MEMORANDUM

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District Department of Transportation (DDOT)

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Subject: Benning Road Reconstruction and Streetcar Project
Existing Conditions (2019) Vissim Model Calibration Results Memorandum (Revision 2)

Introduction

This memorandum documents the Existing Conditions (2019) Vissim model calibration results for the Benning Road Reconstruction and Streetcar Project. The calibration process followed the agreed upon methodology documented in the *Forecasting and Traffic Operations Analysis Framework Document* (dated July 31, 2019) and based on guidance set forth in FHWA's *Traffic Analysis Toolbox Volume III* (2004).

Simulation Analysis Period Development

A network-wide representative peak hour (herein referred to as the "network peak hour") was determined for the AM peak (7:45 AM to 8:45 AM) and PM peak (5:00 PM to 6:00 PM). During these periods, the key corridors of the study network experience the worst traffic operations conditions, characterized by demand greater than capacity, constrained throughput volumes, and plateauing of corridor travel times. This concept is discussed further in the *Framework Document*.

As described in the *Framework Document*, peak volumes and travel times along Benning Road did not align with those on DC-295. To best serve the purpose and need of the project, the study team placed emphasis on the peak direction of Benning Road when selecting a network peak hour and Vissim analysis period. Table 1 summarizes the Vissim seeding, peak, and shoulder periods applied for each peak period of a typical weekday. Given that extensive congestion was observed on DC-295 during the data collection period, the study team utilized one-hour seeding and shoulder periods to allow adequate time for congestion to propagate and dissipate in the model.

Table 1: Vissim Simulation Periods

Time of Day	Vissim Seeding Period	Vissim Peak Period	Vissim Shoulder Period	Network Peak Hour
AM	6:00 AM to 7:00 AM	7:00 AM to 9:00 AM	9:00 AM to 10:00 AM	7:45 AM to 8:45 AM
PM	3:30 PM to 4:30 PM	4:30 PM to 6:30 PM	6:30 PM to 7:30 PM	5:00 PM to 6:00 PM

Simulation Network Development

Study Network Overview

Vissim 11 was used for a comprehensive traffic analysis performed within the study area limits shown in Figure 1. The freeway portion of the study network includes approximately three miles of DC-295, from just north of Pennsylvania Avenue SE to just south of US 50, and three interchanges – Nannie Helen Burroughs Avenue NE, Benning Road NE, and East Capitol Street. The arterial portion of the study network includes shorter segments of Deane Avenue NE, Nannie Helen Burroughs Avenue NE, Minnesota Avenue NE, and East Capitol Street, with a focus on the segment of Benning Road NE from 26th Street NE to East Capitol Street.

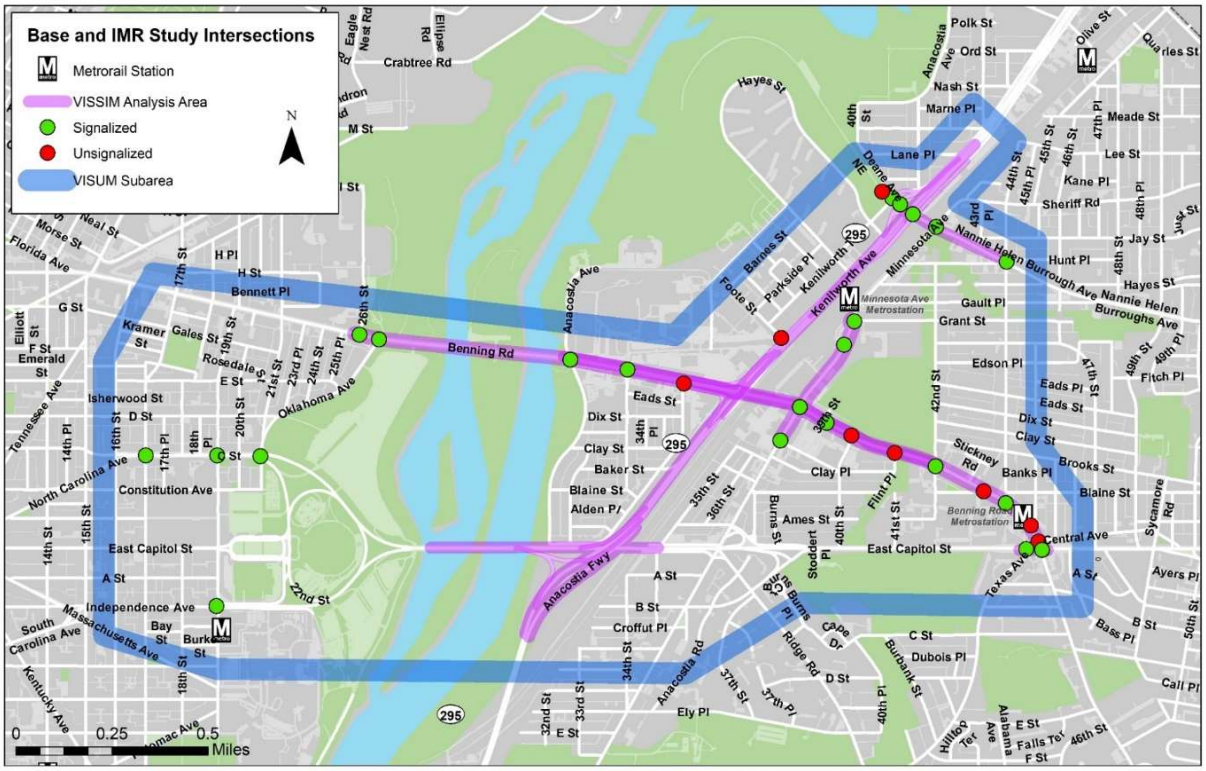


Figure 1: Project Study Area

Roadway Geometry

The Bing Maps interface within Vissim 11 was utilized to code network geometry with the following exceptions:

- The number of lanes or length of links at intersections and freeway ramps was modified where justified by field observations (e.g. a de facto right-turn lane was coded on northbound 44th Street NE at Nannie Helen Burroughs Avenue NE).
- Construction activity at the intersection of Benning Road NE and Minnesota Avenue NE required that lane assignment be modified from the typical existing geometry.
- Construction activity at the intersection of Benning Road NE and Minnesota Avenue NE required that lane closures be modeled in Vissim during the PM peak period.

Video footage from April 2, 2019 confirmed that the right lane was closed on eastbound Benning Road NE just downstream of the Minnesota Avenue intersection throughout the entire peak period, while the left-turn lane on northbound Minnesota Avenue was blocked by a construction vehicle until 5:00 PM. These conditions substantially constrained throughput and caused queueing on both approaches to the intersection. Though included as part of the calibration process, these lane closures will not be modeled during alternatives analysis.

Traffic Control

Key traffic control devices, such as traffic signals, stop signs, lane configurations, and speed limits were coded based on Synchro files provided by DDOT, Google Street View, and field observations. Traffic signal timing and phasing was verified through video footage and required modification in one location:

- The cycle length at the intersection of Benning Road NE and Minnesota Avenue NE during the AM and PM peak period was coded as 120 seconds in the provided Synchro files but observed as 150 seconds in the field.

Desired speed distributions in Vissim were initially coded based on roadway speed limits but modified as necessary based on supplemental probe data analyzed in Kimley-Horn's Traction application. Traction is a web interface developed by Kimley-Horn to assist in the collection and aggregation of travel time data, both field-collected and probe-based, and will be referenced periodically throughout the rest of this memorandum.

Vehicle Routing and Compositions

End-to-end vehicular routing was coded in Vissim through the process shown in Figure 2**.** Existing balanced volumes were developed as described in the *Framework Document* and combined with Location Services-based origin-destination (O-D) data from StreetLight to develop a seed O-D matrix. Existing balanced volumes were converted to target link and turning movement volumes to iteratively adjust this seed matrix in Visum 18 using the TFlowFuzzy origin-destination matrix estimation procedure. The resultant final O-D matrices were used to load one set of vehicle routes per peak period in Vissim, as travel patterns were found to not differ substantially between the start and finish of the AM and PM analysis periods. This consistency in O-D between the first and second halves of

the AM and PM peak periods are shown in Table 2 and Table 3, respectively. Derived from StreetLight data, these tables provide the percent difference in vehicular trips for major O-D pairs within the network. As shown, minimal differences exist, which supports the use of a single O-D matrix for the entire simulated peak period.

Table 2: Percent Difference in O-D Trips between first and second half of AM Peak Period

Origin/Destination Zone Names	DC-295 North of Deane Avenue NE	DC-295 South of E Capitol Street	Benning Road NE East of E Capitol Street	Benning Road NE West of 26th Street NE	All zones along Benning Road east of DC-295	All zones along Benning Road west of DC-295	Oklahoma Avenue
DC-295 North of Deane Avenue NE		-8.3%	0.2%	1.4%	0.3%	3.8%	1.9%
DC-295 South of E Capitol Street	-3.0%		0.0%	0.9%	1.2%	1.7%	0.0%
Benning Road NE East of E Capitol Street	2.4%	2.7%		1.8%	12.9%	1.8%	0.0%
Benning Road NE West of 26th Street NE	-1.5%	-1.8%	-0.3%		-0.5%	6.1%	3.7%
All zones along Benning Road east of DC-295	1.3%	4.3%	0.2%	-1.2%		0.1%	0.1%
All zones along Benning Road west of DC-295	1.1%	2.3%	0.3%	-2.0%	-9.6%		2.8%
Oklahoma Avenue	-6.3%	0.0%	0.0%	-5.4%	4.5%	-6.8%	

Table 3: Percent Difference in O-D Trips between first and second half of PM Peak Period

Origin/Destination Zone Names	DC-295 North of Deane Avenue NE	DC-295 South of E Capitol Street	Benning Road NE East of E Capitol Street	Benning Road NE West of 26th Street NE	All zones along Benning Road east of DC-295	All zones along Benning Road west of DC-295	Oklahoma Avenue
DC-295 North of Deane Avenue NE		-2.8%	0.0%	0.2%	-1.2%	0.0%	-0.1%
DC-295 South of E Capitol Street	-2.9%		0.0%	0.2%	0.5%	0.2%	0.0%
Benning Road NE East of E Capitol Street	-1.4%	0.5%		3.3%	1.3%	2.3%	-0.2%
Benning Road NE West of 26th Street NE	3.3%	1.2%	1.1%		-2.8%	-1.4%	-1.1%
All zones along Benning Road east of DC-295	1.0%	-1.5%	0.4%	0.1%		-0.7%	-0.2%
All zones along Benning Road west of DC-295	2.5%	1.8%	1.2%	-1.3%	-1.0%		-1.1%
Oklahoma Avenue	3.4%	-4.3%	0.1%	-1.5%	2.1%	-1.0%	

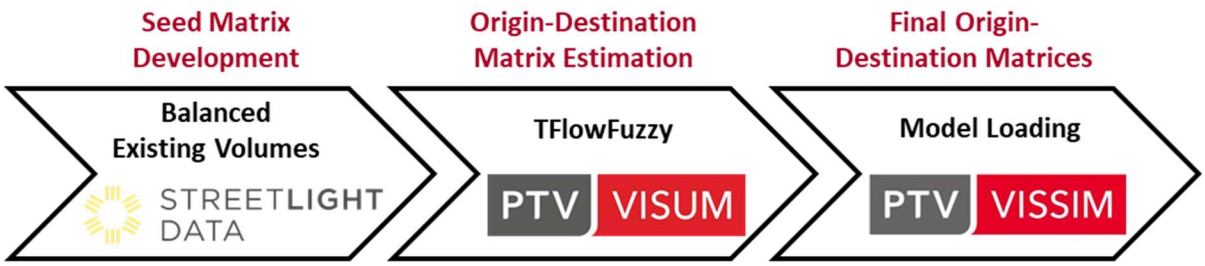


Figure 2: Vehicle Route Development Procedure

Three vehicle classes were assumed to sufficiently define the primary traffic stream and coded in Vissim: passenger cars, single unit trucks, and tractor-trailers. Separate vehicle compositions were coded for the freeway and arterials during each peak period based on vehicle classification data collected on mainline DC-295, interchange ramps, and arterial segments in the study area. Table 4 summarizes the vehicle compositions used in the AM and PM models. These vehicle compositions were developed from the 72-hour freeway, ramp, and arterial counts, as well as the intersection turning movement counts. In Vissim, Vehicle Compositions defined the percentage of passenger cars and trucks in the model, whereas the distribution of single unit trucks and tractor-trailers were accounted for in the 2D/3D Model Distributions.

Table 4: Vehicle Compositions Summary

Vehicle Class	Facility Type	Composition
Passenger Cars	Freeway	95.0% (AM) 98.3% (PM)
	Arterial	95.5% (AM) 97.3% (PM)
Single Unit Trucks	Freeway	4.7% (AM) 1.6% (PM)
	Arterial	4.2% (AM) 2.5% (PM)
Tractor-Trailers	Freeway	0.3% (AM) 0.1% (PM)
	Arterial	0.8% (AM) 0.2% (PM)

Public Transit

Transit vehicles (bus and streetcar) were coded separately using the Public Transport Lines tool in Vissim. Bus routes and stops in the Vissim network area were coded using posted maps and schedules. Routes included in the models are shown in Table 5. Bus stop dwell times were set using a normal distribution with a mean of 20 seconds and standard deviation of 10 seconds.

Table 5: Public Transit Route Summary

Operator	Bus Route
DDOT	DC Streetcar
Metrobus	X1, X2, X3, X9, V2, V4, V7, V8, U4, U5, U6, U7, 96

Pedestrian Mode

The magnitude of pedestrian and bicyclist activities was assessed at the intersections adjacent to Metrorail stations or existing streetcar stops and coded in Vissim accordingly. No dedicated bicycle facilities were included in the models.

Vissim Calibration Overview and Methodology

Purpose of Calibration

Microsimulation models are developed to assess the impacts of proposed improvement alternatives. However, to establish confidence in model outputs under future build and no-build scenarios, it is critical that a model is capable of accurately replicating existing conditions. Calibration entails the adjustment of various input parameters to improve a model's ability to reproduce such conditions and associated measures of effectiveness (MOEs). Vissim contains a variety of adjustable parameters that support the calibration process, most notably those related to car-following and lane-changing.

Calibration Methodology and Targets

The Existing Conditions (2019) Vissim models were calibrated according to the guidelines presented in FHWA's *Traffic Analysis Toolbox* (TAT) *Volume III* (2004). Vehicle throughput, travel time, speed, and queue length were used as calibration MOEs. Since queue length calibration is not defined in FHWA's TAT, the Virginia Department of Transportation's (VDOT) *Traffic Operations and Safety Analysis Manual* (TOSAM) was referenced for queue length calibration guidance. Table 6 provides the calibration measures and targets. The critical locations for queue calibration are identified in Table 7.

Table 6: Vissim Calibration Criteria and Acceptance Targets

Simulated Measure	Calibration Threshold	Calibration Period
Simulated Traffic Volume – Individual Links (vehicles per hour) • **For mainline and interchange ramps, difference targets must be met for a minimum of 85% of mainline segments and ramps** • **At intersections, difference targets must be met for a minimum of 85% of approaches for the study intersections**	Within ± 100 vph for <700 vph Within ± 15% for ≥700 vph to <2,700 vph Within ± 400 for ≥2,700 vph	Peak Hour
Simulated Traffic Volume – Sum of All Link Flows	Within 5% of sum of all link counts	Peak Hour
Simulated Traffic Volume – GEH Statistic • **For mainline and interchange ramps, GEH statistic target must be met for a minimum of 85% of segments**	< 5 for individual link flows < 4 for sum of all link flows	Peak Hour
Simulated Average Link Speed (miles per hour)	Visually inspecting model speed heat map against INRIX or Google 15-minute average speed data for study corridor segments during the entire peak period and shoulder period	Peak Period + Shoulder Period
Simulated Travel Time (minutes)	Within ± 15% for average observed travel times of Benning Road and DC-295 study corridors	Peak Period
Visual Audits • **Bottleneck locations** • **Queuing impact at the identified critical locations that consist of ramps and intersection approaches**	Visually inspecting bottleneck locations using model speed heat map against INRIX or Google speed data as well as field-observed conditions Visually inspecting model queues against observed data to verify queues that have the potential of impacting: • Spillover to an adjacent intersection • Spillover from a turn lane • The mainline in the case of a signal or junction at the end of a ramp terminal	Peak Period + Shoulder Period

Table 7: Critical Locations for Bottleneck and Queue Verification

Location Type	Location Description
Intersection	All approaches at Benning Road NE/Minnesota Avenue NE
Intersection	All approaches at Benning Road NE/East Capitol Street
Intersection	Westbound left turn at Benning Road NE/Oklahoma Avenue NE
Mainline	All merge and weave areas on DC-295 at the study area interchanges
Mainline	AM/PM: Southbound DC-295 freeway basic segments throughout study area PM: Northbound DC-295 freeway basic segments throughout study area
Ramp	All ramps associated with the DC-295/Benning Road NE interchange

As mentioned previously, the intersection of Benning Road NE and Minnesota Avenue NE was under construction throughout the data collection period. In order to calibrate to observed data, network geometry and traffic conditions were modeled to reflect the current phase of construction, which included multiple lane closures. While it was necessary to use construction-constrained traffic volume data to reproduce the queue length, travel time, and throughput data collected in the field, the study team was informed of DDOT's concerns that calibrated behavior at this intersection may not be appropriate for application to subsequent model scenarios. As such, the following were considered during calibration:

- Calibration efforts were focused on system-wide measures, such as Benning Road NE end-to-end corridor travel times.
- The study team attempted to calibrate the model without adjusting arterial driving behavior or by applying the same changes to driving behavior throughout the entire network.
- Any construction-specific geometry and driving behavior changes at the intersection of Benning Road NE and Minnesota Avenue NE were coded with the intent to remove for subsequent model scenarios.

The study team engaged DDOT throughout the process, including an interim over-the-shoulder review conducted on August 14th, 2019.

Number of Model Runs

Since microsimulation models are stochastic and will produce unique results from run-to-run, multiple iterations must be conducted with different random seeds and post-processed to determine an "average" state of traffic operations in the study network. To obtain a statistically valid result, the number of runs necessary for the analysis were determined based on the methodology recommended in FHWA's TAT (2004) and the *Florida Traffic Analysis Handbook* (2014). The following MOEs were used as inputs to evaluate the sample size:

- End-to-end travel time in both directions on DC-295 and Benning Road NE.
- Traffic Volumes in both directions on Benning Road NE at Minnesota Avenue NE.

- Traffic Volumes in both directions on DC-295 between Benning Road NE and East Capitol Street.

Assuming a tolerable error of 10% of the mean for each MOE, desired confidence level of 95%, and nine degrees of freedom (degrees of freedom = trial number of runs - 1), the equation below was used to determine whether 10 simulation runs were sufficient.

$$n = \left(\frac{s * t_{(\alpha,df)}}{\mu * \varepsilon}\right)^2$$

N = required number of simulation runs

S = standard deviation of simulated MOE

μ = mean of simulated MOE

t = t-statistic

α = confidence level

df = degrees of freedom

ε = tolerable error

The results of this statistical analysis are presented in Table 8 and Table 9. As shown, ten simulation runs were deemed adequate for each of the seven MOEs in both Existing Conditions Vissim models.

Table 8: Sample Size Verification (AM Model MOEs)

Simulation Run Number (Random Seed Number)	NB DC-295 (Travel Time, min)	SB DC-295 (Travel Time, min)	EB Benning Road NE (Travel Time, min)	WB Benning Road NE (Travel Time, min)	Benning Road NE at Minnesota Avenue NE (Volume, veh)	NB DC-295 Between Benning Road NE and East Capitol Street (Volume, veh)	SB DC-295 Between Benning Road NE and East Capitol Street (Volume, veh)
1 (100)	3.4	18.8	7.6	9.2	2607	3200	3035
2 (110)	3.4	19.4	10.2	8.1	2547	3192	3066
3 (120)	3.4	19.0	9.5	10.1	2578	3154	3021
4 (130)	3.4	18.7	8.6	8.9	2582	3182	3089
5 (140)	3.4	19.0	8.8	12.6	2633	3162	2984
6 (150)	3.4	18.7	11.6	8.9	2646	3190	3049
7 (160)	3.4	19.0	9.5	10.1	2614	3160	3002
8 (170)	3.4	18.5	8.7	9.3	2617	3172	3041
9 (180)	3.4	18.5	8.7	9.7	2597	3169	3108
10 (190)	3.4	18.7	8.0	9.4	2599	3163	3043
Mean	3.4	18.8	9.1	9.6	2602	3174	3044
Standard Deviation	0.00	0.44	1.12	0.98	118	14	31
Tolerable Error	0.34	1.88	0.91	0.96	260	317	304
Calculated Number of Runs Required	0.0	0.3	7.7	5.3	1.1	0.0	0.1
10 Runs Sufficient?	YES	YES	YES	YES	YES	YES	YES

Table 9: Sample Size Verification (PM Model MOEs)

Simulation Run Number (Random Seed Number)	NB DC-295 (Travel Time, min)	SB DC-295 (Travel Time, min)	EB Benning Road NE (Travel Time, min)	WB Benning Road NE (Travel Time, min)	Benning Road NE at Minnesota Avenue NE (Volume, veh)	NB DC-295 Between Benning Road NE and East Capitol Street (Volume, veh)	SB DC-295 Between Benning Road NE and East Capitol Street (Volume, veh)
1 (100)	11.1	6.3	23.6	8.1	2068	3496	3105
2 (110)	12.0	6.9	19.9	8.3	2060	3513	3123
3 (120)	10.7	5.7	25.4	8.2	2061	3502	3105
4 (130)	10.7	6.1	22.6	8.0	2062	3499	3116
5 (140)	10.9	5.8	26.5	8.0	2118	3486	3102
6 (150)	11.8	6.5	27.9	8.0	2070	3502	3111
7 (160)	11.3	7.3	24.3	8.1	2006	3508	3113
8 (170)	11.4	5.8	24.5	8.1	2026	3482	3104
9 (180)	10.9	5.6	27.3	8.0	2056	3502	3122
10 (190)	11.2	5.5	25.6	7.9	2124	3513	3098
Mean	11.2	6.2	24.8	8.1	2065	3500	3110
Standard Deviation	0.42	0.57	2.24	0.11	34	10	8
Tolerable Error	1.15	0.63	2.10	0.82	211	350	311
Calculated Number of Runs Required	0.7	2.7	9.3	0.3	0.1	0.0	0.0
10 Runs Sufficient?	YES	YES	YES	YES	YES	YES	YES

Calibration Data

Traffic Throughput Volume

Existing traffic volumes were collected from April 2nd – 4th (arterials) and April 9th – 11th (freeway) and balanced as described in the *Framework Document.* These balanced volumes were used as targets during the calibration process.

Travel Time

Field travel time runs were conducted on April 2nd (arterials) and April 9th (freeway) and supplemented with crowdsourced probe data supplied by Google and analyzed in Kimley-Horn's Traction application. However, the following data challenge was encountered:

- An incident occurred on northbound DC-295 off-ramp to Benning Road during the AM peak period on April 9th, so all applicable northbound field travel time runs were deemed insufficient for model calibration (i.e. the travel time runs were not representative of typical traffic conditions).

Since the crowdsourced probe data provided a substantially larger sample size, the study team decided to use these data for freeway calibration targets based on crowdsourced probe data from April 9th – 11th. Arterial travel time targets were set based on field travel time data runs because field run data closely represents the impact from the specific construction activities on April 2nd.

Given the high variability observed in both sources of travel time data, the probe data was validated by ensuring that the average field travel time fell within the range of travel times observed in the probe data. This comparison is provided in Table 10 and confirms that the crowdsourced probe data were appropriate for use as calibration targets.

Table 10: Comparison of Field and Probe Travel Time Data

Travel Time Corridor	Average Field-Collected Travel Time (MM:SS)	Probe Travel Time Range (MM:SS)			
		Minimum	Maximum	Mean	Std. Dev.
NB DC-295 (AM Peak)	06:01	03:13	11:39	05:34	02:10
SB DC-295 (AM Peak)	14:48	14:46	20:43	18:10	01:34
NB DC-295 (PM Peak)	08:57	05:39	13:37	10:10	02:13
SB DC-295 (PM Peak)	04:18	03:39	06:54	04:52	01:03

** Only includes data from April 9th, 2019*

Calibration Parameters and Adjustments

Several calibration tools and strategies were used to reproduce the operational conditions described for each peak period later in this memorandum. These strategies used are summarized in the following sections.

Desired Speed Distributions and Reduced Speed Areas

Desired Speed Distributions – General: Vissim is loaded with default free flow speed distributions that are often sufficient for replicating speeds on a given roadway. While arterial speeds were replicated with this approach, it was determined that the variability in freeway speeds was not adequately captured by these simplified, linear distributions. As such, the range of desired speeds on the freeway was increased, with a greater probability assigned for drivers selecting a speed between 50mph and 60mph under free flow conditions. This increase in desired speed successfully allowed for a more realistic depiction of discretionary lane changes.

Reduced Speed Areas – General: Reduced speed areas were used to accurately model turning movements and replicate speeds on freeway ramps. When justified by field observations, turning speeds were increased or decreased slightly to better replicate throughput.

Reduced Speed Areas – Terminal Conditions: The study team determined that external bottlenecks cause congestion that impacts operations within the study network. Consequently, terminal speed conditions were developed to replicate this congestion (e.g. southbound DC-295 at Pennsylvania Avenue SE in the AM peak period and northbound DC-295 at US 50 in the PM peak period). These terminal speed conditions were coded using reduced speed areas set at 15-minute intervals with the intent of matching observed probe vehicle speed data.

Reduced Speed Areas – Seeding Conditions: Traffic volume patterns on DC-295 lead to congested conditions that begin prior to the simulation period during the AM and PM peak periods. To ensure that such congestion could be realized in the model prior to the collection of MOEs, reduced speed areas were coded during the first 30 minutes of the one hour seeding period to induce breakdown at known bottleneck locations and mimic the effects of the initial surge in demand not observed in the collected traffic count data. These reduced speed areas were deactivated for the second 30 minutes of the seeding period to ensure that traffic flow could stabilize before the analysis period.

Lane-Change Distances

One tool provided to a modeler during calibration is the lane change distance (LCD). LCDs are defined in Vissim as the distance upstream of a necessary lane change (e.g. lane drop or off-ramp) where a vehicle will first attempt to change lanes. The LCD is a parameter that applies to every connector in the Vissim network, and its default value is 656 feet. This distance is typically acceptable for low speed, intersection turning movements but doesn't represent realistic lane change behavior on freeway facilities.

Freeway LCDs were initially coded based on the location of exit signage and updated iteratively to accurately replicate the congestion patterns demonstrated by the speed heat maps and travel times included later in this memorandum.

Arterial LCDs were updated on an as-needed basis. Traffic operations at approaches with high demand and weaving movements were often supplemented with longer LCDs at turning movement connectors. These locations include: Benning Road NE and East Capitol Street, Benning Road NE at the lane drop just east of Oklahoma Avenue NE, Nannie Helen Burroughs Avenue NE and Minnesota Avenue NE, and Nannie Helen Burroughs Avenue NE and Kenilworth Avenue NE. Most notably, LCD

was an important calibration parameter for controlling queue length at the lane closure on eastbound Benning Road NE at Minnesota Avenue NE.

Emergency stop distances were also calibrated on a location-by-location basis. This parameter enables more realistic queueing behavior when vehicles are unable to make their desired movements. This parameter was adjusted at off-ramps and intersection approaches as needed.

Driving Behavior

Vehicular driving behavior in Vissim is regulated by two primary driving behavior models: car-following models and lane-changing models. Car-following models aim to replicate the natural fluctuations in following distance of two vehicles within the same travel lane. Therefore, these models control a following vehicle's acceleration and deceleration with respect to a leading vehicle. The recommended car-following models for freeways (Wiedemann 99) and arterials (Wiedemann 74) were used. The most common parameters adjusted during calibration are listed below:

- Wiedemann 99
  - CC0 – Standstill Distance (ft)
  - CC1 – Time Headway (s)
  - CC2 – Following Variation (ft)
- Wiedemann 74
  - Average standstill distance (ft)
  - Additive part of safety distance
  - Multiplicative part of safety distance

Lane-changing models are used to asses when a driver wishes to change lanes and when the desired lane change is safe to complete. A driver's desire to make a lane change is defined in Vissim by two categories:

- Mandatory lane changes – lane changes required to follow the designated route.
- Discretionary lane changes – lane changes performed when a driver desires to travel at a higher speed or in a less congested travel lane.

Once the decision is made that a lane change is necessary or desirable, the vehicle searches for an acceptable gap in the desired travel lane. The model regulating this acceptable gap is influenced by a variety of parameters that can be calibrated to match local conditions. Among these, the most influential parameters used to calibrate this network were:

- Maximum deceleration (ft/s^2)
- Minimum headway (ft)
- Safety distance reduction factor (SDRF)
- Maximum speed difference for cooperative lane-changing (CLC)

A baseline driving behavior was defined for typical arterial segments and basic freeway segments. These behaviors were updated slightly from default behaviors to more accurately match local driving conditions. Along the freeways, a unique driving behavior was assigned at merge, diverge, and weaving segments to more accurately portray lane change behaviors at these junctions. The CC0 and CC1 car-following parameters remained consistent between the basic freeway segments and the freeway merge/diverge/weave segments. The rationale for this decision was to prevent unrealistic shockwaves between links with different driving behaviors (i.e., sudden braking or acceleration to meet a new "desired headway"). The CC2 parameter was adjusted from default for basic segments to account for the increased oscillation or variation in following distance, likely caused by the narrow lanes and other unique roadway characteristics for DC-295. This parameter was further increased to account for the amplified variation in driving behavior in freeway merge, diverge, and weaving segments. By increasing the variation in following distance, some vehicles' following distances are longer (potentially representing drivers letting other vehicles into their travel lane) and others are shorter (potentially representing drivers preventing other vehicles from entering their travel lane).

Similarly, arterial approaches with heavy demand and high lane-changing activities were assigned a unique driving behavior. The driving behaviors selected are shown in Table 11 and Table 12.

Table 11: Freeway Driving Behavior Parameters

Parameter		Vissim Default	Basic Freeway Segments	Freeway Merge/Diverge /Weave Segments
Car-Following	CC0 (ft)	4.92	4.92	4.92
	CC1 (s)	Normal Dist: Mean = 0.9, Std. Dev. = 0	Normal Dist: Mean = 1.2, Std. Dev. = 0.1	Normal Dist: Mean = 1.2, Std. Dev. = 0.1
	CC2 (ft)	13.12	26.00	35.00
Lane-Changing	Maximum Deceleration (ft/s2)	-13.12	-15.00	-15.00
	Minimum Headway (ft)	1.64	1.50	1.64
	SDRF	0.60	0.50	0.40
	Maximum Speed Difference for CLC	6.71	6.71	10.00

Table 12: Arterial Driving Behavior Parameters

Parameter		Vissim Default	Typical Segments	Increased Capacity Segments
Car-Following	Average Standstill Distance (ft)	6.56	6.56	4.00
	Additive Part of Safety Distance	2	2.50	1.00
	Multiplicative Part of Safety Distance	3	3.50	2.00
Lane-Changing	Maximum Deceleration (ft/s2)	-13.12	-13.12	-13.12
	Minimum Headway (ft)	1.64	1.64	1.50
	SDRF	0.6	0.50	0.40
	Maximum Speed Difference for CLC	N/A	N/A	4.00

Vissim Calibration Results

EXISTING AM MODEL

Existing Operational Conditions

The following sections describe the observed field conditions from the days of data collection.

DC-295

Based on field-collected count data, southbound DC-295 reaches its highest vehicular throughput between 5:15AM and 5:30AM, and congestion begins to form at 5:30AM. This results in speeds as low as 15 mph at 6:00AM, the start of the Vissim model simulation period. This congestion persists throughout the simulation period and during the peak period, and extends the full length of the study area from East Capitol Street to Nannie Helen Burroughs Avenue NE. The primary bottleneck on southbound DC-295 occurs at the East Capitol Street off-ramp, which includes a lane drop. Merging, diverging, and weaving behavior at other ramp junctions along southbound DC-295 (e.g. Benning Road NE and Kenilworth Avenue NE) also result in reduced speeds and additional congestion. While external to the direct study area, the impact of congestion at the ramp junction with Pennsylvania Avenue SE extends to the southern boundary of the study area. Northbound DC-295 operates under free flow conditions throughout the AM peak period.

Arterials

During the AM peak period, the arterial network also experiences significant demand. The intersection of Benning Road NE and Minnesota Avenue NE was under construction during the data collection period; however, all lanes were operating as planned during the current phase of construction (e.g., eastbound left-turn was restricted). The signal timing had been changed from typical conditions to support the construction efforts, as noted in a previous section of this memorandum. Further east on Benning Road NE, congestion was observed in the eastbound direction between 44th Street NE and East Capitol Street. This congestion was primarily caused by queueing from the eastbound approach to East Capitol Street as well as turning volumes from crossing streets (e.g., 44th and 45th Street NE) that are closely spaced to East Capitol Street. Traveling westbound on Benning Road NE, west of the DC-295/Benning Road NE interchange, congestion was observed at Benning Road NE and Oklahoma Avenue NE, primarily caused by high left-turn volumes at this intersection. Significant queueing was observed on Nannie Helen Burroughs Avenue NE and the surrounding local streets (e.g. southbound Minnesota Avenue NE, southbound Kenilworth Avenue NE, and Deane Avenue NE).

Calibration Results Summary

The Vissim model was coded to reproduce the operational conditions described above. The ability of the model to sufficiently match these conditions is characterized through calibration criteria defined in the **Vissim Calibration Overview and Methodology** section of this memorandum. The calibration summary provided in Table 13 demonstrates that the AM model meets each of the designated calibration criteria. Detailed calibration results can be found in **Appendix A**.

Table 13: AM Model Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Criteria Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 87)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	86	99%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 29)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	29	100%	85%	Yes
Simulated Traffic Volume (Sum of All Link Flows)	**All Segments/Approaches**	Within 5% of sum of all link counts		0%	5%	Yes
Simulated Traffic Volume (GEH Statistic)	**Segments/Approaches (n = 116)**	< 5 for individual link flows	115	99%	85%	Yes
	All Segments/Approaches	< 4 for the sum of all link flows	0.3		4.0	Yes
Simulated Travel Time	**Segments (n=4)**	Within ± 15% for average travel time	4	100%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 14)**	Modeled queues qualitatively reflect the impacts of observed queues				Yes
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect the pattern and duration of congestion				Yes

Throughput Volume Calibration Results

The Existing Conditions (2019) AM Vissim-processed throughput was compared with existing balanced traffic counts. As shown in Table 6, several methodologies are outlined in FHWA's TAT to verify that model-processed volume matches observed traffic counts.

First, to evaluate traffic volumes along individual roadway segments (i.e., freeway segments and intersection approaches), specific criteria are established for segments based on their serviced volume. In order to reach calibration, 85 percent of all freeway segments and intersection approaches must meet these criteria. In the AM model, 100 percent of the freeway segments fell within these thresholds, and of the 87 intersection approaches, 99 percent were within the designated volume range.

Second, network-wide throughput is assessed by taking the sum of all link volumes to compare with balanced volumes. The calibration criterion requires that the percent difference between balanced counts and Vissim throughput be within +/- 5 percent. In the AM model, a difference of 0.1 percent was observed, which meets this criterion.

Third, another metric for evaluating network-wide throughput is in the form of the GEH statistic. The GEH statistic is calculated with an empirical formula similar to a chi-squared test. It is used to overcome the pitfalls when using simple percentages to compare volumes; specifically, the GEH statistic is a normalized proportion that provides a fair baseline of comparison for a wide range of volumes. The calibration criteria are separated into two parts: individual segments and the full network. 85 percent of all individual roadway segments (i.e., freeway segments and intersection approaches) must achieve a GEH statistic of 5 or less. When combined, the total volume on freeways and arterials must achieve a GEH statistic of 4 or less. In the AM model, 99 percent of all 115 roadway segments produced a GEH statistic less than 5. Similarly, the total GEH statistic for network-wide volumes was calculated to be 0.3, which is below the requirement of 4.

Tables detailing the computation of each of these volume criteria are provided in **Appendix A**.

Travel Time Calibration Results

Travel time calculated in Vissim was compared with field travel time runs and crowdsourced probe data, as explained in the **Vissim Calibration Overview and Methodology** section of this memorandum. Travel time along the four major corridors (i.e., northbound DC-295, southbound DC-295, eastbound Benning Road NE, and westbound Benning Road NE) were divided into segments for field data collection. Similarly, these smaller segments were analyzed from the Vissim model outputs. However, only the sum of all segments along the corridor were considered for the travel time calibration criteria, which dictates that 85 percent of the travel time segments fall within 15 percent of the observed travel time. As shown in Table 14, each corridor-specific travel time measurement from the calibrated AM Vissim model falls within 15 percent of the observed travel time data. Detailed calibration results can be found in **Appendix A**.

Table 14: AM Model Travel Time Calibration Summary

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
5	NB DC-295 from East Capitol Street to Benning Road NE	00:38	00:37	-00:01	-3%
6	NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE	00:42	00:44	00:02	4%
7	NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE	00:45	00:45	-00:00	0%
18	NB DC-295 from Nelson Place NE to East Capitol Street Bridge	01:15	01:15	00:00	1%
Total	**NB DC-295**	**03:20**	**03:21**	**00:01**	**0%**
8	SB DC-295 from Polk Street NE to Lane Place NE	03:07	03:11	00:04	2%
9	SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE	01:17	01:28	00:11	14%
10	SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE	05:54	06:35	00:41	11%
11	SB DC-295 from Benning Road NE to East Capitol Street	03:33	03:42	00:09	4%
12	SB DC-295 from East Capitol Street NE to N Street NE	03:57	03:50	-00:07	-3%
Total	**SB DC-295**	**17:49**	**18:46**	**00:57**	**5%**
14	WB Benning Road NE from East Capitol Street to Minnesota Ave NE	03:33	04:23	00:50	24%
15	WB Benning Road NE from Minnesota Ave NE to 36th Street NE	00:35	00:42	00:07	21%
16	WB Benning Road NE from 36th Street NE to Anacostia Ave NE	01:06	00:47	-00:19	-29%
17	WB Benning Road NE from Anacostia Ave NE to 26th Street NE	01:49	01:29	-00:20	-18%
Total	**WB Benning Road NE**	**07:03**	**07:21**	**00:19**	**4%**
1	EB Benning Road NE from 26th Street NE to Anacostia Ave NE	00:59	01:09	00:10	17%
2	EB Benning Road NE from Anacostia Ave NE to 36th Street NE	00:55	00:44	-00:11	-20%
3	EB Benning Road NE from 36th Street NE to Minnesota Ave NE	01:54	01:30	-00:24	-21%
4	EB Benning Road NE from Minnesota Ave NE to East Capitol Street	05:26	05:43	00:17	5%
Total	**EB Benning Road NE**	**09:14**	**09:06**	**-00:08**	**-1%**

Bottleneck Locations

Bottleneck locations and overall traffic flow along DC-295 were calibrated qualitatively by verifying the bottleneck extent and duration as observed in the field and using the probe data. This was done by comparing probe- and Vissim-based speed heat maps and average link speeds plotted on the heat maps. Speed heat maps are contour plots of space mean speed that are a useful tool for visually identifying bottlenecks and observing the propagation and dissipation of congestion over time. The same segments provided in Table 14 were used to develop speed heat maps for both directions of DC-295 during each peak period. Figure 3 depicts the speed heat maps for the DC-295 northbound and southbound corridors during the AM peak period. It is important to note that the speed heat maps derived from the probe data and Vissim data will not match perfectly due to slight differences in the exact segments defined to collect average speed. Nonetheless, this visual comparison is useful for evaluating traffic conditions on DC-295.

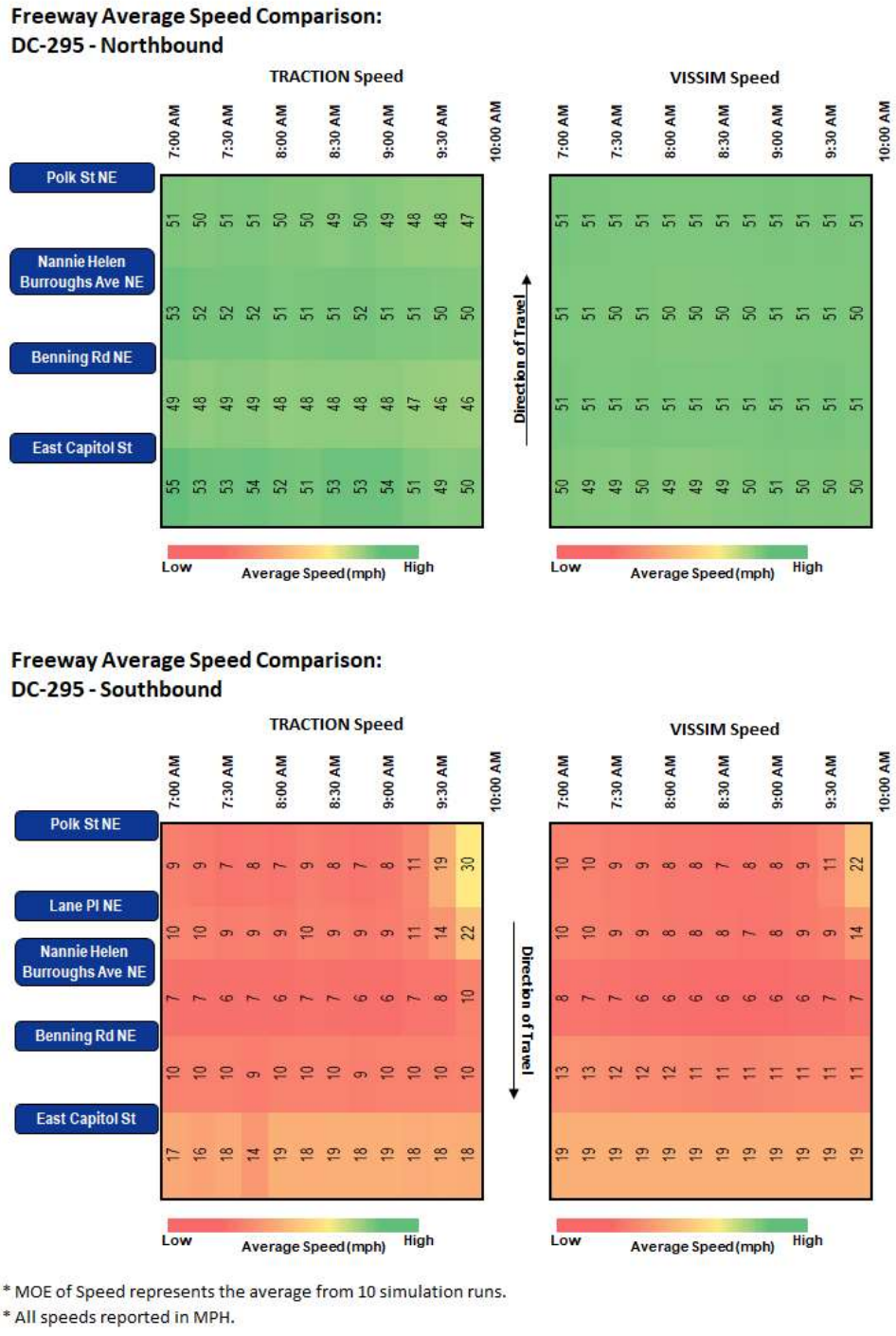
As shown in Figure 3, there is a clear qualitative match between the observed probe vehicle speeds and the Vissim results. In the northbound direction, traffic flow operates under free flow conditions throughout the analysis period. In the southbound direction, congestion has already formed by the beginning of the analysis period and is just beginning to diffuse on the north end of the network by the end of the shoulder period.

Simulated Queue Length

Queuing within the study area is notably inconsistent, oscillating numerous times within each peak period and absent altogether some days. A qualitative assessment of queue lengths at targeted locations was conducted in conjunction with a review of freeway mainline congestion patterns against the speed heat maps. Based on the Vissim results, the modeled queues reasonably reflect the impacts of observed queues at most identified locations. A summary of the observed and modeled queues in each of the specified locations are provided in **Appendix A**.

Calibration Summary

As described in the preceding sections, the Existing Conditions (2019) AM Vissim model meets all criteria for traffic throughput volume, travel time, queue length, and bottleneck formation required by FHWA's TAT and stated in the *Framework Document*.



* MOE of Speed represents the average from 10 simulation runs.
* All speeds reported in MPH.

Figure 3: Existing AM Speed Heat Maps – Comparison of Probe- and Vissim-based Speeds

PM MODEL: EXISTING CONDITIONS

Existing Operational Conditions

The following sections describe the observed field conditions from the days of data collection.

DC-295

Based on field-collected count data, northbound DC-295 reaches its highest vehicular throughput around 2:00PM, and congestion extends throughout the network by 3:30PM, resulting in speeds as low as 15 mph at the start of the Vissim model simulation period. This congestion persists throughout the simulation period and during the peak period, and extends the full length of the study area from East Capitol Street to Nannie Helen Burroughs Avenue NE. The primary bottlenecks responsible for this congestion include the US 50 interchange (external to the network), the Benning Road NE on-ramp, and the Kenilworth Avenue NE on-ramp.

Likewise, volumes on southbound DC-295 begin to plateau around 11:00AM and do not substantially rise or fall until after 6:00PM. Congestion extends from the southern terminus of the network to near the interchange at Nannie Helen Burroughs Avenue NE well before the start of the Vissim model simulation period due to two primary bottlenecks: the Pennsylvania Avenue SE interchange (external to the network) and the East Capitol Street lane drop.

Arterials

During the PM peak period, the arterial network also experiences significant demand. The intersection of Benning Road NE and Minnesota Avenue NE was under construction during the data collection period. Unlike during the AM peak period, two unexpected lane closures were in place during the PM peak period: eastbound Benning Road NE at Minnesota Avenue NE and northbound Minnesota Avenue NE at Benning Road NE. As mentioned previously, one lane was closed on eastbound Benning Road NE just downstream of the Minnesota Avenue NE intersection, and a construction vehicle blocked the left-turn lane on northbound Minnesota Avenue NE until 5:00PM. These lane closures led to significant queueing west (through the Anacostia Avenue NE intersection) on Benning Road NE and south (through the Dix Street NE intersection) of Minnesota Avenue NE.

Bottleneck conditions were also observed on Nannie Helen Burroughs Avenue NE and the surrounding local streets (e.g. southbound Minnesota Avenue NE, southbound Kenilworth Avenue NE, and Deane Avenue NE).

Calibration Results Summary

The Vissim model was coded to reproduce the operational conditions described above. The ability of the model to sufficiently match these conditions is characterized through calibration criteria defined in the **Vissim Calibration Overview and Methodology** section of this memorandum. The calibration summary provided in Table 15 demonstrates that the PM model meets each of the designated calibration criteria. Detailed calibration results can be found in **Appendix B**.

Table 15: PM Model Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Criteria Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 87)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	81	93%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 29)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	29	100%	85%	Yes
Simulated Traffic Volume (Sum of All Link Flows)	**All Segments/Approaches**	Within 5% of sum of all link counts		0%	5%	Yes
Simulated Traffic Volume (GEH Statistic)	**Segments/Approaches (n = 116)**	< 5 for individual link flows	110	95%	85%	Yes
	All Segments/Approaches	< 4 for the sum of all link flows	0.2		4.0	Yes
Simulated Travel Time	**Routes (n=4)**	Within ± 15% for average travel time	4	100%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 14)**	Modeled queues qualitatively reflect the impacts of observed queues				Yes
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect the pattern and duration of congestion				Yes

Volume Calibration Results

The Existing Conditions (2019) PM Vissim-processed throughput was compared with existing balanced traffic counts. As shown in Table 6 and described in greater detail for the AM model, several methodologies are outlined in FHWA's TAT to verify that model-processed volume matches observed traffic counts. In each case, the PM model met or exceeded calibration requirements. These thresholds are summarized below.

- Traffic volumes along individual roadway segments – in the PM model, 100 percent of all freeway segments and 93 percent of all intersection approaches meet segment-level volume requirements, which meets the calibration criteria.
- Network-wide throughput – in the PM model, no difference was observed between the network wide throughput and balanced volumes, which meets the calibration criteria.

- GEH statistic – in the PM model, the GEH statistic calibration requirements related to individual link throughput and total network-wide throughput were met.

Tables detailing the computation of each of these volume criteria are provided in **Appendix B**.

Travel Time Calibration Results

Travel time calculated in Vissim was compared with field travel time runs and crowdsourced probe data, as explained in the **Vissim Calibration Overview and Methodology** section. As shown in Table 16, each of the four corridor-specific travel time measurements (i.e., northbound DC-295, southbound DC-295, eastbound Benning Road NE, and westbound Benning Road NE) from the calibrated PM Vissim model falls within 15 percent of the observed travel time data. Detailed calibration results can be found in **Appendix B.**

Bottleneck Locations

Bottleneck locations and overall traffic flow along DC-295 were calibrated qualitatively by verifying the bottleneck extent and duration as described earlier. Figure 4 depicts the speed heat maps for the DC-295 northbound and southbound corridors during the PM peak period. As shown, there is a clear qualitative match between the observed probe vehicle speeds and the Vissim results.

Simulated Queue Length

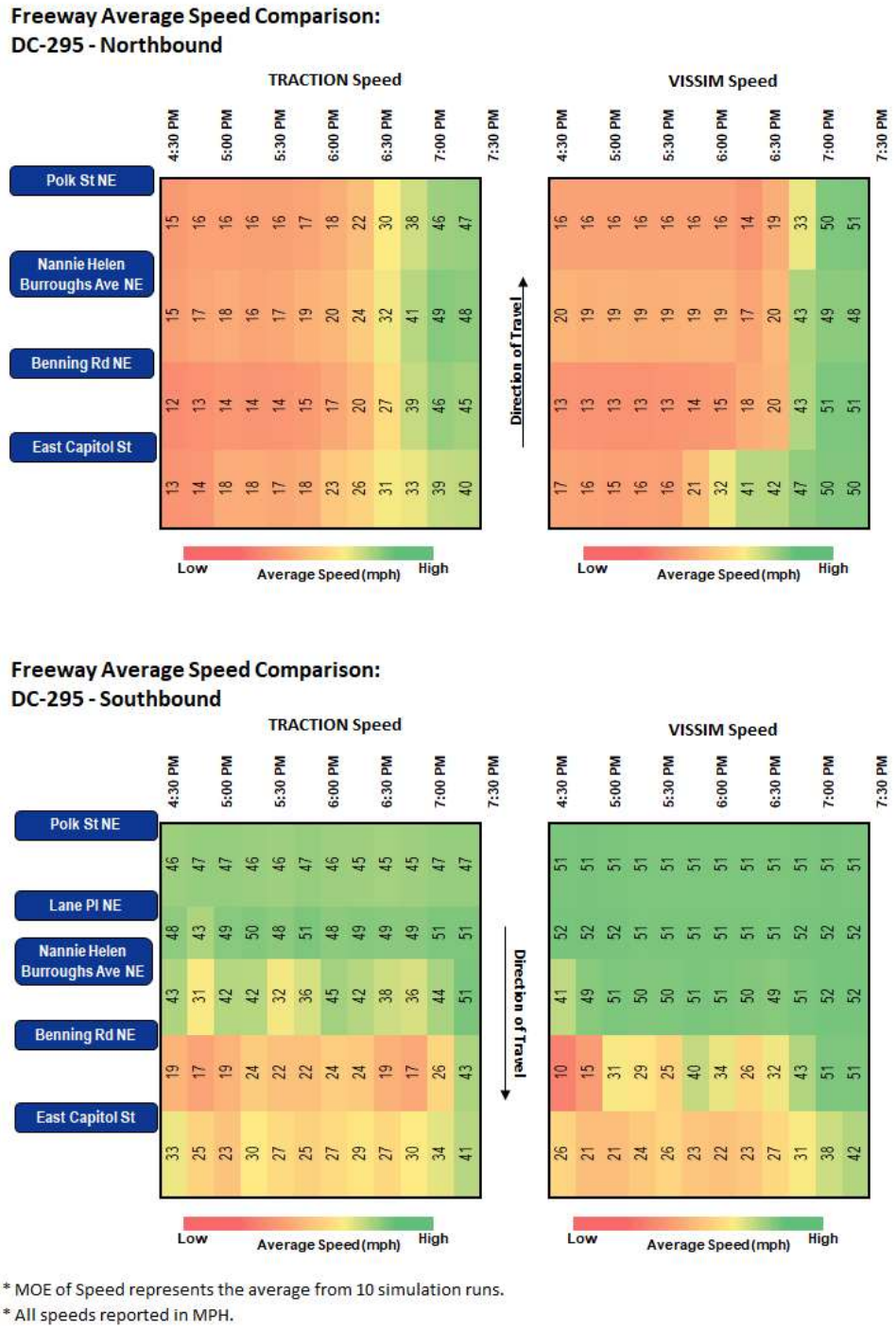
As noted for the AM peak period, queuing within the study area is notably inconsistent, oscillating numerous times within each peak period and absent altogether some days. A qualitative assessment of queue lengths at targeted locations was conducted in conjunction with a review of freeway mainline congestion patterns against the speed heat maps. Based on the Vissim results, the modeled queues reasonably reflect the impacts of observed queues at most identified locations. A summary of the observed and modeled queues in each of the specified locations are provided in **Appendix B**.

Calibration Summary

As described in the preceding sections, the Existing Conditions (2019) PM Vissim model meets all criteria for traffic throughput volume, travel time, queue length, and bottleneck formation required by FHWA's TAT and stated in the *Framework Document*. Modifications to the network and driving behavior at the intersection of Benning Road NE and Minnesota Avenue NE required based on the construction activities during the days of data collection will be removed for subsequent analyses of future no-build and build alternatives.

Table 16: PM Model Travel Time Calibration Summary

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
18	NB DC-295 from East Capitol Street to Benning Road NE	03:46	03:34	-00:12	-5%
5	NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE	02:07	02:16	00:09	7%
6	NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE	02:02	02:31	00:29	24%
7	NB DC-295 from Nelson Place NE to East Capitol Street Bridge	02:17	02:49	00:32	23%
Total	**NB DC-295**	**10:13**	**11:10**	**00:57**	**9%**
8	SB DC-295 from Polk Street NE to Lane Place NE	00:33	00:31	-00:02	-5%
9	SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE	00:15	00:13	-00:02	-13%
10	SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE	01:02	00:48	-00:14	-22%
11	SB DC-295 from Benning Road NE to East Capitol Street	01:38	01:44	00:06	6%
12	SB DC-295 from East Capitol Street NE to N Street NE	02:33	02:51	00:18	11%
Total	**SB DC-295**	**06:01**	**06:07**	**00:06**	**2%**
14	WB Benning Road NE from East Capitol Street to Minnesota Ave NE	03:32	03:53	00:21	10%
15	WB Benning Road NE from Minnesota Ave NE to 36th Street NE	00:34	00:39	00:05	15%
16	WB Benning Road NE from 36th Street NE to Anacostia Ave NE	00:53	00:44	-00:10	-18%
17	WB Benning Road NE from Anacostia Ave NE to 26th Street NE	01:10	01:07	-00:03	-5%
Total	**WB Benning Road NE**	**06:09**	**06:23**	**00:13**	**4%**
1	EB Benning Road NE from 26th Street NE to Anacostia Ave NE	05:14	05:40	00:26	8%
2	EB Benning Road NE from Anacostia Ave NE to 36th Street NE	08:11	08:34	00:23	5%
3	EB Benning Road NE from 36th Street NE to Minnesota Ave NE	05:05	07:11	02:07	42%
4	EB Benning Road NE from Minnesota Ave NE to East Capitol Street	04:17	03:19	-00:58	-23%
Total	**EB Benning Road NE**	**22:46**	**24:44**	**01:58**	**9%**



* MOE of Speed represents the average from 10 simulation runs.
* All speeds reported in MPH.

Figure 4: Existing PM Speed Heat Maps - Comparison of Probe- and Vissim-based Speeds

Conclusions

Based on the results obtained from the AM and PM Existing Conditions (2019) Vissim models and their comparison with field counts, travel times, speeds, and queue lengths, the models are considered to be reasonably calibrated to the standards and guidelines established by FHWA's *Traffic Analysis Toolbox Volume III* (2004).

The impacts of construction at the intersection of Benning Road NE and Minnesota Avenue NE that were present during data collection raise challenges for direct application of these Existing Conditions models to the development and analysis of future no build and build alternatives. While the Existing Conditions calibration required that prevailing conditions during the days of data collection be reasonably replicated, the study team avoided over-calibrating the model to these temporary conditions by making changes to network geometry and driving behavior sparingly. As stated in the *Framework Document*, calibration to these conditions were required to match calibration targets, but engineering judgement will be used to update the presented Existing Conditions models to become a typical "baseline" model for assessing future conditions.

Appendix A: AM Calibration Results

- Freeway/Ramp Individual Link Volume Calibration
- Arterial Intersection Volume Calibration
- Aggregate Network-Wide Volume Calibration
- Travel Time Calibration
- Speed Congestion Map Calibration
- Queue Length Calibration

Appendix B: PM Calibration Results

- Freeway/Ramp Individual Link Volume Calibration
- Arterial Intersection Volume Calibration
- Aggregate Network-Wide Volume Calibration
- Travel Time Calibration
- Speed Congestion Map Calibration
- Queue Length Calibration

AM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Criteria Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 77)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	86	99%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 29)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	29	100%	85%	Yes
Simulated Traffic Volume (Sum of All Link Flows)	**All Segments/Approaches**	Within 5% of sum of all link counts		0%	5%	Yes
Simulated Traffic Volume (GEH Statistic)	**Segments/Approaches (n = 116)**	< 5 for individual link flows	115	99%	85%	Yes
	All Segments/Approaches	< 4 for the sum of all link flows	0.3		4.0	Yes
Simulated Travel Time	**Segments (n=4)**	Within ± 15% for average travel time	4	100%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 14)**	Modeled queues qualitatively reflect the impacts of observed queues				Yes
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect the pattern and duration of congestion				Yes

1. Simulated Average Speed – Speeds are highly variable on the freeway and arterials, sometimes varying substantially by hour and by day. Simulated average speed was captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat maps.

2. Simulated Queue Length – Queuing within the study area is notably inconsistent, oscillating numerous times within each peak period and absent altogether some days. A qualitative assessment of queue lengths at targeted locations was conducted in conjunction with a review of freeway mainline congestion patterns against the speed heat maps.

Volume Calibration (Freeways)

AM Peak Hour (7:45 AM - 8:45 AM)

		Subtotal	Total	Percent	Target	Target Met
Segments (n = 29)	Within ± 100 vph for < 700 vph	14	29	100%	85%	Yes
	Within ± 15% for ≥ 700 vph to < 2,700 vph	3				
	Within ± 400 vph for ≥ 2,700 vph	12				

* MOEs of Throughput, Speed, and Density represent an average of 10 simulation runs.

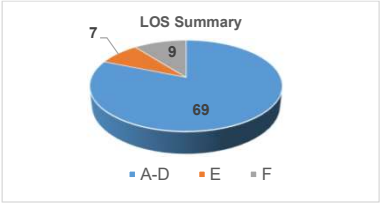
Facility	Segment	Type	Balanced Count (vph)	VISSIM Throughput (vph)	Difference (vph)	Difference (%)	Average Speed (mph)	Average Density (vpmpl)
NB DC-295	Mainline south of EB Capitol Street On-Ramp	Basic	2,875	2,874	-1	0%	49	29.5
	Between EB Capitol Street On-Ramp and WB Benning Road Off-Ramp	Merge/Diverge	3,180	3,178	-2	0%	51	20.5
	Between WB Benning Road Off-Ramp and EB Benning Road/Kenilworth Avenue On-Ramp	Basic	2,910	2,905	-5	0%	51	18.9
	Between EB Benning Road/Kenilworth Avenue On-Ramp and Nannie Helen Burroughs Aveneue Off-Ramp	Merge/Diverge	3,240	3,226	-14	0%	50	20.2
	Between Nannie Helen Burroughs Avenue Off-Ramp and Kenilworth Avenue On-Ramp	Basic	2,795	2,792	-3	0%	52	18.0
	Mainline north of Nannie Helen Burroughs Avenue	Merge/Basic	3,330	3,328	-2	0%	43	21.1
SB DC-295	Mainline North of Deane Avenue Off-Ramp	Merge/Diverge	3,145	3,137	-8	0%	8	114.7
	Between Deane Avenue Off-Ramp and Kenilworth Avenue Off-Ramp	Basic/Diverge	2,900	2,880	-20	-1%	7	132.9
	Between Kenilworth Avenue Off-Ramp and Kenilworth Avenue On-Ramp	Basic	2,190	2,159	-31	-1%	4	165.2
	Between Kenilworth Avenue On-Ramp and EB Benning Road On-Ramp	Merge/Basic	2,840	2,782	-58	-2%	6	143.1
	Between EB Benning Road On-Ramp and Baker Street Off-Ramp	Weave	3,120	3,044	-76	-2%	8	100.7
	Between Baker Street Off-Ramp and WB Capitol Street Off-Ramp	Diverge	3,095	3,032	-63	-2%	11	90.6
	Between WB Capitol Street Off-Ramp and EB Capitol Street On-Ramp	Basic	2,600	2,534	-66	-3%	12	102.6
	Mainline south of EB Capitol Street On-Ramp	Merge/Basic	2,990	2,912	-78	-3%	15	90.2

Interchange	Ramp		Balanced Count (vph)	VISSIM Throughput (vph)	Difference (vph)	Difference (%)	Average Speed (mph)	Average Density (vpmpl)
Capitol Street	EB Capitol Street to SB DC-295		390	390	0	0%	26	15.9
	EB Capitol Street to NB DC-295		305	305	-1	0%	33	9.6
	SB DC-295 to WB Capitol Street		495	495	-1	0%	40	12.7
Baker Street	SB DC-295 to WB Baker Street		25	22	-4	-14%	20	1.1
Benning Road	EB Benning Road to SB DC-295		280	275	-5	-2%	36	7.6
	EB Benning Road to NB DC-295 or WB Benning Road (U-turns)		295	288	-7	-2%	27	18.0
	NB DC-295 to WB Benning Road		270	275	5	2%	28	18.9
	NB DC-295/EB Benning Road (U-turns) to WB Benning Road		280	285	5	2%	3	132.4
	SB Kenilworth Avenue NE to NB DC-295		45	45	-1	-1%	23	1.9
	EB Benning Road/SB Kenilworth Avenue NE to NB DC-295		330	322	-8	-3%	39	8.2
Kenilworth Avenue	SB Kenilworth Avenue to SB DC-295 (South)		650	646	-4	-1%	5	126.8
	SB DC-295 to SB Kenilworth Avenue		710	722	12	2%	19	44.4
	NB Kenilworth Avenue to NB DC-295		535	538	3	0%	22	23.6
Nannie Helen Burroughs Avenue	NB DC-295 to Nannie Helen Burroughs Avenue/Kenilworth Avenue		445	434	-11	-2%	47	9.1
	SB DC-295 to Deane Aveneue/Kenilworth Terrace/Kenilworth Avenue		245	235	-11	-4%	40	5.8

Volume Calibration (Intersections)

AM Peak Hour (7:45 AM - 8:45 AM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 77)	Within ± 100 vph for < 700 vph	61	86	99%	85%	Yes
	Within ± 15% for ≥ 700 vph to < 2,700 vph	24				
	Within ± 400 vph for ≥ 2,700 vph	1				



Approaches:

LOS	Count
A-D	69
E	7
F	9

* MOEs of Throughput, Delay, and Queue Lenth represent an average of 10 simulation runs.

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
101	Benning Road NE at Anacostia Avenue NE	NB	LT	64	89	65	90	1	1	2%	1%	51.5	39.4	19	19	145	149	D	D
			RT	25		24		-1		-3%		6.6		15		149		A	
		SB	LT	19	28	20	28	2	1	9%	3%	48.9	49.2	7	7	65	65	D	D
			RT	9		8		-1		-10%		50.2		7		65		D	
		EB	LT	10	953	10	938	0	-14	1%	-2%	34.4	3.1	6	6	150	150	C	A
			TH	918		904		-14		-1%		2.7		6		150		A	
			RT	25		24		-1		-3%		4.6		0		34		A	
		WB	LT	21	2,580	23	2,692	2	112	11%	4%	15.0	2.7	16	16	364	385	B	A
			TH	2,546		2,658		112		4%		2.6		16		364		A	
			RT	13		11		-2		-16%		8.3		10		385		A	
		Intersection		3,649		3,748		99		3%		4.0						A	
102	Benning Road NE at 34th Street NE	NB	LT	18	70	19	76	1	6	4%	8%	38.7	18.3	7	7	106	115	D	B
			RT	52		56		4		8%		11.3		6		115		B	
		SB	LT	30	70	28	70	-2	0	-5%	0%	38.7	37.4	15	15	133	133	D	D
			RT	40		42		2		4%		36.5		15		133		D	
		EB	LT	8	962	10	948	2	-14	20%	-1%	17.6	11.1	0	28	29	206	B	B
			TH	933		917		-16		-2%		11.1		23		183		B	
			RT	21		21		0		1%		8.2		28		206		A	
		WB	LT	219	2,791	225	2,951	6	160	3%	6%	28.6	15.8	54	101	479	582	C	B
			TH	2,523		2,623		100		4%		14.3		98		575		B	
			RT	49		45		-4		-7%		19.7		101		582		B	
			U	76		58		-18		-24%		28.6		54		479		C	
		Intersection		3,893		3,986		93		2%		15.3						B	
103	Benning Road NE Ramp to DC-295 at 36th Street NE	NB	RT	171	171	169	169	-2	-2	-1%	-1%	2.1	2.1	0	0	42	42	A	A
		EB	TH	404	410	395	400	-9	-9	-2%	-2%	1.5	1.4	2	2	134	134	A	A
			RT	6		5		-1		-15%		1.3		1		122		A	
		Intersection		581		569		-12		-2%		1.7						A	
104	Benning Road NE at Minnesota Avenue NE	NB	LT	307	637	302	645	-6	8	-2%	1%	35.4	31.4	85	85	457	457	D	C
			TH	296		308		12		4%		28.5		85		457		C	
			RT	34		35		1		3%		22.8		85		457		C	
		SB	LT	50	510	61	547	11	36	21%	7%	48.2	42.0	18	119	285	575	D	D
			TH	323		334		11		3%		44.7		119		575		D	
			RT	137		152		15		11%		33.5		119		575		C	
		EB	LT	129	681	133	639	3	-42	3%	-6%	118.8	68.9	178	178	576	576	F	E
			TH	306		277		-29		-9%		59.6		178		576		E	
			RT	245		229		-16		-7%		51.3		178		576		D	
		WB	LT	16	692	11	772	-5	79	-32%	11%	94.6	75.6	234	234	437	437	F	E
			TH	629		701		72		11%		75.0		234		437		E	
			RT	47		59		12		26%		79.8		234		437		E	
		Intersection		2,521		2,602		81		3%		56.0						E	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
105	Benning Road NE at 39th Street NE/Driveway	NB	LT	10	20	10	20	0	0	1%	-2%	74.7	50.1	5	5	76	82	E	D
			RT	10		9		-1		-13%		18.7		3		82		B	
		SB	LT	5	10	5	8	0	-2	-2%	-20%	55.0	46.1	1	1	29	29	D	D
			RT	5		0		-5		-100%		-		0		0		-	
		EB	LT	10	390	11	372	0	-18	3%	-5%	4.2	7.5	13	13	186	186	A	A
			TH	359		338		-21		-6%		7.7		13		186		A	
			RT	21		23		2		11%		7.0		13		186		A	
		WB	LT	20	708	17	779	-3	72	-14%	10%	45.9	65.7	285	285	806	806	D	E
			TH	678		760		82		12%		66.2		285		806		E	
			RT	10		3		-8		-75%		49.8		285		806		D	
		Intersection		1,127		1,179		51		5%		47.0						D	
106	Benning Road NE at 40th Street NE	NB	LT	7	121	6	118	-1	-4	-17%	-3%	33.3	12.0	8	8	127	127	C	B
			RT	114		112		-3		-2%		10.8		8		127		B	
		EB	TH	354	373	333	351	-21	-22	-6%	-6%	0.8	0.8	0	3	132	138	A	A
			RT	19		18		-1		-5%		1.0		3		138		A	
		WB	LT	311	1,010	313	1,089	2	79	0%	8%	23.4	27.2	107	107	463	463	C	C
			TH	699		777		78		11%		28.7		107		462		C	
		Intersection		1,505		1,558		53		4%		20.1						C	
107	Benning Road NE at 41st Street NE	NB	LT	7	31	6	27	-1	-4	-10%	-12%	15.4	8.5	1	1	51	52	B	A
			RT	24		21		-3		-12%		6.5		1		52		A	
		EB	TH	459	468	435	444	-24	-25	-5%	-5%	0.4	0.4	0	0	39	39	A	A
			RT	9		9		0		-4%		0.9		0		18		A	
		WB	LT	99	1,102	90	1,176	-9	74	-9%	7%	9.9	9.1	39	39	306	306	A	A
			TH	1,003		1,086		82		8%		9.1		39		306		A	
		Intersection		1,601		1,647		46		3%		6.8						A	
108	Benning Road NE at 42nd Street NE	NB	LT	26	87	17	83	-10	-4	-38%	-5%	23.5	18.5	7	7	98	124	C	B
			TH	57		47		-10		-18%		20.9		7		98		C	
			RT	4		20		16		408%		9.0		7		124		A	
		SB	LT	12	466	9	448	-3	-18	-23%	-4%	46.4	47.5	146	157	510	528	D	D
			TH	136		134		-2		-2%		52.4		146		510		D	
			RT	318		305		-13		-4%		45.3		157		528		D	
		EB	LT	106	483	108	458	2	-25	2%	-5%	59.1	25.5	48	59	262	287	E	C
			TH	331		310		-21		-6%		15.7		48		262		B	
			RT	46		40		-6		-14%		10.8		59		287		B	
		WB	LT	7	796	6	889	-1	92	-10%	12%	18.9	11.9	33	34	272	291	B	B
			TH	758		850		92		12%		11.8		33		272		B	
			RT	31		32		1		4%		12.3		34		291		B	
		Intersection		1,833		1,879		46		2%		24.0						C	
208	Benning Road NE at 26th Street NE	SB	LT	170	225	162	214	-8	-11	-5%	-5%	53.7	50.7	69	79	398	426	D	D
			RT	55		52		-3		-5%		41.1		79		426		D	
		EB	LT	65	868	67	880	2	12	3%	1%	40.8	9.6	7	11	115	147	D	A
			TH	803		813		10		1%		7.0		11		147		A	
		WB	TH	1,784	2,204	1,877	2,285	93	81	5%	4%	5.3	6.3	70	75	311	336	A	A
			RT	419		408		-12		-3%		11.1		75		336		B	
		Intersection		3,297		3,379		81		2%		10.0						A	
209	Benning Road NE at Oklahoma Avenue NE	NB	LT	68	120	67	117	-1	-3	-1%	-2%	49.0	37.4	23	23	182	193	D	D
			RT	52		50		-2		-4%		21.9		22		193		C	
		EB	TH	900	973	906	977	6	3	1%	0%	10.6	10.8	39	39	256	270	B	B
			RT	73		71		-2		-3%		12.3		38		270		B	
		WB	LT	483	2,619	462	2,679	-21	60	-4%	2%	151.5	51.7	593	593	1,650	1,650	F	D
			TH	2,136		2,217		81		4%		30.9		189		1,060		C	
		Intersection		3,712		3,773		61		2%		40.6						D	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
210	Minnesota Avenue NE at Dix Street NE	NB	LT	5	677	5	687	0	10	-2%	1%	10.5	8.6	19	19	196	237	B	A
			TH	586		593		7		1%		8.8		19		196		A	
			RT	86		89		3		3%		7.4		14		237		A	
		SB	LT	41	584	34	573	-7	-11	-17%	-2%	16.1	8.0	15	15	217	249	B	A
			TH	528		526		-3		-1%		7.5		15		217		A	
			RT	15		14		-1		-8%		5.5		12		249		A	
		EB	LT	4	10	3	10	-1	0	-17%	-2%	45.0	40.7	2	2	41	41	D	D
			TH	3		4		1		23%		37.2		2		41		D	
			RT	3		3		0		-7%		40.4		2		41		D	
		WB	LT	93	158	94	159	1	1	1%	1%	46.7	42.6	39	45	237	256	D	D
			TH	18		16		-2		-11%		48.5		39		237		D	
			RT	47		49		2		3%		32.6		45		256		C	
		Intersection		1,430		1,430		0		0%		12.4						B	
211	Minnesota Avenue NE at Bus Exit South	NB	TH	473	473	499	499	26	26	5%	5%	19.7	19.7	40	40	497	497	B	B
		SB	TH	480	480	497	497	16	16	3%	3%	4.2	4.2	8	8	93	93	A	A
		EB	LT	19	50	11	57	-8	7	-43%	14%	54.6	27.4	17	17	162	168	D	C
			RT	31		46		15		49%		21.0		11		168		C	
		Intersection		1,003		1,052		49		5%		12.8						B	
212	Minnesota Avenue NE at Grant Street NE and Bus Entrance North	NB	LT	38	489	16	484	-22	-4	-58%	-1%	17.1	13.2	2	36	69	357	B	B
			TH	407		428		21		5%		13.3		36		357		B	
			RT	44		41		-3		-8%		10.7		36		357		B	
		SB	LT	7	430	8	446	1	15	10%	4%	23.9	10.9	16	17	125	153	C	B
			TH	402		438		36		9%		10.7		16		125		B	
			RT	21		0		-21		-100%		-		17		153		-	
		WB	LT	75	109	73	109	-2	0	-3%	0%	15.2	12.2	6	6	111	144	B	B
			RT	34		36		2		7%		6.2		6		144		A	
		Intersection		1,027		1,039		11		1%		12.1						B	
213	Benning Road NE at Blaine Street NE	NB	LT	1	53	1	53	0	0	-20%	0%	19.2	11.5	2	3	61	67	B	B
			RT	52		52		0		1%		11.4		3		67		B	
		EB	TH	345	347	334	336	-11	-11	-3%	-3%	23.5	23.4	20	28	124	176	C	C
			RT	2		3		0		17%		5.5		28		176		A	
		WB	LT	228	1,023	236	1,121	8	97	4%	10%	5.3	2.1	8	8	253	253	A	A
			TH	795		885		89		11%		1.3		5		222		A	
		Intersection		1,423		1,510		86		6%		7.2						A	
214	Benning Road NE at 44th Street NE	SB	LT	130	378	130	371	0	-7	0%	-2%	70.1	58.3	144	147	561	568	E	E
			RT	248		241		-7		-3%		52.0		147		568		D	
		EB	LT	109	397	102	383	-7	-14	-7%	-3%	125.4	54.9	128	128	356	356	F	D
			TH	288		282		-6		-2%		29.5		128		356		C	
		WB	TH	775	934	874	1,021	99	87	13%	9%	14.0	13.5	50	50	322	351	B	B
			RT	159		147		-12		-7%		10.6		21		351		B	
		Intersection		1,709		1,775		66		4%		31.8						C	
215	Benning Road NE at 45th Street NE	SB	LT	48	117	39	87	-9	-29	-19%	-25%	449.9	409.6	312	315	541	545	F	F
			RT	69		49		-20		-29%		377.3		315		545		F	
		EB	LT	19	418	19	406	0	-12	-1%	-3%	132.1	123.2	178	178	407	407	F	F
			TH	399		387		-12		-3%		122.8		178		407		F	
		WB	TH	864	926	972	1,037	108	111	13%	12%	1.0	1.2	351	351	599	599	A	A
			RT	62		65		3		5%		3.3		8		236		A	
		Intersection		1,460		1,530		70		5%		56.9						E	
216	Benning Road NE at Central Avenue NE	WB	TH	499	513	538	551	39	38	8%	7%	0.5	0.4	0	0	78	86	A	A
			RT	14		13		-1		-9%		0.0		0		86		A	
		EB	TH	459	459	426	426	-33	-33	-7%	-7%	108.9	108.9	90	90	206	206	F	F
		SB	RT	437	437	495	495	57	57	13%	13%	11.8	11.8	36	36	383	383	B	B
		Intersection		1,410		1,471		61		4%		35.7						D	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
217	Benning Road NE at East Capitol Street SE	NB	LT	453	693	419	687	-34	-6	-8%	-1%	132.6	103.2	287	287	790	795	F	F
			TH	218		247		29		13%		57.8		287		790		E	
			RT	22		21		-1		-3%		51.2		287		795		D	
		SB	LT	97	461	88	423	-9	-38	-10%	-8%	32.3	22.7	0	119	7	172	C	C
			TH	243		224		-19		-8%		27.4		1		24		C	
			RT	121		112		-9		-8%		5.8		119		172		A	
		EB	LT	262	789	272	764	10	-25	4%	-3%	47.1	19.3	103	103	231	246	D	B
			TH	409		370		-39		-10%		4.4		103		231		A	
			RT	118		122		4		3%		2.5		34		246		A	
		WB	TH	1,817	1,851	1,805	1,835	-12	-16	-1%	-1%	57.8	57.7	302	308	945	954	E	E
			RT	34		30		-3		-9%		52.9		308		954		D	
		Intersection		3,793		3,709		-84		-2%		54.2						D	
218	East Capitol Street SE at Texas Avenue SE	NB	RT	242	242	134	134	-109	-109	-45%	-45%	666.5	666.5	649	649	703	703	F	F
		EB	TH	542	556	617	630	74	73	14%	13%	47.1	46.6	72	72	287	298	D	D
			RT	14		13		-1		-8%		21.8		69		298		C	
		WB	U	4	2,391	14	2,375	10	-17	260%	-1%	73.2	3.5	41	43	316	316	E	A
			LT	117		110		-7		-6%		50.8		43		315		D	
			TH	2,270		2,250		-20		-1%		0.8		11		213		A	
		Intersection		3,190		3,138		-52		-2%		40.4						D	
310	Deane Avenue NE at Lee St NE	SB	LT	256	258	252	252		-6		-2%								
			RT	2															
		EB	LT	2	5	4	4		-1		-10%								
			TH	3															
		WB	TH	2	67	77	77		11		16%								
			RT	65															
		Intersection		329		334		4		1%									
311	Deane Avenue NE at Kenilworth Terrace NE	NB	LT	8	280	9	279	1	-1	6%	0%	48.7	30.7	30	30	289	289	D	C
			RT	272		271		-1		0%		30.1		23		269		C	
		SB	LT	387	547	398	558	11	11	3%	2%	175.3	173.1	556	580	1,287	1,315	F	F
			TH	153		160		7		5%		167.6		580		1,315		F	
			RT	7		0		-7		-100%		-		0		0		-	
		EB	TH	193	261	183	246	-10	-16	-5%	-6%	205.3	201.3	571	601	1,071	1,101	F	F
			RT	68		62		-6		-8%		189.6		601		1,101		F	
		WB	LT	194	249	189	251	-5	2	-3%	1%	2.8	2.9	2	2	37	37	A	A
			TH	55		62		7		13%		3.1		2		37		A	
		Intersection		1,337		1,334		-3		0%		116.5						F	
312	Deane Avenue NE at Kenilworth Avenue NE	SB	LT	174	224	137	175	-37	-49	-21%	-22%	281.4	281.8	964	964	1,168	1,168	F	F
			TH	50		38		-12		-24%		283.0		964		1,168		F	
		EB	TH	645	852	653	854	8	1	1%	0%	9.9	8.7	74	79	176	183	A	A
			RT	207		200		-7		-3%		4.6		79		183		A	
		WB	LT	604	842	604	855	-1	12	0%	1%	11.1	14.1	32	32	280	280	B	B
			TH	238		251		13		5%		21.2		32		280		C	
		Intersection		1,918		1,883		-36		-2%		36.5						D	
313	Nannie Helen Burroughs Avenue NE at Kenilworth Avenue NE and DC-295 U-turns	NB	U	127	445	125	433	-2	-12	-2%	-3%	16.8	9.6	5	29	126	195	B	A
			LT	20		19		-1		-5%		53.2		29		195		D	
			TH	21		22		0		1%		49.0		0		0		D	
			RT	276	276	267	267	-10	-10	-4%	-4%	22.1	22.1	30	30	216	216	C	C
		EB	LT	165	819	160	822	-5	3	-3%	0%	36.9	18.8	37	37	271	271	D	B
			TH	654		662		8		1%		14.4		37		271		B	
		WB	TH	822	1,354	836	1,374	14	20	2%	1%	32.3	28.3	175	196	358	384	C	C
			RT	532		538		6		1%		22.1		196		384		C	
		Intersection		2,894		2,629		-266		-9%		24.5						C	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
314	Nannie Helen Burroughs Avenue NE at Minnesota Avenue NE	NB	LT	314	436	320	447	6	11	2%	3%	57.2	45.8	114	114	456	456	E	D
			TH	78		80		2		3%		24.4		9		90		C	
			RT	44		48		4		8%		5.4		9		114		A	
		SB	TH	166	538	172	548	6	9	4%	2%	53.5	168.4	517	538	910	932	D	F
			RT	372		376		3		1%		221.0		538		932		F	
		EB	LT	70	928	71	928	1	0	2%	0%	33.1	17.7	80	84	335	345	C	B
			TH	478		477		-1		0%		20.1		80		335		C	
			RT	381		381		0		0%		11.9		84		345		B	
		WB	LT	36	669	31	718	-5	49	-14%	7%	73.3	59.5	18	165	190	429	E	E
			TH	666		677		11		2%		58.9		147		405		E	
			RT	3		10		7		227%		58.4		165		429		E	
		Intersection		2,571		2,641		70		3%		65.1						E	
315	Nannie Helen Burroughs Avenue NE at 44th Street NE and Hunt Place NE	NB	LT	132	227	132	223	0	-4	0%	-2%	68.4	57.5	66	66	354	357	E	E
			TH	53		53		0		-1%		49.1		66		354		D	
			RT	42		38		-4		-9%		31.5		66		357		C	
		SB	LT	6	359	6	353	-1	-6	-8%	-2%	42.8	38.9	87	101	426	456	D	D
			TH	205		203		-2		-1%		39.5		87		426		D	
			SBR - NHB EB	52		50		-3		-5%		32.5		101		456		C	
			SBR - Hunt	96		96		-1		-1%		40.7		87		426		D	
		EB	LT	15	526	14	526	-1	0	-5%	0%	17.1	10.7	24	24	267	267	B	B
			TH	364		379		15		4%		9.8		24		267		A	
			EBR - Hunt Street	4		4		0		-5%		17.2		24		267		B	
			EBR - 44th Street	142		128		-14		-10%		12.3		24		267		B	
		Hunt Street	NBL- NHB EB	30	50	28	47	-2	-3	-8%	-6%	44.9	45.0	12	12	87	87	D	D
			NBT - 44th SB	11		10		-1		-9%		46.1		12		87		D	
			NBR - NHB WB	9		9		0		-3%		42.8		12		87		D	
		WB	WBL - Hunt Street	52	559	52	560	0	1	-1%	0%	38.6	28.3	74	91	502	531	D	C
			WBL - 44th Street	5		5		0		-4%		40.9		74		502		D	
			TH	490		493		3		1%		27.3		74		502		C	
			RT	12		11		-1		-12%		17.9		91		531		B	
		Intersection		1,721		1,709		-12		-1%		29.3						C	
316	Kenilworth Avenue NE at Foote Street NE	SB	TH	1,317	1,373	1,314	1,370	-3	-3	0%	0%	179.1	177.5	0	0	0	2	F	D
			RT	56		56		0		1%		141.8		0		2		F	
		EB	RT	240	240	238	238	-2	-2	-1%	-1%	16.3	16.3	26	26	181	181	B	B
		Intersection		1,613		1,609		-5		0%		153.7						F	

*Simulated level of service is approximated based on delay but is not equivalent to that produced using *Highway Capacity Manual* methodology.
*The intersections are numbered based on their inclusion in both the Streetcar and IMR projects (100s), the Streetcar project (200s), and the IMR project (300s).

Volume Calibration (GEH Statistic)

AM Network Peak Hour (7:45-8:45 AM)

Sum of all Link Flows

	Sum of balanced counts	Sum of all link flows	Percent Difference	GEH
Freeways	46,510	46,057	-1.0%	2.1
Arterials	52,551	53,111	1.1%	2.4
Total	99,061	99,167	0.1%	0.3

Individual Link Flows

	Number of Segments	Number of Segments with GEH < 5	Percent Compliance
Freeways	29	29	100%
Arterials	87	86	99%
Total	116	115	99%

*Refer to "Freeways and Ramps" and "Intersections" sheets.

The GEH statistic is computed as follows, where E = VISSIM estimated throughput and V = balanced field count:

$$GEH=\sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

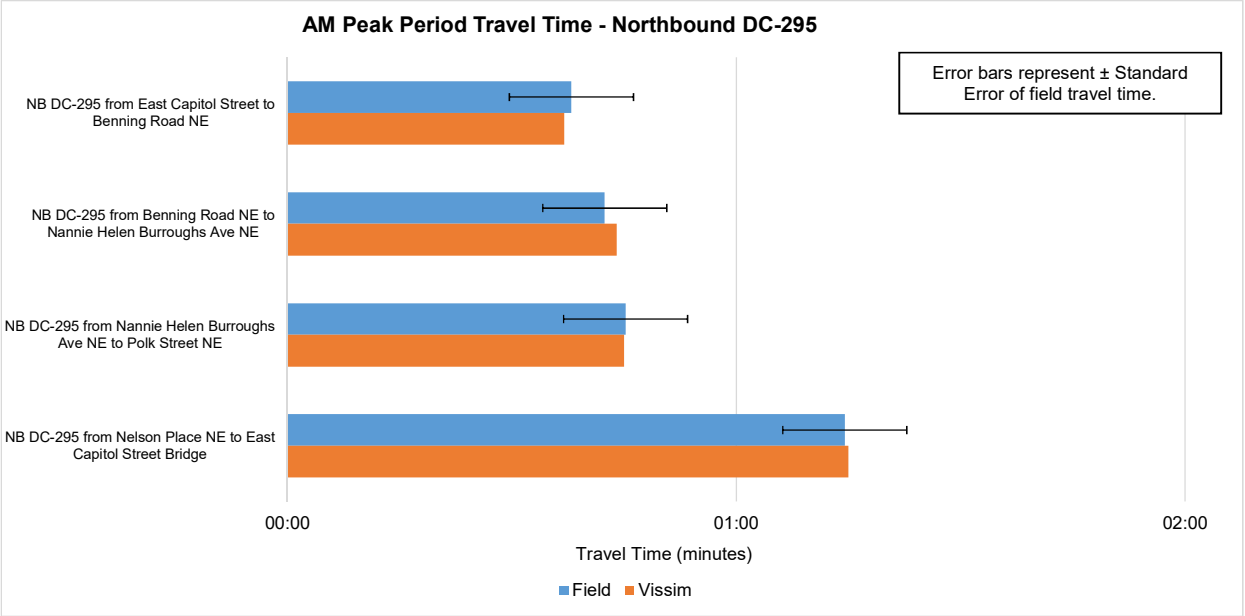
Travel Time Calibration

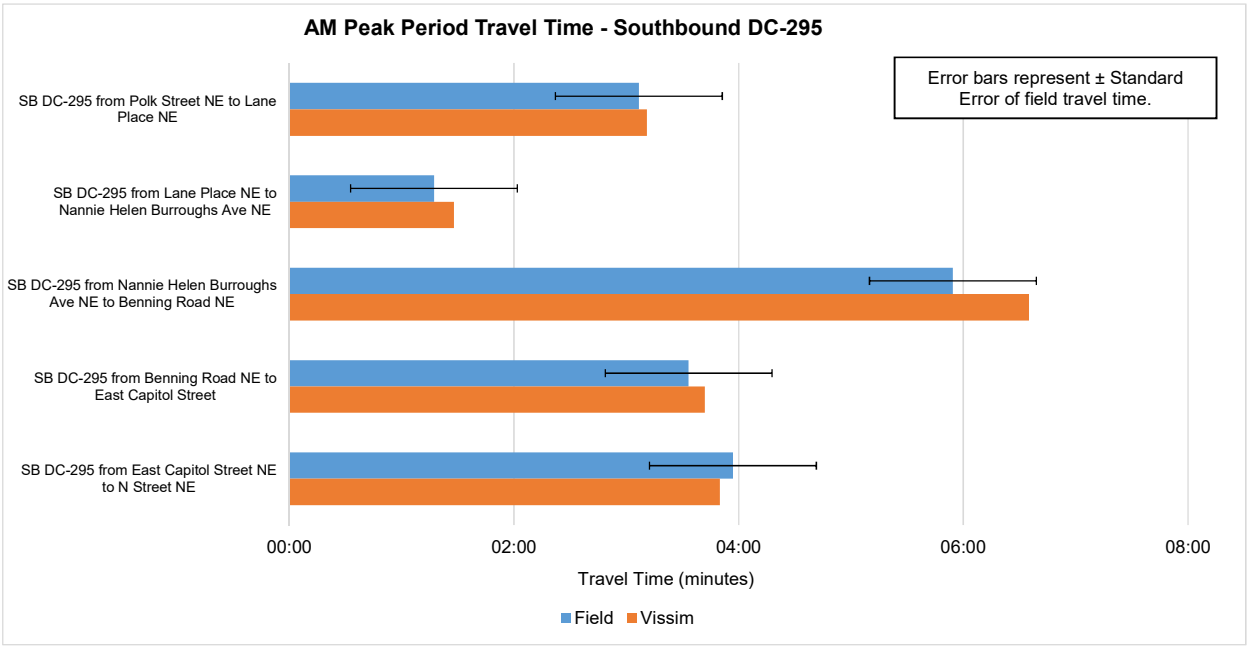
AM Peak Period (7:00 AM - 9:00 AM)

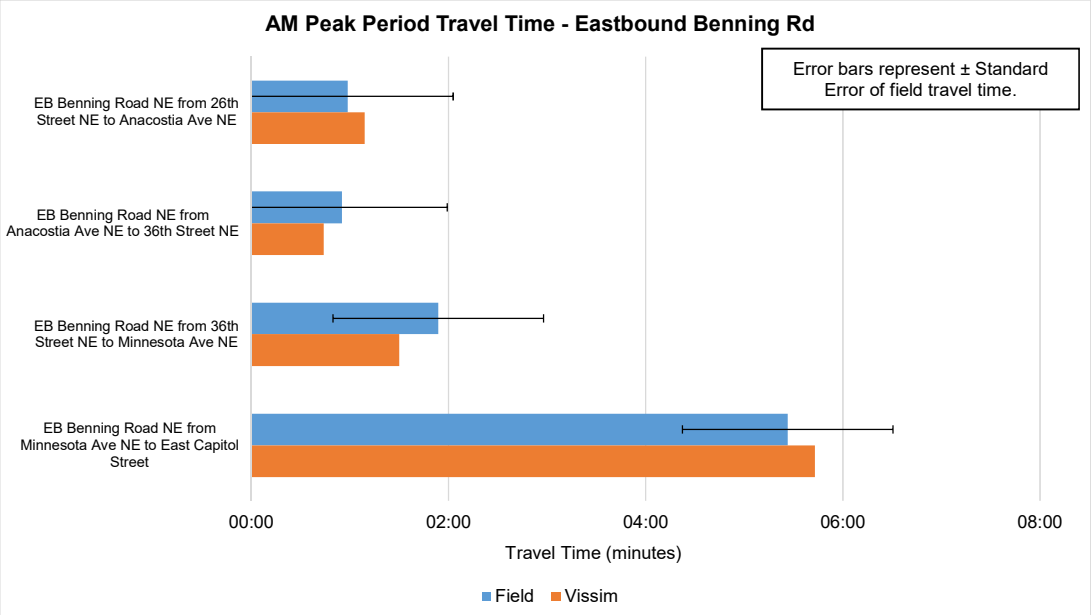
	Travel Time Criteria	Total	Percent	Target	Target Met
NB 295	Within ± 15% for average travel time on freeways	1	100%	85%	Yes
SB 295	Within ± 15% for average travel time on freeways	1	100%	85%	Yes
EB Benning	Within ± 15% for average travel time on arterials	1	100%	85%	Yes
WB Benning	Within ± 15% for average travel time on arterials	1	100%	85%	Yes
Total (n = 4)	Within ± 15% for average travel time	4	100%	85%	Yes

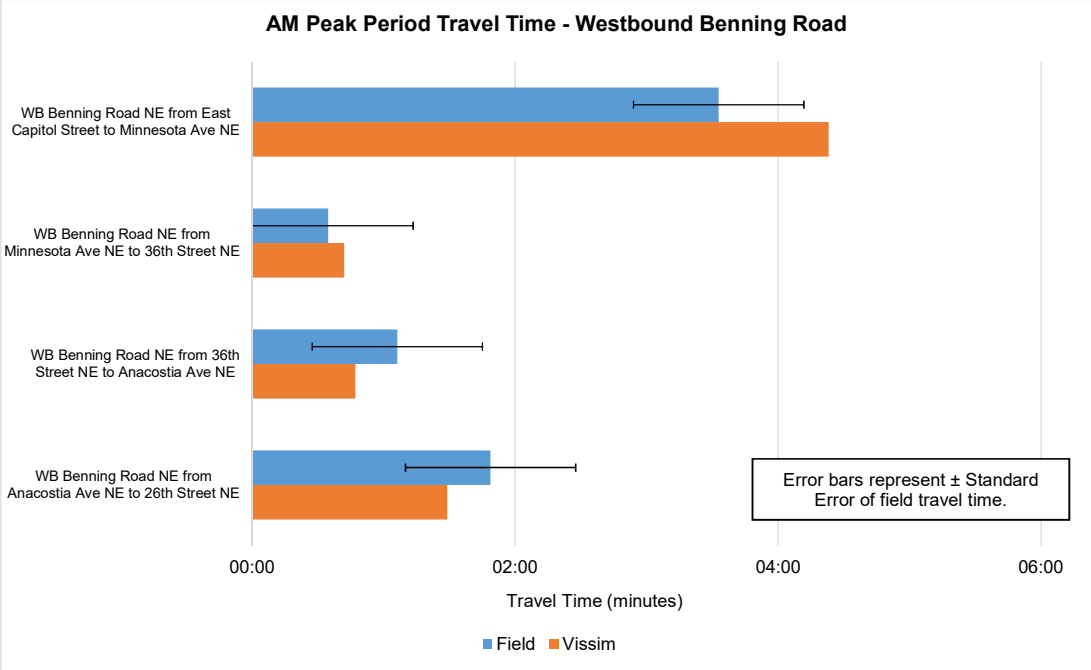
* MOE of Vissim Travel Time represents the average from 10 simulation runs.

Segment ID	Route	Peak Period Travel Time				
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)	VISSIM STDEV (MM:SS)
5	NB DC-295 from East Capitol Street to Benning Road NE	00:38	00:37	-00:01	-3%	00:00
6	NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE	00:42	00:44	00:02	4%	00:00
7	NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE	00:45	00:45	-00:00	0%	00:00
18	NB DC-295 from Nelson Place NE to East Capitol Street Bridge	01:15	01:15	00:00	1%	00:00
Total	**NB DC-295**	**03:20**	**03:21**	**00:01**	**0%**	
8	SB DC-295 from Polk Street NE to Lane Place NE	03:07	03:11	00:04	2%	00:24
9	SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE	01:17	01:28	00:11	14%	00:12
10	SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE	05:54	06:35	00:41	11%	00:42
11	SB DC-295 from Benning Road NE to East Capitol Street	03:33	03:42	00:09	4%	00:19
12	SB DC-295 from East Capitol Street NE to N Street NE	03:57	03:50	-00:07	-3%	00:05
Total	**SB DC-295**	**17:49**	**18:46**	**00:57**	**5%**	
14	WB Benning Road NE from East Capitol Street to Minnesota Ave NE	03:33	04:23	00:50	24%	01:40
15	WB Benning Road NE from Minnesota Ave NE to 36th Street NE	00:35	00:42	00:07	21%	00:00
16	WB Benning Road NE from 36th Street NE to Anacostia Ave NE	01:06	00:47	-00:19	-29%	00:01
17	WB Benning Road NE from Anacostia Ave NE to 26th Street NE	01:49	01:29	-00:20	-18%	00:25
Total	**WB Benning Road NE**	**07:03**	**07:21**	**00:19**	**4%**	
1	EB Benning Road NE from 26th Street NE to Anacostia Ave NE	00:59	01:09	00:10	17%	00:01
2	EB Benning Road NE from Anacostia Ave NE to 36th Street NE	00:55	00:44	-00:11	-20%	00:01
3	EB Benning Road NE from 36th Street NE to Minnesota Ave NE	01:54	01:30	-00:24	-21%	00:27
4	EB Benning Road NE from Minnesota Ave NE to East Capitol Street	05:26	05:43	00:17	5%	02:30
Total	**EB Benning Road NE**	**09:14**	**09:06**	**-00:08**	**-1%**	


AM Peak Period Travel Time - Northbound DC-295
Error bars represent ± Standard Error of field travel time.
NB DC-295 from East Capitol Street to Benning Road NE
NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE
NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE
NB DC-295 from Nelson Place NE to East Capitol Street Bridge
00:00
01:00
02:00
Travel Time (minutes)
Field
Vissim


AM Peak Period Travel Time - Southbound DC-295
Error bars represent ± Standard Error of field travel time.
SB DC-295 from Polk Street NE to Lane Place NE
SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE
SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE
SB DC-295 from Benning Road NE to East Capitol Street
SB DC-295 from East Capitol Street NE to N Street NE
00:00
02:00
04:00
06:00
08:00
Travel Time (minutes)
Field
Vissim


AM Peak Period Travel Time - Eastbound Benning Rd
Error bars represent ± Standard Error of field travel time.
EB Benning Road NE from 26th Street NE to Anacostia Ave NE
EB Benning Road NE from Anacostia Ave NE to 36th Street NE
EB Benning Road NE from 36th Street NE to Minnesota Ave NE
EB Benning Road NE from Minnesota Ave NE to East Capitol Street
00:00
02:00
04:00
06:00
08:00
Travel Time (minutes)
Field
Vissim


AM Peak Period Travel Time - Westbound Benning Road
WB Benning Road NE from East Capitol Street to Minnesota Ave NE
WB Benning Road NE from Minnesota Ave NE to 36th Street NE
WB Benning Road NE from 36th Street NE to Anacostia Ave NE
WB Benning Road NE from Anacostia Ave NE to 26th Street NE
Error bars represent ± Standard Error of field travel time.
00:00
02:00
04:00
06:00
Travel Time (minutes)
Field
Vissim

Queue Length Calibration

AM Peak Period (7:00 AM - 9:00 AM)

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 14)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	11	92%	85%	Yes

Freeway Ramps

* MOE of Vissim Max Queue Length represents the average from 10 simulation runs.

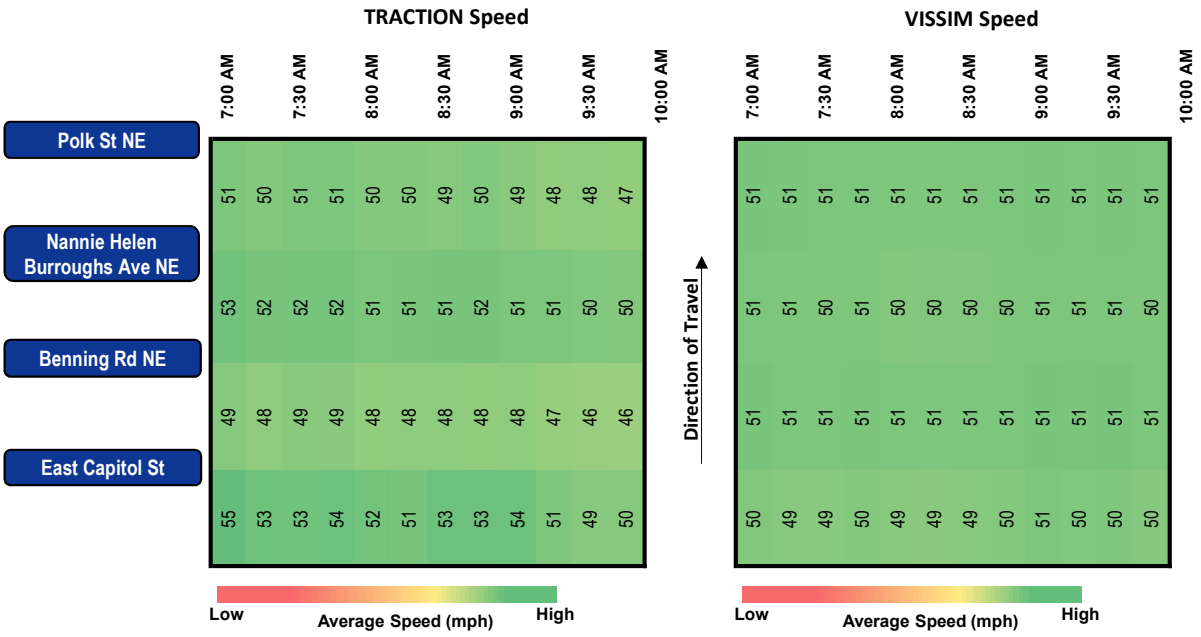
Interchange	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)	Vissim Max Queue Standard Deviation (feet)	Field-Observed Queue Description	Queue Calibration Justification
Benning Road	Eastbound Benning Road NE to Southbound DC-295	250	0	-250	-100%	N	0	Slowdown from Google Maps typical traffic conditions estimated to extend 650 feet	The Vissim model displayed consistently reduced speeds on this ramp; however, the reduced speeds did not result in a queue being measured in Vissim.
	Eastbound Benning Road NE/ Southbound Kenilworth Avenue NE to Northbound DC-295	-	3	-	-	Y	4	Slowdown from Google Maps typical traffic conditions estimated to extend 0 feet	
	Southbound Kenilworth Avenue NE to Northbound DC-295	-	16	-	-	Y	9	Queue from Google Maps typical traffic conditions estimated to be 0 feet	
	Northbound DC-295 to Westbound Benning Road NE	-	375	-	-	Y	118	Queue from Google Maps typical traffic conditions estimated to be 200 feet	Traffic was observed to occupy two lanes' space approaching the stop sign after the weaving area, which results in shorter queue length than VISSIM output; however, such yield behavior is difficult to model and therefore was not coded. The resultant queue impact does not affect operations at other locations becasue average queue is much shorter.
	Northbound DC-295/Southbound Kenilworth Avenue NE to Westbound Benning Road NE	-	0	-	-	Y	0	Slowdown from Google Maps typical traffic conditions estimated to extend 800 feet	The westbound service road merges with Benning Road without needing to stop; Google data represents a slowdown due to traffic friction, not queuing.

Arterial Queue Counters

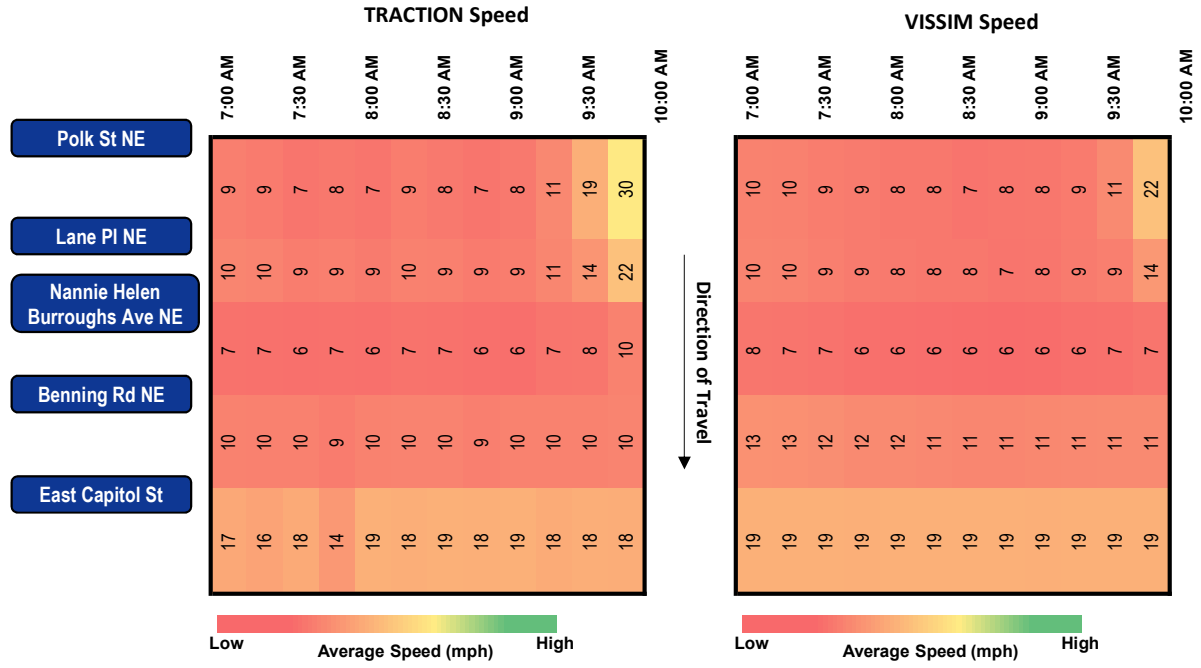
* MOE of Vissim Max Queue Length represents the average from 10 simulation runs.

Interchange	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)	Vissim Max Queue Standard Deviation (feet)	Field-Observed Queue Description	Queue Calibration Justification
Benning Road and East Capitol Street Intersection	Southbound Benning Road NE at East Captiol Street	550	979	429	78%	Y	384	Queue spillback from East Capital Street intersection was observed to impact 44th and 45th Street intersections	The queue spillback impact was reasonably modeled
	Northbound Benning Road NE at East Capitol Street	475+	715	-	-	Y	272	Slowdown from Google Maps typical traffic conditions estimated to extend 1900 feet	The queue spillback impact was reasonably modeled; field measured queue data was limited to adjacent driveways (e.g., A Street SE, B Street SE)
	Westbound East Capitol Street at Benning Road NE	750+	831	-	-	Y	207	Slowdown from Google Maps typical traffic conditions estimated to extend 550 feet	The queue spillback impact was reasonably modeled
	Eastbound East Capitol Street at Benning Road NE	200	279	79	39%	Y	54	Queue spillback from Benning Road intersection was observed to fill the short block between Texas Avenue and Benning Road all the time	The queue spillback impact was reasonably modeled; field measured queue data was limited to Texas Avenue
Benning Road and Oklahoma Avenue Intersection	Westbound Benning Road at Oklahoma Avenue	300+	1650	-	-	Y	614	Queue spillback from the intersection extends out of the turn lane frequently and as far as Anacostia Avenue intersection; Slowdown from Google Maps typical traffic conditions estimated to extend 2600 feet	The queue spillback impact was reasonably modeled; field measured queue data was limited.
Benning Road and Minnesota Avenue	Eastbound Benning Road NE at Minnesota Avenue NE	300+	576	-	-	Y	101	Slowdown from Google Maps typical traffic conditions estimated to extend 725 feet	The queue spillback impact was reasonably modeled
	Westbound Benning Road NE at Minnesota Avenue NE	300+	437	-	-	Y	32	Queue spillback from Minnesota Avenue intersection was observed to extend east of 39th Street	The queue spillback impact was reasonably modeled; field measured queue data was limited to adjacent intersections
	Northbound Minnesota Avenue NE at Benning Road NE	475	457	-18	-4%	Y	65	Slowdown from Google Maps typical traffic conditions estimated to extend 700 feet	The queue spillback impact was reasonably modeled
	Southbound Minnesota Avenue NE at Benning Road NE	400	575	175	44%	Y	70	Slowdown from Google Maps typical traffic conditions estimated to extend 1000 feet	The queue spillback impact was reasonably modeled

Freeway Average Speed Comparison: DC-295 - Northbound



Freeway Average Speed Comparison: DC-295 - Southbound



* MOE of Speed represents the average from 10 simulation runs.
* All speeds reported in MPH.

PM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Criteria Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 77)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	81	93%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 29)**	Within ± 100 vph for < 700 vph Within ± 15% for ≥ 700 vph to < 2,700 vph Within ± 400 vph for ≥ 2,700 vph	29	100%	85%	Yes
Simulated Traffic Volume (Sum of All Link Flows)	**All Segments/Approaches**	Within 5% of sum of all link counts		0%	5%	Yes
Simulated Traffic Volume (GEH Statistic)	**Segments/Approaches (n = 116)**	< 5 for individual link flows	111	96%	85%	Yes
	All Segments/Approaches	< 4 for the sum of all link flows	0.2		4.0	Yes
Simulated Travel Time	**Routes (n=4)**	Within ± 15% for average travel time	4	100%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 14)**	Modeled queues qualitatively reflect the impacts of observed queues				Yes
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect the pattern and duration of congestion				Yes

1. Simulated Average Speed – Speeds are highly variable on the freeway and arterials, sometimes varying substantially by hour and by day. Simulated average speed was captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat maps.

2. Simulated Queue Length – Queuing within the study area is notably inconsistent, oscillating numerous times within each peak period and absent altogether some days. A qualitative assessment of queue lengths at targeted locations was conducted in conjunction with a review of freeway mainline congestion patterns against the speed heat maps.

Volume Calibration (Freeways)

PM Peak Period (4:30 PM - 5:30 PM)

		Subtotal	Total	Percent	Target	Target Met
Segments (n = 29)	Within ± 100 vph for < 700 vph	11	29	100%	85%	Yes
	Within ± 15% for ≥ 700 vph to < 2,700 vph	5				
	Within ± 400 vph for ≥ 2,700 vph	13				

* MOEs of Throughput, Speed, and Density represent an average of 10 simulation runs.

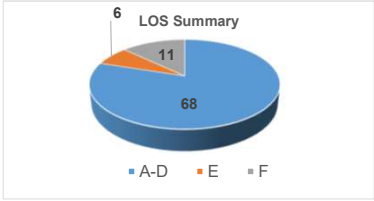
Facility	Segment	Type	Balanced Count (vph)	VISSIM Throughput (vph)	Difference (vph)	Difference (%)	Average Speed (mph)	Average Density (vpmpl)
NB DC-295	Mainline south of EB E Capitol Street On-Ramp	Basic	2,660	2,964	304	11%	19	82.9
	Between EB E Capitol Street On-Ramp and WB Benning Road NE Off-Ramp	Merge/Diverge	3,585	3,874	289	8%	15	89.4
	Between WB Benning Road Off-Ramp and EB Benning Road/Kenilworth Avenue NE On-Ramp	Basic	3,490	3,795	305	9%	12	104.7
	Between EB Benning Road NE/Kenilworth Avenue NE On-Ramp and Nannie Helen Burroughs Avenue NE Off-Ramp	Merge/Diverge	4,375	4,564	189	4%	19	76.5
	Between Nannie Helen Burroughs Avenue NE Off-Ramp and Kenilworth Avenue NE On-Ramp	Basic	3,560	3,782	222	6%	12	101.7
	Mainline north of Nannie Helen Burroughs Avenue	Merge/Basic	3,865	4,055	190	5%	13	85.8
SB DC-295	Mainline North of Deane Avenue NE Off-Ramp	Merge/Diverge	3,345	3,554	209	6%	51	20.6
	Between Deane Avenue NE Off-Ramp and Kenilworth Avenue NE Off-Ramp	Basic/Diverge	3,005	3,200	195	6%	51	20.1
	Between Kenilworth Avenue NE Off-Ramp and Kenilworth Avenue NE On-Ramp	Basic	2,775	2,956	181	7%	52	19.0
	Between Kenilworth Avenue NE On-Ramp and EB Benning Road NE On-Ramp	Merge/Basic	3,025	3,172	147	5%	50	21.0
	Between EB Benning Road NE On-Ramp and Baker Street Off-Ramp	Weave	3,300	3,401	101	3%	39	33.2
	Between Baker Street Off-Ramp and WB E Capitol Street Off-Ramp	Diverge	3,245	3,356	111	3%	25	61.3
	Between WB E Capitol Street Off-Ramp and EB E Capitol Street On-Ramp	Basic	2,925	3,013	88	3%	21	75.6
	Mainline south of EB E Capitol Street On-Ramp	Merge/Basic	3,080	3,167	87	3%	25	68.4

Interchange	Ramp		Balanced Count (vph)	VISSIM Throughput (vph)	Difference (vph)	Difference (%)	Average Speed (mph)	Average Density (vpmpl)
Capitol Street	EB E Capitol Street to SB DC-295		155	161	6	4%	29	5.7
	EB E Capitol Street to NB DC-295		925	910	-15	-2%	28	34.2
	SB DC-295 to WB E Capitol Street		320	332	12	4%	40	8.5
Baker Street	SB DC-295 to WB Baker Street		55	53	-2	-4%	20	2.6
Benning Road	EB Benning Road NE to SB DC-295		275	243	-32	-12%	36	6.9
	EB Benning Road NE to NB DC-295 or WB Benning Road NE (U-turns)		840	736	-104	-12%	16	53.1
	NB DC-295 to WB Benning Road NE		95	103	8	8%	31	3.9
	NB DC-295/EB Benning Road NE (U-turns) to WB Benning Road NE		85	103	18	21%	13	9.1
	SB Kenilworth Avenue NE to NB DC-295		35	32	-3	-9%	13	35.9
	EB Benning Road NE/SB Kenilworth Avenue NE to NB DC-295		885	770	-115	-13%	13	72.5
Kenilworth Avenue	SB Kenilworth Avenue NE to SB DC-295 (South)		250	218	-32	-13%	25	8.4
	SB DC-295 to SB Kenilworth Avenue NE		230	244	14	6%	39	6.3
	NB Kenilworth Avenue NE to NB DC-295		305	277	-28	-9%	20	15.5
Nannie Helen Burroughs Avenue	NB DC-295 to Nannie Helen Burroughs Avenue NE/Kenilworth Avenue NE		815	784	-31	-4%	40	20.9
	SB DC-295 to Deane Avenue NE/Kenilworth Terrace NE/Kenilworth Avenue NE		340	349	9	3%	41	8.2

Volume Calibration (Intersections)

PM Peak Period (4:30 PM - 5:30 PM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 77)	Within ± 100 vph for < 700 vph	62	81	93%	85%	Yes
	Within ± 15% for ≥ 700 vph to < 2,700 vph	19				
	Within ± 400 vph for ≥ 2,700 vph	0				



Approaches:	
LOS	Count
A-D	68
E	6
F	11

* MOEs of Throughput, Delay, and Queue Lenth represent an average of 10 simulation runs.

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
101	Benning Road NE at Anacostia Avenue NE	NB	LT	63	86	55	73	-8	-12	-13%	-14%	56.1	44.0	17	17	120	124	E	D
			RT	23		19		-4		-17%		8.8		13		124		A	
		SB	LT	1	3	2	5	1	2	50%	73%	94.6	62.3	2	2	33	33	F	E
			RT	2		4		2		85%		47.5		2		33		D	
		EB	LT	1	2,073	1	1,784	0	-288	0%	-14%	396.2	343.6	1,584	1,625	2,618	2,682	F	F
			TH	1,768		1,526		-242		-14%		361.5		1,584		2,618		F	
			RT	304		258		-46		-15%		237.7		1,625		2,682		F	
		WB	LT	9	953	7	913	-2	-41	-21%	-4%	23.3	2.6	5	5	86	86	C	A
			TH	944		905		-39		-4%		2.4		5		86		A	
		Intersection		3,115		2,776		-339		-11%		223.0						F	
102	Benning Road NE at 34th Street NE	NB	LT	30	120	30	121	-1	1	-2%	1%	36.3	19.5	12	12	169	179	D	B
			TH	2		0		-2		-100%		-		12		169		-	
			RT	88		91		3		4%		14.1		12		179		B	
		SB	LT	19	30	9	14	-10	-16	-52%	-54%	55.7	47.5	2	2	48	48	E	D
			TH	4		1		-3		-73%		30.2		2		48		C	
			RT	7		4		-4		-50%		31.9		2		48		C	
		EB	TH	1,772	1,792	1,508	1,524	-264	-269	-15%	-15%	194.4	193.0	787	810	863	886	F	F
			RT	20		16		-5		-23%		65.6		810		886		E	
		WB	LT	141	1,064	137	1,030	-4	-33	-3%	-3%	114.2	24.9	97	97	362	362	F	C
			TH	917		879		-38		-4%		10.0		30		278		A	
			RT	6		4		-2		-34%		8.9		26		284		A	
			U	16		10		-6		-36%		113.3		97		362		F	
		Intersection		3,006		2,678		-328		-11%		120.5						F	
103	Benning Road NE Ramp to DC-295 at 36th Street NE	NB	RT	241	241	240	240	-1	-1	-1%	-1%	11.0	11.0	9	9	167	167	B	B
		EB	TH	874	876	734	736	-139	-139	-16%	-16%	79.3	79.1	879	879	996	996	E	E
			RT	2		2		0		5%		25.6		757		851		C	
		Intersection		1,117		976		-141		-13%		62.4						E	
104	Benning Road NE at Minnesota Avenue NE	NB	LT	132	411	129	452	-3	41	-2%	10%	180.3	161.4	386	386	580	580	F	F
			TH	257		304		47		18%		154.2		386		580		F	
			RT	22		19		-3		-14%		145.8		386		580		F	
		SB	LT	52	429	52	414	0	-15	0%	-3%	53.5	39.2	14	88	208	432	D	D
			TH	306		285		-21		-7%		42.7		88		432		D	
			RT	71		77		6		9%		16.9		88		432		B	
		EB	LT	203	1,020	177	850	-26	-170	-13%	-17%	645.4	406.3	1,616	1,616	1,677	1,677	F	F
			TH	561		456		-105		-19%		361.0		1,616		1,677		F	
			RT	256		218		-38		-15%		307.0		1,616		1,677		F	
		WB	LT	14	357	11	349	-3	-7	-22%	-2%	124.9	82.9	104	104	279	279	F	F
			TH	256		243		-13		-5%		84.1		104		279		F	
			RT	87		96		9		10%		75.3		104		279		E	
		Intersection		2,216		2,065		-151		-7%		224.4						F	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
105	Benning Road NE at 39th Street NE/Driveway	NB	LT	10	19	11	20	1	1	10%	6%	71.6	49.1	4	4	74	80	E	D
			RT	9		9		0		1%		20.7		3		80		C	
		SB	LT	4	9	3	8	-1	-1	-33%	-13%	51.8	32.7	1	1	28	28	D	C
			RT	5		0		-5		-100%		-		0		0		-	
		EB	LT	10	634	9	526	-1	-108	-8%	-17%	7.0	7.5	22	22	397	397	A	A
			TH	604		504		-101		-17%		7.5		22		397		A	
			RT	20		13		-7		-36%		6.6		22		397		A	
		WB	LT	19	370	15	358	-4	-12	-22%	-3%	4.6	2.6	3	3	72	72	A	A
			TH	342		335		-7		-2%		2.5		3		72		A	
			RT	9		9		-1		-9%		4.0		3		72		A	
		Intersection		1,032		911		-121		-12%		6.7						A	
106	Benning Road NE at 40th Street NE	NB	LT	31	292	33	310	2	19	5%	6%	19.8	16.4	28	28	198	198	B	B
			RT	261		278		17		7%		16.0		28		198		B	
		EB	TH	592	617	494	516	-98	-101	-17%	-16%	0.7	0.7	0	3	124	125	A	A
			RT	25		22		-3		-13%		1.2		3		125		A	
		WB	LT	138	477	127	451	-11	-26	-8%	-5%	5.1	2.4	5	5	118	118	A	A
			TH	339		325		-15		-4%		1.4		5		118		A	
		Intersection		1,386		1,277		-109		-8%		5.1						A	
107	Benning Road NE at 41st Street NE	NB	LT	4	102	2	89	-3	-13	-63%	-13%	11.9	8.5	3	3	62	64	B	A
			RT	98		87		-11		-11%		8.4		3		64		A	
		EB	TH	847	853	766	771	-81	-81	-10%	-10%	0.5	0.5	0	0	46	46	A	A
			RT	6		6		0		-5%		0.8		0		11		A	
		WB	LT	41	515	44	494	3	-21	6%	-4%	6.6	1.3	3	3	108	108	A	A
			TH	473		450		-24		-5%		0.8		3		108		A	
		Intersection		1,469		1,353		-116		-8%		1.3						A	
108	Benning Road NE at 42nd Street NE	NB	LT	32	123	38	148	6	25	18%	21%	27.0	25.9	18	22	163	193	C	C
			TH	79		96		17		22%		26.7		18		163		C	
			RT	12		14		2		20%		17.1		22		193		B	
		SB	LT	23	221	20	198	-4	-23	-15%	-10%	27.8	19.3	17	19	175	192	C	B
			TH	70		65		-5		-8%		25.9		17		175		C	
			RT	128		114		-14		-11%		14.2		19		192		B	
		EB	LT	316	945	294	850	-22	-95	-7%	-10%	21.4	14.9	52	62	312	337	C	B
			TH	574		505		-68		-12%		11.8		52		312		B	
			RT	55		51		-4		-7%		8.0		62		337		A	
		WB	LT	4	393	3	377	-1	-17	-26%	-4%	16.9	6.6	9	9	135	154	B	A
			TH	355		341		-13		-4%		6.7		9		135		A	
			RT	35		32		-3		-7%		4.6		8		154		A	
		Intersection		1,682		1,573		-109		-6%		14.5						B	
208	Benning Road NE at 26th Street NE	SB	LT	264	328	246	305	-17	-23	-7%	-7%	119.1	117.0	249	267	763	791	F	F
			RT	64		59		-5		-8%		108.3		267		791		F	
		EB	LT	40	1,781	40	1,794	0	13	-1%	1%	54.8	59.1	66	303	339	913	D	E
			TH	1,741		1,754		13		1%		59.2		303		913		E	
		WB	LT	811	968	778	927	-33	-41	-4%	-4%	4.3	4.2	13	13	161	177	A	A
			TH	158		149		-8		-5%		4.2		11		177		A	
		Intersection		3,077		3,026		-51		-2%		48.1						D	
209	Benning Road NE at Oklahoma Avenue NE	NB	LT	71	347	69	316	-2	-31	-3%	-9%	174.4	152.0	335	344	879	890	F	F
			RT	276		247		-29		-10%		145.7		344		890		F	
		EB	TH	1,797	2,004	1,802	2,006	5	2	0%	0%	15.8	15.7	106	110	297	311	B	B
			RT	207		204		-3		-2%		14.3		110		311		B	
		WB	LT	113	1,009	113	971	0	-38	0%	-4%	41.9	11.9	13	13	120	178	D	B
			TH	896		859		-38		-4%		8.0		11		178		A	
		Intersection		3,360		3,293		-66		-2%		27.6						C	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
210	Minnesota Avenue NE at Dix Street NE	NB	LT	5	434	6	538	1	104	24%	24%	60.7	102.1	229	252	1,009	1,055	E	F
			TH	350		439		88		25%		96.5		229		1,009		F	
			RT	79		93		14		18%		131.5		252		1,055		F	
		SB	LT	58	576	54	513	-5	-63	-9%	-11%	28.2	12.3	21	21	238	278	C	B
			TH	502		449		-54		-11%		10.5		21		238		B	
			RT	15		11		-4		-29%		9.2		20		278		A	
		EB	LT	19	66	17	63	-2	-4	-11%	-6%	47.9	37.9	10	10	104	104	D	D
			TH	30		29		-1		-4%		33.9		10		104		C	
			RT	17		17		0		-2%		34.7		10		104		C	
		WB	LT	150	220	154	220	4	0	2%	0%	112.4	115.0	165	179	582	601	F	F
			TH	29		27		-3		-9%		109.5		165		582		F	
			RT	41		40		-1		-3%		128.8		179		601		F	
		Intersection		1,297		1,334		37		3%		66.7						E	
211	Minnesota Avenue NE at Bus Exit South	NB	TH	546	546	573	573	27	27	5%	5%	19.9	19.9	58	58	555	555	B	B
		SB	TH	385	385	383	383	-2	-2	-1%	-1%	3.0	3.0	5	5	78	78	A	A
		EB	LT	20	63	22	54	2	-9	9%	-14%	41.3	30.5	19	19	153	167	D	C
			RT	43		32		-11		-25%		23.2		9		167		C	
		Intersection		994		1,010		16		2%		14.1						B	
212	Minnesota Avenue NE at Grant Street NE and Bus Entrance North	NB	LT	40	565	16	563	-24	-2	-60%	0%	19.1	16.3	2	55	69	372	B	B
			TH	470		501		31		7%		16.2		55		372		B	
			RT	55		47		-8		-15%		16.1		55		372		B	
		SB	LT	11	370	10	372	-1	2	-5%	1%	25.5	12.2	15	16	135	162	C	B
			TH	345		362		17		5%		11.9		15		135		B	
			RT	14		0		-14		-100%		-		16		162		-	
		WB	LT	39	68	34	60	-5	-8	-12%	-12%	16.5	11.7	3	3	64	97	B	B
			RT	29		26		-3		-11%		5.2		2		97		A	
		Intersection		1,003		995		-7		-1%		14.5						B	
213	Benning Road NE at Blaine Street NE	NB	LT	3	54	1	53	-2	-1	-70%	-2%	12.3	9.5	2	2	54	60	B	A
			RT	51		52		1		2%		9.4		2		60		A	
		EB	TH	603	608	533	539	-70	-69	-12%	-11%	1.7	1.7	0	0	13	63	A	A
			RT	5		6		1		14%		2.1		0		63		A	
		WB	LT	44	434	40	416	-4	-18	-8%	-4%	5.4	0.9	1	1	82	82	A	A
			TH	390		376		-15		-4%		0.4		0		50		A	
		Intersection		1,097		1,007		-89		-8%		1.8						A	
214	Benning Road NE at 44th Street NE	SB	LT	186	270	176	254	-10	-16	-6%	-6%	35.6	32.3	48	48	270	277	D	C
			RT	84		78		-6		-7%		24.7		48		277		C	
		EB	LT	165	656	147	584	-18	-71	-11%	-11%	27.0	18.0	44	44	316	316	C	B
			TH	491		438		-53		-11%		15.0		44		316		B	
		WB	TH	351	543	337	524	-14	-19	-4%	-4%	11.3	11.4	24	24	251	292	B	B
			RT	192		187		-5		-3%		11.5		19		292		B	
		Intersection		1,468		1,362		-107		-7%		18.1						B	
215	Benning Road NE at 45th Street NE	SB	LT	14	28	8	15	-6	-12	-41%	-45%	17.5	13.1	1	1	38	42	B	B
			RT	14		7		-7		-49%		8.1		0		42		A	
		EB	LT	28	676	25	611	-3	-66	-10%	-10%	11.3	8.9	33	33	255	255	B	A
			TH	648		585		-63		-10%		8.8		33		255		A	
		WB	TH	527	578	518	571	-9	-8	-2%	-1%	1.0	1.1	0	5	123	224	A	A
			RT	51		53		1		3%		2.9		5		224		A	
		Intersection		1,283		1,196		-86		-7%		5.2						A	
216	Benning Road NE at Central Avenue NE	WB	TH	481	504	471	492	-10	-13	-2%	-2%	0.4	0.4	0	0	63	79	A	A
			RT	23		21		-2		-10%		0.0		0		79		A	
		EB	TH	671	671	594	594	-77	-77	-11%	-11%	49.3	49.3	102	102	298	298	D	D
		SB	RT	100	100	100	100	-1	-1	-1%	-1%	3.8	3.8	3	3	68	68	A	A
		Intersection		1,275		1,185		-90		-7%		25.2						C	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
217	Benning Road NE at East Capitol Street SE	NB	LT	172	507	161	505	-11	-2	-6%	0%	65.1	63.7	79	86	300	313	E	E
			TH	291		302		10		4%		64.7		79		300		E	
			RT	44		42		-2		-4%		50.9		86		313		D	
		SB	LT	192	672	167	595	-25	-77	-13%	-11%	1.3	0.9	0	83	2	170	A	A
			TH	380		345		-35		-9%		0.7		0		4		A	
			RT	100		83		-17		-17%		0.8		83		170		A	
		EB	LT	126	2,002	110	2,042	-17	40	-13%	2%	47.2	4.6	33	34	205	223	D	A
			TH	1,653		1,687		34		2%		2.1		33		205		A	
			RT	223		245		22		10%		3.1		34		223		A	
		WB	TH	648	735	644	724	-5	-11	-1%	-2%	39.7	38.4	68	81	285	315	D	D
			RT	87		80		-7		-8%		28.3		81		315		C	
		Intersection		3,916		3,866		-51		-1%		18.1						B	
218	East Capitol Street SE at Texas Avenue Se	EB	RT	218	218	218	218	0	0	0%	0%	70.3	70.3	70	70	320	320	E	E
		NB	TH	1,779	1,802	1,812	1,833	33	31	2%	2%	46.0	46.1	228	237	727	740	D	D
			RT	23		21		-2		-7%		51.0		237		740		D	
		SB	U	5	920	18	902	13	-18	258%	-2%	33.0	7.2	34	34	229	229	C	A
			LT	213		203		-11		-5%		27.8		34		229		C	
			TH	702		681		-21		-3%		0.4		4		124		A	
		Intersection		2,940		2,952		12		0%		36.0						D	
310	Deane Avenue NE at Lee St NE	SB	LT	73	74	68	68		-6		-8%								
			RT	1															
		EB	LT	0	2	0	0		-2		-100%								
			TH	2															
		WB	TH	1	107	108	108		1		1%								
			RT	106															
		Intersection		183		176		-7		-4%									
311	Deane Avenue NE at Kenilworth Terrace NE	NB	LT	13	275	10	239	-3	-36	-23%	-13%	46.5	17.6	16	16	205	205	D	B
			RT	262		229		-33		-13%		16.3		12		186		B	
		SB	LT	208	281	171	243	-38	-38	-18%	-13%	44.6	42.9	38	48	208	236	D	D
			TH	70		73		3		4%		38.8		48		236		D	
			RT	3		0		-3		-100%		-		0		0		-	
		EB	TH	68	78	63	72	-5	-6	-7%	-8%	47.2	45.0	14	15	89	119	D	D
			RT	10		9		-1		-11%		29.9		15		119		C	
		WB	LT	125	219	120	213	-5	-6	-4%	-3%	2.2	1.6	1	1	37	37	A	A
			TH	94		94		0		0%		0.9		1		37		A	
		Intersection		853		767		-86		-10%		23.7						C	
312	Deane Avenue NE at Kenilworth Avenue NE	SB	LT	265	284	271	293	6	9	2%	3%	52.8	52.8	51	51	212	212	D	D
			TH	19		23		4		19%		52.5		51		212		D	
		EB	TH	524	538	453	463	-71	-75	-14%	-14%	9.4	9.3	31	35	167	174	A	A
			RT	14		10		-4		-28%		3.2		35		174		A	
		WB	LT	282	493	273	486	-10	-7	-3%	-1%	16.7	18.1	22	22	234	234	B	B
			TH	211		213		2		1%		19.9		22		234		B	
		Intersection		1,315		1,242		-73		-6%		23.0						C	
313	Nannie Helen Burroughs Avenue NE at Kenilworth Avenue NE and DC-295 U-turns	NB	U	147	337	137	329	-10	-8	-7%	-2%	120.7	133.9	2,147	2,166	3,009	3,043	F	F
			LT	36		33		-3		-9%		142.7		2,166		3,043		F	
			TH	153		158		5		3%		143.6		0		18		F	
			RT	478	478	457	457	-21	-21	-4%	-4%	156.2	156.2	2,166	2,166	3,044	3,044	F	F
		EB	LT	131	791	121	731	-10	-60	-8%	-8%	10.4	15.8	14	14	209	209	B	B
			TH	660		610		-50		-8%		16.9		14		209		B	
		WB	TH	459	1,043	453	1,004	-6	-39	-1%	-4%	30.5	30.3	133	156	340	369	C	C
			RT	584		551		-33		-6%		30.1		156		369		C	
		Intersection		2,649		2,521		-128		-5%		62.4						E	

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)		LOS*	
314	Nannie Helen Burroughs Avenue NE at Minnesota Avenue NE	NB	LT	383	570	401	613	18	43	5%	8%	52.2	41.6	146	146	603	603	D	D
			TH	135		150		15		11%		27.7		17		162		C	
			RT	52		63		11		21%		7.4		20		186		A	
		SB	TH	59	211	56	191	-3	-20	-5%	-9%	50.6	35.3	24	32	152	174	D	D
			RT	152		135		-17		-11%		29.0		32		174		C	
		EB	LT	137	1,137	130	1,067	-7	-70	-5%	-6%	46.9	30.2	137	144	341	351	D	C
			TH	695		657		-38		-5%		29.8		137		341		C	
			RT	305		280		-25		-8%		23.4		144		351		C	
		WB	LT	41	526	50	534	9	8	22%	2%	77.4	61.4	25	127	172	464	E	E
			TH	507		466		-41		-8%		59.8		111		440		E	
			RT	19		18		-1		-4%		57.7		127		464		E	
		Intersection		2,444		2,405		-39		-2%		40.5						D	
315	Nannie Helen Burroughs Avenue NE at 44th Street NE and Hunt Place NE	NB	NBU-onto Hunt	0	320	0	257	0	-64	-	-20%	-	33.2	-	35	-	257	-	C
			LT	142		113		-29		-20%		39.9		35		255		D	
			TH	84		69		-15		-18%		36.3		35		255		D	
			RT	94		74		-20		-21%		20.2		33		257		C	
		SB	LT	13	142	14	135	1	-8	5%	-5%	37.2	32.6	23	30	180	201	D	C
			TH	69		65		-5		-7%		34.8		23		180		C	
			SBR - NHB EB	32		29		-3		-8%		24.2		30		201		C	
			SBR - Hunt	28		27		-1		-3%		34.1		23		180		C	
		EB	LT	31	752	28	719	-2	-33	-8%	-4%	13.5	14.0	41	41	417	417	B	B
			TH	446		428		-18		-4%		11.2		41		417		B	
			EBR - Hunt Street	2		0		-2		-100%		-		41		417		-	
			EBR - 44th Street	273		263		-11		-4%		18.5		41		417		B	
		Hunt Street	NBL- NHB EB	87	196	93	218	6	22	7%	11%	43.6	43.5	55	55	276	276	D	D
			NBT - 44th SB	51		56		5		9%		44.4		55		276		D	
			NBR - NHB WB	58		68		10		17%		42.7		55		276		D	
		WB	WBL - Hunt Street	38	365	38	346	0	-19	1%	-5%	72.2	36.0	49	64	281	310	E	D
			WBL - 44th Street	4		4		-1		-13%		53.0		49		281		D	
			TH	307		288		-19		-6%		32.0		49		281		C	
			RT	16		16		0		2%		18.7		64		310		B	
		Intersection		1,775		1,674		-101		-6%		26.8						C	
316	Kenilworth Avenue NE at Foote Street NE	SB	TH	495	566	464	527	-32	-39	-6%	-7%	2.2	2.2	0	0	0	5	A	A
			RT	71		64		-7		-10%		2.8		0		5		A	
		EB	RT	76	76	52	52	-24	-24	-31%	-31%	5.5	5.5	2	2	57	57	A	A
		Intersection		642		579		-63		-10%		2.5						A	

*Simulated level of service is approximated based on delay but is not equivalent to that produced using *Highway Capacity Manual* methodology.

*The intersections are numbered based on their inclusion in both the Streecar and IMR projects (100s), the Streecar project (200s), and the IMR project (300s).

Volume Calibration (GEH Statistic)

PM Peak Period (4:30 PM - 5:30 PM)

Sum of all Link Flows

	Sum of balanced counts	Sum of all link flows	Percent Difference	GEH
Freeways	51,845	54,168	4.5%	10.1
Arterials	46,592	44,201	-5.1%	11.2
Total	98,437	98,369	-0.1%	0.2

Individual Link Flows

	Number of Segments	Number of Segments with GEH < 5	Percent Compliance
Freeways	29	27	93%
Arterials	87	84	97%
Total	116	111	96%

*Refer to "Freeways and Ramps" and "Intersections" sheets.

The GEH statistic is computed as follows, where E = VISSIM estimated throughput and V = balanced field count:

$$GEH=\sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

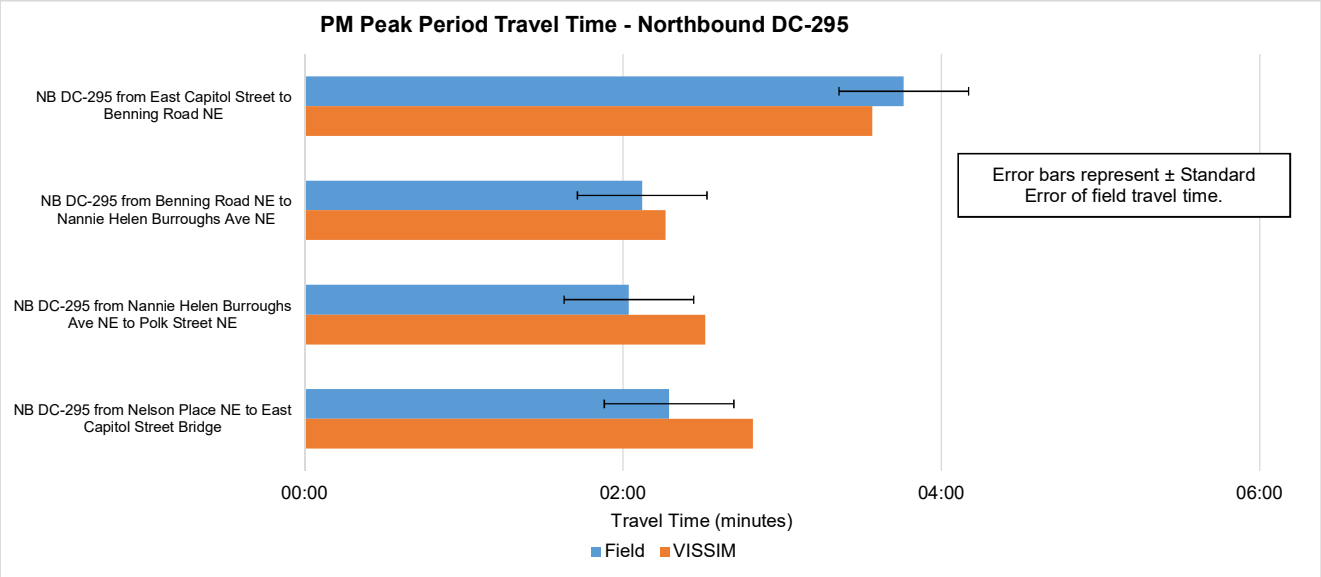
Travel Time Calibration

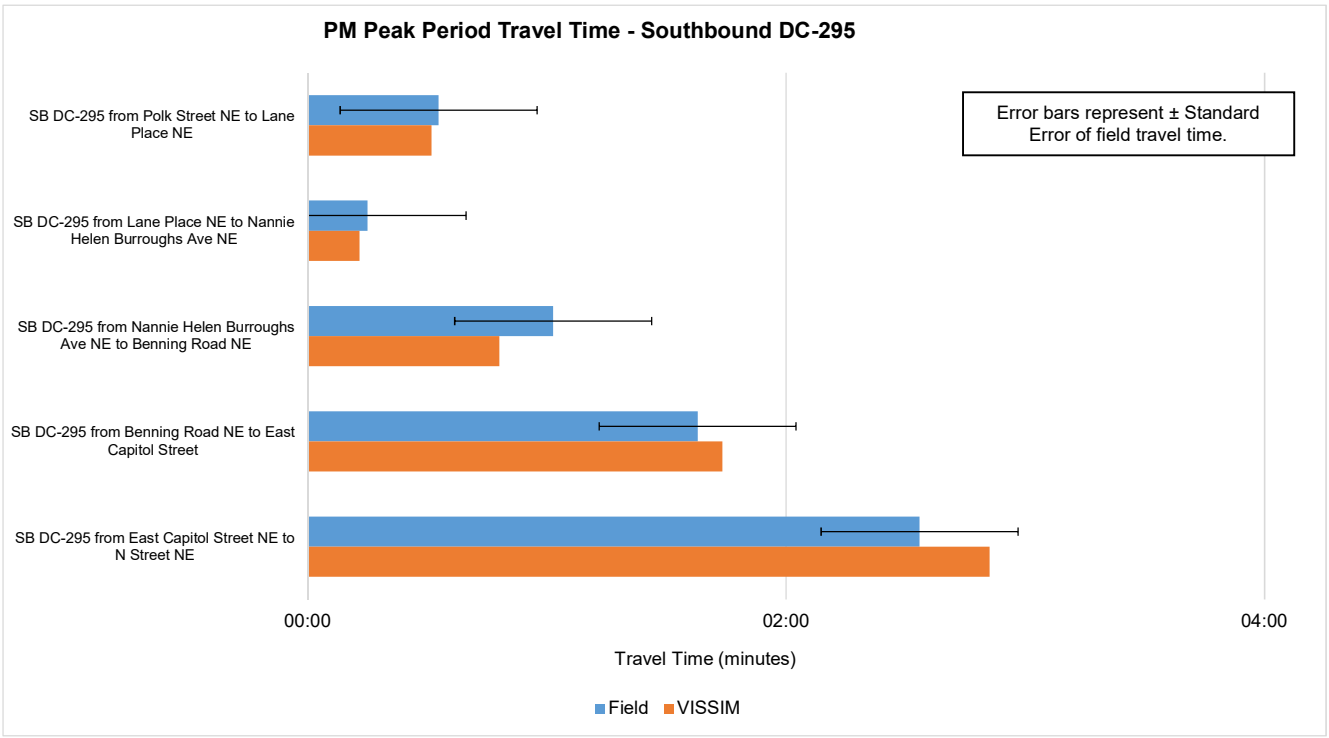
PM Peak Period (4:30 PM - 6:30 PM)

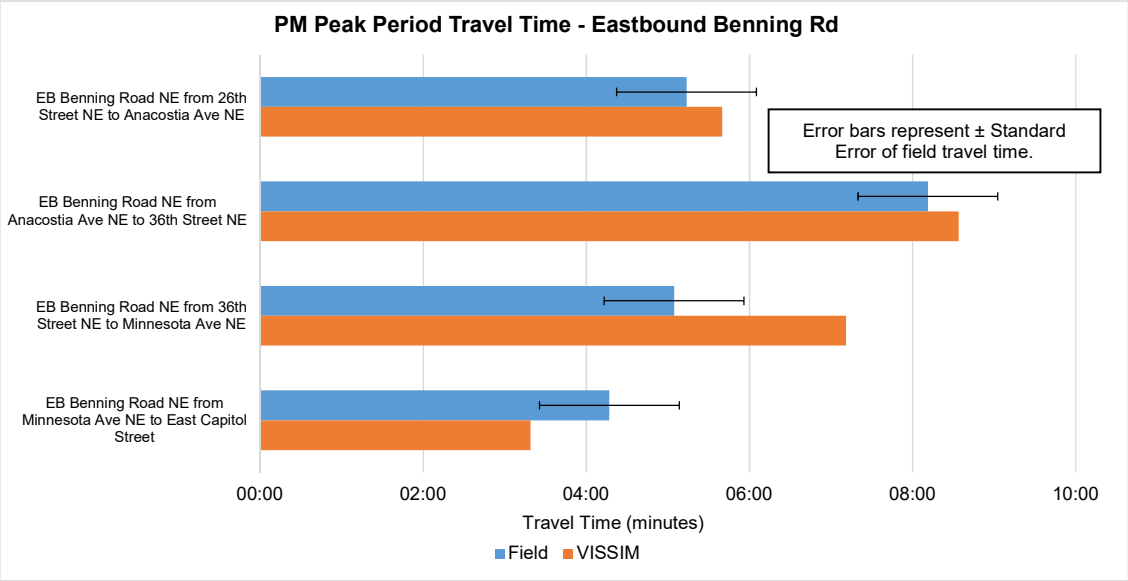
	Travel Time Criteria	Total	Percent	Target	Target Met
NB 295 (n = 1)	Within ± 15% for average travel time on freeways	1	100%	85%	Yes
SB 295 (n = 1)	Within ± 15% for average travel time on freeways	1	100%	85%	Yes
EB Benning (n = 1)	Within ± 15% for average travel time on arterials	1	100%	85%	Yes
WB Benning (n = 1)	Within ± 15% for average travel time on arterials	1	100%	85%	Yes
Total (n = 4)	Within ± 15% for average travel time	4	100%	85%	Yes

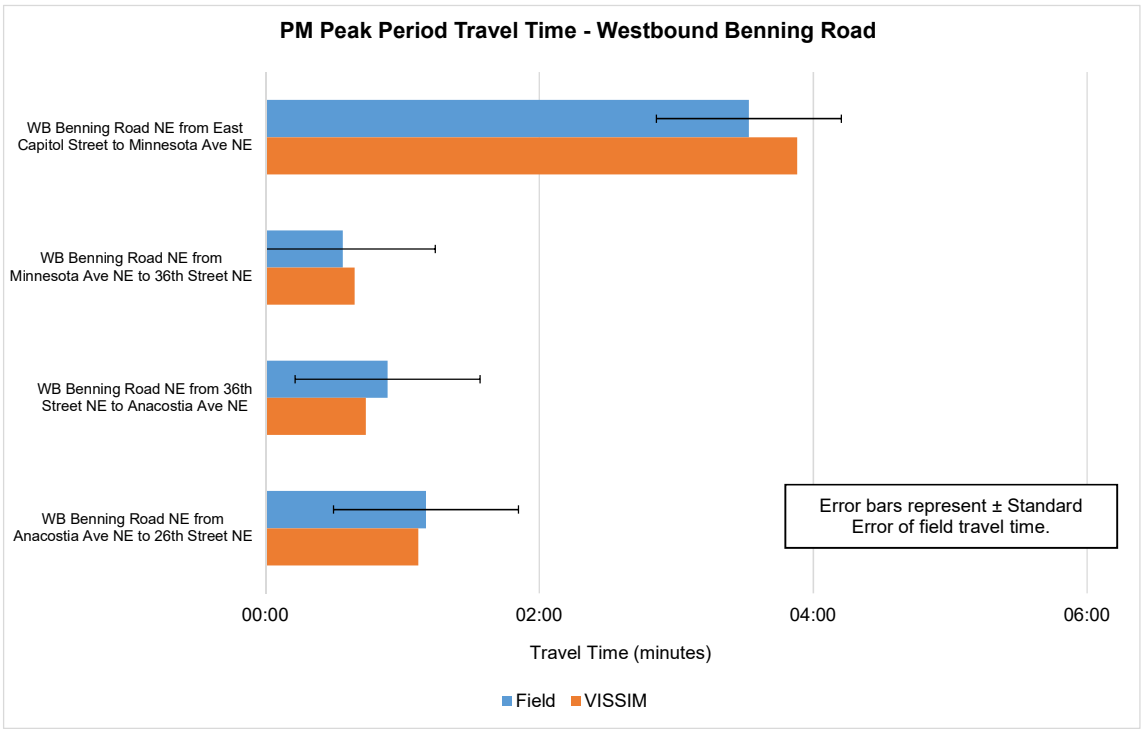
* MOE of Vissim Travel Time represents the average from 10 simulation runs.

Segment ID	Route	Peak Period Travel Time				
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)	VISSIM STDEV (MM:SS)
18	NB DC-295 from East Capitol Street to Benning Road NE	03:46	03:34	-00:12	-5%	01:07
5	NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE	02:07	02:16	00:09	7%	00:19
6	NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE	02:02	02:31	00:29	24%	00:07
7	NB DC-295 from Nelson Place NE to East Capitol Street Bridge	02:17	02:49	00:32	23%	00:07
Total	**NB DC-295**	**10:13**	**11:10**	**00:57**	**9%**	
8	SB DC-295 from Polk Street NE to Lane Place NE	00:33	00:31	-00:02	-5%	00:00
9	SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE	00:15	00:13	-00:02	-13%	00:00
10	SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE	01:02	00:48	-00:14	-22%	00:08
11	SB DC-295 from Benning Road NE to East Capitol Street	01:38	01:44	00:06	6%	00:45
12	SB DC-295 from East Capitol Street NE to N Street NE	02:33	02:51	00:18	11%	00:13
Total	**SB DC-295**	**06:01**	**06:07**	**00:06**	**2%**	
14	WB Benning Road NE from East Capitol Street to Minnesota Ave NE	03:32	03:53	00:21	10%	00:21
15	WB Benning Road NE from Minnesota Ave NE to 36th Street NE	00:34	00:39	00:05	15%	00:00
16	WB Benning Road NE from 36th Street NE to Anacostia Ave NE	00:53	00:44	-00:10	-18%	00:01
17	WB Benning Road NE from Anacostia Ave NE to 26th Street NE	01:10	01:07	-00:03	-5%	00:02
Total	**WB Benning Road NE**	**06:09**	**06:23**	**00:13**	**4%**	
1	EB Benning Road NE from 26th Street NE to Anacostia Ave NE	05:14	05:40	00:26	8%	04:32
2	EB Benning Road NE from Anacostia Ave NE to 36th Street NE	08:11	08:34	00:23	5%	03:04
3	EB Benning Road NE from 36th Street NE to Minnesota Ave NE	05:05	07:11	02:07	42%	00:35
4	EB Benning Road NE from Minnesota Ave NE to East Capitol Street	04:17	03:19	-00:58	-23%	00:12
Total	**EB Benning Road NE**	**22:46**	**24:44**	**01:58**	**9%**	


PM Peak Period Travel Time - Northbound DC-295
NB DC-295 from East Capitol Street to Benning Road NE
NB DC-295 from Benning Road NE to Nannie Helen Burroughs Ave NE
NB DC-295 from Nannie Helen Burroughs Ave NE to Polk Street NE
NB DC-295 from Nelson Place NE to East Capitol Street Bridge
Error bars represent ± Standard Error of field travel time.
00:00
02:00
04:00
06:00
Travel Time (minutes)
Field
VISSIM


PM Peak Period Travel Time - Southbound DC-295
SB DC-295 from Polk Street NE to Lane Place NE
SB DC-295 from Lane Place NE to Nannie Helen Burroughs Ave NE
SB DC-295 from Nannie Helen Burroughs Ave NE to Benning Road NE
SB DC-295 from Benning Road NE to East Capitol Street
SB DC-295 from East Capitol Street NE to N Street NE
Error bars represent ± Standard Error of field travel time.
00:00
02:00
04:00
Travel Time (minutes)
Field
VISSIM


PM Peak Period Travel Time - Eastbound Benning Rd
EB Benning Road NE from 26th Street NE to Anacostia Ave NE
EB Benning Road NE from Anacostia Ave NE to 36th Street NE
EB Benning Road NE from 36th Street NE to Minnesota Ave NE
EB Benning Road NE from Minnesota Ave NE to East Capitol Street
Error bars represent ± Standard Error of field travel time.
00:00
02:00
04:00
06:00
08:00
10:00
Travel Time (minutes)
Field
VISSIM


PM Peak Period Travel Time - Westbound Benning Road
WB Benning Road NE from East Capitol Street to Minnesota Ave NE
WB Benning Road NE from Minnesota Ave NE to 36th Street NE
WB Benning Road NE from 36th Street NE to Anacostia Ave NE
WB Benning Road NE from Anacostia Ave NE to 26th Street NE
Error bars represent ± Standard Error of field travel time.
00:00
02:00
04:00
06:00
Travel Time (minutes)
Field
VISSIM

Queue Length Calibration

PM Peak Period (4:30 PM - 5:30 PM)

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 14)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	13	93%	85%	Yes

Freeway Ramps

* MOE of Vissim Max Queue Length represents the average from 10 simulation runs.

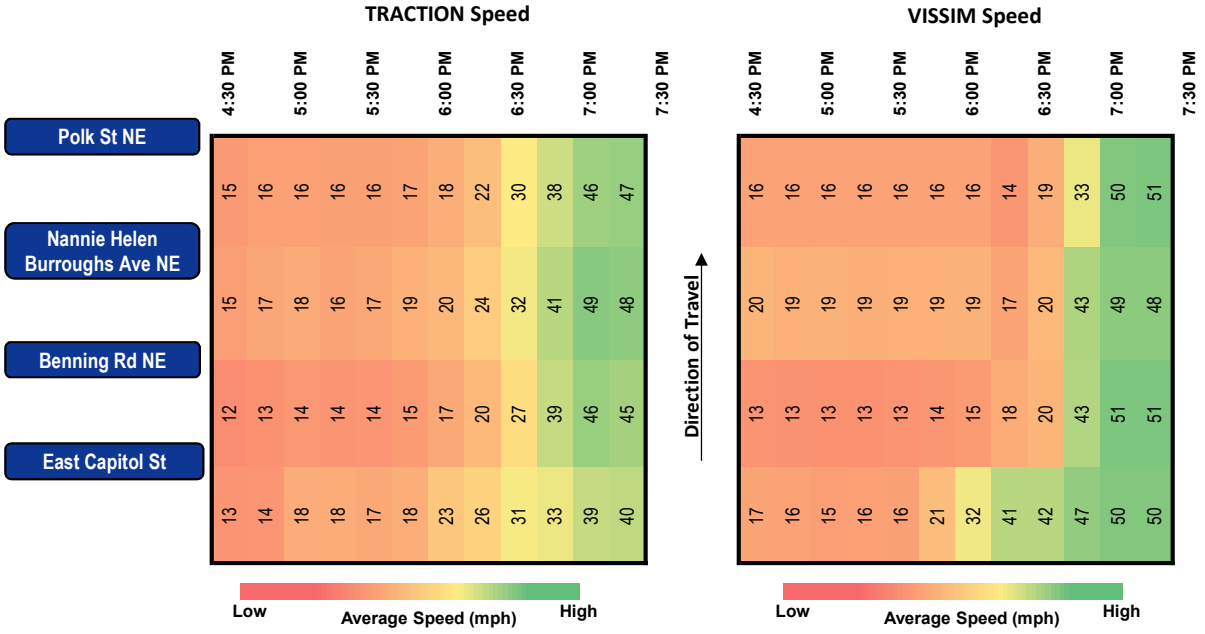
Interchange	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)	Vissim Max Queue Standard Deviation (feet)	Field-Observed Queue Description	Queue Calibration Justification
Benning Road NE	Eastbound Benning Road NE to Southbound DC-295	75	120	45	60%	Y	54		The queue spillback impact was reasonably modeled.
	Eastbound Benning Road NE/Southbound Kenilworth Avenue NE to Northbound DC-295	-	4,370	-	-	Y	1877	Slowdown from Google Maps typical traffic conditions estimated to spill back to Benning Road (> 1500 feet)	Vissim queues extend back to Benning Road, as estimated by Google Maps typical traffic conditions; queue length output is likely overestimated due to queue spillback on eastbound Benning Road NE from Minnesota Avenue NE.
	Southbound Kenilworth Avenue NE to Northbound DC-295	-	229	-	-	Y	128	Slowdown from Google Maps typical traffic conditions estimated to extend 100 feet	The queue spillback impact was reasonably modeled.
	Northbound DC-295 to Westbound Benning Road NE	-	590	-	-	N	1073	Slowdown from Google Maps typical traffic conditions estimated to extend 0 feet	Queue length output is not reflective of observed conditions in the simulation and may be overestimated due to queue spillback from other movements; measured throughput at this location exceeds volume targets.
	Northbound DC-295/Southbound Kenilworth Avenue NE to Westbound Benning Road NE	-	0	-	-	Y	0	Slowdown from Google Maps typical traffic conditions estimated to extend 0 feet	

Arterial Queue Counters

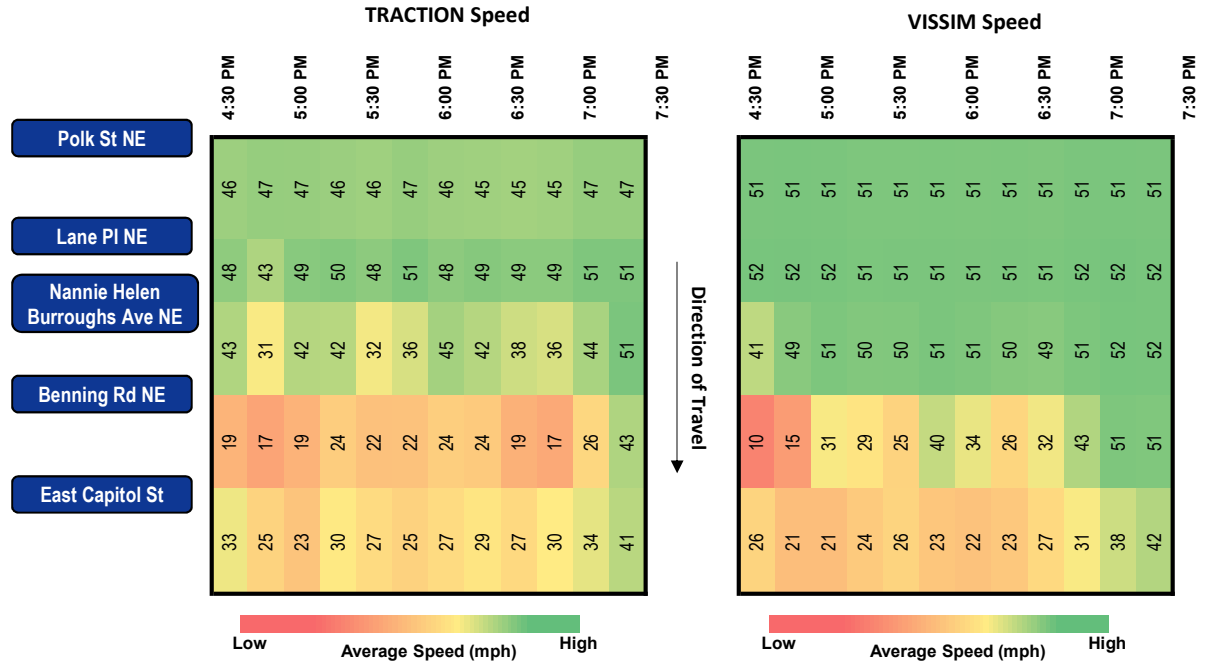
* MOE of Vissim Max Queue Length represents the average from 10 simulation runs.

Intersection	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)		Field-Observed Queue Description	Queue Calibration Justification
Benning Road NE at E Capitol Street	Southbound Benning Road NE at E Capitol Street	400	512	112	28%	Y	284	Slowdown from Google Maps typical traffic conditions estimated to extend 800 feet	The queue spillback impact was reasonably modeled.
	Northbound Benning Road NE at E Capitol Street	475	278	-197	-41%	Y	45	Slowdown from Google Maps typical traffic conditions estimated to extend 200 feet	The queue spillback impact was reasonably modeled.
	Westbound E Capitol Street at Benning Road NE	375	276	-99	-26%	Y	35	Slowdown from Google Maps typical traffic conditions estimated to extend 0 feet	The queue spillback impact was reasonably modeled.
	Eastbound E Capitol Street at Benning Road NE	150	690	540	360%	Y	75	Slowdown from Google Maps typical traffic conditions estimated to extend 2000 feet	The queue spillback impact was reasonably modeled; queue length at this location is highly variable, as shown by the difference in queue lengths reported from field measurements and Google Maps typical traffic conditions.
Benning Road NE at Oklahoma Avenue NE	Westbound Benning Road NE at Oklahoma Avenue NE	125	178	53	42%	Y	35	Slowdown from Google Maps typical traffic conditions estimated to extend 0 feet	The queue spillback impact was reasonably modeled.
Benning Road NE at Minnesota Avenue NE	Eastbound Benning Road NE at Minnesota Avenue NE	300+	5317	-	-	Y	1121	Slowdown from Google Maps typical traffic conditions estimated to extend 4200 feet	The queue spillback impact was reasonably modeled and aligns with the length of slowdown estimated by Google Maps typical traffic conditions; slightly longer queue lengths are attributable to the lane closure present during data collection.
	Westbound Benning Road NE at Minnesota Avenue NE	300	279	-21	-7%	Y	20	Slowdown from Google Maps typical traffic conditions estimated to extend 600 feet	The queue spillback impact was reasonably modeled.
	Northbound Minnesota Avenue NE at Benning Road NE	325+	580	-	-	Y	62	Slowdown from Google Maps typical traffic conditions estimated to extend 700 feet	The queue spillback impact was reasonably modeled.
	Southbound Minnesota Avenue NE at Benning Road NE	425	432	7	2%	Y	7	Slowdown from Google Maps typical traffic conditions estimated to extend 1000 feet	The queue spillback impact was reasonably modeled.

Freeway Average Speed Comparison: DC-295 - Northbound



Freeway Average Speed Comparison: DC-295 - Southbound



* MOE of Speed represents the average from 10 simulation runs.
* All speeds reported in MPH.