CHAPTER 7. TRAVEL PATTERNS AND TRAVEL FORECASTING

TRAVEL PATTERNS

Northwest Arkansas has experienced unprecedented growth in population and employment in the past 25 years. The economic vitality and diversity of population have been strong catalysts for the growth of the region.

In Northwest Arkansas, the majority of the population uses an automobile for work related trips. According to the American Community Survey (ACS) 5-year estimate of 2019, the vast majority, over 90 percent of workers 16 years and over, in Benton and Washington Counties in Arkansas and McDonald County in Missouri, commuted to work by car, truck, or van.

Figure 7.1 and Figure 7.2 illustrate the percentages for each mode of transportation that workers 16 years and over used to commute to work for two five-year estimates (2009-20013 and 2015-2019). In Benton County, the percent of workers who drove alone increased from 82.4 percent in 2013 to 84.9 percent in 2019. In Washington County this group increased from 76.8 percent in 2013 to 78.6 in 2019. McDonald County experienced an increase from 78.6 to 79.5 percent. For the public transportation mode, in Washington County which decreased from 1 percent to 0.7 percent by 2019. In the same category, Benton and McDonald County percent stayed at 0.1 percent.

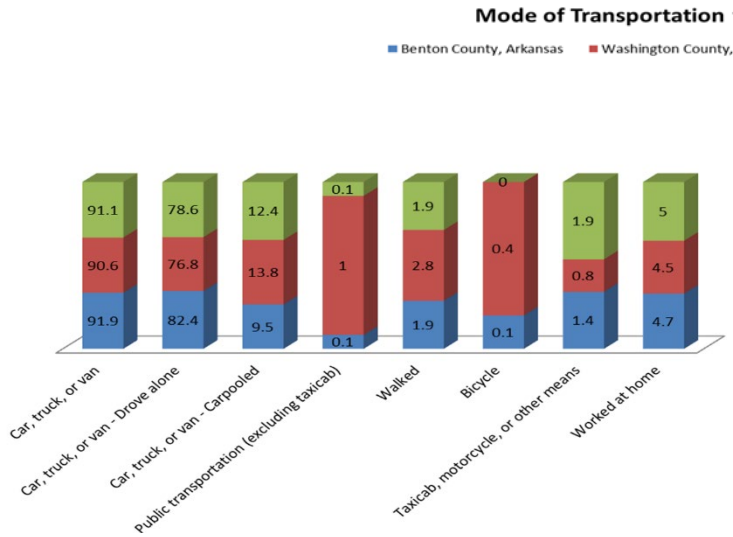


Figure 7.1 - Mode of Transportation to Work (percent) ACS 2009-2013

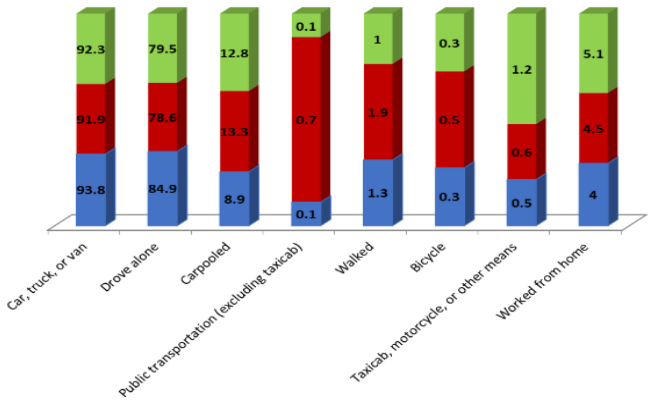
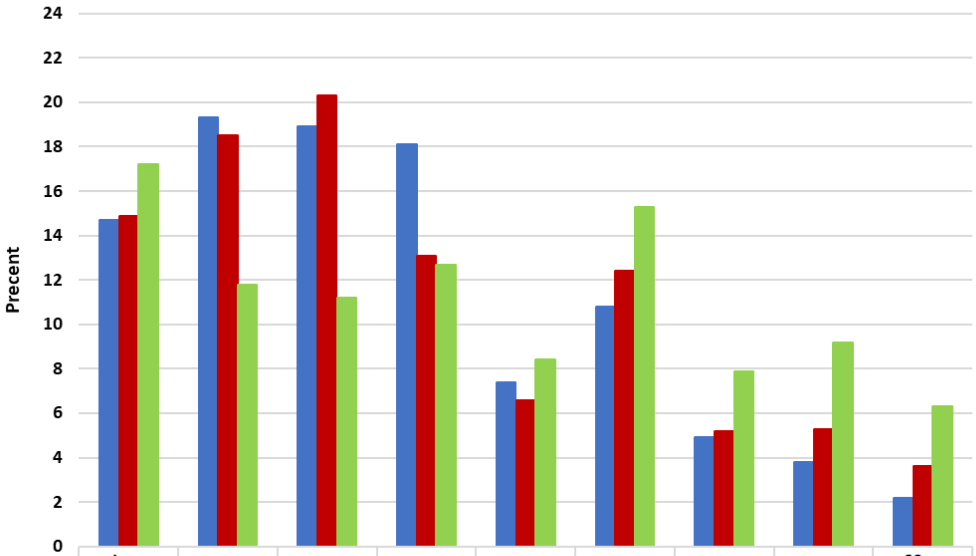


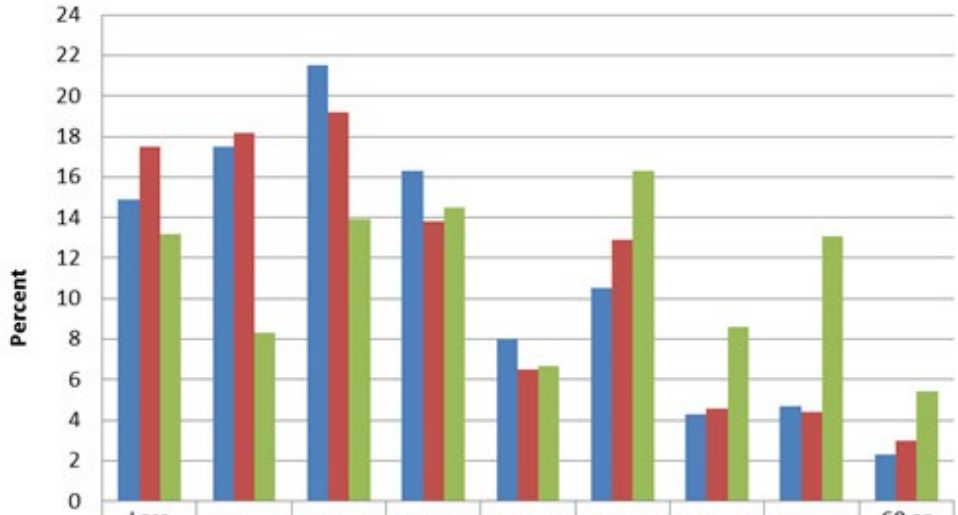
Figure 7.2 - Mode of Transportation to Work (percent) ACS 2015-2019

In terms of travel time, the ACS data collected between 2009-2013 and 2015-2019 illustrates the following percent by travel time in minutes and patterns by county:



	Less than 10 minutes	10 to 14 minutes	15 to 19 minutes	20 to 24 minutes	25 to 29 minutes	30 to 34 minutes	35 to 44 minutes	45 to 59 minutes	60 or more minutes
Benton County, Arkansas	14.7	19.3	18.9	18.1	7.4	10.8	4.9	3.8	2.2
Washington County, Arkansas	14.9	18.5	20.3	13.1	6.6	12.4	5.2	5.3	3.6
McDonald County, Missouri	17.2	11.8	11.2	12.7	8.4	15.3	7.9	9.2	6.3

Figure 7.3 - Travel Time Estimate ACS 2009-2013



	Less than 10 minutes	10 to 14 minutes	15 to 19 minutes	20 to 24 minutes	25 to 29 minutes	30 to 34 minutes	35 to 44 minutes	45 to 59 minutes	60 or more minutes
Benton County, Arkansas	14.9	17.5	21.5	16.3	8	10.5	4.3	4.7	2.3
Washington County, Arkansas	17.5	18.2	19.2	13.8	6.5	12.9	4.6	4.4	3
McDonald County, Missouri	13.2	8.3	13.9	14.5	6.7	16.3	8.6	13.1	5.4

Figure 7.4 - Travel Time Estimate ACS 2015-2019

Daily Vehicle Miles Traveled

Table 7.1 and Table 7.2 summarize the daily vehicle miles traveled in 2019 by road functional class for Benton and Washington Counties.

Route Sign	Functional Class	Pop: < 5,000 Rural		Pop: 5,000 to 49,999 Small Urban		Pop: >=50,000 Urbanized		Total	
		Road Length	DVMT	Road Length	DVMT	Road Length	DVMT	Road Length	DVMT
State Highway	Interstate	0.00	0	0.00	0	17.29	1,208,363	17.29	1,208,363
	Other Freeways & Expressways	0.00	0	0.00	0	0.42	22,842	0.42	22,842
	Other Principal Arterials	22.48	331,533	5.27	135,271	35.40	841,094	63.16	1,307,898
	Minor Arterials	50.73	232,913	22.96	218,576	82.66	784,438	156.35	1,235,927
	Major Collectors	88.86	233,120	7.32	29,009	39.93	171,660	136.11	433,789
	Minor Collectors	0.00	0	0.00	0	0.00	0	0.00	0
	Locals	0.00	0	0.23	23	0.00	0	0.23	23
	Total	162.08	797,566	35.77	382,879	175.71	3,028,397	373.56	4,208,842
County Roads	Other Freeways & Expressways	0.00	0	0.00	0	0.00	0	0.00	0
	Other Principal Arterials	0.00	0	0.00	0	0.00	0	0.00	0
	Minor Arterials	2.65	938	0.00	0	3.55	5,647	6.20	6,585
	Major Collectors	105.46	114,041	9.65	13,620	35.90	137,353	151.01	265,013
	Minor Collectors	59.53	19,322	0.00	0	12.06	3,573	71.59	22,894
	Locals	1,807.37	159,890	28.85	5,511	119.87	28,359	1,956.09	193,759
	Total	1,975.01	294,190	38.50	19,131	171.38	174,931	2,184.89	488,252
City Streets	Other Freeways & Expressways	0.00	0	0.00	0	0.00	0	0.00	0
	Other Principal Arterials	0.00	0	0.00	0	0.00	0	0.00	0
	Minor Arterials	0.32	52	9.41	42,646	97.87	890,121	107.60	932,818
	Major Collectors	16.24	6,006	24.97	44,373	177.38	371,069	218.59	421,447
	Minor Collectors	4.00	3,681	1.26	740	8.75	5,157	14.01	9,578
	Locals	52.95	14,311	132.62	43,763	1,482.65	558,376	1,668.22	616,450
	Total	73.51	24,050	168.26	131,523	1,766.65	1,824,722	2,008.42	1,980,294
BENTON County Total		2,210.60	1,115,806	242.53	533,532	2,113.74	5,028,050	4,566.87	6,677,388

Table 7.1 - Benton County Daily Vehicle Miles Traveled (DMVT) for 2019 – Source: ARDOT

Route Sign	Functional Class	Pop: < 5,000 Rural		Pop: 5,000 to 49,999 Small Urban		Pop: >=50,000 Urbanized		Total	
		Road Length	DVMT	Road Length	DVMT	Road Length	DVMT	Road Length	DVMT
State Highway	Interstate	16.24	352,143	0.00	0	17.70	1,052,912	33.94	1,405,055
	Other Freeways & Expressways	0.00	0	0.00	0	3.24	102,135	3.24	102,135
	Other Principal Arterials	10.35	154,898	0.00	0	48.44	1,216,999	58.79	1,371,897
	Minor Arterials	70.94	202,698	0.00	0	54.84	600,359	125.78	803,057
	Major Collectors	80.61	90,051	0.00	0	16.49	51,472	97.10	141,523
	Minor Collectors	5.32	3,688	0.00	0	0.00	0	5.32	3,688
	Locals	2.64	161	0.00	0	6.14	6,241	8.77	6,402
	Total	186.11	803,639	0.00	0	146.83	3,030,120	332.95	3,833,759
County Roads	Other Freeways & Expressways	0.00	0	0.00	0	0.00	0	0.00	0
	Other Principal Arterials	0.00	0	0.00	0	0.00	0	0.00	0
	Minor Arterials	0.00	0	0.00	0	2.60	10,929	2.60	10,929
	Major Collectors	98.47	104,639	0.00	0	44.09	70,200	142.56	174,839
	Minor Collectors	148.02	57,302	0.00	0	19.48	14,215	167.50	71,517
	Locals	1,466.17	159,004	0.00	0	55.09	10,805	1,521.26	169,809
	Total	1,712.66	320,945	0.00	0	121.26	106,148	1,833.92	427,094
City Streets	Other Freeways & Expressways	0.00	0	0.00	0	0.00	0	0.00	0
	Other Principal Arterials	0.00	0	0.00	0	1.02	18,400	1.02	18,400
	Minor Arterials	0.00	0	0.00	0	61.20	602,007	61.20	602,007
	Major Collectors	9.47	7,104	0.00	0	174.45	624,563	183.92	631,667
	Minor Collectors	3.42	5,921	0.00	0	10.06	6,739	13.48	12,659
	Locals	41.95	14,308	0.00	0	851.48	407,607	893.43	421,914
	Total	54.84	27,332	0.00	0	1,098.21	1,659,316	1,153.05	1,686,648
WASHINGTON County Total		1,953.61	1,151,916	0.00	0	1,366.30	4,795,584	3,319.92	5,947,500

Table 7.2 - Washington County Daily Vehicle Miles Traveled (DMVT) for 2019 – Source: ARDOT

As it can be noted from Table 7.3, the Daily and Annual VMT have increased comparing 2009 to 2019; however, the daily VMT per capita in the two-county area has fluctuated by approximately 1% and has been decreasing slightly over the last few years.

Year	Population Estimate	Daily VMT	Annual VMT	Daily VMT per capita
2009	416,394	9,840,518	3,591,789,070	23.63
2010	424,404	9,983,349	3,643,922,385	23.52
2011	435,662	10,094,273	3,684,409,645	23.17
2012	444,473	10,514,234	3,848,209,644	23.66
2013	454,054	10,761,582	3,927,977,430	23.70
2014	463,113	11,014,631	4,020,340,315	23.78
2015	475,084	11,663,293	4,257,101,945	24.55
2016	486,340	12,008,651	4,395,166,266	24.69
2017	498,296	12,243,078	4,468,723,470	24.57
2018	509,569	12,483,276	4,556,395,740	24.50
2019	518,328	12,624,888	4,608,084,120	24.36

Table 7.3 - Annual Vehicles Miles of Travel in the Two County Area Source: ARDOT

Both the Table 7.4 and Figure 7.5 indicate an increasing trend of the total VMT in both Washington and Benton Counties.

	2009		2010		2011		2012		2013		2014	
	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT
Benton	5,209,912	1,901,617,880	5,273,634	1,924,876,410	5,297,149	1,933,459,385	5,561,922	2,035,663,452	5,690,060	2,076,871,900	6,036,296	2,203,248,040
Washington	4,630,606	1,690,171,190	4,709,715	1,719,045,975	4,797,124	1,750,950,260	4,952,312	1,812,546,192	5,071,522	1,851,105,530	4,978,335	1,817,092,275
2 Counties	9,840,518	3,591,789,070	9,983,349	3,643,922,385	10,094,273	3,684,409,645	10,514,234	3,848,209,644	10,761,582	3,927,977,430	11,014,631	4,020,340,315
Statewide	90,854,940	33,162,053,100	92,188,754	33,648,895,210	90,288,068	32,955,144,820	91,423,220	33,460,898,520	91,756,533	33,491,134,545	93,169,936	34,007,026,640

	2015		2016		2017		2018		2019	
	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT	DVMT	AVMT
Benton	6,275,314	2,290,489,610	6,458,633	2,363,859,678	6,559,181	2,394,101,065	6,699,070	2,445,160,550	6,677,388	2,437,246,620
Washington	5,387,979	1,966,612,335	5,550,018	2,031,306,588	5,683,897	2,074,622,405	5,784,206	2,111,235,190	5,947,500	2,170,837,500
2 Counties	11,663,293	4,257,101,945	12,008,651	4,395,166,266	12,243,078	4,468,723,470	12,483,276	4,556,395,740	12,624,888	4,608,084,120
Statewide	95,606,254	34,896,282,710	97,685,237	35,752,796,742	99,598,641	36,353,503,965	100,648,852	36,736,830,980	101,668,223	37,108,901,395

Table 7.4 - Daily Vehicles Miles of Travel and Annual Vehicles Miles of Travel in the 2 County Area and Statewide Arkansas (2009-2019)

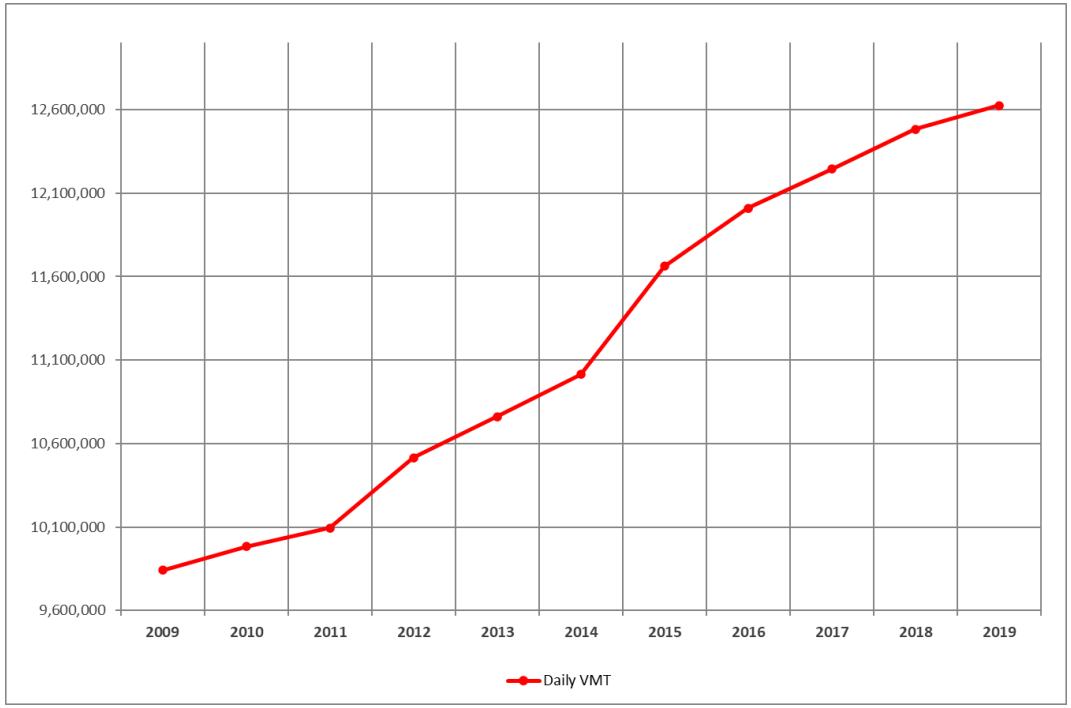


Figure 7.5 - Daily Vehicle Miles of Travel (VMT) Benton and Washington Counties 2009-2019

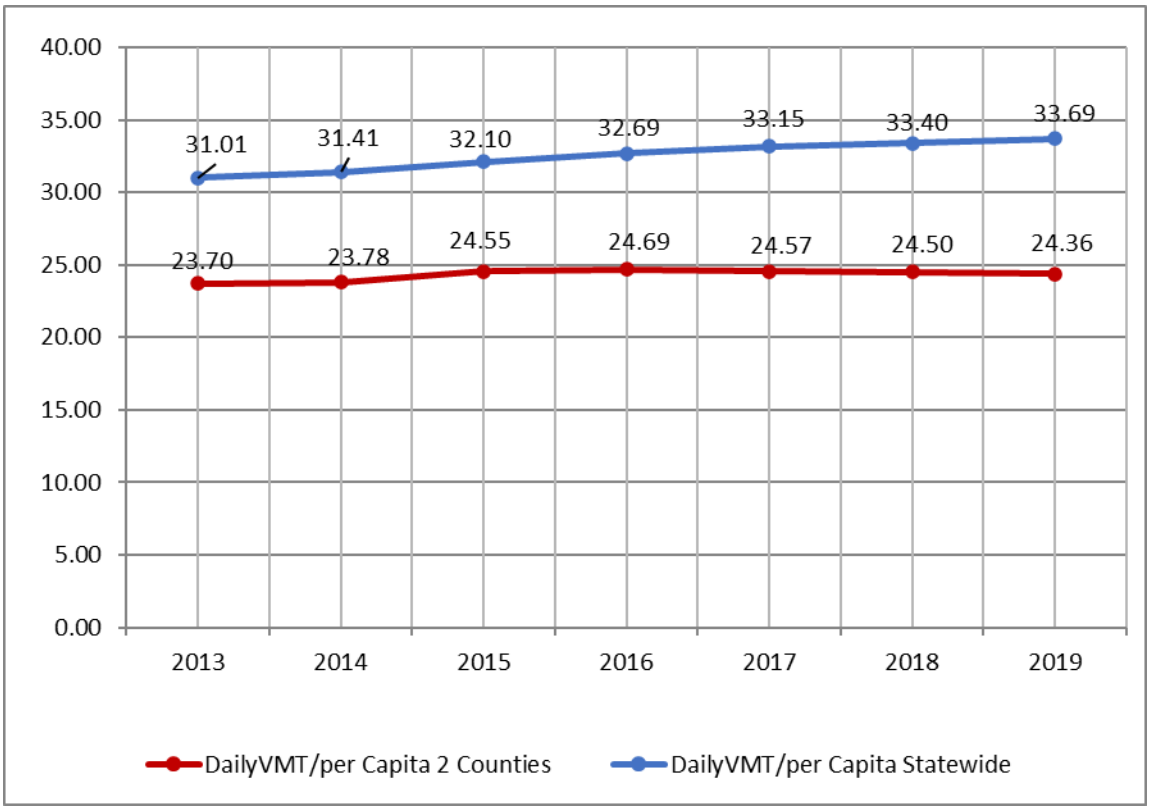


Figure 7.6 - Daily Vehicles Miles Traveled Per Capita for Benton and Washington Counties and Arkansas Statewide

TRAVEL FORECASTING MODEL

A travel demand or forecasting model is typically utilized by planners, engineers, MPOs and state departments of transportation to forecast future year transportation system deficiencies that may not exist today. These agencies also use models to evaluate the impact of alternative transportation solutions for development of long-range transportation plans. They are primarily used to forecast traffic flows on the transportation system. Models are generally mathematical expressions that are used to replicate the movement of people and vehicles within a transportation system. The traffic forecasts are based on forecasted land use, demographic data, socio-economic factors and travel patterns unique to the region. Travel models are also created to support decision making by providing information about the impacts of alternative transportation and land use policies, as well as demographic and socio-economic trends. A Travel Forecasting Model can be used in a variety of ways, such as for:

Specific Highway Construction Projects:

- Five-to-thirty-year forecasts
- Traffic impact of changes in land use and development
- Traffic pattern and volumes that are used by city and regional planners before deciding on roads improvements or construction

Transportation Studies:

- Major investment studies
- Interchange justification studies
- Bypass studies
- Freight studies
- Corridor studies
- Transit studies

General Highway Planning:

- Traffic impact of changes in land use and development
- Traffic impacts of new roadways or closing roadways
- Evaluate bypasses
- Generate inputs to micro simulation models
- Accident prone locations identification

Development of Long-Range Transportation Plans:

- State and Regional Plan and TIP development
- Traffic impact of changes in land use and development
- Congestion Management Programs
- Forecast regional pollution from vehicles
- Evaluate Environmental Justice
- Transit route planning

Other uses for the model:

- Provides inputs for site-specific studies (including whole cities) that will make studies more accurate (by looking at the big picture) and less costly (future projections for major roads will be readily available to cities and consultants).
- Gives the local jurisdictions an on-going resource of traffic count projections to answer “what-if” questions such as:
  - What if we build a four-lane segment here versus a three lanes road segment?
  - What if we did not make any road improvements in the future? Would more people take transit? How bad would congestion be? What if we add an additional lane?
  - What if a large shopping mall will be built at this location versus that location?
  - What if we put in this east/west corridor?
  - What if we increased mixed-use development? Would more people walk? Would there be more intrazonal trips (origin and destination zone are the same)?

- **Provides jurisdictions with results for traffic scenarios such as:**
  - Projected traffic counts for the base year as well as forecast years
  - Traffic counts for different road improvement scenarios
  - Traffic counts for intersection improvement and signalization analysis
  - Daily vehicle miles traveled in a region

NORTHWEST ARKANSAS TRAVEL FORECASTING MODEL

In 2004 NWARPC and the AHTD hired Bernardin, Lochmueller & Associates, Inc. to develop the Northwest Arkansas Travel Demand Model for Benton and Washington Counties, AR. The base year for the model was 2005 and scenario runs have been developed for 2010, 2030 and 2035.

Between the years 2007-2010 NWARPC maintained the model in-house with continuous updates to the network, TAZs, socio-economic data, land use, etc. and used it for projects prioritization, scenarios and the 2035 Regional Transportation Plan and TIP.

In 2010, NWARPC hired Parsons Brinckerhoff to conduct a Western Beltway Corridor Study in Benton and Washington County that would connect to the future Hwy. 549 (Bella Vista bypass) in the northern part of Benton County. Part of the Study was to update the existing model to add McDonald County, Missouri to the study area. The model structure and code were also improved as part of the analysis.

In 2010, NWARPC also administered a study to develop a Transit Development Plan (TDP) in cooperation with the two area transit agencies, Ozark Regional Transit, Inc. and the University of Arkansas Razorback Transit, and Connetics Transportation Group consulting firm.

In November 2012, NWARPC started a Transportation Alternatives Analysis Study that was funded by FTA and NWARPC matching funds as part of an Alternatives Analysis grant awarded that year. NWARPC contracted URS Corporation to determine the need for a major transit investment in the corridor, and to estimate costs, benefits and possible environmental impacts of the various alternatives. As part of the analysis, the consultants used the existing travel demand model to generate ridership estimates in the analyzed corridor. Alliance Transportation Group was the sub-consultant hired to develop the conceptual transit ridership for the Study.

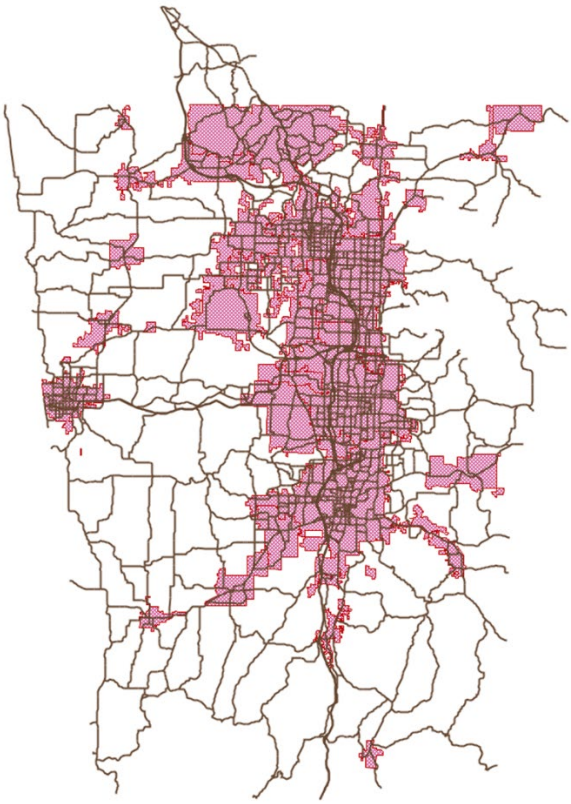
As a requirement of the Census Bureau, the MPO delineated new TAZs and Transportation Analysis Districts (TADs) for the 2010 Census Bureau data collection. The newly delineated 673 internal TAZs and 11 TADs were accepted by the Census Bureau in 2011 and are available at NWARPC.

In July of 2014, the upgrade of the existing travel forecasting model began which added mode choice to the model for the purpose of modeling vehicular travel as well as transit in the MPA. Under this scope of work NWARPC hired Parsons Brinckerhoff to conduct a travel forecasting model upgrade that addressed all the model needs for a functional true mode choice model. The purpose of the project was to develop the mode choice model to include the transit component; upgrade the model from the 2005 base year to 2010 base year; add the Missouri portion of the MPA into the model; and develop the 2020, 2030 and 2040 forecast years. The upgraded model also incorporated a special generator that is easier to configure and update, reconfigured the GISDK code to current industry standards, and identified ways of utilizing the travel time results from the model to aid the local transit agencies in their route planning, evaluation and needs assessment. The validation report for this upgrade can be found at this link: NWA Travel Demand Forecasting Model.

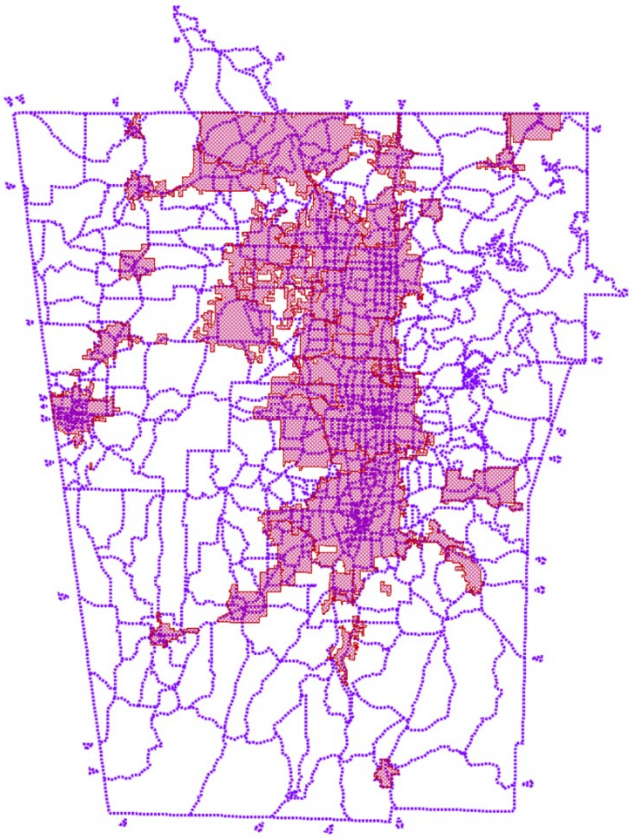
Between 2016-2020 the Northwest Arkansas Travel Forecasting Model was upgraded to update the base year to 2018 and forecast years to 2025, 2035 and 2045 and calibrate the transit component to the 2018 completed On-board transit origin-destination survey. WSP completed enhancements to the mode choice model work by refining the model calibration and performing additional sensitivity testing. This model enhancement improved the coded transit route system and the transit assignment calibration and validation. More about the model upgrade and validation are

detailed in the next section.

The Northwest Arkansas Travel Forecasting model area includes Washington and Benton Counties in Arkansas and the McDonald County, Missouri portion of the MPA. This area includes 678 internal TAZs (Traffic Analysis Zones), of which 348 in Benton County, 324 in Washington County and 6 in McDonald County. The road network includes roads classified Collectors, Arterials and Interstate. The road network and TAZs extent in the MPA are illustrated below.



Map 7.1 – 2045 Road Network and city limits



Map 7.2 – 2045 TAZs and city limits

The Northwest Arkansas Travel Forecasting Model is a regional model based on the traditional four-step sequential modeling method with a feedback loop. The process is summarized in the following steps:

- **Trip Generation** – Trip Generation calculates the decimal number of trips of each purpose produced by each household. It does this via regression models estimated on data collected in a 2005 household travel survey.
- **Trip Distribution** – Trip Distribution aggregates the household trip productions by purpose and by TAZ and calculates the trip attractions by purpose by TAZ. Productions (Ps) and Attractions (As) are matched up based on a gravity model whereby productions are pulled towards TAZs based on their number of attractions and the travel time from the production TAZ. The skims are used to determine travel times.
- **Mode Choice** – The mode of travel for each PA pair is determined based on a logit model which takes the level of service characteristics, the household attributes and the cost of each mode into consideration. The skims are used to determine level of service and cost for each mode.
- **Time of Day** – The PA matrices are transformed into origin/destination pairs by time period (am peak, pm peak, off-peak) based on observed percentages of daily traffic.
- **Assignment** – The auto trips are assigned to the highway network and the transit trips are assigned to the transit network. Travel times and costs are re-calculated and are fed back to the trip distribution and mode choice steps. This feedback is done multiple times so that congested travel times are considered in the final set of choices.

Below is a flow-chart of the model. The main model steps are Trip Generation, Destination Choice, Mode Choice and Assignment (both highway and transit). There are several initial steps, like setting the initial speed and capacity of highway links based on area type and determining the number of households in each zone that own 0, 1, 2 or 3+ cars, that are executed prior to the main steps. In addition, the NWA TDM models external trips, special generator trips and truck/commercial vehicle trips.

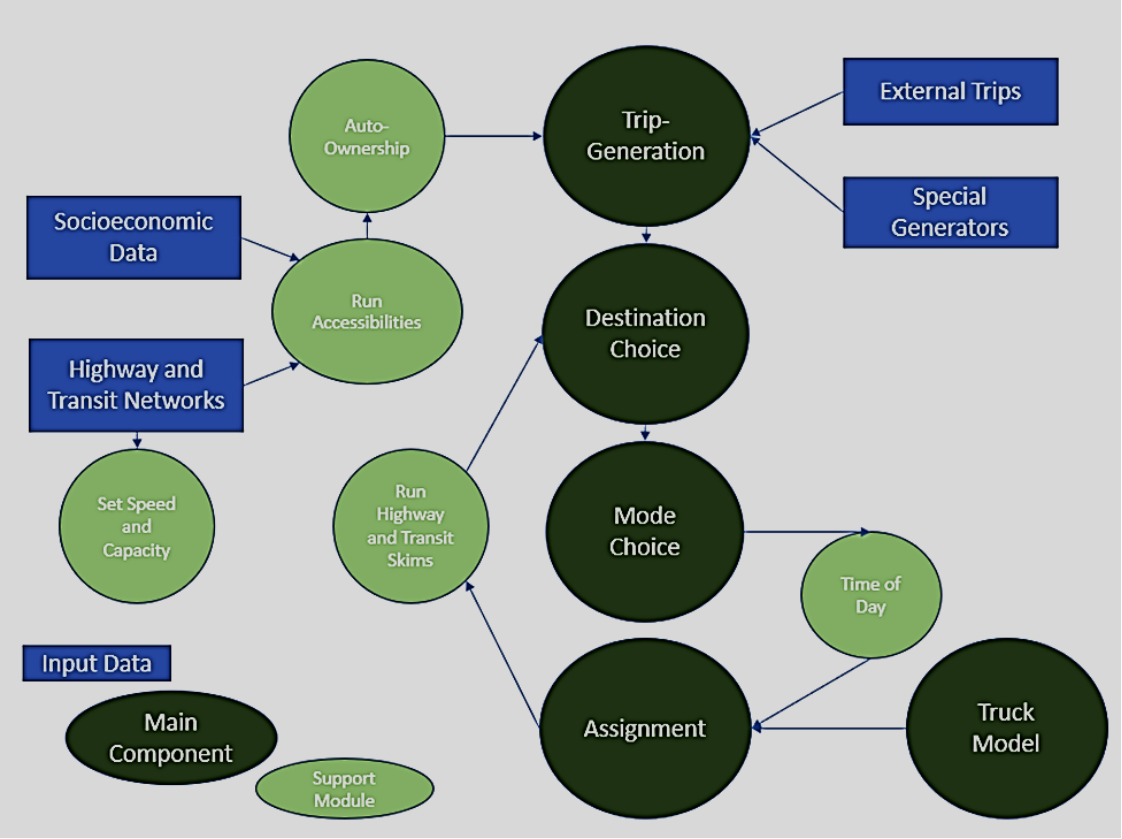


Figure 7.7 - Travel Demand Forecasting Steps

Model Steps:

The following are updated model steps and statistics based on the most recent model upgrade:

- **Household Generation**

A recent transit on-board survey was completed which enabled a better understanding of transit access, rider profiles, model calibration. Land-use and demographics were captured through employment and household data at Traffic Analysis Zone (TAZ) level:

- In 2018 there are approximately 200K HHs (520K persons) and approximately 250K Jobs (Industry, retail, office and service)
- In 2045 there are approximately 380K HHs (980K persons) and approximately 465K Jobs
- The Northwest Arkansas Region's population and employment almost doubles in 25 years

- **Auto Ownership**

- 5% of HHs have 0 vehicles, 21% have 3 or more vehicles

- **Trip Generation**
  - Average trips per HH target was 9.9

- **Destination Choice**
  - 75% of work trips are 15 miles or less, 80% of university trips are < 5 miles, only 6% of school trips are less than15 miles
  - Average trip length for work trips is 12 miles, shopping/personal business is about 6.7 miles

- **Mode Choice**
  - Regional transit share is less than 1%
  - 87% of work trips are drive-alone (dominate mode for all purposes)
  - 25% of university trips are transit, 13% non-motorized, almost 50% drive alone

Mode of Trip	2018	2045
Auto	1,570,000	2,900,000
Transit	9,000	15,000
Walk/Bike	62,000	105,000
Total Household Trips	1,640,000	3,000,000

Daily Weekday Resident Trips by Mode – 2018 and 2045

Trip Mode	2018	2045
Auto	95.7%	96.0%
Transit	0.6%	0.5%
Walk/Bike	3.8%	3.5%

Daily Weekday Resident Trips by Purpose – 2018 and 2045

Types of Trips: In the Regional Travel Forecasting Model, trips are classified by trip purpose. Broadly, trips are grouped into the following purposes:

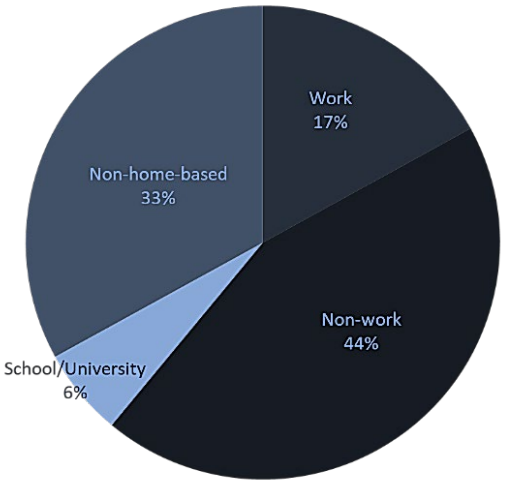
Home-Based Work (HBW): These trips are from home to work and from work back to home. They occur more in peak hours and are a large component of congestion.

Home-Based Shop/Personal Business (HBSB): These trips begin or end at home and cover the range of other trips that people make - shopping, visiting friends, or appointments.

Non-Home-Based (NHB): These are the trips made while people are out of their residence, either at work (e.g., a trip to lunch), or between stops while running errands (e.g., a trip from the grocery store to the cleaners). Generally, given their nature, non-home-based trips are shorter than home-based trips and are often made at off-peak travel times.

In addition to these trips, the model also includes the following types of trips: **Home-Based School (HBSC), Home-Based University/College (HBU) and Home-Based Other (HBO)** as well as **Non-Home-Based Work (NHBW).**

The mode share is illustrated in the pie-chart below. The majority of trips in both 2018 and 2045 (45 percent) are non-work related, followed by non-home-based types of trips (33 percent).



Mode Share – 2018 and 2045

Base Year Model Calibration and Validation

Version 3.0.0 of the NWA TDM was calibrated and validated to confirm that the changes made to the model subcomponents still provided highway and transit assignments that could be validated against observed data in the 2018 base year.

Trip Purpose	Observed (2017 NHTS)		Estimated (Model)	
	Trips	Percent	Trips	Percent
Home-based Work (HBW)	8,901,384	15%	327,342	17%
Home-based University (HBU)	412,322	1%	27,899	1%
Home-based School (HBSC)	1,606,200	3%	88,235	5%
Home-based Shopping Business (HBS	15,530,720	26%	469,221	24%
Home-based Other (HBO)	12,206,072	20%	373,616	19%
Non-home Based Work (NHBW)	3,971,321	7%	132,722	7%
Non-home Based Other (NHBO)	17,468,043	29%	503,012	26%
All	60,096,062	100%	1,922,047	100%

Table 7-5: 2018 Trip Comparison

Trip Purpose	Observed Average Length	Estiamted Average Length
Home-based Work (HBW)	11.9	10.6
Home-based University (HBU)	7.6	5.3
Home-based School (HBSC)	5.8	6.8
Home-based Shopping Business (HBSB)	6.7	4.9
Home-based Other (HBO)	9.1	7.1
Non-home Based Work (NHBW)	11.5	8.7
Non-home Based Other (NHBO)	7.4	6.3

Table 7-6: Average Trip Length (Miles) by Trip Purpose

Trip Generation Calibration

The 2018 trip generation results were calibrated to match the percentage of trip productions by purpose and trip rates by household observed in the 2017 NHTS data. Due to the small number of Arkansas households, the targets also include households from Mississippi, Missouri and Louisiana.

The comparison is shown in Table 7.5. Clearly, the total trips from the survey does not match but the percentage of trips by purpose matches reasonably well.

The observed trips per household were 9.9 and the modeled trips per household were 9.8. This aligns with values in other regions which range between 8 and 10 daily trips per household on average.

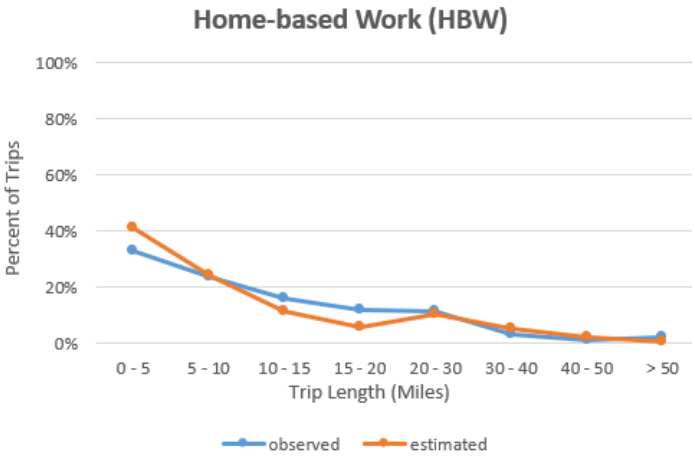
Calibration of Destination Choice

The calibration of the destination choice model focused on trip-length frequency distributions by purpose and average trip lengths by purpose. The 2017 NHTS data was used to develop the targets. Table 7-6 shows average trip lengths by purpose.

Figure 1: Trip Length Frequency Distributions (TLFD) by Purpose

Home-based Work (HBW)

Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	33%	41%
5 - 10	24%	24%
10 - 15	16%	11%
15 - 20	12%	6%
20 - 30	11%	10%
30 - 40	3%	5%
40 - 50	1%	2%
> 50	2%	1%
Total	100%	100%



The figures below show the percentage of trips in each distance bin and the observed vs. estimated graphs.

Figure 7-8: Home-based Work

Home-based University (HBU)

Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	79%	76%
5 - 10	0%	8%
10 - 15	6%	4%
15 - 20	2%	2%
20 - 30	6%	6%
30 - 40	5%	3%
40 - 50	0%	0%
> 50	2%	0%
Total	100%	100%

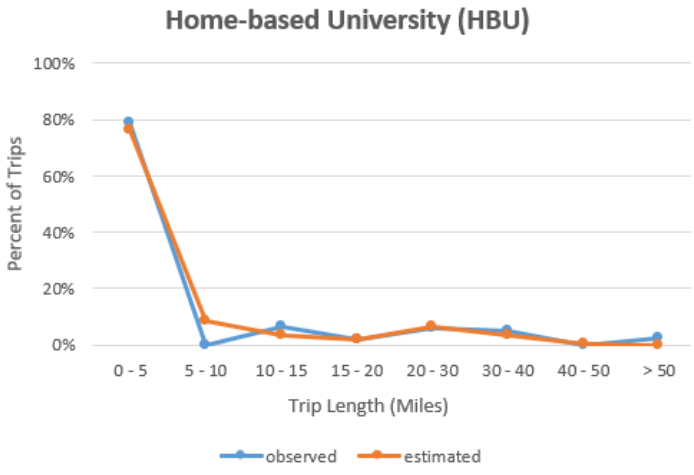


Figure 7-9: Home-based University

Home-based School (HBSC)		
Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	63%	63%
5 - 10	18%	21%
10 - 15	13%	5%
15 - 20	2%	2%
20 - 30	3%	4%
30 - 40	0%	3%
40 - 50	1%	1%
> 50	0%	0%
Total	100%	100%

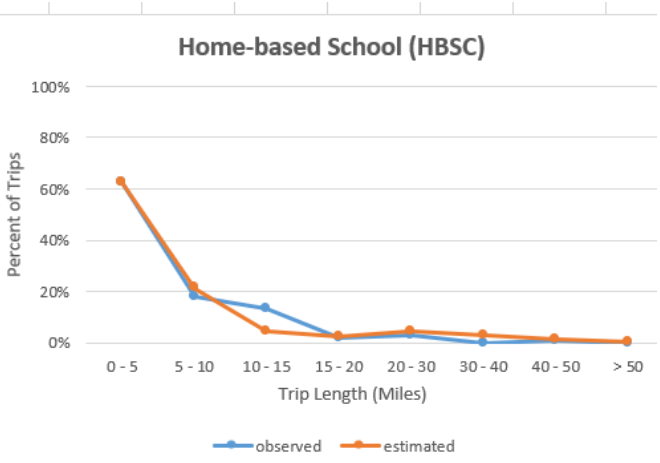


Figure 7-10: Home-based School

Home-based Shopping and Personal Business (HBSHPB)		
Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	62%	66%
5 - 10	20%	25%
10 - 15	8%	6%
15 - 20	4%	1%
20 - 30	4%	1%
30 - 40	1%	0%
40 - 50	0%	0%
> 50	1%	0%
Total	100%	100%

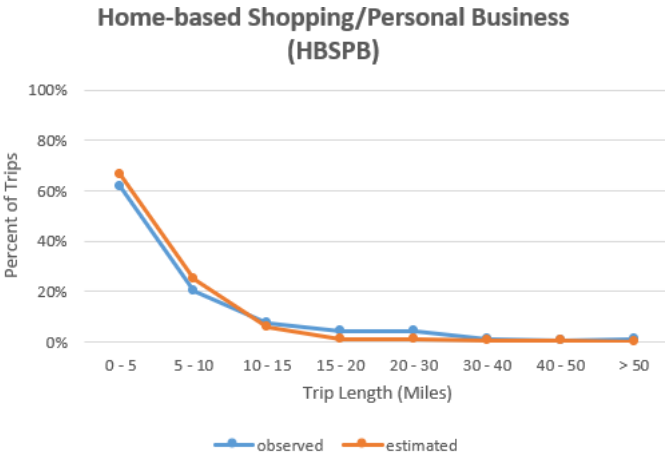


Figure 7-11: Home-based Shopping and Personal Business

Home-based Other (HBO)		
Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	58%	55%
5 - 10	15%	26%
10 - 15	11%	9%
15 - 20	4%	3%
20 - 30	6%	3%
30 - 40	2%	2%
40 - 50	1%	1%
> 50	3%	0%
Total	100%	100%

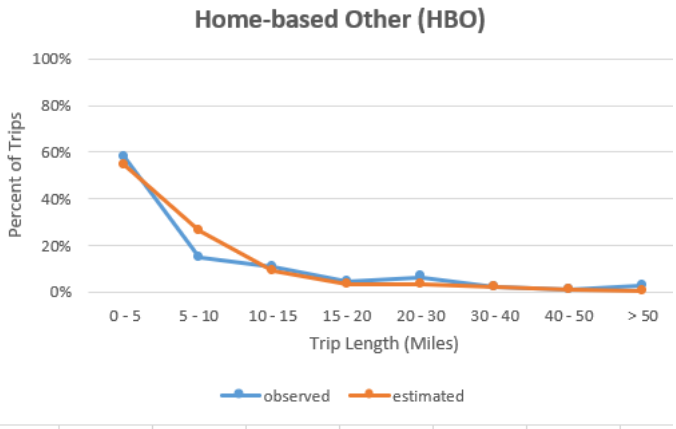


Figure 7-12: Home-based Other

Non-home Based Work (NHBW)		
Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	50%	54%
5 - 10	20%	19%
10 - 15	11%	6%
15 - 20	5%	5%
20 - 30	6%	10%
30 - 40	3%	4%
40 - 50	2%	1%
> 50	2%	0%
Total	100%	100%

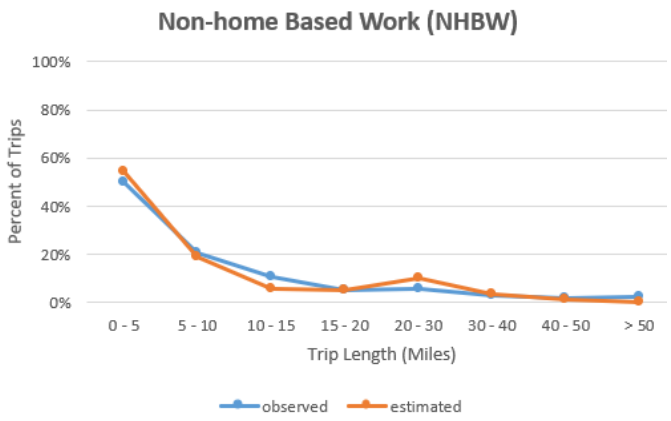


Figure 7-13: Non-home-based Work

Non-home Based Work (NHBO)		
Distance Categories (Miles)	Percentage	
	Observed	Estimated
0 - 5	67%	67%
5 - 10	15%	18%
10 - 15	6%	4%
15 - 20	4%	3%
20 - 30	4%	6%
30 - 40	2%	2%
40 - 50	0%	1%
> 50	1%	0%
Total	100%	100%

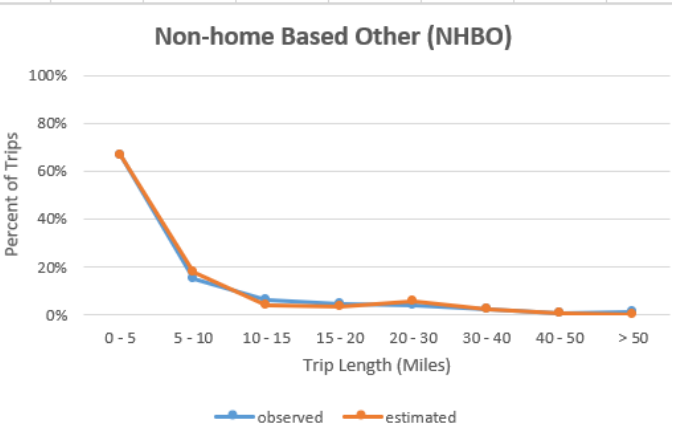


Figure 7-14: Non-home-based Other

Mode Choice

NWARPC hired ETC in 2018 to complete a transit on-board survey. This survey data was used to calibrate the mode choice model for the 2018 base year. Below are some model comparisons after calibration.

Mode	Observed	Estimated
Auto	97.1%	96.2%
Transit	0.6%	0.5%
Non-motorized (walk + bike)	2.3%	3.3%
Total	100.0%	100.0%

Table 7-7: Observed to Estimated Mode Shares in NW Arkansas

Observed

Trip Mode	Observed Trip Pecent						
	HBW	HBU	HBSC	HBSB	HBO	NHB	Total
Drive Alone	87%	47%	61%	87%	69%	58%	68%
Shared Ride 2	8%	9%	13%	8%	11%	16%	13%
Shared Ride 3	3%	1%	20%	4%	17%	24%	17%
Drive to Razorback (>= 5 miles)	0%	4%	0%	0%	0%	0%	0%
Walk to Transit	0%	21%	0%	1%	0%	0%	0%
PnR to Transit (<5 miles)	0%	4%	0%	0%	0%	0%	0%
KnR to Transit	0%	0%	0%	0%	0%	0%	0%
Walk	2%	11%	5%	1%	3%	2%	2%
Bike	0%	2%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%

Estimated

Trip Mode	Estimated Trip Percent						
	HBW	HBU	HBSC	HBSB	HBO	NHB	Total
Drive Alone	82%	46%	62%	87%	68%	58%	71%
Shared Ride 2	10%	9%	13%	8%	12%	16%	12%
Shared Ride 3	3%	0%	20%	3%	16%	23%	13%
Drive to Razorback (>= 5 miles)	0%	2%	0%	0%	0%	0%	0%
Walk to Transit	0%	23%	0%	0%	0%	0%	0%
PnR to Transit (<5 miles)	0%	5%	0%	0%	0%	0%	0%
KnR to Transit	0%	0%	0%	0%	0%	0%	0%
Walk	4%	12%	5%	2%	4%	2%	3%
Bike	0%	2%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%

Table 7-8: Detailed Observed Mode Shares to Modeled Shares

Highway Assignment Validation

The trip generation, trip distribution and mode choice models were calibrated to observed data and the resulting trips were assigned to either the highway or the transit network, depending on the mode chosen.

There were 900 count locations used to compare the model results to however it should be noted that the NWARPC lacked confidence in the observed highway volumes. The model shows higher freeway volumes, but it was decided to leave the validation alone since the observed counts were thought to be low. Table 7-9 below shows the number of observations by facility type within rural and urban TAZs, the sum of the counts on those links, and the corresponding modeled volumes.

Facility Type	Number of Links with Counts	Observed Count	Estimated Volume	Percent Difference	Percent RMSE
Interstate	24	1,172,500	1,433,455	22%	40%
Principal Arterial	222	4,177,167	4,528,738	8%	37%
Minor Arterial	171	1,328,284	1,434,671	8%	65%
Collector	368	1,528,015	1,411,706	-8%	71%
Local	15	45,790	40,710	-11%	49%
Ramp & Median Cross-over	100	572,630	675,586	18%	57%
Total	**900**	**8,824,386**	**9,524,867**	**8%**	

Table 7-9: Observed vs. Modeled Volumes by Facility Type

Table 7-10 shows the validation statistics by volume group. The largest variation is again in the high-count links (i.e. the freeways) which is believed to be a problem with the counts, not the modeled values.

Count Range	Number of Links with Counts	Observed Count	Estimated Volume	Percent Difference
< 5000	399	893,464	1,022,824	14%
5000 - 10000	216	1,551,422	1,434,730	-8%
10000 - 20000	143	1,971,500	2,066,158	5%
20000 - 30000	86	2,054,500	2,222,394	8%
30000 - 40000	41	1,364,500	1,585,788	16%
40000 - 50000	4	163,000	167,148	3%
> 50000	11	826,000	1,025,824	24%
Total	**900**	**8,824,386**	**9,524,867**	**8%**

Table 7-10: Observed vs. Modeled by Volume Group

The scatterplot in Figure 7-15 below show the observed count vs. the modeled volume at each count location. If the model replicated the observed counts exactly, then the points on the graph would all lie on the regression line and the R-squared value would be 1.0. The results again are skewed by the freeway counts that may not fully reflect the daily flow. In Figure 7-16 the I-49 counts vs. the I-49 modeled volumes are shown.

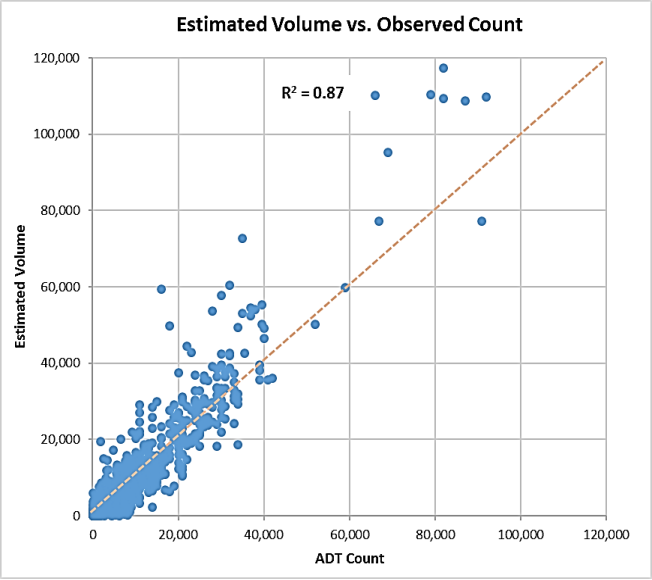


Figure 7-15: Scatterplot and R-squared Value for the 2018 Base Year Model

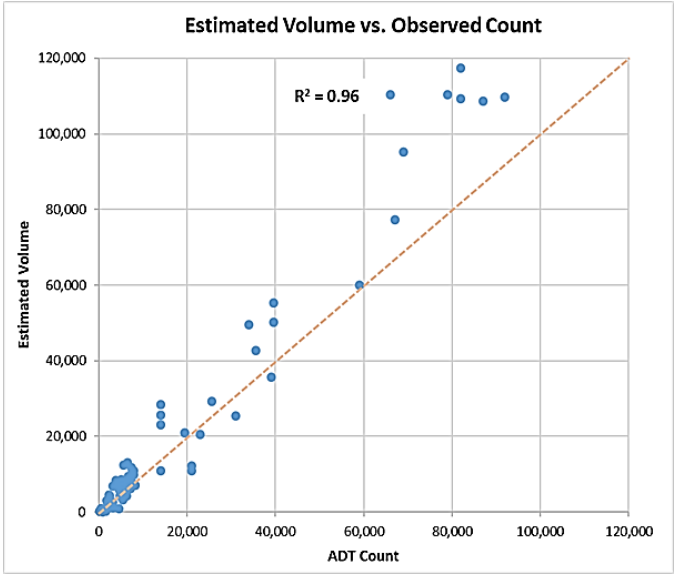


Figure 7-16: Scatterplot and R-squared Value for I-49 Count Locations

Transit Assignment Validation

The transit validation was done by looking at observed boardings by route for both Razorback Transit and Ozark Regional Transit (ORT). Several of the ORT transit routes had very low observed boardings which leads to large percent differences when compared to the model values (Table 7-11).

Agency	Route	Observed Boardings/Ridership (2018)	Estimated Boardings/Ridership	Percent Difference
Ozark	Route 1	154	38	
	Route 2	83	167	
	Route 3	58	92	
	Route 4	171	127	
	Route 11	86	157	
	Route 51	63	129	
	Route 52	28	56	
	Route 61	87	166	
	Route 62	75	74	
	Route 63	57	91	
	Route 64	14	81	
	Route 490	207	219	
	Ozark Total	*1,083*	*1,397*	*29%*
Razorback	Route 1	141	1	
	Route 4	141	0	
	Route7	20	323	
	Route 11	2,237	2,082	
	Route 13	939	1,479	
	Route 17	122	493	
	Route 22	1,794	1,027	
	Route 26	1,342	2,063	
	Route 33	834	273	
	Route 35	596	202	
	Route 48	1,175	1,712	
	Razorback Total	*9,341*	*9,655*	*3%*
	Total	**10,424**	**11,052**	**6%**

Table 7-11: Observed Boardings Compared to the ETC On-board Survey

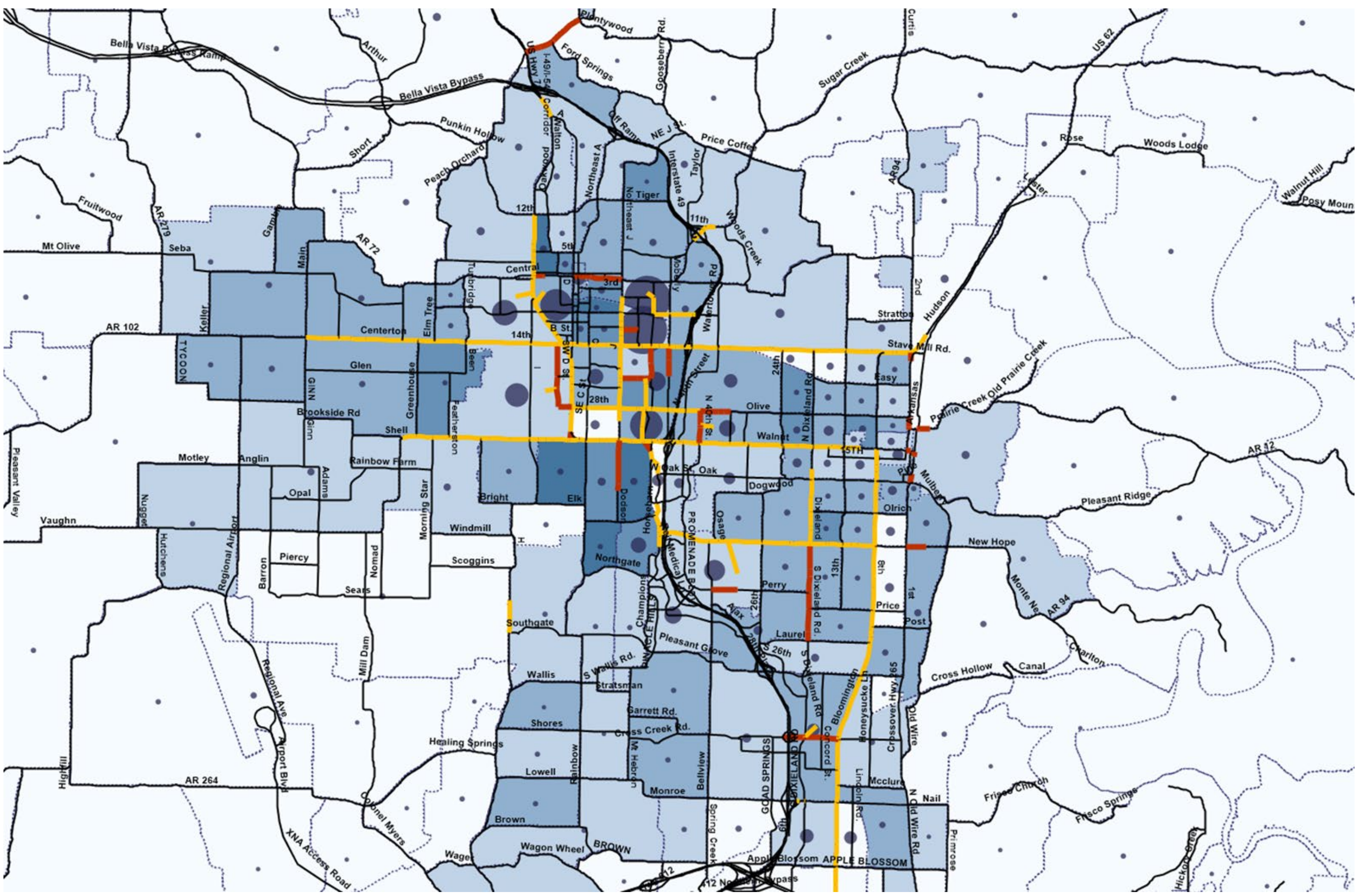
Travel Forecasting Results

The 2045 forecast model has proved beneficial in identifying segments of the network that may need improvements in the next 25 years. A series of selection sets have been developed based on a 2045 Fiscally Constrained list of projects and using forecasted socio-economic data from the model.

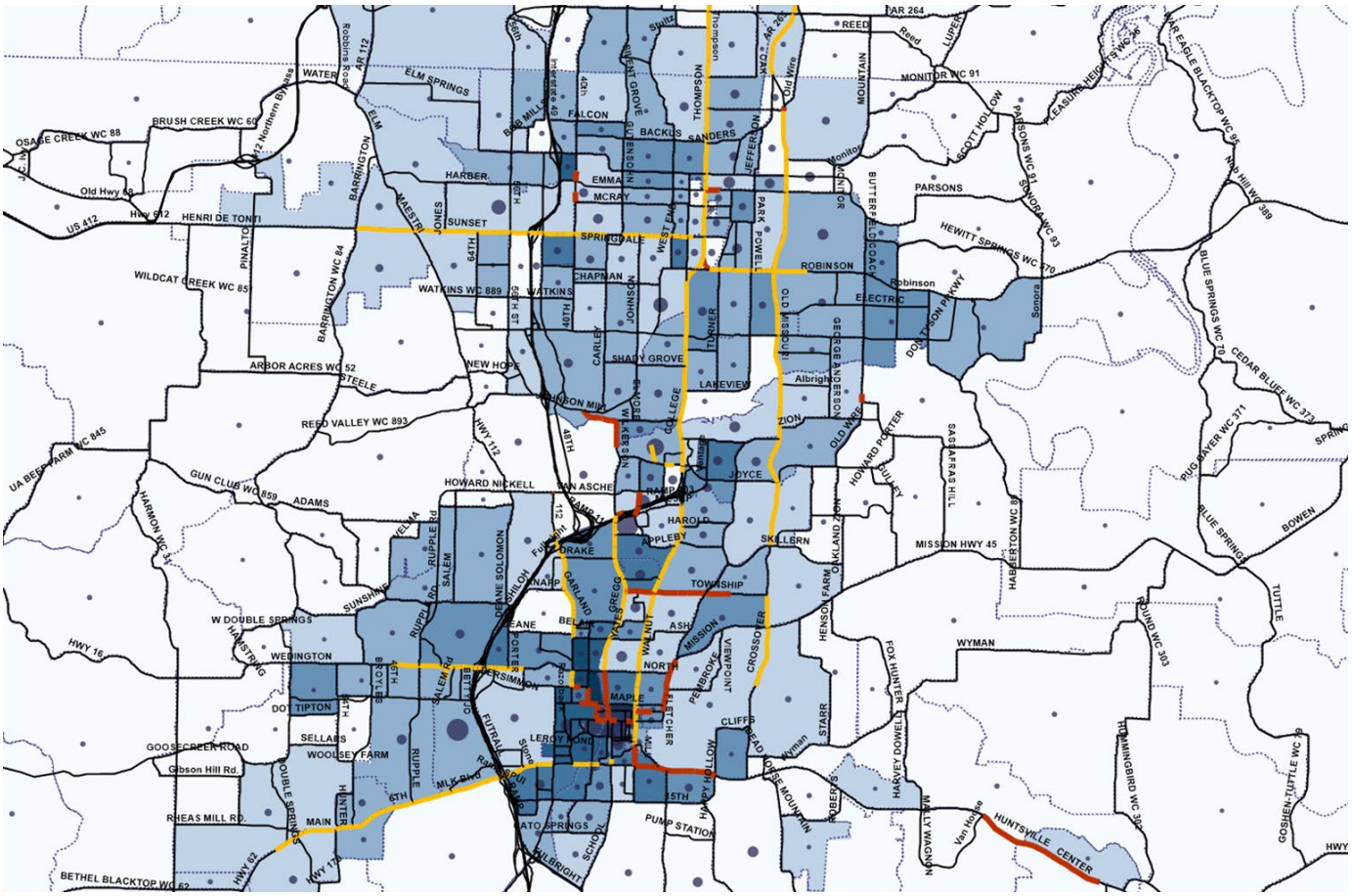
The Fiscally Constrained List for the road network consists of projects that can reasonably be expected to be funded with Federal-aid funds during the 25-year planning period. This is determined by estimates of Federal-aid funds that can reasonably be expected to come to the area given the area's highway network, Urbanized Area, population, etc. These estimates are provided by ARDOT and MoDOT and are not limits, nor are they guarantees of funding. They are conservative, reasonable estimates of future funding to guide development of the 2045 MTP. The Fiscally Unconstrained List includes projects not limited to the estimated available funding.

The following two maps represent selections from the 2045 Constrained Model runs with the following specifications:

- Two lane roads with at least 18,000 vehicles per day (vpd) and roads with four lanes or more and 36,000 vpd for the Constrained List of Projects (Map 7.3) for the urbanized corridor in Benton County and
- Two lane roads with at least 18,000 vpd and roads with four lanes or more and 36,000 vpd for the Unconstrained List of Projects (Map 7.4) for the urbanized corridor in Washington County



Map 7.3 - 2045 Constrained List of Projects with selected 2 lanes and 18,000+ volumes and 4+ lanes and 36,000+ volumes and employment density in Benton County



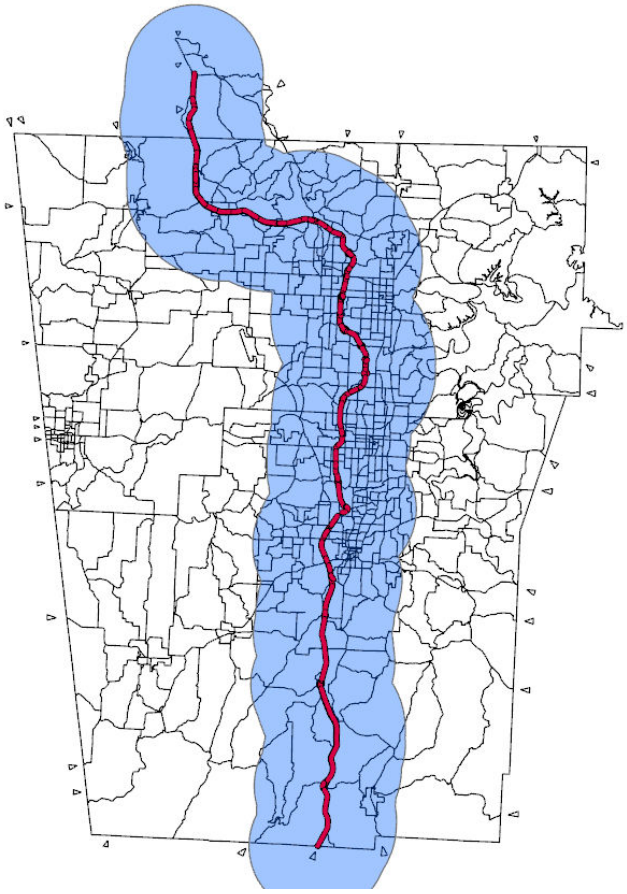
Map 7.4 - 2045 Constrained List of Projects with selected 2 lanes and 18,000+ volumes and 4+ lanes and 36,000+ volumes and employment density in Washington County

The red highlighted roads suggest potential for congestion in 2045 under the current planned road improvements. In general, given the projected increase in population and economic development in the region, the overall road system will become more and more congested in the next 25 years. Map 7-5 illustrates a buffer of 10 miles from I-49 for 2045. Based on the projected socio-economic data in the TAZs in this buffer, there will be 755,205 (77.5%) people and 424,284 (90.9%) jobs in 2045. There is no question that in this scenario most trips will occur between the TAZs in this corridor. Map 7.6 illustrates the total volume of traffic as a gradient on the 2045 Fiscally Constrained forecasted network. Maps 7-7 and 7-8 further illustrate 2045 projected density for both households and employment in the MPA.

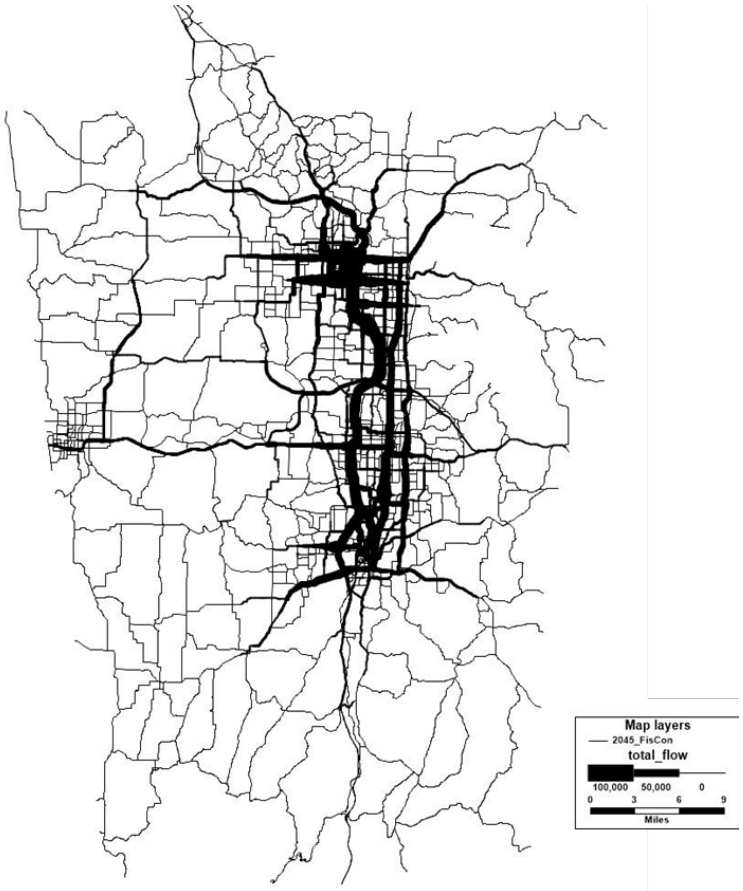
Key Modeling Takeaways

- Many cities and regions around the country are trying to reduce driving (reduce congestion) by introducing congestion pricing, cordon pricing, road usage charges, high parking costs, etc. As a result, cities and regions are using funds from the policies above to fund transit improvements. Locally in our region, no significant incentives/policies have been introduced so far.
- The "cost" of driving is one of the most important factors in travel modeling. Time is money and therefore all modes compete. Besides increasing the "cost" to drive, future mode share changes will be dependent on additional investment in other modes (walk, bike, transit) to reduce their cost.

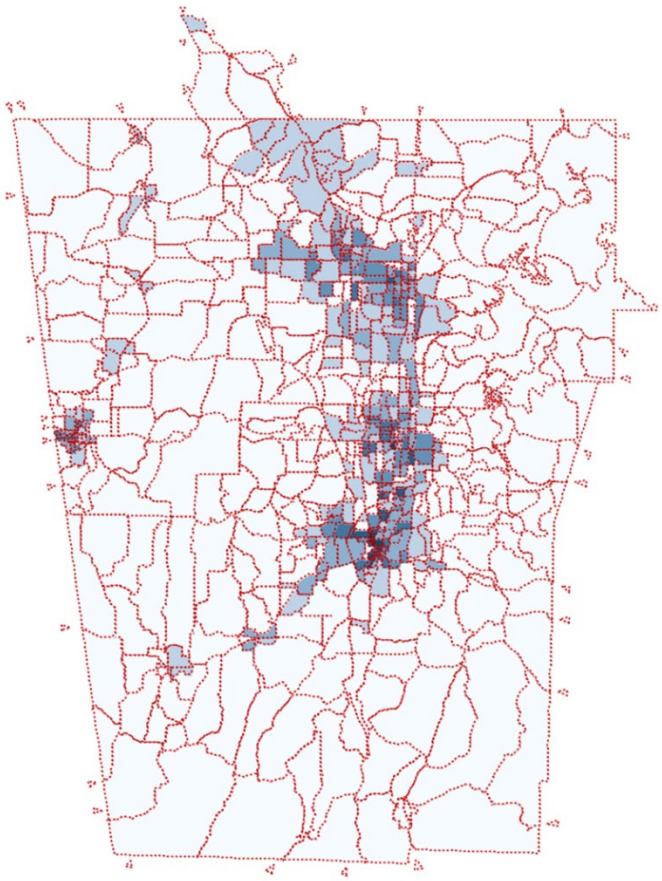
- The NWA Travel Forecasting Model has no significant projected changes in mode share over the next 25 years even if the *Connect Northwest Arkansas Transit Plan* was to be fully implemented - parallel improvements to the highway network keeps auto mode competitive.
- Historical surveyed/observed behavior establishes travelers' likelihood to make trips, own a vehicle, etc. and their ***responses*** to land-use and cost. Future behavior assumes the same ***responses***
- Shifts in behavior require shifts in household composition, land-use, and/or cost of travel for example.
    - if driving becomes more costly (i.e. severe congestion in 2045), other modes will be more competitive
    - if land-use is mixed such walking and biking mode shares will increase
- For FTA's New Starts and Small Starts, FTA will review transit assumptions against actual Northwest Arkansas transit data and past transit trends. FTA's Simplified Trips on Transit Software (STOPS) modeling or regional modeling will be required for the application.



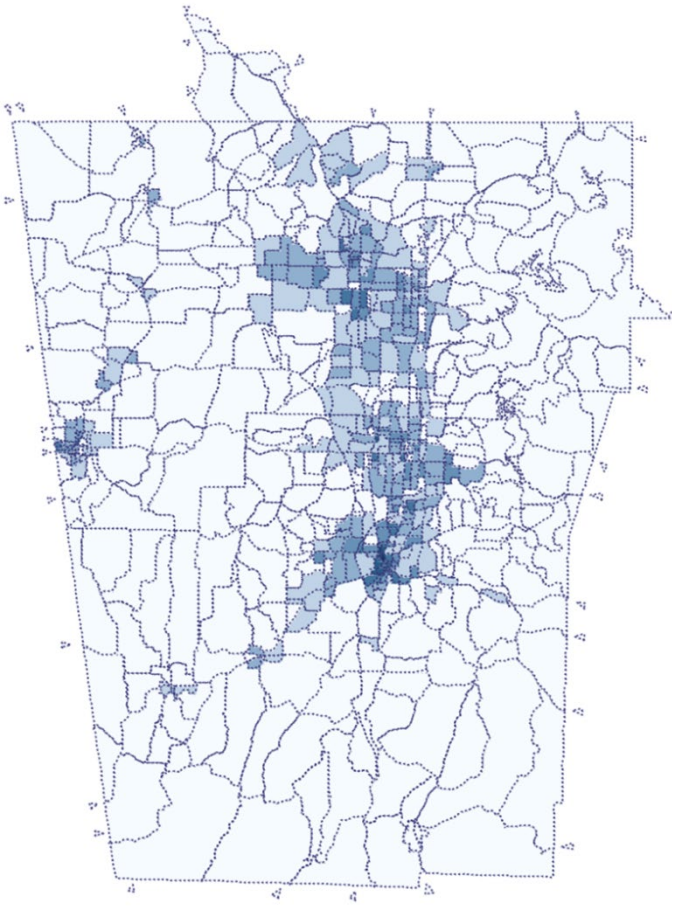
Map 7-5 - I-49 10-Mile Buffer and NWA Travel Forecasting Model TAZs



Map 7.6 - 2045 Total Volume Map – NWA Travel Forecasting Model



Household Density by TAZ - 2018

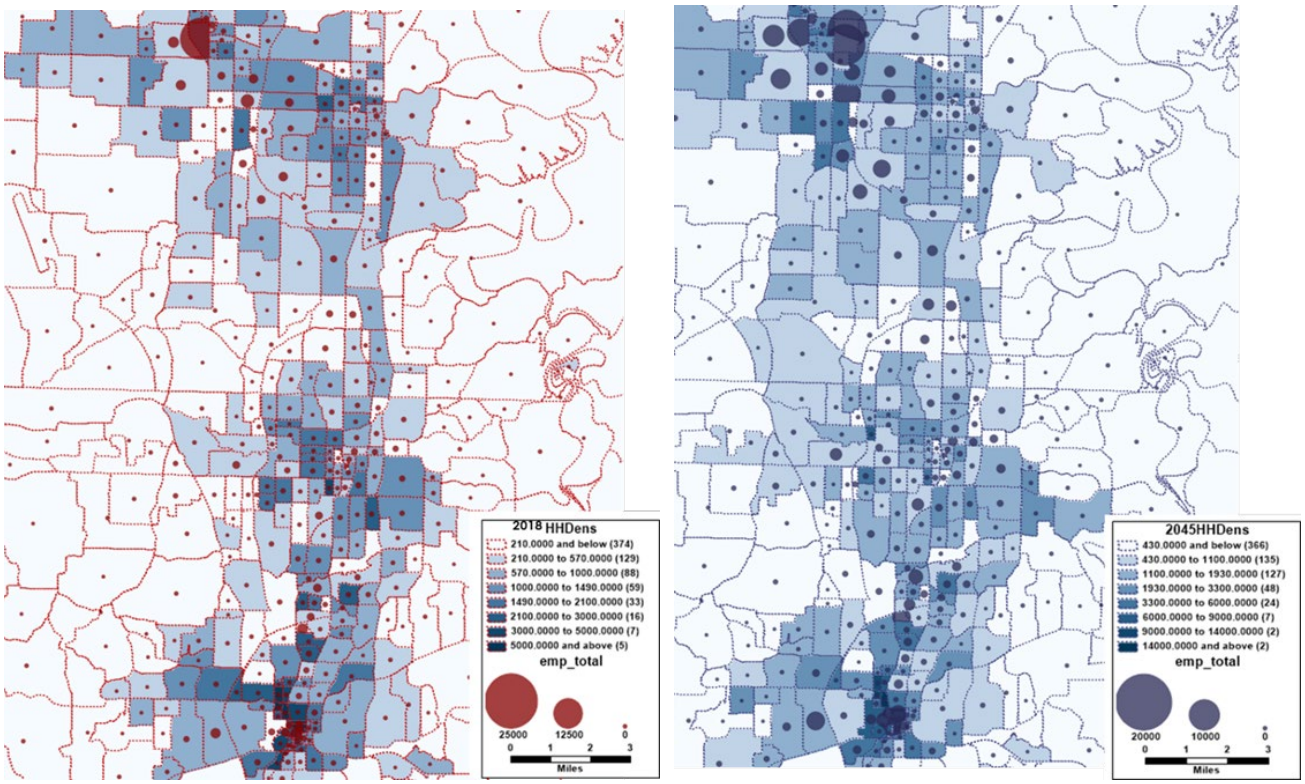


Household Density by TAZ - 2045

Map 7-7 – 2018 TAZs Household Density Distribution in 2018 and NWARPC 2045 NWARPC Projected Household Density Distribution

Table 7-12 and 7-13 and Figure 7-17 bellow illustrate actual Level of Service, Annual Average Daily Counts, model results from the 2006 I-540 Study and forecasted 2045 Travel Demand Model volumes. Note that in both tables and figure below, the forecasted 2045 volumes are calculated at the best available location to match the actual ADT data, therefore some inconsistencies may occur. A generalized description of the Level of Service thresholds published by the Utah Department of Transportation is illustrated in Figure 7-18.

The recently updated travel demand model also includes a post-processing tool that builds LOS maps on the fly as the model scenarios are produced. This tool will be utilized by transportation planners and engineers to identify traffic volume bottle-neck areas and for a variety of scenarios for future years. An example of the maps produced by this post-processing is illustrated in Map- 7-9.



Map 7-8 – 2018 TAZs Employment Density Distribution and NWARPC 2045 NWARPC projected Employment Density

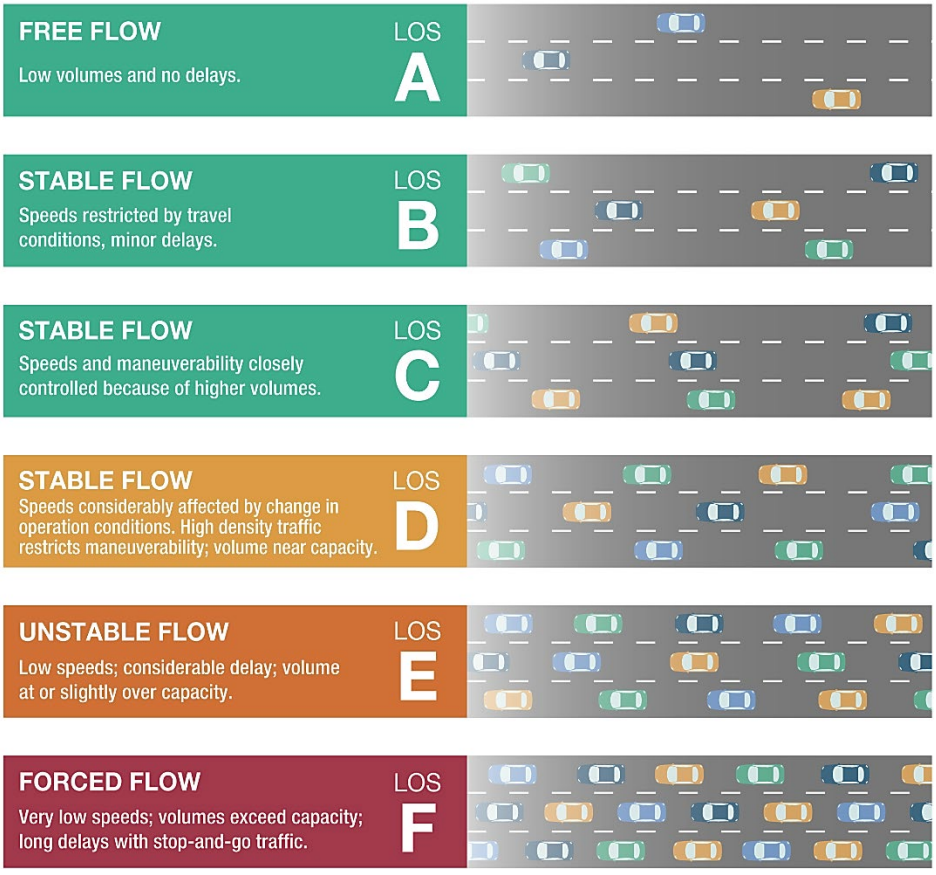


Figure 7-18 – Levels of Service (LOS) – Source: Utah Department of Transportation (UDOT) at -https://www.parleyseis.com/assets/images/Parleys%20LOS%20Levels_rev2.png

Interstate 49 Levels of Service (LOS) for Washington and Benton County 2006 Study)						
1-49 LOCATION	Traffic Volumes 2004	LOS (4 Lanes) 2004	Traffic Volumes 2024 (2006 Data)	LOS (4 Lanes) 2024 (2006 Data)	LOS (6 Lanes) 2024 (I-49 in now Constructed to Six Lanes)	LOS (8 Lanes) 2024
Exit 45 Hwy 74	14,600	A	26,400	B	A	A
Exit 53 Hwy 170	18,700	A	33,800	C	B	A
Exit 58 W. Wilson St.	20,200	B	36,600	C	B	A
Exit 61 Hwy 265/ Hwy 112	27,300	B	49,300	D	C	B
Exit 62 Hwy 62 / Hwy 180	44,000	C	79,500	F	D	C
Exit 64 Hwy 16 / Hwy 112 Spur	51,800	D	93,600	F	E	C
Exit 65 N. Porter Rd.	54,000	D	97,500	F	E	C
Exit 66 Hwy 112	60,700	D	109,600	F	F	D
Exit 67 Hwy 71 Business	48,800	D	88,100	F	D	C
Exit 69 Great House Springs Rd.	50,200	D	92,400	F	E	C
Exit 72 Hwy 412	49,700	D	93,300	F	E	D
Exit 73 Elm Springs Rd.	55,800	D	106,800	F	F	D
Exit 76 E. Wagon Wheel Rd.	55,400	D	108,100	F	F	D
Exit 77 Proposed Hwy 412	55,400	D	110,000	F	F	D
Exit 78 Hwy 264	51,100	D	101,700	F	E	C
Exit 81 Pleasant Grove Rd.	52,100	D	103,700	F	E	D
Exit 82 Proposed W. Perry Rd.	52,100	D	101,500	F	E	C
Exit 83 Hwy 94	51,700	D	100,900	F	E	C
Exit 85 Hwy 71 Business	46,200	C	91,900	F	D	C
Exit 86 Hwy 102 / Hwy 62	33,900	B	68,800	E	C	B
Exit 88 Hwy 71 / Hwy 72	26,900	B	54,600	D	B	B
https://www.nwarpc.org/pdf/Congestion%20Management/1-11-105%20I-540%20Improvement%20Study%20AHTD%202006.pdf						

Table 7-12: I-49 Levels of Service in Year 2024 (2006 I-540 Improvement Study)

1-49 LOCATION	ARDOT 2004 ADT Counts	ARDOT 2019 ADT Counts	Projected Traffic Volumes 2024 (2006 I-540 Study)	Projected Traffic Volumes 2045 NWA Travel Demand Forecast Model	LOS (6 Lanes) 2045 based on Simplified Highway Capacity Calculation Method	Percent Change 2004 to 2019 ARDOT Counts	Percent Change 2019 to 2045 ARDOT Counts to Projected
Exit 45 Hwy 74	14,600	21,000	26,400	15,300	A	43.84%	-27.14%
Exit 53 Hwy 170	18,700	24,000	33,800	27,700	B	28.34%	15.42%
Exit 58 W. Wilson St.	20,200	32,000	36,600	38,000	B	58.42%	18.75%
Exit 61 Hwy 265/ Hwy 112	27,300	41,000	49,300	52,700	B	50.18%	28.54%
Exit 62 Hwy 62 / Hwy 180	44,000	59,000	79,500	86,700	E	34.09%	46.95%
Exit 64 Hwy 16 / Hwy 112	51,800	67,000	93,600	115,900	E	29.34%	72.99%
Exit 65 N. Porter Rd.	54,000	71,000	97,500	120,000	F	31.48%	69.01%
Exit 66 Hwy 112	60,700	88,000	109,600	101,100	E	44.98%	14.89%
Exit 67 Hwy 71 Business	48,800	68,000	88,100	126,800	F	39.34%	86.47%
Exit 69 Great House Springs	50,200	87,000	92,400	146,600	F	73.31%	68.51%
Exit 72 Hwy 412	49,700	67,000	93,300	137,900	F	34.81%	105.82%
Exit 73 Elm Springs Rd.	55,800	95,000	106,800	134,500	F	70.25%	41.58%
Exit 76 E. Wagon Wheel Rd.	55,400	95,000	108,100	134,500	F	71.48%	41.58%
Exit 77 Hwy 412 Bypass	55,400	79,000	110,000	120,200	F	42.60%	52.15%
Exit 78 Hwy 264	51,100	79,000	101,700	144,400	F	54.60%	82.78%
Exit 81 Pleasant Grove Rd.	52,100	79,000	103,700	161,800	F	51.63%	104.81%
Exit 82 Promenade Blvd.	52,100	82,000	101,500	167,700	F	57.39%	104.51%
Exit 83 Hwy 94	51,700	82,000	100,900	179,500	F	58.61%	118.90%
Exit 85 Hwy 71 Business	46,200	76,000	91,900	160,400	F	64.50%	111.05%
Exit 86 Hwy 102 / Hwy 62	33,900	55,000	68,800	98,900	D	62.24%	79.82%
Exit 88 Hwy 71 / Hwy 72	26,900	43,000	54,600	82,000	C	59.85%	90.70%
Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System							

Table 7-13: I-49 Levels of Service in Year 2045

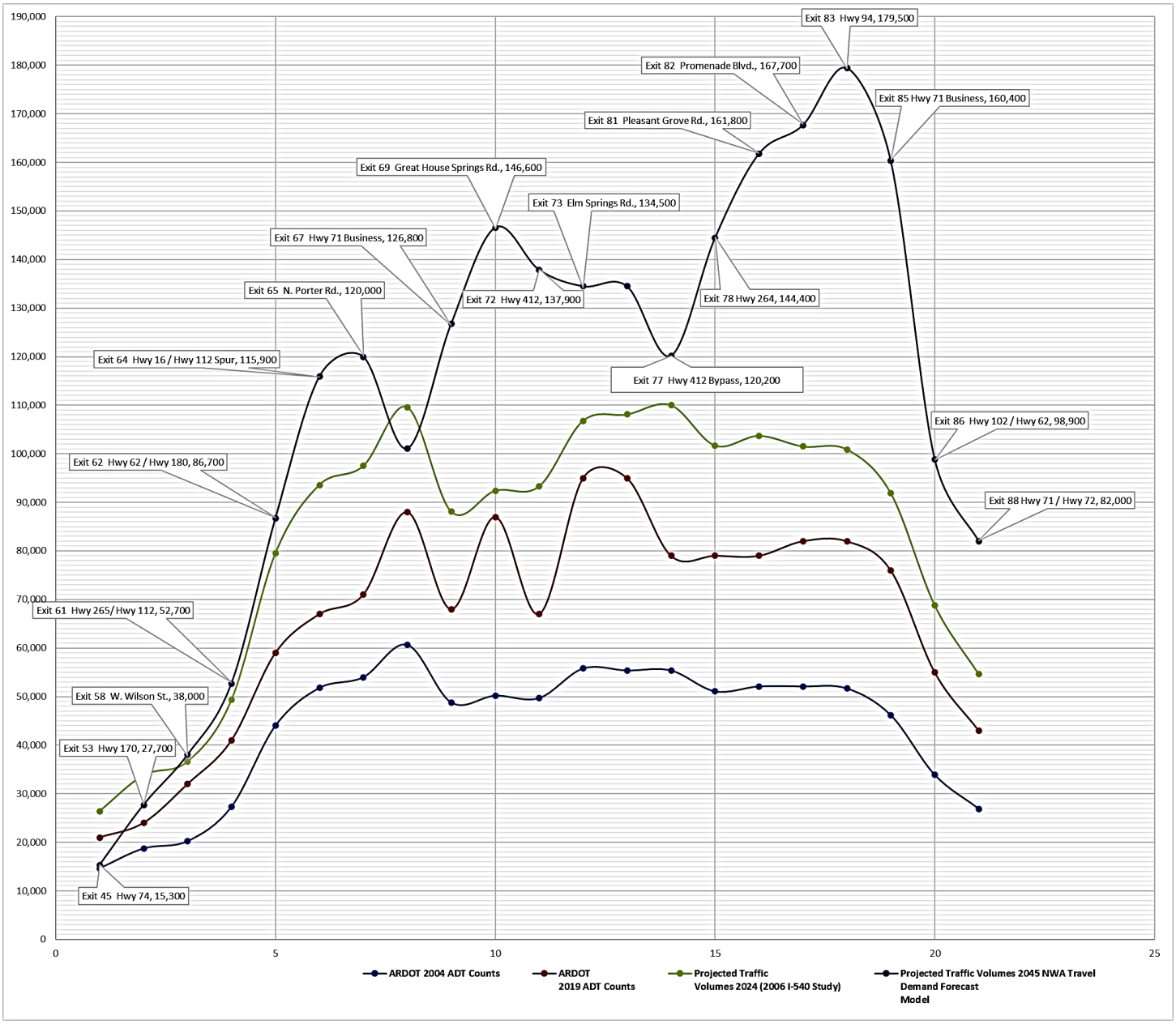
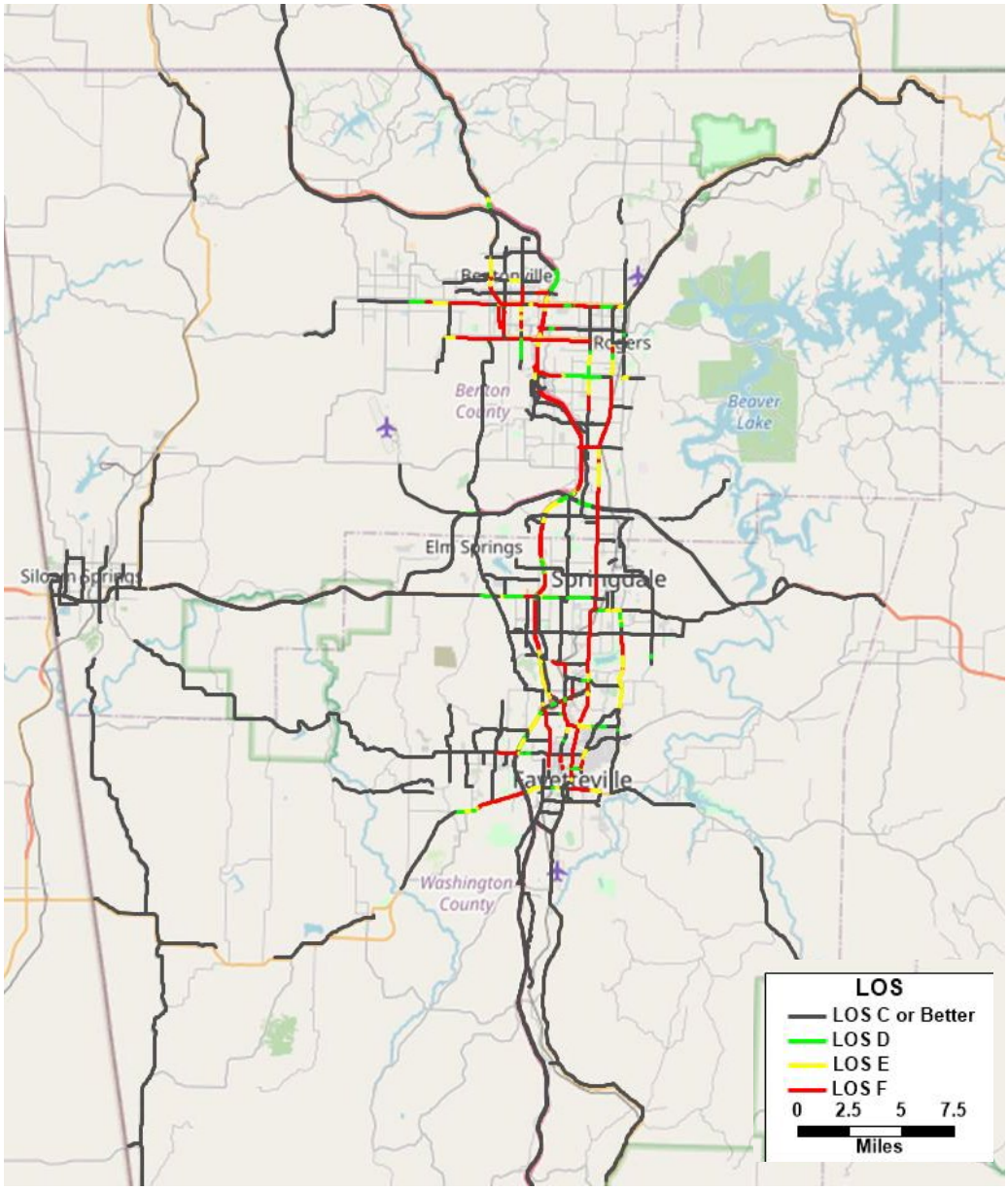


Figure 7-17: I-49 Selected Exit Locations – Average Daily Counts and Projected Volumes



Map 7-9-: 2045 Fiscally Constrained Model Scenario – Level of Service (LOS) Map