2045
Metropolitan Transportation Plan

Technical Report #1
Transportation Modeling and Forecasting

Jackson Metropolitan Planning Organization

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CMPDD
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1.0 Introduction and Model Overview

1.1 Introduction

This report includes a description of the procedures used in developing the updated demographics and travel estimates used in the 2045 Metropolitan Transportation Plan (MTP) for the Jackson Metropolitan Planning Organization (MPO). It also describes the relationship between planning data and trip making, and the calibration and testing of the model. This report does not include how to operate the model.

1.2 Model Overview

The Jackson MPO Travel Demand Model (TDM) is being updated for use in the MPO's new 2045 MTP. The new TDM is an update of the model used in the previous MTP. The updated model was calibrated and validated to meet the requirements established by the Federal Highway Administration (FHWA) and uses the calibration and validation parameters described in the latest *Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee*[1].

The updated TDM continues to use the 2013 base year. Additional updates to the TDM include:

- updated master roadway network;
- updated socioeconomic data and trip rates; and
- updated turn penalties, time penalties, capacity factors, and external trip data.

[1] http://tnmug.utk.edu/wp-content/uploads/sites/47/2017/06/MinimumTravelDemandModel2016.pdf

The Jackson MPO TDM is based upon the conventional trip-based four-step modeling approach.

Broadly, the main model components fall within the following four categories:

Trip Generation

- The process of estimating trip productions and attractions at each Traffic Analysis Zone (TAZ)

Trip Distribution

- The process of linking trip productions to trip attractions for each TAZ pair.

Mode Choice

- The process of estimating the number of trips by mode for each TAZ pair.
- This process allows the model to calculate transit trips.

Trip Assignment

- The process of assigning auto and truck trips onto specific highway facilities in the region.

The TDM's focus is on the region's highway network due to a limited number of transit trips. As a result, a transit element has not been included, eliminating the Mode Choice step. The TDM was developed in TransCAD 8.0 travel demand forecasting software and the model interface was developed using GISDK macros.

2.0 Traffic Analysis Zones and Socioeconomic Data

2.1 Study Area and Traffic Analysis Zones

The accuracy necessary for generating trips from planning data requires it to be aggregated by small geographic areas. These areas are called Traffic Analysis Zones (TAZs).

TAZs are generally homogeneous areas and were delineated based on:

- population,
- land use,
- census geography,
- physical landmarks, and
- governmental jurisdictions.

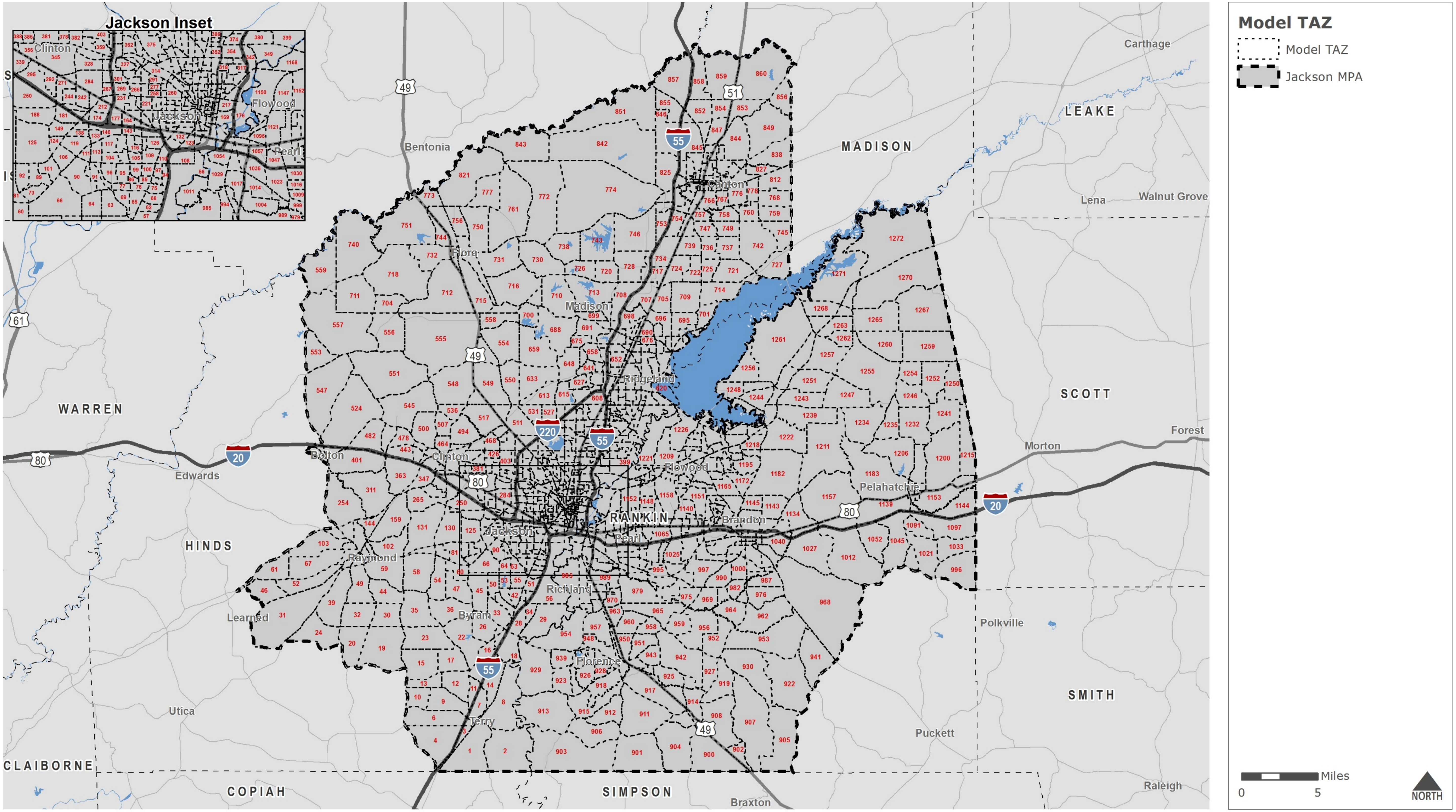
The 2045 MTP study area and TAZ structure are the same as those established in the 2040 MTP. The Jackson Urbanized Area 2040 MTP study area was divided into 1,193 TAZs with 559 in Hinds County, 261 in Madison County and 373 in Rankin County. Additionally, there are 20 external stations. A map of the TAZs is shown in Figure 2.1.

All of the local governments in the Metropolitan Planning Area (MPA), including county governments, are members of the MPO. This includes:

- City of Jackson
- City of Clinton
- City of Pearl
- City of Madison
- City of Ridgeland
- City of Brandon
- City of Canton
- City of Byram
- City of Flowood
- City of Richland
- City of Florence
- City of Raymond
- Town of Flora
- Town of Pelahatchie
- Town of Terry
- Town of Bolton
- Hinds County
- Madison County
- Rankin County

The study area is comprised of the the incorporated areas listed above, and portions of Hinds, Madison, and Rankin Counties.

Figure 2.1: MPO Study Area



Data Sources: Census Bureau; MPO Staff

Disclaimer: This map is for planning purposes only.

2.2 Base Year (2013) Model Socioeconomic Data Update

The previous TDM had a 2013 base year that used housing, income, employment, and school attendance data as model inputs. The 2045 MTP uses the same base year as the previous model, but included an in-depth review of the study area's socioeconomic data. This section describes the procedures used to update the model files to create the updated base year socioeconomic data.

Household Data Update

Household data for the MPO TAZs was updated from the previous model's 2013 data using aerial imagery analysis to account for major areas of growth from the 2010 Census. Google Earth's "historical imagery" feature was used to find areas of growth and redevelopment and a household count corresponding to the growth was estimated and assigned for each TAZ. A corresponding population change was then developed for these locations using the ratio of population to household from the 2010 Census. Finally, the estimated changes were added to the 2010 household and population data to obtain the updated 2013 data.

Table 2.1 displays the updated household data within the study area by the portion of each county within the study area.

Table 2.1: Study Area Households and Population, Base Year 2013

Variable	Hinds County	Madison County	Rankin County	Total
Total Population	235,520	93,111	141,561	470,192
Household Population	227,233	91,375	135,303	453,911
Households	87,511	35,037	52,587	175,135

Source: Census 2010; NSI, 2019

Employment Data Update

Employment data for the MPO TAZs was updated from the previous model's 2013 data using an updated geocoding process and a review of aerial imagery and third-party employment data. First, all establishments were re-geocoded using an updated geocoding process that improved overall accuracy. Then, Google Earth's "historical imagery" feature was used to find major employment areas not included in the 2013 dataset. Then, the Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) 2013 dataset was compared and major discrepancies were adddressed. For new establishments added, the number of employees and NAICS industry classification was estimated based on local news articles, LEHD data, and similar developments across the state.

Table 2.2 displays the study area employment by type. For modeling purposes, employment variables were differentiated into the following categories:

- Agriculture, Mining and Construction (NAICS 11, 21, 23)
- Manufacturing, Transportation/Communications/Utilities, and Wholesale Trade (NAICS 31-33, 48-49, 22, 42)
- Retail Trade (NAICS 44-45, NAICS 722)
- Government, Office, and Services (NAICS 51-56, 61, 62, 71, 721, 81, 92)
- Other Employment (NAICS 99)

Table 2.2: Study Area Households and Population, Base Year 2013

Variable	Description	Hinds County	Madison County	Rankin County	Total
TOT_EMP	Total Employment	157,684	62,083	70,899	290,666
AMC_EMP	Agriculture, Mining and Construction Employment	6,883	4,264	4,804	15,951
MTCUW_EMP	Manufacturing, Transportation/Communications/ Utilities and Wholesale Trade Employment	13,532	5,930	11,980	31,442
RET_EMP	Retail Employment	24,176	20,191	16,836	61,203
OS_EMP	Government, Office and Services Employment	110,141	30,831	35,970	176,942
OTH_EMP	Other Employment	2,952	867	1,309	5,128

Source: InfoUSA; NSI, 2019

School Enrollment Data Update

The 2045 MTP school enrollment uses the same data as the previous TDM. School attendance figures include public and private elementary, middle, and high schools; colleges; universities; vocational and business schools. Total school attendance in the study area in 2013 was 132,718 students with 79,298 in Hinds County, 23,062 in Madison County, and 30,358 in Rankin County. For modeling purposes, the school attendance is measured by the number of students attending a school in a traffic zone and *not* by the number of students residing in a traffic zone.

3.0 Roadway Network

3.1 Network Line Layer

The simulation of travel patterns in a computer model requires a representation of the street and highway system in digital format. The TransCAD model creates such a network from a geographic line layer in GIS. The line layer dataview records contain descriptive information for each link and its properties. Turn prohibitions are also coded into the network at locations where certain movements are not allowed or physically cannot be made.

Adjustments were made to the model network to update the base year for accuracy.

These adjustments included:

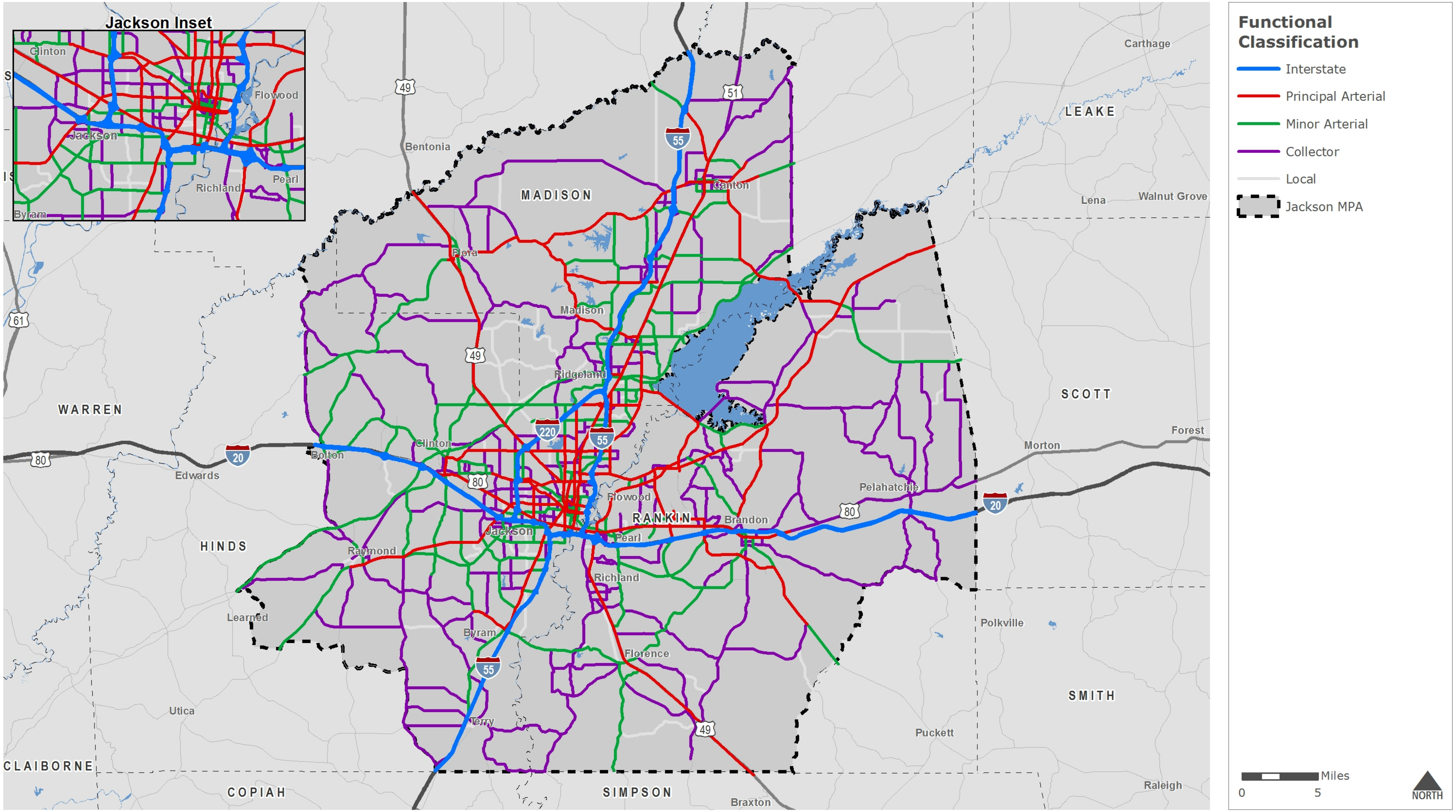
- number of lanes and/or turn lanes,
- speeds,
- functional classification to the most up-to-date data,
- volume-delay function parameters (alpha and beta values), and
- daily traffic counts and traffic stations (where necessary).

The updated TDM continues to use a master network in the model's setup folder. This line layer contains the records for all roadway links used in the TDM process. The master network contains the data for the base year, Existing Plus Committed network, and all roadway test projects. Figure 3.1 displays the base year roadway network links and link functional classifications used in the TDM.

3.2 Functional Classification

Each link in the model's roadway network was assigned a functional classification based on the system maintained by the Mississippi Department of Transportation (MDOT). The functional classifications used in the TDM are shown in Table 3.1.

Figure 3.1: Roadway Network and Functional Classification, Base Year



Data Sources: MDOT

Disclaimer: This map is for planning purposes only.

Table 3.1: Functional Classification Used in MPO Model

FHWA Functional Classification		Description	MDOT Functional Classification Number
Rural	01	Interstate	1
	02	Other Principal Arterial	2
	06	Minor Arterial	3
	07	Major Collector	4
	08	Minor Collector	5
	09	Local	6
	N/A	Ramp	**
Urban	11	Interstate	11
	12	Freeway/Expressway	12
	14	Principal Arterial	14
	16	Minor Arterial	16
	17	Collector	17
	19	Local	18
	N/A	Ramp	**
Other	N/A	System Ramp	**
	N/A	Centroid Connector	0

**NOTE: Ramps follow the same functional classification as the primary roadway they connect to.

Source: FHWA, MDOT

3.3 Model Link Speeds and Capacities

Roadway speeds and capacities are important TDM inputs that affect the traffic assignment model. The posted speed, which is assumed to be the free flow speed, for each roadway link is contained In the network database. The model has been updated with new capacity factors, which are shown in Figure 3.2. The capacity inputs consider factors such as:

- Roadway functional classification
- Location of roadway in an urban or rural area
- Number of lanes
- Width of travel lanes
- Presence of a median or dividing feature
- Presence and width of shoulder on roadway

Figure 3.2: Model Capacity Factors

Link Capacity (LOS D)

Vehicles per hour per lane - vphpl

Functional Class		vphpl Directional
All Interstate		
2 Lanes		2,300
>2 Lanes		2,400
Principal Arterial		
Rural	Divided	1,700
Rural	Undivided	1,500
Urban	Divided	1,500
Urban	Undivided	1,300
Minor Arterial		
Rural	Divided	1,600
Rural	Undivided	1,350
Urban	Divided	1,400
Urban	Undivided	1,150
Collector		
Rural	Divided	1,350
Rural	Undivided	1,150
Urban	Divided	1,150
Urban	Undivided	950
Local		
Rural	2 Lane	900
Rural	>2 Lane	1,000
Urban	2 Lane	800
Urban	>2 Lane	900
Ramps		1,000
Centroid Connectors		9,999

SF = c x N x Fw x Fhv x Fp x Fe x Fd x Fsd x Fctl x Fpark X (V/C)i

SF = Model vphpl for desired level of service
c = Ideal vphpl
N = Number of Lanes
(V/C)i = Rate of service flow for level of service D

Adjustment Factors

Acronym	Name	Facility Type	Lane Width	LW Code	Shoulder	SW Code	Factor
Fw	Lane & Shoulder Width	Interstate & Sys Ramp	<=10'	1	0-<2'	1	0.78
		Interstate & Sys Ramp	<=10'	1	2'-5'	2	0.83
		Interstate & Sys Ramp	<=10'	1	>5'	3	0.88
		Interstate & Sys Ramp	>10'	2	0-<2'	1	0.90
		Interstate & Sys Ramp	>10'	2	2'-5'	2	0.95
		Interstate & Sys Ramp	>10'	2	>5'	3	1.00
		Principal Arterial Div	<=10'	1	0-<2'	1	0.78
		Principal Arterial Div	<=10'	1	2'-5'	2	0.83
		Principal Arterial Div	<=10'	1	>5'	3	0.88
		Principal Arterial Div	>10'	2	0-<2'	1	0.92
		Principal Arterial Div	>10'	2	2'-5'	2	0.96
		Principal Arterial Div	>10'	2	>5'	3	1.00
		Principal Arterial Undiv	<=10'	1	0-<2'	1	0.78
		Principal Arterial Undiv	<=10'	1	2'-5'	2	0.82
		Principal Arterial Undiv	<=10'	1	>5'	3	0.86
		Principal Arterial Undiv	>10'	2	0-<2'	1	0.90
		Principal Arterial Undiv	>10'	2	2'-5'	2	0.95
		Principal Arterial Undiv	>10'	2	>5'	3	1.00
		Minor Arterial Div	<=9'	3	0-<2'	1	0.81
		Minor Arterial Div	<=9'	3	2'-5'	2	0.86
		Minor Arterial Div	<=9'	3	>5'	3	0.93
		Minor Arterial Div	>9'	4	0-<2'	1	0.94
		Minor Arterial Div	>9'	4	2'-5'	2	1.00
		Minor Arterial Div	>9'	4	>5'	3	1.05
		Minor Arterial Undiv	<=9'	3	0-<2'	1	0.77
		Minor Arterial Undiv	<=9'	3	2'-5'	2	0.83
		Minor Arterial Undiv	<=9'	3	>5'	3	0.88
		Minor Arterial Undiv	>9'	4	0-<2'	1	0.89
		Minor Arterial Undiv	>9'	4	2'-5'	2	0.95
		Minor Arterial Undiv	>9'	4	>5'	3	1.00
		Collector Div	<=9'	3	0-<2'	1	0.81
		Collector Div	<=9'	3	2'-5'	2	0.86
		Collector Div	<=9'	3	>5'	3	0.93
		Collector Div	>9'	4	0-<2'	1	0.96
		Collector Div	>9'	4	2'-5'	2	1.00
		Collector Div	>9'	4	>5'	3	1.05
		Collector Undiv	<=9'	3	0-<2'	1	0.81
		Collector Undiv	<=9'	3	2'-5'	2	0.85
		Collector Undiv	<=9'	3	>5'	3	0.90
		Collector Undiv	>9'	4	0-<2'	1	0.94
		Collector Undiv	>9'	4	2'-5'	2	1.00
		Collector Undiv	>9'	4	>5'	3	1.04
		Local 2 Lane	<=9'	3	0-<2'	1	0.65
		Local 2 Lane	<=9'	3	2'-5'	2	0.78
		Local 2 Lane	<=9'	3	>5'	3	0.90
		Local 2 Lane	>9'	4	0-<2'	1	0.85
		Local 2 Lane	>9'	4	2'-5'	2	1.00
		Local 2 Lane	>9'	4	>5'	3	1.04
		Local >2 Lane	<=9'	3	0-<2'	1	0.81
		Local >2 Lane	<=9'	3	2'-5'	2	0.85
		Local >2 Lane	<=9'	3	>5'	3	0.92
		Local >2 Lane	>9'	4	0-<2'	1	0.96
		Local >2 Lane	>9'	4	2'-5'	2	1.00
		Local >2 Lane	>9'	4	>5'	3	1.10
Fhv	Heavy Vehicle	Interstate					0.88
		Principal Arterial					0.90
		Minor Arterial					0.90
		Collector					0.92
		Local					0.97
Fp	Driver Population	Rural Interstate					0.90
		Urban Interstate					0.92
		System Ramp					0.92
		Principal Arterial					0.95
		Minor Arterial					0.98
		Collector					NA
		Local					NA
Fe	Driving Environment	Interstate					NA
		Rural Prin Art	Divided				1.00
		Rural Prin Art	Undivided				0.90
		Urban Prin Art	Divided				0.90
		Urban Prin Art	Undivided				0.80
		Rural Minor Art	Divided				1.00
		Rural Minor Art	Undivided				0.90
		Urban Minor Art	Divided				0.90
		Urban Minor Art	Undivided				0.80
		Rural Collector	Divided				1.00
		Rural Collector	Undivided				0.90
		Urban Collector	Divided				0.90
		Urban Collector	Undivided				0.80
		Rural Local	2 Lane				0.90
		Rural Local	>2 Lane				0.90
		Urban Local	2 Lane				0.80
		Urban Local	>2 Lane				0.80
Fd	Directional Distribution (Local only)	2 Lane	Divided				0.94
		>2 Lane	Divided				1.16
		2 Lane	Undivided				0.94
		>2 Lane	Undivided				1.10
Fsd	Signal Density	Principal Arterial - CBD					0.90
		Principal Arterial - Urban					0.85
		Principal Arterial - Suburban					0.88
		Minor Arterial - CBD					0.90
		Minor Arterial - Urban					0.92
		Minor Arterial - Suburban					0.95
		Collector - CBD					0.90
		Collector - Urban					1.00
		Collector - Suburban					1.00
		Local - CBD					0.90
		Local - Urban					1.00
		Local - Suburban					1.00
Fctl	Center Turn Lane	Interstate					NA
		All Other					1.08
Fpark	On Street Parking	Any					0.95

3.4 Centroid Connectors

Centroid connectors are imaginary roadway network links that connect a TAZ's centroid to the adjacent roadway network at nodes. These links represent the local streets on the street and highway system that are not in the model network. Centroid connectors provide the model the ability to move trips generated from individual TAZs to the roadway network. Where centroid connectors access the model network is based on features such as neighborhood roadway entrances, driveways, and parking lots.

During the TDM update, the centroid connectors were adjusted to match locations where traffic is most likely to access the model’s roadways. This was accomplished by relocating the centroid for the TAZ to reflect the “center of mass” of developed land and/or moving the centroid connector roadway network access points to a location where trips generally enter or leave the TAZ. This changes the length of the centroid connectors and the travel times on the links to encourage modeled traffic to use certain access points to reflect the observed traffic.

3.5 Traffic Counts

The updated model contains the same traffic counts as the TDM for the 2040 MTP. These counts come from MDOT and reflect the 2013 base year. The update process included the verification of count stations upon the existing TDM links and ensuring that the ADTs are assigned to the correct link, with adjustments made as necessary.

3.6 Network Attributes

Table 3.2 displays the network attributes used on the links in the TDM.

Table 3.2: Model Link Attributes

Attribute Name	Description	Input Type
LENGTH	Real (4 bytes) Segment length in miles	Automatic
DIR	Integer (2 Bytes) 0 = Two way link 1 = One way link, AB fields will be used -1 = One way link, BA fields will be used.	Automatic but user can override.
NAME	Character Street Name	User
ADT_2013	Integer (4 bytes) 2013 Daily Traffic Count	User

Attribute Name	Description	Input Type
DIR_13	Integer (2 Bytes) 2013 Link Direction 0 = Two way link 1 = One way link, AB fields will be used -1 = One way link, BA fields will be used.	User
NETWORK_13	Integer (2 bytes) 1= Network Road link 2= Centroid connector 0 or null= Link will not be included in the model run	User*
AB_MDOT_FC_13	Integer (4 bytes) Refer to Table 3.1	User
BA_MDOT_FC_13	Integer (4 bytes) Refer to Table 3.1	User
MDOT_FC_DESC_13	Character Refer toTable 3.1	User
MODEL_FC_13	Integer (4 bytes) Model functional classification code	User*
MODEL_FC_DESC_13	Character Model functional classification description	User
AB_CLASS_13	Integer (4 bytes) Field denoting number of lanes and configuration in AB direction	User
BA_CLASS_13	Integer (4 bytes) Field denoting number of lanes and configuration in BA direction	User
POSTED_SPEED_13	Integer (4 bytes) Posted Link Speed (mph)	User
AB_SPEED_13	Real (8 bytes) Link speed (mph) in AB direction	User*
BA_SPEED_13	Real (8 bytes) Link speed (mph) in BA direction	User*
LANES_13	Integer (4 bytes) Number of lanes for the roadway	User
AB_LANES_13	Integer (4 bytes) Number of lanes in AB direction	User*
BA_LANES_13	Integer (4 bytes) Number of lanes in BA direction	User*
ALPHA_13	Real (8 bytes) BPR Function Parameter	User*

Attribute Name	Description	Input Type
BETA_13	Real (8 bytes) BPR Function Parameter	User*
AB_TT_13	Real (8 bytes) Link travel time in AB direction	Model
BA_TT_13	Real (8 bytes) Link travel time in BA direction	Model
Fw_13	Real (8 bytes) Capacity factor for lane and shoulder width	User
Fhv_13	Real (8 bytes) Capacity factor for heavy vehicles	User
Fp_13	Real (8 bytes) Capacity factor for driver population	User
Fe_13	Real (8 bytes) Capacity factor for driving environment	User
Fd_13	Real (8 bytes) Capacity factor for directional distribution	User
Fctl_13	Real (8 bytes) Capacity factor for center turn lanes	User
Fpark_13	Real (8 bytes) Capacity factor for on street parking	User
Fall_13	Real (8 bytes) Overall capacity factor	User
IDEAL_VPHPL_13	Real (8 bytes) Maximum capacity in vehicles/hour/lane	User
AB_VPHPL_13	Real (8 bytes) Capacity in AB direction in vehicles/hour/lane	User
BA_VPHPL_13	Real (8 bytes) Capacity in BA direction in vehicles/hour/lane	User
IS_MANUAL_CAP_13	Integer (2 bytes) 0 or null= Model calculates the link capacity Any other value= Link capacity value input by User will be retained	User*
AB_CAPACITY_13	Integer (4 bytes) Capacity in AB direction	Model
BA_CAPACITY_13	Integer (4 bytes) Capacity in BA direction	Model
AB_CAP_AM_13	Integer (4 bytes) Morning capacity in AB direction	Model

Attribute Name	Description	Input Type
BA_CAP_AM_13	Integer (4 bytes) Morning capacity in BA direction	Model
AB_CAP_MD_13	Integer (4 bytes) Mid-day capacity in AB direction	Model
BA_CAP_MD_13	Integer (4 bytes) Mid-day capacity in BA direction	Model
AB_CAP_PM_13	Integer (4 bytes) Afternoon capacity in AB direction	Model
BA_CAP_PM_13	Integer (4 bytes) Afternoon capacity in BA direction	Model
AB_CAP_NT_13	Integer (4 bytes) Night time capacity in AB direction	Model
BA_CAP_NT_13	Integer (4 bytes) Night time capacity in BA direction	Model
DAILY_FLOW	Real (8 bytes) Total daily model volume	Model
AB_DAILY_FLOW	Real (8 bytes) AB directional daily model volume	Model
BA_DAILY_FLOW	Real (8 bytes) BA directional daily model volume	Model
DAILY_TOT_VMT	Real (8 bytes) Total daily vehicle miles travelled	Model
DAILY_AB_VMT	Real (8 bytes) AB directional daily vehicle miles travelled	Model
DAILY_BA_VMT	Real (8 bytes) BA directional daily vehicle miles travelled	Model
DAILY_TOT_VHT	Real (8 bytes) Total daily vehicle hours travelled	Model
DAILY_AB_VHT	Real (8 bytes) AB directional daily vehicle hours travelled	Model
DAILY_BA_VHT	Real (8 bytes) BA directional daily vehicle hours travelled	Model
DAILY_TOT_VHD	Real (8 bytes) Total daily vehicle hours delay	Model
DAILY_AB_VHD	Real (8 bytes) AB directional daily vehicle hours delay	Model
DAILY_BA_VHD	Real (8 bytes) BA directional daily vehicle hours delay	Model

Attribute Name	Description	Input Type
DAILY_AB_VOC	Real (8 bytes) AB directional volume/capacity	Model
DAILY_BA_VOC	Real (8 bytes) BA directional volume/capacity	Model
DAILY_MAX_VOC	Real (8 bytes) Higher of AB and BA volume/capacity	Model
DAILY_TRK_FLOW	Real (8 bytes) Total daily model truck volume	Model
AB_DAILY_TRK_FLOW	Real (8 bytes) AB directional daily model truck volume	Model
BA_DAILY_TRK_FLOW	Real (8 bytes) BA directional daily model truck volume	Model
Note: 1. Each of the suffix “13” fields should be repeated for EC, VIS, and SCE suffixes as well. 2. Volume-delay function parameter fields ALPHA_13 and BETA_13 are based on Bureau of Public Roads (BPR) function. 3. In addition to the base year fields, each planned year should have a field called “PROJECT_[suffix]” of type Integer. This field should have a unique project number for each committed or planned project.		

Source: NSI, 2019

4.0 External Travel

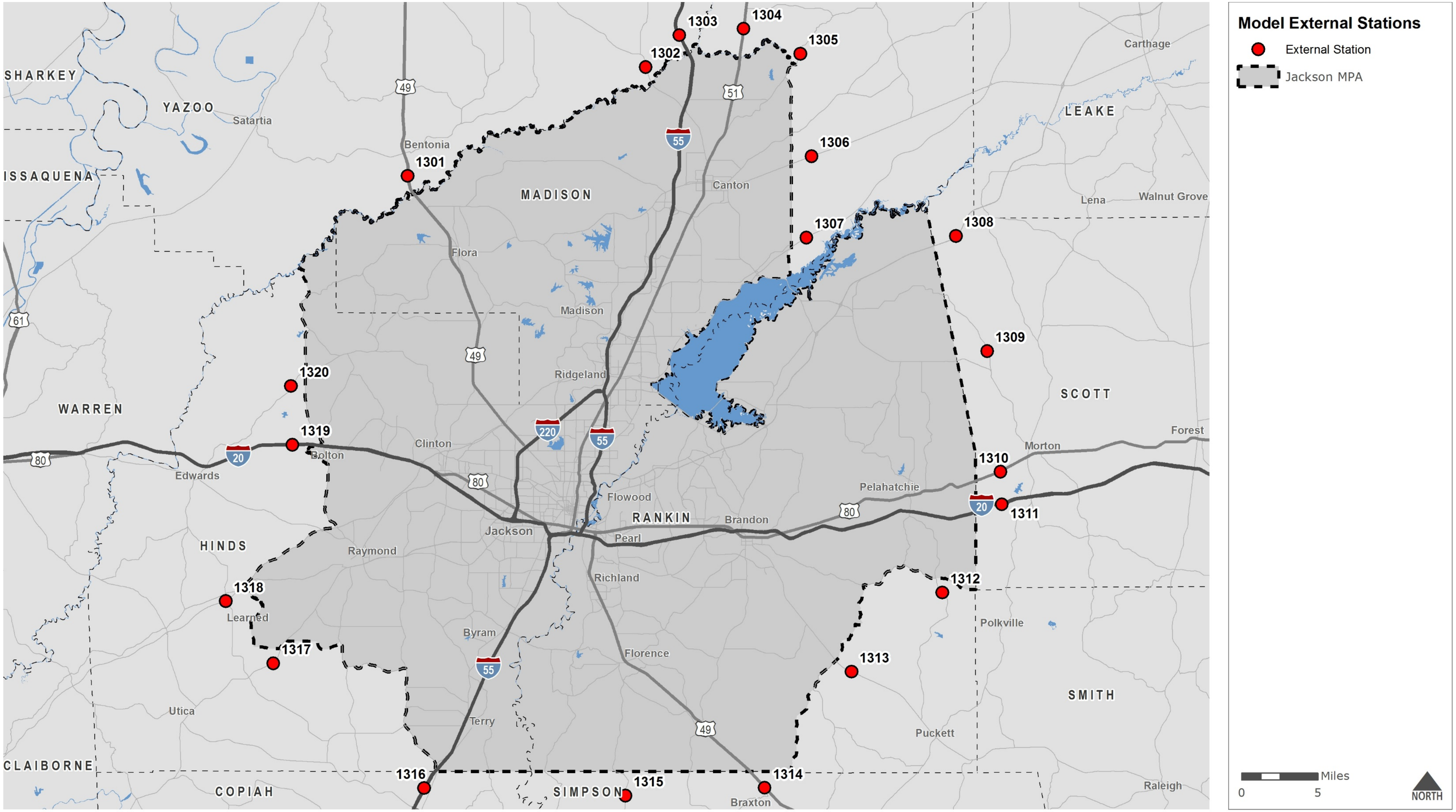
There are two types of external travel trips: External-Internal (EI) trips and External-External (EE) trips. EI trips have one end of the trip inside the study area, and the other outside. EE trips pass through the study area and have no origin or destination within the study area itself. Both trip types are assigned at external stations located on significant roadways that are at the study area's periphery. These stations represent most of the trips that are crossing the study area boundary.

Since there were no changes to the study area boundary or the base year, and no additional roadways were added to the network crossing the study area boundary, the external stations are the same as the previous model.

The locations of the TDM's external stations are shown in Figure 4.1.

External trips in the model are divided into auto trips (AUTO) and truck (TRK) trips. Auto trips are those that are made in a personal vehicle. While not actually an auto trip, commercial vehicle (CMVEH) trips are included in AUTO trips for the purposes of external trips and represent four-tire commercial vehicles. Commercial vehicles include delivery and service vehicles. Truck trips represent single-unit with six or more tires and multi-unit with three-plus axle combination trucks.

Figure 4.1: Model External Stations



Data Sources: MDOT; MPO Staff

Disclaimer: This map is for planning purposes only.

4.1 External-External Trips

The 2045 MTP TDM uses the same external-external trip matrices developed as part of the 2040 MTP TDM. The matrices were developed using data provided through AirSage on the travel patterns in the metropolitan area and the methodology described in NCHRP 716, with the Fratar procedure used to obtain balanced trips crossing the study area boundary. Table 4.1 displays the expanded 24 hour EE trip table for all vehicles.

4.2 External-Internal Trips

The EI attraction equations used in this model were derived by regression analysis using the AirSage data and knowledge of the area's travel patterns. In addition, EI trips were also separated into auto and truck trips based on the vehicle classification counts at external stations.

The following EI attraction equations were used in the travel demand model for EIAUTO and EITRK trips.

EIAUTO Attractions = 85.2120 + 0.1310 * (OCCDU) + 0.2140 * (RET_EMP + RET_EMP2) +

0.1340 * (AMC_EMP + MTCUW_EMP + OS_EMP + OTH_EMP) + 0.0360 * (SHATT)

EITRK Attractions = 0.0654 * (OCCDU) + 0.1518 * (RET_EMP + RET_EMP2) +

0.0368 (OS_EMP + OTH_EMP) + 0.2210 * (AMC_EMP) + 0.1651 * (MTCUW_EMP)

Descriptions of the variables used in the equations were included in Tables 2.1 and 2.2. Table 4.2 displays the EI trips at each external station.

Table 4.1: Expanded 24-Hour EE Trip Table for All Vehicles

Station Number	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	Total
1301	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	0.0	0.0	62.7	0.0	15.5	548.8	0.0	300.3	33.9	0.0	20.4	0.0	990.0
1302	0.0	0.0	0.0	0.0	0.0	22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.3
1303	0.0	0.0	0.0	0.0	0.0	2.2	0.0	35.6	0.0	0.0	75.9	0.0	20.7	716.6	0.0	1,953.4	0.0	0.0	1,187.6	0.0	3,991.9
1304	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1305	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1306	8.4	22.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	33.6
1307	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	4.8
1308	0.0	0.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	113.5	3.9	0.0	100.3	0.0	271.3
1309	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1310	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1311	62.7	0.0	75.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	9.1	0.0	177.9	0.0	0.0	2,207.6	0.0	2,534.3
1312	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1313	15.5	0.0	20.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	2.3	0.0	0.0	17.3	0.0	56.9
1314	548.8	0.0	716.6	0.0	0.0	0.0	0.0	18.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	21.0	1.9	0.0	433.8	0.0	1,749.3
1315	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1316	300.3	0.0	1,953.4	0.0	0.0	0.6	4.8	113.5	0.0	0.0	177.9	0.0	2.3	21.0	0.0	0.0	12.2	0.0	272.2	0.0	2,858.1
1317	33.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	1.9	0.0	12.2	0.0	0.0	0.0	0.0	51.9
1318	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1319	20.4	0.0	1,187.6	0.0	0.0	0.0	0.0	100.3	0.0	0.0	2,207.6	0.0	17.3	433.8	0.0	272.2	0.0	0.0	0.0	0.0	4,239.2
1320	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	990.0	22.3	3,991.9	0.0	0.0	33.6	4.8	271.3	0.0	0.0	2,534.3	0.0	56.9	1,749.3	0.0	2,858.1	51.9	0.0	4,239.2	0.0	16,803.6

Source: NSI, 2019

Table 4.2: External Station EI Data

Station Number	Description	EI AUTO Trips	EI TRK Trips
1301	US 49 North	7,757	1,263
1302	MS 16 West	2,518	437
1303	I-55 North	9,502	3,515
1304	US 51 North	820	0
1305	MS 43 North	1,500	0
1306	MS 16 East	3,631	902
1307	Natchez Trace Pkwy North	764	87
1308	MS 25 North	4,129	729
1309	MS 481 East	1,500	0
1310	US 80 East	2,200	0
1311	I-20 East	12,360	4,572
1312	MS 43 South	770	0
1313	MS 18 East	3,728	658
1314	US 49 South	14,526	2,975
1315	MS 469 South	1,100	0
1316	I-55 South	15,537	5,747
1317	MS 18 West	2,443	854
1318	Natchez Trace Pkwy South	340	0
1319	I-20 West	15,711	5,811
1320	MS 22 West	830	0

Source: NSI, 2019

5.0 Trip Generation

This section describes the procedures used to determine the number of trips that begin or end in a given traffic zone. Trip generation is the estimation of the amount of person trips that are produced and attracted to each TAZ. Trip rates for the various types of trips are based upon the land use properties and demographic characteristics of each TAZ.

The model considers the following internal trip purposes:

- Home-based Work (HBW)
- Home-based Other (HBO)
- Non-home-based (NHB)
- Commercial Vehicle (CMVEH)
- Truck (TRK)

Home-based trips are those that have one trip end located at the traveler's household. Examples of home-based trips include travel from home to work, shopping, or other personal business. Non-home-based trips include travel to and from any location that does not involve the traveler's household. Examples of these trips can include travel from work to shopping, from school to daycare, and from work to a lunch location.

5.1 Internal Travel Model

For home-based trips, the productions refer to the home end, and the attractions refer to the non-home end of the trip. For NHB, CMVEH, and TRK trips, productions and attractions refer to the origin and destination respectively.

The model uses cross-classification trip production models for the home-based and non-home-based trip purposes. This means that trip rates that vary by household type are applied at the zonal level. The trip attraction models are linear regression equations that relate zonal employment, school enrollment, and households to trip attractions. For the commercial vehicle and freight vehicle trip purposes, the model applies a linear regression equation that relates zonal employment and households to trip productions and attractions. These equations are based on the Quick Response Freight Manual II.

The trip production and attraction models used in the 2040 MTP were checked for reasonableness and determined to be valid for the 2045 MTP. However, adjustments were made to the trip rates from the previous model. The final trip generation production and attraction models for HBW, HBO, and NHB trips are shown in Tables 5.1 and 5.2 respectively. The final trip generation production and attraction models for CMVEH and TRK trips are shown in Tables 5.3 and 5.4 respectively.

Table 5.1: HBW, HBO, and NHB Trip Production Rates

Trip Purpose	Number of Vehicles	Household Size				
		HHS1	HHS2	HHS3	HHS4	HHS5P
HBW	VEH0	0.4882	1.0229	1.3251	1.5459	1.5808
	VEH1	0.9996	1.6110	1.9434	2.4735	2.6083
	VEH2	0.9996	1.9179	2.3410	2.8710	3.0430
	VEH3P	0.9996	1.9179	2.8710	3.3790	3.6161
HBO	VEH0	0.9828	1.8721	2.9121	3.5188	4.2988
	VEH1	2.0125	2.9485	4.2711	5.6301	7.0931
	VEH2	2.0125	3.5101	5.1447	6.5349	8.2753
	VEH3P	2.0125	3.5101	6.3096	7.6911	9.8336
NHB	VEH0	0.6054	1.0644	1.6632	1.7852	1.8628
	VEH1	1.2396	1.6765	2.4394	2.8563	3.0736
	VEH2	1.2396	1.9958	2.9383	3.3153	3.5859
	VEH3P	1.2396	1.9958	3.6036	3.9019	4.2611

Source: NSI, 2019

Table 5.2: HBW, HBO, and NHB Trip Attraction Rates

	OCCDU	RET_EMP	RET_EMP2	OS_EMP	OTH_EMP	AMC_EMP	MTCUW_EMP	SCHATT
HBW	0.0000	1.2180	1.2180	1.2180	1.2180	1.2180	1.2180	0.0000
HBO	0.9630	2.1400	9.6300	1.8190	0.5350	0.5350	0.5350	0.7137
NHB	0.5000	1.4000	4.1000	1.2000	0.5000	0.5000	0.5000	0.2760

Source: NSI, 2019

Table 5.3: CMVEH and TRK Trip Production Rates

	OCCDU	RET_EMP	RET_EMP2	OS_EMP	OTH_EMP	AMC_EMP	MTCUW_EMP
CMVEH	0.1883	0.6660	0.6660	0.3278	0.3278	0.8325	0.7035
TRK	0.0373	0.0867	0.0867	0.0210	0.0210	0.1263	0.0944

Source: NSI, 2019

Table 5.4: CMVEH and TRK Trip Attraction Rates

	OCCDU	RET_EMP	RET_EMP2	OS_EMP	OTH_EMP	AMC_EMP	MTCUW_EMP
CMVEH	0.1883	0.6660	0.6660	0.3278	0.3278	0.8325	0.7035
TRK	0.0373	0.0867	0.0867	0.0210	0.0210	0.1263	0.0944

Source: NSI, 2019

5.2 Special Generators

A special generator is a land use with unusually low or high trip generation characteristics when compared to the established trip generation rates. For the Jackson TDM these special generators included:

- TAZs 370 and 383; Mississippi College (27,500 trips) - the college experiences more trips than generic school attendance trip rates suggest it would receive.
- TAZ 315; Belhaven University (7,000 trips) - the college experiences more trips than generic school attendance trip rates suggest it would receive.
- TAZ 56; UPS Customer Center (2,500 trips) - the employment numbers at this facility do not provide adequate TRK and CMVEH trips since this center is a distribution hub for UPS vehicles.
- TAZ 525 (6,000 trips) - several car dealerships, a hospital, and an apartment complex are located in this TAZ and standard trip rates under-predict near this area, likely due to the extra trips the dealerships experience and are not accounted for in generic trips rates.

5.3 Balancing Productions and Attractions

Productions and attractions are balanced at the study area level for all trip purposes. This means that the area-wide trip attractions match the amount of area-wide trip productions. HBW, HBO, and TRK trips are balanced by holding the productions as a constant. The NHB and CMVEH trips are balanced by holding the attractions as a constant. This reflects that the trips produced at the households or trip origins must be equal to the total number of trips attracted to the non-home ends or destinations. Table 5.5 shows the daily trips by trip purpose before and after balancing.

Table 5.5: Balanced Productions and Attractions

Trip Purpose	Before Balancing		After Balancing	
	Productions	Attractions	Productions	Attractions
HBW	375,508	368,970	375,508	375,508
HBO	835,808	781,178	835,808	835,808
NHB	469,688	483,875	483,875	483,875
CMVEH	178,237	178,237	178,237	178,237
TRK	22,073	22,073	22,073	22,073

Source: NSI, 2019

5.4 Summary

Two separate documents were used In the calibration and validation of the Jackson MPO TDM. The first is the *Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee*, which was last updated in 2016. The second is the *Travel Model Validation and Reasonableness Checking Manual, 2nd Edition*.[2] Using these guidelines, several key statistics for trip generation were monitored, which are shown in Table 5.6.

Table 5.6: Modeled vs Benchmark Trip Rates

Trip Rate	Modeled	Low Benchmark	High Benchmark
Person Trips per Person	3.9	3.3	4.0
Person Trips per Household	10.2	8.0	10.0
HBW Trips	21.8%	12.0%	24.0%
HBO Trips	48.7%	45.0%	60.0%
NHB Trips	29.5%	20.0%	33.0%

Source: Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee; NSI, 2019

These statistics are within the reasonable limits established by the Tennessee Model Users Group (TNMUG) guidance except person trips per household which is slightly off from the recommended benchmark range. No further adjustments were made since the model was performing well within all other benchmark ranges and persons were not directly used in the trip rates.

[2] Travel Model Validation and Reasonableness Checking Manual, 2nd Edition. Travel Model Improvement Program.

6.0 Trip Distribution

The next step in travel demand modeling is the trip distribution process. This function determines the destinations of trips produced in the trip generation model, and conversely, where the attracted trips originated.

6.1 Gravity Model

Many models are available for this process; however, the Jackson MPO TDM effort used the traditional gravity model.

This model employs two relationships, the first of which is indirect:

> The shorter the travel time to the destination zone, the greater the number of trips will be distributed to it from the origin zone.

The second relationship is a direct one:

> The more attractions there are in a destination zone, the more trips will be distributed to it from the origin zone.

The generalized equation for this model is:

$$T_{ij} = \frac{(P_i)(A_j)(F_{ij})}{\sum_{j=1}^{n}(A_j)(F_{ij})(K_{ij})}$$

Where: T_{ij} = Trips distributed between zones i and j

P_i = Trips produced at zone i

A_j = Trips attracted to zone j

F_{ij} = Relative distribution rate (friction factors or impedance function) reflecting impedance between zone i and zone j

K_{ij} = Calibration parameter

n = Total number of zones in study area

6.2 Shortest Path Matrix

The TDM uses a travel time impedance matrix for each zonal pairing within the study area. This matrix traced the shortest free-flow travel time path from zone i (the start of the trip) to zone j (the end of the trip). These values are used in the calculation of F_{ij} as described in Section 6.1.

6.3 Friction Factors

Friction factors are another input used to calculate F_{ij}. This is the first relationship that was mentioned for the gravity model. These factors measure the probability of trip making at one-minute increments of travel time. Friction factors in the gravity model are an inverse function of travel time and each unique trip purpose has its own friction factors. This TDM effort uses the gamma function to derive the friction factors. Calibration of a gamma impedance function involves estimating the three parameters of the gamma function; a, b, and c. The gamma function parameter values used for each trip purpose are shown in Table 6.1.

Table 6.1: Gamma Function Friction Factors

Trip Purpose	a	b	c
HBO	9946343.527445	1.4219	0.1079
HBW	2,216.9405	-0.8434	0.1278
NHB	2,801,620.8184	1.2539	0.1023
CMVEH	1.0000	0.0000	0.0800
EIAUTO	5.8171	-2.1712	0.1281
TRK	1.0000	0.0000	0.1000
EITRK	1.0000	0.0000	0.0307

Source: NSI, 2019

6.4 Terminal Times

Terminal times reflect additional travel that is associated with a trip. These can be events such as parking or walking to vehicles and/or facilities. This factor was added to the beginning and end of each trip and is stored in a matrix used by the model. This value was derived from the previous TDM and adjusted as needed.

6.5 Trip Length Frequency Distribution

As mentioned previously, the gravity model develops friction factors in one minute increments and accommodates various trip lengths. The average trip lengths obtained from the model are displayed in Table 6.2. The average trip lengths that were estimated from the 2013 AirSage data are also displayed in Table 6.2. Figures 6.1 through 6.3 show the modeled trip length frequency distribution for HBW, HBO, and NHB trips. These curves were compared to those used in the AirSage data and determined to be within an acceptable level of consistency.

Table 6.2: Average Trip Length by Trip Purpose

Trip Purpose	2013 Model Average Trip Length (min)	2013 AirSage Average Trip Length (min)
HBO	10.7	11.4
HBW	16.5	15.7
NHB	11.6	11.6

Source: AirSage, 2013; NSI, 2019

Figure 6.1: Modeled HBW Trip Length Frequency Distribution

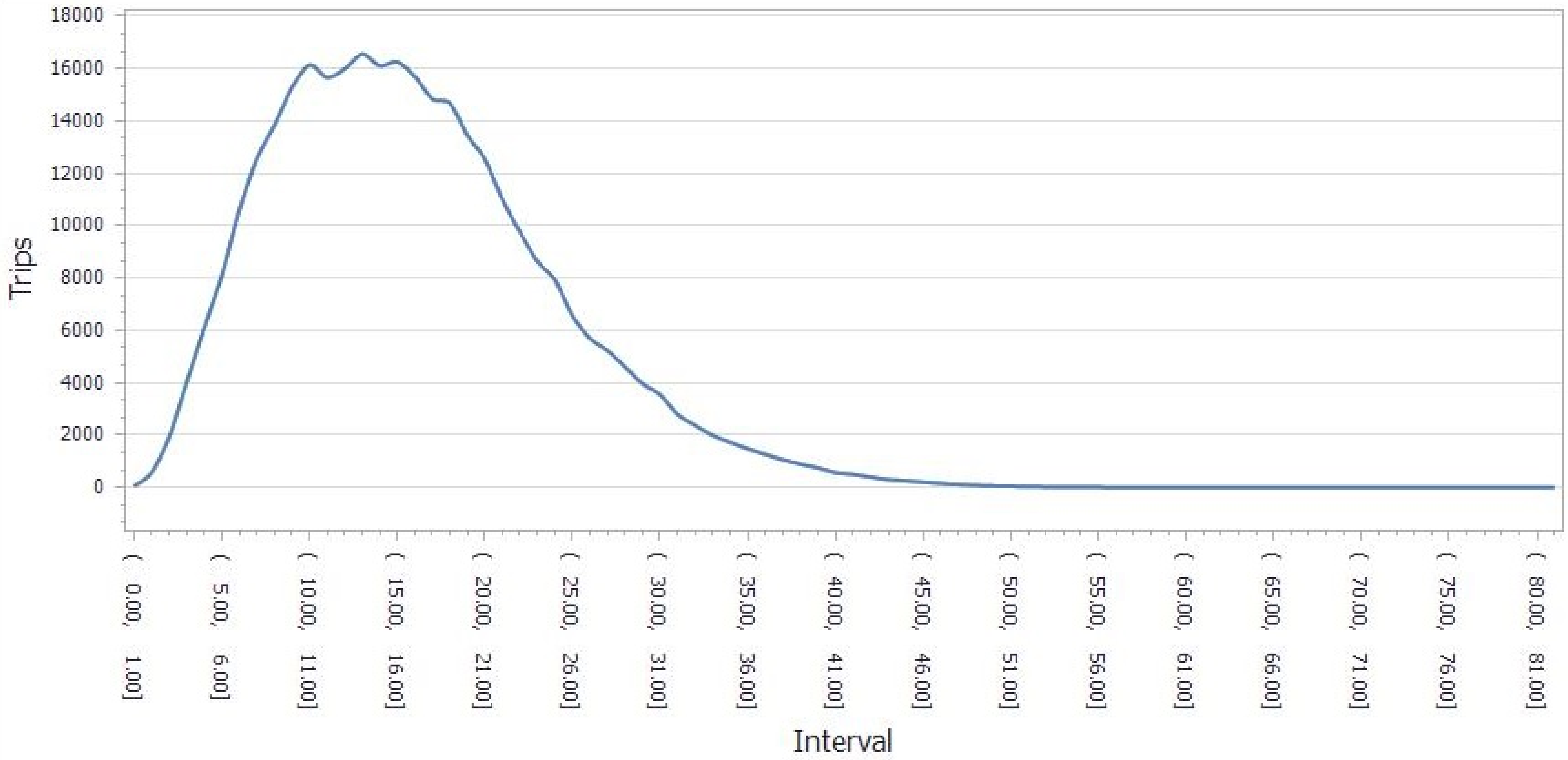


Figure 6.2: Modeled HBO Trip Length Frequency Distribution

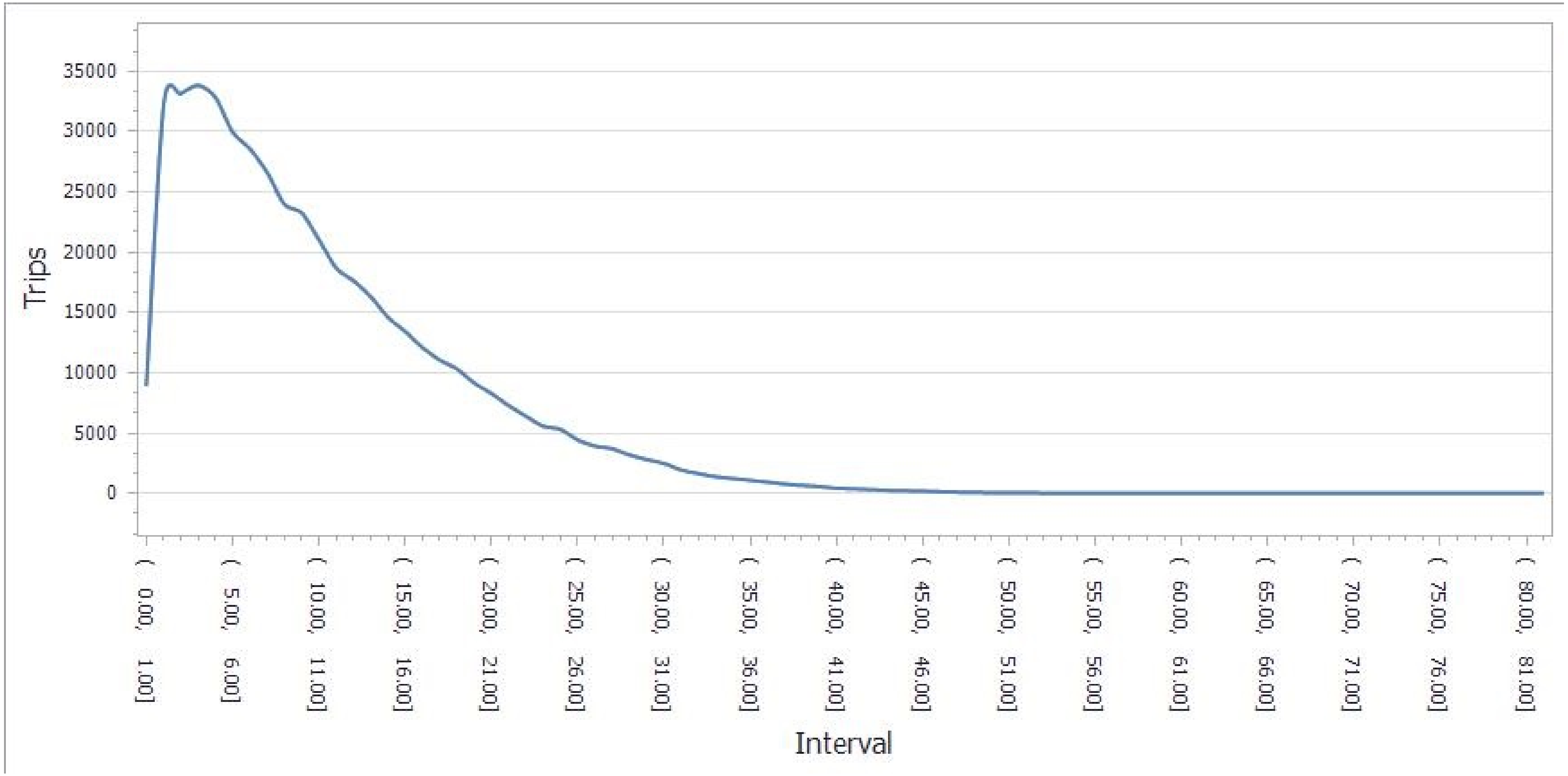
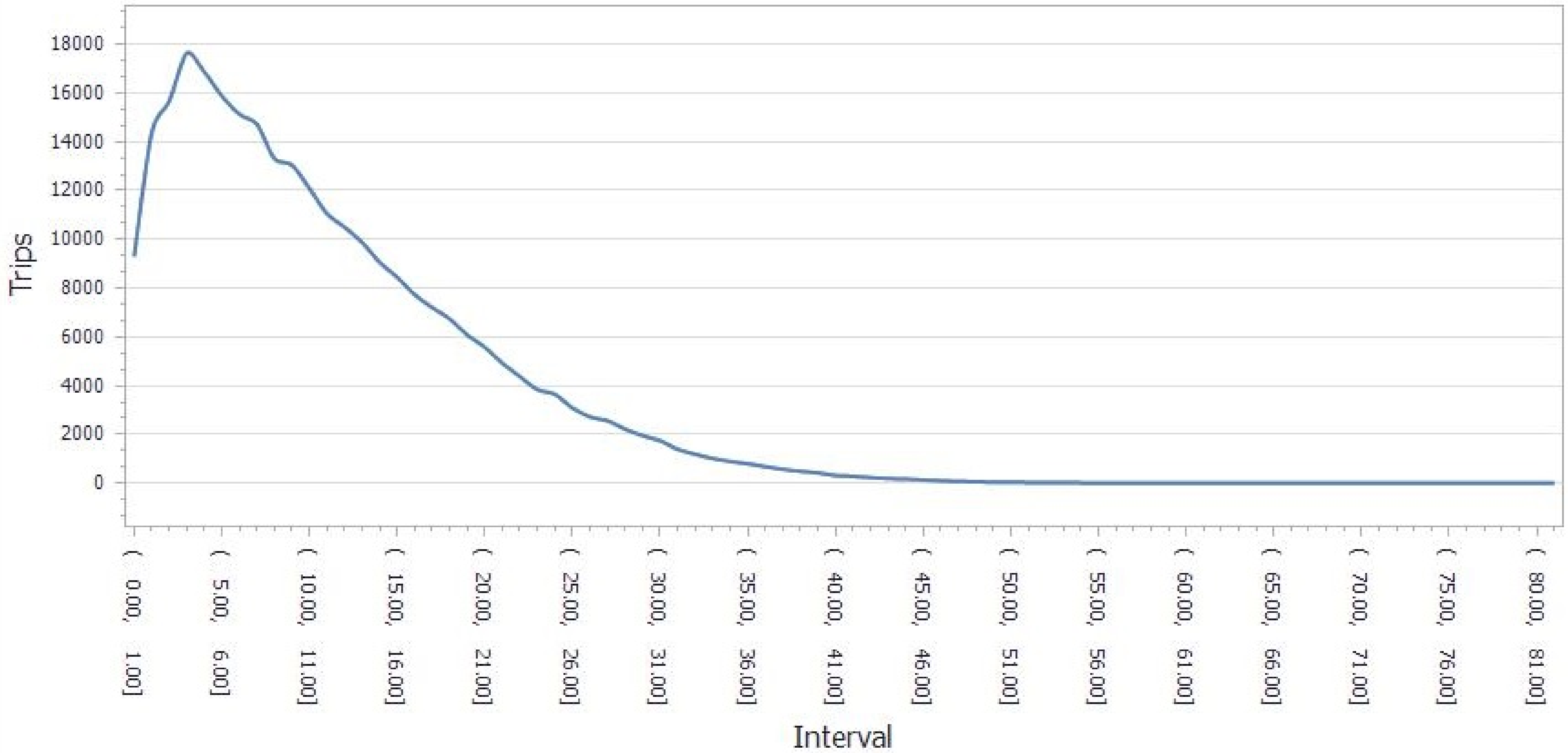


Figure 6.3: Modeled NHB Trip Length Frequency Distribution



6.6 Auto Occupancy Rates

The trip rates calculated in the Trip Generation step for HBW, HBO, and NHB trips are in person trips. In order for the TDM to assign vehicles to the roadway network, the amount of trips assigned must be in vehicle trips. This process is done using auto occupancy factors. It divides the amount of person trips by the corresponding occupancy factors shown in Table 6.3. These auto occupancy factors are the same as those used in the previous TDM effort.

Table 6.3: Model Auto Occupancy Factors

Trip Purpose	Auto Occupancy Factor
HBW	1.11
HBO	1.67
NHB	1.66
CMVEH	1.00
TRK	1.00

Source: NSI, 2019

7.0 Trip Assignment

Trip assignment is the final step in the traditional four step planning model.

Traffic assignment models are used to estimate the traffic flows on a network.

The main input to these models is a matrix of flows that indicate the volume of traffic between Origin-Destination (O-D) pairs. The other inputs to these models are network topology, link characteristics, and link performance functions.

The trips between each O-D pair are loaded onto the network based on the travel time or impedance of the alternative paths that could carry this traffic. The 2045 MTP model is a user equilibrium model with a generalized cost assignment that uses travel time as the cost.

7.1 BPR Volume-Delay Functions

The TDM link travel time was estimated by the Bureau of Public Roads (BPR) Volume-Delay function. The values that were used in the BPR formula are determined by facility type. The TDM uses the same alpha and beta values from the previous MTP effort, which are assigned by a roadway's functional classification. The assignment process used in the TDM analyzes link and intersection delay. As traffic volume increases on a roadway and approaches its maximum capacity, the average speed on the roadway declines. After a point, the roadway speed declines past that of the free flow speed and indicates congestion.

The generalized equation for the BPR formula is:

$$T = T_0 * (1 + \alpha * (\frac{v}{c})^{\beta})$$

Where: T = Congested travel time

T_0 = Free flow travel time

v = Assigned link volume

c = Capacity

α, β= BPR coefficients

This allows for the calculation of the roadway's peak hour travel:

$$\text{Peak Hour Travel Speed} = (\text{Free Flow Speed}) / (1 + \alpha * (\frac{v}{c})^{\beta}$$

The BPR coefficients used in the TDM are shown in Table 7.1.

Table 7.1: BPR Volume-Delay Function Parameters

Model Functional Classification	Alpha	Beta
Rural Interstate	0.71	2.10
Rural Principal Arterial	0.71	2.10
Rural Minor Arterial	0.71	2.10
Rural Major Collector	0.60	1.60
Rural Minor Collector	0.60	1.60
Rural Local	0.60	1.60
Rural Other	0.60	1.60
Rural On/Off Ramp	0.56	3.60
Urban Interstate	0.71	2.10
Urban Expressway	0.71	2.10
Urban Principal Arterial	0.71	2.10
Urban Minor Arterial	0.71	2.10
Urban Collector	0.60	1.60
Urban Local	0.60	1.60
Urban Other	0.60	1.60
Urban On/Off Ramp	0.56	3.60
System Ramp	0.71	2.10
Centroid Connector	0.15	4.00

Source: NSI, 2019

8.0 Model Validation

The purpose of model validation is to make the adjustments necessary to replicate the base-year traffic conditions as closely as possible.

In practice, this means making the link assignment volumes approximate the traffic estimates, based on actual counts, within acceptable limits of deviation. Generally speaking, the lower the volume, the greater the relative deviation that is acceptable. Conversely, the greater the amount of traffic, the greater the degree of accuracy required. This is because the ultimate purpose of the model is to determine whether additional vehicular capacity will be needed on any given roadway at a designated future date.

Where existing volumes are low, the model assignment may deviate from actual conditions by 40 or 50 percent without affecting the projected need for additional capacity. On the other hand, in the case of a heavily traveled interstate route, a deviation of 20 percent may be significant (i.e., alter the projection of required capacity). The validation process is intended to ensure that the model is performing within the limits that define acceptable ranges of deviation from observed "real-world" values.

As stated previously, this modeling effort uses the *Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee* and the *Travel Model Validation and Reasonableness Checking Manual, 2nd Edition,* as guidelines for the validation of TDMs.

The following criteria were used to validate the Jackson MPO TDM:

- Percent Root Mean Square Error (RMSE) by ADT Group
- Percent RMSE by Roadway Functional Classification
- Percent Error/Deviation by ADT Group
- Percent Error/Deviation by Functional Classification

8.1 Percent RMSE

The RMSE measure was chosen because when comparing model flows versus counts, sometimes a direct aggregate sum by link group can be misleading. The sum of all traffic counts for a particular link group may be close to the sum of the corresponding traffic flows, but individual link flows may still be very different than their corresponding link count. However, the RMSE statistic does not convey information about the magnitude of the error relative to that of the counts. Therefore, the Percent Root Mean Square Error (Percent RMSE or % RMSE) is often computed. This measure expresses the RMSE as a percentage of the average count value. The Percent RMSE is defined below:

$$\%RMSE = \frac{\sqrt{\sum_j (Model_j - Count_j)^2 / (Numberofcounts)}}{\left(\sum_j Count_j \Big/ Numberofcounts \right)} * 100$$

Validation results by ADT group and functional class are shown in Table 8.1 and Table 8.2 respectively.

Table 8.1: RMSE by ADT Group

ADT Range	Number of Observations	Total Count	Total Model Volume	% RMSE	% RMSE Limit[1]
ADT<5,000	582	1,370,260	1,463,729	59.1	45.0 - 100.0
5,000 <= ADT < 10,000	241	1,740,500	1,682,281	31.6	35.0 - 45.0
10,000 < =ADT < 15,000	142	1,683,000	1,700,867	21.7	27.0 - 35.0
15,000 < =ADT < 20,000	75	1,243,000	1,271,792	21.8	25.0 – 30.0
20,000 < =ADT < 30,000	85	2,018,000	1,995,790	20.0	15.0 – 27.0
30,000 < =ADT <50,000	43	1,622,000	1,606,453	10.8	15.0 – 25.0
ADT>=50,000	23	1,271,000	1,288,953	7.6	10.0 – 20.0
Areawide	1,191	10,947,760	11,009,866	27.0	35.0 – 45.0

Source: Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee; NSI, 2019

Table 8.2: RMSE by Functional Classification

Functional Classification	Number of Observations	Total Count	Total Model Volume	% RMSE	% RMSE Limit[1]
Interstate	342	4,454,020	4,574,817	22.6	20
Principal Arterial	282	4,032,480	4,084,464	22.3	30
Minor Arterial	231	1,496,390	1,456,004	29.7	40
Collector	306	924,760	855,028	48.0	70
Local	30	40,110	39,553	59.1	N/A
Areawide	1,191	10,947,760	11,009,866	27.0	35.0-45.0

Source: Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee; NSI, 2019

[1] % RMSE Limit is the maximum acceptable magnitude of the error relative to that of the counts conducted by MDOT

8.2 Percent Error

The next measure of model validation is the percent error, or percent deviation, of the model's assigned traffic volumes to the observed traffic counts. Tables 8.3 and 8.4 display the validation results by ADT group, ADT and lane group, and by facility category respectively.

Table 8.3: Percent Deviation by ADT Group

ADT Range	Number of Observations	Total Count	Total Model Volume	% Deviation	% Deviation Limit[1]
ADT<1,000	101	65,660	74,191	13.0	200.0
1,000 < =ADT < 2,500	211	361,000	403,122	11.7	100.0
2,500 <= ADT < 5,000	270	943,600	986,416	4.5	50.0
5,000 <= ADT < 10,000	241	1,740,500	1,682,281	-3.3	25.0
10,000 < =ADT <25,000	271	4,114,000	4,181,840	1.6	20.0
25,000 < =ADT < 50,000	74	2,452,000	2,393,062	-2.4	15.0
ADT>=50,000	23	1,271,000	1,288,953	1.4	10.0
Areawide	1,191	10,947,760	11,009,866	0.6	5.0

Source: Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee; NSI, 2019

Table 8.4: Percent Deviation by Functional Classification

Functional Classification	Number of Observations	Total Count	Total Model Volume	% Deviation	% Deviation Limit[1]
Interstate	342	4,454,020	4,574,817	2.7	+/- 7.0
Principal Arterial	282	4,032,480	4,084,464	1.3	+/- 15.0
Minor Arterial	231	1,496,390	1,456,004	-2.7	+/- 15.0
Collector	306	924,760	855,028	-7.5	+/- 25.0
Local	30	40,110	39,553	-1.4	N/A
Areawide	1,191	10,947,760	11,009,866	0.6	+/- 5.0

Source: Minimum Travel Demand Model Calibration and Validation Guidelines for State of Tennessee; NSI, 2019

[1] % Deviation Limit is the maximum acceptable magnitude of the error relative to that of the counts conducted by MDOT

With exception to Interstate RMSEs, caused by ramp volumes being difficult to match traffic counts, the validation effort concluded that the Jackson MPO study area travel demand forecasting model performs within the established limits of acceptable deviation from base-year estimated volumes.

9.0 Future Year Model Development

Future year models were developed to forecast traffic that the study area will experience based on its anticipated growth. This includes forecast socioeconomic data, external travel, and special generator data. Forecast models also require updates to the roadway network based on projects that are expected to occur or have allocated funding in the near future.

9.1 Future Year Socioeconomic Data Development

To adequately forecast future transportation system needs, future projections of demographic variables were developed for each Traffic Analysis Zone (TAZ).

Population and Employment Growth

County level population and employment control totals for the years 2025, 2035, and 2045 were derived using forecasts developed for the Mississippi 2045 Statewide Long Range Transportation Plan. These forecasts were based on historical trends, national projections, and stakeholder input and were validated against third-party projections. Areas in a county that are not included in the MPO study area were included in this analysis and then removed at the end.

After setting control totals for each county in the study area, growth was then sub-allocated to each TAZ in the travel demand model.

- First, growth that has occurred since the base year was added, based upon local and MPO staff knowledge of recent development (e.g. new Tire Plant, Costco, Waterton, redevelopment in downtown Jackson, and Reservoir lease developments)
- Then, MPO staff allocated the remaining growth through 2045, with an emphasis on expected major growth areas. This process considered the attractiveness of each TAZ for residential, commercial, and industrial development and its capacity for such development based on existing land development patterns and future land use regulations.

Figures 9.1 and 9.2 show the projected growth in population and employment by TAZ.

School Enrollment Growth

For public primary and secondary schools, enrollment growth was projected for each school based upon the projected population growth rates in its "attendance zone." Growth rates for each "attendance zone" were developed by assigning each TAZ to a school, based on proximity and school zone boundaries, and then calculating the population growth rate for these areas from 2013 to 2045. New/planned schools were also included as necessary.

For private primary and secondary schools and colleges/universities, student enrollment was assumed to grow one percent annually based on historical and recent trends.

Table 9.1: Population and Households by Year

Variable	2013	2025	2035	2045
Total Population	470,192	512,577	545,699	579,086
Household Population	453,911	496,296	529,418	562,805
Households	175,135	190,183	201,878	213,711

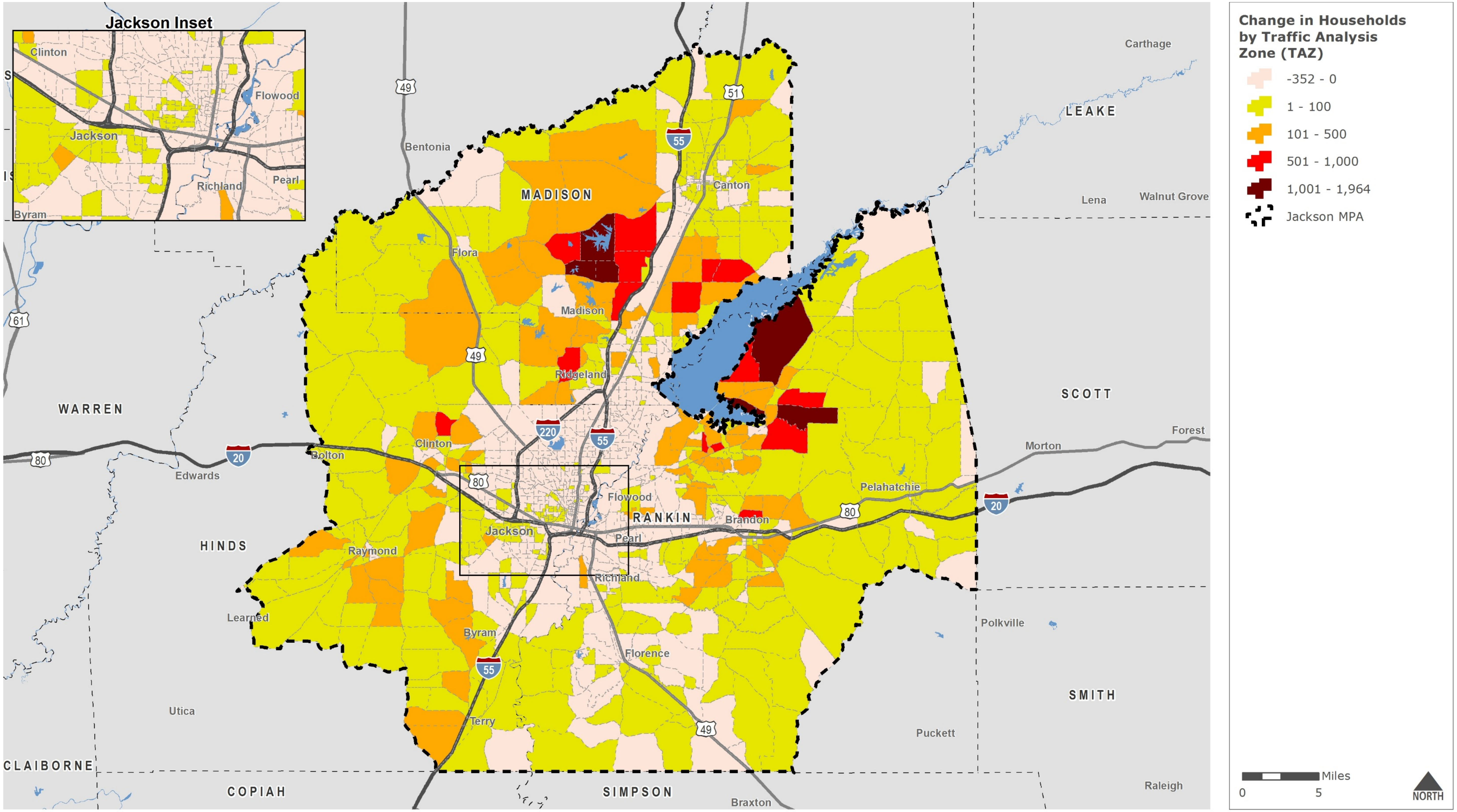
Source: NSI, 2019

Table 9.2: Employment by Year

Variable	2016	2025	2035	2045
TOT_EMP	290,666	320,033	344,760	368,071
AMC_EMP	15,951	17,489	18,819	20,140
MTCUW_EMP	31,442	37,676	43,593	48,103
RET_EMP	61,203	67,626	72,890	78,172
OS_EMP	176,942	191,488	203,154	214,823
OTH_EMP	5,128	5,754	6,304	6,833

Source: NSI, 2019

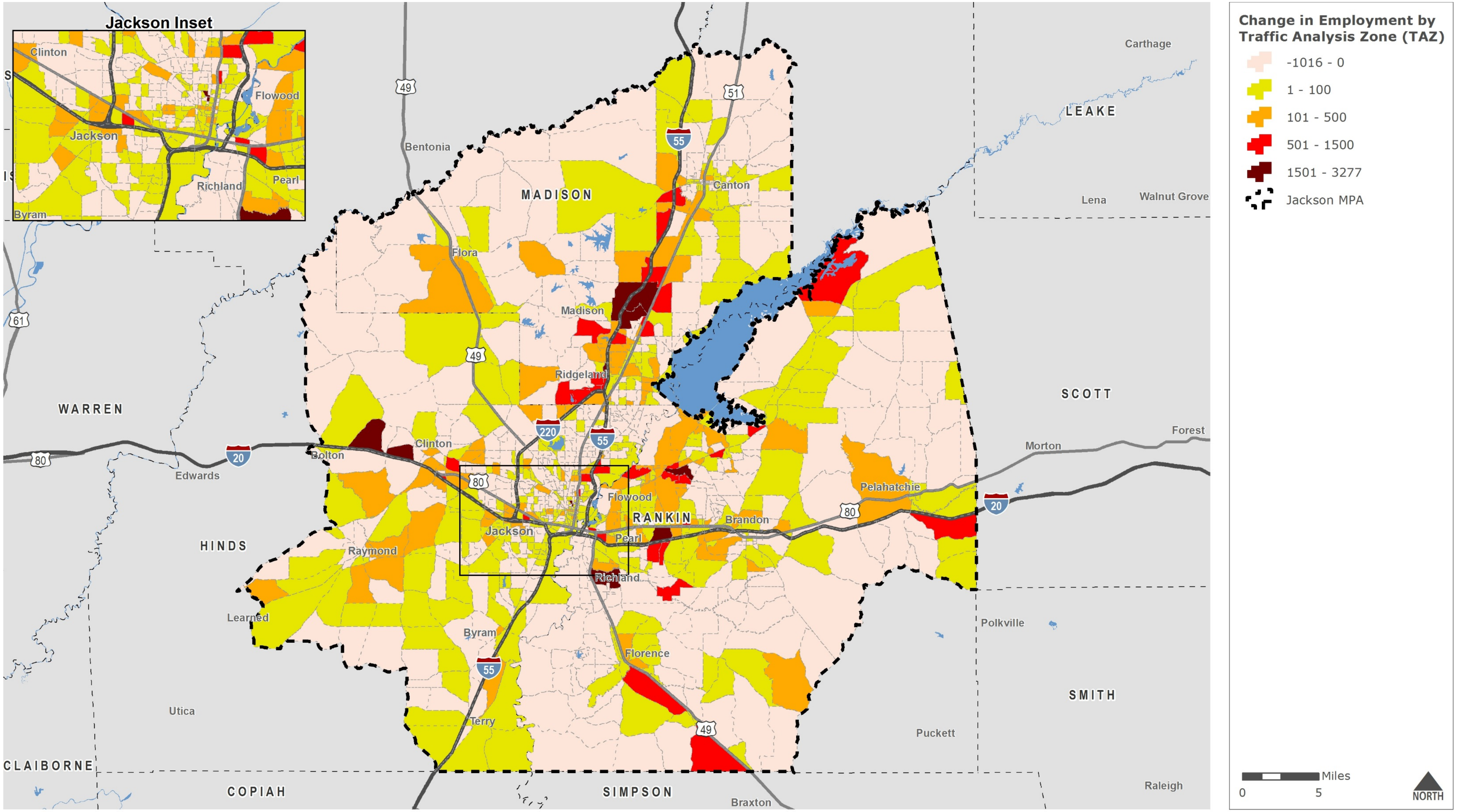
Figure 9.1: Household Growth, 2013-2045



Data Sources: Neel-Schaffer, Inc.

Disclaimer: This map is for planning purposes only.

Figure 9.2: Employment Growth, 2013-2045



Data Sources: Neel-Schaffer, Inc.

Disclaimer: This map is for planning purposes only.

9.2 Existing Plus Committed (E+C) Network

The base year network was defined as the street and highway system that existed in year 2013. Once the base year network was calibrated, the E+C network was developed which included committed projects.

Committed projects are those improvements for which:

- construction was either completed or begun since 2013,
- a contract for construction has been awarded,
- the National Environmental Policy Act (NEPA) phase has been completed, or
- funding for right-of-way and/or construction has been programmed in the MPO's Transportation Improvement Program.

Committed projects were added to the base network using the following procedure:

- New routes were coded with the proposed number of lanes, and with the posted speed and volume-delay function attributes that reflect the project's functional classification.
- Widened roadways change the number of lanes to the appropriate amount in each direction as well as the lane configuration field required by the network.
- All E+C projects were flagged in the 'PROJECT_VIS' field using a unique project ID.

The committed projects are listed in Table 9.3 and shown in Figure 9.3.

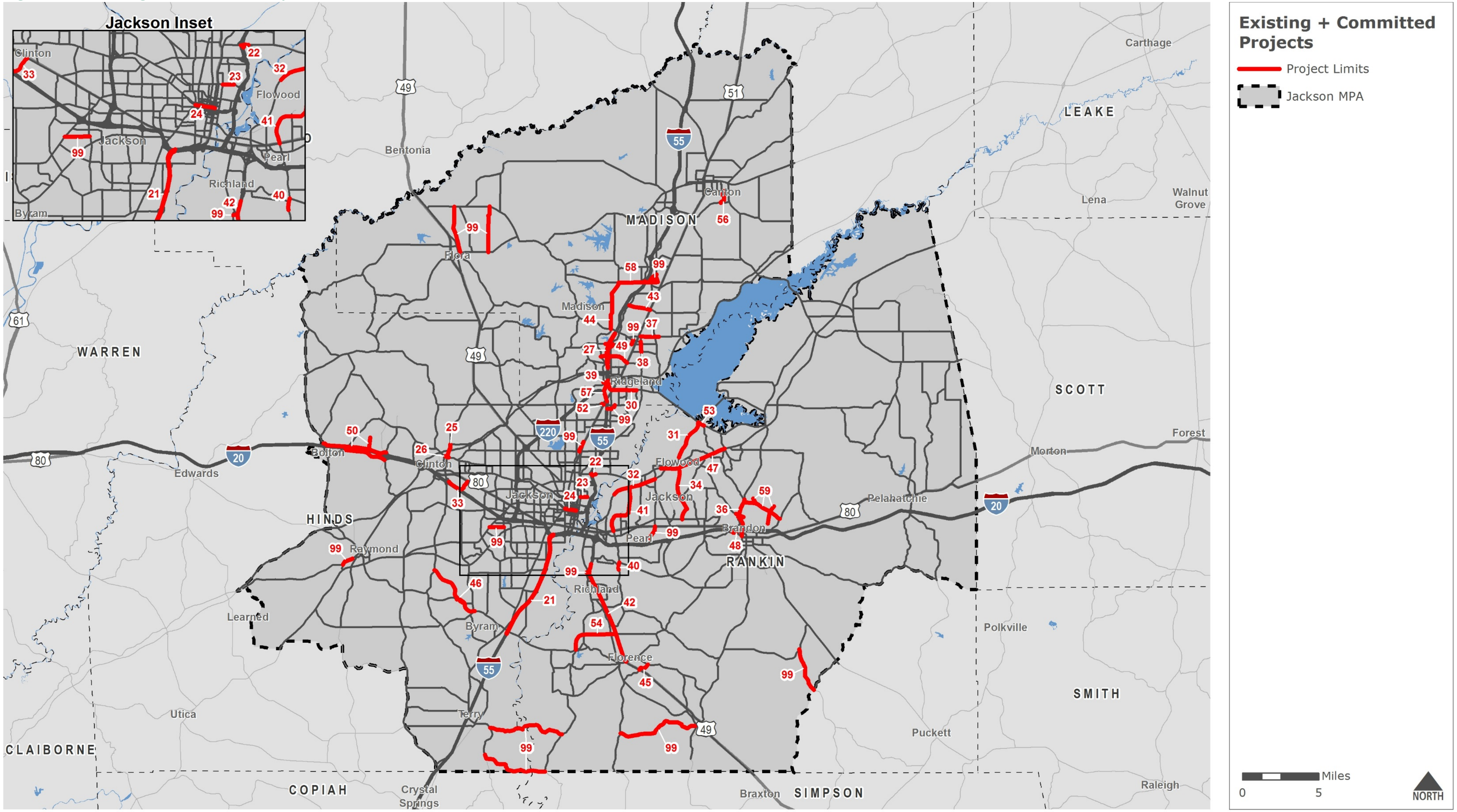
Table 9.3: Existing + Committed Projects

Project ID	Roadway	Location	Improvement
21	I-55	I-20 to Siwell rd	Widen to 6 Lanes
22	I-55	At Lakeland Dr	Intersection Improvements
23	E Fortification St	N Jefferson St to Greymont Ave	Reduce to 3 Lanes
24	E Capitol St	Gallatin St to State St	Convert to Two-way Operation
25	Pinehaven Dr	Northside Dr to Arrow Dr	Widen to 4 Lanes
26	Northside Dr	Pinehaven Dr to Huntcliff Way	Widen to 4 Lanes
27	I-55	Old Agency Rd To MS 463	Widen to 8 Lanes, New Intch, Svc Rds
28	I-55	At Gluckstadt Rd	Interchange Modification
29	Cotton Hill Rd	At Grandview Blvd/ Madison Ave	Realignment
30	Lake Harbour Dr	US 51 to Northpark Dr	Widen to 5 Lanes
31	Old Fannin Rd	Liberty Rd to Spillway Rd	Widen to 5 Lanes
32	MS 468	4th St in Flowood to MS 475	Widen to 4 Lanes
33	Hampstead Blvd	US 80 to Springridge Rd	New 3 Lane Road
34	E. Metro Corridor	MS 25 to Cooper Rd	New 4 Lane Road
35	E. Metro Corridor	Cooper Rd to Old Brandon Rd	New 4 Lane Road
36	MS 471	Grants Ferry Rd to US 80	Widen to 5 Lanes with realignment at RR crossing
37	Hoy Rd	Old Canton Rd to W. Bradford Lane	Widen to 5, 4, 3 Lanes
38	Old Canton Rd	Main St to St Augustine Dr	Widen to 3 Lanes
39	Lake Harbour Dr Extenstion	US 51 to Highland Colony Pkwy	New 5 Lane Road
40	Pearl/Richland Intermodal Connector	MS 468 to Richland Creek	New 4 Lane Road
41	MS. 477/West Rankin Pkwy	US 80 to Hwy 25	New 4 Lane Road
42	US 49	Florence to Scale Area	Widen to 6 Lanes
43	Reunion Pkwy Phase 3	Parkway East to US 51	New 2 Lane Road
44	Bozeman Rd	MS 463 to Gluckstadt Rd	Widen to 5 Lanes
45	Erlich Rd Ext	US 49 to Williams Rd	New 2 Lane Road
46	Byram-Clinton Corridor	Siwell Rd to Parks Rd	New 4 Lane Road
47	Lakeland Dr (MS 25)	MS 475 to Grants Ferry Rd	Widen to 6 Lanes
48	I-20 at US 80	US 80 Interchange at Brandon	Widen on/off ramps

Project ID	Roadway	Location	Improvement
49	Colony Park Blvd	Highland Colony Pkwy to US 51	New 4 Lane Roadway
50	I-20 at Norrell Rd	Norrell Rd	Interchange and Frontage Rd Improvements
52	W County Line Rd	McLaurin Rd to US 51	New 4 Lane road
53	Spillway Rd	Northshore Pkwy to Hugh Ward Blvd	Widen to 5 Lanes
54	Gunter Rd Ext	US 49 to Florence-Byram Rd	New 2 Lane road
55	Madison Ave	Grandview Blvd to US 51	Widen to 4 Lanes
56	Woodland Dr	E Dinkins St to Canton Pkwy	New 2 Lane road
57	I-55	County Line Rd On Ramp to Natchez Trace	Add 1 Lane Northbound
58	Gluckstadt Rd	Bozeman Rd to I-55	Widen to 4 Lanes
59	Grants Ferry Pkwy	MS 471 to Trickham Bridge Rd	New 2 Lane Roadway
98	EC Updates	Various Locations	Functional Class Changes from 2013 through 2018
99	EC Updates	I-20 to Siwell Rd	Functional Class Changes from 2018 through 2025

Source: Jackson MPO, MDOT

Figure 9.3: Existing + Committed Projects



Data Sources: Jackson MPO, MDOT

Disclaimer: This map is for planning purposes only.

9.3 External Station Growth

The base year traffic counts at each external station were projected to 2025, 2035, and 2045 using growth factors developed based on historic traffic counts at the external stations. Development of the growth rates used the following methodology:

- Developed an average annual growth rate using historical traffic counts from 2007 through 2013.
- If the calculated average annual growth rate is less than one (1) percent, then the growth rate for that station was set at one (1) percent.
- If the calculated average annual growth rate is more than three (3) percent, then the growth rate for that station was set at three (3) percent.
- If the calculated average annual growth rate is between one (1) percent and three (3) percent, then the calculated average annual growth rate was used with no changes.
- If it was determined that a growth rate was not expected to be sustained for a long period of time it was adjusted to a reasonable rate.

It should be noted that the vast majority of external stations within the study area grew at less than one (1) percent and so were adjusted to meet that threshold.

The final forecast growth rates for each external station and comparison of external travel forecast for the base year and target years is shown in Table 9.4.

The total traffic at each station was then divided into EI and EE trips with the assumption that there would not be a significant change in the distribution from the base year. In addition, both EI and EE forecast trips were also separated into auto and truck trips.

Table 9.4: External Station Forecast Growth

External Station	Forecast Growth Rate	2016 Volume	2026 Volume	2036 Volume	2045 Volume
1301	1.0%	11,000	12,395	13,692	15,124
1302	1.0%	3,000	3,377	3,727	4,114
1303	1.0%	21,000	23,663	26,139	28,874
1304	1.0%	820	924	1,021	1,127
1305	1.0%	1,500	1,690	1,867	2,062
1306	2.0%	4,600	5,824	7,089	8,629
1307	1.0%	860	969	1,070	1,182
1308	1.0%	5,400	6,085	6,721	7,425
1309	1.0%	1,500	1,690	1,867	2,062
1310	1.0%	2,200	2,479	2,738	3,025
1311	1.0%	22,000	24,790	27,384	30,249
1312	1.0%	770	868	958	1,059
1313	1.0%	4,500	5,071	5,601	6,187
1314	1.0%	21,000	23,663	26,139	28,874
1315	1.0%	1,100	1,240	1,369	1,512
1316	1.0%	27,000	30,424	33,607	37,123
1317	1.0%	3,400	3,831	4,232	4,675
1318	1.0%	340	383	423	467
1319	1.0%	30,000	33,805	37,341	41,248
1320	1.0%	830	935	1,033	1,141

Source: Jackson MPO; NSI, 2019

9.4 Future Year Model Runs

The TDM was used to forecast traffic for the future years using the E+C network and forecast socioeconomic, external station, and special generator data. Interpolation was used where necessary to obtain a future year scenario that occurred between the base year (2013), interim years (2025 and 2035), or the horizon year (2045). This feature was also used to conduct a 2018 model run for the purposes of the existing conditions (Technical Report 2) analysis.