Appendix 1

Traffic Forecasting Memorandum

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION
1263 S. Stewart Street
Carson City, Nevada 89712

STEVE SISOLAK
Governor

KRISTINA L. SWALLOW, P.E., *Director*

In Reply Refer to:

February 13, 2020

Mr. John Karachepone, P.E.
Jacobs Engineering Group Inc
250 Pilot Road, Suite 160
Las Vegas, Nevada 89119

Dear Mr. Karachepone:

The Nevada Department of Transportation's Traffic Information Section has reviewed the forecasting methodology and traffic volumes used in the I-515/I-215 Interchange Feasibility Study Traffic Forecasting Memorandum produced by John Karachepone of Jacobs dated February 11, 2020. The current and future traffic volumes seem reasonable for use in the traffic operation analysis. Should you require clarification or additional information please contact myself or Chris Wright at (775) 888-7443.

Sincerely,

Mark Wooster

Mark Wooster
NDOT Traffic Information Assistant Chief

CC: Hoang Hong, Traffic Operations
Sam Ahiamadi, Traffic Operations
Dave Bowers, NDOT Project Manager

Technical Memorandum

TO:	Thomas Davy, P.E., City of Henderson	**DATE:**	November 27, 2019
FROM:	John Karachepone, P.E., Jacobs		
SUBJECT:	I-515/I-215 Interchange Feasibility Study: Traffic Forecasting Memorandum		
COPIES:	Chris Wright, NDOT; Mark Wooster, NDOT; Hoang Hong, P.E., NDOT; Samuel Ahiamadi, NDOT; David Bowers, P.E., NDOT; Jim Mischler, P.E., CA Group		

1. INTRODUCTION AND BACKGROUND

The I-515/I-215 Interchange Feasibility Study was initiated by the City of Henderson to develop and evaluate alternatives to alleviate recurring congestion, address high crash locations, and to accommodate future growth at the interchange and adjoining interstate corridors.

In 2015, the City initiated the Southbound I-515 Improvement Study to assess deteriorating traffic operations, including low travel speeds and long queues, on the interstate system-to-system ramp from I-515 southbound (SB) to I-215 westbound (WB). The results of the study included a short-term recommendation to reconfigure the I-515 SB to I-215 WB ramp. NDOT, in turn, has designed and implemented this short-term solution in December 2018.

In 2016, NDOT initiated the Southern Nevada Traffic Study (SNTS) to understand the existing and future freeway operations and to develop improvement concepts for poorly performing freeway segments in Southern Nevada. As part of the SNTS, the I-515/I-215 interchange was modeled at a microscopic simulation level of detail using Aimsun Next and evaluated for various improvement concepts to improve traffic operations.

This feasibility study builds upon and advances the findings and recommendations of the previous studies. This study is designed to identify long-term solutions to advance under the direction of the City and NDOT into the NEPA process, and subsequently into final design and construction. One of the key steps in the feasibility study is the evaluation of the traffic operations performance of improvement alternatives.

The Project team originally intended to use the Aimsun Next model developed, calibrated, and utilized by the SNTS, without any modifications to model the year 2017 Existing Conditions and

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year 2040 No-Action Alternative. This proposed methodology was documented in the January 28, 2019 memorandum[1]: *"I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum,"* included as Appendix A. However, during the Project, discrepancies were observed between the year 2017 Aimsun Next model volumes and the corresponding NDOT field counts. Similarly, the model's year 2040 volumes were noted to be of concern because the future year volumes did not have a reasonable growth over year 2017 volumes. These observations were documented in the May 6, 2019 memorandum: "*I-515/I-215 Interchange Feasibility Study: Aimsun Next Model Observations."*

Due to these concerns, the Project team decided to update the calibration of the "I-515/I-215 FS" subarea (the study area of this Feasibility Study) to improve the model's ability to reflect Existing Conditions (the year 2017) volumes and consequently, to improve the reliability of the model's year 2040 forecast volumes and operational results. Therefore, the Project team completed static and dynamic calibration of the I-515/I-215 FS subarea. Where possible, the Project team retained the assumptions and parameters of the previous modeling effort completed as part of SNTS. This memorandum summarizes the calibration methodology, assumptions, and results. Subsequently, the Project team utilized the calibrated model to develop the future year 2040 traffic volumes. This memorandum also documents the methodology and assumptions involved with the process of developing the future year volumes. Appendix B of this memorandum contains the electronic files for the Aimsun Next model. A completed "Traffic Forecasting Guidelines Checklist" is included in Appendix C.

2. PROJECT LIMITS

The I-515/I-215 Interchange lies in the heart of the City of Henderson, Nevada. The Project limits for Aimsun Next modeling and traffic operations analysis include:

- I-515 Freeway between (and including) Sunset Road to the north and Horizon Drive to the south. The Galleria Drive on-ramp to I-515 SB and the Galleria Drive off-ramp from I-515 northbound (NB) are also included.
- I-215 Freeway/Lake Mead Parkway between (and including) Stephanie Street to the west and Eastgate Road to the east. The Valle Verde Drive on-ramp to I-215 eastbound (EB) and the Valle Verde Drive off-ramp from I-215 WB are also included.

[1] The *I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum* was submitted to NDOT on January 28, 2019 and was approved by NDOT on February 4, 2019.

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Figure 1 shows the Project limits for the operations analysis. The following are the study intersections included in the analysis:

1. I-515 NB and Sunset Road
2. I-515 SB and Sunset Road
3. I-515 NB and Auto Show Drive
4. I-515 SB and Auto Show Drive
5. I-515 NB and Horizon Drive
6. I-515 SB and Horizon Drive
7. I-215 EB and Stephanie Street
8. I-215 WB and Stephanie Street
9. I-215 EB and Gibson Road
10. I-215 WB and Gibson Road
11. Gibson Road and Wigwam Parkway
12. Gibson Road and Las Palmas Entrada Avenue
13. Lake Mead Parkway and Eastgate Road
14. Auto Show Drive and Eastgate Road

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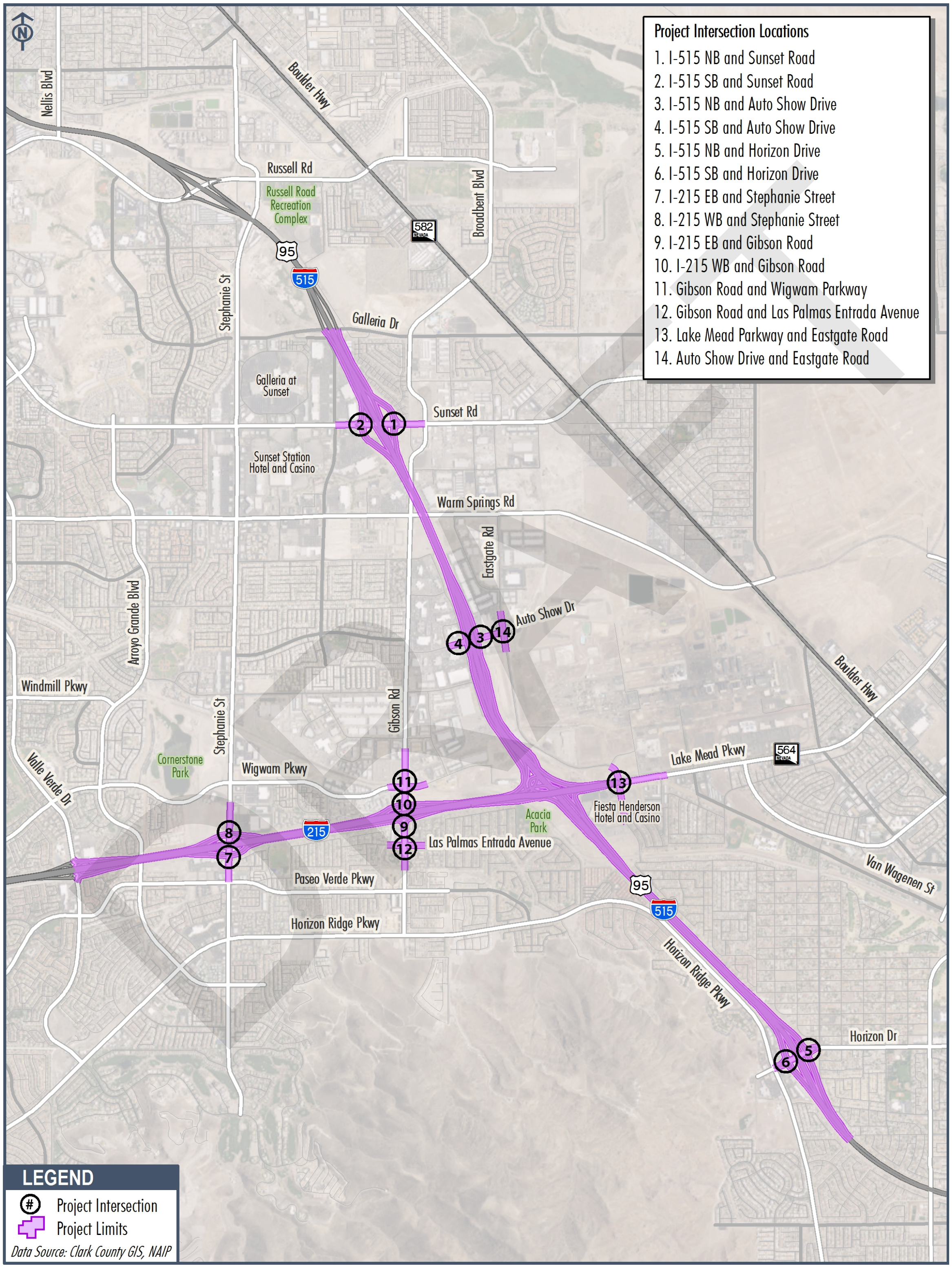
Figure 1: Project Limits for Traffic Operations Analysis



3. TECHNICAL GUIDANCE, STANDARDS, AND TOOLS

The following technical documents and guidelines are the key references that were used in the traffic analysis and modeling of this study:

- *Aimsun Next Modeling Guidelines*, NDOT, 2018
- Technical memorandums developed, reviewed, and approved (by NDOT) for this Project:
    - *I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum,* January 2019
    - *I-515/I-215 Interchange Feasibility Study: Aimsun Next Model Observations,* May 2019
- *Traffic Forecasting Methods and Assumptions Memorandum* (Appendix A of NDOT SNTS Final Report), 2018
- *Traffic Operations Methodology and Assumptions Memorandum* (Appendix B of NDOT SNTS Final Report), 2018
- *2017 Aimsun Next Model Development and Calibration Report* (Appendix C of NDOT SNTS Final Report), 2018
- *Existing Conditions Report* (Appendix D of NDOT SNTS Final Report), 2018
- *Future Conditions Report* (Appendix E of NDOT SNTS Final Report), 2018
- *Highway Capacity Manual 6th Edition*, Transportation Research Board, 2016

Traffic modeling was completed using Aimsun Next (Version 8.2.4).

4. YEAR 2017 STATIC VOLUME CALIBRATION AND DEVELOPMENT OF TRAFFIC DEMAND

4.1. Development of the Year 2017 Aimsun Next Model

Modeling for this Project was completed using the Southern Nevada Aimsun Next model provided by NDOT. The I-515/I-215 interchange was previously modeled during SNTS; the "I-215/I-515" subarea in the Southern Nevada Aimsun Next model was developed as part of SNTS. This subarea (the year 2017 for existing conditions) was modeled to a microscopic level of detail as part of SNTS. Where needed, the existing conditions network coding was augmented for this Project. As an example, the intersections of Gibson Road/Wigwam Parkway and Gibson Road/Las Palmas Entrada Avenue were not modeled to a microscopic level of detail as part of SNTS. Therefore, the geometry and the existing signal timings for these intersections were modeled as part of this Project. The Southern Nevada Aimsun Next model includes a two-hour

AM peak (7:00 AM – 9:00 AM) and PM peak (4:00 PM – 6:00 PM) period origin-destination (OD) matrices for the I-215/I-515 subarea. The modeling periods for this Project matches these periods.

4.2. Creation of Subnetwork and Static Traversal

For this Project, NDOT created a new subarea, the "I-515/I-215 FS" subarea in the Southern Nevada Aimsun Next model. This new subarea focuses on the freeway sections and intersections listed in Section 2 and shown in Figure 1. All modeling for this Project was completed within this new I-515/I-215 FS subarea.

The static traversal procedure for the I-515/I-215 FS subarea was run using the year 2017 static assignment results of the SNTS' I-215/I-515 subarea to extract demands/Origin-Destination (OD) matrices for the I-515/I-215 FS subarea for the AM and the PM period under existing conditions. The static traversal procedure produced the following four OD matrices for each modeling period:

- Drive Alone (DA)
- Shared Ride 2 passengers per vehicle (SR2)
- Shared Ride 3 or more passengers per vehicle (SR3)
- Truck

Similarly, for the future year 2040, the static traversal procedure for the I-515/I-215 FS subarea was run using the year 2040 Build Alternative's static assignment results of the SNTS' I-215/I-515 subarea to extract the year 2040 demands/OD matrices for the AM and the PM period for the I-515/I-215 FS subarea. These OD matrices (the year 2040) were later used in the development of future year volumes (see Section 6.2).

4.3. Year 2017 Static Volume Calibration

The year 2017 volumes for the freeway mainline and ramps were available and obtained from NDOT's short-term count stations. These NDOT counts were observed in the field during June and September. Within the Project limits, March was identified to be a month of peak traffic (based on NDOT ATR #0035370 [IR215 .5 mi W of Gibson Intch]). Therefore, the raw NDOT counts were seasonally adjusted using the factors from ATR #0035370 before using them in static calibration.

The seasonally adjusted count data (7:00 AM – 9:00 AM and 4:00 PM – 6:00 PM) were compiled at both a 15-minute aggregation interval and a two-hour interval and used for OD matrix adjustment in the model. The static traversal procedure explained in the previous Section produced two-hour (7:00 AM – 9:00 AM and 4:00 PM – 6:00 PM) OD matrices for the "I-515/I-215 FS" subarea.

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A Static OD Adjustment Experiment was first run to adjust the two-hour OD matrices using the two-hour field count data. The resultant adjusted two-hour OD matrices were then used as input to a Static OD Departure Adjustment Experiment; the 15-minute field count data was used as the basis for this adjustment experiment. This Departure Adjustment Experiment produced 15-minute OD matrices, thus imparting a time-varying "profile" to the demand. These steps were repeated once for the AM period and again for the PM period. At the end of this process, the refined OD matrices produced freeway mainline and ramp volumes in the model that resembled the field counts. Section 5.1 shows the volume calibration targets and Section 5.3 shows the results of the calibration.

5. YEAR 2017 DYNAMIC CALIBRATION

The refined OD matrices (obtained as explained in Section 4.3) were used to run the year 2017 dynamic microsimulation scenarios. The existing traffic signal timing and ramp meter timing information included in the Southern Nevada Aimsun Next model were used for the year 2017 existing conditions model. The Southern Nevada Aimsun Next model did not include signal timing information for the intersections of Gibson Road/Wigwam Parkway and Gibson Road/Las Palmas Entrada Avenue. Existing traffic signal timing for these intersections was obtained from RTC FAST and coded in the model.

5.1. Calibration Measures of Effectiveness (MOEs) and Targets

In addition to volume calibration, spot speeds along the freeways was selected as the MOE for calibration. Calibration targets for these MOEs are listed in Table 1.

Table 1: Calibration Targets for an Acceptable Match

Calibration MOE	Calibration Criteria and Measures	Calibration Target	Calibration Target adapted from Reference Technical Guidance Document
Volume	Individual Link Flows: Within 100 veh/h, for Flow < 700 veh/h Within 15%, for 700 veh/h < Flow < 2700 veh/h Within 10%, for 2700 veh/h < Flow < 5000 veh/h Within 250 veh/h, for Flow > 5000 veh/h	> 85% of cases > 85% of cases > 85% of cases > 85% of cases	NDOT's Southern Nevada Traffic Study
	Sum of All Link Flows	Within 5%	
	GEH Statistic < 5 for Individual Link Flows	> 85% of cases	
	GEH Statistic < 10 for Individual Link Flows	100%	
Spot Speed	Absolute difference between field observed Spot Speeds and Aimsun Next model simulated Spot Speeds	within ±10 mph	

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5.2. Modified Calibration Parameters

The calibration process was iterative and involved comparing model outputs with the field MOE, and then adjusting calibration parameters until an acceptable match was achieved. Several calibration parameters were adjusted to meet the calibration targets for the selected MOEs (volumes and speeds), and to match the observed field conditions. As a first step, the Distance Zone 1 and Distance Zone 2 values for freeway off-ramps were set to 5,000 feet and 2,500 feet respectively to better reflect the location of exit information signs and driver behavior in the field. Similarly, the Side Lane Merging Distance for freeway on-ramps was set to 1,000 feet to better model the merging behavior. Table 2 and Table 3 list the adjustments to the calibration parameters made to the model, the specific location of these adjustments, and the rationale behind the adjustments for the AM period and the PM period respectively. The modified calibration parameters are stored as Attribute Overrides in the Aimsun Next model.

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Table 2: Modified Calibration Parameters – AM Period

No.	Location	Aimsun Next Object	Calibration Parameter	New Value	Rationale
1	I-215 EB/Stephanie Street off-ramp	356205: RAMP I215 E STEPHANI (20212) - Section	Acceleration Factor	2	With the default model parameters, long queues were observed in the model at this off-ramp/ramp terminal intersection and vehicles spilled back onto the freeway. This limited the number of vehicles that could travel past this point and created traffic flow issues downstream of here. Therefore, these model parameters were modified to increase the aggressiveness of vehicles in the model. With these changes, the queues at the off-ramp/ramp terminal intersection better match field conditions.
2		5947: RAMP I215 E STEPHANI (20212) - Section	Acceleration Factor	2	
3		356207: RAMP I215 E STEPHANI (20212) - Section	Acceleration Factor	2	
4	I-215 WB between Gibson Road and Stephanie Street	11197: I 215 (22253) - Section	Deceleration Factor	4	Vehicles were observed to travel at higher speeds in the model than what was observed in the field along this stretch of the freeway when the default model parameters were used. Therefore, these model parameters were modified to better reflect the congested conditions observed in the field.
5		11197: I 215 (22253) - Section	Lane-Changing Cooperation	0	
6	I-215 WB/Stephanie Street off-ramp	47271 - Turn	Distance Zone 1	1000	
7		47271 - Turn	Distance Zone 2	500	
8	I-515 NB downstream of the Horizon Drive on-ramp	6177: US 95 (9605) - Section	Acceleration Factor	2	With the default model parameters, unreasonably long queues were observed in the model, upstream of the on-ramp merge and spilling back along Horizon Drive. This also limited the number of vehicles processed through this on-ramp onto the freeway. Therefore, these model parameters were modified to increase the aggressiveness of vehicles in the model. With these changes, the operations of the ramp and the merge segment better match field conditions.
9		6177: US 95 (9605) - Section	Imprudent Lane Changing	TRUE	
10	I-515 NB between I-215 EB on-ramp and Auto Show Drive on-ramp	17600: US 95 (36462) - Section	Imprudent Lane Changing	TRUE	With the default model parameter, vehicles in the model were observed to be more conservative than in the field when completing the merge/lane-change maneuver. Therefore, this model parameter was modified to better reflect the driving behavior observed in the field.

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Table 3: Modified Calibration Parameters – PM Period

No.	Location	Aimsun Next Object	Calibration Parameter	New Value	Rationale
1	Northbound leg of the Lake Mead Parkway/Eastgate Road intersection	6184: FIESTA HENDERSON (20249) - Section	Acceleration Factor	2	With the default model parameters, unreasonably long queues were observed in the model at the northbound and westbound legs of this intersection. This limited the number of vehicles that could travel through this intersection and created traffic flow issues downstream of here. Therefore, these model parameters were modified to increase the aggressiveness of vehicles in the model. With these changes, the queues at the intersection better match field conditions.
2	Westbound leg of the Lake Mead Parkway/Eastgate Road intersection	6187: W LAKE MEAD PKWY (20247) - Section	Acceleration Factor	2	
3		356279: W LAKE MEAD PKWY (20247) - Section	Acceleration Factor	2	
4	I-215 WB between Gibson Road and Stephanie Street	11197: I 215 (22253) - Section	Lane-Changing Cooperation	20	Vehicles were observed to travel at higher speeds in the model than what was observed in the field along this stretch of the freeway when the default model parameters were used. Therefore, these model parameters were modified to better reflect the congested conditions observed in the field.
5		11197: I 215 (22253) - Section	Deceleration Factor	2	
6	I-215 EB between Valle Verde Drive and Stephanie Street	5961: I 215 (20216) - Section	Lane-Changing Aggressiveness	50	With the default model parameters, the vehicles in the model were observed to be too conservative when completing the weave/lane-change maneuvers. As a result, along this stretch of the freeway, vehicles were observed to travel at lower speeds in the model than what was observed in the field. Therefore, these model parameters were modified to increase the aggressiveness of vehicles in the model. With these changes, the vehicle flow along the corridor better matches field conditions, including the field observed speeds.
7		5961: I 215 (20216) - Section	Imprudent Lane Changing	TRUE	
8		5961: I 215 (20216) - Section	Acceleration Factor	2	
9	I-215 EB between Stephanie Street off-ramp and on-ramp	5949: I 215 (20217) - Section	Lane-Changing Aggressiveness	50	
10		5949: I 215 (20217) - Section	Imprudent Lane Changing	TRUE	
11		5949: I 215 (20217) - Section	Acceleration Factor	2	
12	I-215 EB between Stephanie Street on-ramp and Gibson Road	11194: I 215 (22244) - Section	Lane-Changing Aggressiveness	50	
13		11194: I 215 (22244) - Section	Imprudent Lane Changing	TRUE	
14		11194: I 215 (22244) - Section	Acceleration Factor	2	

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Table 3: Modified Calibration Parameters – PM Period (continued)

No.	Location	Aimsun Next Object	Calibration Parameter	New Value	Rationale
15	I-215 EB to I-515 NB ramp	27970 - Turn	Distance Zone 1	10000	These parameters were modified to better match the lane positioning and driving behavior observed in the field. These parameters were also modified to better match the observed field speeds along I-215 EB upstream of this location.
16		27970 - Turn	Distance Zone 2	6500	
17	I-215 EB to I-515 SB ramp	27969 - Turn	Distance Zone 1	10000	
18		27969 - Turn	Distance Zone 2	6500	
19	I-215 EB to I-515 SB ramp	6193: RAMP E I 215 US95 S (32348) - Section	Lane-Changing Aggressiveness	50	With the default model parameters, vehicles in the model were observed to be more conservative than in the field when completing the merge/lane-change maneuver. Therefore, these model parameters were modified to better reflect the driving behavior observed in the field.
20	I-515 SB downstream of the I-215 EB on-ramp	6170: US 95 (9451) - Section	Lane-Changing Aggressiveness	50	
21		6176: US 95 (9671) - Section	Lane-Changing Aggressiveness	50	
22	I-515 NB between I-215 EB on-ramp and Auto Show Drive on-ramp	17600: US 95 (36462) - Section	Lane-Changing Aggressiveness	80	
23		17600: US 95 (36462) - Section	Imprudent Lane Changing	TRUE	

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5.3. Volume Calibration

A comparison of the microsimulation model traffic flows to field count volumes is shown in Table 4 and Table 5 for the AM and the PM period respectively. Graphical results of volume calibration are shown in Figure 2 and Figure 3 for the AM period, and Figure 4 and Figure 5 for the PM period. A detailed comparison of the model traffic flows to field count volumes is provided in Appendix D.

The results show that all calibration targets are met for the AM period except for one location during the 7:00 AM to 8:00 AM period, where the model volume was higher than the field volume. At this location, the model volume was approximately 311 vehicles more than field observed volume (exceeded the 250 veh/h target). Similarly, the results show that all calibration targets are met for the PM period except for one location during the 4:00 PM to 5:00 PM period, where the model volume was higher than the field volume. At this location, the model volume was approximately 251 vehicles more than field observed volume (exceeded the 250 veh/h target by one veh/h). In both these cases, the targets were exceeded only slightly and the calculated GEH is less than 4.0. Furthermore, from Figure 2 through Figure 5, it can be seen that there is a good overall fit between the field and the model volumes. Therefore, the model volumes are considered calibrated.

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Table 4: Link/Section Volume Calibration Results – AM Period

Criteria	Acceptance Target	7AM			8AM		
		Points	Pass	Acceptance	Points	Pass	Acceptance
FLOW < 700, within 100 veh/h	> 85%	17	17	100.0	20	20	100.0
700 < FLOW < 2700, within 15%	> 85%	13	13	100.0	10	10	100.0
2700 < FLOW < 5000, within 10%	> 85%	2	2	100.0	3	3	100.0
FLOW > 5000 within 250 veh/h	> 85%	3	2	66.7	2	2	100.0
GEH Statistic < 5 for individual link flows	> 85%	35	35	100.0	35	35	100.0
GEH Statistic < 10 for individual link flows	100%	35	35	100.0	35	35	100.0
Sum of all link flows	> 95%			97.7			99.9

Table 5: Link/Section Volume Calibration Results – PM Period

Criteria	Acceptance Target	4PM			5PM		
		Points	Pass	Acceptance	Points	Pass	Acceptance
FLOW < 700, within 100 veh/h	> 85%	14	14	100.0	14	14	100.0
700 < FLOW < 2700, within 15%	> 85%	18	18	100.0	18	18	100.0
2700 < FLOW < 5000, within 10%	> 85%	2	2	100.0	2	2	100.0
FLOW > 5000 within 250 veh/h	> 85%	2	1	50.0	2	2	100.0
GEH Statistic < 5 for individual link flows	> 85%	36	34	94.4	36	36	100.0
GEH Statistic < 10 for individual link flows	100%	36	36	100.0	36	36	100.0
Sum of all link flows	> 95%			97.9			99.9

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Figure 2: Link/Section Volume Calibration (Graphical) Results for 7:00 AM to 8:00 AM

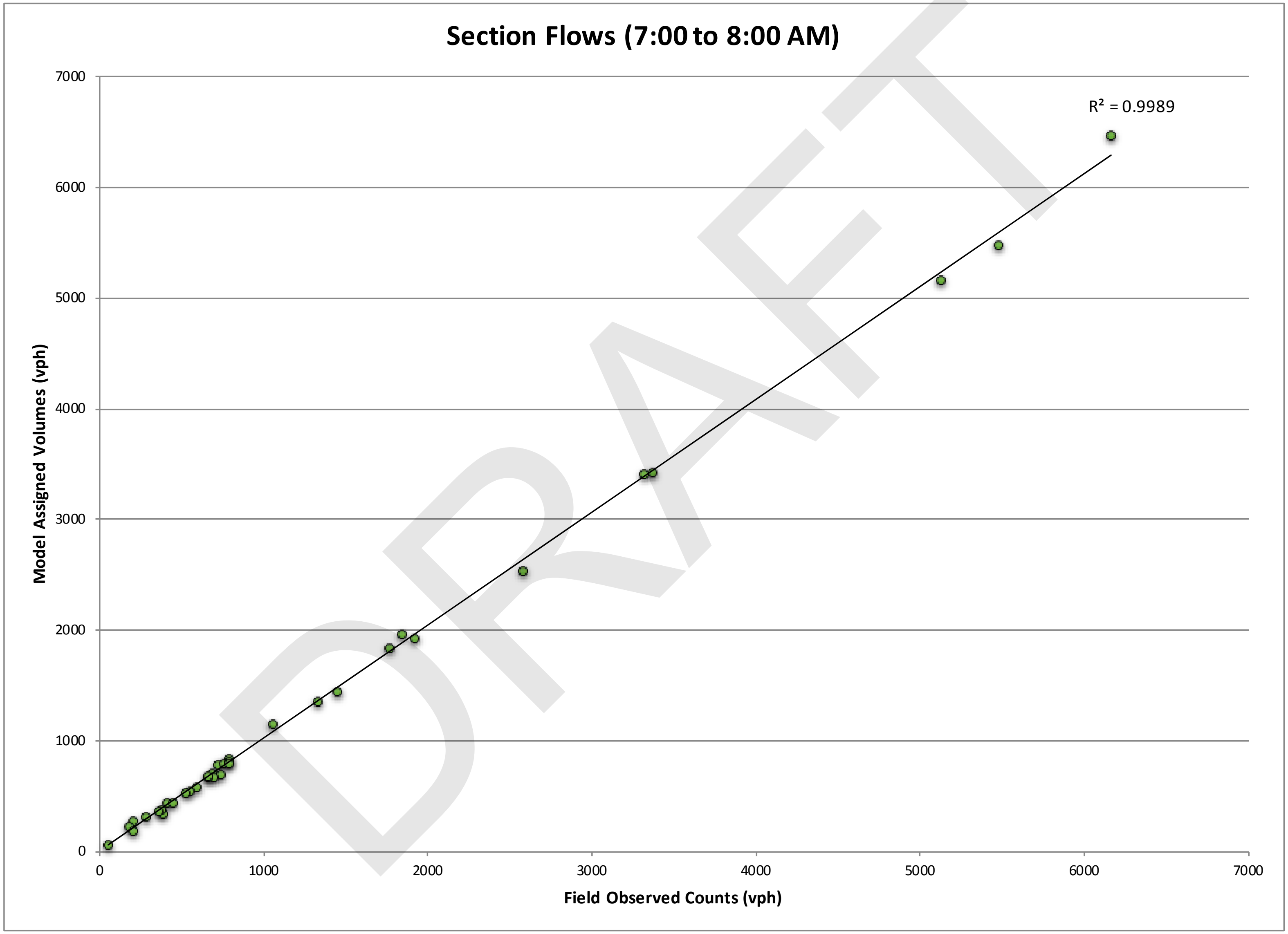

Figure 3: Link/Section Volume Calibration (Graphical) Results for 8:00 AM to 9:00 AM

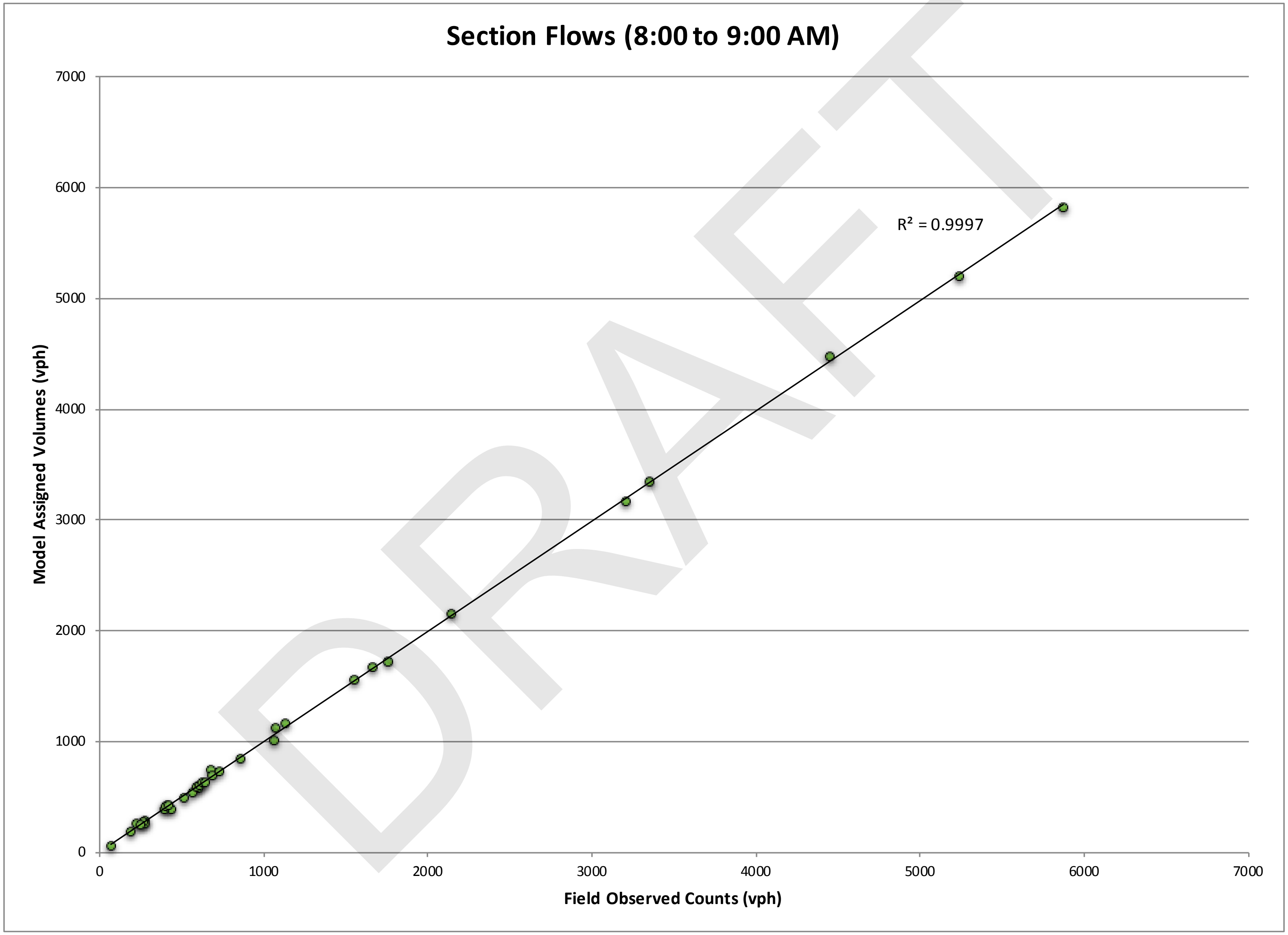

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Figure 4: Link/Section Volume Calibration (Graphical) Results for 4:00 PM to 5:00 PM

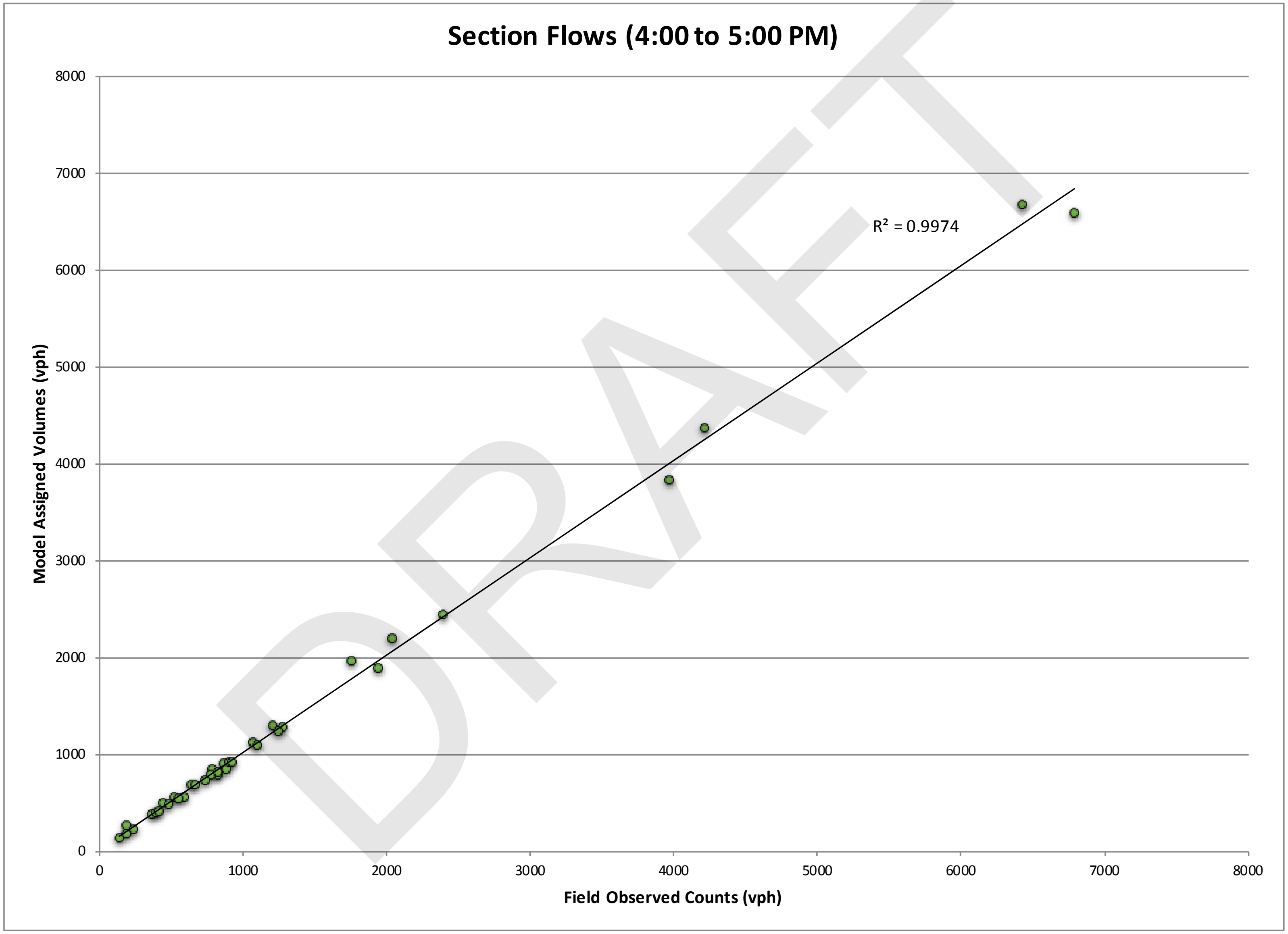

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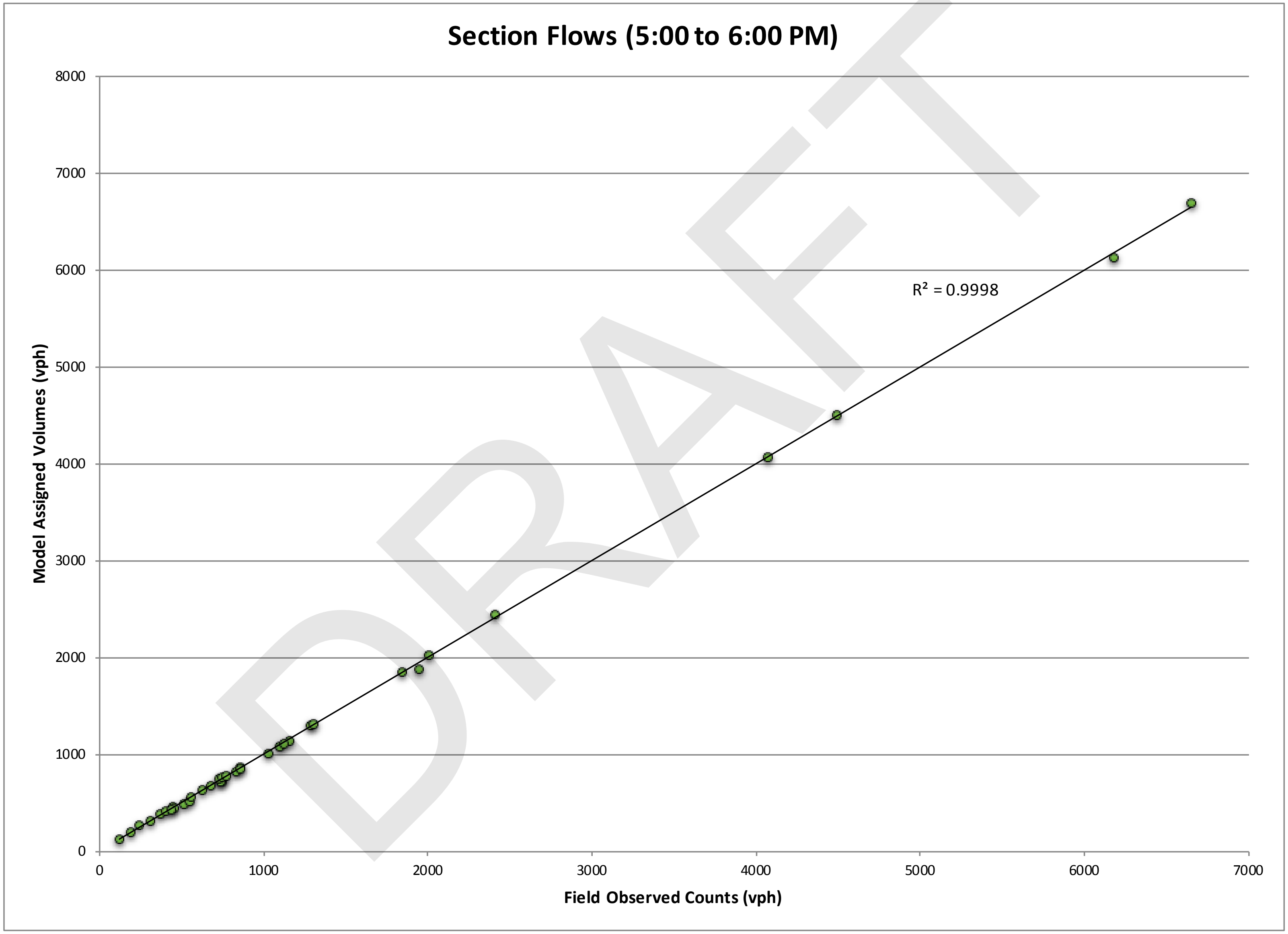
Figure 5: Link/Section Volume Calibration (Graphical) Results for 5:00 PM to 6:00 PM



5.4. Speed Calibration

Field spot speed data along the freeways were available from SNTS. Spot speed data was available for the entire modeling period (AM and PM) at four locations within the Project limits. These locations are:

- I-215 EB east of Stephanie Street
- Lake Mead Parkway (I-215 WB) east of I-515
- I-215 WB east of Stephanie Street
- I-515 NB north of Horizon Drive

Detectors were placed in the Aimsun Next model, and the speed data from these detectors in the model were compared to the field spot speed data for calibration.

Table 6 and Table 7 show the spot speed calibration results for the AM and the PM period respectively; Figure 6 through Figure 9 and Figure 10 through Figure 13 show the field and model speeds in graphical form for the AM and the PM period respectively. Table 6 and Table 7 show the field speed data, speeds observed in the model (detectors), the percent difference and the absolute difference in the speeds. Initially, the posted speed limit (65 mph) was used as the Maximum Speed in the Aimsun Next model for all freeway sections. However, the field observed spot speed data shows that at some locations within the Project limits, the observed speed is higher than the posted speed limit. When the model was run with the posted speed limit as the Maximum Speed, the simulated speed observed at model detectors did not match the field spot speed. Therefore, the Maximum Speed was increased to 70 mph to better model field conditions.

As seen from Table 6, the speed calibration targets are met (for each 15-minute period) at three out of four locations in the AM period. Similarly, from Table 7, the speed calibration targets are met (for each 15-minute period) at three out of four locations in the PM period. At these locations, the absolute difference in speeds is usually within 5 mph, much less than the target of 10 mph. The calibration target is not met (for each 15-minute period) at I-215 WB east of Stephanie Street in the AM period and I-215 EB east of Stephanie Street in the PM period. In both these cases, it is noted that the absolute difference in speeds for the entire two-hour period is within the target of 10 mph. The field spot speed data was obtained from NDOT's SNTS, which was collected in early 2017. The volume/count data was collected in 2017 and seasonally adjusted to March 2017 (as explained in Section 4.3). After multiple iterations, with various changes to the model parameters, the speed calibration target was not met at both these locations. The speed calibration target is likely not met because the volume and speed data were collected during different periods, representing different traffic flow/peaking patterns. Unrealistic changes to the model would likely be needed to meet the targets at these two locations; therefore, it was decided to leave the targets unmet at these locations. However, from Figure 8 and Figure 10, it can be seen that the severity of the congestion at these locations is replicated in the model (although during a different 15-minute period).

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Table 6: Speed Calibration Results – AM Period

	Field Observed Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
7:00 to 7:15 AM	65.4	53.7	60.6	65.8
7:15 to 7:30 AM	65.1	51.2	50.9	64.8
7:30 to 7:45 AM	64.6	49.0	34.7	64.7
7:45 to 8:00 AM	64.6	45.9	29.5	66.6
8:00 to 8:15 AM	64.6	47.3	44.9	65.1
8:15 to 8:30 AM	64.5	45.6	54.0	65.7
8:30 to 8:45 AM	65.1	49.5	52.9	66.2
8:45 to 9:00 AM	64.0	49.1	51.7	65.4
7:00 to 9:00 AM	64.7	48.9	47.4	65.5

	Aimsun Next Model Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
7:00 to 7:15 AM	67.7	49.6	27.0	64.9
7:15 to 7:30 AM	66.6	50.2	39.8	64.7
7:30 to 7:45 AM	65.5	49.0	62.3	67.0
7:45 to 8:00 AM	65.3	48.8	60.3	67.8
8:00 to 8:15 AM	67.5	50.0	62.4	68.5
8:15 to 8:30 AM	67.5	49.2	58.7	68.1
8:30 to 8:45 AM	67.4	50.7	60.8	68.1
8:45 to 9:00 AM	67.2	50.4	62.4	67.8
7:00 to 9:00 AM	66.7	49.7	53.3	67.0

	Percent Difference between Field Observed Speeds and Aimsun Next Model Speeds			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
7:00 to 7:15 AM	-4%	8%	55%	1%
7:15 to 7:30 AM	-2%	2%	22%	0%
7:30 to 7:45 AM	-1%	0%	-80%	-4%
7:45 to 8:00 AM	-1%	-6%	-104%	-2%
8:00 to 8:15 AM	-5%	-6%	-39%	-5%
8:15 to 8:30 AM	-5%	-8%	-9%	-4%
8:30 to 8:45 AM	-4%	-3%	-15%	-3%
8:45 to 9:00 AM	-5%	-3%	-21%	-4%
7:00 to 9:00 AM	-3%	-1%	-12%	-2%

	Absolute Difference between Field Observed Speeds and Aimsun Next Model Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
7:00 to 7:15 AM	2.3	4.2	33.6	0.9
7:15 to 7:30 AM	1.5	1.0	11.1	0.1
7:30 to 7:45 AM	0.9	0.0	27.6	2.3
7:45 to 8:00 AM	0.8	2.9	30.7	1.1
8:00 to 8:15 AM	2.9	2.7	17.5	3.4
8:15 to 8:30 AM	3.0	3.5	4.7	2.3
8:30 to 8:45 AM	2.3	1.3	8.0	1.9
8:45 to 9:00 AM	3.1	1.2	10.7	2.4
7:00 to 9:00 AM	2.0	0.7	5.9	1.4

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Table 7: Speed Calibration Results – PM Period

	Field Observed Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
4:00 to 4:15 PM	48.7	47.2	56.9	63.9
4:15 to 4:30 PM	53.0	48.8	52.5	63.4
4:30 to 4:45 PM	58.7	52.3	54.6	64.5
4:45 to 5:00 PM	58.9	49.4	57.5	63.7
5:00 to 5:15 PM	54.7	48.1	60.7	64.9
5:15 to 5:30 PM	51.1	47.0	58.0	64.2
5:30 to 5:45 PM	52.3	47.3	56.2	63.3
5:45 to 6:00 PM	51.8	49.9	59.5	63.8
4:00 to 6:00 PM	53.6	48.7	57.0	64.0

	Aimsun Next Model Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
4:00 to 4:15 PM	56.1	48.2	62.6	65.4
4:15 to 4:30 PM	41.2	48.5	62.3	66.8
4:30 to 4:45 PM	48.5	48.4	63.0	65.9
4:45 to 5:00 PM	40.4	49.6	64.2	66.8
5:00 to 5:15 PM	52.6	48.4	63.1	65.7
5:15 to 5:30 PM	43.7	49.8	64.9	66.2
5:30 to 5:45 PM	44.9	49.2	64.6	67.1
5:45 to 6:00 PM	52.0	50.3	65.7	67.0
4:00 to 6:00 PM	47.5	48.9	63.7	66.3

	Percent Difference between Field Observed Speeds and Aimsun Next Model Speeds			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
4:00 to 4:15 PM	-15%	-2%	-10%	-2%
4:15 to 4:30 PM	22%	1%	-19%	-5%
4:30 to 4:45 PM	17%	8%	-15%	-2%
4:45 to 5:00 PM	31%	0%	-12%	-5%
5:00 to 5:15 PM	4%	-1%	-4%	-1%
5:15 to 5:30 PM	15%	-6%	-12%	-3%
5:30 to 5:45 PM	14%	-4%	-15%	-6%
5:45 to 6:00 PM	0%	-1%	-10%	-5%
4:00 to 6:00 PM	11%	0%	-12%	-4%

	Absolute Difference between Field Observed Speeds and Aimsun Next Model Speeds (mph)			
	I-215 EB east of Stephanie Street	Lake Mead Parkway (I-215 WB) east of I-515	I-215 WB east of Stephanie Street	I-515 NB north of Horizon Drive
4:00 to 4:15 PM	7.5	1.0	5.7	1.5
4:15 to 4:30 PM	11.8	0.3	9.7	3.4
4:30 to 4:45 PM	10.1	4.0	8.4	1.4
4:45 to 5:00 PM	18.5	0.2	6.7	3.1
5:00 to 5:15 PM	2.2	0.3	2.4	0.8
5:15 to 5:30 PM	7.4	2.8	6.9	1.9
5:30 to 5:45 PM	7.3	1.9	8.4	3.8
5:45 to 6:00 PM	0.2	0.4	6.1	3.1
4:00 to 6:00 PM	6.2	0.2	6.7	2.4

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Figure 6: Comparison of Field Observed and Model Speeds - AM Period - I-215 EB east of Stephanie Street

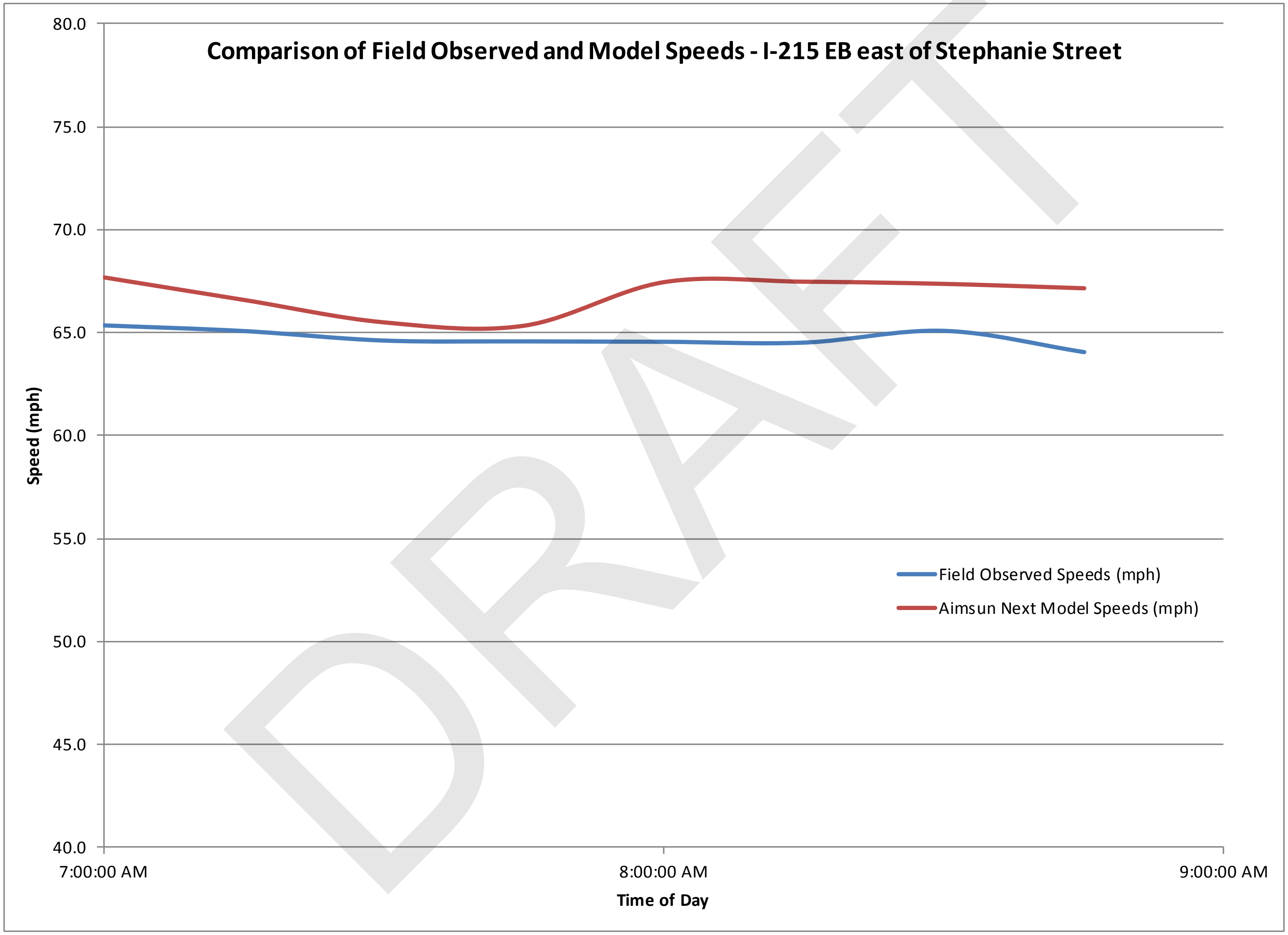

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Figure 7: Comparison of Field Observed and Model Speeds - AM Period - Lake Mead Parkway (I-215 WB) east of I-515

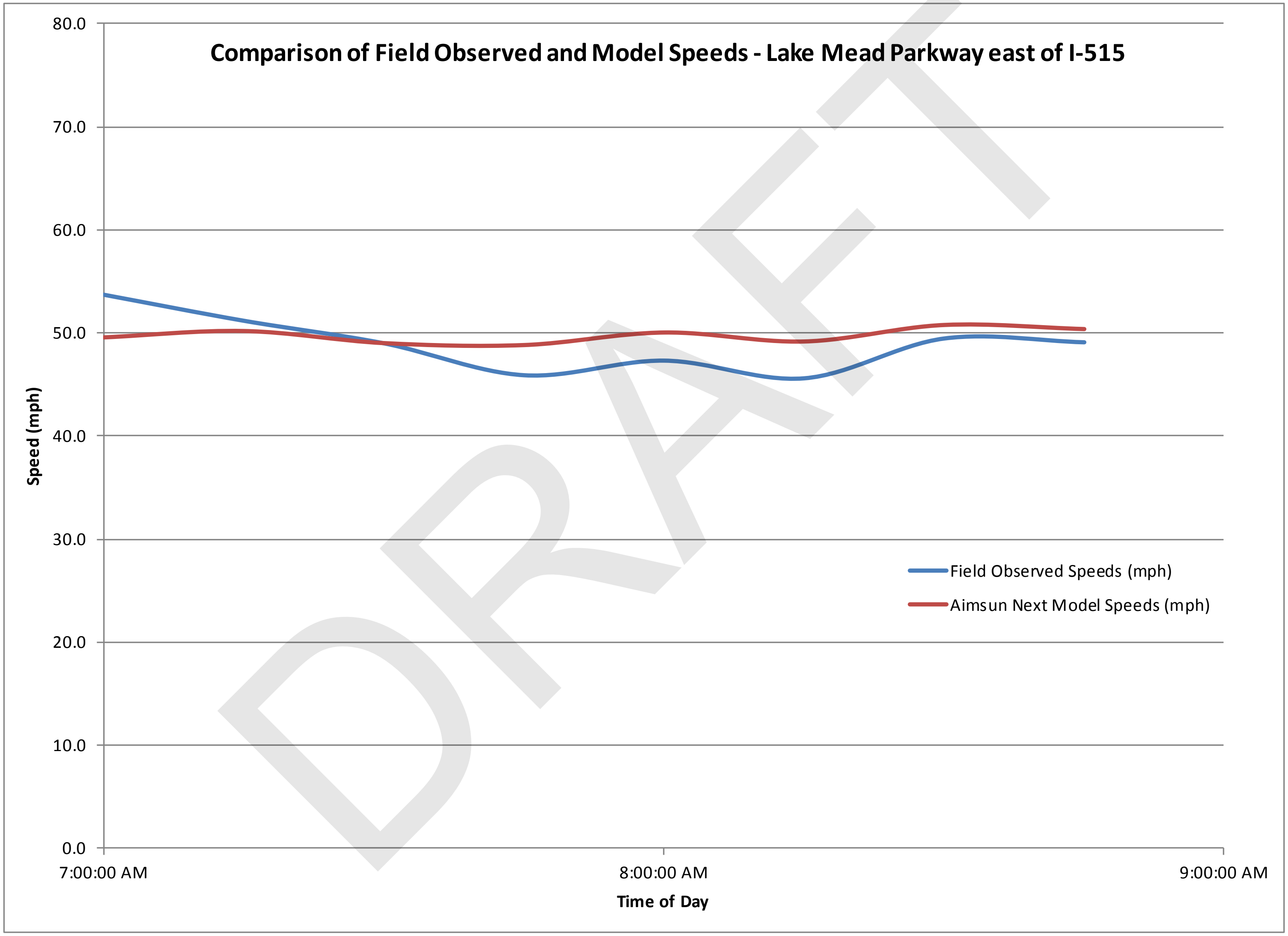

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Figure 8: Comparison of Field Observed and Model Speeds - AM Period - I-215 WB east of Stephanie Street

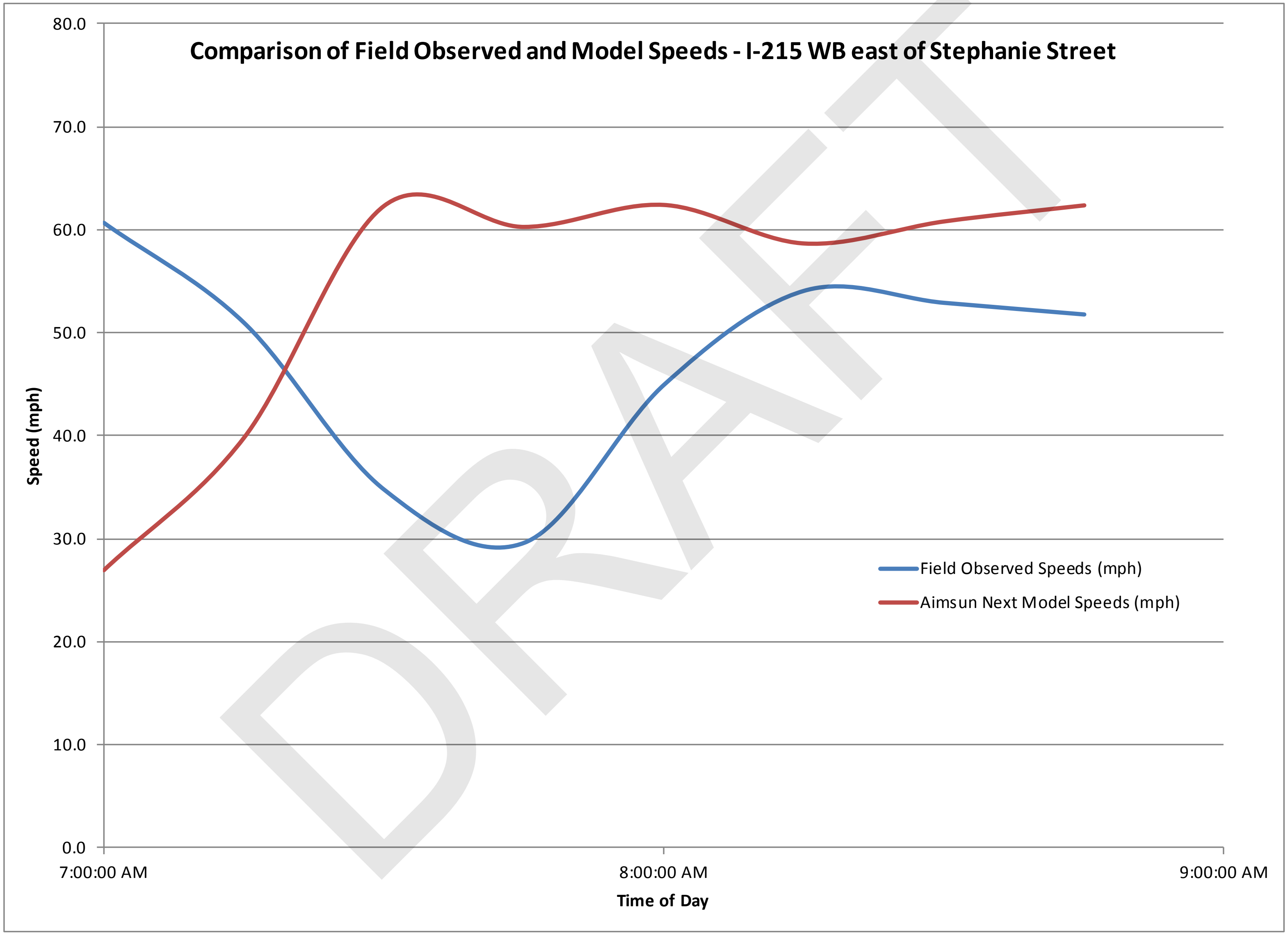

Figure 9: Comparison of Field Observed and Model Speeds - AM Period - I-515 NB north of Horizon Drive

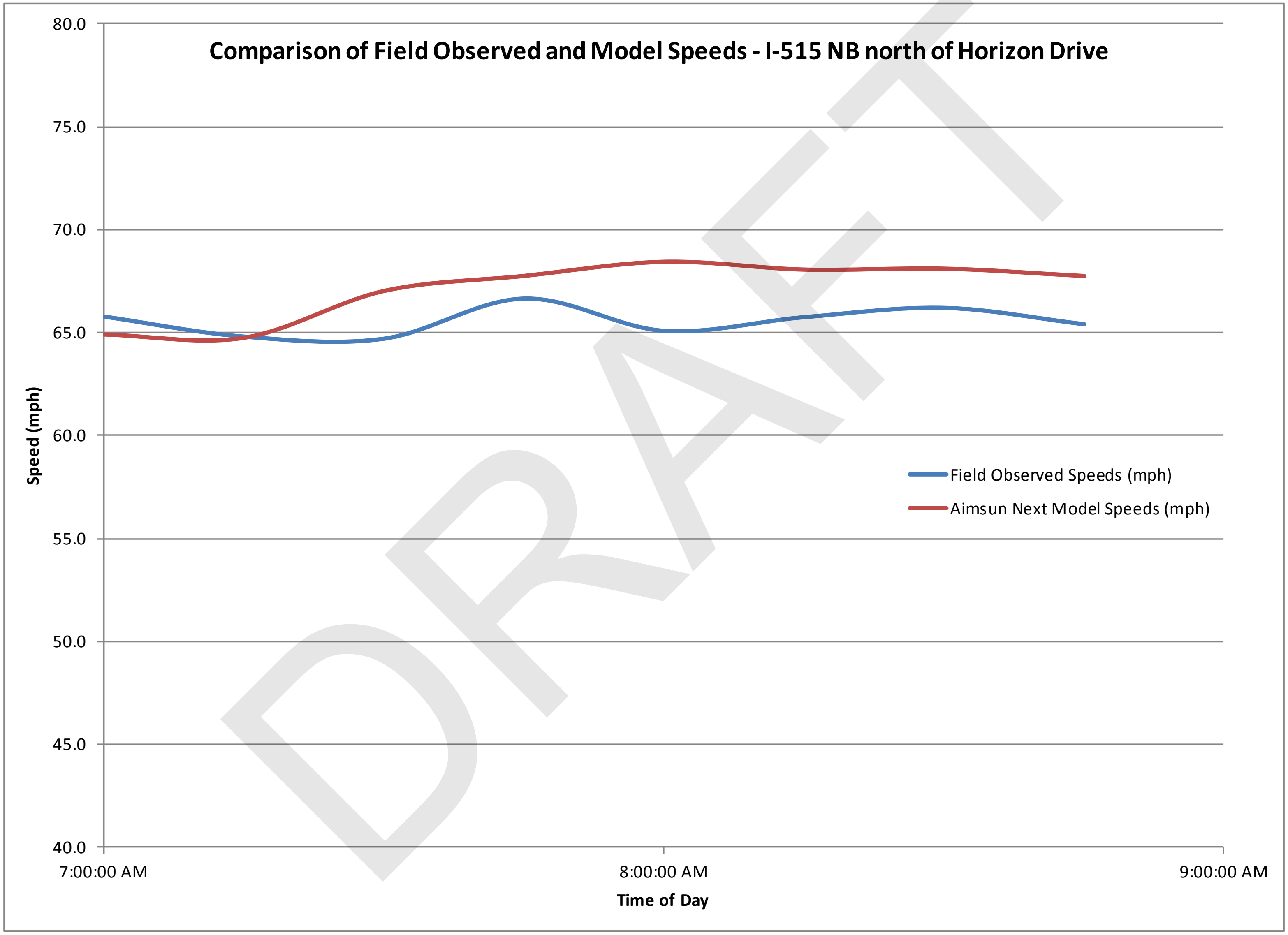

Figure 10: Comparison of Field Observed and Model Speeds - PM Period - I-215 EB east of Stephanie Street

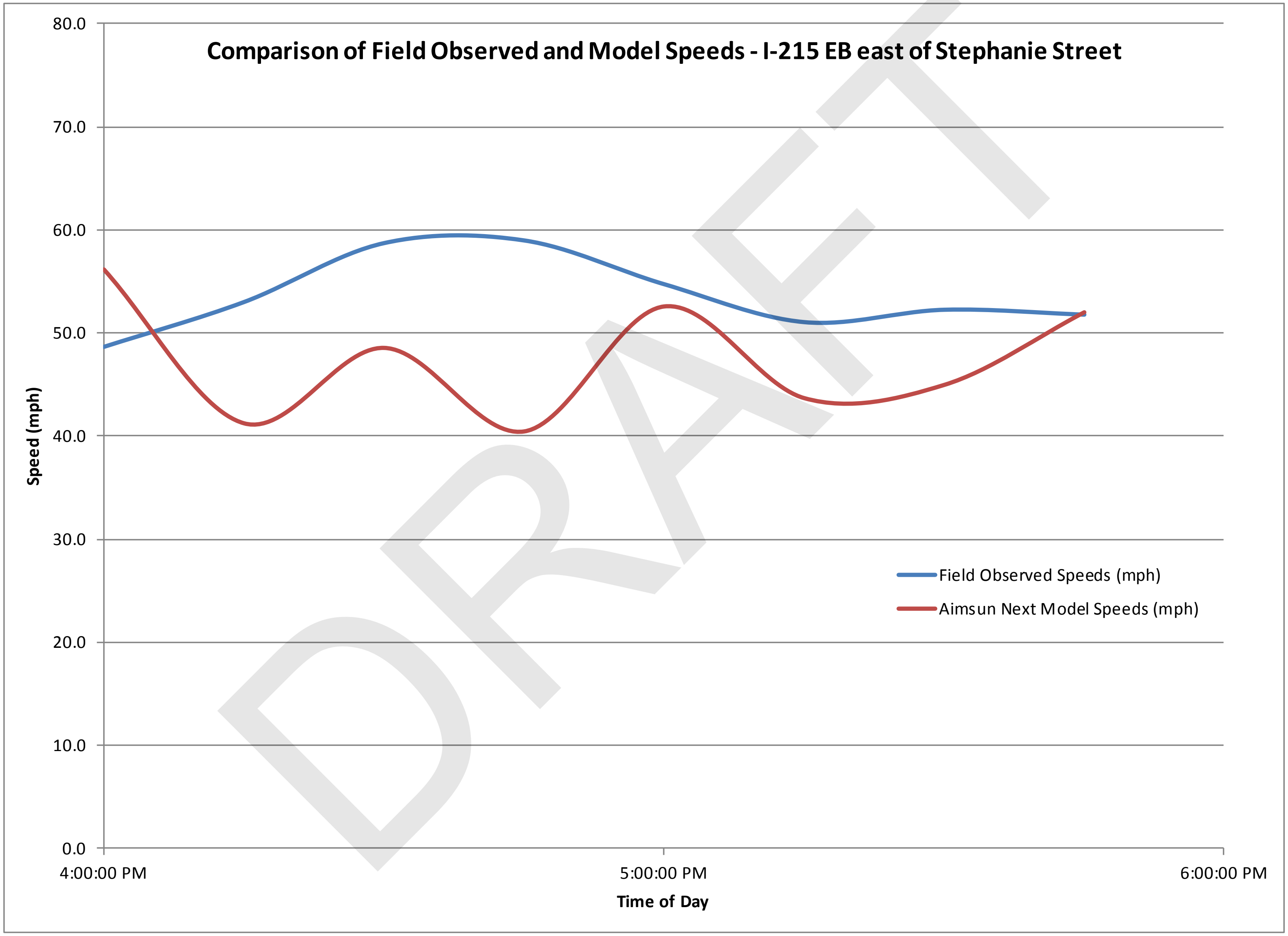

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Figure 11: Comparison of Field Observed and Model Speeds - PM Period - Lake Mead Parkway (I-215 WB) east of I-515

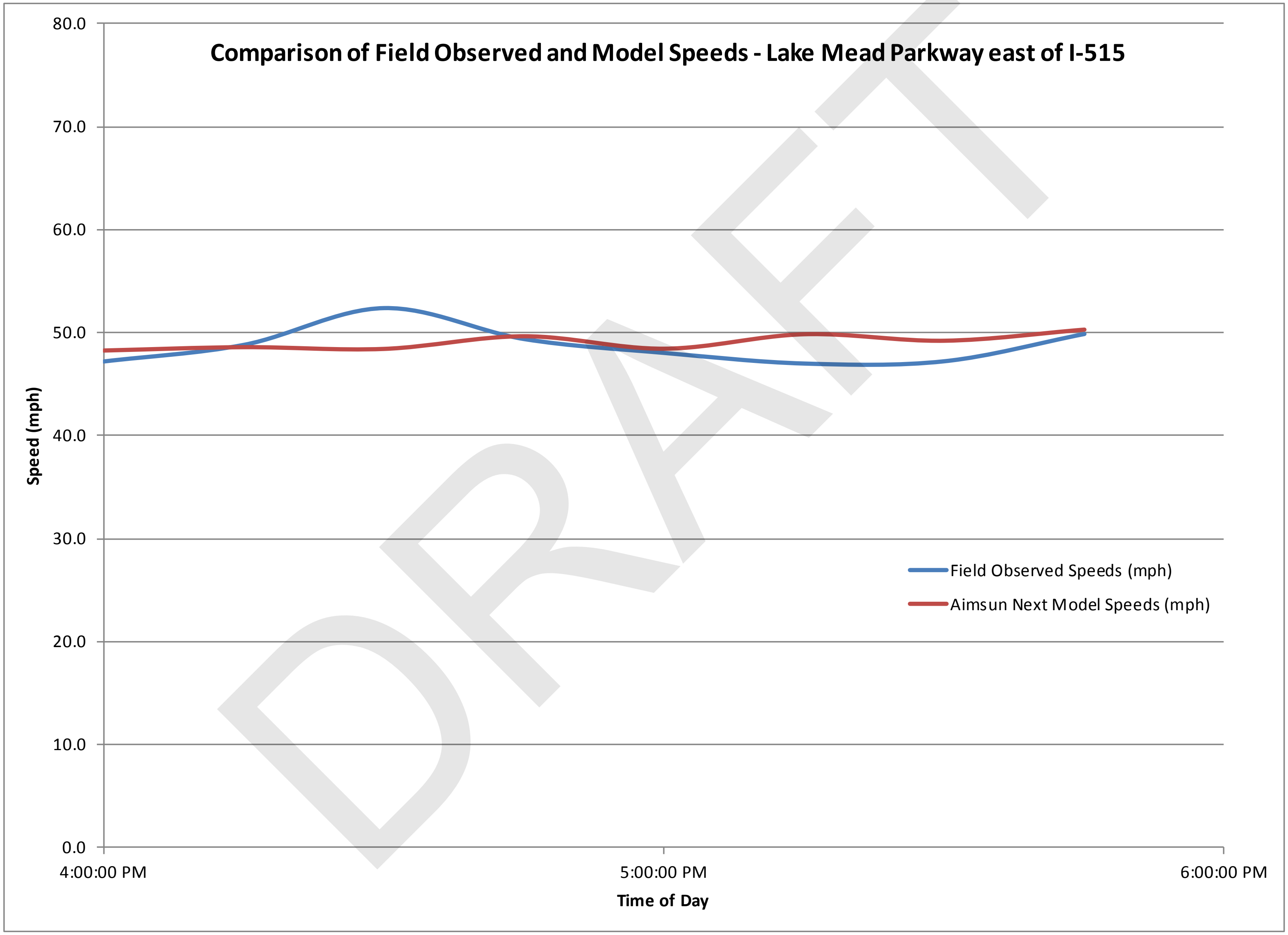

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Figure 12: Comparison of Field Observed and Model Speeds - PM Period - I-215 WB east of Stephanie Street

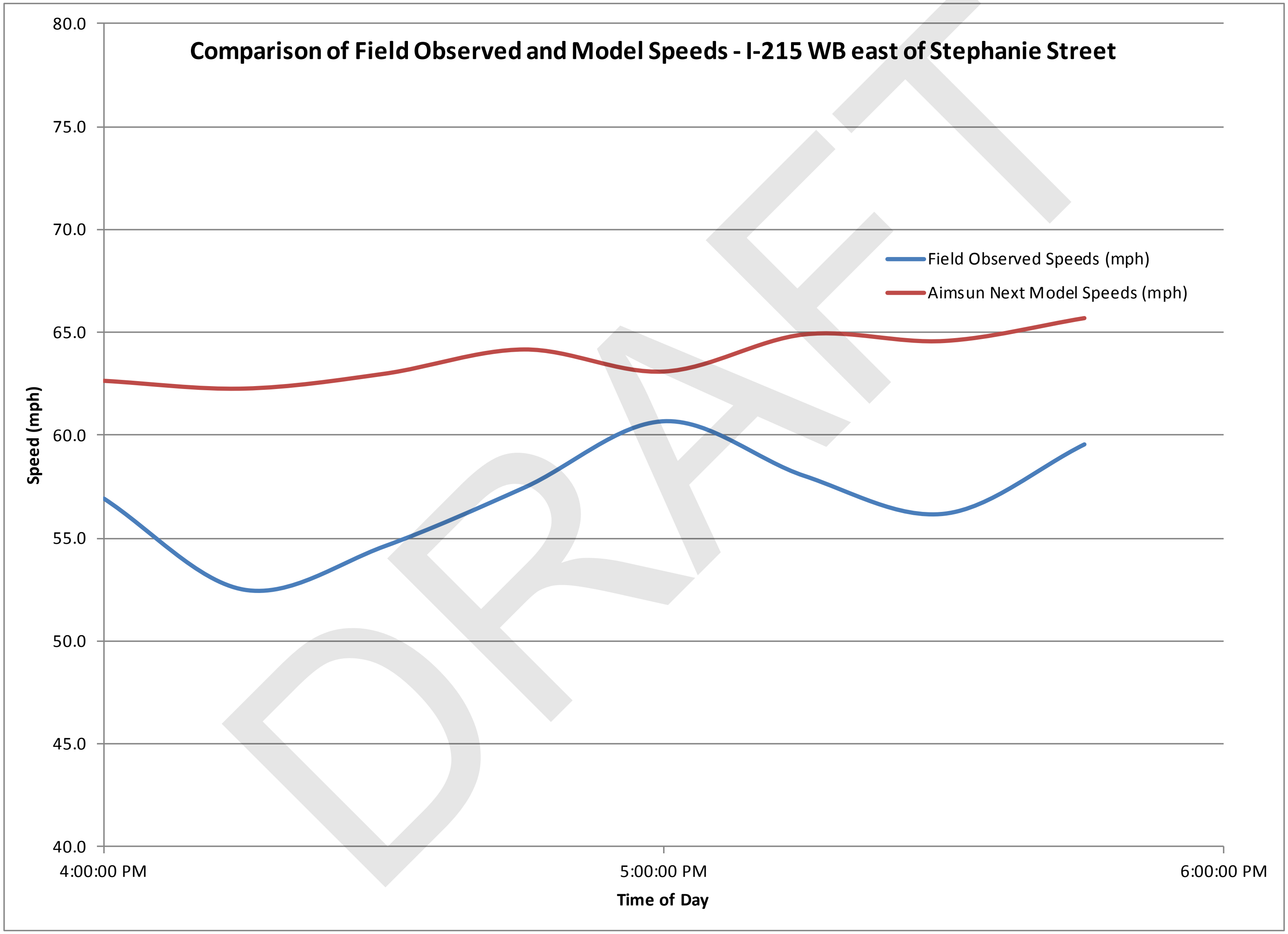
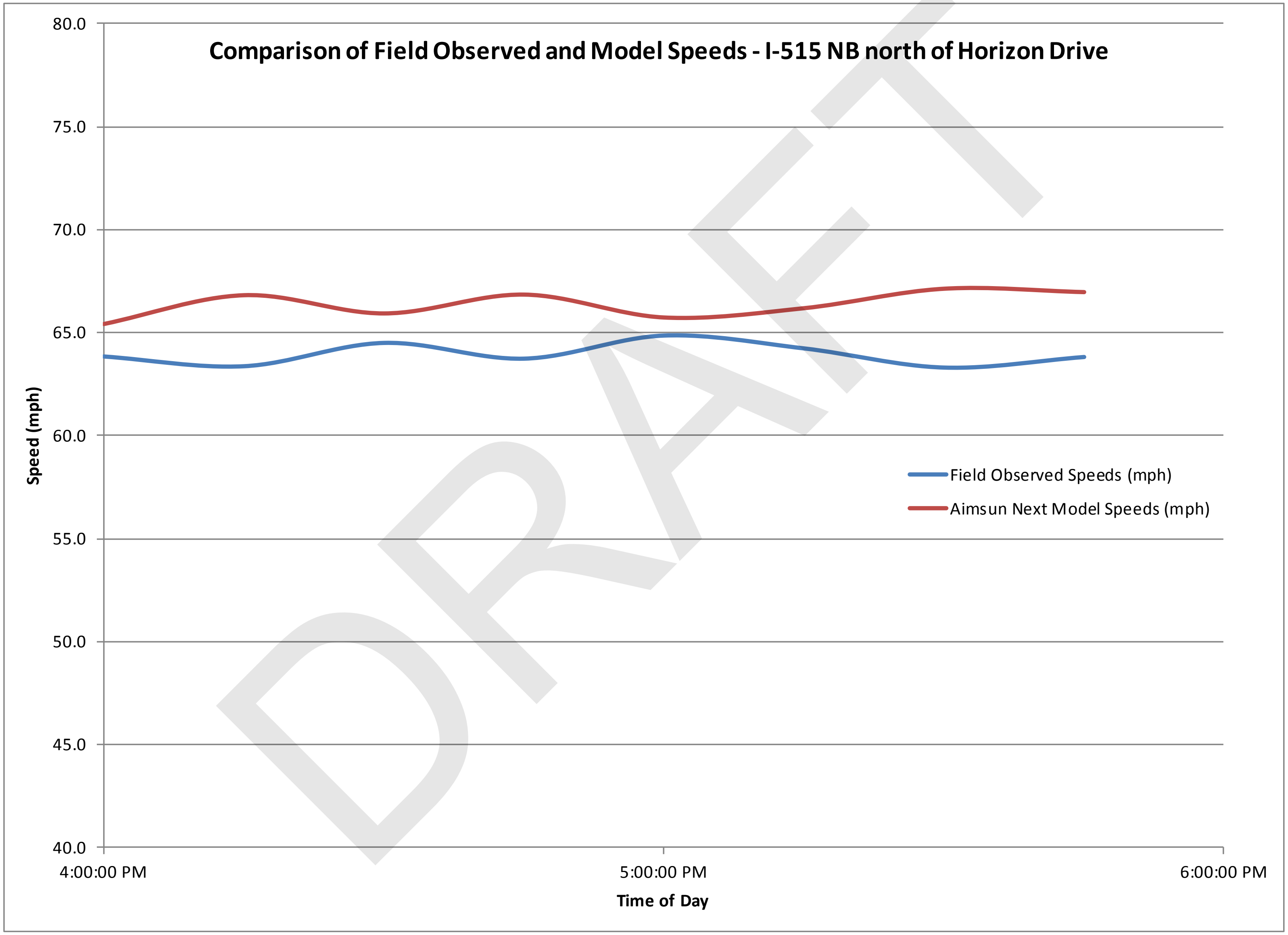


Figure 13: Comparison of Field Observed and Model Speeds - PM Period - I-515 NB north of Horizon Drive



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6. FUTURE YEAR 2040 TRAFFIC FORECASTS

6.1. Forecast Scenarios

Peak hour volume forecasts were developed for the following forecast scenarios:

- Future Year 2040 No-Action Alternative
- Future Year 2040 Build Alternatives (Two options)

Within this Project's limits, the year 2040 No-Action Alternative network included the changes introduced as part of the I-515/I-215 Restriping Project. NDOT implemented the I-515/I-215 Restriping Project during the second half of 2018; therefore, this was not part of the existing conditions year 2017 network. The schematics for the two Build Alternative options that were modeled are included in Appendix E.

6.2. Future Year 2040 Peak Hour Volumes

The year 2040 No-Action Alternative and Build Alternative (microsimulation level-of-detail) networks were modeled in Aimsun Next, and the changes to calibration parameters (from the base year 2017 model – shown in Table 2 and Table 3) were replicated in these future year networks. Changes corresponding to the future year network were coded as Geometry Configurations in Aimsun Next; changes to the roadway network were made only within this Project's limits. No changes were made to the Aimsun Next roadway network outside of this Project's limits.

The following series of steps were completed to develop the year 2040 No-Action Alternative and Build Alternative scenarios in the Aimsun Next model. These steps were repeated twice, once for the AM modeling period and again for the PM period:

1. The year 2017 OD matrices for the I-515/I-215 FS subarea were refined as part of static calibration (explained in Section 4.3).
    a. The adjustments made to the year 2017 OD matrices as part of calibration were replicated in the year 2040 OD matrices.[2]
    b. This was accomplished using the "Pivot-Point Method" utilized in NDOT SNTS. Additional details of this methodology are available in the 2040 Micro/Meso Future Volume Development Technical Memorandum (Appendix F). The adjusted OD

[2] The year 2040 OD matrices for the I-515/I-215 FS subarea were obtained as explained in Section 4.2.

matrices corresponding to the I-515/I-215 FS subarea were used for all further modeling steps.

2. The time-varying “profile” of the year 2017 traffic demand was applied to the year 2040 demand. With this, traffic demands were available for the two-hour modeling period with a time-varying “profile,” with the demand varying every 15 minutes.
3. The macroscopic static assignment was run using this two-hour demand (with a time-varying profile) for the I-515/I-215 FS subarea for the No-Action Alternative and the Build Alternatives to develop the year 2040 static assigned volumes and to generate a path assignment for dynamic microsimulation.
4. For documentation, a peak one-hour (7:30 AM to 8:30 AM for the AM period and 4:30 PM to 5:30 PM for the PM period) demand was also created. The macroscopic static assignment was run using this peak hour demand to develop the year 2040 peak hour static assigned volumes. These year 2040 peak hour volumes are shown in Figure 14 through Figure 16 and are the traffic forecasts for the Project.

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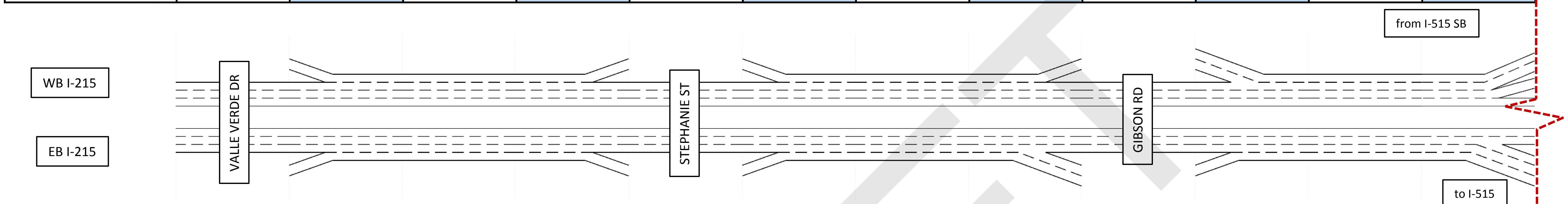
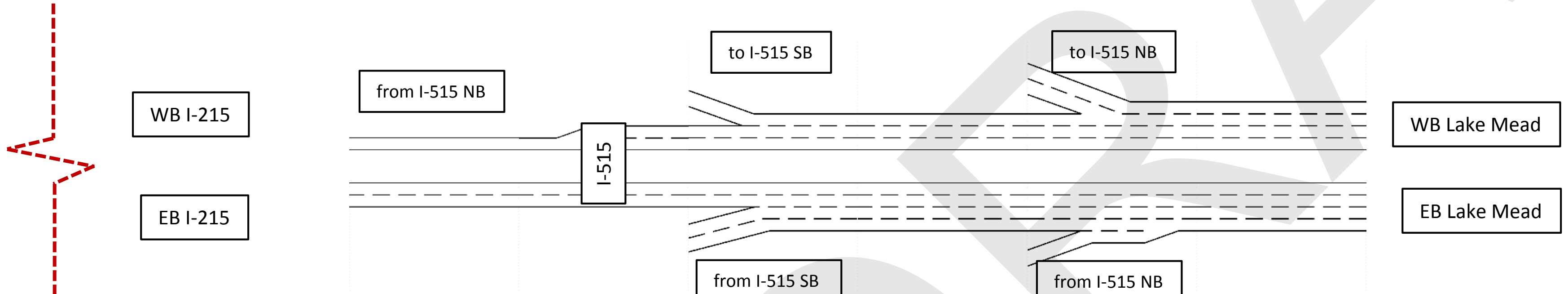
Figure 14: Year 2040 No-Action Alternative Peak Hour Volumes (along I-215)

AM Demand Volume (vph)	7610	450	8060	1300	6760	1040	7800	1200	6600	810	7410	2690
PM Demand Volume (vph)	7770	740	8510	2040	6470	830	7300	1070	6230	860	7090	2100



AM Demand Volume (vph)	6670	630	7300	1470	5830	910	6740	990	5750	800	6550	4580
PM Demand Volume (vph)	7890	740	8630	1430	7200	1370	8570	1180	7390	460	7850	6520

AM Demand Volume (vph)	1610	3110	120	3230	1500	4730
PM Demand Volume (vph)	2020	2970	270	3240	1430	4670



AM Demand Volume (vph)	1970	1300	3270	250	3520
PM Demand Volume (vph)	1330	2050	3380	280	3660

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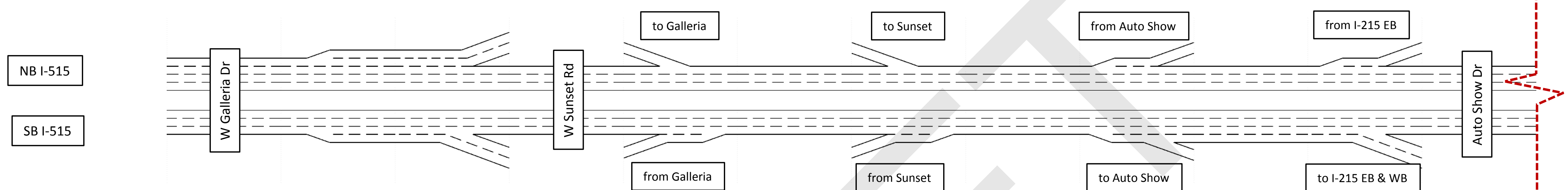
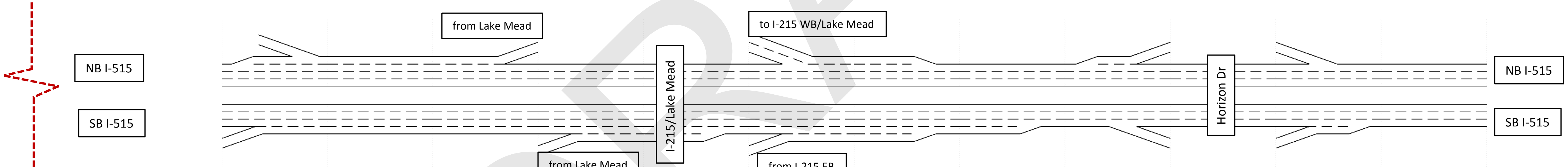
Figure 14: Year 2040 No-Action Alternative Peak Hour Volumes (along I-515)

AM Demand Volume (vph)	7250	1050	6200	370	6570	1000	7570	540	7030	2640	4390
PM Demand Volume (vph)	5950	910	5040	780	5820	1180	7000	810	6190	3470	2720



AM Demand Volume (vph)	6810	970	5840	400	6240	640	6880	830	6050	4000	2050
PM Demand Volume (vph)	6130	900	5230	490	5720	1170	6890	590	6300	4150	2150

AM Demand Volume (vph)	390	4780	1500	3280	1860	5140	2090	3050	360	3410
PM Demand Volume (vph)	570	3290	1430	1860	2300	4160	1220	2940	430	3370



AM Demand Volume (vph)	410	2460	120	2580	1940	4520	1770	2750	240	2990
PM Demand Volume (vph)	550	2700	270	2970	3050	6020	2750	3270	440	3710

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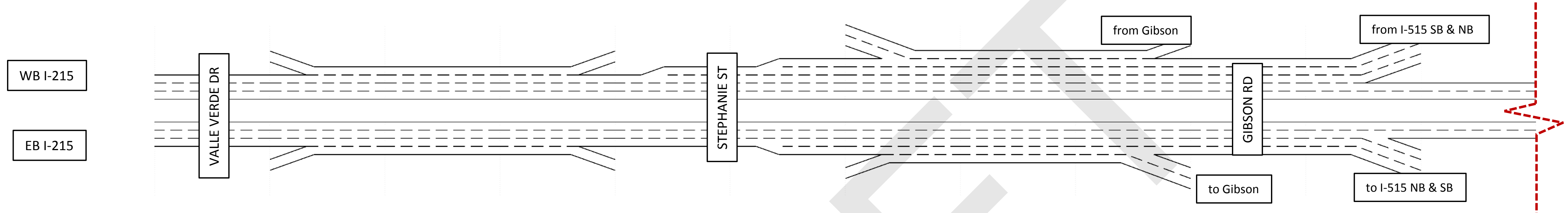
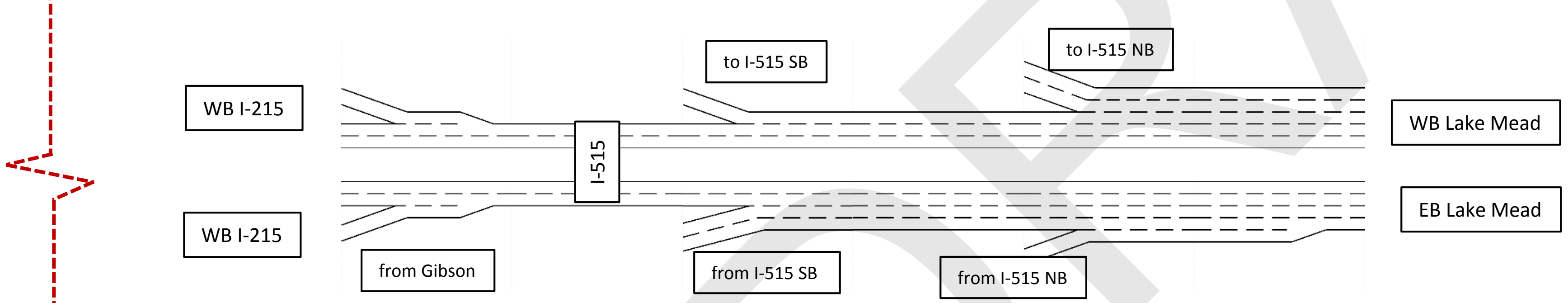
Figure 15: Year 2040 Build Alternative Option 1 Peak Hour Volumes (along I-215)

AM Demand Volume (vph)	7620	450	8070	1300	6770	1040	7810	1200	6610	3570	3040
PM Demand Volume (vph)	7770	740	8510	2040	6470	830	7300	1070	6230	3320	2910



AM Demand Volume (vph)	6670	630	7300	1470	5830	910	6740	990	5750	3890	1860
PM Demand Volume (vph)	7890	740	8630	1430	7200	1370	8570	1180	7390	6120	1270

AM Demand Volume (vph)	160	3200	120	3320	1500	4820
PM Demand Volume (vph)	200	3110	270	3380	1150	4530



AM Demand Volume (vph)	110	1970	1520	3490	250	3740
PM Demand Volume (vph)	60	1330	2050	3380	280	3660

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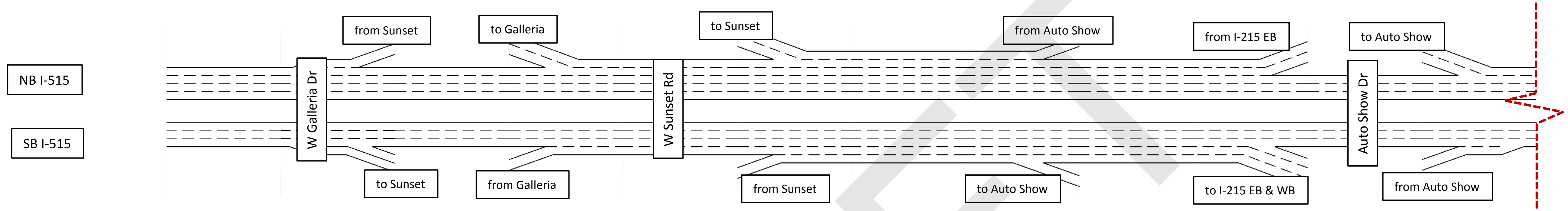
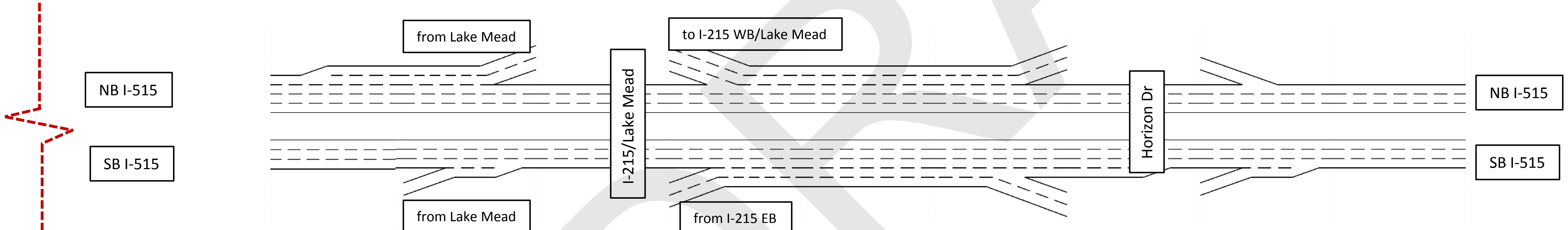
Figure 15: Year 2040 Build Alternative Option 1 Peak Hour Volumes (along I-515)

AM Demand Volume (veh)	7240	1050	6190	370	6560	1030	7590	540	7050	2670	4380	360
PM Demand Volume (veh)	5950	910	5040	780	5820	1180	7000	810	6190	3470	2720	570



AM Demand Volume (veh)	6810	970	5840	400	6230	670	6910	860	6050	4210	1830	410
PM Demand Volume (veh)	6130	900	5230	490	5730	1170	6890	590	6310	4150	2160	550

AM Demand Volume (veh)	4740	1500	3240	1780	5020	1970	3050	360	3410
PM Demand Volume (veh)	3290	1150	2140	2160	4300	1360	2940	430	3370



AM Demand Volume (veh)	2250	120	2360	1910	4270	1520	2750	240	2990
PM Demand Volume (veh)	2710	270	2980	3050	6030	2750	3280	440	3710

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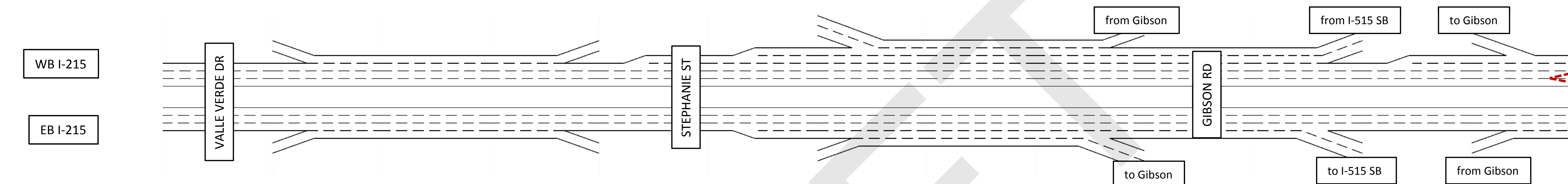
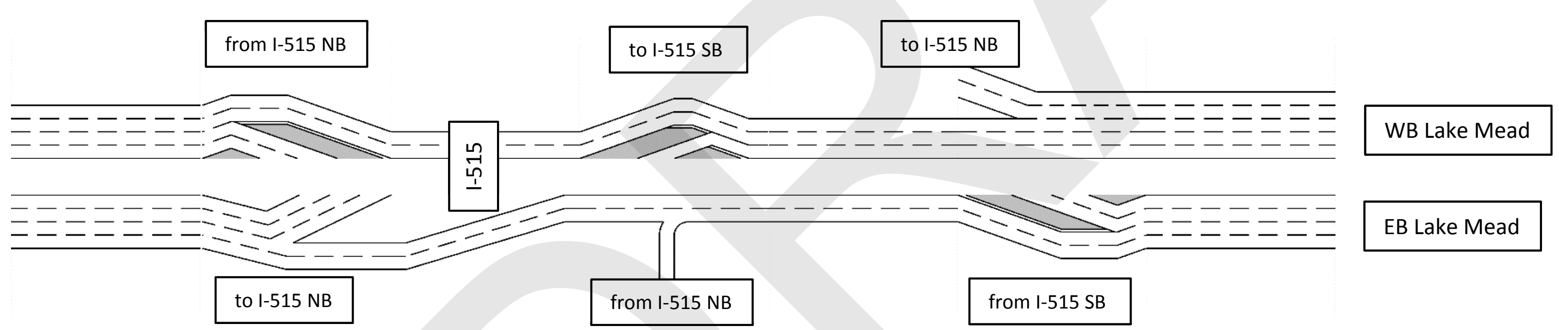
Figure 16: Year 2040 Build Alternative Option 2 Peak Hour Volumes (along I-215)

AM Demand Volume (vph)	7620	450	8070	1300	6770	1040	7810	1200	6610	2100	4510	220
PM Demand Volume (vph)	7770	740	8510	2040	6470	830	7300	1070	6230	1470	4760	320



AM Demand Volume (vph)	6670	630	7300	1470	5830	910	6740	990	5750	1860	3890	760
PM Demand Volume (vph)	7890	740	8630	1430	7200	1370	8570	1180	7390	2910	4480	400

AM Demand Volume (vph)	4730	1530	3200	120	3320	1450	4770
PM Demand Volume (vph)	5080	1890	3190	270	3460	1230	4690



AM Demand Volume (vph)	4650	2680	1970	250	2220	1550	3770
PM Demand Volume (vph)	4880	3550	1330	280	1610	2090	3700

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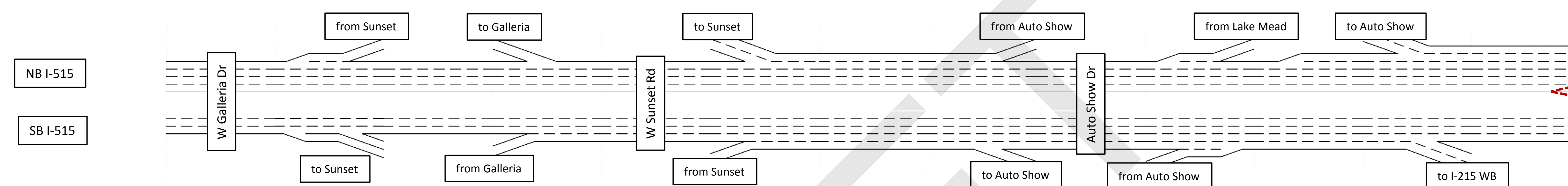
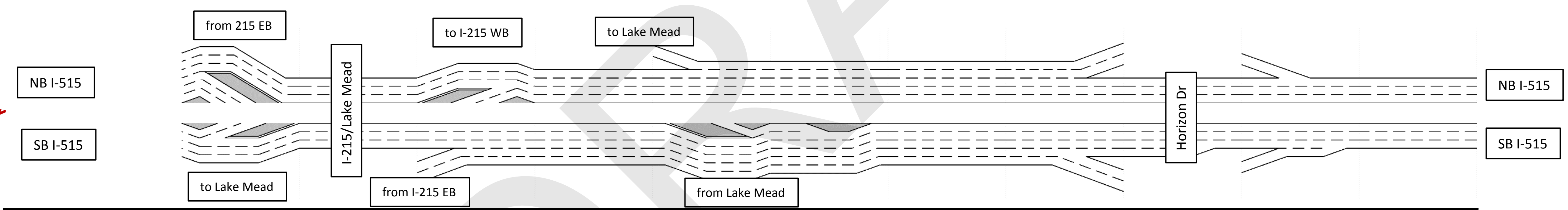
Figure 16: Year 2040 Build Alternative Option 2 Peak Hour Volumes (along I-515)

AM Demand Volume (vph)	7240	1050	6190	370	6560	1000	7560	540	7020	1450	5570	390	5960
PM Demand Volume (vph)	5940	910	5030	780	5810	1130	6940	800	6140	1230	4910	610	5520



AM Demand Volume (vph)	6810	970	5840	400	6240	640	6880	830	6050	410	6460	2690	3770
PM Demand Volume (vph)	6130	900	5230	490	5720	1120	6840	550	6290	560	6850	2100	4750

AM Demand Volume (vph)	2680	3280	1530	4810	250	5060	2010	3050	360	3410
PM Demand Volume (vph)	3550	1970	1890	3860	280	4140	1200	2940	430	3370



AM Demand Volume (vph)	1550	2220	1910	4130	120	4250	1490	2760	240	3000
PM Demand Volume (vph)	2090	2660	3050	5710	270	5980	2710	3270	440	3710

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6.3. AADT and Heavy Vehicles Forecast

AADT forecasts were developed for the year 2040 No-Action Alternative and the Build Alternative options, using the peak hour volumes presented in Figure 14 through Figure 16. A K_{30} of 8.4 percent (from NDOT ATR #0032230 [IR515/US95 .3 mi S of Russell Rd]) was used to determine the AADT. The AADT forecasts are presented in Appendix G.

The heavy vehicles percentage for future year conditions for the Project was calculated based on the trips in the “Truck” OD matrices and the trips in OD matrices for all vehicle types, developed for the I-515/I-215 FS subarea. Note that the OD matrices in the Aimsun Next model for this Project were developed using the OD matrices for SNTS’ I-215/I-515 subarea, which were originally developed from the RTC’s regional travel demand model.

The heavy vehicles percentage for future year conditions (the year 2040 No-Action Alternative and Build Alternatives) is estimated to be 4.7 percent for the AM peak period and 7.7 percent for the PM peak period.

7. SUMMARY AND CONCLUSION

This memorandum summarizes the existing conditions (the year 2017) calibration methodology, assumptions, and results. This memorandum also documents the methodology and assumptions involved in the development of the future (the year 2040) traffic volumes for the I-515/I-215 Interchange Feasibility Study. NDOT review and approval of the year 2040 traffic forecasts (Section 6) is requested before using the forecast volumes and associated traffic operations results for NEPA documentation.

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Appendices

Appendix A: I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum

Appendix B: Electronic Files of the Aimsun Next Model and other Associated Model Files

Appendix C: Traffic Forecasting Guidelines Checklist

Appendix D: Detailed Volume Calibration Results

Appendix E: Schematics of the Build Alternative Options modeled in Aimsun Next

Appendix F: NDOT SNTS' 2040 Micro/Meso Future Volume Development Technical Memorandum

Appendix G: Future Year 2040 AADTs

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Traffic Forecasting Memorandum

Appendices

Appendix A

I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum

Technical Memorandum

TO:	Thomas Davy, P.E., City of Henderson	**DATE:**	January 28, 2019
FROM:	John Karachepone, P.E., Jacobs		
SUBJECT:	I-515/I-215 Interchange Feasibility Study: Traffic Operations Methodology Memorandum		
COPIES:	Hoang Hong, P.E., NDOT; Casey Sylvester, P.E., NDOT; Samuel Ahiamadi, NDOT; Chris Wright, NDOT; Mark Wooster, NDOT; Jack Sjostrom, P.E., CA Group		

1. INTRODUCTION AND BACKGROUND

The I-515/I-215 Interchange Feasibility Study was initiated by the City of Henderson to develop and evaluate alternatives to alleviate recurring congestion, address high crash locations, and to accommodate future growth in the interchange and adjoining interstate corridors.

In 2015, the City initiated the Southbound I-515 Improvement Study to assess deteriorating traffic operations, including low travel speeds and long queues, on the interstate system-to-system ramp from I-515 southbound (SB) to I-215 westbound (WB). The results of the study included a short-term recommendation to reconfigure the I-515 SB to I-215 WB ramp. NDOT, in turn, has designed and implemented this short-term solution in December 2018.

In 2016, NDOT initiated the Southern Nevada Traffic Study (SNTS) to understand the existing and future freeway operations and to develop improvement concepts for poorly performing freeway segments in Southern Nevada. As part of the SNTS, the I-515/I-215 interchange was modeled at a microscopic simulation level of detail using Aimsun Next and evaluated for various improvement concepts to improve traffic operations.

This feasibility study builds upon and advances the findings and recommendations of the previous studies. This study is designed to identify long-term solutions that could be feasibly advanced under the direction of the City and NDOT into the NEPA process and subsequently into final design and construction. One of the key steps in the feasibility study is the evaluation of the traffic operations performance of improvement alternatives. This memorandum explains the methodology and assumptions of the Aimsun Next modeling process to be used for the traffic operations analysis. A completed “Methodology Memorandum Content Checklist” is included as Attachment 1 at the end of this memorandum.

2. PROJECT LIMITS

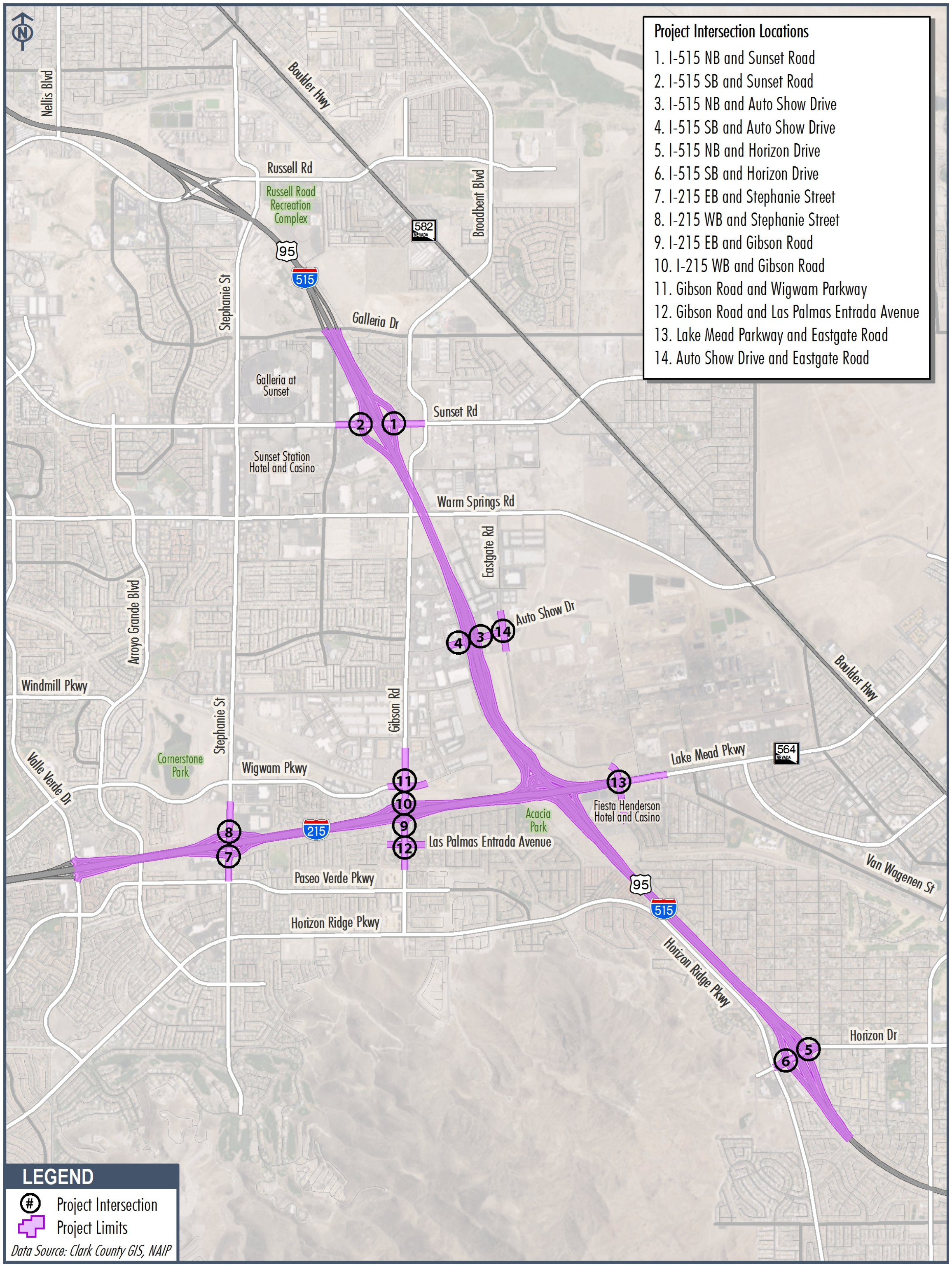
The I-515/I-215 Interchange lies in the heart of the City of Henderson, Nevada. The Project limits for Aimsun Next modeling and traffic operations analysis include:

- I-515 Freeway between (and including) Sunset Road in the north and Horizon Drive in the south. The Galleria Drive on-ramp to I-515 SB and the Galleria Drive off-ramp from I-515 northbound (NB) are also included.
- I-215 Freeway/Lake Mead Parkway between (and including) Stephanie Street in the west and Eastgate Road in the east. The Valle Verde Drive on-ramp to I-215 eastbound (EB) and the Valle Verde Drive off-ramp from I-215 WB are also included.

Figure 1 shows the Project limits for the operations analysis. The following are the study intersections that will be included in the analysis:

1. I-515 NB and Sunset Road
2. I-515 SB and Sunset Road
3. I-515 NB and Auto Show Drive
4. I-515 SB and Auto Show Drive
5. I-515 NB and Horizon Drive
6. I-515 SB and Horizon Drive
7. I-215 EB and Stephanie Street
8. I-215 WB and Stephanie Street
9. I-215 EB and Gibson Road
10. I-215 WB and Gibson Road
11. Gibson Road and Wigwam Parkway
12. Gibson Road and Las Palmas Entrada Avenue
13. Lake Mead Parkway and Eastgate Road
14. Auto Show Drive and Eastgate Road

Figure 1: Project Limits for Traffic Operations Analysis



3. TECHNICAL GUIDANCE, STANDARDS, AND TOOLS

The following technical documents and guidelines are the key references to be used in the traffic analysis and modeling of this study:

- Aimsun Next Modeling Guidelines, NDOT, 2018
- Traffic Forecasting Methods and Assumptions Memorandum (Appendix A of NDOT SNTS Final Report), 2018
- Traffic Operations Methodology and Assumptions Memorandum (Appendix B of NDOT SNTS Final Report), 2018
- 2017 Aimsun Next Model Development and Calibration Report (Appendix C of NDOT SNTS Final Report), 2018
- Existing Conditions Report (Appendix D of NDOT SNTS Final Report), 2018
- Future Conditions Report (Appendix E of NDOT SNTS Final Report), 2018
- Highway Capacity Manual 6th Edition, Transportation Research Board, 2016

Traffic microsimulation modeling will be completed using Aimsun Next version 8.2.4 (or the most recent version available at the start of the analysis). Traffic signal timings for the study intersections for Build Alternatives will be optimized using Synchro (version 10 or the most recent version available at the start of the analysis) and will be used in Aimsun Next as a starting point. Synchro and Highway Capacity Software (HCS version 7.7 or the most recent version available at the start of the analysis) will be used only as supporting traffic analysis tools. All final traffic operations analysis results will be reported from Aimsun Next.

4. ANALYSIS SCENARIOS, MODELING PERIODS, AND MULTIPLE TIME PERIODS

Aimsun Next microscopic simulation modeling will be completed for the following scenarios:

- Existing Year 2017 (No new modeling, reporting of results [for comparative analysis purposes] only as described in the Scope of Services)
- Future Year 2040 No-Action Alternative (No new modeling, reporting of results [for comparative analysis purposes] only as described in the Scope of Services)
- Future Year 2040 Build Alternatives (Up to three Alternatives)

The Aimsun Next scenarios for this Project will be developed using the Southern Nevada Aimsun Next model provided by NDOT. This model includes a new “I-515/I-215 FS” subarea created for this Project. The I-515/I-215 interchange was modeled during SNTS; the “I-215/I-515” subarea in the Southern Nevada Aimsun Next model was developed as part of SNTS. Along I-215, the limits of the SNTS I-215/I-515 subarea extend from Windmill Lane to the I-515/I-215 interchange; along I-515, the limits of this subarea extend from Boulder Highway to the I-515/I-215 interchange. This subarea was modeled and calibrated to a microscopic level of detail as part of SNTS. Therefore, no new existing conditions modeling or calibration to existing conditions will be completed for this Project. Similarly, the year 2040 No-Action Alternative was modeled during SNTS; no new modeling will be completed as part of this Project for the year 2040 No-Action Alternative. However, the existing year 2017 and year 2040 No-Action Alternative microsimulation scenarios will be run in Aimsun Next for the I-515/I-215 FS subarea and results will be reported for comparative purposes.

Up to three (3) Build Alternatives for the year 2040 will be modeled to a microsimulation level as part of this Project in the I-515/I-215 FS subarea and the results will be compared against the 2040 No-Action Alternative. The Build Alternatives will be selected from a list of potential improvements through a high-level screening process; the three highest-ranked alternatives from the screening process will be modeled in Aimsun Next.

The Southern Nevada Aimsun Next model includes two-hour AM peak (7:00 AM – 9:00 AM) and PM peak (4:00 PM – 6:00 PM) period origin-destination (OD) matrices for the I-215/I-515 subarea. The modeling periods for this Project will also match these periods. For year 2017 conditions, OD matrices are available for each 15-minute period. Therefore, the existing conditions modeling for this Project will reflect this time-varying profile in demand. Such a time-varying profile in demand is not available in the Southern Nevada Aimsun Next model for future year 2040 conditions. Therefore, for the future year 2040 modeling for this Project, the variation in traffic within the two-hour modeling period will not be considered; a flat two-hour demand will be used for the future year 2040 modeling.

5. AIMSUN NEXT MODELING – METHODOLOGY AND ASSUMPTIONS

The modeling limits for this Project consist of a new subarea (I-515/I-215 FS subarea) within the limits of the I-215/I-515 subarea developed and calibrated as part of SNTS. This new subarea focuses on the freeway sections and intersections listed in Section 2 and shown in Figure 1. All modeling for this Project will be completed within this new I-515/I-215 FS subarea created in the Southern Nevada Aimsun Next model.

The following are assumptions and key steps to be completed during the Aimsun Next modeling process:

1. The static traversal procedure for the I-515/I-215 FS subarea will be run using the year 2017 static assignment results of the SNTS' I-215/I-515 subarea to extract demands/OD matrices for the I-515/I-215 FS subarea under existing conditions. Because the I-215/I-515 subarea was already calibrated as part of SNTS, the resulting traversal matrices for the I-515/I-215 FS subarea are also considered to be calibrated.
2. The subarea OD matrices generated from the static traversal (Step 1), will be used to develop and run Static Assignment and Dynamic scenarios for the year 2017 existing conditions.
   a. The settings and parameters used for the scenarios in SNTS' I-215/I-515 subarea will be used for the scenarios in the new I-515/I-215 FS subarea.
3. The existing traffic signal timing and ramp meter timing information included in the Southern Nevada Aimsun Next model will be used for the year 2017 existing conditions modeling.
   a. The Southern Nevada Aimsun Next model did not include signal timing information for the intersections of Gibson Road/Wigwam Parkway and Gibson Road/Las Palmas Entrada Avenue. Existing traffic signal timing for these intersections will be obtained from FAST and coded in the model.
4. The static traversal procedure for the I-515/I-215 FS subarea will be run using the year 2040 Build Alternative's static assignment results of the SNTS' I-215/I-515 subarea to extract year 2040 demands/OD matrices for the I-515/I-215 FS subarea.
   a. These year 2040 matrices will be used as input demand for the year 2040 No-Action and Build Alternatives.
   b. No TransCAD modeling will be completed for this Project.
5. The subarea OD matrices generated from the static traversal (Step 4), will be used to develop and run Static Assignment and Dynamic scenarios for the year 2040 No-Action and Build Alternatives.
   a. The settings and parameters used for the scenarios in SNTS' I-215/I-515 subarea will be used for the scenarios in the new I-515/I-215 FS subarea.
6. Minor adjustments to traffic signal timings may be made for the year 2040 No-Action Alternative; these adjustments will be based on visual observations and engineering judgment.
7. Traffic signal timings for the year 2040 Build Alternatives will be optimized in Synchro and used in Aimsun Next.
8. Existing ramp meter timing information included in the Southern Nevada Aimsun Next model will be used for the year 2040 No-Action and Build Alternatives.

9. Because the year 2040 No-Action Alternative was developed and run as part of SNTS, it is assumed that the appropriate Dynamic calibration parameters are already coded for the year 2040 No-Action Alternative scenario.
10. For the year 2040 Build Alternatives, appropriate Dynamic calibration parameters will be coded based on the calibration parameter values in the year 2017 Dynamic scenario.

A summary of the data needs for Aimsun Next modeling and the sources for these are listed in Table 1.

Table 1: Data Needs for Modeling and Sources

Data Need	Source
Year 2017 Existing Conditions field data for cursory review of the I-515/I-215 FS subarea	SNTS – Files dated January 2018
Traffic signal timing for the following intersections that do not have signal timing coded in the Southern Nevada Aimsun Next model: • Gibson Road and Wigwam Parkway • Gibson Road and Las Palmas Entrada Avenue • I-515 NB and Horizon Drive • I-515 SB and Horizon Drive	SNTS, RTC FAST
Ramp metering control schedule file	SNTS – Files dated February 2018
Volume and speed calibration spreadsheets	SNTS – Files dated June 2018
Dynamic scenario/experiment settings/parameters[1]	SNTS – Aimsun Next revision file dated July 2018
Year 2017 Existing Conditions line diagram to report section-specific results	SNTS – Files dated July 2018
Year 2040 No-Action Alternative line diagram to report section-specific results	Will be developed using the year 2017 Existing Conditions line diagram
Spreadsheets to report subarea-wide Measures of Effectiveness (MOEs)	SNTS – Files dated August 2018

[1] The current Southern Nevada Aimsun Next model does not have any dynamic scenarios for the SNTS' I-215/I-515 subarea.

6. CURSORY REVIEW OF YEAR 2017 EXISTING CONDITIONS IN THE I-515/I-215 FS SUBAREA

Even though the year 2017 existing conditions were calibrated to a microscopic level of detail as part of SNTS, and no additional calibration will be completed as part of this Project as explained previously, a cursory review of the year 2017 existing conditions in the I-515/I-215 FS subarea was completed. The results of this review are included in Attachment 2 of this memorandum. The field data obtained as part of SNTS was used for this review.

It is noted that one of the primary reasons for the variation (in the PM period) between the model outputs and the field data are the volumes at the Gibson Road and Las Palmas Entrada Avenue intersection. Las Palmas Entrada Avenue was not modeled as part of SNTS and did not exist in the Southern Nevada Aimsun Next model; this was added to the model subsequently by NDOT. The resulting year 2017 static assignment volumes for the I-515/I-215 FS subarea at this intersection are observed to be unreasonable. The model assigned PM peak hour southbound left turn volume is approximately 1,350 vph. The AM and PM peak hour static assignment volumes are included in Attachment 3. Given that the southbound left turn at the Gibson Road and Las Palmas Entrada Avenue intersection is a one-lane turn, the high turning movement volume in the PM period model results in unreasonable upstream queues through the I-215/Gibson Road interchange, which eventually spills back on to the freeway system as well.

Once the intersection turning movement volumes are collected from the field for this Project, the model volumes for this southbound left turn will be refined to be reasonably close to the field volumes. It is expected that this will result in model outputs that are slightly closer to the field data.

7. ANALYSIS RESULTS

The traffic operations analysis results for the year 2017 existing conditions and the future year 2040 No-Action and Build Alternatives will be obtained from the Aimsun Next model developed for this Project. Average results from 10 microsimulation runs (replications) were reported in SNTS. Therefore, results reported as part of this Project will also correspond to an average of 10 microsimulation runs.

Section-specific MOEs will be reported for all alternatives and include the following:

- Speed
- Density
- Flow

- Static Assigned Volumes

Subarea-wide MOEs will also be reported for all alternatives and include the following:

- Network Vehicles
- Latent Vehicles
- Latent Delay Time
- Number of Arrived Vehicles
- Number of Active Vehicles
- Total Network Delay
- Average Network Delay

These MOEs will be reported using the spreadsheets developed as part of the SNTS.

8. CONCLUSION

Following approval of this Methodology Memorandum, the Aimsun Next modeling will be completed. We request approval of this Traffic Operations Methodology Memorandum so that the operations analysis can begin.

Attachment 1: Methodology Memorandum Content Checklist

Item	Description	Check
Project Description and Background	Brief information about the project (purpose, general study area, etc.)	✓
Technical Guidance and Standards	Technical guidance and standards to be followed along with their version (HCM, MUTCD, NDOT Access Management Standards, etc.)	✓
Traffic Analysis Tools	Software to be used along with their version (CORSIM, HCS, TRAFFIX, etc.)	✓
Study Limits	Geographic limits of the analysis. This is to be consistent with the NDOT Microsimulation Modeling Guidelines. List all study intersections to be included.	✓
Analysis Years	Design, opening and interim years.	✓
Analysis Scenarios	Existing, No-Action, Build - describe build alternatives to the extent possible.	✓
Analysis Periods	Modeling periods and multiple time periods description . The use of multiple time periods should conform to NDOT Microsimulation Modeling Guidelines.	✓
Existing Conditions	Description of existing conditions and/or how existing analysis will be performed.	✓
Data Sources	List of sources of data and relevant information.	✓
Traffic Operations Analysis Calculations/Assumptions	Signal timing/phasing, i.e., whether to use optimized timing or actual timing data, peak hour factors, etc.	✓
Truck Percentages	Truck percentage to use for existing and future scenarios and their calculation/estimation.	N/A
Storage Length Calculation Method	How the turn bay lengths will be calculated.	N/A
Traffic Forecasts	General methodology for projecting traffic forecasts. Note that a separate Traffic Forecast Memorandum is needed for NDOT Traffic Information Division approval of the projected volumes per NDOT Traffic Forecasting Guidelines. Note if the Traffic Information Division approved the traffic forecasts.	✓
Aimsun Coding and Analysis Assumptions	Documentation of support tools (if to be used) for intersection timing/optimization (such as Synchro, TRANSYT-7F, TEAPAC etc), pre-timed versus actuated control for signals, free-flow speeds (measured versus estimated/assumed). Coding items, such as O-Ds, conditional turning movements, handling weave/merge/diverge, and node numbering convention are to conform to the NDOT Microsimulation Modeling Guidelines. HOV lanes, express lanes/managed lanes, and ramp meters are to be addressed.	✓
Calibration Approach	Calibration approach is to follow the methodologies described in the NDOT Microsimulation Modeling Guidelines.	N/A
Calibration MOEs, Locations, Targets	Calibration MOEs, locations to be calibrated and targets for acceptable match.	N/A
Selected MOEs for Evaluation	List of MOEs for evaluation and alternatives analysis along with the selected threshold for successful operations. Clearly state if intersection/arterial MOEs will be reported from Aimsun output or from the signal timing tool used.	✓
Additional item(s)	Any unique item(s) that is appropriate to be discussed/approved by NDOT.	✓
Comments: The proposed methodology will not report LOS corresponding to Aimsun outputs.		

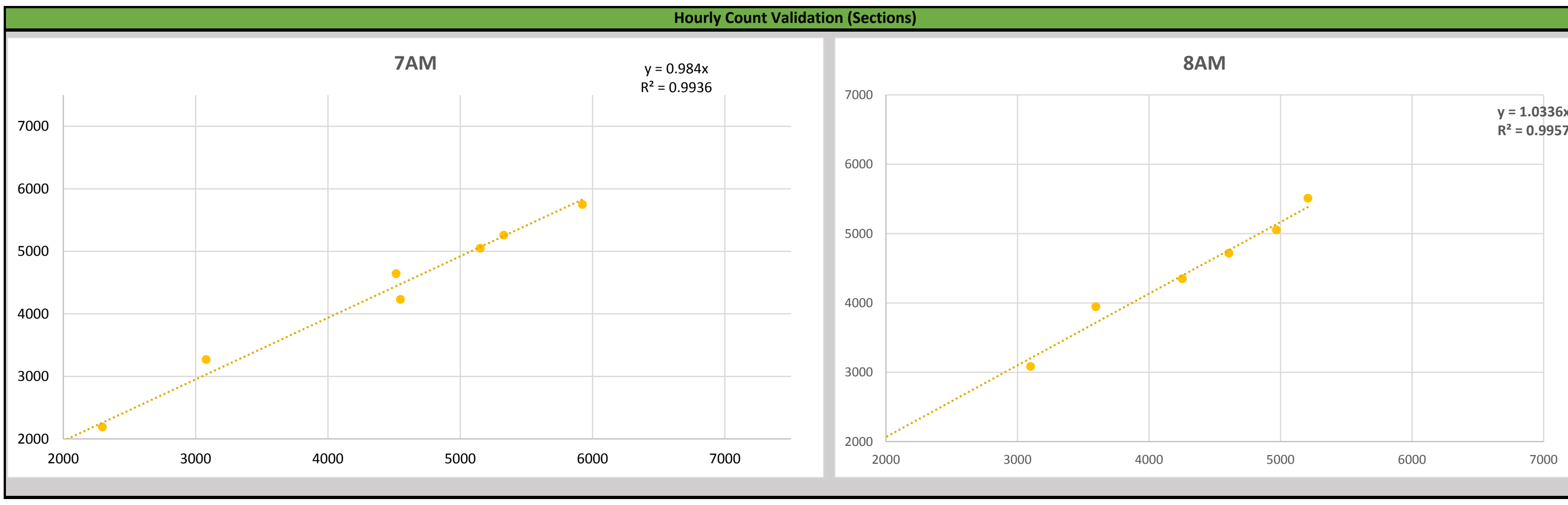
Attachment 2

Cursory Review of Year 2017 Existing Conditions Aimsun Next Scenarios in the I-515/I-215 FS Subarea

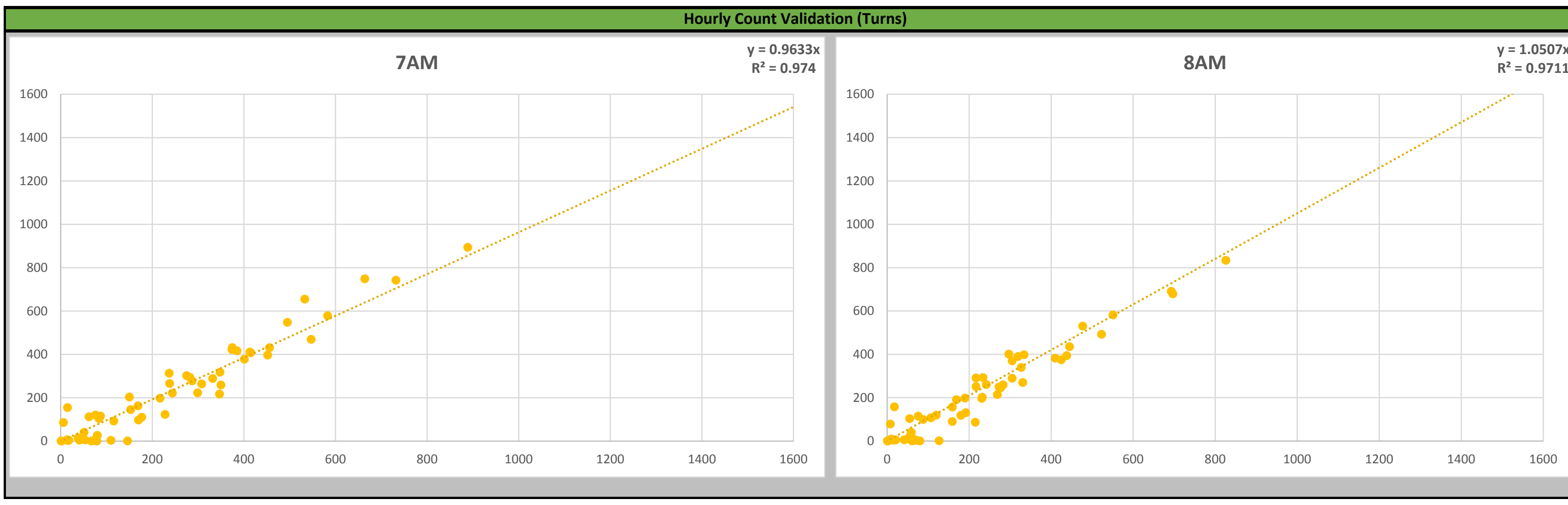
I-515/I-215 FS Subarea – Volume Comparison Results – Year 2017 AM Period

Criteria	Acceptance Target	7AM Points	7AM Pass	7AM Acceptance	8AM Points	8AM Pass	8AM Acceptance
FLOW < 700, within 100 veh/h	> 85%	0	0	#N/A	0	0	#N/A
700 < FLOW < 2700, within 15%	> 85%	5	5	100.0	5	5	100.0
2700 < FLOW < 5000, within 10%	> 85%	3	3	100.0	4	4	100.0
FLOW > 5000 within 250 veh/h	> 85%	3	3	100.0	2	2	100.0
GEH Statistic < 5 for individual link flows	> 85%	11	11	100.0	11	10	90.9
GEH Statistic < 10 for individual link flows	100%	11	11	100.0	11	11	100.0
GEH Stastistic < 5 for all Turns	> 75%	62	42	67.7	62	45	72.6
GEH Stastistic < 10 for all Turns	> 95%	62	51	82.3	62	53	85.5
Percent GEH Passing	> 95%	73	62	84.9	73	64	87.7
Sum of all link flows	> 95%			98.8			97.0

Hourly Count Validation (Sections)



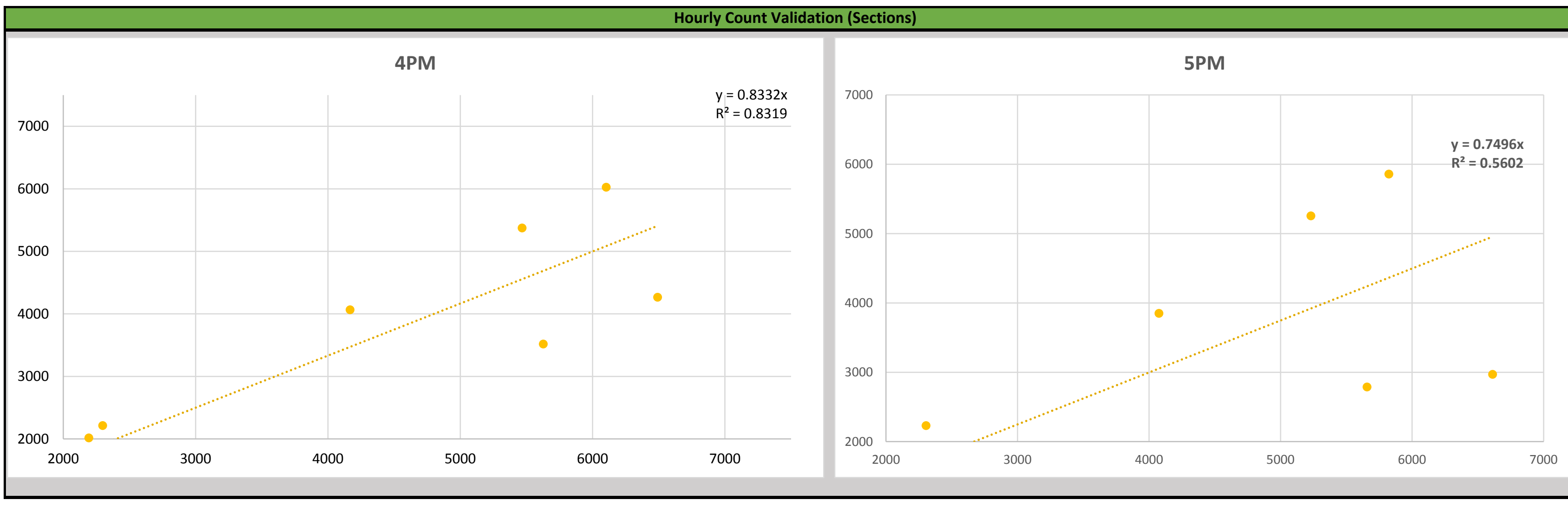
Hourly Count Validation (Turns)



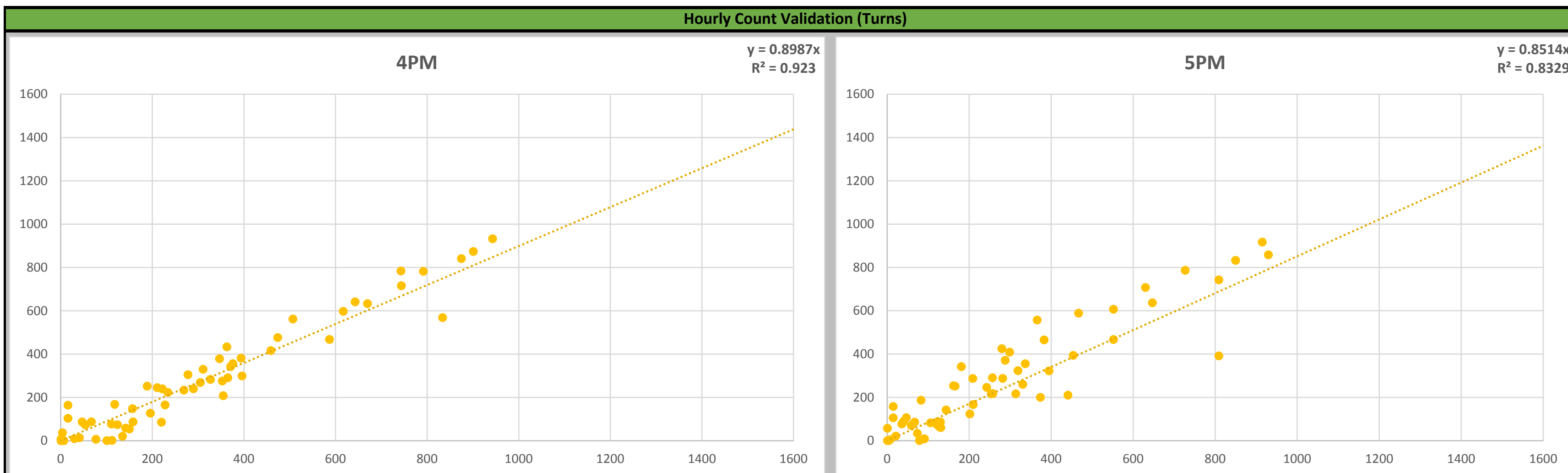
I-515/I-215 FS Subarea – Volume Comparison Results – Year 2017 PM Period

Criteria	Acceptance Target	4PM			5PM		
		Points	Pass	Acceptance	Points	Pass	Acceptance
FLOW < 700, within 100 veh/h	> 85%	0	0	#N/A	1	1	100
700 < FLOW < 2700, within 15%	> 85%	5	5	100.0	4	4	100.0
2700 < FLOW < 5000, within 10%	> 85%	3	3	100.0	3	3	100.0
FLOW > 5000 within 250 veh/h	> 85%	2	2	100.0	2	2	100.0
GEH Statistic < 5 for individual link flows	> 85%	10	7	70.0	10	7	70.0
GEH Statistic < 10 for individual link flows	100%	10	7	70.0	10	7	70.0
GEH Stastistic < 5 for all Turns	> 75%	63	43	68.3	63	37	58.7
GEH Stastistic < 10 for all Turns	> 95%	63	54	85.7	63	54	85.7
Percent GEH Passing	> 95%	73	61	83.6	73	61	83.6
Sum of all link flows	> 95%			85.1			78.8

Hourly Count Validation (Sections)



Hourly Count Validation (Turns)



I-515/I-215 FS Subarea – Speed Comparison Results – Year 2017 AM Period

INRIX vs Aimsun Next		I215 EB E of Stephanie	Lake Mead Parkway (I215 WB) E of I515	I215 WB W of Stephanie	I515 NB N of Horizon
INRIX	7:00 AM	65.4	53.7	60.6	65.8
	7:15 AM	65.1	51.2	50.9	64.8
	7:30 AM	64.6	49.0	34.7	64.7
	7:45 AM	64.6	45.9	29.5	66.6
	8:00 AM	64.6	47.3	44.9	65.1
	8:15 AM	64.5	45.6	54.0	65.7
	8:30 AM	65.1	49.5	52.9	66.2
	8:45 AM	64.0	49.1	51.7	65.4
	7:00 - 9:00	64.7	48.9	47.4	65.5
Aimsun Next	7:00 AM	64.6	46.4	61.6	63.3
	7:15 AM	64.6	46.5	61.7	62.9
	7:30 AM	63.6	46.1	59.7	62.2
	7:45 AM	63.6	46.3	60.4	62.7
	8:00 AM	64.2	46.6	60.8	63.3
	8:15 AM	64.5	46.4	62.1	63.2
	8:30 AM	64.6	46.8	62.6	63.2
	8:45 AM	64.6	46.6	62.1	63.0
	7:00 - 9:00	64.3	46.4	61.3	63.0
Absolute Difference	7:00 AM	0.8	7.3	1.0	2.5
	7:15 AM	0.5	4.7	10.8	1.9
	7:30 AM	1.0	2.9	25.0	2.5
	7:45 AM	1.0	0.3	30.9	3.9
	8:00 AM	0.3	0.7	15.9	1.8
	8:15 AM	0.0	0.8	8.0	2.5
	8:30 AM	0.5	2.7	9.7	3.0
	8:45 AM	0.5	2.5	10.4	2.4
	7:00 - 9:00	0.5	2.5	13.9	2.6

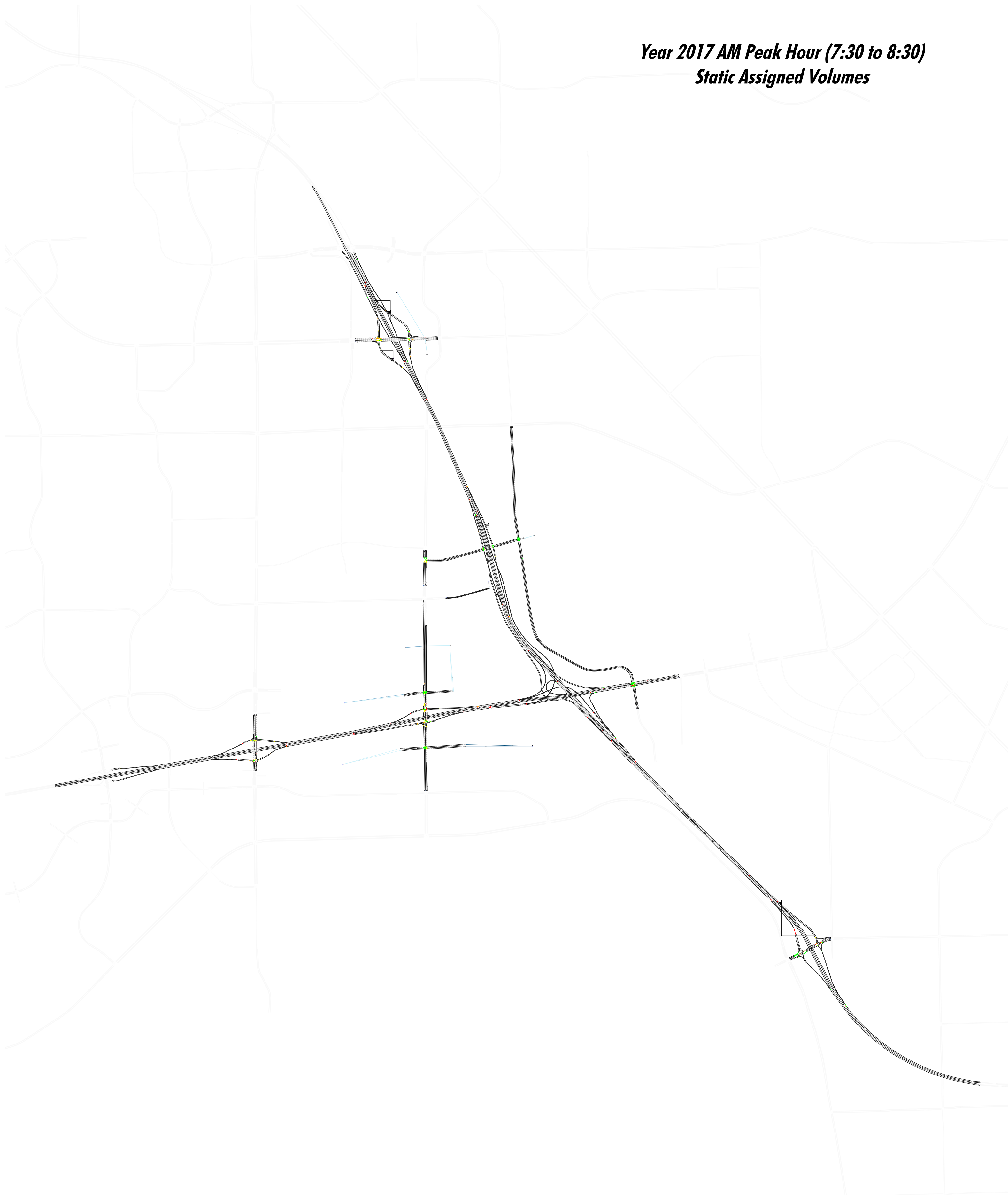
I-515/I-215 FS Subarea – Speed Comparison Results – Year 2017 PM Period

INRIX vs Aimsun Next		I215 EB E of Stephanie	Lake Mead Parkway (I215 WB) E of I515	I215 WB W of Stephanie	I515 NB N of Horizon
INRIX	4:00 PM	48.7	47.2	56.9	63.9
	4:15 PM	53.0	48.8	52.5	63.4
	4:30 PM	58.7	52.3	54.6	64.5
	4:45 PM	58.9	49.4	57.5	63.7
	5:00 PM	54.7	48.1	60.7	64.9
	5:15 PM	51.1	47.0	58.0	64.2
	5:30 PM	52.3	47.3	56.2	63.3
	5:45 PM	51.8	49.9	59.5	63.8
	4:00 - 6:00	53.6	48.7	57.0	64.0
Aimsun Next	4:00 PM	49.6	45.1	61.2	61.5
	4:15 PM	13.1	45.6	62.1	61.9
	4:30 PM	9.0	44.4	60.9	61.5
	4:45 PM	9.5	44.7	61.6	61.4
	5:00 PM	8.2	43.4	61.2	61.6
	5:15 PM	7.9	44.0	61.9	61.4
	5:30 PM	8.2	43.8	60.7	61.4
	5:45 PM	7.9	44.6	58.6	61.8
	4:00 - 6:00	17.8	44.4	61.0	61.6
Absolute Difference	4:00 PM	0.9	2.1	4.3	2.3
	4:15 PM	39.8	3.2	9.6	1.5
	4:30 PM	49.7	7.9	6.3	3.0
	4:45 PM	49.4	4.7	4.2	2.3
	5:00 PM	46.5	4.7	0.5	3.3
	5:15 PM	43.2	3.0	3.9	2.8
	5:30 PM	44.1	3.4	4.5	1.9
	5:45 PM	43.9	5.3	1.0	2.0
	4:00 - 6:00	35.9	4.3	4.0	2.4

Attachment 3

Year 2017 AM and PM Peak Hour Static Assignment Volumes

Year 2017 AM Peak Hour (7:30 to 8:30)
Static Assigned Volumes



Year 2017 PM Peak Hour (4:30 to 5:30)
Static Assigned Volumes

Appendix B

Aimsun Next Model and other Associated Model Files (Provided Electronically)

Appendix C

Traffic Forecasting Guidelines Checklist

No.	Item	Description	Check
1	Definitions	Terms used in your traffic forecast are in accordance with the definitions provided in the Traffic Forecasting Guidelines.	✓
2	Truth in Data Principle	The traffic forecast satisfies the requirements of the Truth in Data principle.	✓
3	Rounding Convention	The traffic forecast was developed adhering to the rounding convention.	✓
4	Methodology Memorandum	A methodology memorandum document was prepared and submitted to NDOT as per guidance offered in the Traffic Forecasting Guidelines. Any changes from the accepted methodology memorandum are documented clearly in the traffic forecasting report.	✓
5	Traffic Factors (Seasonal Factors, Axle Factors, AADT, K_{30}, D_{30}, T%, etc.)	The traffic factors were obtained according to the guidance offered in the Traffic Forecasting Guidelines.	✓
6	Data Sources	The data sources were chosen according to the guidance offered in the Traffic Forecasting Guidelines.	✓
7	Adjusting K_{30} and D_{30}	K_{30} and D_{30} values were adjusted according to the guidance offered in the Traffic Forecasting Guidelines.	✓
Items 8 through 10 are relevant only if a travel demand model and the Traffic Forecasting Guidelines' Project Traffic Forecasting methodology was used for traffic forecasting.			
8	Accuracy Levels	The accuracy levels listed in the Traffic Forecasting Guidelines were met or the necessary NCHRP Report 255 adjustments were performed.	N/A
9	Model Output Conversion Factor (MOCF) (if needed)	An MOCF was estimated to obtain AADT from model outputs.	N/A
10	Reasonableness Check with Historical Trend Projection	Historical trend projection was carried out to evaluate the reasonableness of the model projected volumes.	N/A
11	Historical Trend Projection	A historical trend projection analysis was carried out according to the guidance in the Traffic Forecasting Guidelines.	N/A
12	Constrained Facilities (if needed)	Guidance offered in the Traffic Forecasting Guidelines pertaining to constrained facilities was adopted.	✓
13	Peak Hour Volumes from DDHV	Peak hours of traffic were identified and the peak hour volumes were obtained from DDHV as per guidance offered in the Traffic Forecasting Guidelines.	N/A
14	Estimation of Intersection Turning Movements	Intersection turning movements were estimated following recommended methodologies.	N/A
15	Truck Traffic Forecasting	Truck traffic was forecast according to the guidance offered in the Traffic Forecasting Guidelines.	✓

Comments:

Appendix D

Detailed Volume Calibration Results

Section Volume Comparison

7:00 to 8:00 AM					
Object	Count	Model	Absolute Difference	Relative Difference (%)	GEH
356272: RAMP US95 N AUTO SHO (24995)	205	276.8	71.8	35.02439024	4.626004429
5982: I 215 (20221)	6164	6475.1	311.1	5.047047372	3.913424269
13551: RAMP AUTO SHO US95 S (24996)	177	227.8	50.8	28.70056497	3.570741888
6192: RAMP US95 N I215 W (24916)	1057	1152.6	95.6	9.044465468	2.876179983
16078: RAMP I215E US95 (32349)	1846	1959.5	113.5	6.148429036	2.601986244
17161: RAMP I215 E GIBSON (24911)	719	789.6	70.6	9.819193324	2.570589014
13549: RAMP AUTO SHO US95 N (24994)	387	341.7	-45.3	11.70542636	2.373224456
13478: RAMP US95 S I215 W (24925)	1764	1843.4	79.4	4.501133787	1.869555446
356271: RAMP S US95 AUTO SHO (21737)	741	694.5	-46.5	6.275303644	1.735666784
18244: RAMP US95S HORIZON (9771)	788	836.9	48.9	6.205583756	1.715578274
13479: US 95 (24926)	3317	3410.4	93.4	2.815797407	1.610416637
356194: RAMP I215 W VA VERDE (18802)	408	439.3	31.3	7.671568627	1.520690148
356214: RAMP I125 W STEPHANI (20214)	756	795.8	39.8	5.264550265	1.428828802
356240: RAMP US95 N E GALLER (24987)	287	310.4	23.4	8.153310105	1.353936344
6164: RAMP US95N HORIZON (9842)	203	187.6	-15.4	7.586206897	1.101969563
6190: RAMP E I 215 US95 S (32347)	3370	3429.2	59.2	1.756676558	1.015331351
5937: RAMP I215 W US95 S (24919)	53	60.6	7.6	14.33962264	1.008415296
356267: RAMP US95 N SUNSET (8807)	682	704.8	22.8	3.343108504	0.865850532
16985: US 95 (35378)	2580	2537.9	-42.1	1.631782946	0.832245002
5948: RAMP STEPHANI I215 W (20215)	1330	1358.4	28.4	2.135338346	0.774615877
356263: RAMP US95 S SUNSET (8587)	691	673.6	-17.4	2.518089725	0.666133941
13472: RAMP I215 W GIBSON (24914)	790	808.4	18.4	2.329113924	0.650863752
6727: RAMP SUNSET US95 N (8611)	590	574.3	-15.7	2.661016949	0.65070209
11194: I 215 (22244)	5123	5166.8	43.8	0.854967792	0.610640551
6097: RAMP STEPHANI I215 E (20213)	657	671.9	14.9	2.267884323	0.578036304
13477: RAMP US95S I215E (24924)	664	678.4	14.4	2.168674699	0.555823005
5941: RAMP LK MEAD US95 N (15426)	787	799.6	12.6	1.601016518	0.447354508
6016: RAMP VA VERDE I215 E (18806)	446	438	-8	1.793721973	0.380521195
6726: RAMP SUNSET US95 S (8740)	375	380.2	5.2	1.386666667	0.267600765
17002: RAMP I215 W GIBSON (24913)	553	547.7	-5.3	0.95840868	0.225920887
13544: RAMP W GALLER US95 S (24991)	364	368.1	4.1	1.126373626	0.214295796
6191: RAMP US95 E I 215 (12253)	1451	1444.9	-6.1	0.420399724	0.160307209
16075: RAMP GIBSON I215 E (32344)	527	528	1	0.189753321	0.043540034
6206: RAMP HORIZON US95N (9774)	1921	1922.9	1.9	0.098906819	0.043339366
5961: I 215 (20216)	5474	5476.5	2.5	0.045670442	0.033786098
Sum	47247	48311.6	-1064.6	97.75%	4.870421753

Section Volume Comparison

8:00 to 9:00 AM					
Object	**Count**	**Model**	**Absolute Difference**	**Relative Difference (%)**	**GEH**
13472: RAMP I215 W GIBSON (24914)	677	751.2	74.2	10.96011817	2.776670772
13551: RAMP AUTO SHO US95 S (24996)	224	267.4	43.4	19.375	2.768771725
6726: RAMP SUNSET US95 S (8740)	436	383.9	-52.1	11.94954128	2.573192506
6191: RAMP US95 E I 215 (12253)	1068	1124.6	56.6	5.299625468	1.709431585
5937: RAMP I215 W US95 S (24919)	73	60.9	-12.1	16.57534247	1.478802172
6192: RAMP US95 N I215 W (24916)	1063	1016.4	-46.6	4.383819379	1.445213117
5948: RAMP STEPHANI I215 W (20215)	1134	1167.7	33.7	2.971781305	0.993391729
16075: RAMP GIBSON I215 E (32344)	408	428.3	20.3	4.975490196	0.992727351
13544: RAMP W GALLER US95 S (24991)	272	287.5	15.5	5.698529412	0.926715977
6727: RAMP SUNSET US95 N (8611)	563	541.7	-21.3	3.78330373	0.906300927
356271: RAMP S US95 AUTO SHO (21737)	516	497.7	-18.3	3.546511628	0.812851786
16078: RAMP I215E US95 (32349)	1758	1724.4	-33.6	1.911262799	0.805220732
356267: RAMP US95 N SUNSET (8807)	599	580.2	-18.8	3.138564274	0.774246252
13549: RAMP AUTO SHO US95 N (24994)	278	266	-12	4.316546763	0.727606875
5982: I 215 (20221)	5875	5826.9	-48.1	0.818723404	0.628828017
356272: RAMP US95 N AUTO SHO (24995)	263	272.2	9.2	3.498098859	0.562399302
5961: I 215 (20216)	5237	5197.3	-39.7	0.758067596	0.549634323
6190: RAMP E I 215 US95 S (32347)	3204	3173.9	-30.1	0.939450687	0.533018939
6164: RAMP US95N HORIZON (9842)	193	186.6	-6.4	3.316062176	0.464549364
18244: RAMP US95S HORIZON (9771)	859	845.9	-13.1	1.525029104	0.448680131
11194: I 215 (22244)	4452	4481	29	0.651392633	0.433924657
17002: RAMP I215 W GIBSON (24913)	397	388.7	-8.3	2.090680101	0.41875954
13478: RAMP US95 S I215 W (24925)	1659	1673	14	0.843881857	0.34299717
356194: RAMP I215 W VA VERDE (18802)	407	413.2	6.2	1.523341523	0.306158841
16985: US 95 (35378)	2143	2153	10	0.466635558	0.215765926
13477: RAMP US95S I215E (24924)	593	588.1	-4.9	0.826306914	0.201635847
356263: RAMP US95 S SUNSET (8587)	609	604.3	-4.7	0.771756979	0.190822138
356214: RAMP I125 W STEPHANI (20214)	690	694.9	4.9	0.710144928	0.186209516
6097: RAMP STEPHANI I215 E (20213)	630	634.6	4.6	0.73015873	0.182934762
356240: RAMP US95 N E GALLER (24987)	253	250.4	-2.6	1.027667984	0.163882183
6016: RAMP VA VERDE I215 E (18806)	421	424	3	0.712589074	0.145951277
6206: RAMP HORIZON US95N (9774)	1552	1555.2	3.2	0.206185567	0.081185856
17161: RAMP I215 E GIBSON (24911)	733	730.9	-2.1	0.286493861	0.077620884
5941: RAMP LK MEAD US95 N (15426)	639	637.2	-1.8	0.281690141	0.071257098
13479: US 95 (24926)	3348	3348.7	0.7	0.020908005	0.012097137
Sum	43226	43177.9	48.1	99.89%	0.23141601

Section Volume Comparison

4:00 to 5:00 PM					
Object	Count	Model	Absolute Difference	Relative Difference (%)	GEH
356272: RAMP US95 N AUTO SHO (24995)	188	266.7	78.7	41.86170213	5.219480184
18244: RAMP US95S HORIZON (9771)	1750	1969.6	219.6	12.54857143	5.092126853
13478: RAMP US95 S I215 W (24925)	2038	2194.9	156.9	7.698724239	3.410506936
5982: I 215 (20221)	6428	6678.8	250.8	3.901680149	3.098091169
356240: RAMP US95 N E GALLER (24987)	442	500	58	13.12217195	2.67249893
13479: US 95 (24926)	4210	4379.4	169.4	4.023752969	2.584919304
6191: RAMP US95 E I 215 (12253)	1208	1296.6	88.6	7.334437086	2.503684102
5961: I 215 (20216)	6794	6598.5	-195.5	2.877539005	2.389081317
356214: RAMP I125 W STEPHANI (20214)	786	851.1	65.1	8.282442748	2.275403292
356194: RAMP I215 W VA VERDE (18802)	637	693.8	56.8	8.916797488	2.201947385
6190: RAMP E I 215 US95 S (32347)	3971	3839.1	-131.9	3.321581466	2.110724232
17002: RAMP I215 W GIBSON (24913)	517	561.7	44.7	8.646034816	1.924740486
6192: RAMP US95 N I215 W (24916)	1069	1122.4	53.4	4.995322732	1.613226793
13472: RAMP I215 W GIBSON (24914)	862	903.1	41.1	4.767981439	1.383477697
6726: RAMP SUNSET US95 S (8740)	884	846.1	-37.9	4.287330317	1.288601417
16985: US 95 (35378)	2392	2453.3	61.3	2.56270903	1.245417995
16078: RAMP I215E US95 (32349)	1942	1894.4	-47.6	2.451081359	1.086825975
13551: RAMP AUTO SHO US95 S (24996)	364	381.8	17.8	4.89010989	0.921772634
5941: RAMP LK MEAD US95 N (15426)	668	690.9	22.9	3.428143713	0.878530272
356263: RAMP US95 S SUNSET (8587)	820	796.8	-23.2	2.829268293	0.815971204
13549: RAMP AUTO SHO US95 N (24994)	586	567.7	-18.3	3.122866894	0.761938013
356267: RAMP US95 N SUNSET (8807)	770	790.8	20.8	2.701298701	0.744568578
13477: RAMP US95S I215E (24924)	906	928.5	22.5	2.483443709	0.742914197
6165: RAMP HORZON US95 S (9844)	234	227	-7	2.991452991	0.461065445
13544: RAMP W GALLER US95 S (24991)	480	488.7	8.7	1.8125	0.395311638
5948: RAMP STEPHANI I215 W (20215)	1277	1290.3	13.3	1.041503524	0.371217403
5937: RAMP I215 W US95 S (24919)	137	140.9	3.9	2.846715328	0.330853194
6097: RAMP STEPHANI I215 E (20213)	733	741.7	8.7	1.186903138	0.320392551
356271: RAMP S US95 AUTO SHO (21737)	547	553.5	6.5	1.188299817	0.277097962
17161: RAMP I215 E GIBSON (24911)	827	820.4	-6.6	0.798065296	0.229963761
6164: RAMP US95N HORIZON (9842)	187	184	-3	1.604278075	0.220266929
6016: RAMP VA VERDE I215 E (18806)	395	398.6	3.6	0.911392405	0.180724349
16075: RAMP GIBSON I215 E (32344)	416	418.9	2.9	0.697115385	0.141937047
6727: RAMP SUNSET US95 N (8611)	918	921.3	3.3	0.359477124	0.108818479
6206: RAMP HORIZON US95N (9774)	1097	1098.4	1.4	0.127620784	0.042255788
356207: RAMP I215 E STEPHANI (20212)	1246	1244.9	-1.1	0.088282504	0.031169479
Sum	48726	49734.6	-1008.6	97.93%	4.545720434

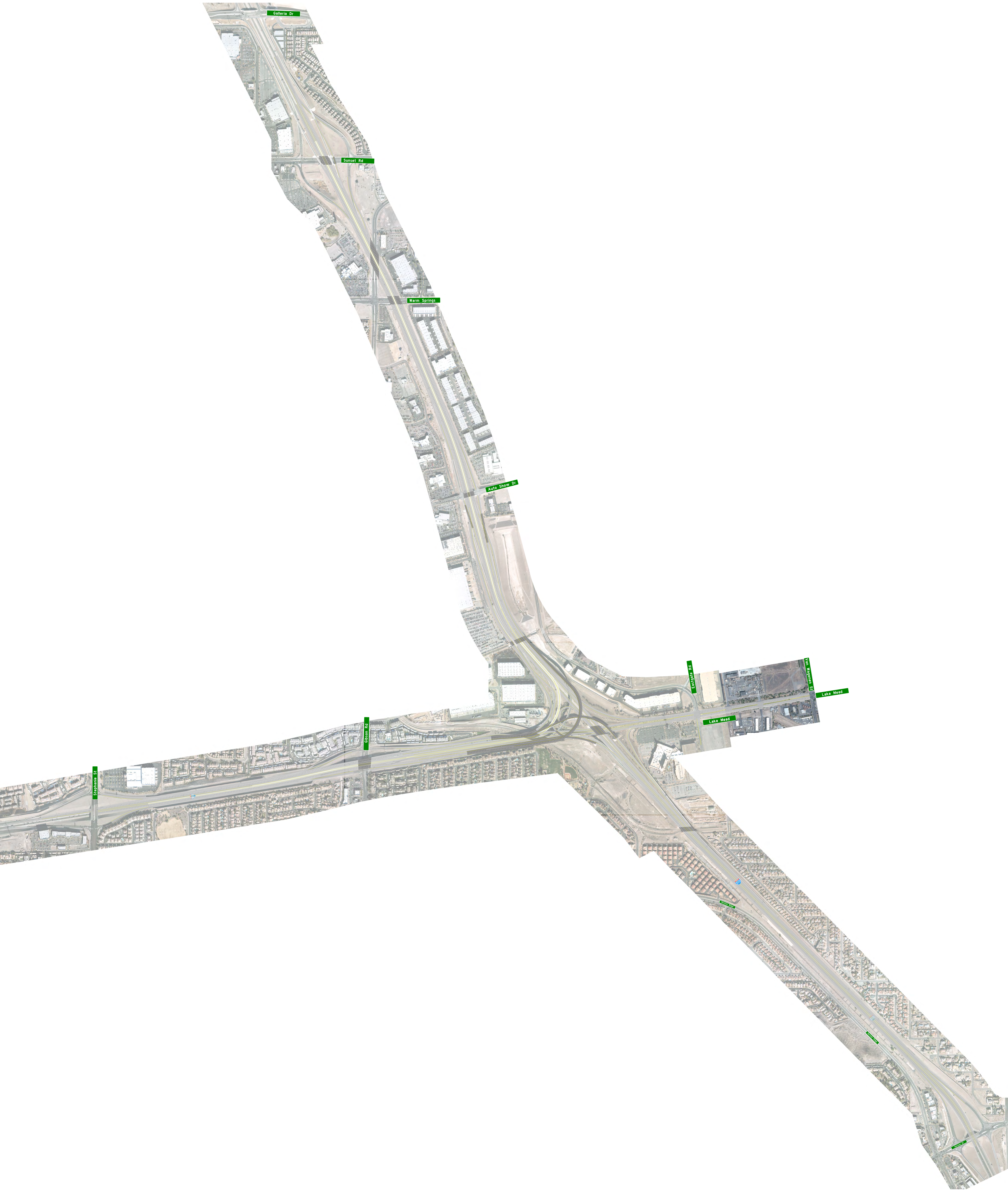
Section Volume Comparison

5:00 to 6:00 PM					
Object	Count	Model	Absolute Difference	Relative Difference (%)	GEH
356272: RAMP US95 N AUTO SHO (24995)	240	276.6	36.6	15.25	2.277292848
356271: RAMP S US95 AUTO SHO (21737)	514	482.7	-31.3	6.089494163	1.402093921
16078: RAMP I215E US95 (32349)	1942	1882	-60	3.089598352	1.372168061
13549: RAMP AUTO SHO US95 N (24994)	546	518.6	-27.4	5.018315018	1.187605854
16075: RAMP GIBSON I215 E (32344)	367	387.4	20.4	5.558583106	1.050374876
16985: US 95 (35378)	2410	2453.4	43.4	1.800829876	0.880105494
356263: RAMP US95 S SUNSET (8587)	745	726.5	-18.5	2.483221477	0.682034892
356214: RAMP I125 W STEPHANI (20214)	737	719.7	-17.3	2.347354138	0.641026584
6097: RAMP STEPHANI I215 E (20213)	727	744	17	2.338376891	0.626841271
5961: I 215 (20216)	6648	6697.1	49.1	0.73856799	0.601084562
5982: I 215 (20221)	6178	6131.6	-46.4	0.75105212	0.591440429
6192: RAMP US95 N I215 W (24916)	1030	1012.1	-17.9	1.737864078	0.560182485
6016: RAMP VA VERDE I215 E (18806)	400	410.3	10.3	2.575	0.511716361
356267: RAMP US95 N SUNSET (8807)	750	763.2	13.2	1.76	0.479888964
13551: RAMP AUTO SHO US95 S (24996)	448	458.2	10.2	2.276785714	0.479184918
5948: RAMP STEPHANI I215 W (20215)	1288	1304.7	16.7	1.296583851	0.463826262
17161: RAMP I215 E GIBSON (24911)	858	871.5	13.5	1.573426573	0.459080116
6164: RAMP US95N HORIZON (9842)	187	193.1	6.1	3.262032086	0.442482295
13478: RAMP US95 S I215 W (24925)	2005	2021.8	16.8	0.837905237	0.37440725
6726: RAMP SUNSET US95 S (8740)	835	824.3	-10.7	1.281437126	0.371480754
356207: RAMP I215 E STEPHANI (20212)	1304	1315.3	11.3	0.866564417	0.31224883
5937: RAMP I215 W US95 S (24919)	120	123.4	3.4	2.833333333	0.308200705
6191: RAMP US95 E I 215 (12253)	1155	1145	-10	0.865800866	0.294883912
13479: US 95 (24926)	4496	4513.4	17.4	0.387010676	0.259248535
13477: RAMP US95S I215E (24924)	1096	1087.8	-8.2	0.748175182	0.248154651
6165: RAMP HORZON US95 S (9844)	306	310	4	1.307189542	0.227921153
6206: RAMP HORIZON US95N (9774)	1126	1118.6	-7.4	0.657193606	0.220890602
356194: RAMP I215 W VA VERDE (18802)	628	633	5	0.796178344	0.199125766
356240: RAMP US95 N E GALLER (24987)	454	451.1	-2.9	0.63876652	0.136321612
6727: RAMP SUNSET US95 N (8611)	771	774.6	3.6	0.46692607	0.129499754
17002: RAMP I215 W GIBSON (24913)	555	557.6	2.6	0.468468468	0.110234825
13544: RAMP W GALLER US95 S (24991)	436	438.2	2.2	0.504587156	0.105228233
6190: RAMP E I 215 US95 S (32347)	4074	4078.8	4.8	0.117820324	0.07518009
18244: RAMP US95S HORIZON (9771)	1845	1847.7	2.7	0.146341463	0.062835742
5941: RAMP LK MEAD US95 N (15426)	679	679.9	0.9	0.132547865	0.034527391
13472: RAMP I215 W GIBSON (24914)	859	858.8	-0.2	0.023282887	0.006824309
Sum	48759	48812	-53	99.89%	0.239955379

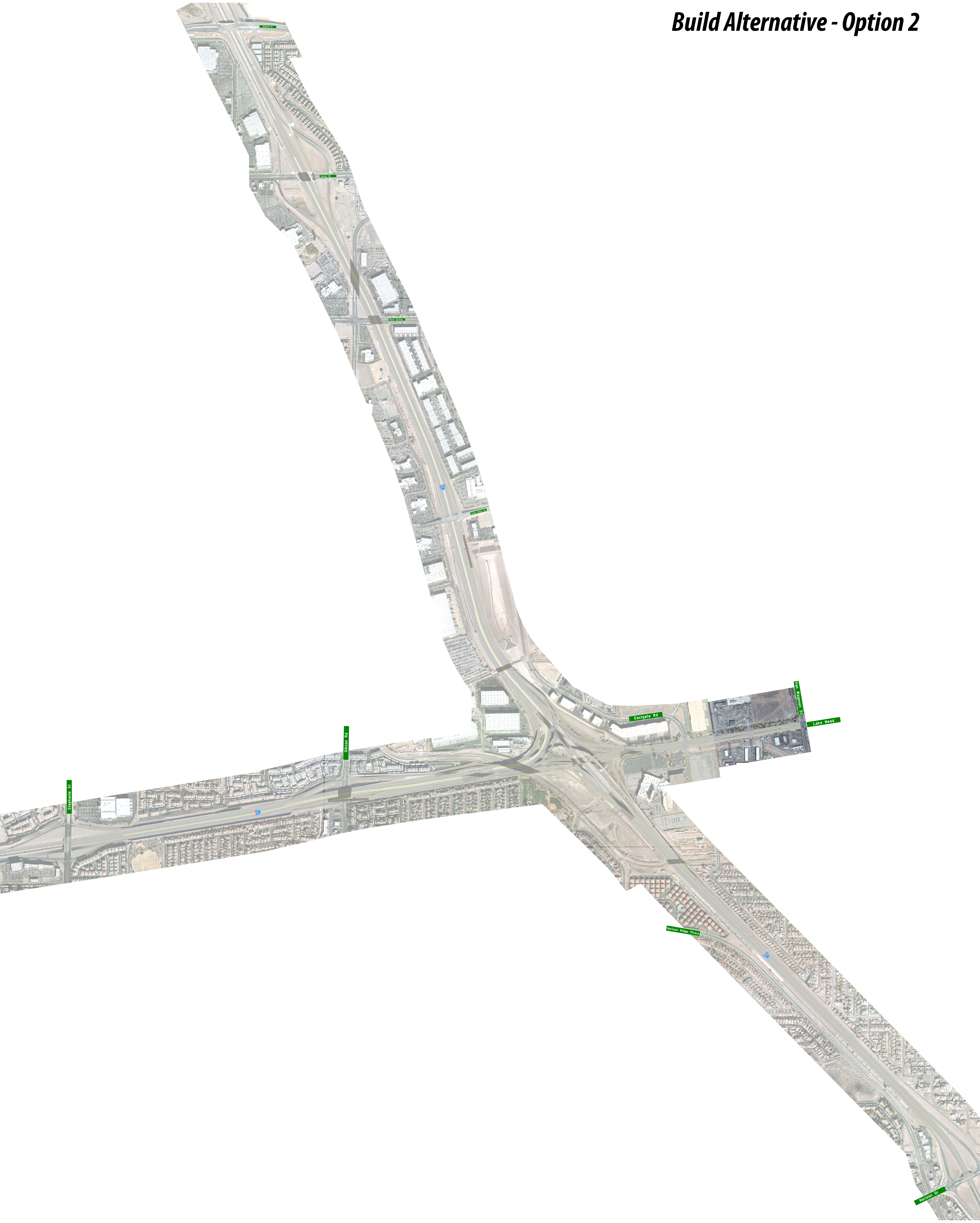
Appendix E

Schematics of the Build Alternative Options modeled in Aimsun Next

Build Alternative - Option 1



Build Alternative - Option 2



Appendix F

NDOT SNTS’ 2040 Micro/Meso Future Volume Development Technical Memorandum

2040 Micro/Meso Future Volume Development Technical Memorandum

September 2018

2040 Micro/Meso Future Volume Development Technical Memorandum

for

Southern Nevada Traffic Study

Prepared for:

Prepared by:

September 2018

Contents

Figures

INTRODUCTION

This document outlines the approach used to develop 2040 future traffic volumes for the Southern Nevada Traffic Study (SNTS), using standard methodologies to adjust the demand matrices outside of the Aimsun and TransCAD software packages. Input demand data sets were based on the Regional Transportation Commission of Southern Nevada's (RTCSNV) TransCAD travel demand model. Traffic counts collected in the field were used to create calibrated base year 2017 ("adjusted") traffic volumes for the study. This document describes the methodology used to apply the growth patterns forecasted by the RTCSNV TransCAD model to the calibrated 2017 adjusted matrix to develop a refined or "adjusted" 2040 set of traffic forecast volumes.

This document also provides an overview of why these methodologies were necessary and the benefits of the methodology selected.

2040 MICRO/MESO FUTURE VOLUME DEVELOPMENT

2040 "No-Build" macro-level future volume matrices were created using TransCAD and imported into Aimsun Next in the same manner as the 2017 matrices (as described in section 4.3 of the *2017 Aimsun Next Model Development and Calibration Report*). The macro-level TransCAD assignment volumes provided an initial demand set. However, it is standard industry practice to post-process travel demand model demand matrices by referencing observed field traffic counts in the base year. These post-processing adjustments are applied in the future year to produce refined traffic forecasts that are suitable for micro/meso analysis. The Aimsun software was not capable of providing these refined/post-processed demand sets. Thus, a methodology was developed that utilized the calibrated/adjusted 2017 traffic flows and the unique forecasted traffic patterns from the TransCAD model for the SNTS study area to establish refined/adjusted 2040 traffic volume forecasts.

The process of creating individual calibrated 2017 subnetwork matrices (as outlined in section 4.3 of the *2017 Aimsun Next Model Development and Calibration Report*) required a combination of creating subnetwork traversals and origin-destination (O-D) matrix adjustments. However, a new process was required to develop refined forecasts of 2040 future volume matrices.

Two methods were tested for development of the refined 2040 future volume matrices. The terms defined below are used in the discussion of the two methods.

- 2017 Unadjusted—A matrix that represents the subnetwork 2-hour O-D traversals that were created based on the full network 2017 TransCAD assignment using Aimsun Next static assignment process. These reflect "unadjusted" matrices as the full network matrices were taken directly from TransCAD output.
- 2017 Adjusted—A matrix that represents the product of O-D adjustments at the subnetwork level. The matrices were "adjusted" through an O-D matrix estimation (ODME) approach that refines individual O-D volume pairs to better fit observed traffic counts on subnetwork turns and sections.
- 2040 Unadjusted—A matrix that represents the subnetwork 2-hour O-D traversals (similar to the 2017 Unadjusted), that were generated based on the full network 2040 TransCAD assignment volumes. The

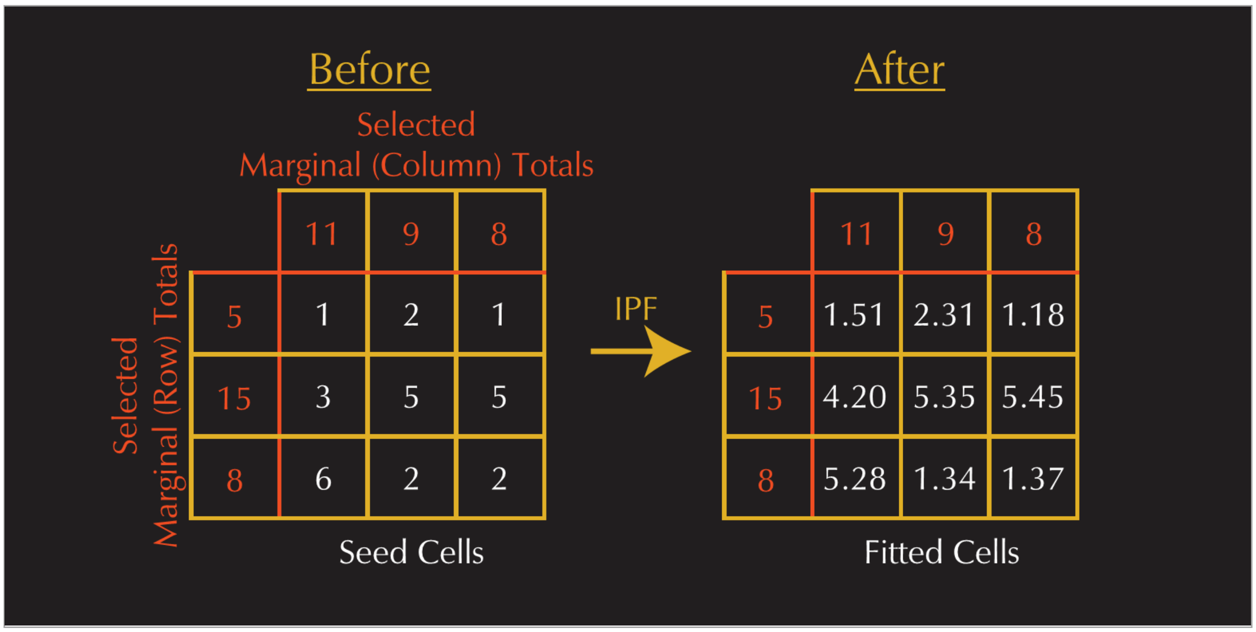
development of these matrices was created by running traversals of specific subnetworks based on the 2040 TransCAD full network matrices. No O-D adjustments were ran on “Unadjusted” matrices.

- 2040 Adjusted—A matrix that represents the refined “finished product” that was the result of applying the preferred matrix growth methodology detailed below.

Iterative Proportional Fitting Method

Sometimes referred to as the ‘Raking’ method, the Iterative Proportional Fitting (IPF) Method is an iterative procedure for adjusting a table of data cells such that they add up to the selected totals for both the columns and rows of the table. The unadjusted values in each data cell are referred to as the ‘seeds’ and the selected totals are referred to as the ‘marginal’ totals. Figure 1 shows an example of what the IPF Method looks like before and after application to a matrix.

Figure 1. Example of IPF Application



As illustrated in Figure 1, the row and column totals of the seeds from the “Before” matrix seed cells do not match the desired “selected” column and row marginal totals. The IPF Method adjusts the individual cell values, using the seeds as the starting point, until all row and column sums are equal to, or are as close as possible to, the desired marginal totals.

In the case of the SNTS study, the “Before” matrix was the 2017 unadjusted matrix and the “After” matrix was the 2017 adjusted matrix. A flow chart of how the IPF Method was applied to the SNTS study is presented in Figure 2.

Figure 2. Illustration of Potential IPF Approach Framework for the SNTS Study

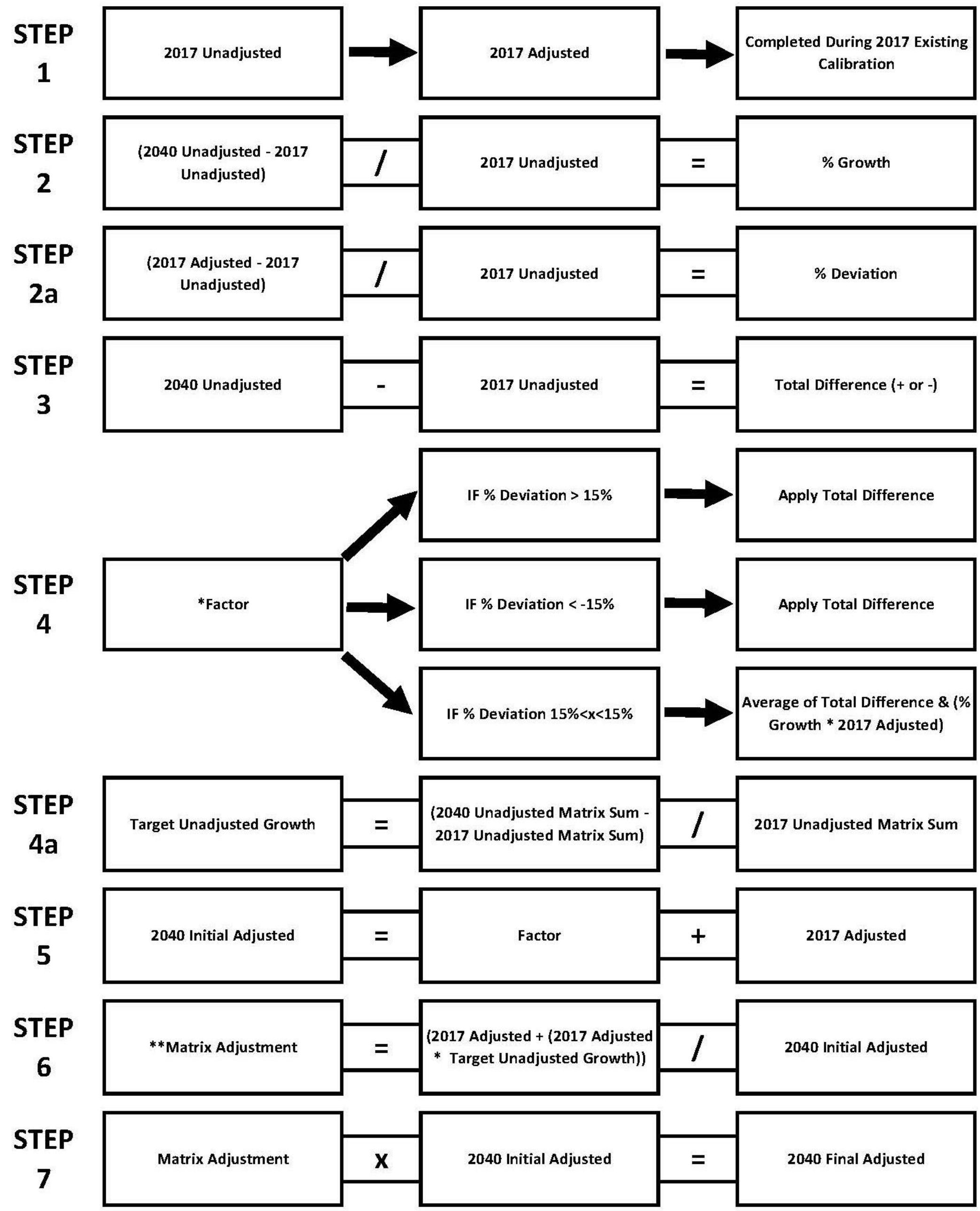
STEP 1	2017 Unadjusted	→	2017 Adjusted	→	Completed During 2017 Existing Calibration
STEP 2	2040 Unadjusted	-	2017 Unadjusted	=	2040 Marginal Growth
STEP 3	2017 Adjusted	+	2040 Marginal Growth	=	2040 Target Origins & Destinations
STEP 4	Run Iterative Proportional Fitting (IPF)	→	2017 Adjusted Seed + 2040 Target Origins & Destinations	→	Continue iterative process until convergence is hit. (test was done at 100 iterations and 10% delta (cell changes)

The IPF is a methodology that has been used in travel modeling for many years, and the results of the IPF Method are acceptable and reasonable at the macro level. The IPF methodology focuses on the “margin” for its growth-factoring approach, meaning that, it applies a growth factor according to the growth of all origins or destinations for that zone. It does not focus on the individual zone-to-zone growth patterns reflected between the 2017 and 2040 Unadjusted matrices. When applied for the SNTS study area, the IPF Method application provided a set of matrices that were passable. However, this method did not result in an optimal match when comparing the total growth rates of the 2040 Adjusted to 2017 Adjusted matrices. Because of the methodological issue identified above, and the imprecision of the IPF application results, a zone-to-zone growth percentage, or “Pivot-Point” Method, was tested and applied.

Pivot-Point Method

The modified Pivot-Point Method established an enhanced base-year matrix and then “pivots” off that enhanced base-year matrix based on unique zone-to-zone growth characteristics. The zone-to-zone change in tripmaking came from the RTCSNV regional model’s base year model and future year model unadjusted matrices. The technique takes advantage of the adjusted base year matrix, which was refined with available traffic counts, while maintaining the regional model’s zone-to-zone future tripmaking patterns and changes. In this case, the purpose is to “pivot” from a fixed base year matrix (the 2017 Adjusted matrix) by adjusting individual cells of the matrix according to unique levels of growth identified by the TransCAD unadjusted matrices for 2017 and 2040. A flow chart of the modified Pivot-Point Method is presented in Figure 3.

Figure 3. Potential Pivot-Point Approach Framework for the SNTS Study



*15% threshold for deviation between base year unadjusted and adjusted
**Matrix Adjustment applied to each individual OD pair

All calculations are performed for each OD pair (individual cell)

The modified Pivot-Point Method combines elements of absolute (or additive) matrix adjustments and relative (or multiplicative) matrix adjustments. In instances where there were large matrix corrections between the 2017 Unadjusted and Adjusted matrices, there can be a tendency for a purely relative/multiplicative factor to skew growth unreasonably high. The following is a hypothetical situation for a single matrix cell between two zones i and j (also called an “i-j pair”):

- The TransCAD model estimates only 1 trip between zones i and j for 2017 (this is the 2017 Unadjusted matrix value).
- Based on observed data, the adjusted matrix indicates 100 trips between zones i and j for 2017 (this is the 2017 Adjusted matrix value).
- The TransCAD model estimates 2 trips between zones i and j for 2040 (this is the 2040 Unadjusted matrix value).

In this case, because of high levels of base year deviation between unadjusted and adjusted, using a relative/multiplicative factor would indicate 200 trips between zones i and j for 2040 (because of the growth factor of 2.0—1 trip in 2017 doubled to 2 trips in 2040).

For this reason, a 15 percent threshold was applied for use of a relative/multiplicative factor for creating the 2040 Adjusted matrix. Thus, in developing the unique 2040 Adjusted matrix cell values:

- For all i-j pairs where the 2017 Unadjusted and Adjusted values deviated by more than 15 percent, only an absolute trip adjustment was applied to the 2040 Unadjusted matrix. This means, in the example above, instead of doubling the number of 2017 Adjusted trips (100 trips in 2017 x 2.0 = 200 trips in 2040), the Pivot-Point Method would add 1 trip (100 trips in 2017 + 1 new trip = 101 trips in 2040).
- For all i-j pairs where the 2017 Unadjusted and Adjusted values deviate by 15 percent or less, the average of the absolute (using addition) and relative (using multiplication) trip corrections was applied to the 2040 Unadjusted matrix.

This is similar to a link-based forecasting methodology applied in NCHRP 255 (now updated as NCHRP 765).

The calculations described in Figure 3 are performed for each i-j pair of the matrix. An example of the modified Pivot-Point Method is presented in Figure 4.

Figure 4. Example of Pivot-Point Approach Methodology

Unadjusted TransCAD Volumes

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50									
Example 2	100	200	100%	100									

Absolute GROWTH in original TCAD model (2017 to 2040)

% GROWTH in original TCAD model (2017 to 2040)

Number of trips between origin and destination (O-D) pairs (2017 & 2040)

Change to 2017 Adjusted

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25						
Example 2	100	200	100%	100	110	10%	10						

Absolute DEVIATION in 2017 Unadjusted to 2017 Adjusted trips

% DEVIATION in 2017 Unadjusted to 2017 Adjusted trips

Adjusted 2017 trips between O-D pairs (based on observed counts)

2040 Adjusted Methods

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25	150	100				
Example 2	100	200	100%	100	110	10%	10	220	210				

% Growth Method: 110 + (110 * 100%) = 220

Absolute Growth Method: 110 + 100 = 210

2040 Adjusted Trips based on two methods: % Growth and Absolute Growth.

Initial 2040 Adjusted

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25						
Example 2	100	200	100%	100	110	10%	10						

Absolute DEVIATION in 2017 Unadjusted to 2017 Adjusted trips

% DEVIATION in 2017 Unadjusted to 2017 Adjusted trips

Adjusted 2017 trips between O-D pairs (based on observed counts)

Figure 4. Example of Pivot-Point Approach Methodology

Final 2040 Adjusted

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25	150	100	% Deviation > 15%, so ABSOLUTE GROWTH	100	-5%	95
Example 2	100	200	100%	100	110	10%	10	220	210	15% > % Deviation > -15%, so AVERAGE	215	-5%	204

Target adjustment is applied to all cells within a matrix and is based on the 2017 Unadjusted to 2040 Unadjusted matrix overall growth. The "-5%" is an example.

Note: Calculation for matrix target adjustment is **(2017adj + (2017adj * TargetGrowth)) / 2040adj INITIAL**

All Steps

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25	150	100	% Deviation > 15%, so ABSOLUTE GROWTH	100	-5%	95
Example 2	100	200	100%	100	110	10%	10	220	210	15% > % Deviation > -15%, so AVERAGE	215	-5%	204

CONCLUSION

Although both methods provide acceptable results, the Pivot-Point Method provided the best representation for 2040 No-Build volume matrices compared to the IPF Method.

The main benefit of the Pivot-Point Method is its ability to maintain the unique zone-to-zone growth patterns identified by the TransCAD model. In this respect, a negative aspect of the IPF Method is that, it implements a “margin-based” approach, where a single origin or destination factor is applied to all origins or destinations for each zone.

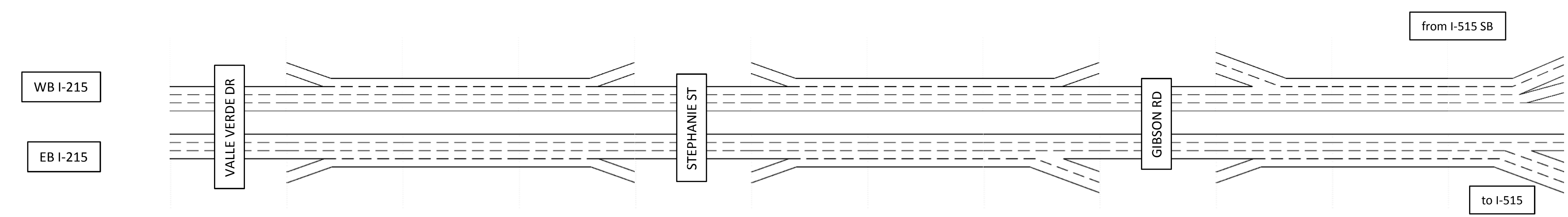
A second benefit of the Pivot-Point Method is its ability to employ a 15 percent deviation factor, which limits any multiplicative growth factors only to those matrix cells that have a good base year fit between the TransCAD model and observed counts. This eliminates the issue of a traffic movement having an unreasonably high multiplicative factor applied to it in situations where the model is under-estimating or over-estimating demand.

Appendix G

Future Year 2040 AADTs

Year 2040 No-Action Alternative

AADT (vpd)	92,500	8,800	101,000	24,500	77,000	12,500	87,000	14,500	74,000	10,000	84,500	32,000

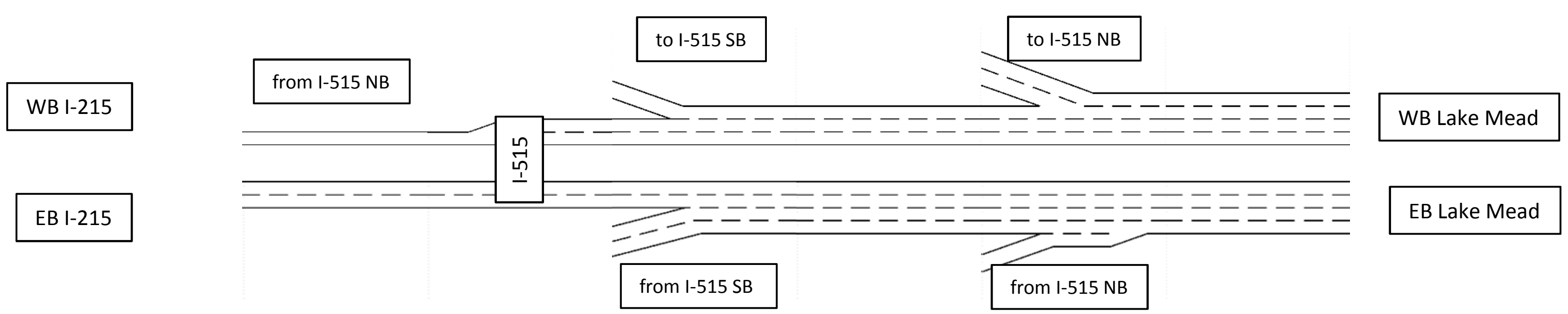


AADT (vpd)	94,000	8,800	103,000	17,500	85,500	16,500	102,000	14,000	88,000	9,500	93,500	77,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 No-Action Alternative

AADT	24,000	37,000	3,200	38,500	18,000	55,500

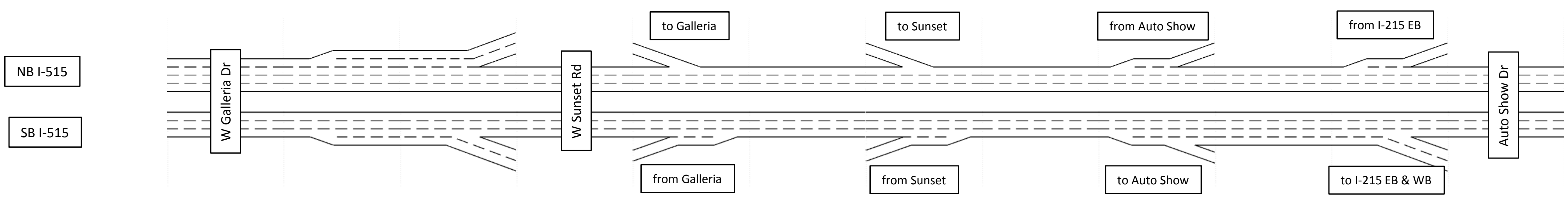


AADT		23,500	24,500	40,000	3,300	43,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 No-Action Alternative

AADT (vpd)	86,500	12,500	74,000	9,300	78,000	14,000	90,000	9,600	83,500	41,500	52,500

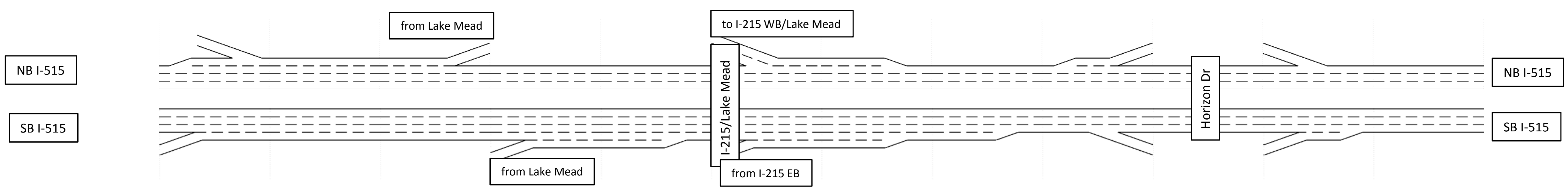


AADT (vpd)	81,000	11,500	69,500	5,800	74,500	14,000	82,000	9,900	72,000	49,500	24,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 No-Action Alternative

AADT (vpd)										
AADT (vpd)	6,800	57,000	18,000	39,000	27,500	49,500	25,000	35,000	5,100	40,000

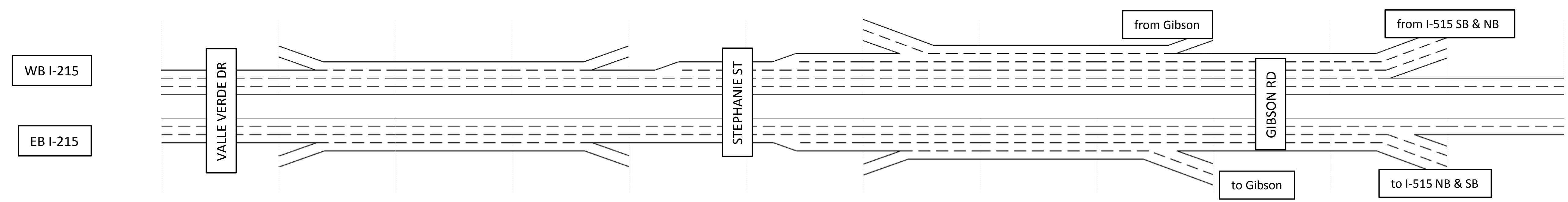


AADT (vpd)										
AADT (vpd)	6,500	29,500		3,200	30,500	36,500	71,500	32,500	39,000	5,200	44,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 Build Alternative Option 1 - Expanded Existing Configuration

AADT (vpd)	92,500	8,800	101,000	24,500	77,000	12,500	87,000	14,500	74,000	42,500	36,000

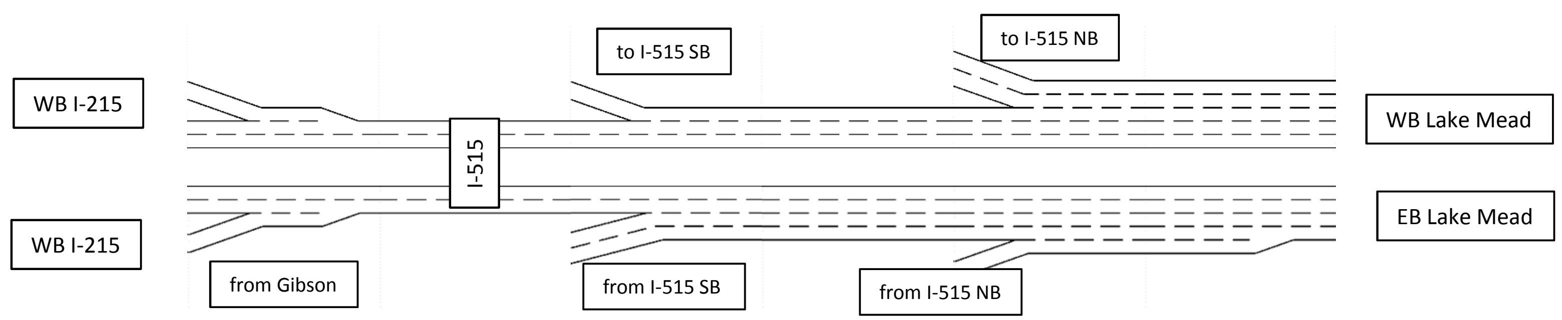


AADT (vpd)	94,000	8,800	103,000	17,500	85,500	16,500	102,000	14,000	88,000	73,000	22,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 Build Alternative Option 1 - Expanded Existing Configuration

AADT (vpd)	2,400	38,000	3,200	39,500	18,000	57,500

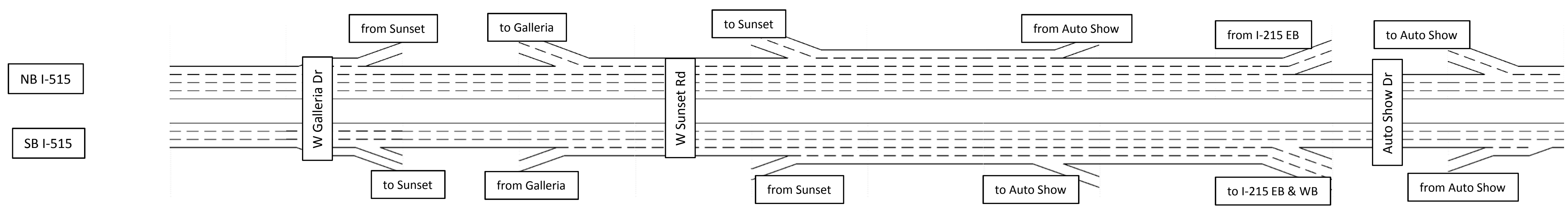


AADT (vpd)	1,300	23,500	24,500	41,500	3,300	44,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 Build Alternative Option 1 - Expanded Existing Configuration

AADT (vpd)	86,000	12,500	73,500	9,300	78,000	14,000	90,500	9,600	84,000	41,500	52,000	6,800

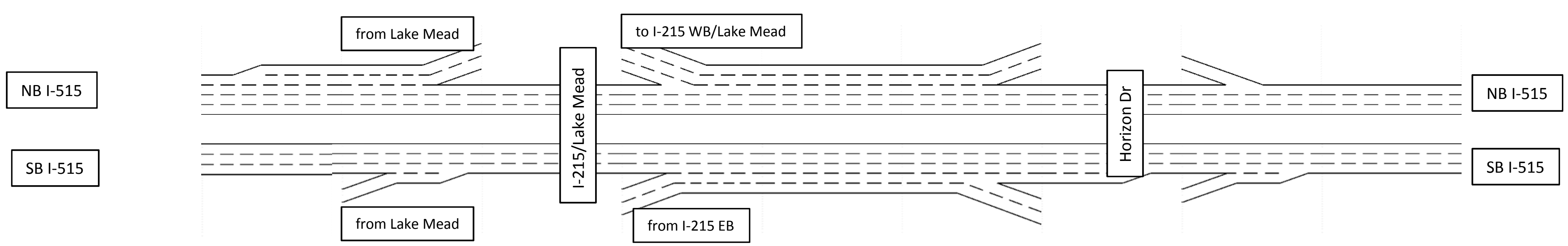


AADT (vpd)	81,000	11,500	69,500	5,800	74,000	14,000	82,500	10,000	72,000	49,500	22,000	6,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

Year 2040 Build Alternative Option 1 - Expanded Existing Configuration

AADT (vpd)	56,500	18,000	38,500	25,500	51,000	23,500	35,000	5,100	40,000

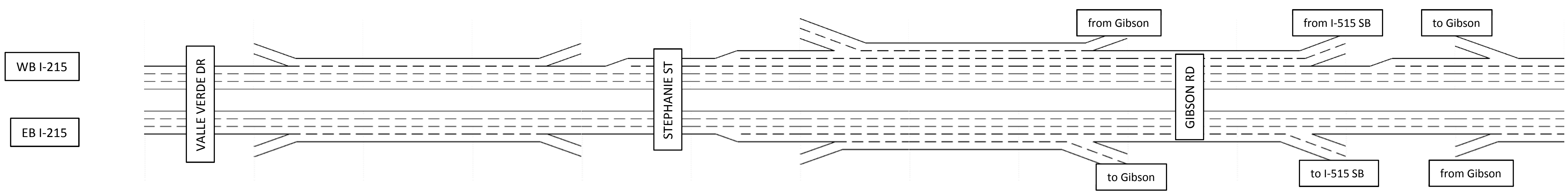


AADT (vpd)	27,000	3,200	28,000	36,500	72,000	32,500	39,000	5,200	44,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

2040 Build Alternative Option 2 - Double Diverging System Interchange

AADT (vpd)	92,500	8,800	101,000	24,500	77,000	12,500	87,000	14,500	74,000	25,000	56,500	3,800

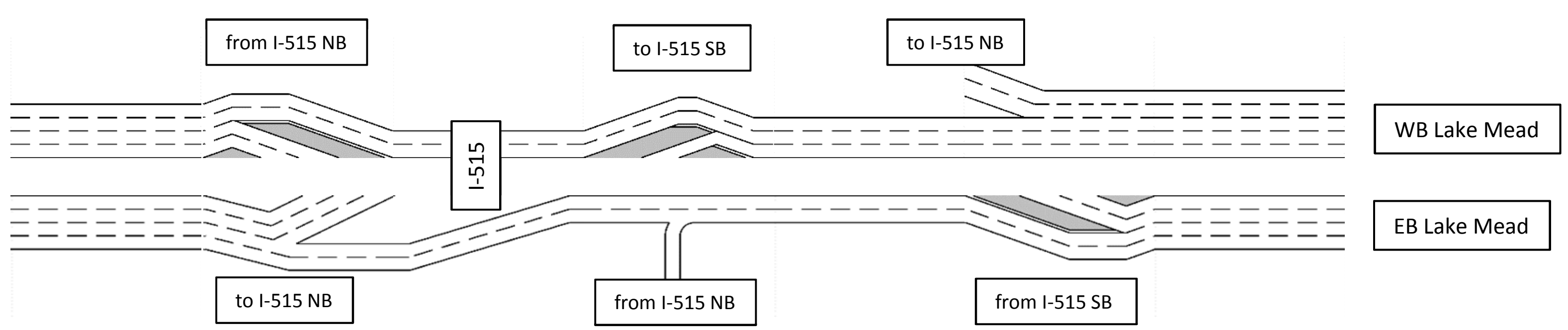


AADT (vpd)	94,000	8,800	103,000	17,500	85,500	16,500	102,000	14,000	88,000	34,500	53,500	9,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

2040 Build Alternative Option 2 - Double Diverging System Interchange

AADT (vpd)	60,500	22,500	38,000	3,200	39,500	17,500	57,000

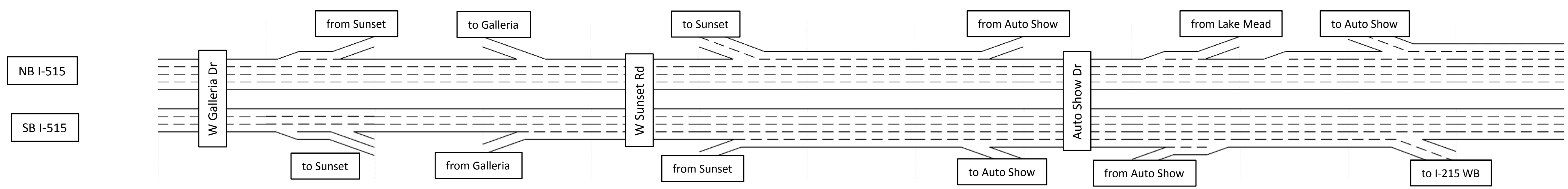


AADT (vpd)	58,000	42,500	23,500	3,300	26,500	25,000	45,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

2040 Build Alternative Option 2 - Double Diverging System Interchange

AADT (vpd)	86,000	12,500	73,500	9,300	78,000	13,500	90,000	9,500	83,500	17,500	66,500	7,300	65,500

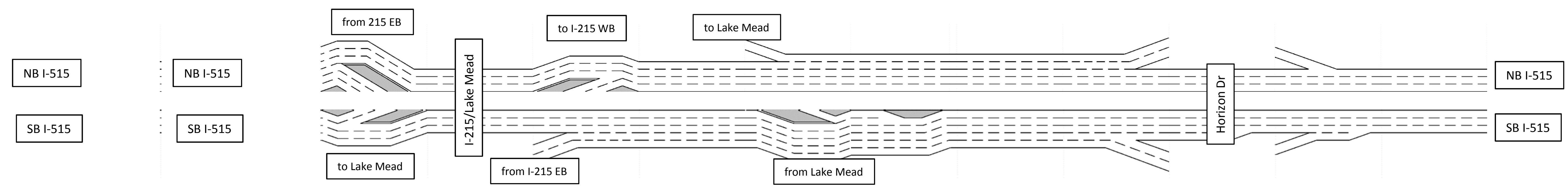


AADT (vpd)	81,000	11,500	69,500	5,800	74,500	13,500	82,000	9,900	72,000	6,700	77,000	32,000	56,500

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.

2040 Build Alternative Option 2 - Double Diverging System Interchange

AADT (vpd)	**AADT (vpd)**	42,500	39,000	22,500	46,000	3,300	49,500	24,000	35,000	5,100	40,000



AADT (vpd)	**AADT (vpd)**	25,000	26,500	36,500	68,000	3,200	71,000	32,500	39,000	5,200	44,000

Volumes are reported according to the rounding convention provided in the NDOT Traffic Forecasting Guidelines. Volumes along the corridor may not be balanced.