	10.0
5-Axle	9	258	1	258	2	516
6-Axle	10	6	1	6	2	12
Multi-Trailers						
5-Axle	11	0	5	0	0	0
6-Axle	12	0	4	0	1	0
7-Axle	13	1	3	3	2	2
Total		353		446.0		547.0

(Singles + Tandems) / Total Trucks = Axle Factor	2.81
(Singles Axles / (Singles + Tandems))	0.45

Light Duty Vehicles	Motorcycles	1
	Passenger Cars	912
	Pickup or Van	689
Single Units	Buses	3
	Other 2 Axle	58
	3 Axles	7
	4 Axles or more	0
Single Trailer	3-4 Axles	20
	5 Axles	258
	6 Axles or more	6
Multi-Trailers	5 Axles or less	0
	6 Axles	0
	7 Axles or more	1

Light	1602
Medium	71
Heavy	282
Trucks	353
Total Vehicles	1955
%T of Tot. Veh.	18.1
Num. of Trucks	353
Axle Factor	2.81
% Single Axles	0.45

Texas Department of Transportation

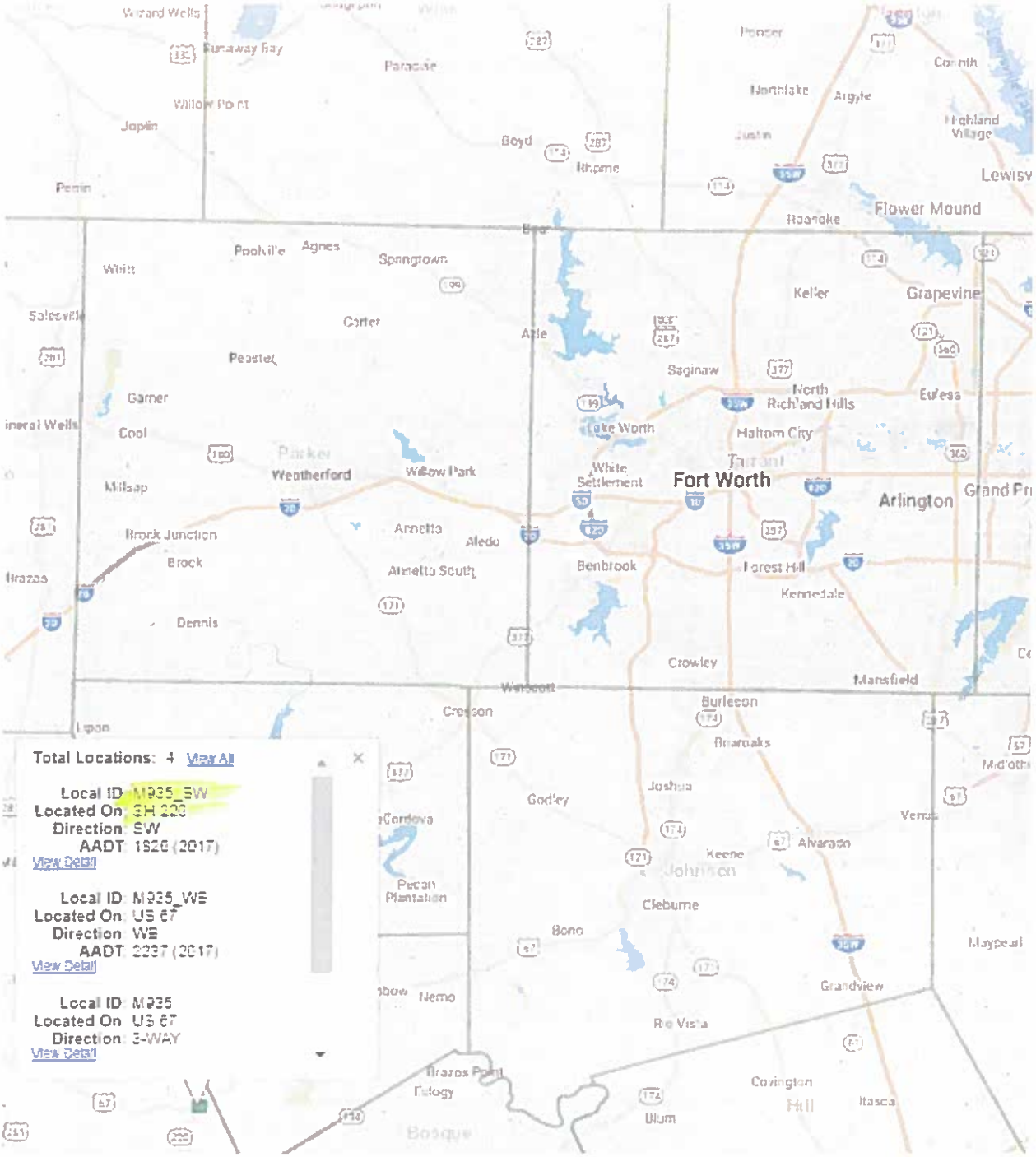
Transportation Planning and Programming Division's
Statewide Traffic Analysis and Reporting System II

High Hourly Volumes for Year for 1/1/2016 - 12/31/2016
Criteria: Location ID = s77

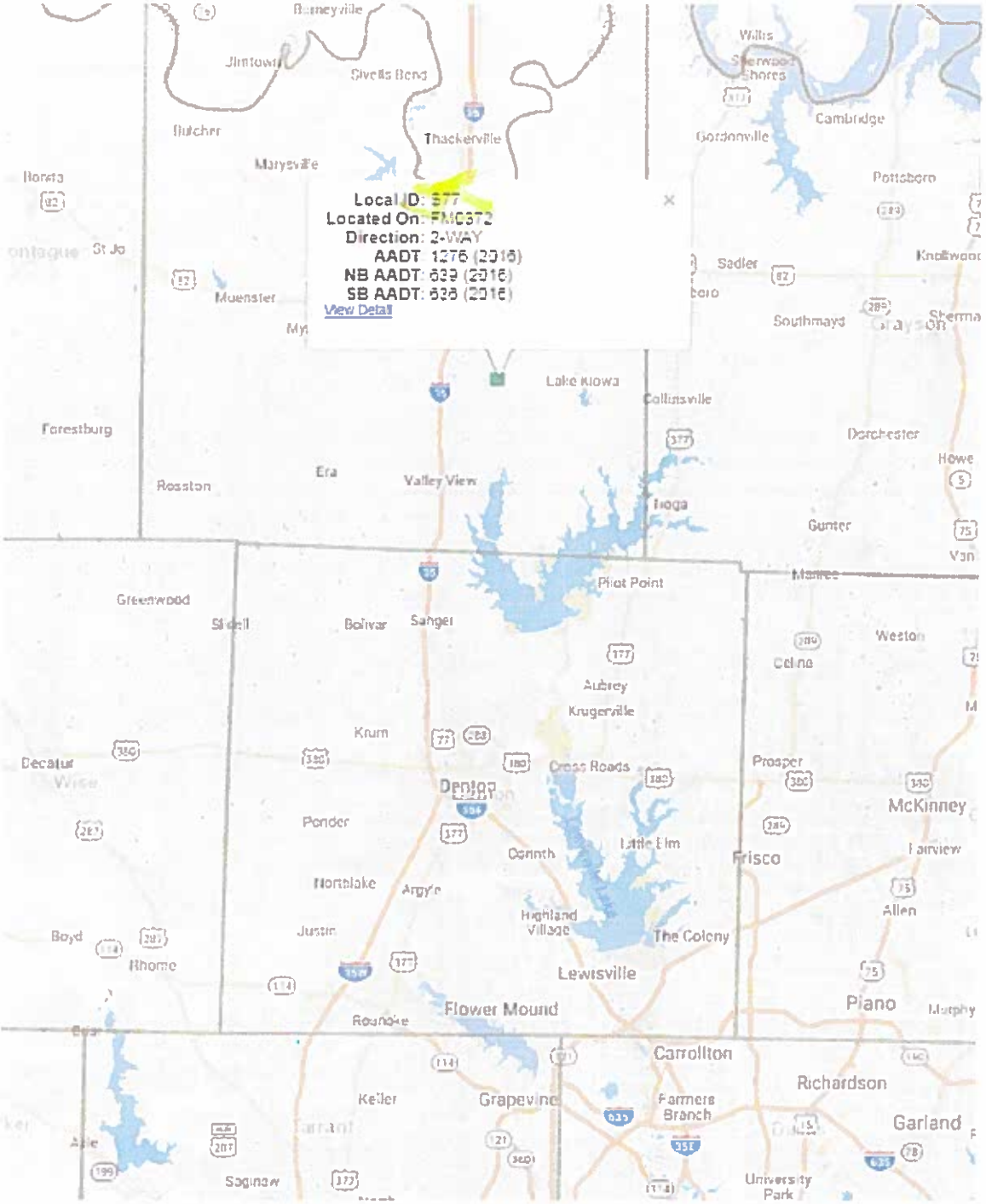
District : Wichita Falls **County :** Cooke **Community :** Gainsville
Route: 4.5 miles southeast of US0082, Gainesville **On Road:** FM0372
Location ID : S77 **Collection Type :** PERM **AADT:** 1,276
Roadbed : ML

Ordinal High Hour	Date	Day of Week	Hour	Volume	K Factor	Peak Direction	Directional Distribution
1	8/12/2016	Friday	5pm-6pm	215	16.8	SB	59
2	6/29/2016	Wednesday	5pm-6pm	175	13.7	SB	57
3	9/2/2016	Friday	2am-3am	173	13.6	NB	100
4	8/12/2016	Friday	10pm-11pm	167	13.1	SB	56
5	12/10/2016	Saturday	10am-11am	163	12.8	NB	81
6	7/27/2016	Wednesday	1pm-2pm	161	12.6	SB	61
7	3/17/2016	Thursday	10am-11am	160	12.5	NB	51
8	7/8/2016	Friday	5pm-6pm	160	12.5	SB	61
9	5/23/2016	Monday	7am-8am	158	12.4	NB	58
10	4/21/2016	Thursday	5pm-6pm	157	12.3	SB	56
20	11/9/2016	Wednesday	5pm-6pm	147	11.5	SB	65
25	2/4/2016	Thursday	5pm-6pm	144	11.3	SB	57
30	6/24/2016	Friday	5pm-6pm	142	11.1	SB	54
35	10/26/2016	Wednesday	5pm-6pm	142	11.1	SB	51
40	5/3/2016	Tuesday	5pm-6pm	139	10.9	SB	52
45	9/7/2016	Wednesday	5pm-6pm	139	10.9	SB	66
50	12/2/2016	Friday	5pm-6pm	138	10.8	SB	71
75	10/22/2016	Saturday	12pm-1pm	134	10.5	SB	51
100	3/24/2016	Thursday	5pm-6pm	130	10.2	SB	55
125	12/21/2016	Wednesday	5pm-6pm	128	10	SB	56
150	2/1/2016	Monday	5pm-6pm	124	9.7	SB	65
175	4/21/2016	Thursday	4pm-5pm	123	9.6	SB	54
200	2/5/2016	Friday	5pm-6pm	121	9.5	SB	55

This information has been prepared for internal use within the
Texas Department of Transportation.



Vehicle Class Site Location



ATR Station Site

File

Texas Department of Transportation

PAST PROJECT

MEMO

July 31, 2015

To: Stan Hall, P.E., Advance Project Development Director
Attention: Moose Saghian, P.E., Director of TPD

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

From: Robert C. Williams
Transportation Analyst, TPP

Subject: Traffic Data
CSJ: 1310-01-027
FM 407:
At Denton Creek

Denton County

Attached is a tabulation showing traffic analysis for highway design for the 2016 to 2036 twenty year period for the described limits of the route. Included is a tabulation showing data for use in air and noise analysis.

Please refer to your original memorandum dated July 24, 2015.

If you have any questions or need additional information, please contact Robert C. Williams at (512) 486-5145.

Attachment

CC: Godfrey Sendawula, Dallas District
Transportation Specialist
Design Division

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Dallas District

July 28, 2015

Description of Location	Average Daily Traffic 2016	Average Daily Traffic 2036	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 (2016 to 2036) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 407												
At Denton Creek	4,800	7,000	60 - 40	11.1	11.9	8.9	11,000	40	1,877,000	3	2,381,000	8"
Denton County												

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	88.1	91.1
Medium Duty	6.3	4.7
Heavy Duty	5.6	4.2

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES
Kevin Eric Knowles, P.E.
License Number 84701

TRAFFIC DATA REQUEST FORM

DISTRICT: Dallas **COUNTY:** Denton **CSJ:** 1310-01-027

HIGHWAY: FM 407

LIMITS: At Denton Creek

DISTRICT PRIORITY: High **EST. LETTING DATE:** February 2017

EXISTING NUMBER OF LANES: 2

PROPOSED NUMBER OF LANES: 2

DISTRICT CONTACT PERSON: Godfrey Sendawula

TELEPHONE NUMBER: 214-320-6266

PLEASE ATTACH A 8-1/2" x 11" LOCATION MAP

The following to be completed: (please mark information to be provided)

✓ **1.** Basic Highway Traffic Data for pavement design.
(No line diagram analysis required)

A. Base year / Beginning year: **2016**
B. Forecasted 20 year: **2036**
C. Forecasted 30 year:
D. Directional Distribution
E. K-factor
F. Percent Trucks ADT/DHV
G. Average Ten Heaviest Wheel Loads (ATHWLD)
H. Percent Tandem Axles in the ATHWLD
I. One directional cumulative 18 KSA at the end of the 20 years/30 years
J. Slab Thickness (8" unless otherwise specified):
K. Structural Number (3 unless otherwise specified):

2. Vehicle classification for environmental studies (Air and Noise Analysis).

3. Line Diagram Analysis (straight line turning movements; please provide line diagram).

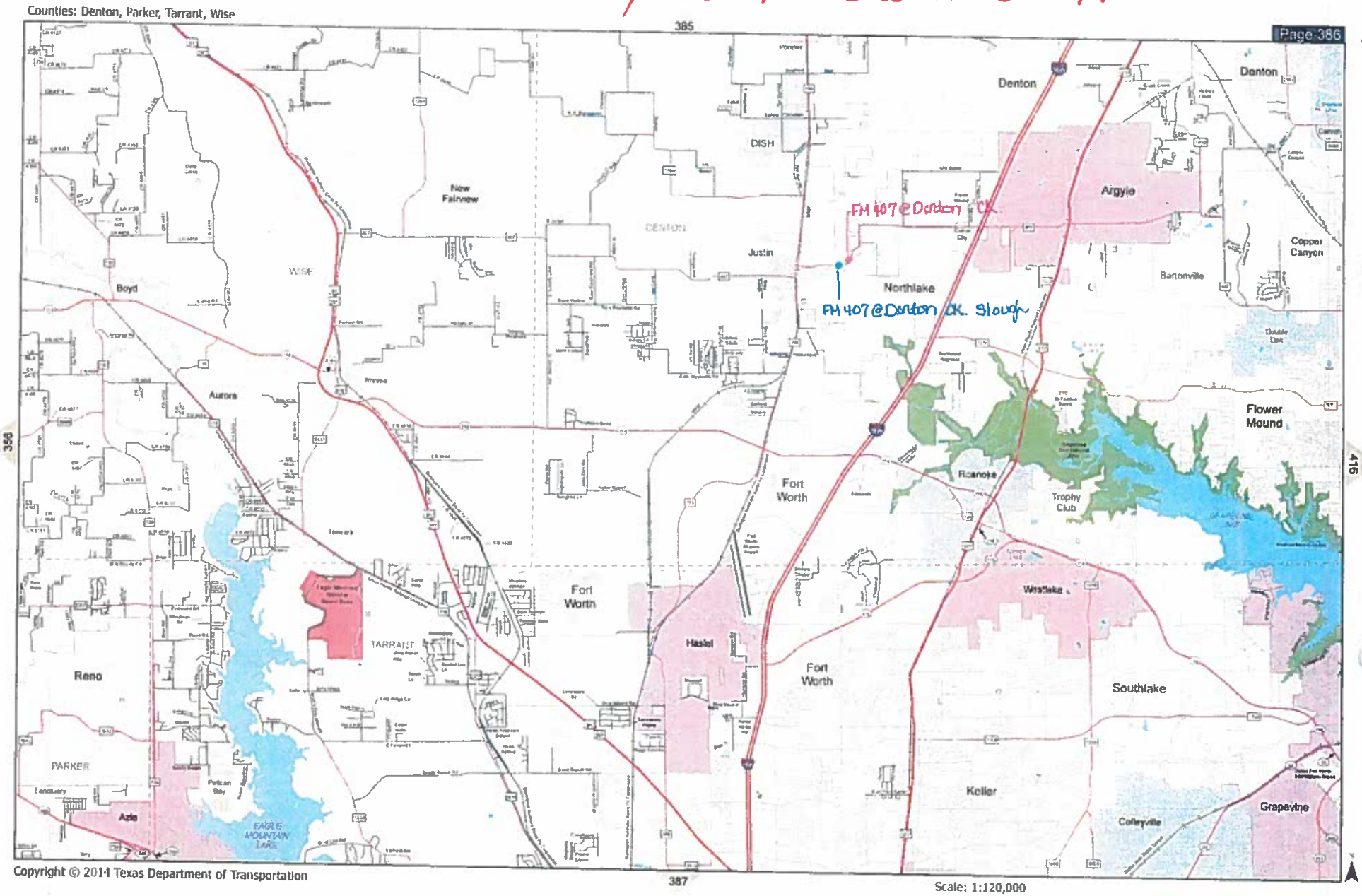
4. Complete Corridor Analysis (includes basic highway traffic data for pavement design and environmental studies and detailed schematic turning movements; please provide detailed schematic).

Note: If a complete corridor analysis is requested, please attach a traffic schematic diagram. Please make note of any known proposed development that will be a traffic generator.

CSJ: 1310-01-027, 036 (FM 407)

DENTON CREEK

& DENTON CREEK SLOUGH



Texas Department of Transportation

MEMO

July 21, 2015

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

From: Stan Hall, P.E.
Dallas District, Advance Project Development

Subject: Traffic Data Request
CSJ: 1310-01-027 &, 1310-01-036 (FM 407)
0092-13-024, 025, 026 & 027 (BI 45-F)
0918-46-287 (CS - Mobberly Rd)
0918-11-088 (CR 340)
0918-11-091 (CR 324)
0918-46-277 (CS - Hilltop Rd)
0918-46-274 (CS – S. Blue Mound Rd)

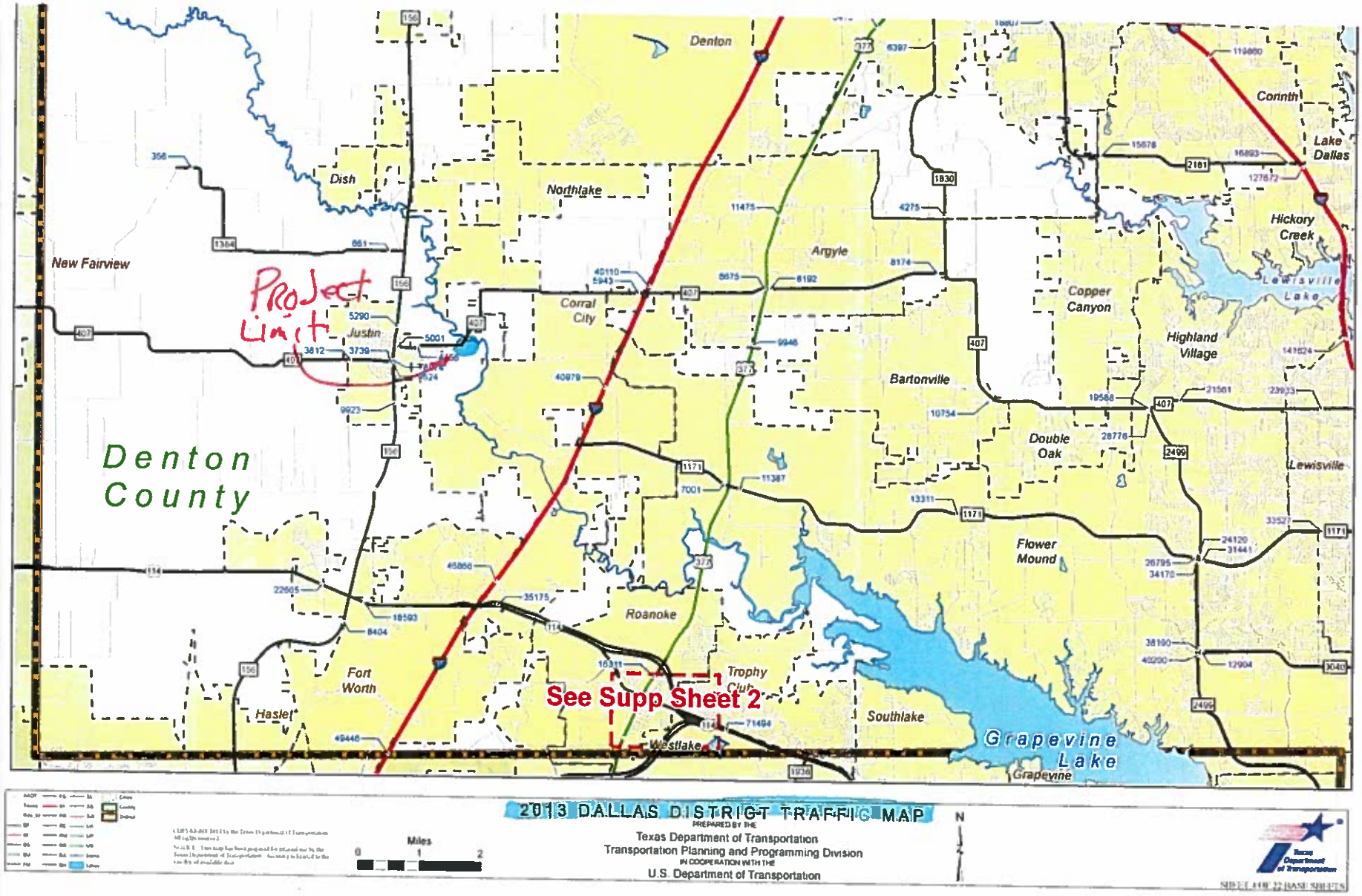
Denton, Kaufman & Navarro Counties

Attached please find traffic data request forms, and location maps for the above subject projects. Please provide our office with the requested traffic data. If any additional information is needed, please contact Godfrey Sendawula at (214)320-6266.

H. Stan Hall, P.E.
District Advance Project
Development Engineer

Attachments

RECEIVED TRP
0266 JUL 23 15


Denton
Corinth
Lake Dallas
Dish
Northlake
New Fairview
Project Limit
Argyle
Hickory Creek
Lewisville Lake
Corral City
Justin
Copper Canyon
Highland Village
Bartonville
Denton County
Double Oak
Lewisville
Flower Mound
Roanoke
Fort Worth
Trophy Club
See Supp Sheet 2
Haslet
Southlake
Westlake
Grapevine Lake
Grapevine
2013 DALLAS DISTRICT TRAFFIC MAP
PREPARED BY THE
Texas Department of Transportation
Transportation Planning and Programming Division
IN COOPERATION WITH THE
U.S. Department of Transportation
Miles
0 1 2
N

Corridor Analysis Worksheet: 1 Section, 1 Forecast Year, Air & Noise

Project	FM 407	Date for Memorandum	7/31/2015
Rd Type	FM	District	Dallas
		County	Denton
Project Limits	At Denton Creek	CSJ	1310-01-027
		Analyst	RCW

Date: Request	7/24/2015	Received	7/24/2015	Started	7/28/2015	Completed	7/28/2015
District Contact				Phone #			

ADT's	Year	ADT		% Trks ADT	% Trks DHV
Count	2013	4456		11.9	8.9
Base	2016	4800	# Trks	571	
Forecast	2036	7000			

SPR Station	S-77	MC Stn	M-935	% Trks	17.9
Year	2013	Dir	3	Num Trks	280
Peak Hour	13.0	Year	2013	Axle Factor	2.43
DD	60	ADT	1561	% Single Axles	0.68
100-DD	40				
K-Factor	11.1				

Main Road Growth Rate	2.6	TDM Assignment	N/A
Growth Rate after 20 Years	2.0		
Section 1 Growth Factor	2.292		
Design Period	20	LOD	99999

				# Lanes	
Structural Number (SN)	3			Existing	2
Slab Thickness (ST)	8			Proposed	2

Past Projects	
Project	FM 407
From	At Draw
To	1.0 mile EaST OF fm 156
Date	9/2/2008
County	Denton
CSJ	1310-01-036

T. Log			
ADT			
% Growth Rate			
K-Factor			
DD			
% Trucks ADT			
% Trucks DHV			
MC Station			
SPR Station			

Items Done on This Project

Straight Line Turning Movements	No	Detailed Schematic Turning Movements	No
Traffic Analysis for Highway Design	Yes	Field Trip	No
Vehicle Mix	Yes	Travel Demand Model Used	No
Manual Count Worksheet	Yes		

NOTES:

M.C. Station M-1089 don't have station by legs, last time by legs was 1988. So I used M-1019-3
See Attachments for T-log

DATA CALCULATIONS FOR USE IN AIR & NOISE ANALYSIS

◉ FHWA Format

Light Duty Vehicles	Motorcycles	11
	Passenger	751
	Pickup or Van	519
Single Units	Buses	10
	Other 2 Axle	122
	3 Axles	26
	4 Axles or more	1
Truck Combs.	3-4 Axles	32
	5 Axles	85
	6 Axles or more	4
Semi-Trailer-Trailer	5 Axles or less	0
	6 Axles	0
	7 Axles or more	0

○ Texas 6 Format

Light Duty Vehicles	Passenger	
	Panel & Pickup	
Single Units	Buses	
	Other 2 Axle	
	3 Axle	
	4 Axle or More	
Truck Combs.	3 Axle	
	4 Axle	
	5 Axle	
	6 Axle or more	
Semi-Trailer-Trailer	5 Axle	
	6 Axle	
	7 Axle or more	

FHWA Format Data

	Number	%
Light	1281	82.1
Medium	148	9.5
Heavy	132	8.5
Trucks	280	17.9

SECTION 1

FM

	ADT	DHV
Light	88.1	91.1
Medium	6.3	4.7
Heavy	5.6	4.2

Total Vehicles	1561
Total Trucks	280
Total Singles	460.0
Total Tandems	221.0
AXLE FACTOR	2.43
SINGLE AX FACT	0.68

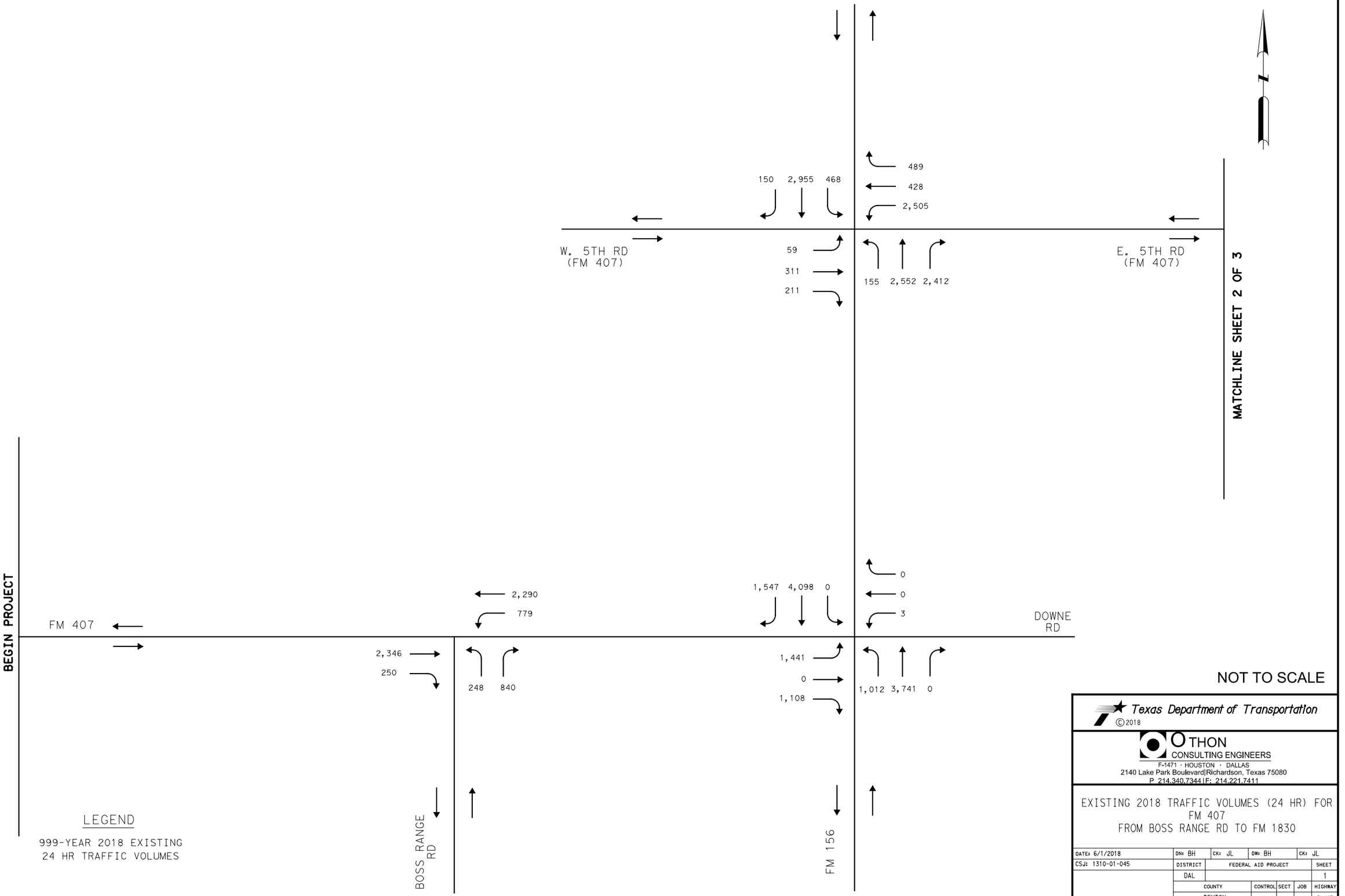
INPUT DATA FOR KIPS: AUTOMATIC

SN, ST	3, 8		
Year 1	16		
Year 2	36		
ADT	4800		
% Trks	11.9		
Growth Rate	2.292		
Years	20		
Facil Type	C		
S.N.	3		
SLAB	8		
Weight Sta	99999		
Axle Factor	2.43		
Single Axle	0.68		

OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST	3, 8		
ATHWLD	11000		
% T in ATHWLD	40		
FLEXIBLE	1877000		
RIGID	2381000		

Existing 2018 Traffic Volumes



NOT TO SCALE

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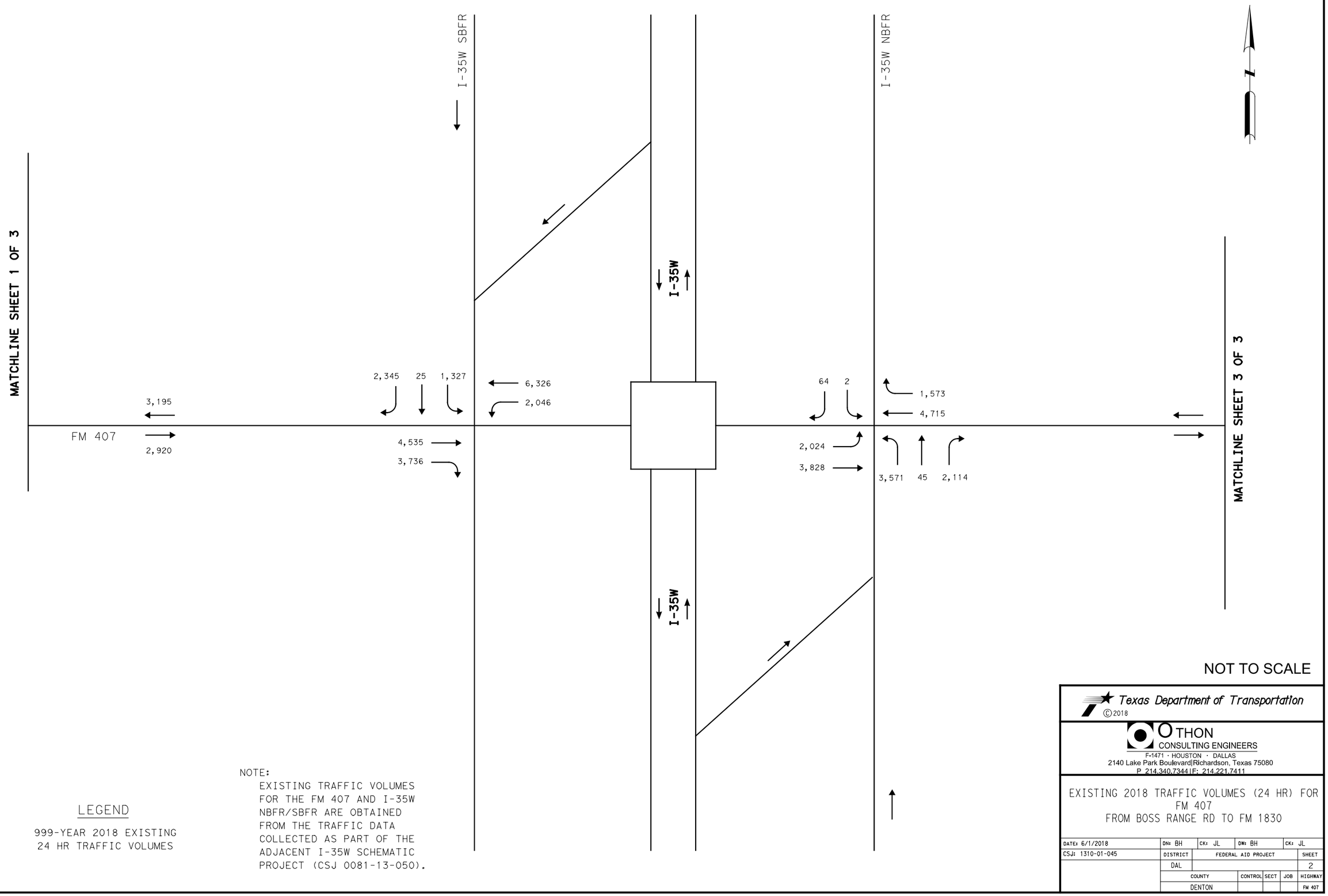
F-1471 · HOUSTON · DALLAS
2140 Lake Park Boulevard|Richardson, Texas 75080
P 214.340.7344|F: 214.221.7411

EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR
FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/1/2018	DN: BH	CK: JL	DW: BH	CK: JL		
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT			SHEET	
	DAL				1	
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	DENTON					FM 407

6/1/2018 1:37:06 PM
FM 407 Exist 24hr Vol_01.dgn



NOT TO SCALE

LEGEND

999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

NOTE:
EXISTING TRAFFIC VOLUMES FOR THE FM 407 AND I-35W NBFR/SBFR ARE OBTAINED FROM THE TRAFFIC DATA COLLECTED AS PART OF THE ADJACENT I-35W SCHEMATIC PROJECT (CSJ 0081-13-050).

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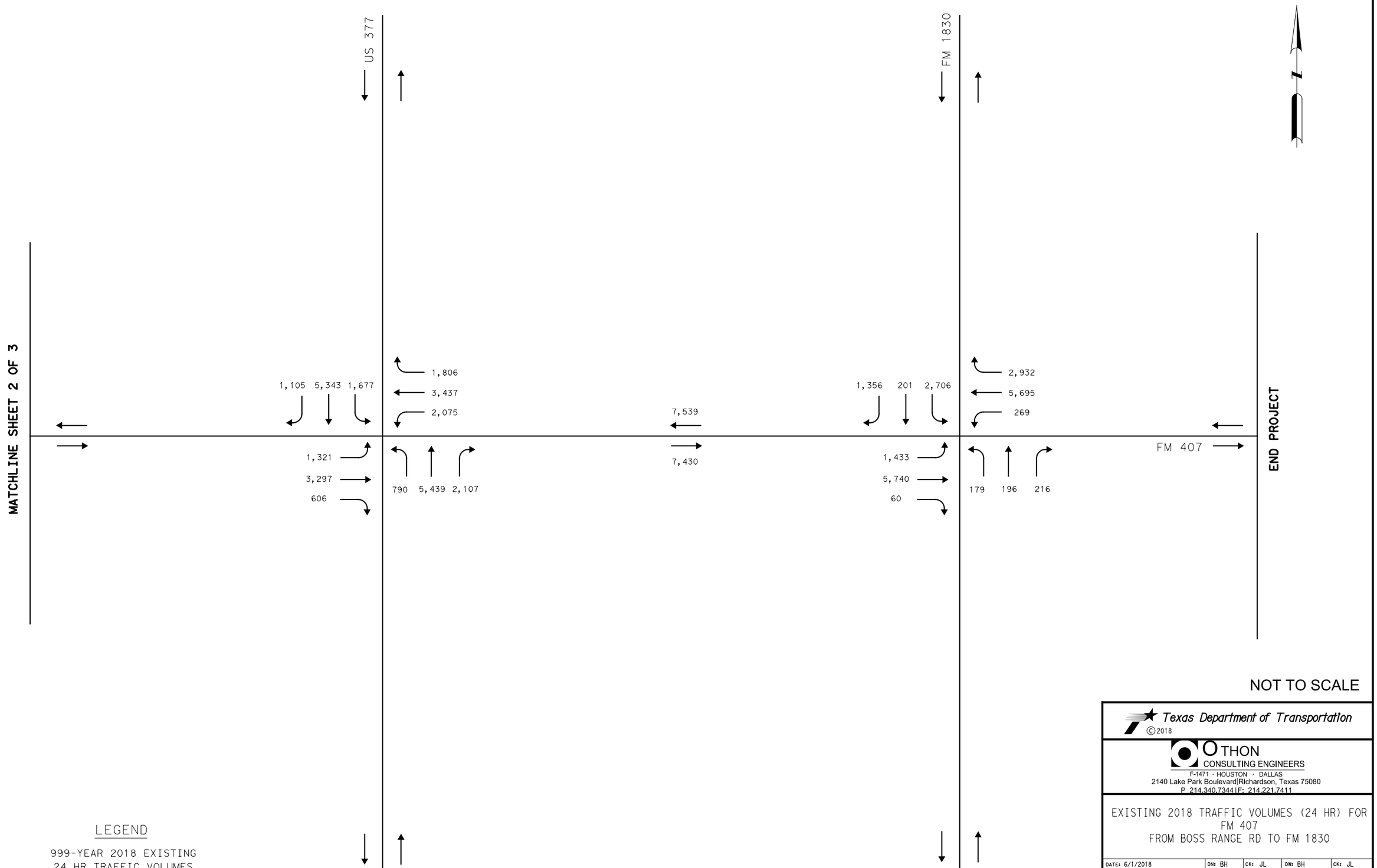
EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/1/2018	DN: BH	CK: JL	DW: BH	CK: JL
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2

COUNTY	CONTROL	SECT	JOB	HIGHWAY
DENTON				FM 407

6/1/2018 11:37:07 PM
FM 407 Exist 24hr Vol_02.dgn



LEGEND

999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

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EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR
FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/1/2018	DN: BH	CK: JL	DW: BH	CK: JL	
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT			SHEET
	DAL				3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

6/1/2018 11:37:07 PM
FM 407 Exist 24hr Vol_03.dgn

APPENDIX

Traffic Operational Analyses Report

FM 407 Traffic Operational Analysis Report

From West of FM 156 to FM 1830 in Denton County, TX

Contract No.: 36-7IDP5033, Work Authorization No. 1
CSJ: 1310-01-045

June 2020

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APPENDIX C - Diagrammatic by Civil Associates, Inc. (May 2020)

APPENDIX D - Traffic Volume Exhibits

APPENDIX E - Detailed Synchro Outputs – Existing Year 2018

APPENDIX F - Detailed Synchro Outputs – Year 2045 No Build

APPENDIX G - Detailed Synchro Outputs – Year 2045 Build

1. Executive Summary

The Texas Department of Transportation (TxDOT) is recommending improvements, via an FM 407 Feasibility Study, to an approximately 13-mile segment on FM 407 in Denton County, TX (CSJ: 1310-01-045). The primary goals for these improvements are to improve the daily travel conditions along FM 407, such as the traffic operations, mobility, and reliability. This report summarizes Traffic Operational Level of Service (LOS) analysis of the proposed roadway configurations of FM 407 at seven (7) study area intersections within the study limits. Civil Associates, Inc. has developed a diagrammatic conceptual solution (May 2020) for the recommended improvements to the corridor. This report will provide Civil Associates, Inc. with the evaluation of the diagrammatic conceptual solution (May 2020) and necessary documentation for submittal to the TxDOT Dallas District Office.

The scope of this study is to perform traffic operational analysis along FM 407 within the study limits for the base year 2018 Existing Conditions using year 2018 AM and PM peak hour traffic volumes collected in the field, as well as for the projected peak hour traffic volumes design year 2045 No Build Conditions and design year 2045 Build Conditions. The intersection operational analysis was conducted using AM and PM peak hour traffic volumes for the base year 2018 Existing Conditions, design year 2045 No Build Conditions and design year 2045 Build Conditions. One (1) unsignalized intersections and six (6) signalized intersections were analyzed in the Existing Conditions and (2) unsignalized intersections and (6) signalized were analyzed in the design year 2045 No Build Conditions. Twelve (12) signalized intersections were analyzed in the design year 2045 Build Conditions. The basic intersection alignment and intersection layout of the recommended route were obtained from Civil Associates, Inc.

The Level of Service (LOS) analysis indicated that during the base year 2018 Existing Conditions, the intersections at the existing study area operate at LOS E and F for the following movements:

1. FM 407/Downe Rd at FM 156
    - Signalized approach (NBLTR) experiences significant delays during PM peak hours.
2. FM 407/E. 5th St at FM 156
    - Signalized approach (WBLTR) experiences significant delays during PM peak hours.
3. FM 407 at I-35W SBFR
    - Signalized approaches (WBL and WBT) experience significant delays during AM and PM peak hours.
4. FM 407 at I-35W NBFR
    - Signalized approaches (WBR and NBL) experience significant delays during AM and PM peak hours.
5. FM 407 at US 377
    - Signalized approaches (EBTR, WBL, and SBT) experience significant delays during AM and PM peak hours.

The Level of Service (LOS) analysis indicated that during the design year 2045 No Build Conditions, several intersections continue to operate at LOS E or F:

1. FM 407 at Boss Range Rd
    - Unsignalized approach (NBL) experiences significant delays during AM and PM peak hours.
2. FM 407/Downe Rd at FM 156
    - Signalized approaches (EBL, EBTR, WBLTR, and NBL) experience significant delays during AM and PM peak hours.
3. FM 407/E. 5th St at FM 156
    - Signalized approaches (WBLTR, NBT, NBR, and SBL) experience significant delays during AM and PM peak hours.
4. FM 407 at Cleveland Gibbs Rd
    - Unsignalized approaches (EBL, NBLTR, and SBLTR) experience significant delays during AM and PM peak hours.
5. FM 407 at I-35W SBFR
    - Signalized approaches (EBT, WBL, WBT, SBL, and SBTR) experience significant delays during AM and PM peak hours.
6. FM 407 at I-35W NBFR
    - Signalized approaches (EBL, EBT, WBT, WBR, NBL, and NBTR) experience significant delays during AM and PM peak hours.
7. FM 407 at US 377
    - Signalized approaches (EBL, EBTR, WBL, WBT, WBR, NBL, NBT, NBR, SBL, SBT, and SBR) experience significant delays during AM and PM peak hours.
8. FM 407 at FM 1830
    - Signalized approaches (EBL, EBTR, WBT, WBR, NBL, NBTR, SBL, and SBTR) experience significant delays during AM and PM peak hours.

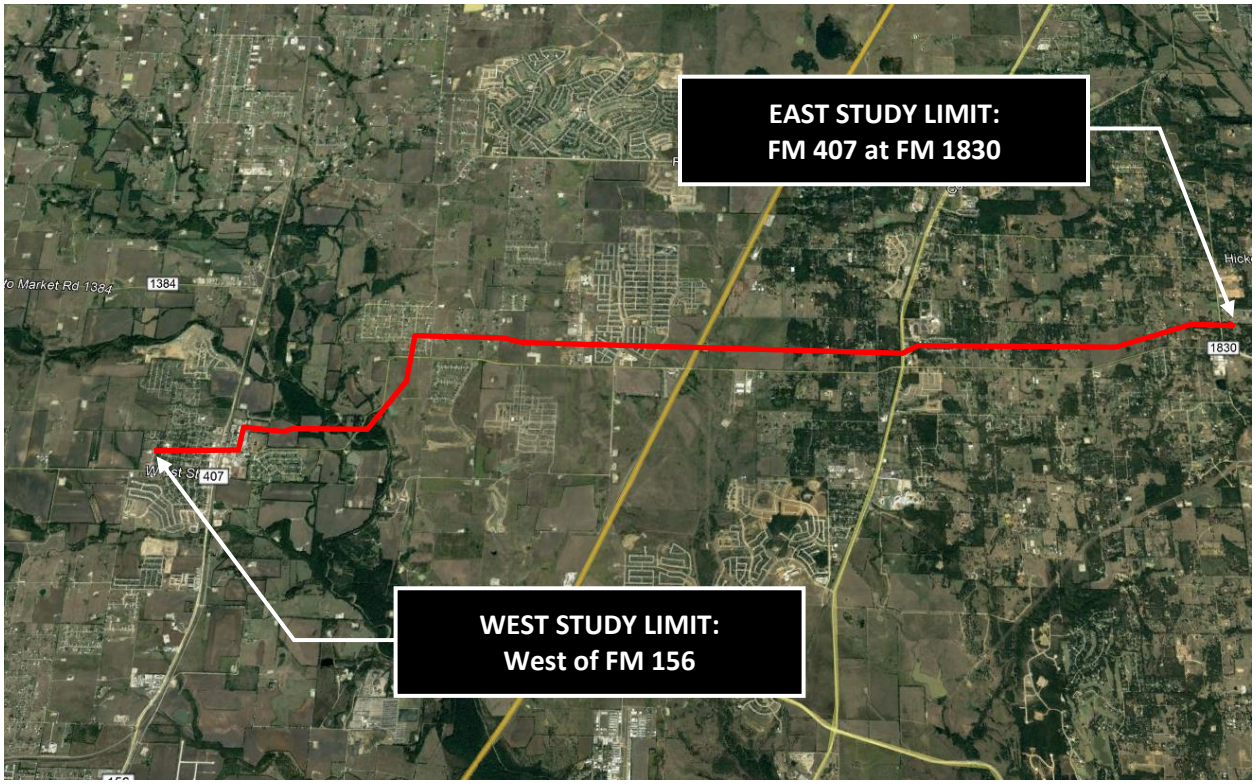
The Level of Service (LOS) analysis indicated that during the design year 2045 Build Conditions, all intersections operate at LOS D or better with the study's recommended Build improvements.

The stated purpose of this study is to improve the daily travel conditions on FM 407, such as the traffic operations, mobility, and reliability, by reducing conflicting traffic movements and accommodating future (year 2045) traffic volumes. The recommended improvements reduce traffic conflicts on FM 407 by placing signals at every intersection and increasing the number of lanes on FM 407 to six lanes in the project corridor.

2. Introduction

The Texas Department of Transportation (TxDOT) is recommending improvements, via an FM 407 Feasibility Study, to an approximately 13-mile segment on FM 407 in Denton County, TX (CSJ: 1310-01-045). The primary goals for these improvements are to improve the daily travel conditions along FM 407, such as the traffic operations, mobility, and reliability. Civil Associates, Inc. has developed a diagrammatic conceptual solution for the recommended improvements to the corridor. The recommended improvements will reduce traffic conflict on FM 407 by increasing the number of lanes on FM 407 to six lanes and placing signals at every intersection. This report summarizes the traffic analysis performed to evaluate the recommended configuration of the intersections within the study limits. The Study Location Map in **Figure 1** shows the limits for the traffic analysis and the major cross streets that are the part of the corridor. This report evaluates the proposed new route and intersection layouts shown on the diagrammatic, includes recommended intersection geometry, and will provide necessary documentation for submittal to the TxDOT Dallas District Office.

Figure 1: FM 407 Study Limits for Traffic Analysis



Source: Background map obtained from Google Earth

3. Scope & Methodology

The purpose of this study is to perform traffic operational analysis associated with the recommended improvement of an approximately 13-mile segment on FM 407 for the base year 2018 Existing Conditions using year 2018 traffic volumes collected in the field and design year 2045 No Build Conditions and design year 2045 Build Conditions using the projected traffic volumes provided by the TxDOT Transportation Planning and Programming Division (TP&P) from the traffic package dated March 16, 2018. The No Build and Build traffic projections from TP&P are provided in **Appendix A**. The base year 2018 traffic volumes were obtained from the traffic data collected along the existing FM 407 corridor in May 2018. The peak volumes used in this analysis were derived from the existing collected traffic data.

The intersection operational analysis was conducted using AM and PM peak hour traffic volumes for the base year 2018 Existing Conditions and projected traffic volumes for design year 2045 No Build Conditions and design year 2045 Build Conditions. The intersection Level of Service (LOS) analysis was specifically conducted at the following intersections:

1. FM 407 & Boss Range Rd
2. FM 407/Downe Rd & FM 156
3. FM 407/E. 5th St & FM 156
4. FM 407 & Cleveland Gibbs Rd
5. FM 407 & I-35W SBFR
6. FM 407 & I-35W NBFR
7. FM 407 & US 377
8. FM 407 & FM 1830

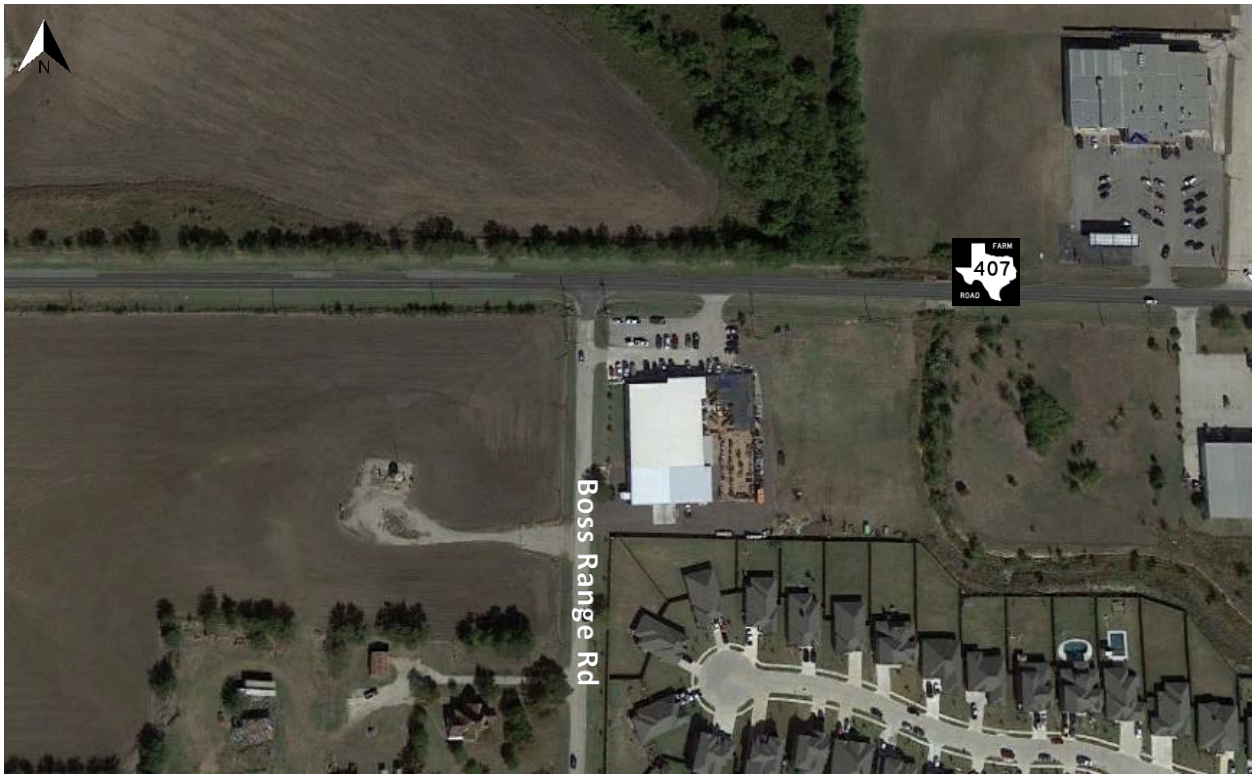
3.1 Existing Intersection Geometry

Intersection operational analysis was performed for the base year 2018 Existing Conditions using the existing intersection geometry, obtained from aerial photographs (Google Earth). Existing lane geometry exhibits are provided in **Appendix B** and a description of the lane configuration of each intersection within the study limits is listed below.

FM 407 & Boss Range Rd **(Figure 2)**

- This intersection is a three-leg unsignalized intersection. The eastbound approach has one lane with one shared through-right lane. The westbound approach has one lane with one shared left-through lane. The northbound approach has one lane with one shared left-right lane.

Figure 2: FM 407 & Boss Range Rd



FM 407/Downe Rd & FM 156 (

Figure 3)

- This under construction intersection is a four-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one shared through-right lane. The westbound approach has one lane with one shared left-through-right lane. The northbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane. The southbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane.

Figure 3: FM 407/Downe Rd & FM 156

FM 407/E. 5th St & FM 156 **(Figure 4)**

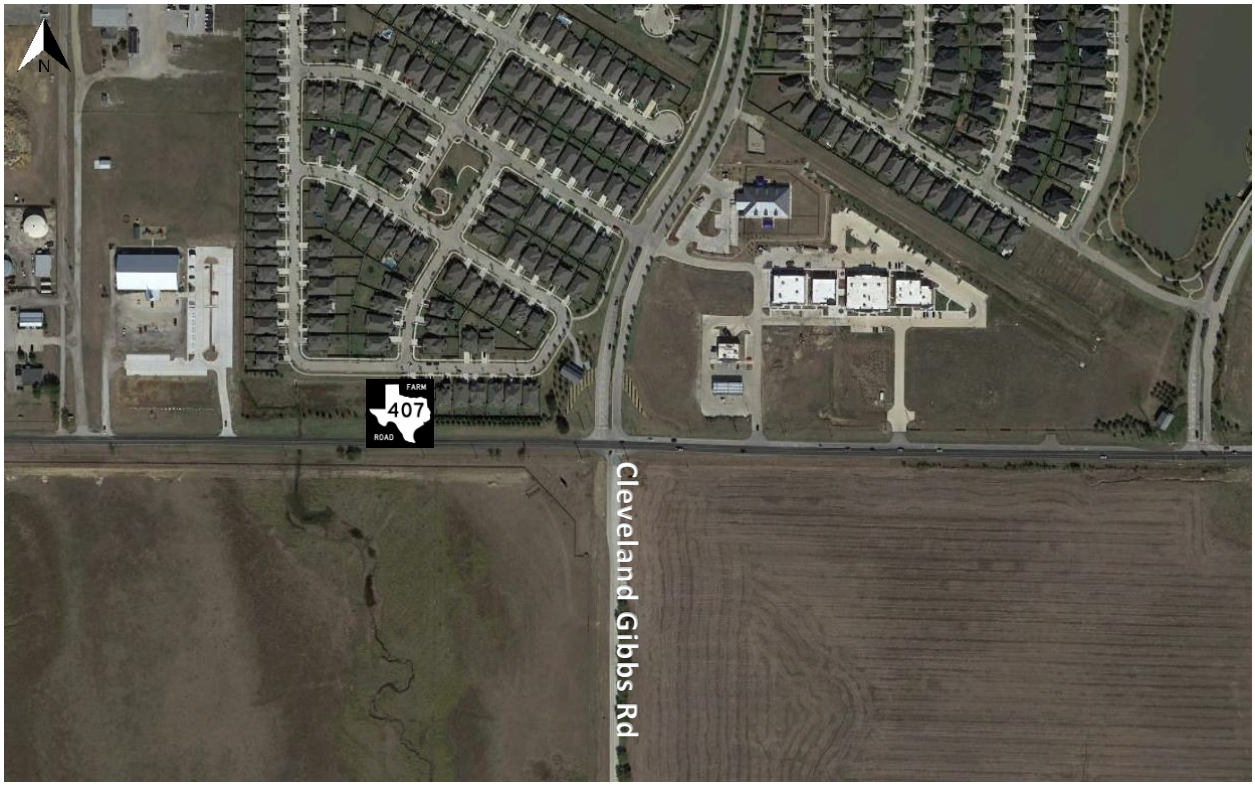
- This intersection is a four-leg signalized intersection. The eastbound approach has one lane with one shared left-through-right lane. The westbound approach has one lane with one shared left-through-right lane. The northbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane. The southbound approach has four lanes with one dedicated left turn lane, two through lanes, and one shared through-right lane. Construction is currently ongoing at this intersection.

Figure 4: FM 407/E. 5th St & FM 156

FM 407 & Cleveland Gibbs Rd (***Figure 5***)

- This intersection is a four-leg unsignalized intersection. The eastbound approach has one lane with one shared left-through-right lane. The westbound approach has two lanes with one shared left-through lane and one dedicated right turn lane. The northbound approach has two lanes with one dedicated left turn lane and one through-right lane. The southbound approach has two lanes with one shared left-through lane and one dedicated right turn lane.

Figure 5: FM 407 & Cleveland Gibbs Rd



FM 407 & I-35W SBFR **(Figure 6)**

- This intersection is a four-leg signalized intersection. The eastbound approach has two lanes with one through lane and one dedicated right turn lane. The westbound approach has two lanes with one dedicated left turn lane and one through lane. The southbound approach has two lanes with one dedicated left turn lane and one shared through-right lane.

FM 407 & I-35W NBFR **(Figure 6)**

- This intersection is a four-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one through lane. The westbound approach has two lanes with one through lane and one dedicated right turn lane. The northbound approach has two lanes with one dedicated left turn lane and one shared through-right lane. The southbound approach has one lane with one shared left-right lane.

Figure 6: FM 407 & I-35W

FM 407 & US 377 **(Figure 7)**

- This intersection is a four-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one shared through-right lane. The westbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane. The northbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane. The southbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane.

Figure 7: FM 407 & US 377

FM 407 & FM 1830 **(Figure 8)**

- This intersection is a four-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one shared through-right lane. The westbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane. The northbound approach has two lanes with one dedicated left turn lane and one shared through-right lane. The southbound approach has two lanes with one dedicated left turn lane and one shared through-right lane.

Figure 8: FM 407 & FM 1830

3.2 Recommended Roadway Improvements

The Build Conditions included analysis of the recommended intersection improvements. The basic alignment and intersection layouts used in the analysis were obtained from the diagrammatic prepared by Civil Associates, Inc. The diagrammatic (May 2020) is included in **Appendix C** for reference. The recommended geometry for the main lanes and the intersection approaches was evaluated using the Build scenario traffic volumes for design year 2045.

4. Traffic Operational Analysis

For the purposes of the traffic operational analysis for the design year 2045 No Build and design year 2045 Build Conditions, ADT volumes obtained from the traffic data collection were converted to AM and PM peak hour volumes based on the directional design hour volumes (DDHV) method. The *Highway Capacity Manual 6 (HCM6)* provides an equation (ref. Equation 3-1, *HCM6)* to calculate DDHV using the annual average daily traffic (AADT), the K-factor (the proportion of AADT occurring in the design hour) and the directional distribution "D". This equation is shown below. [NOTE: The AADT in this equation is the total of both directions of traffic.]

DDHV = AADT * K * D * 2

The values of AADT were taken from the design year 2045 projected traffic volumes. Since the study AADT volumes were one-way, the AADT volumes in the above equations were multiplied by 2. The values of AADT, K (11.1) and D (54%/46%) were obtained from TP&P package dated March 16, 2018 **(Appendix A)**. The directional distribution factor (54%) was applied accordingly to all turning movement volumes. Exhibits summarizing the base year 2018 AM and PM peak hour turning movement volumes and design year 2045 AM and PM peak hour volumes used in this analysis are provided in **Appendix D**.

The following technical parameters were also used in this analysis for No Build and Build Conditions:

- Peak hour factors (PHF) = 0.92
- Truck Percentage = 8.0% (obtained from TP&P package)

4.1 Intersection Operational Analysis

FM 407 is currently a two-lane, undivided highway within the study limits. The purpose of this analysis was to evaluate the recommended intersection geometry shown on the diagrammatic prepared by Civil Associates, Inc. (May 2020). Existing geometry was assumed as a base geometry for the design year (2045) Existing Conditions. The recommended geometry was assumed as a base geometry for the design year 2045 Build Conditions analysis. The study area intersections were evaluated based upon the **HCM6** methodology using the **Synchro 10** software.

Traffic operational conditions for stop-controlled ("unsignalized") roadway intersections are quantitatively measured in terms of average delay per vehicle in a one-hour period through the intersection as a function of roadway capacity and operational characteristics of the traffic signal. The standardized methodology applied herein was developed by the **Transportation Research Board** as presented in the *HCM6*. *HCM6* also qualitatively rates the overall delay conditions in terms of "Level of Service" (LOS) ranging from "A" (free-flowing conditions) to "F" (over-capacity conditions). Generally, *LOS D* or better is considered an acceptable condition for signalized intersections in urban and suburban conditions. The LOS thresholds for signalized intersection are summarized in **Table 1**.

Table 1. Signalized Intersection Capacity Thresholds
(Obtained from Exhibit 19-8 of HCM6)

Control Delay (s/veh)	LOS
≤ 10	A
> 10-20	B
> 20-35	C
> 35-55	D
> 55-80	E
> 80	F

NOTE: According to *HCM6*, the above thresholds characterize the LOS for overall intersection or an approach. For a lane group LOS, both control delay and volume-to-capacity (v/c) ratios are evaluated.

The standard methodology for measuring the operational conditions of Two-Way-Stop-Controlled (TWSC) and All-Way-Stop-Controlled (AWSC) intersection capacity was also developed by the **Transportation Research Board** and presented in the *HCM6*. These operational conditions are also qualitatively defined in terms of LOS ranging from "A" to "F" and are quantitatively measured in terms of average delay per vehicle in a one-hour period. LOS for unsignalized AWSC locations are measured for both the approaches and the entire intersection, however, LOS for unsignalized TWSC locations is only calculated for individual traffic movements that must stop or yield right-of-way. The LOS thresholds for unsignalized TWSC and AWSC intersection are summarized in **Table 2** and **Table 3**, respectively.

Table 2. Unsignalized (Two-Way-Stop-Controlled) Intersection Capacity Thresholds
(Obtained from Exhibit 20-2 of HCM6)

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
0 – 10	A	F
> 10-15	B	F
> 15-25	C	F
> 25-35	D	F
> 35-50	E	F
> 50	F	F

NOTE: According to HCM6, the above thresholds apply to each lane on a given approach and each approach on a minor street. LOS is not calculated for major-street approaches or for the entire intersection.

Table 3. Unsignalized (All-Way-Stop-Controlled) Intersection Capacity Thresholds
(Obtained from Exhibit 21-8 of HCM6)

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
0 – 10	A	F
> 10-15	B	F
> 15-25	C	F
> 25-35	D	F
> 35-50	E	F
> 50	F	F

NOTE: According to HCM6, for approaches and intersectionwide assessment, LOS is defined solely by control delay.

In order to evaluate the impact of the recommended improvements, the following scenarios were analyzed in this study:

- Base Year (2018) Existing Conditions (Existing Geometry)
- Design Year (2045) No Build Conditions (No Build Geometry)
- Design Year (2045) Build Conditions (Recommended Geometry)

4.1.1 Base Year Existing Conditions

Traffic volumes for the base year 2018 Existing Conditions were collected in May 2018. Base year 2018 AM and PM peak hour volumes exhibits are provided in **Appendix D** and the existing intersection geometry is provided in **Appendix B**. All the study area intersections within study limits are currently signalized except for FM 407 at Boss Range Rd and FM 407 at Cleveland Gibbs Rd. The following technical parameters were used in this analysis:

- Peak hour factors (PHF) = 0.92
- Truck Percentage = Variable based on existing year 2018 collected traffic data. Truck Percentage values range from 2.0-50.0%. *(Note: Individual turning movements with very low volumes may have disproportionately high truck percentages).*

Table 4 summarizes the results of the peak hour intersection analysis during the base year 2018 Existing Conditions. It should be noted that data was not collected for Cleveland Gibbs Rd for the base year 2018 since it was not included in the initial project scope, therefore it is not included in **Table 4.** Detailed software outputs are included in **Appendix E**. As shown in **Table 4**, the existing (May 2018) study area intersections operate at LOS E or F for the following movements:

1. FM 407/Downe Rd at FM 156
    - Signalized approach (NBLTR) experiences significant delays during PM peak hours.

2. FM 407/E. 5th St at FM 156
    - Signalized approach (WBLTR) experiences significant delays during PM peak hours.
3. FM 407 at I-35W SBFR
    - Signalized approaches (WBL and WBT) experience significant delays during AM and PM peak hours.
4. FM 407 at I-35W NBFR
    - Signalized approaches (WBR and NBL) experience significant delays during AM and PM peak hours
5. FM 407 at US 377
    - Signalized approaches (EBTR, WBL, and SBT) experience significant delays during AM and PM peak hours.

Table 4. Peak Hour Intersection Analysis Results (Year 2018 Existing Conditions)

Intersection	Movement	Existing 2018 AM		Existing 2018 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
FM 407 at Boss Range Rd *[Unsignalized]*[3]	WBLT	A	8.9	A	7.8
	NBLR	C	22.4	B	11.7
FM 407/Downe Rd at FM 156 *[Signalized]*[1]	***Overall***	***B***	***17.7***	***F***	***>100.0***
	EBLTR	C	34.4	D	42.6
	WBLTR	A	0	A	0
	NBLTR	B	10.3	F	>100.0
	SBLTR	B	10.2	A	4.8
FM 407/E. 5th St at FM 156 *[Signalized]*[1]	***Overall***	***B***	***17.0***	***F***	***>100.0***
	EBLTR	C	22.5	C	29.1
	WBLTR	D	38.7	F	>100.0
	NBLTR	A	7.8	A	2.3
	SBLTR	B	10.1	A	6.9
FM 407 at I-35W SBFR *[Signalized]*[2]	***Overall***	***C***	***33.7***	***D***	***39.5***
	EBT	D	38.2	C	25.4
	EBR	C	23.3	B	19.4
	WBL	E	59.3	C	26.8
	WBT	C	23.3	E	78.6
	SBL	C	27.5	C	21.9
	SBTR	C	24.1	C	20.5
FM 407 at I-35W NBFR *[Signalized]*[2]	***Overall***	***C***	***32.7***	***D***	***40.5***
	EBL	C	27.6	D	36.9
	EBT	C	23.5	B	15.0
	WBT	C	26.0	D	41.8

Intersection	Movement	Existing 2018 AM		Existing 2018 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
	WBR	D	35.6	F	94.9
	NBL	E	63.0	D	41.6
	NBTR	C	26.2	C	20.3
	SBLR	C	23.2	B	18.2
FM 407 at US 377	***Overall***	***E***	***55.1***	***D***	***36.9***
[Signalized]	EBL	C	23.7	C	34.2
	EBTR	D	38.6	E	69.9
	WBL	E	69.5	C	30.2
	WBT	C	30.3	C	27.9
	WBR	C	27.2	B	16.3
	NBL	C	23.3	C	26.9
	NBT	C	33.7	D	44.3
	NBR	B	20.0	C	24.7
	SBL	C	30.1	D	50.2
	SBT	F	>100.0	C	26.2
	SBR	B	16.3	C	22.5
FM 407 at FM 1830	***Overall***	***C***	***25.3***	***D***	***37.2***
[Signalized]	EBL	B	16.7	D	41.8
	EBTR	C	27.7	C	29.6
	WBL	B	17.9	C	28.4
	WBT	C	24.6	D	38.3
	WBR	C	21.2	D	48.6
	NBL	C	27.5	C	32.6
	NBTR	C	29.8	C	31.6
	SBL	C	23.8	C	31.1
	SBTR	C	30.1	C	26.1

NOTES:

NB, SB, EB, WB = North-, South-, East-, Westbound Intersection Approach

L, T, R = Left, Through, Right, Intersection Approach Turning Movement

(1) -Perm+Prot left-turn type from a share lane intersections not supported by HCM6 methodology. LOS shown in table were obtained from HCM 2000 Intersection Analysis methodology.

(2) -Clustered intersections not supported by HCM6 methodology. LOS shown in table were obtained from HCM 2000 Intersection Analysis methodology.

(3) = Two way stop controlled (TWSC) Intersection

4.1.2 Design Year No Build Conditions

The No Build alternative maintains the existing geometry at all study area intersections on the FM 407 corridor. AM and PM peak hour volumes used in this analysis were derived from the projected year 2045 volumes obtained from year ADT traffic volume projections **(Appendix D)**. Exhibits summarizing AM and PM peak hour volumes for design year 2045 No Build Conditions are included in **Appendix D** and were evaluated using the No Build Geometry **(Appendix B)**. The following technical parameters were used in this analysis:

- Peak hour factors (PHF) = 0.92
- Truck Percentage= 8.0% (obtained from TP&P package)
- K Factor = 11.1 (obtained from TP&P package)
- Directional Distribution percentage (D) = 54% (obtained from TP&P package)

Information regarding proposed developments along the project corridor have been received from City of Justin and Hillwood Communities and traffic projections have been reconciled to ensure projected growth in traffic volumes from adjacent development projects. The following adjustments have been made to the 2045 No Build traffic projections using trip generation from the proposed developments within or adjacent to the project:

- Petrus Development
  - 4,600 bidirectional trips added to FM 407
  - 2,300 bidirectional trips added to Boss Range Rd
- Petrus Industrial Development
  - 13,600 bidirectional trips added to FM 156
- Timberbrook Development
  - 4,400 bidirectional trips added to FM 156
- The Highlands Development
  - 2,100 bidirectional trips added to FM 407
- Pecan Square Development
  - 8,400 bidirectional trips added to FM 407
  - 14,000 bidirectional trips added to Cleveland Gibbs Rd
- Harvest Development
  - 23,500 bidirectional trips added to Cleveland Gibbs Rd
  - 3,400 bidirectional trips added to I-35W SBFR
- Indian Springs Development
  - 1,500 bidirectional trips added to I-35W NBFR
- Canyon Falls Development
  - 4,000 bidirectional trips added to I-35W NBFR
  - 6,000 bidirectional trips added to FM 407
- Argyle at Avalon Development
  - 5,300 bidirectional trips added to FM 407

- Heath Track Development
    - 6,600 bidirectional trips added to FM 407
- Waterbrook Development
    - 3,000 bidirectional trips added to US 377
    - 4,400 bidirectional trips added to FM 407

Table 5 summarizes the results of the design hourly intersection analysis for the design year 2045 No Build Conditions. Detailed software outputs are included in **Appendix F**. As shown in **Table 5**, several of the study area intersections operate at LOS E or F during the design year 2045 No Build Conditions:

1. FM 407 at Boss Range Rd
    - Unsignalized approach (NBL) experiences significant delays during AM and PM peak hours.
2. FM 407/Downe Rd at FM 156
    - Signalized approaches (EBL, EBTR, WBLTR, and NBL) experience significant delays during AM and PM peak hours.
3. FM 407/E. 5th St at FM 156
    - Signalized approaches (WBLTR, NBT, NBR, and SBL) experience significant delays during AM and PM peak hours.
4. FM 407 at Cleveland Gibbs Rd
    - Unsignalized approaches (EBL, NBLTR, and SBLTR) experience significant delays during AM and PM peak hours.
5. FM 407 at I-35W SBFR
    - Signalized approaches (EBT, WBL, WBT, SBL, and SBTR) experience significant delays during AM and PM peak hours.
6. FM 407 at I-35W NBFR
    - Signalized approaches (EBL, EBT, WBT, WBR, NBL, and NBTR) experience significant delays during AM and PM peak hours.
7. FM 407 at US 377
    - Signalized approaches (EBL, EBTR, WBL, WBT, WBR, NBL, NBT, NBR, SBL, SBT, and SBR) experience significant delays during AM and PM peak hours.
8. FM 407 at FM 1830
    - Signalized approaches (EBL, EBTR, WBT, WBR, NBL, NBTR, SBL, and SBTR) experience significant delays during AM and PM peak hours.

Table 5. Peak Hour Intersection Analysis Results (Year 2045 No Build Conditions)

Intersection	Movement	No Build 2045 AM		No Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
FM 407 at Boss Range Rd	WBL	B	11.9	B	11.3
[Unsignalized][2]	NBL	F	>100.0	F	>100.0
FM 407/Downe Rd at FM 156	***Overall***	***D***	***53.7***	***E***	***62.9***
[Signalized]	EBL	F	>100.0	F	>100.0
	EBTR	F	88.0	C	27.4
	WBLTR	F	87.3	B	19.4
	NBL	F	>100.0	F	>100.0
	NBT	B	16.1	C	20.3
	NBR	B	11.1	B	11.8
	SBL	A	8.8	B	17.3
	SBTR	C	31.9	D	39.5
FM 407/E. 5th St at FM 156	***Overall***	***F***	***>100.0***	***F***	***>100.0***
[Signalized]	EBLTR	B	17.5	B	17.1
	WBLTR	F	>100.0	F	>100.0
	NBL	D	35.8	C	29.0
	NBT	F	>100.0	F	>100.0
	NBR	F	>100.0	F	>100.0
	SBL	F	>100.0	F	>100.0
	SBT	C	34.5	C	30.8
	SBR	D	36.9	C	33.0
FM 407 at Cleveland Gibbs Rd	EBL	D	26.1	F	63.9
[Unsignalized]	WBL	C	24.7	B	14.4
	NBLTR	F	>100.0	F	>100.0
	SBLTR	F	>100.0	F	99.8
FM 407 at I-35W SBFR	***Overall***	***F***	***>100.0***	***F***	***>100.0***
[Signalized][1]	EBT	F	>100.0	D	47.7
	EBR	C	30.7	C	20.6
	WBL	F	>100.0	F	>100.0
	WBT	F	>100.0	F	>100.0
	SBL	F	>100.0	F	>100.0
	SBTR	F	>100.0	F	>100.0
FM 407 at I-35W NBFR	***Overall***	***F***	***>100.0***	***F***	***>100.0***
[Signalized][1]	EBL	F	>100.0	F	>100.0
	EBT	F	>100.0	D	52.4
	WBT	F	>100.0	F	>100.0

Intersection	Movement	No Build 2045 AM		No Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
	WBR	F	>100.0	F	>100.0
	NBL	E	75.3	F	>100.0
	NBTR	F	>100.0	F	>100.0
	SBLR	C	26.5	C	32.6
FM 407 at US 377	***Overall***	***F***	***>100.0***	***F***	***>100.0***
[Signalized]	EBL	F	>100.0	F	>100.0
	EBTR	F	>100.0	F	>100.0
	WBL	F	>100.0	F	>100.0
	WBT	F	>100.0	F	>100.0
	WBR	D	36.7	E	55.3
	NBL	F	>100.0	F	>100.0
	NBT	F	>100.0	F	>100.0
	NBR	F	97.8	D	53.7
	SBL	F	>100.0	F	>100.0
	SBT	F	>100.0	F	>100.0
	SBR	F	>100.0	F	>100.0
FM 407 at FM 1830	***Overall***	***F***	***>100.0***	***F***	***>100.0***
[Signalized]	EBL	F	>100.0	F	>100.0
	EBTR	F	>100.0	F	>100.0
	WBL	D	40.4	D	39.6
	WBT	F	>100.0	F	>100.0
	WBR	E	56.4	F	86.3
	NBL	E	59.5	E	59.9
	NBTR	E	68.7	E	68.1
	SBL	F	>100.0	F	>100.0
	SBTR	F	>100.0	F	>100.0

NOTES:

NB, SB, EB, WB = North-, South-, East-, Westbound Intersection Approach

L, T, R = Left, Through, Right, Intersection Approach Turning Movement

(1) -Clustered intersections not supported by HCM6 methodology. LOS shown in table were obtained from HCM 2000 Intersection Analysis methodology.

(2) = Two way stop controlled (TWSC) Intersection

4.1.3 Recommended Intersection Geometry

Intersection operational analysis was performed for the Build Condition using the recommended route and intersection layouts, obtained from the FM 407 diagrammatic (May 2020) prepared by Civil Associates, Inc., included in **Appendix C**. The recommended basic geometry and intersection layouts can be found in the exhibits from **Appendix B**. The entire project corridor is recommended to be six-lane urban section with a

raised median. The recommended geometry with a description of the lane configuration of each intersection within the study limits is listed below:

Recommended FM 407 (12th St) at Boss Range Rd

- This intersection is a three-leg signalized intersection. The westbound approach has two lanes with one dedicated left turn lane and one dedicated right turn lane. The northbound approach has four lanes with three through lanes and one dedicated right turn lane. The southbound approach has four lanes with one dedicated left turn lane and three through lanes.

FM 407 & Boss Range Rd

- This intersection is a three-leg signalized intersection. The westbound approach has two lanes with one dedicated left turn lane and one dedicated right turn lane. The northbound approach has two lanes with one through lane and one dedicated right turn lane. The southbound approach has one dedicated left turn lane and one through lane.

FM 407/Downe Rd & FM 156

- This intersection is a four-leg signalized intersection. The eastbound approach has four lanes with one dedicated left turn lane, one through lane, and two dedicated right turn lanes. The westbound approach has two lanes with one shared left-through lane and one shared through-right lane. The northbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane. The southbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane.

FM 407/E. 5th St & FM 156

- This intersection is a four-leg signalized intersection. The eastbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane. The westbound approach has four lanes with two dedicated left turn lanes, one through lane, and one dedicated right. The northbound approach has four lanes with one dedicated left turn lane, two through lanes, and one dedicated right turn lane. The southbound approach has five lanes with two dedicated left turn lanes, two through lanes, and one dedicated right turn lane.

Recommended FM 407 (12th St) WB Ramp at FM 156

- This intersection is a three-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one dedicated right turn lane. The northbound approach has three lanes with one dedicated left turn lane and two through lanes. The southbound approach has three lanes with two through lanes and one dedicated right turn lane. All the recommended FM 407 travel lanes will overpass FM 156 and the BNSF RR, which is located east of FM 156.

Recommended FM 407 (12th St) EB Ramp at FM 156

- This intersection is a three-leg signalized intersection. The eastbound approach has two lanes with one dedicated left turn lane and one dedicated right turn lane. The northbound approach has three lanes with one dedicated left turn lane and two through lanes. The southbound approach has three lanes with two through lanes and one dedicated right turn lane. All the recommended FM 407 travel lanes will overpass FM 156 and the BNSF RR, which is located east of FM 156.

Recommended FM 407 at FM 407

- This intersection is a three-leg signalized intersection. The eastbound approach has four lanes with two through lanes, one shared through-right lane, and one dedicated right turn lane. The westbound approach has four lanes with one dedicated left turn lane and three through lanes. The northbound approach has two lanes with one dedicated left turn lane and one dedicated right turn lane.

FM 407 & Cleveland Gibbs Rd

- This intersection is a four-leg signalized intersection. The eastbound approach has five lanes with one dedicated left turn lane, two through lanes, one shared through-right lane, and one dedicated right turn lane. The westbound approach has six lanes with two dedicated left turn lanes, three through lanes, and one dedicated right turn lane. The northbound approach has six lanes with two dedicated left turn lanes, two through lanes, and two dedicated right turn lanes. The southbound approach has six lanes with two dedicated left turn lanes, two through lanes, and two dedicated right turn lanes.

FM 407 & I-35W SBFR

- This intersection is a four-leg signalized intersection. The eastbound approach has six lanes with four through lanes and two dedicated right turn lanes. The westbound approach has six lanes with two dedicated left turn lanes and four through lanes. The southbound approach has four lanes with two dedicated right turn lanes, one through lane, and one dedicated right turn lane.

FM 407 & I-35W NBFR

- This intersection is a four-leg signalized intersection. The eastbound approach has six lanes with two dedicated left turn lanes and four through lanes. The westbound approach has six lanes with four through lanes and two dedicated right turn lanes. The northbound approach has six lanes with two dedicated left turn lanes, two through lanes, and two dedicated right turn lanes.

FM 407 & US 377

- This intersection is a four-leg signalized intersection. The eastbound approach has six lanes with two dedicated left turn lanes, three through lanes, and one dedicated right turn lane. The westbound approach has six lanes with two dedicated left turn lanes, three through lanes, and one dedicated right turn lane. The northbound approach has seven lanes with two dedicated left turn lanes, three through lanes, and two dedicated right turn lanes. The southbound approach has seven lanes with two dedicated left turn lanes, three through lanes, and two dedicated right turn lanes. All the

recommended FM 407 travel lanes will merge with US 377 at-grade, as well as cross the UP RR, which is located west of US 377.

FM 407 & FM 1830

- This intersection is a four-leg signalized intersection. The eastbound approach has six lanes with two dedicated left turn lanes, three through lanes, and one dedicated right turn lane. The westbound approach has six lanes with one dedicated left turn lane, three through lanes, and two dedicated right turn lanes. The northbound approach has three lanes with one dedicated left turn lane, one through lane, and one dedicated right turn lane. The southbound approach has four lanes with two dedicated left turn lanes, one through lane, and one dedicated right turn lane.

4.1.4 Design Year Build Conditions

FM 407 has been recommended to be widened to a six-lane urban (curb and gutter) section with a raised median. The recommended intersection geometry described in the prior section of this report has been analyzed as the Build Condition. The AM and PM peak hour volumes for the design year 2045 were derived from the year 2045 ADT volumes from traffic volume projections **(Appendix D)**. Exhibits summarizing AM and PM peak hour volumes for design year 2045 Build Conditions are included in **Appendix D** and were evaluated using the No Build Geometry **(Appendix B)**. The following technical parameters were used in this analysis:

- Peak hour factors (PHF) = 0.92
- Truck Percentage= 8.0% (obtained from TP&P package)
- K Factor = 11.1 (obtained from TP&P package)
- Directional Distribution percentage (D) = 54% (obtained from TP&P package)

Information regarding proposed developments along the project corridor have been received from City of Justin and Hillwood Communities and traffic projections have been reconciled to ensure projected growth in traffic volumes from adjacent development projects. The following adjustments have been made to the 2045 Build traffic projections using trip generation from the proposed developments within or adjacent to the project:

- Petrus Development
    - 4,600 bidirectional trips added to FM 407
    - 2,300 bidirectional trips added to Boss Range Rd
- Petrus Industrial Development
    - 13,600 bidirectional trips added to FM 156
- Timberbrook Development
    - 4,400 bidirectional trips added to FM 156
- The Highlands Development
    - 2,100 bidirectional trips added to FM 407

- Pecan Square Development
    - 8,400 bidirectional trips added to FM 407
    - 14,000 bidirectional trips added to Cleveland Gibbs Rd
- Harvest Development
    - 23,500 bidirectional trips added to Cleveland Gibbs Rd
    - 3,400 bidirectional trips added to I-35W SBFR
- Indian Springs Development
    - 1,500 bidirectional trips added to I-35W NBFR
- Canyon Falls Development
    - 4,000 bidirectional trips added to I-35W NBFR
    - 6,000 bidirectional trips added to FM 407
- Argyle at Avalon Development
    - 5,300 bidirectional trips added to FM 407
- Heath Track Development
    - 6,600 bidirectional trips added to FM 407
- Waterbrook Development
    - 3,000 bidirectional trips added to US 377
    - 4,400 bidirectional trips added to FM 407

Table 6 summarizes the results of the peak hour intersection analysis for the design year 2045 Build Condition. Detailed software outputs are included in **Appendix G**. As shown in **Table 6**, all study area intersection movements operate at LOS D or better with the study's recommended Build improvements.

Table 6. Peak Hour Intersection Analysis Results (Year 2045 Build Conditions)

Intersection	Movement	Build 2045 AM		Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
Recommended FM 407 (12th St) at Boss Range Rd *[Signalized]*[1]	***Overall***	***C***	***16.1***	***B***	***12.2***
	WBL	C	29.4	C	22.2
	WBR	C	24.2	B	16.0
	NBT	B	19.9	B	12.0
	NBR	C	20.8	B	13.0
	SBL	A	5.0	A	6.5
	SBT	A	4.0	A	5.8
FM 407 at Boss Range Rd *[Signalized]*	***Overall***	***C***	***21.5***	***C***	***27.2***
	WBL	B	19.1	B	16.5
	WBR	C	26.8	D	41.7
	NBT	A	6.7	A	8.5
	NBR	A	8.2	B	10.2
	SBL	C	29.9	C	32.0

Intersection	Movement	Build 2045 AM		Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
	SBT	A	6.5	A	8.2
FM 407/Downe Rd at FM 156 *[Signalized]*	***Overall***	***C***	***31.3***	***C***	***28.8***
	EBL	C	34.5	D	53.7
	EBT	C	24.0	C	22.6
	EBR	D	37.8	C	26.2
	WBLTR	C	24.3	C	22.9
	NBL	C	33.6	B	15.0
	NBT	D	36.5	C	34.9
	NBR	B	18.9	B	16.3
	SBL	C	31.4	C	25.4
	SBT	B	19.4	B	17.9
	SBR	A	0.0	A	0.0
FM 407/E. 5th St at FM 156 *[Signalized]*	***Overall***	***C***	***29.6***	***C***	***26.4***
	EBL	C	23.9	C	23.0
	EBT	C	26.7	C	25.5
	EBR	B	11.2	B	11.0
	WBL	D	40.9	D	39.5
	WBT	C	23.2	C	22.7
	WBR	D	38.2	D	39.6
	NBL	B	19.8	B	19.3
	NBT	B	17.0	C	20.3
	NBR	D	37.2	C	21.7
	SBL	C	31.6	C	24.9
	SBT	C	23.6	C	22.3
	SBR	A	9.7	A	9.7
Recommended FM 407 (12th St) WB Ramp at FM 156 *[Signalized]*	***Overall***	***C***	***31.6***	***C***	***21.4***
	EBL	C	53.0	D	41.6
	EBR	D	36.0	C	25.4
	NBL	D	43.9	C	30.6
	NBT	B	12.2	B	12.4
	SBT	D	40.8	C	25.3
	SBR	A	3.4	A	3.4
Recommended FM 407 (12th St) EB Ramp at FM 156 *[Signalized]*	***Overall***	***B***	***13.5***	***B***	***11.9***
	EBL	C	34.1	D	35.1
	EBR	C	25.6	C	26.8
	NBL	C	23.4	B	16.7

Intersection	Movement	Build 2045 AM		Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
	NBT	A	4.5	A	0.4
	SBT	B	11.5	B	13.2
	SBR	B	13.8	B	15.2
Recommended FM 407 at FM 407 *[Signalized]*[1]	***Overall***	***C***	***30.4***	***C***	***22.3***
	EBTT	C	30.6	C	22.6
	EBR	C	27.3	C	22.0
	WBL	C	28.0	D	44.3
	WBT	B	15.6	B	13.5
	NBL	B	14.7	B	12.3
	NBR	D	50.7	C	26.5
FM 407 at Cleveland Gibbs Rd *[Signalized]*	***Overall***	***D***	***40.1***	***D***	***37.2***
	EBL	C	30.3	C	30.6
	EBT	D	37.3	C	32.7
	EBR	D	50.7	D	35.7
	WBL	D	51.1	D	49.3
	WBT	C	23.6	C	23.8
	NBL	D	53.3	D	53.4
	NBT	D	37.1	C	33.6
	NBR	D	52.9	D	37.3
	SBL	C	27.5	C	22.6
	SBT	C	26.1	C	27.1
	SBR	D	50.2	D	54.1
FM 407 at I-35W SBFR *[Signalized]*[1]	***Overall***	***C***	***33.2***	***C***	***33.4***
	EBT	C	27.4	C	21.0
	EBR	C	33.9	C	30.8
	WBL	D	51.1	D	48.2
	WBT	C	32.9	C	33.3
	SBL	D	36.0	D	46.7
	SBT	C	26.6	C	32.9
	SBR	C	29.4	D	35.2
FM 407 at I-35W NBFR *[Signalized]*[1]	***Overall***	***D***	***39.5***	***D***	***42.1***
	EBL	D	54.4	D	53.8
	EBT	C	29.9	B	19.4
	WBT	C	34.2	D	38.7
	WBR	D	39.7	D	51.3
	NBL	C	32.0	D	53.7

Intersection	Movement	Build 2045 AM		Build 2045 PM	
		LOS	*Delay (s/veh)*	*LOS*	*Delay (s/veh)*
	NBT	C	29.2	D	38.4
	NBR	D	54.2	D	46.9
FM 407 at US 377 *[Signalized]*	***Overall***	***D***	***35.6***	***D***	***37.5***
	EBL	C	21.5	D	52.6
	EBT	D	41.8	C	26.3
	EBR	C	32.7	C	30.2
	WBL	D	39.7	C	33.4
	WBT	C	26.7	D	36.1
	WBR	D	36.7	D	47.7
	NBL	D	45.3	D	52.3
	NBT	C	32.8	D	35.7
	NBR	C	32.7	C	30.8
	SBL	C	24.6	C	27.7
	SBT	D	40.6	D	37.1
	SBR	D	41.8	D	44.2
FM 407 at FM 1830 *[Signalized]*	***Overall***	***C***	***28.9***	***C***	***33.1***
	EBL	C	32.9	D	45.8
	EBT	C	26.3	C	21.3
	EBR	B	12.9	B	14.9
	WBL	C	22.9	B	19.1
	WBT	C	25.6	D	42.9
	WBR	A	5.7	B	11.9
	NBL	D	51.6	D	51.7
	NBT	D	50.9	D	52.5
	NBR	D	47.6	D	46.1
	SBL	D	49.0	C	33.6
	SBT	C	30.4	C	27.3
	SBR	D	53.1	D	54.9

NOTES:

NB, SB, EB, WB = North-, South-, East-, Westbound Intersection Approach

L, T, R = Left, Through, Right, Intersection Approach Turning Movement

(1) -Clustered intersections and Non-NEMA phasing not supported by HCM6 methodology. LOS shown in table were obtained from HCM 2000 Intersection Analysis methodology.

5. Conclusion

The Texas Department of Transportation (TxDOT) is recommending improvements, via an FM 407 Feasibility Study, to an approximately 13-mile segment on FM 407 in Denton County, TX (CSJ: 1310-01-045). The primary goals for these improvements are to improve the daily travel conditions along FM 407, such as the traffic operations, mobility, and reliability. This report summarizes Traffic Operational Level of Service (LOS) analysis of the proposed roadway configurations of FM 407 at seven (7) study area intersections within the study limits. Civil Associates, Inc. has developed a diagrammatic conceptual solution (May 2020) for the recommended improvements to the corridor. This report will provide Civil Associates, Inc. with the evaluation of the diagrammatic conceptual solution (May 2020) and necessary documentation for submittal to the TxDOT Dallas District Office.

The scope of this study is to perform traffic operational analysis along FM 407 within the study limits for the base year 2018 Existing Conditions using year 2018 AM and PM peak hour traffic volumes collected in the field, as well as for the projected peak hour traffic volumes design year 2045 No Build Conditions and design year 2045 Build Conditions. The intersection operational analysis was conducted using AM and PM peak hour traffic volumes for the base year 2018 Existing Conditions, design year 2045 No Build Conditions and design year 2045 Build Conditions. One (1) unsignalized intersections and six (6) signalized intersections were analyzed in the Existing Conditions and (2) unsignalized intersections and (6) signalized were analyzed in the design year 2045 No Build Conditions. Twelve (12) signalized intersections were analyzed in the design year 2045 Build Conditions. The basic intersection alignment and intersection layout of the recommended diagrammatic route were obtained from Civil Associates, Inc.

The Level of Service (LOS) analysis indicated that during the base year 2018 Existing Conditions, the intersections at the existing study area operate at LOS E and F for the following movements:

1. FM 407/Downe Rd at FM 156
    - Signalized approach (NBLTR) experiences significant delays during PM peak hours.
2. FM 407/E. 5th St at FM 156
    - Signalized approach (WBLTR) experiences significant delays during PM peak hours.
3. FM 407 at I-35W SBFR
    - Signalized approaches (WBL and WBT) experience significant delays during AM and PM peak hours.
4. FM 407 at I-35W NBFR
    - Signalized approaches (WBR and NBL) experience significant delays during AM and PM peak hours.
5. FM 407 at US 377
    - Signalized approaches (EBTR, WBL, and SBT) experience significant delays during AM and PM peak hours.

The Level of Service (LOS) analysis indicated that during the design year 2045 No Build Conditions, several intersections continue to operate at LOS E or F:

1. FM 407 at Boss Range Rd
    - Unsignalized approach (NBL) experiences significant delays during AM and PM peak hours.
2. FM 407/Downe Rd at FM 156
    - Signalized approaches (EBL, EBTR, WBLTR, and NBL) experience significant delays during AM and PM peak hours.
3. FM 407/E. 5th St at FM 156
    - Signalized approaches (WBLTR, NBT, NBR, and SBL) experience significant delays during AM and PM peak hours.
4. FM 407 at Cleveland Gibbs Rd
    - Unsignalized approaches (EBL, NBLTR, and SBLTR) experience significant delays during AM and PM peak hours.
5. FM 407 at I-35W SBFR
    - Signalized approaches (EBT, WBL, WBT, SBL, and SBTR) experience significant delays during AM and PM peak hours.
6. FM 407 at I-35W NBFR
    - Signalized approaches (EBL, EBT, WBT, WBR, NBL, and NBTR) experience significant delays during AM and PM peak hours.
7. FM 407 at US 377
    - Signalized approaches (EBL, EBTR, WBL, WBT, WBR, NBL, NBT, NBR, SBL, SBT, and SBR) experience significant delays during AM and PM peak hours.
8. FM 407 at FM 1830
    - Signalized approaches (EBL, EBTR, WBT, WBR, NBL, NBTR, SBL, and SBTR) experience significant delays during AM and PM peak hours.

The Level of Service (LOS) analysis indicated that during the design year 2045 Build Conditions, all intersections operate at LOS D or better with the improvements recommended by TxDOT's FM 407 Feasibility Study.

The stated purpose of this study is to improve the daily travel conditions on FM 407, such as the traffic operations, mobility, and reliability, by reducing conflicting traffic movements and accommodating future (year 2045) traffic volumes. The recommended improvements reduce traffic conflicts on FM 407 by placing signals at every intersection and increasing the number of lanes on FM 407 to six lanes in the project corridor.

Appendix A
TP&P Traffic Package

Texas Department of Transportation

MEMO

March 16, 2018

To: James K. Selman, P.E., District Engineer
Attention: Ceason C. Clemens, P.E., Director of TPD

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

From: Bruce R. Uphaus
Planner, TPP

Subject: Traffic Data
CSJ: 1310-01-045
FM 407:
From West of FM 156
To FM 1830

Denton County

Attached is a corridor analysis package for the defined limits of the route.

Please refer to your original memorandum dated February 20, 2018.

If you have any questions or need additional information, please contact Bruce R. Uphaus at (512) 486-5104.

Attachments

CC: Godfrey Sendawula, Transportation Specialist, Dallas District

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN (Option C)

Dallas District **December 9, 2019**

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 407 Section 1 From West of FM 156 To West of I-35W Denton County	7,900	11,000	54 - 46	11.1	3.3	2.5	10,600	60	963,000	3	1,273,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	96.7	97.5
Medium Duty	1.4	1.1
Heavy Duty	1.9	1.4

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 407 Section 1 From West of FM 156 To West of I-35W Denton County	7,900	12,300	54 - 46	11.1	3.3	2.5	10,700	60	1,545,000	3	2,041,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN (Option C)

Dallas District **December 9, 2019**

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 407 Section 2 From West of I-35W To FM 1830 Denton County	19,800	27,300	54 - 46	11.1	2.6	2.0	10,900	40	1,495,000	3	1,818,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	97.4	98.0
Medium Duty	1.4	1.1
Heavy Duty	1.2	0.9

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 407 Section 2 From West of I-35W To FM 1830 Denton County	19,800	30,500	54 - 46	11.1	2.6	2.0	10,900	40	2,394,000	3	2,913,000	8"

Texas Department of Transportation

MEMO

February 20, 2018

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

From: Dan Perge, P.E.
Dallas District, Advance Project Development

Subject: Traffic Analysis Packet Request
CSJ: 1310-01-045
FM 407
From West of FM 156 to FM 1830

Denton County

Attached please find traffic data request form and a location map for the above subject project. Please provide our office with a Consultant Corridor Information Packet. If any additional information is needed, please contact Godfrey Sendawula at (214)320-6266.

Attachments

RECEIVED TPP
0093 FEB21 18

Request for Traffic Data

Form 2124
(Rev. 09/16)
Page 1 of 1

Date: 02/16/2018

District: DALLAS **County:** DENTON **CSJ:** 1310-01-045

Highway: FM 407

Limits: W of FM 156 to FM 1830

Texas Reference Marker System

From Marker: 558 From Displacement: +0.000 From DFO: 8.401

To Marker: 570 To Displacement: +0.593 To DFO: 21.032

Is it in the UTP: ☒ Yes ☐ No District Priority: Est. Letting Date: 10/01/2019

Existing Number of Lanes: 2

Proposed Number of Lanes: 6

District Contact Person: Stephen Endres, P.E.

Phone Number: 214-320-4469

Please attach an 8-1/2" x 11" location map and make note of any existing or proposed development that will be a traffic generator. NOTE:

The following to be completed (Please mark information to be provided):

RECEIVED
FEB 21 2018
BY TPP

☒ 1. Basic Highway Traffic Data for pavement design
(No line diagram analysis required)
- A. Base year/ Beginning year: 2025
- B. Forecasted 20 year: 2045
- C. Forecasted 30 year: 2055
- D. Directional Distribution
- E. K-factor
- F. Percent Trucks ADT/DHV
- G. Average Ten Heaviest Wheel Loads (ATHWLD)
- H. Percent Tandem Axles in the ATHWLD
- I. One Directional cumulative 18 KSA at the end of the 20 years/30 years
- J. Slab Thickness (8" unless otherwise specified):
- K. Structural Number (3 unless otherwise specified):

☒ 2. Vehicle classification for environmental studies (Air and Noise Analysis)

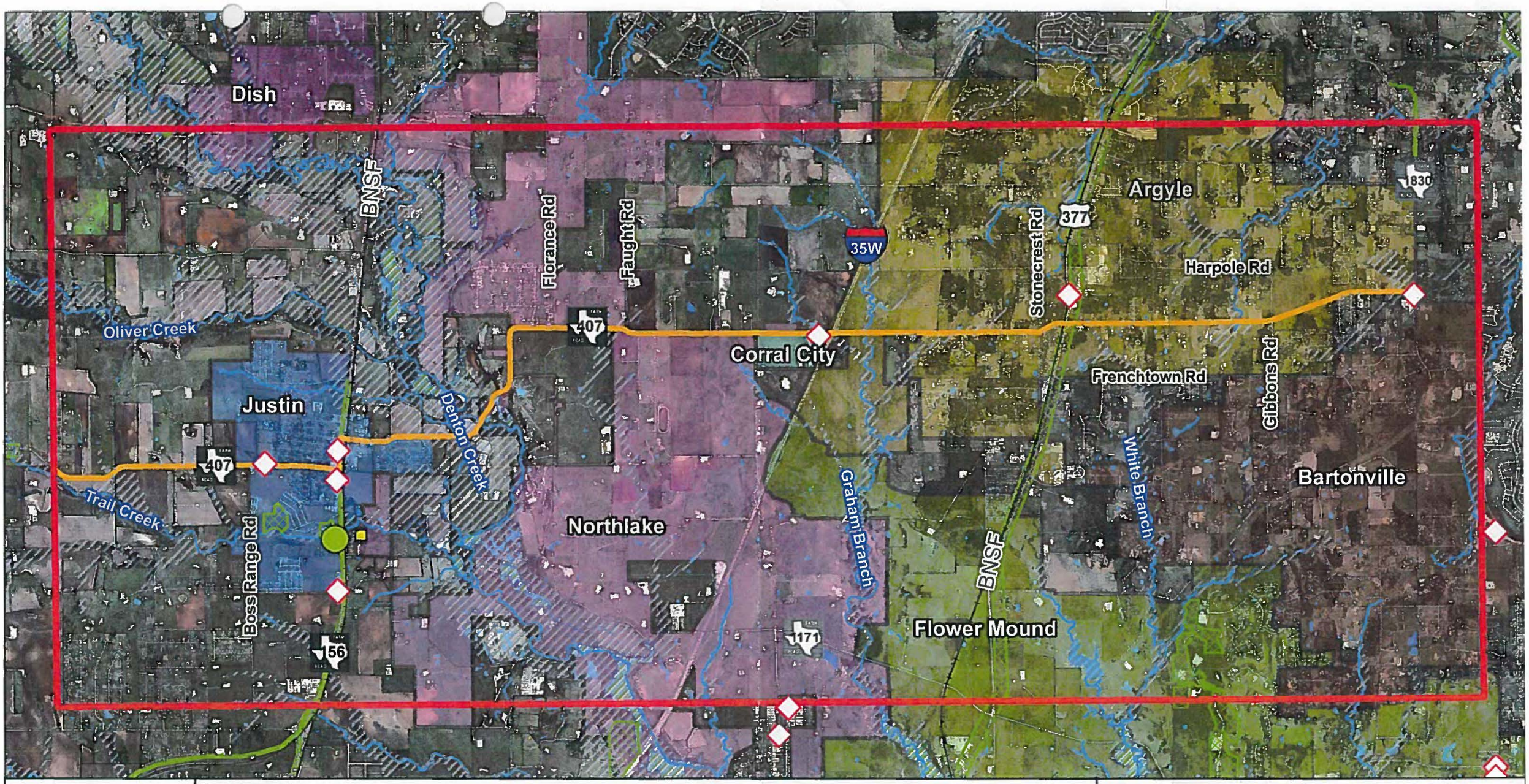
☐ 3. Line diagram analysis (straight line turning movements; please provide line diagram).

☐ 4. Complete Corridor Analysis (includes basic highway traffic data for pavement design, environmental studies and detailed schematic turning movements; *please provide detailed schematic*).

☒ 5. Consultant Corridor Information Packet

☐ 6. No build traffic analysis.
- ☐ EA
- ☐ EIS
- ☐ EA/EIS Reevaluation

Note: If complete corridor analysis is requested, please attach a traffic schematic diagram.



N
W E
S
0 4,200 Feet

Legend

- Existing FM 407 Alignment to FM 1830
- Study Area
- PST (TCEQ)
- Historical Marker (THC)
- Archeo Project Area (THC)
- Cemetery (THC)
- Wetland (USFWS)
- Pond/Lake (USFWS)
- Stream (USCB)
- Railroad (DOT)

Preliminary Constraints Map
FM 407

1310-01-045

From West of FM 156
To FM 1830
Denton County, TX

Texas Department of Transportation

MEMO

March 6, 2018

To: James K. Selman, P.E.
Attention: Ceason G. Clemens, P.E

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

Subject: Traffic Data Request

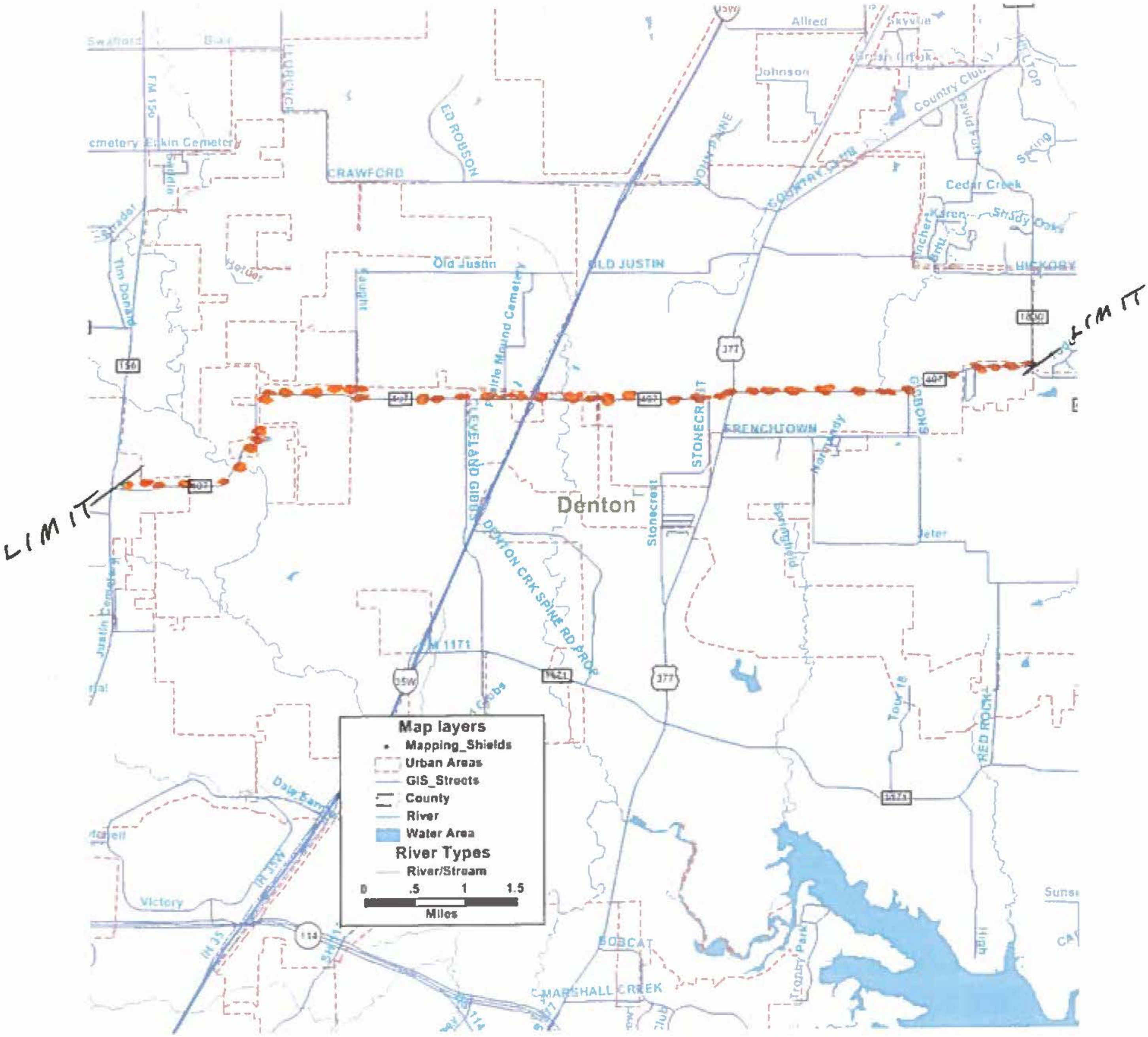
The Transportation Planning and Programming Division received the following request February 21, 2018

Request Date: February 21, 2018

CSJ: 1310-01-045

Highway/Limits:
FM 407/W of FM 156 to FM 1830

The project will be entered into our Project Priority List at the priority level requested by the district. If no priority was indicated in your request, this project will be entered as your district's last priority. You will be contacted by a member of our staff if additional information is needed.

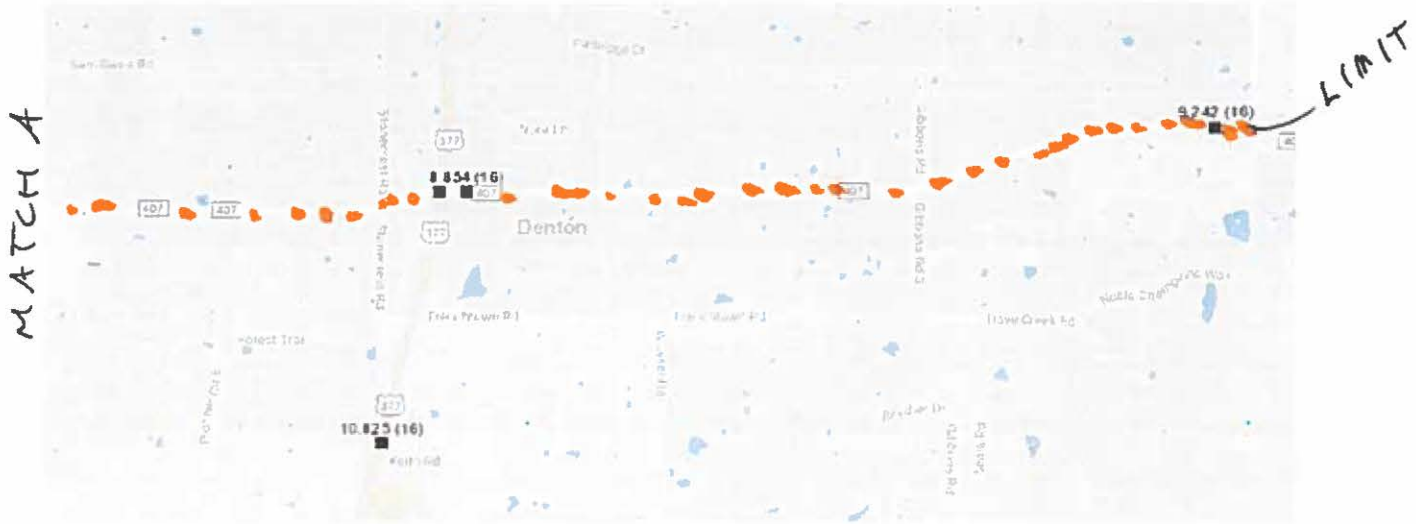


Project Location Map

2016 District Traffic Map, FM 407 at FM 156

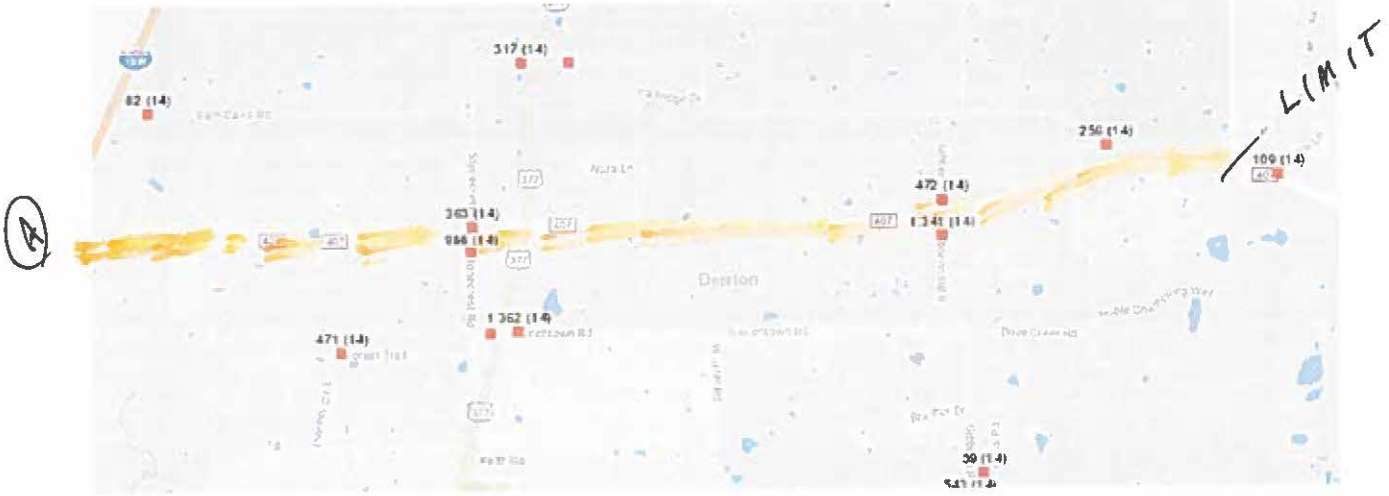
2016 District Traffic Map, FM 407 at FM 1830

2016 STARS II District Traffic Map at FM 156 limit



2016 STARS II District Traffic Map at FM 1830 limit

2014 Urban Saturation Map at western limit



2014 Urban Saturation Map at eastern limit

Corridor Analysis Worksheet: 2 Sections, 2 Forecast Years, Air & Noise

Project	FM 407			District	Dallas
Rd Type	FM			County	Denton
Direction	Two-Way			CSJ	1310-01-045
Limits	From West of FM 158 to FM 1830				
Section 1				Analyst	bru
Limits					
Section 2					
Limits					

Date: Request	2/20/2018	Received	2/21/2018	Started	3/13/2018	Completed	3/14/2018
District Contact	Godfery Sendawula				Phone #	214/320-6266	

	Year	ADT's			% Trks ADT		% Trks DHV	
Count	2016	6610	9242		11.2	10.6	8.4	8
Base	2025	8000	11200	# Trks	896	1187		
Forecast	2045	11000	15300	DRAFT				
Forecast	2055	12300	17200	PROJECTIONS				

SPR Station	S 77	MC Stn	M 935	% Trks	18.06	
Year	2016	Dir	SW leg	Num Trks	353	
Peak Hour	16.8	Year	2016	Axle Factor	2.81	
DD	54	ADT	1955	% Single Axles	0.45	
100-DD	46					
K-Factor	11.1					

TDM Assignment							
Main Road Growth Rate	2.4						
Growth Rate after 20 Years	2.0				LOD		
20 Year G.F.	Sectn 1	1.875	Sectn 2	1.830	Design Period	20	
30 Year G.F.	Sectn 1	1.792	Sectn 2	1.786	Design Period	30	

				# Lanes	
Structural Number (SN)	3			Existing	2
Slab Thickness (ST)	8			Proposed	6

Past Projects	
Project	FM 407
From	At Denton Creek
To	
Date	7/31/2015
County	Denton
CSJ	1310-01-027

Items Done on This Project

Straight Line Turning Movements		Detailed Schematic Turning Movements	
Traffic Analysis for Highway Design	X	Field Trip	
Vehicle Mix		Travel Demand Model Used	
Manual Count Worksheet			

NOTES:

INPUT DATA FOR KIPS: AUTOMATIC

SN, ST	3, 8							
Section	Section 1		Section 2					
Des. Yr.	1st Yr	2nd Yr	1st Yr	2nd Yr				
Year 1	25	25	25	25				
Year 2	45	55	45	55				
ADT	8000	8000	11200	11200				
% Trks	11.2	11.2	10.6	10.6				
GR	1.875	1.792	1.830	1.786				
Years	20	30	20	30				
FacilType	C	C	C	C				
S.N.	3	3	3	3				
SLAB	8	8	8	8				
WeightSta	0	0	0	0				
A.F.	2.81	2.81	2.81	2.81				
S.A.	0.45	0.45	0.45	0.45				

DATA CALCULATIONS FOR USE IN AIR & NOISE ANALYSIS

FHWA Format Vehicle Class. Counts		
Light Duty Vehicles	Motorcycles	1
	Passenger	912
	Pickup or Van	689
Single Units	Buses	3
	Other 2 Axle	58
	3 Axles	7
	4 Axles or more	0
Truck Combs.	3-4 Axles	20
	5 Axles	258
	6 Axles or more	6
Semi-Trailer-Trailer	5 Axles or less	0
	6 Axles	0
	7 Axles or more	1

	Number	%
Light	1602	81.9
Medium	71	3.6
Heavy	282	14.4
Trucks	353	18.1

SECTION 1

FM

	ADT	DHV
Light	88.8	91.6
Medium	2.2	1.7
Heavy	9	6.7

SECTION 2

FM

	ADT	DHV
Light	89.4	92
Medium	2.1	1.6
Heavy	8.5	6.4

Total Vehicles	1955
Total Trucks	353
Total Singles	446.0
Total Tandems	547.0
AXLE FACTOR	2.81
SINGLE AX FACT	0.45

INPUT DATA FOR KIPS: AUTOMATIC

SN, ST				
Section				
Design Year				
Year 1				
Year 2				
ADT				
% Trks				
Growth Rate				
Years				
Facil Type				
S.N.				
SLAB				
WeightSta				
Axle Factor				
Single Axle				

OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST	3, 8			
Section	Section 1		Section 2	
Design Year	1st Yr	2nd Yr	1st Yr	2nd Yr
ATHWLD				
%T in ATHWLD				
FLEXIBLE				
RIGID				

OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST								
Section								
Design Year								
ATHWLD								
% T in ATHWLD								
FLEXIBLE								
RIGID								

TRAFFIC VOLUME REGRESSION WORKSHEET

March 13, 2018

PROJECT: FM 407
LIMITS: From FM 156 To FM 1830
District: Dallas
County: Denton
CSJ: 1310-01-045

ROUTE		FM 407		FM 407		FM 407		FM 407		FM 407		FM 407
LOCATION		T 37		H 119		H 118		H 107		H 106		H 88
1996		3100		2600		2600		2500		2500		2500
1997		2900		2800		2700		2800		2700		2700
1998		3800		3700		3900		3400		2600		2900
1999		4400		3500		3700		3900		3900		3900
2000		4700		3900		4000		4000		4500		4200
2001		4600		3800		4400		4000		4400		4100
2002		4600		3900		4500		4300		4900		4800
2003		5400		4900		4800		5200		5200		5500
2004		5300		4800		4400		5500		6500		6000
2005		5500		4520		5070		5350		5280		6650
2006		5400		4500		5600		5700		5900		7300
2007		5900		4800		5500		7600		8500		8500
2008		4600		4000		4900		6200		7300		7300
2009		5200		4400		4500		6100		8000		7500
2010		4800		4200		5000		7000		8800		8200
2011		5200		4200		5200		7500		11000		10000
2012		5300		4400		5600		7500		9800		9600
2013		5001		4456		5943		6675		8192		8174
2014		4877		4030		5462		7278		9715		9524
2015		3928		3446		5542		6578		8466		8763
2016		4173		3876		6182		6610		8854		9242
	Regr01	Regr02	Regr03	Regr04	Regr05	Regr06	Regr07	Regr08	Regr09	Regr10	Regr11	Regr12
Low Linear Annual Growth Rate		0.1%		0.1%		1.3%		1.8%		2.2%		2.2%
Forecast Lnr. An. Grwth Rate	☐	1.0% ☑	☐	0.9% ☑	☐	2.2% ☑	☐	3.0% ☑	☐	3.7% ☑	☐	3.7% ☑
High Linear Annual Growth Rate		1.9%		1.7%		3.2%		4.2%		5.2%		5.1%
Estimated Standard Deviation		709.93		549.78		451.16		676.59		957.63		744.81
B (Slope)		50		41		137		235		382		378
A (Intercept)		4198		3628		3365		3156		2710		2763
R=		0.401		0.417		0.884		0.907		0.926		0.953
Confidence Interval		+/- 90% CI 47		+/- 90% CI 37		+/- 90% CI 58		+/- 90% CI 98		+/- 90% CI 155		+/- 80% CI 149
	Avg. of selected Forecast Linear Annual Growth Rates:					2.4%	Avg. of all Forecast Linear Annual Growth Rates:			2.4%		
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. 2010

Enter Base Year 2020

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

Enter Model Year

Optional input: SPR Station, Yr
Optional input: K-Factor
Optional input: Dir. Dist.

Enter Earliest Variable Year 2015
Enter Latest Variable Year 2025

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	○ 1.3%
Use Avg. of Selected Forecast Growth Rates	◉ 2.4%
Use Avg. of Selected High Growth Rates	○ 3.6%
Use Avg. of All Low Growth Rates	○ 1.3%
Use Avg. of All Forecast Growth Rates	○ 2.4%
Use Avg. of All High Growth Rates	○ 3.6%
Use Highest Forecast Growth Rate	○ 3.7%
Use Lowest Forecast Growth Rate	○ 0.9%
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%

ROUTE		FM 407		FM 407		FM 407		FM 407		FM 407		FM 407
LOCATION		T 37		H 119		H 118		H 107		H 106		H 88
20/PIVOT YR AN. GROWTH RATE		2.4%		2.4%		2.4%		2.4%		2.4%		2.4%
Count Year - 2016		4173		3876		6182		6610		8854		9242
Base Year - 2020		4600		4200		6800		7200		9700		10100
Ten Year Forecast - 2030		5600		5200		8300		8800		11800		12300
Twenty Year Forecast - 2040		6500		6000		9600		10300		13800		14400
Thirty Year Forecast - 2050		7300		6800		10900		11600		15600		16300
Forty Year Forecast - 2060		8200		7600		12100		13000		17400		18100
GR Pivot Year Forecast - 2036		6200		5700		9100		9800		13100		13700
Earliest Var Yr Frcst - 2015		4100		3800		6000		6500		8600		9000
Latest Var Yr Frcst - 2025		5100		4700		7500		8000		10800		11200
Model Year Forecast - Model Traffic Assignment												
Difference of Model Yr Forecast from Model Traffic Assignment Above Difference in DDHV												
% Difference of Model Yr Forecast from Model Traffic Assignment												

Classification Report

Location ID	M935_SW	**Located On**	SH 220	**County**	Erath
Counted By			At junction of US 67	**Community**	-
Start Date	Tue 4/19/2016	**Loc On Alias**		**Station**	M935_SW
Start Time	12:00:00 AM	**Direction**	SW	**Agency**	Texas DOT
Source		**Sensor Type**		**Owner**	Stacey.Lewis
Axle Factor	0.821	**Count Status**	Accepted		
Filename	M-935.16				

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Pick up	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	TOTAL
12:00 AM	0	7	2	0	0	0	0	0	6	0	0	0	0	0	0	15
1:00 AM	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	5
2:00 AM	0	3	1	0	1	0	0	0	3	0	0	0	0	0	0	8
3:00 AM	0	5	1	0	0	0	0	0	17	0	0	0	0	0	0	23
4:00 AM	0	7	3	0	1	0	0	0	7	0	0	0	0	0	0	18
5:00 AM	0	15	12	0	2	0	0	0	8	0	0	0	0	0	0	37
6:00 AM	0	22	25	1	0	1	0	2	17	0	0	0	0	0	0	68
7:00 AM	0	40	40	0	5	0	0	1	10	0	0	0	0	0	0	96
8:00 AM	0	36	33	0	4	1	0	1	12	1	0	0	0	0	0	88
9:00 AM	0	56	38	0	9	0	0	2	20	0	0	0	0	0	0	125
10:00 AM	0	59	43	0	6	0	0	2	15	0	0	0	0	0	0	125
11:00 AM	0	74	56	0	7	0	0	0	18	5	0	0	1	0	0	161
12:00 PM	0	57	48	0	6	0	0	1	14	0	0	0	0	0	0	126
1:00 PM	1	70	46	0	2	1	0	2	15	0	0	0	0	0	0	137
2:00 PM	0	77	56	0	4	0	0	2	10	0	0	0	0	0	0	149
3:00 PM	0	87	64	0	5	3	0	2	12	0	0	0	0	0	0	173
4:00 PM	0	74	52	1	4	1	0	0	10	0	0	0	0	0	0	142
5:00 PM	0	76	59	0	1	0	0	1	14	0	0	0	0	0	0	151
6:00 PM	0	51	51	1	0	0	0	0	12	0	0	0	0	0	0	115
7:00 PM	0	29	24	0	0	0	0	0	10	0	0	0	0	0	0	63
8:00 PM	0	23	14	0	1	0	0	2	5	0	0	0	0	0	0	45
9:00 PM	0	20	13	0	0	0	0	0	7	0	0	0	0	0	0	40
10:00 PM	0	14	5	0	0	0	0	1	8	0	0	0	0	0	0	28
11:00 PM	0	9	3	0	0	0	0	1	4	0	0	0	0	0	0	17
TOTAL	1	912	689	3	58	7	0	20	258	6	0	0	1	0	0	1955

MANUAL COUNT DESIGN DATA - FHWA FORMAT

Station Number M 935 **Direction** SW leg **Year** 2016

Optional Misc. Info. (loc., etc.)

Type of Truck		Number of Trucks	Single Axles Mult.		Tandem Axle Sets Mult.	
Single Units						
Buses	4	3	2	6	0	0
2-D	5	58	2	116	0	0
3-Axle	6	7	1	7	1	7
4-Axle	7	0	1	0	1	0
Single Trailer						
3-4-Axle	8	20	2.5	50.0	0.5	10.0
5-Axle	9	258	1	258	2	516
6-Axle	10	6	1	6	2	12
Multi-Trailers						
5-Axle	11	0	5	0	0	0
6-Axle	12	0	4	0	1	0
7-Axle	13	1	3	3	2	2
Total		353		446.0		547.0

(Singles + Tandems) / Total Trucks = Axle Factor	2.81
(Singles Axles / (Singles + Tandems))	0.45

Light Duty Vehicles	Motorcycles	1
	Passenger Cars	912
	Pickup or Van	689
Single Units	Buses	3
	Other 2 Axle	58
	3 Axles	7
	4 Axles or more	0
Single Trailer	3-4 Axles	20
	5 Axles	258
	6 Axles or more	6
Multi-Trailers	5 Axles or less	0
	6 Axles	0
	7 Axles or more	1

Light	1602
Medium	71
Heavy	282
Trucks	353
Total Vehicles	1955
%T of Tot. Veh.	18.1
Num. of Trucks	353
Axle Factor	2.81
% Single Axles	0.45

Texas Department of Transportation

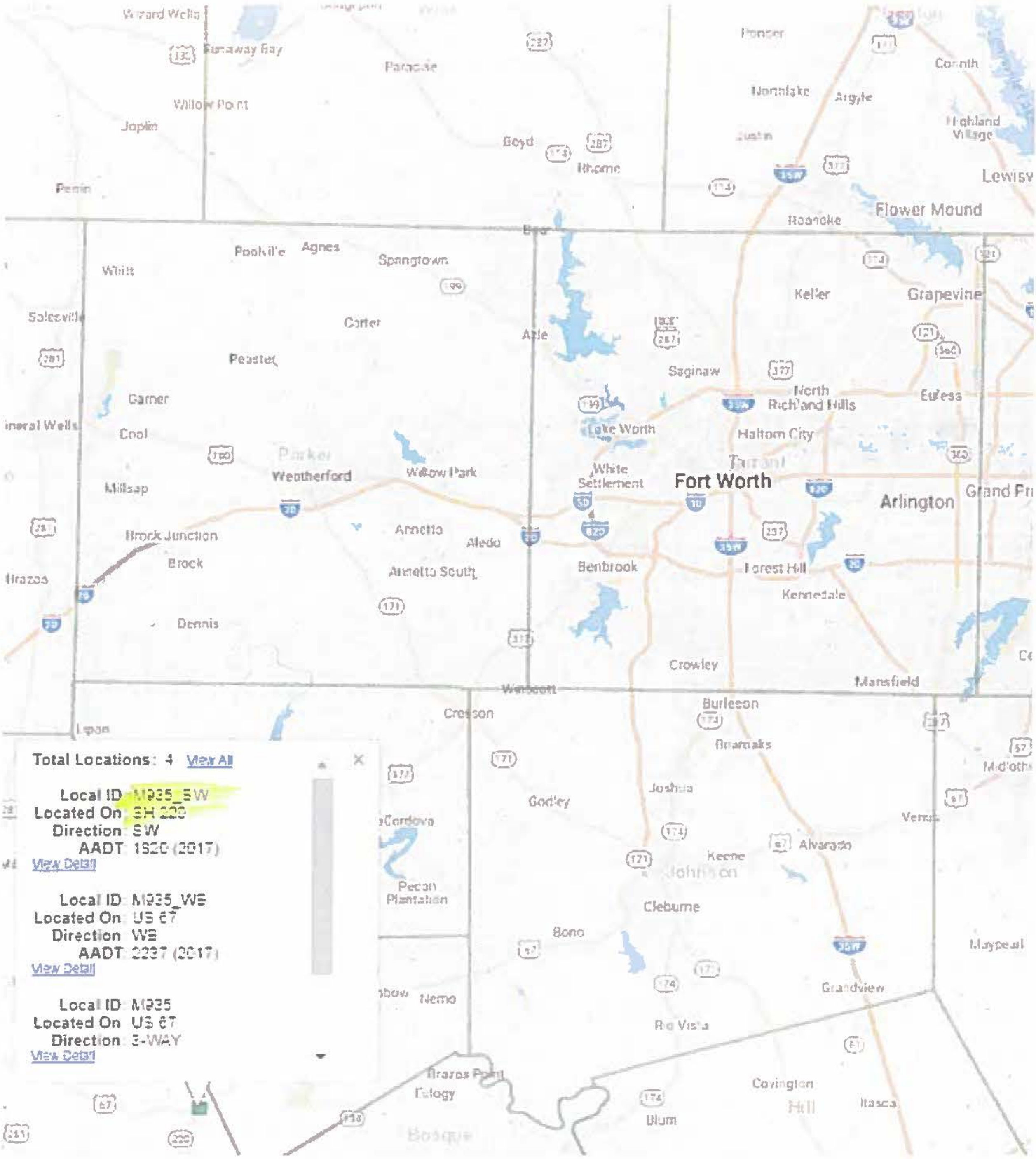
Transportation Planning and Programming Division's
Statewide Traffic Analysis and Reporting System II

High Hourly Volumes for Year for 1/1/2016 - 12/31/2016
Criteria: Location ID = s77

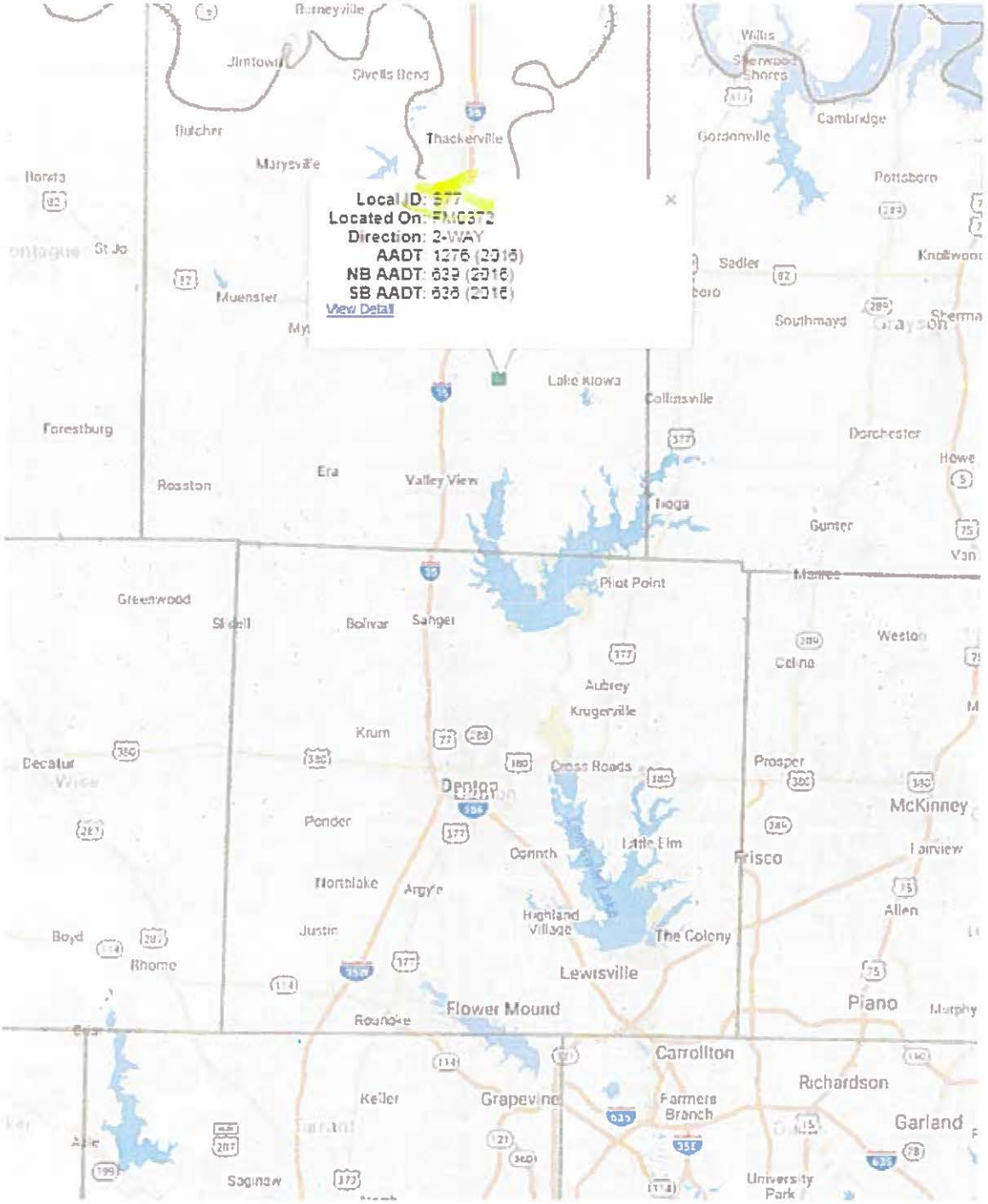
District : Wichita Falls **County :** Cooke **Community :** Gainsville
Route: 4.5 miles southeast of US0082, Gainesville **On Road:** FM0372
Location ID : S77 **Collection Type :** PERM **AADT:** 1,276
Roadbed : ML

Ordinal High Hour	Date	Day of Week	Hour	Volume	K Factor	Peak Direction	Directional Distribution
1	8/12/2016	Friday	5pm-6pm	215	16.8	SB	59
2	6/29/2016	Wednesday	5pm-6pm	175	13.7	SB	57
3	9/2/2016	Friday	2am-3am	173	13.6	NB	100
4	8/12/2016	Friday	10pm-11pm	167	13.1	SB	56
5	12/10/2016	Saturday	10am-11am	163	12.8	NB	81
6	7/27/2016	Wednesday	1pm-2pm	161	12.6	SB	61
7	3/17/2016	Thursday	10am-11am	160	12.5	NB	51
8	7/8/2016	Friday	5pm-6pm	160	12.5	SB	61
9	5/23/2016	Monday	7am-8am	158	12.4	NB	58
10	4/21/2016	Thursday	5pm-6pm	157	12.3	SB	56
20	11/9/2016	Wednesday	5pm-6pm	147	11.5	SB	65
25	2/4/2016	Thursday	5pm-6pm	144	11.3	SB	57
30	6/24/2016	Friday	5pm-6pm	142	11.1	SB	54
35	10/26/2016	Wednesday	5pm-6pm	142	11.1	SB	51
40	5/3/2016	Tuesday	5pm-6pm	139	10.9	SB	52
45	9/7/2016	Wednesday	5pm-6pm	139	10.9	SB	66
50	12/2/2016	Friday	5pm-6pm	138	10.8	SB	71
75	10/22/2016	Saturday	12pm-1pm	134	10.5	SB	51
100	3/24/2016	Thursday	5pm-6pm	130	10.2	SB	55
125	12/21/2016	Wednesday	5pm-6pm	128	10	SB	56
150	2/1/2016	Monday	5pm-6pm	124	9.7	SB	65
175	4/21/2016	Thursday	4pm-5pm	123	9.6	SB	54
200	2/5/2016	Friday	5pm-6pm	121	9.5	SB	55

This information has been prepared for internal use within the
Texas Department of Transportation.



Vehicle Class Site Location



ATR Station Site

File

Texas Department of Transportation

PAST PROJECT

MEMO

July 31, 2015

To: Stan Hall, P.E., Advance Project Development Director
Attention: Moose Saghian, P.E., Director of TPD

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

From: Robert C. Williams
Transportation Analyst, TPP

Subject: Traffic Data
CSJ: 1310-01-027
FM 407:
At Denton Creek

Denton County

Attached is a tabulation showing traffic analysis for highway design for the 2016 to 2036 twenty year period for the described limits of the route. Included is a tabulation showing data for use in air and noise analysis.

Please refer to your original memorandum dated July 24, 2015.

If you have any questions or need additional information, please contact Robert C. Williams at (512) 486-5145.

Attachment

CC: Godfrey Sendawula, Dallas District
Transportation Specialist
Design Division

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

Dallas District **July 28, 2015**

Description of Location	Average Daily Traffic 2016	Average Daily Traffic 2036	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 (2016 to 2036) Flexible Pavement	S N	Rigid Pavement	SLAB
FM 407												
At Denton Creek	4,800	7,000	60 - 40	11.1	11.9	8.9	11,000	40	1,877,000	3	2,381,000	8"
Denton County												

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	88.1	91.1
Medium Duty	6.3	4.7
Heavy Duty	5.6	4.2

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES
Registered Engineer Eric Knowles, P.E.
License Number 84704

TRAFFIC DATA REQUEST FORM

DISTRICT: Dallas **COUNTY:** Denton **CSJ:** 1310-01-027

HIGHWAY: FM 407

LIMITS: At Denton Creek

DISTRICT PRIORITY: High **EST. LETTING DATE:** February 2017

EXISTING NUMBER OF LANES: 2

PROPOSED NUMBER OF LANES: 2

DISTRICT CONTACT PERSON: Godfrey Sendawula

TELEPHONE NUMBER: 214-320-6266

PLEASE ATTACH A 8-1/2" x 11" LOCATION MAP

The following to be completed: (please mark information to be provided)

✓ **1.** Basic Highway Traffic Data for pavement design.
(No line diagram analysis required)

A. Base year / Beginning year: **2016**
B. Forecasted 20 year: **2036**
C. Forecasted 30 year:
D. Directional Distribution
E. K-factor
F. Percent Trucks ADT/DHV
G. Average Ten Heaviest Wheel Loads (ATHWLD)
H. Percent Tandem Axles in the ATHWLD
I. One directional cumulative 18 KSA at the end of the 20 years/30 years
J. Slab Thickness (8" unless otherwise specified):
K. Structural Number (3 unless otherwise specified):

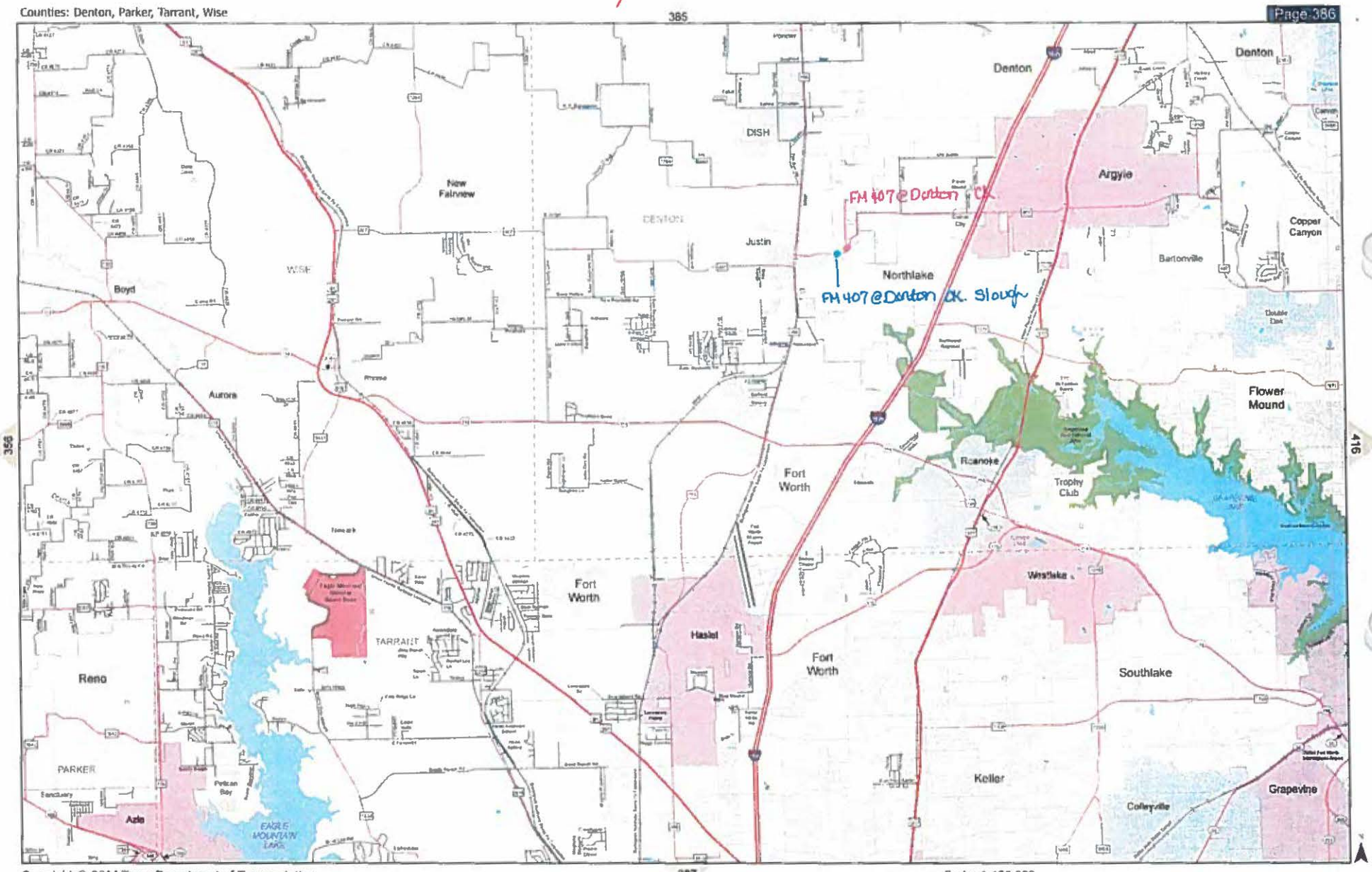
2. Vehicle classification for environmental studies (Air and Noise Analysis).

3. Line Diagram Analysis (straight line turning movements; please provide line diagram).

4. Complete Corridor Analysis (includes basic highway traffic data for pavement design and environmental studies and detailed schematic turning movements; please provide detailed schematic).

Note: If a complete corridor analysis is requested, please attach a traffic schematic diagram. Please make note of any known proposed development that will be a traffic generator.

CSJ: 1310-01-027, 036 (FM 407)
DENTON CREEK
& DENTON CREEK SLOUGH



Texas Department of Transportation

MEMO

July 21, 2015

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

From: Stan Hall, P.E.
Dallas District, Advance Project Development

Subject: Traffic Data Request
CSJ: 1310-01-027 &, 1310-01-036 (FM 407)
0092-13-024, 025, 026 & 027 (BI 45-F)
0918-46-287 (CS - Mobberly Rd)
0918-11-088 (CR 340)
0918-11-091 (CR 324)
0918-46-277 (CS - Hilltop Rd)
0918-46-274 (CS – S. Blue Mound Rd)

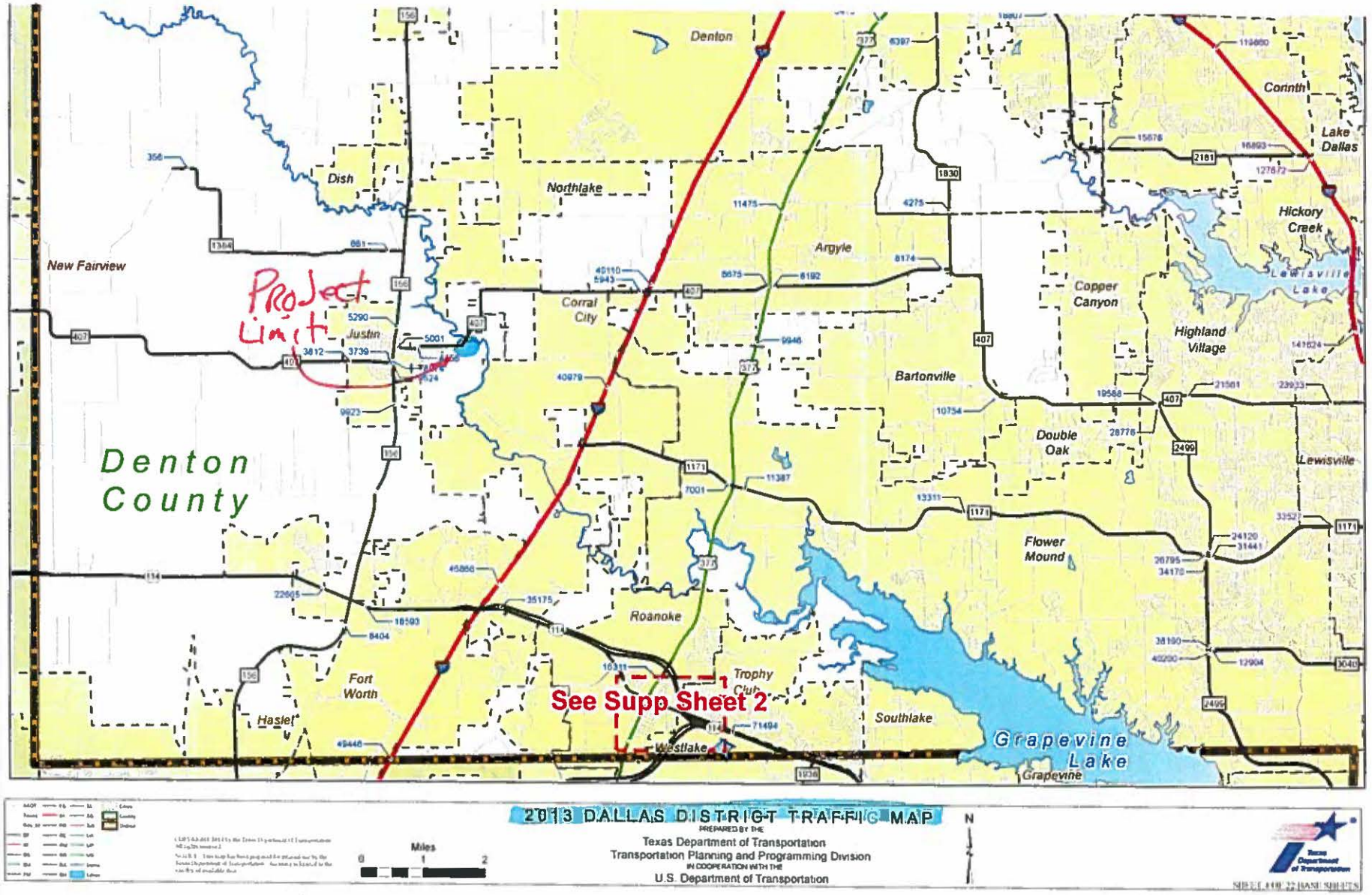
Denton, Kaufman & Navarro Counties

Attached please find traffic data request forms, and location maps for the above subject projects. Please provide our office with the requested traffic data. If any additional information is needed, please contact Godfrey Sendawula at (214)320-6266.

H. Stan Hall, P.E.
District Advance Project
Development Engineer

Attachments

RECEIVED TPP
0268 JUL 23 15


Denton
Corinth
Lake Dallas
Dish
Northlake
Hickory Creek
New Fairview
Argyle
Project Limit
Corral City
Copper Canyon
Lewisville Lake
Highland Village
Justin
Bartonville
Denton County
Double Oak
Lewisville
Flower Mound
Roanoke
Fort Worth
Trophy Club
See Supp Sheet 2
Haslet
Southlake
Grapevine Lake
Westlake
Grapevine
2013 DALLAS DISTRICT TRAFFIC MAP
PREPARED BY THE
Texas Department of Transportation
Transportation Planning and Programming Division
IN COOPERATION WITH THE
U.S. Department of Transportation
Miles
0 1 2
N

Corridor Analysis Worksheet: 1 Section, 1 Forecast Year, Air & Noise

Project	FM 407	Date for Memorandum	7/31/2015
Rd Type	FM	District	Dallas
		County	Denton
Project Limits	At Denton Creek	CSJ	1310-01-027
		Analyst	RCW

Date: Request	7/24/2015	Received	7/24/2015	Started	7/28/2015	Completed	7/28/2015
District Contact				Phone #			

	ADT's Year	ADT		% Trks ADT	DHV
Count	2013	4456		11.9	8.9
Base	2016	4800	# Trks	571	
Forecast	2036	7000			

SPR Station	S-77	MC Stn	M-935	% Trks	17.9
Year	2013	Dir	3	Num Trks	280
Peak Hour	13.0	Year	2013	Axle Factor	2.43
DD	60	ADT	1561	% Single Axles	0.68
100-DD	40				
K-Factor	11.1				

Main Road Growth Rate	2.6	TDM Assignment	N/A
Growth Rate after 20 Years	2.0		
Section 1 Growth Factor	2.292		
Design Period	20	LOD	99999

				# Lanes	
Structural Number (SN)	3			Existing	2
Slab Thickness (ST)	8			Proposed	2

Past Projects	
Project	FM 407
From	At Draw
To	1.0 mile EaST OF fm 156
Date	9/2/2008
County	Denton
CSJ	1310-01-036

T. Log			
ADT			
% Growth Rate			
K-Factor			
DD			
% Trucks ADT			
% Trucks DHV			
MC Station			
SPR Station			

Items Done on This Project

Straight Line Turning Movements	No	Detailed Schematic Turning Movements	No
Traffic Analysis for Highway Design	Yes	Field Trip	No
Vehicle Mix	Yes	Travel Demand Model Used	No
Manual Count Worksheet	Yes		

NOTES:

M.C. Station M-1089 don't have station by legs, last time by legs was 1988. So I used M-1019-3
See Attachments for T-log

DATA CALCULATIONS FOR USE IN AIR & NOISE ANALYSIS

	◉ FHWA Format			○ Texas 6 Format	
Light Duty Vehicles	Motorcycles	11	Light Duty Vehicles	Passenger	
	Passenger	751		Panel & Pickup	
	Pickup or Van	519	Single Units	Buses	
Single Units	Buses	10		Other 2 Axle	
	Other 2 Axle	122		3 Axle	
	3 Axles	26		4 Axle or More	
	4 Axles or more	1	Truck Combs.	3 Axle	
Truck Combs.	3-4 Axles	32		4 Axle	
	5 Axles	85		5 Axle	
	6 Axles or more	4		6 Axle or more	
Semi-Trailer-Trailer	5 Axles or less	0	Semi-Trailer-Trailer	5 Axle	
	6 Axles	0		6 Axle	
	7 Axles or more	0		7 Axle or more	

FHWA Format Data		
	Number	%
Light	1281	82.1
Medium	148	9.5
Heavy	132	8.5
Trucks	280	17.9

SECTION 1

FM

	ADT	DHV
Light	88.1	91.1
Medium	6.3	4.7
Heavy	5.6	4.2

Total Vehicles	1561
Total Trucks	280
Total Singles	460.0
Total Tandems	221.0
AXLE FACTOR	2.43
SINGLE AX FACT	0.68

INPUT DATA FOR KIPS: AUTOMATIC

SN, ST	3, 8		
Year 1	16		
Year 2	36		
ADT	4800		
% Trks	11.9		
Growth Rate	2.292		
Years	20		
Facil Type	C		
S.N.	3		
SLAB	8		
Weight Sta	99999		
Axle Factor	2.43		
Single Axle	0.68		

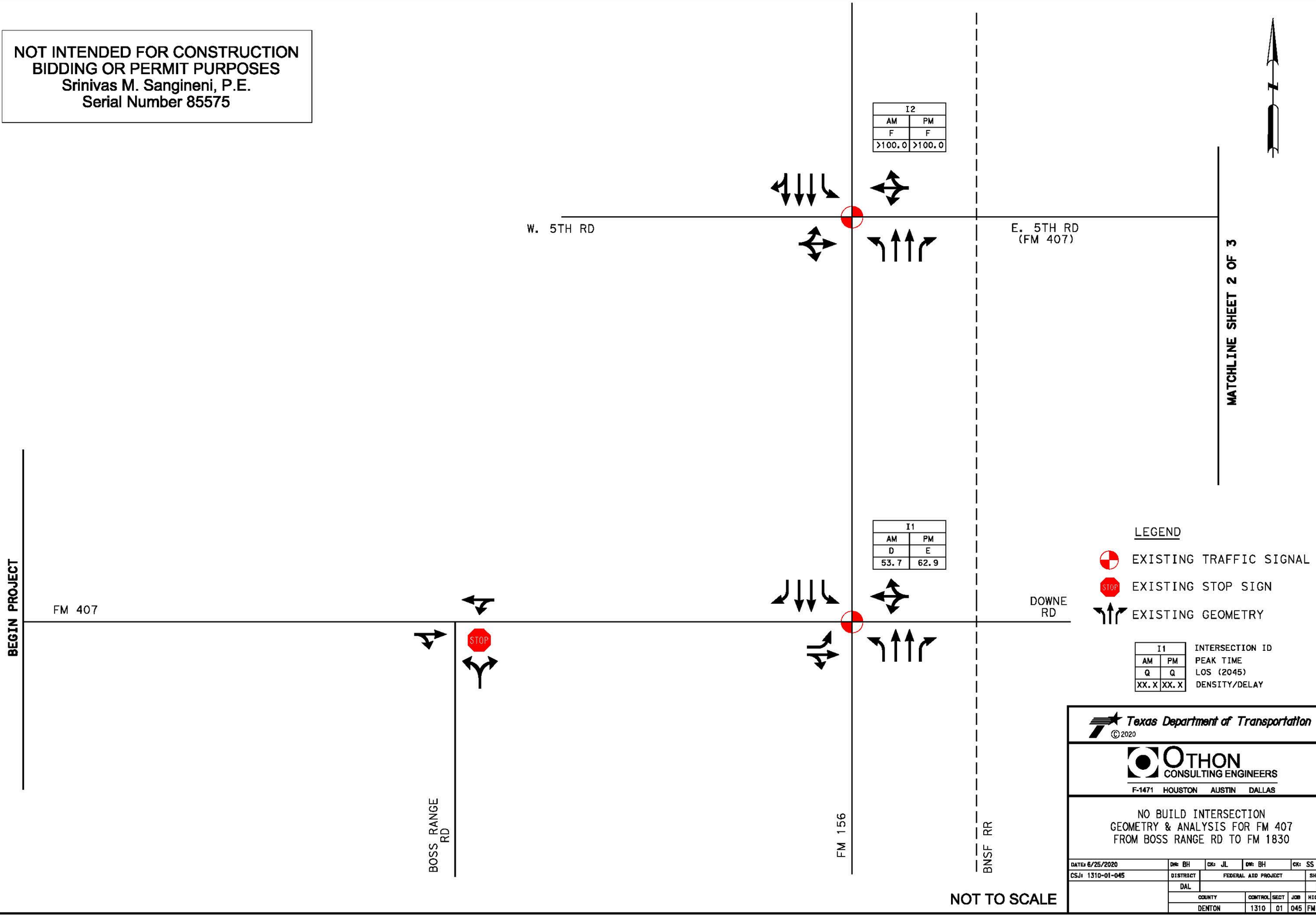
OUTPUT DATA FROM KIPS: ENTER FOR TAHD FORM

SN, ST	3, 8		
ATHWLD	11000		
% T in ATHWLD	40		
FLEXIBLE	1877000		
RIGID	2381000		

Appendix B
Geometry and Analysis Exhibits

Year 2018 & Year 2045 No Build Intersection Geometry & Analysis

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

- EXISTING TRAFFIC SIGNAL
- EXISTING STOP SIGN
- EXISTING GEOMETRY

I1	
AM	PM
Q	Q
XX.X	XX.X

I1 INTERSECTION ID
AM PM PEAK TIME
Q Q LOS (2045)
XX.X XX.X DENSITY/DELAY

Texas Department of Transportation
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OTHON CONSULTING ENGINEERS
F-1471 HOUSTON AUSTIN DALLAS

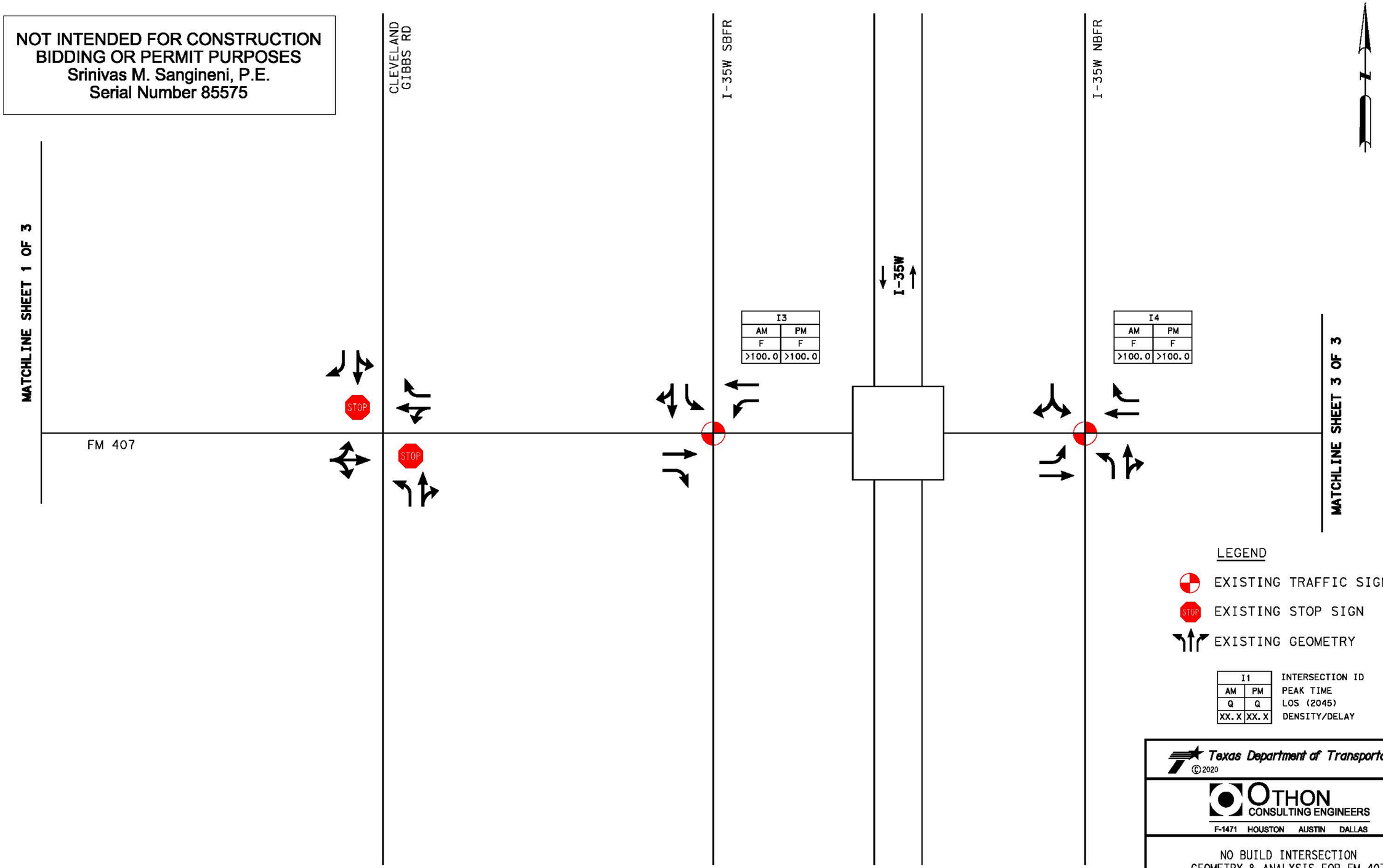
NO BUILD INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1

COUNTY	CONTROL	SECT	JOB	HIGHWAY
DENTON	1310	01	045	FM 407

6/25/2020 4:10:40 PM
FM 407 Exist Geom_01.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

- EXISTING TRAFFIC SIGNAL
- EXISTING STOP SIGN
- EXISTING GEOMETRY

I1	
AM	PM
Q	Q
XX.X	XX.X

INTERSECTION ID
PEAK TIME
LOS (2045)
DENSITY/DELAY

NOT TO SCALE

Texas Department of Transportation
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OTHON CONSULTING ENGINEERS
F-1471 HOUSTON AUSTIN DALLAS

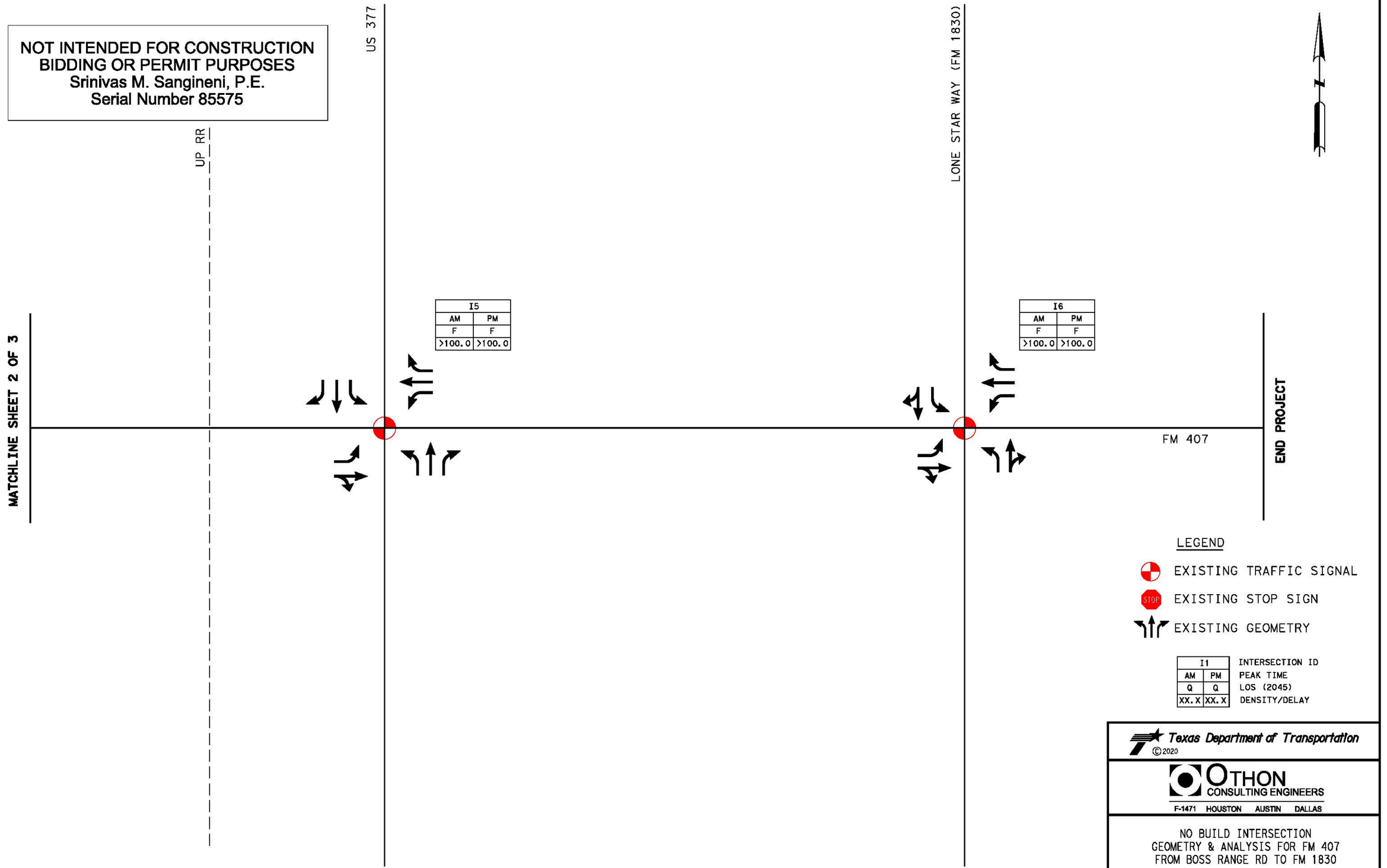
NO BUILD INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2

COUNTY	CONTROL	SECT	JOB	HIGHWAY
DENTON	1310	01	045	FM 407

6/25/2020 4:10:41 PM
FM 407 Exist Geom_02.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

- EXISTING TRAFFIC SIGNAL
- EXISTING STOP SIGN
- EXISTING GEOMETRY

I1	
AM	PM
Q	Q
XX.X	XX.X

INTERSECTION ID
PEAK TIME
LOS (2045)
DENSITY/DELAY

NOT TO SCALE

Texas Department of Transportation
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F-1471 HOUSTON AUSTIN DALLAS

NO BUILD INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

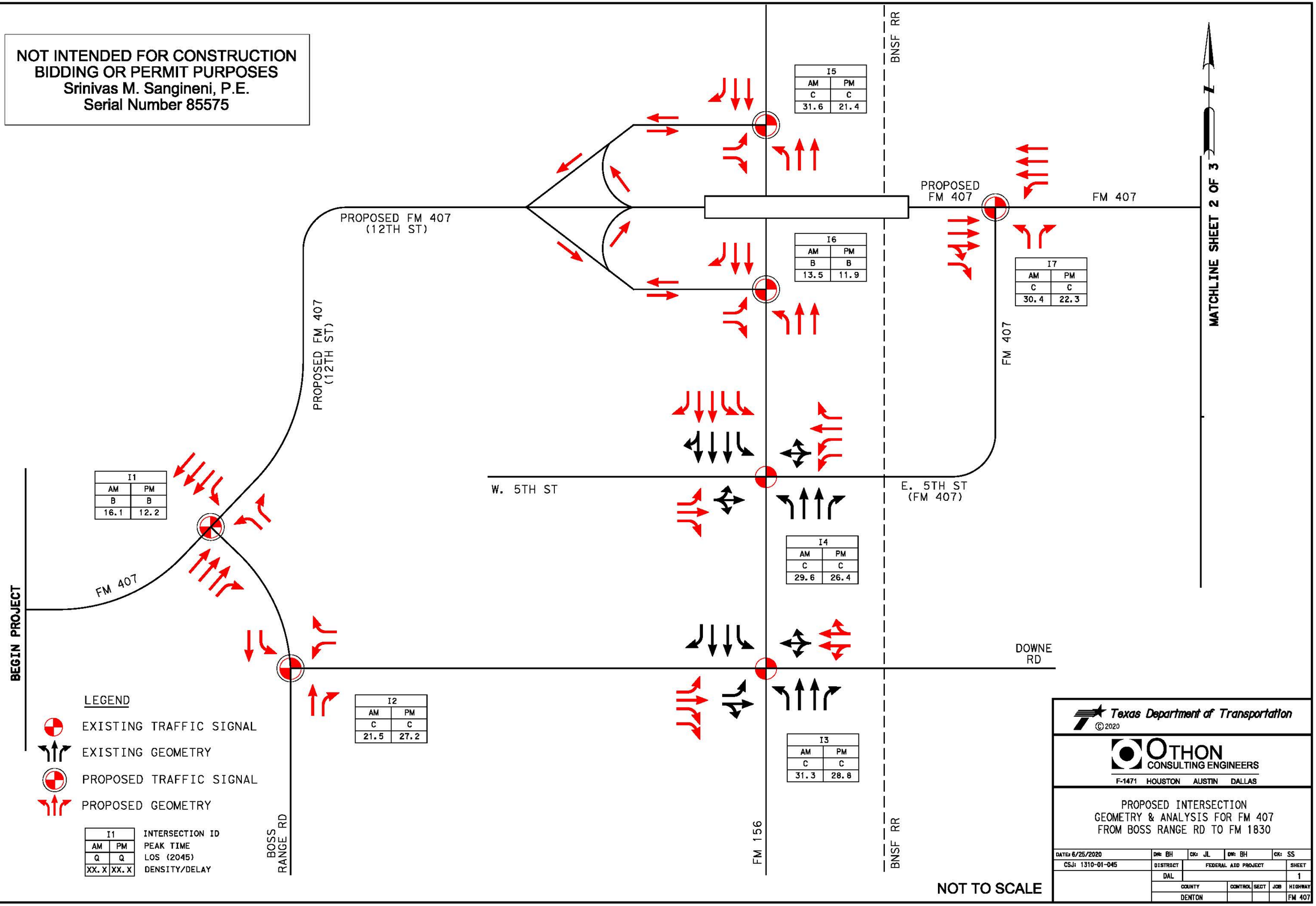
DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			3

COUNTY	CONTROL	SECT	JOB	HIGHWAY
DENTON	1310	01	045	FM 407

6/25/2020 4:10:41 PM
FM 407 Exist Geom_03.dgn

Year 2045 Build Intersection Geometry & Analysis

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



NOT TO SCALE

6/25/2020 4:22:17 PM
FM 407 Buildred Geom_01.dgn

Texas Department of Transportation
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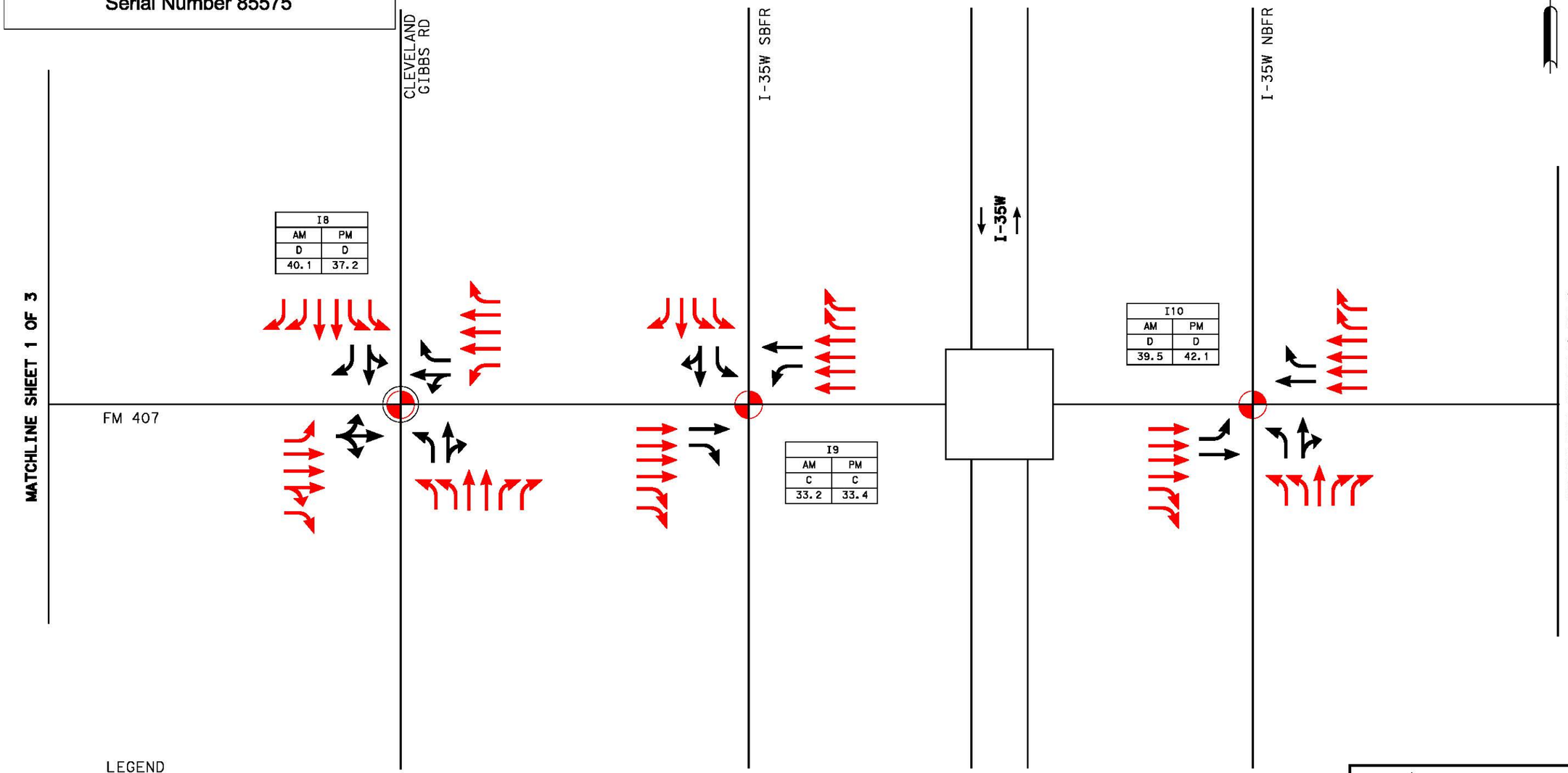
F-1471 HOUSTON AUSTIN DALLAS

PROPOSED INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

- EXISTING TRAFFIC SIGNAL
- EXISTING GEOMETRY
- PROPOSED TRAFFIC SIGNAL
- PROPOSED GEOMETRY

I1	
AM	PM
Q	Q
XX.X	XX.X

I1 = INTERSECTION ID; AM/PM = PEAK TIME; Q = LOS (2045); XX.X = DENSITY/DELAY

NOT TO SCALE

Texas Department of Transportation
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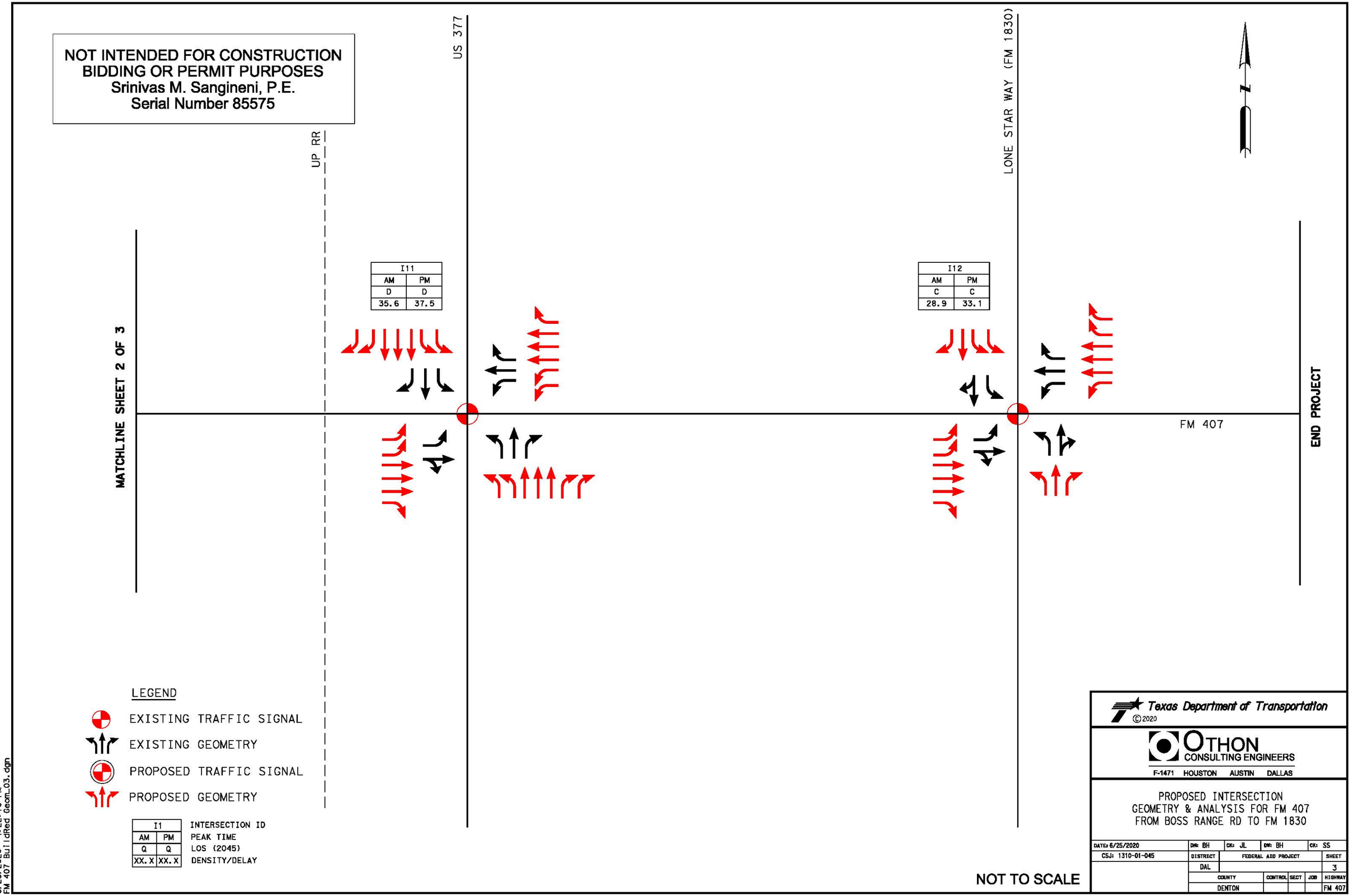
OTHON CONSULTING ENGINEERS
F-1471 HOUSTON AUSTIN DALLAS

PROPOSED INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

6/25/2020 4:22:18 PM
FM 407 BuildRed Geom_02.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

- EXISTING TRAFFIC SIGNAL
- EXISTING GEOMETRY
- PROPOSED TRAFFIC SIGNAL
- PROPOSED GEOMETRY

I1	
AM	PM
Q	Q
XX.X	XX.X

INTERSECTION ID
PEAK TIME
LOS (2045)
DENSITY/DELAY

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PROPOSED INTERSECTION
GEOMETRY & ANALYSIS FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 6/25/2020	DN: BH	CK: JL	DW: BH	CK: SS	
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT			SHEET
	DAL				3
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	DENTON					FM 407

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Appendix C
Diagrammatic by Civil Associates, Inc. (May 2020)

FM 407 Feasibility Study

Technically Preferred (Build) Alternative

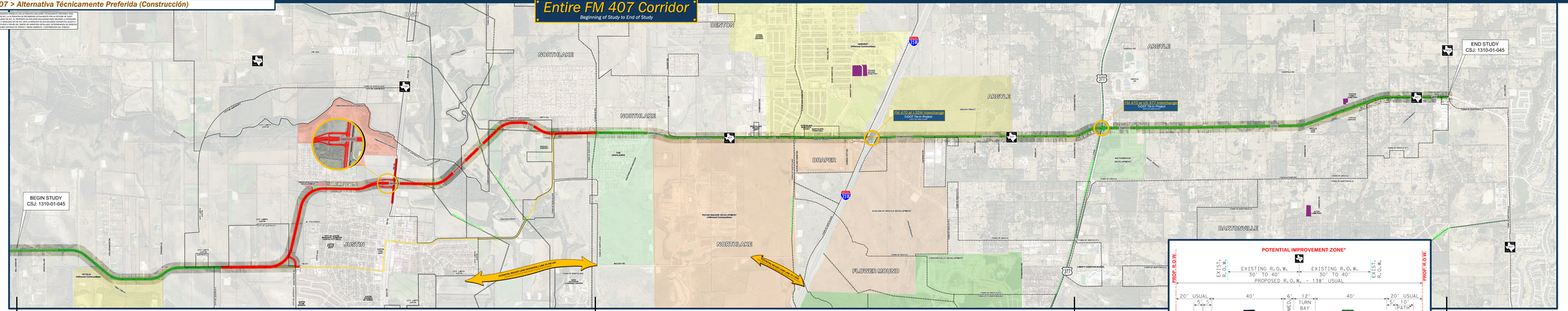
Estidio de Viabilidad FM 407 > Alternativa Técnicamente Preferida (Construcción)

THE ENVIRONMENTAL PROCESS IS CURRENTLY PROCEEDING AS TECHNICIAN DESIGNATED TO MAINTAIN THE 407. THE ALTERNATIVE IS CURRENTLY RECOMMENDED AS A "LIGHT RAIL MAY" FEASIBILITY STUDY. THE PURPOSE OF MAKE IS EXPLORING SOLUTIONS TO IMPROVE THE 407 TRAFFIC OPERATIONS, SAFETY, AND MOBILITY IN THE CORRIDOR. THE PROJECT IS EXPLORING SOLUTIONS THAT INCLUDE A PERFORMANCE THROUGH MULTIMODAL MOBILITY, MANAGEMENT, AND OPERATIONAL SOLUTIONS WHICH MAY INCLUDE TRANSPORTATION, HIGHWAY, AND PUBLIC POLICY.

ESTE PROCESO AMBIENTAL SE ENCUENTRA ACTUALMENTE PROCEDIENDO COMO DESIGNADO PARA MANTENER EL 407. LA ALTERNATIVA SE RECOMIENDA ACTUALMENTE COMO UN ESTUDIO DE "LUZ DE TRÁFICO" EN EL PROPÓSITO ES EXPLORAR SOLUCIONES PARA MEJORAR LA OPERACIÓN DE TRÁFICO, SEGURIDAD Y MOVILIDAD EN EL CORREDOR. EL PROYECTO ESTÁ EXPLORANDO SOLUCIONES QUE INCLUYEN EL RENDIMIENTO A TRAVÉS DE SOLUCIONES MULTIMODALES, GESTIÓN Y OPERACIONALES QUE PUEDEN INCLUIR TRANSPORTE, AUTOPISTA Y POLÍTICA PÚBLICA.

Entire FM 407 Corridor

Beginning of Study to End of Study



- *Provided roadway construction and Row acquisition only; assembly dimensions would vary by location. Refer to Typical Sections on Technically Preferred (Build) Alternative Schematic Sheets for additional details.
- ★ The Regional Veloweb is a 1,600 mile network of off-street shared use paths (trails) connecting communities across North Central Texas. The Veloweb is a key component of the Mobility 2045 plan, which identifies the Veloweb as one of the region's highest-priority regional transportation networks. The Veloweb is comprised of a regional trail network, and it includes the north of the Veloweb is a key component of the Mobility 2045 plan, which identifies the Veloweb as one of the region's highest-priority regional transportation networks. The Veloweb is comprised of a regional trail network, and it includes the north of the Veloweb is a major destination. Any trails supplement the Veloweb network. Alignments were determined through the cooperative efforts of local governments and NCTCOG staff as:
  - Identifying mobility and "context sensitive"
  - Identifying trail alignments that provide the greatest potential for mobility
  - Identifying corridors that provide the greatest potential for implementation

The Regional Veloweb is adopted by the Regional Transportation Council, the transportation policy body for the Dallas-Fort Worth area. Guidance and direction on the Veloweb is provided by transportation plan for the Dallas/Fort Worth area. Guidance and direction on the Veloweb as the Regional Transportation Council, the transportation policy body for the Dallas-Fort Worth area. NCTCOG staff is responsible for the planning and implementation of regional and cooperative infrastructure and amenities. The North Central Texas Council of Governments (NCTCOG) notes those responsibilities as the Metropolitan Planning Organization for the region, with a focus on alternative commute modes. Source: NCTCOG.org

1. AERIAL PHOTO SOURCE: TEXAS NATURAL RESOURCES INFORMATION SYSTEM
2. ENVIRONMENTAL CONSTRAINTS IN CONCEPTUAL, PRELIMINARY AND SUBJECT TO CHANGE
3. ENVIRONMENTAL CONSTRAINTS ARE APPROXIMATE & SUBJECT TO CHANGE
4. EXISTING RIGHT OF WAY LIMITS SHOWN ARE APPROXIMATE
5. ENVIRONMENTAL CONCEPTS ARE PRELIMINARY AND SUBJECT TO CHANGE.

TECHNICALLY PREFERRED (BUILD) TYPICAL SECTION
Not to scale

PRELIMINARY
This information is a preliminary draft for planning purposes only. RECOMMENDED CONCEPTS ARE SUBJECT TO CHANGE.
THIS INFORMATION IS NOT TO BE USED FOR CONSTRUCTION.

SECTION I - BEGINNING OF STUDY TO FLORANCE ROAD

SECTION II - FLORANCE ROAD TO STONECREST ROAD

SECTION III - STONECREST ROAD TO END OF STUDY (FM 1830)

FM 407 FEASIBILITY STUDY

COUNTY: DENTON
DATE: MAY 2020

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Appendix D
Traffic Volume Exhibits

Year 2018 Existing 24 Hour Volumes

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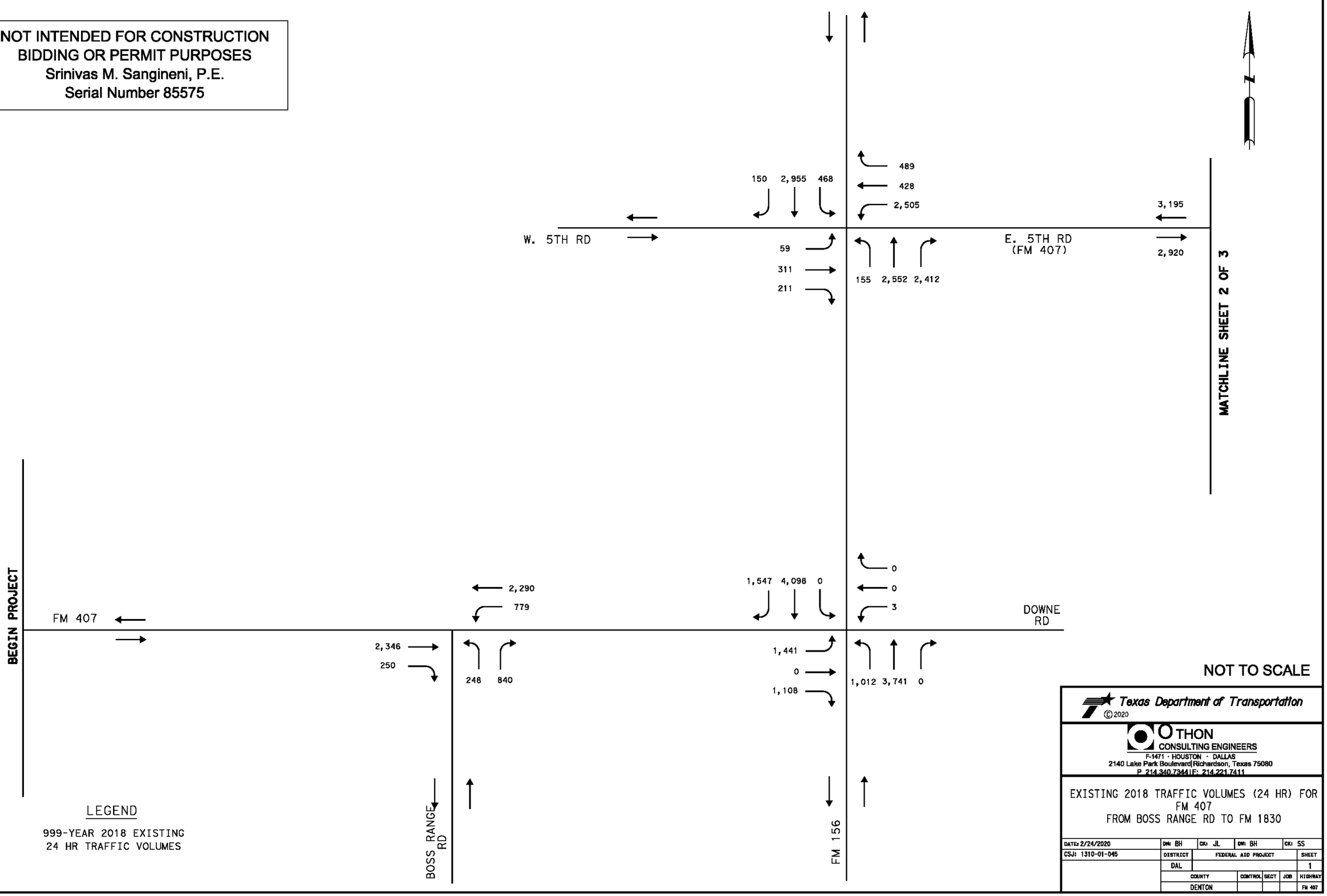

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EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR
FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 2/24/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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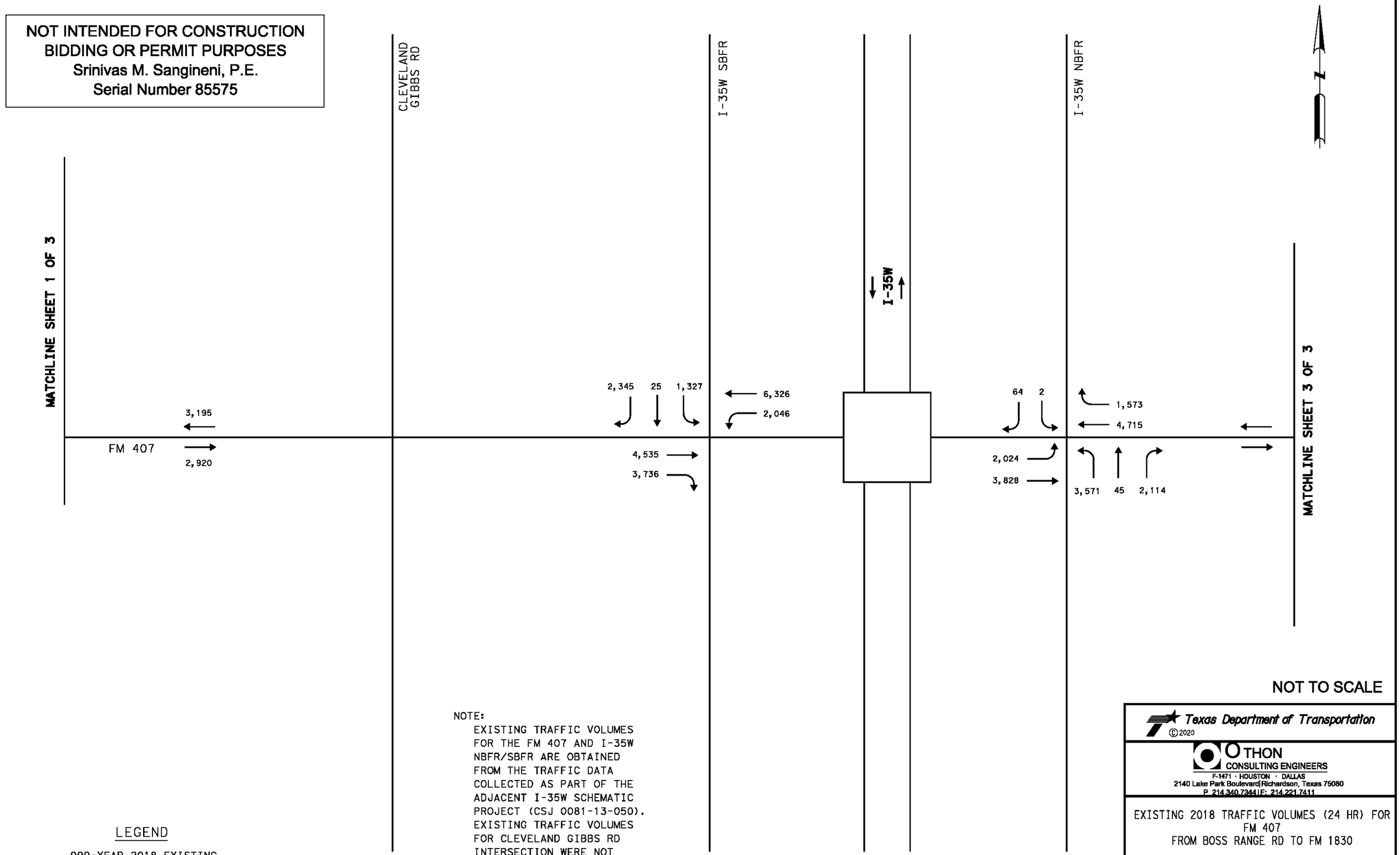
FM 407 Exist 24hr Vol_01.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



NOT TO SCALE

LEGEND

999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

NOTE:
EXISTING TRAFFIC VOLUMES FOR THE FM 407 AND I-35W NBFR/SBFR ARE OBTAINED FROM THE TRAFFIC DATA COLLECTED AS PART OF THE ADJACENT I-35W SCHEMATIC PROJECT (CSJ 0081-13-050). EXISTING TRAFFIC VOLUMES FOR CLEVELAND GIBBS RD INTERSECTION WERE NOT COLLECTED.

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EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR FM 407
FROM BOSS RANGE RD TO FM 1830

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CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
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	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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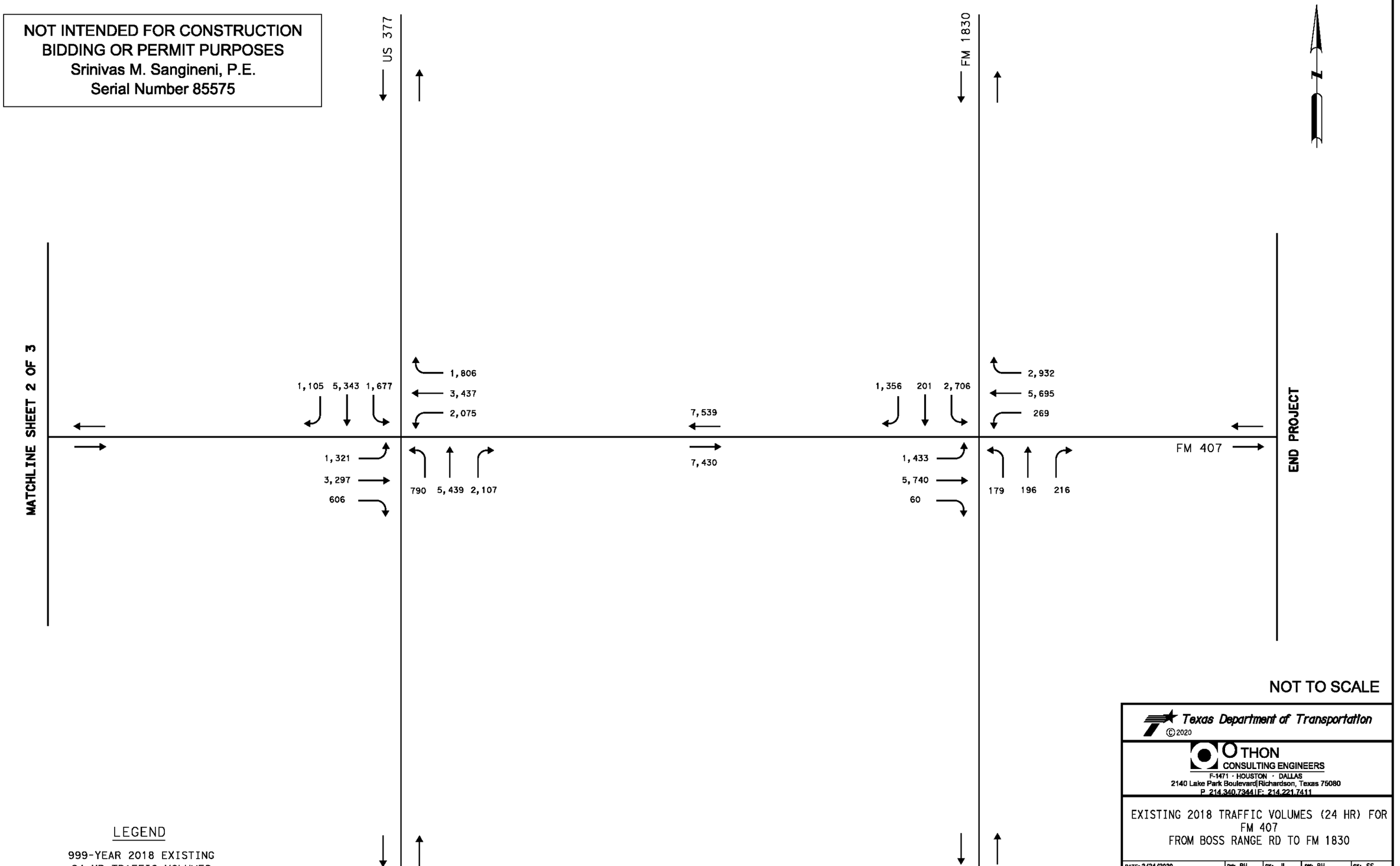

LEGEND

999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

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EXISTING 2018 TRAFFIC VOLUMES (24 HR) FOR
FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 2/24/2020	DN: BH	CK: JL	DW: BH	CK: SS
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	DENTON				FM 407

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FM 407 Exist 24hr Vol_03.dgn

Year 2018 Existing Peak Hour Volumes

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BIDDING OR PERMIT PURPOSES
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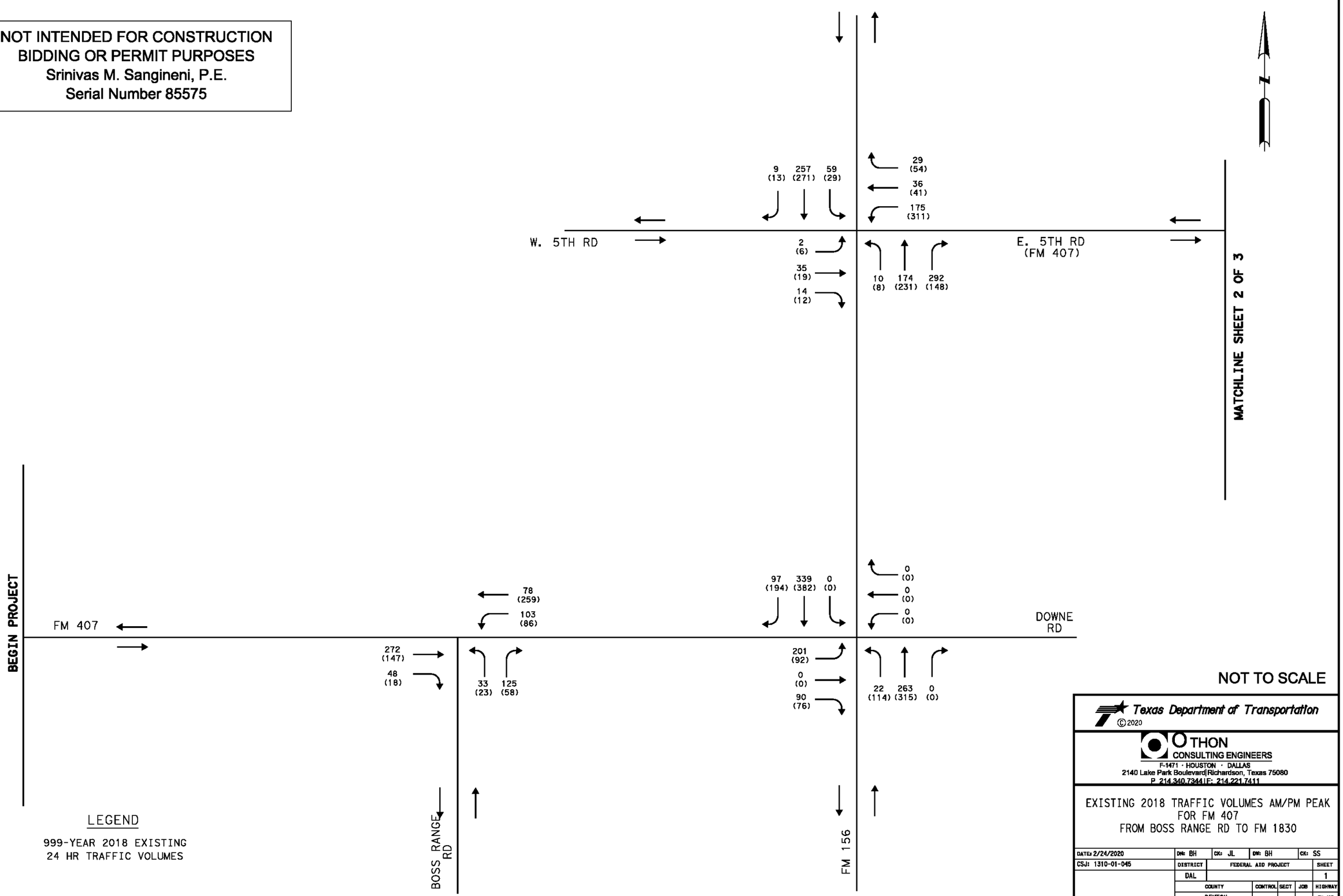
Serial Number 85575



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EXISTING 2018 TRAFFIC VOLUMES AM/PM PEAK
FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 2/24/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
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	DENTON				FM 407

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FM 407 Exist Peak Vol_01.dgn

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BIDDING OR PERMIT PURPOSES
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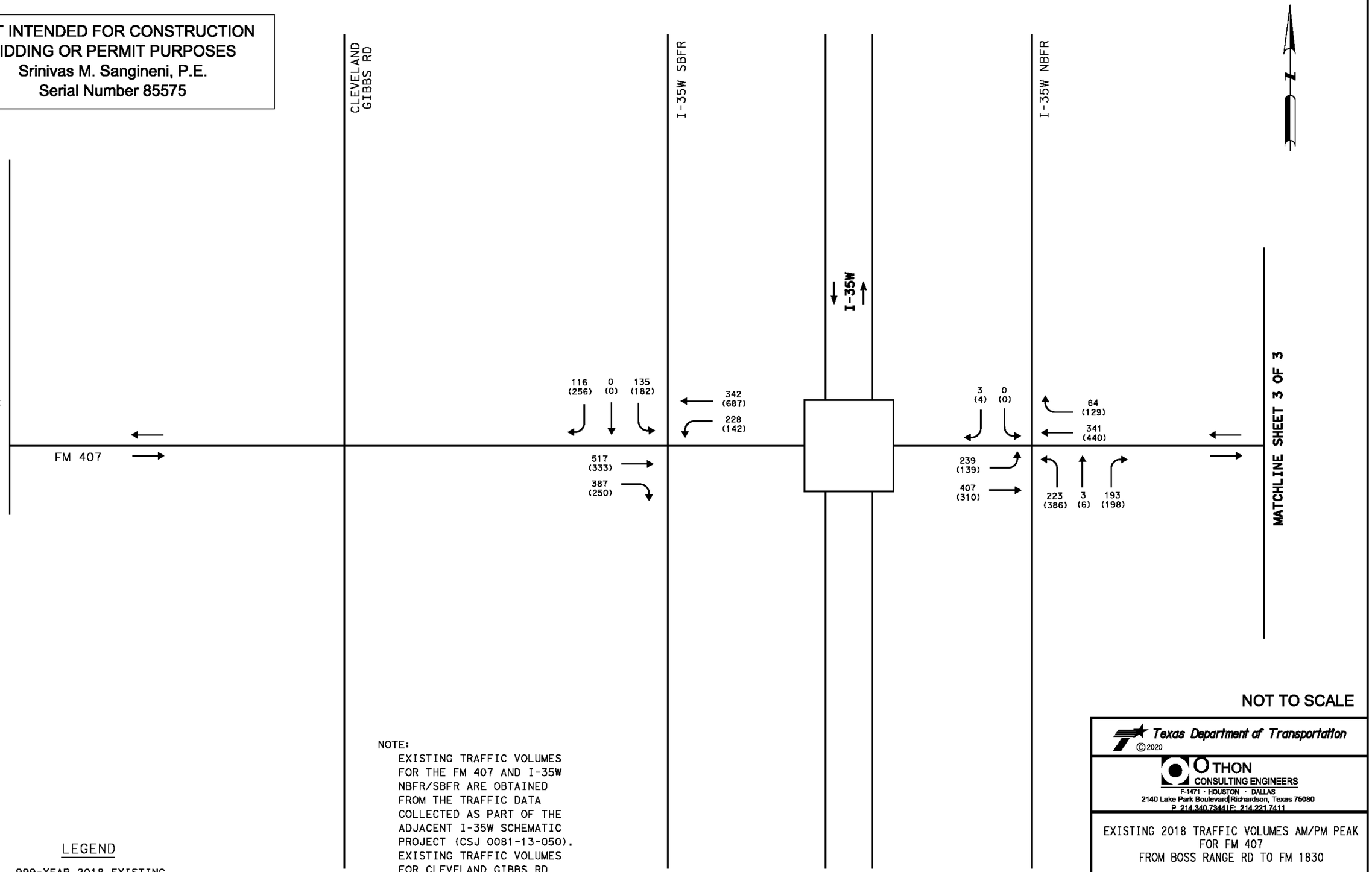

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NOTE:
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LEGEND

999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

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EXISTING 2018 TRAFFIC VOLUMES AM/PM PEAK
FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 2/24/2020	DN: BH	CK: JL	DW: BH	CK: SS
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	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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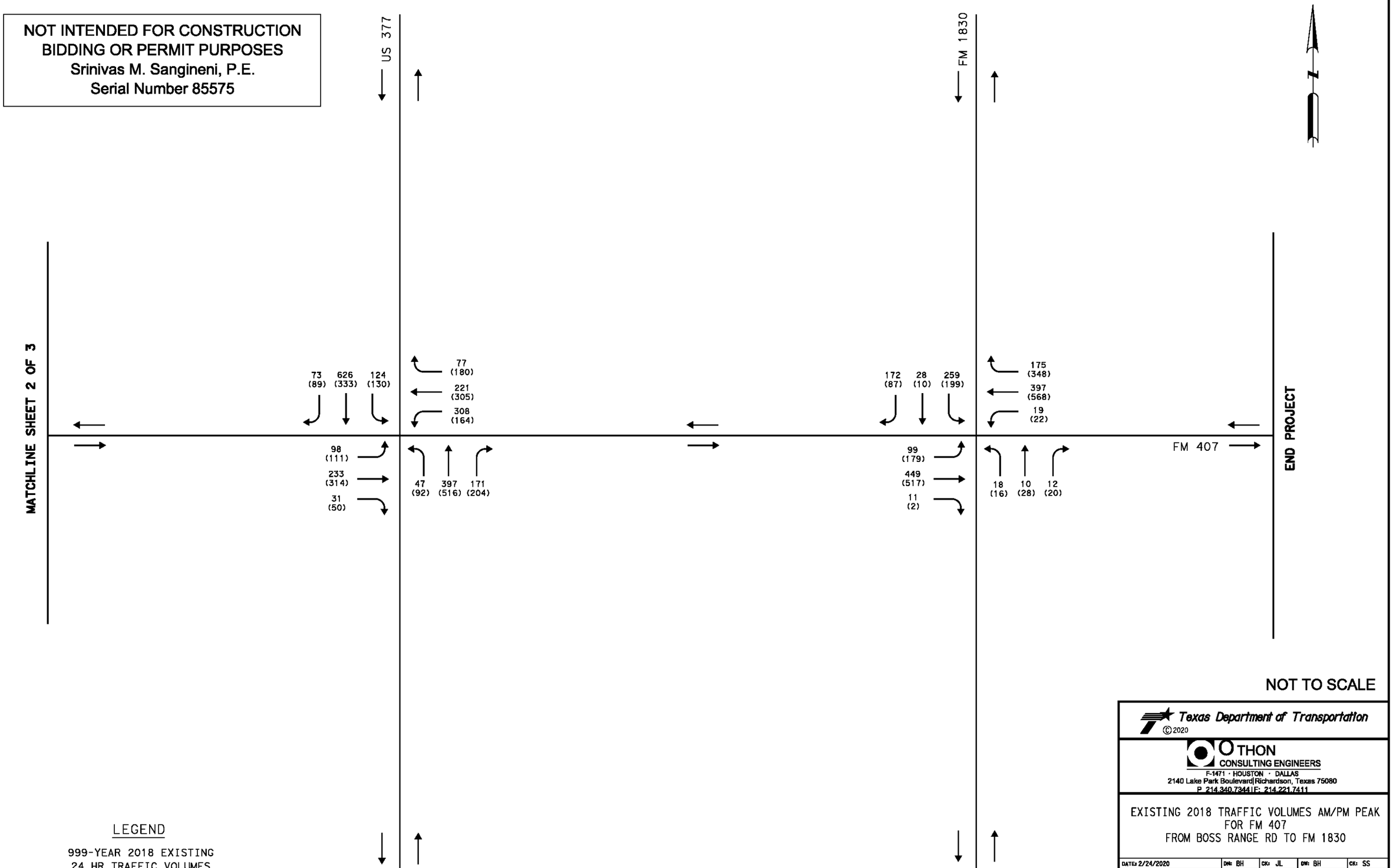

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999-YEAR 2018 EXISTING
24 HR TRAFFIC VOLUMES

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FOR FM 407
FROM BOSS RANGE RD TO FM 1830

DATE: 2/24/2020	DN: BH	CK: JL	DW: BH	CK: SS
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	DAL			3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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FM 407 Exist Peak Vol_03.dgn

Year 2045 No Build 24 Hour Volumes

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BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
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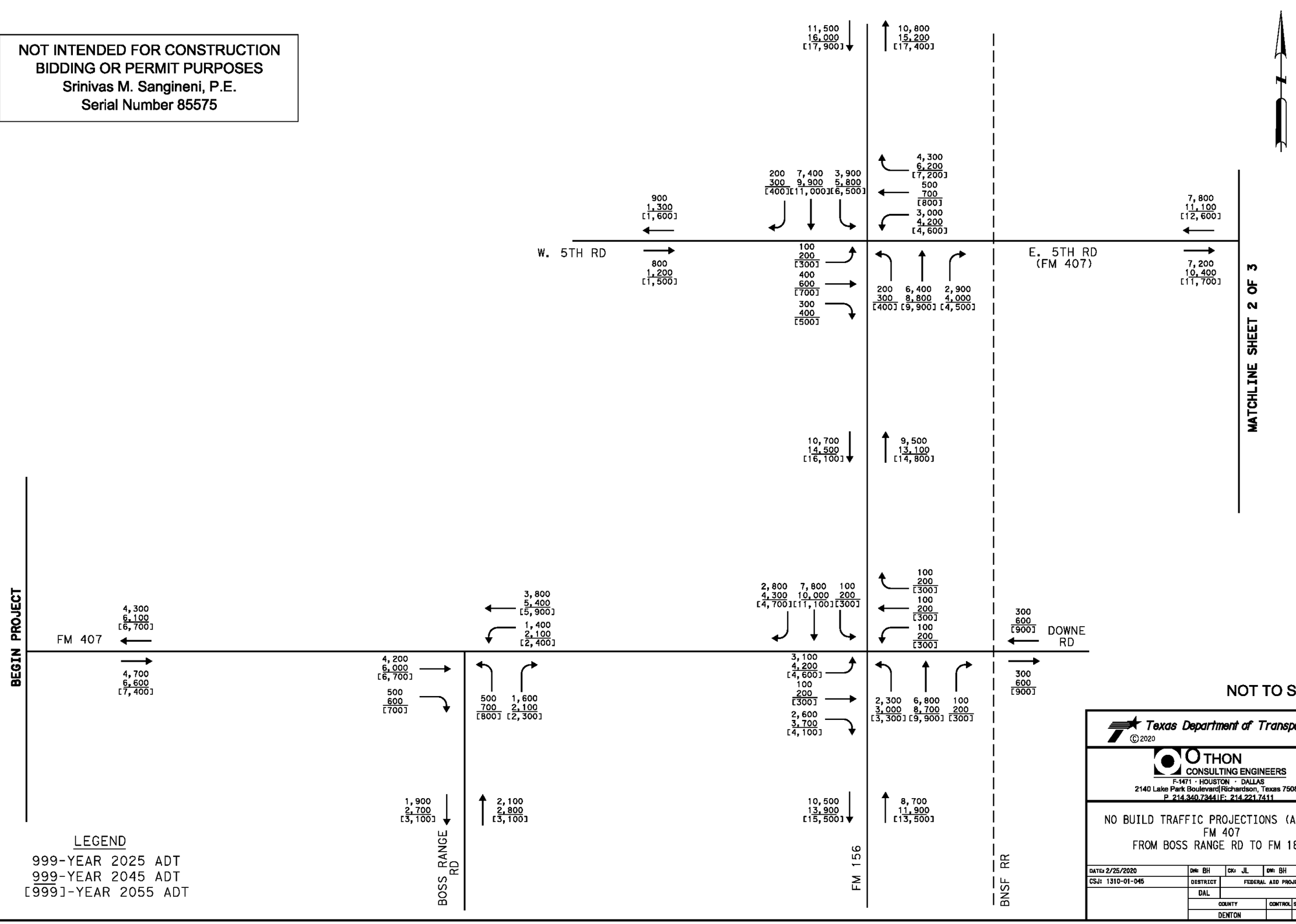

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NO BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407
FROM BOSS RANGE RD TO FM 1830

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	DENTON				FM 407

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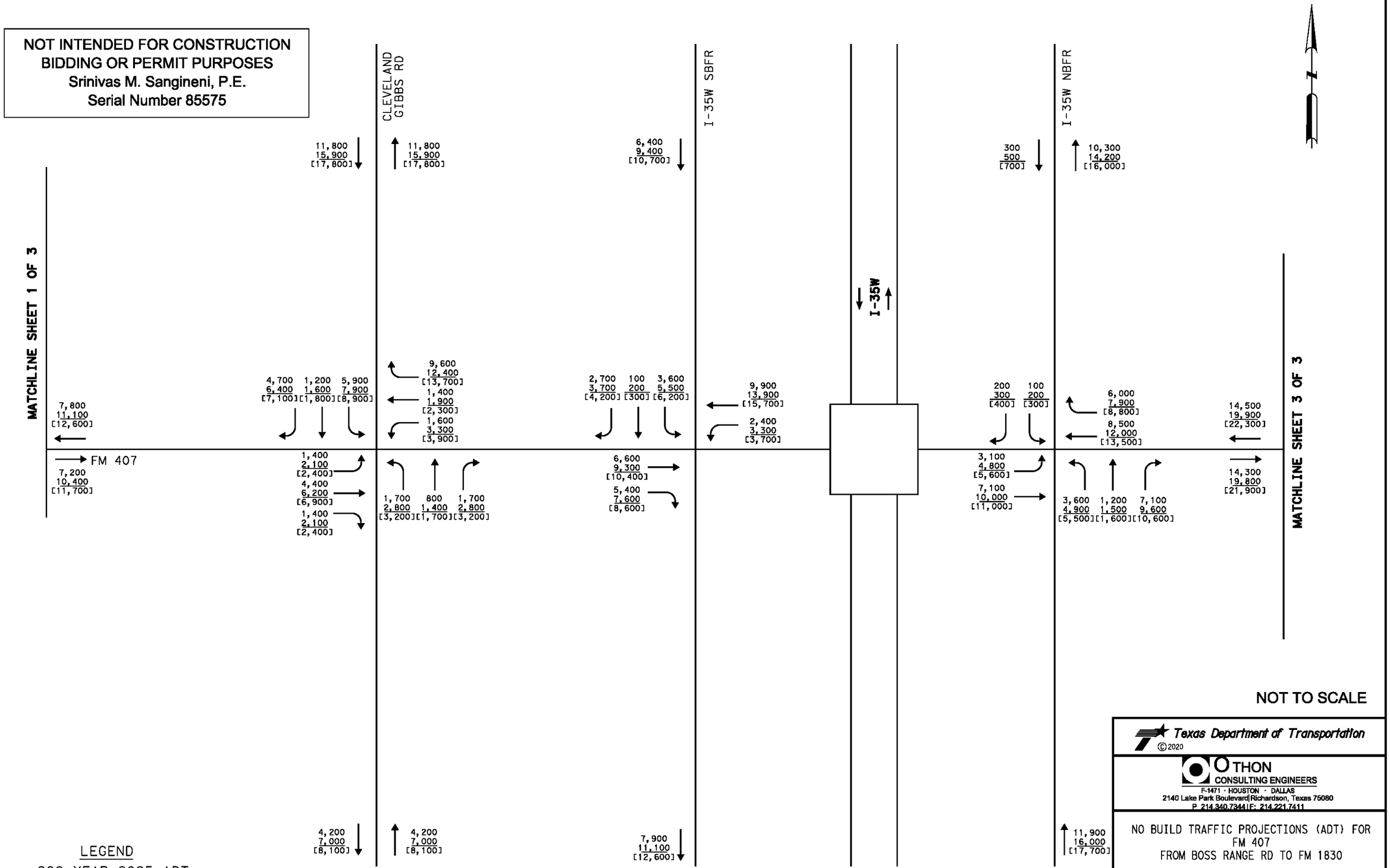

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FROM BOSS RANGE RD TO FM 1830

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	DENTON				FM 407

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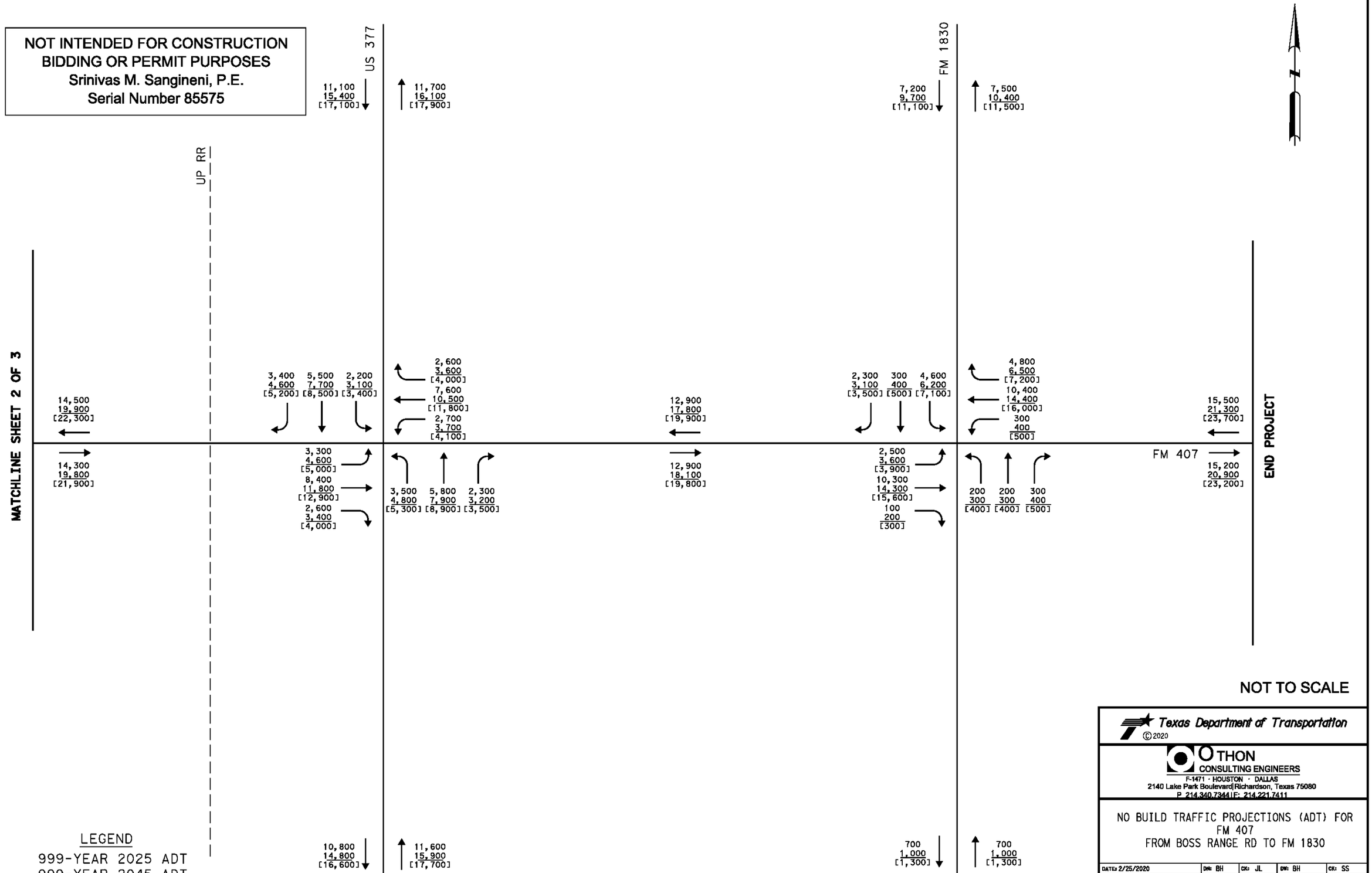

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FM 407
FROM BOSS RANGE RD TO FM 1830

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	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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FM 407 Traffic Projection Nobuild_03.dgn

Year 2045 No Build Peak Hour Volumes

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BIDDING OR PERMIT PURPOSES
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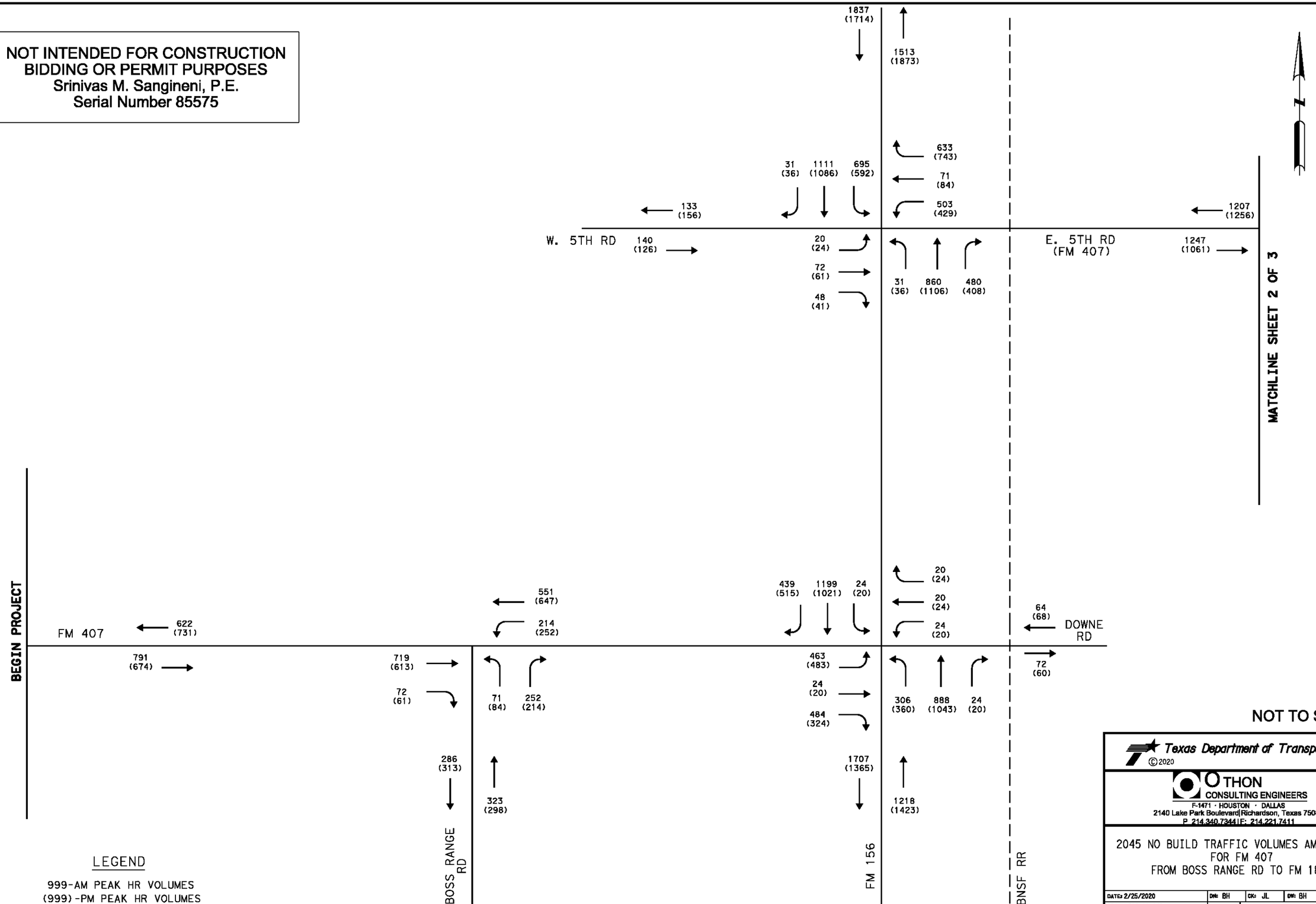

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999-AM PEAK HR VOLUMES
(999)-PM PEAK HR VOLUMES

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FOR FM 407
FROM BOSS RANGE RD TO FM 1830

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	DENTON				FM 407

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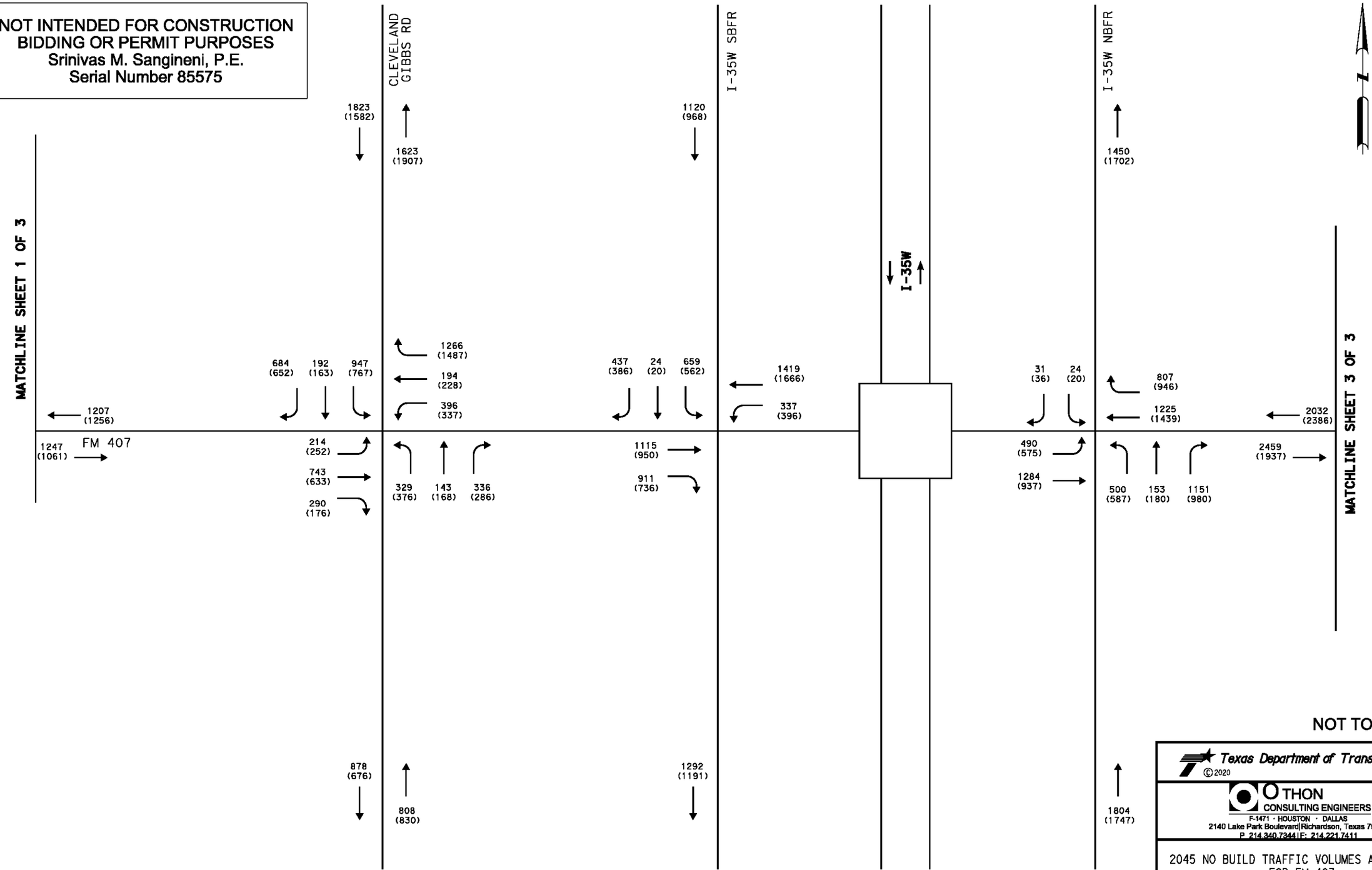

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LEGEND

999-AM PEAK HR VOLUMES
(999)-PM PEAK HR VOLUMES

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2045 NO BUILD TRAFFIC VOLUMES AM/PM PEAK
FOR FM 407
FROM BOSS RANGE RD TO FM 1830

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	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

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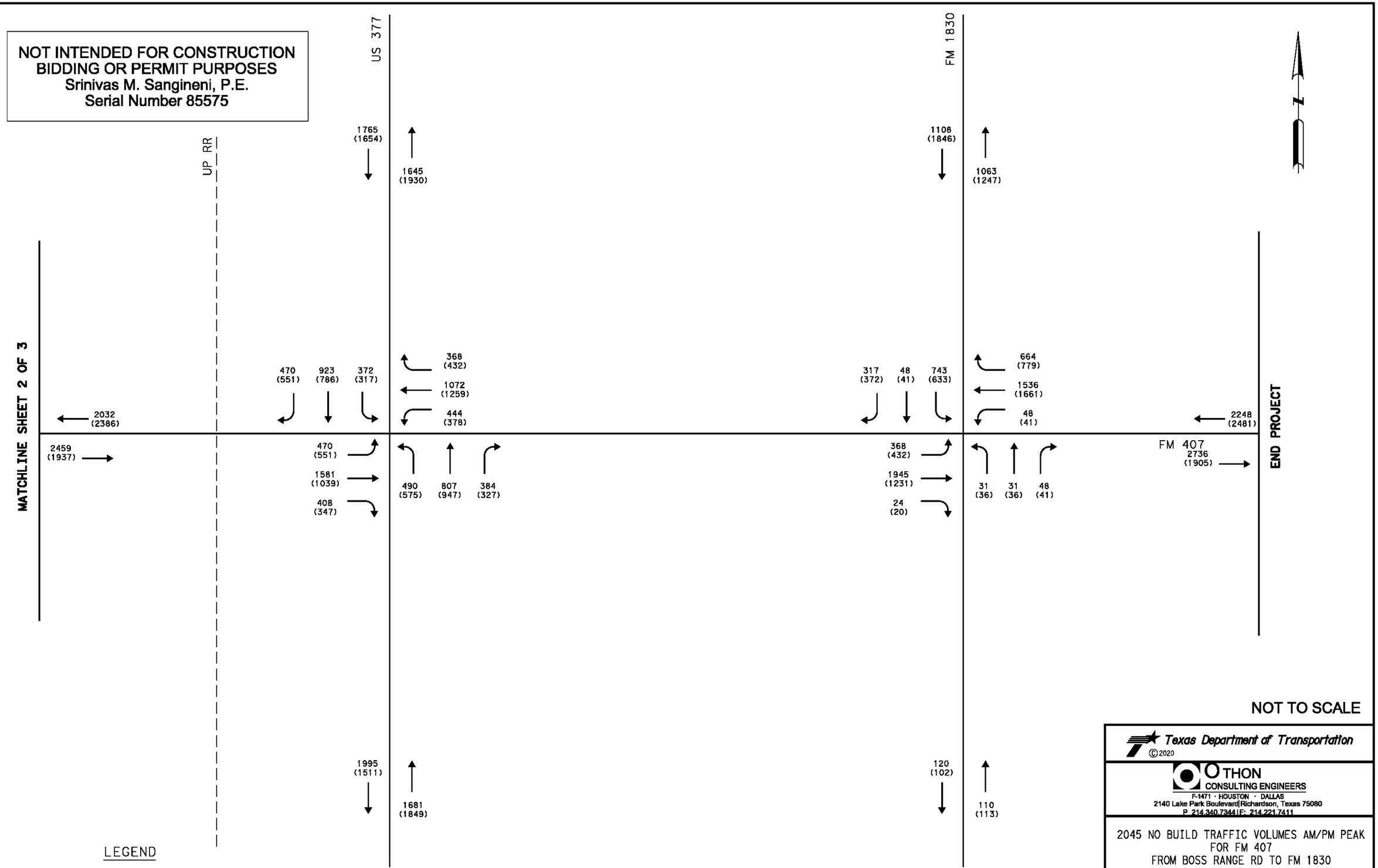

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LEGEND

999-AM PEAK HR VOLUMES
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2045 NO BUILD TRAFFIC VOLUMES AM/PM PEAK
FOR FM 407
FROM BOSS RANGE RD TO FM 1830

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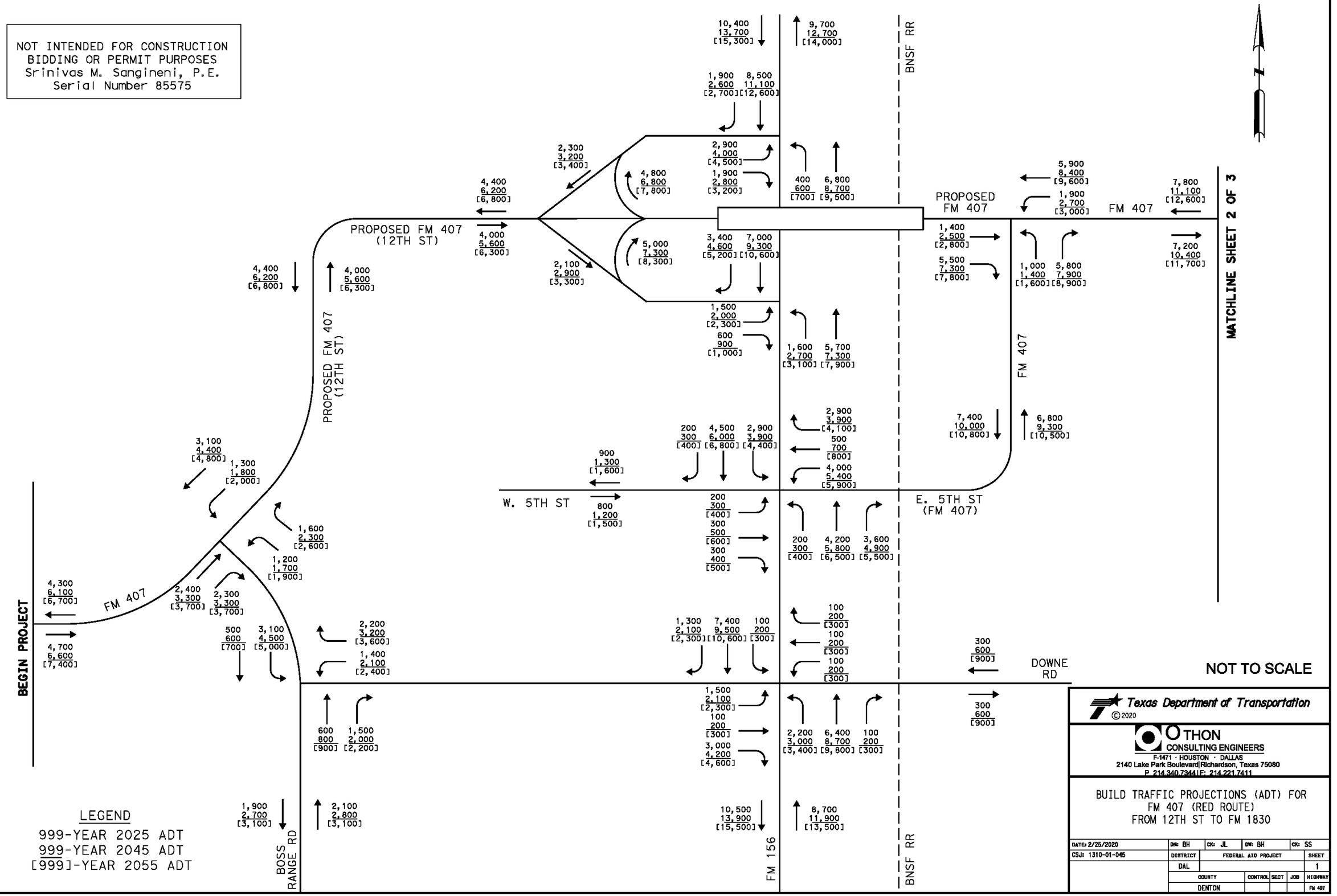
	DENTON				FM 407

2/25/2020 9:59:27 AM
FM 407 Traffic Projection 2045 Nobuild_03.dgn

Year 2045 Build
24 Hour Volumes

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



2/25/2020 9:52:16 AM
FM 407 Traffic Projection BuildRed_01.dgn

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BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (RED ROUTE)
FROM 12TH ST TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
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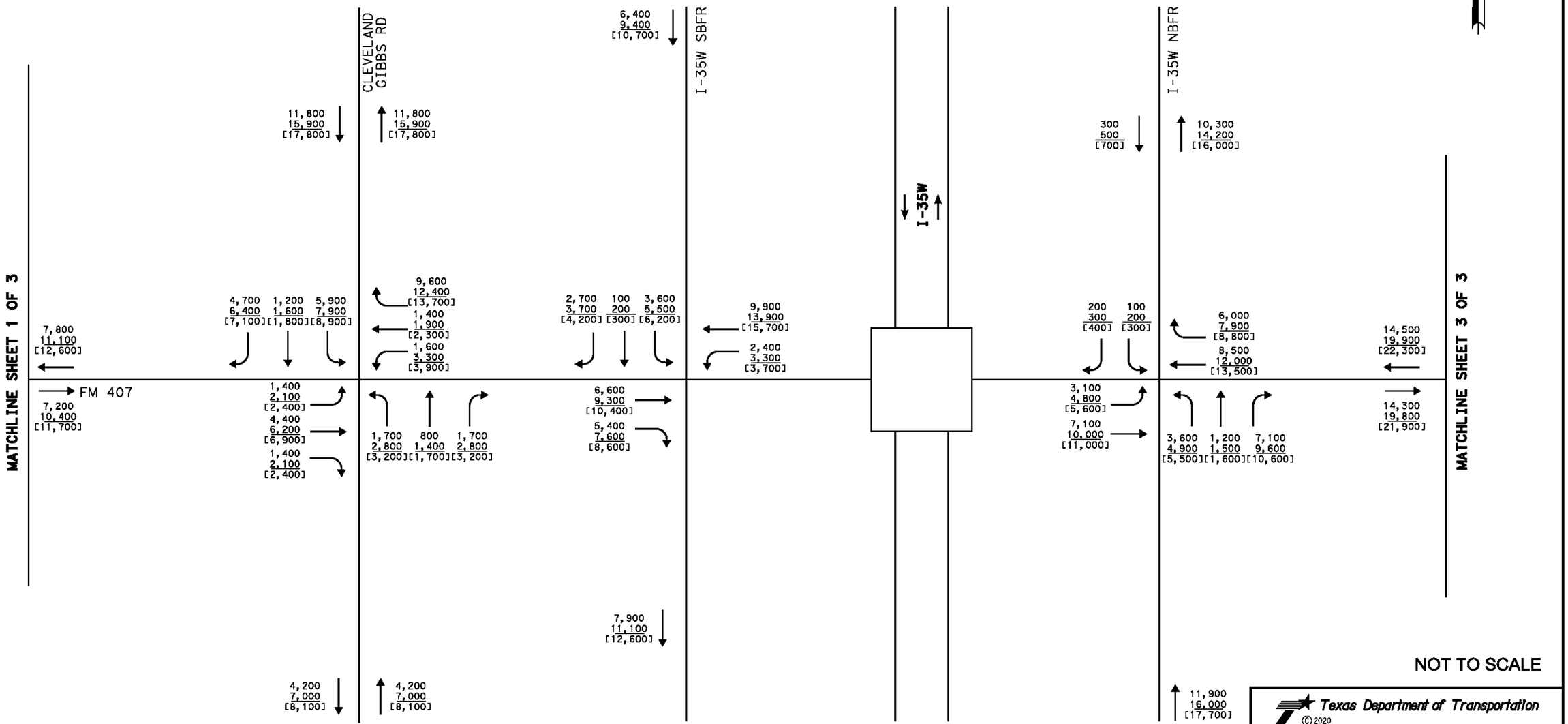
	DAL			1
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



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LEGEND
999-YEAR 2025 ADT
999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

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BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (RED ROUTE)
FROM 12TH ST TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
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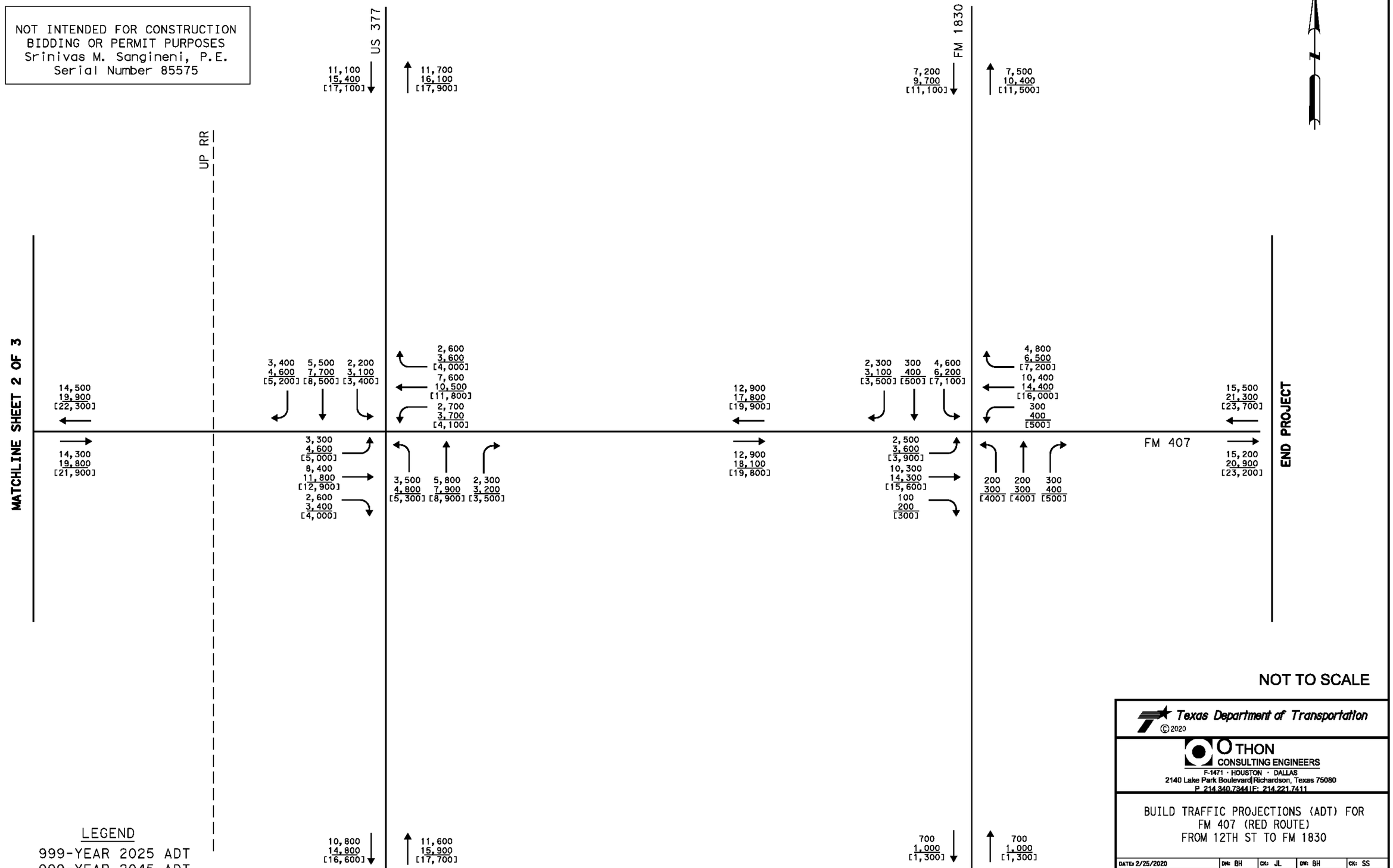
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

2/25/2020 9:52:16 AM
FM 407 Traffic Projection BuildRed_02.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND
999-YEAR 2025 ADT
999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

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BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (RED ROUTE)
FROM 12TH ST TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

2/25/2020 9:52:16 AM
FM 407 Traffic Projection BuildRed_03.dgn

Year 2045 Build Peak Hour Volumes

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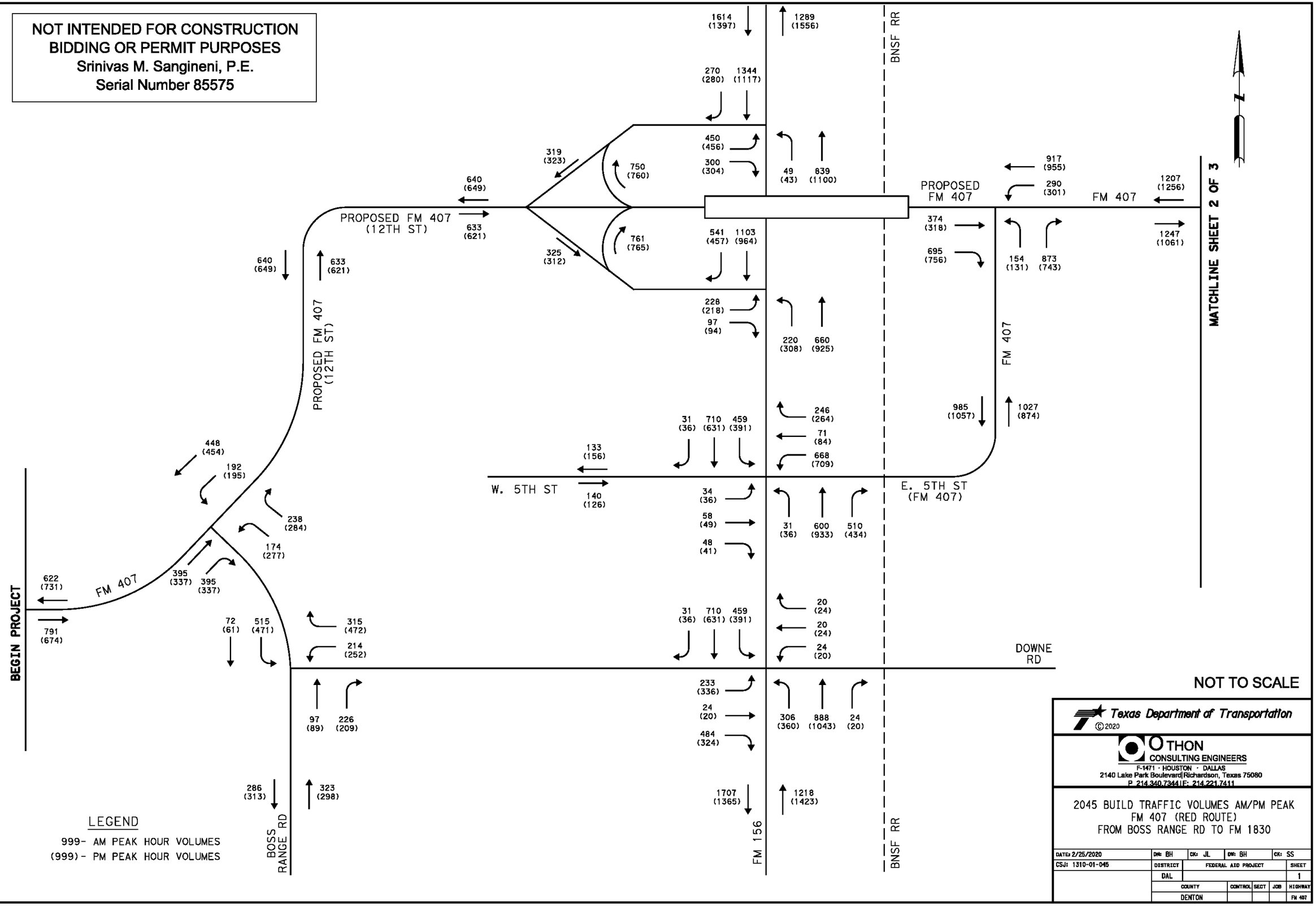
Serial Number 85575



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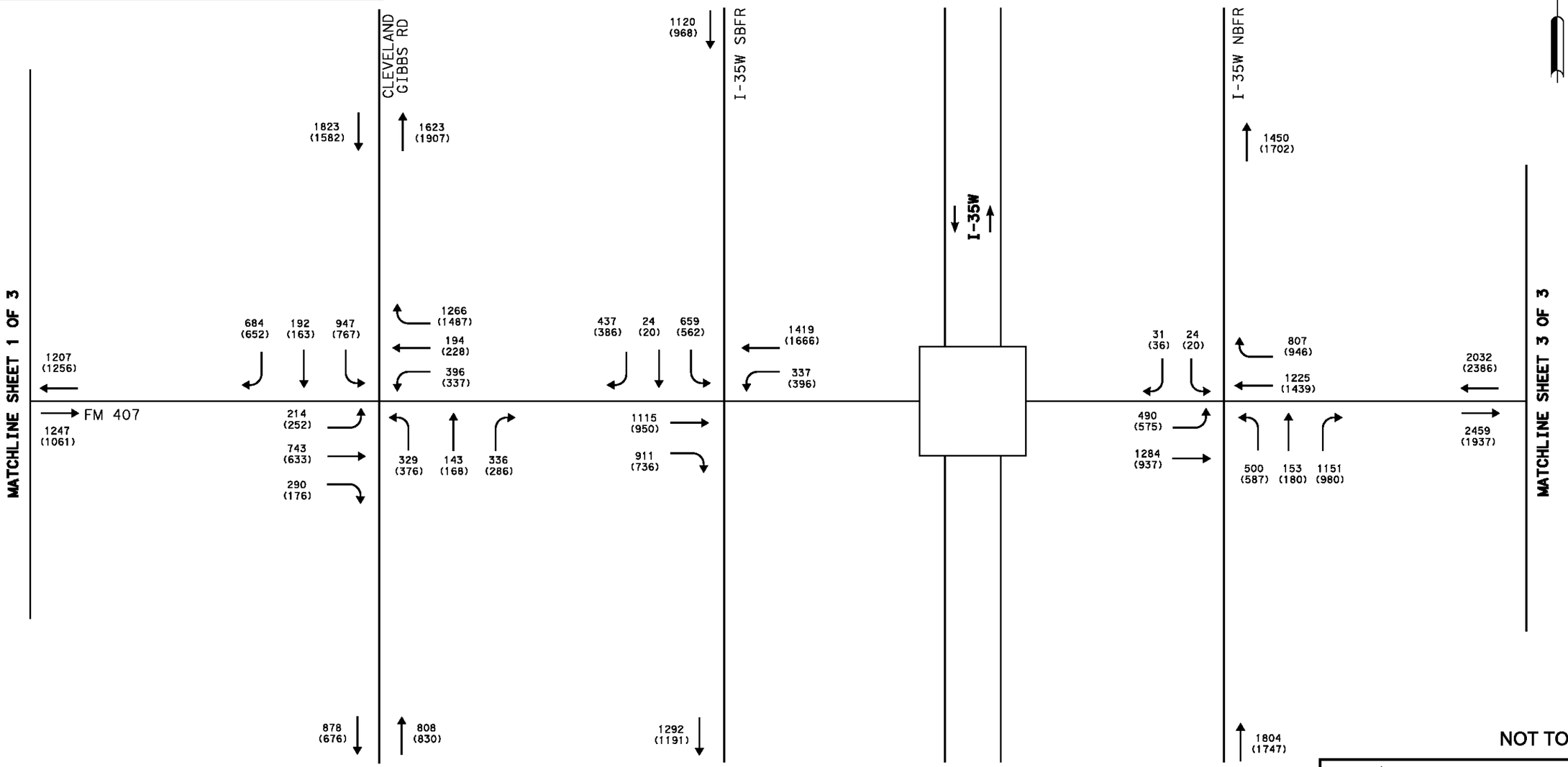
2045 BUILD TRAFFIC VOLUMES AM/PM PEAK
FM 407 (RED ROUTE)
FROM BOSS RANGE RD TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

2/25/2020 9:52:17 AM
FM 407 AMPM BuildRed_01.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



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LEGEND

999- AM PEAK HOUR VOLUMES
(999)- PM PEAK HOUR VOLUMES

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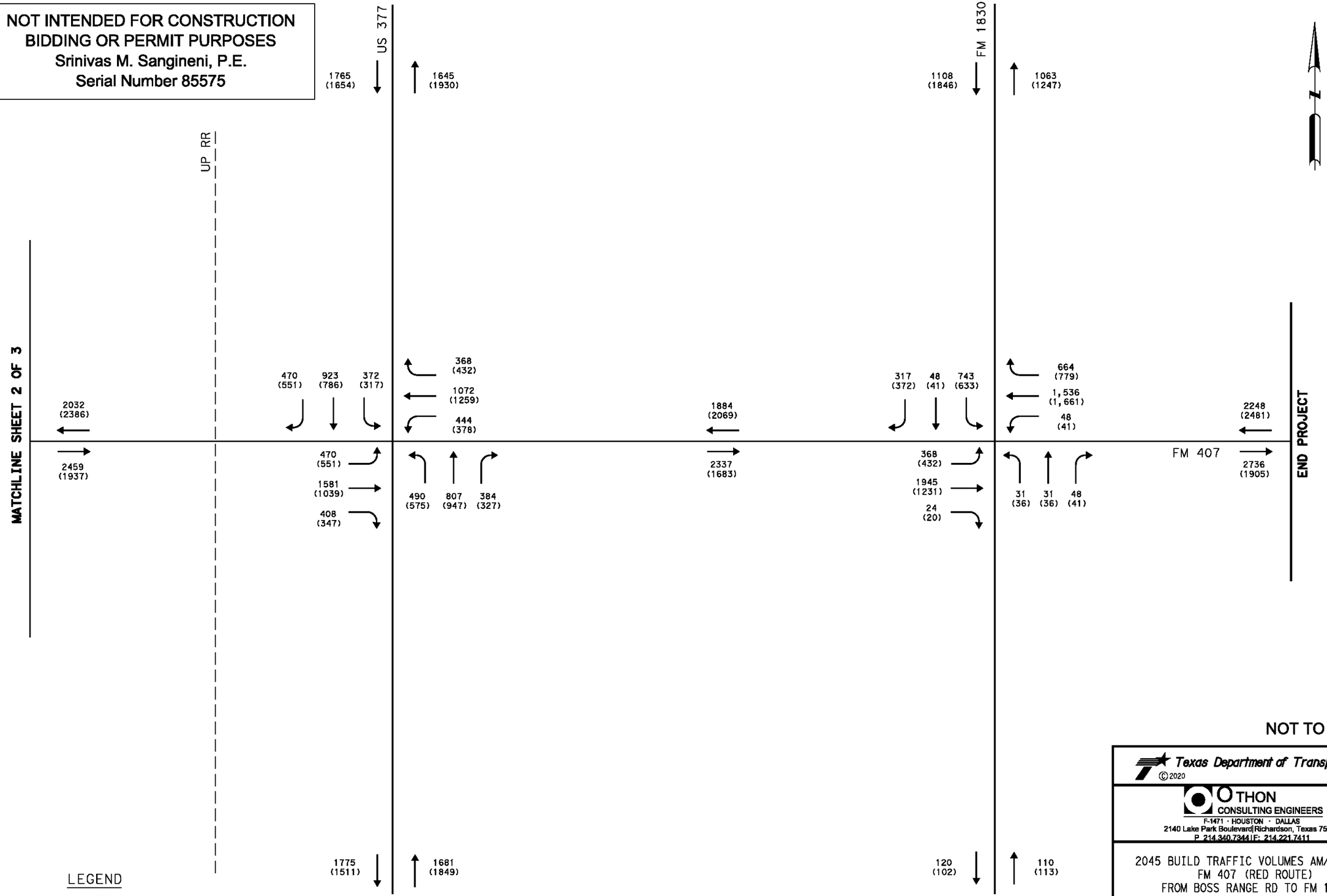
2045 BUILD TRAFFIC VOLUMES AM/PM PEAK
FM 407 (RED ROUTE)
FROM BOSS RANGE RD TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

2/25/2020 9:52:17 AM
FM 407 AMPM Build Red_02.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Srinivas M. Sangineni, P.E.
Serial Number 85575



LEGEND

999- AM PEAK HOUR VOLUMES
(999)- PM PEAK HOUR VOLUMES

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2045 BUILD TRAFFIC VOLUMES AM/PM PEAK
FM 407 (RED ROUTE)
FROM BOSS RANGE RD TO FM 1830

DATE: 2/25/2020	DN: BH	CK: JL	DW: BH	CK: SS
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

2/25/2020 9:52:18 AM
FM 407 AMPM Buildred_03.dgn

Appendix E
Detailed Synchro Outputs - Existing Year 2018

1: BOSS RANGE RD & FM 407

Intersection	
Int Delay, s/veh	8.1

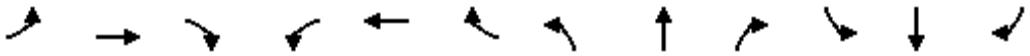
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	272	48	103	78	33	125
Future Vol, veh/h	272	48	103	78	33	125
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	52	50	75	50	59
Heavy Vehicles, %	3	4	6	9	9	4
Mvmt Flow	320	92	206	104	66	212

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	412	0	882	366
Stage 1	-	-	-	-	366	-
Stage 2	-	-	-	-	516	-
Critical Hdwy	-	-	4.16	-	6.49	6.24
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	-	-	2.254	-	3.581	3.336
Pot Cap-1 Maneuver	-	-	1126	-	308	675
Stage 1	-	-	-	-	686	-
Stage 2	-	-	-	-	585	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1126	-	248	675
Mov Cap-2 Maneuver	-	-	-	-	248	-
Stage 1	-	-	-	-	686	-
Stage 2	-	-	-	-	472	-

Approach	EB	WB	NB
HCM Control Delay, s	0	5.9	22.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	479	-	-	1126	-
HCM Lane V/C Ratio	0.58	-	-	0.183	-
HCM Control Delay (s)	22.4	-	-	8.9	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	3.6	-	-	0.7	-

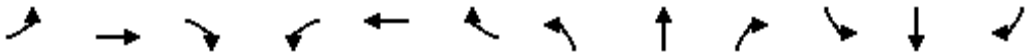
2: FM 407/DOWNE RD & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	201	0	90	0	0	0	22	263	0	0	339	97
Future Volume (vph)	201	0	90	0	0	0	22	263	0	0	339	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5						4.5			4.5	
Lane Util. Factor		1.00						1.00			1.00	
Frt		0.96						1.00			0.96	
Flt Protected		0.97						0.99			1.00	
Satd. Flow (prot)		1692						1836			1776	
Flt Permitted		0.79						0.90			1.00	
Satd. Flow (perm)		1385						1671			1776	
Peak-hour factor, PHF	0.74	0.50	0.78	0.50	0.50	0.50	0.55	0.90	0.50	0.50	0.90	0.59
Adj. Flow (vph)	272	0	115	0	0	0	40	292	0	0	377	164
RTOR Reduction (vph)	0	49	0	0	0	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	338	0	0	0	0	0	332	0	0	529	0
Heavy Vehicles (%)	5%	2%	2%	2%	2%	2%	9%	2%	2%	2%	2%	4%
Turn Type	pm+pt	NA					pm+pt	NA			NA	
Protected Phases	7	4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.1						51.9			51.9	
Effective Green, g (s)		29.1						51.9			51.9	
Actuated g/C Ratio		0.32						0.58			0.58	
Clearance Time (s)		4.5						4.5			4.5	
Vehicle Extension (s)		3.0						3.0			3.0	
Lane Grp Cap (vph)		447						963			1024	
v/s Ratio Prot											c0.30	
v/s Ratio Perm		c0.24						0.20				
v/c Ratio		0.76						0.34			0.52	
Uniform Delay, d1		27.3						10.1			11.5	
Progression Factor		1.00						1.00			0.76	
Incremental Delay, d2		7.1						0.2			1.6	
Delay (s)		34.4						10.3			10.2	
Level of Service		C						B			B	
Approach Delay (s)		34.4			0.0			10.3			10.2	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

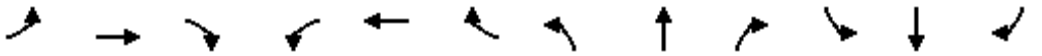
3: FM 407 /E. 5th St & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	35	14	175	36	29	10	174	292	59	257	9
Future Volume (vph)	2	35	14	175	36	29	10	174	292	59	257	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.95			0.98			0.91			0.99	
Flt Protected		1.00			0.97			1.00			0.99	
Satd. Flow (prot)		1769			1708			1601			1774	
Flt Permitted		0.98			0.77			0.99			0.82	
Satd. Flow (perm)		1741			1365			1583			1465	
Peak-hour factor, PHF	0.50	0.88	0.58	0.71	0.60	0.73	0.63	0.91	0.78	0.82	0.94	0.56
Adj. Flow (vph)	4	40	24	246	60	40	16	191	374	72	273	16
RTOR Reduction (vph)	0	17	0	0	6	0	0	54	0	0	1	0
Lane Group Flow (vph)	0	51	0	0	340	0	0	527	0	0	360	0
Heavy Vehicles (%)	2%	2%	2%	7%	3%	2%	2%	15%	5%	2%	6%	11%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		27.4			27.4			53.6			53.6	
Effective Green, g (s)		27.4			27.4			53.6			53.6	
Actuated g/C Ratio		0.30			0.30			0.60			0.60	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		530			415			942			872	
v/s Ratio Prot												
v/s Ratio Perm		0.03			c0.25			c0.33			0.25	
v/c Ratio		0.10			0.82			0.56			0.41	
Uniform Delay, d1		22.4			29.0			11.0			9.8	
Progression Factor		1.00			0.94			0.65			1.00	
Incremental Delay, d2		0.1			11.3			0.6			0.3	
Delay (s)		22.5			38.7			7.8			10.1	
Level of Service		C			D			A			B	
Approach Delay (s)		22.5			38.7			7.8			10.1	
Approach LOS		C			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

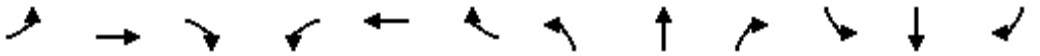
4: FM 407 & I-35W SBFR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	517	387	228	342	0	0	0	0	135	0	116
Future Volume (vph)	0	517	387	228	342	0	0	0	0	135	0	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Lane Util. Factor		1.00	1.00	1.00	1.00					1.00	1.00	
Frt		1.00	0.85	1.00	1.00					1.00	0.85	
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	
Satd. Flow (prot)		1827	1583	1736	1792					1770	1482	
Flt Permitted		1.00	1.00	0.15	1.00					0.95	1.00	
Satd. Flow (perm)		1827	1583	266	1792					1770	1482	
Peak-hour factor, PHF	0.70	0.95	0.50	0.50	0.95	0.87	0.50	0.50	0.50	0.78	0.50	0.93
Adj. Flow (vph)	0	544	774	456	360	0	0	0	0	173	0	125
RTOR Reduction (vph)	0	0	436	0	0	0	0	0	0	0	90	0
Lane Group Flow (vph)	0	544	339	456	360	0	0	0	0	173	35	0
Heavy Vehicles (%)	2%	4%	2%	4%	6%	2%	2%	2%	2%	2%	2%	9%
Turn Type		NA	Perm	pm+pt	NA					Split	NA	
Protected Phases		4		3	8					6	6	
Permitted Phases			4	8								
Actuated Green, G (s)		31.5	31.5	53.2	33.7					25.5	25.5	
Effective Green, g (s)		31.5	31.5	53.2	33.7					25.5	25.5	
Actuated g/C Ratio		0.35	0.35	0.59	0.37					0.28	0.28	
Clearance Time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	
Lane Grp Cap (vph)		639	554	475	671					501	419	
v/s Ratio Prot		0.30		c0.21	0.20					c0.10	0.02	
v/s Ratio Perm			0.21	c0.36								
v/c Ratio		0.85	0.61	0.96	0.54					0.35	0.08	
Uniform Delay, d1		27.1	24.2	23.5	22.0					25.6	23.7	
Progression Factor		0.92	0.76	1.41	0.95					1.00	1.00	
Incremental Delay, d2		13.3	4.9	26.1	2.4					1.9	0.4	
Delay (s)		38.2	23.3	59.3	23.3					27.5	24.1	
Level of Service		D	C	E	C					C	C	
Approach Delay (s)		29.5			43.4			0.0			26.1	
Approach LOS		C			D			A			C	

Intersection Summary			
HCM 2000 Control Delay	33.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	58.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

5: FM 407 & I-35W NBFR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	239	407	0	0	341	64	223	3	193	0	0	3
Future Volume (vph)	239	407	0	0	341	64	223	3	193	0	0	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00			1.00	
Frt	1.00	1.00			1.00	0.85	1.00	0.85			0.86	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00			1.00	
Satd. Flow (prot)	1770	1863			1810	1583	1719	1488			1611	
Flt Permitted	0.42	1.00			1.00	1.00	0.75	1.00			1.00	
Satd. Flow (perm)	791	1863			1810	1583	1364	1488			1611	
Peak-hour factor, PHF	0.50	0.90	0.68	0.60	0.96	0.50	0.62	0.50	0.56	0.50	0.50	0.50
Adj. Flow (vph)	478	452	0	0	355	128	360	6	345	0	0	6
RTOR Reduction (vph)	0	0	0	0	0	80	0	247	0	0	4	0
Lane Group Flow (vph)	478	452	0	0	355	48	360	104	0	0	2	0
Heavy Vehicles (%)	2%	2%	2%	2%	5%	2%	5%	2%	9%	2%	2%	2%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA			NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4					8	2			6		
Actuated Green, G (s)	48.8	31.5			33.7	33.7	25.5	25.5			25.5	
Effective Green, g (s)	48.8	31.5			33.7	33.7	25.5	25.5			25.5	
Actuated g/C Ratio	0.54	0.35			0.37	0.37	0.28	0.28			0.28	
Clearance Time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)	617	652			677	592	386	421			456	
v/s Ratio Prot	c0.15	0.24			0.20			0.07			0.00	
v/s Ratio Perm	c0.27					0.03	c0.26					
v/c Ratio	0.77	0.69			0.52	0.08	0.93	0.25			0.00	
Uniform Delay, d1	13.5	25.1			21.9	18.2	31.4	24.8			23.1	
Progression Factor	1.67	0.73			1.06	1.94	1.00	1.00			1.00	
Incremental Delay, d2	5.1	5.0			2.8	0.3	31.6	1.4			0.0	
Delay (s)	27.6	23.5			26.0	35.6	63.0	26.2			23.2	
Level of Service	C	C			C	D	E	C			C	
Approach Delay (s)		25.6			28.5			44.9			23.2	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

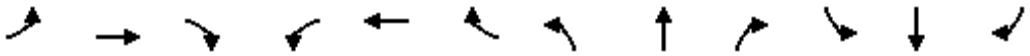
6: FM 407 & US 377

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	98	233	31	308	221	77	47	397	171	124	626	73
Future Volume (veh/h)	98	233	31	308	221	77	47	397	171	124	626	73
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1767	1826	1826	1870	1841	1870	1767	1856	1826	1870	1856	1841
Adj Flow Rate, veh/h	124	268	40	342	228	112	51	620	238	180	882	85
Peak Hour Factor	0.79	0.87	0.77	0.90	0.97	0.69	0.93	0.64	0.72	0.69	0.71	0.86
Percent Heavy Veh, %	9	5	5	2	4	2	9	3	5	2	3	4
Cap, veh/h	367	369	55	352	499	430	147	730	609	250	773	650
Arrive On Green	0.07	0.24	0.24	0.11	0.27	0.27	0.04	0.39	0.39	0.06	0.42	0.42
Sat Flow, veh/h	1682	1552	232	1781	1841	1585	1682	1856	1547	1781	1856	1560
Grp Volume(v), veh/h	124	0	308	342	228	112	51	620	238	180	882	85
Grp Sat Flow(s),veh/h/ln	1682	0	1784	1781	1841	1585	1682	1856	1547	1781	1856	1560
Q Serve(g_s), s	4.9	0.0	14.3	9.5	9.3	5.0	1.6	27.4	9.9	5.5	37.5	3.0
Cycle Q Clear(g_c), s	4.9	0.0	14.3	9.5	9.3	5.0	1.6	27.4	9.9	5.5	37.5	3.0
Prop In Lane	1.00		0.13	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	367	0	424	352	499	430	147	730	609	250	773	650
V/C Ratio(X)	0.34	0.00	0.73	0.97	0.46	0.26	0.35	0.85	0.39	0.72	1.14	0.13
Avail Cap(c_a), veh/h	367	0	424	352	499	430	173	759	633	250	773	650
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.66	0.00	0.66	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.4	0.0	31.6	29.5	27.3	25.7	21.9	24.9	19.6	20.5	26.2	16.2
Incr Delay (d2), s/veh	0.4	0.0	7.0	40.0	3.0	1.5	1.4	8.8	0.4	9.6	78.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.0	6.6	6.4	4.1	1.9	0.6	12.2	3.2	2.6	31.2	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.7	0.0	38.6	69.5	30.3	27.2	23.3	33.7	20.0	30.1	104.8	16.3
LnGrp LOS	C	A	D	E	C	C	C	C	B	C	F	B
Approach Vol, veh/h		432			682			909			1147	
Approach Delay, s/veh		34.4			49.4			29.5			86.5	
Approach LOS		C			D			C			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.2	39.9	14.0	25.9	8.1	42.0	11.0	28.9
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	5.7	36.8	9.5	20.0	5.0	37.5	6.5	23.0
Max Q Clear Time (g_c+I1), s	7.5	29.4	11.5	16.3	3.6	39.5	6.9	11.3
Green Ext Time (p_c), s	0.0	2.6	0.0	0.5	0.0	0.0	0.0	1.1

Intersection Summary	
HCM 6th Ctrl Delay	55.1
HCM 6th LOS	E

7: FM 407 & FM 1830



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	99	449	11	19	397	175	18	10	12	259	28	172
Future Volume (veh/h)	99	449	11	19	397	175	18	10	12	259	28	172
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	125	548	15	35	409	222	25	15	15	355	42	265
Peak Hour Factor	0.79	0.82	0.75	0.55	0.97	0.79	0.71	0.67	0.81	0.73	0.67	0.65
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	362	757	21	278	727	616	304	172	172	603	72	453
Arrive On Green	0.06	0.42	0.42	0.03	0.39	0.39	0.03	0.20	0.20	0.15	0.32	0.32
Sat Flow, veh/h	1781	1812	50	1781	1870	1585	1781	858	858	1781	221	1397
Grp Volume(v), veh/h	125	0	563	35	409	222	25	0	30	355	0	307
Grp Sat Flow(s),veh/h/ln	1781	0	1861	1781	1870	1585	1781	0	1716	1781	0	1619
Q Serve(g_s), s	3.7	0.0	22.7	1.0	15.4	9.0	1.0	0.0	1.3	13.5	0.0	14.2
Cycle Q Clear(g_c), s	3.7	0.0	22.7	1.0	15.4	9.0	1.0	0.0	1.3	13.5	0.0	14.2
Prop In Lane	1.00		0.03	1.00		1.00	1.00		0.50	1.00		0.86
Lane Grp Cap(c), veh/h	362	0	777	278	727	616	304	0	343	603	0	525
V/C Ratio(X)	0.35	0.00	0.72	0.13	0.56	0.36	0.08	0.00	0.09	0.59	0.00	0.58
Avail Cap(c_a), veh/h	384	0	777	319	727	616	357	0	343	603	0	525
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	16.2	0.0	21.9	17.7	21.5	19.5	27.4	0.0	29.3	22.3	0.0	25.4
Incr Delay (d2), s/veh	0.6	0.0	5.8	0.2	3.1	1.6	0.1	0.0	0.5	1.5	0.0	4.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	9.8	0.4	6.6	3.2	0.4	0.0	0.6	5.4	0.0	5.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	16.7	0.0	27.7	17.9	24.6	21.2	27.5	0.0	29.8	23.8	0.0	30.1
LnGrp LOS	B	A	C	B	C	C	C	A	C	C	A	C
Approach Vol, veh/h		688			666			55			662	
Approach Delay, s/veh		25.7			23.1			28.8			26.7	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	18.0	22.5	7.4	42.1	6.8	33.7	10.0	39.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	13.5	18.0	5.0	35.5	5.0	26.5	6.6	33.9
Max Q Clear Time (g_c+I1), s	15.5	3.3	3.0	24.7	3.0	16.2	5.7	17.4
Green Ext Time (p_c), s	0.0	0.1	0.0	2.3	0.0	1.2	0.0	2.7

Intersection Summary	
HCM 6th Ctrl Delay	25.3
HCM 6th LOS	C

1: BOSS RANGE RD & FM 407

Intersection	
Int Delay, s/veh	2.8

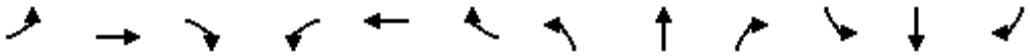
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	147	18	86	259	23	58
Future Vol, veh/h	147	18	86	259	23	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	64	90	82	82	76
Heavy Vehicles, %	2	6	2	2	4	2
Mvmt Flow	163	28	96	316	28	76

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	191	0	685	177
Stage 1	-	-	-	-	177	-
Stage 2	-	-	-	-	508	-
Critical Hdwy	-	-	4.12	-	6.44	6.22
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	-	-	2.218	-	3.536	3.318
Pot Cap-1 Maneuver	-	-	1383	-	411	866
Stage 1	-	-	-	-	849	-
Stage 2	-	-	-	-	600	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1383	-	376	866
Mov Cap-2 Maneuver	-	-	-	-	376	-
Stage 1	-	-	-	-	849	-
Stage 2	-	-	-	-	550	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.8	11.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	641	-	-	1383	-
HCM Lane V/C Ratio	0.163	-	-	0.069	-
HCM Control Delay (s)	11.7	-	-	7.8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.2	-

2: FM 407/DOWNE RD & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	92	0	76	0	0	0	114	315	0	0	382	194
Future Volume (vph)	92	0	76	0	0	0	114	315	0	0	382	194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5						4.5			4.5	
Lane Util. Factor		1.00						1.00			1.00	
Frt		0.92						1.00			0.97	
Flt Protected		0.98						0.99			1.00	
Satd. Flow (prot)		1669						1838			1804	
Flt Permitted		0.87						0.36			1.00	
Satd. Flow (perm)		1486						679			1804	
Peak-hour factor, PHF	0.97	0.95	0.50	0.50	0.93	0.75	0.50	0.50	0.50	0.69	0.50	0.84
Adj. Flow (vph)	95	0	152	0	0	0	228	630	0	0	764	231
RTOR Reduction (vph)	0	76	0	0	0	0	0	0	0	0	6	0
Lane Group Flow (vph)	0	171	0	0	0	0	0	858	0	0	989	0
Heavy Vehicles (%)	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA					pm+pt	NA			NA	
Protected Phases	7	4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.2						65.8			65.8	
Effective Green, g (s)		15.2						65.8			65.8	
Actuated g/C Ratio		0.17						0.73			0.73	
Clearance Time (s)		4.5						4.5			4.5	
Vehicle Extension (s)		3.0						3.0			3.0	
Lane Grp Cap (vph)		250						496			1318	
v/s Ratio Prot											0.55	
v/s Ratio Perm		c0.11						c1.26				
v/c Ratio		0.68						1.73			0.75	
Uniform Delay, d1		35.1						12.1			7.2	
Progression Factor		1.00						1.00			0.50	
Incremental Delay, d2		7.5						336.8			1.1	
Delay (s)		42.6						348.9			4.8	
Level of Service		D						F			A	
Approach Delay (s)		42.6			0.0			348.9			4.8	
Approach LOS		D			A			F			A	

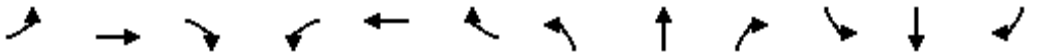
Intersection Summary			
HCM 2000 Control Delay	149.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

3: FM 407 /E. 5th St & FM 156

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	19	12	311	41	54	8	231	148	29	271	13
Future Volume (vph)	6	19	12	311	41	54	8	231	148	29	271	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.95			0.98			0.95			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1756			1757			1750			1830	
Flt Permitted		0.97			0.75			0.98			0.93	
Satd. Flow (perm)		1718			1364			1726			1713	
Peak-hour factor, PHF	0.69	0.97	0.77	0.80	0.94	0.69	0.60	0.75	0.69	0.61	0.50	0.70
Adj. Flow (vph)	9	20	16	389	44	78	13	308	214	48	542	19
RTOR Reduction (vph)	0	13	0	0	7	0	0	18	0	0	1	0
Lane Group Flow (vph)	0	32	0	0	504	0	0	517	0	0	608	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	3%	2%	3%	3%	2%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		18.5			18.5			62.5			62.5	
Effective Green, g (s)		18.5			18.5			62.5			62.5	
Actuated g/C Ratio		0.21			0.21			0.69			0.69	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		353			280			1198			1189	
v/s Ratio Prot												
v/s Ratio Perm		0.02			c0.37			0.30			c0.36	
v/c Ratio		0.09			1.80			0.43			0.51	
Uniform Delay, d1		28.9			35.8			6.0			6.5	
Progression Factor		1.00			0.53			0.38			1.00	
Incremental Delay, d2		0.1			366.3			0.0			0.4	
Delay (s)		29.1			385.4			2.3			6.9	
Level of Service		C			F			A			A	
Approach Delay (s)		29.1			385.4			2.3			6.9	
Approach LOS		C			F			A			A	

Intersection Summary			
HCM 2000 Control Delay	119.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

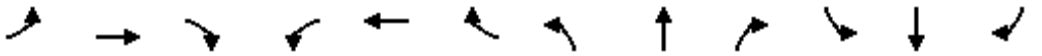
4: FM 407 & I-35W SBFR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	333	250	142	687	0	0	0	0	182	0	256
Future Volume (vph)	0	333	250	142	687	0	0	0	0	182	0	256
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Lane Util. Factor		1.00	1.00	1.00	1.00					1.00	1.00	
Frt		1.00	0.85	1.00	1.00					1.00	0.85	
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	
Satd. Flow (prot)		1863	1553	1770	1863					1770	1583	
Flt Permitted		1.00	1.00	0.39	1.00					0.95	1.00	
Satd. Flow (perm)		1863	1553	719	1863					1770	1583	
Peak-hour factor, PHF	0.89	0.95	0.50	0.50	0.94	0.86	0.50	0.50	0.50	0.87	0.50	0.77
Adj. Flow (vph)	0	351	500	284	731	0	0	0	0	209	0	332
RTOR Reduction (vph)	0	0	325	0	0	0	0	0	0	0	211	0
Lane Group Flow (vph)	0	351	175	284	731	0	0	0	0	209	121	0
Heavy Vehicles (%)	2%	2%	4%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type		NA	Perm	pm+pt	NA					Split	NA	
Protected Phases		4		3	8					6	6	
Permitted Phases			4	8								
Actuated Green, G (s)		31.5	31.5	44.5	32.3					32.8	32.8	
Effective Green, g (s)		31.5	31.5	44.5	32.3					32.8	32.8	
Actuated g/C Ratio		0.35	0.35	0.49	0.36					0.36	0.36	
Clearance Time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	
Lane Grp Cap (vph)		652	543	497	668					645	576	
v/s Ratio Prot		0.19		c0.08	c0.39					c0.12	0.08	
v/s Ratio Perm			0.11	0.20								
v/c Ratio		0.54	0.32	0.57	1.09					0.32	0.21	
Uniform Delay, d1		23.4	21.4	23.4	28.9					20.6	19.7	
Progression Factor		0.95	0.83	1.10	0.69					1.00	1.00	
Incremental Delay, d2		3.2	1.6	1.2	58.8					1.3	0.8	
Delay (s)		25.4	19.4	26.8	78.6					21.9	20.5	
Level of Service		C	B	C	E					C	C	
Approach Delay (s)		21.9			64.1			0.0			21.1	
Approach LOS		C			E			A			C	

Intersection Summary			
HCM 2000 Control Delay	39.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	59.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

5: FM 407 & I-35W NBFR

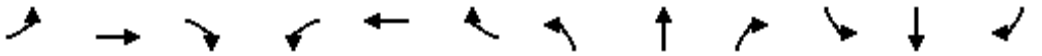


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	139	310	0	0	440	129	386	6	198	0	0	4
Future Volume (vph)	139	310	0	0	440	129	386	6	198	0	0	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00			1.00	
Frt	1.00	1.00			1.00	0.85	1.00	0.86			0.86	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00			1.00	
Satd. Flow (prot)	1770	1863			1863	1583	1770	1595			1611	
Flt Permitted	0.25	1.00			1.00	1.00	0.75	1.00			1.00	
Satd. Flow (perm)	460	1863			1863	1583	1402	1595			1611	
Peak-hour factor, PHF	0.50	0.96	0.68	0.93	0.94	0.50	0.90	0.50	0.72	0.50	0.50	0.50
Adj. Flow (vph)	278	323	0	0	468	258	429	12	275	0	0	8
RTOR Reduction (vph)	0	0	0	0	0	165	0	175	0	0	5	0
Lane Group Flow (vph)	278	323	0	0	468	93	429	112	0	0	3	0
Turn Type	pm+pt	NA			NA	Perm	Perm	NA			NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4					8	2			6		
Actuated Green, G (s)	42.9	31.5			32.3	32.3	32.8	32.8			32.8	
Effective Green, g (s)	42.9	31.5			32.3	32.3	32.8	32.8			32.8	
Actuated g/C Ratio	0.48	0.35			0.36	0.36	0.36	0.36			0.36	
Clearance Time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)	385	652			668	568	510	581			587	
v/s Ratio Prot	c0.09	0.17			0.25			0.07			0.00	
v/s Ratio Perm	c0.25					0.06	c0.31					
v/c Ratio	0.72	0.50			0.70	0.16	0.84	0.19			0.00	
Uniform Delay, d1	28.3	23.0			24.7	19.6	26.2	19.6			18.2	
Progression Factor	1.09	0.54			1.46	4.80	1.00	1.00			1.00	
Incremental Delay, d2	6.1	2.5			5.6	0.6	15.4	0.7			0.0	
Delay (s)	36.9	15.0			41.8	94.9	41.6	20.3			18.2	
Level of Service	D	B			D	F	D	C			B	
Approach Delay (s)		25.1			60.7			33.1			18.2	
Approach LOS		C			E			C			B	

Intersection Summary			
HCM 2000 Control Delay	40.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

6: FM 407 & US 377

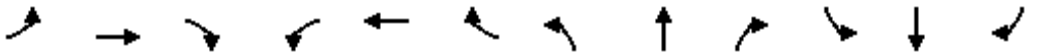


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	111	314	50	164	305	180	92	516	204	130	333	89
Future Volume (veh/h)	111	314	50	164	305	180	92	516	204	130	333	89
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1826	1870	1870	1870
Adj Flow Rate, veh/h	135	324	64	184	343	225	116	555	232	140	354	124
Peak Hour Factor	0.82	0.97	0.78	0.89	0.89	0.80	0.79	0.93	0.88	0.93	0.94	0.72
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	5	2	2	2
Cap, veh/h	233	334	66	436	624	529	237	611	505	190	608	515
Arrive On Green	0.09	0.22	0.22	0.20	0.33	0.33	0.06	0.33	0.33	0.05	0.32	0.32
Sat Flow, veh/h	1781	1517	300	1781	1870	1585	1781	1870	1547	1781	1870	1585
Grp Volume(v), veh/h	135	0	388	184	343	225	116	555	232	140	354	124
Grp Sat Flow(s),veh/h/ln	1781	0	1816	1781	1870	1585	1781	1870	1547	1781	1870	1585
Q Serve(g_s), s	6.0	0.0	19.1	3.8	13.5	7.6	4.4	25.6	10.7	2.1	14.2	5.2
Cycle Q Clear(g_c), s	6.0	0.0	19.1	3.8	13.5	7.6	4.4	25.6	10.7	2.1	14.2	5.2
Prop In Lane	1.00		0.16	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	233	0	400	436	624	529	237	611	505	190	608	515
V/C Ratio(X)	0.58	0.00	0.97	0.42	0.55	0.43	0.49	0.91	0.46	0.74	0.58	0.24
Avail Cap(c_a), veh/h	272	0	400	436	624	529	237	680	562	228	717	608
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.86	0.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.3	0.0	34.8	29.5	24.5	13.8	25.3	29.0	24.0	40.5	25.3	22.3
Incr Delay (d2), s/veh	2.0	0.0	35.1	0.7	3.5	2.5	1.6	15.3	0.7	9.7	0.9	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	0.0	11.8	3.1	5.9	3.5	1.8	12.7	3.6	3.3	5.9	1.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	34.2	0.0	69.9	30.2	27.9	16.3	26.9	44.3	24.7	50.2	26.2	22.5
LnGrp LOS	C	A	E	C	C	B	C	D	C	D	C	C
Approach Vol, veh/h		523			752			903			618	
Approach Delay, s/veh		60.7			25.0			37.0			30.9	
Approach LOS		E			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.3	33.9	22.5	24.3	9.5	33.7	12.2	34.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	6.8	32.7	12.7	19.8	5.0	34.5	9.7	22.8
Max Q Clear Time (g_c+I1), s	4.1	27.6	5.8	21.1	6.4	16.2	8.0	15.5
Green Ext Time (p_c), s	0.1	1.8	0.2	0.0	0.0	2.1	0.0	1.5

Intersection Summary	
HCM 6th Ctrl Delay	36.9
HCM 6th LOS	D

7: FM 407 & FM 1830



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	179	517	2	22	568	348	16	28	20	199	10	87
Future Volume (veh/h)	179	517	2	22	568	348	16	28	20	199	10	87
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1752	1752
Adj Flow Rate, veh/h	206	539	2	26	604	552	22	50	29	243	16	113
Peak Hour Factor	0.87	0.96	0.82	0.85	0.94	0.63	0.73	0.56	0.68	0.82	0.61	0.77
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	10	10
Cap, veh/h	305	735	3	349	707	599	291	222	129	475	55	390
Arrive On Green	0.10	0.39	0.39	0.09	0.38	0.38	0.02	0.20	0.20	0.12	0.29	0.29
Sat Flow, veh/h	1781	1862	7	1781	1870	1585	1781	1110	644	1781	188	1326
Grp Volume(v), veh/h	206	0	541	26	604	552	22	0	79	243	0	129
Grp Sat Flow(s),veh/h/ln	1781	0	1869	1781	1870	1585	1781	0	1754	1781	0	1513
Q Serve(g_s), s	3.7	0.0	22.2	0.0	26.7	29.9	0.0	0.0	3.4	0.0	0.0	5.9
Cycle Q Clear(g_c), s	3.7	0.0	22.2	0.0	26.7	29.9	0.0	0.0	3.4	0.0	0.0	5.9
Prop In Lane	1.00		0.00	1.00		1.00	1.00		0.37	1.00		0.88
Lane Grp Cap(c), veh/h	305	0	737	349	707	599	291	0	351	475	0	446
V/C Ratio(X)	0.68	0.00	0.73	0.07	0.85	0.92	0.08	0.00	0.23	0.51	0.00	0.29
Avail Cap(c_a), veh/h	305	0	737	349	707	599	348	0	351	532	0	446
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	36.0	0.0	23.2	28.3	25.7	26.7	32.5	0.0	30.2	30.2	0.0	24.5
Incr Delay (d2), s/veh	5.8	0.0	6.4	0.1	12.6	21.9	0.1	0.0	1.5	0.9	0.0	1.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	0.0	9.8	0.4	13.0	13.6	0.4	0.0	1.6	4.4	0.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	41.8	0.0	29.6	28.4	38.3	48.6	32.6	0.0	31.6	31.1	0.0	26.1
LnGrp LOS	D	A	C	C	D	D	C	A	C	C	A	C
Approach Vol, veh/h		747			1182			101			372	
Approach Delay, s/veh		33.0			42.9			31.9			29.4	
Approach LOS		C			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.1	22.5	12.4	40.0	6.6	31.0	13.9	38.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	13.5	18.0	5.0	35.5	5.0	26.5	6.5	34.0
Max Q Clear Time (g_c+I1), s	2.0	5.4	2.0	24.2	2.0	7.9	5.7	31.9
Green Ext Time (p_c), s	0.5	0.2	0.0	2.2	0.0	0.5	0.0	1.2

Intersection Summary	
HCM 6th Ctrl Delay	37.2
HCM 6th LOS	D

Appendix F
Detailed Synchro Outputs – Year 2045 No Build

1: BOSS RANGE RD & FM 407

Intersection	
Int Delay, s/veh	144

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	719	72	214	551	71	252
Future Vol, veh/h	719	72	214	551	71	252
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	8	8	8	8	8	8
Mvmt Flow	782	78	233	599	77	274

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	860	0	1886	821
Stage 1	-	-	-	-	821	-
Stage 2	-	-	-	-	1065	-
Critical Hdwy	-	-	4.18	-	6.48	6.28
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	-	-	2.272	-	3.572	3.372
Pot Cap-1 Maneuver	-	-	756	-	~ 75	365
Stage 1	-	-	-	-	422	-
Stage 2	-	-	-	-	323	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	756	-	~ 40	365
Mov Cap-2 Maneuver	-	-	-	-	~ 40	-
Stage 1	-	-	-	-	422	-
Stage 2	-	-	-	-	174	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.3	$ 830.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	131	-	-	756	-
HCM Lane V/C Ratio	2.68	-	-	0.308	-
HCM Control Delay (s)	$ 830.1	-	-	11.9	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	31.7	-	-	1.3	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

2: FM 407/DOWNE RD & FM 156

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	463	24	484	24	20	20	306	888	24	24	1199	439
Future Volume (veh/h)	463	24	484	24	20	20	306	888	24	24	1199	439
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	503	26	526	26	22	22	333	965	26	26	1303	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	455	25	507	41	32	15	319	1946	868	270	1314	
Arrive On Green	0.16	0.35	0.35	0.15	0.15	0.15	0.15	0.57	0.57	0.78	0.78	0.00
Sat Flow, veh/h	1697	72	1449	0	214	98	1697	3385	1510	541	3385	1510
Grp Volume(v), veh/h	503	0	552	70	0	0	333	965	26	26	1303	0
Grp Sat Flow(s),veh/h/ln	1697	0	1521	312	0	0	1697	1692	1510	541	1692	1510
Q Serve(g_s), s	19.5	0.0	42.0	0.0	0.0	0.0	17.9	20.3	0.9	1.4	44.8	0.0
Cycle Q Clear(g_c), s	19.5	0.0	42.0	18.0	0.0	0.0	17.9	20.3	0.9	1.4	44.8	0.0
Prop In Lane	1.00		0.95	0.37		0.31	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	455	0	532	88	0	0	319	1946	868	270	1314	
V/C Ratio(X)	1.11	0.00	1.04	0.80	0.00	0.00	1.04	0.50	0.03	0.10	0.99	
Avail Cap(c_a), veh/h	455	0	532	88	0	0	319	1946	868	270	1314	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.69	0.69	0.00
Uniform Delay (d), s/veh	39.4	0.0	39.0	49.1	0.0	0.0	38.1	15.2	11.0	8.4	13.2	0.0
Incr Delay (d2), s/veh	74.0	0.0	49.0	38.3	0.0	0.0	62.3	0.9	0.1	0.5	18.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.9	0.0	22.4	3.1	0.0	0.0	14.9	7.7	0.3	0.2	8.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	113.4	0.0	88.0	87.3	0.0	0.0	100.5	16.1	11.1	8.8	31.9	0.0
LnGrp LOS	F	A	F	F	A	A	F	B	B	A	C	
Approach Vol, veh/h		1055			70			1324			1329	A
Approach Delay, s/veh		100.1			87.3			37.2			31.4	
Approach LOS		F			F			D			C	

Timer - Assigned Phs		2		4	5	6	7	8				
Phs Duration (G+Y+Rc), s		73.5		46.5	22.4	51.1	24.0	22.5				
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s		69.0		42.0	17.9	46.6	19.5	18.0				
Max Q Clear Time (g_c+I1), s		22.3		44.0	19.9	46.8	21.5	20.0				
Green Ext Time (p_c), s		8.6		0.0	0.0	0.0	0.0	0.0				

Intersection Summary												
HCM 6th Ctrl Delay			53.7									
HCM 6th LOS			D									

Notes

Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.

3: FM 156 & FM 407/E. 5TH ST

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	72	48	503	71	633	31	860	480	695	1111	31
Future Volume (veh/h)	20	72	48	503	71	633	31	860	480	695	1111	31
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	22	78	52	547	77	688	34	935	522	755	1208	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	118	404	254	323	39	352	178	719	321	378	1808	51
Arrive On Green	0.49	0.49	0.49	0.49	0.49	0.49	0.03	0.21	0.21	0.19	0.37	0.37
Sat Flow, veh/h	172	829	520	575	81	723	1697	3385	1510	1697	4862	137
Grp Volume(v), veh/h	152	0	0	1312	0	0	34	935	522	755	805	437
Grp Sat Flow(s),veh/h/ln	1521	0	0	1379	0	0	1697	1692	1510	1697	1621	1757
Q Serve(g_s), s	0.0	0.0	0.0	52.4	0.0	0.0	1.9	25.5	25.5	22.5	24.9	24.9
Cycle Q Clear(g_c), s	6.1	0.0	0.0	58.5	0.0	0.0	1.9	25.5	25.5	22.5	24.9	24.9
Prop In Lane	0.14		0.34	0.42		0.52	1.00		1.00	1.00		0.08
Lane Grp Cap(c), veh/h	776	0	0	715	0	0	178	719	321	378	1205	653
V/C Ratio(X)	0.20	0.00	0.00	1.84	0.00	0.00	0.19	1.30	1.63	2.00	0.67	0.67
Avail Cap(c_a), veh/h	776	0	0	715	0	0	206	719	321	378	1205	653
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	0.59	0.59	0.59	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.3	0.0	0.0	32.4	0.0	0.0	35.4	47.2	47.2	35.9	31.5	31.5
Incr Delay (d2), s/veh	0.1	0.0	0.0	381.5	0.0	0.0	0.3	141.1	290.6	457.9	2.9	5.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	0.0	96.5	0.0	0.0	0.8	24.5	35.1	57.0	9.8	11.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	17.5	0.0	0.0	413.9	0.0	0.0	35.8	188.4	337.8	493.7	34.5	36.9
LnGrp LOS	B	A	A	F	A	A	D	F	F	F	C	D
Approach Vol, veh/h		152			1312			1491			1997	
Approach Delay, s/veh		17.5			413.9			237.2			208.6	
Approach LOS		B			F			F			F	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	27.0	30.0		63.0	7.9	49.1		63.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	22.5	25.5		58.5	5.4	42.6		58.5				
Max Q Clear Time (g_c+I1), s	24.5	27.5		8.1	3.9	26.9		60.5				
Green Ext Time (p_c), s	0.0	0.0		1.1	0.0	6.9		0.0				

Intersection Summary												
HCM 6th Ctrl Delay			265.8									
HCM 6th LOS			F									

4: CLEVELAND GIBBS RD & FM 407

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	214	743	290	396	194	1266	329	143	336	947	192	684
Future Vol, veh/h	214	743	290	396	194	1266	329	143	336	947	192	684
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	300	150	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	8	8	8	8	8	8	8	8	8	8	8	8
Mvmt Flow	233	808	315	430	211	1376	358	155	365	1029	209	743

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1587	0	0	1123	0	0	3667	3879	966	2763	2660	211
Stage 1	-	-	-	-	-	-	1432	1432	-	1071	1071	-
Stage 2	-	-	-	-	-	-	2235	2447	-	1692	1589	-
Critical Hdwy	4.18	-	-	4.18	-	-	7.18	6.58	6.28	7.18	6.58	6.28
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.18	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.18	5.58	-
Follow-up Hdwy	2.272	-	-	2.272	-	-	3.572	4.072	3.372	3.572	4.072	3.372
Pot Cap-1 Maneuver	397	-	-	600	-	-	~ 3	~ 3	~ 301	~ 12	~ 22	814
Stage 1	-	-	-	-	-	-	~ 162	194	-	~ 260	290	-
Stage 2	-	-	-	-	-	-	~ 54	~ 59	-	~ 114	~ 162	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	397	-	-	600	-	-	-	0	~ 301	-	0	814
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	0	-	-	0	-
Stage 1	-	-	-	-	-	-	~ 162	0	-	~ 260	290	-
Stage 2	-	-	-	-	-	-	~ 1	~ 59	-	-	0	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	4.5	5.3		
HCM LOS			-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	301	397	-	-	600	-	-	-	814
HCM Lane V/C Ratio	-	1.73	0.586	-	-	0.717	-	-	-	1.17
HCM Control Delay (s)	-	$ 371.6	26.1	0	-	24.7	0	-	-	109.2
HCM Lane LOS	-	F	D	A	-	C	A	-	-	F
HCM 95th %tile Q(veh)	-	33.3	3.6	-	-	5.9	-	-	-	29.4

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

5: I-35W SBFR & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1115	911	337	1419	0	0	0	0	659	24	437
Future Volume (vph)	0	1115	911	337	1419	0	0	0	0	659	24	437
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Lane Util. Factor		1.00	1.00	1.00	1.00					1.00	1.00	
Frt		1.00	0.85	1.00	1.00					1.00	0.86	
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	
Satd. Flow (prot)		1759	1495	1671	1759					1671	1509	
Flt Permitted		1.00	1.00	0.04	1.00					0.95	1.00	
Satd. Flow (perm)		1759	1495	79	1759					1671	1509	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1212	990	366	1542	0	0	0	0	716	26	475
RTOR Reduction (vph)	0	0	278	0	0	0	0	0	0	0	44	0
Lane Group Flow (vph)	0	1212	712	366	1542	0	0	0	0	716	457	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type		NA	Perm	pm+pt	NA					Split	NA	
Protected Phases		2		1	2 1					4	4	
Permitted Phases			2	2 1								
Actuated Green, G (s)		89.5	89.5	101.0	105.5					35.5	35.5	
Effective Green, g (s)		89.5	89.5	101.0	105.5					35.5	35.5	
Actuated g/C Ratio		0.60	0.60	0.67	0.70					0.24	0.24	
Clearance Time (s)		4.5	4.5	4.5						4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0						3.0	3.0	
Lane Grp Cap (vph)		1049	892	175	1237					395	357	
v/s Ratio Prot		0.69		c0.16	0.88					c0.43	0.30	
v/s Ratio Perm			0.48	c1.25								
v/c Ratio		1.16	0.80	2.09	1.25					1.81	1.28	
Uniform Delay, d1		30.2	23.3	65.9	22.2					57.2	57.2	
Progression Factor		1.00	1.00	0.81	0.67					1.00	1.00	
Incremental Delay, d2		80.9	7.4	492.9	111.6					375.6	145.6	
Delay (s)		111.2	30.7	546.5	126.4					432.8	202.9	
Level of Service		F	C	F	F					F	F	
Approach Delay (s)		75.0			207.0			0.0			338.2	
Approach LOS		E			F			A			F	

Intersection Summary			
HCM 2000 Control Delay	182.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.02		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	125.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

6: I-35W NBFR & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	490	1284	0	0	1225	807	500	153	1151	24	0	31
Future Volume (vph)	490	1284	0	0	1225	807	500	153	1151	24	0	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00			1.00	
Frt	1.00	1.00			1.00	0.85	1.00	0.87			0.92	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00			0.98	
Satd. Flow (prot)	1671	1759			1759	1495	1671	1526			1590	
Flt Permitted	0.07	1.00			1.00	1.00	0.73	1.00			0.34	
Satd. Flow (perm)	129	1759			1759	1495	1292	1526			544	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	533	1396	0	0	1332	877	543	166	1251	26	0	34
RTOR Reduction (vph)	0	0	0	0	0	206	0	15	0	0	34	0
Lane Group Flow (vph)	533	1396	0	0	1332	671	543	1402	0	0	26	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA		Perm	NA	
Protected Phases	5	6 5			6			8			8	
Permitted Phases	6 5					6	8	8		8		
Actuated Green, G (s)	72.0	76.5			54.5	54.5	64.5	64.5			64.5	
Effective Green, g (s)	72.0	76.5			54.5	54.5	64.5	64.5			64.5	
Actuated g/C Ratio	0.48	0.51			0.36	0.36	0.43	0.43			0.43	
Clearance Time (s)	4.5				4.5	4.5	4.5	4.5			4.5	
Vehicle Extension (s)	3.0				3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)	241	897			639	543	555	656			233	
v/s Ratio Prot	c0.26	c0.79			0.76			c0.92				
v/s Ratio Perm	c0.80					0.45	0.42				0.05	
v/c Ratio	2.21	1.56			2.08	1.24	0.98	2.14			0.11	
Uniform Delay, d1	62.8	36.8			47.8	47.8	42.1	42.8			25.6	
Progression Factor	1.12	1.19			0.79	0.69	1.00	1.00			1.00	
Incremental Delay, d2	546.5	250.8			488.5	107.9	33.2	516.6			1.0	
Delay (s)	616.7	294.6			526.4	140.9	75.3	559.3			26.5	
Level of Service	F	F			F	F	E	F			C	
Approach Delay (s)		383.6			373.3			425.2			26.5	
Approach LOS		F			F			F			C	

Intersection Summary			
HCM 2000 Control Delay	389.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.18		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	182.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

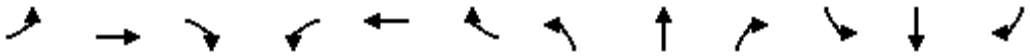
7: US 377 & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	470	1581	408	444	1072	368	490	807	384	372	923	470
Future Volume (veh/h)	470	1581	408	444	1072	368	490	807	384	372	923	470
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	511	1718	443	483	1165	400	533	877	417	404	1003	511
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	201	596	154	201	778	659	212	493	418	178	457	387
Arrive On Green	0.09	0.44	0.44	0.09	0.44	0.44	0.10	0.28	0.28	0.08	0.26	0.26
Sat Flow, veh/h	1697	1366	352	1697	1781	1510	1697	1781	1510	1697	1781	1510
Grp Volume(v), veh/h	511	0	2161	483	1165	400	533	877	417	404	1003	511
Grp Sat Flow(s),veh/h/ln	1697	0	1718	1697	1781	1510	1697	1781	1510	1697	1781	1510
Q Serve(g_s), s	13.5	0.0	65.5	13.5	65.5	30.5	14.5	41.5	41.4	11.5	38.5	38.5
Cycle Q Clear(g_c), s	13.5	0.0	65.5	13.5	65.5	30.5	14.5	41.5	41.4	11.5	38.5	38.5
Prop In Lane	1.00		0.20	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	201	0	750	201	778	659	212	493	418	178	457	387
V/C Ratio(X)	2.55	0.00	2.88	2.41	1.50	0.61	2.51	1.78	1.00	2.27	2.19	1.32
Avail Cap(c_a), veh/h	201	0	750	201	778	659	212	493	418	178	457	387
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.09	0.00	0.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	49.7	0.0	42.3	49.7	42.2	32.4	44.3	54.3	54.2	42.7	55.7	55.8
Incr Delay (d2), s/veh	697.1	0.0	846.6	648.0	230.7	4.1	695.2	358.9	43.6	588.5	544.3	160.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	42.4	0.0	202.3	39.7	76.7	11.3	46.4	66.9	20.1	33.8	85.7	31.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	746.8	0.0	888.8	697.6	272.9	36.5	739.4	413.1	97.8	631.1	600.0	216.4
LnGrp LOS	F	A	F	F	F	D	F	F	F	F	F	F
Approach Vol, veh/h		2672			2048			1827			1918	
Approach Delay, s/veh		861.6			326.9			436.3			504.4	
Approach LOS		F			F			F			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	16.0	46.0	18.0	70.0	19.0	43.0	18.0	70.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	11.5	41.5	13.5	65.5	14.5	38.5	13.5	65.5
Max Q Clear Time (g_c+I1), s	13.5	43.5	15.5	67.5	16.5	40.5	15.5	67.5
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	559.5
HCM 6th LOS	F

8: FM 1830 & FM 407



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	368	1945	24	48	1536	664	31	31	48	743	48	317
Future Volume (veh/h)	368	1945	24	48	1536	664	31	31	48	743	48	317
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	400	2114	26	52	1670	722	34	34	52	808	52	345
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	212	1008	12	98	903	765	91	76	117	402	51	337
Arrive On Green	0.10	0.57	0.57	0.03	0.51	0.51	0.03	0.12	0.12	0.16	0.25	0.25
Sat Flow, veh/h	1697	1756	22	1697	1781	1510	1697	635	971	1697	202	1339
Grp Volume(v), veh/h	400	0	2140	52	1670	722	34	0	86	808	0	397
Grp Sat Flow(s),veh/h/ln	1697	0	1778	1697	1781	1510	1697	0	1607	1697	0	1540
Q Serve(g_s), s	14.5	0.0	86.1	2.2	76.0	67.8	2.6	0.0	7.5	23.5	0.0	37.7
Cycle Q Clear(g_c), s	14.5	0.0	86.1	2.2	76.0	67.8	2.6	0.0	7.5	23.5	0.0	37.7
Prop In Lane	1.00		0.01	1.00		1.00	1.00		0.60	1.00		0.87
Lane Grp Cap(c), veh/h	212	0	1020	98	903	765	91	0	193	402	0	387
V/C Ratio(X)	1.89	0.00	2.10	0.53	1.85	0.94	0.37	0.00	0.45	2.01	0.00	1.03
Avail Cap(c_a), veh/h	212	0	1020	105	903	765	106	0	193	402	0	387
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	53.1	0.0	32.0	35.9	37.0	35.0	57.0	0.0	61.4	52.8	0.0	56.1
Incr Delay (d2), s/veh	416.3	0.0	497.5	4.4	386.9	21.4	2.5	0.0	7.3	464.3	0.0	52.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	28.3	0.0	173.9	1.0	127.3	27.5	1.2	0.0	3.4	55.9	0.0	19.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	469.4	0.0	529.4	40.3	423.9	56.4	59.5	0.0	68.7	517.1	0.0	108.4
LnGrp LOS	F	A	F	D	F	E	E	A	E	F	A	F
Approach Vol, veh/h		2540			2444			120			1205	
Approach Delay, s/veh		520.0			307.2			66.1			382.5	
Approach LOS		F			F			E			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.0	22.5	8.9	90.6	8.3	42.2	19.0	80.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	23.5	18.0	5.0	85.5	5.1	36.4	14.5	76.0
Max Q Clear Time (g_c+I1), s	25.5	9.5	4.2	88.1	4.6	39.7	16.5	78.0
Green Ext Time (p_c), s	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	402.6
HCM 6th LOS	F

1: BOSS RANGE RD & FM 407

Intersection	
Int Delay, s/veh	189.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	613	61	252	647	84	214
Future Vol, veh/h	613	61	252	647	84	214
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	8	8	8	8	8	8
Mvmt Flow	666	66	274	703	91	233

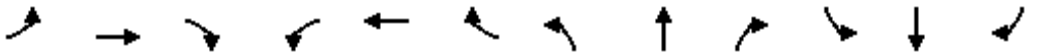
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	732	0	1950	699
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	1251	-
Critical Hdwy	-	-	4.18	-	6.48	6.28
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	-	-	2.272	-	3.572	3.372
Pot Cap-1 Maneuver	-	-	846	-	~ 68	430
Stage 1	-	-	-	-	482	-
Stage 2	-	-	-	-	262	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	846	-	~ 32	430
Mov Cap-2 Maneuver	-	-	-	-	~ 32	-
Stage 1	-	-	-	-	482	-
Stage 2	-	-	-	-	123	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.2	$ 1178.4
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	95	-	-	846	-
HCM Lane V/C Ratio	3.41	-	-	0.324	-
HCM Control Delay (s)	$ 1178.4	-	-	11.3	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	32.4	-	-	1.4	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

2: FM407/DOWNE RD & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	483	20	324	20	24	24	360	1043	20	20	1021	515
Future Volume (veh/h)	483	20	324	20	24	24	360	1043	20	20	1021	515
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	525	22	352	22	26	26	391	1134	22	22	1110	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	389	31	493	111	126	96	345	1568	699	220	1164	
Arrive On Green	0.34	0.34	0.34	0.34	0.34	0.34	0.14	0.46	0.46	0.02	0.34	0.00
Sat Flow, veh/h	1288	90	1434	152	365	280	1697	3385	1510	1697	3385	1510
Grp Volume(v), veh/h	525	0	374	74	0	0	391	1134	22	22	1110	0
Grp Sat Flow(s),veh/h/ln	1288	0	1523	798	0	0	1697	1692	1510	1697	1692	1510
Q Serve(g_s), s	9.7	0.0	17.1	0.7	0.0	0.0	11.5	21.6	0.6	0.7	25.6	0.0
Cycle Q Clear(g_c), s	27.5	0.0	17.1	17.8	0.0	0.0	11.5	21.6	0.6	0.7	25.6	0.0
Prop In Lane	1.00		0.94	0.30		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	389	0	524	333	0	0	345	1568	699	220	1164	
V/C Ratio(X)	1.35	0.00	0.71	0.22	0.00	0.00	1.13	0.72	0.03	0.10	0.95	
Avail Cap(c_a), veh/h	389	0	524	333	0	0	345	1568	699	285	1164	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.72	0.72	0.00
Uniform Delay (d), s/veh	31.2	0.0	22.8	19.0	0.0	0.0	21.1	17.3	11.7	17.1	25.6	0.0
Incr Delay (d2), s/veh	173.6	0.0	4.6	0.3	0.0	0.0	89.3	2.9	0.1	0.1	13.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	26.2	0.0	6.3	0.9	0.0	0.0	12.6	8.2	0.2	0.2	11.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	204.8	0.0	27.4	19.4	0.0	0.0	110.4	20.3	11.8	17.3	39.5	0.0
LnGrp LOS	F	A	C	B	A	A	F	C	B	B	D	
Approach Vol, veh/h		899			74			1547			1132	A
Approach Delay, s/veh		131.0			19.4			42.9			39.0	
Approach LOS		F			B			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.4	41.6		32.0	16.0	32.0		32.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	34.0		27.5	11.5	27.5		27.5				
Max Q Clear Time (g_c+I1), s	2.7	23.6		29.5	13.5	27.6		19.8				
Green Ext Time (p_c), s	0.0	5.6		0.0	0.0	0.0		0.2				

Intersection Summary			
HCM 6th Ctrl Delay		62.9	
HCM 6th LOS		E	

Notes

Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.

3: FM 156 & FM 407/E. 5TH ST

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	24	61	41	429	84	743	36	1106	408	592	1086	36
Future Volume (veh/h)	24	61	41	429	84	743	36	1106	408	592	1086	36
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	26	66	45	466	91	808	39	1202	443	643	1180	39
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	136	334	211	272	45	396	196	877	391	320	1825	60
Arrive On Green	0.47	0.47	0.47	0.47	0.47	0.47	0.03	0.26	0.26	0.15	0.38	0.38
Sat Flow, veh/h	207	712	450	487	95	845	1697	3385	1510	1697	4835	160
Grp Volume(v), veh/h	137	0	0	1365	0	0	39	1202	443	643	791	428
Grp Sat Flow(s),veh/h/ln	1369	0	0	1427	0	0	1697	1692	1510	1697	1621	1753
Q Serve(g_s), s	0.0	0.0	0.0	46.3	0.0	0.0	1.8	28.5	28.5	16.5	22.1	22.1
Cycle Q Clear(g_c), s	5.2	0.0	0.0	51.5	0.0	0.0	1.8	28.5	28.5	16.5	22.1	22.1
Prop In Lane	0.19		0.33	0.34		0.59	1.00		1.00	1.00		0.09
Lane Grp Cap(c), veh/h	680	0	0	712	0	0	196	877	391	320	1224	662
V/C Ratio(X)	0.20	0.00	0.00	1.92	0.00	0.00	0.20	1.37	1.13	2.01	0.65	0.65
Avail Cap(c_a), veh/h	680	0	0	712	0	0	221	877	391	320	1224	662
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	0.46	0.46	0.46	1.00	1.00	1.00
Uniform Delay (d), s/veh	16.9	0.0	0.0	30.6	0.0	0.0	28.7	40.8	40.8	32.2	28.2	28.2
Incr Delay (d2), s/veh	0.1	0.0	0.0	417.9	0.0	0.0	0.2	170.2	74.2	465.3	2.6	4.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	0.0	101.3	0.0	0.0	0.7	32.0	18.1	47.7	8.5	9.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	17.1	0.0	0.0	448.5	0.0	0.0	29.0	211.0	114.9	497.5	30.8	33.0
LnGrp LOS	B	A	A	F	A	A	C	F	F	F	C	C
Approach Vol, veh/h		137			1365			1684			1862	
Approach Delay, s/veh		17.1			448.5			181.5			192.5	
Approach LOS		B			F			F			F	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	21.0	33.0		56.0	8.0	46.0		56.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	16.5	28.5		51.5	5.1	39.9		51.5				
Max Q Clear Time (g_c+I1), s	18.5	30.5		7.2	3.8	24.1		53.5				
Green Ext Time (p_c), s	0.0	0.0		1.1	0.0	6.8		0.0				

Intersection Summary												
HCM 6th Ctrl Delay			253.3									
HCM 6th LOS			F									

4: CLEVELAND GIBBS RD & FM 407

Intersection	
Int Delay, s/veh	3.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	252	633	176	337	228	1487	376	168	286	767	163	652
Future Vol, veh/h	252	633	176	337	228	1487	376	168	286	767	163	652
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	300	150	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	8	8	8	8	8	8	8	8	8	8	8	8
Mvmt Flow	274	688	191	366	248	1616	409	183	311	834	177	709

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1864	0	0	879	0	0	3563	3928	784	2559	2407	248
Stage 1	-	-	-	-	-	-	1332	1332	-	980	980	-
Stage 2	-	-	-	-	-	-	2231	2596	-	1579	1427	-
Critical Hdwy	4.18	-	-	4.18	-	-	7.18	6.58	6.28	7.18	6.58	6.28
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.18	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.18	5.58	-
Follow-up Hdwy	2.272	-	-	2.272	-	-	3.572	4.072	3.372	3.572	4.072	3.372
Pot Cap-1 Maneuver	309	-	-	744	-	-	~ 3	~ 3	384	~ 17	~ 32	776
Stage 1	-	-	-	-	-	-	~ 185	217	-	~ 293	320	-
Stage 2	-	-	-	-	-	-	~ 54	~ 49	-	~ 133	195	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	309	-	-	744	-	-	-	0	384	-	0	776
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	0	-	-	0	-
Stage 1	-	-	-	-	-	-	~ 185	0	-	~ 293	320	-
Stage 2	-	-	-	-	-	-	~ 2	~ 49	-	-	0	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.2	2.4		
HCM LOS			-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	384	309	-	-	744	-	-	-	776
HCM Lane V/C Ratio	-	1.285	0.886	-	-	0.492	-	-	-	1.142
HCM Control Delay (s)	-	176.2	63.9	0	-	14.4	0	-	-	99.8
HCM Lane LOS	-	F	F	A	-	B	A	-	-	F
HCM 95th %tile Q(veh)	-	22.1	8.2	-	-	2.7	-	-	-	26.3

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

5: I-35W SBFR & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	950	736	396	1666	0	0	0	0	562	20	386
Future Volume (vph)	0	950	736	396	1666	0	0	0	0	562	20	386
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	
Lane Util. Factor		1.00	1.00	1.00	1.00					1.00	1.00	
Frt		1.00	0.85	1.00	1.00					1.00	0.86	
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	
Satd. Flow (prot)		1759	1495	1671	1759					1671	1509	
Flt Permitted		1.00	1.00	0.05	1.00					0.95	1.00	
Satd. Flow (perm)		1759	1495	97	1759					1671	1509	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1033	800	430	1811	0	0	0	0	611	22	420
RTOR Reduction (vph)	0	0	262	0	0	0	0	0	0	0	31	0
Lane Group Flow (vph)	0	1033	538	430	1811	0	0	0	0	611	411	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type		NA	Perm	pm+pt	NA					Split	NA	
Protected Phases		2		1	2 1					4	4	
Permitted Phases			2	2 1								
Actuated Green, G (s)		91.5	91.5	105.0	109.5					31.5	31.5	
Effective Green, g (s)		91.5	91.5	105.0	109.5					31.5	31.5	
Actuated g/C Ratio		0.61	0.61	0.70	0.73					0.21	0.21	
Clearance Time (s)		4.5	4.5	4.5						4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0						3.0	3.0	
Lane Grp Cap (vph)		1072	911	209	1284					350	316	
v/s Ratio Prot		0.59		c0.18	1.03					c0.37	0.27	
v/s Ratio Perm			0.36	c1.26								
v/c Ratio		0.96	0.59	2.06	1.41					1.75	1.30	
Uniform Delay, d1		27.7	17.8	58.6	20.2					59.2	59.2	
Progression Factor		1.00	1.00	0.91	0.76					1.00	1.00	
Incremental Delay, d2		20.0	2.8	477.3	185.1					347.2	156.8	
Delay (s)		47.7	20.6	530.4	200.4					406.5	216.1	
Level of Service		D	C	F	F					F	F	
Approach Delay (s)		35.9			263.7			0.0			326.5	
Approach LOS		D			F			A			F	

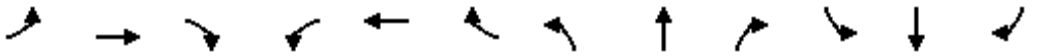
Intersection Summary			
HCM 2000 Control Delay	195.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.98		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	126.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

6: I-35W NBFR & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	575	937	0	0	1439	946	587	180	980	20	0	36
Future Volume (vph)	575	937	0	0	1439	946	587	180	980	20	0	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00			1.00	
Frt	1.00	1.00			1.00	0.85	1.00	0.87			0.91	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00			0.98	
Satd. Flow (prot)	1671	1759			1759	1495	1671	1536			1579	
Flt Permitted	0.07	1.00			1.00	1.00	0.73	1.00			0.36	
Satd. Flow (perm)	114	1759			1759	1495	1284	1536			579	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	625	1018	0	0	1564	1028	638	196	1065	22	0	39
RTOR Reduction (vph)	0	0	0	0	0	205	0	67	0	0	39	0
Lane Group Flow (vph)	625	1018	0	0	1564	823	638	1194	0	0	22	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA		Perm	NA	
Protected Phases	5	6 5			6			8			8	
Permitted Phases	6 5					6	8	8		8		
Actuated Green, G (s)	82.0	86.5			61.5	61.5	54.5	54.5			54.5	
Effective Green, g (s)	82.0	86.5			61.5	61.5	54.5	54.5			54.5	
Actuated g/C Ratio	0.55	0.58			0.41	0.41	0.36	0.36			0.36	
Clearance Time (s)	4.5				4.5	4.5	4.5	4.5			4.5	
Vehicle Extension (s)	3.0				3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)	275	1014			721	612	466	558			210	
v/s Ratio Prot	c0.31	0.58			0.89			c0.78				
v/s Ratio Perm	c0.93					0.55	0.50				0.04	
v/c Ratio	2.27	1.00			2.17	1.34	1.37	2.14			0.11	
Uniform Delay, d1	61.3	31.8			44.2	44.2	47.8	47.8			31.6	
Progression Factor	1.19	1.35			0.82	0.86	1.00	1.00			1.00	
Incremental Delay, d2	573.8	9.4			526.6	155.9	179.4	519.0			1.0	
Delay (s)	647.0	52.4			562.8	193.9	227.1	566.8			32.6	
Level of Service	F	D			F	F	F	F			C	
Approach Delay (s)		278.6			416.5			452.6			32.6	
Approach LOS		F			F			F			C	

Intersection Summary			
HCM 2000 Control Delay	387.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.22		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	188.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

7: US 377 & FM 407

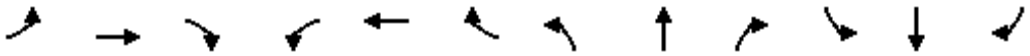


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	551	1039	347	378	1259	432	575	947	327	317	786	551
Future Volume (veh/h)	551	1039	347	378	1259	432	575	947	327	317	786	551
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	599	1129	377	411	1368	470	625	1029	355	345	854	599
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	257	532	178	189	671	569	269	552	468	167	445	377
Arrive On Green	0.12	0.42	0.42	0.08	0.38	0.38	0.13	0.31	0.31	0.07	0.25	0.25
Sat Flow, veh/h	1697	1278	427	1697	1781	1510	1697	1781	1510	1697	1781	1510
Grp Volume(v), veh/h	599	0	1506	411	1368	470	625	1029	355	345	854	599
Grp Sat Flow(s),veh/h/ln	1697	0	1705	1697	1781	1510	1697	1781	1510	1697	1781	1510
Q Serve(g_s), s	18.5	0.0	62.5	12.5	56.5	42.3	19.5	46.5	31.8	10.5	37.5	37.5
Cycle Q Clear(g_c), s	18.5	0.0	62.5	12.5	56.5	42.3	19.5	46.5	31.8	10.5	37.5	37.5
Prop In Lane	1.00		0.25	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	257	0	710	189	671	569	269	552	468	167	445	377
V/C Ratio(X)	2.33	0.00	2.12	2.17	2.04	0.83	2.33	1.86	0.76	2.07	1.92	1.59
Avail Cap(c_a), veh/h	257	0	710	189	671	569	269	552	468	167	445	377
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.09	0.00	0.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.4	0.0	43.8	46.6	46.7	42.3	47.2	51.7	46.7	44.6	56.3	56.3
Incr Delay (d2), s/veh	598.9	0.0	504.6	543.7	472.6	12.9	608.8	395.4	7.1	501.0	421.2	276.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	47.9	0.0	124.3	32.5	111.7	17.0	52.2	80.5	12.4	27.7	68.3	42.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	649.3	0.0	548.3	590.3	519.4	55.3	656.0	447.1	53.7	545.6	477.4	332.8
LnGrp LOS	F	A	F	F	F	E	F	F	D	F	F	F
Approach Vol, veh/h		2105			2249			2009			1798	
Approach Delay, s/veh		577.1			435.3			442.6			442.3	
Approach LOS		F			F			F			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	51.0	17.0	67.0	24.0	42.0	23.0	61.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	10.5	46.5	12.5	62.5	19.5	37.5	18.5	56.5
Max Q Clear Time (g_c+I1), s	12.5	48.5	14.5	64.5	21.5	39.5	20.5	58.5
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	475.2
HCM 6th LOS	F

8: FM 1830 & FM 407



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	432	1231	20	41	1661	779	36	36	41	633	41	372
Future Volume (veh/h)	432	1231	20	41	1661	779	36	36	41	633	41	372
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	470	1338	22	45	1805	847	39	39	45	688	45	404
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	235	1063	17	96	938	795	94	91	104	347	33	299
Arrive On Green	0.11	0.61	0.61	0.03	0.53	0.53	0.03	0.12	0.12	0.12	0.22	0.22
Sat Flow, veh/h	1697	1748	29	1697	1781	1510	1697	754	870	1697	154	1379
Grp Volume(v), veh/h	470	0	1360	45	1805	847	39	0	84	688	0	449
Grp Sat Flow(s),veh/h/ln	1697	0	1776	1697	1781	1510	1697	0	1625	1697	0	1533
Q Serve(g_s), s	16.5	0.0	91.3	1.8	79.0	79.0	3.0	0.0	7.2	18.5	0.0	32.5
Cycle Q Clear(g_c), s	16.5	0.0	91.3	1.8	79.0	79.0	3.0	0.0	7.2	18.5	0.0	32.5
Prop In Lane	1.00		0.02	1.00		1.00	1.00		0.54	1.00		0.90
Lane Grp Cap(c), veh/h	235	0	1081	96	938	795	94	0	195	347	0	332
V/C Ratio(X)	2.00	0.00	1.26	0.47	1.92	1.07	0.42	0.00	0.43	1.98	0.00	1.35
Avail Cap(c_a), veh/h	235	0	1081	105	938	795	105	0	195	347	0	332
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	54.3	0.0	29.4	36.1	35.5	35.5	57.0	0.0	61.2	56.0	0.0	58.8
Incr Delay (d2), s/veh	466.3	0.0	123.9	3.5	419.7	50.8	2.9	0.0	6.8	451.5	0.0	177.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	38.7	0.0	71.2	0.9	140.5	37.6	1.3	0.0	3.3	48.0	0.0	28.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	520.6	0.0	153.2	39.6	455.2	86.3	59.9	0.0	68.1	507.5	0.0	236.1
LnGrp LOS	F	A	F	D	F	F	E	A	E	F	A	F
Approach Vol, veh/h		1830			2697			123			1137	
Approach Delay, s/veh		247.6			332.4			65.5			400.3	
Approach LOS		F			F			E			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	23.0	22.5	8.7	95.8	8.5	37.0	21.0	83.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	18.5	18.0	5.0	90.5	5.0	31.5	16.5	79.0
Max Q Clear Time (g_c+I1), s	20.5	9.2	3.8	93.3	5.0	34.5	18.5	81.0
Green Ext Time (p_c), s	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	313.2
HCM 6th LOS	F

Appendix G
Detailed Synchro Outputs – Year 2045 Build

1: BOSS RANGE RD & PROPOSED FM 407 (12TH St)

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	174	238	395	395	192	448
Future Volume (vph)	174	238	395	395	192	448
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1671	1495	4803	1495	1671	4803
Flt Permitted	0.95	1.00	1.00	1.00	0.40	1.00
Satd. Flow (perm)	1671	1495	4803	1495	702	4803
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	189	259	429	429	209	487
RTOR Reduction (vph)	0	211	0	304	0	0
Lane Group Flow (vph)	189	48	429	125	209	487
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	3	3		2	6	
Actuated Green, G (s)	13.1	13.1	20.4	20.4	47.9	47.9
Effective Green, g (s)	13.1	13.1	20.4	20.4	47.9	47.9
Actuated g/C Ratio	0.19	0.19	0.29	0.29	0.68	0.68
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	312	279	1399	435	798	3286
v/s Ratio Prot			c0.09		c0.09	0.10
v/s Ratio Perm	c0.11	0.03		0.08	0.09	
v/c Ratio	0.61	0.17	0.31	0.29	0.26	0.15
Uniform Delay, d1	26.1	23.9	19.3	19.2	4.2	3.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.3	0.3	0.6	1.7	0.8	0.1
Delay (s)	29.4	24.2	19.9	20.8	5.0	4.0
Level of Service	C	C	B	C	A	A
Approach Delay (s)	26.4		20.4			4.3
Approach LOS	C		C			A

Intersection Summary			
HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	42.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

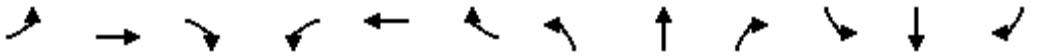
2: EXIST FM 407 & BOSS RANGE RD

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	214	315	97	226	515	72
Future Volume (veh/h)	214	315	97	226	515	72
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	233	342	105	246	560	78
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	509	453	980	830	632	980
Arrive On Green	0.30	0.30	0.55	0.55	0.55	0.55
Sat Flow, veh/h	1697	1510	1781	1510	981	1781
Grp Volume(v), veh/h	233	342	105	246	560	78
Grp Sat Flow(s),veh/h/ln	1697	1510	1781	1510	981	1781
Q Serve(g_s), s	6.7	12.3	1.7	5.3	31.3	1.2
Cycle Q Clear(g_c), s	6.7	12.3	1.7	5.3	33.0	1.2
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	509	453	980	830	632	980
V/C Ratio(X)	0.46	0.76	0.11	0.30	0.89	0.08
Avail Cap(c_a), veh/h	509	453	980	830	632	980
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.68	0.68	1.00	1.00	0.82	0.82
Uniform Delay (d), s/veh	17.0	19.0	6.5	7.3	15.7	6.4
Incr Delay (d2), s/veh	2.0	7.8	0.2	0.9	14.2	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	4.5	0.6	1.6	9.1	0.4
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	19.1	26.8	6.7	8.2	29.9	6.5
LnGrp LOS	B	C	A	A	C	A
Approach Vol, veh/h	575		351			638
Approach Delay, s/veh	23.7		7.7			27.1
Approach LOS	C		A			C

Timer - Assigned Phs		2			6	8
Phs Duration (G+Y+Rc), s		37.5			37.5	22.5
Change Period (Y+Rc), s		4.5			4.5	4.5
Max Green Setting (Gmax), s		33.0			33.0	18.0
Max Q Clear Time (g_c+I1), s		7.3			35.0	14.3
Green Ext Time (p_c), s		1.4			0.0	0.8

Intersection Summary		
HCM 6th Ctrl Delay		21.5
HCM 6th LOS		C

3: EXIST FM 407/Downe Rd & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	233	24	484	24	20	20	306	888	24	459	710	3
Future Volume (veh/h)	233	24	484	24	20	20	306	888	24	459	710	3
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	253	26	526	26	22	22	333	965	26	499	772	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	367	412	614	225	194	226	428	1088	485	577	1356	
Arrive On Green	0.23	0.23	0.23	0.23	0.23	0.23	0.20	0.32	0.32	0.28	0.40	0.00
Sat Flow, veh/h	1298	1781	2657	645	837	977	1697	3385	1510	1697	3385	1510
Grp Volume(v), veh/h	253	26	526	37	0	33	333	965	26	499	772	0
Grp Sat Flow(s),veh/h/ln	1298	1781	1329	1014	0	1445	1697	1692	1510	1697	1692	1510
Q Serve(g_s), s	15.2	0.9	15.2	0.8	0.0	1.4	13.9	21.6	1.0	17.1	14.2	0.0
Cycle Q Clear(g_c), s	16.7	0.9	15.2	1.7	0.0	1.4	13.9	21.6	1.0	17.1	14.2	0.0
Prop In Lane	1.00		1.00	0.69		0.68	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	367	412	614	311	0	334	428	1088	485	577	1356	
V/C Ratio(X)	0.69	0.06	0.86	0.12	0.00	0.10	0.78	0.89	0.05	0.87	0.57	
Avail Cap(c_a), veh/h	367	412	614	311	0	334	444	1155	515	577	1356	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	1.00	0.00	1.00	1.00	1.00	1.00	0.43	0.43	0.00
Uniform Delay (d), s/veh	30.7	24.0	29.5	24.2	0.0	24.2	25.4	25.8	18.7	25.2	18.6	0.0
Incr Delay (d2), s/veh	3.8	0.0	8.4	0.2	0.0	0.1	8.2	10.7	0.2	6.2	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.7	0.4	5.4	0.6	0.0	0.5	6.1	9.5	0.3	9.0	5.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	34.5	24.0	37.8	24.4	0.0	24.3	33.6	36.5	18.9	31.4	19.4	0.0
LnGrp LOS	C	C	D	C	A	C	C	D	B	C	B	
Approach Vol, veh/h		805			70			1324			1271	A
Approach Delay, s/veh		36.4			24.3			35.4			24.1	
Approach LOS		D			C			D			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	26.8	30.2		23.0	20.5	36.5		23.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	20.7	27.3		18.5	16.7	31.3		18.5				
Max Q Clear Time (g_c+I1), s	19.1	23.6		18.7	15.9	16.2		3.7				
Green Ext Time (p_c), s	0.3	2.1		0.0	0.1	4.5		0.3				

Intersection Summary			
HCM 6th Ctrl Delay		31.3	
HCM 6th LOS		C	

Notes

Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.

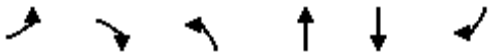
4: FM 156 & FM 407/E. 5TH ST

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	34	58	48	668	71	246	31	600	510	459	710	31
Future Volume (veh/h)	34	58	48	668	71	246	31	600	510	459	710	31
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	37	63	52	726	77	267	34	652	554	499	772	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	312	266	225	799	371	314	464	1303	581	577	1078	481
Arrive On Green	0.04	0.15	0.15	0.10	0.21	0.21	0.18	0.39	0.39	0.11	0.32	0.32
Sat Flow, veh/h	1697	1781	1510	3291	1781	1510	1697	3385	1510	3291	3385	1510
Grp Volume(v), veh/h	37	63	52	726	77	267	34	652	554	499	772	34
Grp Sat Flow(s),veh/h/ln	1697	1781	1510	1646	1781	1510	1697	1692	1510	1646	1692	1510
Q Serve(g_s), s	1.3	2.2	1.4	6.7	2.5	11.9	0.0	10.3	25.0	7.9	14.1	0.8
Cycle Q Clear(g_c), s	1.3	2.2	1.4	6.7	2.5	11.9	0.0	10.3	25.0	7.9	14.1	0.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	312	266	225	799	371	314	464	1303	581	577	1078	481
V/C Ratio(X)	0.12	0.24	0.23	0.91	0.21	0.85	0.07	0.50	0.95	0.86	0.72	0.07
Avail Cap(c_a), veh/h	371	458	388	799	501	425	464	1303	581	577	1078	481
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.46	0.46	0.46	0.61	0.61	0.61
Uniform Delay (d), s/veh	23.7	26.3	10.7	26.7	22.9	26.7	19.8	16.4	20.9	23.2	21.1	9.5
Incr Delay (d2), s/veh	0.2	0.5	0.5	14.2	0.3	11.5	0.0	0.6	16.3	8.4	2.5	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.9	0.7	4.4	1.0	5.0	0.4	3.6	10.4	3.8	5.3	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.9	26.7	11.2	40.9	23.2	38.2	19.8	17.0	37.2	31.6	23.6	9.7
LnGrp LOS	C	C	B	D	C	D	B	B	D	C	C	A
Approach Vol, veh/h		152			1070			1240			1305	
Approach Delay, s/veh		20.7			39.0			26.1			26.3	
Approach LOS		C			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.4	31.5	11.2	14.9	17.1	26.8	7.1	19.1
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.9	19.4	6.7	18.0	5.0	22.3	5.0	19.7
Max Q Clear Time (g_c+I1), s	9.9	27.0	8.7	4.2	2.0	16.1	3.3	13.9
Green Ext Time (p_c), s	0.0	0.0	0.0	0.3	0.0	2.6	0.0	0.7

Intersection Summary	
HCM 6th Ctrl Delay	29.6
HCM 6th LOS	C

5: PROPOSED FM 407 (12TH ST) WB RAMP & FM 156

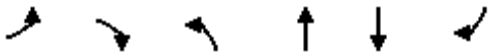


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	450	300	49	839	1344	270
Future Volume (veh/h)	450	300	49	839	1344	270
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	489	326	53	912	1461	293
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	526	468	257	2058	1554	693
Arrive On Green	0.31	0.31	0.11	0.61	0.46	0.46
Sat Flow, veh/h	1697	1510	1697	3474	3474	1510
Grp Volume(v), veh/h	489	326	53	912	1461	293
Grp Sat Flow(s),veh/h/ln	1697	1510	1697	1692	1692	1510
Q Serve(g_s), s	30.7	20.9	0.0	15.9	45.2	3.9
Cycle Q Clear(g_c), s	30.7	20.9	0.0	15.9	45.2	3.9
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	526	468	257	2058	1554	693
V/C Ratio(X)	0.93	0.70	0.21	0.44	0.94	0.42
Avail Cap(c_a), veh/h	578	515	257	2058	1554	693
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.72	0.72	0.91	0.91	1.00	1.00
Uniform Delay (d), s/veh	36.8	33.4	43.5	11.6	28.3	1.5
Incr Delay (d2), s/veh	16.3	2.6	0.4	0.6	12.5	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.5	17.2	1.3	5.6	19.6	10.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	53.0	36.0	43.9	12.2	40.8	3.4
LnGrp LOS	D	D	D	B	D	A
Approach Vol, veh/h	815			965	1754	
Approach Delay, s/veh	46.2			13.9	34.5	
Approach LOS	D			B	C	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		71.4		38.6	16.4	55.0
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		63.5		37.5	8.5	50.5
Max Q Clear Time (g_c+I1), s		17.9		32.7	2.0	47.2
Green Ext Time (p_c), s		7.4		1.4	0.0	2.7

Intersection Summary		
HCM 6th Ctrl Delay		31.6
HCM 6th LOS		C

6: PROPOSED FM 407 (12th St) EB RAMP



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	228	97	220	660	1103	541
Future Volume (veh/h)	228	97	220	660	1103	541
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	248	105	239	717	1199	588
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	303	270	307	2332	1859	829
Arrive On Green	0.18	0.18	0.07	0.69	0.55	0.55
Sat Flow, veh/h	1697	1510	1697	3474	3474	1510
Grp Volume(v), veh/h	248	105	239	717	1199	588
Grp Sat Flow(s),veh/h/ln	1697	1510	1697	1692	1692	1510
Q Serve(g_s), s	9.6	4.2	3.9	5.7	16.8	19.6
Cycle Q Clear(g_c), s	9.6	4.2	3.9	5.7	16.8	19.6
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	303	270	307	2332	1859	829
V/C Ratio(X)	0.82	0.39	0.78	0.31	0.64	0.71
Avail Cap(c_a), veh/h	449	400	307	2332	1859	829
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.99	0.99	0.86	0.86	0.48	0.48
Uniform Delay (d), s/veh	26.9	24.7	12.9	4.2	10.7	11.3
Incr Delay (d2), s/veh	7.2	0.9	10.5	0.3	0.8	2.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	1.4	2.7	1.2	5.0	5.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	34.1	25.6	23.4	4.5	11.5	13.8
LnGrp LOS	C	C	C	A	B	B
Approach Vol, veh/h	353			956	1787	
Approach Delay, s/veh	31.6			9.2	12.3	
Approach LOS	C			A	B	

Timer - Assigned Phs		2			5	6	8
Phs Duration (G+Y+Rc), s		51.4			9.5	41.9	16.6
Change Period (Y+Rc), s		4.5			4.5	4.5	4.5
Max Green Setting (Gmax), s		26.8			5.0	31.7	18.0
Max Q Clear Time (g_c+I1), s		7.7			5.9	21.6	11.6
Green Ext Time (p_c), s		4.5			0.0	6.9	0.6

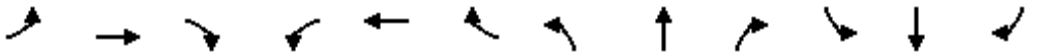
Intersection Summary		
HCM 6th Ctrl Delay	13.5	
HCM 6th LOS	B	

7: FM 407 & PROPOSED FM 407

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	374	695	290	917	154	873
Future Volume (vph)	374	695	290	917	154	873
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.86	0.86	1.00	0.91	1.00	1.00
Frt	0.93	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	4211	1286	1671	4803	1671	1495
Flt Permitted	1.00	1.00	0.19	1.00	0.95	1.00
Satd. Flow (perm)	4211	1286	332	4803	1671	1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	407	755	315	997	167	949
RTOR Reduction (vph)	216	298	0	0	0	311
Lane Group Flow (vph)	569	79	315	997	167	638
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	16.7	16.7	35.8	35.8	35.2	35.2
Effective Green, g (s)	16.7	16.7	35.8	35.8	35.2	35.2
Actuated g/C Ratio	0.21	0.21	0.45	0.45	0.44	0.44
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	879	268	392	2149	735	657
v/s Ratio Prot	0.14		c0.15	0.21	0.10	
v/s Ratio Perm		0.06	c0.21			c0.43
v/c Ratio	0.65	0.29	0.80	0.46	0.23	0.97
Uniform Delay, d1	29.0	26.7	16.7	15.4	13.9	21.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	0.6	11.3	0.2	0.7	28.8
Delay (s)	30.6	27.3	28.0	15.6	14.7	50.7
Level of Service	C	C	C	B	B	D
Approach Delay (s)	29.5			18.6	45.3	
Approach LOS	C			B	D	

Intersection Summary			
HCM 2000 Control Delay	30.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

8: FM 407 & CLEVELAND GIBBS RD



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	214	743	290	396	194	666	329	143	336	947	192	684
Future Volume (veh/h)	214	743	290	396	194	666	329	143	336	947	192	684
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	233	859	281	430	211	0	358	155	365	1029	209	743
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	439	1279	361	491	1602		426	546	429	1231	1022	802
Arrive On Green	0.06	0.24	0.24	0.15	0.33	0.00	0.13	0.16	0.16	0.27	0.30	0.30
Sat Flow, veh/h	1697	5344	1510	3291	4863	1510	3291	3385	2657	3291	3385	2657
Grp Volume(v), veh/h	233	859	281	430	211	0	358	155	365	1029	209	743
Grp Sat Flow(s),veh/h/ln	1697	1781	1510	1646	1621	1510	1646	1692	1329	1646	1692	1329
Q Serve(g_s), s	5.9	14.6	17.4	12.8	3.0	0.0	10.6	4.0	13.4	24.9	4.6	27.1
Cycle Q Clear(g_c), s	5.9	14.6	17.4	12.8	3.0	0.0	10.6	4.0	13.4	24.9	4.6	27.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	439	1279	361	491	1602		426	546	429	1231	1022	802
V/C Ratio(X)	0.53	0.67	0.78	0.88	0.13		0.84	0.28	0.85	0.84	0.20	0.93
Avail Cap(c_a), veh/h	439	1279	361	510	1602		497	626	492	1233	1032	810
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.57	0.57	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.1	34.5	35.6	41.6	23.5	0.0	42.5	36.9	40.8	22.4	26.0	33.8
Incr Delay (d2), s/veh	1.2	2.8	15.2	9.5	0.1	0.0	10.8	0.3	12.2	5.2	0.1	16.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	6.2	7.5	5.6	1.1	0.0	4.8	1.6	4.8	9.6	1.8	9.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.3	37.3	50.7	51.1	23.6	0.0	53.3	37.1	52.9	27.5	26.1	50.2
LnGrp LOS	C	D	D	D	C		D	D	D	C	C	D
Approach Vol, veh/h		1373			641	A		878			1981	
Approach Delay, s/veh		38.9			42.1			50.3			35.9	
Approach LOS		D			D			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	31.5	20.6	19.4	28.4	17.5	34.7	10.4	37.4
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	27.1	18.5	15.5	20.9	15.1	30.5	5.9	30.5
Max Q Clear Time (g_c+I1), s	26.9	15.4	14.8	19.4	12.6	29.1	7.9	5.0
Green Ext Time (p_c), s	0.1	0.8	0.1	0.9	0.3	0.7	0.0	1.2

Intersection Summary	
HCM 6th Ctrl Delay	40.1
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

9: I-35W SBFR & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1115	911	337	1419	0	0	0	0	659	24	437
Future Volume (vph)	0	1115	911	337	1419	0	0	0	0	659	24	437
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	4.5
Lane Util. Factor		0.86	0.88	0.97	0.86					0.97	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		6052	2632	3242	6052					3242	1759	1495
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		6052	2632	3242	6052					3242	1759	1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1212	990	366	1542	0	0	0	0	716	26	475
RTOR Reduction (vph)	0	0	720	0	0	0	0	0	0	0	0	328
Lane Group Flow (vph)	0	1212	270	366	1542	0	0	0	0	716	26	147
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type		NA	custom	Prot	NA					Split	NA	Perm
Protected Phases		2 10		1	6 9					4	4	
Permitted Phases			2								4	4
Actuated Green, G (s)		40.9	30.0	17.0	34.7					34.1	34.1	34.1
Effective Green, g (s)		40.9	30.0	17.0	34.7					34.1	34.1	34.1
Actuated g/C Ratio		0.37	0.27	0.15	0.32					0.31	0.31	0.31
Clearance Time (s)			4.5	4.5						4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0						3.0	3.0	3.0
Lane Grp Cap (vph)		2250	717	501	1909					1005	545	463
v/s Ratio Prot		c0.20		c0.11	c0.25					c0.22	0.01	
v/s Ratio Perm			0.10									0.10
v/c Ratio		0.54	0.38	0.73	0.81					0.71	0.05	0.32
Uniform Delay, d1		27.1	32.4	44.3	34.6					33.6	26.6	29.0
Progression Factor		1.00	1.00	1.06	0.89					1.00	1.00	1.00
Incremental Delay, d2		0.3	1.5	4.2	2.0					2.4	0.0	0.4
Delay (s)		27.4	33.9	51.1	32.9					36.0	26.6	29.4
Level of Service		C	C	D	C					D	C	C
Approach Delay (s)		30.3			36.4			0.0			33.3	
Approach LOS		C			D			A			C	

Intersection Summary			
HCM 2000 Control Delay	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

10: FM 407 & I-35W NBFR

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	490	1284	0	0	1225	807	500	153	1151	0	0	0
Future Volume (vph)	490	1284	0	0	1225	807	500	153	1151	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5	4.5			
Lane Util. Factor	0.97	0.86			0.86	0.88	0.97	1.00	0.88			
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00			
Satd. Flow (prot)	3242	6052			6052	2632	3242	1759	2632			
Flt Permitted	0.95	1.00			1.00	1.00	0.95	1.00	1.00			
Satd. Flow (perm)	3242	6052			6052	2632	3242	1759	2632			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	533	1396	0	0	1332	877	543	166	1251	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	628	0	0	491	0	0	0
Lane Group Flow (vph)	533	1396	0	0	1332	249	543	166	760	0	0	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type	Prot	NA			NA	custom	Perm	NA	Perm			
Protected Phases	5	2 10			6 9			8				
Permitted Phases						6	8		8			
Actuated Green, G (s)	23.2	40.9			34.7	23.8	34.1	34.1	34.1			
Effective Green, g (s)	23.2	40.9			34.7	23.8	34.1	34.1	34.1			
Actuated g/C Ratio	0.21	0.37			0.32	0.22	0.31	0.31	0.31			
Clearance Time (s)	4.5					4.5	4.5	4.5	4.5			
Vehicle Extension (s)	3.0					3.0	3.0	3.0	3.0			
Lane Grp Cap (vph)	683	2250			1909	569	1005	545	815			
v/s Ratio Prot	c0.16	0.23			c0.22			0.09				
v/s Ratio Perm						0.09	0.17		c0.29			
v/c Ratio	0.78	0.62			0.70	0.44	0.54	0.30	0.93			
Uniform Delay, d1	41.0	28.2			33.0	37.3	31.5	28.9	36.8			
Progression Factor	1.21	1.04			1.00	1.00	1.00	1.00	1.00			
Incremental Delay, d2	4.7	0.4			1.1	2.4	0.6	0.3	17.3			
Delay (s)	54.4	29.9			34.2	39.7	32.0	29.2	54.2			
Level of Service	D	C			C	D	C	C	D			
Approach Delay (s)		36.7			36.4			45.9			0.0	
Approach LOS		D			D			D			A	

Intersection Summary			
HCM 2000 Control Delay	39.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

11: US 377 & FM 407/FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	470	1581	408	444	1072	368	490	807	384	342	923	470
Future Volume (veh/h)	470	1581	408	444	1072	368	490	807	384	342	923	470
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	511	1718	443	483	1165	400	533	877	417	372	1003	511
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	689	1762	547	530	1631	506	576	1181	645	581	1130	617
Arrive On Green	0.13	0.34	0.34	0.10	0.32	0.32	0.11	0.23	0.23	0.10	0.22	0.22
Sat Flow, veh/h	3456	5106	1585	3456	5106	1585	3456	5106	2790	3456	5106	2790
Grp Volume(v), veh/h	511	1718	443	483	1165	400	533	877	417	372	1003	511
Grp Sat Flow(s),veh/h/ln	1728	1702	1585	1728	1702	1585	1728	1702	1395	1728	1702	1395
Q Serve(g_s), s	7.7	26.6	20.3	7.5	16.1	18.4	8.7	12.8	10.8	6.6	15.2	14.0
Cycle Q Clear(g_c), s	7.7	26.6	20.3	7.5	16.1	18.4	8.7	12.8	10.8	6.6	15.2	14.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	689	1762	547	530	1631	506	576	1181	645	581	1130	617
V/C Ratio(X)	0.74	0.98	0.81	0.91	0.71	0.79	0.92	0.74	0.65	0.64	0.89	0.83
Avail Cap(c_a), veh/h	743	1762	547	530	1631	506	576	1181	645	581	1130	617
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.8	25.9	23.8	19.8	24.0	24.8	24.4	28.5	27.8	22.2	30.2	29.7
Incr Delay (d2), s/veh	3.7	15.9	8.9	20.0	2.7	11.9	20.9	4.2	4.9	2.4	10.4	12.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.9	11.9	8.0	4.0	6.1	7.7	5.1	5.1	3.7	2.5	6.6	5.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.5	41.8	32.7	39.7	26.7	36.7	45.3	32.8	32.7	24.6	40.6	41.8
LnGrp LOS	C	D	C	D	C	D	D	C	C	C	D	D
Approach Vol, veh/h		2672			2048			1827			1886	
Approach Delay, s/veh		36.4			31.7			36.4			37.8	
Approach LOS		D			C			D			D	

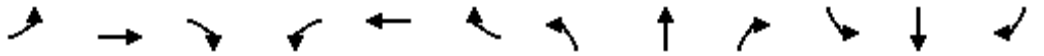
Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.4	23.0	12.5	32.1	13.2	22.2	14.5	30.1
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.9	18.5	8.0	27.6	8.7	17.7	11.3	24.3
Max Q Clear Time (g_c+I1), s	8.6	14.8	9.5	28.6	10.7	17.2	9.7	20.4
Green Ext Time (p_c), s	0.0	2.3	0.0	0.0	0.0	0.4	0.3	2.8

Intersection Summary	
HCM 6th Ctrl Delay	35.6
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

12: FM 1830 & FM 407



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	368	1945	24	48	1536	664	31	31	48	743	48	317
Future Volume (veh/h)	368	1945	24	48	1536	664	31	31	48	743	48	317
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	400	2114	26	52	1670	722	34	34	52	808	52	345
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	470	2480	770	155	2240	1224	119	89	76	898	448	380
Arrive On Green	0.09	0.51	0.51	0.04	0.46	0.46	0.03	0.05	0.05	0.23	0.25	0.25
Sat Flow, veh/h	3291	4863	1510	1697	4863	2657	1697	1781	1510	3291	1781	1510
Grp Volume(v), veh/h	400	2114	26	52	1670	722	34	34	52	808	52	345
Grp Sat Flow(s),veh/h/ln	1646	1621	1510	1697	1621	1329	1697	1781	1510	1646	1781	1510
Q Serve(g_s), s	6.5	39.6	0.9	1.7	29.6	8.7	2.1	1.9	3.1	20.5	2.4	23.3
Cycle Q Clear(g_c), s	6.5	39.6	0.9	1.7	29.6	8.7	2.1	1.9	3.1	20.5	2.4	23.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	470	2480	770	155	2240	1224	119	89	76	898	448	380
V/C Ratio(X)	0.85	0.85	0.03	0.33	0.75	0.59	0.28	0.38	0.69	0.90	0.12	0.91
Avail Cap(c_a), veh/h	577	2480	770	246	2240	1224	149	305	259	905	636	539
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.0	22.3	12.8	21.6	23.3	3.6	50.3	48.3	37.2	37.2	30.3	38.1
Incr Delay (d2), s/veh	9.9	4.0	0.1	1.3	2.3	2.1	1.3	2.6	10.4	11.8	0.1	15.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	14.0	0.3	0.7	11.4	5.5	0.9	0.9	1.5	10.8	1.0	10.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.9	26.3	12.9	22.9	25.6	5.7	51.6	50.9	47.6	49.0	30.4	53.1
LnGrp LOS	C	C	B	C	C	A	D	D	D	D	C	D
Approach Vol, veh/h		2540			2444			120			1205	
Approach Delay, s/veh		27.2			19.6			49.7			49.4	
Approach LOS		C			B			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.8	9.8	8.4	58.0	7.6	30.9	13.6	52.9
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	24.5	18.0	9.5	35.0	5.0	37.5	12.5	32.0
Max Q Clear Time (g_c+I1), s	22.5	5.1	3.7	41.6	4.1	25.3	8.5	31.6
Green Ext Time (p_c), s	0.7	0.2	0.0	0.0	0.0	1.1	0.5	0.4

Intersection Summary	
HCM 6th Ctrl Delay	28.9
HCM 6th LOS	C

Notes

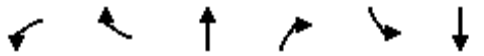
User approved pedestrian interval to be less than phase max green.

1: BOSS RANGE RD & PROPOSED FM 407 (12TH St)

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	277	284	337	337	195	454
Future Volume (vph)	277	284	337	337	195	454
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1671	1495	4803	1495	1671	4803
Flt Permitted	0.95	1.00	1.00	1.00	0.43	1.00
Satd. Flow (perm)	1671	1495	4803	1495	758	4803
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	301	309	366	366	212	493
RTOR Reduction (vph)	0	227	0	230	0	0
Lane Group Flow (vph)	301	82	366	136	212	493
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	3	3		2	6	
Actuated Green, G (s)	14.6	14.6	20.5	20.5	31.4	31.4
Effective Green, g (s)	14.6	14.6	20.5	20.5	31.4	31.4
Actuated g/C Ratio	0.27	0.27	0.37	0.37	0.57	0.57
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	443	396	1790	557	538	2742
v/s Ratio Prot			0.08		c0.05	0.10
v/s Ratio Perm	c0.18	0.05		0.09	c0.18	
v/c Ratio	0.68	0.21	0.20	0.24	0.39	0.18
Uniform Delay, d1	18.1	15.7	11.7	11.9	6.0	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.1	0.3	0.3	1.0	0.5	0.1
Delay (s)	22.2	16.0	12.0	13.0	6.5	5.8
Level of Service	C	B	B	B	A	A
Approach Delay (s)	19.1		12.5			6.0
Approach LOS	B		B			A

Intersection Summary			
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	43.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

2: EXIST FM 407 & BOSS RANGE RD

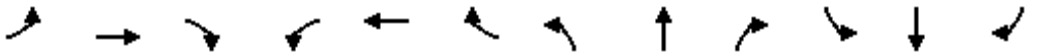


Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	252	472	89	209	471	61
Future Volume (veh/h)	252	472	89	209	471	61
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	274	513	97	227	512	66
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	608	541	876	742	585	876
Arrive On Green	0.36	0.36	0.49	0.49	0.49	0.49
Sat Flow, veh/h	1697	1510	1781	1510	1006	1781
Grp Volume(v), veh/h	274	513	97	227	512	66
Grp Sat Flow(s),veh/h/ln	1697	1510	1781	1510	1006	1781
Q Serve(g_s), s	7.4	19.8	1.8	5.4	27.7	1.2
Cycle Q Clear(g_c), s	7.4	19.8	1.8	5.4	29.5	1.2
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	608	541	876	742	585	876
V/C Ratio(X)	0.45	0.95	0.11	0.31	0.88	0.08
Avail Cap(c_a), veh/h	608	541	876	742	585	876
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.75	0.75	1.00	1.00	0.85	0.85
Uniform Delay (d), s/veh	14.7	18.7	8.2	9.1	17.4	8.1
Incr Delay (d2), s/veh	1.8	23.0	0.3	1.1	14.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	8.8	0.6	1.7	8.7	0.4
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	16.5	41.7	8.5	10.2	32.0	8.2
LnGrp LOS	B	D	A	B	C	A
Approach Vol, veh/h	787		324			578
Approach Delay, s/veh	33.0		9.7			29.3
Approach LOS	C		A			C

Timer - Assigned Phs		2			6	8
Phs Duration (G+Y+Rc), s		34.0			34.0	26.0
Change Period (Y+Rc), s		4.5			4.5	4.5
Max Green Setting (Gmax), s		29.5			29.5	21.5
Max Q Clear Time (g_c+I1), s		7.4			31.5	21.8
Green Ext Time (p_c), s		1.3			0.0	0.0

Intersection Summary		
HCM 6th Ctrl Delay	27.2	
HCM 6th LOS	C	

3: EXIST FM 407/Downe Rd & FM 156



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	336	20	324	20	24	24	360	1043	20	391	631	36
Future Volume (veh/h)	336	20	324	20	24	24	360	1043	20	391	631	36
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	365	22	352	22	26	26	391	1134	22	425	686	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	393	452	674	227	250	274	563	1251	558	467	1383	
Arrive On Green	0.25	0.25	0.25	0.25	0.25	0.25	0.17	0.37	0.37	0.21	0.41	0.00
Sat Flow, veh/h	1288	1781	2657	618	984	1078	1697	3385	1510	1697	3385	1510
Grp Volume(v), veh/h	365	22	352	40	0	34	391	1134	22	425	686	0
Grp Sat Flow(s),veh/h/ln	1288	1781	1329	1253	0	1427	1697	1692	1510	1697	1692	1510
Q Serve(g_s), s	18.8	0.7	9.1	0.0	0.0	1.5	11.1	25.4	0.7	14.0	12.0	0.0
Cycle Q Clear(g_c), s	20.3	0.7	9.1	1.4	0.0	1.5	11.1	25.4	0.7	14.0	12.0	0.0
Prop In Lane	1.00		1.00	0.56		0.76	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	393	452	674	388	0	362	563	1251	558	467	1383	
V/C Ratio(X)	0.93	0.05	0.52	0.10	0.00	0.10	0.70	0.91	0.04	0.91	0.50	
Avail Cap(c_a), veh/h	393	452	674	388	0	362	630	1251	558	553	1383	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.68	0.68	0.68	1.00	0.00	1.00	1.00	1.00	1.00	0.26	0.26	0.00
Uniform Delay (d), s/veh	32.2	22.6	25.7	22.8	0.0	22.8	12.2	23.9	16.1	19.7	17.5	0.0
Incr Delay (d2), s/veh	21.5	0.0	0.5	0.1	0.0	0.1	2.9	11.0	0.1	5.7	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.1	0.3	2.8	0.6	0.0	0.5	3.9	11.0	0.3	5.4	4.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.7	22.6	26.2	22.9	0.0	22.9	15.0	34.9	16.3	25.4	17.9	0.0
LnGrp LOS	D	C	C	C	A	C	B	C	B	C	B	
Approach Vol, veh/h		739			74			1547			1111	A
Approach Delay, s/veh		39.7			22.9			29.6			20.8	
Approach LOS		D			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	21.1	34.1		24.8	18.0	37.2		24.8				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	20.7	25.5		20.3	16.7	29.5		20.3				
Max Q Clear Time (g_c+I1), s	16.0	27.4		22.3	13.1	14.0		3.5				
Green Ext Time (p_c), s	0.6	0.0		0.0	0.5	3.9		0.3				

Intersection Summary			
HCM 6th Ctrl Delay		28.8	
HCM 6th LOS		C	

Notes

Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.

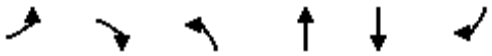
4: FM 156 & FM 407/E. 5TH ST

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	36	49	41	709	84	264	36	933	434	391	631	36
Future Volume (veh/h)	36	49	41	709	84	264	36	933	434	391	631	36
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	39	53	45	771	91	287	39	1014	472	425	686	39
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	324	291	247	851	394	334	462	1256	560	577	1078	481
Arrive On Green	0.04	0.16	0.16	0.10	0.22	0.22	0.17	0.37	0.37	0.11	0.32	0.32
Sat Flow, veh/h	1697	1781	1510	3291	1781	1510	1697	3385	1510	3291	3385	1510
Grp Volume(v), veh/h	39	53	45	771	91	287	39	1014	472	425	686	39
Grp Sat Flow(s),veh/h/ln	1697	1781	1510	1646	1781	1510	1697	1692	1510	1646	1692	1510
Q Serve(g_s), s	1.3	1.8	1.2	6.7	2.9	12.8	0.0	18.8	20.0	7.4	12.1	1.0
Cycle Q Clear(g_c), s	1.3	1.8	1.2	6.7	2.9	12.8	0.0	18.8	20.0	7.4	12.1	1.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	324	291	247	851	394	334	462	1256	560	577	1078	481
V/C Ratio(X)	0.12	0.18	0.18	0.91	0.23	0.86	0.08	0.81	0.84	0.74	0.64	0.08
Avail Cap(c_a), veh/h	380	458	388	851	501	425	462	1256	560	577	1078	481
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.09	0.09	0.09	0.65	0.65	0.65
Uniform Delay (d), s/veh	22.9	25.3	10.6	26.3	22.4	26.2	19.3	19.8	20.1	21.7	20.4	9.5
Incr Delay (d2), s/veh	0.2	0.3	0.4	13.3	0.3	13.4	0.0	0.5	1.5	3.2	1.9	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.8	0.6	4.8	1.2	5.5	0.4	6.5	6.5	2.8	4.5	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.0	25.5	11.0	39.5	22.7	39.6	19.3	20.3	21.7	24.9	22.3	9.7
LnGrp LOS	C	C	B	D	C	D	B	C	C	C	C	A
Approach Vol, veh/h		137			1149			1525			1150	
Approach Delay, s/veh		20.0			38.2			20.7			22.8	
Approach LOS		C			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.4	30.5	11.2	15.9	16.1	26.8	7.2	20.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.9	19.4	6.7	18.0	5.0	22.3	5.0	19.7
Max Q Clear Time (g_c+I1), s	9.4	22.0	8.7	3.8	2.0	14.1	3.3	14.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.3	0.0	2.8	0.0	0.7

Intersection Summary	
HCM 6th Ctrl Delay	26.4
HCM 6th LOS	C

5: PROPOSED FM 407 (12TH ST) WB RAMP & FM 156

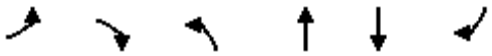


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	456	304	43	1100	1117	280
Future Volume (veh/h)	456	304	43	1100	1117	280
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	496	330	47	1196	1214	304
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	536	477	254	1910	1444	644
Arrive On Green	0.32	0.32	0.08	0.56	0.43	0.43
Sat Flow, veh/h	1697	1510	1697	3474	3474	1510
Grp Volume(v), veh/h	496	330	47	1196	1214	304
Grp Sat Flow(s),veh/h/ln	1697	1510	1697	1692	1692	1510
Q Serve(g_s), s	21.2	14.4	0.0	17.9	24.0	2.6
Cycle Q Clear(g_c), s	21.2	14.4	0.0	17.9	24.0	2.6
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	536	477	254	1910	1444	644
V/C Ratio(X)	0.93	0.69	0.19	0.63	0.84	0.47
Avail Cap(c_a), veh/h	554	493	254	1910	1444	644
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.72	0.72	0.86	0.86	1.00	1.00
Uniform Delay (d), s/veh	24.8	22.5	30.3	11.0	19.2	0.9
Incr Delay (d2), s/veh	16.8	2.9	0.3	1.3	6.1	2.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.1	12.0	0.8	5.7	9.3	7.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	41.6	25.4	30.6	12.4	25.3	3.4
LnGrp LOS	D	C	C	B	C	A
Approach Vol, veh/h	826			1243	1518	
Approach Delay, s/veh	35.1			13.0	20.9	
Approach LOS	D			B	C	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		46.8		28.2	10.3	36.5
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		41.5		24.5	5.0	32.0
Max Q Clear Time (g_c+I1), s		19.9		23.2	2.0	26.0
Green Ext Time (p_c), s		8.8		0.5	0.0	4.1

Intersection Summary	
HCM 6th Ctrl Delay	21.4
HCM 6th LOS	C

6: PROPOSED FM 407 (12th St) EB RAMP



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	218	94	308	925	964	457
Future Volume (veh/h)	218	94	308	925	964	457
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	237	102	335	1005	1048	497
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8
Cap, veh/h	290	258	410	2370	1724	769
Arrive On Green	0.17	0.17	0.25	1.00	0.51	0.51
Sat Flow, veh/h	1697	1510	1697	3474	3474	1510
Grp Volume(v), veh/h	237	102	335	1005	1048	497
Grp Sat Flow(s),veh/h/ln	1697	1510	1697	1692	1692	1510
Q Serve(g_s), s	9.4	4.2	6.6	0.0	15.4	16.9
Cycle Q Clear(g_c), s	9.4	4.2	6.6	0.0	15.4	16.9
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	290	258	410	2370	1724	769
V/C Ratio(X)	0.82	0.39	0.82	0.42	0.61	0.65
Avail Cap(c_a), veh/h	436	388	474	2370	1724	769
HCM Platoon Ratio	1.00	1.00	2.00	2.00	1.00	1.00
Upstream Filter(I)	0.99	0.99	0.66	0.66	0.64	0.64
Uniform Delay (d), s/veh	27.9	25.8	10.2	0.0	12.2	12.6
Incr Delay (d2), s/veh	7.1	1.0	6.5	0.4	1.0	2.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	1.5	2.8	0.1	5.0	5.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	35.1	26.8	16.7	0.4	13.2	15.2
LnGrp LOS	D	C	B	A	B	B
Approach Vol, veh/h	339			1340	1545	
Approach Delay, s/veh	32.6			4.4	13.9	
Approach LOS	C			A	B	

Timer - Assigned Phs		2			5	6	8
Phs Duration (G+Y+Rc), s		53.5			13.4	40.2	16.5
Change Period (Y+Rc), s		4.5			4.5	4.5	4.5
Max Green Setting (Gmax), s		43.0			11.5	27.0	18.0
Max Q Clear Time (g_c+I1), s		2.0			8.6	18.9	11.4
Green Ext Time (p_c), s		8.4			0.3	5.2	0.6

Intersection Summary		
HCM 6th Ctrl Delay		11.9
HCM 6th LOS		B

7: FM 407 & PROPOSED FM 407

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	318	756	301	955	131	743
Future Volume (vph)	318	756	301	955	131	743
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.86	0.86	1.00	0.91	1.00	1.00
Frt	0.92	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	4169	1286	1671	4803	1671	1495
Flt Permitted	1.00	1.00	0.21	1.00	0.95	1.00
Satd. Flow (perm)	4169	1286	376	4803	1671	1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	346	822	327	1038	142	808
RTOR Reduction (vph)	321	321	0	0	0	295
Lane Group Flow (vph)	436	90	327	1038	142	513
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	14.2	14.2	28.2	28.2	27.8	27.8
Effective Green, g (s)	14.2	14.2	28.2	28.2	27.8	27.8
Actuated g/C Ratio	0.22	0.22	0.43	0.43	0.43	0.43
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	910	280	352	2083	714	639
v/s Ratio Prot	0.10		c0.14	0.22	0.08	
v/s Ratio Perm		0.07	c0.27			c0.34
v/c Ratio	0.48	0.32	0.93	0.50	0.20	0.80
Uniform Delay, d1	22.2	21.3	14.2	13.3	11.6	16.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.7	30.1	0.2	0.6	10.3
Delay (s)	22.6	22.0	44.3	13.5	12.3	26.5
Level of Service	C	C	D	B	B	C
Approach Delay (s)	22.4			20.9	24.3	
Approach LOS	C			C	C	

Intersection Summary			
HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

8: FM 407 & CLEVELAND GIBBS RD

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	252	633	176	337	228	687	376	168	286	767	163	652
Future Volume (veh/h)	252	633	176	337	228	687	376	168	286	767	163	652
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	274	688	191	366	248	0	409	183	311	834	177	709
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	457	1387	392	432	1599		478	693	544	1149	962	755
Arrive On Green	0.06	0.26	0.26	0.13	0.33	0.00	0.15	0.20	0.20	0.22	0.28	0.28
Sat Flow, veh/h	1697	5344	1510	3291	4863	1510	3291	3385	2657	3291	3385	2657
Grp Volume(v), veh/h	274	688	191	366	248	0	409	183	311	834	177	709
Grp Sat Flow(s),veh/h/ln	1697	1781	1510	1646	1621	1510	1646	1692	1329	1646	1692	1329
Q Serve(g_s), s	6.2	10.9	10.7	10.9	3.6	0.0	12.1	4.5	10.5	18.7	4.0	26.1
Cycle Q Clear(g_c), s	6.2	10.9	10.7	10.9	3.6	0.0	12.1	4.5	10.5	18.7	4.0	26.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	457	1387	392	432	1599		478	693	544	1149	962	755
V/C Ratio(X)	0.60	0.50	0.49	0.85	0.16		0.86	0.26	0.57	0.73	0.18	0.94
Avail Cap(c_a), veh/h	457	1387	392	484	1599		543	693	544	1282	975	765
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.53	0.53	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.4	31.5	31.4	42.5	23.7	0.0	41.7	33.4	35.8	20.7	27.0	35.0
Incr Delay (d2), s/veh	2.2	1.3	4.3	6.9	0.1	0.0	11.7	0.2	1.4	1.8	0.1	19.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	4.6	4.1	4.6	1.3	0.0	5.5	1.8	3.3	6.8	1.5	9.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.6	32.7	35.7	49.3	23.8	0.0	53.4	33.6	37.3	22.6	27.1	54.1
LnGrp LOS	C	C	D	D	C		D	C	D	C	C	D
Approach Vol, veh/h		1153			614	A		903			1720	
Approach Delay, s/veh		32.7			39.0			43.8			36.1	
Approach LOS		C			D			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	27.0	25.0	17.6	30.5	19.0	32.9	10.7	37.4
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	26.5	18.8	14.7	22.0	16.5	28.8	6.2	30.5
Max Q Clear Time (g_c+I1), s	20.7	12.5	12.9	12.9	14.1	28.1	8.2	5.6
Green Ext Time (p_c), s	1.8	1.3	0.3	3.3	0.4	0.4	0.0	1.4

Intersection Summary	
HCM 6th Ctrl Delay	37.2
HCM 6th LOS	D

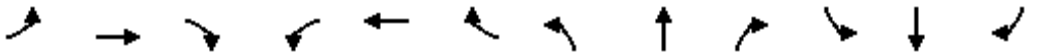
Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

9: FM 407 & I-35W SBFR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	950	736	396	1666	0	0	0	0	562	20	386
Future Volume (vph)	0	950	736	396	1666	0	0	0	0	562	20	386
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	4.5
Lane Util. Factor		0.86	0.88	0.97	0.86					0.97	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		6052	2632	3242	6052					3242	1759	1495
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		6052	2632	3242	6052					3242	1759	1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1033	800	430	1811	0	0	0	0	611	22	420
RTOR Reduction (vph)	0	0	561	0	0	0	0	0	0	0	0	323
Lane Group Flow (vph)	0	1033	239	430	1811	0	0	0	0	611	22	97
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type		NA	custom	Prot	NA					Split	NA	Perm
Protected Phases		2 10		1	6 9					4	4	
Permitted Phases			2								4	4
Actuated Green, G (s)		48.3	32.8	18.2	39.5					25.5	25.5	25.5
Effective Green, g (s)		48.3	32.8	18.2	39.5					25.5	25.5	25.5
Actuated g/C Ratio		0.44	0.30	0.17	0.36					0.23	0.23	0.23
Clearance Time (s)			4.5	4.5						4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0						3.0	3.0	3.0
Lane Grp Cap (vph)		2657	784	536	2173					751	407	346
v/s Ratio Prot		c0.17		c0.13	c0.30					c0.19	0.01	
v/s Ratio Perm			0.09									0.07
v/c Ratio		0.39	0.30	0.80	0.83					0.81	0.05	0.28
Uniform Delay, d1		20.9	29.8	44.2	32.2					40.0	32.9	34.7
Progression Factor		1.00	1.00	1.00	0.99					1.00	1.00	1.00
Incremental Delay, d2		0.1	1.0	4.0	1.4					6.7	0.1	0.4
Delay (s)		21.0	30.8	48.2	33.3					46.7	32.9	35.2
Level of Service		C	C	D	C					D	C	D
Approach Delay (s)		25.3			36.1			0.0			41.8	
Approach LOS		C			D			A			D	

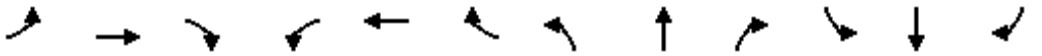
Intersection Summary			
HCM 2000 Control Delay	33.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

10: FM 407 & I-35W NBFR

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	575	937	0	0	1439	946	587	180	980	0	0	0
Future Volume (vph)	575	937	0	0	1439	946	587	180	980	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5	4.5	4.5	4.5	4.5			
Lane Util. Factor	0.97	0.86			0.91	0.88	0.97	1.00	0.88			
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00			
Satd. Flow (prot)	3242	6052			4803	2632	3242	1759	2632			
Flt Permitted	0.95	1.00			1.00	1.00	0.95	1.00	1.00			
Satd. Flow (perm)	3242	6052			4803	2632	3242	1759	2632			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	625	1018	0	0	1564	1028	638	196	1065	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	440	0	0	607	0	0	0
Lane Group Flow (vph)	625	1018	0	0	1564	588	638	196	458	0	0	0
Heavy Vehicles (%)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Turn Type	Prot	NA			NA	custom	Perm	NA	Perm			
Protected Phases	5	2 10			6 9			8				
Permitted Phases						6	8		8			
Actuated Green, G (s)	27.2	47.8			40.3	28.8	24.5	24.5	24.5			
Effective Green, g (s)	27.2	47.8			40.3	28.8	24.5	24.5	24.5			
Actuated g/C Ratio	0.25	0.43			0.37	0.26	0.22	0.22	0.22			
Clearance Time (s)	4.5					4.5	4.5	4.5	4.5			
Vehicle Extension (s)	3.0					3.0	3.0	3.0	3.0			
Lane Grp Cap (vph)	801	2629			1759	689	722	391	586			
v/s Ratio Prot	c0.19	0.17			c0.33			0.11				
v/s Ratio Perm						0.22	c0.20		0.17			
v/c Ratio	0.78	0.39			0.89	0.85	0.88	0.50	0.78			
Uniform Delay, d1	38.6	21.1			32.8	38.6	41.4	37.4	40.2			
Progression Factor	1.29	0.91			1.00	1.00	1.00	1.00	1.00			
Incremental Delay, d2	4.2	0.1			5.9	12.8	12.4	1.0	6.7			
Delay (s)	53.8	19.4			38.7	51.3	53.7	38.4	46.9			
Level of Service	D	B			D	D	D	D	D			
Approach Delay (s)		32.5			43.7			48.3			0.0	
Approach LOS		C			D			D			A	

Intersection Summary			
HCM 2000 Control Delay	42.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

11: US 377 & FM 407/FM 407



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	551	1039	347	378	1259	432	575	947	327	317	786	551
Future Volume (veh/h)	551	1039	347	378	1259	432	575	947	327	317	786	551
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	599	1129	377	411	1368	470	625	1029	355	345	854	599
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	660	1719	534	548	1577	490	649	1316	719	536	1140	623
Arrive On Green	0.14	0.34	0.34	0.11	0.31	0.31	0.13	0.26	0.26	0.09	0.22	0.22
Sat Flow, veh/h	3456	5106	1585	3456	5106	1585	3456	5106	2790	3456	5106	2790
Grp Volume(v), veh/h	599	1129	377	411	1368	470	625	1029	355	345	854	599
Grp Sat Flow(s),veh/h/ln	1728	1702	1585	1728	1702	1585	1728	1702	1395	1728	1702	1395
Q Serve(g_s), s	10.7	16.9	18.6	8.7	22.8	18.9	11.5	16.9	9.7	6.8	14.0	13.2
Cycle Q Clear(g_c), s	10.7	16.9	18.6	8.7	22.8	18.9	11.5	16.9	9.7	6.8	14.0	13.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	660	1719	534	548	1577	490	649	1316	719	536	1140	623
V/C Ratio(X)	0.91	0.66	0.71	0.75	0.87	0.96	0.96	0.78	0.49	0.64	0.75	0.96
Avail Cap(c_a), veh/h	660	1719	534	548	1577	490	649	1316	719	536	1140	623
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.3	25.4	26.0	27.7	29.4	15.9	26.1	31.0	28.4	25.1	32.6	16.5
Incr Delay (d2), s/veh	16.4	0.9	4.2	5.7	6.7	31.8	26.2	4.7	2.4	2.6	4.5	27.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.4	6.3	7.0	3.7	9.4	10.1	6.9	6.8	3.2	2.7	5.7	6.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	52.6	26.3	30.2	33.4	36.1	47.7	52.3	35.7	30.8	27.7	37.1	44.2
LnGrp LOS	D	C	C	C	D	D	D	D	C	C	D	D
Approach Vol, veh/h		2105			2249			2009			1798	
Approach Delay, s/veh		34.5			38.0			40.0			37.7	
Approach LOS		C			D			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.9	27.7	14.6	34.8	16.0	24.6	17.1	32.3
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	8.4	23.2	10.1	30.3	11.5	20.1	12.6	27.8
Max Q Clear Time (g_c+I1), s	8.8	18.9	10.7	20.6	13.5	16.0	12.7	24.8
Green Ext Time (p_c), s	0.0	2.8	0.0	5.6	0.0	2.6	0.0	2.4

Intersection Summary	
HCM 6th Ctrl Delay	37.5
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

12: FM 1830 & FM 407

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	432	1231	20	41	1661	779	36	36	41	653	41	372
Future Volume (veh/h)	432	1231	20	41	1661	779	36	36	41	653	41	372
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781	1781
Adj Flow Rate, veh/h	470	1338	22	45	1805	847	39	39	45	710	45	404
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	8	8	8	8	8	8	8	8	8	8	8	8
Cap, veh/h	526	2295	712	231	1899	1038	123	85	72	1040	516	437
Arrive On Green	0.12	0.47	0.47	0.03	0.39	0.39	0.03	0.05	0.05	0.27	0.29	0.29
Sat Flow, veh/h	3291	4863	1510	1697	4863	2657	1697	1781	1510	3291	1781	1510
Grp Volume(v), veh/h	470	1338	22	45	1805	847	39	39	45	710	45	404
Grp Sat Flow(s),veh/h/ln	1646	1621	1510	1697	1621	1329	1697	1781	1510	1646	1781	1510
Q Serve(g_s), s	10.1	21.0	0.8	1.6	37.8	12.3	2.4	2.2	2.7	15.4	1.9	27.3
Cycle Q Clear(g_c), s	10.1	21.0	0.8	1.6	37.8	12.3	2.4	2.2	2.7	15.4	1.9	27.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	526	2295	712	231	1899	1038	123	85	72	1040	516	437
V/C Ratio(X)	0.89	0.58	0.03	0.19	0.95	0.82	0.32	0.46	0.63	0.68	0.09	0.92
Avail Cap(c_a), veh/h	535	2295	712	301	1899	1038	157	305	259	1040	653	554
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.7	20.2	14.9	18.7	31.0	4.8	50.2	48.7	37.4	31.7	27.2	36.2
Incr Delay (d2), s/veh	17.1	1.1	0.1	0.4	11.9	7.1	1.4	3.8	8.6	1.8	0.1	18.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.8	7.4	0.3	0.7	16.3	3.7	1.0	1.0	1.3	7.6	0.8	12.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	45.8	21.3	14.9	19.1	42.9	11.9	51.7	52.5	46.1	33.6	27.3	54.9
LnGrp LOS	D	C	B	B	D	B	D	D	D	C	C	D
Approach Vol, veh/h		1830			2697			123			1159	
Approach Delay, s/veh		27.5			32.7			49.9			40.8	
Approach LOS		C			C			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	33.3	9.5	8.2	54.0	7.9	34.9	16.7	45.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	26.0	18.0	8.0	35.0	5.5	38.5	12.5	30.5
Max Q Clear Time (g_c+I1), s	17.4	4.7	3.6	23.0	4.4	29.3	12.1	39.8
Green Ext Time (p_c), s	1.8	0.2	0.0	6.5	0.0	1.1	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	33.1
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

APPENDIX

Build Alternative Alignment Concepts Diagrammatic and Alternative Typical Sections

FM 407 Feasibility Study > Build Alternative Alignment Concepts

Estudio de Viabilidad FM 407 > Construir Conceptos Alternativos de Aliniación

Entire FM 407 Corridor

Beginning of Study to End of Study

SECTION I - BEGINNING OF STUDY TO FLORANCE ROAD

View this section at the center room display

SECTION II - FLORANCE ROAD TO STONECREST ROAD

View this section at the center room display

SECTION III - STONECREST ROAD TO END OF STUDY (FM 1830)

View this section at the center room display

PRELIMINARY

PRELIMINARY

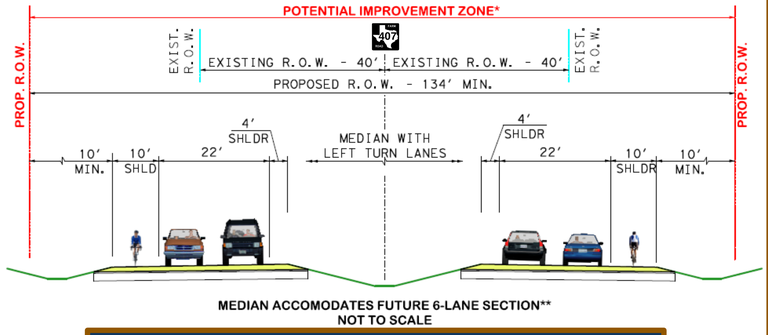
FM 407 FEASIBILITY STUDY

COUNTY: DENTON
DATE: MARCH 2019

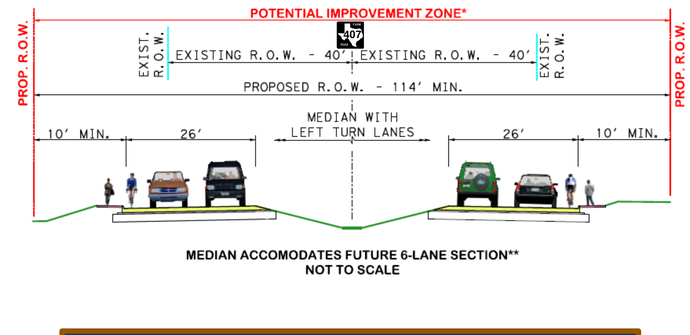
FM 407 Typical Section Concepts

(from Begin Study Limit to FM 156, and from FM 156 to End Study Limit)

Minimum Right-of-Way & Roadway Width Options



MEDIAN ACCOMODATES FUTURE 6-LANE SECTION**
NOT TO SCALE



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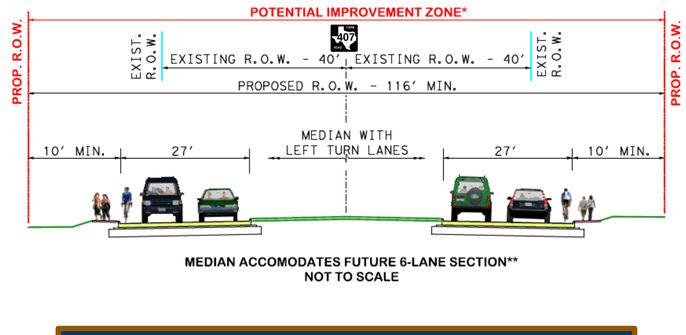
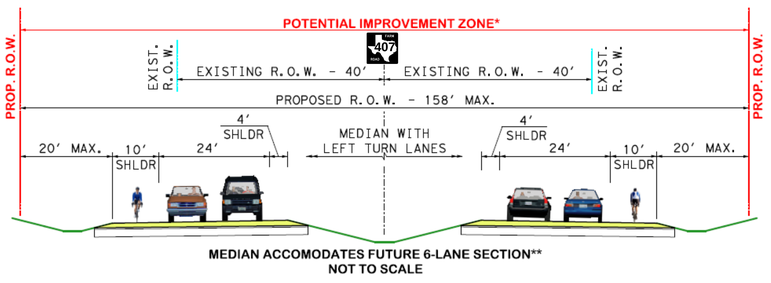


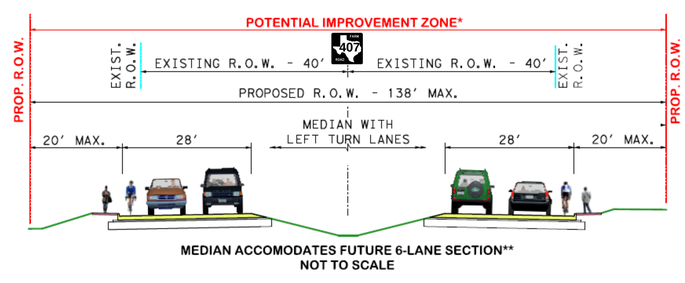
MEDIAN ACCOMODATES FUTURE 6-LANE SECTION**
NOT TO SCALE

RURAL SECTION
with Open Ditch Drainage



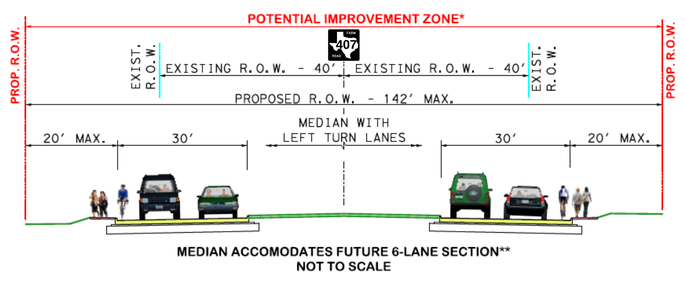
MEDIAN ACCOMODATES FUTURE 6-LANE SECTION**
NOT TO SCALE

SEMI-URBAN SECTION
with semi-Curb & Gutter Drainage



MEDIAN ACCOMODATES FUTURE 6-LANE SECTION**
NOT TO SCALE

URBAN SECTION
with full Curb & Gutter Drainage



MEDIAN ACCOMODATES FUTURE 6-LANE SECTION**
NOT TO SCALE

Maximum Right-of-Way & Roadway Width Options

*Potential roadway construction and land acquisition zone; specific dimensions would be determined during TxDOT's future FM 407 Roadway Schematic Design, Environmental Analyses, and Public Involvement phase.

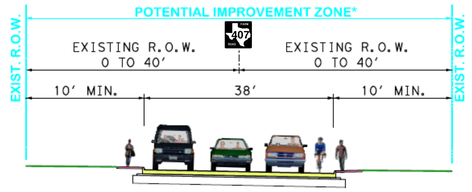
**Non-curb flush medians with continuous two-way left-turn lanes will also be considered and evaluated pursuant to roadway geometric design standards and guidelines, operating practices and engineering judgement.

Typical Section Concepts

for the 1-Way Couplet Alternative

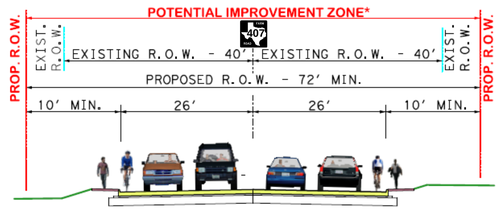
Minimum Right-of-Way & Roadway Width Options

1-WAY COUPLET STREET SECTION
with full Curb & Gutter Drainage

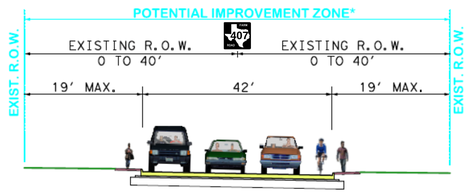


ONE-WAY COUPLET SECTION
NOT TO SCALE

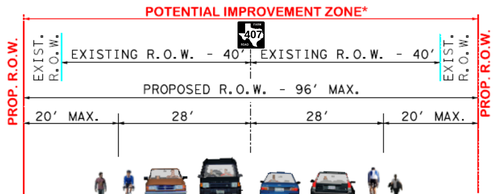
URBAN SECTION link to COUPLET
with full Curb & Gutter Drainage



4-LANE SECTION
NOT TO SCALE



ONE-WAY COUPLET SECTION
NOT TO SCALE



4-LANE SECTION
NOT TO SCALE

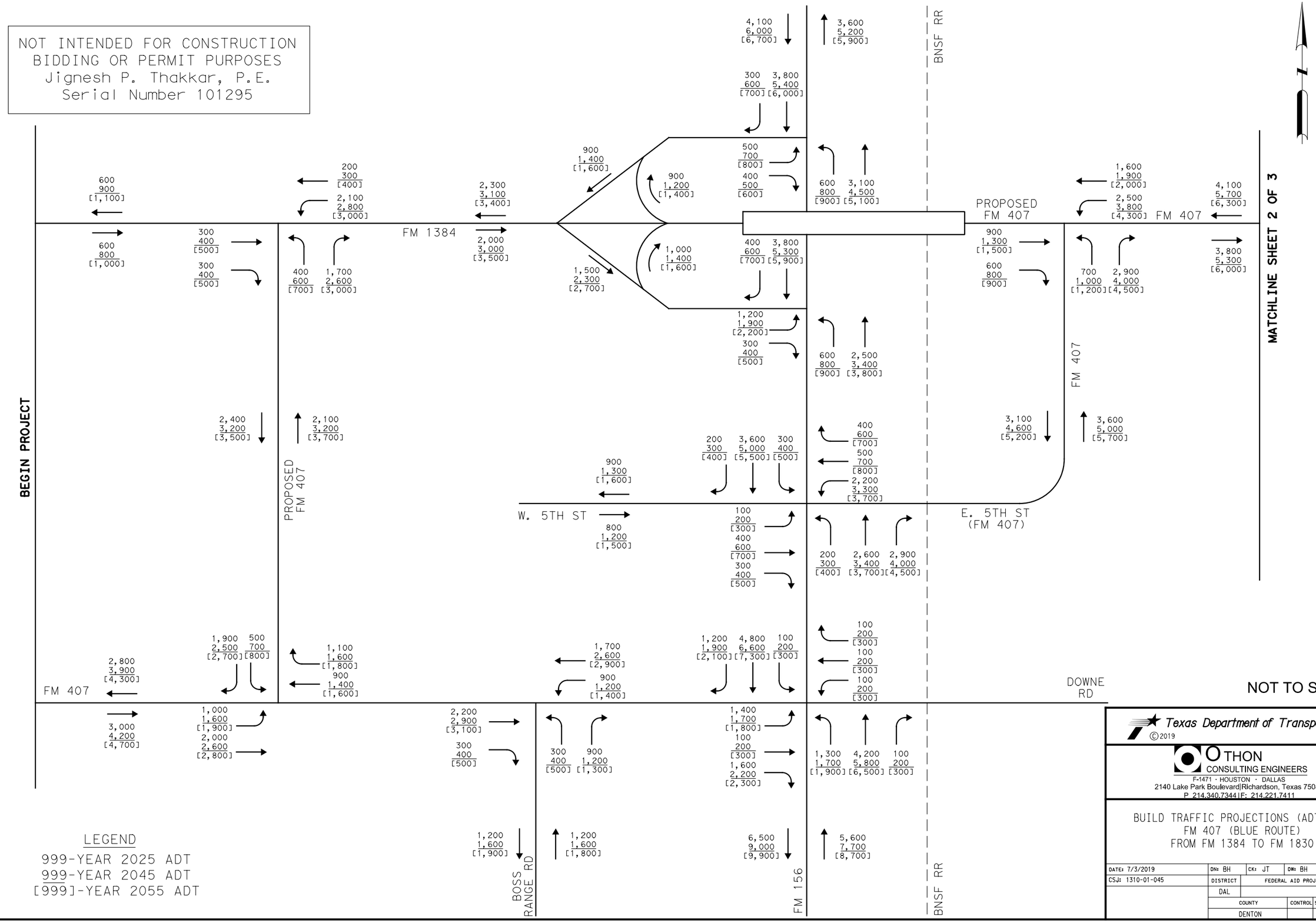
Maximum Right-of-Way & Roadway Width Options

*Potential roadway construction and land acquisition zone; specific dimensions would be determined during TxDOT's future FM 407 Roadway Schematic Design, Environmental Analyses, and Public Involvement phase.

APPENDIX

Build Alternatives (Red Route and Blue Route) Traffic Projections

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



LEGEND
999-YEAR 2025 ADT
999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

NOT TO SCALE

Texas Department of Transportation
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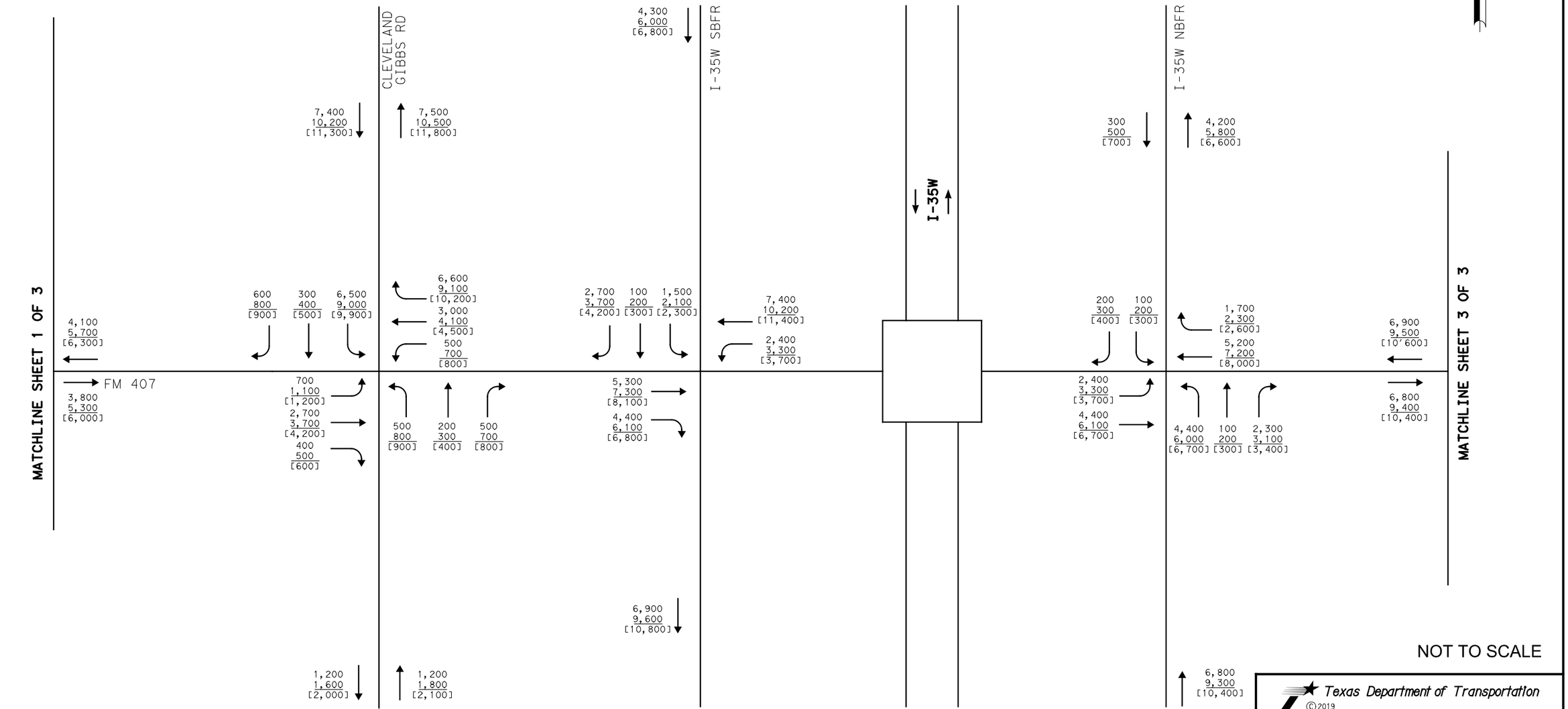
2140 Lake Park Boulevard|Richardson, Texas 75080
P 214.340.7344|F: 214.221.7411

BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (BLUE ROUTE)
FROM FM 1384 TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			1
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

7/3/2019 10:29:43 AM
FM 407 Traffic Projection BuildBlue_01.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



NOT TO SCALE

LEGEND
999-YEAR 2025 ADT
999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

7/3/2019 10:29:43 AM
FM 407 Traffic Projection BuildBlue_02.dgn

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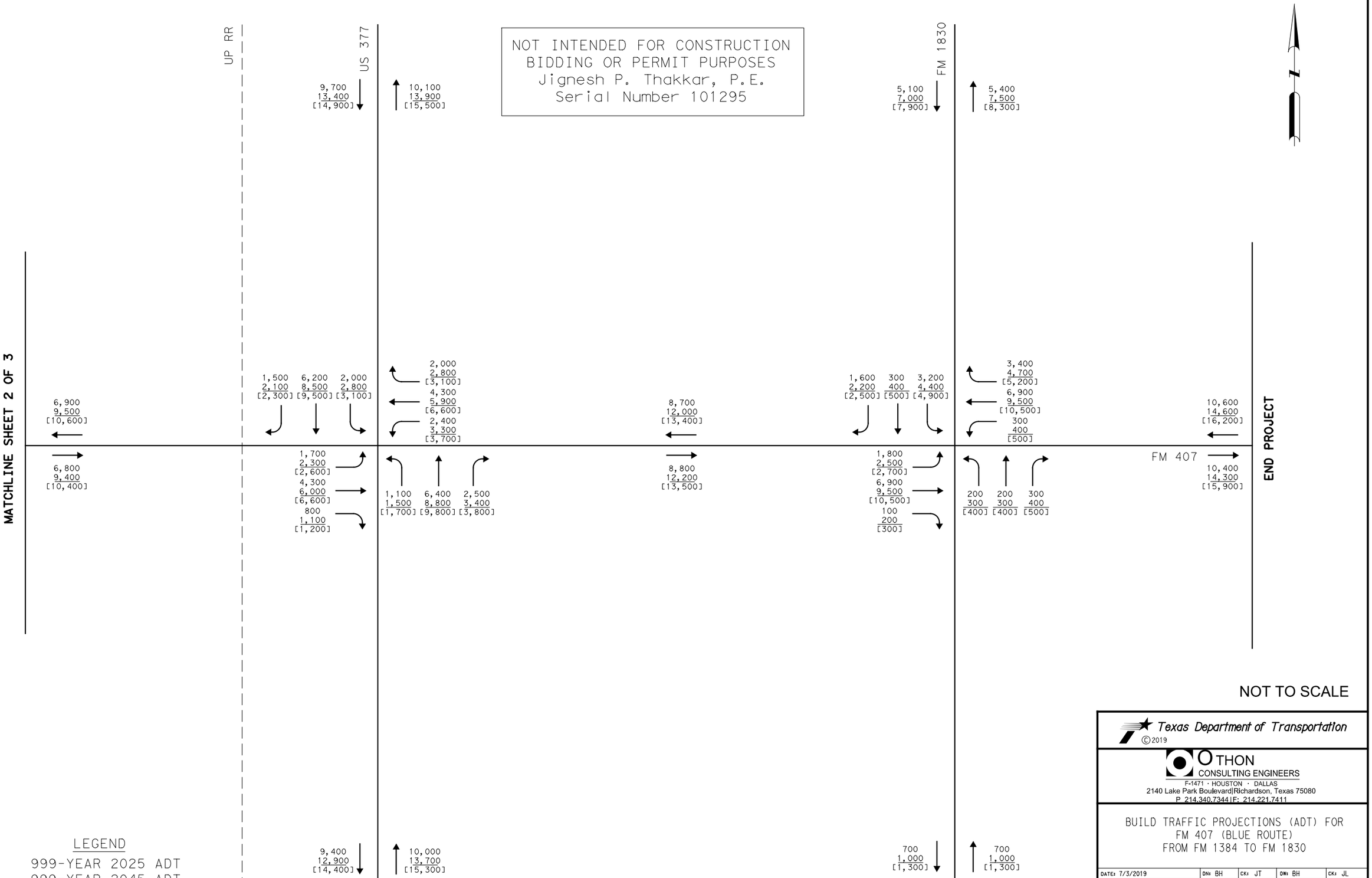
BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (BLUE ROUTE)
FROM FM 1384 TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL		
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT			SHEET	
	DAL				2	
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	DENTON					FM 407

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



NOT TO SCALE

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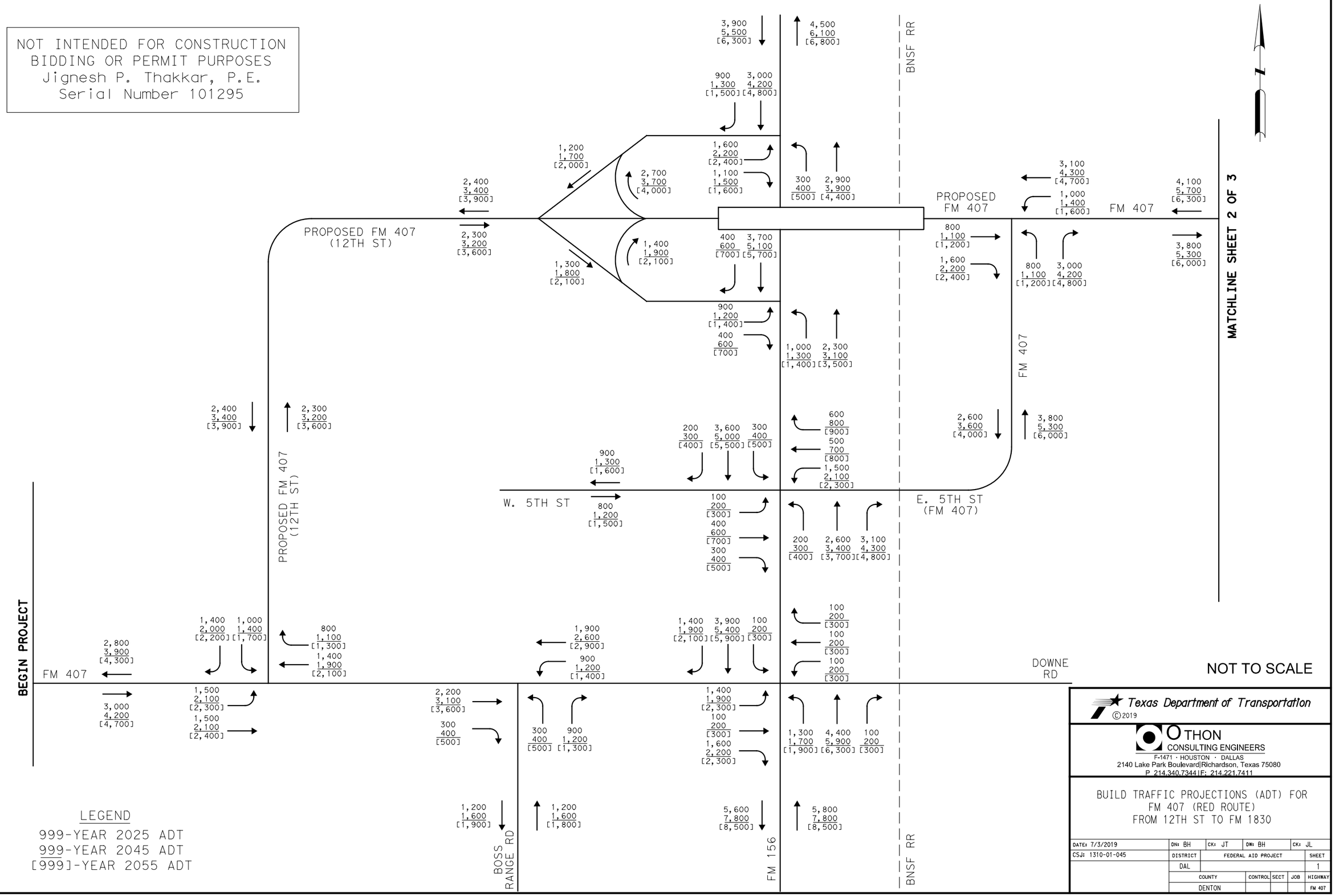
BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (BLUE ROUTE)
FROM FM 1384 TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

7/3/2019 10:29:44 AM
FM 407 Traffic Projection BuildBlue_03.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



NOT TO SCALE

LEGEND

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999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

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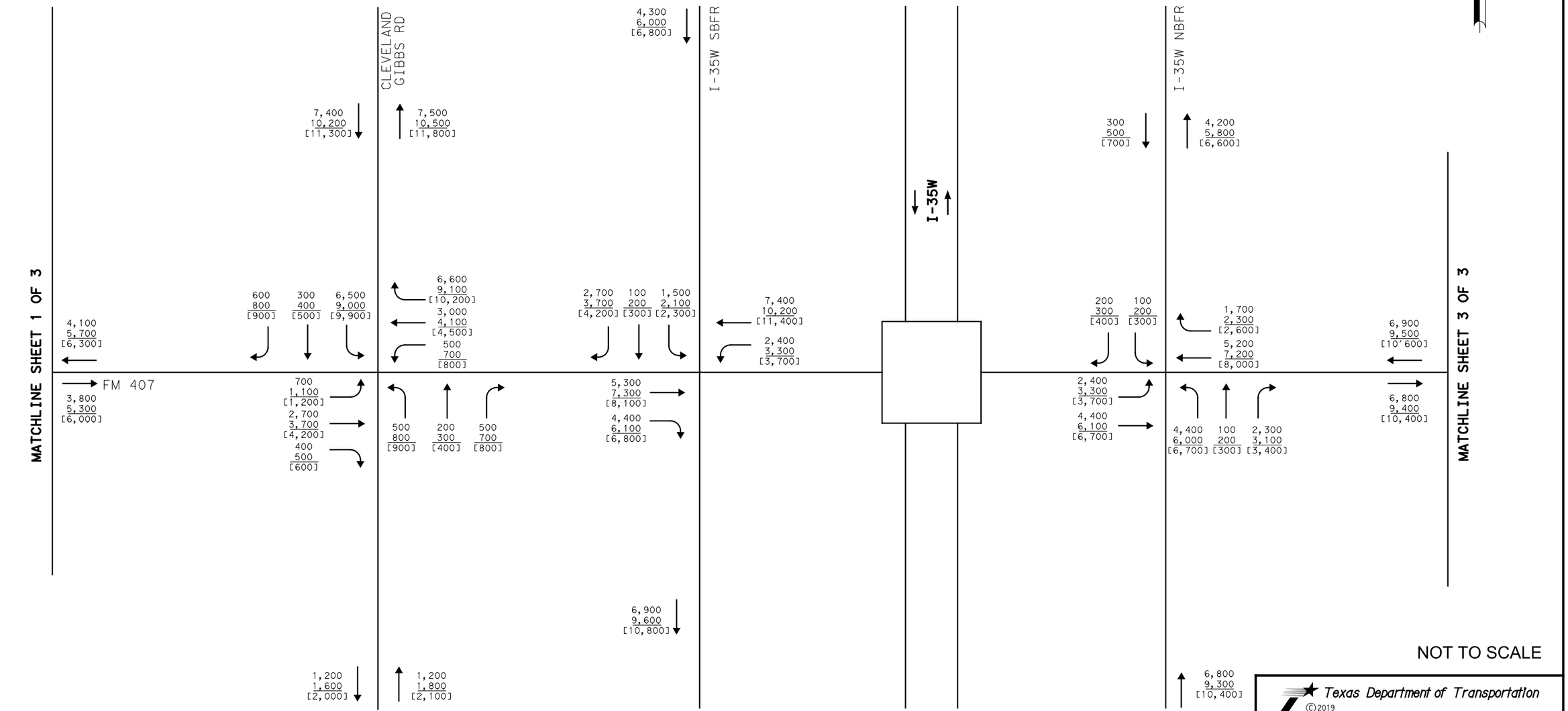
BUILD TRAFFIC PROJECTIONS (ADT) FOR FM 407 (RED ROUTE) FROM 12TH ST TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL	
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT			SHEET
	DAL				1
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	DENTON					FM 407

7/3/2019 10:29:44 AM
FM 407 Traffic Projection BuildRed_01.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



NOT TO SCALE

LEGEND
999-YEAR 2025 ADT
999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

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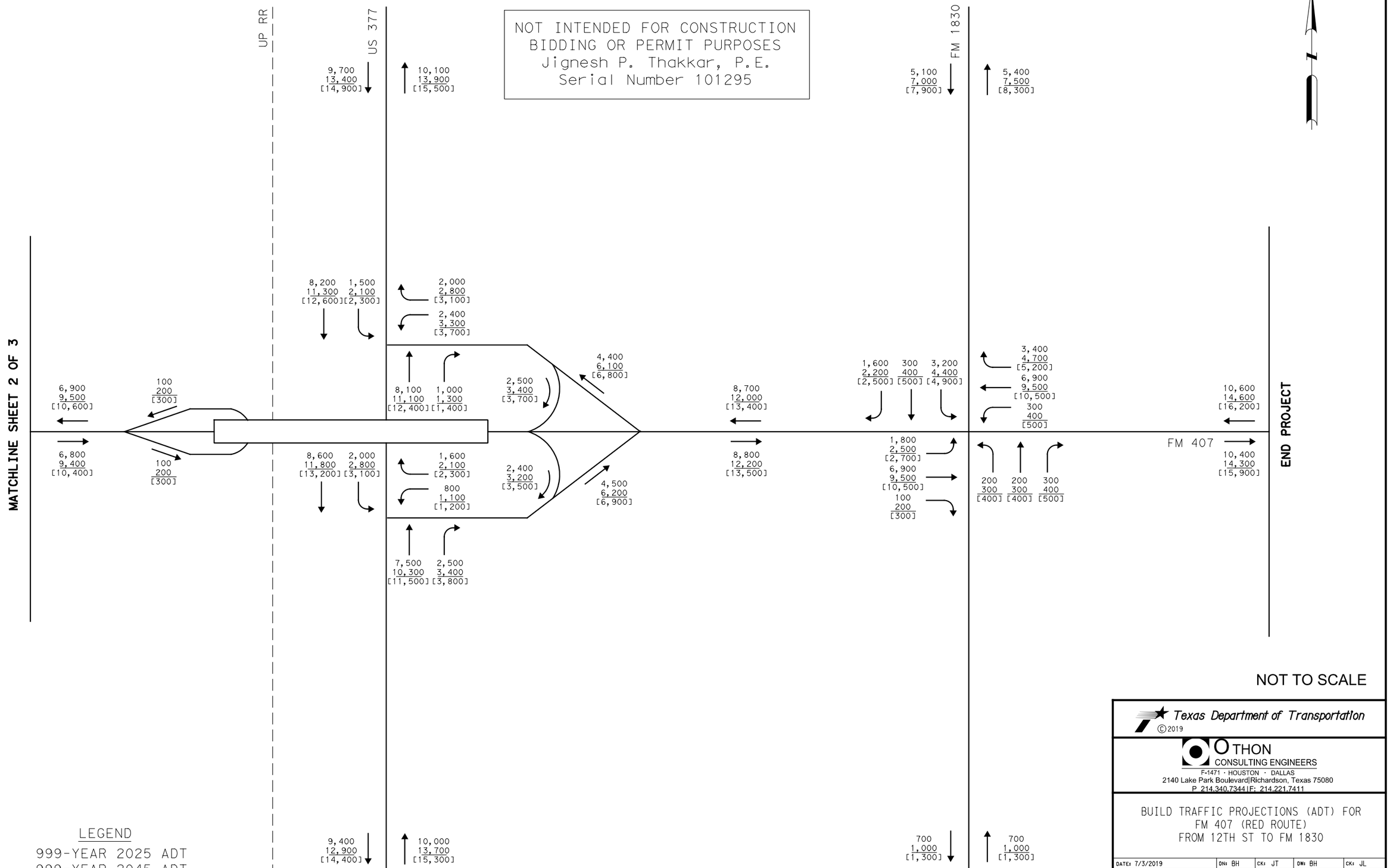
BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (RED ROUTE)
FROM 12TH ST TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			2
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

7/3/2019 10:29:45 AM
FM 407 Traffic Projection BuildRed_02.dgn

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
Jignesh P. Thakkar, P.E.
Serial Number 101295



LEGEND
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999-YEAR 2045 ADT
[999]-YEAR 2055 ADT

NOT TO SCALE

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BUILD TRAFFIC PROJECTIONS (ADT) FOR
FM 407 (RED ROUTE)
FROM 12TH ST TO FM 1830

DATE: 7/3/2019	DN: BH	CK: JT	DW: BH	CK: JL
CSJ: 1310-01-045	DISTRICT	FEDERAL AID PROJECT		SHEET
	DAL			3
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	DENTON				FM 407

7/3/2019 10:29:45 AM
FM 407 Traffic Projection BuildRed_03.dgn

APPENDIX

Recommended Build Alternative Diagrammatic

FM 407 Feasibility Study > Recommended Build Alternative

Estudio de Viabilidad FM 407 > Alternativa de Construcción Recomendada

FM 407 FEASIBILITY STUDY | COUNTY: DENTON | DATE: JULY 2020

Texas Department of Transportation

THIS ENVIRONMENTAL PROJECT IS CURRENTLY PROPOSED AS CATEGORICAL EXCLUSION TO BE APPROVED BY THE FHWA. THIS ALTERNATIVE IS CURRENTLY RECOMMENDED AS A BUILD THAT MEET FEASIBILITY CRITERIA FOR THE PURPOSE OF NEED IN ADDRESSING SOLUTIONS TO IMPROVE THE NS 407 TRAFFIC OPERATIONS, SAFETY, MOBILITY, AND CONNECTIVITY. THE RECOMMENDED ALTERNATIVE WILL BE REFINED AND DEVELOPED THROUGH ADDITIONAL ENGINEERING DESIGN, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL CLEARANCE AND PUBLIC INPUT.

ESTE PROYECTO AMBIENTAL SE PROPONE ACTUALMENTE COMO EXCLUSIÓN CATEGÓRICA PARA SER APROBADA POR EL F.H.W.A. ESTA ALTERNATIVA SE RECOMIENDA ACTUALMENTE POR UN ESTUDIO DE SUST ENTE PRELIMINAR POR NEC. EL PROPÓSITO ES EXPLORAR SOLUCIONES PARA MEJORAR LA OPERACIÓN DE TRÁFICO NS 407, SEGURIDAD, MOVILIDAD Y CONECTIVIDAD. LA ALTERNATIVA RECOMENDADA SERÁ REFINADA Y DESARROLLADA A TRAVÉS DE DISEÑO DE INGENIERÍA ADICIONAL, EVALUACIÓN AMBIENTAL, AUTORIZACIÓN AMBIENTAL Y PARTICIPACIÓN PÚBLICA.

N

Scale in Miles

LEGEND

- EXISTING FM 407 ALIGNMENT
- RECOMMENDED BUILD ALTERNATIVE *
- RECOMMENDED TRAILHEAD / TRAILS
- EXISTING PROPERTY LINES
- TOWN / CITY LIMITS (APPROXIMATE)
- SCHOOL
- AVALON AT ARGYLE DEVELOPMENT
- HARVEST DEVELOPMENT (VILLAGE COMMUNITIES)
- HEALTH TRACT DEVELOPMENT
- THE HIGHLANDS DEVELOPMENT
- PECAN SQUARE DEVELOPMENT (VILLAGES COMMUNITIES)
- CANYON FALLS DEVELOPMENT
- WATERRIDGE DEVELOPMENT
- TIMBERMESA DEVELOPMENT
- CREEKVIEW ESTATES DEVELOPMENT
- 100-YR FLOOD PLAIN
- POTENTIAL WETLANDS
- SURFACE WATER / TIMBERWIDES
- SURFACE WELLS
- COUNTRY

MOBILITY AND REGIONAL VELOCITY ★★

POTENTIAL VELOCITY LINK ★★ (TO BE STUDIED / DETERMINED BY OTHERS)

BRIDGE LIMITS (APPROXIMATE)

SENDA ARCOS
40 mph (SENDA30)
50 mph (SENDA50)

★ SHOWS BEGIN AND END

★ Potential roadway construction and future acquisition cross sections dimensions would accommodate 4 travel lanes with a median, 2 frontage roads, 4 travel lanes, 2 shoulders and 2 bicycle facilities and sidewalks.

★★ The Regional Velocities & Links (RVL) network consists of all of the planned and existing freeways, toll roads, and major arterials in the region. The RVL network is the backbone of the roadway system and is the basis for the Metropolitan Transportation Plan (MTP). The RVL network is the highest expressway network. Its entire transportation, and it extends the reach of the region's transportation system to the rest of the state and to locations throughout the country. The network has planned connections to 23 counties and 120 cities in North Central Texas. Its purpose is to provide a high-speed, high-capacity network that connects major activity centers in a major destination, thru-ride supplement to the transport network. Alignments were determined through the cooperative efforts of local governments and TXDOT staff as:

- Identifying mobility and connectivity needs;
- Identifying potential solutions to address the potential mobility needs;
- Identifying potential alignments to address the identified mobility and connectivity needs; and
- Identifying corridors that provide the greatest potential for implementation.

The Regional Velocities is adopted by the Regional Transportation Council, the transportation policy body for the Dallas-Fort Worth area. Corridors identified on the Regional Velocities Transportation plan for the Dallas/Fort Worth area. Corridors identified on the network as potential velocities are not approved projects. Each project will require a study to be reasonable for the planning and implementation of regular and cooperative infrastructure and amenities. The North Central Texas Council of Governments (NCTCOG) notes those corridors identified on the Regional Velocities Network Map with a ★★ or otherwise defined velocity status. Source: NCTCOG.org

1. AERIAL PHOTO SOURCE: TEXAS NATURAL RESOURCES INFORMATION SYSTEM
2. ENVIRONMENTAL CONSTRAINTS CONCEPTUAL, PRELIMINARY AND SUBJECT TO CHANGE.
3. ENVIRONMENTAL CONSTRAINTS ARE SHOWN FOR INFORMATIONAL PURPOSES ONLY.
4. EXISTING RIGHT OF WAY LIMITS SHOWN ARE APPROXIMATE.
5. ENVIRONMENTAL CONCEPT PLAN LOCATIONS ARE SUBJECT TO CHANGE.

PRELIMINARY

THIS DRAWING IS INCOMPLETE AND IS RELEASED FOR THE PURPOSE OF REVIEW UNDER THE AUTHORITY OF KELLY RECOMMENDED ENGINEER. IT IS NOT TO BE USED FOR BIDDING OR CONSTRUCTION PURPOSES.

POTENTIAL IMPROVEMENT ZONE*

RECOMMENDED BUILD TYPICAL SECTION
Not to scale

RECOMMENDED BUILD TYPICAL SECTION AT 12TH ST
Not to scale

SECTION I - BEGINNING OF STUDY TO FLORANCE ROAD

SECTION II - FLORANCE ROAD TO STONECREST ROAD

SECTION III - STONECREST ROAD TO END OF STUDY (FM 1830)

BEGIN STUDY
CSJ: 1310-01-045

END STUDY
CSJ: 1310-01-045

FM 407 at I-35W Interchange
TxDOT Tie-in Project

FM 407 at SR 114 Interchange
TxDOT Tie-in Project

PROPOSED SQUARE TUBE SIGNAL POLE

PROPOSED SQUARE TUBE SIGNAL POLE

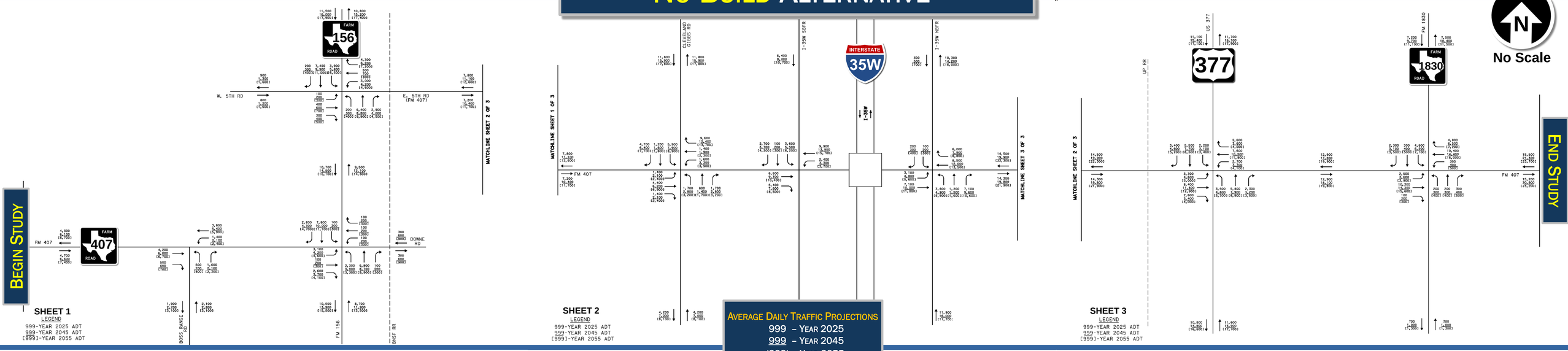
DENTON
NORTHLAKE
ARGYLE
DRAPER
AVALON AT ARGYLE DEVELOPMENT
PECAN SQUARE DEVELOPMENT (VILLAGES COMMUNITIES)
HARVEST (Village Communities)
HEALTH TRACT
THE HIGHLANDS
WATERRIDGE DEVELOPMENT
CANYON FALLS DEVELOPMENT
JUSTIN
PETRUS (Village Communities)
FLOWER MOUND
DARTMOUTH DR
BARTONVILLE
TOWN OF ARGYLE
TOWN OF NORTHLAKE
TOWN OF DENTON
TOWN OF FLOWER MOUND
TOWN OF BARTONVILLE

APPENDIX

Recommended Build Alternative Traffic Exhibits

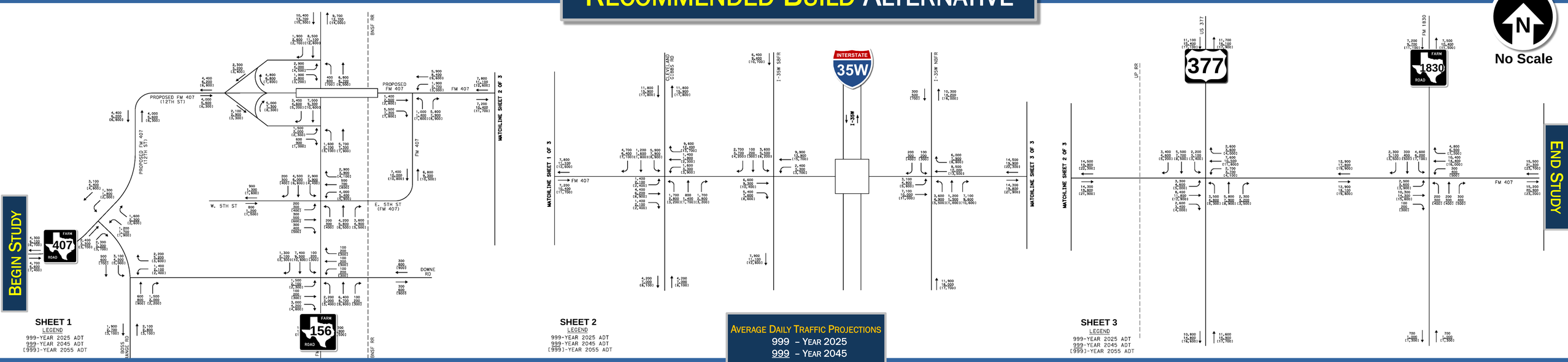
Projected FM 407 Traffic Volumes

No Build Alternative



Average Daily Traffic Projections
999 – Year 2025
999 – Year 2045
(999) – Year 2055

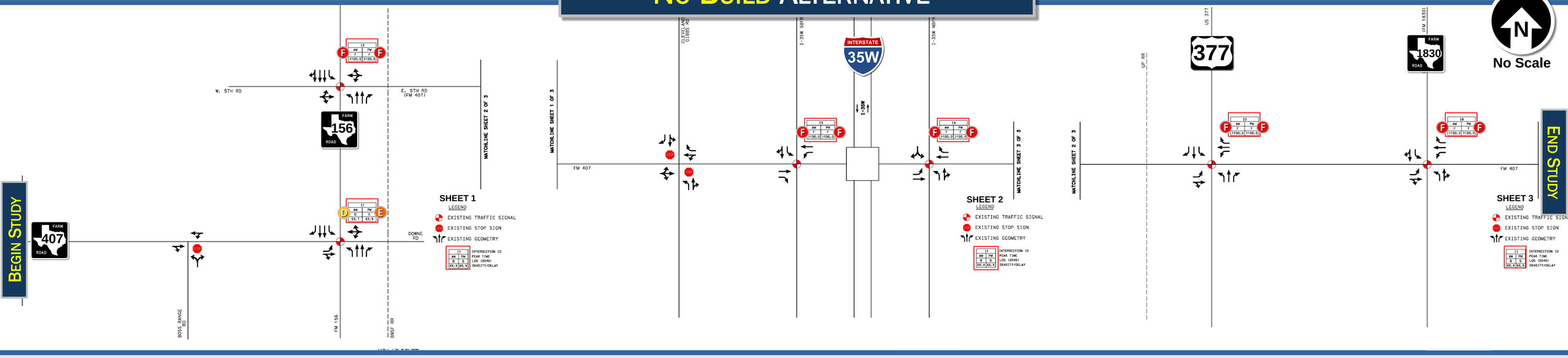
Recommended Build Alternative



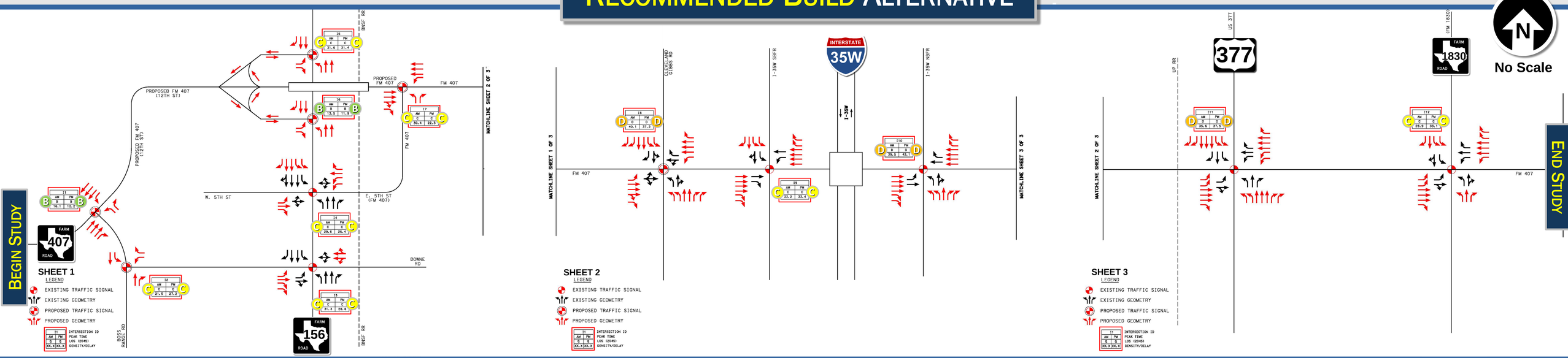
Average Daily Traffic Projections
999 – Year 2025
999 – Year 2045
(999) – Year 2055

Projected FM 407 Level of Service (Traffic Flow)

No Build Alternative



Recommended Build Alternative



Level of Service (LOS) is a qualitative measure used to relate the quality of motor vehicle traffic service and utilized to analyze roadways:

A = free flow traffic **B** = reasonably free flow **C** = stable flow **D** = approaching unstable flow **E** = unstable flow, operating at capacity **F** = forced or breakdown flow

APPENDIX

Recommended Build Alternative Preliminary Construction Sequence Exhibit

FM 407 Feasibility Study > Recommended (Build) Alternative

Estidio de Viabilidad FM 407 > Alternativa Recomendado (Construcción)

FM 407 FEASIBILITY STUDY | COUNTY: DENTON | DATE: NOVEMBER 2020 | Texas Department of Transportation

THIS ENVIRONMENTAL PROJECT IS TECHNICALLY PROCESSED AS TERMINOLOGY DEFINED TO MEANING SECTION 201.101. THIS ALTERNATIVE IS CURRENTLY RECOMMENDED AS A "BUILD" OR ONE OF "FEASIBLE" STUDY. THE PURPOSE OF WORK IS OPTIMIZING SOLUTIONS TO IMPROVE THE AM PEAK TRAFFIC OPERATIONS, SAFETY, AND MOBILITY ON FM 407 FROM FLORANCE ROAD TO STONECREST ROAD. THE PROJECT IS PERFORMANCE THROUGH EFFICIENCY, ENHANCED MOBILITY, AND OTHER ENVIRONMENTAL OUTCOMES AND COMMUNITY INTERACTIONS, AND FINAL IMPACT.

ESTE PROYECTO AMBIENTAL SE PROCESA TÉCNICAMENTE COMO SE DEFINE EN LA TERMINOLOGÍA DEL SECTIONAL 201.101. ESTA ALTERNATIVA SE RECOMIENDA ACTUALMENTE COMO UNA ALTERNATIVA DE "BUILD" O UNA DE LAS ALTERNATIVAS DE RECOMENDACIÓN DE ESTUDIO. EL PROPÓSITO DE ESTE PROYECTO ES OPTIMIZAR SOLUCIONES PARA MEJORAR LA OPERACIÓN DE TRÁFICO, LA SEGURIDAD Y LA MOVILIDAD EN FM 407 DESDE FLORANCE ROAD HASTA STONECREST ROAD. EL PROYECTO ES RENDIMIENTO A TRAVÉS DE EFICIENCIA, MOVILIDAD MEJORADA Y OTROS RESULTADOS AMBIENTALES Y LAS INTERACCIONES DE LA COMUNIDAD, Y EL IMPACTO FINAL.

Entire FM 407 Corridor

Beginning of Study to End of Study

BEGIN STUDY
CSJ: 1310-01-045

END STUDY
CSJ: 1310-01-045

DENTON | NORTHLAKE | JUSTIN | PETRUS | HARVEST (Master Development) | DRAPER | AVALON AT ARGYLE DEVELOPMENT | PECAN SQUARE DEVELOPMENT (Withdrawn Communities) | ARGYLE | HEALTH TRACT | THE HIGHLANDS | CANYON FALLS DEVELOPMENT | FLOWER MOUND | BARTONVILLE

FM 1830 at I-35W Interchange
TxDOT Ten-In Project
Under Construction

FM 1830 at SH 377 Interchange
TxDOT Ten-In Project
Under Construction

N
Scale 1" = 800'

LEGEND

- EXISTING FM 407 ALIGNMENT
- TECHNICALLY PREFERRED (BUILD) ALTERNATIVE*
- EXISTING FM 407 PAVEMENT REMOVAL
- PROPERTY LINES
- TOWN / CITY LIMITS (APPROXIMATE)
- SCHOOL
- AVALON AT ARGYLE DEVELOPMENT
- HARVEST DEVELOPMENT (UNLIKELY COMMUNITIES)
- HEALTH TRACT DEVELOPMENT
- THE HIGHLANDS DEVELOPMENT
- PECAN SQUARE DEVELOPMENT (UNLIKELY COMMUNITIES)
- CANYON FALLS DEVELOPMENT
- WATERBROOK DEVELOPMENT
- TIMBERBROOK DEVELOPMENT
- CREEKVIEW ESTATES DEVELOPMENT
- 100-YR FLOOD PLAIN
- POTENTIAL WETLANDS
- SURFACE WATER
- SURFACE WATER TRIBUTARIES
- CEMETERY

UTILITY (OVERHEAD, ALIGNED) ● ●
POTENTIAL UTILITIES LINE ● ●
(TO BE STUDIED / DETERMINED BY OTHERS)
BRIDGE (LIMITS APPROXIMATE)

SIGNAL NEEDED
NO LEFT TURN(S)
NO RIGHT TURN(S)

CONSTRUCTION SEQUENCE

- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4
- PHASE 5
- PHASE 6

* Technically preferred alternative and future acquisition runs, possibly diminishes small number of ROW parcels, but not all. Source: Kimley-Horn & Associates, Inc.

● The Regional Hallmark is a 1,000 mile network of off-street shared use paths (trails) connecting communities across North Central Texas. The Regional Hallmark Network is the backbone of the system envisioned as part of Mobility 2045. The network serves as the regional expressway network. To safely transportation, and it extends the reach of the region's transportation system by connecting to existing and planned local trail networks. The network has also been envisioned as 12 corridors and 150 miles in North Central Texas. Each corridor is envisioned to have a trail that connects to the urban core and other major destinations, to a major destination, thru hike supplement the network network. Alignments were determined through the cooperative efforts of the all governments and NCTCOG staff as:

- Identifying mobility and "critical facilities"
- Identifying connections to existing and planned bike facilities
- Identifying connections to existing and planned transit stops and access to transit stations and major destinations
- Identifying corridors that provide the greatest potential for regional connectivity

The Regional Hallmark is adopted by the Regional Transportation Council, the transportation policy body for the Dallas-Fort Worth area. Subsequently, the Regional Transportation Council (also the Fort Worth Transportation Authority) is responsible for the planning and implementation of regional and statewide transportation and amenities. The North Central Texas Council of Governments (NCTCOG) relies these responsibilities to the Regional Transportation Council. Refer to Mobility 2045 or alternative sources review. Source: NCTCOG.org

1. AERIAL PHOTO SOURCE: TEXAS NATURAL RESOURCES INFORMATION SYSTEM
2. ENVIRONMENTAL CONTEXT IS CONCEPTUAL, PRELIMINARY AND SUBJECT TO CHANGE
3. ROADWAY ALIGNMENTS ONLY. RECOMMENDED CROSS SECTIONS MAY REQUIRE ADDITIONAL RIGHT-OF-WAY
4. EXISTING RIGHT OF WAY LIMITS SHOWN ARE APPROXIMATE
5. ENVIRONMENTAL CONTEXT TBD AS CUSTOMS ARE SUBJECT TO CHANGE.

PRELIMINARY
This information is a preliminary product of ongoing ROADWAY ENVIRONMENTAL CELL. RECOMMENDED CROSS SECTIONS MAY REQUIRE ADDITIONAL RIGHT-OF-WAY
CONCEPTS ARE SUBJECT TO CHANGE.
FOR PRELIMINARY PURPOSES ONLY.

EXISTING R.O.W. 50' TO 40' | EXISTING R.O.W. 50' TO 40' | EXIST. R.O.W.
PROPOSED R.O.W. = 138' USUAL
20' USUAL 5' | 40' | 6' MEDIAN | 12' TURN BAY | 40' | 20' USUAL 5' | 10' PATH
LOCATION TBD

TECHNICALLY PREFERRED (BUILD) TYPICAL SECTION
Not to scale

SECTION I - BEGINNING OF STUDY TO FLORANCE ROAD

SECTION II - FLORANCE ROAD TO STONECREST ROAD

SECTION III - STONECREST ROAD TO END OF STUDY (FM 1830)