

**APPENDIX A: TRAFFIC
MICROSIMULATION
MODEL CALIBRATION
TECHNICAL
MEMORANDUM**

To: Jayalakshmi Balaji
KYTC Division of Planning
File: West Richmond SUA Study

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Reference: West Richmond SUA Simulation Model Calibration Memo

Introduction

As a part of the *West Richmond Small Urban Area (SUA) Study*, Stantec developed a traffic simulation model depicting existing peak hour conditions using Caliper's TransModeler (version 6.1) simulation package. **Figure 1** presents the simulation model study area, which includes the study corridor along KY 876 from just east of Killarney Lane to just west of Deer Creek Drive including the I-75 Exit 87 interchange in Richmond, Kentucky.



Figure 1: Simulation Model Study Area

Model Development

The simulation model network was originally exported from the Lexington Area Metropolitan Planning Organization (LAMPO) Regional Travel Demand Model. Roadway names and classifications were then added to the link layer based on KYTC's HIS data. Turning movement files were created based on turning movement counts (collected in March 2023) at the following locations (shown in **Figure 2** in blue):

- 1) KY 876 at Killarney Lane
- 2) KY 876 at I-65 Northbound Ramps
- 3) KY 876 at I-65 Southbound Ramps
- 4) KY 876 at Lantern Ridge Drive / Amberly Way
- 5) KY 876 at Lantern Ridge Drive / Frankie Drive
- 6) KY 876 at Goggins Lane / Willis Branch Road

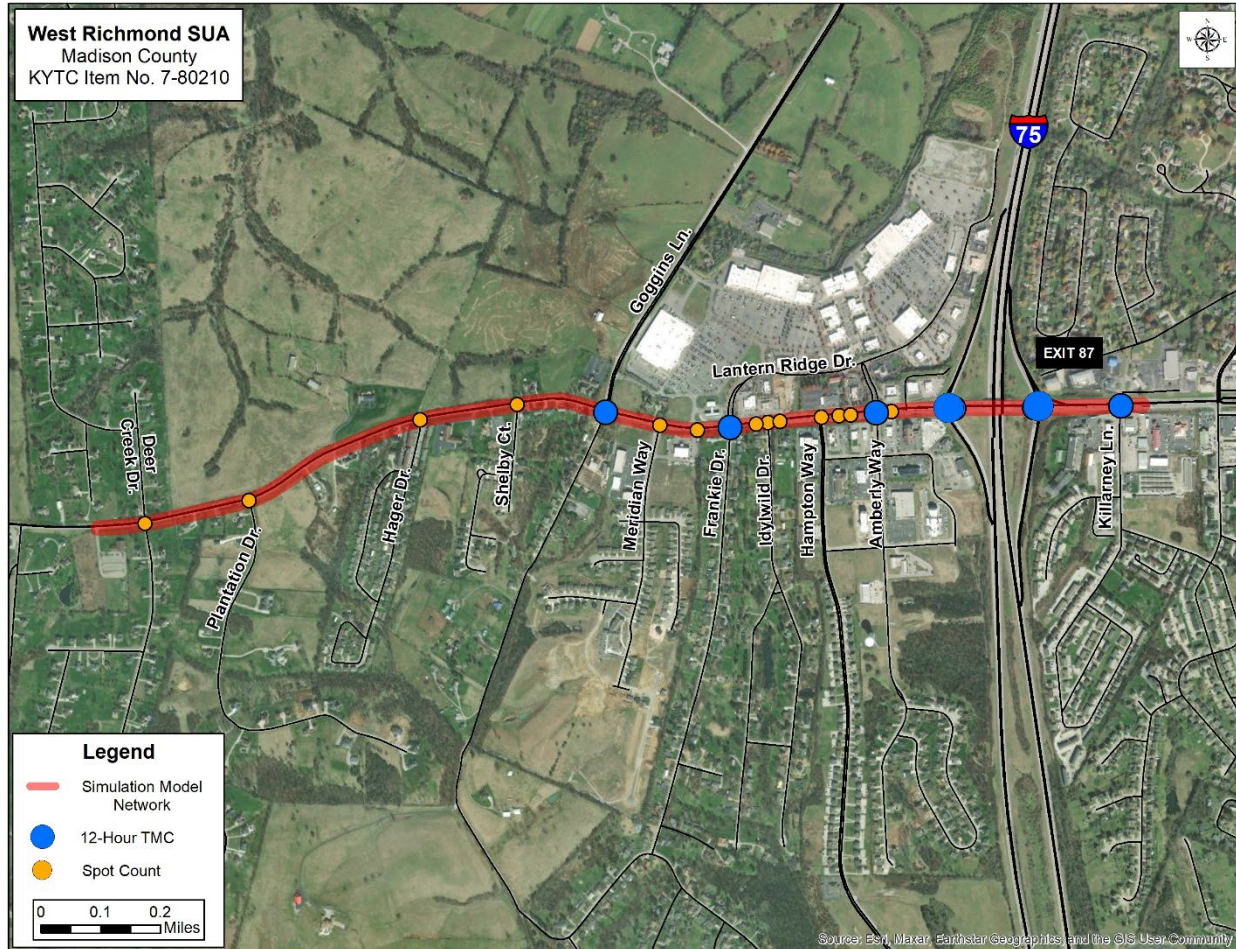


Figure 2: Turning Movement Count Locations

Based on a review of the traffic counts, it was determined that the AM peak hour is 7:30 AM – 8:30 AM and the PM peak hour is 4:30 PM – 5:30 PM. Additionally, spot counts were collected during the peak hours at the following intersections (shown in **Figure 2** in orange):

- KY 876 at Mattress Firm
- KY 876 at Shell
- KY 876 at Chick-Fil-A
- KY 876 at Hampton Way
- KY 876 at Raising Canes
- KY 876 at Idylwild Drive
- KY 876 at Sleep Outfitters
- KY 876 at Meijer Gas
- KY 876 at Meridian Way
- KY 876 at Shelby Court
- KY 876 at Hager Drive
- KY 876 at Plantation Drive
- KY 876 at Deer Creek Drive

Model Trip Tables

Trip tables for the AM and PM peak hours were developed for a 27 x 27 matrix with rows and columns representing each of the external nodes or internal centroids in the network via which vehicles can enter and exit the network. AM and PM turning movement counts and seed matrices developed from aggregated Streetlight origin-destination data were used as inputs for TransModeler's origin-destination matrix estimation (ODME) procedure. The ODME procedure

uses an iterative algorithm to estimate trip tables for the AM and PM peak hour trip patterns reflected in the counts. These counts, which were collected in 15-minute intervals, were also analyzed to develop the time distribution curve of traffic in the trip tables. **Table 1** and **Table 2** present the time distribution of traffic for the AM and PM peaks.

Table 1: Time Distribution for AM Peak

Time	% of Total
7:30	27.90%
7:45	29.13%
8:00	22.98%
8:15	19.99%

Table 2: Time Distribution for PM Peak

Time	% of Total
4:30	24.34%
4:45	24.94%
5:00	24.79%
5:15	25.93%

Parameters & Road Class Definitions

The KYTC Microsimulation Guidelines provide a framework for conducting simulation analysis in Kentucky. The TransModeler Seed file, which includes a parameters file and a road class definition file, were used to update default Caliper values for the following parameters:

- Time Headway
- Minimum Headway
- Standstill Distance
- Acceleration
- Deceleration
- Lane Change Distance
- Vehicle Speed Ranges
- Vehicle Classification
- Truck Weight/Power

Vehicle Fleet

TransModeler's default vehicle fleet distribution was updated to better reflect Kentucky averages, which tend to have a higher percentage of pickups and SUVs. KYTC's vehicle fleet distribution was used as a starting point. The percent of single-unit trucks was then increased from 2.96 to 5.17 and the Car Low, Car Mid, Car High, and Pickup/SUV classes were decreased proportionally to counteract the increase. A matrix defining multi-unit truck trips was developed separately and not included in the general vehicle fleet mix. The vehicle fleet mix for this project is as follows:

- Car Low MPR (High performance passenger cars) – 3.14%
- Car Mid MPR (Middle performance passenger cars) – 13.83%
- Car High MPR (Low performance passenger cars) – 16.16%
- Pickup/SUV – 59.56%
- SU Truck – 5.17%
- Bus – 0.53%
- Motorcycle – 2.61%

Calibration

The criteria used to confirm that the simulation model has been sufficiently calibrated were taken from the Federal Highway Administration's (FHWA) *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, July 2004 (FHWA Publication No. FHWA-HRT-04-040)*. The specific criteria, which were originally developed by the Wisconsin Department of Transportation, are found in Table 4 on page 64 of that document. The criteria consist of three general metrics: 1) visual audits, 2) traffic flow, and 3) travel speeds. Traffic flow and travel speeds are quantifiable based on observed data and the model output while the guidance says that visual audits are to be conducted to the "analyst's satisfaction."

Visual audits were performed throughout the calibration process. At the beginning of the process, areas with congestion were specifically targeted to ensure that these areas reflected existing traffic conditions.

Intersections were checked to ensure that the turning movement and link-based counts were accurate. Once errors in data and the model geography were resolved, areas where the traffic was inconsistent with expected volumes were reexamined. In rare cases where necessary for low volume external nodes, minor adjustments were made to trip tables to reflect professional judgement of expected minimal traffic levels from those locations. An iterative process of incremental adjustments made in isolation was used to ensure the overall balance of the model was maintained.

To compare traffic flows, link-based trip volumes for the five runs were averaged and compiled for each direction of each link and compared to actual traffic counts on the segments. Several statistical measures were used to measure model assignment volumes to matched observed counts. The most important of these measures is percent root-mean-square error (RMSE) with a target threshold of 20 percent or lower to confirm the model was sufficiently calibrated for assigned volumes. **Table 3** presents the calibration statistics for both the AM and PM models.

Table 3: Volume Calibration Statistics

Total Volume to Count:	AM Peak	PM Peak
Target: within 5% of count		
Sum of assignment	29,799	41,303
Sum of counts	28,608	41,340
Percent Difference (within 5%)	4.16%	0.09%
Percent Root Mean Square Error		
Target: < 20.00%	7.93%	6.93%

Average vehicle speeds are reported for each network link segment for both the AB and BA directions. The model speeds were compared to 2021 weekday HERE speed data provided by KYTC. **Table 4** presents the comparison of HERE speeds to KY 876 simulation model speeds. All model speeds are within 5 miles per hour (mph) of the HERE speeds.

Table 4: Speed Comparison

Segment	Route	BMP	EMP	AM			PM		
				Speed	Model	Abs Dif	Speed	Model	Abs Dif
N of I-75 Interchange	EB KY 876	7.21	7.4	34.0	34.8	0.8	30.8	28.8	2.0
	WB KY 876			32.8	32.5	0.3	27.9	32.5	4.6
Between I-75 Ramps	EB KY 876	7.083	7.21	24.9	25.1	0.2	27.8	25.1	2.7
	WB KY 876			26.1	24.1	2.0	26.6	24.1	2.4
I-75 Interchange to Goggins Lane	EB KY 876	6.491	7.083	31.2	27.8	3.3	25.4	27.8	2.4
	WB KY 876			31.9	27.0	4.9	29.2	27.0	2.1
West of Goggins Lane	EB KY 876	5.6	6.941	42.9	41.6	1.2	41.7	41.6	0.0
	WB KY 876			45.2	43.9	1.3	43.4	43.9	0.5

Next Steps

With the model calibrated to simulate existing conditions, the next step is to develop a 2033 No-Build simulation model.

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