

**Pembroke Corridor Study  
Traffic Forecast Report and Model Amendment Report  
Christian County  
Item Number 2-381.00**

Prepared for:  
Kentucky Transportation Cabinet



Prepared by:  
Qk4, Inc.



June 30, 2017

# Table of Contents

## Contents

<b>1.0</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Study Corridor.....	1
<b>2.0</b>	<b>Traffic Data .....</b>	<b>2</b>
2.1	Turning Movements and Tube Counts .....	2
2.2	Train Counts .....	7
<b>3.0</b>	<b>Travel Times .....</b>	<b>7</b>
<b>4.0</b>	<b>Committed Projects .....</b>	<b>9</b>
<b>5.0</b>	<b>Traffic Generators.....</b>	<b>9</b>
<b>6.0</b>	<b>Signal Warrant.....</b>	<b>12</b>
<b>7.0</b>	<b>Growth Rates .....</b>	<b>12</b>
<b>8.0</b>	<b>Vehicle Miles and Vehicle Hours Traveled (VMTs and VHTs).....</b>	<b>13</b>

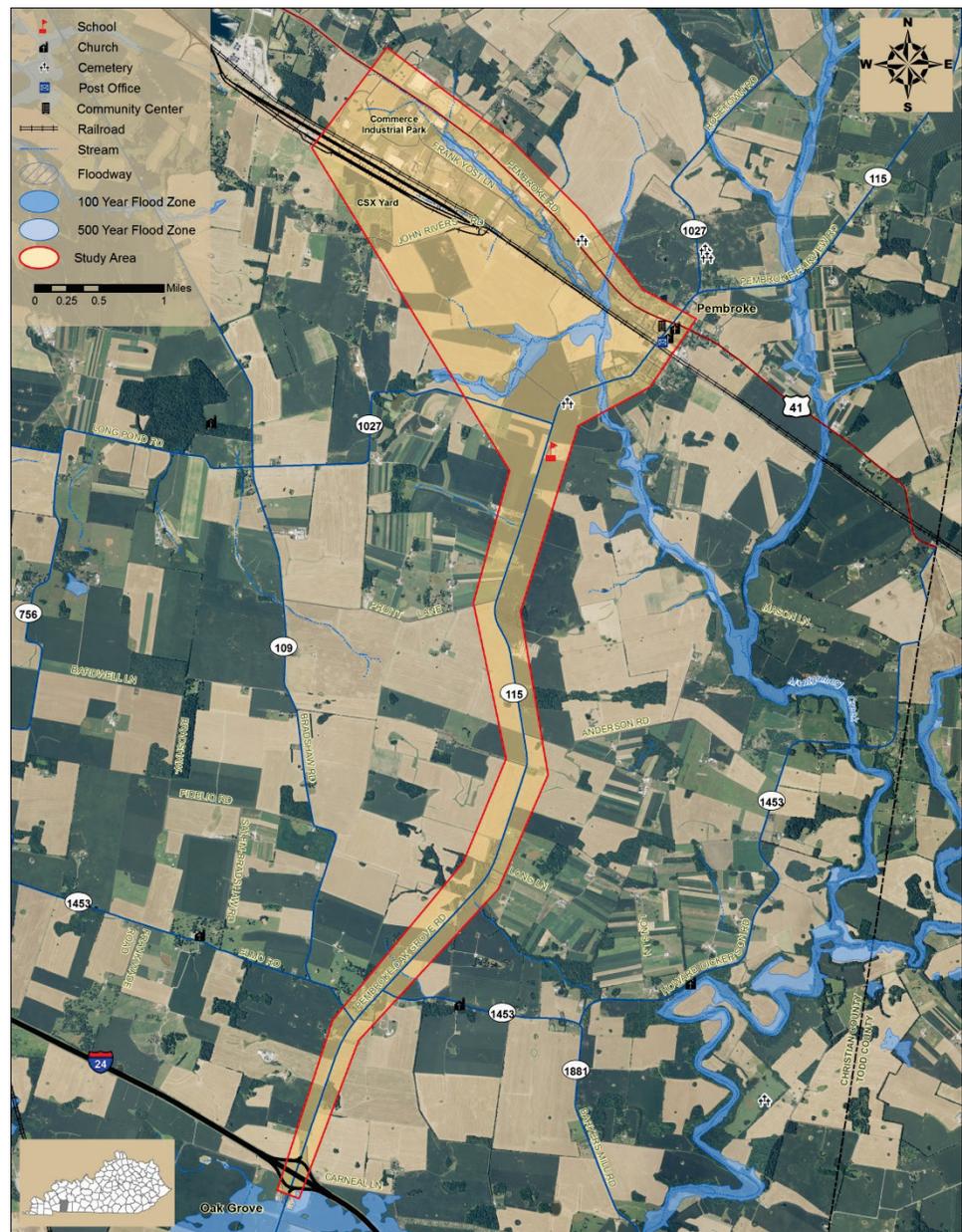
## 1.0 Introduction

As part of Qk4’s Statewide Planning Services Agreement, the Kentucky Transportation Cabinet (KYTC) requested Qk4 provide the travel demand modeling and traffic analysis as part of the Pembroke Corridor Planning Study in Christian County, Kentucky. The purpose of the study is to improve truck access from the newly expanded Commerce Park to I-24. Trucks use US 41 (Weight Class AAA, 80,000 pounds) and KY 115 (Weight Class A, 44,000 pounds) to access I-24. In addition, the intersection of US 41 and KY 115 in Pembroke does not have the required turning radius for trucks.

### 1.1 Study Corridor

The study corridor encompasses US 41 and KY 115 in Christian County. In the study area, US 41 begins east of Pembroke at Krusteaz Way (MP 5.758) to the KY 115 intersection (MP 2.786). The corridor is classified as a Minor Arterial. KY 115 begins at I-24 and extends north to US 41. Near I-24, KY 115 is classified as a Minor Arterial. At the urban boundary, the functional classification changes to a Major Collector. The corridor includes intersections with side streets, driveways, and a CSX rail crossing at the northern end KY 115. **Figure 1** shows the study corridors in amber.

Both corridors are two lanes wide with no bicycle facilities and limited pedestrian



**Figure 1: Study Area**

facilities. With the exceptions of the northern end of KY 115 and the southern end of US 41. All minor approaches in the study area are stop controlled. The US 41/ KY 115 intersection has a flashing yellow beacon.

## 2.0 Traffic Data

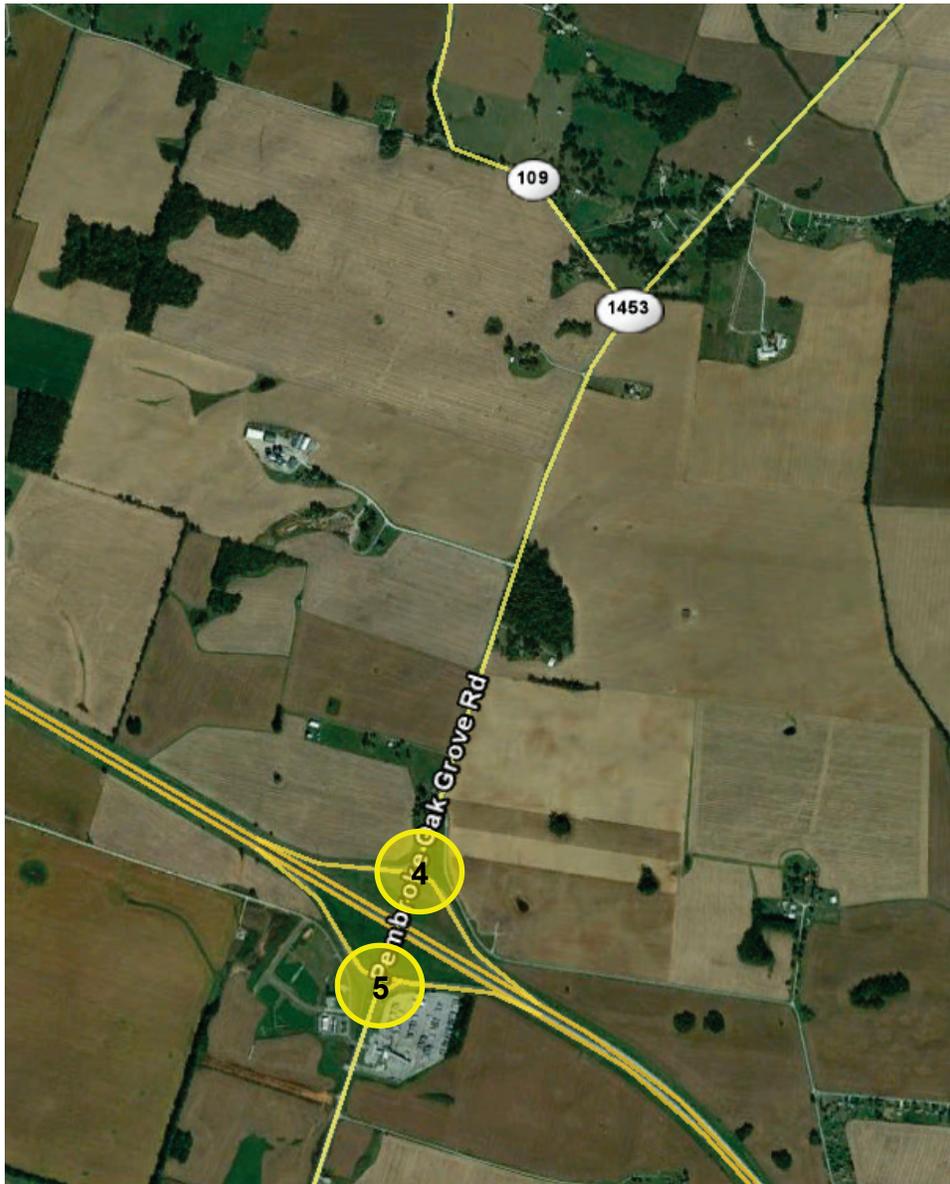
### 2.1 Turning Movements and Tube Counts

Traffic counts were collected on September 27-28, 2016 using Miovision cameras stationed at various locations along the corridor. Peak period turn movement counts (TMCs) were collected at five intersections. In addition, KY 115 at CSX railroad was counted to determine the number of trains and peak delays, and times to clear the tracks. The first four counts are illustrated in Figure 2. The five locations are shown in Figures 2 and 3.

- US 41/Frank Yost Lane (1) (24 hour count)
- US 41/John Rivers Road (2)
- US 41/KY 115 (3)
- KY 115/CSX Railroad (Train 48 hour count)
- I-24/KY 115 Westbound Ramps (4)
- I-24/KY 115 Eastbound Ramps (5)



Figure 2: Turn Movement Count Locations



**Figure 3: Additional KY 115 Turn Movement Counts**

Six 48-hour volume/classification counts were conducted using tubes to identify an accurate percentage of trucks in the corridor. Tube count locations are illustrated in blue on **Figure 4**. The TMCs are shown again in yellow.

KYTC conducted a class count at STA 303 by counting axel patterns to determine cars and trucks. With this method, there is potential to miss cars that are overlapping as trucks. This method may produce a lower ADT and possibly higher truck %. Therefore, a normal classification was not performed since each lane could not be counted independently because median space was not available to the place counters. A volume/axel count at STA 303 would count every two axels as a vehicle (semi-tractor trailers would count as 2.5 cars). This method

would produce a higher ADT than actual, 10,690 ADT. So, a 24-hour Miovision Turn Movement video count at the US 41/Frank Yost Lane recorded and counted actual vehicles to determine ADT and Truck %.

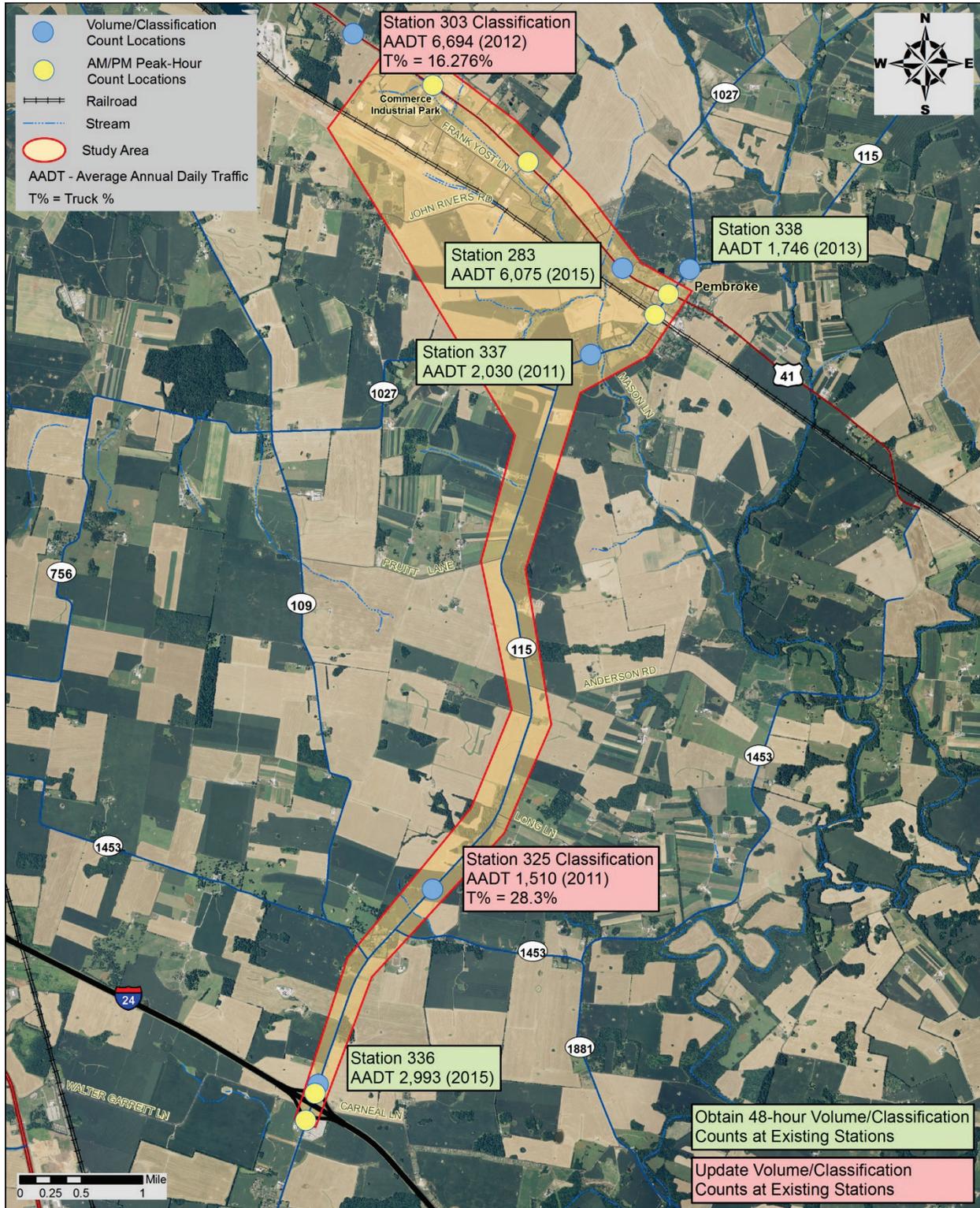


Figure 4: Traffic Count Locations

Both the TMCs and directional counts were collected in 15-minute increments and include cars and trucks. The TMCs were taken from 7:00 A.M. to 9:00 A.M. and from 3:00 P.M. to 6:00 P.M. Within these time periods, the two highest consecutive 60-minute periods were identified. Directional counts were used to establish the average daily traffic (ADT) along the corridor as well as help identify the AM and PM peak hours. The TMC are included in **Appendix A**.

**Table 2** presents the peak hour volume entering and exiting US 41 and KY 115 from the TMCs collected through this study.

**Table 1: Cross Street Traffic Volumes from Counts**

	Approach	Direction	US 41 / Frank Yost Lane	US 41 / John Rivers Road	US 41 / KY 115	I-24 / KY 115 Eastbound Ramps	I-24 / KY 115 West bound Ramps
AM Peak Hour (8:00 AM - 9:00 AM)	North Approach	Enter	30		60		
		Exit	10		100		
	South Approach	Enter	100		140		
		Exit	160		140		
	East Approach	Enter		0	140	270	0
		Exit		70	180	0	310
	West Approach	Enter			310	0	250
		Exit			230	130	0
PM Peak Hour (3:00 PM - 5:45 PM)	North Approach	Enter	40		130		
		Exit	150		70		
	South Approach	Enter	180		220		
		Exit	360		150		
	East Approach	Enter		220	240	390	0
		Exit		0	190	0	290
	West Approach	Enter			440	0	180
		Exit			260	250	0

The resultant 2016 traffic volumes and associated turn movements and traffic operations are illustrated on **Figure 5**.

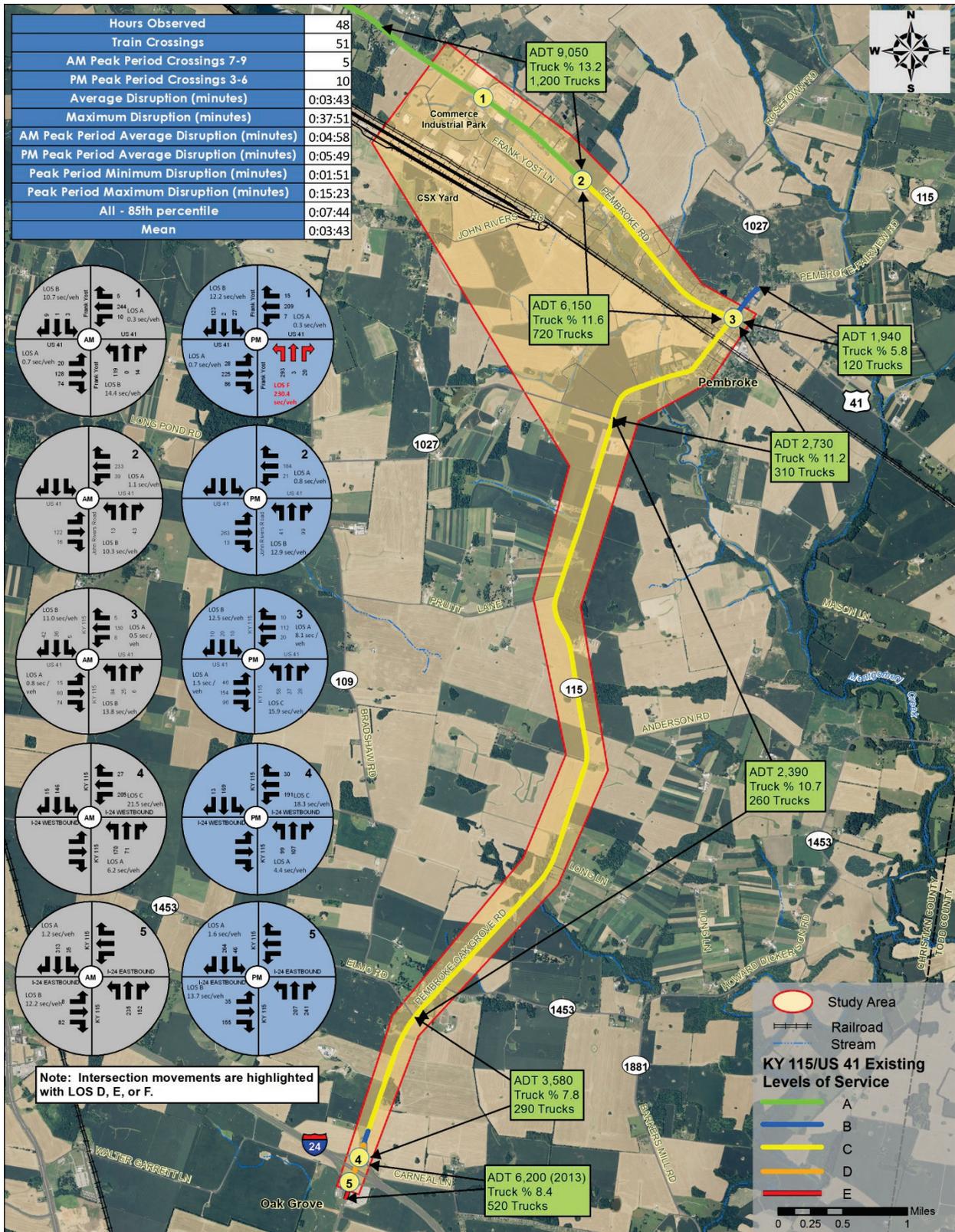


Figure 5: 2016 Traffic and Levels of Service

## 2.2 Train Counts

Using Miovision during the same peak periods, 51 trains were observed in a 48 hours period. **Table 2** summarizes the minutes trains took to clear the tracks.

**Table 2: CSX Train Observations**

Hours Observed	48
Train Crossings	51
AM Peak Period Crossings 7-9	5
PM Peak Period Crossings 3-6	10
Average Disruption (minutes)	0:03:43
Maximum Disruption (minutes)	0:37:51
AM Peak Period Average Disruption (minutes)	0:04:58
PM Peak Period Average Disruption (minutes)	0:05:49
Peak Period Minimum Disruption (minutes)	0:01:51
Peak Period Maximum Disruption (minutes)	0:15:23
All - 85th percentile	0:07:44
Mean	0:03:43

Total peak disruptions for the two days counted are shown in **Table 3**.

**Table 3: Peak Train Disruptions**

9/27 AM Peak Total Disruption (min)	0:00:00
9/27 PM Peak Total Disruption (min)	0:35:16
9/28 AM Peak Total Disruption (min)	0:24:52
9/28 PM Peak Total Disruption (min)	0:22:56

## 3.0 Travel Times

The corridor from Frank Yost Lane to I-24 was driven once in each direction during normal daytime hours. This average travel time was also compared to the 2010 Christian County Model times. **Table 4** summarizes the travel data for these trips.

**Table 4: Corridor Travel Times**

Direction	Field Measured Travel Time	2010 Christian County Travel Demand Model
John Rivers Road to I-24	12:28.34	11.932
I-24 to John Rivers Road	12:42.17	



### 4.0 Committed Projects

Table 5 list committed projects in the model. No additional projects were added beyond the build scenarios for the Pembroke Corridor Study.

Table 5: Committed Projects

Project No.	Roadway	Improvement	Time frame
2-100.50	Pennyrile parkway extension	New road	2016
2-136.00	E.T.Breathitt parkway	New road	2016
2-7010.00	KY-380	New road	2016
KY-05	Gate 4 extension	New road	2025
KY-06	KY-400 (State line Rd.)	From 2 to 3 lanes	2025
KY-07/08	KY-115 (Pembroke-Oak grove Rd.)	From 2 to 3 lanes	2025
KY-12	Oatts-Riggins Rd.	New road	2025
KY-02	Hugh hunter/Gritton chuch Rd.	Reconstruction	2035
KY-04	I-24	From 4 to 6 lanes	2035
KY-10	KY-117	New road	2035
KY-11	Gate 5 extension	New road	2035
K-13	KY-1453 (Elmo Rd)	From 2 to 3 lanes	2035
K-14	KY-109 (Bradshaw Rd)	From 2 to 3 lanes	2035

### 5.0 Traffic Generators

The major traffic generators in or near the study area are a proposed “mega” Industrial park just north of the I-24/KY 115 interchange (Figure 7) and the existing Commerce Park (Figure 8).

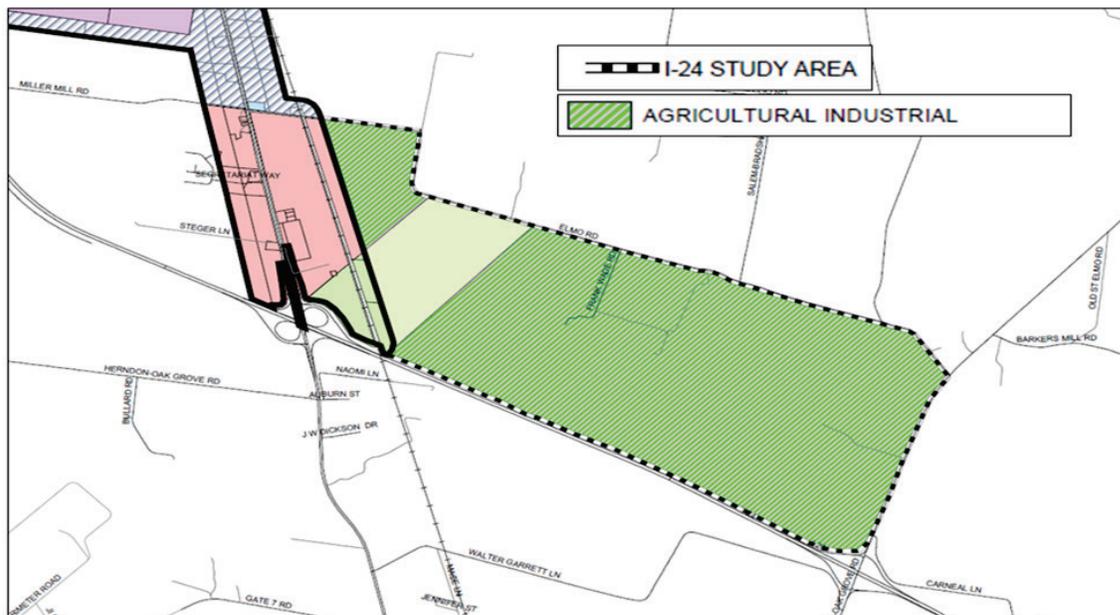


Figure 7: Approximate Location of Proposed "Mega" Industrial Park

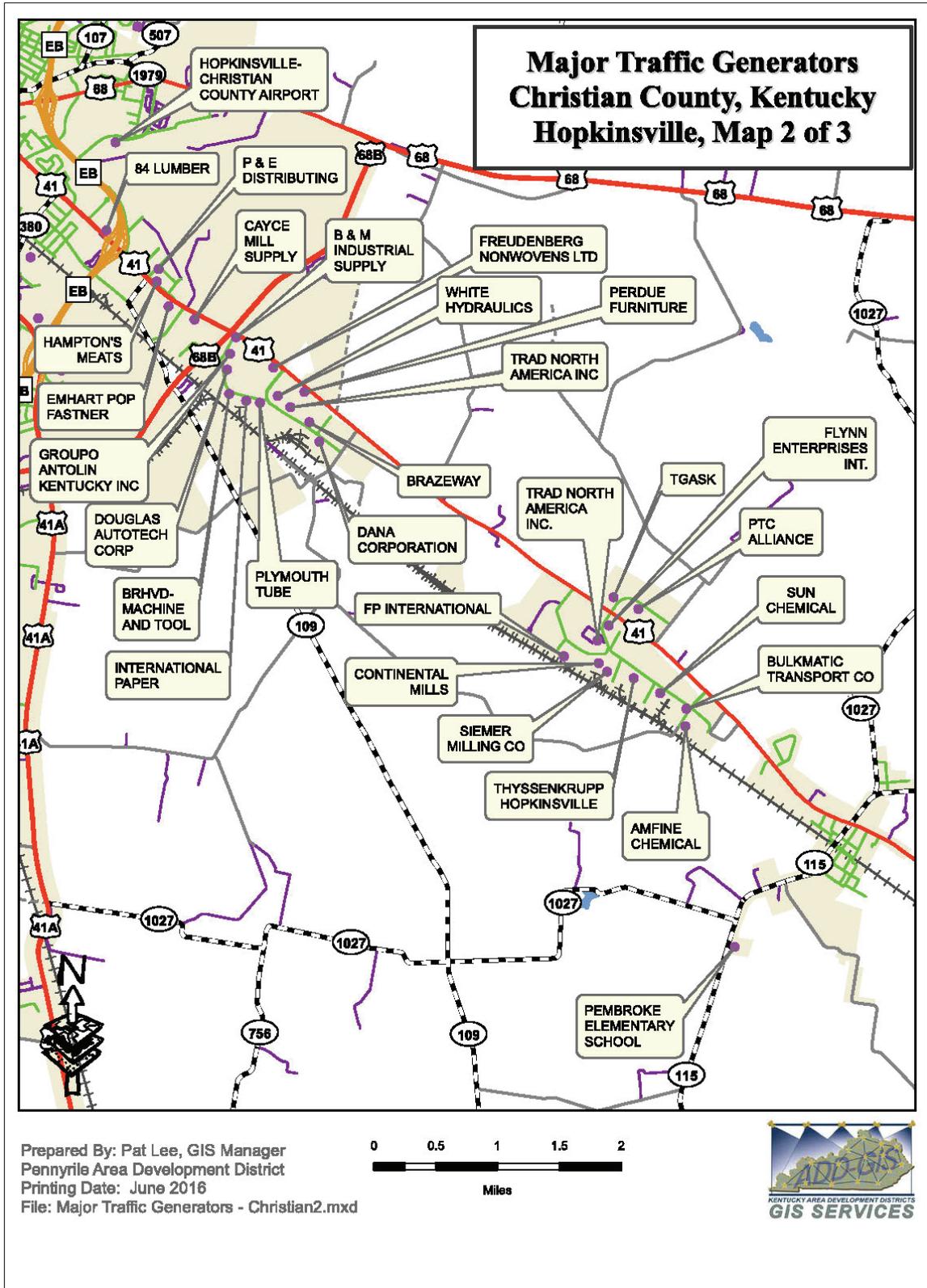


Figure 8: Traffic Generators in the Region



industrial park,” additional, employment/jobs were not added to the study area.

## 6.0 Signal Warrant

US 41 and Frank Yost Way operates at LOS F due to left turns in the PM peak hour. A signal warrant analysis for 2016 was performed. The intersection only meets three of the eight hours required for Warrant 1A to warrant a signal. For Warrant 1B, it did not meet warrants for any hour. It does barely meet the peak hour warrant; however, KYTC usually requests an intersection meet Warrant 1A or 1B also.

## 7.0 Growth Rates

A growth rate of 1.03% was found by comparing assignments between the 2016 and 2040 Christian County Travel Demand Models. After the study area for the project was determined, a subset of the 2016 model network was selected and exported. This subarea can be seen below (**Figure 10**). This subset was joined with the 2040 dataview, and the same selection was also applied to the 2040 model. The cumulative flow rates for all subarea links were calculated for both the 2016 and 2040 models and compared to determine the proposed growth rate of 1.03%. It was found that the vehicle type prohibition in the travel demand model was not working correctly which resulted in trucks being assigned to smaller roads that do not realistically carry heavy trucks. These trucks were noted and accounted for when looking at vehicle assignments to KY 115.

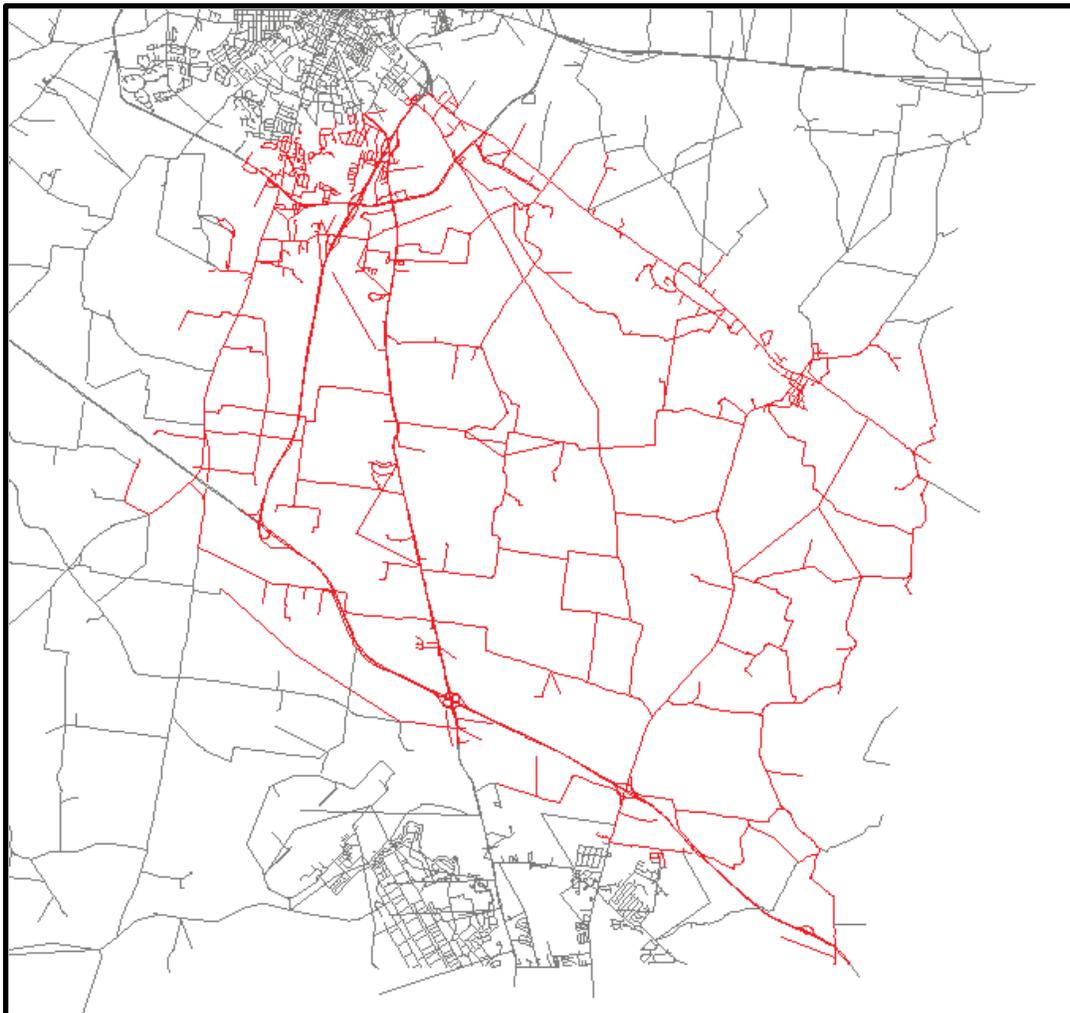


Figure 10: Travel Demand Model Subarea

### 8.0 Vehicle Miles and Vehicle Hours Traveled (VMTs and VHTs)

No Build and Build scenarios were examined for a connector (one connector alignment was modeled) and US 41 and KY 115 widening between US 41 at the Commerce Park along KY 115 to I-24. The Build versus No Build daily change in VHT and VMT is shown in **Table 6**. If the connector is not constructed, and US 41 and KY 115 are widened, the model showed no change in VMT or VHT over the No Build scenario.

- 37 Change in VHT
- 891 Change in VMT

**Table 6: No Build Versus Build VHTs and VMTs**

<b>No Build</b>		<b>Build</b>	
Auto VHT	69,208	Auto VHT	69,183
Auto VMT	3,509,063	Auto VMT	3,508,629
Truck VHT	7,917	Truck VHT	7,905
Truck VMT	442,537	Truck VMT	442,080
Total VHT	77,125	Total VHT	77,088
Total VMT	3,951,600	Total VMT	3,950,709

The resultant for projected 2040 No Build and Build Traffic volumes and projected operations are shown in **Figures 11 and 12**, respectively.

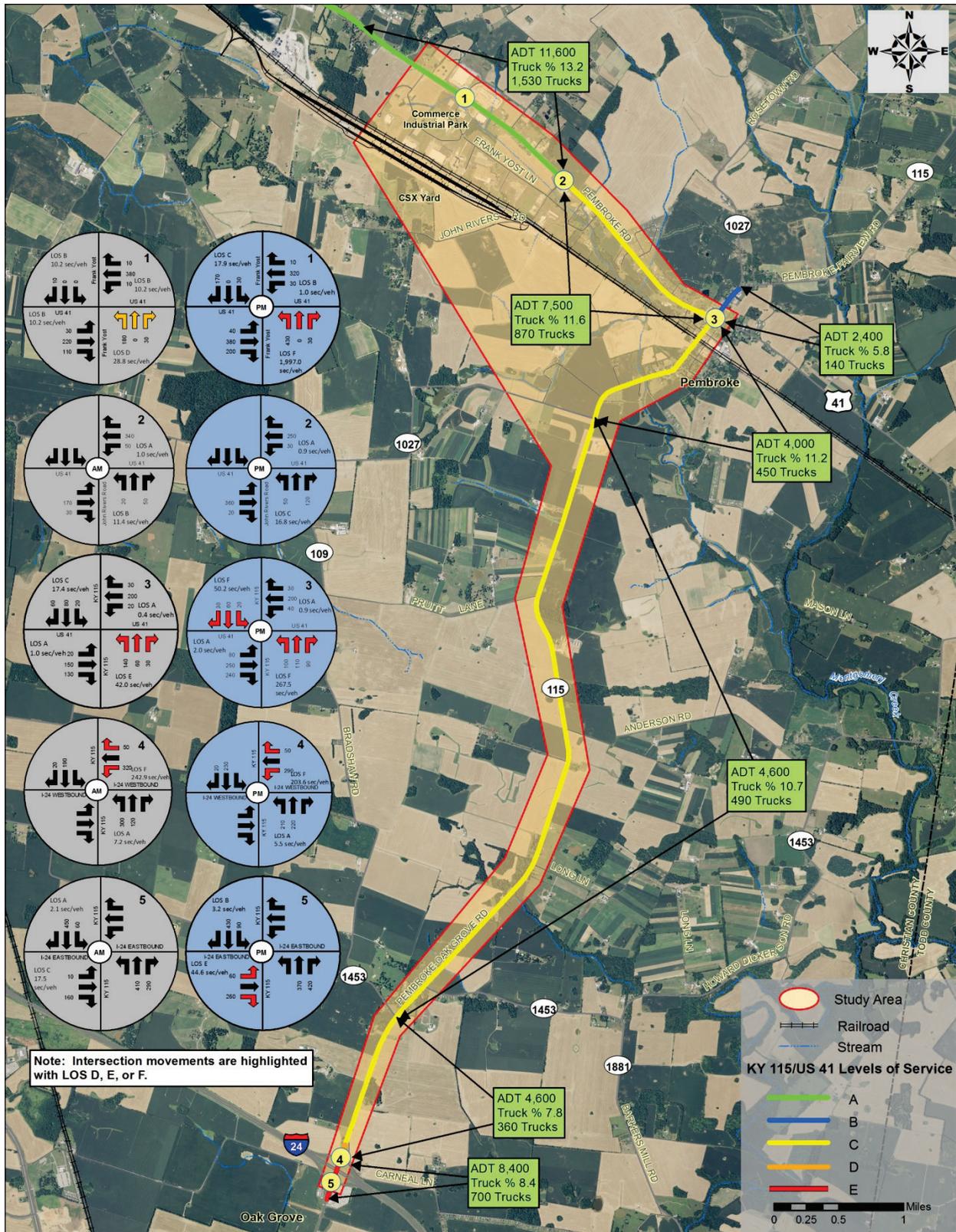


Figure 11: 2040 No Build Traffic Volumes and Operations

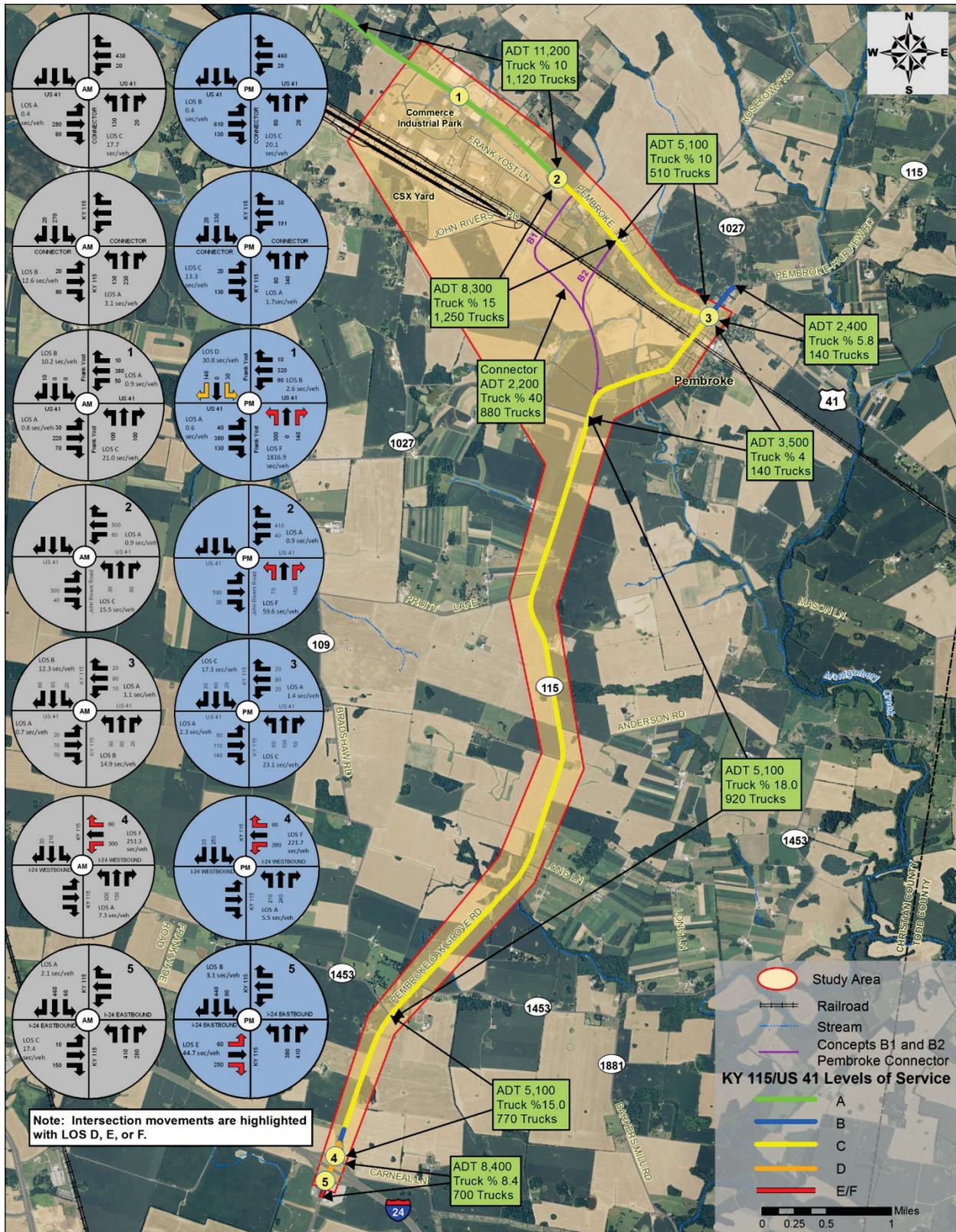


Figure 12: 2040 Build Traffic Volumes and Operations

**APPENDIX A:  
EXISTING TURNING MOVEMENT COUNTS**

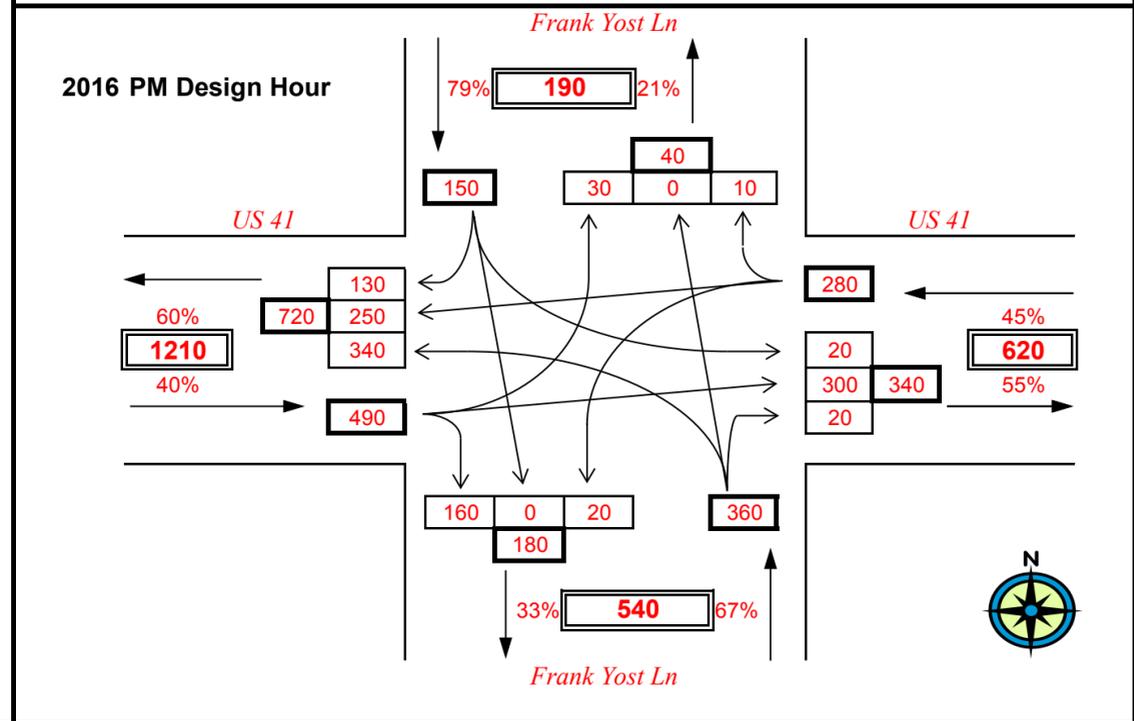
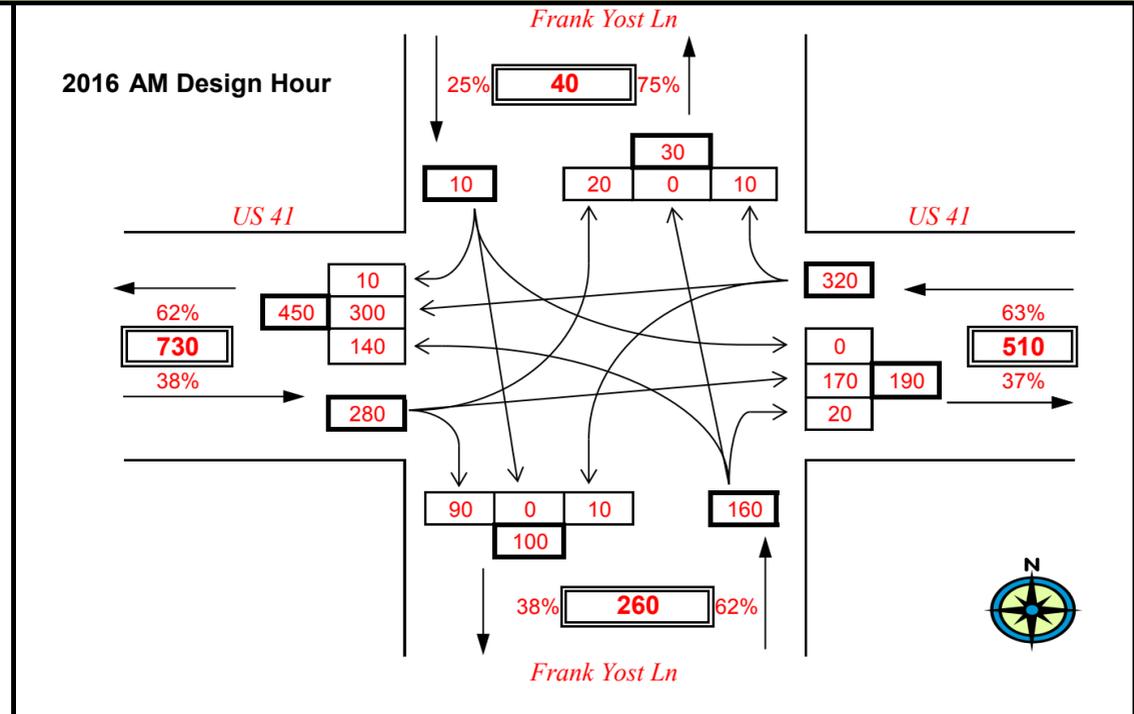
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 REQUEST DATE: 0  
 ANALYST: 0  
 YEAR: 2016 Design Hour Volumes  
 INTERSECTION: US 41 & Frank\_Yost\_Ln

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2016 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

### TURN MOVEMENT (2016)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



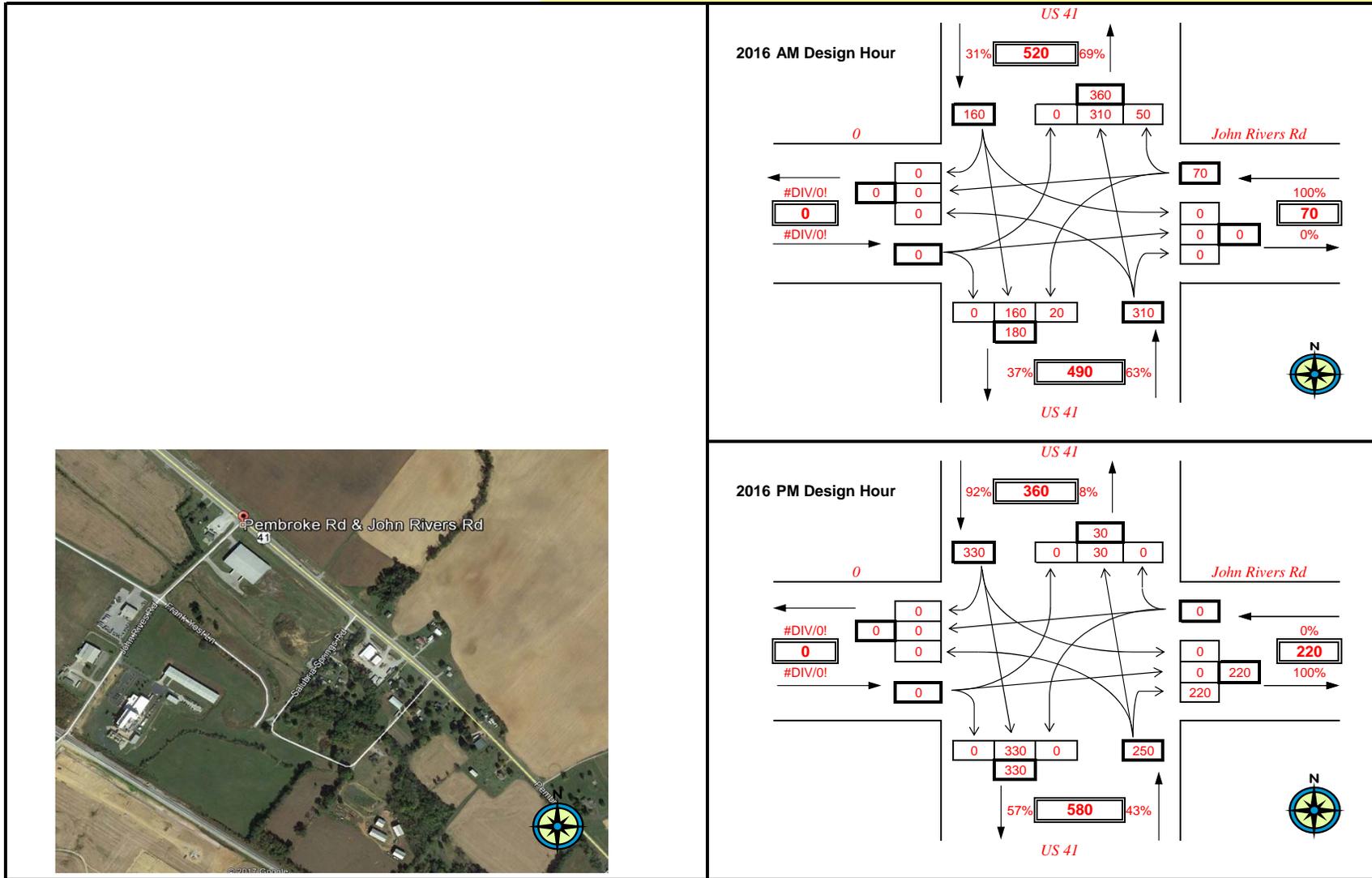
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 YEAR: 2016 Design Hour Volumes  
 INTERSECTION: US 41 & John Rivers Rd

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2016 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2016)

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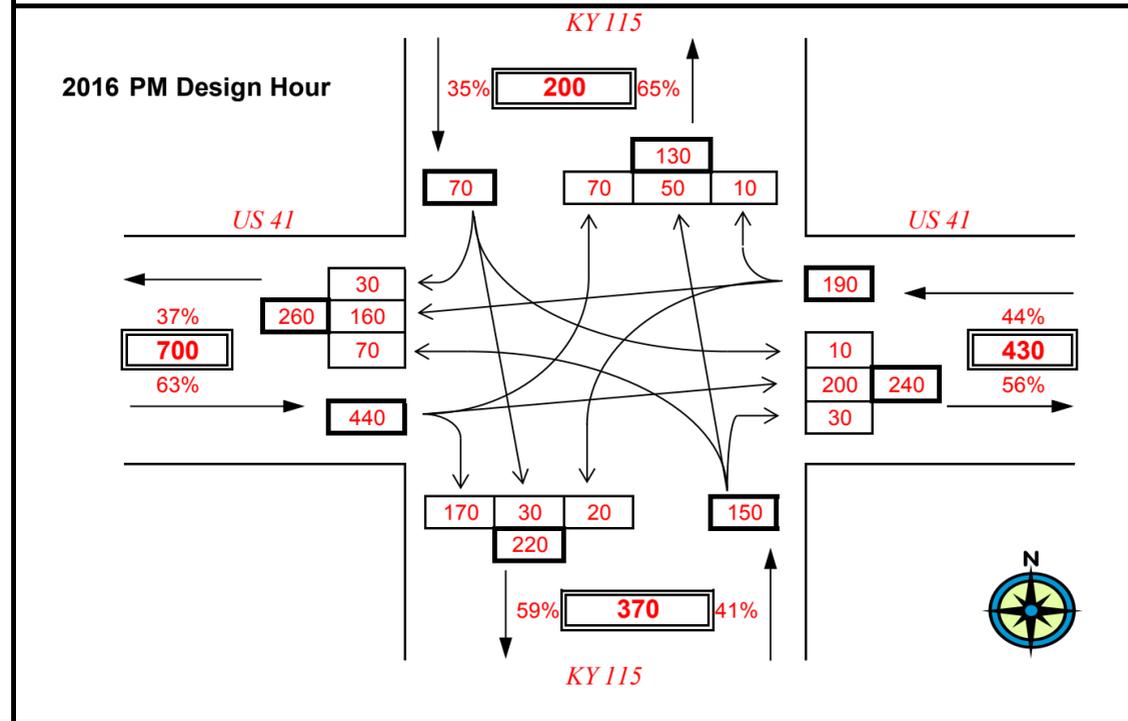
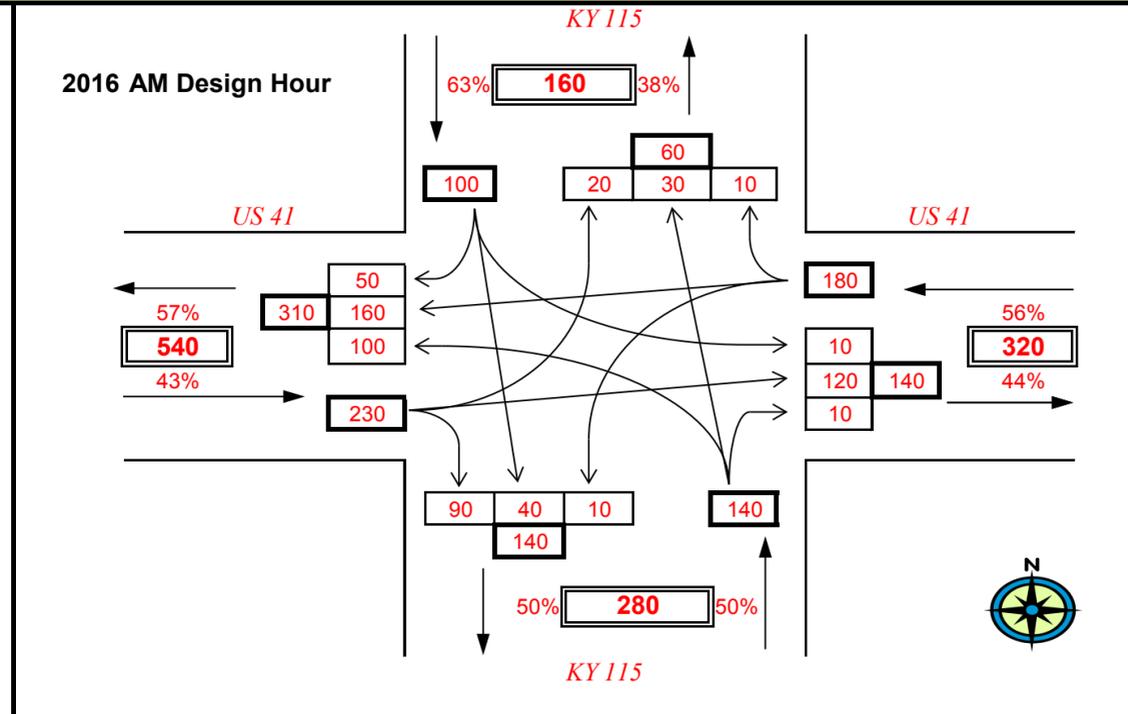
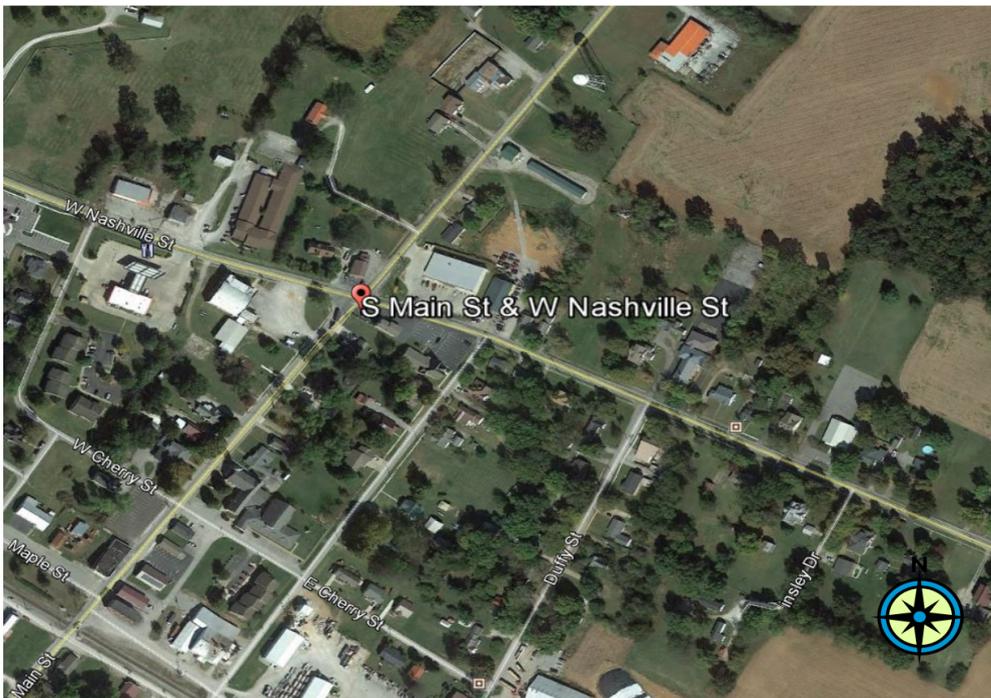
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 ANALYST: 0  
 YEAR: 2016 Design Hour Volumes  
 INTERSECTION: US 41 & KY 115

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2016 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

**TURN MOVEMENT (2016)**

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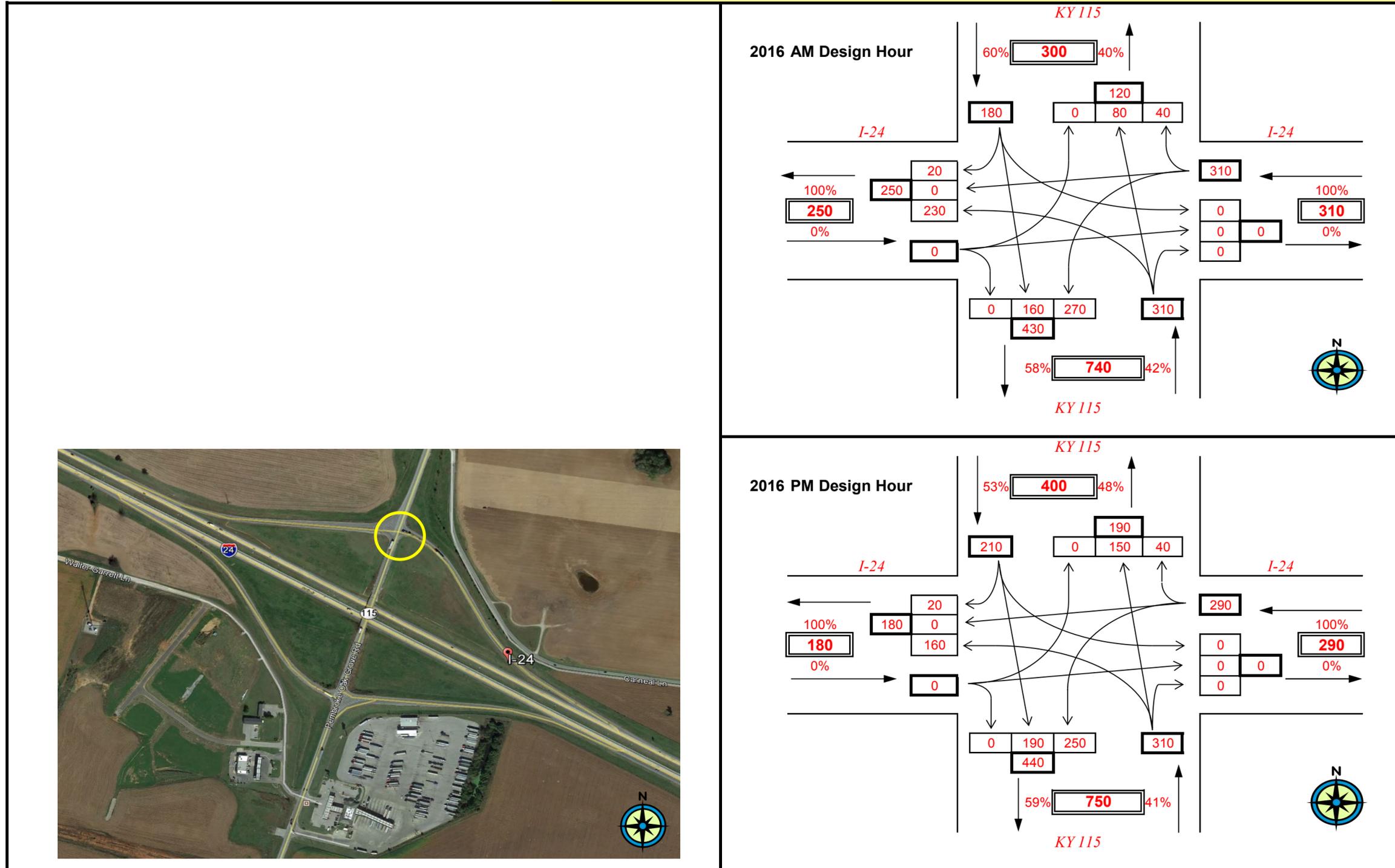
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 YEAR: 2016 Design Hour Volumes  
 INTERSECTION: KY 115 & I-24 WB Ramps

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2016 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

TURN MOVEMENT (2016)

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**APPENDIX B:  
NO BUILD TURNING MOVEMENTS**

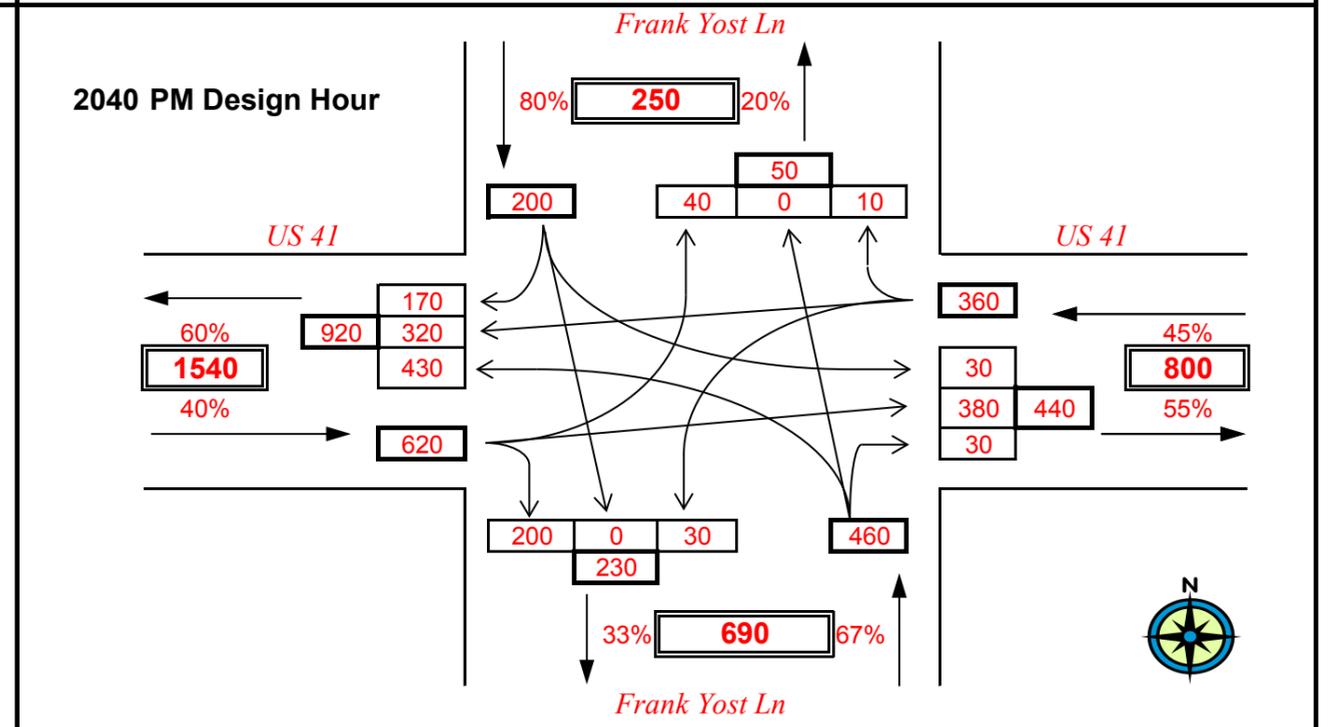
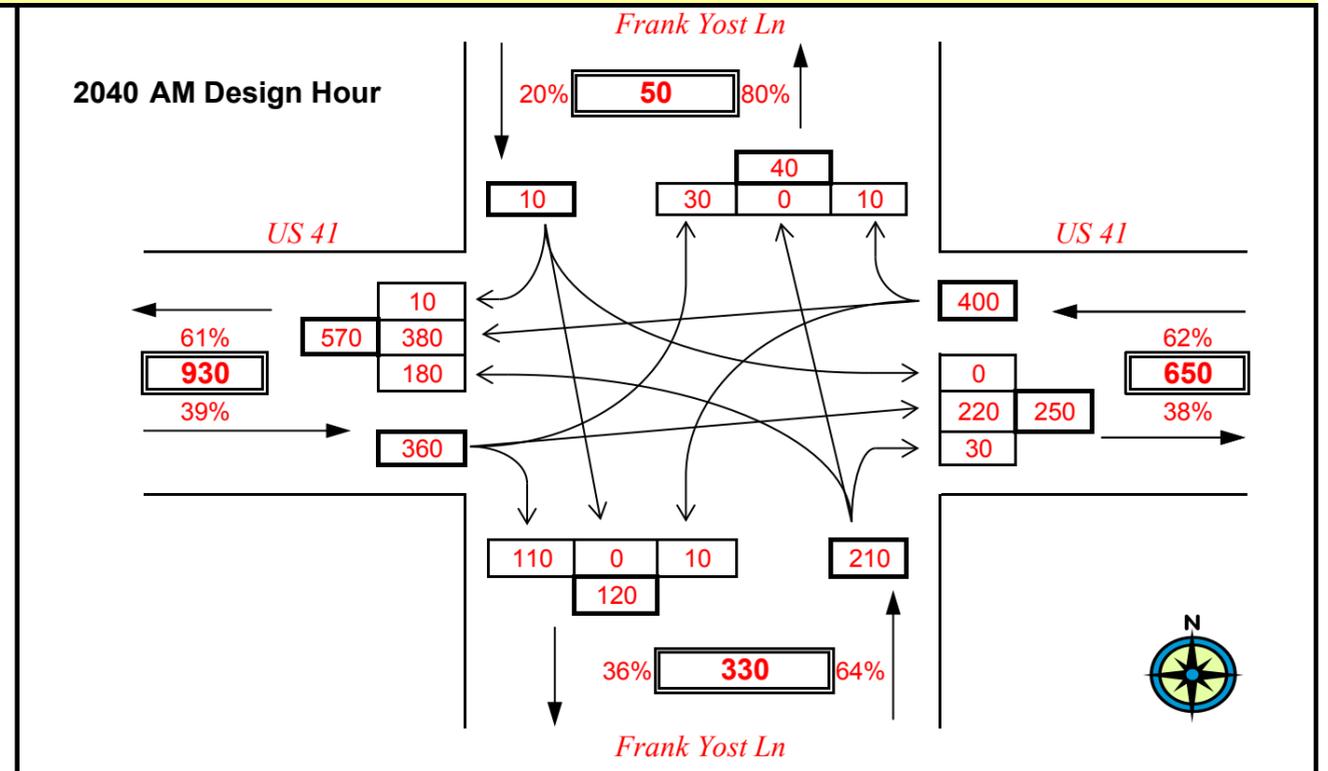
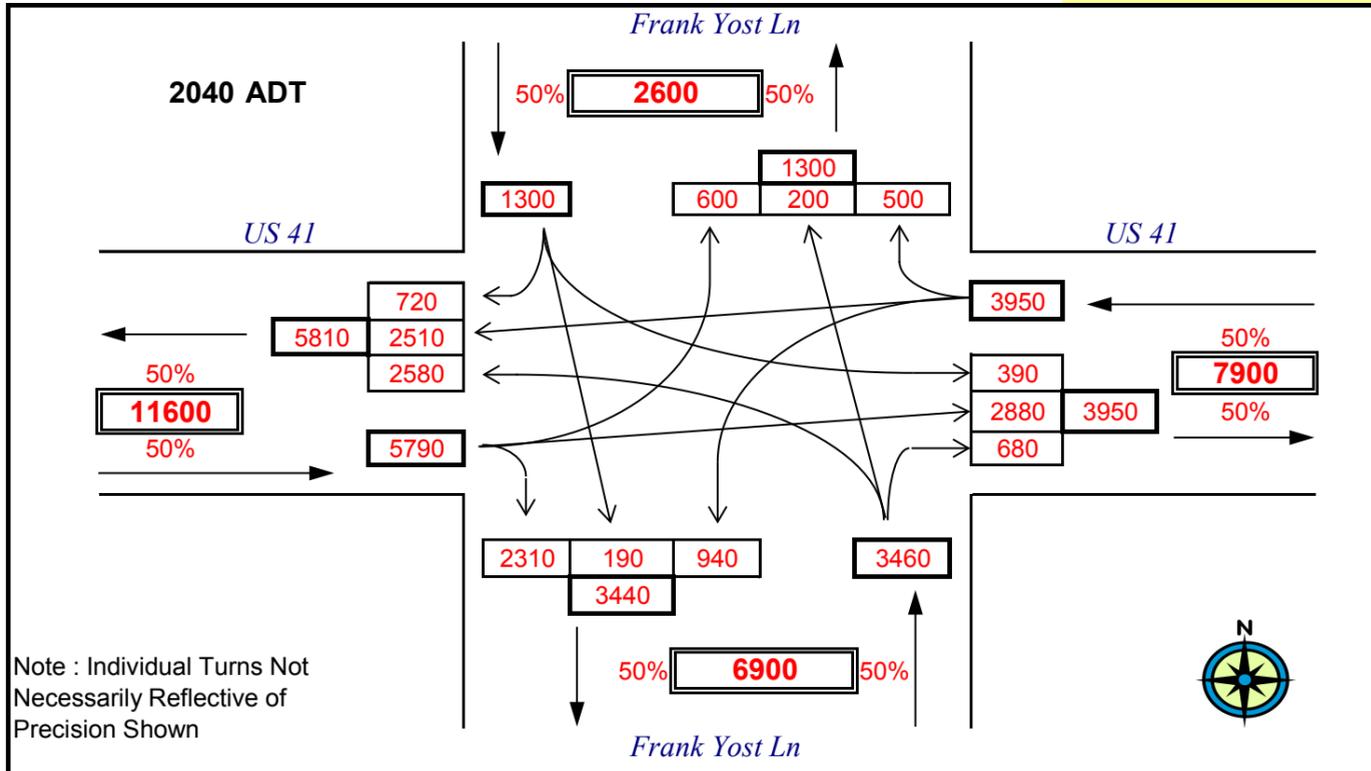
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 INTERSECTION: US 41 & Frank\_Yost\_Ln

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



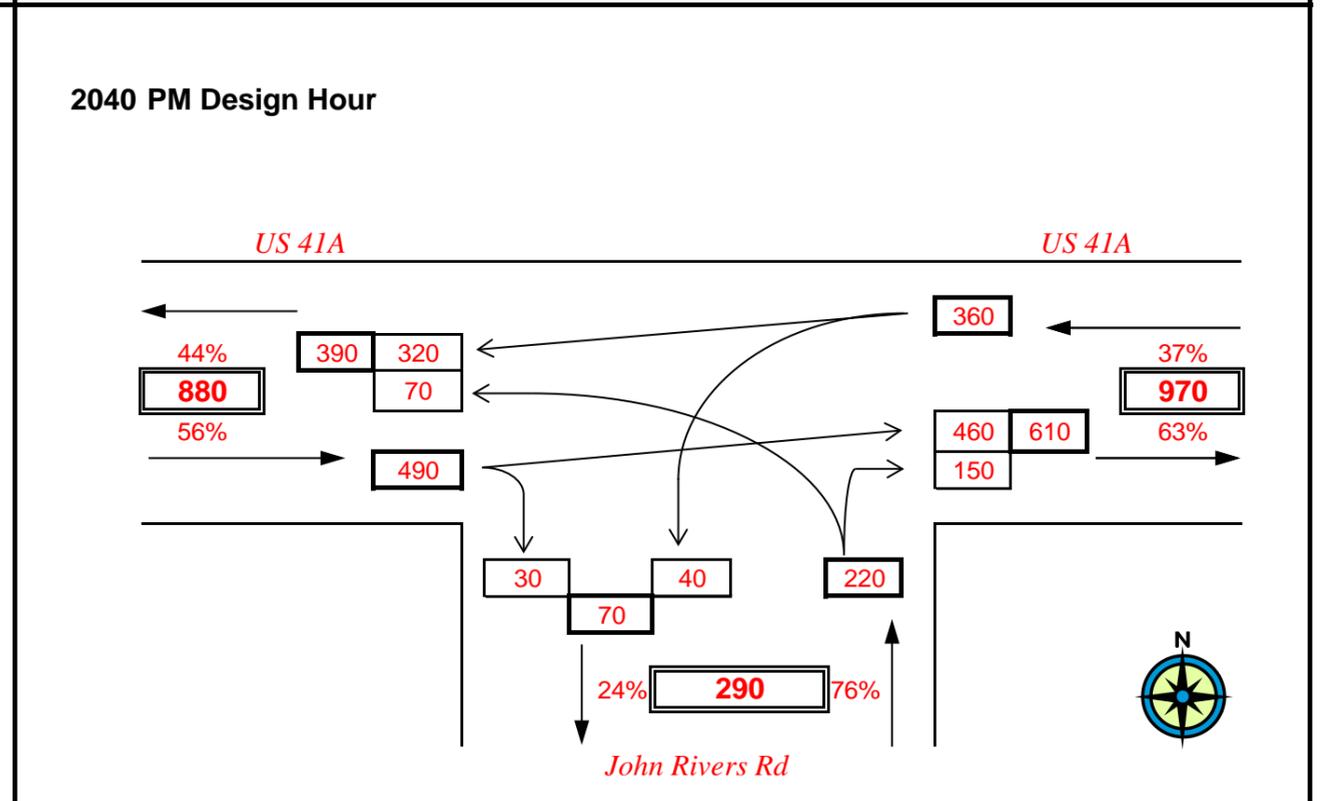
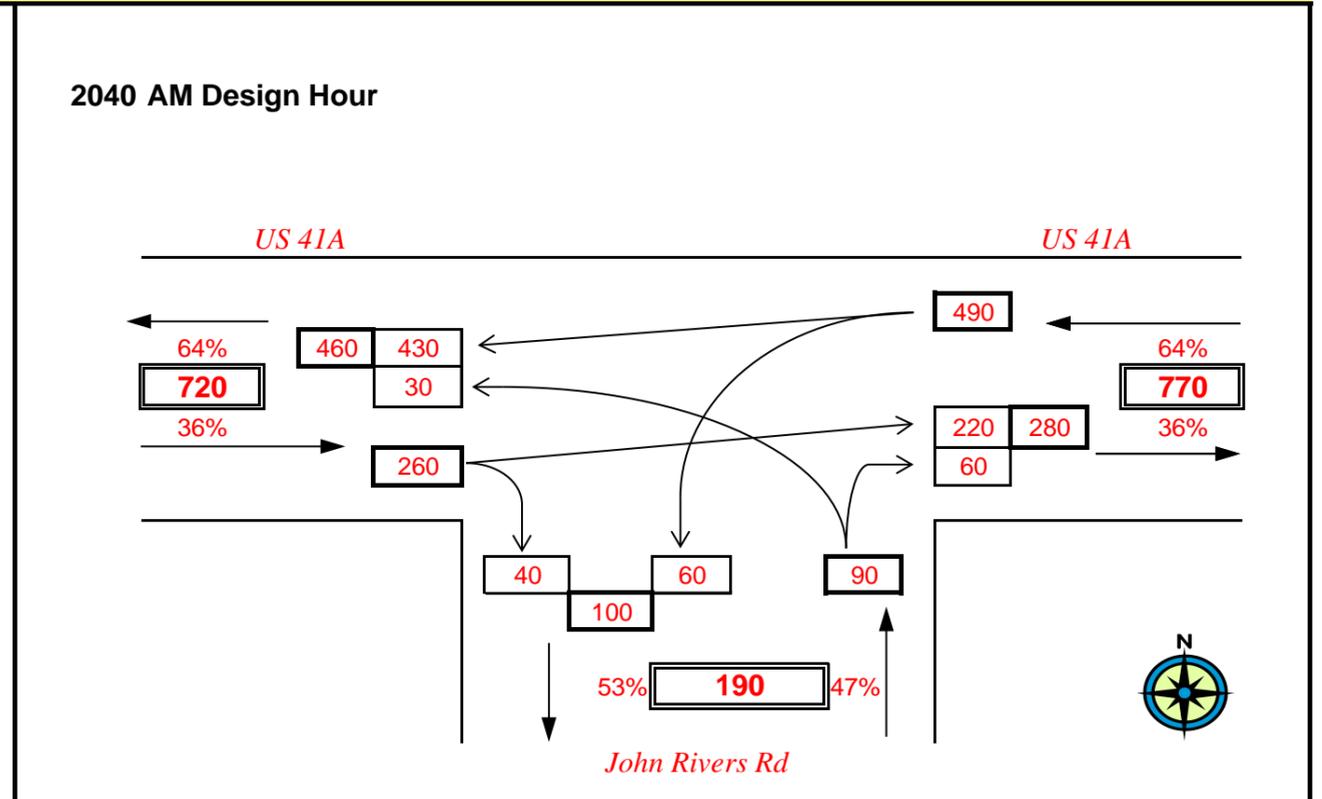
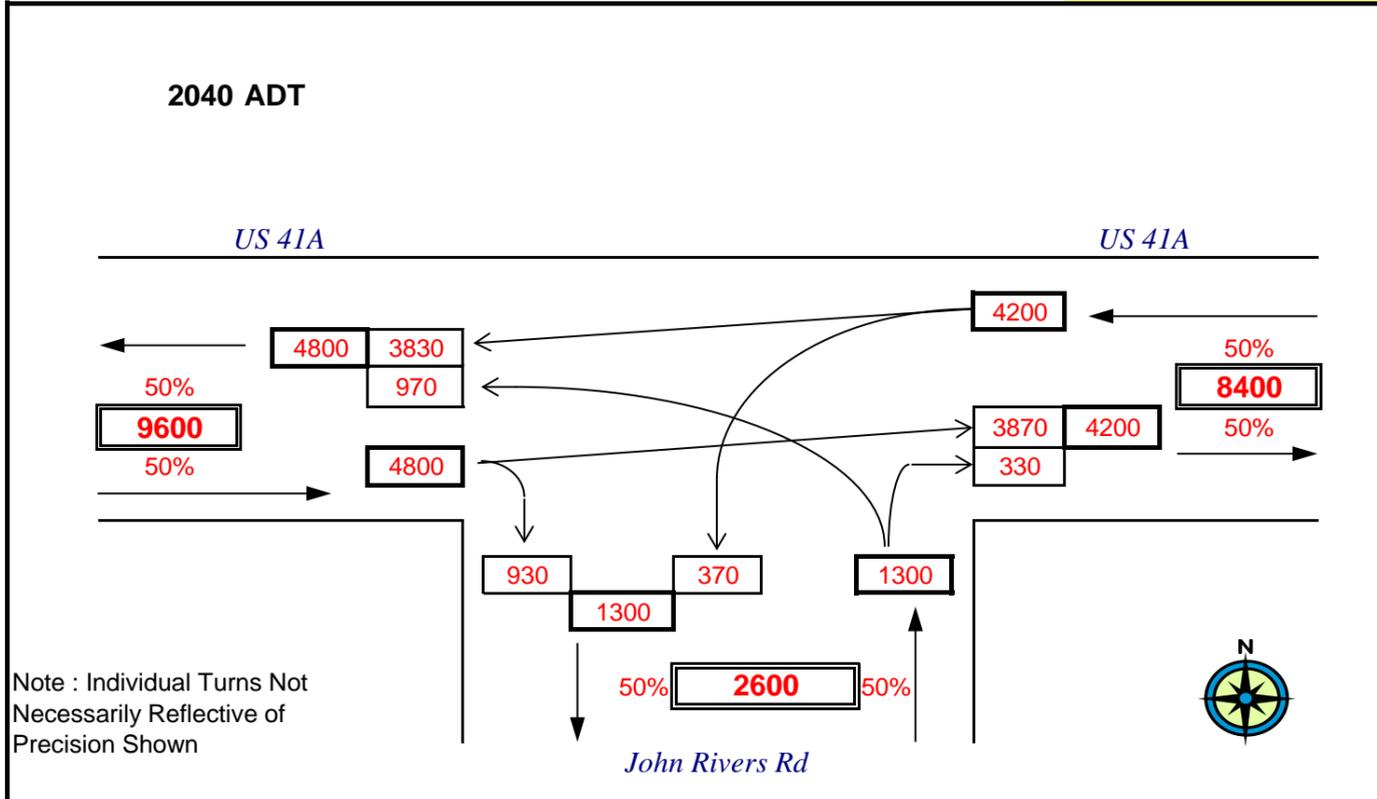
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 INTERSECTION: US 41 & John Rivers Rd

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

TURN MOVEMENT (2040)

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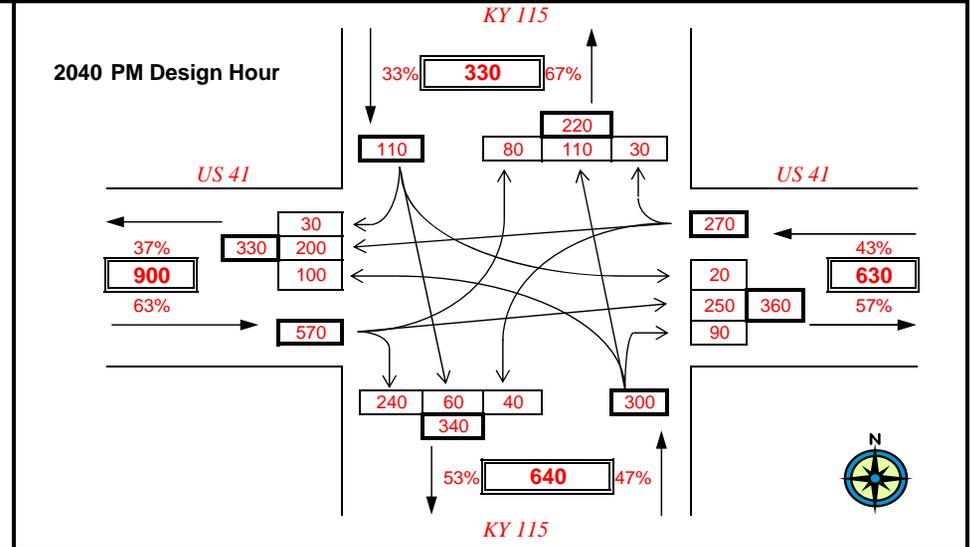
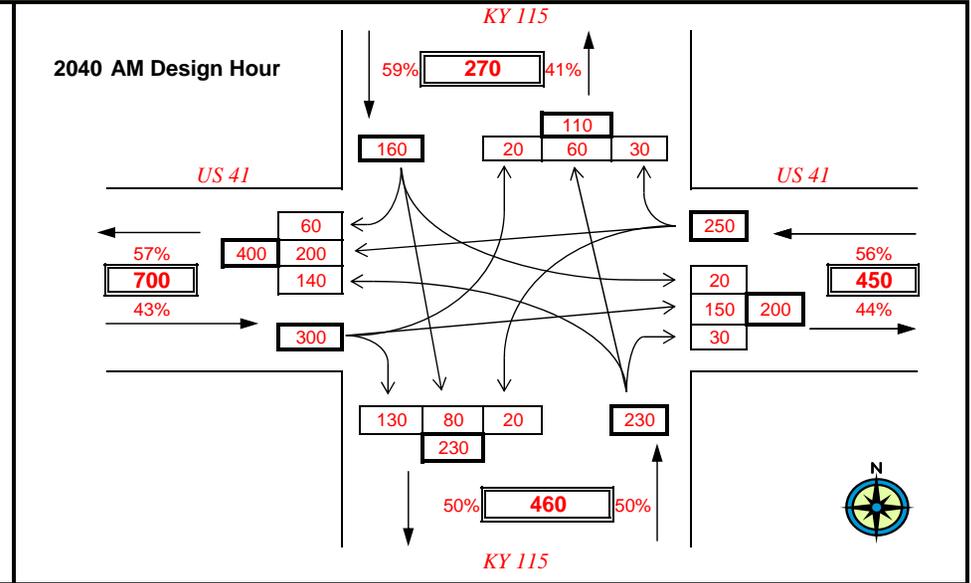
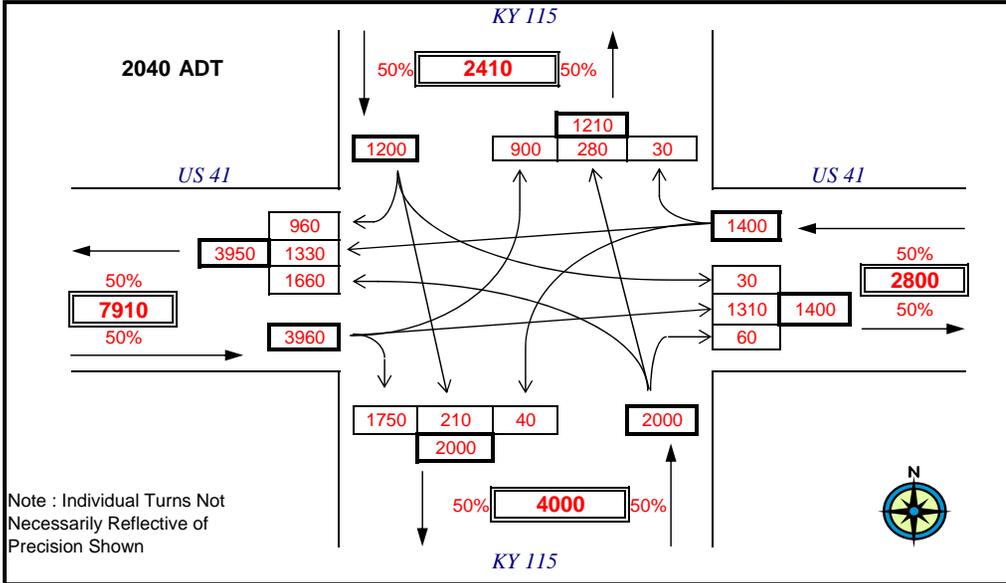
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 ANALYST: 0  
 YEAR: 2040 No Build ADT and Design Hour Volumes  
 INTERSECTION: US 41 & KY 115

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

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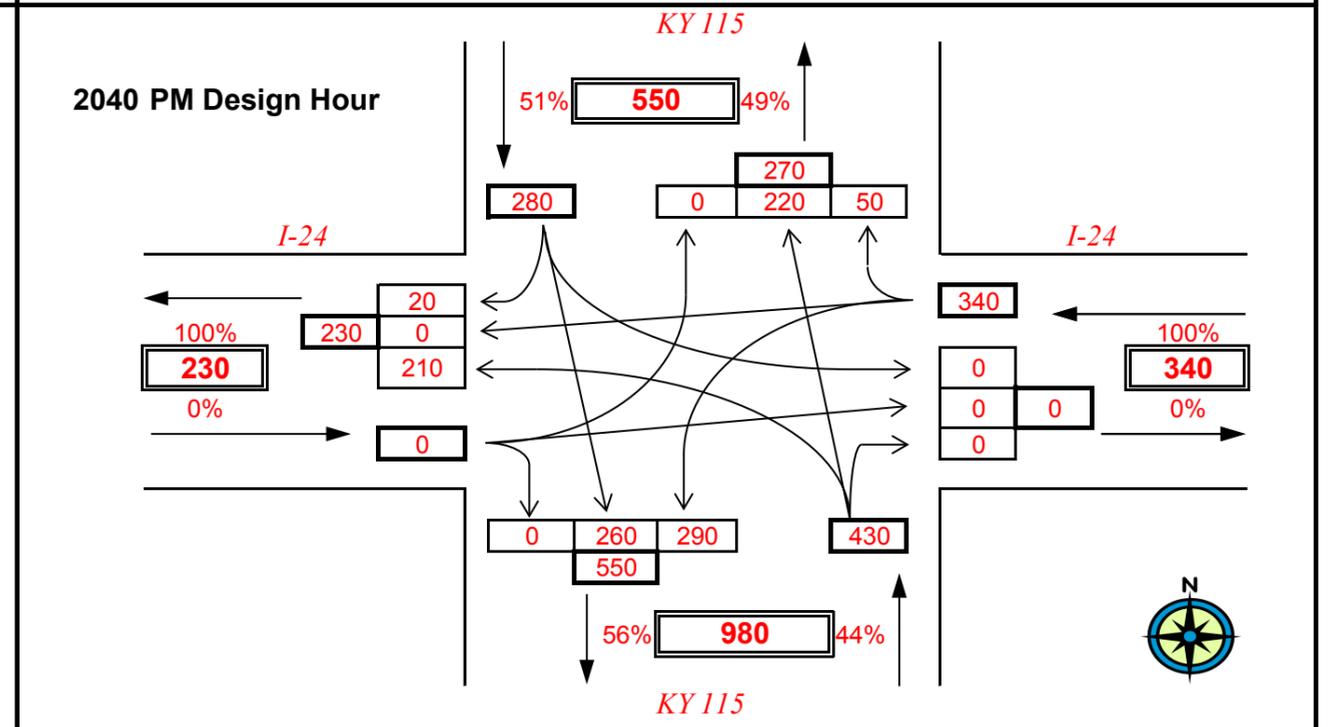
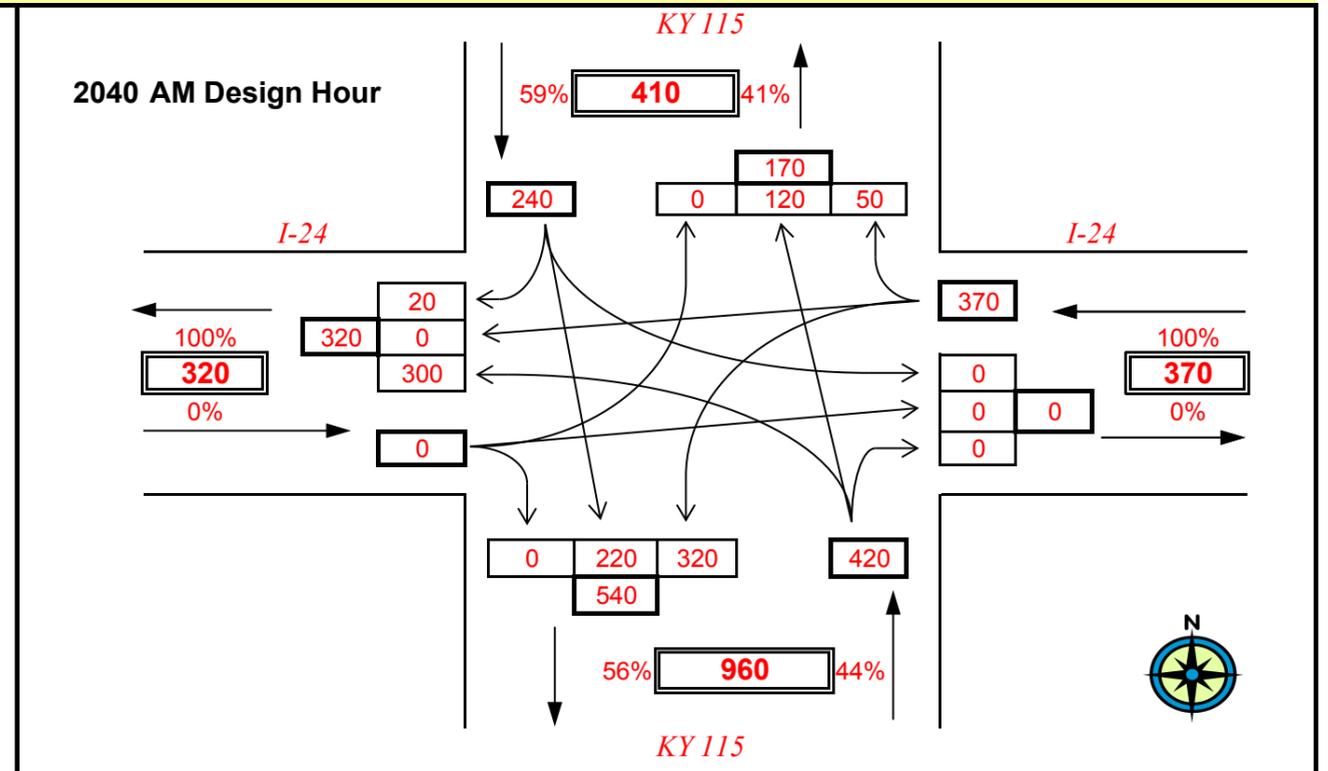
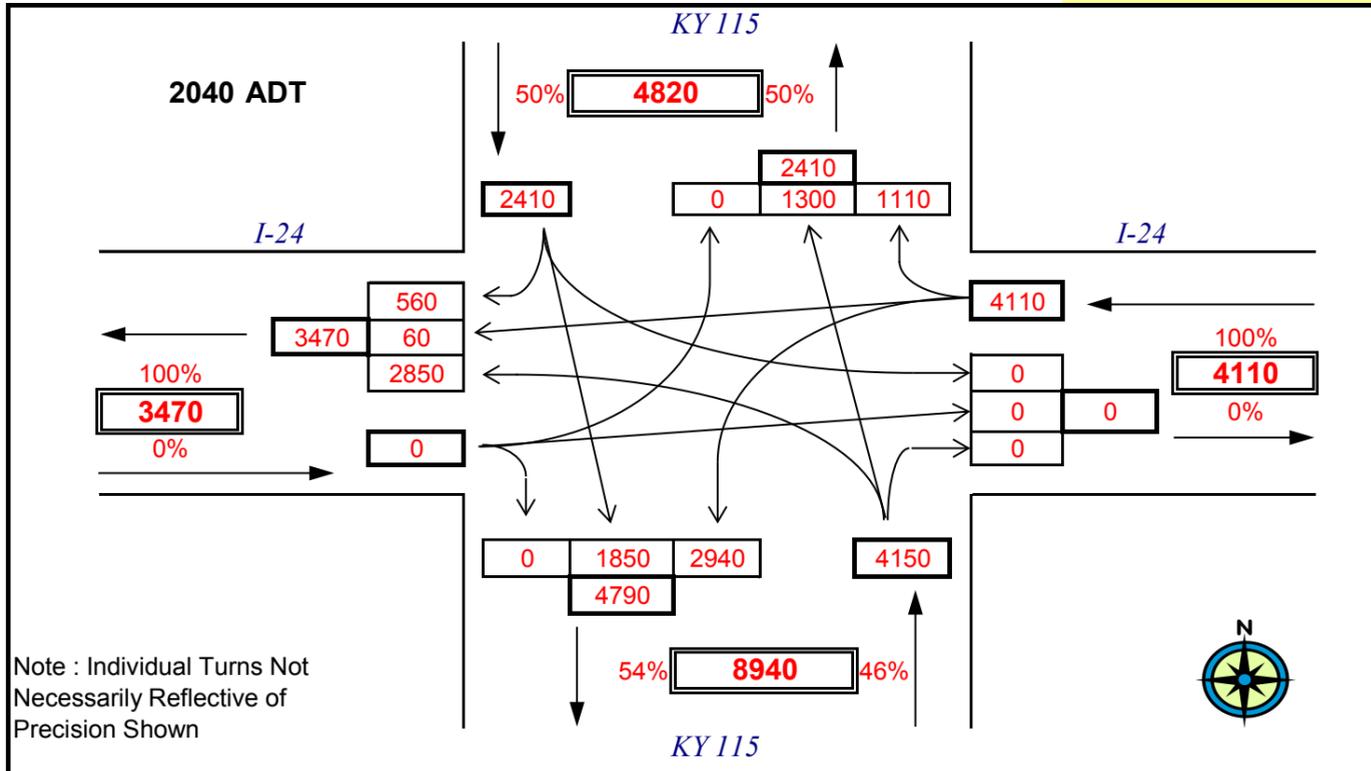
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 MARS NUMBER: 0  
 REQUEST DATE: Saturday, January 00, 1900  
 ANALYST: 0  
 YEAR: **2040 No Build** ADT and Design Hour Volumes  
 INTERSECTION: KY 115 & I-24 WB Ramps

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

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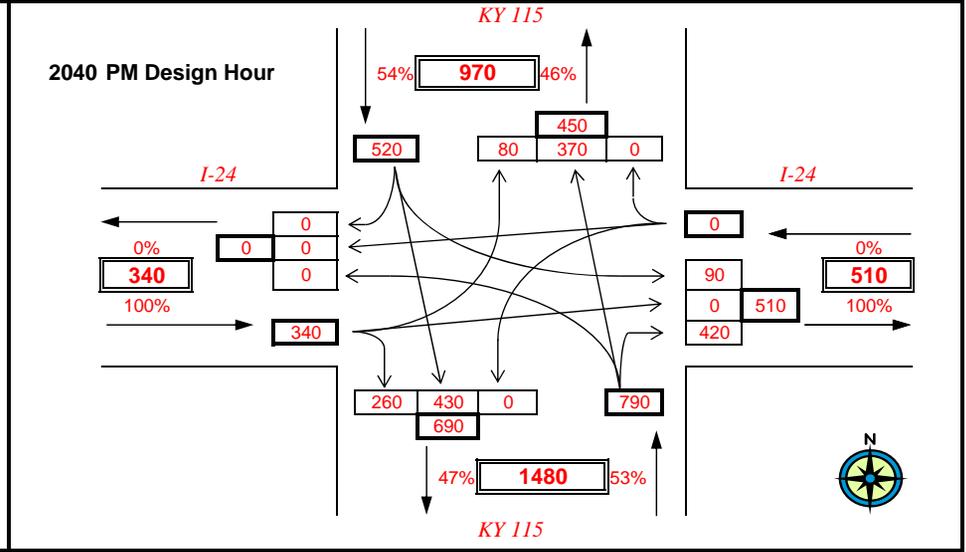
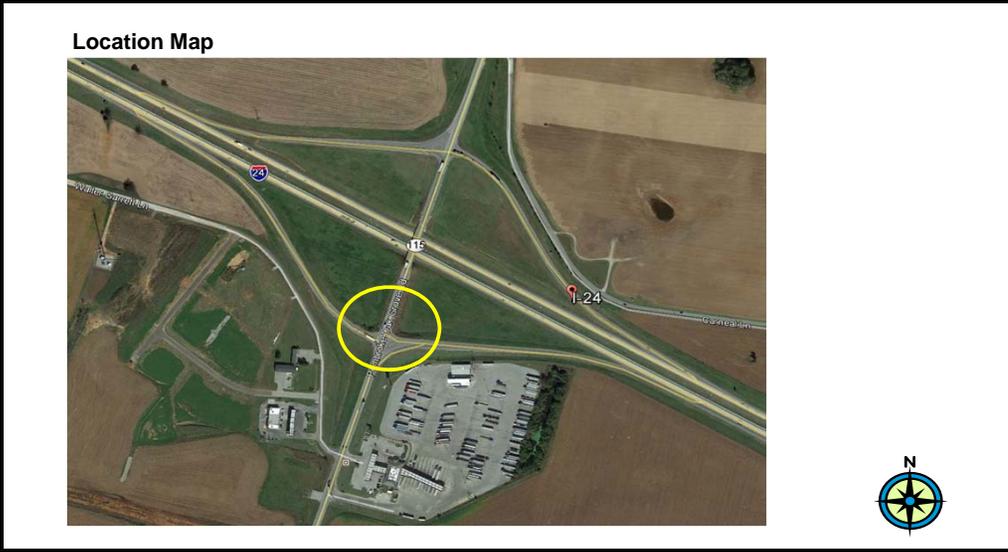
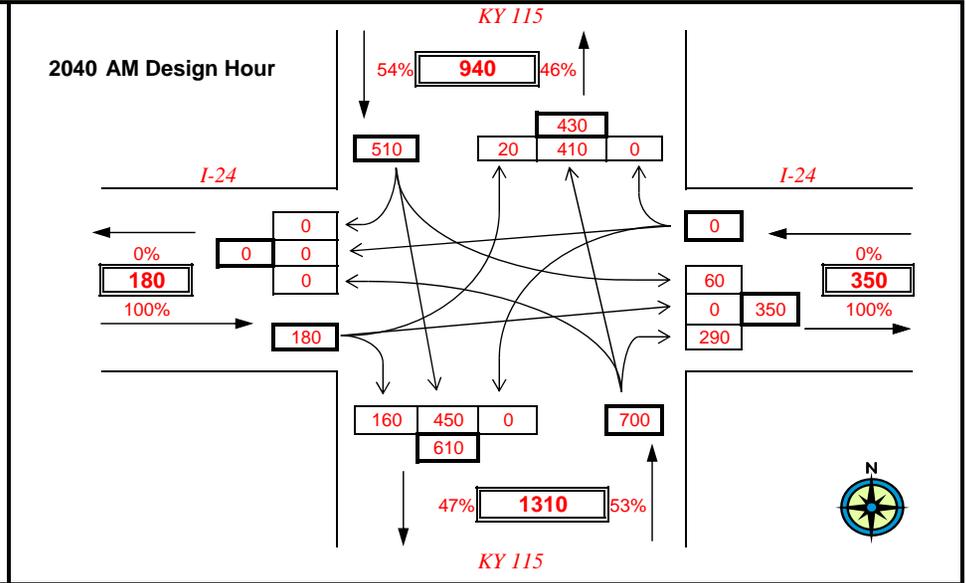
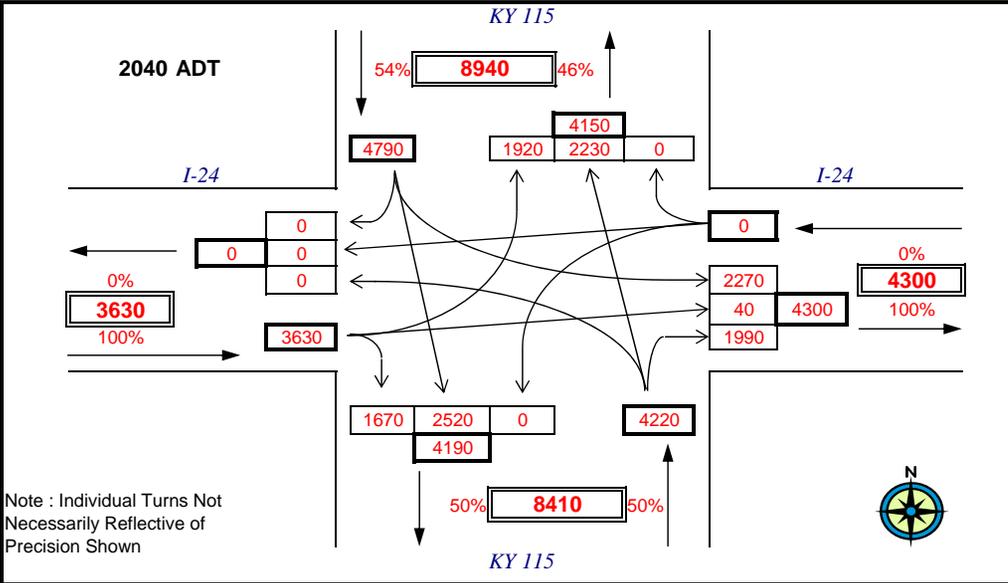
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 ANALYST: 0  
 YEAR: **2040 No Build ADT and Design Hour Volumes**  
 INTERSECTION: KY 115 & I-24 EB Ramps

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



**APPENDIX C:  
BUILD TURNING MOVEMENTS**



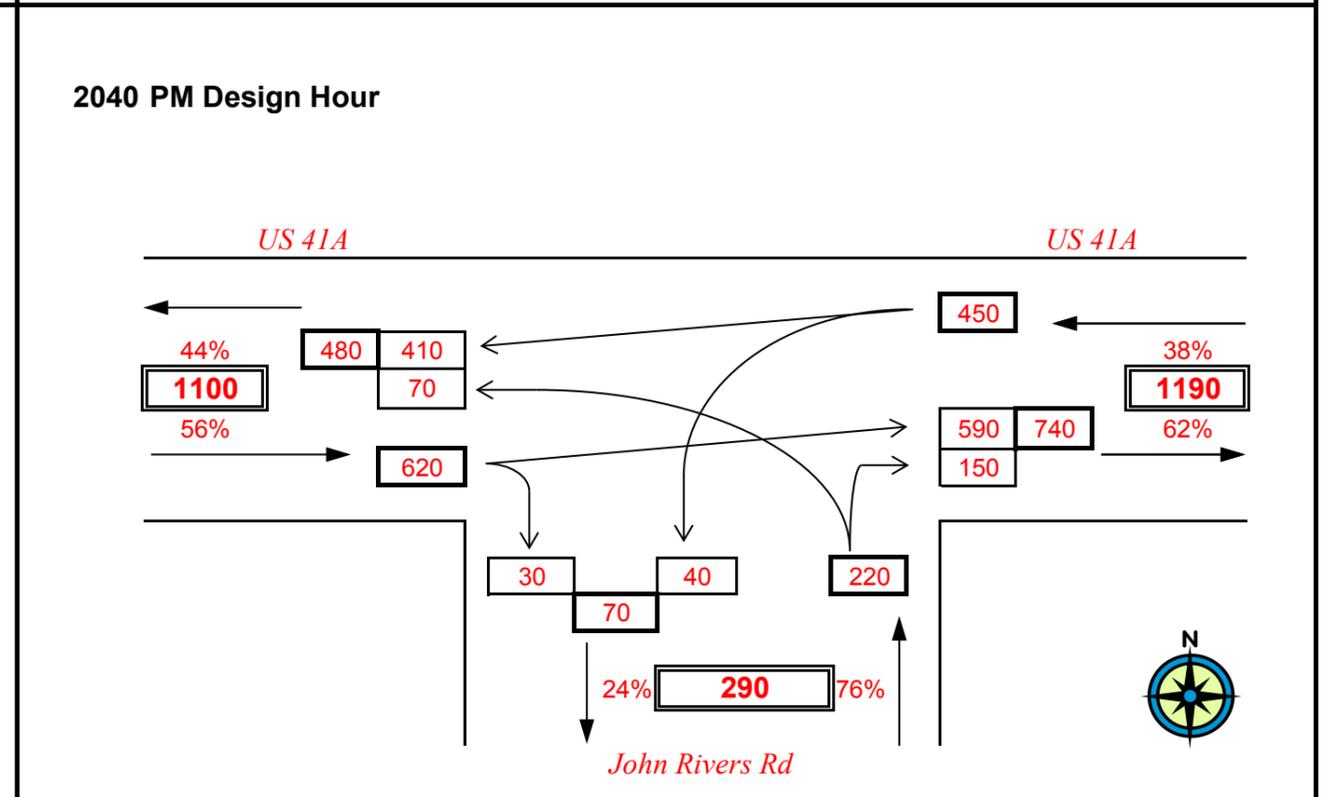
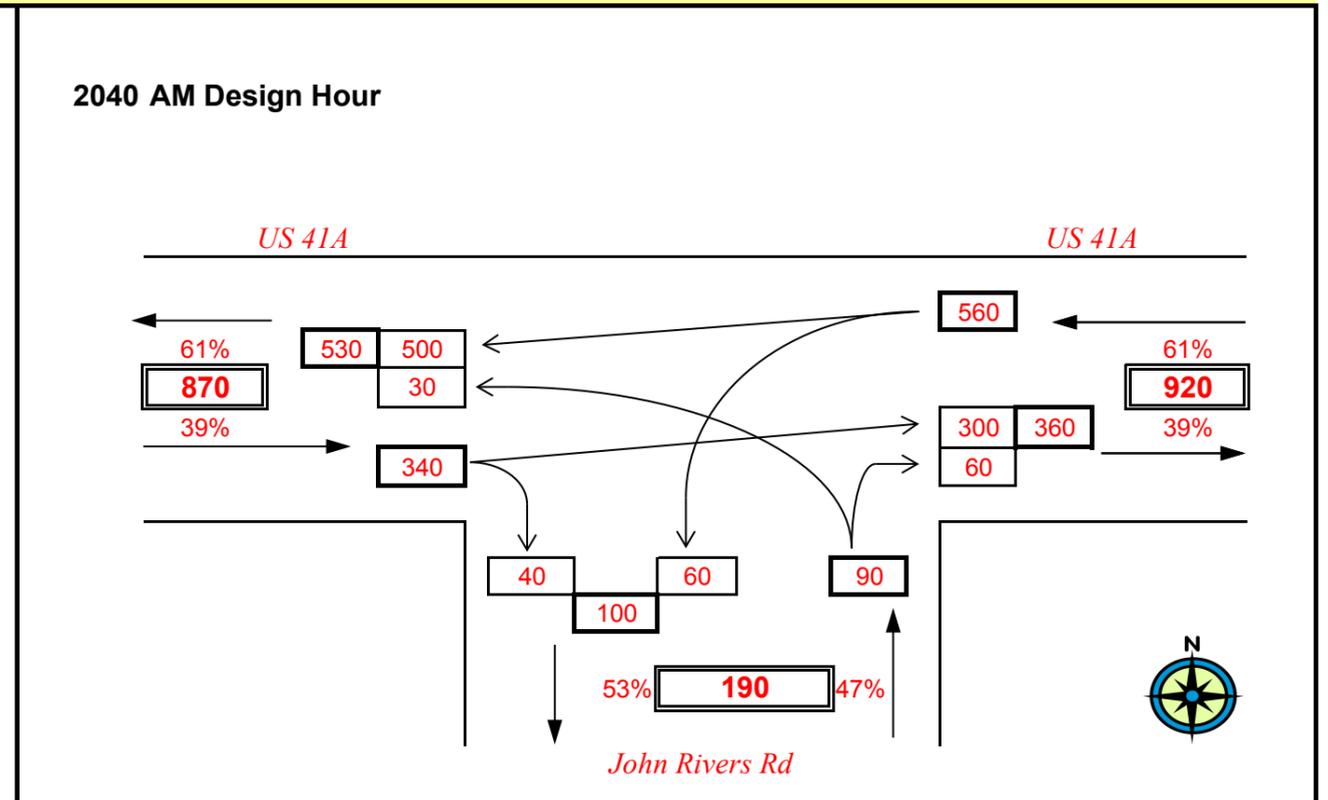
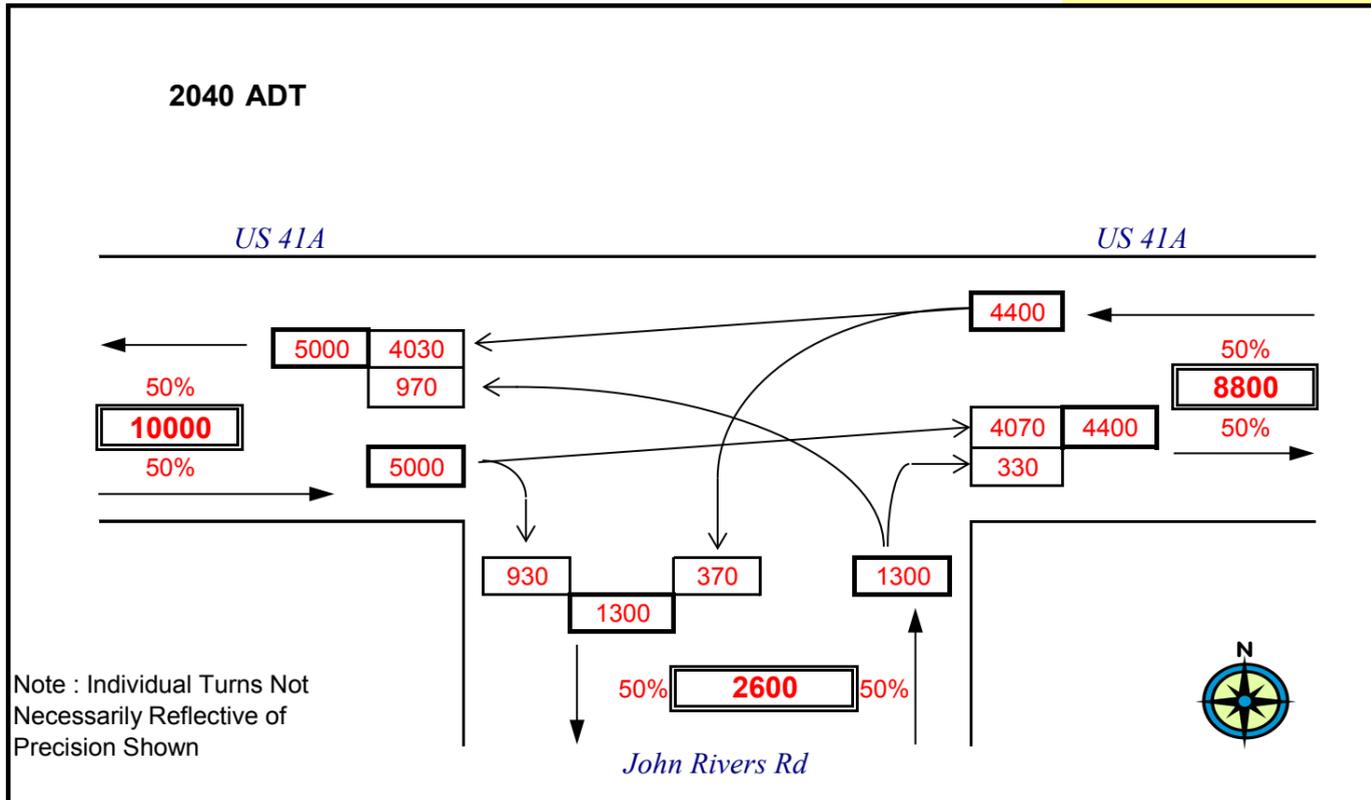
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 MARS NUMBER: 0  
 REQUEST DATE: Saturday, January 00, 1900  
 ANALYST: 0  
 YEAR: 2040 Build ADT and Design Hour Volumes  
 INTERSECTION: US 41 & John Rivers Rd

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



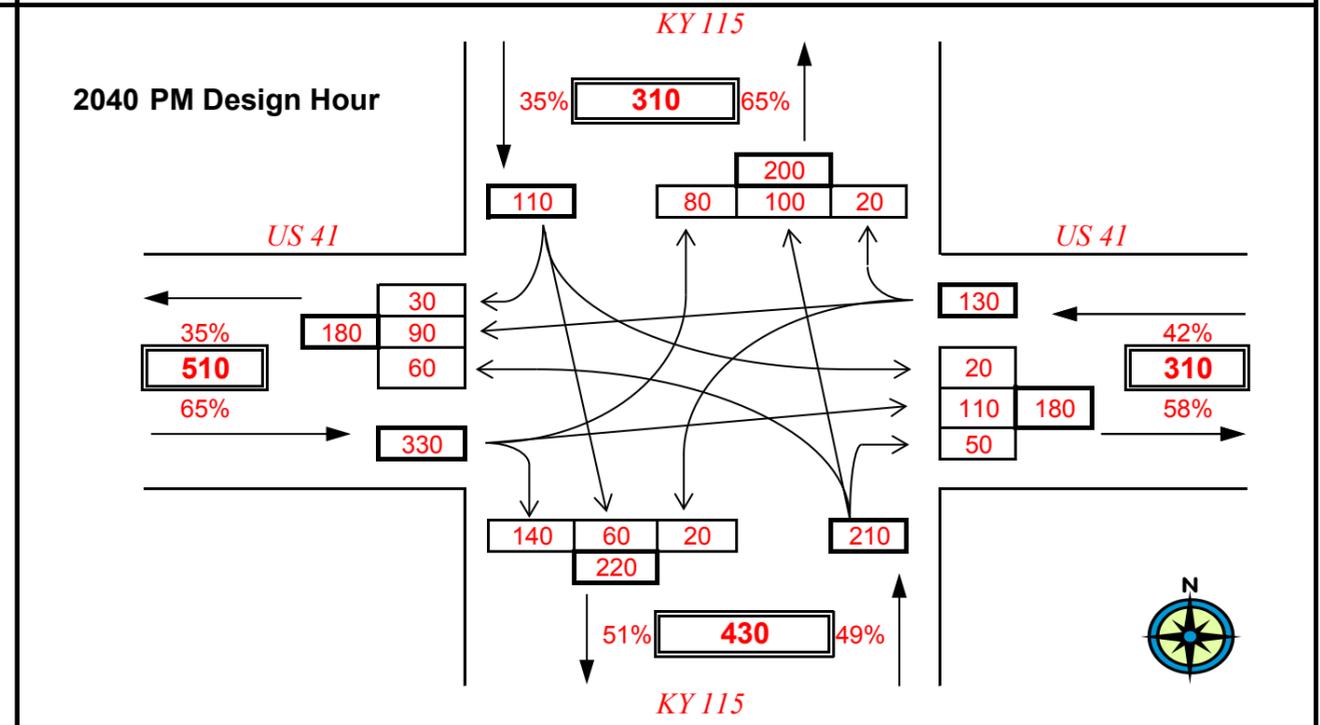
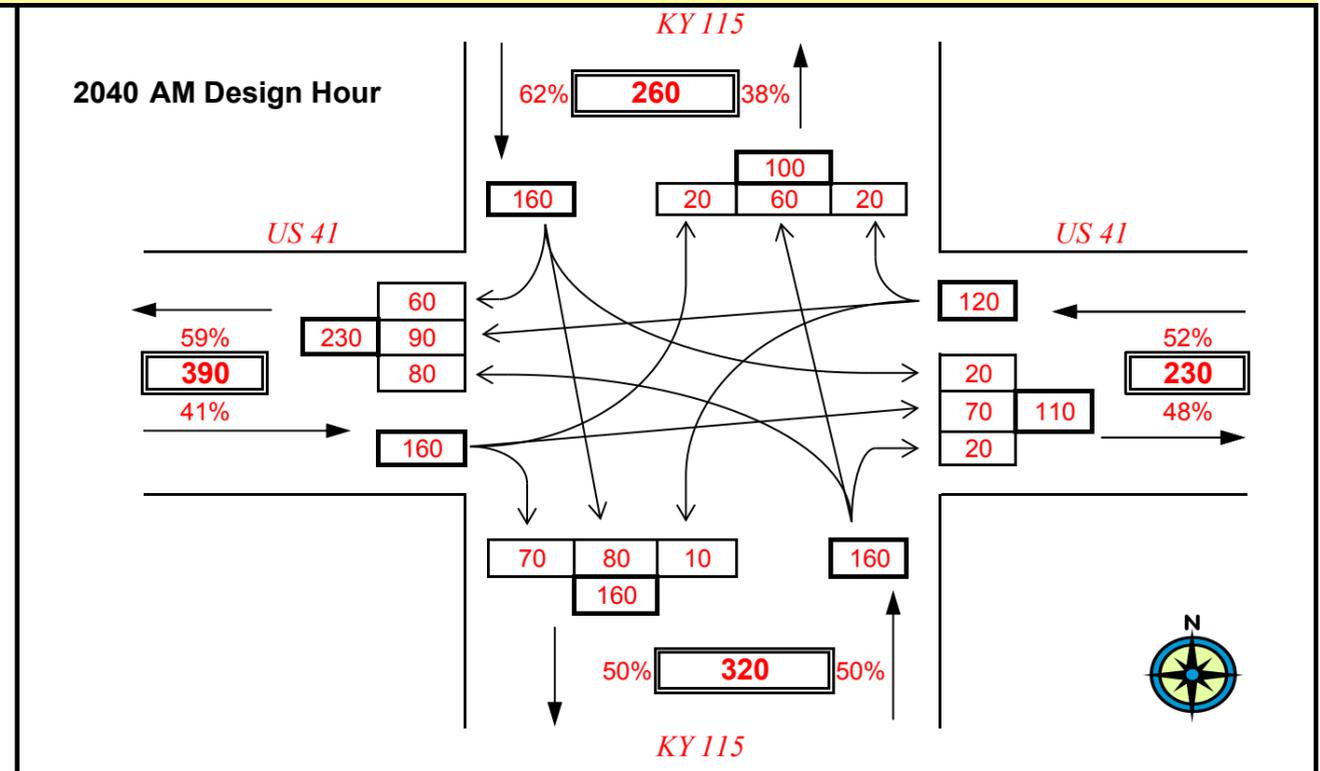
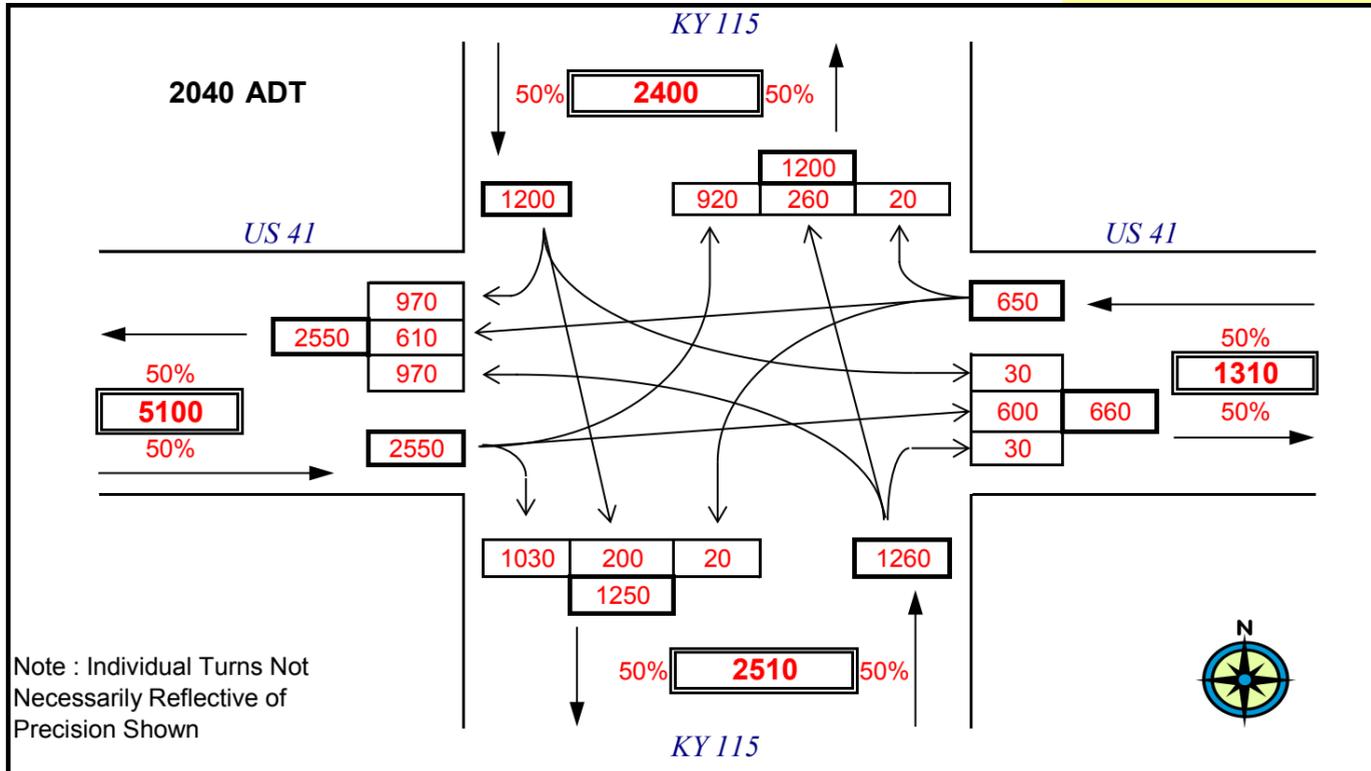
TM 3

PROJECT: Pembroke Corridor Study  
 ITEM NUMBER: 2-381.00  
 MARS NUMBER: 0  
 REQUEST DATE: Saturday, January 00, 1900  
 ANALYST: 0  
 YEAR: 2040 Build ADT and Design Hour Volumes  
 INTERSECTION: US 41 & KY 115

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

# TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



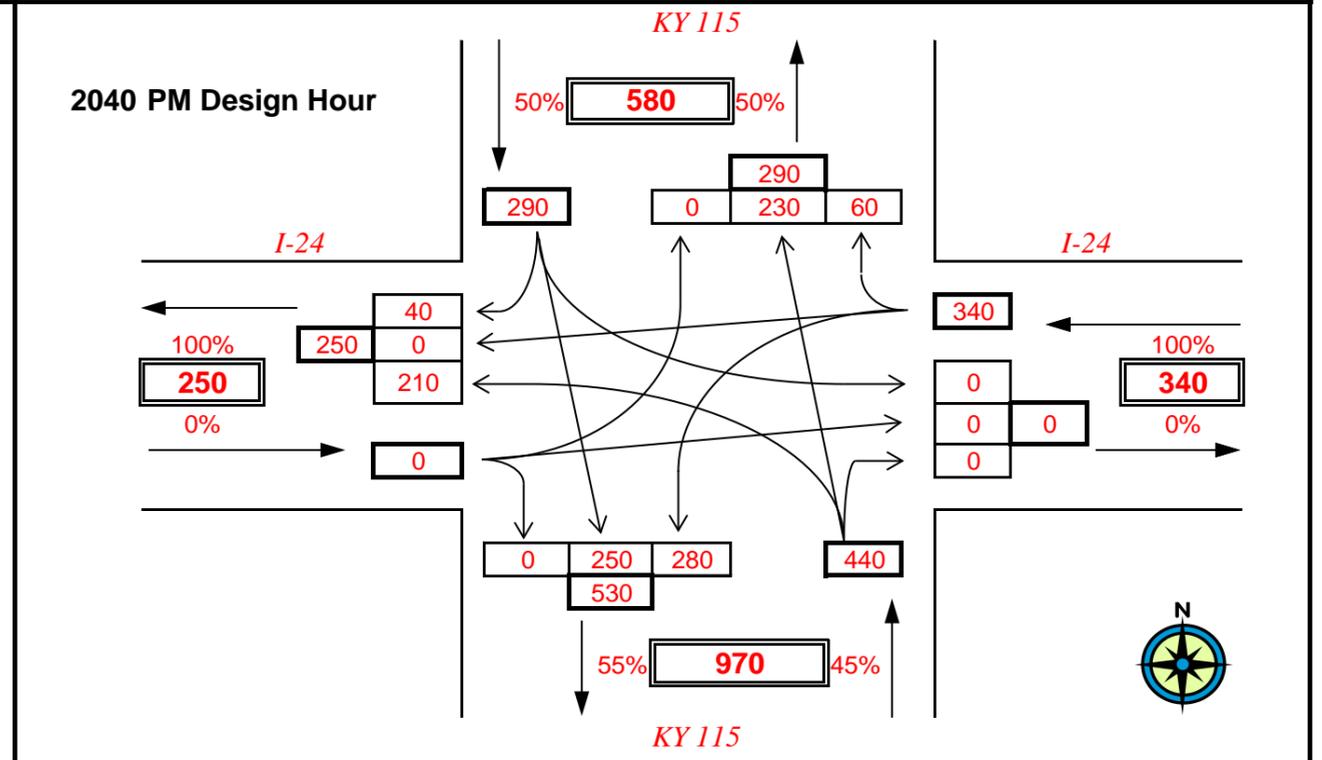
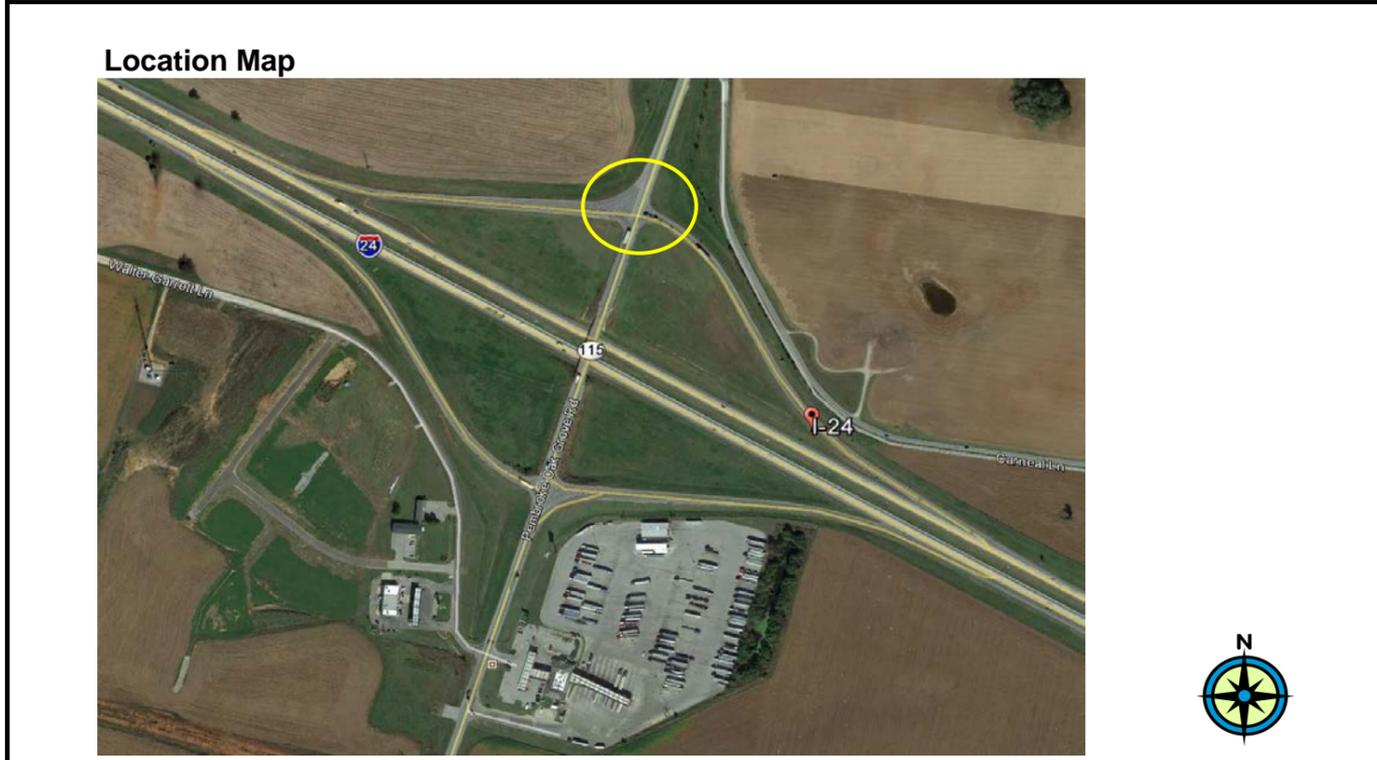
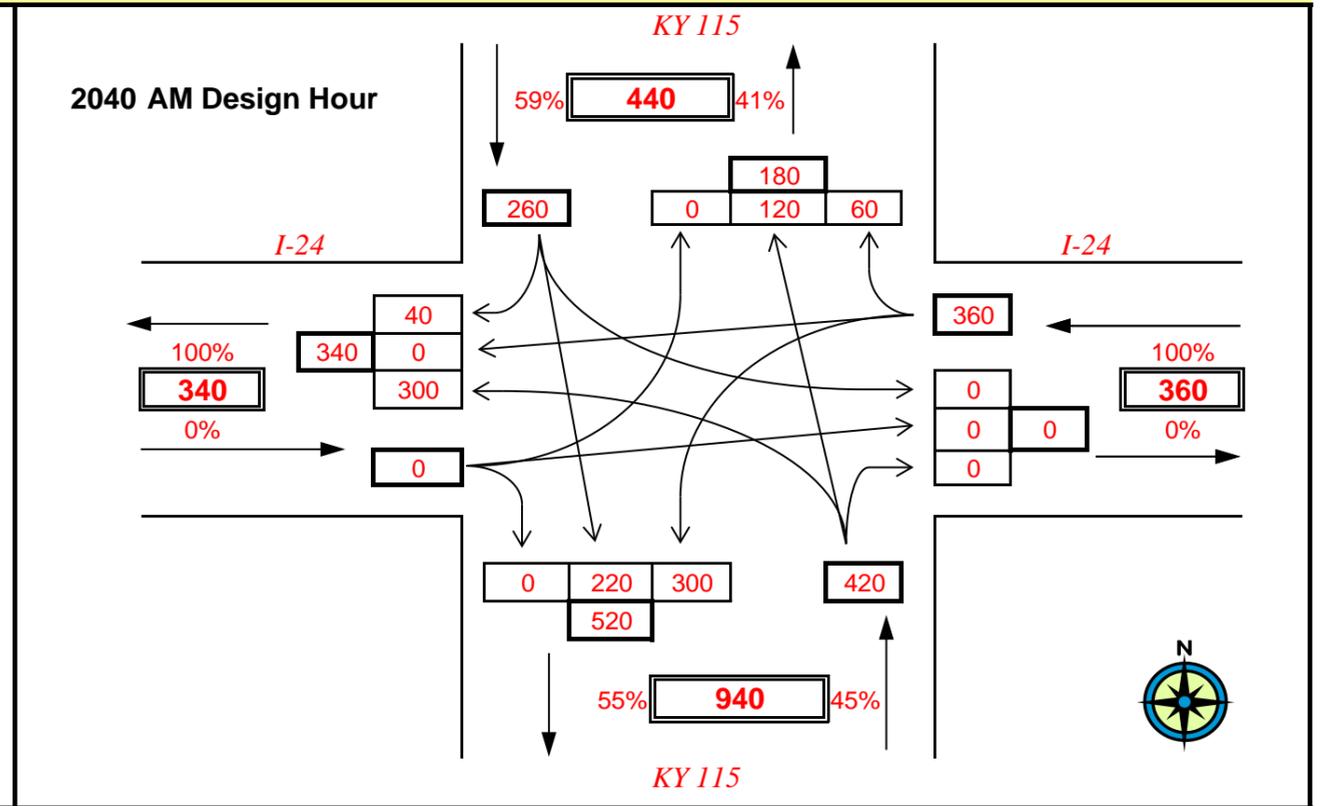
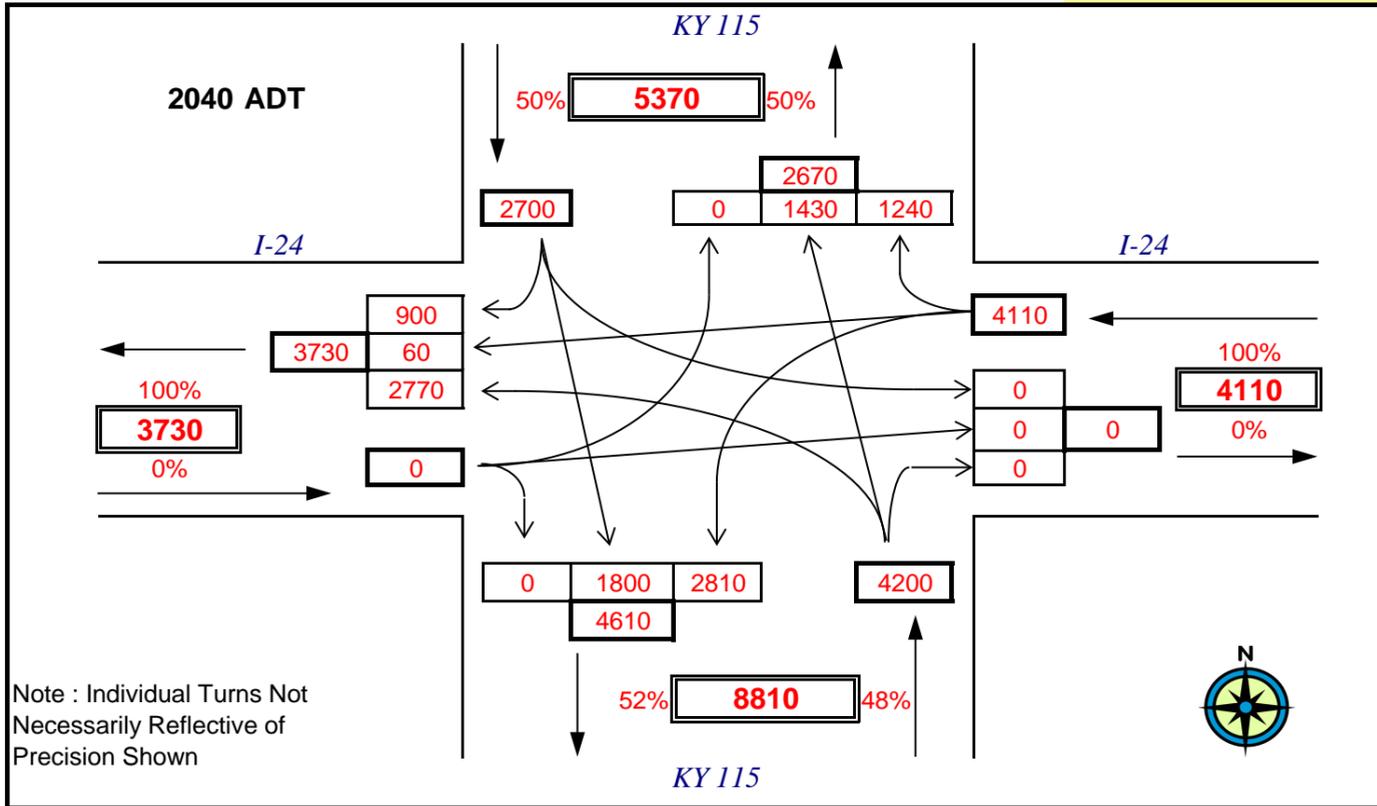
TM 4

PROJECT: Pembroke Corridor Study  
 ITEM NUMBER: 2-381.00  
 MARS NUMBER: 0  
 REQUEST DATE: Saturday, January 00, 1900  
 ANALYST: 0  
 YEAR: 2040 Build ADT and Design Hour Volumes  
 INTERSECTION: KY 115 & I-24 WB Ramps

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**



# TM 5

PROJECT: Pembroke Corridor Study  
 ITEM NUMBER: 2-381.00  
 MARS NUMBER: 0  
 REQUEST DATE: Saturday, January 00, 1900  
 ANALYST: 0  
 YEAR: **2040 Build ADT and Design Hour Volumes**  
 INTERSECTION: KY 115 & I-24 EB Ramps

NOTE: K-Factors, Directional Distributions, and Peak Hour Factors were determined from a 2040 Turning Movement Count. AM and PM DHVs represent 30th highest hour estimates for each turn maneuver.

## TURN MOVEMENT (2040)

**\*\*DHV TURN MOVEMENT FORECASTS SHOULD NOT BE USED FOR SIGNAL TIMING OR WARRANT ANALYSIS**

