Appendix B

Technical Memoranda and Reports

Disclaimer:

Technical memoranda and reports were prepared as independent documents to support the preparation of the Final Environmental Impact Statement (FEIS) for the Dallas CBD Second Light Rail Alignment (D2 Subway). Information from these documents was incorporated into the FEIS to provide information on existing conditions, and in some cases, assess potential impacts to the resources. Information contained in the FEIS is the most current and supersedes information in the technical memoranda and reports.

B-15

Traffic Analysis Methodology Technical Memorandum

MEMO

Date:	Tuesday, March 24, 2020
Project:	DART General Planning Consultant Contract C-2012668 TO39 D2 Subway - Traffic Analysis Methodology Development
To:	Ernie Martinez – DART Capital Planning, PM D2 Subway Project Kay Shelton – DART Project Manager, Capital Planning
From:	Reddy Edulakanti and Fan Gao – GPC6
Subject:	DART TO39 D2 Subway Project Development SDEIS – Traffic Analysis Methodology and Use of TransModeler Model

INTRODUCTION

Dallas Area Rapid Transit (DART) is conducting Project Development, including Preliminary Engineering (PE) and development of a Supplemental Draft Environmental Impact Statement (SDEIS) for a second Central Business District (CBD) light rail alignment, known as the D2 Subway. The General Planning Consultant (GPC), was tasked with developing a methodology and conducting traffic analysis to evaluate the potential traffic impacts of the project associated with:

- Permanent changes to the downtown transportation network, such as changes to lane capacity or turn movements, proposed street closures, and new street connections; and
- Temporary construction impacts on the downtown street network based on a set of assumed construction scenarios.

The purpose of this technical memorandum is to provide a description of the study area, an overview of the traffic model development and calibration process, traffic impact analysis methodology, and a summary of Year 2017 existing conditions compared to Year 2024 no build conditions. A future technical memorandum will document the 2024 no build comparison with the 2024 build, as well as the 2045 no build and 2045 build analysis and results. The results of the traffic analysis will be included in the SDEIS and will provide the basis for traffic mitigation measures, as well as provide recommendations to alleviate potential construction impacts. A summary of the models and their purpose is provided below in **Table 1**.

TABLE 1. MODEL SCENARIO SUMMARY

2017	2024		2045	
Existing Conditions	No Build	Build	No Build	Build
Baseline	Opening year without project	Opening year with project to identify potential impacts compared to no build and identify mitigation construction scenario analysis to inform construction approach	Future year without project	Future year with project to identify potential impacts compared to no build and identify mitigation

Source: DART, GPC6

Study Area

The study area includes intersections located within downtown Dallas between IH 35E on the west, IH 345 on the east, Woodall Rodgers Freeway on the north and Young Street on the south along with several intersections in the Deep Ellum and Victory areas. While a significant portion of the alignment will be below grade through the core of downtown Dallas, several intersections in this core area were included in order to analyze potential construction impacts along major streets such as Griffin and Commerce. The intersections in Victory and Deep Ellum are important relative to the potential permanent changes associated with the project and daily operations in at-grade conditions. A list of the study area intersections where data was collected along with a figure showing the locations is provided below.

MODEL DEVELOPMENT METHODOLOGY

This section describes the methodology to develop the models to be used in the traffic analysis. A total of five models are developed, out of which the 2017 existing conditions model and Year 2024 models with and without project (build and no-build) are completed. A comparison of Year 2024 conditions with and without project are provided in a memorandum dated July 19, 2019. HDR is currently finalizing two Year 2045 models with and without the project. The 2045 models will be used to forecast no build and build network conditions. The Year 2024 models will be used to compare opening year conditions with and without the project in place, as well as to document potential traffic impacts under different construction scenarios. The Year 2045 model will estimate future long-term conditions with and without the project.

The following sections describe the software and analysis tool, data collection, and assumptions for each model development including calibration results for the Year 2017 existing conditions and Year 2024 models.

SOFTWARE CHOICE AND ANALYSIS TOOL

The North Central Texas Council of Governments (NCTCOG) maintains the Dallas-Fort Worth calibrated four-step Regional Travel Demand Model (DFX) using TransCAD software. TransCAD is a product of Caliper Corporation (Caliper) used for macro level modeling. Caliper developed TransModeler software to conduct sub-regional analysis at mesoscopic and microscopic levels. TransModeler is designed to cooperate with TransCAD and includes additional features that streamline the use of simulation for travel demand forecasting. Both TransCAD and TransModeler integrate very well with the geographical information system (GIS) environment and are used by several agencies.

TransModeler is particularly effective with transportation networks in grid patterns such as the D2 Subway study area. The ease of coding signalized intersections, interchangeability of origin-destination (OD) nodes between TransCAD and TransModeler, availability of dynamic route choice methods to assign traffic to the network, and special features to test work zone conditions and incident management make TransModeler a logical choice to conduct the analysis for the D2 Subway project.

TransModeler can simulate all kinds of road networks, from freeway to downtown areas, and can analyze wide area multimodal networks in detail. The behavior of complex traffic systems can be modeled and visualized in a 2-dimensional or 3-dimensional GIS environment to illustrate and evaluate traffic flow dynamics, traffic signal and ITS operations, and overall network performance.

HDR worked with DART to develop the TransModeler microscopic simulation model for use in the project traffic analysis. The model will allow the prediction of the effects of modified lane configurations, traffic control, and any changes made in the transportation system on the system's operational performance. Operational performance is measured in terms of measures of effectiveness (MOEs), which include average delays, level of service (LOS) and queue lengths, among others. The MOEs provide useful input in the recommendations for mitigation and other improvements to handle issues related to traffic congestion, delay and queues.

DATA COLLECTION

A range of data was collected to support the development of the model and to assist with calibration of existing conditions. The data collection efforts included:

- Turning Movement Counts (TMCs) and Vehicle Classification Counts (VCCs)
- Travel times
- Signal timing
- Signal preemption observations, and
- Field observations for lane closures and other temporary conditions.

Turning Movement Counts

TMCs were collected on Tuesday, March 28, 2017 by GRAM NTX, Inc. at selected intersections within the study area, along with VCCs and pedestrian and bicycle counts. These intersections were selected by HDR in coordination with DART, in order to capture the traffic activity at the majority of the intersections within the study area. Table 2 lists the 93 counted intersections and they are shown in **Figure 1**. The TMC data was collected in 15-minute intervals during the two peak periods:

- AM peak period: 7:00 AM to 9:00 AM
- PM peak period: 4:15 PM to 6:15 PM

Since the data collection was only performed at selected intersections within the study area, historical data from previous projects and the Texas Department of Transportation (TxDOT) Statewide Traffic Analysis and Reporting System (STARS II) database were used as supplements.

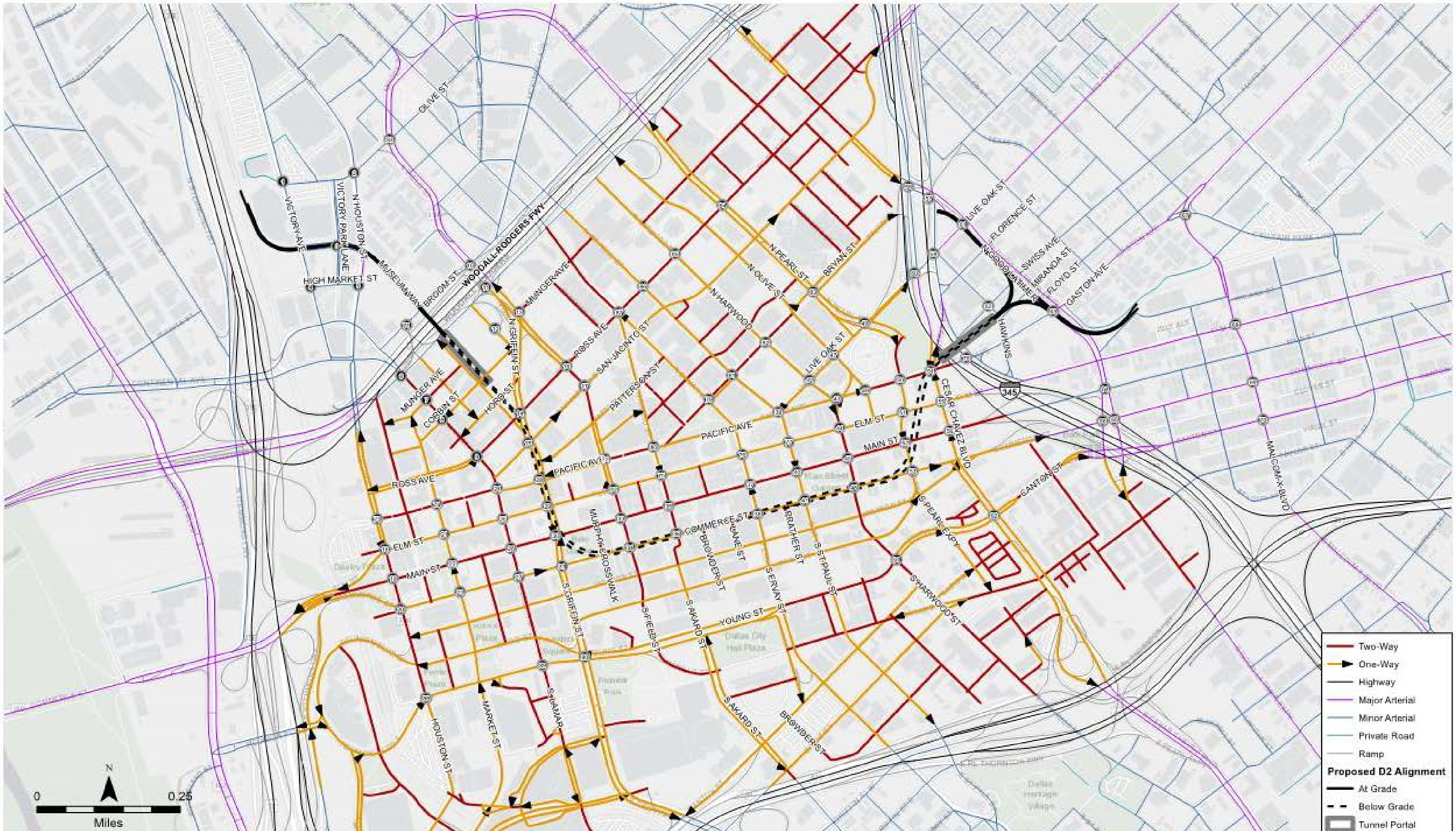
TABLE 2. SELECTED INTERSECTIONS

No.	Intersection	No.	Intersection
1	Victory Ave @ Olive St	48	Pacific Ave @ N Olive St
2	Houston St @ Olive St	49	Live Oak St @ N Pearl St
3	Victory Park Ln @ Museum Way	50	Pacific Ave @ S Pearl St
4	Victory Ave @ High Market St	51	Elm St @ S Pearl St
5	Houston St @ High Market St	52	Main St @ S Pearl St
6	Lamar St @ McKinney Ave	53	Commerce St @ S Pearl Expy
7	Lamar St @ Munger Ave	54	Pacific Ave @ N Cesar Chavez Blvd
8	Lamar St @ Corbin St	55	Elm St @ N Cesar Chavez Blvd
9	Lamar St @ Ross Ave	56	Main St @ Cesar Chavez Blvd
10	Field St @ Woodall Rogers WBFR	57	N Good Latimer Expy @ N Central Expy
11	Field St @ Woodall Rogers EBFR	58	N Good Latimer Expy @ S Central Expy
12	Magnolia St @ Off Ramp	59	Live Oak St @ N Central Expy
13	Field St @ Munger Ave	60	Live Oak St @ S Central Expy
14	Griffin St @ Ross Ave	61	Live Oak St @ N Good Latimer Expy
15	Griffin St @ San Jacinto St	62	Swiss Ave @ N Hawkins St
16	Ross Ave @ N Field St	63	Gaston Ave @ N Good Latimer Expy
17	N Field St @ San Jacinto St	64	Main St @ N Good Latimer Expy
18	Elm St @ N Houston St	65	Commerce St @ N Good Latimer Expy
19	Main St @ S Houston St	66	Commerce St @ S Good Latimer Expy
20	Commerce St @ S Houston St	67	Gaston Ave @ N Malcolm X Blvd
21	Elm St @ N Market St	68	Elm St @ N Malcolm X Blvd
22	Main St @ S Market St	69	Malcolm X Blvd @ Commerce St
23	Commerce St @ S Market St	70	Canton St @ S Malcolm X Blvd
24	Pacific Ave @ N Lamar St	71	Broom St @ Laws St
25	Elm St @ N Lamar St	72	Pacific Ave @ Field St
26	Main St @ S Lamar St	73	Pacific Ave @ Houston St
27	Commerce St @ S Lamar St	74	Pacific Ave @ Market St
28	Pacific Ave @ N Griffin St	75	Elm St @ N Akard St
29	Elm St @ N Griffin St	76	Elm St @ N Ervay St
30	Main St @ S Griffin St	77	Elm St @ N St Paul St
31	Griffin St @ Commerce St	78	Pacific Ave @ N Central Expy

TABLE 2. SELECTED INTERSECTIONS

No.	Intersection	No.	Intersection
32	Elm St @ N Field St	79	Bryan St @ Ervay St
33	Main St @ S Field St	80	Bryan St @ Pacific Ave @ N Akard St
34	Commerce St @ S Field St	81	Bryan St @ St Paul St
35	Main St @ Akard St	82	N Harwood St @ Bryan St
36	Commerce St @ S Akard St	83	Pearl St @ Bryan St
37	Main St @ Ervay St	84	Ross Ave @ N Pearl St
38	Commerce St @ S Ervay St	85	Harwood St @ Ross Ave
39	Pacific Ave @ Live Oak St @ St Paul St	86	St Paul St @ Ross Ave
40	Main St @ St Paul St	87	Ross Ave @ Ervay St
41	Commerce St @ S St Paul St	88	Reunion Blvd @ Young St @ Houston St
42	Live Oak St @ N Harwood St	89	Young St @ Lamar St
43	Harwood St @ Olive St @ Pacific Ave	90	Young St @ Griffin St
44	Elm St @ N Harwood St	91	Young St @ S Harwood St
45	Main St @ N Harwood St	92	Canton St @ S Cesar Chavez Blvd
46	Commerce St @ S Harwood St	93	Field St @ Olive St
47	Olive St @ Live Oak St		

Source: DART, February 16, 2017.



DART

Figure 1
Selected Intersections within the
Central Business District Roadways and Street Network
Data Source: DART, GPC6, City of Dallas

D2 Subway Project
Existing Conditions Technical Memo

Travel Time

The travel times along primary streets within the study area were used for calibrating the 2017 existing conditions model. The primary north-south streets selected for travel time collection include: Lamar Street, Griffin Street, St. Paul Street, and Harwood Street. The primary east-west streets selected for travel time collection include: Elm Street, Main Street and Commerce Street.

To collect travel times more efficiently, these streets were combined into five loops, shown in **Figure 2** below. Travel times were collected on Thursday, March 23, 2017 by GRAM NTX, Inc., during the same peak periods while TMC data was collected.

Signal Timing

Signal timings were obtained from the City of Dallas through a Synchro file. HDR conducted field visits on March 28 and 29, 2017 to verify and update the signal timing information to make sure the most recent information is included in the 2017 existing conditions model.

Signal Preemption along Light Rail

The signal preemption settings at existing light rail crossings were observed by project team from HDR and DART along with Michael Wobken, from the City of Dallas on September 13, 2017 and replicated in the existing conditions model to the extent possible given software settings.

Field Observations

Temporary lane closures due to construction and other construction activity were collected by HDR on March 28, 2017. Closed lanes were noted during field visits and coded in to the existing conditions model.

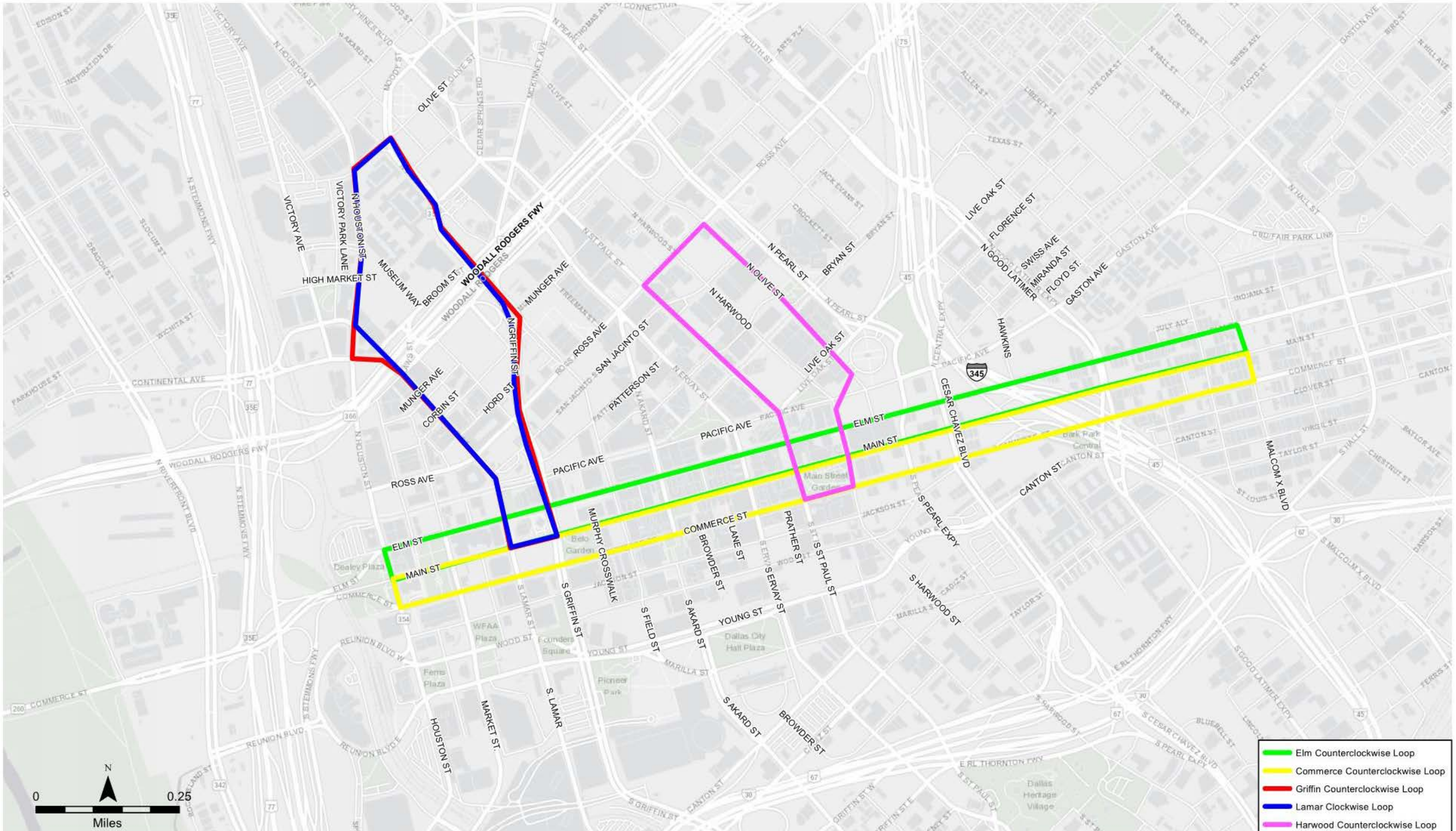


Figure 2
Travel Time Loops
Data Source: DART, GPC6, City of Dallas

D2 Subway Project
Existing Conditions Technical Memo

2017 EXISTING CONDITIONS MODEL

The following describes the development and calibration of the 2017 existing conditions model, which serves as the baseline for future year models.

2017 Existing Origin-Destination (OD) Matrix

The base OD matrices provided by DART, which were obtained from the NCTCOG DFX TransCAD model, were used as the starting point to develop an OD matrix reflecting existing conditions. The traffic counts collected for this project along with historical counts from TxDOT and other sources were used to update the base OD matrix through an OD Matrix Estimation (ODME) procedure in TransModeler. This method has the advantage of reducing the risks of introducing the unknowns and uncertainties of the planning process into the simulation model. The resulting OD matrix was further refined manually through an iterative process, based on the area knowledge and professional judgment to filter any unusual travel patterns. As part of the iterative process, trip matrix settings were altered to result in the most appropriate OD matrices reflective of the existing conditions. This process resulted in the traffic volume distribution within the model.

Model Inputs

Since the data collection was undertaken in March 2017 and the DFX OD matrices were adjusted using the 2017 traffic volumes, a base year model reflecting those of the 2017 conditions was developed and known as existing conditions model. The existing conditions model included the following major inputs:

- Roadway Geometry: The first step in defining a simulation network is describing the network geometry. TransCAD network obtained from DART was first imported into TransModeler and the road editor function was used to define the individual link attributes such as roadway class, number of lanes, lane widths etc. Field observations and aerial photographs were used to update roadway geometrics. All the temporary lane closures due to maintenance and construction observed during field visits, were coded in the model as well. These lane closures will not be applied for future year models.
- Speed limits: The speed limits as obtained for roadway classes from the DFX were field verified and incorporated into the existing conditions model.
- Traffic Volumes: TMCs and VCCs described in the Data Collection section above were aggregated into link volumes to code into the model. The locations where 2017 data was unavailable, historical traffic data increased by a growth rate of 1% per annum was utilized, where available.
- Heavy vehicle percentage: The percentage of vehicle classes from VCCs including the heavy vehicle percentage was added to vehicle fleet input as a global parameter, describing the basic makeup of traffic in the network. As the public transit was coded separately, buses were not considered part of the heavy vehicles.
- Signal Timings: Existing conditions analysis involved coding of traffic signal phasing, timing, and coordination settings in the model. The traffic signal information obtained from the City of Dallas and verified/updated in the field was imported into the TransModeler models to simulate the operation of existing signalized intersections. The signal timings at light rail crossings in the

model was adjusted using special settings to imitate the operation of trains in downtown in today's conditions.

- Pedestrian volumes: Pedestrian crosswalks were coded to capture the effect of pedestrians on traffic flow in urban areas.
- Public Transit: Existing conditions analysis involved coding of buses, light rail trains, and street car services. The route information and ridership data as provided by DART was incorporated into the model. The frequency of buses and street car service was defined by headways and that of light rail train service defined by GTFS data and compared to schedules in the model.

2017 Existing Conditions Model Calibration

After the network was coded, all the existing data was incorporated to compile existing conditions for AM peak and PM peak hour simulation models. These models were then calibrated based on the methodology contained in the Federal Highway Administration's (FHWA) Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software. Calibration is an important step in development of the base model. If the model is not calibrated or incorrectly calibrated, it may create misleading results.

The global parameters that affect the driving behavior such as critical distance, headway, and look ahead distances were adjusted from the default value to reflect more realistic field conditions. Lane changing behavior is an important element of the microscopic traffic simulation model.

All lane changes are classified as either mandatory or discretionary in TransModeler. In this case, the selection of discretionary lane change will impact the driver behaviors significantly. A discretionary lane change is one made in order to achieve a perceived improvement in driving conditions, such as improving ones speed. There are two discretionary lane changing models to choose from in TransModeler – 'the neighboring lane model' and 'the target lane model'. In the neighboring lane model, drivers consider only their adjacent lanes, whereas in the target lane model, drivers consider all lanes on a segment in their choice set. In the target lane model, therefore, drivers can make lane changing maneuvers not necessarily based on the merits of the neighboring lane, but as part of a higher level plan to reach a desirable lane two or more lanes away. Due to the moderate to high demand within the study area, the target lane model was applied in the model to improve the lane utilization which is more likely to happen in a downtown area.

The following MOEs were used in calibrating the base model – link volumes, travel times and queue length observations.

- Square Error (% RMSE) is a common calculation performed in the traffic assignment and calibration process to determine if modeled volumes match traffic counts. Percent RMSE values are usually between 10 and 100 with 10% indicating the best match. Due to the size of the study area and based on a discussion with Caliper, 20% was used as the desirable statistics threshold to verify the accuracy. The percent RMSE values for AM and PM existing conditions models are 19% and 18%, respectively and hence considered acceptable.
- The average of several travel time runs collected along preset routes within the network (see Figure 2) were compared to the travel times obtained from the corresponding routes in the existing conditions model. As shown in **Table 3** below, the travel times are within 10% of

observed values in almost all cases with the exception of Harwood Loop in AM, which is deemed a data outlier.

- Queue lengths observed during field visits were visually confirmed during the simulation of the existing conditions models.

TABLE 3. COMPARISON OF TRAVEL TIME RUNS BETWEEN FIELD VISITS AND EXISTING CONDITIONS MODEL

Travel Time Runs	AM Peak			PM Peak		
	Field visit	2017 Existing Condition Model	Comparison	Field visit	2017 Existing Condition Model	Comparison
Lamar clockwise loop	7 minutes and 20 seconds	7 minutes and 19 seconds	100%	10 minutes and 59 seconds	11 minutes and 1 seconds	100%
Harwood Loop	8minutes and 13 seconds	6 minutes and 3 seconds	74%	6 minutes and 58 seconds	6 minutes and 38 seconds	95%
Griffin Counterclockwise Loop	9 minutes and 31 seconds	8 minutes and 41 seconds	91%	10 minutes and 12 seconds	11 minutes and 5 seconds	109%
Elm Loop	15 minutes and 7 seconds	14 minutes and 28 seconds	95%	19 minutes and 26 seconds	17 minutes and 49 seconds	92%
Commerce Loop	15 minutes and 9 seconds	13 minutes and 34 seconds	90%	16 minutes and 36 seconds	18 minutes and 35 seconds	112%
Total	55 minutes and 20 seconds	50 minutes and 5 seconds	90%	64 minutes and 11 seconds	65 minutes and 8 seconds	101%

Source: Data Collection (Thursday, March 23, 2017) and Model Results.

YEAR 2024 MODEL

2024 OD Matrix Forecasting

To estimate trips within the modeled network in 2024, the Origin-Destination (OD) matrices derived from the DFX model for year 2017 and year 2024 were examined to determine the changes occurring during that period. The comparison yielded an average annual demand growth rate of 2.2%. However, applying that growth rate directly to the existing conditions' calibrated OD matrix for deriving 2024 no build conditions, resulted in unreasonably high traffic within the study area for the Year 2024. Based on a review of this growth rate with the City of Dallas[1], a more reasonable growth rate of 1% per annum was assumed.

[1] Michael Wobken, City of Dallas, Department of Transportation, July 10, 2018 (e-mail correspondence)

A reduction factor was developed by comparing the compounded growth calculated using 1% and 2.2% and was applied to different categories of OD pairs within the calibrated OD matrix. The categories of OD pairs are formed depending on whether trips are traveling within the study area, or entering/exiting a highway ramp or traveling to/from a minor street. It was noted from a comparison of existing and future DFX matrices, that the trips entering/exiting a highway are expected to reduce slightly. Hence, no growth was assumed for the trips connected to highway ramps.

The lowered growth rate was applied to remaining OD categories within the 2017 calibrated OD matrix and the resulting 2024 no-build matrix for the study area was derived.

Year 2024 Network Change Assumptions

Once the 2017 existing conditions model was calibrated, it was used to develop the Year 2024 Model and no build network. All temporary constructions that were observed during field visits were assumed to be completed for the future year 2024 no build model. Also, changes proposed to the current geometry were coded into the no build network based on the information available from the City of Dallas[2]. The following geometry changes were assumed to be completed by 2024 and were incorporated into the network.

- Pearl Street will operate as a two-way street between Pacific Avenue and Young Street
- Cesar Chavez Boulevard will operate as a two-way street between Pacific Avenue and Young Street
- Live Oak will operate as a two-way street between CBD East Transfer Center (Olive) and Central (Cesar Chavez)
- Commerce Street will operate as a three-lane one-way street between Akard Street and Lane Street

Signal timing and phasing were optimized as needed across the network to reflect the new geometry and the increased traffic volumes. It is assumed that the signal timing update is a constant process applied by the City on an as-needed basis to reflect the worsening traffic conditions. Hence, the new signal timings/phasing proposed in the 2024 no build model sometimes reflect better operations and Level of Service (LOS) compared to the 2017 existing conditions model.

YEAR 2045 MODEL

2045 OD Matrix Forecasting

Similar to the 2024 OD matrix described above, a 2045 OD matrix was developed to estimate the trips within the 2045 model network. A comparison of similar trips within the matrices derived from the DFX model for the years 2024 and 2045 yielded an annual growth rate of 1.4%. However, in agreement with the City of Dallas, a more reasonable and moderate long term growth rate of 0.5% was utilized to project 2024 trips to the year 2045. A reduction factor was derived by comparing the two growth rates which was slightly adjusted on a trial and error basis and applied to individual trip categories of OD pairs within 2024 matrix, to derive the OD trip matrix for the year 2045. The resultant OD matrix

[2] Michael Wobken, City of Dallas, Department of Transportation, October 23, 2018 (e-mail correspondence)

demonstrates an overall annual growth of 0.53% in the AM peak period and 0.54% in the PM peak period.

Year 2045 Network Change Assumptions

The year 2045 no build and build network models were developed and will assume traffic growth and network changes through the year 2045. The following changes are made to the network besides signal timing changes to reflect the new geometry and traffic volume growth:

- Eastbound Commerce Street converted to three lane roadway between Houston Street and Cesar Chavez Boulevard
- Westbound Elm Street converted to four lane roadway between Houston Street and Cesar Chavez Boulevard and
- The three intersections along Museum Way at Victory Avenue, Victory Park Lane and Houston Street are kept fully operational for vehicular and pedestrian crossing with pre-empted traffic signals allowing train movements.

CAPACITY ANALYSIS

METHODOLOGY

Capacity analysis is a method by which traffic volumes are compared to the calculated roadway and intersection capacities to evaluate existing and future traffic conditions. The Transportation Research Board (TRB) describes the methodology used in the 2016 Highway Capacity Manual (HCM). In general, the terminology “Level of Service” (LOS) is used to provide a “qualitative” evaluation based on certain “quantitative” calculations related to empirical values. The definition of LOS as contained in 2016 HCM is briefly described below.

Level of Service range from A to F. In general, LOS A represents the best traffic operating condition and LOS F represents the worst condition (typically associated with congestion and long delays). The LOS values for unsignalized and signalized intersections are defined in terms of average delay. Delay is used as a measure of driver discomfort, frustration, efficiency, etc. See **Table 4** for the LOS criteria for signalized and unsignalized intersections. Any lane group that operates at LOS E or F requires mitigation to achieve LOS D or better.

The operational conditions within the study area were evaluated using LOS as the measure of effectiveness (MOE). After the calibration and validating efforts were completed for existing and future no build models, the results of the model runs were extracted to obtain the LOS. To account for the different range of traffic conditions seen in the field, the models were run 10 times without fixed random seeds and the average results were used. If the total control delay of one run is much higher than other runs, the run will be considered as an outlier and excluded from the set to calculate the average results.

Article IX “Traffic Mitigation Measures” of the Planning and Development Supplemental Agreement #1 to the DART/City of Dallas Inter-local Agreement outlines the analysis process for determining potential traffic impacts. In general, an impact is likely to occur when either one of two warrants is exceeded:

(1) Level of Service (LOS) and (2) queuing.

Based on DART policy and industry standards, mitigation should be initially considered when the LOS along major or minor thoroughfares, or at intersections, is reduced from the No-Build condition by two or more levels or creates a LOS "F." LOS D is considered an acceptable LOS. If the presence of the Build Alternative causes vehicular traffic on streets adjacent to the rail line to queue through adjoining intersections, or queue through the D2 Subway tracks, a queuing impact may exist. Table 4 summarizes LOS criteria.

TABLE 4. LEVEL OF SERVICE (LOS) CRITERIA

Level of Service	Average Control Delay (seconds/vehicle)	
	Signalized	Unsignalized
A	Less than or equal to 10.0	Less than or equal to 10.0
B	Greater than 10.0 to 20.0	Greater than 10.0 to 15.0
C	Greater than 20.0 to 35.0	Greater than 15.0 to 25.0
D	Greater than 35.0 to 55.0	Greater than 25.0 to 35.0
E	Greater than 55.0 to 80.0	Greater than 35.0 to 50.0
F	Greater than 80.0	Greater than 50.0

Source: HCM 2016

CAPACITY ANALYSIS RESULTS – YEAR 2017 EXISTING CONDITIONS AND YEAR 2024 NO BUILD

A summary of the number of intersections operating at a particular LOS during 2017 existing and 2024 no build conditions are summarized in **Table 5** below. **Appendix A** provides a more detailed summary of LOS for all intersections in 2017 Existing and 2024 no build conditions. Both **Table 5** and **Appendix A** report MOEs for all 93 intersections counted during data collection along with the remaining signalized intersections within the study area for a total of 160 intersections.

TABLE 5. SUMMARY OF INTERSECTION LOS FOR YEAR 2017 EXISTING CONDITIONS AND YEAR 2024 NO BUILD CONDITIONS

LOS	AM Peak Hour		PM Peak Hour	
	Existing 2017	No Build 2024	Existing 2017	No Build 2024
A	62	54	55	53
B	83	90	75	74
C	12	12	25	27
D	2	4	5	6
E	1	0	0	0
Total	160	160	160	160

Source: GPC6

2017 Existing Conditions

During existing AM peak conditions, all intersections operate at LOS C or better other than the following three intersections:

- Commerce Street and Cesar Chavez Boulevard
- Ross Avenue and Pearl Street
- Woodall Rodgers westbound service road (Broom Street) and Field Street

During existing PM peak conditions, most of the intersections operate at LOS C or better. The intersections that operate at LOS D or worse are concentrated on the west side of downtown Dallas, between Houston Street and Lamar Street, and along Elm Street and Main Street, and as more fully identified in Appendix A. This is reflective of the traffic exiting downtown to access IH 35E and IH 30.

2024 No Build Conditions

During no build AM peak conditions, most of the intersections operate at LOS C or better. The distribution of the LOS did not change significantly compared to 2017 AM existing conditions.

During no build PM peak conditions, most of the intersections still operate at LOS C. However, the distribution of LOS D changed. The operations on the west side of Dallas downtown area are expected to improve to a LOS C or better by Year 2024. The operations at some intersections along Pearl Street became worse. This is potentially caused by the geometric change along Pearl Street between Pacific Avenue and Young Street. As Pearl Street becomes a two-way street in the future Year 2024 no build condition, the heavy southbound left turning movements at the intersections with Main Street and Commerce Street cannot be served as quickly as in the existing condition. Since the signal timing cannot meet the demand at the downstream intersection, the upstream intersection would experience queuing.

NO BUILD VS. BUILD TRAFFIC IMPACT ANALYSIS CRITERIA

After the 2024 build model and 2045 no build and build models are finalized, a new memorandum will be developed to compare no build and build conditions. This comparison will look at MOEs such as LOS, delays and queue lengths on individual approaches of the key intersections along with corridor travel times to understand changes and any required mitigation resulting from the build project.

CONCLUSION AND NEXT STEPS

Based on the traffic modeling efforts and results described in the previous sections, the overall operations of the entire study area are expected to be acceptable during all conditions, including Year 2017 existing AM and PM conditions, and Year 2024 no build AM and PM conditions. However, the geometric changes proposed for the future 2024 no build network impact the AM and PM conditions differently. For example, the geometric change along Pearl Street has no significant impact on the operation of the 2024 no build AM condition, while the impact to the 2024 no build PM conditions is noticeable.

NEXT STEPS

Next steps include finalizing the 2024 build network, and 2045 no-build and build networks. The build networks are based on 10% design progress and street network changes with the project in place. T to analyze and compare future year conditions with and without the project in place.

APPENDIX A

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
1	Elm St and Houston St	Signalized	20.51	C	19.86	B	35.76	D	26.01	C
2	Elm St and Record St	Signalized	10.76	B	12.42	B	30.49	C	16.97	B
3	Elm St and Market St	Signalized	10.68	B	14.65	B	43.79	D	14.15	B
4	Elm St and Austin St	Signalized	3.74	A	6.50	A	25.33	C	6.56	A
5	Elm St and Lamar St	Signalized	11.72	B	15.11	B	34.21	C	21.98	C
6	Elm St and Griffin St	Signalized	16.05	B	19.22	B	25.86	C	16.12	B
7	Elm St and Field St	Signalized	14.30	B	14.63	B	24.48	C	21.04	C
8	Elm St and Akard St	Signalized	13.89	B	14.45	B	11.23	B	13.25	B
9	Elm St and Ervay St	Signalized	10.62	B	11.00	B	10.67	B	11.81	B
10	Elm St and St Paul St	Signalized	14.15	B	16.12	B	14.76	B	17.54	B
11	Elm St and Harwood St	Signalized	13.29	B	11.90	B	11.69	B	18.98	B
12	Elm St and Pearl St	Signalized	6.90	A	12.16	B	10.93	B	25.55	C
13	Elm St and Cesar Chavez Blvd	Signalized	17.37	B	16.35	B	11.82	B	15.33	B
14	Elm St and Good Latimer Expy	Signalized	21.02	C	26.24	C	22.76	C	21.47	C
15	Elm St and Malcolm X Blvd	Signalized	11.13	B	12.61	B	11.53	B	12.52	B
16	Main St and Houston St	Signalized	27.25	C	25.32	C	43.33	D	25.59	C
17	Main St and Record St	Signalized	13.70	B	10.94	B	33.73	C	15.27	B
18	Main St and Market St	Signalized	17.17	B	16.05	B	54.30	D	16.36	B
19	Main St and Austin St	Signalized	14.70	B	14.75	B	39.39	D	9.16	A
20	Main St and Lamar St	Signalized	10.42	B	11.89	B	31.03	C	20.74	C
21	Main St and Griffin St	Signalized	16.11	B	18.30	B	19.76	B	15.74	B
22	Main St and Murphy Dr	Signalized	4.22	A	4.15	A	7.46	A	3.45	A
23	Main St and Field St	Signalized	13.94	B	15.28	B	23.31	C	18.94	B

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
24	Main St and Akard St	Signalized	9.97	A	11.40	B	16.97	B	19.65	B
25	Main St and Ervay St	Signalized	11.96	B	13.55	B	16.25	B	12.17	B
26	Main St and St Paul St	Signalized	8.75	A	10.28	B	15.11	B	20.26	C
27	Main St and Harwood St	Signalized	14.30	B	13.94	B	9.91	A	14.58	B
28	Main St and Pearl St	Signalized	10.11	B	11.83	B	8.74	A	21.42	C
29	Main St and Cesar Chavez Blvd	Signalized	33.77	C	21.84	C	15.38	B	22.33	C
30	Main St and Good Latimer Expy	Signalized	15.54	B	15.03	B	13.16	B	13.59	B
31	Main St and Malcolm X Blvd	Signalized	10.77	B	12.71	B	11.08	B	11.32	B
32	Commerce St and Houston St	Signalized	19.86	B	24.85	C	13.37	B	18.53	B
33	Commerce St and Record St	Signalized	6.97	A	6.93	A	5.78	A	8.70	A
34	Commerce St and Market St	Signalized	11.72	B	13.72	B	12.33	B	6.15	A
35	Commerce St and Austin St	Signalized	7.75	A	9.52	A	8.55	A	9.89	A
36	Commerce St and Lamar St	Signalized	7.19	A	8.57	A	10.44	B	10.46	B
37	Commerce St and Griffin St	Signalized	12.01	B	11.41	B	20.27	C	14.79	B
38	Commerce St and Field St	Signalized	9.53	A	11.23	B	9.26	A	8.54	A
39	Commerce St and Akard St	Signalized	11.18	B	11.21	B	7.70	A	10.93	B
40	Commerce St and Browder St	Signalized	4.51	A	4.11	A	3.30	A	4.49	A

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
41	Commerce St and Lane St	Signalized	3.31	A	5.45	A	5.80	A	7.71	A
42	Commerce St and Ervay St	Signalized	6.35	A	6.60	A	6.98	A	5.90	A
43	Commerce St and Prather St	Signalized	3.19	A	2.50	A	1.48	A	1.98	A
44	Commerce St and St Paul St	Signalized	7.62	A	8.13	A	14.43	B	13.25	B
45	Commerce St and Harwood St	Signalized	10.70	B	11.72	B	10.04	B	9.65	A
46	Commerce St and Pearl St	Signalized	5.46	A	11.99	B	11.24	B	9.47	A
47	Commerce St, Cesar Chavez Blvd and Jackson St	Signalized	71.64	E	46.66	D	19.56	B	23.18	C
48	Commerce St and SB Good Latimer Expy	Signalized	11.55	B	10.68	B	9.57	A	8.88	A
49	Commerce St and NB Good Latimer Expy	Signalized	12.72	B	14.29	B	5.54	A	5.79	A
50	Commerce St and Malcolm X Blvd	Signalized	12.23	B	12.07	B	9.19	A	7.58	A
51	Pacific Ave and Houston St	Signalized	8.38	A	7.67	A	8.01	A	10.80	B
52	Pacific Ave and Record St	Signalized	7.69	A	6.70	A	11.75	B	14.96	B
53	Pacific Ave and Market St	Signalized	9.45	A	11.37	B	16.59	B	16.83	B
54	Pacific Ave and Lamar St	Signalized	7.14	A	5.95	A	7.67	A	5.96	A
55	Pacific Ave and Griffin St	Signalized	9.66	A	9.68	A	17.52	B	14.91	B

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
56	Pacific Ave and Field St	Signalized	7.77	A	8.01	A	17.04	B	13.71	B
57	Pacific Ave and Akard St	Signalized	8.87	A	11.00	B	16.74	B	15.06	B
58	Pacific Ave and Ervay St	Signalized	7.22	A	6.89	A	12.59	B	13.10	B
59	Pacific Ave and St Paul St	Signalized	18.53	B	19.66	B	15.72	B	20.04	C
60	Pacific Ave and Harwood St	Signalized	17.62	B	16.92	B	22.20	C	40.16	D
61	Pacific Ave and Olive St (Harwood)	Signalized	13.28	B	13.00	B	6.65	A	9.71	A
62	Pacific Ave and Olive St	Stop	7.38	A	4.83	A	7.13	A	2.71	A
63	Pacific Ave and Pearl St	Signalized	13.84	B	14.32	B	25.54	C	54.29	D
64	Pacific Ave and Cesar Chavez Blvd	Signalized	22.05	C	20.56	C	17.94	B	17.94	B
65	Pacific Ave and N Central Expy	Stop	0.36	A	0.40	A	0.22	A	0.67	A
66	Gaston Ave and Good Latimer Expy	Signalized	18.13	B	19.07	B	28.01	C	30.60	C
67	Gaston St and Malcolm X Blvd	Signalized	12.79	B	12.13	B	10.27	B	9.47	A
68	Ross Ave and Houston St	Signalized	9.66	A	9.63	A	14.09	B	19.63	B
69	Ross Ave and Lamar St	Signalized	15.97	B	15.59	B	24.17	C	25.04	C
70	Ross Ave and Griffin St	Signalized	21.35	C	20.40	C	31.10	C	27.59	C
71	Ross Ave and Field St	Signalized	14.07	B	13.39	B	15.57	B	15.66	B
72	Ross Ave, Akard St and Ervay St and	Signalized	16.78	B	15.81	B	20.54	C	20.02	C
73	Ross St and St Paul St	Signalized	13.86	B	12.91	B	16.42	B	20.99	C
74	Ross Ave and Harwood St	Signalized	12.98	B	14.07	B	13.68	B	16.35	B

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
75	Ross St and Olive St	Signalized	12.23	B	13.34	B	13.03	B	16.65	B
76	Ross Ave and Pearl St	Signalized	39.61	D	45.23	D	28.99	C	46.10	D
77	San Jacinto St and Griffin St	Signalized	14.05	B	14.39	B	12.17	B	12.02	B
78	San Jacinto St and Field St	Signalized	14.61	B	15.81	B	11.00	B	11.80	B
79	San Jacinto St and Akard St	Signalized	12.37	B	12.17	B	14.19	B	13.12	B
80	San Jacinto St and Ervay St	Signalized	11.16	B	12.55	B	8.10	A	8.95	A
81	San Jacinto St and St Paul St	Signalized	8.61	A	8.46	A	10.47	B	9.83	A
82	San Jacinto St and Harwood St	Signalized	9.67	A	10.70	B	9.41	A	9.67	A
83	San Jacinto St and Olive St	Signalized	14.20	B	13.18	B	18.55	B	17.74	B
84	San Jacinto St and Pearl St	Signalized	17.82	B	17.12	B	13.55	B	19.37	B
85	Jackson St and Houston St	Signalized	14.59	B	14.97	B	18.03	B	25.93	C
86	Jackson St and Austin St	Signalized	13.06	B	13.79	B	14.69	B	17.09	B
87	Jackson St and Market St	Signalized	13.61	B	17.30	B	14.80	B	11.26	B
88	Jackson St and Lamar St	Signalized	10.34	B	12.05	B	10.57	B	13.73	B
89	Jackson St and Griffin St	Signalized	7.62	A	7.07	A	11.12	B	10.99	B
90	Jackson St and Field St	Signalized	10.44	B	8.92	A	7.71	A	6.60	A
91	Jackson St and Akard St	Signalized	8.08	A	7.41	A	4.56	A	6.86	A
92	Jackson St and Ervay St	Signalized	6.98	A	7.64	A	5.85	A	6.46	A

			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
93	Jackson St and St Paul St	Signalized	7.41	A	5.06	A	6.51	A	9.29	A
94	Jackson St and Harwood St	Signalized	5.83	A	8.25	A	7.56	A	8.48	A
95	Jackson St and Pearl St	Signalized	5.09	A	16.51	B	5.27	A	11.27	B
96	Young St and Houston St	Signalized	16.71	B	19.66	B	19.18	B	20.73	C
97	Young St and Record St	Signalized	10.49	B	9.44	A	9.12	A	9.54	A
98	Young St and Market St	Signalized	15.99	B	29.44	C	9.20	A	9.94	A
99	Young St and Lamar St	Signalized	14.38	B	15.88	B	10.17	B	10.20	B
100	Young St and Griffin St	Signalized	16.71	B	17.25	B	12.39	B	13.80	B
101	Young St and Field St	Signalized	6.44	A	7.35	A	7.60	A	7.12	A
102	Young St and Akard St	Signalized	9.34	A	9.95	A	9.97	A	9.44	A
103	Young St and Ervay St	Signalized	16.89	B	16.35	B	15.67	B	18.48	B
104	Young St and St Paul St	Signalized	8.65	A	11.02	B	13.82	B	14.37	B
105	Young St and Harwood St	Signalized	15.50	B	19.70	B	13.53	B	13.23	B
106	Young St and Pearl St	Signalized	4.52	A	3.67	A	6.96	A	8.17	A
107	Canton St and Cesar Chavez Blvd	Signalized	21.86	C	15.19	B	7.60	A	7.76	A
108	Canton St and SB Good Latimer Expy	Signalized	14.41	B	17.55	B	16.85	B	17.02	B
109	Canton St and NB Good Latimer Expy	Signalized	33.89	C	37.14	D	7.89	A	8.41	A
110	Canton St and Malcolm X Blvd	Signalized	11.66	B	12.05	B	10.31	B	11.32	B
111	Wood St and Houston St	Signalized	11.62	B	11.50	B	23.17	C	27.95	C
112	Wood St and Record St	Signalized	8.98	A	7.80	A	10.72	B	19.89	B

Traffic Analysis Summary

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
113	Wood St and Market St	Signalized	15.10	B	16.91	B	7.41	A	13.12	B
114	Wood St, Young St and Lamar St	Signalized	10.62	B	11.26	B	17.76	B	19.76	B
115	Wood St and Griffin St	Signalized	4.32	A	6.16	A	4.57	A	4.76	A
116	Wood St and Field St	Signalized	9.18	A	8.93	A	8.46	A	8.18	A
117	Wood St and Akard St	Signalized	7.63	A	7.15	A	5.70	A	5.26	A
118	Wood St and Ervay St	Signalized	5.85	A	7.51	A	9.99	A	10.35	B
119	Wood St and St Paul St	Signalized	5.67	A	3.56	A	8.56	A	10.01	B
120	Wood St and Harwood St	Signalized	6.03	A	9.32	A	8.92	A	10.23	B
121	Bryan St and Ervay St	Signalized	7.79	A	7.55	A	7.59	A	7.08	A
122	Bryan St and St Paul St	Signalized	10.19	B	11.54	B	10.74	B	14.67	B
123	Bryan St and Harwood St	Signalized	10.57	B	11.56	B	9.57	A	12.31	B
124	Bryan St and Olive St	Signalized	15.85	B	16.02	B	13.27	B	12.25	B
125	Bryan St and Pearl St	Signalized	20.33	C	16.18	B	24.12	C	44.14	D
126	Patterson St and Akard St	Signalized	13.87	B	15.22	B	17.53	B	18.12	B
127	Patterson St and Ervay St	Signalized	7.63	A	8.86	A	4.56	A	2.68	A
128	Federal St and Ervay St	Signalized	9.32	A	9.07	A	10.68	B	8.38	A
129	Federal St and St Paul St	Signalized	8.65	A	8.69	A	21.53	C	24.86	C
130	Federal St and Harwood St	Signalized	7.34	A	6.45	A	14.20	B	20.80	C
131	Olive St and Victory Park Ln	Signalized	5.48	A	6.12	A	7.12	A	7.32	A
132	Olive St and Field St	Signalized	21.41	C	23.40	C	19.29	B	20.50	C

Traffic Analysis Summary										
			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
133	Cedar Springs Rd and Field St	Signalized	8.02	A	8.37	A	4.04	A	4.49	A
134	Woodall EBSR and Field St	Signalized	11.90	B	11.66	B	10.52	B	10.99	B
135	Woodall WBSR and Field St	Signalized	38.83	D	44.70	D	26.68	C	37.98	D
136	Munger Ave and Field St	Signalized	15.81	B	17.43	B	17.18	B	17.69	B
137	Live Oak St and Harwood St	Signalized	11.59	B	10.80	B	10.23	B	18.06	B
138	Live Oak St and Olive St	Signalized	15.24	B	12.90	B	9.97	A	22.07	C
139	Live Oak St and Pearl St	Signalized	16.79	B	13.35	B	34.57	C	46.48	D
140	Live Oak St and SB Cesar Chavez Blvd	Signalized	8.43	A	5.63	A	10.40	B	20.14	C
141	Live Oak St and NB Cesar Chavez Blvd	Signalized	17.39	B	24.08	C	17.14	B	24.76	C
142	Live Oak St and Good Latimer Expy	Signalized	17.10	B	23.24	C	22.37	C	27.07	C
143	Olive St and Victory Ave	Signalized	4.47	A	6.40	A	3.20	A	4.40	A
144	Olive St and Houston St	Signalized	15.22	B	16.34	B	20.43	C	19.90	B
145	Continental Ave and Victory Ave	Signalized	18.10	B	18.00	B	16.24	B	17.02	B
146	Museum Way and Victory Park Ln	Stop	1.64	A	3.39	A	0.38	A	3.98	A
147	High Market St and Victory Ave	Stop	0.05	A	0.05	A	0.13	A	0.07	A
148	High Market St and Houston St	Stop	0.01	A	0.04	A	0.32	A	0.03	A
149	Off Ramp and Magnolia St	Stop	0.51	A	0.54	A	4.16	A	3.24	A

			AM Peak Hour				PM Peak Hour			
			Existing 2017		No-Build 2024		Existing 2017		No-Build 2024	
	Intersection	Control Type	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS	Average Control Delay (sec)	LOS
150	Broom St and Laws St	Stop	0.10	A	0.11	A	0.11	A	0.10	A
151	Continental Ave and Houston St	Signalized	6.75	A	6.85	A	9.63	A	9.97	A
152	Lamar St and Houston St	Signalized	12.07	B	12.42	B	11.77	B	11.65	B
153	Lamar St and Victory Ave	Signalized	15.65	B	15.70	B	13.48	B	12.64	B
154	Corbin St and Lamar St	Signalized	6.21	A	6.47	A	15.99	B	10.70	B
155	Munger Ave and Lamar St	Signalized	26.15	C	29.91	C	24.68	C	7.62	A
156	McKinney Ave and Houston St	Signalized	13.44	B	13.32	B	13.53	B	12.86	B
157	McKinney Ave and Lamar St	Signalized	22.24	C	22.72	C	16.91	B	17.35	B
158	Good Latimer Expy and SB Central Expy	Signalized	16.25	B	16.70	B	16.96	B	17.40	B
159	Good Latimer Expy and NB Central Expy	Signalized	14.63	B	15.54	B	12.73	B	11.95	B
160	Swiss Ave and Hawkins St	Stop	0.00	A	0.00	A	0.00	A	0.00	A

Traffic Analysis Summary

Notes:

1. The Highway Capacity Manual (HCM) level of service is not directly from TransModeler.
2. The Control Delay for the intersections is the average of 10 simulation runs in TransModeler.
3. The Control Delay obtained from TransModeler is compared to the following tables from HCM to obtain LOS:
   a. Signalized Intersection - Exhibit 19-8 LOS Criteria: Motorized Vehicle Mode (page 19-16, HCM 2016)
   b. Two-Way Stop-Controlled Intersections - Exhibit 20-2 LOS Criteria: Motorized Vehicle Mode (Page 20-6, HCM 2016)
   c. All-Way Stop-Controlled Intersections - Exhibit 21-8 LOS Criteria: Motorized Vehicle Mode (Page 21-9, HCM 2016).