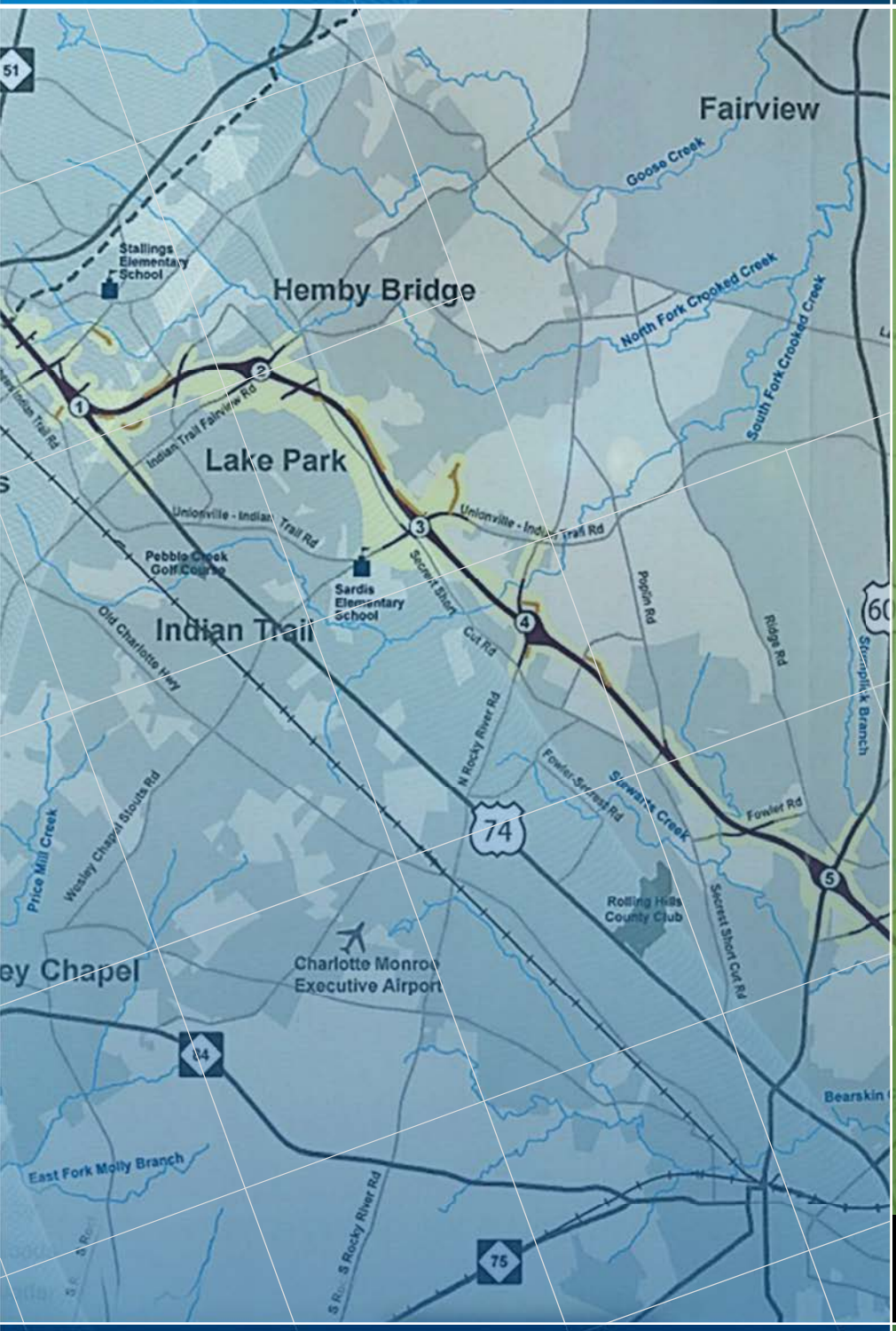
North Carolina
Monroe Expressway
Traffic and Toll Revenue Study
Final Report



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Prepared for

North Carolina
Department of Transportation

CDM Smith

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Chapter 1
Introduction

This report documents the methodology and findings of the Monroe Expressway Traffic and Revenue Study conducted for the North Carolina Department of Transportation (NCDOT) and the North Carolina Turnpike Authority (NCTA). The purpose of the study is to develop a forty-year annual traffic and toll revenue forecast for the proposed Monroe Expressway (the Project) from its assumed opening year (2019) through 2059. The traffic and toll revenue forecasts are suitable for use in support of bond financing.

1.1 General Project Description

The proposed Monroe Expressway, shown in **Figure 1.1**, will be a controlled-access toll road, roughly parallel with US 74, extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 19.7 miles.

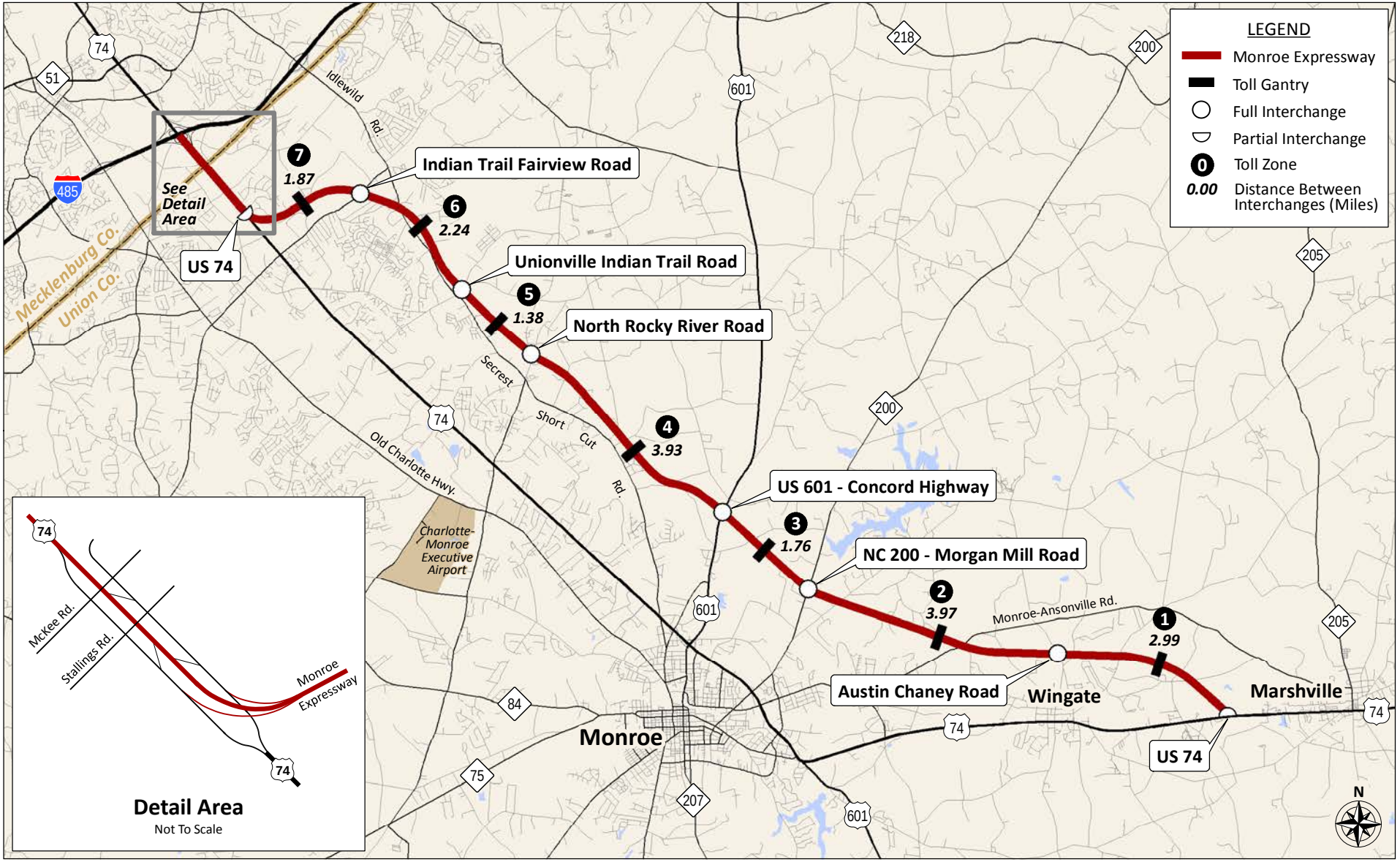
US 74 is a major east–west roadway that connects southeastern North Carolina, including the Port of Wilmington, to the Charlotte metropolitan area and points beyond. US 74 is a primary transportation corridor between Union County and Charlotte/Mecklenburg County. In addition, US 74 provides access to many retail, commercial and employment centers. Due to its important regional and local roles, US 74 traffic volumes have increased and traffic congestion occurs during weekday peak time periods. The Monroe Expressway would provide a high-speed alternative to US 74 for area motorists.

1.2 Project Alignment and Toll Concept

Figure 1.1 shows the general alignment of the proposed Monroe Expressway and the toll concept. The project alignment will follow the existing US 74 for approximately one mile from east of I-485 to the east side of Stallings Road (SR 1365) and continue on a new southeasterly alignment to the terminus with US 74 between the towns of Wingate and Marshville. The project is almost entirely contained in Union County, NC, although the westernmost portion is located in Mecklenburg County.

Six intermediate interchanges will be located at Indian Trail Fairview Road (SR 1520), Unionville Indian Trail Road (SR 1367), North Rocky River Road (SR 1514), US 601, NC 200 (Morgan Mill Road), and Austin Chaney Road (SR 1758). These will be full-access interchanges. Partial interchanges will be located between US 74 and the Monroe Expressway at the east and west termini of the tolled portion of the project. Additionally, access to and from Stallings Road and McKee Road will be available via frontage roads in the toll free portion of the project.

Tolls will be collected electronically via overhead mainline gantries using both electronic toll collection (ETC) and video toll collection (VTC). The NCTA VTC program is named Bill by Mail (BBM). Cash payments on the roadside will not be available. A gantry will be located on each mainline section at appropriate locations. Gantry locations shown in Figure 1.1 do not represent exact locations. There will not be any toll-free movements on the project from the western interchange with US 74 to the eastern interchange with US 74. Toll rates would be based on the distance covered on each mainline section. Each mainline section with a gantry is called a toll zone. The toll zones are numbered 1 through 7, and are depicted in Figure 1.1 along with the distance covered for each toll zone.



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PROJECT ALIGNMENT AND TOLL CONCEPT

FIGURE 1.1

The project includes an upgrading of US 74 for approximately one mile at the far western end, to a controlled-access roadway with one-way frontage roads. The inset box in Figure 1.1 shows the upgraded section of US 74, including the frontage road system and the partial interchange with the Monroe Expressway. There will not be any toll collection on the upgraded section of US 74 or the frontage roads. A detailed description of the project configuration is provided in Section 3.3.

1.3 Scope of Work

The scope of work for this study was designed to produce traffic and toll revenue forecasts suitable for bond financing. The study work scope is comprised of the following seven tasks:

- Task 1: Data Collection and Summarization
- Task 2: Corridor Growth Analysis
- Task 3: Model Refinement and Calibration
- Task 4: Traffic and Toll Revenue Analysis
- Task 5: Traffic and Toll Revenue Sensitivity Tests
- Task 6: Study Documentation and Coordination
- Task 7: Traffic and Revenue Sensitivity Tests

A brief description of these tasks is provided below.

Task 1: Data Collection and Summarization

Subtask 1.1: Traffic Counts

- CDM Smith obtained available traffic count data in the study area from the NCDOT.
- Seven-day vehicle classification counts were conducted at thirteen locations in the study area.

Subtask 1.2: Video License Plate Recognition

An automatic license plate recognition (ALPR) survey was conducted at 13 locations in the study corridor from 5:30 to 7:00 PM on a weekday in October 2015. Seven locations were on US 74, two locations were on Old Charlotte Highway, and three locations were on Secrest Short Cut Road. License plate images were obtained by video cameras in the westbound direction of travel. The survey was conducted to aid in identifying trip distances in the study area.

Subtask 1.3: Travel Time and Speed Data

- INRIX travel time data was obtained from RITIS.org for US 74 and other roadways in the study area.
- CDM Smith conducted independent travel time runs to validate the INRIX data.

Subtask 1.4: Transportation Improvements

Information on current and planned roadway improvements in the study area was collected from the NCDOT and various planning agencies.

Task 2: Corridor Growth Analysis

Economic growth forecasts are one of the most critical elements of any traffic and revenue forecast, particularly for a new toll facility such as the Monroe Expressway. For this study, an independent economist, Dr. Stephen J. Appold, was engaged to review the socioeconomic and land-use forecasts that are assumed in the travel demand model. The goal of this effort was to evaluate the reasonableness of the socioeconomic and land-use assumptions and make suggested adjustments where appropriate. Dr. Appold revised population and number-of-households in select traffic analysis zones (TAZs) in the study area. After a review of Dr. Appold's work, CDM Smith implemented the recommended changes by developing new trip tables based on the new socioeconomic data.

Task 3: Model Refinement and Calibration

CDM Smith obtained the most recent travel demand model, the Metrolina Regional Model 2015 version 1.1 (referred to as MRM or MRM15v1.1 in this report). This model is a key toll for evaluating future travel demand in the Charlotte/Mecklenburg County area. A review of the networks was conducted, including a review of the size of the TAZs in the study area for potential disaggregation and evaluating whether additional roads needed to be added to the networks.

The model was calibrated to base year 2015 conditions in the immediate project area. The traffic assignments were calibrated to collected traffic counts, travel speeds, and trip distance data. Calibration refinements were carried through to future-year assignments.

Task 4: Traffic and Toll Revenue Analysis

The refined model was used to run a series of traffic assignments. Each assignment was run for four time periods: AM Peak, Midday, PM Peak and Overnight. Toll sensitivity assignments were conducted at opening year (2019) and 2030 to determine optimum per-mile toll rates for the project. Optimum rates were developed for each future-year traffic and revenue assignment. The MRM15v1.1 supports model years 2015, 2025, 2030 and 2040. CDM Smith developed a 2019 trip table and network to reflect opening year conditions.

Future-year assignments were conducted with the selected toll rates to evaluate the traffic and toll revenue potential of the Monroe Expressway. Based on the traffic modeling analysis, annual estimates of traffic and toll revenue were developed for the base-case condition from 2019 through 2040. The forecasts beyond 2040 were developed by assuming a modest increase in traffic growth on the project.

Toll revenue estimates in the early years were adjusted downwards to reflect ramp-up; the pattern of gradual build-up in demand for a new road. Finally, estimates of toll revenue leakage were developed to reflect the loss of toll revenue associated with video tolling, such as unreadable license plates, unidentified vehicle owners, and account collection issues.

Task 5: Traffic and Toll Revenue Sensitivity Tests

A series of sensitivity tests were performed to identify how sensitive the base-case traffic and toll revenue estimates are to changes in specific variables. These variables include:

- Reduce economic growth by 30 percent,
- Reduce motorist values of time by 25 percent,
- Increased ETC market share,

- Increased motor fuel prices, and
- Reduced truck share.

Task 6: Documentation and Coordination

CDM Smith produced a series of technical memoranda to document key points in the study. These memoranda were submitted to the NCDOT/NCTA for review and comment prior to advancing to the next stage of the study. These technical memoranda included:

- ***Monroe Expressway – Data Collection***, dated December 18, 2015,
- ***Monroe Expressway – Independent Economic Review***, dated December 30, 2015,
- ***Monroe Expressway – Project Configuration and Modeling Inputs***, dated February 3, 2016, and
- ***Monroe Expressway – Toll Rate Assumptions***, dated March 10, 2016.

In addition, CDM Smith submitted Dr. Appold's report to the NCDOT. The report, titled ***Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Expressway,*** dated February 17, 2016, presented Dr. Appold's methodology and findings.

The documents just described are summarized in this report in corresponding chapters, as appropriate.

1.4 Report Structure

This report consists of seven chapters.

- Chapter 1: Introduction – contains the purpose of the study, a description of the project, and the structure of the report.
- Chapter 2: Existing Conditions and Data Collection – presents the data collection efforts and the traffic conditions in the immediate study corridor.
- Chapter 3: Network Refinement – summarizes changes made to the base year and future year networks.
- Chapter 4: Independent Economic Review – summarizes the socio-economic assumptions in the MRM, the review of the socio-economic data by the economist, and the revisions to the socio-economics based on the economist's recommendations.
- Chapter 5: Model Calibration - reviews the model calibration methodology. Provides data to illustrate the calibration in the study area.
- Chapter 6: Traffic and Toll Revenue Analysis – describes the modeling inputs and process, the toll sensitivity analysis, the traffic and gross toll revenue forecast for the Monroe Expressway, and the gross toll revenue forecast adjusted for revenue leakage and fee revenue.
- Chapter 7: Traffic and Revenue Sensitivity Tests – describes the results of the tests.

Chapter 2

Existing Conditions and Data Collection

This chapter summarizes the data collection efforts undertaken as part of this study, as well as the existing traffic and travel conditions they are meant to reflect. The following sections will discuss traffic volumes, travel speeds, and travel patterns in the project corridor. This data was used to aid in model calibration as well as for use in developing traffic and toll revenue annualization factors since the model reflects a typical weekday. In addition to the information provided in this chapter, a detailed Technical Memorandum titled ***NCDOT TIP R-3329/R-2559 Monroe Expressway – Data Collection*** was prepared and submitted to NCDOT in December 2015.

2.1 Data Collection Program

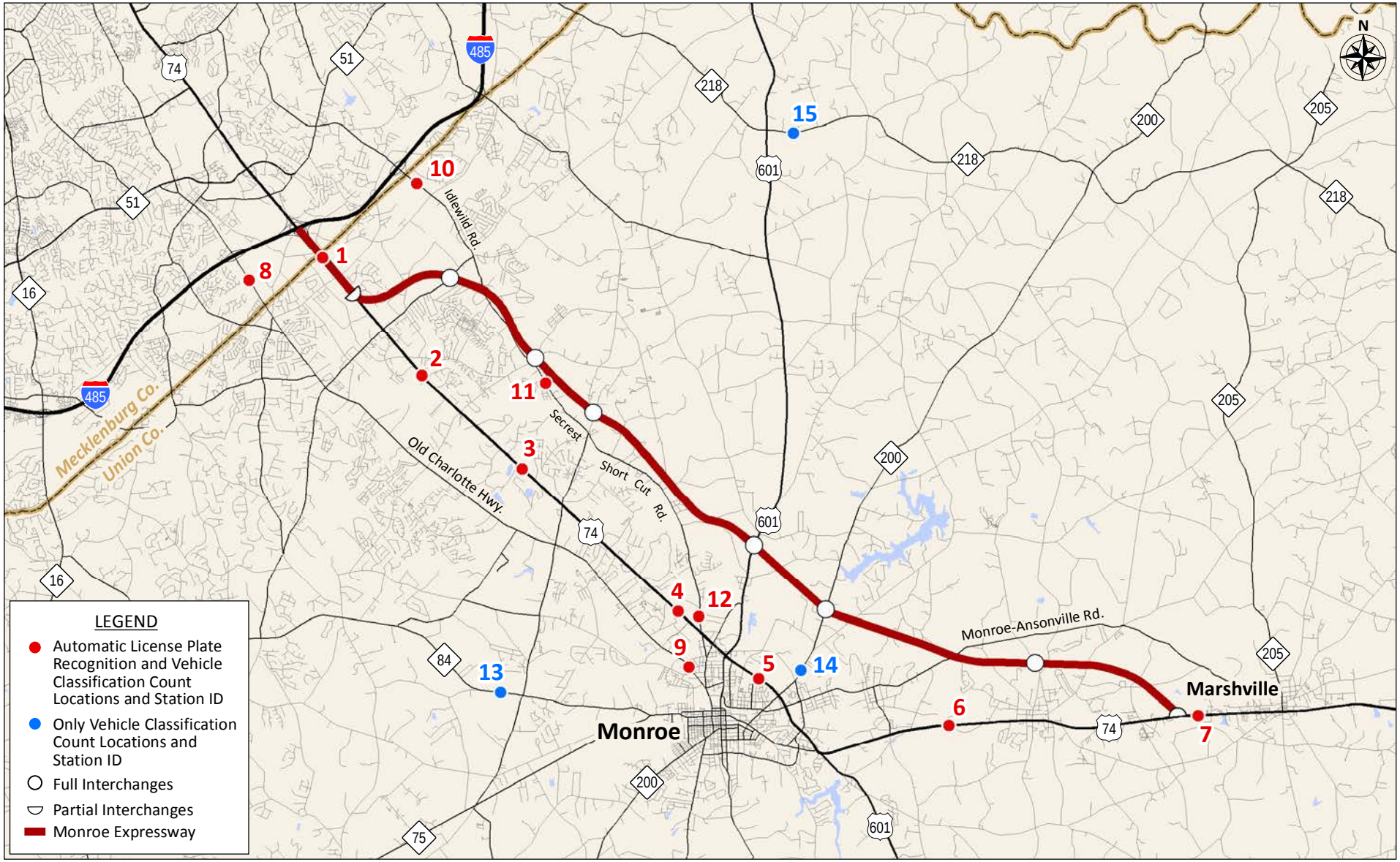
CDM Smith collected the following data for use in this traffic and toll revenue study:

- Available average annual daily traffic (AADT) counts were obtained from the NCDOT.
- Vehicle classification counts were conducted by The Traffic Group, a sub-consultant to CDM Smith, at 15 locations on US 74 and several other roads that are alternatives to US 74. The traffic counts were conducted at all the red and blue locations shown in **Figure 2.1**. Traffic counts were conducted in 15-minute increments by FHWA vehicle classifications for the 7-day period from October 22, 2015 through October 29, 2015. A description of the count locations is provided in **Table 2.1.**
- An automatic license plate recognition (ALPR) survey was conducted at 12 of the 15 traffic count locations. ALPR survey locations are shown in red on Figure 2.1. This effort consisted of recording license plate images by video camera and matching the plates across the survey locations to assist in determining car and truck trip lengths on US 74 between Wingate and I-485. These ALPR surveys were conducted from 5:30 AM to 7:00 PM on Thursday, October 22, 2015.
- INRIX travel times and speeds were obtained for roads in the study area.

The collected data are described in the following sections.

2.2 NCDOT Average Annual Daily Traffic Volumes

In addition to the traffic counts conducted as part of this study, CDM Smith collected and reviewed traffic counts provided by NCDOT. **Figure 2.2** shows the 2014 average annual daily traffic volumes at NCDOT count locations throughout the study region. As shown, the coverage area is quite extensive and includes multiple count locations along key competing and complementary routes to the proposed Monroe Expressway.



TRAFFIC COUNT AND AUTOMATIC LICENSE PLATE RECOGNITION SURVEY LOCATIONS

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FIGURE 2.1

Table 2.1
Locations for Automatic License Plate Recognition and Vehicle Classification Counts

Station ID (1)	Count Location	Data Collected Between These Crossroads	
		Crossroad 1	Crossroad 2
1	US 74	Independence Commerce Drive	Stallings Road
2	US 74	Indian Trail Fairview Road	Faith Church Road
3	US 74	Chamber Drive	Breckenridge Center Drive
4	US 74	Roland Drive	Secrest Short Cut Road
5	US 74	Miller Street	NC 200/Morgan Mill Road
6	US 74	S Bivens Road	Edgewood Drive
7	US 74	Forest Hills Road	N. Austin Street
8	Old Charlotte Highway	I-485	Morningwood Drive
9	North Charlotte Avenue	Dickerson Boulevard	Concord Ave
10	Idlewild Road	I-485	Stevens Mill Road
11	Secrest Short Cut Road	Unionville Indian Trail Road W	N Rocky River Road
12	Secrest Short Cut Road	Kim Court	Euclid Street
13	NC 84	Willoughby Road	Rocky River Road
14	NC 200	Creekridge Drive	N. Sutherland Avenue
15	NC 218	Price Tucker Road	US 601

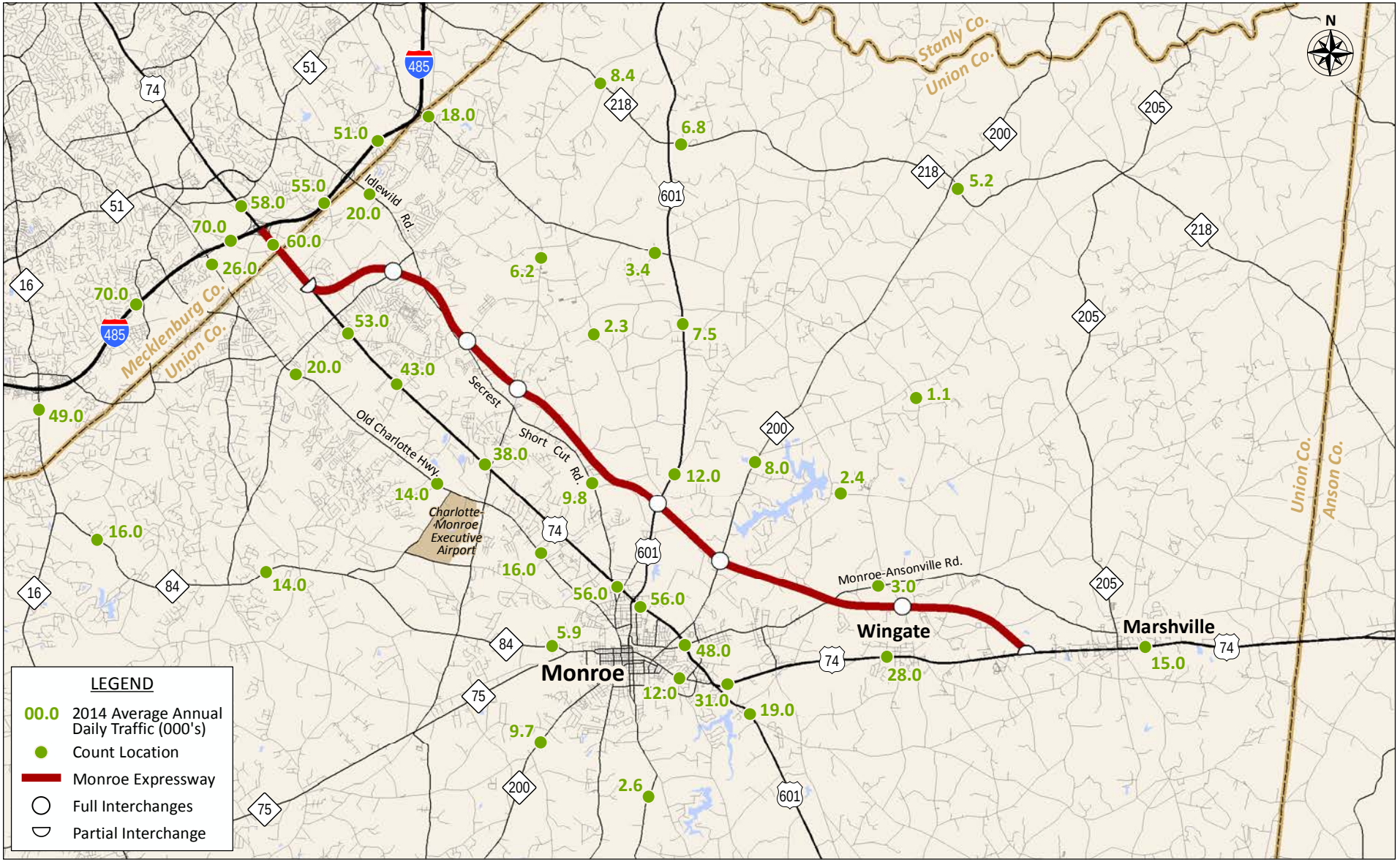
1) Seven-day vehicle classification counts were conducted at all locations. ALPR surveys were conducted at Stations 1 through 13.

AADT volumes on US 74 were about 15,000 just east of the eastern Project terminus, in the vicinity of Marshville. Volumes nearly doubled on US 74 just west of the eastern Project terminus, to about 28,000. Daily volumes then increase considerably (to between 48,000 and 56,000) in the vicinity of Monroe. Peak volumes were recorded just east of the interchange with I-485, where daily trips reach 60,000. Daily volumes along the secondary parallel route to the Project, Old Charlotte Highway, ranged from about 14,000 in the middle of the corridor, to a high of 26,000 just east of I-485. Idlewild Road/Secrest Short Cut Road, which largely follows much of the western alignment of the Monroe Expressway, had average daily traffic volumes that ranged from 9,800 to 20,000.

2.3 Summary of 7-Day Continuous Traffic Count Program

This section shares key information collected regarding daily and hourly traffic variations, as well as the mix of vehicles along key existing roads in the Project corridor.

Figure 2.3 presents both the 2015 average weekday and average weekend day traffic volumes and the Station ID at each of the 15 data collection points. At all locations, average weekday volumes were higher than average weekend day volumes. Along US 74 west of Monroe, average weekday volumes at count stations 1 through 4 were between 10.4 percent and 12.6 percent higher than weekend day volumes. Weekday volumes were relatively higher compared to weekend day volumes on US 74 at count stations 5 through 7 (in Monroe and between Monroe and Marshville). At these three locations, weekday volumes were 17.1 percent to 19.3 percent greater than weekend day volumes.



Source: NCDOT AADT Maps

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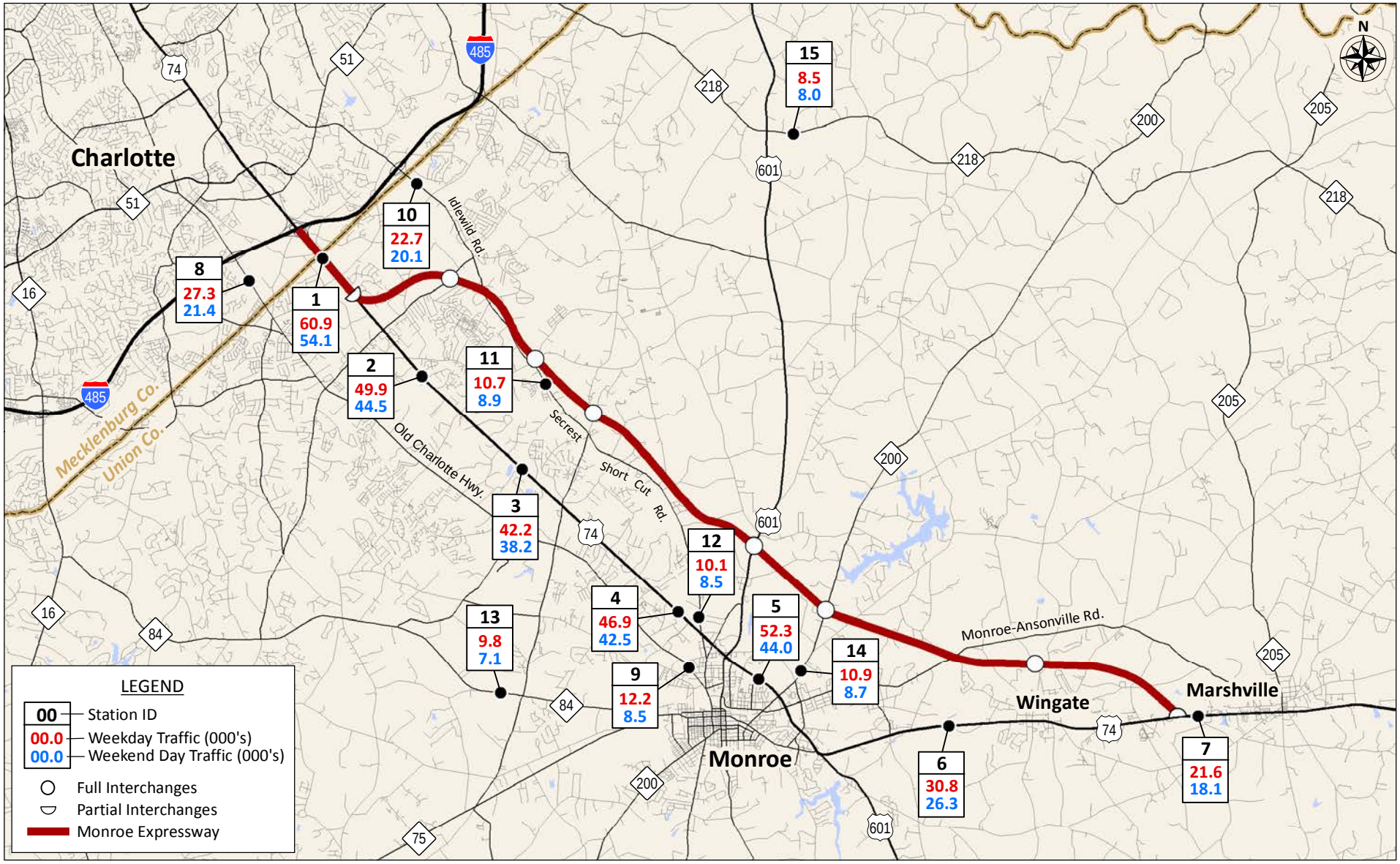
2014 AVERAGE ANNUAL DAILY TRAFFIC

FIGURE 2.2



Source: Counts conducted by The Traffic Group from October 22 through 29, 2015.

2015 AVERAGE ANNUAL WEEKDAY AND WEEKEND DAY TRAFFIC VOLUMES

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FIGURE 2.3

These relatively higher weekday volumes would suggest a larger weekday commuter component compared to the other locations.

Most of the other count stations in and around the Monroe area exhibited a relatively high weekday traffic component, ranging from 6.3 percent to 43.5 percent higher than weekend day volumes. Again, this would suggest a high commuter base of traffic on these roads.

Table 2.2 provides a detailed review of the distribution of average weekday traffic volumes by time period for each of the 15 count locations. The time periods used in Table 2.2 are the same four periods used in the Metrolina Regional Model. As shown, the distribution of traffic by time period was fairly consistent across all 15 count stations. The AM Peak period (3 hours) consisted of 15 to 21 percent of total weekday traffic. The Midday (6 hours) consisted of about 31 to 40 percent of total weekday traffic. The PM Peak period (3 hours) consisted of about 20 to 27 percent of total weekday traffic, and the Overnight period (12 hours) consisted of about 21 to 27 percent of total weekday traffic.

Table 2.2
Distribution of 2015 Average Annual Weekday Traffic by Time Period

Station ID	Route	Percent Distribution of Weekday Traffic				
		AM Peak 6:30-9:30 AM	Midday 9:30 AM-3:30 PM	PM Peak 3:30-6:30 PM	Overnight 6:30 PM-6:30 AM	Total Day
1	US 74	19.7 %	34.5 %	20.2 %	25.6 %	100.0 %
2	US 74	18.2	35.4	20.4	26.0	100.0
3	US 74	18.3	34.7	20.5	26.6	100.0
4	US 74	15.7	37.8	21.2	25.2	100.0
5	US 74	15.4	37.3	21.5	25.7	100.0
6	US 74	17.2	34.7	22.2	25.9	100.0
7	US 74	17.5	34.7	22.0	25.8	100.0
US 74 - Average		**17.5**	**35.7**	**21.0**	**25.8**	**100.0**
8	Old Charlotte Hwy	19.2	35.9	22.4	22.5	100.0
9	North Charlotte Avenue	15.7	39.8	23.3	21.2	100.0
Old Charlotte/N. Charlotte -Average		**18.1**	**37.1**	**22.7**	**22.1**	**100.0**
10	Idlewild Road	19.2	32.4	24.5	23.9	100.0
11	Secrest Short Cut Rd	18.8	32.2	26.0	23.0	100.0
12	Secrest Short Cut Rd	18.3	32.7	26.5	22.5	100.0
Idlewild/Secrest Road - Average		**18.9**	**32.4**	**25.3**	**23.4**	**100.0**
13	NC 84	21.4	31.4	25.6	21.6	100.0
14	NC 200	19.6	32.8	23.9	23.7	100.0
15	NC 218	18.7	33.6	25.6	22.1	100.0

Source: Based on traffic counts conducted by The Traffic Group from October 22 through 29, 2015.

Daily traffic variations are shown in **Table 2.3** for US 74 count stations. The table shows average daily traffic variations by day of week and by two-axle, three-or-more axle, and total vehicles.

Along US 74 (Table 2.3) Monday through Thursday total volumes tended to be relatively similar (all near an index of 1.0). In all cases, Sunday represented the lowest travel day of the week, with indices between 80 percent and 85 percent of the average day. Friday, on the other hand, was the highest travel day at all stations, with total volume indices ranging 7 to 19 percent greater than average daily volumes.

Table 2.3
2015 Daily Traffic Variations On US 74

Day of Week	Station 1 Traffic Volume	Station 1 Index	Station 2 Traffic Volume	Station 2 Index	Station 3 Traffic Volume	Station 3 Index	Station 4 Traffic Volume	Station 4 Index
Two-Axle Vehicles								
Sunday	46,664	0.85	39,007	0.88	33,734	0.90	36,672	0.87
Monday	56,260	1.03	45,722	1.03	38,356	1.02	42,474	1.00
Tuesday	52,629	0.96	42,563	0.96	36,621	0.97	40,678	0.96
Wednesday	55,489	1.01	44,098	0.99	36,919	0.98	40,765	0.96
Thursday	57,190	1.04	45,153	1.02	37,077	0.99	43,205	1.02
Friday	58,090	1.06	48,472	1.09	40,944	1.09	47,431	1.12
Saturday	57,563	1.05	46,264	1.04	39,514	1.05	45,386	1.07
Average Day	54,841	1.00	44,468	1.00	37,595	1.00	42,373	1.00
Average Weekday	55,932	1.02	45,202	1.02	37,983	1.01	42,911	1.01
Average Weekend Day	52,114	0.95	42,636	0.96	36,624	0.97	41,029	0.97
Three-or-More Axle Vehicles								
Sunday	1,535	0.37	1,487	0.38	1,236	0.36	1,175	0.36
Monday	5,140	1.25	4,828	1.24	4,229	1.22	3,836	1.17
Tuesday	5,062	1.23	4,721	1.21	4,204	1.21	3,924	1.20
Wednesday	5,030	1.23	4,687	1.20	4,219	1.22	4,012	1.22
Thursday	4,637	1.13	4,685	1.20	4,378	1.26	4,301	1.31
Friday	4,969	1.21	4,694	1.21	4,077	1.18	3,881	1.18
Saturday	2,342	0.57	2,161	0.55	1,909	0.55	1,801	0.55
Average Day	4,102	1.00	3,895	1.00	3,465	1.00	3,276	1.00
Average Weekday	4,968	1.21	4,723	1.21	4,221	1.22	3,991	1.22
Average Weekend Day	1,939	0.47	1,824	0.47	1,573	0.45	1,488	0.45
Total Vehicles								
Sunday	48,199	0.82	40,494	0.84	34,970	0.85	37,847	0.83
Monday	61,400	1.04	50,550	1.05	42,585	1.04	46,310	1.01
Tuesday	57,691	0.98	47,284	0.98	40,825	0.99	44,602	0.98
Wednesday	60,519	1.03	48,785	1.01	41,138	1.00	44,777	0.98
Thursday	61,827	1.05	49,838	1.03	41,455	1.01	47,506	1.04
Friday	63,059	1.07	53,166	1.10	45,021	1.10	51,312	1.12
Saturday	59,905	1.02	48,425	1.00	41,423	1.01	47,187	1.03
Average Day	58,943	1.00	48,363	1.00	41,060	1.00	45,649	1.00
Average Weekday	60,899	1.03	49,925	1.03	42,205	1.03	46,901	1.03
Average Weekend Day	54,052	0.92	44,460	0.92	38,197	0.93	42,517	0.93

Source: Based on traffic counts conducted by The Traffic Group from October 22 through 29, 2015.

Table 2.3 (Continued)
2015 Daily Traffic Variations On US 74

Day of Week	Station 5 Traffic Volume	Station 5 Index	Station 6 Traffic Volume	Station 6 Index	Station 7 Traffic Volume	Station 7 Index
Two-Axle Vehicles						
Sunday	38,878	0.82	22,992	0.84	16,540	0.90
Monday	48,178	1.02	27,343	1.00	18,531	1.01
Tuesday	44,656	0.95	25,456	0.93	17,090	0.93
Wednesday	45,198	0.96	27,125	0.99	17,468	0.95
Thursday	52,710	1.12	28,287	1.04	19,092	1.04
Friday	53,899	1.14	32,033	1.17	21,899	1.19
Saturday	46,675	0.99	27,926	1.02	17,921	0.98
Average Day	47,171	1.00	27,309	1.00	18,363	1.00
Average Weekday	48,928	1.04	28,049	1.03	18,816	1.02
Average Weekend Day	42,777	0.91	25,459	0.93	17,231	0.94
Three-or-More Axle Vehicles						
Sunday	1,043	0.38	684	0.31	694	0.31
Monday	3,292	1.19	2,676	1.20	2,657	1.17
Tuesday	2,816	1.02	2,687	1.20	2,878	1.27
Wednesday	2,877	1.04	2,875	1.29	2,888	1.28
Thursday	4,310	1.56	3,002	1.34	3,040	1.34
Friday	3,566	1.29	2,669	1.19	2,654	1.17
Saturday	1,387	0.50	1,057	0.47	1,041	0.46
Average Day	2,756	1.00	2,236	1.00	2,265	1.00
Average Weekday	3,372	1.22	2,782	1.24	2,823	1.25
Average Weekend Day	1,215	0.44	871	0.39	868	0.38
Total Vehicles						
Sunday	39,921	0.80	23,676	0.80	17,234	0.84
Monday	51,470	1.03	30,019	1.02	21,188	1.03
Tuesday	47,472	0.95	28,143	0.95	19,968	0.97
Wednesday	48,075	0.96	30,000	1.02	20,356	0.99
Thursday	57,020	1.14	31,289	1.06	22,132	1.07
Friday	57,465	1.15	34,702	1.17	24,553	1.19
Saturday	48,062	0.96	28,983	0.98	18,962	0.92
Average Day	49,926	1.00	29,545	1.00	20,628	1.00
Average Weekday	52,300	1.05	30,831	1.04	21,639	1.05
Average Weekend Day	43,992	0.88	26,330	0.89	18,098	0.88

Source: Based on traffic counts conducted by The Traffic Group from October 22 through 29, 2015.

Table 2.4
2015 Daily Traffic Variations On Alternative Roads

	Old Charlotte Hwy. and North Charlotte Ave.				Idlewild Rd. and Secrest Short Cut Rd.					
	Station 8		Station 9		Station 10		Station 11		Station 12	
Day of Week	Traffic Volume	Index	Traffic Volume	Index	Traffic Volume	Index	Traffic Volume	Index	Traffic Volume	Index
Two Axle Vehicles										
Sunday	18,948	0.75	7,151	0.65	18,223	0.84	7,988	0.80	7,572	0.80
Monday	26,386	1.05	11,547	1.05	21,574	1.00	10,113	1.01	9,606	1.01
Tuesday	25,407	1.01	11,307	1.03	20,594	0.95	9,533	0.95	9,168	0.97
Wednesday	26,220	1.04	11,546	1.05	21,448	0.99	10,014	1.00	9,477	1.00
Thursday	27,299	1.09	12,234	1.11	23,049	1.06	10,731	1.07	9,887	1.04
Friday	28,052	1.12	13,501	1.23	25,088	1.16	11,908	1.19	11,350	1.20
Saturday	23,547	0.94	9,767	0.89	21,797	1.01	9,643	0.97	9,282	0.98
Average Day	25,123	1.00	11,008	1.00	21,682	1.00	9,990	1.00	9,477	1.00
Average Weekday	26,673	1.06	12,027	1.09	22,351	1.03	10,460	1.05	9,898	1.04
Average Weekend Day	21,248	0.85	8,459	0.77	20,010	0.92	8,816	0.88	8,427	0.89
Three-or-More Axle Vehicles										
Sunday	72	0.14	23	0.18	76	0.27	38	0.17	35	0.20
Monday	796	1.53	154	1.20	372	1.32	322	1.45	295	1.68
Tuesday	554	1.07	135	1.05	288	1.02	219	0.99	174	0.99
Wednesday	508	0.98	151	1.18	223	0.79	227	1.02	165	0.94
Thursday	715	1.38	181	1.41	380	1.35	315	1.42	244	1.39
Friday	755	1.45	191	1.49	457	1.62	302	1.36	213	1.21
Saturday	242	0.47	64	0.50	181	0.64	130	0.59	104	0.59
Average Day	520	1.00	128	1.00	282	1.00	222	1.00	176	1.00
Average Weekday	666	1.28	162	1.27	344	1.22	277	1.25	218	1.24
Average Weekend Day	157	0.30	44	0.34	129	0.46	84	0.38	70	0.40
Total Vehicles										
Sunday	19,020	0.74	7,174	0.64	18,299	0.83	8,026	0.79	7,607	0.79
Monday	27,182	1.06	11,701	1.05	21,946	1.00	10,435	1.02	9,901	1.03
Tuesday	25,961	1.01	11,442	1.03	20,882	0.95	9,752	0.95	9,342	0.97
Wednesday	26,728	1.04	11,697	1.05	21,671	0.99	10,241	1.00	9,642	1.00
Thursday	28,014	1.09	12,415	1.11	23,429	1.07	11,046	1.08	10,131	1.05
Friday	28,807	1.12	13,692	1.23	25,545	1.16	12,210	1.20	11,563	1.20
Saturday	23,789	0.93	9,831	0.88	21,978	1.00	9,773	0.96	9,386	0.97
Average Day	25,643	1.00	11,136	1.00	21,964	1.00	10,212	1.00	9,653	1.00
Average Weekday	27,338	1.07	12,189	1.09	22,695	1.03	10,737	1.05	10,116	1.05
Average Weekend Day	21,405	0.83	8,503	0.76	20,139	0.92	8,900	0.87	8,497	0.88

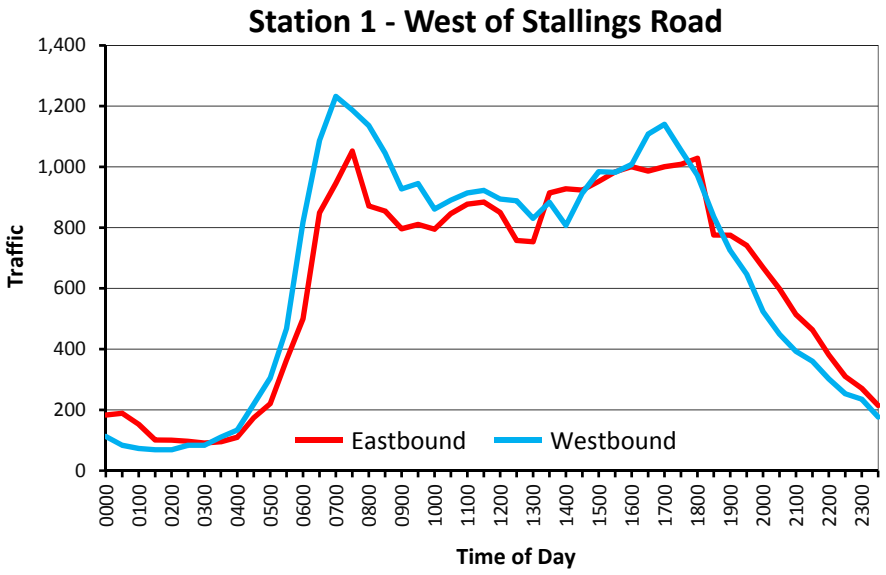
Source: Based on traffic counts conducted by The Traffic Group from October 22 through 29, 2015.

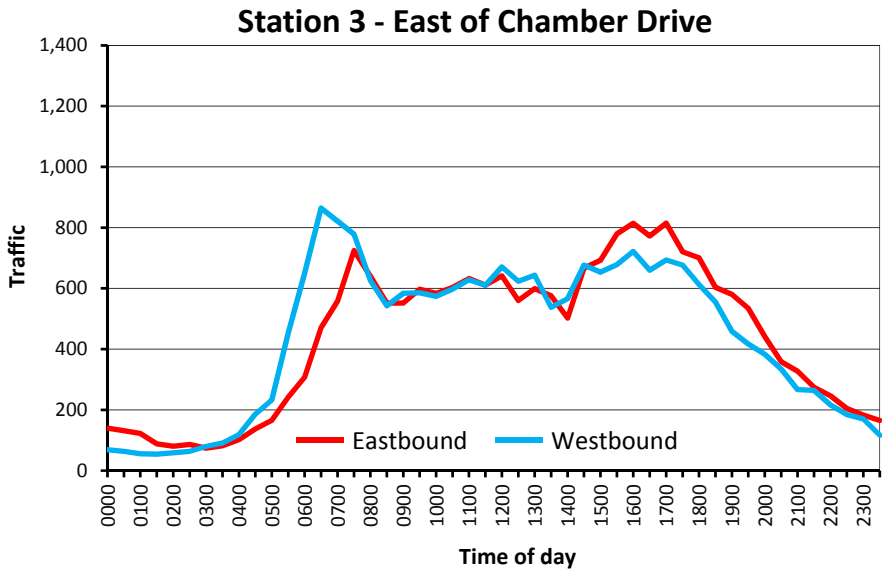
Passenger car traffic volumes on US 74 were quite consistent between average weekdays and average weekend days. Average weekday passenger car volumes ranged from 1 to 4 percent above the average daily volume, and average weekend volumes ranged from 3 to 9 percent below the average daily volume. As would be expected, commercial-vehicle travel was highly concentrated on weekdays. Commercial vehicle traffic on US 74 was 21 to 25 percent higher on a weekday compared to an average day. Weekend commercial vehicle volumes on US 74 were less than half that of average daily commercial traffic.

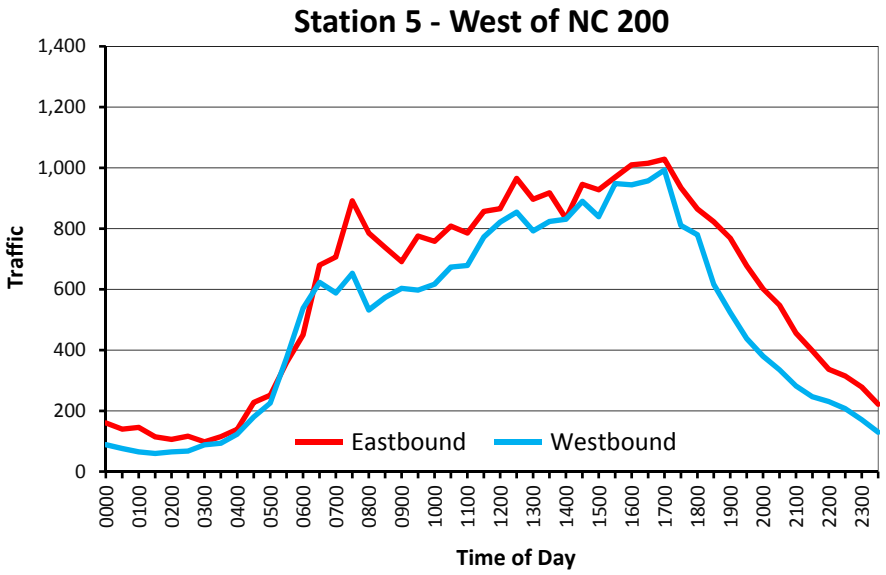
Daily traffic variations for two roads parallel to US 74 are presented in **Table 2.4.** These two roads, Old Charlotte Highway/North Charlotte Avenue and Idlewild Road/Secrest Short Cut Road share similar daily variations in traffic volumes. Passenger car volumes were consistently lowest on Sundays and highest on Fridays. Average weekday passenger car volumes ranged from 6 to 9 percent above the average day on Old Charlotte Highway/North Charlotte Avenue, and from 3 to 5 percent above the average day on Idlewild Road/Secrest Short Cut Road. Commercial vehicle traffic was highly concentrated on weekdays. Weekend commercial vehicle volumes were 30 to 46 percent of the average daily commercial volume, while average weekday volumes range from 22 to 28 percent above the average day.

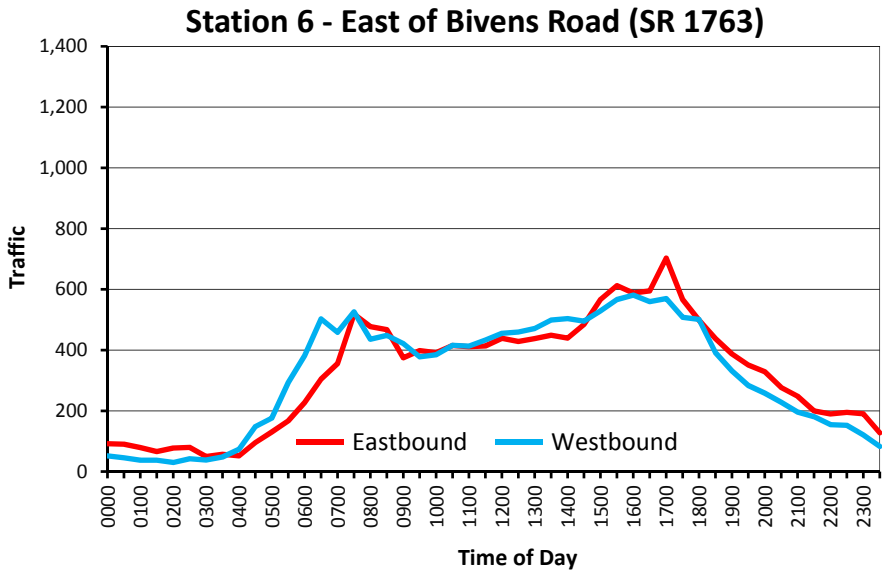
Weekday hourly traffic variations, by direction, are shown graphically for four count stations along US 74 in **Figure 2.4**. Stations 1 and 3 (both west of Monroe) exhibit clear morning and evening peaking characteristics. Stations 5 and 6 (in Monroe and east of Monroe) had a slight morning peak and a gradual building of traffic throughout the day, culminating in an evening peak. What is most noticeable is the similarity in traffic volumes in each hour for between the two travel directions. There are some divergences, but they are relatively small.

Figure 2.5 depicts weekday hourly variations for count stations along Old Charlotte Highway (Station 8) and North Charlotte Avenue (Station 9), and Idlewild Road (Station 10) and Secrest Short Cut Road (Station 12). Count Stations 8 and 10 are both at the far western end of the Project corridor, near I-485. Both exhibit very similar characteristics in that there is a pronounced westbound morning peak and a pronounced eastbound evening peak. At Station 12 on Secrest Short Cut Road, which is very close to downtown Monroe, the peaking directionality is reversed, with an eastbound morning peak and a westbound evening peak. At Station 9, on North Charlotte Highway in downtown Monroe, the hourly traffic profile is flatter, with a small peak in the morning hours and subsequently increasing volumes through the midday and into a small evening peak. Based on the traffic counts, the westbound traffic volumes were slightly higher for most of the day, including both the morning and evening peaks.









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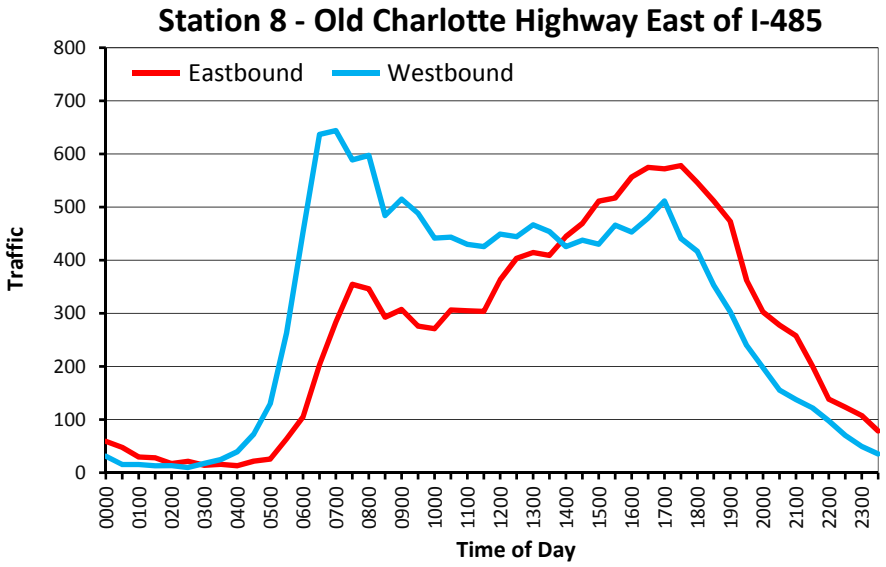
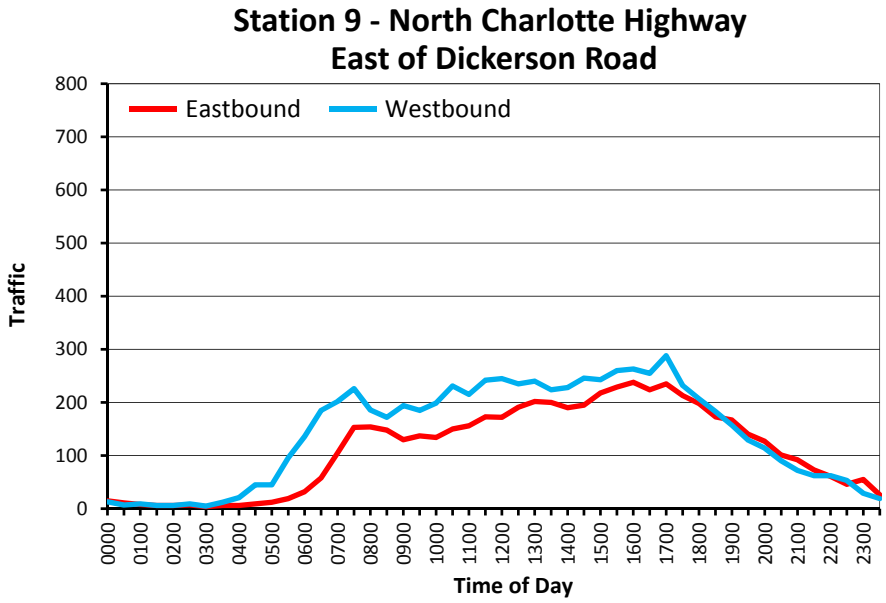
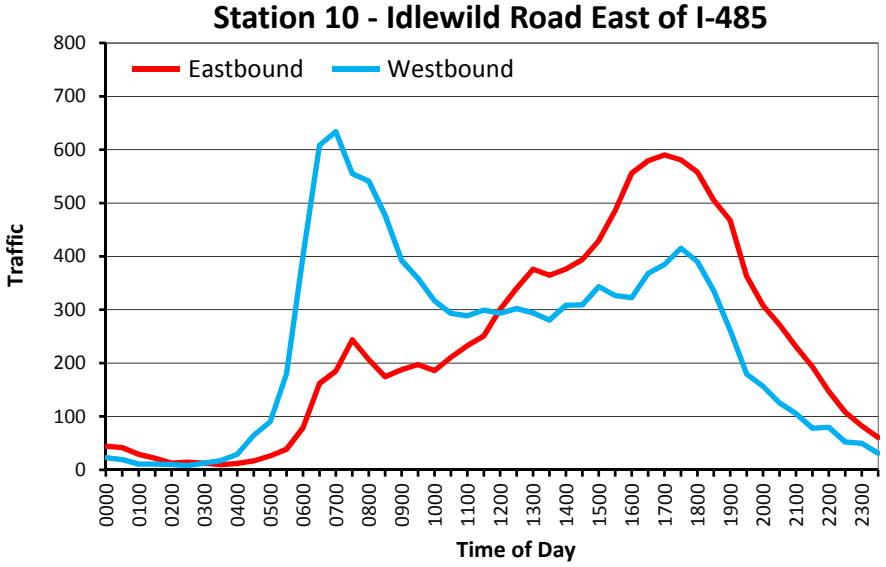
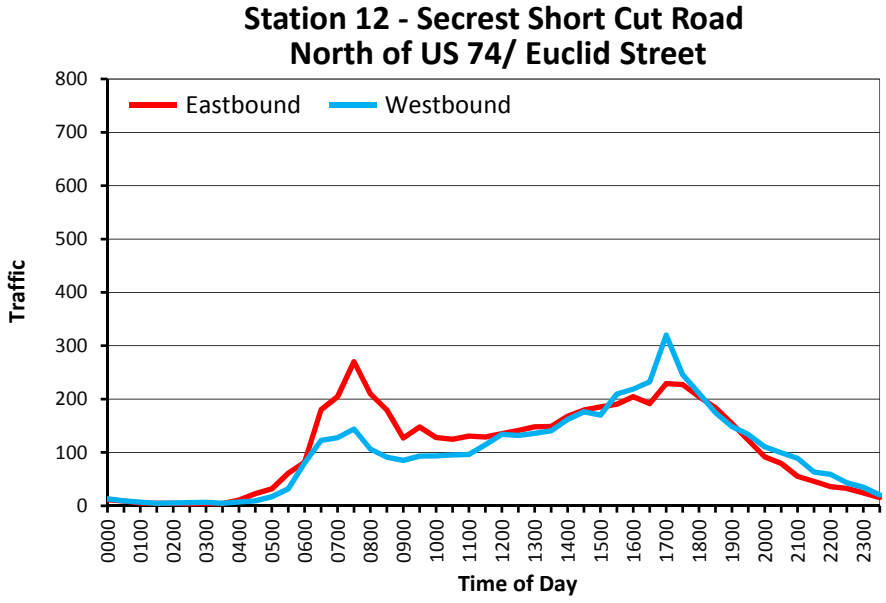
WEEKDAY HOURLY TRAFFIC VARIATIONS - US 74

FIGURE 2.4









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WEEKDAY HOURLY TRAFFIC VARIATIONS - ALTERNATIVE ROUTES

FIGURE 2.5

Table 2.5 provides information on the typical weekday vehicle-class composition at count stations on US 74, Old Charlotte Highway/North Charlotte Avenue, Idlewild Road/Secrest Short Cut Road, and NC 84, NC 200, and NC 218. Three vehicle categories (which align with the assumed toll class schedules) are provided; consisting of two axle, three axle, and four-or-more axle vehicles. Two axle vehicles comprised the vast majority of traffic at all count stations; ranging between 87.0 percent at Station 2 to 98.7 percent at Station 9.

Table 2.5
2015 Traffic Composition by Vehicle Class – Week Day

	Percent Vehicle Class Distribution By Axle Class				
Station	2 Axles	3 Axles	4-or-more Axles	Subtotal 3-or-more Axles	Total
			US 74		
1	91.8 %	1.9 %	6.2 %	8.2 %	100.0 %
2	90.5	1.6	7.8	9.5	100.0
3	90.0	2.0	8.0	10.0	100.0
4	91.5	1.6	6.9	8.5	100.0
5	93.6	1.4	5.0	6.4	100.0
6	91.0	1.5	7.5	9.0	100.0
7	87.0	2.0	11.0	13.0	100.0
			Old Charlotte Highway/North Charlotte Avenue		
8	97.6	0.8	1.6	2.4	100.0
9	98.7	0.7	0.6	1.3	100.0
			Idlewild Road/Secrest Short Cut Road		
10	98.5	0.5	1.0	1.5	100.0
11	97.4	1.1	1.5	2.6	100.0
12	97.8	0.9	1.2	2.2	100.0
			Other Roads (NC 84, NC 200, NC 218, respectively)		
13	97.5	1.5	1.0	2.5	100.0
14	94.9	2.2	2.9	5.1	100.0
15	91.4	1.7	6.9	8.6	100.0

Source: Based on traffic counts conducted by The Traffic Group from October 22 through 29, 2015.

Three axle vehicles were the smallest component of traffic at all locations; ranging from 0.5 percent at Station 11 to 2.2 percent at Station 14. Larger commercial vehicles (4-or-more axles) represented 5.0 to 11.0 percent of the traffic at US 74 count stations, and a much smaller proportion on Old Charlotte Highway/North Charlotte Avenue and Idlewild Road/Secrest Short Cut Road.

2.4 Travel Speed Summary

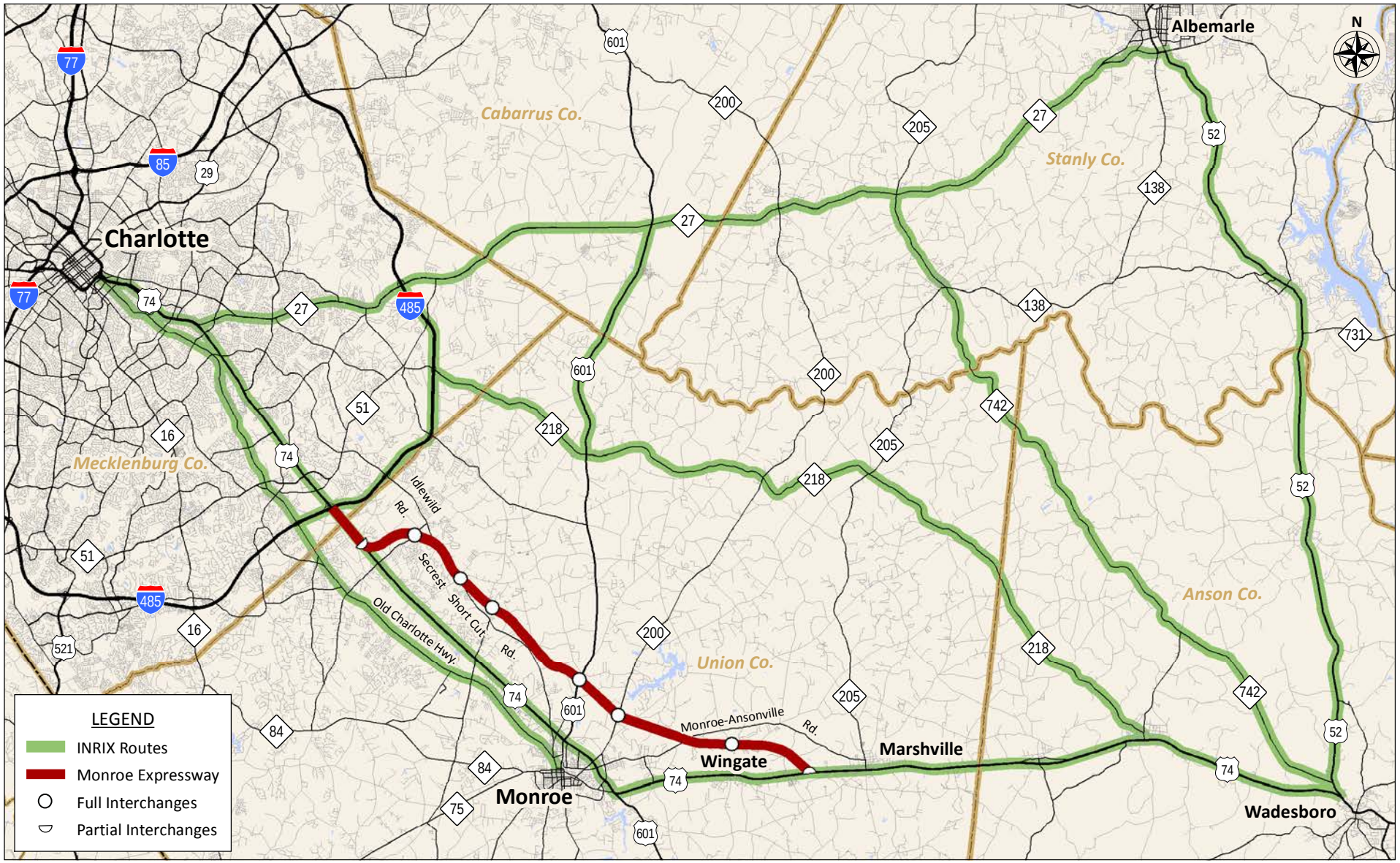
A key element of model validation, was verifying that the model output accurately reflected current travel speeds on competing and complementary routes to the Monroe Expressway by time period. Two sources of travel time information were utilized in the validation process. The primary data source was INRIX, while secondary travel time data was collected by CDM Smith staff in order to confirm the INRIX information. Summaries of data from both sources are provided in this section.

Figure 2.6 identifies all the roads for which INRIX data was available. One full year of weekday data (November 2014 through October 2015) was requested for the highlighted roads in this figure. All of the data was summarized by hour, direction, and roadway segment.

Table 2.6 shows the summarized average weekday INRIX travel speed data for US 74 between NC 205/Elm Street in Marshville and I-485 near Matthews. Establishing actual travel speeds, particularly on US 74 is important, as the majority of traffic on the Monroe Expressway would come from US 74. The Monroe Expressway in intended to provide reliable high-speed travel to longer distance trips as an alternative to US 74 which provides local access to area homes and businesses. Posted speed limits on US 74 between NC 205/Elm Street in Marshville and I-485 range from 35 to 55 mph.

The visual "heat map" in Table 2.6 depicts travel speed by direction and hour, for road segments provided by INRIX. Each box shows the average weekday travel speed for a particular hour. Variations in travel speed can occur within the hour. The boxes are color coded to represent average travel speeds in 10 mile-per-hour increments. In general, travel speeds are slower in the westbound direction compared to eastbound travel. In the westbound direction, travel speeds showed the most extended declines between East Franklin Street and NC 200/Morgan Mill Road beginning around 7:00 AM through 10:00 PM (hour 21). As shown, speeds in this section ranged from 18 to 29 mph. During the same time period, average travel speeds were slightly faster on the adjacent segment, from NC 200/Morgan Hill Road to US 601, when speeds averaged around 30 mph.

Operating speeds were a little faster in the eastbound direction. The segment between I-485 and Stallings Road is the only segment that experienced average speeds less than 20 mph during a typical weekday. This condition occurred between 4:00 PM and 6:00 PM. The East Franklin Street to US 601/Pageland Highway segment exhibited the longest time period of suboptimal travel speeds; operating at around 30 mph between 10:00 AM and 4:00 PM.



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AVAILABLE INRIX TRAVEL TIME DATA

FIGURE 2.6

Table 2.6
US 74 Weekday Travel Speeds from INRIX – Average from November 2014 through October 2015

Segment Name	Distance (mi)	Westbound Speed by Hour																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NC-205/Elm St.	8.54	55	55	56	56	56	56	55	55	55	55	55	55	55	56	55	55	56	56	56	56	55	55	56	56
US-601/Pageland Hwy.	0.12	48	48	48	48	48	48	47	46	46	46	47	46	46	47	46	46	45	46	46	47	47	47	48	48
E. Franklin St.	1.21	34	34	35	35	34	35	32	29	28	21	20	20	18	19	19	19	20	21	23	29	28	28	31	33
NC-200/Morgan Mill Rd.	1.02	38	38	38	39	38	38	34	30	30	30	30	29	28	29	29	29	28	28	30	32	33	33	35	36
US-601(Concord Hwy)/NC-200	0.35	43	44	44	44	45	44	43	43	42	39	39	37	35	37	37	36	35	36	38	42	41	39	41	42
US-601(Concord Hwy)/NC-200	1.58	46	46	46	46	47	47	47	47	47	46	45	45	43	44	44	45	45	44	46	46	45	44	45	46
Roland Dr.	6.86	40	41	41	41	41	42	40	38	36	35	33	30	27	28	30	31	32	32	32	34	35	33	37	39
Indian Trail Fairview Rd.	1.27	48	48	49	49	49	47	43	38	39	43	44	43	40	39	39	38	37	35	37	41	42	42	45	47
Stallings Rd.	0.75	49	49	50	50	50	49	41	24	23	37	45	45	43	43	44	42	40	33	34	38	42	43	46	48
I-485	0.76	51	51	52	52	52	52	48	44	43	47	49	49	48	48	48	48	48	45	45	43	46	47	48	50

Segment Name	Distance (mi)	Eastbound Speed by Hour																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NC-205/Elm St.	9.54	49	49	49	49	49	49	48	48	47	48	48	48	48	48	47	47	47	47	47	48	48	47	48	48
US-601/Pageland Hwy.	8.55	37	38	37	37	37	38	38	33	34	30	30	29	28	28	27	29	30	30	31	36	35	32	34	36
E. Franklin St.	0.11	39	40	39	40	39	39	36	31	31	33	34	33	32	32	32	31	31	31	32	34	35	34	37	38
NC-200/Morgan Mill Rd.	1.21	43	44	44	44	45	45	43	41	40	39	39	37	34	33	34	37	38	37	36	34	36	39	41	42
US-601(Concord Hwy)/NC-200	0.97	46	46	47	47	47	47	47	47	47	46	46	45	44	44	44	44	44	43	44	44	44	44	45	45
US-601(Concord Hwy)/NC-200	0.30	40	40	41	41	40	39	38	38	37	36	35	32	28	27	29	30	30	29	29	31	33	32	36	38
Roland Dr.	1.66	49	49	49	50	49	50	47	47	47	47	46	44	43	42	42	40	38	38	39	42	43	44	46	48
Indian Trail Fairview Rd.	6.86	49	50	51	52	51	50	48	43	42	42	42	40	39	39	40	36	33	31	32	34	42	43	46	48
Stallings Rd.	1.26	51	52	53	54	54	51	47	36	37	37	38	35	31	27	26	22	19	18	20	21	43	46	49	51
I-485	0.61	53	54	54	55	55	54	54	53	53	54	54	53	52	51	50	49	46	44	47	47	52	53	53	54

Legend
50.0 - 59.9 mph
40.0 - 49.9 mph
30.0 - 39.9 mph
20.0 - 29.9 mph
10.0 - 19.9 mph

CDM Smith performed a limited number of travel time runs to validate the reasonableness of the INRIX speed data. Travel time runs were conducted on US 74 and Old Charlotte Highway/North Charlotte Avenue on November 12, 2015. A summary of the travel time runs is provided in **Table 2.7.**

The INRIX travel speeds exceeded the travel time study speeds by about 4 to 11 percent on US 74 and about 4 to 10 percent on Old Charlotte Highway/North Charlotte Avenue. It was concluded that the INRIX data is an acceptable indicator of current travel speeds for this study. The percent differences in travel speeds between the two sources were generally below 10 percent. The differences are likely due to the greater number of INRIX data points that represent all months out of a year, compared to the limited number of travel time studies conducted by CDM Smith.

Table 2.7
Validation of INRIX Travel Times and Speeds

		Travel Time Studies (TTS) (1)			INRIX		Percent Difference INRIX to TTS	
Direction	**Period**	Number of Runs	Travel Time (2)	Speed (mph)	Travel Time (2)	Speed (mph)	Travel Time (2)	Speed (mph)
					US 74 (3)			
Westbound	AM	3	0:32:44	35.0	0:29:52	38.4	(8.8)	9.6
	MD	2	0:27:10	42.2	0:26:12	43.8	(3.6)	3.8
	PM	3	0:32:57	34.8	0:30:47	37.2	(6.6)	7.0
Eastbound	AM	3	0:27:39	41.7	0:26:51	42.9	(2.9)	3.0
	MD	2	0:30:41	37.6	0:28:29	40.4	(7.1)	7.7
	PM	2	0:34:35	33.3	0:31:14	36.9	(9.7)	10.7
					Old Charlotte Highway/North Charlotte Avenue (4)			
Westbound	AM	2	0:30:07	24.5	0:27:54	26.4	(7.3)	7.9
	MD							
	PM	2	0:25:20	29.1	0:24:21	30.3	(3.9)	4.1
Eastbound	AM	2	0:24:57	29.6	0:22:40	32.6	(9.1)	10.1
	MD							
	PM	2	0:26:46	27.6	0:25:46	28.6	(3.8)	3.9

1) Travel time runs conducted by CDM Smith
2) Travel time in minutes and seconds
3) Travel time between I-485 and Forest Hills Road in Marshville, NC
4) Travel time between I-485 and W. Cromwell Street in Monroe, NC

2.5 License Plate Surveys

Automatic license plate recognition surveys were conducted at 12 locations within the study corridor from 5:30 AM to 7:00 PM on October 22, 2015. These locations are shown in Figure 2.1. The purpose of the study was to gather data on trip lengths, particularly on US 74, and compare the collected trip-length data to estimated trip lengths in the Metrolina Model. This data is beneficial to calibrating the model because motorists currently on US 74 would be much more likely to use the Monroe Expressway for longer distance trips compared to very short trips.

License plate images were collected in the westbound direction only. License plate images were processed using optical character recognition software, followed by a manual image review to ensure accuracy. Vehicle classification for each record was assigned during the manual image review process and was limited to distinguishing between passenger cars (FHWA Classes 1-5) and commercial vehicles (FHWA Classes 6-13).

Table 2.8 presents the number of successfully captured license plate images at each location by time of day and vehicle class. Successfully captured license plate images are also presented as a percent of passing traffic during the survey period. Several instances of capture rates in excess of 100 percent are shown for commercial vehicles. This is likely due to incorrect vehicle classification of a small proportion of commercial vehicles in the manual image review process. The key point is that the sample size is very large. For US 74 locations, the successful identification rate of passenger car plates ranged from 81 to 94 of passing traffic on a total day. The successful identification of commercial vehicle trips on US 74 ranged from 67 to 94 percent on a total day.

Captured license-plate images were matched across survey stations and checked for reasonableness based on logical movements and travel time to identify unique trips. The results of the ALPR survey for trips on US 74 are summarized in **Table 2.9** for a weekday AM period, PM period and total day, for passenger cars and commercial vehicles. All movements reflect westbound trips along US 74. The station where a plate was first identified (the origin) is shown in the left column, while the last station where the same plate was identified (the destination) is shown across the top. The percent distribution of trips from each origin station are unique, thus, the sum of each row adds up to 100 percent. Each row describes movements that are identified as a percentage of the trips that started at a station and traveled far enough to be captured at a downstream station.

For example, for passenger cars in the AM time period, 4 percent of trips with an origin at Station 7 went as far as Station 3 (but did not reach Station 2), another 4 percent had a destination that went as far as Station 2 (but did not reach Station 1), and 17 percent had a destination that went as far as Station 1, or beyond. Any trip that was captured at Station 7, but did not also pass through Stations 6, 5, 4, 3, 2, or 1, would not be represented in this table.

Commercial trucks exhibited a higher percentage of long distance trips than passenger cars. On a total day basis, 39 percent of trips first identified at Station 7 continued through Station 1, compared to 19 percent for passenger cars, and 58 percent of commercial vehicles that entered at Station 5 continued through Station 1 compared to 34 percent of passenger cars.

It is important to recognize that these are not complete trip tables, as US 74 is not a limited access roadway. The number of access points are numerous, and this data set represents snapshots of specific locations, chosen to fall between major intersecting roads with US 74. However, the data was useful for comparing against trip-distance distributions in the Metrolina Model. Adjustments were made to the MRM's trip table to adjust for the observed trip distances.

Table 2.8
License Plate Capture Rate as a Percentage of Passing Traffic

Survey Station	Total Day: (5:30 AM - 7:00 PM)						AM Period (7:00 AM - 10:00 AM)						PM Period (3:00 PM - 7:00 PM)					
	Passenger Cars			Commercial Vehicles			Passenger Cars			Commercial Vehicles			Passenger Cars			Commercial Vehicles		
	Passing Traffic	Captured License Plates	Percent Capture Rate	Passing Traffic	Captured License Plates	Percent Capture Rate	Passing Traffic	Captured License Plates	Percent Capture Rate	Passing Traffic	Captured License Plates	Percent Capture Rate	Passing Traffic	Captured License Plates	Percent Capture Rate	Passing Traffic	Captured License Plates	Percent Capture Rate
1	25,293	23,792	94%	1,661	1,469	88%	6,516	5,176	79%	306	327	107%	7,790	7,554	97%	430	399	93%
2	18,335	16,035	87%	1,536	1,380	90%	4,100	3,063	75%	278	295	106%	5,966	5,600	94%	400	369	92%
3	15,411	14,251	92%	1,333	1,081	81%	3,536	3,195	90%	273	192	70%	4,979	4,620	93%	346	310	90%
4	18,357	17,009	93%	1,342	1,051	78%	3,390	2,891	85%	276	216	78%	6,074	5,739	94%	319	273	86%
5	22,216	18,098	81%	1,238	1,162	94%	4,074	3,082	76%	224	232	104%	7,352	6,373	87%	320	282	88%
6	11,773	9,984	85%	942	682	72%	2,313	2,003	87%	164	125	76%	4,108	3,286	80%	289	168	58%
7	8,084	7,389	91%	965	651	67%	1,668	1,545	93%	175	142	81%	2,814	2,466	88%	277	155	56%
8	11,066	9,017	81%	273	204	75%	3,115	2,165	70%	48	36	75%	3,553	1,932	54%	66	45	68%
9	5,819	4,899	84%	54	72	133%	1,097	924	84%	10	11	110%	1,957	1,794	92%	18	21	117%
10	10,274	8,976	87%	138	98	71%	2,778	2,187	79%	37	13	35%	2,976	2,845	96%	31	22	71%
11	4,582	3,983	87%	115	71	62%	903	733	81%	29	17	59%	1,692	1,496	88%	29	13	45%
12	4,364	3,249	74%	87	40	46%	1,054	472	45%	11	3	27%	1,545	1,476	96%	25	14	56%

Source: Automatic License Plate Recognition conducted by The Traffic Group on Thursday, October 22, 2015.

Table 2.9
Results of Vehicle License Plate Recognition Survey
Based on Westbound Trips on Thursday, October 22, 2015

Passenger Cars

AM Time Period (7:00 AM - 10:00 AM)

Origin Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	60%	40%					
	4	44%	24%	32%				
	5	32%	16%	20%	32%			
	6	20%	10%	11%	18%	42%		
	7	17%	4%	4%	9%	17%	50%	

PM Time Period (3:00 PM - 7:00 PM)

Origin Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	60%	40%					
	4	48%	26%	26%				
	5	37%	14%	10%	40%			
	6	20%	8%	6%	19%	47%		
	7	23%	5%	3%	7%	21%	42%	

Total Day Time Period (5:30 AM - 7:00 PM)

Origin Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	62%	38%					
	4	47%	26%	27%				
	5	34%	13%	13%	40%			
	6	20%	8%	7%	21%	45%		
	7	19%	4%	3%	11%	20%	44%	

Commercial Vehicles

AM Time Period (7:00 AM - 10:00 AM)

First Identified At This Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	89%	11%					
	4	52%	22%	26%				
	5	71%	8%	14%	7%			
	6	42%	16%	0%	11%	32%		
	7	46%	4%	10%	7%	8%	24%	

PM Time Period (3:00 PM - 7:00 PM)

First Identified At This Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	69%	31%					
	4	61%	22%	16%				
	5	62%	11%	9%	19%			
	6	27%	0%	15%	27%	31%		
	7	43%	6%	7%	6%	11%	26%	

Total Day Time Period (5:30 AM - 7:00 PM)

First Identified At This Station		Destination Station 1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	77%	23%					
	4	58%	21%	21%				
	5	58%	11%	11%	19%			
	6	26%	11%	6%	27%	30%		
	7	39%	6%	8%	14%	11%	23%	

Source: ALPR conducted by The Traffic group on October 22, 2015.

Chapter 3
Network Refinement

CDM Smith obtained the latest regional transportation demand model from the Charlotte Department of Transportation (CDOT). This section describes the model, the review of the model network, and subsequent refinements to the network in the study area.

3.1 The Metrolina Regional Model

The Metrolina Regional Model is the primary modeling tool for evaluating existing and future travel demand in the greater Charlotte area. The current model is in TransCAD and is designated the Metrolina Regional Travel Demand Model 2015 Version 1.1 (MRM15v1.1 or MRM). It covers a twelve county, bi-state region. In North Carolina, all of Cabarrus, Cleveland, Gaston, Lincoln, Mecklenburg, Rowan, Stanly and Union Counties are included, as well as the portion of Iredell County from the Mecklenburg County line northward to the Yadkin River, and the southeast corner of Catawba County. The model area also includes the entirety of York County, SC and the northern panhandle of Lancaster County, SC. The area encompassed by the MRM15v1.1 boundaries can be seen in **Figure 3.1**. The detailed study area is shaded in green. The proposed Monroe Expressway is shown in red.

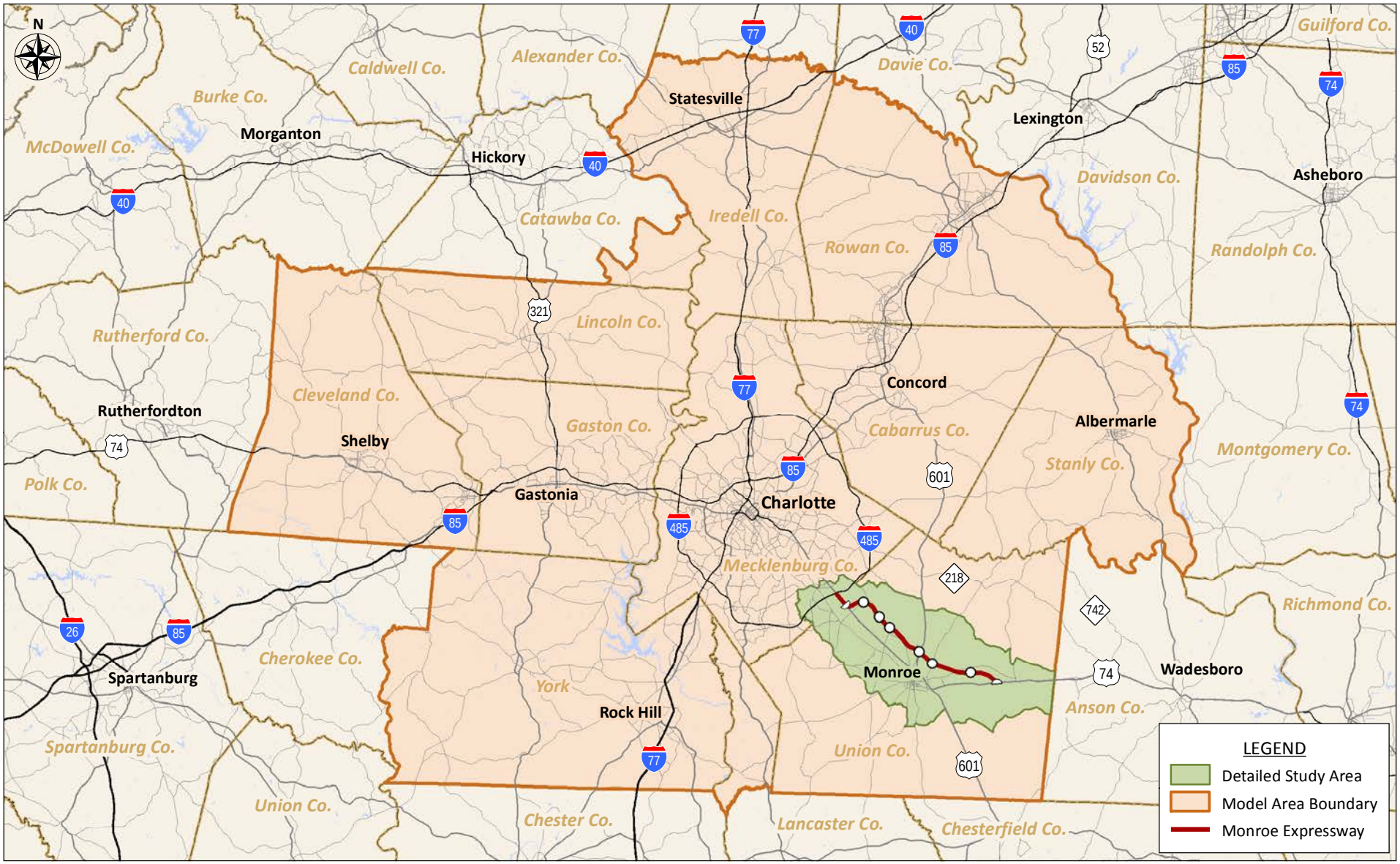
The MRM is cooperatively developed and maintained by a team of modelers from the following agencies:

1. North Carolina Department of Transportation (NCDOT),
2. South Carolina Department of Transportation (SCDOT),
3. Charlotte Regional Transportation Planning Organization (CRTPO),
4. Cabarrus-Rowan Metropolitan Planning Organization (CRMPO),
5. Gaston – Cleveland – Lincoln Metropolitan Planning Organization (GCLMPO),
6. Rock Hill - Fort Mill Area Transportation Study (RFATS),
7. Charlotte Department of Transportation (CDOT) and,
8. Rocky River Rural Planning Organization (RRRPO).

The official base year of the MRM15v1.1 is 2010, which incorporates 2010 US Census data. The model forecast years include 2015, 2025, 2030 and 2040. Each model year contains planned roadway and transit improvements based on the financially constrained metropolitan transportation plans for each of the respective MPOs. Projects in the non-MPO (RPO) areas are reflected in the networks only if they were included in the respective NC and SC Transportation Improvement Plan (TIP) documents.

The MRM is a weekday model, consisting of 3,439 TAZs, 82 externals, and with the following defined time periods:

- AM Peak Period: 6:30 AM to 9:30 AM
- Midday: 9:30 AM to 3:30 PM
- PM Peak Period: 3:30 PM to 6:30 PM
- Overnight Period: 6:30 PM to 6:30 AM



CDM Smith

METROLINA REGIONAL MODEL AREA MAP

FIGURE 3.1

In the fall of 2015, CDM Smith obtained a working version of the MRM15v1.1 and the model documentation. CDM Smith used the 2015 network as the base year, and 2025, 2030 and 2040 networks for future-year assignments. A review of the MRM networks was conducted to determine whether any refinements were needed to improve the modeling output for this study. The review included the network coding of the Monroe Expressway, the size of TAZs in the study area, the location of centroid connectors in the study area, and whether additional roads needed to be added to the networks.

3.2 Project Configuration

The most up-to-date, detailed Monroe Expressway configuration was used to code the project. **Figure 3.2** presents a not-to-scale schematic that shows the location and configuration of the interchanges and the number of through travel lanes on the Expressway. The blue highlighted lanes represent the tolled Monroe Expressway and the green highlighted lanes represent the non-tolled, upgraded section of US 74. The distance in miles between interchanges on the tolled Monroe Expressway are shown in red. Four continuous, through travel lanes (two per direction) will be provided on the tolled Monroe Expressway through the forecast period, from 2019 through 2058.

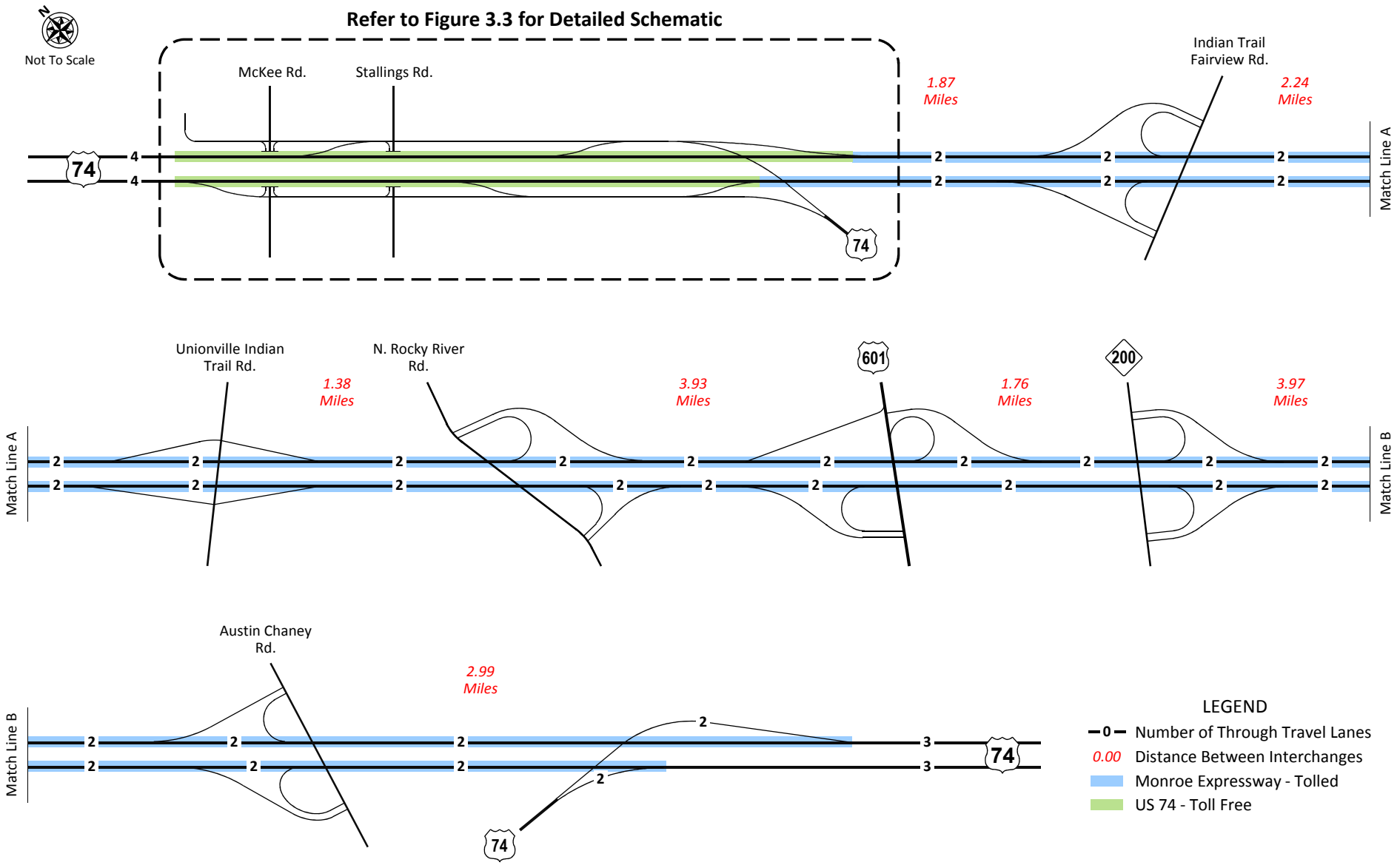
Figure 3.3 is a schematic of the upgraded section of US 74, the frontage road system, and the partial interchange with the Monroe Expressway. There will not be any toll collection on the upgraded section of US 74 or the frontage roads, highlighted in green and orange, respectively. The upgraded section of US 74 will maintain four to six through travel lanes. The system of frontage roads and the upgraded section of US 74 will provide multiple opportunities for vehicles to move between US 74 and the tolled Monroe Expressway. The Monroe Expressway will have a posted speed limit of 65 mph.

The Monroe Expressway was already coded into the MRM network years 2025, 2030 and 2040. The project coding, including distances, access points, and number of lanes was compared to the Monroe Bypass Constructors RFC Roadway Plans for accuracy. No substantive changes to distances, access points, or number of lanes were required.

3.3 Traffic Analysis Zones, Centroid Connectors, and Added Roadways

The networks contain geographic areas called traffic analysis zones. Some TAZs in the study area were too large for the purposes of this study as they would not accurately differentiate how motorists would access the project. In order to more accurately reflect travel distances and times, CDM Smith disaggregated some TAZs in the vicinity of the proposed Monroe Expressway. Twenty TAZs were split into two, three or four new zones. The disaggregated zones are shown in **Figure 3.4**. Each original TAZ has one color, split by a dark black border.

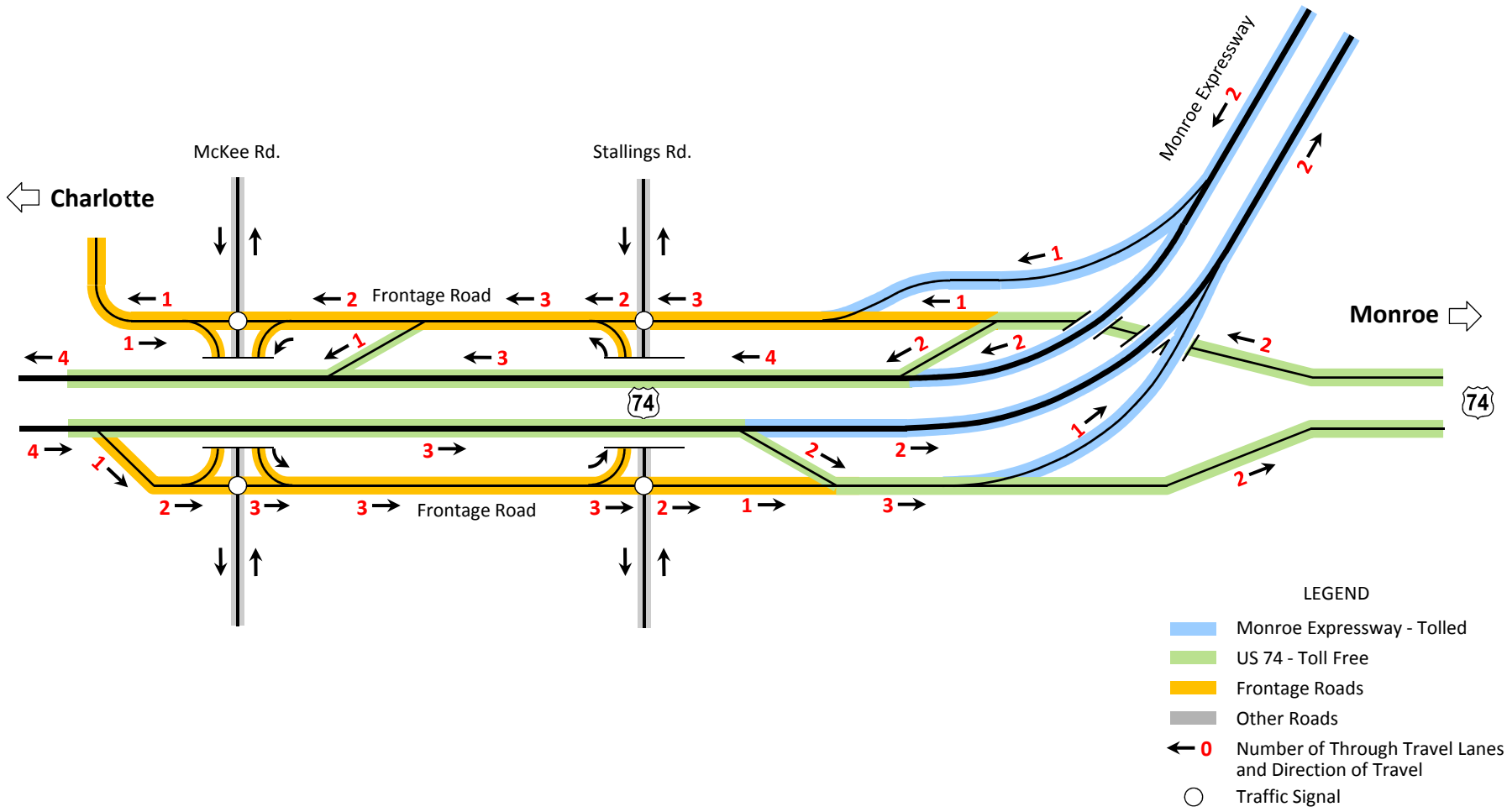
After a review of the 2015 network and aerials available on the internet, it was determined that centroid connections for some TAZs needed to be modified in existing TAZs to more accurately reflect where traffic would access the roadway system. Centroid connectors represent where traffic loads onto the roadway network in each TAZ. Depending upon the TAZ, a centroid connector may have been re-located, deleted, or added. Modifications to centroid connectors were made to 19 existing TAZs and to the 20 disaggregated TAZs.



PROJECT CONFIGURATION

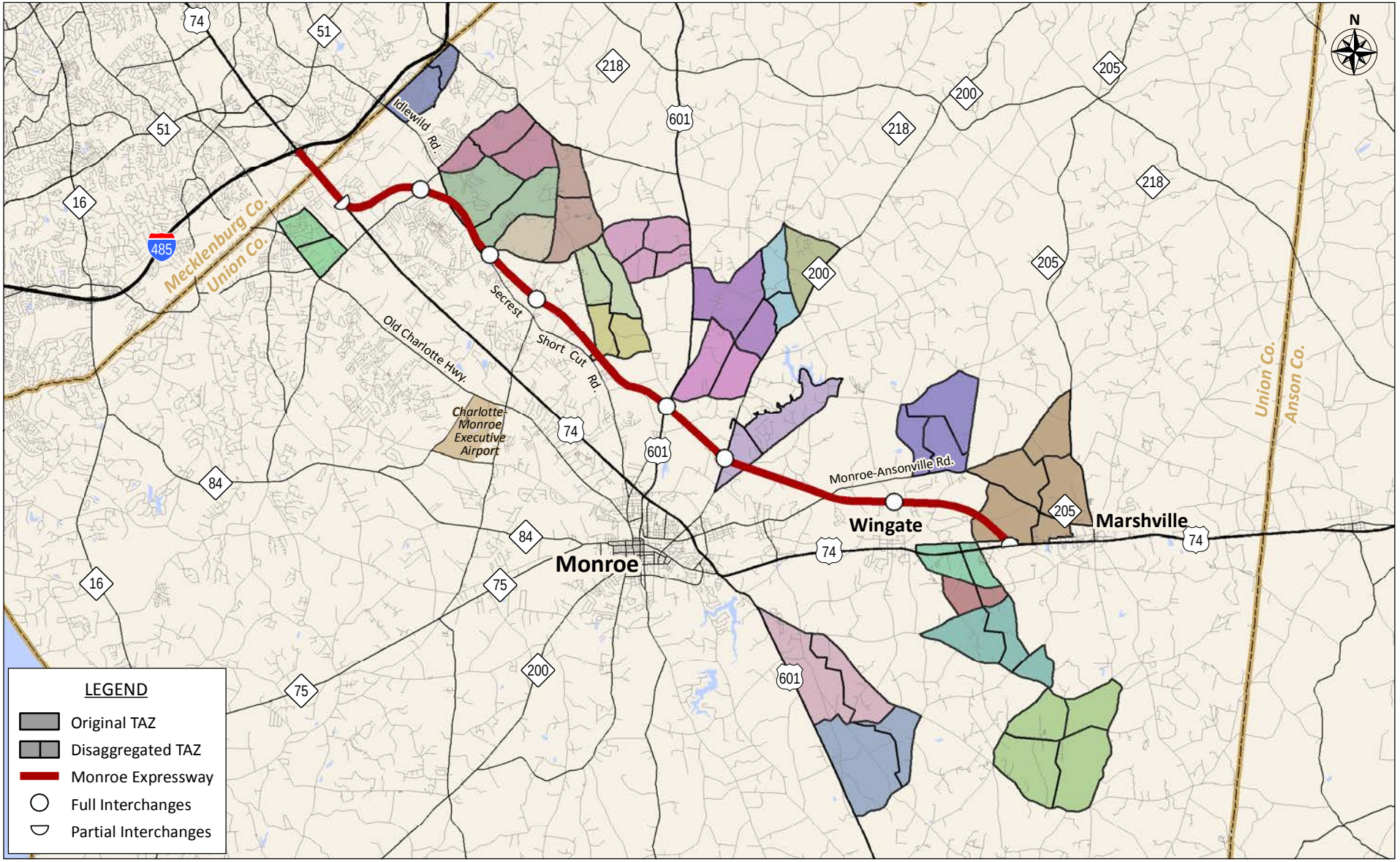
FIGURE 3.2

Not To Scale



MONROE EXPRESSWAY AND US 74 JUNCTION CONFIGURATION

FIGURE 3.3



CDM Smith

NETWORK TAZ DISAGGREGATION

FIGURE 3.4

Several existing roads, or sections of roads, were added to networks in order to more accurately reflect likely travel patterns of motorists that would potentially access the Monroe Expressway. These roads included Mills Harris Road, Nash Road, McIntyre Road, Ellis Griffin Road, Camden Road, Price Dairy Road, and Oak Spring Road.

3.4 Review of 2015 Network to Actual Ground Conditions

A review of the 2015 network was made, comparing actual ground conditions from aerials available on internet mapping sites to the roads coded in the network. The review focused on validating distances, intersection access points and number of travel lanes. This review focused primarily in the vicinity of the study area. No substantive changes were required, with the exception of those changes described in Section 3.3.

Chapter 4
Independent Economic Review

Economic growth forecasts are one of the most critical elements of any traffic and revenue forecast, particularly for a new toll facility such as the proposed Monroe Expressway. Because of the inherent uncertainty in the economic forecasting process, this has also become an area of considerable review and scrutiny by rating agencies and others in the financial community. As such, CDM Smith engaged Dr. Stephen J. Appold, an economist with local expertise, to conduct an independent analysis of the economic growth forecasts assumed in the Metrolina Regional Travel Demand Model (MRM15v1.1), a key tool for evaluating future travel demand in the region.

The goal of this effort was to evaluate the reasonableness of regional and corridor growth rates contained in the MRM15v1.1 and to make adjustments where appropriate. In this process Dr. Appold identified and analyzed major employers, employment centers, housing developments, and commercial and retail developments in order to derive an understanding of the economic drivers of the region. He also conducted an analysis of state-wide, regional and corridor growth rates based on the latest available historic trends and forecasts.

Dr. Appold's review specifically addressed forecasts for population, numbers of households, and employment, all of which are directly related to the traffic forecasts that the MRM15v1.1 produces. Each of these parameters was addressed for forecast years officially supported by the MRM15v1.1 (2015, 2025, 2030 and 2040) and for years used for forecast interpolation purposes (2020 and 2035).

The following presents a summary of the existing socioeconomic projections contained in the MRM15v1.1 in comparison with forecasts developed by Dr. Appold. Forecasts are presented on a region-wide basis, with a focus on Mecklenburg and Union Counties, and subsequently with a focus on the study corridor itself. The adjusted data set was reviewed by CDM Smith and was used as input in the travel demand modeling conducted in support of this study. A detailed description of Dr. Appold's methodology and conclusions can be found in his February 2016 ***Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Expressway***.

4.1 Model Area Adjustments

4.1.1 Model Area Boundaries

The MRM15v1.1 includes 10 North Carolina counties: Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, and Union; and two South Carolina counties: Lancaster and York. Of the 12 counties, Catawba, Iredell, and Lancaster are only partially covered in the MRM. The area encompassed by the MRM15v1.1 boundary can be seen in Figure 3.1. The detailed study area is shaded in green. Year 2010 is the official base year, supported by 2010 US Census data. Future year socio-economic and land-use assumptions in the MRM15v1.1 are forecasts, including year 2015.

4.1.2 Model Area Population

Table 4.1 presents MRM15v1.1 population projections by county for each model year. The upper portion of Table 4.1 shows the original data set. The lower portion shows the data set adjusted by Dr. Appold. Population growth rates for each 5-year interval are calculated using Average Annual Percent Change (AAPC).

Table 4.1
Model Area Population Forecasts by County - MRM15v1.1 and Adjusted Data

MRM15v1.1 Data

County	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
Cabarrus	178,012	2.1%	197,837	3.3%	232,934	2.8%	267,877	3.5%	318,094	1.2%	337,916	1.1%	357,601	2.4%
Catawba	9,978	2.9%	11,517	2.0%	12,704	2.0%	14,036	2.0%	15,523	2.0%	17,147	2.0%	18,886	2.1%
Cleveland	98,072	0.2%	98,968	0.3%	100,367	0.9%	105,058	1.0%	110,361	1.4%	118,270	1.3%	126,103	0.8%
Gaston	206,086	0.8%	214,374	0.8%	222,605	0.7%	230,793	0.7%	238,816	0.7%	247,798	0.7%	256,689	0.7%
Iredell	145,359	1.4%	155,570	1.3%	165,746	1.6%	179,804	1.5%	193,845	1.5%	208,843	1.4%	223,790	1.4%
Lincoln	78,265	1.8%	85,587	1.6%	92,858	1.5%	100,170	1.4%	107,433	1.4%	115,056	1.3%	122,641	1.5%
Mecklenburg	919,628	2.0%	1,016,280	1.8%	1,112,324	1.6%	1,206,967	1.5%	1,301,009	1.4%	1,396,793	1.3%	1,491,996	1.6%
Rowan	138,428	0.5%	142,241	0.9%	148,962	0.9%	155,571	1.2%	165,088	0.5%	168,900	0.4%	172,602	0.7%
Stanly	60,585	0.5%	62,036	0.4%	63,392	1.0%	66,737	1.0%	70,000	1.2%	74,349	1.1%	78,602	0.9%
Union	201,288	2.6%	228,719	2.0%	252,424	1.7%	274,861	1.6%	297,021	1.4%	319,173	1.3%	341,132	1.8%
Lancaster	19,729	0.3%	20,032	0.9%	20,974	1.6%	22,718	2.8%	26,095	2.7%	29,845	2.6%	33,895	1.8%
York	226,073	1.9%	248,692	2.3%	278,117	2.1%	307,957	1.0%	322,899	1.1%	340,394	1.4%	365,266	1.6%
Model Area Total	2,281,503	1.7%	2,481,853	1.7%	2,703,407	1.6%	2,932,549	1.5%	3,166,184	1.3%	3,374,484	1.2%	3,589,203	1.5%

Adjusted Data

County	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
Cabarrus	178,012	1.6%	192,856	3.0%	223,625	2.6%	254,149	3.2%	297,582	1.1%	314,610	1.1%	331,483	2.1%
Catawba	9,978	0.2%	10,097	1.2%	10,714	1.2%	11,387	1.2%	12,106	1.2%	12,866	1.2%	13,645	1.0%
Cleveland	98,072	-0.1%	97,698	0.3%	99,059	0.9%	103,499	0.9%	108,498	1.3%	115,843	1.2%	123,167	0.8%
Gaston	206,086	0.5%	211,488	0.7%	218,619	0.7%	226,332	0.7%	233,885	0.7%	242,557	0.7%	251,139	0.7%
Iredell	145,359	1.1%	153,613	1.1%	161,900	1.6%	175,059	1.5%	188,213	1.2%	199,681	1.2%	212,169	1.3%
Lincoln	78,265	0.6%	80,545	1.5%	86,932	1.4%	92,989	1.3%	98,952	1.2%	105,120	1.1%	111,228	1.2%
Mecklenburg	919,628	2.1%	1,018,549	1.8%	1,115,877	1.5%	1,204,019	1.4%	1,291,649	1.4%	1,382,555	1.3%	1,473,062	1.6%
Rowan	138,428	0.0%	138,771	0.9%	145,250	0.8%	151,049	1.1%	159,380	0.4%	162,684	0.4%	165,913	0.6%
Stanly	60,585	0.2%	61,053	0.3%	62,054	1.0%	65,345	0.9%	68,408	1.2%	72,463	1.1%	76,421	0.8%
Union	201,288	1.8%	220,194	1.7%	239,703	1.7%	260,900	1.6%	281,836	1.4%	302,775	1.3%	323,524	1.6%
Lancaster	19,729	0.3%	20,032	0.9%	20,974	1.0%	22,005	1.7%	23,966	1.7%	26,027	1.6%	28,133	1.2%
York	226,073	2.0%	249,185	2.3%	279,025	2.0%	308,773	0.9%	323,633	1.1%	341,576	0.5%	349,753	1.5%
Model Area Total	2,281,503	1.5%	2,454,081	1.7%	2,663,732	1.5%	2,875,506	1.4%	3,088,108	1.2%	3,278,757	1.1%	3,459,637	1.4%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.

The official base year for the MRM15v1.1 is 2010 and serves as a fixed point from which growth is measured in this analysis. The base year contains actual data from the US Census. Since the Project is located within Mecklenburg County and Union County, labels for these counties are shown in italics for emphasis.

As seen in Table 4.1, the unadjusted 2010 total population in the 12-county region amounted to nearly 2.28 million residents. The 2010 population in Mecklenburg and Union Counties was 920,000 and 201,000, respectively. These levels are forecast to increase to 3.59 million in the 12-county region, 1.49 million in Mecklenburg County, and 341,000 in Union County. An additional 1.31 million residents in the region over the 30-year period translates to an average annual growth rate of approximately 1.5 percent. Mecklenburg County is expected to add 572,000 residents over the same 30-year period, resulting in an average annual growth rate of approximately 1.6 percent. The corresponding population increase expected for Union County is 140,000, or an average annual increase of 1.8 percent.

When compared with region-wide MRM15v1.1 projections, the adjusted population forecast shows approximately 28,000 fewer residents in 2015 and 130,000 fewer by 2040. Within Mecklenburg County, the adjusted projections forecast approximately 2,000 additional residents in 2015 and 19,000 fewer in 2040. Within Union County, the adjusted projections forecast approximately 9,000 fewer residents in 2015 and 18,000 fewer in 2040.

4.1.3 Model Area Households

Table 4.2 presents MRM15v1.1 household projections by county for each model year. The upper portion of Table 4.2 shows the original data set. The lower portion shows the adjusted data set.

The unadjusted data set for 2010 shows 875,000 households region-wide, 362,000 in Mecklenburg County, and 68,000 in Union County. By 2040, households are projected to total about 1.40 million region-wide, 595,000 in Mecklenburg County, and 115,000 in Union County. This represents an increase of 520,000 households region-wide resulting in an average annual increase of 1.6 percent. Mecklenburg County is expected to gain about 232,000 households over the same 30-year period, resulting in an average annual growth rate of approximately 1.7 percent. Households within Union County are forecast to increase by 47,000, representing an average annual increase of approximately 1.8 percent.

When compared with region-wide MRM15v1.1 projections, the adjusted forecast shows approximately 10,000 fewer households in 2015 and 51,000 fewer by 2040. Within Mecklenburg County, the adjusted projections forecast approximately 1,000 additional households in 2015 and 8,000 fewer in 2040. Within Union County, the adjusted projections forecast approximately 3,000 fewer households in 2015 and 7,000 fewer in 2040.

4.1.4 Model Area Employment

Table 4.3 presents MRM15v1.1 employment projections by county for each model year. Growth rates for each 5-year interval are calculated using AAPC. No adjustments were made to the employment projections contained within the model.

Table 4.2
Model Area Household Forecasts by County - MRM15v1.1 and Adjusted Data

MRM15v1.1 Data

County	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
Cabarrus	65,667	2.2%	73,074	3.3%	86,131	2.8%	99,045	3.5%	117,615	1.2%	125,020	1.1%	132,273	2.4%
Catawba	4,032	2.8%	4,626	2.0%	5,113	2.0%	5,654	2.0%	6,257	2.0%	6,913	2.0%	7,616	2.1%
Cleveland	38,553	0.1%	38,790	0.2%	39,189	0.9%	41,061	1.0%	43,156	1.4%	46,300	1.3%	49,364	0.8%
Gaston	80,197	0.8%	83,592	0.8%	86,866	0.7%	90,087	0.7%	93,243	0.8%	96,809	0.7%	100,280	0.7%
Iredell	55,724	1.3%	59,449	1.2%	63,023	1.7%	68,472	1.5%	73,832	1.6%	79,741	1.4%	85,548	1.4%
Lincoln	30,343	1.7%	33,075	1.6%	35,751	1.6%	38,626	1.4%	41,452	1.4%	44,483	1.3%	47,456	1.5%
Mecklenburg	362,213	2.1%	401,572	1.9%	440,389	1.7%	479,065	1.5%	517,196	1.5%	556,239	1.3%	594,699	1.7%
Rowan	53,139	0.6%	54,680	1.0%	57,373	0.9%	59,952	1.2%	63,693	0.5%	65,233	0.4%	66,665	0.8%
Stanly	23,589	0.5%	24,234	0.5%	24,796	1.1%	26,165	1.0%	27,456	1.2%	29,185	1.1%	30,829	0.9%
Union	67,862	2.6%	76,979	2.0%	85,147	1.7%	92,814	1.6%	100,335	1.5%	107,863	1.3%	115,220	1.8%
Lancaster	8,008	0.3%	8,143	1.0%	8,544	1.6%	9,269	2.8%	10,654	2.7%	12,187	2.6%	13,858	1.8%
York	85,864	2.0%	94,578	1.8%	103,622	1.6%	112,173	1.5%	120,735	1.4%	129,416	3.2%	151,831	1.9%
Model Area Total	875,191	1.7%	952,792	1.7%	1,035,944	1.6%	1,122,383	1.6%	1,215,624	1.3%	1,299,389	1.4%	1,395,639	1.6%

Adjusted Data

County	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
Cabarrus	65,667	1.6%	70,942	3.0%	82,330	2.6%	93,542	3.2%	109,508	1.1%	115,839	1.0%	122,015	2.1%
Catawba	4,032	0.1%	4,056	1.2%	4,312	1.2%	4,587	1.2%	4,880	1.2%	5,187	1.2%	5,503	1.0%
Cleveland	38,553	-0.1%	38,352	0.2%	38,659	0.9%	40,430	1.0%	42,401	1.3%	45,318	1.2%	48,177	0.7%
Gaston	80,197	0.6%	82,602	0.7%	85,408	0.7%	88,443	0.7%	91,413	0.7%	94,858	0.7%	98,210	0.7%
Iredell	55,724	1.1%	58,782	0.9%	61,554	1.6%	66,650	1.5%	71,665	1.2%	76,218	1.2%	81,075	1.3%
Lincoln	30,343	0.5%	31,156	1.4%	33,465	1.4%	35,850	1.3%	38,171	1.3%	40,634	1.2%	43,029	1.2%
Mecklenburg	362,213	2.2%	403,025	1.9%	442,390	1.6%	478,316	1.4%	513,734	1.4%	550,708	1.3%	587,193	1.6%
Rowan	53,139	0.1%	53,302	1.0%	55,898	0.8%	58,153	1.1%	61,424	0.4%	62,761	0.4%	64,006	0.6%
Stanly	23,589	0.2%	23,846	0.4%	24,274	1.1%	25,622	0.9%	26,834	1.2%	28,449	1.1%	29,977	0.8%
Union	67,862	1.7%	73,655	1.7%	80,163	1.7%	87,343	1.6%	94,384	1.5%	101,431	1.3%	108,319	1.6%
Lancaster	8,008	0.3%	8,143	1.0%	8,544	1.0%	8,979	1.7%	9,785	1.7%	10,629	1.6%	11,503	1.2%
York	85,864	2.1%	95,062	1.8%	104,075	1.6%	112,623	1.5%	121,195	1.4%	129,886	2.3%	145,864	1.8%
Model Area Total	875,191	1.5%	942,923	1.6%	1,021,072	1.5%	1,100,538	1.5%	1,185,394	1.3%	1,261,918	1.3%	1,344,871	1.4%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.

Table 4.3
Model Area Employment Forecast by County - MRM15v1.1

	MRM15v1.1 Data													
County	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
Cabarrus	69,595	2.9%	80,341	2.6%	91,409	2.2%	101,930	2.0%	112,729	1.9%	123,594	1.6%	133,988	2.2%
Catawba	1,756	2.5%	1,986	1.9%	2,179	1.0%	2,289	1.0%	2,405	1.2%	2,551	1.1%	2,698	1.4%
Cleveland	34,079	1.0%	35,858	0.8%	37,364	0.8%	38,826	0.6%	39,991	0.9%	41,805	0.7%	43,283	0.8%
Gaston	79,116	1.6%	85,548	1.4%	91,581	1.0%	96,414	0.9%	100,856	0.8%	105,215	0.7%	109,202	1.1%
Iredell	68,658	3.0%	79,590	2.5%	89,976	1.1%	94,969	0.9%	99,406	1.3%	105,845	1.1%	111,762	1.6%
Lincoln	25,101	1.1%	26,526	0.9%	27,700	1.0%	29,159	0.8%	30,396	1.2%	32,208	1.0%	33,806	1.0%
Mecklenburg	689,849	2.2%	768,304	1.9%	843,257	1.3%	899,099	1.1%	951,356	1.4%	1,017,632	1.2%	1,080,218	1.5%
Rowan	53,475	0.7%	55,432	0.7%	57,488	0.6%	59,168	0.6%	60,856	0.6%	62,812	0.5%	64,474	0.6%
Stanly	25,106	1.1%	26,559	0.8%	27,652	1.5%	29,842	1.2%	31,633	1.7%	34,476	1.3%	36,774	1.3%
Union	73,735	3.1%	85,974	1.4%	92,231	1.2%	97,759	1.1%	103,282	1.4%	110,518	1.1%	116,645	1.5%
Lancaster	4,210	16.7%	9,105	0.4%	9,281	0.3%	9,407	0.6%	9,672	0.6%	9,948	1.1%	10,494	3.1%
York	85,157	5.5%	111,318	1.4%	119,197	1.1%	125,836	1.1%	132,592	1.2%	140,482	1.1%	148,699	1.9%
Model Area Total	1,209,837	2.5%	1,366,541	1.7%	1,489,315	1.2%	1,584,698	1.1%	1,675,174	1.3%	1,787,086	1.1%	1,892,043	1.5%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.

The unadjusted data set shows total employment in the model region at 1.21 million in 2010. The majority of these jobs, nearly 690,000, were in Mecklenburg County. Total employment in Union County in 2010 was approximately 74,000. Mecklenburg County, at 1.08 million jobs, is projected to remain the largest employment engine in the region in 2040. Union County employment is forecast to reach about 117,000 by 2040.

4.1.5 Model Area Summary of Adjustments

Table 4.4 presents a summary of adjustments for population, households and employment on a region-wide basis. Differences between the original MRM15v1.1 data set and the adjusted data set are presented on an absolute and percent basis for all model years. Growth rates for the 30-year period from 2010 to 2040 are also provided for comparison.

Region-wide, adjustments to 2015 population and household projections totaled negative 1.1 percent and negative 1.0 percent, respectively. The downward adjustments made to population and household forecasts increase over time. By 2040, adjustments to population and household forecasts totaled negative 3.6 percent.

Table 4.4
Model Area Summary of Adjustments

Economic Input	2010	Forecast Year 2015	2020	2025	2030	2035	2040	AAPC 2010-40
Population								
MRM15v1.1 Data	2,281,503	2,481,853	2,703,407	2,932,549	3,166,184	3,374,484	3,589,203	1.5%
Adjusted Data	2,281,503	2,454,081	2,663,732	2,875,506	3,088,108	3,278,757	3,459,637	1.4%
Difference		-27,772	-39,675	-57,043	-78,076	-95,727	-129,566	
Percent Difference		-1.1%	-1.5%	-1.9%	-2.5%	-2.8%	-3.6%	
Households								
MRM15v1.1 Data	875,191	952,792	1,035,944	1,122,383	1,215,624	1,299,389	1,395,639	1.6%
Adjusted Data	875,191	942,923	1,021,072	1,100,538	1,185,394	1,261,918	1,344,871	1.4%
Difference		-9,869	-14,872	-21,845	-30,230	-37,471	-50,768	
Percent Difference		-1.0%	-1.4%	-1.9%	-2.5%	-2.9%	-3.6%	
Employment								
MRM15v1.1 Data	1,209,837	1,366,541	1,489,315	1,584,698	1,675,174	1,787,086	1,892,043	1.5%
Adjusted Data	1,209,837	1,366,541	1,489,315	1,584,698	1,675,174	1,787,086	1,892,043	1.5%
Difference		0	0	0	0	0	0	
Percent Difference		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.

4.2 Study Area Adjustments

4.2.1 Study Area Boundaries

The MRM15v1.1 is divided into 3,439 geographic units called Traffic Analysis Zones (TAZs). Of those, 211 TAZs are in the vicinity of US 74 and the proposed Monroe Expressway. These 211 TAZs constitute the study area. The majority of the study area TAZs are in Union County. The western-most TAZs in the study area are in Mecklenburg County. The 211 study area TAZs have been grouped into

19 superzones for reporting purposes. These 19 superzones are numbered and depicted in relation to the proposed Monroe Expressway in **Figure 4.1**. The following sections describe the MRM15v1.1 forecast population, number of households, and employment in the study area compared to the adjusted forecasts.

4.2.2 Study Area Population

Table 4.5 presents the study area population projections by superzone for each model year. The upper portion of Table 4.5 shows the original data set. The lower portion shows the adjusted data set.

In the unadjusted data set, Superzone 2 (located near I-485 and to the north of the proposed Monroe Expressway) is expected to have the most rapid growth in population between 2010 and 2040 (averaging 3.0 percent per year). Population in the adjacent Superzone 3 is forecast to grow at an average 2.5 percent per year over the same time period. In absolute terms, population in Superzone 13 and Superzone 14 is expected to see the greatest increase between 2010 and 2040. Both of these zones are located near I-485 and south of US 74.

Within the adjusted data set, the most notable changes to population projections were made to superzones on the eastern end of the study area. Population projections for 2015 in Superzone 7 and Superzone 19 were reduced by 22.1 percent and 19.9 percent, respectively. Population projections for 2015 in Superzone 6 and Superzone 18 were reduced by 12.2 percent and 10.8 percent, respectively. Similar downward adjustments to these eastern-most superzones were made for all forecast years.

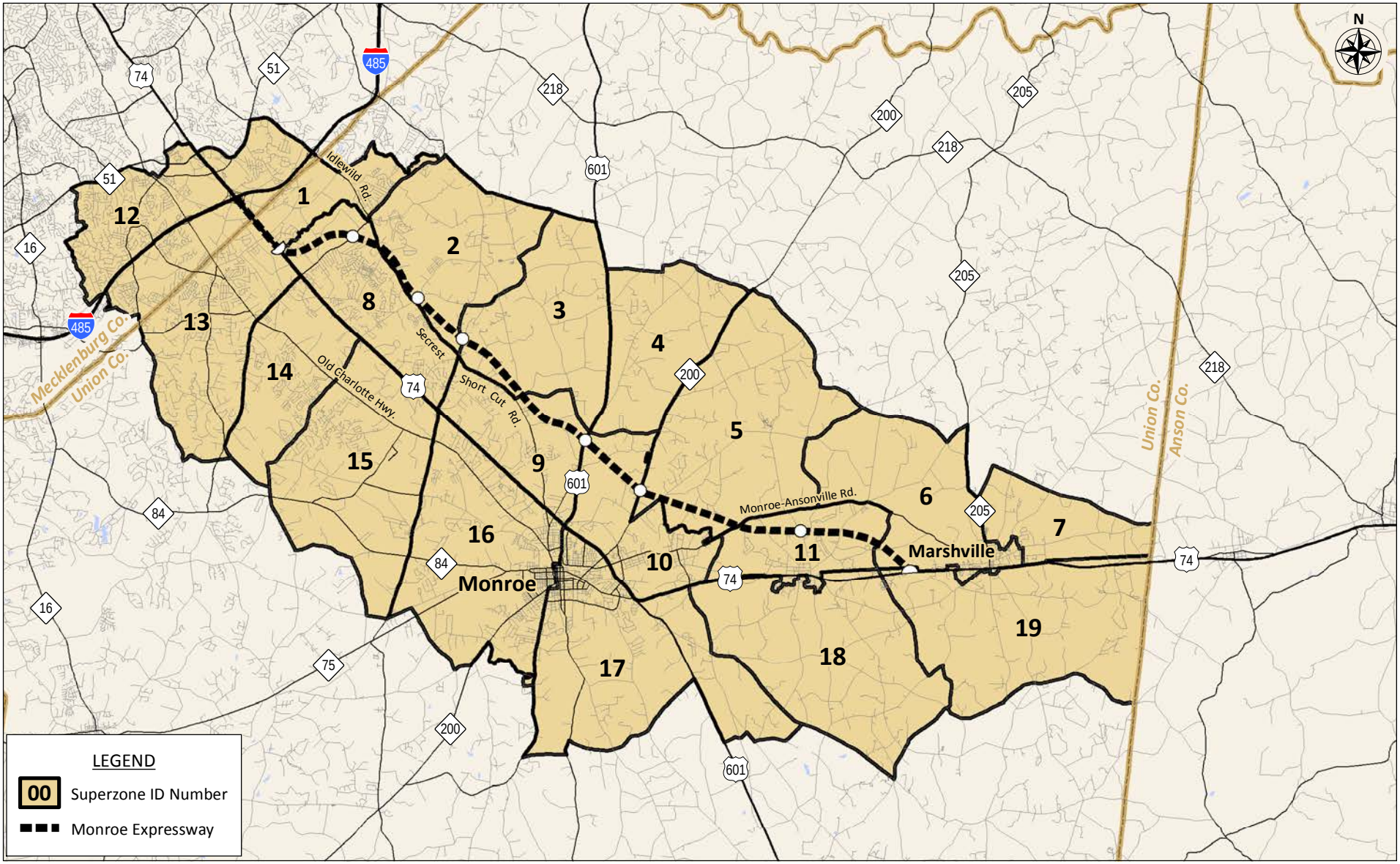
Figure 4.2 visually portrays the total forecasted change in population in the study area in the adjusted data set between 2010 and 2040 by TAZ (the smallest geographic unit of analysis in the model). It is apparent that forecast population growth is smallest in TAZs located east of Monroe. Larger increases in population growth are forecast to occur towards the western side of the study area, both to the north and south of US 74.

4.2.3 Study Area Households

Table 4.6 presents study area household projections by superzone for each model year. The upper portion of Table 4.6 shows the original data set. The lower portion shows the adjusted data set.

Unadjusted study area projections for number of households mirror population projections. Superzone 2 is anticipated to have the highest annual rate of growth in number of households, averaging 2.9 percent per year from 2010 to 2040. Households in Superzone 3 are forecast to increase by an average 2.6 percent per year during the same time period. These superzones are located in the western portion of the study area. The largest increase in the number of households is anticipated to occur in Superzones 13, 14 and 2. These superzones are all located in the western half of the study area.

Within the adjusted data set, the most notable changes to household projections were made to superzones on the eastern end of the study area. Household projections in Superzones 7 and 19 were reduced by more than 20 percent in all forecast years, and reduced by more than 10 percent in Superzones 6 and 18 in all forecast years.



CDM Smith

SUPERZONE BOUNDARIES

FIGURE 4.1

Table 4.5
Study Area Population Forecast by Superzone - MRM15v1.1 and Adjusted Data

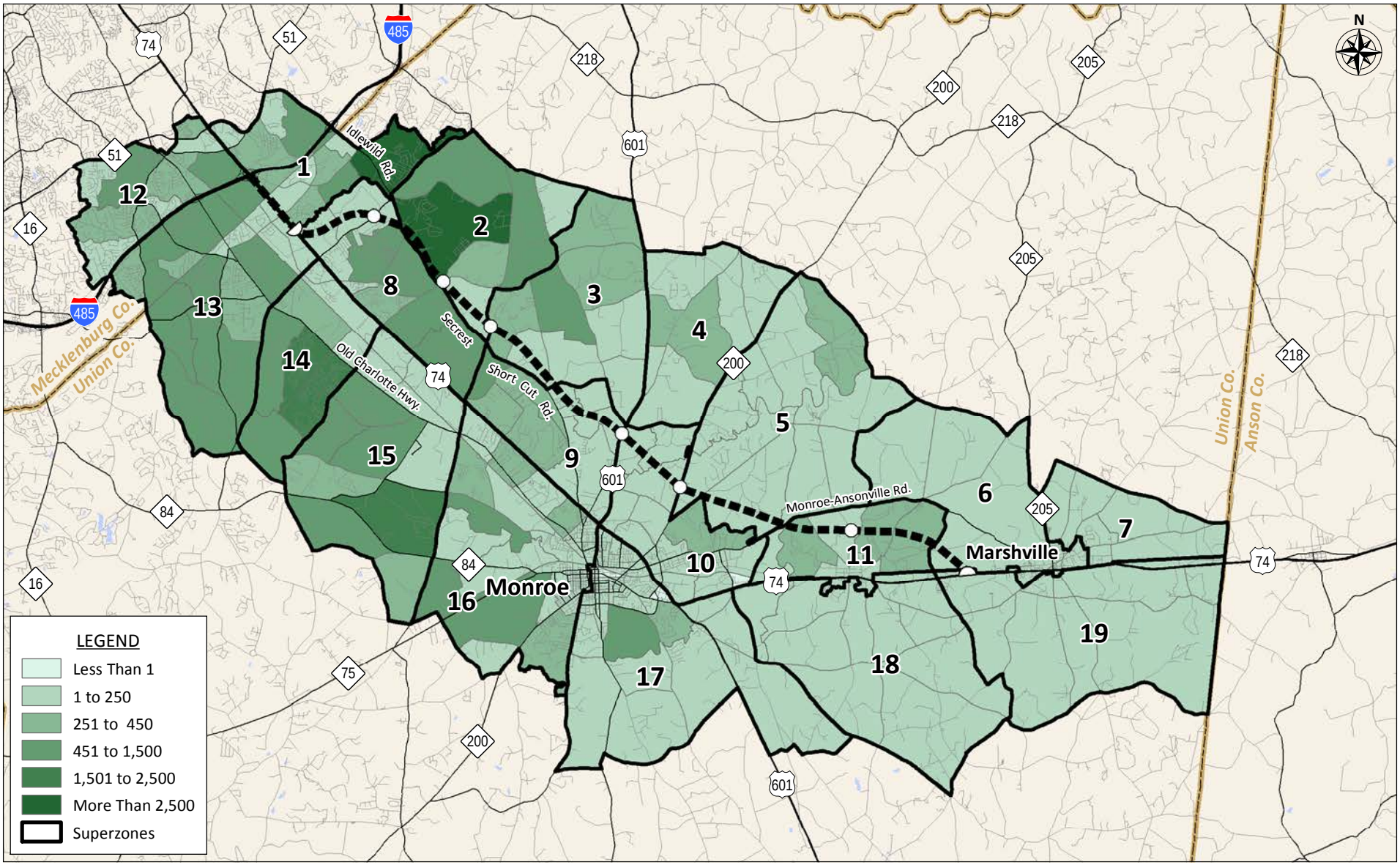
MRM15v1.1 Data

Superzone	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
1	9,919	2.0%	10,969	1.6%	11,888	1.6%	12,871	1.5%	13,853	1.3%	14,799	1.2%	15,741	1.6%
2	5,387	4.2%	6,617	7.8%	9,649	1.6%	10,458	1.5%	11,277	1.5%	12,119	1.3%	12,958	3.0%
3	2,151	3.0%	2,493	5.1%	3,196	2.1%	3,549	1.9%	3,892	1.7%	4,224	1.5%	4,554	2.5%
4	2,209	1.4%	2,366	1.1%	2,495	1.5%	2,688	1.4%	2,875	1.2%	3,057	1.2%	3,238	1.3%
5	2,762	1.8%	3,016	1.4%	3,228	1.9%	3,547	1.7%	3,856	1.5%	4,157	1.4%	4,455	1.6%
6	2,304	3.3%	2,712	1.3%	2,899	1.3%	3,090	1.1%	3,270	1.0%	3,443	1.0%	3,612	1.5%
7	621	5.6%	814	2.0%	897	1.6%	972	1.4%	1,041	1.2%	1,106	1.1%	1,168	2.1%
8	12,871	1.7%	13,988	0.8%	14,550	1.3%	15,551	1.3%	16,550	1.2%	17,560	1.1%	18,564	1.2%
9	5,033	1.7%	5,470	1.3%	5,830	1.8%	6,367	1.6%	6,884	1.4%	7,387	1.3%	7,883	1.5%
10	4,417	1.1%	4,657	0.8%	4,850	1.2%	5,139	1.1%	5,417	1.0%	5,690	0.9%	5,957	1.0%
11	4,860	0.0%	4,851	0.9%	5,065	1.4%	5,422	1.3%	5,788	1.2%	6,156	1.2%	6,520	1.0%
12	15,388	0.8%	16,031	0.8%	16,669	1.1%	17,563	1.0%	18,451	0.8%	19,212	0.8%	19,970	0.9%
13	21,515	1.9%	23,602	1.0%	24,750	1.9%	27,245	1.8%	29,731	1.3%	31,746	1.2%	33,750	1.5%
14	10,683	3.0%	12,367	2.5%	13,992	1.7%	15,191	1.5%	16,378	1.4%	17,567	1.3%	18,753	1.9%
15	11,222	2.3%	12,562	-0.1%	12,511	1.9%	13,778	1.8%	15,044	1.7%	16,330	1.5%	17,610	1.5%
16	15,506	1.2%	16,464	1.0%	17,298	1.3%	18,408	1.1%	19,473	1.0%	20,503	1.0%	21,524	1.1%
17	9,415	1.5%	10,136	1.9%	11,142	1.1%	11,793	1.1%	12,429	1.0%	13,051	0.9%	13,658	1.2%
18	2,578	2.1%	2,854	1.6%	3,088	1.9%	3,392	1.7%	3,692	1.6%	3,988	1.4%	4,281	1.7%
19	1,413	4.9%	1,798	1.7%	1,959	1.4%	2,105	1.3%	2,240	1.1%	2,366	1.0%	2,489	1.9%
Study Area Total	140,254	1.9%	153,767	1.5%	165,956	1.5%	179,129	1.4%	192,141	1.3%	204,461	1.2%	216,685	1.5%

Adjusted Data

Superzone	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
1	9,919	2.5%	11,243	1.6%	12,187	1.6%	13,198	1.5%	14,207	1.3%	15,188	1.2%	16,158	1.6%
2	5,387	5.6%	7,061	8.4%	10,560	1.5%	11,393	1.4%	12,238	1.4%	13,103	1.3%	13,966	3.2%
3	2,151	2.8%	2,468	4.1%	3,011	2.1%	3,343	1.9%	3,664	1.7%	3,977	1.5%	4,289	2.3%
4	2,209	0.6%	2,276	1.1%	2,401	1.5%	2,585	1.3%	2,761	1.2%	2,934	1.1%	3,105	1.1%
5	2,762	0.6%	2,840	1.4%	3,038	1.9%	3,333	1.7%	3,619	1.5%	3,897	1.4%	4,172	1.4%
6	2,304	0.7%	2,381	1.3%	2,539	1.2%	2,701	1.1%	2,854	1.0%	3,003	0.9%	3,148	1.0%
7	621	0.4%	634	1.9%	697	1.6%	753	1.3%	804	1.2%	853	1.1%	900	1.2%
8	12,871	0.8%	13,394	0.8%	13,940	1.3%	14,890	1.2%	15,838	1.2%	16,799	1.1%	17,756	1.1%
9	5,033	0.4%	5,141	1.3%	5,475	1.7%	5,969	1.5%	6,444	1.4%	6,907	1.3%	7,366	1.3%
10	4,417	0.2%	4,460	0.8%	4,644	1.2%	4,924	1.1%	5,192	1.0%	5,457	0.9%	5,713	0.9%
11	4,860	-1.1%	4,593	0.9%	4,792	1.4%	5,126	1.3%	5,472	1.2%	5,818	1.1%	6,160	0.8%
12	15,388	0.3%	15,582	0.8%	16,181	1.0%	16,976	0.9%	17,765	0.8%	18,465	0.7%	19,159	0.7%
13	21,515	1.4%	23,098	0.9%	24,103	1.7%	26,161	1.5%	28,220	1.2%	29,989	1.1%	31,742	1.3%
14	10,683	1.9%	11,723	2.3%	13,151	1.7%	14,296	1.5%	15,432	1.4%	16,569	1.3%	17,703	1.7%
15	11,222	1.3%	11,987	-0.1%	11,955	1.9%	13,126	1.7%	14,291	1.6%	15,471	1.5%	16,650	1.3%
16	15,506	0.5%	15,868	1.0%	16,664	1.2%	17,717	1.1%	18,725	1.0%	19,698	1.0%	20,660	1.0%
17	9,415	0.2%	9,519	1.7%	10,346	1.1%	10,940	1.0%	11,519	1.0%	12,085	0.9%	12,634	1.0%
18	2,578	-0.2%	2,546	1.6%	2,752	1.8%	3,012	1.7%	3,272	1.5%	3,529	1.4%	3,781	1.3%
19	1,413	0.4%	1,441	1.6%	1,563	1.4%	1,679	1.3%	1,787	1.1%	1,888	1.1%	1,990	1.1%
Study Area Total	140,254	1.1%	148,255	1.5%	159,999	1.5%	172,122	1.4%	184,104	1.2%	195,630	1.1%	207,052	1.3%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census, and AAPR is an abbreviation for Average Annual Percetn Change.



TOTAL CHANGE IN POPULATION BY TAZ WITHIN THE ADJUSTED DATASET FROM 2010-2040

FIGURE 4.2

Table 4.6
Study Area Household Forecast by Superzone - MRM15v1.1 and Adjusted Data

MRM15v1.1 Data

Superzone	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
1	3,565	1.9%	3,921	1.5%	4,218	1.6%	4,575	1.5%	4,928	1.3%	5,268	1.2%	5,605	1.5%
2	1,846	4.1%	2,255	7.4%	3,229	1.7%	3,512	1.6%	3,796	1.5%	4,089	1.4%	4,379	2.9%
3	769	3.0%	892	5.8%	1,183	2.1%	1,310	1.8%	1,433	1.6%	1,552	1.5%	1,669	2.6%
4	789	1.3%	843	1.1%	892	1.5%	963	1.4%	1,032	1.3%	1,099	1.1%	1,163	1.3%
5	1,077	1.7%	1,171	1.4%	1,255	1.9%	1,378	1.7%	1,497	1.5%	1,615	1.4%	1,727	1.6%
6	780	3.5%	927	1.5%	997	1.3%	1,066	1.2%	1,130	1.0%	1,190	1.0%	1,249	1.6%
7	242	5.3%	314	2.0%	346	1.6%	374	1.4%	401	1.3%	427	1.1%	450	2.1%
8	4,401	1.6%	4,757	0.6%	4,898	1.4%	5,242	1.3%	5,581	1.2%	5,924	1.1%	6,263	1.2%
9	1,892	1.5%	2,042	1.3%	2,179	1.7%	2,376	1.5%	2,564	1.4%	2,749	1.3%	2,928	1.5%
10	1,192	1.1%	1,257	0.9%	1,312	1.2%	1,394	1.1%	1,473	1.1%	1,553	0.9%	1,623	1.0%
11	1,251	1.4%	1,338	1.2%	1,417	1.6%	1,531	1.4%	1,641	1.3%	1,749	1.2%	1,852	1.3%
12	5,699	0.9%	5,966	0.9%	6,230	1.2%	6,612	1.1%	6,990	0.9%	7,310	0.8%	7,625	1.0%
13	7,655	1.9%	8,411	1.0%	8,834	2.2%	9,830	1.9%	10,816	1.4%	11,588	1.3%	12,354	1.6%
14	3,446	2.9%	3,980	2.5%	4,496	1.7%	4,892	1.5%	5,283	1.4%	5,676	1.3%	6,064	1.9%
15	3,747	2.2%	4,173	-0.2%	4,129	2.0%	4,566	1.8%	5,000	1.7%	5,442	1.6%	5,878	1.5%
16	5,557	1.1%	5,878	1.0%	6,190	1.3%	6,594	1.1%	6,981	1.1%	7,357	1.0%	7,720	1.1%
17	3,202	1.4%	3,429	1.6%	3,720	1.2%	3,947	1.1%	4,163	1.0%	4,379	0.9%	4,583	1.2%
18	903	2.7%	1,031	1.8%	1,126	2.0%	1,246	1.8%	1,362	1.6%	1,476	1.4%	1,585	1.9%
19	523	4.8%	662	1.8%	725	1.4%	779	1.3%	830	1.2%	879	0.9%	921	1.9%
Study Area Total	48,536	1.9%	53,247	1.5%	57,376	1.6%	62,187	1.5%	66,901	1.3%	71,322	1.2%	75,638	1.5%

Adjusted Data

Superzone	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
1	3,565	2.3%	3,995	1.5%	4,298	1.6%	4,663	1.5%	5,023	1.4%	5,372	1.3%	5,717	1.6%
2	1,846	5.3%	2,385	8.0%	3,508	1.6%	3,797	1.5%	4,087	1.4%	4,385	1.3%	4,680	3.1%
3	769	3.0%	890	4.6%	1,112	2.1%	1,231	1.8%	1,346	1.6%	1,458	1.5%	1,568	2.4%
4	789	0.5%	809	1.1%	856	1.5%	923	1.4%	988	1.2%	1,051	1.1%	1,111	1.1%
5	1,077	0.5%	1,102	1.4%	1,180	1.9%	1,294	1.6%	1,404	1.5%	1,513	1.3%	1,616	1.4%
6	780	0.7%	807	1.4%	866	1.3%	924	1.2%	979	1.0%	1,030	1.0%	1,080	1.1%
7	242	0.2%	245	1.9%	269	1.5%	290	1.3%	310	1.3%	330	1.0%	347	1.2%
8	4,401	0.7%	4,553	0.6%	4,691	1.4%	5,017	1.3%	5,339	1.2%	5,665	1.1%	5,987	1.0%
9	1,892	0.3%	1,920	1.3%	2,046	1.7%	2,227	1.5%	2,399	1.4%	2,569	1.3%	2,734	1.2%
10	1,192	0.2%	1,202	0.9%	1,254	1.2%	1,333	1.1%	1,409	1.1%	1,486	0.9%	1,553	0.9%
11	1,251	0.0%	1,254	1.2%	1,328	1.6%	1,435	1.4%	1,538	1.3%	1,639	1.1%	1,735	1.1%
12	5,699	0.4%	5,807	0.8%	6,054	1.1%	6,391	1.0%	6,724	0.9%	7,016	0.8%	7,303	0.8%
13	7,655	1.4%	8,212	0.9%	8,572	1.8%	9,366	1.6%	10,153	1.3%	10,810	1.2%	11,461	1.4%
14	3,446	1.8%	3,761	2.3%	4,211	1.7%	4,587	1.6%	4,959	1.5%	5,333	1.3%	5,702	1.7%
15	3,747	1.1%	3,967	-0.2%	3,931	2.0%	4,332	1.8%	4,728	1.6%	5,130	1.5%	5,528	1.3%
16	5,557	0.3%	5,650	1.0%	5,947	1.3%	6,329	1.1%	6,694	1.0%	7,048	0.9%	7,389	1.0%
17	3,202	0.1%	3,220	1.5%	3,466	1.2%	3,674	1.1%	3,871	1.0%	4,069	0.9%	4,255	1.0%
18	903	0.2%	914	1.8%	997	2.0%	1,100	1.8%	1,200	1.6%	1,298	1.4%	1,391	1.5%
19	523	0.2%	529	1.8%	578	1.4%	620	1.3%	661	1.2%	700	1.0%	734	1.1%
Study Area Total	48,536	1.1%	51,222	1.5%	55,164	1.5%	59,533	1.4%	63,812	1.3%	67,902	1.1%	71,891	1.3%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census, and AAPR is an abbreviation for Average Annual Percent Change.

Figure 4.3 visually portrays the total forecasted change in households in the study area, within the adjusted data set, between 2010 and 2040 by TAZ. Growth in the number of households is lowest in virtually all the TAZs east of US 601. Pockets of more aggressive growth in households is forecast to occur in the western TAZs, both to the north and south of US 74.

4.2.4 Study Area Employment

Table 4.7 presents study area employment projections by superzone for each model year. No adjustments were made to study area employment projections contained within the model.

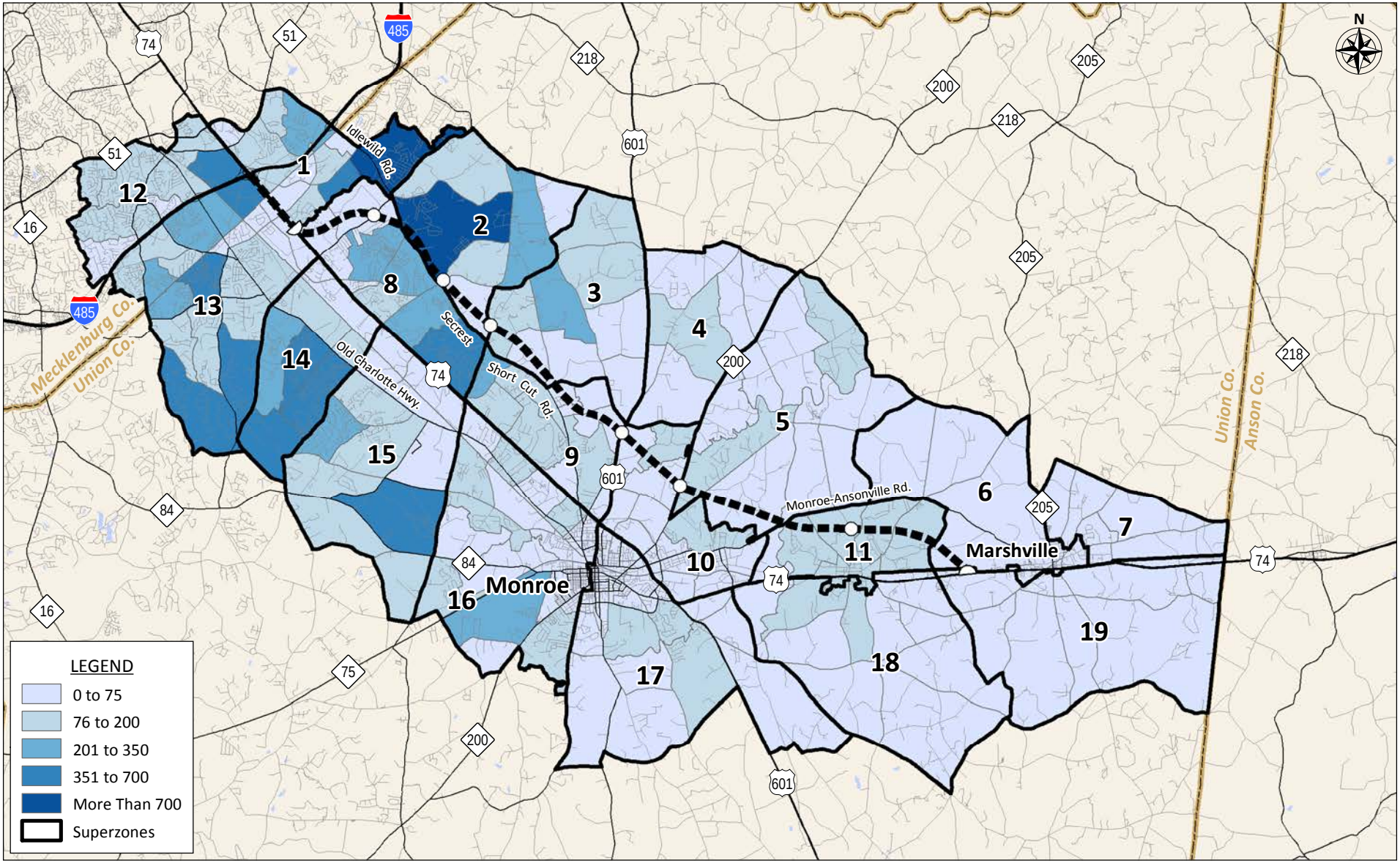
The most rapid growth in employment is expected in Superzone 2, Superzone 3 and Superzone 5, each of which is expected to increase at an average annual rate in excess of 3.0 percent between 2010 and 2040. In absolute terms, Superzone 13 is expected to add the greatest number of jobs (approximately 9,000) over the same 30-year period. This accounts for more than 20 percent of the total increase in employment in the study area between 2010 and 2040.

Figure 4.4 portrays the total forecasted change in employment in the study area, within the adjusted data set, between 2010 and 2040 by TAZ. Larger employment increases are generally forecast to occur along the US 74 corridor compared to the surrounding TAZs.

4.2.5 Study Area Summary

Table 4.8 presents a bottom-line summary of adjustments made to population, household and employment forecasts within the study area. Differences between the original MRM15v1.1 data set and the adjusted data set are presented on an absolute and percent basis for all model years. Growth rates for the 30-year period from 2010 to 2040 are also provided for comparison.

Adjustments to 2015 population and household projections within study-area TAZs totaled negative 3.6 percent and negative 3.8 percent, respectively. By 2040, adjustments to population and household forecasts totaled negative 4.4 percent and negative 5.0 percent, respectively. The resultant impact on 30-year AAPC was a decrease from 1.5 percent to 1.3 percent for both population and households.



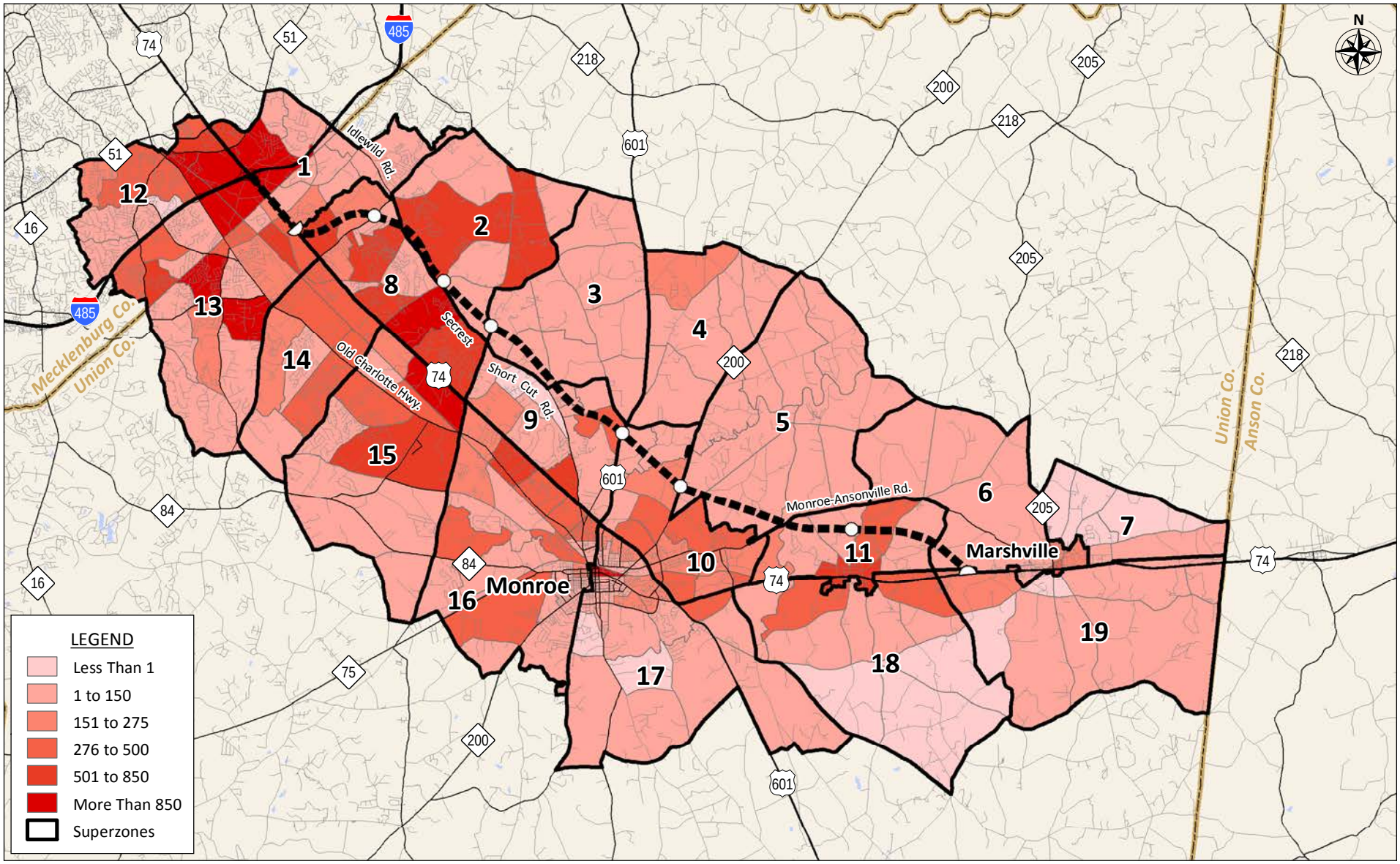
TOTAL CHANGE IN HOUSEHOLDS BY TAZ WITHIN THE ADJUSTED DATASET FROM 2010-2040

FIGURE 4.3

Table 4.7
Study Area Employment Forecasts by Superzone - MRM15v1.1

	MRM15v1.1 Data													
Superzone	2010	AAPC 2010-15	2015	AAPC 2015-20	2020	AAPC 2020-25	2025	AAPC 2025-30	2030	AAPC 2030-35	2035	AAPC 2035-40	2040	AAPC 2010-40
1	2,835	3.5%	3,359	3.0%	3,887	1.6%	4,200	1.5%	4,519	1.8%	4,933	1.5%	5,316	2.1%
2	880	10.5%	1,448	2.6%	1,649	1.8%	1,807	1.7%	1,970	2.0%	2,179	1.7%	2,369	3.4%
3	250	7.6%	361	2.4%	407	2.1%	451	2.0%	499	2.7%	570	1.6%	617	3.1%
4	306	5.2%	395	2.0%	437	1.7%	476	1.5%	513	2.2%	572	1.3%	610	2.3%
5	170	11.0%	287	2.3%	322	3.2%	377	2.0%	417	3.5%	495	1.6%	536	3.9%
6	1,862	2.9%	2,145	0.9%	2,248	1.2%	2,391	1.1%	2,520	1.3%	2,689	1.1%	2,835	1.4%
7	129	2.1%	143	0.8%	149	2.6%	169	1.8%	185	2.3%	207	1.8%	226	1.9%
8	7,458	3.4%	8,798	1.3%	9,375	1.2%	9,943	1.0%	10,450	1.2%	11,066	1.0%	11,637	1.5%
9	3,278	1.9%	3,596	0.8%	3,749	1.4%	4,014	1.0%	4,215	1.2%	4,473	1.0%	4,710	1.2%
10	7,399	3.0%	8,579	0.9%	8,977	1.1%	9,505	0.8%	9,871	0.9%	10,318	0.8%	10,728	1.2%
11	2,110	3.9%	2,551	1.1%	2,701	1.6%	2,918	1.2%	3,090	1.3%	3,304	1.2%	3,499	1.7%
12	10,233	1.8%	11,169	1.6%	12,077	0.9%	12,660	0.9%	13,213	1.1%	13,923	0.9%	14,597	1.2%
13	9,140	6.3%	12,384	1.9%	13,637	1.5%	14,655	1.4%	15,672	1.6%	16,965	1.4%	18,177	2.3%
14	3,991	3.0%	4,634	1.2%	4,920	1.0%	5,174	1.0%	5,430	1.2%	5,754	1.0%	6,043	1.4%
15	5,792	3.2%	6,773	1.3%	7,210	1.5%	7,764	1.1%	8,213	1.3%	8,760	1.1%	9,273	1.6%
16	8,826	2.4%	9,942	1.1%	10,524	1.1%	11,130	1.0%	11,692	1.2%	12,419	1.0%	13,061	1.3%
17	8,475	1.9%	9,310	1.6%	10,064	0.7%	10,400	1.0%	10,939	1.2%	11,632	1.0%	12,238	1.2%
18	1,119	3.9%	1,355	2.7%	1,547	1.1%	1,633	1.6%	1,768	2.0%	1,950	1.5%	2,101	2.1%
19	968	1.9%	1,061	1.1%	1,120	1.0%	1,177	0.9%	1,232	1.4%	1,318	0.9%	1,380	1.2%
Study Area Total	75,221	3.3%	88,290	1.5%	95,000	1.2%	100,844	1.1%	106,408	1.3%	113,527	1.1%	119,953	1.6%

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.



TOTAL CHANGE IN EMPLOYMENT BY TAZ WITHIN THE UNADJUSTED DATASET FROM 2010-2040

FIGURE 4.4

Table 4.8
Study Area Summary of Adjustments

Economic Input	2010	Forecast Year 2015	2020	2025	2030	2035	2040	AAPC 2010-40
Population								
MRM15v1.1 Data	140,254	153,767	165,956	179,129	192,141	204,461	216,685	1.5%
Adjusted Data	140,254	148,255	159,999	172,122	184,104	195,630	207,052	1.3%
Difference		-5,512	-5,957	-7,007	-8,037	-8,831	-9,633	
Percent Difference		-3.6%	-3.6%	-3.9%	-4.2%	-4.3%	-4.4%	
Households								
MRM15v1.1 Data	48,536	53,247	57,376	62,187	66,901	71,322	75,638	1.5%
Adjusted Data	48,536	51,222	55,164	59,533	63,812	67,902	71,891	1.3%
Difference		-2,025	-2,212	-2,654	-3,089	-3,420	-3,747	
Percent Difference		-3.8%	-3.9%	-4.3%	-4.6%	-4.8%	-5.0%	
Employment								
MRM15v1.1 Data	75,221	88,290	95,000	100,844	106,408	113,527	119,953	1.6%
Adjusted Data	75,221	88,290	95,000	100,844	106,408	113,527	119,953	1.6%
Difference		0	0	0	0	0	0	
Percent Difference		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	

Note: MRM15v1.1 socioeconomic data for 2010 were derived from the 2010 U.S. Census.
AAPC is an abbreviation for Average Annual Percent Change.

Chapter 5
Model Calibration

The traffic and toll revenue potential of the Monroe Expressway was analyzed using the Metrolina Regional Travel Demand Model 2015 Version 1.1 (MRM15v1.1 or MRM). In the fall of 2015, CDM Smith obtained a working version of the MRM15v1.1 and the model documentation. The official base year of the MRM15v1.1 is 2010, which incorporates 2010 US Census data. The model forecast years include 2015, 2025, 2030 and 2040. CDM Smith used the 2015 model year as the new base year, and calibrated to 2015 conditions. The calibration effort focused on the detailed study area which is shown in green shading in Figure 3.1. and highlighted in Figure 4.1.

The MRM15v1.1 was calibrated first for traffic volumes, then for observed travel speeds and finally for observed sample trip distances on US 74 within the study corridor. Each of these variables impact each other, thus necessitating an iterative process to achieve the desired results for each target metric.

Calibration involves modifying the model's internal parameters so that the model reflects current observed conditions. This chapter provides a summary of the degree to which the output of the base-year travel demand model matches observed data.

Actual data metrics used for calibration included 1) available traffic counts from NCDOT, 2) traffic counts conducted by The Traffic Group, 3) INRIX travel time and speed data, and 4) sample trip distance distributions, primarily on US 74, obtained from ALPR surveys. Details of the data collection efforts and a summary of the collected data described in Chapter 2 of this report and in the ***Monroe Expressway – Data Collection*** memorandum dated December 18, 2015.

In order to demonstrate that the 2015 base-year model sufficiently represents existing conditions, the following comparisons were made between model results and observed field data:

1. Model traffic-volume output compared to traffic counts at locations along seven screenlines;
2. Model traffic-volume output compared to traffic counts located on US 74;
3. Model travel-speed output compared to 2015 INRIX travel speed data; and
4. Comparisons of select trip lengths on US 74 derived from ALPR surveys compared to model output.

5.1 Traffic Volume Calibration Results

One assessment of model calibration is whether the total assigned screenline volume compares well with actual traffic counts. The level of difference between counts and volumes may vary between individual links, but if the total assigned volume crossing the screenline is reasonably close to actual counts, this is an indication that the general level of traffic and travel patterns is fairly well represented by the model.

As mentioned previously, the model calibration was performed at 2015 levels. Calibrated model was compared to average weekday traffic volumes as the model is a weekday model. An evaluation was conducted by comparing traffic counts with 2015 model output. Various criteria, including minimizing the root mean square error (RMSE), volume count comparisons and GEH statistic (a commonly used

method for comparing two sets of traffic volumes) were used to test model refinements as subsequent calibration tests were performed.

Figure 5.1 shows the location of traffic count screenlines within the detailed study area. As shown in the figure, seven screenlines were developed for this study. All of these screenlines are drawn perpendicular to US 74, capturing roads parallel to the Monroe Expressway. The Monroe Expressway will pull traffic from these roads. Screenlines 2 through 6 pass through the Monroe Expressway project alignment.

Base year calibration adjustments were conducted to obtain reasonable matches between the observed and estimated traffic volumes at screenline count locations. **Table 5.1** provides a comparison of unadjusted MRM screenline volumes and corresponding traffic counts. The first column shows the combined average weekday traffic (AWDT) count across each screenline, while the second and third columns show the pre-and-post calibration MRM results, respectively. Despite an overall difference of only 1.4 percent, four of the seven screenline volume totals differed from corresponding traffic counts by more than 20.0 percent within the pre-calibration results. The calibration process drastically improves this variance and brings the greatest difference down to 1.7 percent. The combined total volume across all screenlines is approximately 0.1 percent above the average weekday counts within the post-calibration results.

Table 5.1
Comparison of Assigned Model Volumes with Actual Counts by Screenline Location

		Pre-Calibration		Post-Calibration	
Screenline ID	Count	Model Output	Difference from Data	Model Output	Difference from Data
1	189,480	229,172	20.9%	188,993	-0.3%
2	163,372	172,726	5.7%	162,634	-0.5%
3	123,939	129,143	4.2%	123,907	0.0%
4	107,628	71,652	-33.4%	109,408	1.7%
5	89,668	102,566	14.4%	89,886	0.2%
6	55,924	41,914	-25.1%	55,748	-0.3%
7	27,624	20,922	-24.3%	27,722	0.4%
Totals	757,635	768,095	1.4%	758,300	0.1%

Figure 5.2 presents a scatter plot comparing post-calibration model volumes versus observed traffic volumes for each of the 154 count locations contained within the 7 screenlines. The comparisons are shown for the four time-periods modeled in this study – AM Peak, Midday, PM Peak and Overnight. These figures show traffic counts plotted against corresponding model output for each time period. Each scatterplot is fitted with a trend line, and the corresponding equation and R^2 value is printed on each. Trend line factors close to 1.00 represent calibrations that are close to observed conditions. The regression line shows that the calibrated 2015 CDM Smith base-year model matches observed traffic closely at most locations, i.e., the plot of model volumes compared to observed traffic volumes is close to the y=x line, and there are no extreme outliers. Overall the model appears to have a very reasonable R^2, or "goodness-of-fit", greater than 0.99.

Table 5.2 presents 2015 base-year volume calibration results for the 15 classification count locations (conducted by The Traffic Group) on US 74 and several other roads that are alternatives to US 74. The

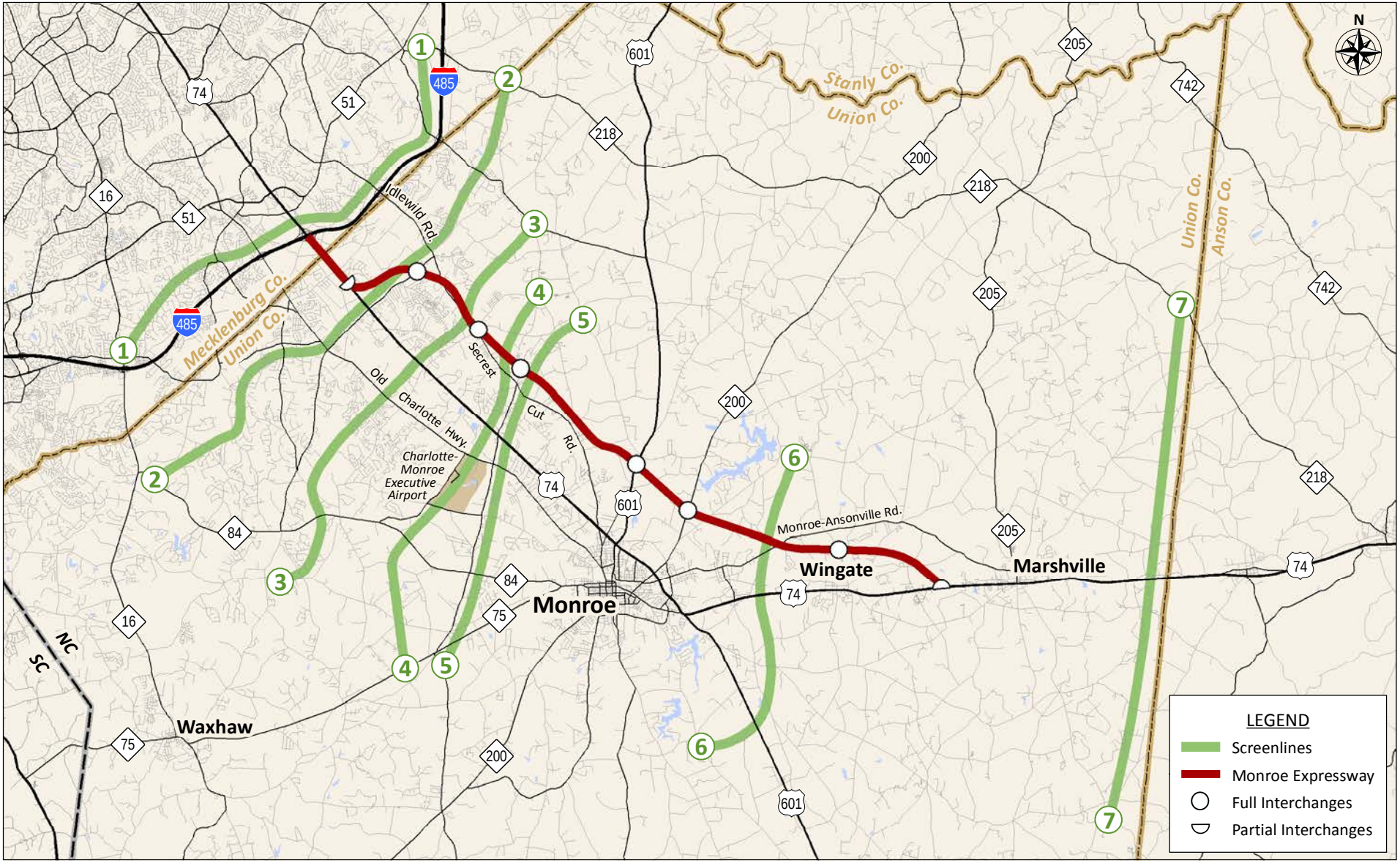
location of each count station is portrayed in Figure 2.1 and described in Table 2.1. Stations 1 through 7 are particularly important as US 74 is the source of the majority of traffic that will shift to the Monroe Expressway. Traffic count volumes presented in Table 5.2 represent three-day weekday averages (Tuesday, Wednesday, Thursday). Pre-calibration results showed variances ranging from 23.9 percent to negative 80.7 percent between traffic counts and model output. Post-calibration results showed variances ranging from 1.2 percent to negative 1.9 percent, while 13 of the 15 locations had a variance of just plus or minus 0.5%.

Table 5.2

Comparison of Assigned Model Volumes with Actual Counts at Classification Count Locations

Station ID	Road	Average Weekday (1)	Pre-Calibration		Post-Calibration	
			Model Output	Difference from Data	Model Output	Difference from Data
1	US 74	60,011	74,369	23.9%	60,736	1.2%
2	US 74	48,637	59,421	22.2%	48,790	0.3%
3	US 74	41,138	44,710	8.7%	41,232	0.2%
4	US 74	45,634	40,737	-10.7%	45,752	0.3%
5	US 74	50,853	29,940	-41.1%	50,914	0.1%
6	US 74	29,810	15,716	-47.3%	29,769	-0.1%
7	US 74	20,816	9,732	-53.2%	20,799	-0.1%
8	Old Charlotte Highway	26,904	24,833	-7.7%	27,045	0.5%
9	North Charlotte Avenue	11,852	7,981	-32.7%	11,630	-1.9%
10	Idlewild Road	21,992	22,211	1.0%	21,993	0.0%
11	Secrest Short Cut Road	10,348	8,786	-15.1%	10,393	0.4%
12	Secrest Short Cut Road	9,704	11,991	23.6%	9,703	0.0%
13	NC 84	9,429	10,515	11.5%	9,385	-0.5%
14	NC 200	10,699	10,825	1.2%	10,702	0.0%
15	NC 218	7,968	1,536	-80.7%	7,945	-0.3%

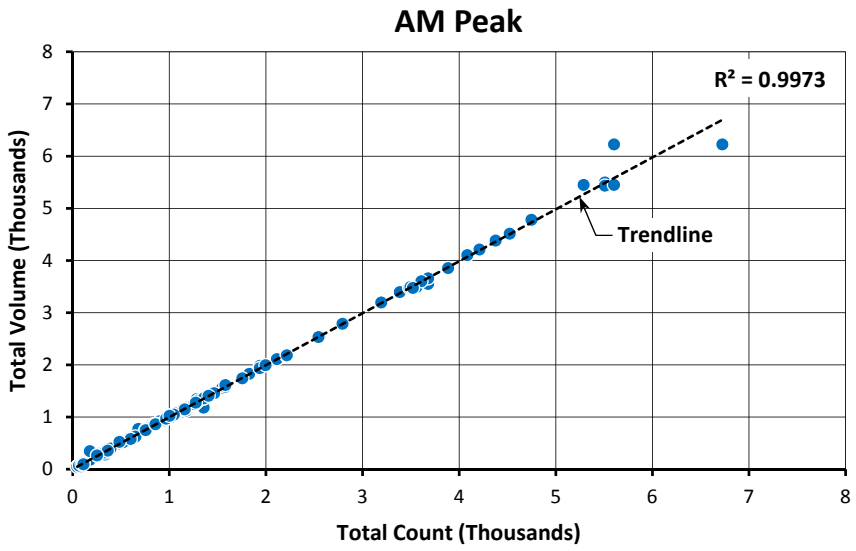
(1) Average weekday taffic volumes are based on a three-day internal weekday average including Tuesday, Wednesday and Thursday.

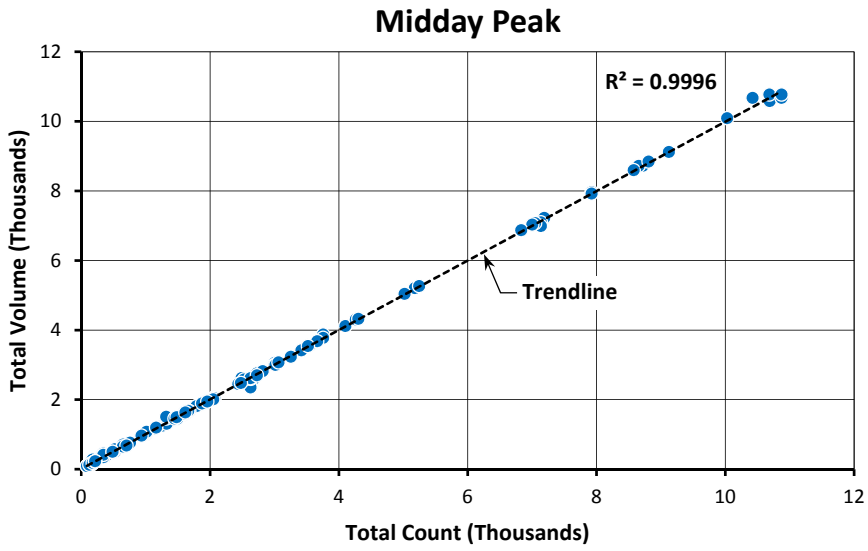


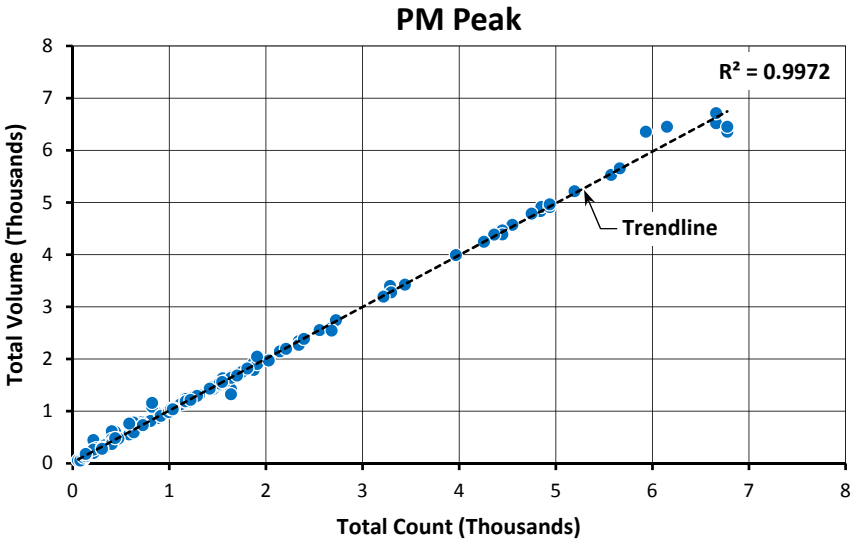
CDM Smith

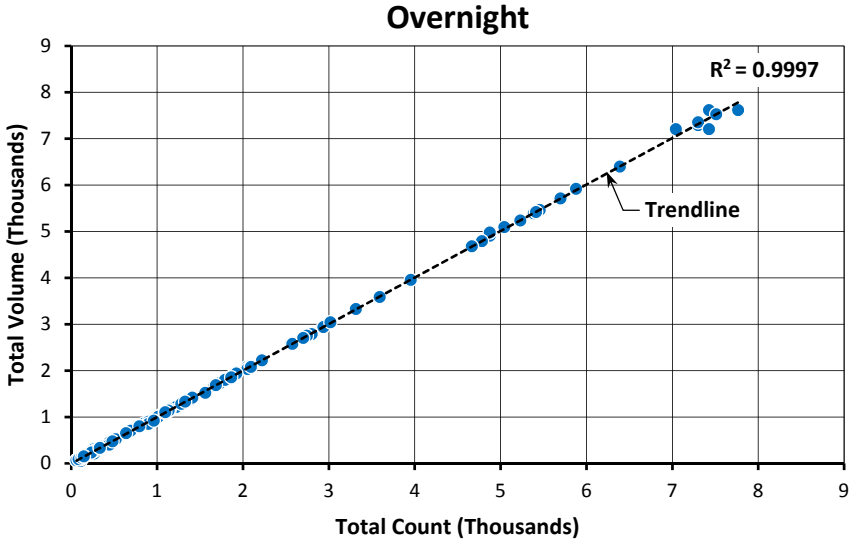
TRAFFIC SCREENLINES

FIGURE 5.1









CDM Smith

REGRESSION RESULTS FROM CALIBRATION

FIGURE 5.2

5.2 Travel Speed Calibration Results

In a well calibrated model, both traffic volumes and travel times must be accurately represented. This section compares model output with INRIX travel speeds on US 74, the primary alternative route to the proposed Monroe Expressway.

Table 5.3 presents a weekday travel time comparison between the INRIX data and model output for a through trip on US 74 between Forest Hills School Road in Marshville and I-485 in Mathews. Comparisons are shown for three modeled time periods – AM Peak, Midday and PM Peak. A before-and-after calibration comparison is included in Table 5.3 to present the impacts of the calibration effort. Similar to the travel time data presented in Table 5.3, travel speed comparisons are shown in **Table 5.4**. US 74 speeds in the model are a little higher than the INRIX data, except during the Midday in the westbound direction. This is a conservative assumption when evaluating the Monroe Expressway as the primary competitor to US 74. Reducing the speeds on US 74 down to the INRIX averages was found to push more volume off of US 74 than desired.

Table 5.3
Comparison of US 74 Observed and Model Travel Times (in minutes)

			Pre-Calibration		Post-Calibration	
Direction	Time Period	INRIX Data	Model Output	Difference from Data	Model Output	Difference from Data
Westbound	AM	29.9	26.9	-2.9	26.9	-3.0
	MD	26.2	26.4	0.2	26.9	0.7
	PM	30.8	26.7	-4.1	27.7	-3.0
Eastbound	AM	26.9	26.8	0.0	27.0	0.2
	MD	28.5	26.6	-1.8	27.3	-1.2
	PM	31.2	27.6	-3.7	28.1	-3.2

Table 5.4
Comparison of US 74 Observed and Model Travel Speeds (in mph)

			Pre-Calibration		Post-Calibration	
Direction	Time Period	INRIX Data	Model Output	Difference from Data	Model Output	Difference from Data
Westbound	AM	38.0	42.6	4.6	42.6	4.6
	MD	44.0	43.6	-0.4	42.8	-1.2
	PM	37.0	43.1	6.1	41.5	4.5
Eastbound	AM	43.0	43.4	0.4	43.1	0.1
	MD	40.0	43.7	3.7	42.7	2.7
	PM	37.0	42.0	5.0	41.2	4.2

5.3 Automatic License Plate Recognition Survey

An ALPR survey was conducted for the primary purpose of identifying sample trip lengths along the study corridor, particularly on US 74. The ALPR survey was conducted at 12 locations from 5:30 AM to 7:00 PM on Thursday, October 22, 2015. These locations are shown in Figure 2.1. The ALPR survey effort consisted of recording license plate images by video camera and matching the plates across the survey locations to assist in determining weekday car and truck trip lengths on US 74 between Wingate and I-485. This data was beneficial to calibrating the model because motorists currently on US 74 are much more likely to use the Monroe Expressway for longer distance trips compared to very short trips, so trip length distributions may impact the travel demand on the Monroe Expressway. The collection efforts are described in Section 2.4.

Captured license-plate images were matched across survey stations and checked for reasonableness based on logical movements and travel time to identify unique trips. The results discussed in this section focus on US 74 during the peak travel periods. ALPR survey results for passenger cars during the AM Peak period on US 74 are summarized in the top box of **Table 5.5**. All movements reflect westbound trips along US 74. The station where a plate was first identified (the origin) is shown in the left column, while the last station where the same plate was identified (the destination) is shown across the top. The percent distribution of trips from each origin station are unique, thus, the sum of each row adds up to 100 percent. Each row describes movements that are identified as a percentage of the trips that started at a station and traveled far enough to be captured at a downstream station. For example, for passenger cars in the AM time period, 4 percent of trips with an origin at Station 7 went as far as Station 3 (but did not reach Station 2), another 4 percent had a destination that went as far as Station 2 (but did not reach Station 1), and 17 percent had a destination that went as far as Station 1, or beyond. Any trip that was captured at Station 7, but did not also pass through Stations 6, 5, 4, 3, 2, or 1, would not be represented in this table.

It is important to recognize that these matrices are not complete trip tables, as US 74 is not an access controlled road. US 74 has numerous access points. The trip distance matrices represent snapshots of specific locations, chosen to fall between major intersecting roads with US 74. However, the data was useful for adjusting trip distance distributions in the MRM.

As discussed previously, the 2015 MRM was initially calibrated to screenline traffic counts and counts along US 74 in the study corridor. Another series of calibration assignments were made to further calibrate to weekday travel speeds by time period. The calibration process resulted in changes to travel patterns within the model, including trip distance distributions. The final iterative calibration process involved re-adjusting trip distances where necessary.

Table 5.5 also contains the resulting passenger-car trip-distance distributions from the calibrated 2015 MRM for the AM Peak period. The resulting calibration shows that the number of the longest distance trips on US 74, from the model output, are underestimated compared to the survey data. For example, the survey data shows that about 17 percent of passenger cars entering Station 7 travel through station 1 (the longest possible trip), while the model output has only 11 percent of passenger car through trips. The longest distance trips are also underestimated for passenger cars entering from stations 6, 5, and 4. Some intermediate distance trips are somewhat over represented in the model output. Examples of this condition includes passenger cars entering from Station 6 and traveling through Station 3. Some movements match exactly, such as movements that entered Station 5 or 4, and traveled through Station 2. Very short distance trips are less likely to divert to the Monroe Expressway.

Table 5.6 compares trip-distance distributions between the 2015 calibrated model and the ALPR survey for passenger cars during the PM Peak period. The comparison shows similar patterns to the AM Peak period, in that the longest distance trips are under-represented in the calibrated model and the intermediate distance trips tend to be over represented.

It is not expected that the calibrated model output will replicate the trip-distance data. US 74 actual travel patterns are complicated due to an unlimited number of access points, while the model is constrained to access at intersections and at a limited numbers of centroid connectors. In addition, calibrating to traffic volumes and travel speeds alter travel patterns in numerous ways. In summary, the model was calibrated to reasonable parameters, and reflects a conservative calibration in that it does not over represent the longest distance trips that are more likely to use the Monroe Expressway.

Table 5.5
US 74 Survey Results vs. MRM Trip Distance Patterns – AM Peak

Entering At Westbound Survey Station		ALPR SURVEY						
		1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	60%	40%					
	4	44%	24%	32%				
	5	32%	16%	20%	32%			
	6	20%	10%	11%	18%	42%		
	7	17%	4%	4%	9%	17%	50%	

Entering At Westbound Survey Station		MRM POST-CALIBRATION						
		1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	45%	55%					
	4	22%	24%	54%				
	5	16%	16%	27%	41%			
	6	16%	16%	18%	21%	29%		
	7	11%	11%	11%	13%	15%	39%	

Table 5.6
US 74 Survey Results vs. MRM Trip Distance Patterns – PM Peak

Entering At Westbound Survey Station		ALPR SURVEY						
		1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	60%	40%					
	4	48%	26%	26%				
	5	37%	14%	10%	40%			
	6	20%	8%	6%	19%	47%		
	7	23%	5%	3%	7%	21%	42%	

Entering At Westbound Survey Station		MRM POST-CALIBRATION						
		1	2	3	4	5	6	7
US 74	1							
	2	100%						
	3	46%	54%					
	4	29%	33%	39%				
	5	13%	18%	21%	47%			
	6	12%	12%	13%	21%	42%		
	7	8%	8%	8%	11%	17%	49%	

Chapter 6
Traffic and Revenue Analysis

This chapter presents a summary of the traffic and revenue analysis conducted for the Monroe Expressway. In addition to an overview of the travel demand modeling process, this chapter also presents information about the regional highway improvement program, basic assumptions and modeling inputs, the toll sensitivity analysis, recommended toll rates, and the Base Condition traffic and toll revenue forecasts for the Monroe Expressway.

6.1 Analytical Methodology

The modeling process used to analyze the traffic and toll revenue potential of the Monroe Expressway is depicted in **Figure 6.1**. The following describes the major steps in the modeling process.

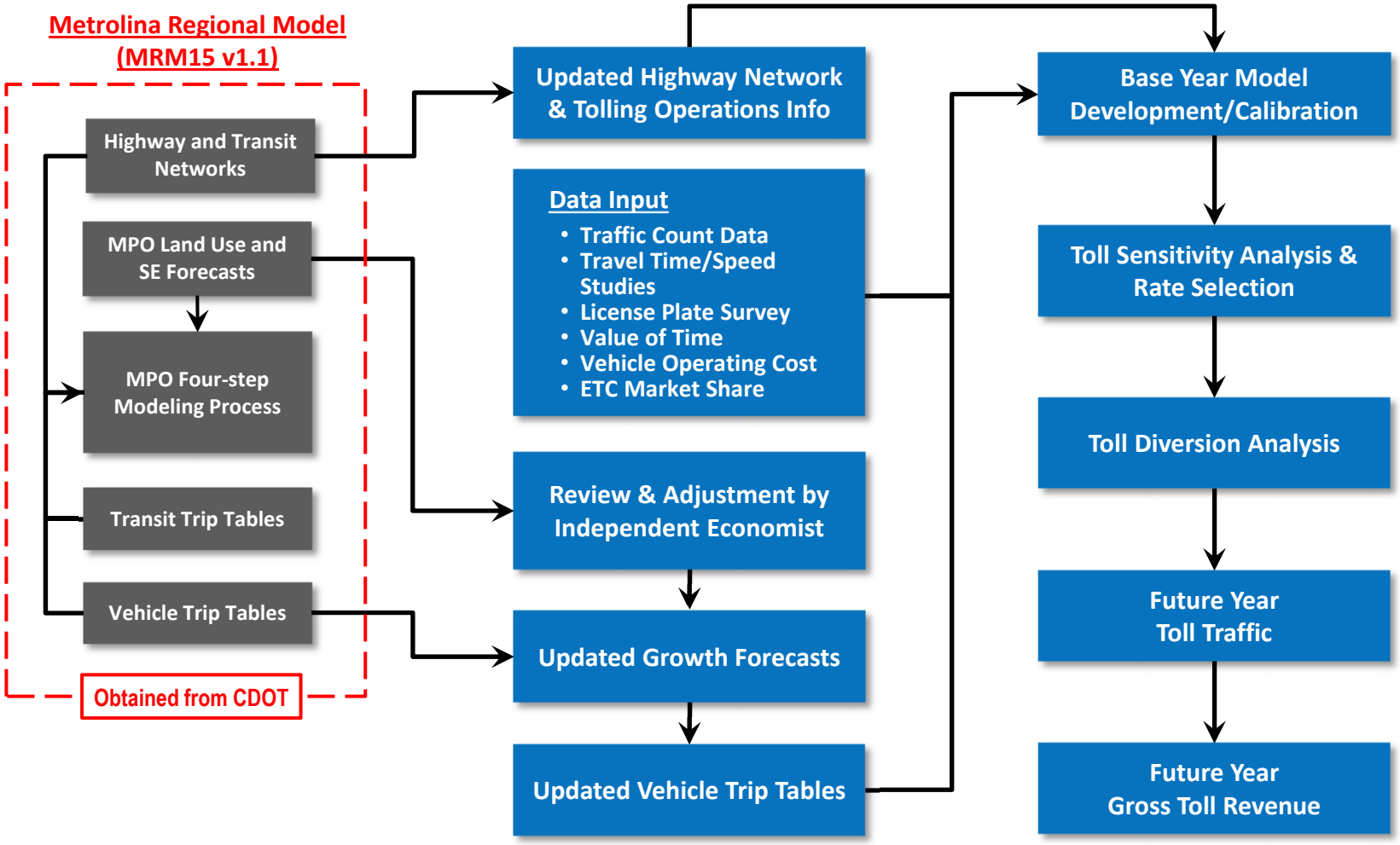
As described in Chapter 3, Section 3.1, the modeling process was initiated by obtaining the Metrolina Regional Model, specifically the MRM15v1.1. This model's base year is 2010, which reflects 2010 US Census data. The MRM supports future years 2015, 2025, 2030 and 2040. The MRM includes highway and transit networks and land-use and socio-economic data for each model year. Transit and vehicle trip tables are derived from the model.

CDM Smith reviewed and modified the highway network as described in Chapter 3. These modifications included disaggregating TAZs, changing centroid connections, and adding additional roads or road segments to the networks. A comparison was also made between the 2015 network and actual ground conditions observed in aerials available on the internet. These comparisons were made to validate the 2015 network in the study area against current conditions. No substantive changes to distances, access points, or number of lanes were required.

Data inputs necessary for calibrating the model and using the model to develop toll transaction and revenue forecasts was obtained and analyzed by CDM Smith. This data included:

1. Traffic count data;
2. Travel time and speed data;
3. License plate survey data;
4. Current values of time;
5. Current vehicle operating costs; and
6. ETC market share.

A major analytical component of the modeling process was the independent review of the underlying socioeconomic assumptions in the MRM. This was undertaken by Dr. Appold, an economist with recognized expertise in the area's land-use and socioeconomic profile. Adjustments to the socioeconomic data in the MRM were made by the economist for all forecast model years. After a review by CDM Smith, the economic adjustments were incorporated into the MRM model resulting in updated vehicle trip tables that reflected new growth forecasts.



CDOT: Charlotte Department of Transportation.

CDM Smith

MODELING PROCESS FOR TOLL ROAD ANALYSIS

FIGURE 6.1

All the new data inputs and the updated vehicle trip tables were incorporated into the MRM forecast years (2015, 2025, 2030 and 2040). The next step was to calibrate the 2015 model to existing conditions in the study area. Calibration included comparing the model output against known traffic volumes and travel speeds on area roads. In addition, the trip distance distributions acquired by the ALPR survey were used in calibration to adjust model trip distances on US 74. The calibration results were described in Chapter 5. Changes in the model necessary to achieve calibration in 2015 were carried forward into the future year networks. Based on the revised model, a 2019 model year was created that contains the Monroe Expressway project coding, as the Expressway is assumed to open on January 1, 2019.

Toll sensitivity analysis was conducted for the opening year (2019) to determine the "optimal" toll rate that should be assessed. This was accomplished by running a series of toll assignments at progressively higher toll rates, and evaluating the resulting toll transactions and toll revenue on the Expressway. "Optimal" can mean different things; in this case, optimal refers to a point on the curve that nearly maximizes toll revenue, yet leaves some room to make some upward adjustments in rates should the need arise. Once the 2019 toll rates were identified, the toll rates were developed for the future years, assuming that the toll rates would be adjusted annually to keep up with inflation.

Once the toll rates were selected for 2019, for Electronic Toll Collection (ETC) and Video Toll Collection (VTC), a series of assignments were made for years 2019, 2025, 2030 and 2040 to develop the traffic and revenue estimates for the Monroe Expressway. These assignments were run for four time periods, by cars and trucks, and by two methods of payment (ETC and VTC). The assignments compared the travel time and distance for a trip path on the Monroe Expressway with a path on the best toll-free alternative route. The estimated traffic that would be expected to use the toll road is a function of 1) the travel time saved and the distance saved, 2) the assumed monetary value of these savings, and 3) the toll rate being tested in any given assignment. In general, as the total costs to use the proposed toll road increase, estimated usage of the toll road decreases. The model recognizes capacity constraints on roadways. Speeds for future-year forecasts are calculated based on volume to capacity ratios and reflect increasing congestion over time on both the proposed toll facility and existing toll free roads.

The toll diversion assignments result in forecasts of calendar-year average annual weekday tolled traffic by toll zone on the Monroe Expressway for the assignment years. Intermediate year traffic volumes were interpolated. Toll transactions for the years subsequent to the available model years were developed by assuming an annual increase in traffic based on decreasing the prior trend line.

Annual gross toll revenue estimates were developed from the average annual weekday transactions (AAWDTs) by annualizing the tolled traffic estimates to take into account weekend day traffic and holidays, and calculating the annual gross toll revenue. The traffic and toll revenue forecasts were developed for calendar years because the MRM model operates on a calendar year basis. The forecasts were then converted to the NCDOT fiscal year, which begins on July 1. The gross toll revenue does not include adjustments for uncollectible revenue or fee revenue associated with VTC. These adjustments were added as a last step based on actual experience from the Triangle Expressway, which has been in operation as a toll facility since January 3, 2012.

6.2 Modeling Inputs

This section describes key inputs to the model that influence the traffic and toll revenue analysis process.

6.2.1 Toll Collection

Toll collection for the Monroe Expressway is assumed to be consistent with the existing toll collection methods used on the Triangle Expressway. The Monroe Expressway will operate as an all-electronic tolling (AET) system. This system will allow motorists to pay their toll without stopping or slowing down. Instead of passing through a conventional toll booth, an overhead toll collection system will be mounted to a gantry, a structure elevated over the road. As the motorist passes under the gantry, either an ETC transponder is read and the toll is automatically charged to the transponder account, or a photo is taken of the license plate and the registered owner of the vehicle will receive a Bill By Mail (BBM) invoice in the mail. An AET system generally provides a safer, quicker, and more convenient experience for motorists.

On the Monroe Expressway, tolls will be collected via NC Quick Pass (NCDOT's ETC program) or by BBM (NCDOT's VTC Program). The NC Quick Pass program is currently interoperable with Georgia's Peach Pass, Florida's Sun Pass and E-ZPass. A map of states with NC Quick Pass interoperable ETC programs is shown in **Figure 6.2**. Throughout this study, ETC refers to NC Quick Pass and the other interoperable systems. This interoperability arrangement is assumed to continue through the forecast period of this study.

All vehicles will be permitted to use the Monroe Expressway. The following three toll classes will be implemented:

- Class 1 (2-axle vehicles): includes all two-axle vehicles regardless of the number of tires.
- Class 2 (3-axle vehicles): includes all three-axle vehicles including two-axle vehicles towing a single-axle trailer.
- Class 3 (4-or-more axle vehicles): includes all vehicles with four-or-more axles (4+) including two-axle vehicles towing a dual-axle trailer.

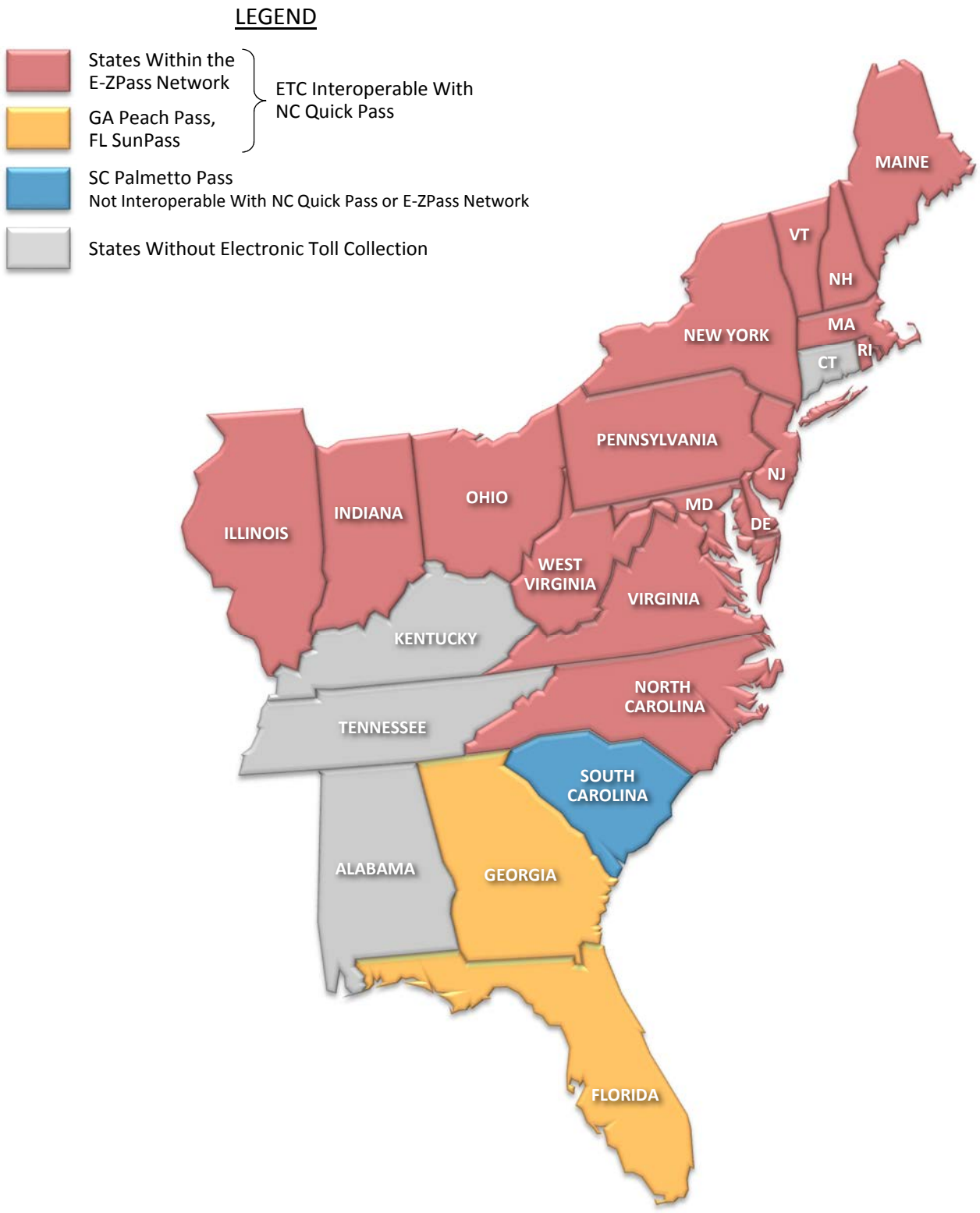
Motorists who pay with NC Quick Pass (or interoperable systems) will receive a 35 percent discount off of the BBM rates for all vehicle toll classes. All Class 2 toll rates will equal two times the Class 1 toll rate, and Class 3 toll rates will equal four times the Class 1 toll rate.

6.2.2 ETC Market Share

The assumed future market shares of ETC and BBM transactions is an important input into the traffic demand model. ETC transactions are at less "risk" of non-payment compared to BBM transactions, which are more prone to "leakage" or non-payment for a variety of reasons. CDM Smith developed ETC and BBM market shares for modeling years 2019, 2025, 2030 and 2040 based on actual experience from the Triangle Expressway and other AET facilities in the US.

Table 6.1 presents total annual weekday toll transactions by ETC and BBM on the Triangle Expressway from its opening year in 2012 through the second quarter of 2015. The ETC market share totaled 49.2 percent in 2012, 57.5 percent in 2013 and 58.1 percent in 2014. Through the second quarter of 2015, the ETC market share totaled 58.3 percent. It appears that the rate of increase in annual ETC market share after 2013 has been quite modest.

The Monroe Expressway is likely to be the second dedicated toll road in North Carolina in 2019, after the Triangle Expressway in the Raleigh area. The I-77 Express lanes project in Charlotte is expected to open in late 2017. Due to the small number of operating toll roads in the state, there won't likely be a



ETC INTEROPERABILITY WITH NC QUICK PASS

FIGURE 6.2

large population of motorists with an NC Quick Pass Account. There will be a positive benefit from North Carolina's proximity to other states with toll facilities that use E-ZPass, as shown previously in Figure 6.2.

Table 6.1
Observed Weekday ETC Market Share on the Triangle Expressway

Calendar Year	Number Of Annual Weekday Transactions			Percent Market Share By Transactions		
	ETC	BBM	Total	ETC	BBM	Total
2012	2,806,662	2,901,039	5,707,701	49.2	50.8	100.0
2013 (1)	13,258,229	9,800,970	23,059,199	57.5	42.5	100.0
2014	17,801,006	12,849,303	30,650,309	58.1	41.9	100.0
2015 (2)	10,378,659	7,431,990	17,810,649	58.3	41.7	100.0

1) The last section of the Triangle Expressway opened to toll traffic on 1/3/2013, from US 64 to NC 55.
2) Data through June 2015.

Source: North Carolina Turnpike Authority Operations Statistics Report

Future-year estimates of ETC and BBM annual weekday market shares for the Monroe Expressway are presented in **Table 6.2** for modeling years 2019, 2025, 2030 and 2040. The estimated percent market shares were developed for Class 1 vehicles (2-axle vehicles) and combined Class 2 and 3 vehicles (3 and 4+ axle vehicles). Weekday market shares are presented because the MRM model represents weekday traffic volumes.

The ETC market share for Class 1 vehicles is estimated to total about 59 percent in 2019, and increase to about 61, 64 and 68 percent in 2025, 2030 and 2040, respectively. These increases represent average annual increases of about 0.4 percentage points per year. Commercial vehicles (Classes 2 and 3 combined are anticipated to have higher ETC participation rates, starting at about 70 percent in 2019, and increasing to about 71, 72 and 74 percent in 2025, 2030 and 2040, respectively.

Table 6.2
Assumed Annual Weekday ETC Market Share on the Monroe Expressway

Calendar Year	Class 1 Vehicles			Class 2 and 3 Vehicles		
	ETC	BBM	Total	ETC	BBM	Total
2019 (1)	59.0	41.0	100.0	70.0	30.0	100.0
2025	61.5	38.5	100.0	71.0	29.0	100.0
2030	64.0	36.0	100.0	72.0	28.0	100.0
2040	68.0	32.0	100.0	74.0	26.0	100.0

1) Assumes the entire Monroe Expressway opens on January 1, 2019.

6.2.3 Value of Time

Estimates of motorist Value of Time (VOT) were calculated based on median household income data in the MRM model. The data was available for each traffic analysis zone (TAZ) in the model. In aggregate, based on weighted trips for each TAZ in the model, the 2015 passenger-car VOT is estimated to equal $10.40 per hour (or $0.173 per minute) in the project corridor. Values of time for commercial vehicles were assumed to increase by a factor of 1.8. The VOTs were inflated annually for use in future-year assignments based on forecast inflation rates described in Section 6.2.5.

6.2.4 Vehicle Operating Cost

Vehicle Operating Costs (VOC) take into account the wear and tear on a vehicle as expressed in maintenance costs, tires, and other variable costs such as oil and fuel. A passenger-car operating cost of $0.168 per mile was estimated for 2015 based on the following data:

- The average cost of gasoline in the Lower Atlantic states provided by the Energy Information Administration.
- The average cost of tires and maintenance by passenger car vehicle type provided in the ***2014 Your Driving Costs*** report published by AAA.
- The passenger-car vehicle type distribution for the State of North Carolina published in the ***2014 National Automobile Dealers Association (NADA) Annual Report***.

Depreciation and insurance are not included in the operating cost.

By 2030, the average passenger-car vehicle operating cost is estimated to total $0.209 per mile. Operating costs for future years were developed based on: 1) forecasts of future crude oil prices, 2) assumed improvements in the average gas mileage associated with government-mandated fuel efficiency standards, and 3) inflation adjusted costs of tires and maintenance.

Commercial vehicle operating costs are much more difficult to calculate due to the variation in truck sizes and types and availability of corporate fleet information. For this study, the vehicle operating costs for commercial vehicle trips was assumed to be three times greater than passenger cars in 2015. This differential increases over time since anticipated fuel efficiency improvements for passenger vehicles are not assumed for commercial vehicles. By 2030, it was assumed that commercial vehicle operating costs were four times greater than passenger cars on a per mile basis.

6.2.5 Annual Inflation Rates

Toll rates, VOT and components of VOC are increased annually in the modeling process assuming they keep pace with inflation. Average annual inflation rates are shown in **Table 6.3** for various historical and forecast time periods. All inflation rates are for the Charlotte-Concord-Gastonia, NC-SC Metropolitan Statistical Area (Charlotte MSA), represented in **Figure 6.3**. Historically, the annual rate of inflation has averaged 2.2 percent from 1995 to 2000, 1.8 percent from 2000 to 2005 and 2.6 percent from 2005 to 2010. The average inflation rate decreased to 1.6 percent from 2010 to 2015, due in part to steeply decreasing gasoline and oil prices.

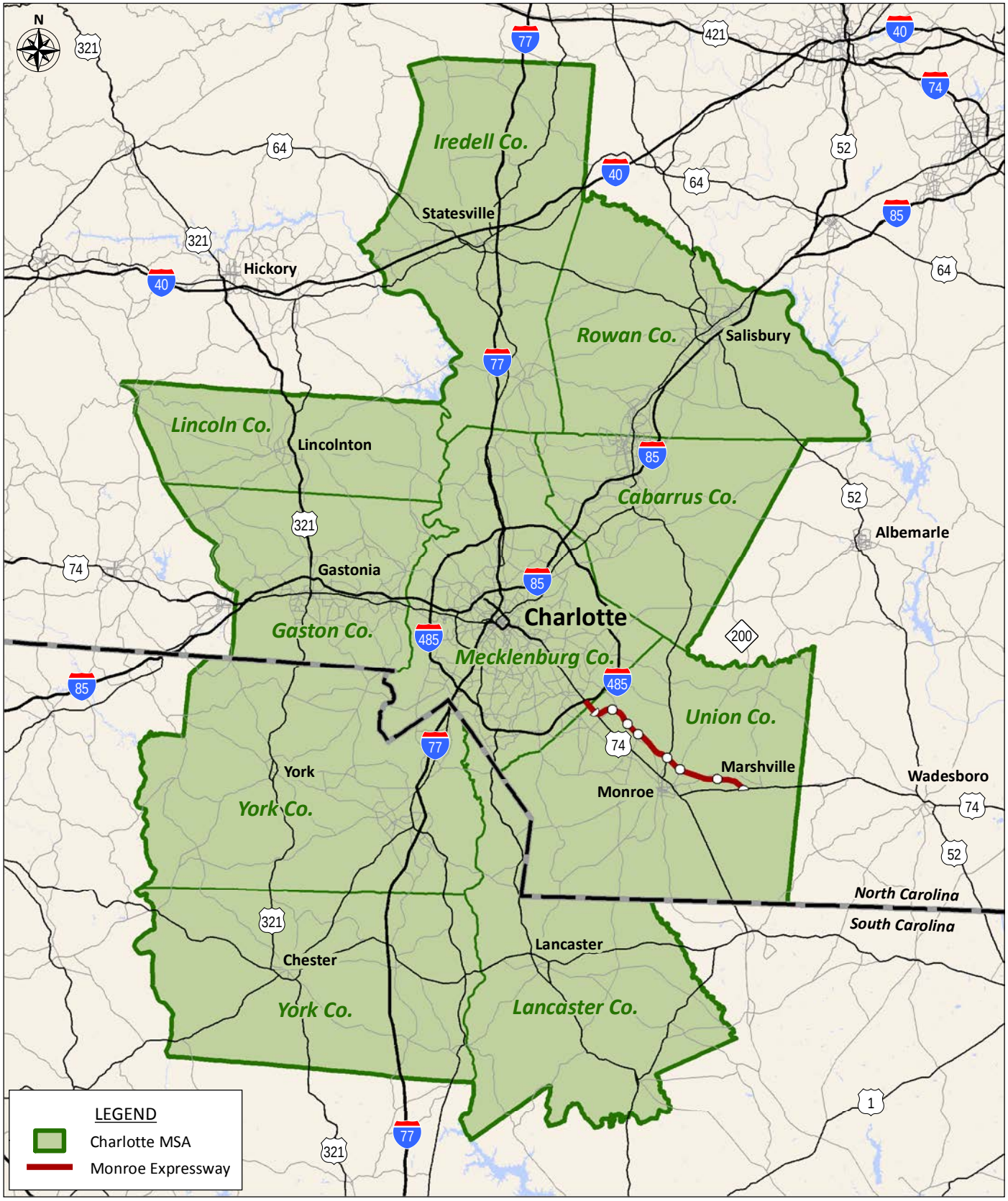
Annual forecasted CPI indices were obtained from Moody's Analytics for 2016 through 2045. As shown in Table 6.3, annual inflation is forecast to average 2.5 percent between 2015 and 2019, 2.3 percent between 2019 and 2025, and 2.1 percent after 2025. Annual inflation is forecast to average 2.2 percent

per year from 2015 to 2040, which equals the historical inflation rate of the past 25 years, from 1990 to 2015.

Table 6.3
Actual and Estimated Average Annual Inflation Rates [1]

Historical Time Period (2)	AAPC (4)
1995 - 2000	2.2%
2000 - 2005	1.8%
2005 - 2010	2.6%
2010 - 2015	1.6%
Forecast Time Period (3)	
2015 - 2019	2.5%
2019 - 2025	2.3%
2025 - 2030	2.1%
2030 - 2040	2.1%

1) Historical data and forecasts are for the Charlotte-Concord-Gastonia, NC-SC Metropolitan Statistical Area.
2) Based on Bureau of Labor Statistics CPI (Index 1982-84 = 100) data for all Urban Consumers through the third quarter of 2015.
3) Based on annual forecasts developed by Moody's Analytics, last updated . on 1/22/2016.
4) AAPC is an abbreviation for Average Annual Percent Change.



CHARLOTTE METROPOLITAN STATISTICAL AREA

FIGURE 6.3

6.3 Basic Assumptions

The traffic and revenue estimates for the Monroe Expressway are predicated on the following basic assumptions, which are considered reasonable for purposes of the base case forecast:

1. The Monroe Expressway, in its entirety as described in Section 3.2 Project Configuration, will open to traffic on January 1, 2019.

2. The configuration, number of lanes, and number of access points on the Monroe Expressway will not change during the forecast period.

3. Tolls will be charged for the three vehicle classes and two payment types described in Section 6.2.1 Toll Structure. The toll rates will be increased annually from the initial 2019 toll rates, to keep up with inflation. The toll rates and tolling zone locations are provided in Section 6.6 Recommended Toll Rates.

4. No transportation improvement projects, particularly new roads, additional road capacity, or new interchanges on limited access roads will be constructed during the forecast period, other than those included in the MRM15v1.1. Assumed roadway improvements are discussed in Section 6.4.

5. The annual percentage of ETC and BBM transactions will match the assumed market shares described in Section 6.2.2.

6. Economic growth in the project study area by TAZs will occur as forecast by the independent economist.

7. Revenue leakage due to unreadable or uncollectible ETC or BBM transactions, or any transactions that cannot be processed and payment collected, will occur. The adjustments made to gross toll revenue forecasts, to account for uncollectible toll revenue, are based on actual experience on the Triangle Expressway. If actual experience on the Monroe Expressway differs from the Triangle Expressway with regard to adjustments for uncollectible toll revenue, the resulting net toll revenue forecasts for Monroe Expressway will differ from those forecast in this study.

8. The leakage estimates contained in this report are dependent upon the selection of appropriate toll collection technology and the adoption of business rules and enforcement procedures designed to minimize the loss of revenue.

9. Annual inflation rates will average those presented in Section 6.2.5.

10. The Monroe Expressway will be well maintained, efficiently operated, effectively signed, and promoted to encourage maximum usage and to reach the assumed percentage goals for ETC usage.

11. Motor fuel will remain in adequate supply throughout the forecast period. Fuel price forecasts were obtained from the U.S. Energy Information Administration in a report titled *Annual Energy Outlook 2015 with projections to 2040.* The forecast fuel costs were incorporated into the estimated vehicle operating costs.

12. No national or regional emergency will arise that would abnormally restrict the use of motor vehicles.

Any significant departure from these basic assumptions could materially affect traffic and revenue potential on the Monroe Expressway.

6.4 Future Transportation Improvements

CDM Smith identified the roadway improvements assumed in the MRM15v1.1 network years 2015, 2025, 2030 and 2040. The assumed improvements in the MRM were compared against those listed in the State Transportation Improvement Program (STIP), and various planning documents in the MRM area obtained from Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs). The goal was two-fold:

1. To verify that roadway improvements listed in current transportation plans and long range plans are present in the MRM in the appropriate years, and

2. To identify roadway improvements that may substantially impact the travel demand on the Monroe Expressway.

The following are the documents that were reviewed in order to identify planned roadway improvements in the MRM model area.

1. ***NCDOT Current STIP, November 2015***

2. ***Cabarrus / Rowan Urban Area Metropolitan Planning Organization, Draft 2040 Metropolitan Transportation Plan, March 2014***

3. ***CRTPO 2040 Metropolitan Transportation Plan Air Quality Conformity Determination Report, March 2014***

4. ***The Way Forward: 2040 Metropolitan Transportation Plan, Gaston-Cleveland-Lincoln Metropolitan Planning Organization, Adopted March 27, 2014***

5. ***Rock Hill – Fort Mill Area Transportation Study FY 2014 – 19 TIP Financial Statement***

6. ***North Carolina Department of Transportation, Prioritization 4.0, NCDOT Strategic Prioritization Office of Transportation, July 2015***

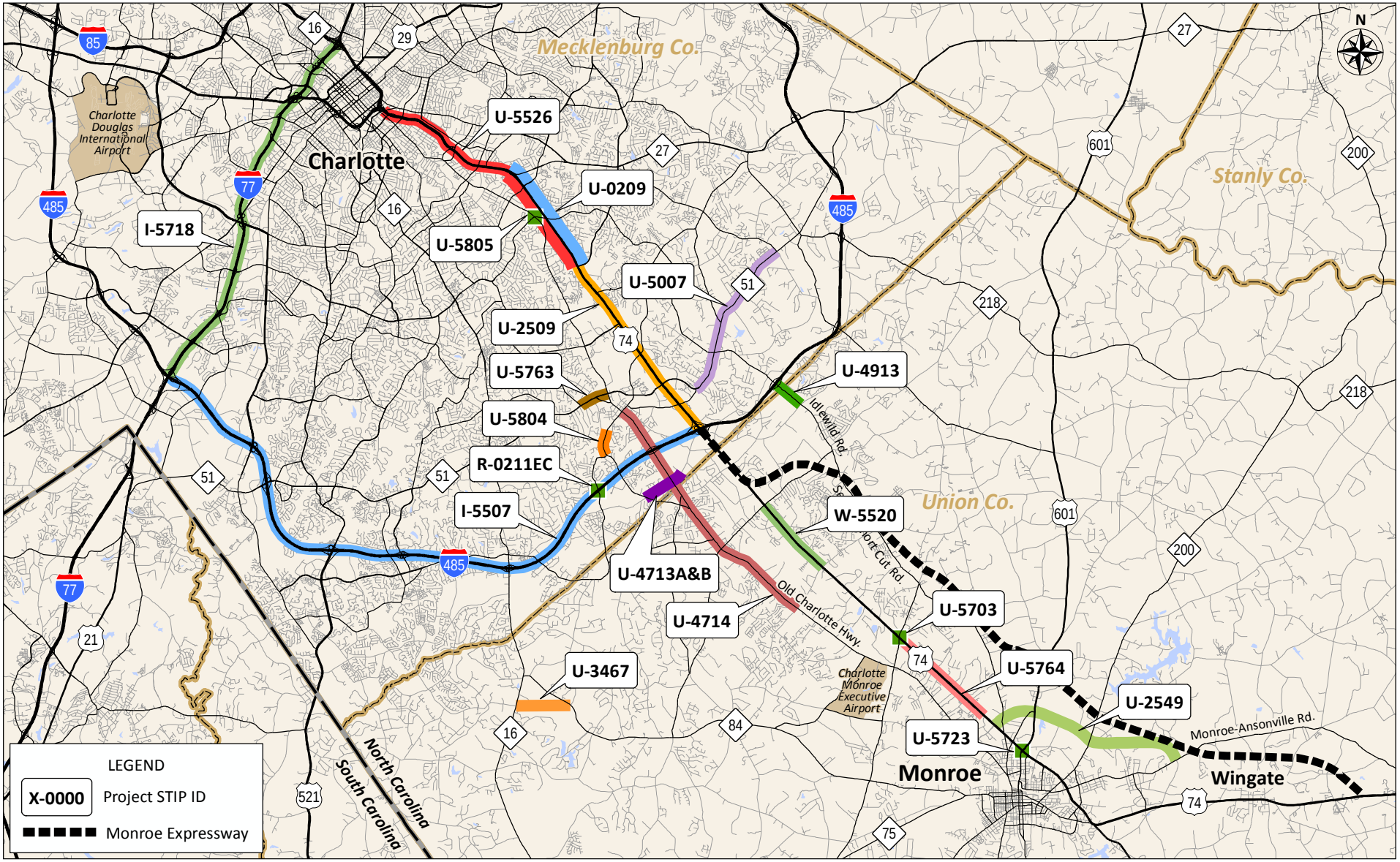
CDM Smith verified that the planned roadway improvements listed in the above documents are reflected in the MRM networks. Based on comments from the NCDOT, the assumed project completion date was changed from that assumed in the MRM network for several projects, and the proper adjustment was made to the networks. CDM Smith also verified that there were no network improvements assumed in the MRM networks that were not listed in a planning document, were located in the study area, and were likely to have an impact on Monroe Expressway usage. In the modeling assignments, CDM Smith used the same roadway assumptions that were included in the MRM15v1.1 with a few changes to assumed completion dates.

Table 6.4 and **Figure 6.4** present a list of selected future roadway improvement projects that are reflected in the MRM networks, are identified in future roadway plans, and are in the vicinity of the Monroe Expressway. These projects were selected because they were fairly major in scope, or were located in the study corridor.

Notable Mecklenburg County roadway improvements in the vicinity of the proposed Monroe Expressway include the addition of express lanes on I-77, I-485 and US 74. The construction of additional toll-free capacity is planned for segments of I-485, US 74 and NC 51. Each of these projects will have some impact on traffic volumes and travel patterns in the area.

Table 6.4
Selected Future-Year Roadway Improvements
Assumed in the Current Monroe Expressway Traffic and Revenue Study

Project STIP ID	Roadway	Location	Description	Assumed Opening Date
Mecklenburg County				
U-0209	US 74	Brookshire Freeway to Idlewild Road in Charlotte	Widen to 4 lanes per direction from NC 27 to Wallace Lane and construct interchanges with Sharon Amity Road and Idlewild Road	Dec. 2016
R-0211EC	I-485	Weddington Road overpass	Construct new interchange between I-485 and Weddington Road	Jan. 1, 2019
U-2509	US 74	Charlotte Outer Loop to Conference Drive in Charlotte	Widen to 3 general purpose lanes per direction and build express lanes in median	Jan. 1, 2025
U-4713A	New Road	SR 3448 (Pleasant Plains Road) to SR 1009 (E. John Street)	Add 1 lane per direction on new location	
U-4713B	New Road	SR 1009 (John Street) to SR 3457 (Campus Ridge Road)	Add 1 lane per direction on new location	
U-5007	NC 51	Matthews Township Parkway to SR 3128 (Lawyers Road)	Add 1 general purpose lane per direction	Jan. 1, 2025
I-5507	I-485	I-77 South of Charlotte to US 74 (Independence Boulevard)	Add 1 express lane per direction	Jan. 1, 2019
U-5526	US 74	I-277 to Wallace Lane	Convert existing and proposed busway to reversible express lane from I-277 to Albemarle Road and add 1 express lane per direction from Albemarle Road to Wallace Lane	Jan. 1, 2018
I-5718	I-77	Phase A: I-485 (Exit 1) to Woodlawn Road (Exit 6) Phase B: Woodlawn Road (Exit 6) to I-277/US 74 (Exit 9) Phase C: I-277/US 74 (Exit 9) to I-277/NC 16 (Exit 11) Phase D: I-277/US 74/NC 27 Interchange Phase E: I-277/NC 16, US 21 Interchange	Add 1 express lane per direction Add 1 express lane per direction Add 1 express lane per direction Interchange improvements Interchange improvements	Jan. 1, 2030
U-5763	NC 51	SR 3356 (Sardis Road) to SR 1009 (Monroe Road)	Add 1 general purpose lane per direction	Jan. 1, 2020
U-5804	SR 3448	Fullwood Lane to Weddington Road	Add 1 lane per direction	Jan. 1, 2017
U-5805	SR 1009	Intersection with Idlewild Road	Construct improvements	Jan. 1, 2021
Union County				
U-2549	Monroe Northern Loop	US 74 TO SR 1751 (Walkup Avenue) at SR 1763 (Bivens Road)	Add 2 lanes per direction on new location	Jan. 1, 2030
U-3467	New Road	NC 16 (Providence Road) to SR 84 (Weddington Road)	Extend SR 1316 (Rea Road) from NC 16 (Providence Road) to SR 84 (Weddington Road)	Jan. 1, 2020
U-4714	SR 1009	SR 3448 (Trade Street) to SR 1377 (Wesley Chapel-Stouts Road)	Add 1 general purpose lane per direction and convert to superstreet	Jan. 1, 2025
U-4913	Idlewild Rd	I-485 TO SR 1524 (Stevens Mill Road)	Add 1 general purpose lane per direction	Jan. 1, 2022
W-5520	US 74	Indian Trail Fairview Road to Wesley Chapel Stouts Road	Convert existing full movement signalized intersections to signalized superstreet design	Jan. 1, 2017
U-5703	US 74	SR 1514 (Rocky River Road) intersection	Reconfigure to superstreet design	Jan. 1, 2022
U-5723	US 74	US 601 Interchange	Construct improvements	Jan. 1, 2022
U-5764	US 74	Hanover Drive to SR 1007 (Rocky River Road)	Add 1 general purpose lane per direction	Jan. 1, 2023



CDM Smith

SELECTED FUTURE-YEAR ROADWAY IMPROVEMENTS

FIGURE 6.4

Roadway improvements within Union County that will directly impact travel demand on the proposed Monroe Expressway include:

1. U-5764 – the addition of 1 general purpose lane in each travel direction on US 74 between Hanover Drive and SR 1007. This roadway improvement is anticipated to be completed by January 1, 2023.

2. U-2549 – the construction of the Monroe Northern Loop, a new 4-lane roadway that will provide enhanced route options for travel in the area of Monroe. This roadway improvement is assumed to be completed by January 1, 2030.

3. U-4714 – the addition of 1 general purpose lane in each travel direction on SR 1009 (Old Charlotte Highway) between SR 3448 (Trade Street) to SR 1377 (Wesley Chapel-Stouts Road). This improvement is assumed to be completed by January 1, 2025.

These three roadway improvements had relatively small, system wide negative impacts on Monroe Expressway toll transactions based on the assignment process.

6.5 Toll Rate Sensitivity Analysis

A toll rate sensitivity analysis was conducted at 2019 opening year conditions, to identify the optimum per-mile toll for the Monroe Expressway. The analysis was conducted by running a series of assignments with gradually increasing per-mile toll rates in order to identify a point on the curve that optimizes toll revenue, but still leaves some room for upward adjustment.

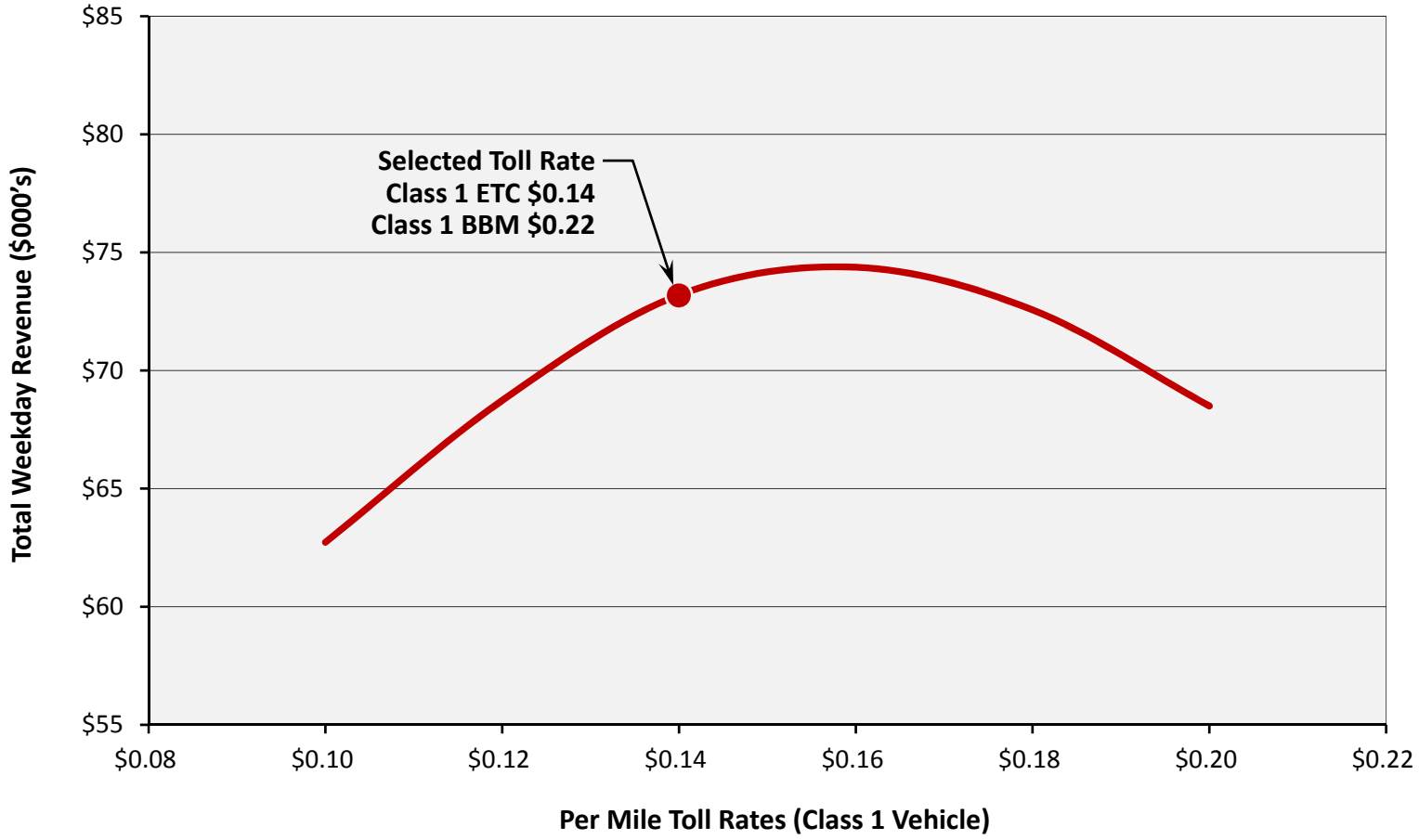
Figure 6.5 illustrates the 2019 Class 1 (two-axle vehicle) toll sensitivity curve for ETC assuming the entire toll road is operational. The x-axis represents the range of tested per-mile toll rates. The y-axis represents the resulting average weekday toll revenue for all three toll classes and both methods of payment.

As shown in the figure, the selected, optimal ETC toll rate for a Class 1 vehicle traveling the full length of the toll road is approximately $0.14 per mile. The associated Class 1 BBM toll rate for the same trip is about $0.22 per mile (assuming the current ETC-BBM toll relationship). Actual tolls collected for each toll zone will be equal to the length of that mainline section multiplied by the per-mile toll rate, and rounded up to the nearest penny. The selected toll rate is set slightly below the rate which would maximize toll revenue in order to provide a limited "margin of safety" for setting future rates. Rates are assumed to increase annually to keep pace with inflation.

6.6 Recommended Toll Rates by Toll Zone

Table 6.5 shows Class 1 ETC and BBM rates, by tolling zone, for all years from 2019 through 2040. These toll rates are based on the 2019 selected optimum toll rates of $0.14 per mile for Class 1 ETC and $0.22 per mile for Class 1 BBM. In all years, Class 2 rates are double Class 1 rates, and Class 3 rates are four times Class 1 rates. ETC toll rates receive a 35 percent discount from BBM toll rates. As shown in this table, annual rate adjustments take place each January 1 to take into account the impacts of annual inflation (see Table 6.3 for a description of the assumed inflation rates).

Figure 6.6 graphically displays the ETC toll rates in 2019 and 2030 at each tolling zone location for Class 1, Class 2 and Class 3 vehicles. The opening-year ETC toll for a full-length trip through all seven tolling zones on the Monroe Expressway will be $2.54 for Class 1 vehicles, increasing to $3.22 in 2030. A



ESTIMATED 2019 MONROE EXPRESSWAY TOLL SENSITIVITY CURVE

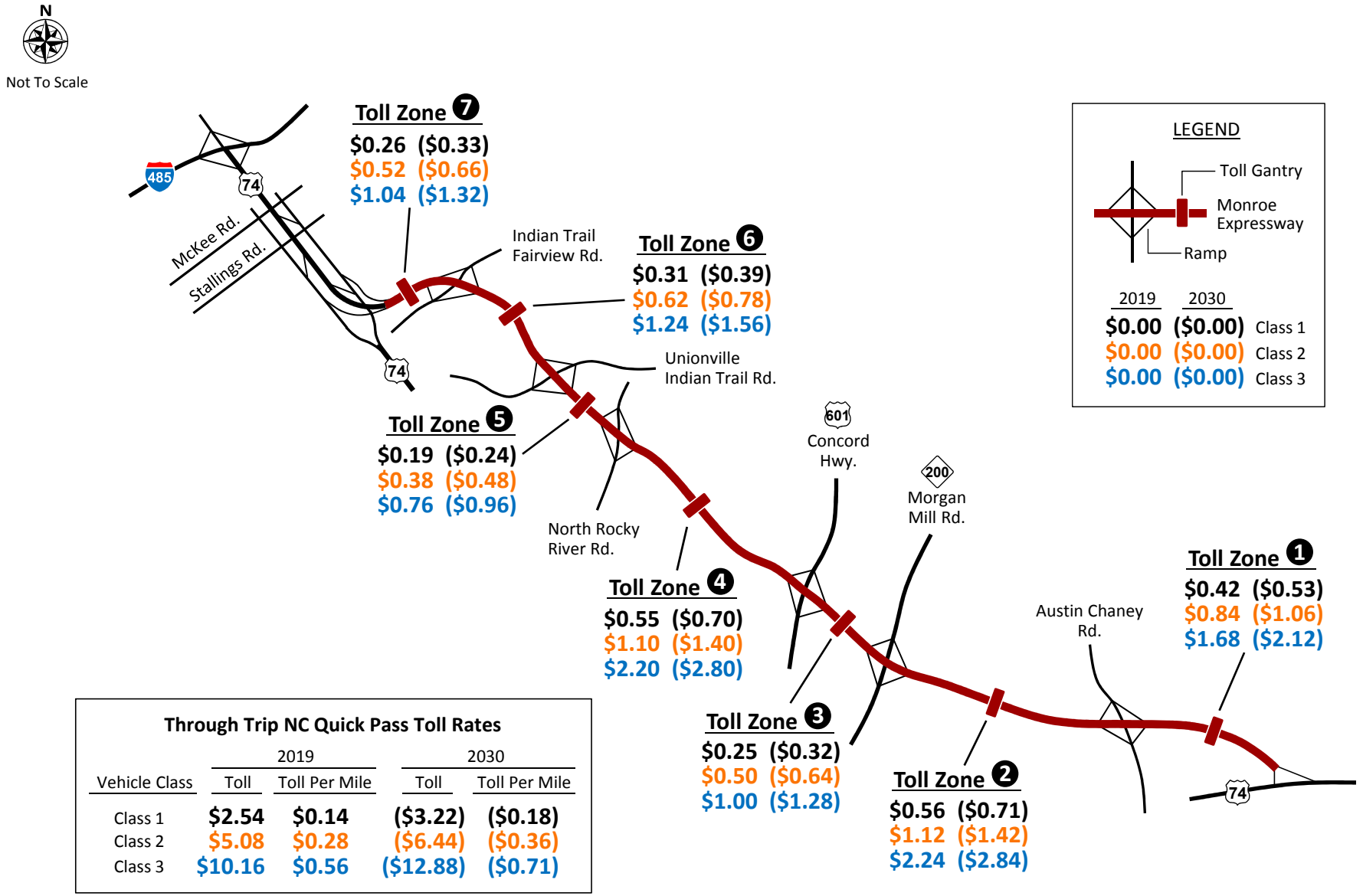
FIGURE 6.5

Table 6.5
Recommended Monroe Expressway Annual Toll Rates by Tolling Zone
Class 1 ETC and BBM

	Zone 1 (2.99 mi.)		Zone 2 (3.97 mi.)		Zone 3 (1.76 mi.)		Zone 4 (3.93 mi.)		Zone 5 (1.38 mi.)		Zone 6 (2.24 mi.)		Zone 7 (1.87 mi.)			
Calendar Year (1)	US 74 - Austin Chaney Rd		Austin Chaney Rd - NC 200		NC 200 - US 601		US 601 - N. Rocky River Rd.		N. Rocky River Rd. - Unionville Indian Trail Rd.		Unionville Indian Trail Rd. - Indian Trail Fairview Rd.		Indian Trail Fairview Rd. - US 74		**Through Trip Toll (Passes through All Zones)**	
	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM
2019	$ 0.42	$ 0.65	$ 0.56	$ 0.86	$ 0.25	$ 0.39	$ 0.55	$ 0.85	$ 0.19	$ 0.29	$ 0.31	$ 0.48	$ 0.26	$ 0.40	$ 2.54	$ 3.92
2020	0.43	0.66	0.57	0.88	0.26	0.40	0.56	0.87	0.19	0.30	0.32	0.49	0.27	0.41	2.60	4.01
2021	0.44	0.68	0.59	0.90	0.26	0.41	0.58	0.89	0.20	0.30	0.32	0.50	0.27	0.42	2.66	4.10
2022	0.45	0.70	0.60	0.92	0.27	0.42	0.59	0.91	0.20	0.31	0.33	0.51	0.28	0.43	2.72	4.20
2023	0.46	0.71	0.61	0.94	0.27	0.43	0.60	0.93	0.21	0.32	0.34	0.53	0.28	0.44	2.77	4.30
2024	0.47	0.73	0.63	0.96	0.28	0.44	0.62	0.95	0.21	0.32	0.35	0.54	0.29	0.45	2.85	4.39
2025	0.48	0.74	0.64	0.99	0.29	0.45	0.63	0.97	0.22	0.33	0.36	0.55	0.30	0.46	2.92	4.49
2026	0.49	0.76	0.66	1.01	0.29	0.46	0.64	0.99	0.22	0.34	0.36	0.56	0.30	0.47	2.96	4.59
2027	0.50	0.78	0.67	1.03	0.30	0.47	0.66	1.02	0.23	0.35	0.37	0.57	0.31	0.48	3.04	4.70
2028	0.51	0.79	0.68	1.05	0.31	0.48	0.67	1.04	0.23	0.35	0.38	0.59	0.32	0.49	3.10	4.79
2029	0.52	0.81	0.70	1.07	0.31	0.49	0.69	1.06	0.24	0.36	0.39	0.60	0.32	0.50	3.17	4.89
2030	0.53	0.83	0.71	1.09	0.32	0.50	0.70	1.08	0.24	0.37	0.39	0.61	0.33	0.51	3.22	4.99
2031	0.55	0.84	0.73	1.12	0.32	0.51	0.71	1.10	0.25	0.38	0.40	0.62	0.34	0.52	3.30	5.09
2032	0.56	0.86	0.74	1.14	0.33	0.52	0.73	1.13	0.25	0.38	0.41	0.64	0.34	0.53	3.36	5.20
2033	0.57	0.88	0.76	1.16	0.34	0.53	0.74	1.15	0.26	0.39	0.42	0.65	0.35	0.54	3.44	5.30
2034	0.58	0.90	0.77	1.19	0.35	0.54	0.76	1.17	0.26	0.40	0.43	0.66	0.36	0.55	3.51	5.41
2035	0.59	0.92	0.79	1.21	0.35	0.55	0.78	1.20	0.27	0.41	0.44	0.68	0.37	0.56	3.59	5.53
2036	0.60	0.94	0.81	1.24	0.36	0.56	0.79	1.22	0.27	0.42	0.45	0.69	0.37	0.58	3.65	5.65
2037	0.62	0.96	0.82	1.26	0.37	0.57	0.81	1.25	0.28	0.43	0.46	0.71	0.38	0.59	3.74	5.77
2038	0.63	0.98	0.84	1.29	0.38	0.59	0.83	1.28	0.29	0.44	0.47	0.72	0.39	0.60	3.83	5.90
2039	0.64	1.00	0.86	1.32	0.38	0.60	0.84	1.30	0.29	0.44	0.47	0.74	0.40	0.61	3.88	6.01
2040	0.66	1.02	0.88	1.35	0.39	0.61	0.86	1.33	0.30	0.45	0.49	0.75	0.41	0.63	3.99	6.14

1) Assumes toll rates will be increased annually on January 1.

Note:
Class 2 tolls will be two times the Class 1 tolls
Class 3 tolls will be four times the Class 1 tolls
ETC tolls receive a 35 percent discount from the BBM tolls



Through Trip NC Quick Pass Toll Rates

	2019		2030	
Vehicle Class	Toll	Toll Per Mile	Toll	Toll Per Mile
Class 1	$2.54	$0.14	($3.22)	($0.18)
Class 2	$5.08	$0.28	($6.44)	($0.36)
Class 3	$10.16	$0.56	($12.88)	($0.71)

RECOMMENDED ETC TOLL RATES (2019 AND 2030)

CDM Smith

FIGURE 6.6

large truck (Class 3) with ETC will pay $10.16 in 2019, and $12.88 in 2030, to travel the length of the Monroe Expressway.

Figure 6.7 illustrates the BBM toll rates for Class 1, Class 2, and Class 3 vehicles by location for 2019 and 2030. In 2019, a Class 1 vehicle with BBM will pay $3.92 for a full-length trip, increasing to $4.99 in 2030. A Class 3 vehicle will pay $15.68 in 2019 and $19.96 in 2030 for the same trip.

6.7 Estimated Weekday Traffic Volumes

Estimates of weekday mainline traffic volumes in 2019, 2025, 2030 and 2040 are shown in **Figure 6.8**. Vehicles will be tolled on each mainline section via overhead gantries. As can be seen in the figure, weekday mainline traffic volumes increase steadily from the easternmost mainline section to the westernmost section. The traffic volumes shown in the figure do not include any downward "ramp-up" adjustment, which is incorporated in the early years of the annual traffic forecasts. Total 2019 weekday traffic volumes range from 9,100 on the easternmost section (Zone 1: US 74 to Austin Chaney Rd.) to a high of 33,100 on the westernmost section (Zone 7: Indian Trail Fairview Rd. to US 74).

In 2030, weekday mainline traffic volumes on the Monroe Expressway are forecast to range from 11,200 (easternmost section) to 42,800 on the westernmost section. Weekday traffic volumes in 2040 are forecast to range from 12,300 on the easternmost section to 48,200 on the westernmost section.

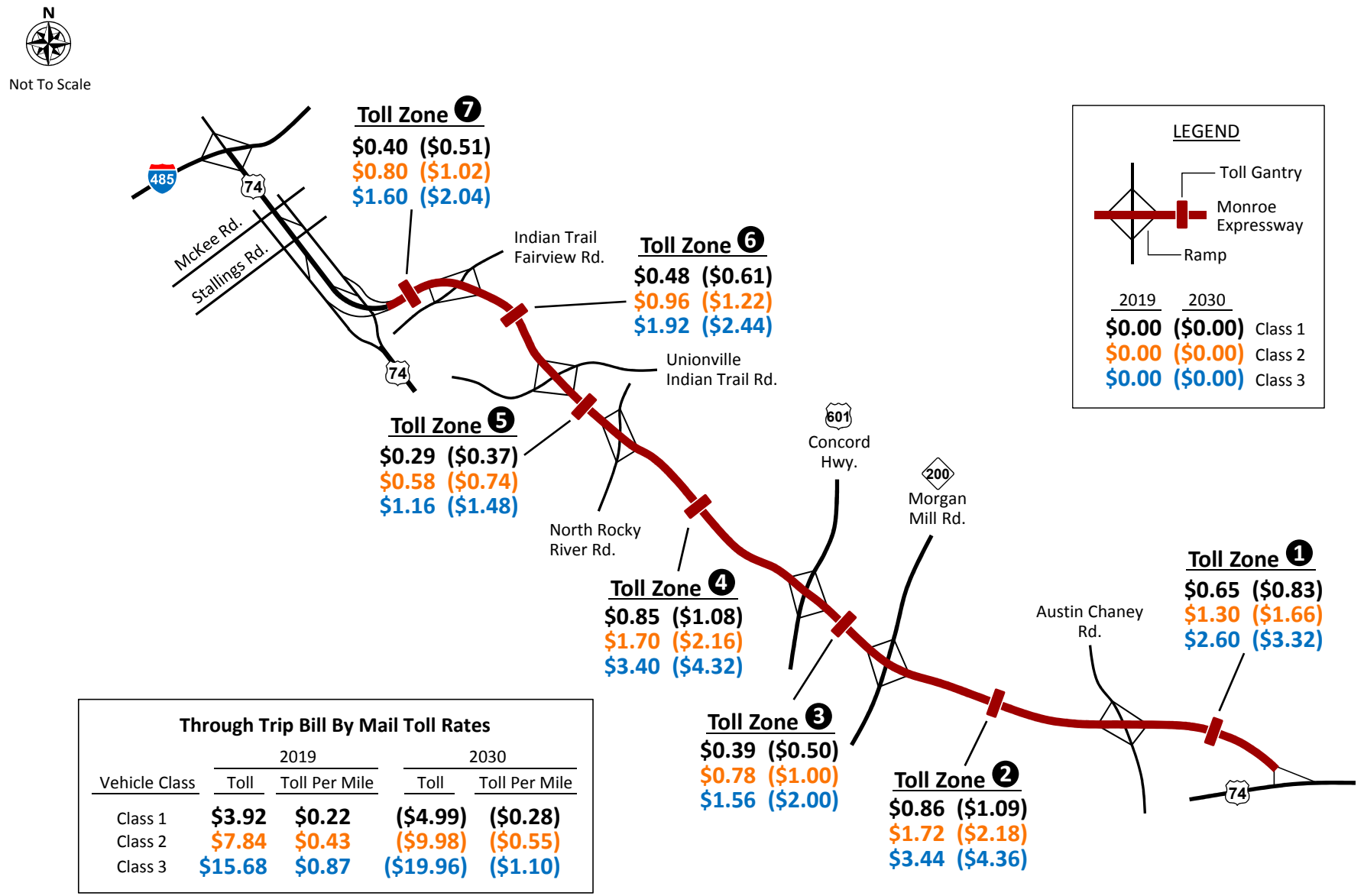
Forecast traffic volumes decrease from 2025 to 2030 in Zone 2 (Austin Chaney Rd – NC 200). This decrease is due to a roadway improvement (Project STIP U-2549) that is assumed to open on January 1, 2030. The improvement consists of a new four-lane road, called the Monroe Northern Loop, that extends from US 74 to SR 1751 (Walkup Ave.) at Bivens Rd. The project is shown in Figure 6.4. This project is estimated to draw traffic off of certain sections of the Monroe Expressway, most notably from Toll Zone 2. On a systemwide basis, the negative impacts of the Monroe Northern Loop are relatively small.

6.8 Sample Travel Time and Distance Savings

Figure 6.9 illustrates estimated average travel-time savings during the three-hour AM Peak Period (6:30 through 9:30 AM), in the westbound direction, in 2019 and 2030, by comparing travel time on the Monroe Expressway to the best alternative toll-free route. Estimated travel times were obtained from the calibrated MRM assignments. The travel times represent average minutes of travel during the three-hour peak period. Actual travel times will vary from these estimates, sometimes significantly, based on actual roadway and weather conditions, and on actual travel demand in shorter increments of time.

The following three trips are shown in Figure 6.9 to illustrate potential travel time savings by using the Monroe Expressway:

- Trip 1 – from Marshville to Mathews,
- Trip 2 – from Monroe to Mathews, and
- Trip 3 from Indian Trail to Mathews.



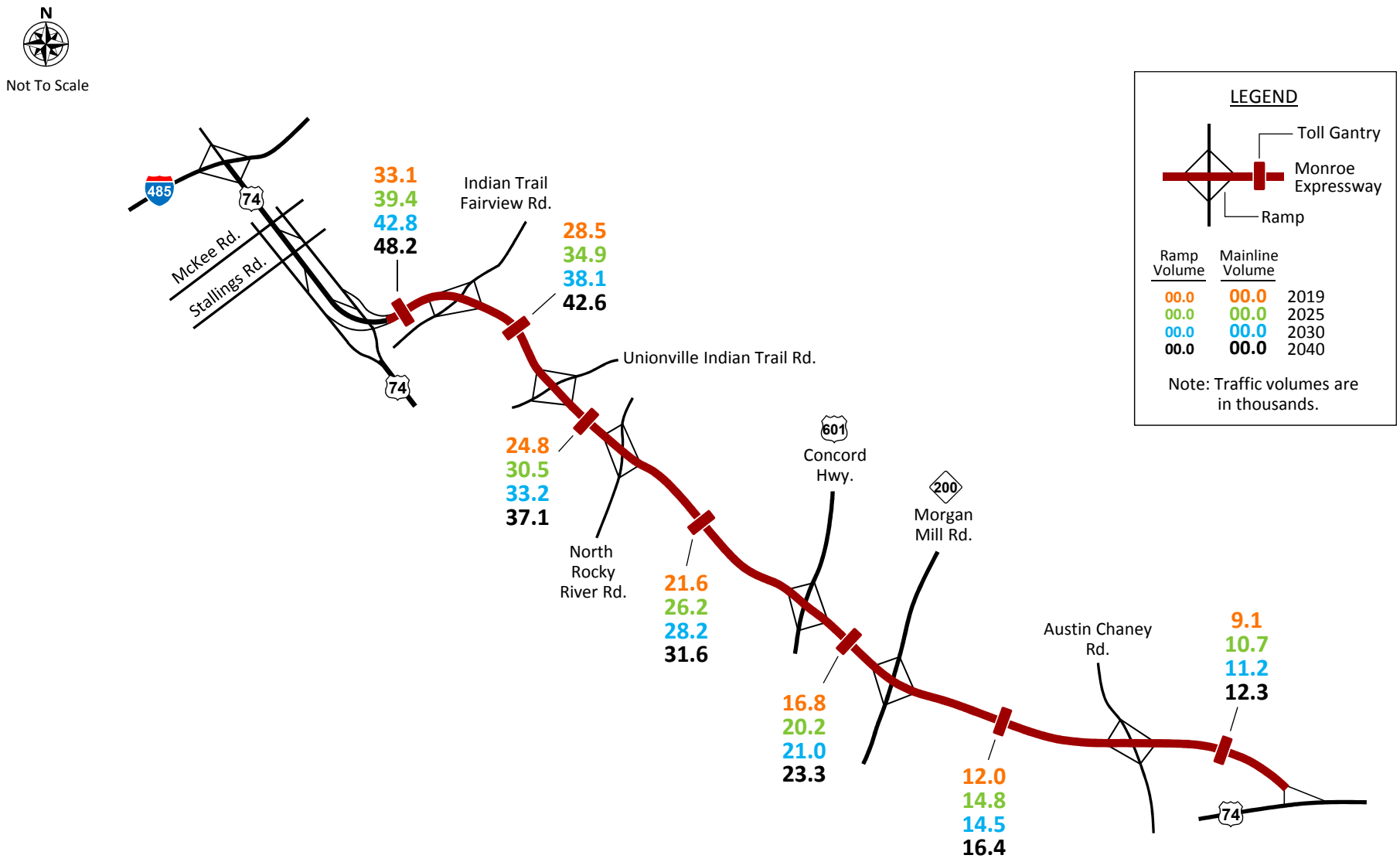
Through Trip Bill By Mail Toll Rates

	2019		2030	
Vehicle Class	Toll	Toll Per Mile	Toll	Toll Per Mile
Class 1	$3.92	$0.22	($4.99)	($0.28)
Class 2	$7.84	$0.43	($9.98)	($0.55)
Class 3	$15.68	$0.87	($19.96)	($1.10)

RECOMMENDED BBM TOLL RATES (2019 AND 2030)

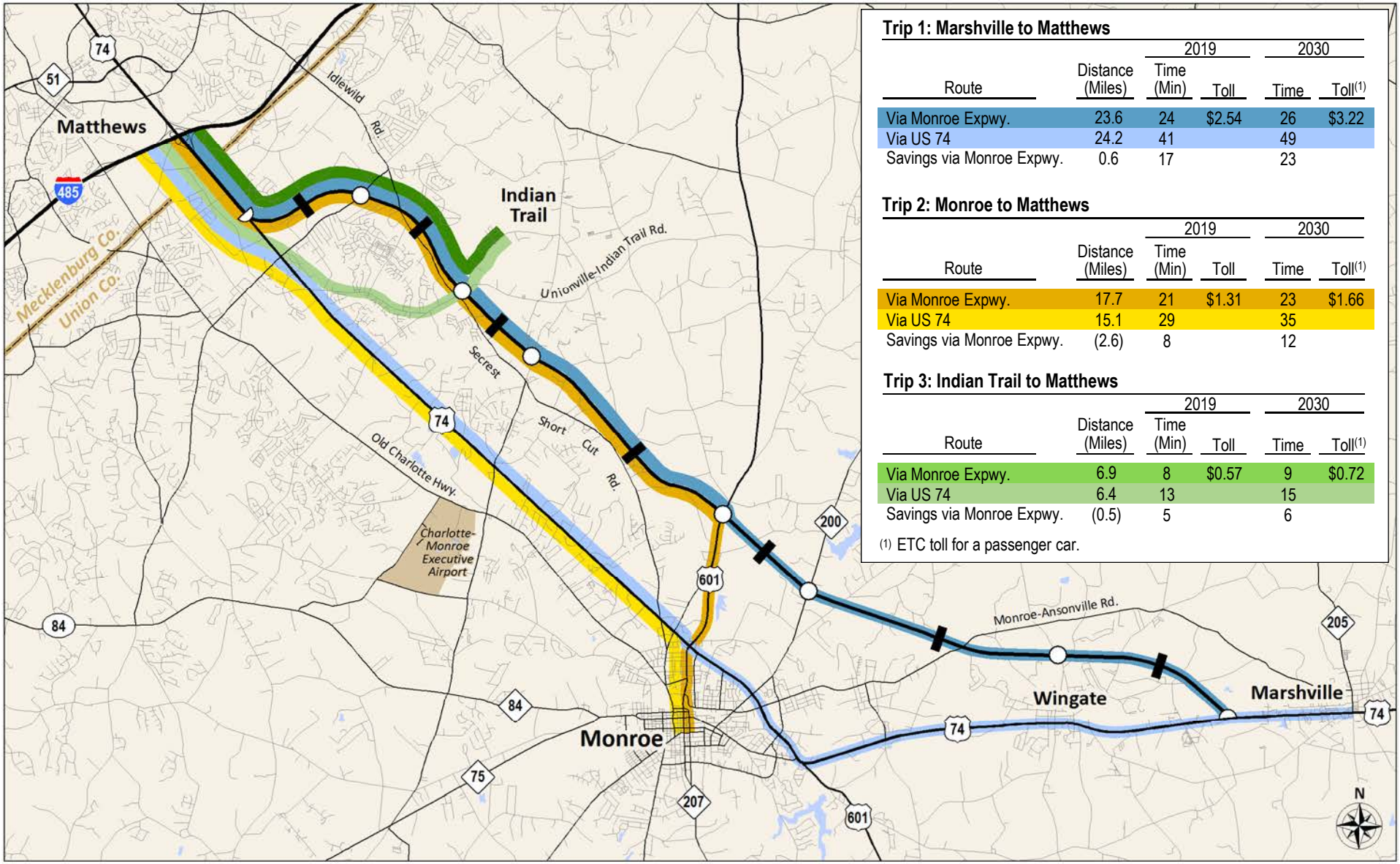
CDM Smith

FIGURE 6.7



ESTIMATED 2019, 2025, 2030 AND 2040 AVERAGE WEEKDAY TRAFFIC VOLUMES - CALENDAR YEAR

FIGURE 6.8



Trip 1: Marshville to Matthews

Route	Distance (Miles)	2019 Time (Min)	2019 Toll	2030 Time	2030 Toll[1]
Via Monroe Expwy.	23.6	24	$2.54	26	$3.22
Via US 74	24.2	41		49	
Savings via Monroe Expwy.	0.6	17		23	

Trip 2: Monroe to Matthews

Route	Distance (Miles)	2019 Time (Min)	2019 Toll	2030 Time	2030 Toll[1]
Via Monroe Expwy.	17.7	21	$1.31	23	$1.66
Via US 74	15.1	29		35	
Savings via Monroe Expwy.	(2.6)	8		12	

Trip 3: Indian Trail to Matthews

Route	Distance (Miles)	2019 Time (Min)	2019 Toll	2030 Time	2030 Toll[1]
Via Monroe Expwy.	6.9	8	$0.57	9	$0.72
Via US 74	6.4	13		15	
Savings via Monroe Expwy.	(0.5)	5		6	

(1) ETC toll for a passenger car.

ESTIMATED AVERAGE TRAVEL TIME SAVINGS AM PEAK PERIOD - WESTBOUND

FIGURE 6.9

The trip comparison data includes the distance traveled, the average travel time in minutes, and the passenger-car ETC toll for the trip on the Expressway. For example, in 2019, a trip from Marshville to Mathews (Trip 1) on the Monroe Expressway would save about 0.6 miles and an average of 17 minutes compared to the same trip via US 74 during the AM Peak Period. In 2030, the average-time savings for using the Monroe Expressway is estimated to increase to 23 minutes. The toll cost for a passenger car making this trip via the Monroe Expressway would be $2.54 in 2019 and $3.22 in 2030. The cost of the toll is accounted for in the route choice assigned in the modeling process.

A trip from Monroe to Mathews (Trip 2) on the Monroe Expressway compared to US 74 would include an increased distance of 2.6 miles, and an average travel-times savings of 8 minutes in 2019 and 12 minutes in 2030. The toll cost for a passenger car making this trip via the Monroe Expressway would be $1.31 in 2019 and $1.66 in 2030.

A trip from Indian Trail to Mathews (Trip 3) on the Monroe Expressway compared to US 74 would include an increased distance of 0.5 miles, and an average travel-times savings of 5 minutes in 2019 and 6 minutes in 2030. The toll cost for a passenger car making this trip via the Monroe Expressway would be $0.57 in 2019 and $0.72 in 2030.

6.9 Assignment-Year Annualization and Ramp-Up Adjustments

This section describes the methodology for developing the following forecasts: 1) the average weekday toll revenue, 2) the calendar-year toll transactions and toll revenue, 3) the ramp-up adjustment for the opening year, and 4) the conversion of traffic and toll revenue to a fiscal year. This process was performed for the assignment years 2019, 2025, 2030 and 2040. **Table 6.6** illustrates the process for year 2019.

6.9.1 Calendar Year 2019 Average Weekday Toll Transactions and Toll Revenue

As seen in Table 6.6, Class 1 toll transactions for each toll zone and by ETC and BBM, are multiplied by their corresponding toll rates to arrive at the average weekday toll revenue. Similarly, the combined Class 2 and 3 toll transactions, are multiplied by an average weighted toll for the two classes to arrive at the average weekday toll revenue for each tolling zone. The result in 2019 is an estimated 145,888 average weekday transactions and $72,686 average weekday toll revenue.

6.9.2 Calendar Year 2019 Annual Toll Transactions and Toll Revenue

The average weekday toll transactions and toll revenue are converted into an annual year forecast. This annualization is based on the assumption that there will be the equivalent of 327.3 weekdays in a calendar year for the Monroe Expressway study. This conversion takes into account lower estimated traffic volumes on weekend days and holidays. For this study, it was assumed that average weekend day traffic will be 68 percent of average weekday traffic on the Expressway. As shown in Table 6.6, the annualized toll transactions for calendar year 2019 will be 47,745,000 (145,888 average weekday transactions multiplied by 327.3). Similarly, annualized toll revenue for calendar year 2019 will be $23,789,000 ($72,686 average weekday revenue multiplied by 327.3).

Table 6.6
Development of FY 2019 Toll Transactions and Gross Toll Revenue Estimates

I. Calendar Year - Estimated Average Weekday Toll Transactions

		Calendar Year 2019				
		Class 1		Classes 2 and 3		
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	All Vehicles
1	US 74 - Austin Chaney Rd.	3,252	4,694	350	823	9,119
2	Aystin Chaney Rd. - NC 200	4,300	6,365	397	959	12,021
3	NC 200 - US 601	6,121	8,876	542	1,286	16,825
4	US 601 - N. Rocky River Rd.	7,823	11,561	659	1,564	21,607
5	N. Rocky River Rd. - Union Indian Trail Rd.	9,019	13,196	757	1,782	24,754
6	Union Indian Trail Rd. - Indian Trail/Fairview Rd.	10,619	15,216	790	1,833	28,458
7	Indian Trail/Fairview Rd. - US 74	12,733	17,624	844	1,902	33,103
	Total	53,867	77,533	4,338	10,150	145,888

II. Calendar Year - Toll Rates

		Calendar Year 2019			
		Class 1		Average Weighted Toll for Classes 2 and 3	
	Toll Zone Number and Name	BBM	ETC	BBM	ETC
1	US 74 - Austin Chaney Rd.	$ 0.65	$ 0.42	$ 2.16	$ 1.40
2	Aystin Chaney Rd. - NC 200	0.86	0.56	2.86	1.86
3	NC 200 - US 601	0.39	0.25	1.30	0.83
4	US 601 - N. Rocky River Rd.	0.85	0.55	2.83	1.83
5	N. Rocky River Rd. - Union Indian Trail Rd.	0.29	0.19	0.97	0.63
6	Union Indian Trail Rd. - Indian Trail/Fairview Rd.	0.48	0.31	1.60	1.03
7	Indian Trail/Fairview Rd. - US 74	0.40	0.26	1.33	0.87

III. Calendar Year - Estimated Average Weekday Gross Toll Revenue

		Calendar Year 2019				
		Class 1		Classes 2 and 3		
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	All Vehicles
1	US 74 - Austin Chaney Rd.	$ 2,114	$ 1,972	$ 755	$ 1,152	$ 5,993
2	Aystin Chaney Rd. - NC 200	3,698	3,564	1,136	1,783	10,182
3	NC 200 - US 601	2,387	2,219	705	1,067	6,378
4	US 601 - N. Rocky River Rd.	6,649	6,359	1,864	2,863	17,735
5	N. Rocky River Rd. - Union Indian Trail Rd.	2,616	2,507	734	1,123	6,980
6	Union Indian Trail Rd. - Indian Trail/Fairview Rd.	5,097	4,717	1,264	1,888	12,966
7	Indian Trail/Fairview Rd. - US 74	5,093	4,582	1,122	1,655	12,453
	Total	$ 27,654	$ 25,920	$ 7,580	$ 11,532	$ 72,686

Annualization Procedure
(in thousands)
Annualization Factor: 327.3 days per year

Period	Annual Toll Transactions	Annual Gross Toll Revenue
Calendar Year (CY) 2019	47,745	$23,789
Apply Ramp-Up Factor To CY 2019	0.60	0.60
Dampened CY 2019	28,647	$14,273
Conversion to Fiscal Year 2019		
Half of CY 2019 (January-June)	14,324	$7,137

6.9.3 Calendar Year 2019 Ramp-Up Adjustment

The annualized transactions and toll revenue were dampened to reflect "ramp-up" in 2019. With new toll facilities, it often takes time for motorists to learn about the new road and change their travel patterns, particularly for motorists who may use the road infrequently or live far from the road. It also accounts for the time it takes motorists to learn about and feel comfortable with the toll collection methods, particularly if there aren't existing toll roads in the area. The duration and level of ramp-up adjustments can be directly affected by a well-conceived promotion and signing program.

For the purposes of this study, a 36-month ramp-up period was assumed. The traffic and toll revenue forecasts for the first three years of operation was adjusted downward to reflect the time it will take to gradually build up to full demand. **Table 6.7** presents the ramp-up factors assumed for this study.

Table 6.7
Assumed Ramp-Up Factors

Calendar Year	Ramp-Up Factor (1)
2019	0.600
2020	0.800
2021	0.950

1) Applied to calendar year transaction estimates.

After applying ramp-up to 2019 estimates, as seen in Table 6.6, the dampened annual toll transactions total 28.6 million, and the dampened toll revenue totals $14.3 million.

6.9.4 Conversion of 2019 to a Fiscal Year

Transaction and toll revenue forecasts on a calendar year basis were divided in half and allocated to the appropriate fiscal year, which is assumed to run from July 1 of one calendar year to June 30 of the following calendar year. Because the Monroe Expressway is assumed to open on January 1, 2019, it will only be open for half of fiscal year 2019 (July 1, 2018 – June 30, 2019). As seen in Table 6.6, FY 2019 transactions and toll revenue are forecast to total 14.3 million and $7.1 million respectively.

6.9.5 FY 2025, FY 2030 and FY 2040 Transactions and Toll Revenue

The same procedure as described in the previous sections for FY 2019 was followed to develop the fiscal year toll transactions and toll revenue. **Tables 6.8** and **6.9** illustrate the procedures to develop FY 2030 and FY 2040. In each of these instances, two adjacent calendar years are calculated, and re-allocated to form the fiscal year estimates. For example, FY 2030 is composed of half of calendar year 2029 and half of calendar year 2030. As mentioned previously, model years are 2019, 2025, 2030, and 2040. Intermediate years were developed by interpolating between assignment years. Ramp-up adjustments were not made to any assignment years except 2019. The same annualization assumptions were made for all assignment years.

Table 6.8
Development of FY 2030 Toll Transactions and Gross Toll Revenue Estimates

I. Calendar Year - Estimated Average Weekday Toll Transactions

		Calendar Year 2029					Calendar Year 2030				
		Class 1		Classes 2 and 3		All	Class 1		Classes 2 and 3		All
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	Vehicles	BBM	ETC	BBM	ETC	Vehicles
1	US 74 - Austin Chaney Rd.	3,669	6,251	366	916	11,202	3,611	6,306	357	912	11,186
2	Austin Chaney Rd. - NC 200	5,319	9,481	474	1,238	16,511	4,667	8,413	388	1,016	14,483
3	NC 200 - US 601	6,542	11,568	551	1,441	20,103	6,749	12,118	590	1,547	21,004
4	US 601 - N. Rocky River Rd.	8,967	16,004	714	1,857	27,542	9,054	16,507	730	1,918	28,209
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	10,624	18,742	841	2,169	32,376	10,721	19,342	866	2,257	33,186
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	12,494	21,578	872	2,218	37,161	12,607	22,276	899	2,312	38,095
7	Indian Trail Fairview Rd. - US 74	14,499	24,227	938	2,314	41,979	14,557	24,911	963	2,404	42,834
	Total	62,115	107,850	4,757	12,152	186,874	61,965	109,873	4,793	12,366	188,997

II. Calendar Year - Toll Rates

		Calendar Year 2029				Calendar Year 2030			
		Class 1		Average Weighted Toll for Classes 2 and 3		Class 1		Average Weighted Toll for Classes 2 and 3	
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC
1	US 74 - Austin Chaney Rd.	$ 0.81	$ 0.52	$ 2.69	$ 1.75	$ 0.83	$ 0.53	$ 2.75	$ 1.78
2	Austin Chaney Rd. - NC 200	1.07	0.70	3.57	2.32	1.09	0.71	3.64	2.37
3	NC 200 - US 601	0.49	0.31	1.62	1.03	0.50	0.32	1.65	1.06
4	US 601 - N. Rocky River Rd.	1.06	0.69	3.53	2.28	1.08	0.70	3.60	2.33
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	0.36	0.24	1.21	0.79	0.37	0.24	1.23	0.80
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	0.60	0.39	1.99	1.28	0.61	0.39	2.04	1.31
7	Indian Trail Fairview Rd. - US 74	0.50	0.32	1.66	1.08	0.51	0.33	1.69	1.11

III. Calendar Year - Estimated Average Weekday Gross Toll Revenue

		Calendar Year 2029					Calendar Year 2030				
		Class 1		Classes 2 and 3		All	Class 1		Classes 2 and 3		All
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	Vehicles	BBM	ETC	BBM	ETC	Vehicles
1	US 74 - Austin Chaney Rd.	$ 2,972	$ 3,251	$ 985	$ 1,603	$ 8,810	$ 2,997	$ 3,342	$ 982	$ 1,624	$ 8,945
2	Austin Chaney Rd. - NC 200	5,691	6,636	1,691	2,872	16,890	5,087	5,973	1,411	2,408	14,879
3	NC 200 - US 601	3,206	3,586	893	1,485	9,169	3,374	3,878	973	1,640	9,865
4	US 601 - N. Rocky River Rd.	9,506	11,043	2,521	4,233	27,302	9,778	11,555	2,629	4,468	28,430
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	3,825	4,498	1,018	1,713	11,054	3,967	4,642	1,065	1,805	11,479
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	7,496	8,415	1,735	2,838	20,486	7,690	8,688	1,835	3,029	21,242
7	Indian Trail Fairview Rd. - US 74	7,250	7,753	1,558	2,499	19,059	7,424	8,221	1,627	2,668	19,940
	Total	$39,945	$45,182	$10,401	$17,242	$112,770	$40,318	$46,299	$10,522	$17,643	$114,781

Annualization Procedure
(rounded to thousands)
Annualization Factor: 327.3 days per year

Period	Annual Toll Transactions	Annual Gross Toll Revenue
Calendar Year (CY) 2029	61,159,000	$ 36,907,000
Calendar Year (CY) 2030	61,854,000	$ 37,565,000
Conversion to Fiscal Year		
Half of CY 2029	30,580,000	$ 18,453,000
Half of CY 2030	30,927,000	$ 18,783,000
Total Fiscal Year 2030	61,507,000	$ 37,236,000

Table 6.9
Development of FY 2040 Toll Transactions and Gross Toll Revenue Estimates

I. Calendar Year - Estimated Average Weekday Toll Transactions

		Calendar Year 2039					Calendar Year 2040				
		Class 1		Classes 2 and 3		All	Class 1		Classes 2 and 3		All
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	Vehicles	BBM	ETC	BBM	ETC	Vehicles
1	US 74 - Austin Chaney Rd.	3,597	7,221	372	1,025	12,216	3,596	7,331	374	1,039	12,339
2	Austin Chaney Rd. - NC 200	4,726	9,870	419	1,185	16,201	4,733	10,047	422	1,206	16,408
3	NC 200 - US 601	6,653	13,960	624	1,785	23,022	6,642	14,181	628	1,814	23,265
4	US 601 - N. Rocky River Rd.	8,990	19,157	793	2,273	31,213	8,983	19,477	800	2,316	31,576
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	10,607	22,439	943	2,691	36,681	10,595	22,812	952	2,745	37,104
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	12,468	25,895	976	2,754	42,093	12,453	26,332	985	2,808	42,577
7	Indian Trail Fairview Rd. - US 74	14,478	29,194	1,041	2,870	47,582	14,469	29,713	1,050	2,927	48,159
	Total	61,520	127,736	5,168	14,584	209,008	61,470	129,892	5,212	14,854	211,429

II. Calendar Year - Toll Rates

		Calendar Year 2039				Calendar Year 2040			
		Class 1		Average Weighted Toll for Classes 2 and 3		Class 1		Average Weighted Toll for Classes 2 and 3	
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC
1	US 74 - Austin Chaney Rd.	$ 1.00	$ 0.64	$ 3.31	$ 2.14	$ 1.02	$ 0.66	$ 3.38	$ 2.19
2	Austin Chaney Rd. - NC 200	1.32	0.86	4.38	2.85	1.35	0.88	4.48	2.91
3	NC 200 - US 601	0.60	0.38	1.99	1.27	0.61	0.39	2.04	1.30
4	US 601 - N. Rocky River Rd.	1.30	0.84	4.33	2.80	1.33	0.86	4.43	2.86
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	0.44	0.29	1.49	0.96	0.45	0.30	1.52	0.99
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	0.74	0.47	2.45	1.58	0.75	0.49	2.50	1.61
7	Indian Trail Fairview Rd. - US 74	0.61	0.40	2.04	1.33	0.63	0.41	2.08	1.36

III. Calendar Year - Estimated Average Weekday Gross Toll Revenue

		Calendar Year 2039					Calendar Year 2040				
		Class 1		Classes 2 and 3		All	Class 1		Classes 2 and 3		All
	Toll Zone Number and Name	BBM	ETC	BBM	ETC	Vehicles	BBM	ETC	BBM	ETC	Vehicles
1	US 74 - Austin Chaney Rd.	$ 3,597	$ 4,622	$ 1,233	$ 2,194	$ 11,645	$ 3,668	$ 4,839	$ 1,265	$ 2,274	$ 12,045
2	Austin Chaney Rd. - NC 200	6,239	8,488	1,834	3,379	19,940	6,389	8,841	1,892	3,509	20,632
3	NC 200 - US 601	3,992	5,305	1,242	2,267	12,805	4,052	5,530	1,281	2,358	13,221
4	US 601 - N. Rocky River Rd.	11,687	16,092	3,434	6,365	37,578	11,947	16,750	3,546	6,625	38,868
5	N. Rocky River Rd. - Unionville Indian Trail Rd.	4,667	6,507	1,406	2,584	15,164	4,768	6,844	1,448	2,717	15,776
6	Jnionville Indian Trail Rd. - Indian Trail Fairview Rd.	9,227	12,171	2,391	4,351	28,139	9,340	12,903	2,462	4,521	29,225
7	Indian Trail Fairview Rd. - US 74	8,831	11,677	2,124	3,817	26,449	9,116	12,182	2,184	3,981	27,462
	Total	$48,239	$64,862	$13,662	$24,956	$151,720	$49,279	$67,889	$14,077	$25,986	$157,230

Annualization Procedure
(rounded to thousands)
Annualization Factor: 327.3 days per year

Period	Annual Toll Transactions	Annual Gross Toll Revenue
Calendar Year (CY) 2039	68,403,000	$ 49,654,000
Calendar Year (CY) 2040	69,195,000	$ 51,457,000
Conversion to Fiscal Year		
Half of CY 2039	34,201,000	$ 24,827,000
Half of CY 2040	34,598,000	$ 25,729,000
Total Fiscal Year 2040	68,799,000	$ 50,556,000

6.10 Fiscal Year Gross Toll Transactions and Toll Revenue

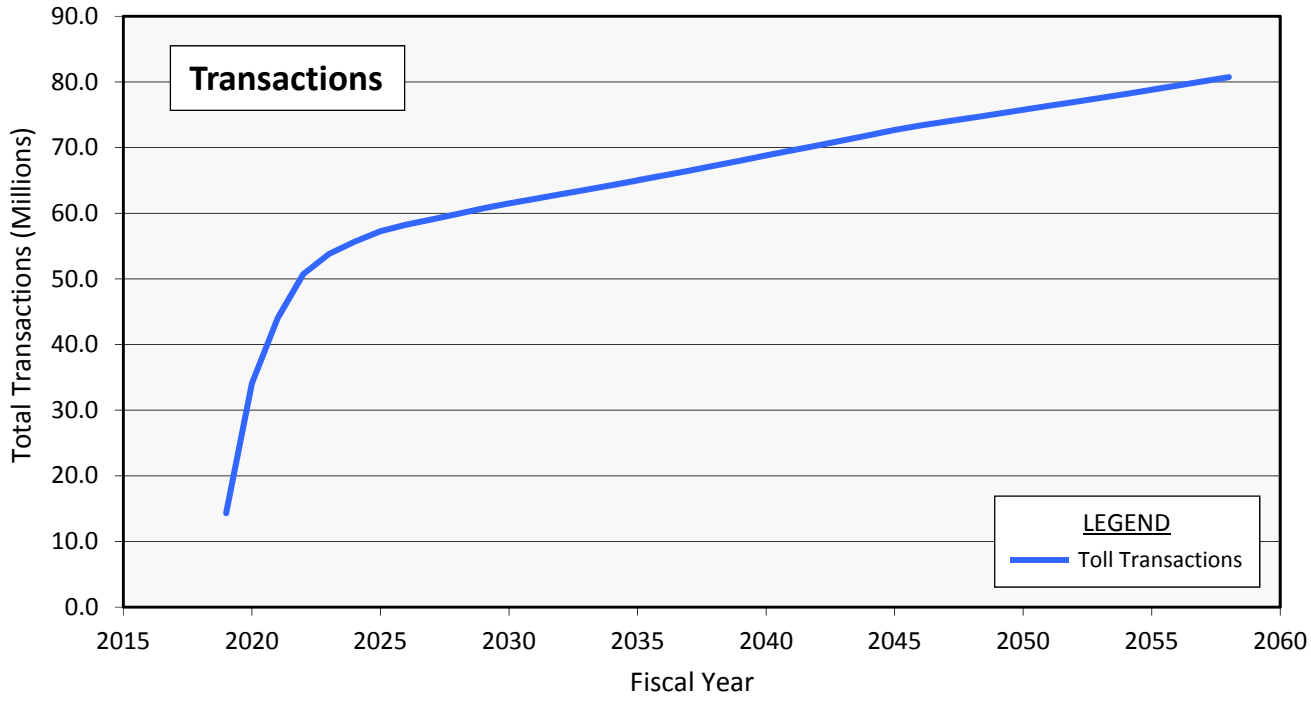
This section presents annual toll transactions and annual gross toll revenue forecasts from FY 2019 through FY 2058. Gross toll revenue consists of toll revenue from all toll transactions, prior to accounting for leakage or processing fee revenue.

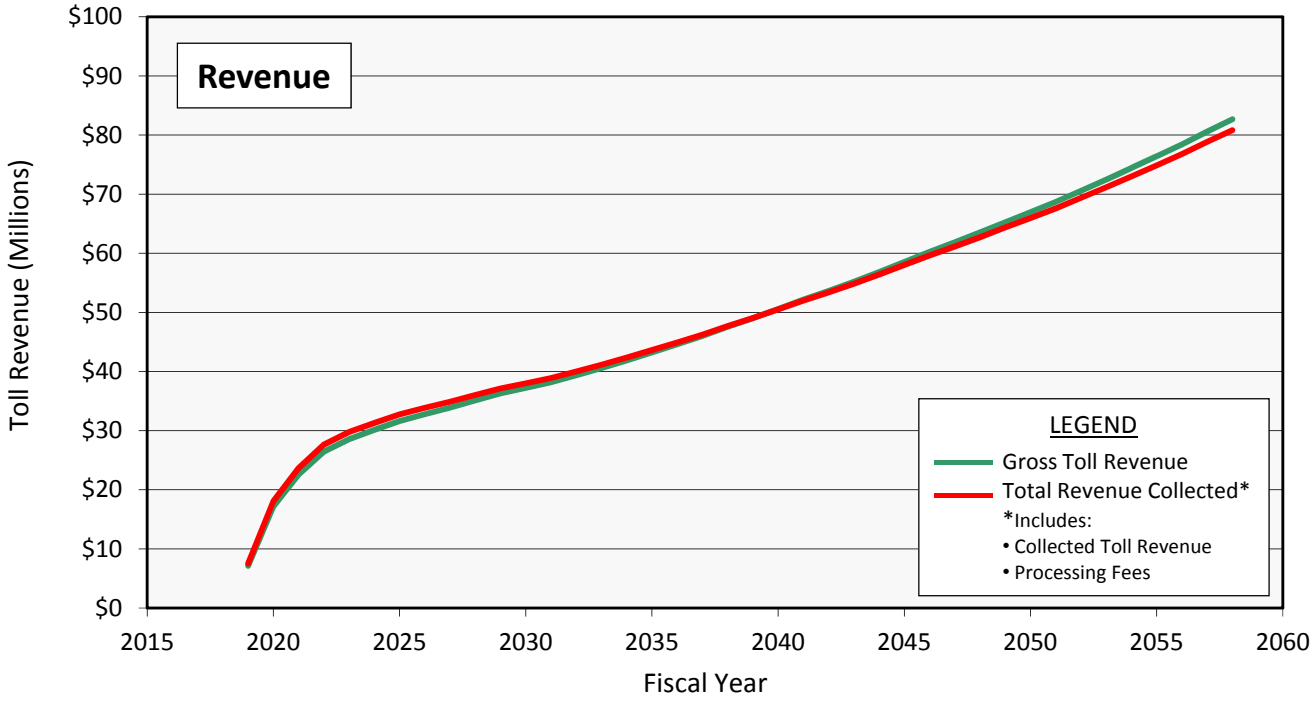
Estimated annual toll transactions by Class 1 and combined Class 2 and 3 vehicles is presented in **Table 6.10** and **Figure 6.10**. Annual transactions are expected to increase from 14.3 million in FY 2019, to 57.3 million in FY 2025, 61.5 million in FY 2030, and 68.8 million in FY 2040. Traffic estimates for FY 2019 through FY 2022 were adjusted downward to reflect the three-year ramp-up period as discussed in Section 6.8.3.

Table 6.10
Estimated Annual Toll Transactions for Monroe Expressway
(in thousands)

Fiscal	Class 1			Classes 2 and 3			All Vehicles			Percent
Year (1)	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total	ETC
2019 (2,3)	5,289	7,612	12,901	426	997	1,422	5,715	8,609	14,324	60.1
2020 (3)	12,521	18,203	30,724	1,002	2,355	3,358	13,523	20,559	34,082	60.3
2021 (3)	16,040	23,714	39,754	1,271	3,009	4,280	17,311	26,723	44,034	60.7
2022 (3)	18,317	27,537	45,854	1,436	3,427	4,863	19,753	30,965	50,717	61.1
2023	19,261	29,455	48,716	1,494	3,594	5,088	20,755	33,049	53,804	61.4
2024	19,754	30,735	50,489	1,516	3,676	5,192	21,270	34,411	55,682	61.8
2025	20,124	31,853	51,977	1,531	3,743	5,274	21,655	35,596	57,251	62.2
2026	20,253	32,676	52,929	1,538	3,794	5,332	21,791	36,470	58,261	62.6
2027	20,274	33,403	53,677	1,543	3,845	5,388	21,817	37,248	59,065	63.1
2028	20,295	34,148	54,443	1,549	3,897	5,446	21,844	38,045	59,889	63.5
2029	20,317	34,911	55,228	1,554	3,950	5,504	21,871	38,861	60,732	64.0
2030	20,304	35,628	55,932	1,563	4,012	5,575	21,867	39,640	61,507	64.4
2031	20,271	36,262	56,534	1,575	4,084	5,660	21,847	40,347	62,193	64.9
2032	20,255	36,874	57,129	1,588	4,160	5,748	21,844	41,034	62,878	65.3
2033	20,239	37,497	57,735	1,602	4,237	5,839	21,841	41,733	63,574	65.6
2034	20,223	38,129	58,352	1,615	4,315	5,931	21,838	42,445	64,283	66.0
2035	20,206	38,773	58,979	1,629	4,395	6,024	21,835	43,168	65,003	66.4
2036	20,190	39,427	59,618	1,643	4,476	6,119	21,833	43,904	65,737	66.8
2037	20,174	40,093	60,267	1,656	4,559	6,216	21,831	44,652	66,483	67.2
2038	20,158	40,770	60,928	1,670	4,644	6,314	21,828	45,413	67,242	67.5
2039	20,142	41,458	61,600	1,684	4,730	6,414	21,826	46,187	68,014	67.9
2040	20,126	42,158	62,283	1,699	4,817	6,516	21,824	46,975	68,799	68.3
2041	20,090	42,877	62,967	1,709	4,895	6,603	21,799	47,772	69,570	68.7
2042	20,035	43,616	63,652	1,714	4,961	6,676	21,750	48,578	70,327	69.1
2043	19,981	44,369	64,349	1,720	5,029	6,749	21,701	49,398	71,098	69.5
2044	19,926	45,134	65,060	1,725	5,098	6,823	21,652	50,231	71,883	69.9
2045	19,872	45,912	65,784	1,731	5,167	6,899	21,603	51,079	72,683	70.3
2046	19,822	46,589	66,411	1,734	5,230	6,964	21,556	51,819	73,375	70.6
2047	19,777	47,161	66,938	1,734	5,286	7,019	21,510	52,447	73,957	70.9
2048	19,731	47,741	67,472	1,733	5,342	7,076	21,465	53,083	74,548	71.2
2049	19,686	48,327	68,013	1,733	5,399	7,132	21,419	53,726	75,146	71.5
2050	19,641	48,921	68,562	1,733	5,457	7,190	21,374	54,377	75,751	71.8
2051	19,589	49,519	69,108	1,732	5,515	7,247	21,321	55,034	76,355	72.1
2052	19,530	50,121	69,651	1,731	5,574	7,304	21,261	55,695	76,956	72.4
2053	19,471	50,731	70,202	1,730	5,633	7,363	21,201	56,364	77,564	72.7
2054	19,412	51,348	70,760	1,729	5,693	7,421	21,141	57,041	78,182	73.0
2055	19,353	51,973	71,327	1,727	5,753	7,481	21,081	57,727	78,807	73.3
2056	19,295	52,606	71,901	1,726	5,814	7,541	21,021	58,420	79,441	73.5
2057	19,236	53,246	72,482	1,725	5,876	7,601	20,962	59,122	80,084	73.8
2058	19,178	53,894	73,072	1,724	5,939	7,663	20,902	59,832	80,735	74.1

1) Fiscal year extends from July 1 through June 30.
2) Monroe Expressway assumed to open on January 1, 2019. Only 6 months of operation are assumed in FY 2019.
3) Includes an assumed ramp-up to full traffic volumes.





ESTIMATED ANNUAL TOLL TRANSACTIONS AND REVENUE

FIGURE 6.10

The ETC market share is anticipated to range from about 60 percent of total transactions in FY 2019 to about 68 percent in FY 2040. **Table 6.11** shows the targeted ETC and BBM market shares, by calendar year, and the resulting ETC and BBM market shares from the model results. As shown in the table, the model market shares closely match with the targeted values.

Table 6.11
Annual Weekday ETC Market Share of Total Transactions
On the Monroe Expressway

		Method-of-Payment Percent Market Share Targets					
Calendar Year		Class 1 Vehicles			Class 2 and 3 Vehicles		
		ETC	BBM	Total	ETC	BBM	Total
2019	(1)	59.0	41.0	100.0	70.0	30.0	100.0
2025		61.5	38.5	100.0	71.0	29.0	100.0
2030		64.0	36.0	100.0	72.0	28.0	100.0
2040		68.0	32.0	100.0	74.0	26.0	100.0

		Model Results - Percent Method of Payment Market Share					
Calendar Year		Class 1 Vehicles			Class 2 and 3 Vehicles		
		ETC	BBM	Total	ETC	BBM	Total
2019	(1)	59.0	41.0	100.0	70.1	29.9	100.0
2025		61.3	38.7	100.0	71.0	29.0	100.0
2030		63.7	36.3	100.0	72.0	28.0	100.0
2040		67.7	32.3	100.0	73.9	26.1	100.0

1) Assumes the Monroe Expressway opens on January 1, 2019.

Transaction forecasts through 2040 were based on modeling results. Transactions after 2040 were based on extrapolating growth rates, taking into account prior year experience. Transactions between FY 2040 and FY 2058 were assumed to increase at the rates shown in **Table 6.12**.

Table 6.12
Outer Year Annual Transaction and Revenue
Growth Rate Assumptions: 2040 – 2058

	Annual Growth Rate	
FY Period	Toll Transactions	Toll Revenue
2040 - 2045	1.1%	3.0%
2045 - 2058	0.8%	2.7%

ETC market share is forecast to increase from 2040 through 2058, ranging from an ETC market share of about 68 percent in 2040 to about 74 percent in 2040. Throughout the forecast period, BBM transactions generally decline, as the proportion of ETC transactions is assumed to gradually increase.

Annual revenue estimates are provided in **Table 6.13** and illustrated in Figure 6.9. Toll revenue estimates are provided for Class 1 and combined Class 2 and 3 vehicles, and by method of payment. The total annual gross toll revenue is expected to increase from about $7.1 million in FY 2019 to about $82.7 million in FY 2058. This reflects the impact of both traffic growth and annual toll increases. Toll revenue estimates for the first four fiscal years is dampened to reflect ramp-up. The assumed annual growth rates for gross toll revenue past the last modeling year of 2040 are shown in Table 6.12. Toll revenue growth was assumed to average 3.0 percent per year from 2040 to 2045, and 2.7 percent per year from 2045 to 2058.

ETC toll revenue is expected to account for about 53 percent of the total gross toll revenue in FY 2025, 60 percent in 2040, and 66 percent in 2058. In comparison, the ETC transactions are expected to comprise about 62 percent in FY 2025, 68 percent in FY 2040, and 74 percent in FY 2058. The lower ETC toll revenue percentages, compared to ETC transaction percentages, are due to the discounted toll that ETC users receive.

6.11 Fiscal Year Net Toll Revenue

This section describes the process by which gross toll revenue was adjusted to reflect unbillable and uncollectible BBM toll transactions. Net toll revenue consists of total collected toll revenue and processing fee revenue. Assumptions contained in this section are based on current NCTA business rules and recent actual experience on the Triangle Expressway.

6.11.1 Unbillable Bill by Mail Transaction Assumptions

Video tolling, while not new, contains inherent risks associated with various steps in the toll collection process. For example, it is possible that some plates may not be properly read, or vehicle owner address information with DMV records is incomplete. During calendar year 2015 NCTA was able to invoice 90.2 percent of Bill by Mail toll transactions on the Triangle Expressway. Approximately 6.7 percent of total Bill by Mail transactions were unbillable based on license plate images that could not be processed due to missing, blocked or damaged license plates, unreadable images, or other reasons. An additional 3.1 percent of Bill by Mail transactions were unbillable based on insufficient vehicle owner address information. Based on this information, 9.8 percent of forecast Monroe Expressway Bill by Mail transactions were assumed to be unbillable. In the development of net toll revenue estimates, expected toll revenue associated with unbillable Bill by Mail transactions was deducted from projected gross toll revenue.

6.11.2 Uncollectible Bill by Mail Revenue Assumptions

Under any video-tolling system, there is also an inherent collection risk of motorists who simply don't pay their invoices. Over the course of calendar years 2014 and 2015 NCTA was able to successfully collect 87.9 percent of invoiced Triangle Expressway Bill by Mail toll revenue. Based on this information 12.1 percent of billable Monroe Expressway Bill by Mail toll revenue was assumed to be uncollectible.

Table 6.13
Estimated Annual Gross Toll Revenue For Monroe Expressway (1)
(in thousands $)

Fiscal Year (2)	Class 1			Classes 2 and 3			All Vehicles			Percent
	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total	ETC
2019 (3,4)	$2,715	$2,545	$5,260	$744	$1,132	$1,876	$3,459	$3,677	$7,137	51.5 %
2020 (4)	6,516	6,173	12,688	1,773	2,708	4,481	8,289	8,880	17,169	51.7
2021 (4)	8,526	8,212	16,739	2,295	3,534	5,829	10,822	11,747	22,568	52.0
2022 (4)	9,949	9,739	19,687	2,649	4,113	6,762	12,598	13,852	26,449	52.4
2023	10,717	10,630	21,347	2,818	4,407	7,225	13,535	15,037	28,572	52.6
2024	11,239	11,355	22,594	2,925	4,608	7,532	14,164	15,963	30,126	53.0
2025	11,701	12,103	23,804	3,021	4,800	7,821	14,722	16,903	31,625	53.4
2026	12,053	12,654	24,707	3,106	4,983	8,089	15,159	17,636	32,796	53.8
2027	12,351	13,201	25,552	3,188	5,163	8,351	15,539	18,364	33,903	54.2
2028	12,647	13,842	26,489	3,270	5,347	8,618	15,917	19,190	35,107	54.7
2029	12,930	14,464	27,394	3,358	5,544	8,902	16,288	20,008	36,296	55.1
2030	13,134	14,970	28,104	3,424	5,709	9,132	16,558	20,678	37,236	55.5
2031	13,322	15,467	28,790	3,494	5,890	9,384	16,816	21,357	38,173	55.9
2032	13,592	16,055	29,647	3,596	6,124	9,720	17,189	22,179	39,368	56.3
2033	13,861	16,668	30,529	3,703	6,360	10,062	17,563	23,028	40,591	56.7
2034	14,119	17,341	31,459	3,813	6,605	10,417	17,931	23,945	41,877	57.2
2035	14,411	18,039	32,450	3,926	6,866	10,792	18,337	24,905	43,242	57.6
2036	14,727	18,696	33,423	4,039	7,136	11,175	18,767	25,832	44,599	57.9
2037	15,043	19,390	34,433	4,156	7,420	11,576	19,199	26,809	46,009	58.3
2038	15,360	20,213	35,574	4,282	7,725	12,007	19,642	27,938	47,580	58.7
2039	15,653	20,930	36,583	4,409	8,025	12,434	20,061	28,956	49,017	59.1
2040	15,958	21,723	37,681	4,539	8,336	12,875	20,497	30,059	50,556	59.5
2041	16,269	22,577	38,846	4,661	8,653	13,313	20,930	31,230	52,159	59.9
2042	16,534	23,353	39,887	4,772	8,953	13,725	21,306	32,305	53,611	60.3
2043	16,806	24,229	41,034	4,884	9,259	14,143	21,690	33,488	55,177	60.7
2044	17,103	25,161	42,264	4,995	9,570	14,565	22,098	34,731	56,829	61.1
2045	17,398	26,152	43,551	5,113	9,885	14,998	22,511	36,038	58,549	61.6
2046	17,733	27,081	44,813	5,223	10,205	15,428	22,955	37,286	60,241	61.9
2047	18,049	27,965	46,014	5,325	10,519	15,843	23,373	38,484	61,857	62.2
2048	18,335	28,907	47,242	5,430	10,849	16,279	23,765	39,756	63,521	62.6
2049	18,668	29,869	48,537	5,537	11,191	16,728	24,204	41,061	65,265	62.9
2050	18,989	30,807	49,796	5,647	11,530	17,177	24,636	42,337	66,973	63.2
2051	19,292	31,762	51,054	5,759	11,884	17,643	25,051	43,646	68,697	63.5
2052	19,624	32,829	52,454	5,872	12,249	18,121	25,497	45,078	70,574	63.9
2053	19,974	33,872	53,846	5,984	12,634	18,618	25,958	46,506	72,464	64.2
2054	20,339	34,957	55,296	6,098	13,026	19,124	26,437	47,984	74,420	64.5
2055	20,668	36,094	56,761	6,217	13,424	19,641	26,884	49,518	76,402	64.8
2056	21,000	37,247	58,247	6,336	13,832	20,168	27,336	51,080	78,415	65.1
2057	21,371	38,498	59,869	6,461	14,260	20,720	27,831	52,758	80,590	65.5
2058	21,709	39,672	61,381	6,586	14,708	21,294	28,296	54,380	82,676	65.8

1) Excludes any allowance for uncollectible revenue.
2) Fiscal year extends from July 1 through June 30.
3) Monroe Expressway assumed to open on January 1, 2019. Only 6 months of operation are assumed in FY 2019.
4) Includes an assumed ramp-up to full traffic volumes.

6.11.3 Bill by Mail Processing Fee Revenue Assumptions

Under current NCTA business rules, Bill by Mail transactions are invoiced on a 35-day cycle. If a customer does not pay the first invoice for an unpaid toll, a $6.00 processing fee is charged with the second invoice. A maximum of $48.00 in processing fees may be assessed in a 12-month period. NCTA assesses an additional $6.00 processing fee and a $25.00 civil penalty as part of the third invoice if a Bill by Mail invoice remains unpaid. A maximum of $50.00 in civil penalties may be assessed in a 12-month period. It is important to note only the processing fee revenue proceeds are retained by NCTA, thus civil penalties have not been considered as part of this analysis.

Over the course of calendar years 2014 and 2015, approximately 56.9 percent of invoiced Bill by Mail revenue was paid on the first invoice, approximately 15.3 percent was paid on the second invoice, and approximately 15.6 percent was paid on the third or later invoice. Based on this information it was assumed that 30.9 percent of Monroe Expressway Bill by Mail invoices will pay the $6.00 processing fee associated with a second invoice. It was also assumed that 15.6 percent of the Monroe Expressway Bill by Mail invoices will pay the additional $6.00 processing fee associated with a third or later invoice.

6.11.4 Net Toll Revenue

Table 6.14 summarizes the estimated net toll revenue from FY 2019 through FY 2058. Toll revenue estimates are provided for Class 1 and combined Class 2 and 3 vehicles, and by method of payment. The total annual net toll revenue is expected to increase from about $7.5 million in FY 2019 to about $80.8 million in FY 2058. Toll revenue estimates for the first four fiscal years is dampened to reflect ramp-up. Net toll revenue exceeds gross toll revenue forecasts from FY 2019 through 2039. Net toll revenue is somewhat less than gross toll revenue from 2040 through 2058. This is because fee revenue becomes a smaller component of gross toll revenue over time due to several factors, including: 1) BBM transactions decrease over time as the ETC market share increases, thus the associated fee revenue decreases, and 2) the processing fee is assumed to remain constant throughout the forecast period, while toll rates are assumed to increase annually, therefore, fee revenue does not keep pace with increasing toll rates.

Table 6.14
Estimated Annual Net Toll Revenue For Monroe Expressway (1)
(in thousands $)

Fiscal Year (2)	Collected Toll Revenue									Percent ETC	Fee Revenue	Net Toll Revenue
	Class 1			Classes 2 and 3			All Vehicles					
	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total			
2019 (3,4)	$2,152	$2,545	$4,697	$590	$1,132	$1,722	$2,742	$3,677	$6,420	57.3 %	$1,100	$7,519
2020 (4)	5,165	6,173	11,338	1,406	2,708	4,113	6,571	8,880	15,451	57.5	2,603	18,055
2021 (4)	6,759	8,212	14,972	1,819	3,534	5,354	8,579	11,747	20,326	57.8	3,333	23,659
2022 (4)	7,887	9,739	17,626	2,100	4,113	6,213	9,987	13,852	23,839	58.1	3,805	27,644
2023	8,496	10,630	19,126	2,234	4,407	6,641	10,730	15,037	25,767	58.4	4,000	29,767
2024	8,910	11,355	20,265	2,319	4,608	6,926	11,228	15,963	27,191	58.7	4,100	31,292
2025	9,276	12,103	21,379	2,395	4,800	7,195	11,671	16,903	28,574	59.2	4,176	32,750
2026	9,555	12,654	22,209	2,462	4,983	7,445	12,018	17,636	29,654	59.5	4,202	33,856
2027	9,791	13,201	22,992	2,528	5,163	7,690	12,319	18,364	30,683	59.9	4,207	34,890
2028	10,026	13,842	23,868	2,593	5,347	7,940	12,619	19,190	31,808	60.3	4,212	36,020
2029	10,250	14,464	24,714	2,662	5,544	8,206	12,912	20,008	32,920	60.8	4,217	37,137
2030	10,412	14,970	25,382	2,714	5,709	8,423	13,126	20,678	33,805	61.2	4,215	38,020
2031	10,561	15,467	26,029	2,770	5,890	8,660	13,332	21,357	34,689	61.6	4,210	38,898
2032	10,776	16,055	26,830	2,851	6,124	8,975	13,627	22,179	35,805	61.9	4,208	40,013
2033	10,988	16,668	27,657	2,935	6,360	9,295	13,924	23,028	36,951	62.3	4,206	41,157
2034	11,193	17,341	28,533	3,023	6,605	9,627	14,215	23,945	38,161	62.7	4,204	42,365
2035	11,425	18,039	29,464	3,112	6,866	9,978	14,537	24,905	39,442	63.1	4,202	43,645
2036	11,675	18,696	30,371	3,202	7,136	10,338	14,878	25,832	40,710	63.5	4,200	44,910
2037	11,926	19,390	31,315	3,295	7,420	10,714	15,220	26,809	42,030	63.8	4,198	46,228
2038	12,177	20,213	32,390	3,394	7,725	11,119	15,571	27,938	43,510	64.2	4,197	47,706
2039	12,409	20,930	33,339	3,495	8,025	11,520	15,904	28,956	44,860	64.5	4,195	49,054
2040	12,651	21,723	34,374	3,598	8,336	11,934	16,249	30,059	46,308	64.9	4,193	50,501
2041	12,897	22,577	35,474	3,695	8,653	12,348	16,592	31,230	47,822	65.3	4,187	52,009
2042	13,108	23,353	36,460	3,783	8,953	12,736	16,891	32,305	49,196	65.7	4,177	53,373
2043	13,323	24,229	37,552	3,872	9,259	13,131	17,195	33,488	50,682	66.1	4,166	54,849
2044	13,559	25,161	38,719	3,960	9,570	13,530	17,518	34,731	52,250	66.5	4,156	56,405
2045	13,793	26,152	39,945	4,053	9,885	13,939	17,846	36,038	53,884	66.9	4,146	58,029
2046	14,058	27,081	41,139	4,141	10,205	14,346	18,198	37,286	55,484	67.2	4,136	59,620
2047	14,309	27,965	42,273	4,221	10,519	14,740	18,530	38,484	57,013	67.5	4,127	61,140
2048	14,535	28,907	43,442	4,305	10,849	15,154	18,840	39,756	58,596	67.8	4,118	62,714
2049	14,799	29,869	44,669	4,389	11,191	15,581	19,188	41,061	60,249	68.2	4,109	64,358
2050	15,054	30,807	45,861	4,477	11,530	16,006	19,530	42,337	61,867	68.4	4,100	65,967
2051	15,294	31,762	47,056	4,566	11,884	16,449	19,860	43,646	63,505	68.7	4,089	67,595
2052	15,557	32,829	48,387	4,655	12,249	16,904	20,213	45,078	65,291	69.0	4,077	69,368
2053	15,835	33,872	49,707	4,744	12,634	17,378	20,579	46,506	67,085	69.3	4,065	71,150
2054	16,124	34,957	51,081	4,834	13,026	17,861	20,958	47,984	68,942	69.6	4,053	72,995
2055	16,385	36,094	52,478	4,928	13,424	18,352	21,313	49,518	70,831	69.9	4,041	74,872
2056	16,648	37,247	53,895	5,023	13,832	18,855	21,671	51,080	72,750	70.2	4,030	76,780
2057	16,942	38,498	55,440	5,122	14,260	19,381	22,064	52,758	74,822	70.5	4,018	78,840
2058	17,210	39,672	56,882	5,221	14,708	19,930	22,432	54,380	76,812	70.8	4,006	80,818

1) Net toll revenue consists of total collected toll revenue and processing fee revenue.
2) Fiscal year extends from July 1 through June 30.
3) Monroe Expressway assumed to open on January 1, 2019. Only 6 months of operation are assumed in FY 2019.
4) Includes an assumed ramp-up to full traffic volumes.

6.12 Disclaimer

Current accepted professional practices and procedures were used in the development of these updated traffic and revenue forecasts. However, as with any forecast of the future, it should be understood that there may be differences between forecasted and actual results caused by events and circumstances beyond the control of CDM Smith. In formulating its forecasts, CDM Smith has reasonably relied upon the accuracy and completeness of information provided (both written and oral) by the NCDOT/NCTA and other local and state agencies. CDM Smith also has relied upon the reasonable assurances of some independent parties and is not aware of any facts that would make such information misleading.

CDM Smith has made qualitative judgments related to several key variables in the development and analysis of the traffic and revenue forecasts that must be considered as a whole; therefore, selecting portions of any individual result without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underlying methodologies used to obtain the results. CDM Smith gives no opinion as to the value or merit to partial information extracted from this report.

All forecasts and projections reported herein are based on CDM Smith's experience and judgment and on a review of information obtained from multiple state and local agencies, including NCDOT/NCTA, by an independent third party. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments cannot be predicted with certainty, and may affect the forecasts or projections expressed in this report, such that CDM Smith does not specifically guarantee or warrant any forecasts or projections contained within this report.

While CDM Smith believes that some of the projections or other forward-looking statements contained within the report are based on reasonable assumptions as of the date in the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. Therefore, following the date of this report, CDM Smith will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to: socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

CDM Smith is not, and has not been, a municipal advisor as defined in Federal law (the Dodd Frank Bill) to NCDOT/NCTA and does not owe a fiduciary duty pursuant to Section 15B of the Exchange Act to NCDOT/NCTA with respect to the information and material contained in this report. CDM Smith is not recommending and has not recommended any action to NCDOT/NCTA. NCDOT/NCTA should discuss the information and material contained in this report with any and all internal and external advisors that it deems appropriate before acting on this information.

Chapter 7
Sensitivity Tests

Five tests were conducted to determine the sensitivity of the Base Condition annual transaction and toll revenue forecasts to changes in key study assumptions. The sensitivity tests were conducted for calendar years 2019 and 2040. The results were converted to fiscal year (FY) and are reported for FY 2019 and FY 2040. The following describes the five sensitivity tests:

1. **Reduced Economic Growth** – trip table growth in the MRM were reduced by 30 percent.
2. **Reduced Value of Time** - passenger car (Class 1) and truck (Classes 2 and 3) values of time were reduced by 25 percent.
3. **Increased ETC Market Share** – passenger car and truck ETC market shares were increased by 20 percent.
4. **Increased Motor Fuel Prices** – motor fuel prices were increased by 50 percent.
5. **Reduced Truck Market Share** – 25 percent of the forecast truck transactions on the Monroe Expressway were assumed to be passenger cars. Total toll transactions remained unchanged.

Table 7.1 shows the Base Condition forecasts for fiscal year toll transactions, gross toll revenue, and net toll revenue. The results of the five sensitivity tests are also shown, including the difference and percent impact between the sensitivity test forecast and the Base Condition forecast. The percent impact of each sensitivity test compared to the Base Condition net toll revenue forecast is graphically shown in **Figure 7.1.**

7.1 Reduced Economic Growth

The rate of trip table growth was reduced by 30 percent between 2015 and 2040 to simulate slower economic growth than assumed in the MRM model. As a result of the slower growth, toll transactions decreased by 13 percent in FY 2019 and 20 percent in FY 2040. Similarly, gross and net toll revenue decreased by 12 percent in FY 2019 and 18 percent in FY 2040. The percent impacts in 2040 are larger compared to the 2019 percent impacts because of the compounding nature of the reduced annual growth rates.

7.2 Reduced Value of Time

Motorist value of time (VOT) is an important factor in the modeling process, as it influences a driver's willingness to pay a toll in order to achieve a time savings by using the toll road. The VOT is based in part on the median household income in each traffic analysis zone in the MRM. Base Condition VOTs were reduced by 25 percent in calendar years 2019 and 2040, resulting in an estimated 11 percent and 10 percent decrease in transactions in FY 2019 and FY 2040, respectively. Annual gross and net toll revenue estimates were also reduced by about 11 and 10 percent in FY 2019 and FY 2040, respectively.

Table 7.1
Summary of Sensitivity Test Results on Fiscal Year Transaction and Toll Revenue Estimates
(in thousands)

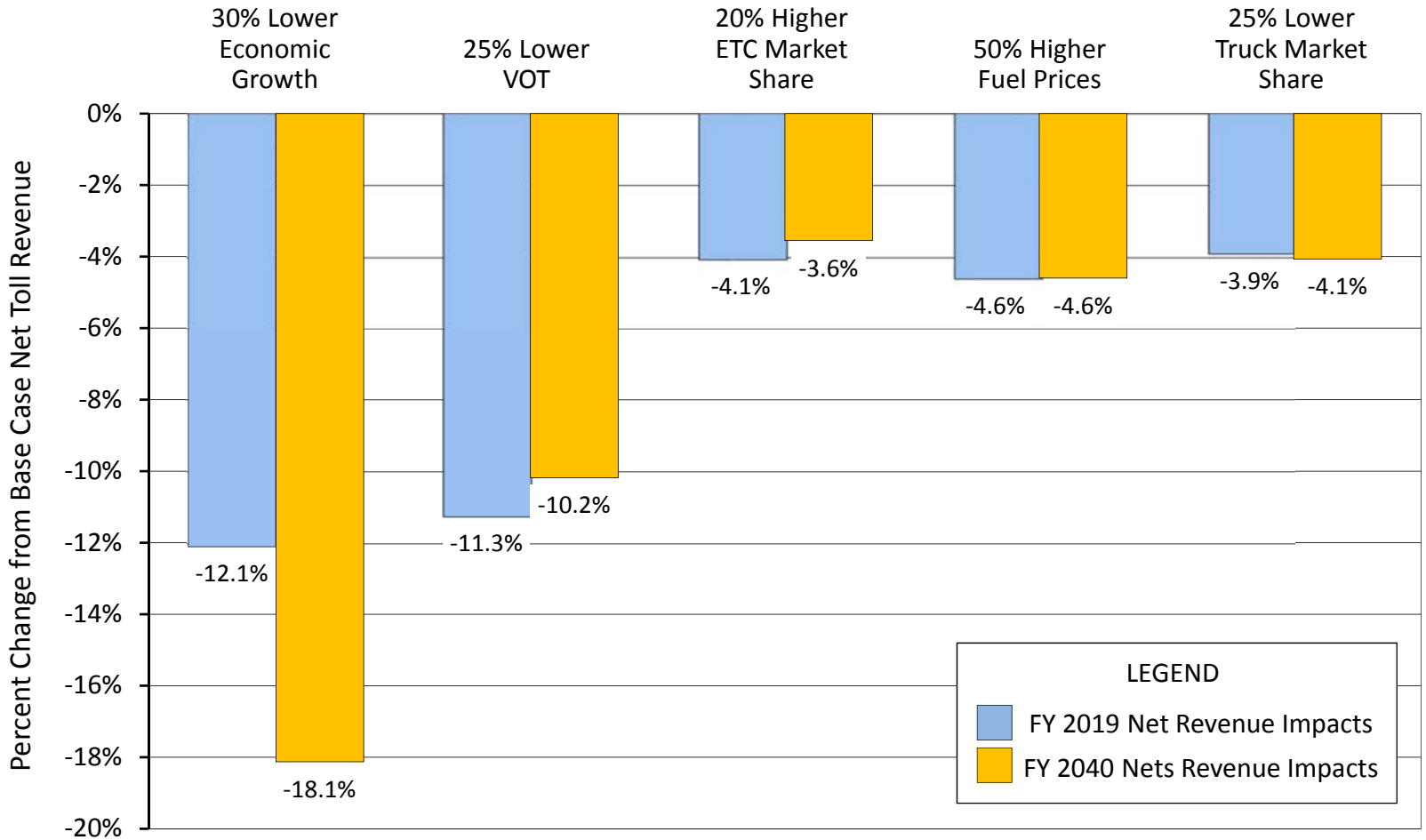
	Base Condition and Sensitivity Scenarios	Annual Toll Transactions 2019 (6)	Annual Toll Transactions 2040	Annual Gross Toll Revenue (7) 2019 (6)	Annual Gross Toll Revenue (7) 2040	Annual Net Revenue (8) 2019 (6)	Annual Net Revenue (8) 2040
	Base Condition	14,324	68,799	$7,137	$50,556	$7,519	$50,501
	Sensitivity Scenarios						
1	Overall Economic Growth Reduced by 30% (1)	12,422	55,326	$6,274	$41,392	$6,610	$41,347
	Difference	(1,902)	(13,473)	(863)	(9,164)	(909)	(9,154)
	Percent Difference	-13.3%	-19.6%	-12.1%	-18.1%	-12.1%	-18.1%
2	Value of Time Reduced by 25% (2)	12,806	61,938	$6,334	$45,408	$6,673	$45,359
	Difference	(1,518)	(6,861)	(803)	(5,148)	(846)	(5,142)
	Percent Difference	-10.6%	-10.0%	-11.3%	-10.2%	-11.3%	-10.2%
3	ETC Market Share Increased by 20% (3)	14,753	70,854	$6,922	$48,633	$7,214	$48,708
	Difference	429	2,055	(215)	(1,923)	(305)	(1,793)
	Percent Difference	3.0%	3.0%	-3.0%	-3.8%	-4.1%	-3.6%
4	Fuel Price Increased by 50% (4)	13,502	64,976	$6,809	$48,255	$7,174	$48,203
	Difference	(822)	(3,823)	(328)	(2,301)	(345)	(2,298)
	Percent Difference	-5.7%	-5.6%	-4.6%	-4.6%	-4.6%	-4.6%
5	Truck Market Share Reduced by 25% (5)	14,324	68,799	$6,805	$48,294	$7,226	$48,447
	Difference	0	0	(332)	(2,262)	(293)	(2,054)
	Percent Difference	0.0%	0.0%	-4.7%	-4.5%	-3.9%	-4.1%

1) 30 percent global reduction in MRM trip table growth from base year 2015 through 2040.
2) Value of time is reduced by 25 percent for cars and trucks.
3) Electronic toll collection market share is reduced by 20 percent for cars and trucks.
4) Fuel price is increased by 50 percent.
5) Truck transactions forecast for the Monroe Expressway are reduced by 25 percent. Those same transactions are assumed to be car transactions. Total transactions remain unchanged.
6) Includes a dampening factor (ramp-up) on traffic and revenue.
7) Total expected toll revenue for all toll transactions, prior to accounting for leakage or fee revenue.
8) Total collected toll revenue and processing fee revenue.

7.3 Increased ETC Market Share

The Base Condition assumes that Class 1 ETC participation will increase from about 59 percent in calendar year 2019, to about 68 percent in 2040. Combined Class 2 and 3 ETC participation will increase from about 70 percent in 2019 to 74 percent in 2040. Conversely, the use of VTC is assumed to decrease over the years as ETC increases.

The increased ETC market share test assumes a 20 percent increase in ETC participation for all vehicle classes. In 2019 the Class 1 ETC market share would be 71 percent, reaching 82 percent in 2040. Because of the 35 percent discounted ETC toll rate, compared to the VTC rate, and a larger pool of ETC vehicles, the toll diversion assignment indicates that toll transactions would increase by about 3 percent in both FY 2019 and FY 2040. Annual gross toll revenue decreases by 3 percent in FY 2019 and 4 percent in FY 2040 due to the lower ETC toll rates. Net toll revenue also decreases by about 4 percent in FY 2019 and FY 2040.



SENSITIVITY TESTS: NET REVENUE IMPACTS COMPARED TO BASE CONDITION

FIGURE 7.1

7.4 Increased Motor Fuel Prices

Motor fuel prices can be volatile, and this test assumes that the Base Condition motor fuel prices increase by 50 percent in each assignment year. This change would result in higher operating costs for the motorist and likely result in reduced travel demand. To reflect the reduced travel demand, the trip tables were reduced by 5 percent. The motor vehicle operating cost was also increased to reflect the increase in motor fuel prices. Under this scenario, annual toll transactions decreased by 6 percent in FY 2019 and FY 2040, and annual gross and net toll revenues decreased by 5 percent in FY 2019 and FY 2040.

7.5 Reduced Truck Market Share

Truck toll rates are significantly higher than passenger car toll rates. Class 2 vehicles (those with 3 axles) pay twice the Class 1 (2 axle vehicles) toll rates, and Class 3 vehicles (those with 4 or more axles) pay four times the Class 1 toll rates. If the market share of Class 2 and Class 3 vehicles on the Monroe Expressway is reduced and converted to Class 1 vehicles, there would be a negative impact on toll revenue. For the sensitivity test, 25 percent of the Class 2 and 3 vehicles forecast to use the Monroe Expressway were assumed to be Class 1 vehicles. The total number of transactions remain unchanged from the Base Condition. Annual gross toll revenue decreased by 5 percent and net toll revenue decreased by 4 percent.