Traffic Forecast Methodology Report

KY 9 Scoping Study
Campbell County
Item No. 6-448.00

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Prepared for:

Kentucky Transportation Cabinet

Prepared by:

HMB Professional Engineers

Introduction and Study Area

The purpose of this document is to outline the methodology proposed by HMB Professional Engineers, Inc. to prepare traffic forecasts for the KY 9 Scoping Study associated with Item No. 6-448.00 in Campbell County, Kentucky. This forecast was requested by District 6 of the Kentucky Transportation Cabinet (KYTC). The forecast includes a base year (2021) and a future design year (2045) for KY 9. The traffic analysis was conducted for 2045; therefore, turning movement counts were also forecast to 2045.

The study area for this traffic forecast encompasses KY 9 from KY 1998 (Pooles Creek Rd) to Hampton Ln and I-275 from MP 76.8 to MP 77.6 in Wilder, KY as well as the eastbound and westbound ramps. Forecasts will be provided for the mainline segments of KY 9 and I-275 along with the following intersections:

- 1 - KY 9 / KY 1998 (Pooles Creek Rd)
- 2 - KY 9 / Rosewood Dr
- 3 - KY 9 / Town Dr
- 4 - KY 9 / I-275 Eastbound Ramps
- 5 - KY 9 / I-275 Westbound Ramps
- 6 - KY 9 / Hampton Ln
- 7 - Gloria Terrell Dr / Town Dr
- 8 - Rosewood Dr / Gloria Terrell Dr

Figure A-1 in **Appendix A** shows a map of the study area.

Traffic Volumes

The annual average daily traffic (AADT) volumes used for this project include traffic counts provided by KYTC. The counts provided by KYTC were conducted between 2019 and 2020, and include the following count stations:

- I-275 – MP 77.07 to MP 77.579 (2020): Station 078 = 97,210
- I-275 – MP 75.437 to MP 77.07 (2020): Station P97 = 75,021
- I-275 Eastbound Entrance Ramp – (2020): Station G14 = 2,720
- I-275 Eastbound Exit Ramp – (2020): Station G09 = 10,140
- I-275 Westbound Exit Ramp – (2020): Station B84 = 3,064
- I-275 Westbound Entrance Ramp – (2020): Station B07 = 10,083
- KY 9 – MP 15.538 to MO 17.82 – (2020): Station 751 = 24,216
- KY 9 – MP 17.82 to MP 20.183 – (2020): Station A33 = 9,569
- KY 1998 – MP 0 to MP 1.738 – (2019): Station A96 = 2,944

The locations are shown in **Figure A-2** in **Appendix A**.

The counts will be forecasted to a base year of 2021 using historical trends, which will be discussed later in the report.

Intersection turning movement forecasts include all the intersections listed in the introduction. Turning movement counts along KY 9 were conducted at each intersection for the AM, Midday and PM peak hours. Turning movement counts along Gloria Terrell Drive were counted during the AM and PM peak hours. **Figure A-3** in **Appendix A** shows the balanced peak hour turning movement volumes.

Growth Rate

The growth rate selected for this study is based on multiple sources:

- Historical traffic growth analysis
- Ohio, Kentucky, Indiana (OKI) Travel Demand Model
- Population trends and projections

The historical growth rates for this study were based upon traffic growth analysis within the study area. The analysis utilized traffic counts obtained from KYTC's Traffic Database which includes counts from 1995 to 2020.

A spreadsheet was developed which analyzes growth trends based on linear equations. The growth rates are averaged in the spreadsheet for each count station. Based on this data, the growth rates identified for each segment within the study area are shown in **Table 1**. HMB pulled traffic counts from KYTC and used that historical traffic data to calculate a growth rate. This data was also plotted to get a best fit trendline that was then used to find another growth rate. The project group also received model outputs from OKI for 2020 and 2050.

Table 1: Historical and Proposed Growth Rates from Count Stations

Route	Count Station	From	To	Historical Growth Rate	Trendline Growth Rate	OKI Model Growth Rate
I-275	078	MP 77.070	MP 77.579	1.12%	0.37%	0.66%
I-275	P97	MP 75.437	MP 77.070	1.52%	0.90%	0.11%
KY 9	751	KY 1998	I-275	1.06%	0.38%	0.43%
KY 9	A33	I-275	KY 1632	1.68%	0.25%	0.44%

Based on historical traffic volumes, the population growth of Campbell County, and the OKI model, a growth rate of 1.00% is proposed for the entirety of the study area. This same growth rate will be used for all segments and intersections within the study.

Figure A-4 in **Appendix A** shows the forecast summary including 2045 AADT, DHV, AADTT, and DHVT volumes. **Figure A-5** in **Appendix A** illustrates the 2045 turning movement volumes used in the traffic analysis of the No Build and Build Improvement Options.

K Factor

Hourly factors (raw or unadjusted) were calculated by using the hourly count data from KYTC traffic counts. The hourly factors were then adjusted by factors provided by KYTC. These factors were derived from ATR data by functional classification, day of week, and month of year. The calculated and adjusted (proposed) hourly factors for each segment are shown in **Table 2**.

Table 2: Summary of Hourly Factors

Route	Count Station	From	To	Raw K Factor		K Factor Adj.
				AM	PM	
I-275	078	MP 77.070	MP 77.579	9.4%	10.6%	10.8%
I-275	P97	MP 75.437	MP 77.070	9.7%	11.2%	11.4%
KY 9	751	MP 16.538	MP 17.820	7.3%	8.7%	7.4%
KY 9	A33	MP 17.820	20.183	10.0%	11.1%	11.5%

Note: Refer to Figure A-2 in Appendix A for the specific locations on a map as shown by the count station.

PHF

Peak hour factors (PHF) were calculated from the turning movement counts. A general analysis of the PHF indicates a range of 0.761 to 0.989. The PHF will be customized to each intersection based on the turning movement counts.

Truck Percentages

Vehicle classification data was obtained from either the Statewide Vehicle Classification Database maintained by KYTC or 24-hour turning movement counts conducted as part of this study. **Table 3** provides the most recent daily truck percentages and volumes for the study area.

Table 3: Truck Percentages and Volumes

Route	Count Station	From	To	Daily Truck %	AADTT
I-275	078	MP 77.07	MP 77.579	9.43%	9,300
I-275	P97	MP 75.437	MP 77.07	6.33%	4,800
KY 9	751	KY 1998	I-275	13.95%	3,400
KY 9	A33	I-275	KY 1632	5.66%	800

Population

Population data was obtained from the Kentucky State Data Center for Campbell County and Kentucky. **Table 4** displays the historical population growth while **Table 5** displays population projections.

Table 4: Historical Population Growth

Area	1990	2000	2010	% Change (2000 - 2010)	% Growth Per Year
Kentucky	3,685,296	4,041,769	4,339,367	7.40%	0.71%
Campbell	83,866	88,616	90,336	1.94%	0.19%

Source: Kentucky State Data Center

Table 5: Population Forecasts

Area	2010 Census	2015 Estimate	2020 Projection	2030 Projection	2040 Projection	% Change (2010 - 2040)	% Growth Per Year
Kentucky	4,339,367	4,425,092	4,533,464	4,726,382	4,886,381	12.61%	0.40%
Campbell	90,336	92,124	92,898	93,473	92,192	2.05%	0.07%

Source: Kentucky State Data Center

As shown in **Table 4**, the population of Campbell County increased by 1.94% from 2000 to 2010 compared to a 7.40% increase for Kentucky during the same period. Similarly, **Table 5** shows the population of Campbell County to increase less than the population of Kentucky based on the state forecast. Campbell County is expected to increase by 2.05%, at a rate of 0.07% between the years 2010 and 2040, while a growth of 12.61% in Kentucky is expected between 2010 and 2040 at a rate of 0.40% per year. This ongoing and projected growth further supports a positive 1.00% growth rate for this forecast.

Microsimulation Technical Report

To support the analysis of the improvement options developed through the KY 9 Scoping Study process, an existing conditions VISSIM traffic model was developed and calibrated. Once the model calibration was approved by KYTC, a 2045 No Build model was developed along with ten Build variations. The traffic analysis results are presented in the KY 9 Scoping Study and the Microsimulation Technical Report is presented in **Appendix B**.

Appendix A – Figures

KY 9 Scoping Study
Campbell County
Item No. 6-448.00

Figure A-1: Study Overview

Figure A-2: Traffic Count Stations

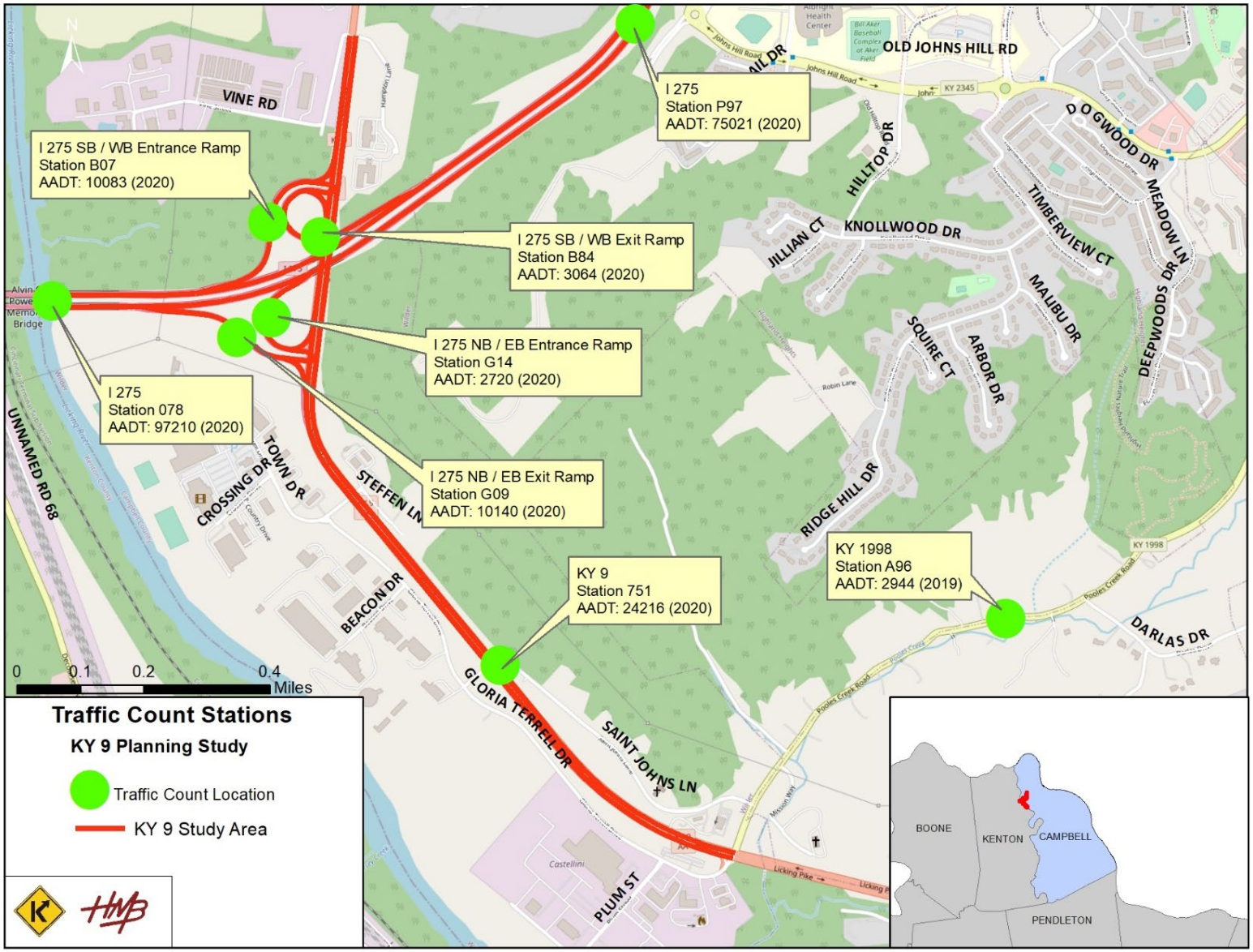


Figure A-3: 2021 Existing Turning Movement Volumes

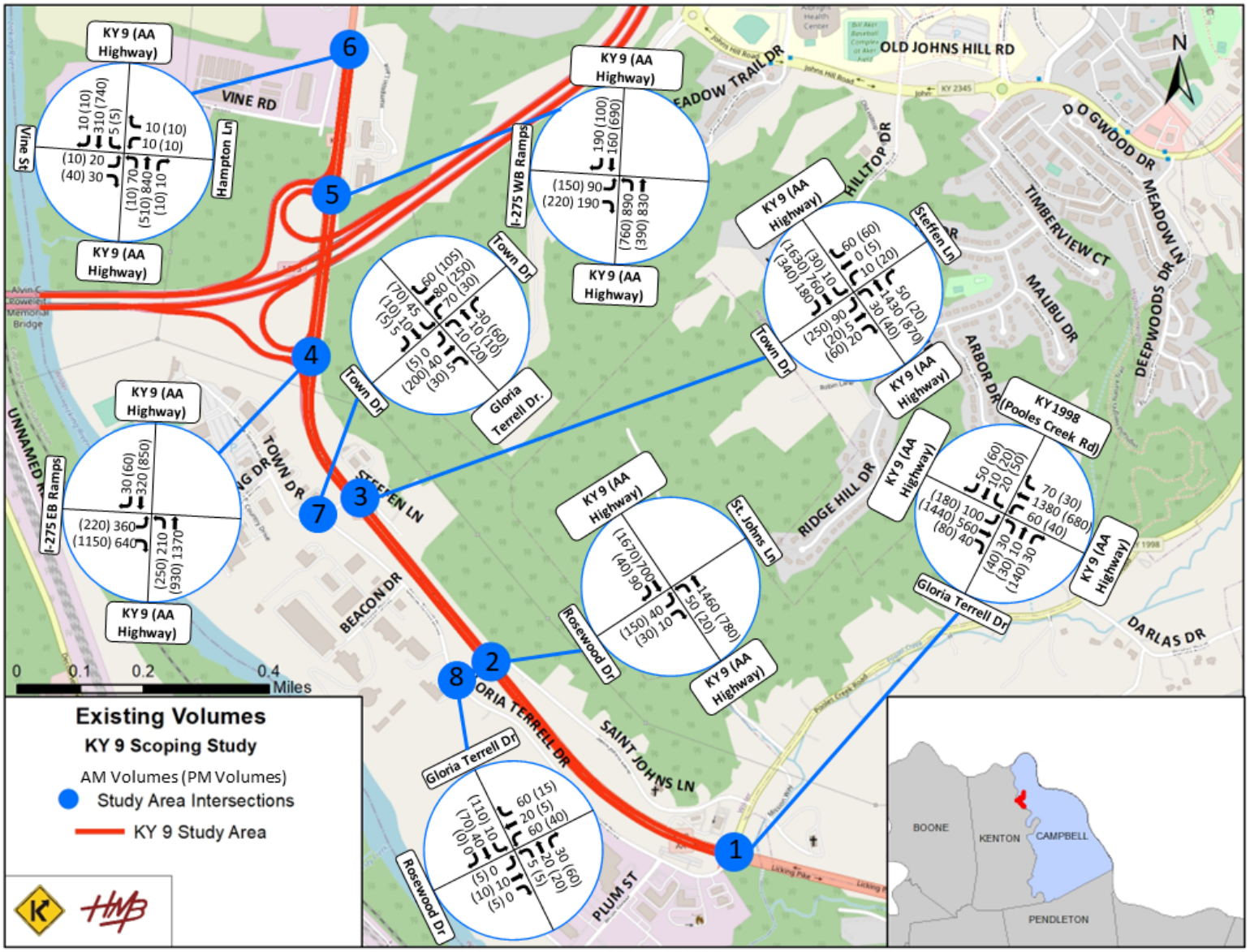


Figure A-4: Forecast Summary

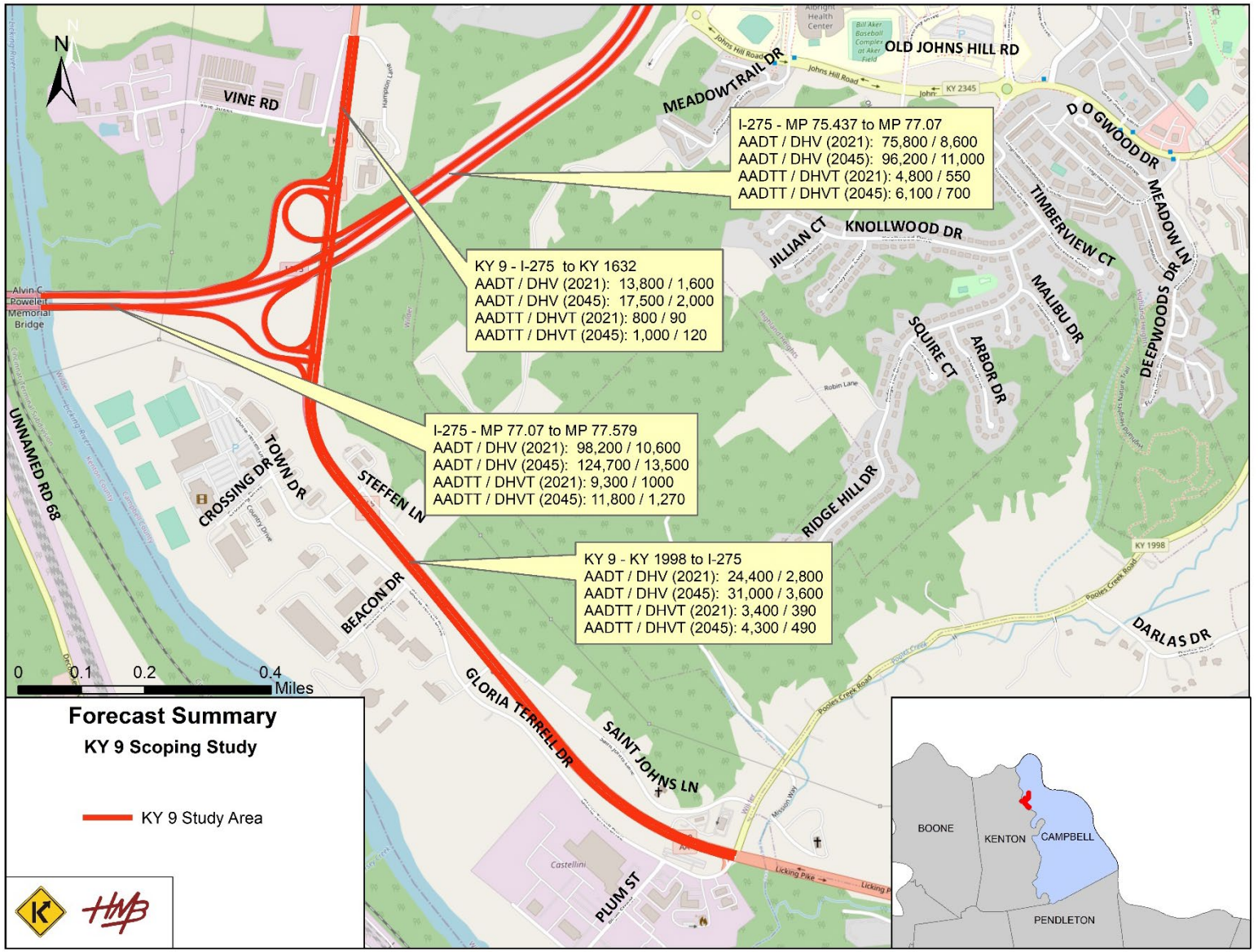
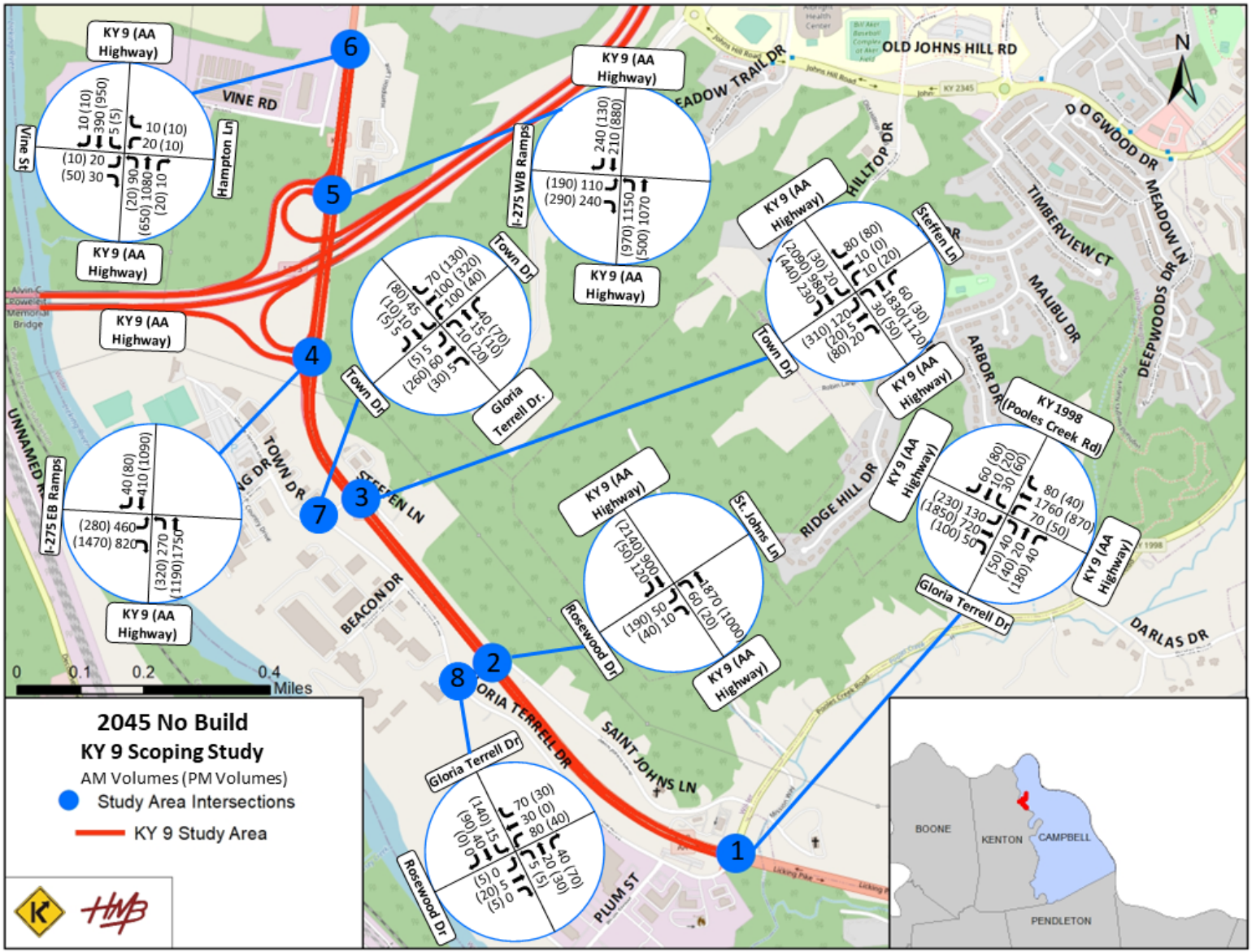


Figure A-5: 2045 No Build Turning Movement Volumes



Appendix B – Model Calibration Report

KY 9 Scoping Study
Campbell County
Item No. 6-448.00

KY 9 Transportation Planning Study
KY 1998 to Hampton Lane
KYTC Item 6-448 | Campbell County

Microsimulation Technical Report

April 2022 Final

TABLE OF CONTENTS

TABLES

FIGURES

1.0 VISSIM MICROSIMULATION MODEL

Microsimulation models using the Vissim software package[1] were developed for the AM and PM peak period operations during each scenario. The AM peak simulated operations 7:15-8:15 AM; the PM peak simulated operations 4:45-5:45 PM. The year 2021 scenario was calibrated using collected data and existing signal timing plans to ensure models replicate existing performance. Default variables were adjusted as appropriate to reflect driver behaviors as discussed below. Once calibrated, future year traffic volumes can be input to evaluate No-Build (baseline) and future Build options to gage their impacts on traffic flow.

1.1 Calibration of Existing Network

AM and PM Vissim models were built to evaluate traffic operations under the Existing, No-Build, and Build scenarios. To ensure accuracy of these models, AM and PM Existing models were calibrated by 15-minute volumes on links, peak travel speeds, and vehicle types.

The Wiedemann 74 car-following model was used to replicate local driver behavior patterns, KYTC standards were used for these values where possible. An average standstill distance of 14.82 feet was applied (**Table 1**).

Table 1: Car-Following Model Adjustments

Parameter	Original	Adjusted
Average Standstill Distance	9.82 ft	14.82 ft
Additive Part of Safety Distance	2.00	4.00
Multiplicative Part of Safety Distance	3.00	5.00

Vehicle compositions were calculated and input for each entry node from classification data in the traffic counts. Vehicle fleet compositions for cars and heavy vehicles were also assigned to mirror Campbell County registration data.

Tables 2 & 3 summarize breakdowns for both cars and heavy vehicles.

[1] PTV Vissim 10.00 – 16 [79178]

Table 2: Light Vehicle Distribution

Car Type	Percentage
Volkswagen Golf	6.7%
Audi A4	6.7%
Mercedes CLK	6.7%
Volkswagen Beetle	6.7%
Toyota Yaris	6.7%
Honda Accord	6.7%
Nissan Altima	6.7%
Nissan Quest	6.7%
Plymouth Voyager	6.7%
Chevy Silverado	6.7%
Ford F150	6.7%
Toyota Tundra	6.7%
Ford Explorer	6.7%
GMC Yukon	6.7%
Jeep Grand Cherokee	6.7%

Table 3: Heavy Vehicle Distribution

Heavy Vehicle Type	Percentage
Single Unit	86%
Articulated	14%

Vissim's desired 70 kph speed distribution curve was used:

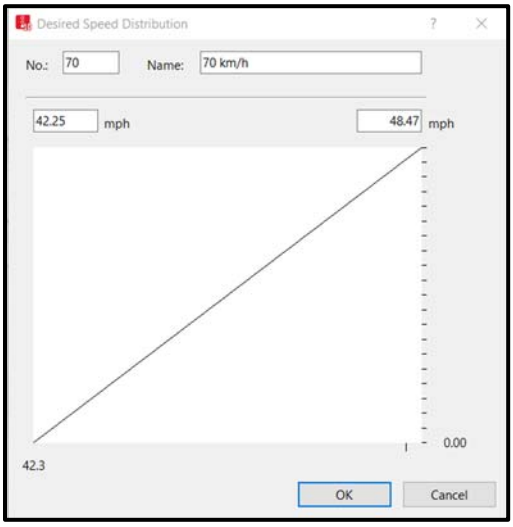


Figure 1: Speed Distribution Applied

Applying these factors to the calibration process, the microsimulation results provided a reasonably accurate representation of existing conditions at each intersection. **Figure 2 & 3** compare speed data between data provided by KYTC (HERE data) and Vissim outputs. **Figure 4** compares travel times collected by Miovision cameras and Vissim outputs.

Figure 2: AM Speed Comparison

Figure 3: PM Speed Comparison

AM Northbound Field Travel Times

Run	Start
1	0:00:57
2	0:00:39
3	0:00:52
4	0:00:48
5	0:00:41
6	0:00:53
7	0:01:02
8	0:00:59
9	0:00:41
10	0:00:48
Field Collected Average	0:00:50
Vissim Average	0:00:48

AM Southbound Field Travel Times

Run	Start
1	0:00:49
2	0:00:59
3	0:00:53
4	0:00:46
5	0:01:02
6	0:00:47
7	0:00:46
8	0:00:54
9	0:00:55
10	0:01:01
Field Collected Average	0:00:53
Vissim Average	0:00:50

PM Northbound Field Travel Times

Run	Start
1	0:01:05
2	0:00:48
3	0:00:42
4	0:00:35
5	0:01:00
6	0:00:45
7	0:01:04
8	0:00:48
9	0:00:45
10	0:00:46
Field Collected Average	0:00:50
Vissim Average	0:00:54

PM Southbound Field Travel Times

Run	Start
1	0:01:19
2	0:00:51
3	0:00:59
4	0:00:57
5	0:01:23
6	0:01:21
7	0:01:05
8	0:01:18
9	0:01:15
10	0:01:22
Field Collected Average	0:01:11
Vissim Average	0:01:16

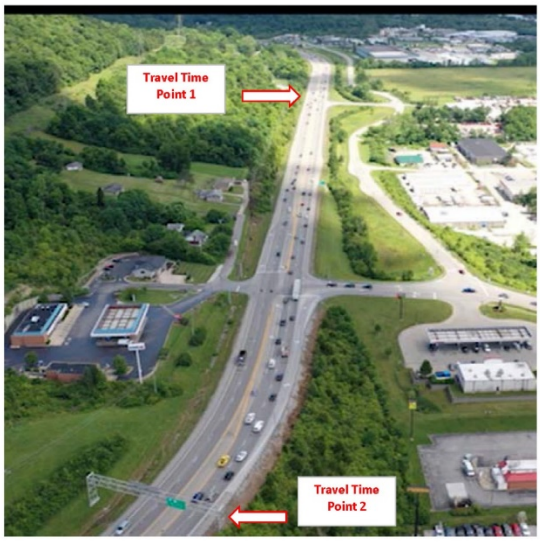


Figure 4: Travel Time Comparison

Figure 5 & 6 provide a visual summary of how model volumes compared to 2021 counts; all intersections were calibrated within ±10% during both peak hours.

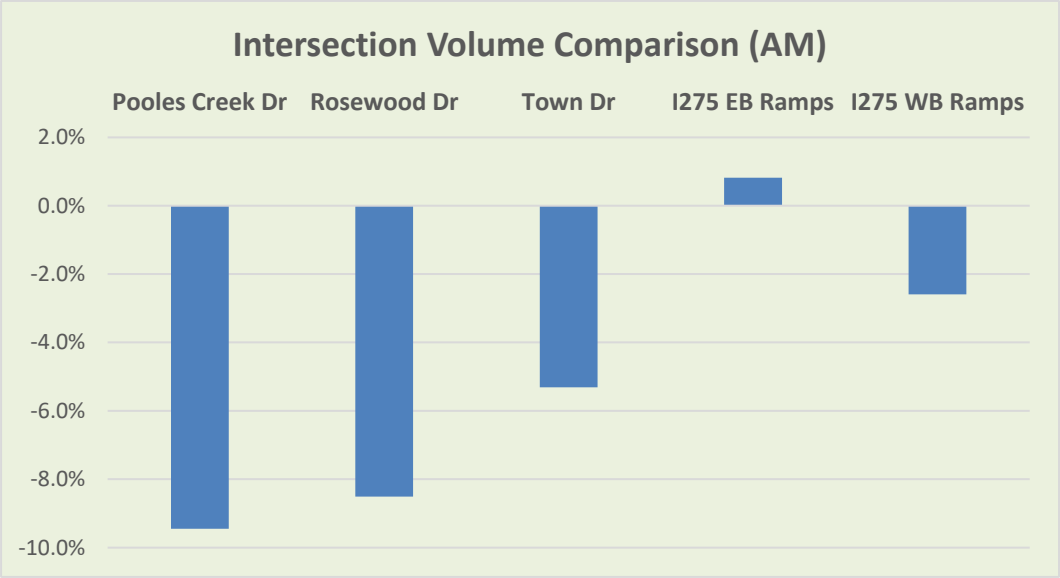


Figure 5: AM Peak Hour Volume Comparison

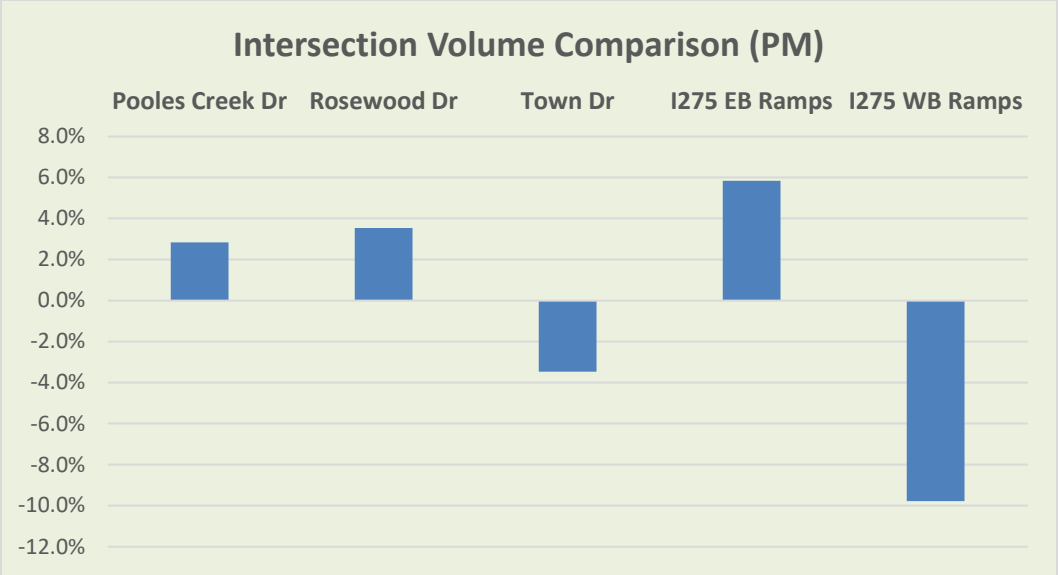


Figure 6: PM Peak Hour Volume Comparison

Queue lengths were also visually similar, as seen in **Figure 7**.

Figure 7: PM Peak Queue Comparison at Interchange

1.2 Vissim Outputs

Vissim outputs summarize system-wide measures of effectiveness (MOEs) including average vehicle delay in seconds and average travel speed in miles per hour.

Table 4: Vissim System-Wide Outputs

		Existing	No Build	Extend Left Turn Lane	Dual Left Turn Lanes	Fly Over	Flyover Full Two Lane Ramp	Dual Exit Ramp	Third Through Lane	Town Drive Dual Left	Close Town Drive	Town Drive RI/RO*	Close Town Steffen Full Access
AM	Delay	31.1	115	61	54.8	41.3	32.4	108	123	120.8	141	148	133.5
	Avg Travel Speed	31.7	21.6	27.1	28	31.9	33.1	21.8	21	20.9	19.8	19.2	20.4
PM	Delay	121.9	208	191	160.1	153.7	141.2	192	87.4	180.4	90.5	63.7	80.1
	Avg Travel Speed	20.4	15.1	16	18	23.6	22.1	16.4	24	16.6	24.5	27.4	25.5

*EB Left turns redistributed from Town Dr to Gloria Terrell