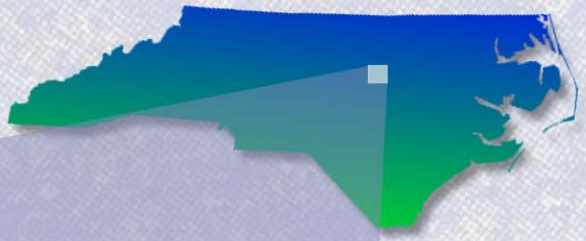
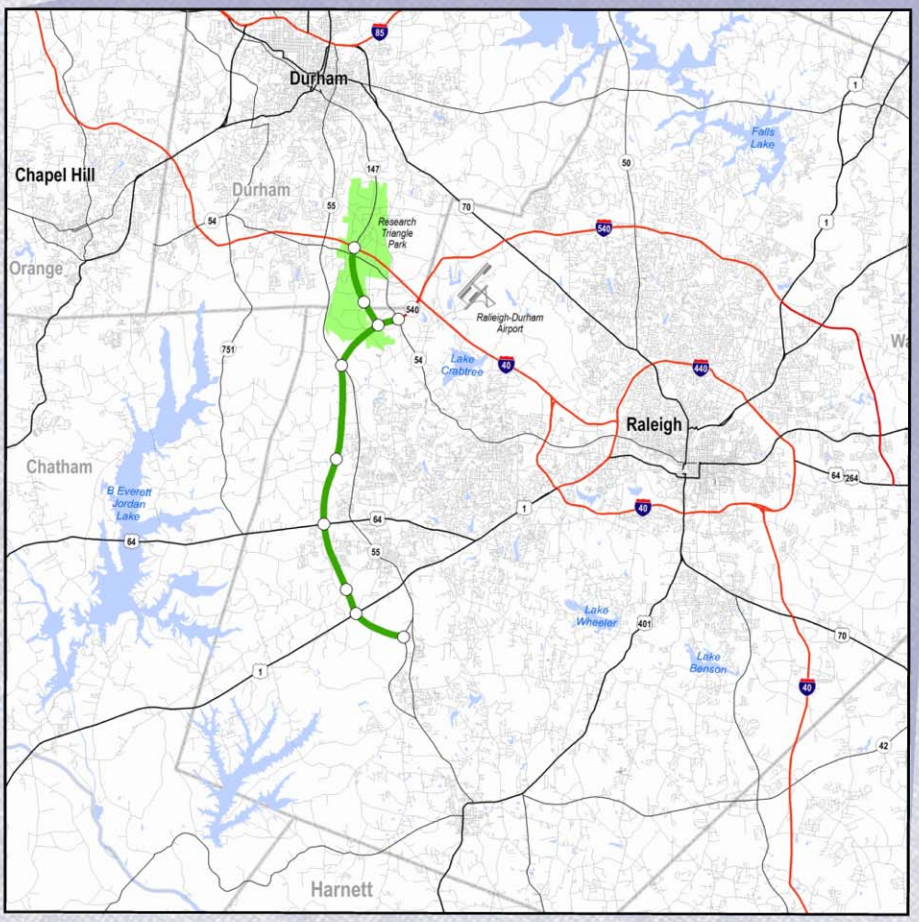
Triangle Expressway

Comprehensive Traffic and Revenue Study

Final Report





NORTH CAROLINA
Turnpike Authority

Triangle Expressway

Comprehensive Traffic and Revenue Study

Final Report

Prepared For

NORTH CAROLINA Turnpike Authority

Prepared By

ENGINEERS PLANNERS ECONOMISTS

WilburSmith ASSOCIATES

June 2008

June 18, 2008

Mr. David Joyner
Executive Director
North Carolina Turnpike Authority
5400 Glenwood Avenue
Suite 400
Raleigh, NC 27612

Re: **Comprehensive Traffic and Revenue Study – Proposed Triangle Expressway**

Dear Mr. Joyner:

Wilbur Smith Associates (WSA) is most pleased to submit this report summarizing the results of our comprehensive traffic and revenue study for the proposed Triangle Expressway in Wake and Durham Counties, North Carolina. This study was conducted at a level of detail that is considered sufficient for use in support of project financing.

The proposed Triangle Expressway (TriEx) is comprised of the Triangle Parkway that would extend from NC 147 to NC 540 through the Research Triangle Park and the Western Wake Freeway that would extend from NC 55 near Morrisville to NC 55 Bypass near Holly Springs. The connecting section between the Triangle Parkway and the Western Wake Freeway, a portion of NC 540 between NC 54 and NC 55, is currently in operation as a free facility and will become part of the Triangle Expressway when the Triangle Parkway is opened in 2010. The Western Wake Freeway is expected to open in 2012.

Toll operations and collection were important considerations during this study. Detailed analyses led the North Carolina Turnpike Authority (NCTA) board to decide to operate this toll facility as a free-flow, cashless system with electronic toll collection and video toll collection for customers without an electronic transponder. Vehicle classifications and payment types will be simplified.

We conducted additional economic and behavioral analyses for this study. An independent economist, the Kenan Institute of Private Enterprise of the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill, reviewed and updated the latest regional socioeconomic forecasts that were used in the approved regional travel demand model. Travel characteristics and traveler behavior were also identified through origin-destination travel surveys and stated preference surveys.

Our project manager, David Danforth, and other key members of the project team including Selvaraj Rayan, Will Letchworth, Bob Josef, and Cissy Szeto, as well as our subconsultant team, gratefully acknowledge the assistance provided by NCTA staff, CAMPO, DCHC, and others during the course of the study. We have appreciated this opportunity to be of service to the Authority.

Very truly yours,

WILBUR SMITH ASSOCIATES

Edward J. Regan, III
Executive Vice President

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CHAPTER 1
INTRODUCTION

The proposed Triangle Expressway (TriEx) in the Raleigh-Durham area is one of several candidate toll facility projects under consideration by the North Carolina Turnpike Authority (NCTA). Preliminary or "Level 2" traffic and revenue studies were conducted in 2006 for the TriEx and the NCTA decided to proceed with this "Level 3" study to support project financing on this approximate 18-mile facility that includes the Western Wake Freeway and Triangle Parkway. (1)

PROJECT DESCRIPTION

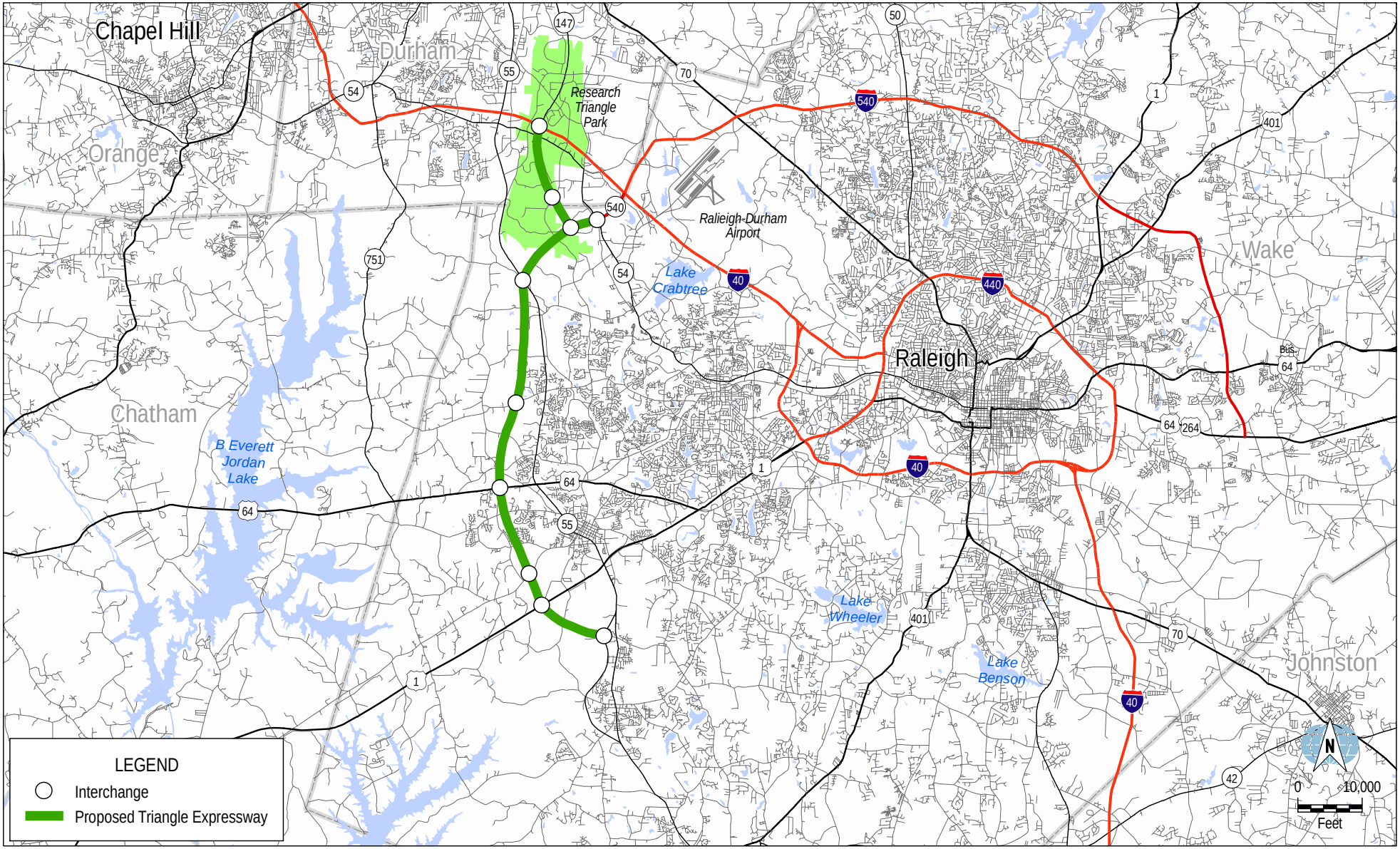
Figures 1-1 and 1-2 depict the project location and its relationship to the surrounding transportation system. The proposed Triangle Expressway is defined for this study as follows: (2)

- Triangle Parkway – NC 147/I-40 Interchange in Research Triangle Park to an interchange with NC 540 (3.4 miles);
- NC 540 - NC 54/NC 540 Interchange to NC 55 near Morrisville (2.8 miles); and
- Western Wake Freeway - NC 55 near Morrisville to NC 55 Bypass at Holly Springs (12.6 miles).

The proposed Triangle Expressway would extend for approximately 18 miles from the interchange of NC 540 and NC 54 south of Research Tri-

(1) Proposed Triangle Parkway Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, March 30, 2006.
Proposed Western and Southern Wake Parkways Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, June 16, 2006.

(2) The three designations discussed herein are based on the earlier studies and are included for continuity and clarity. The working name for the entire project is "Triangle Expressway."



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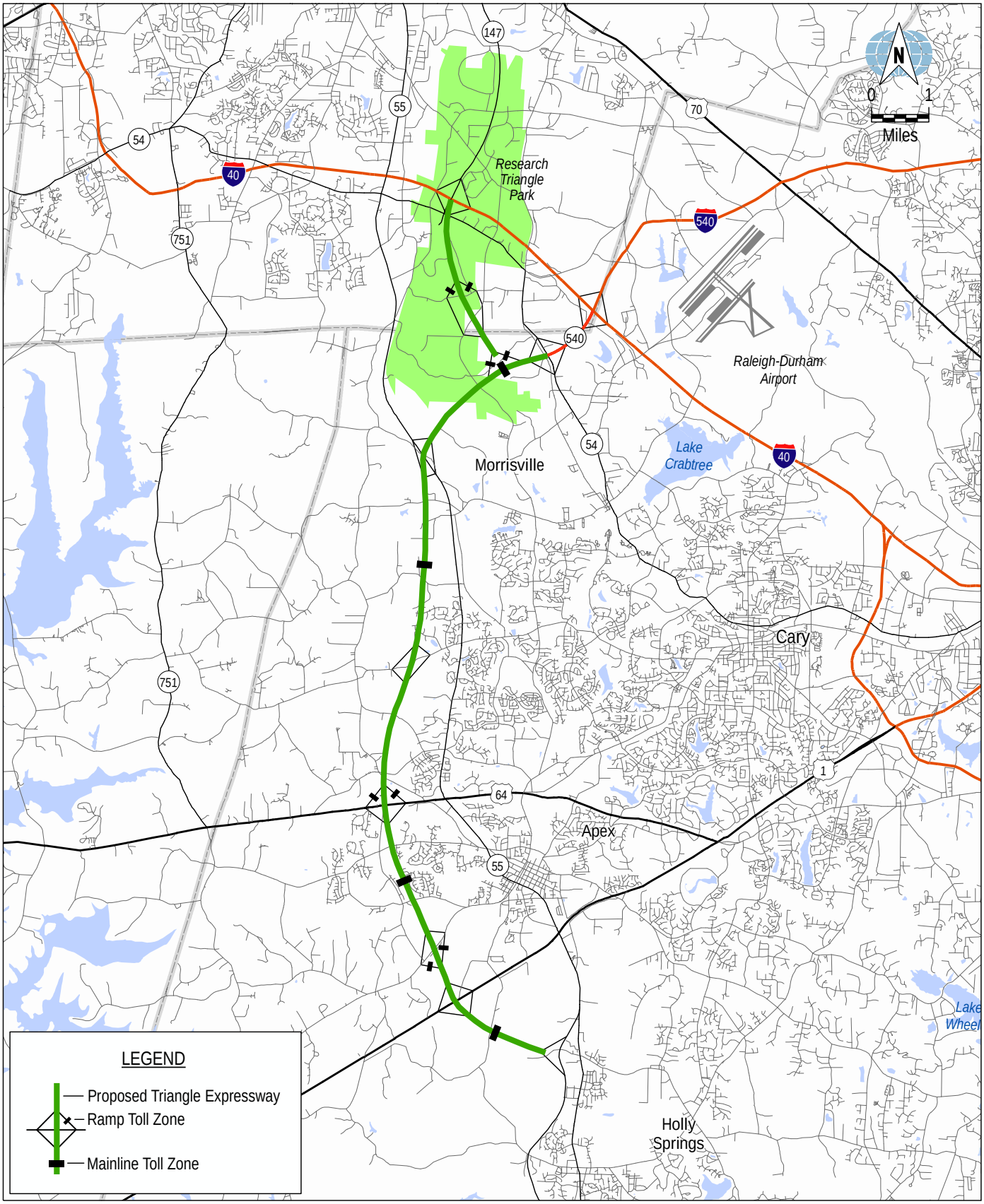
REGIONAL LOCATION MAP

FIGURE 1-1



NORTH CAROLINA Turnpike Authority

PROJECT LOCATION AND TOLL SYSTEM CONFIGURATION

FIGURE 1-2

angle Park at the northern end of the project to NC 55 Bypass near Holly Springs at the southern end of the project, and would include an approximate 3-mile connecting segment from NC 540 to NC 147 through the Research Triangle Park. The section of NC 540 between NC 54 and NC 55 is in operation now as a free facility, but will be re-designated as part of the Triangle Expressway when the Triangle Parkway is opened to traffic in 2010.

The Triangle Expressway would extend the planned and partially complete Wake Outer Loop around the greater Raleigh area. I-540, the northern portion of the Outer Loop terminates at I-40 and continues as state-designated NC 540 to NC 55 near Morrisville. NC 540 between NC 54 and NC 55 will become part of the Triangle Expressway in 2010. With the Triangle Expressway in place, drivers would have a high-grade facility from I-40 to NC 55 Bypass near Holly Springs, which would reduce congestion on the heavily-utilized parallel NC 55. It would also improve access into the Research Triangle Park and other area employment centers.

The Triangle Expressway would follow a generally north-south orientation parallel to NC 55. It would have 10 interchanges. This would provide significantly improved access to a rapidly developing area within the Triangle region, which, as noted below, is projected to have substantial increases in both population and employment over the next 25 years. NC 55 is currently being widened to a minimum of four lanes, with left-turn lane provisions. This will be the primary competing route to the Triangle Expressway. The improvement to NC 55 and other facilities was taken into consideration in this study. Other competing routes include Davis Drive, a major arterial facility located east of NC 55, and NC 751 to the west.

Project Configuration and Toll Collection Concept

The project configuration is shown in Figure 1-2. Intermediate interchanges would be constructed at Davis Drive/Hopson Road, the junction of Triangle Parkway with NC 540 between NC 54 and NC 55, NC 55, Green Level Road, US 64, Old US 1 and US 1. The southern terminus of this project would be at the NC 55 Bypass at Holly Springs. The northern termini would be at NC 147/I-40 and NC 54/NC 540.

An all-electronic, open road tolling (ORT) system is designated for the Triangle Expressway based upon analysis conducted for this study. The system will be structured as a barrier system with no free movements. Cash payments of tolls will not be available. Motorists not equipped for electronic toll collection (ETC) will be permitted to use the road under a video tolling system with premium surcharges.

Since all toll collection will be by either ETC or video at highway speeds, the Triangle Expressway will not have conventional toll plazas. Instead it will have locations, called "tolling zones," with appropriate equipment to read transponders or to capture license plate information by digital video.

Figure 1-2 shows the nominal location of four mainline tolling zones:

- Between US 1 and NC 55 Bypass;
- Between US 64 and Old US 1;
- Between NC 55 and Green Level Road; and
- Within the interchange of the Triangle Parkway and NC 540.

Tolling zones would also be established on certain interchange ramps to ensure no toll-free travel for users of the Triangle Expressway. Under this tolling concept, motorists using the TriEx from "end to end" would pass through four tolling zones without having to stop to pay tolls.

PROJECT PHASING

The proposed Triangle Expressway is expected to open for service in two phases:

- December 31, 2010: NC 147 to NC 55 Near Morrisville and NC 540 between NC 54 and NC 55 (Triangle Parkway and NC 540); and
- January 1, 2012: NC 55 near Morrisville to NC 55 Bypass at Holly Springs (Western Wake Freeway).

SCOPE OF WORK

This study was a follow-on to the preliminary studies described earlier. Previously collected data was reviewed and updated as necessary. Inventories of the corridor operating conditions including traffic counts and speed-delay studies on competing and complementary routes within the traffic impact study area plus other relevant routes outside the study area were conducted. Information on the planned transportation improvement program was reviewed to determine its prospective impact on the traffic and revenue potential of the Triangle Expressway.

Previous reports and study materials related to the proposed Triangle Expressway were also reviewed. This information included previous traffic analysis and transportation modeling analysis prepared by the two Metropolitan Planning Organizations (MPOs) in the area, the Capital Area MPO (CAMPO) and the Durham-Chapel Hill-Carrboro MPO (DCHC).

Supplemental traffic counts were conducted in the project corridor. This information facilitated both the calibration of the travel demand model used in the analysis and provided a "base case" count condition for use in the traffic impact analysis as described below.

Origin-Destination Survey

An origin-destination (OD) survey was conducted in the project area to identify current travel patterns and trip characteristics. A mail-back survey procedure was followed in which motorists were given survey cards while stopped at traffic signals and encouraged to return them by pre-paid mail. The information obtained in this survey was used to supplement the Triangle Regional Model.

Stated Preference Survey

Surveys were also conducted to provide value-of-time data for use in the toll diversion models. Interactive, notepad-based interviews were held at various employment centers, shopping areas, and government offices. Interactive, internet-based surveys were also conducted with OD survey participants who responded to the internet link provided on the OD survey card.

Traffic Model Refinement

The Triangle Regional Model (TRM) used in the preliminary studies was also used for this Level 3 study. This traffic model covers all of Wake, Durham, and Orange Counties as well as adjacent portions of Chatham, Johnston, Harnett, Granville, and Franklin Counties.

A new model platform and revised socioeconomic data was under development during this study but was not adopted by the MPOs prior to the publication of this report. Consequently the older model was used with new socioeconomic forecasts as described below.

The socioeconomic data used in the original TRM trip generation process was replaced by more recent forecasts prepared by the MPO and adjusted by an independent economist. Accordingly, new trip tables were developed by applying the new socioeconomic data to the trip generation, trip distribution, and mode choice modules of the TRM.

The revised base-year model was calibrated in the immediate project area to achieve the best traffic volume assignments compared to observed traffic counts and observed speeds during speed-delay studies. The model also was updated to reflect committed highway improvements.

The toll collection concept used in the preliminary studies was revised to reflect the NCTA's decision to use ORT without toll plazas. As was the case for the earlier studies, considerable zone disaggregation was required along the TriEx. The trip tables were disaggregated on a proportionate basis using the updated trip generation and distribution process. Future-year trip tables were also disaggregated to reflect the new disaggregated zone system.

Information was also obtained regarding regional and corridor income characteristics to aid in the development of estimated values-of-time for potential users of the candidate toll facility. Additional information from the stated preference survey was used to establish values-of-time by trip purpose and income level. This is a critical model parameter used to assess motorists' willingness to pay tolls and to estimate motorists' sensitivity to toll rates for the facility. Vehicle operating cost parameters were also established specific to the study corridor.

Independent Corridor Growth Analysis

Economic growth is particularly important for a start-up toll facility such as the proposed Triangle Expressway. Given the strong employment-related growth in the Research Triangle region and population and employment growth in the project study area, analysis and validation of the projected economic activity is particularly important.

Since the completion of the preliminary studies, the MPOs began a reassessment of the Triangle Region's socioeconomic forecasts for use in the new transportation model that was under development during the Level 3 study. The new MPO forecasts as of June 2007, while not adopted by the MPOs during this study, were used by the independent economist in its review of study area growth.[3] The independent economist adjusted the MPO's new forecasts as described in its report included in the Appendix. These forecasts by the independent economist were then used in the transportation model to create new trip tables for the toll diversion analysis.

Traffic and Revenue Analysis

The refined models were used to run a series of traffic assignments, both with and without the proposed Triangle Expressway. In each case, traffic assignments were run at AM peak, PM peak and off-peak conditions. A review was made of the reasonableness of the travel demand estimates,

[3] Kenan Institute for Private Enterprise of the University of North Carolina at Chapel Hill.

particularly under a toll condition, using various evaluation techniques such as select link, corridor share, and capture rate.
Toll sensitivity curves were developed for 2012 traffic volumes, the first year of full operation, and 2030 volumes to determine optimum toll rates. These optimum rates were then used to conduct traffic assignments for other years.

Based on the results of the traffic modeling analysis, annual estimates of traffic and revenue from the proposed Triangle Expressway were developed for the base-case condition from opening year 2011 through 2035. The forecasts beyond 2035 were based on a computational extrapolation of modeling results from 2035.

Finally, to enable the formulation of annual traffic and toll revenue forecasts, revenue estimates in the early years of the projection period were adjusted to reflect ramp-up, a pattern of gradual build-up in demand for new toll facilities. This reflects the fact that the full demand along a facility is not typically realized when it opens but gradually phases in over a period of two to four years.

SENSITIVITY TESTS

A series of sensitivity tests were also performed to provide additional information on the sensitivity of the forecasts to changes in key parameters such as higher and lower economic growth, different percentages of ETC usage, different values of time, different vehicle operating costs, longer ramp-up periods, the inclusion of additional toll facilities on the Southern Wake Freeway, increased use of transit in the study area, and the introduction of a hypothetical commuter rail service in the study area.

REPORT STRUCTURE

The remainder of this report consists of six chapters.

- Chapter 2 presents the traffic conditions in the project study area.
- Chapter 3 contains a summary of the stated preference surveys.
- Chapter 4 describes the socioeconomic characteristics of the study area using the independent economist's socioeconomic forecast.
- Chapter 5 describes the analysis that led to the decision to adopt all electronic, open road tolling concept as the preferred toll collection method.
- Chapter 6 describes the development of the traffic forecast model, assumed roadway and transit improvements, toll configuration, toll sen-

sitivity, recommended toll rates, and traffic and gross revenue forecasts.

- Chapter 7 contains the results of a series of sensitivity tests on key model parameters.

CHAPTER 2

EXISTING TRAFFIC CONDITIONS

A major part of the effort involved in this phase of the study included the collection of existing data in order to:

- Understand existing travel behavior as a context for the evolution of future travel behavior after the proposed toll road and other area facilities planned for construction over the forecast period are built; and

- Calibrate the base year of the forecasting models to current/baseline observed traffic conditions to assure that the forecasting tools are adequately replicating current conditions in the study area prior to forecasting future traffic volumes.

To achieve these objectives, the latest travel data on traffic speeds, traffic volumes, and vehicle type in the study area were compiled. In addition, extensive route reconnaissance and a review of available traffic statistics on highways within the study area was conducted.

This current empirical documentation of the traffic network in the study area was augmented by available traffic trend data from North Carolina Department of Transportation (NCDOT). Available information on programmed highway improvements scheduled in the study area was incorporated into the analysis also.

This chapter describes the collection of data used to characterize the operational performance of existing facilities in the Triangle Expressway study area.

EXISTING HIGHWAY SYSTEM

The proposed Triangle Expressway would facilitate traffic movement in a north-south direction between I-40 and I-540 and NC 55 southwest of Raleigh. It would pass through or near major employment centers, including

the Research Triangle Park, the dominant location for employment in the area. Table 2-1 summarizes the major features of the Triangle Expressway study area, which are described below.

- I-40 is the major east-west route in the Raleigh-Durham area. It extends from Wilmington on the coast across the State of North Carolina to the Tennessee state line and provides access to major cites along its length, including Asheville, Hickory, Winston Salem, Greensboro, Raleigh and Wilmington. In the area of the proposed project, I-40 is a limited access six to eight lane freeway with interchanges at I-540, Page Road, Miami Boulevard, Davis Drive, Durham Freeway (NC 147), and NC 55. The speed limit on I-40 is 65 mph.

- I-540 is part of a facility that eventually will provide an outer loop around Raleigh. Currently, I-540 extends from US 64 east of Raleigh to I-40 west of Raleigh. The eastern and southern sections of the I-540 Outer Loop, which will extend from US 64 Bypass east of Raleigh to NC 55 at Holly Springs, currently are not funded for right of way or construction. The speed limit on I-540 is 65 mph.

- NC 540 is a short section of the planned outer loop around Raleigh. NC 540 extends from I-40 between Raleigh and RTP to NC 55 near Morrisville. It is a six-lane median-divided freeway with full control of access and interchanges at NC 54 and NC 55. The proposed Triangle Expressway will have its northern terminus at NC 54. The speed limit on NC 540 is 65 mph.

- US 1 is a major highway that runs north to south through Wake County. It is primarily a four-lane, median-divided expressway facility with 65 mph speed limits and multiple interchanges. US 1 is being widened at the time of this study.

- Old US 1 runs parallel to US 1. It is a two-lane roadway with numerous unsignalized intersections.

- US 64 is primarily an east-west route with interchanges at US 1 and NC 55. US 64 is a four-lane, median-divided highway that connects Raleigh, Apex and Cary to points west. Speed limits on US 64 are 45 and 55 mph.

- NC 54 extends east-west from NC 55, parallel to I-40, before turning south to become Miami Boulevard and Chapel Hill Road. It has between two and five lanes and a posted speed limit of 45 mph.

Table 2-1
Key Attributes of Major Routes Within the Study Area

Route	Location in Study Area	Direction in Study Area	Lanes Per Direction	Controlled Access	Traffic Signals	Posted Speed Limit
Davis Drive	North of I-40 to US 64	North - South	1-3	No	Yes	45-55
Green Level Road	NC 55 to NC 751	East - West	1	No	No	45
I-40	Raleigh to Chapel Hill/Durham	East - West	3-4	Yes	No	65
I-540	Proposed Outer Ring Road around Raleigh	East - West	3-4	Yes	No	65
Miami Boulevard	Durham to Research Triangle Park	North - South	2-3	No	Yes	45
Morrisville Carpenter Road	Chapel Hill Road to NC 55	East - West	1	No	No	45
NC 54	Miami Boulevard/Chapel Hill Road to Chapel Hill	East-West	1-3	No	Yes	45
NC 147 (Durham Freeway)	Durham to Research Triangle Park	North - South	2	Yes	No	55-65
NC 55	Durham to US 1/Holly Springs	North - South	2-3	No	Yes	45
Old US 1	Parallel to US 1	North - South	1	No	No	45-55
Page Road/Hopson Road	US 70 to Research Triangle Park	East-West	1-3	No	Yes	45
US 1	Raleigh to Apex/Sanford	North - South	2	Yes	No	65
US 64	Apex/Pittsboro to Raleigh	East - West	2	Yes	No	45-55
NC 540	I-40 to NC 55	East-West	2*	Yes	No	65

* Constructed to 3 lanes per direction but only 2 lanes per direction are currently opearational.

- NC 55 extends north-south along the western side of the study area with an interchange at I-40. NC 55, which would parallel the proposed Triangle Expressway, has between two and five lanes with signalized and unsignalized intersections throughout its length. The majority of NC 55 has a 45 mph speed limit.

- NC 147 (Durham Freeway) provides north-south access from Durham to the Research Triangle Park (RTP). This four-lane facility presently terminates at I-40. The proposed Triangle Expressway would extend south from the NC 147/I-40 Interchange. Speed limits vary from 55 to 65 mph.

- Davis Drive serves the Research Triangle Park from north of I-40 to US 64 south of the Park. It has between two and five lanes with speed limits from 45 to 55 mph.

- Green Level Road is an east-west local road with multiple unsignalized intersections. It is a two-lane roadway with a 45 mph speed limit.

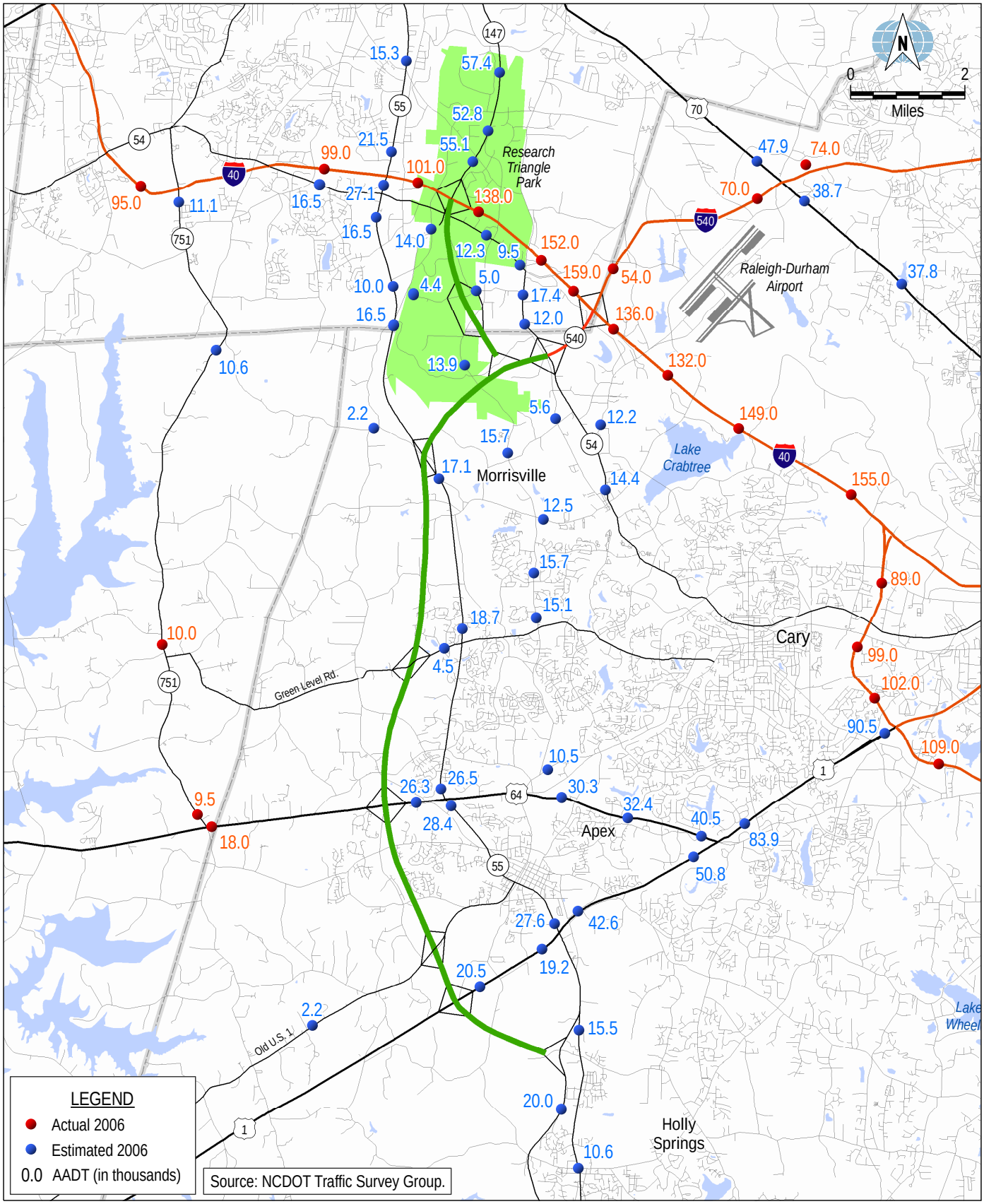
- Hopson Road and Page Road provide east-west access through the study area from an interchange with I-40 east of RTP to Alston Avenue west of RTP. Hopson Road is two lanes, while Page Road has between three and five lanes. The posted speed limit is 45 mph on both roadways.

- Miami Boulevard provides north-south access in the study area with an interchange at I-40. It is five lanes with multiple signalized intersections. The posted speed limit is 45 mph.

- Morrisville Carpenter Road is an east-west local road. It is two to four lanes with a 45 mph speed limit.

Traffic Trends and Variations

The NCDOT Traffic Survey Group conducts traffic counts for selected roadways statewide. Mainline and ramp traffic volumes are collected annually for interstate and limited access highways and used to develop estimates of Average Annual Daily Traffic (AADT). Traffic counts on arterial roadways are usually collected biennially. Existing traffic data from NCDOT were reviewed to aid in the traffic model calibration process. For locations where 2006 data was not available, historical data was used to estimate 2006 traffic volumes. Figure 2-1 provides a summary of available 2006 traffic counts conducted by NCDOT, as well as selected estimates of 2006 traffic volumes. All volumes are shown in thousands of vehicles.



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AVERAGE ANNUAL DAILY TRAFFIC AT SELECTED LOCATIONS, 2006

FIGURE 2-1

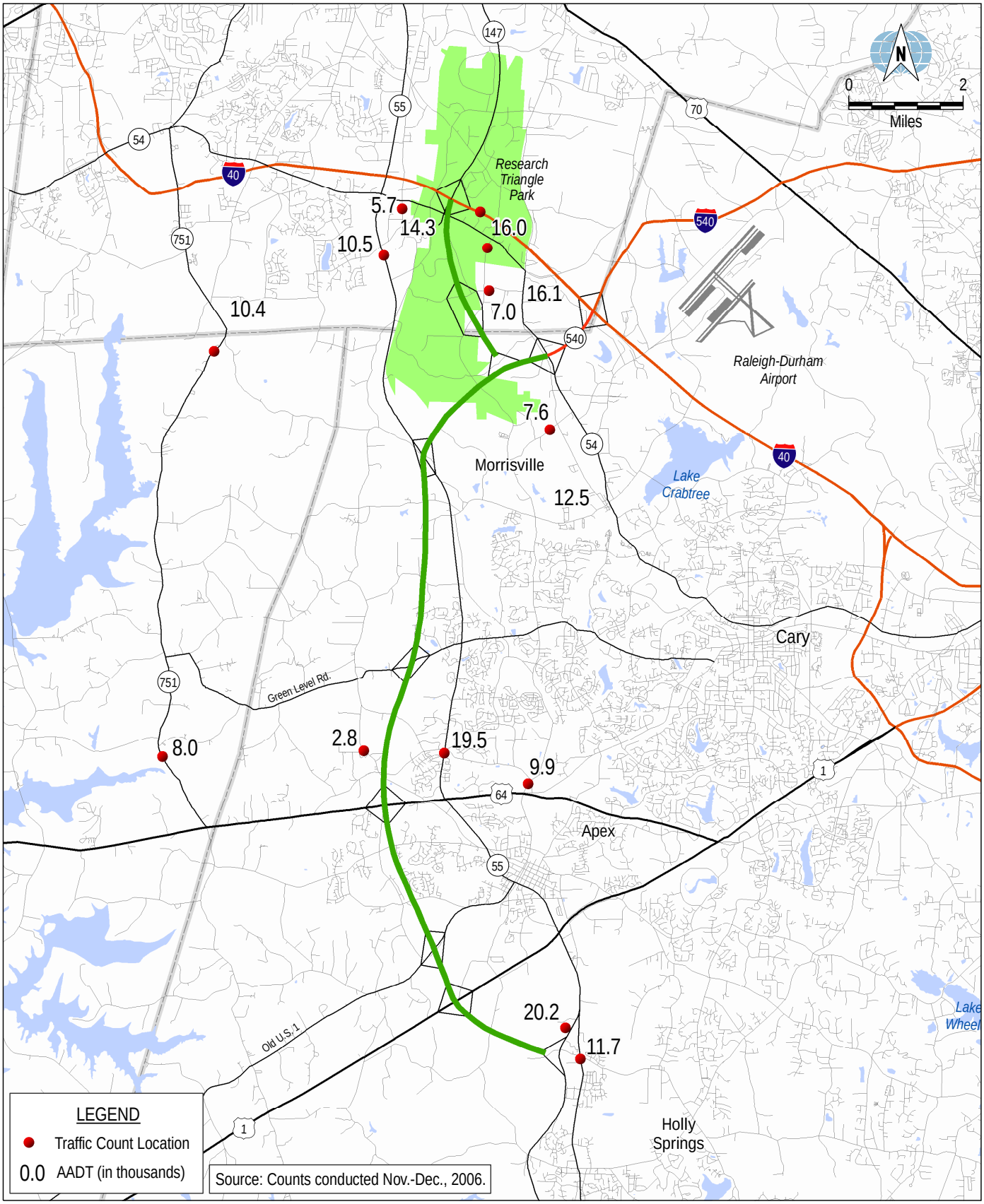
The dominant road within the study area is I-40 with daily volumes up to 159,000 vehicles per day. Other major east-west routes that would connect to the Triangle Expressway include NC 540, US 1, US 64, NC 54, and Green Level Road. The major north-south route parallel to the proposed Triangle Expressway is NC 55 with volumes between 10,600 and 28,400 vehicles per day. Other major north-south routes that could compete with the proposed Triangle Expressway include Davis Drive and NC 751.

Traffic information supplied by NCDOT was supplemented by new traffic counts within the Triangle Expressway study area and other key locations during November and December 2006. The major purpose of this supplemental work was to obtain current traffic volumes as an aid in re-calibrating the regional transportation demand model in the area of the proposed Triangle Expressway. Seven-day counts by day, hour, and vehicle class at 15 locations were obtained as shown in Figure 2-2. The average annual daily traffic volumes resulting from this data collection effort, which were calculated using North Carolina's published axle and seasonal correction factors, are summarized in Table 2-2.

Table 2-2
Average Annual Daily Traffic Volumes
at Supplemental Traffic Count Locations

Location	Average Annual Daily Traffic (AADT)		
	Northbound / Eastbound	Southbound / Westbound	Total
NC 55 Business south of Sunset Lake Road	5,957	5,779	11,736
NC 55 Bypass south of NC 55 Business	9,623	10,615	20,238
NC 55 West Williams Street south of Old Jenks Road	9,826	9,646	19,472
NC 55 south of Sedwick Drive	5,112	5,404	10,516
NC 147 west of TW Alexander Drive [(1)]	7,738	6,516	14,254
NC 751 south of Fayetteville Road	5,023	5,337	10,360
NC 751 south of Luther Road	4,030	3,989	8,019
Davis Drive south of NC 54 [(1)]	8,356	7,620	15,976
Davis Drive south of Old Jenks Road	3,951	5,943	9,894
Green Level Church Road north of Secluded Acres Road	1,465	1,366	2,831
Hopson Road east of Davis Drive	3,351	3,610	6,961
McCrimmon Parkway west of Church Street	3,732	3,916	7,648
Morrisville-Carpenter Road west of Church Street	5,719	6,762	12,481
South Alston Avenue south of NC 54	2,665	2,986	5,651
South Miami Boulevard south of NC 54 [(1)]	8,287	7,856	16,143

[(1)] Based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.



NORTH CAROLINA Turnpike Authority

AVERAGE ANNUAL DAILY TRAFFIC AT SUPPLEMENTAL TRAFFIC COUNT LOCATIONS, 2006

FIGURE 2-2

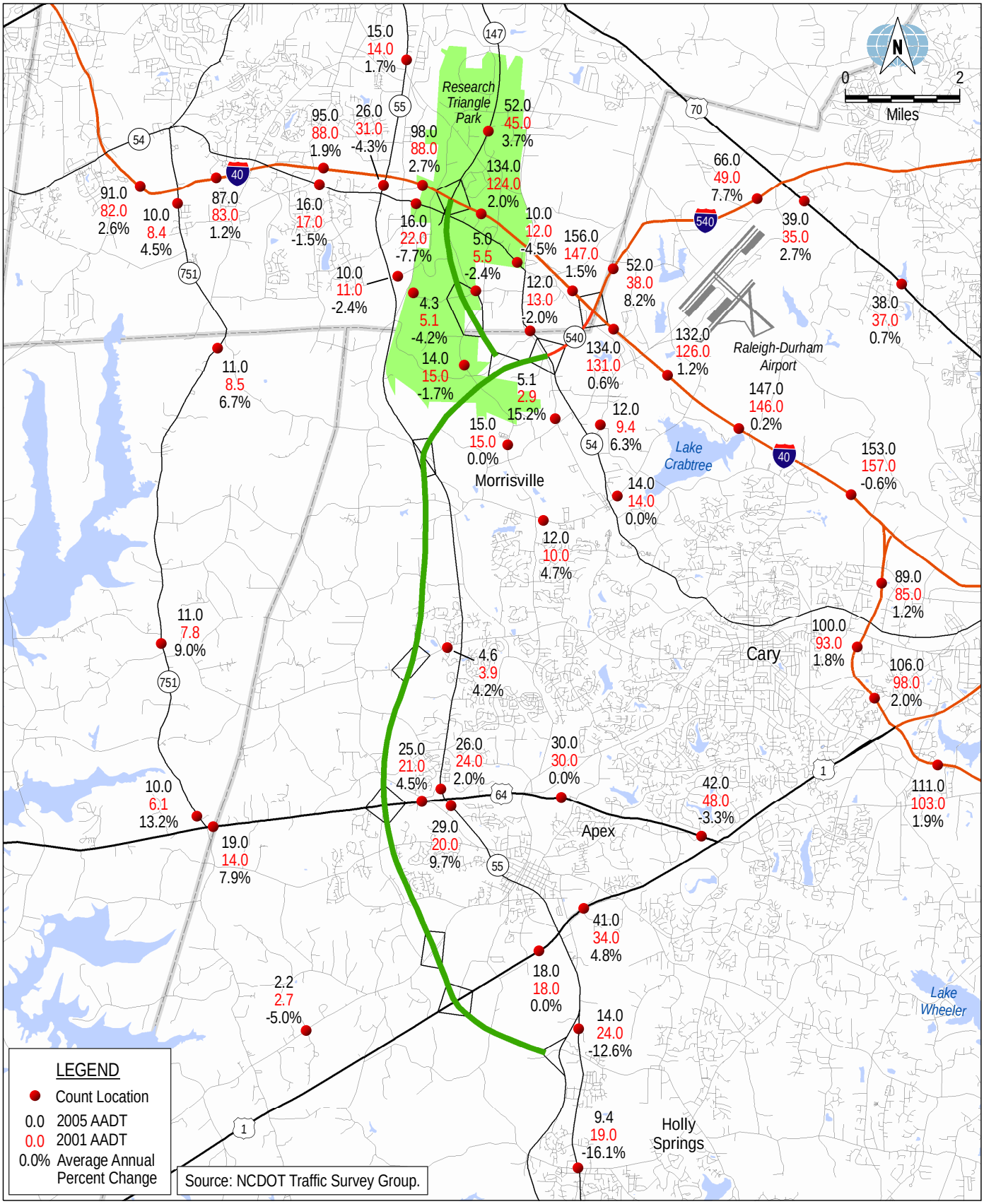
Annual Traffic Trends and Variations

Based on available NCDOT traffic information for the years 2001 and 2005, total traffic within the study area increased a total of 6 percent between 2001 and 2005, with an average annual change of 1.5 percent. Figure 2-3 shows the location of traffic counts conducted on selected roadways, which are further summarized in Table 2-3. The highest percentages of growth occurred on I-540 and on various arterial roadways in Morrisville. This may be due to the opening of I-540 to the east between I-40 and US 1 in 1997. Additional increases in traffic can be seen on roadways near Apex and on NC 751, which would be parallel to the proposed Triangle Expressway. The largest decreases in traffic occurred on NC 55 in Holly Springs, due to the construction of the NC 55 Bypass, which would serve as the southern terminus of the proposed Triangle Expressway. Smaller decreases in traffic also occurred within the Research Triangle Park, which may be due to the diversion of traffic from local roadways to I-540.

Since traffic data for interstates and limited access highways are provided annually, further analysis was conducted regarding these roadways. Figure 2-4 summarizes the interstate traffic counts collected on I-40 in the study area between 2000 and 2006. I-40 is a major east-west roadway that would interchange with the proposed Triangle Expressway. Traffic on I-40 between NC 751 and the I-440/ Wade Avenue increased an average of 2.2 percent per year between 2000 and 2006. Traffic and traffic growth on I-40 were greatest overall between NC 147 and I-540. Traffic information is provided in Table 2-4 for all interstates in the study area between 2000 and 2006. Overall, traffic on interstates within the study area increased by 3 percent between 2000 and 2005, with an additional increase of 1.6 percent between 2005 and 2006.

Monthly Traffic Variations

Seasonal adjustment factors obtained from the NCDOT Traffic Survey Group are shown in Table 2-5. These seasonal adjustment factors reflect the monthly traffic variations that occur on roadways in the study area. As shown in the table, the average May, June, July and August traffic volumes on secondary roads, such as NC 55, NC 54, and Davis Drive are 8 percent above the monthly average traffic volume. By contrast, average January traffic volume is 8 percent below the monthly average. Urban interstates generally have volumes above the monthly average, with the peak month being September with 10 percent above the monthly average. The seasonality on rural interstates is more pronounced, ranging from 12 percent below the monthly average in February to 9 percent above the monthly average in August.



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AVERAGE ANNUAL DAILY TRAFFIC, 2001 - 2005

FIGURE 2-3

Table 2-3
Historic Arterial Roadway Traffic Counts
2001 - 2005

Route Name	Traffic Count Location	Average Annual Daily Traffic (000s) 2001	2003	2005	Average Annual Growth 2001 - 2005
Airport Boulevard	East of NC 54	9.4	11.0	12.0	6.3%
Church Street	North of McCrimmon Parkway	2.9	3.7	5.1	15.2%
Davis Drive	North of Kitt Creek Road	15.0	15.0	14.0	-1.7%
Davis Drive	North of McCrimmon Parkway	15.0	17.0	15.0	0.0%
Hopson Road	West of Davis Drive	5.5	4.9	5.0	-2.4%
Hopson Road	East of South Alston Avenue	5.1	3.9	4.3	-4.2%
Morrisville Carpenter Road	East of Davis Drive	10.0	11.0	12.0	4.7%
NC 147	Between T W Alexander Drive and East Cornwallis Road	45.0	53.0	52.0	3.7%
NC 54	North of Aviation Parkway	14.0	15.0	14.0	0.0%
NC 54 (South Miami Boulevard)	South of Church Street	13.0	11.0	12.0	-2.0%
NC 54	West of NC 54 / South Miami / Creekstone	12.0	11.0	10.0	-4.5%
NC 54	East of South Alston Avenue	22.0	19.0	16.0	-7.7%
NC 54	East of Barbee Road	17.0	17.0	16.0	-1.5%
NC 55	South of Holly Springs Road	19.0	7.0	9.4	-16.1%
NC 55 (East Williams Street)	Between NC 55 Bypass and Sunset Lake Road	24.0	11.0	14.0	-12.6%
NC 55	South of US 64	20.0	24.0	29.0	9.7%
NC 55	North of US 64	24.0	25.0	26.0	2.0%
NC 55 (Apex Highway)	North of NC 54	31.0	31.0	26.0	-4.3%
NC 55	North of Cornwallis Road	14.0	15.0	15.0	1.7%
NC 751	North of US 64	6.1	8.9	10.0	13.2%
NC 751	North of Lewter Shop / Hollands Chapel	7.8	9.7	11.0	9.0%
NC 751	South of Okelly Chapel Road	8.5	8.8	11.0	6.7%
NC 751	South of I-40	8.4	10.0	10.0	4.5%
Old US 1	East of Bosco Road	2.7	2.1	2.2	-5.0%
T W Alexander Drive	East of NC 55 (Apex Highway)	11.0	10.0	10.0	-2.4%
US 1	West of NC 55 (East Williams Street)	18.0	16.0	18.0	0.0%
US 1	Between Ten Ten Road and NC 55 (East Williams Street)	34.0	35.0	41.0	4.8%
US 64	West of US 1	48.0	45.0	42.0	-3.3%
US 64	Between Laura Duncan Road and Salem Street	30.0	31.0	30.0	0.0%
US 64	Between NC 55 and Kelly Road	21.0	24.0	25.0	4.5%
US 64	East of NC 751	14.0	17.0	19.0	7.9%
US 70 (Glenwood Avenue)	Between Ebenezer Church Road and Pinecrest Road	37.0	36.0	38.0	0.7%
US 70 (Glenwood Avenue)	South of I-540	35.0	33.0	39.0	2.7%

Source: NCDOT, Information, Mapping, and Graphics Unit.

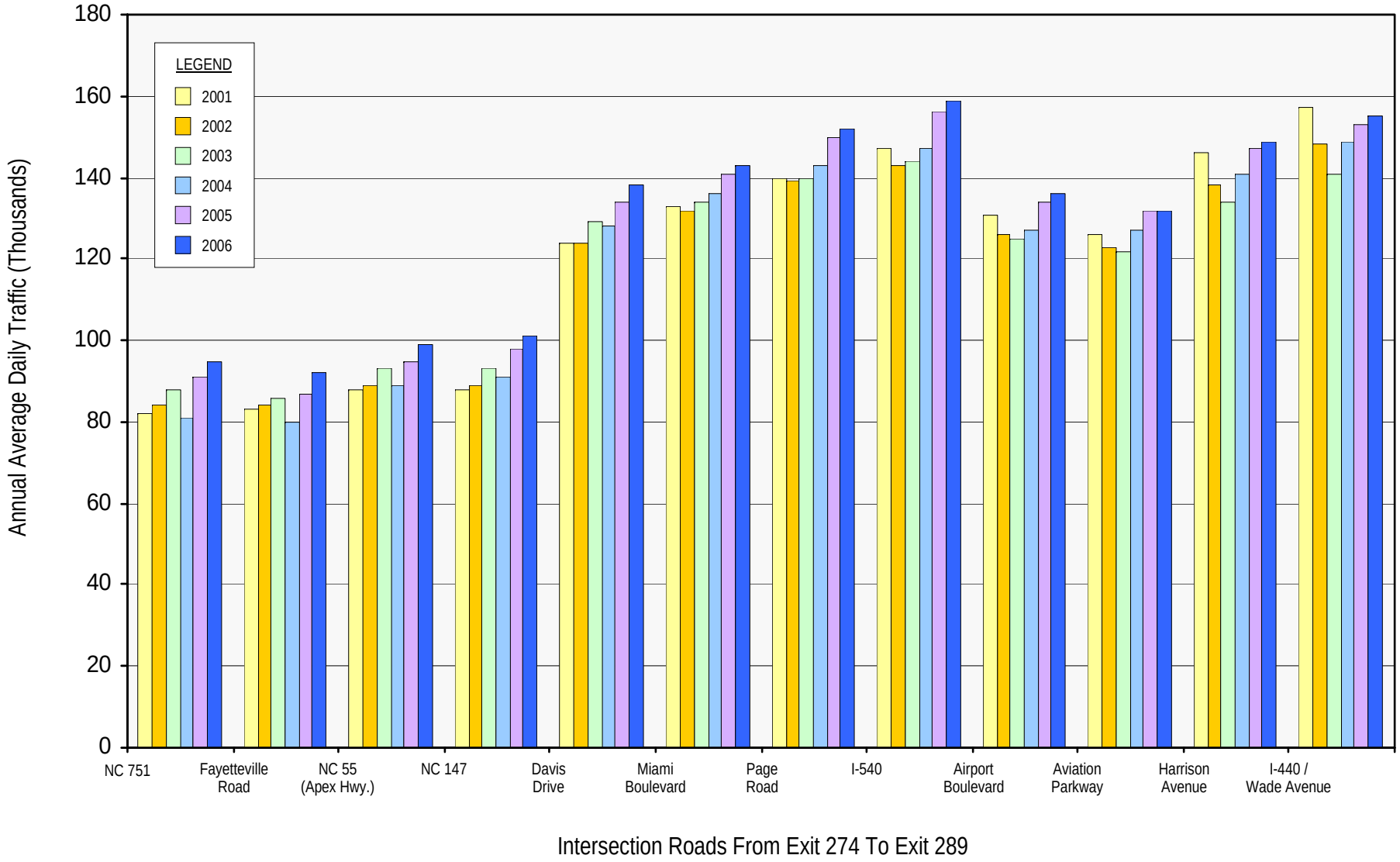

LEGEND
2001
2002
2003
2004
2005
2006
Annual Average Daily Traffic (Thousands)
0
20
40
60
80
100
120
140
160
180
NC 751
Fayetteville Road
NC 55 (Apex Hwy.)
NC 147
Davis Drive
Miami Boulevard
Page Road
I-540
Airport Boulevard
Aviation Parkway
Harrison Avenue
I-440 / Wade Avenue
Intersection Roads From Exit 274 To Exit 289

Table 2-4
Historic Interstate Highway Traffic Counts
2000 - 2006

Route Name	Traffic Count Location	Average Annual Daily Traffic (000s)							Average Annual Growth 2000 - 2006
		2000	2001	2002	2003	2004	2005	2006	
I-40 / I-440	Between Gorman Street and US 1	94	103	101	103	109	111	109	2.5%
I-40	Between US 1 and Cary Towne Boulevard	85	98	96	96	105	106	102	3.1%
I-40	Between Cary Towne Boulevard and NC 54	80	93	91	92	98	100	99	3.6%
I-40	Between NC 54 and Wade Avenue/I-40	72	85	82	83	87	89	89	3.6%
I-40	Between I-40/Wade Avenue and Harrison Avenue	144	157	148	141	149	153	155	1.2%
I-40	Between Harrison Avenue and Aviation Parkway	135	146	138	134	141	147	149	1.7%
I-40	Between Aviation Parkway and Airport Boulevard	118	126	123	122	127	132	132	1.9%
I-40	Between Airport Boulevard and I-540	124	131	126	125	127	134	136	1.6%
I-40	Between I-540 and Page Road	140	147	143	144	147	156	159	2.1%
I-40	Between Page Road and South Miami Boulevard	133	140	139	140	143	150	152	2.3%
I-40	Between South Miami Boulevard and Davis Drive	126	133	132	134	136	141	143	2.1%
I-40	Between Davis Drive and NC 147	118	124	124	129	128	134	138	2.6%
I-40	Between NC 147 and NC 55 (Apex Highway)	83	88	89	93	91	98	101	3.3%
I-40	Between NC 55 (Apex Highway) and Fayetteville Road	83	88	89	93	89	95	99	3.0%
I-40	Between Fayetteville Road and NC 751	81	83	84	86	80	87	92	2.1%
I-40	Between NC 751 and NC 54	79	82	84	88	81	91	95	3.1%
I-540	Between I-40 and Aviation Parkway	28	38	35	47	45	52	54	11.6%
I-540	Between Lumley Road and US 70 (Glenwood Avenue)	36	49	48	58	57	66	70	11.7%

Source: NCDOT, Information, Mapping, and Graphics Unit.

Table 2-5
Seasonal Adjustment for Selected
Automatic Traffic Recorder Groups[1]

Month	Monthly Index [2] Urban Interstate	Rural Interstate	Secondary Roads
January	97	85	92
February	103	88	97
March	105	97	99
April	109	102	104
May	108	104	108
June	106	108	108
July	105	108	108
August	110	109	108
September	103	106	105
October	106	109	106
November	104	105	105
December	99	103	106

[1] An Automatic Traffic Recorder (ATR) Group is a set of roadways that have similar physical characterics and surrounding development patterns.
[2] The ratio of Monthly Traffic Volumes to the Average Monthly Traffic Volumes.
Source: NCDOT Traffic Survey Group - ATR Based Seasonal Factors

DAILY TRAFFIC VARIATIONS

In the absence of any continuous counting stations within the study area, the data collected during the seven-day supplemental counts conducted in November-December 2006 was used to analyze daily traffic variations. Table 2-6 summarizes the daily variations in traffic volumes at the 12 count locations where a full week of data was available. The average weekday traffic volume for all locations is 9 percent above the average daily traffic volume, while the average weekend traffic volume is 23 percent below the average. This suggests the heavy commuter pattern present within the study area. Additionally, the three routes with variations between weekdays and weekends of 50 percent or more are located along local roadways that provide access to the Triangle Research Park: Hopson

Table 2-6
Daily Traffic Variations at Supplemental Traffic Count Locations

	Daily Index [1]							Average	Average	Average
Location	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Weekday**	**Weekend**	**Day**
NC 55 Business south of Sunset Lake Road	76	108	101	104	102	111	97	105	87	100
NC 55 Bypass south of NC 55 Business	69	108	105	107	107	114	91	108	80	100
NC 55 West Williams Street south of Old Jenks Road	80	105	102	104	104	109	97	105	89	100
NC 55 south of Sedwick Drive	61	107	111	111	114	114	83	111	72	100
NC 751 south of Fayetteville Road	63	106	111	109	117	111	83	111	73	100
NC 751 south of Luther Road	62	113	107	109	112	115	82	111	72	100
Davis Drive south of Old Jenks Road	75	107	110	99	112	111	86	108	81	100
Green Level Church Road north of Secluded Acres Road	67	118	111	109	107	109	79	111	73	100
Hopson Road east of Davis Drive	19	127	128	136	135	128	27	131	23	100
McCrimmon Parkway west of Church Street	56	108	108	113	121	122	71	114	64	100
Morrisville-Carpenter Road west of Church Street	87	101	94	104	104	109	102	102	95	100
South Alston Avenue south of NC 54	41	115	116	116	118	118	76	117	59	100
Average	**68**	**108**	**107**	**108**	**111**	**113**	**86**	**109**	**77**	**100**

[1] Ratio of individual day's traffic to average daily traffic for the week.
Source: 7-Day Supplemental Counts in November-December 2006.

Road, McCrimmon Parkway and Alston Avenue. For most locations, the peak day is either Thursday or Friday. The average variation in daily traffic volumes is further illustrated in Figure 2-5.

Hourly Traffic Variations

Table 2-7 summarizes hourly traffic volumes at all 15 supplemental count locations. The average hourly traffic volumes at three locations on NC 55 are summarized in Figure 2-6. Distinct AM and PM peaks are present, as well as a smaller midday peak at the northern end of NC 55 near Research Triangle Park, which suggests the heavy influence of commuters. This midday peak is reduced at the southern end near Holly Springs. The locations that exhibit higher traffic volumes during the AM period are Davis Drive south of NC 54 and Hopson Road east of Davis Drive. These two roadways provide access to the Research Triangle Park.

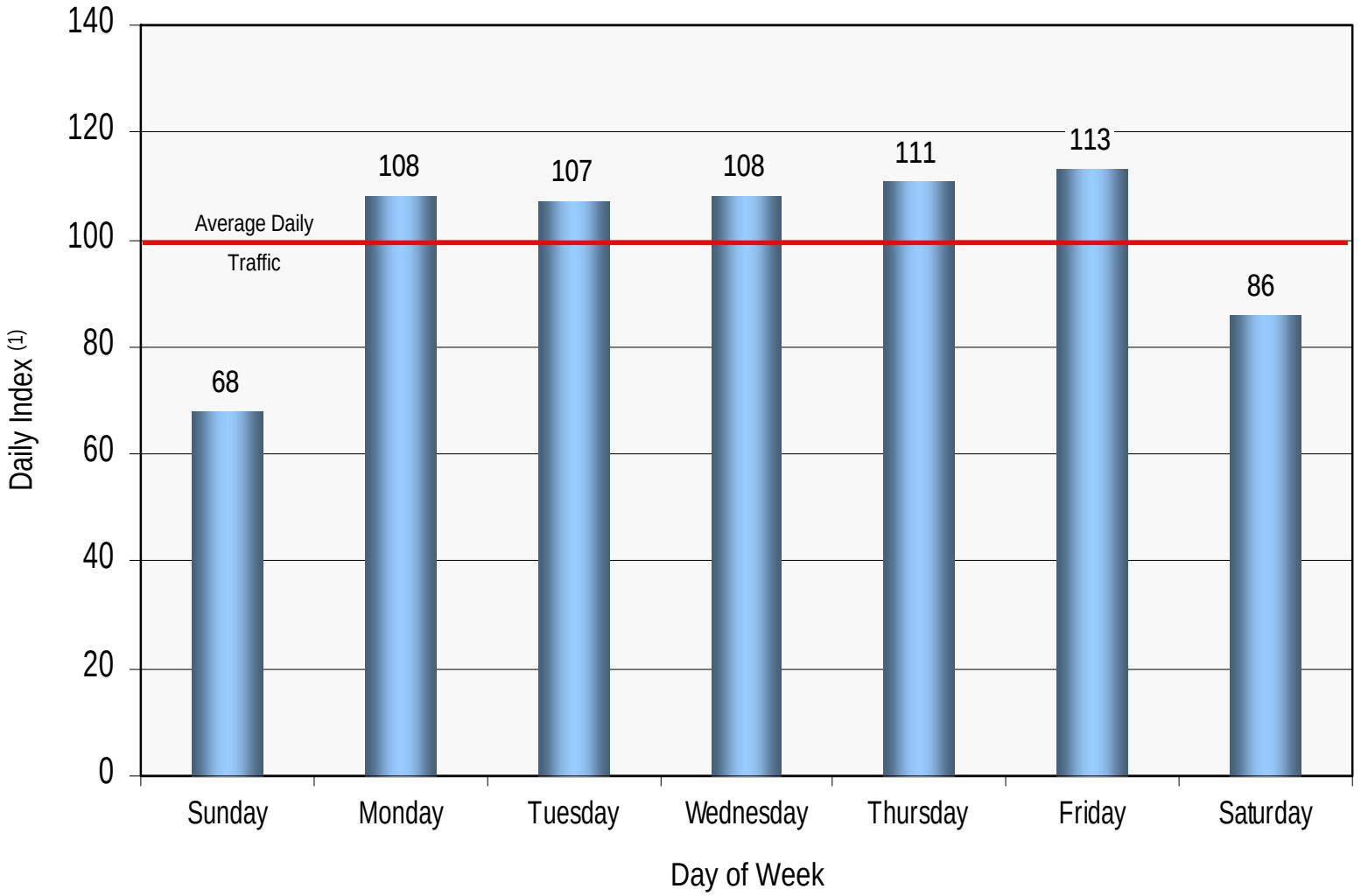
Table 2-8 examines the peak period share of average daily traffic at the 15 supplemental count locations. The AM peak period is defined as 6:00-10:00 a.m., and the PM peak period is defined as 3:00-7:00 p.m. There is also a Midday peak period from 10:00 a.m. to 3:00 p.m. and an Off-peak period from 7:00 p.m. to 6:00 a.m. From the table it is clear that the PM peak represents a significant share of daily traffic. For the supplemental count locations, an average of 30.1 percent of daily traffic occurs during the PM peak period. The AM peak period represents an average of 21.7 percent of daily traffic. This means that the majority of daily traffic occurs during the peak periods further suggesting the influence of commuters within the study area.

Vehicle Classification

Vehicle classification affects many modeling variables, such as value of time and vehicle operating costs. Additionally, it has an influence on revenue generation. Table 2-9 presents the vehicle classification data gathered from the 15 supplemental traffic count locations. Passenger vehicles predominate in this heavy commuter area, with an average of 90.9 percent for all locations. Heavy trucks, which are considered to be tractor trailers, constitute an average of 3.3 percent of all vehicles, while light and medium trucks make up 5.8 percent. The highest percentages of truck traffic were observed on NC 55, Miami Boulevard and Davis Drive, which all provide north-south access through the Research Triangle Park.

Travel Speeds and Delays

Weekday travel speeds within the project study area were measured on July 25 and 26, 2007. Data collection was performed during the AM peak period and PM peak period on multiple roads in each direction, including the following:



(1) Daily Index = Ratio of individual day's traffic to average daily traffic for week.

NORTH CAROLINA Turnpike Authority

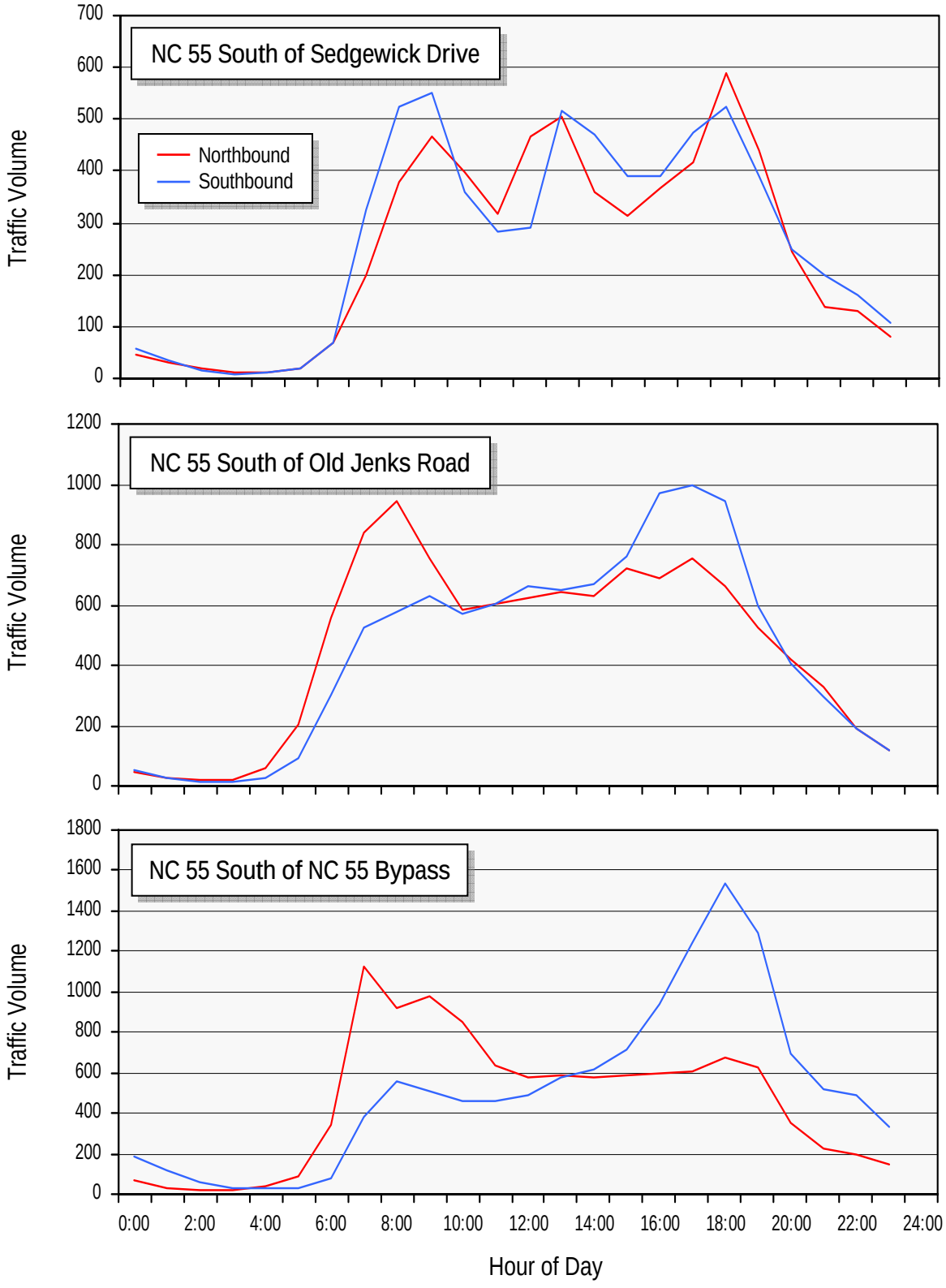
AVERAGE DAILY VARIATIONS
SUPPLEMENTAL TRAFFIC COUNT LOCATIONS

FIGURE 2-5

Table 2-7
Hourly Traffic Variations at Supplemental Traffic Count Locations

Beginning Hour	Percent of Total Day (7-day Counts)															
	NC 55 Business slouth of Sunset Lake	NC 55 Bypass south of NC 55 Business	NC 55 West Williams Street south of Old Jenks Road	NC 55 south of Sedwick Drive	NC 147 west of TW Alexander Drive [1]	NC 751 south of Fayetteville Road	NC 751 south of Luther Road	Davis Drive south of NC 54 [1]	Davis Drive south of Old Jenks Road	Green Level Church Road sorth of Secluded Acres Road	Hopson Road east of Davis Drive	McCrimmon Parkway west of Church Street	Morrisville-Carpenter Road west of Church Street	South Alston Avenue south of NC 54	South Miami Boulevard south of NC 54 [1]	Average
0:00	1.4%	1.5%	0.7%	1.2%	0.8%	0.7%	0.7%	0.7%	0.4%	0.5%	0.7%	0.7%	1.7%	1.2%	0.7%	0.9%
1:00	0.7%	0.9%	0.4%	0.7%	0.5%	0.4%	0.4%	0.4%	0.3%	0.2%	0.4%	0.3%	0.9%	0.6%	0.4%	0.5%
2:00	0.5%	0.5%	0.2%	0.4%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.3%	0.2%	0.4%	0.3%	0.2%	0.3%
3:00	0.4%	0.3%	0.2%	0.3%	0.2%	0.1%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.3%	0.2%	0.2%
4:00	0.5%	0.3%	0.4%	0.2%	0.1%	0.1%	0.1%	0.1%	0.5%	0.1%	0.2%	0.4%	0.2%	0.2%	0.3%	0.3%
5:00	0.5%	0.5%	1.2%	0.3%	0.2%	0.3%	0.3%	0.2%	2.0%	0.0%	0.2%	1.0%	0.5%	0.2%	1.2%	0.6%
6:00	1.2%	1.6%	3.2%	1.0%	1.3%	1.0%	1.1%	0.9%	4.3%	0.2%	1.3%	3.4%	1.2%	0.8%	4.3%	2.0%
7:00	4.1%	5.4%	5.3%	3.8%	4.4%	4.7%	5.0%	4.1%	6.5%	2.6%	3.8%	6.3%	3.3%	2.2%	7.6%	4.9%
8:00	6.3%	5.5%	6.2%	6.2%	9.7%	8.7%	11.0%	9.7%	6.5%	8.4%	8.7%	6.5%	4.8%	7.0%	8.8%	7.4%
9:00	5.9%	5.8%	6.1%	7.4%	10.6%	7.9%	7.9%	11.7%	6.3%	9.6%	10.2%	5.7%	5.0%	7.7%	6.2%	7.4%
10:00	5.5%	5.6%	5.6%	6.0%	6.4%	5.3%	5.0%	7.7%	5.5%	5.7%	7.6%	4.9%	5.6%	4.9%	4.4%	5.7%
11:00	4.9%	5.1%	6.0%	5.2%	3.6%	4.7%	4.6%	4.3%	5.6%	4.4%	4.3%	5.6%	6.1%	4.0%	7.0%	5.2%
12:00	5.0%	5.0%	6.4%	6.2%	4.1%	4.9%	4.5%	4.9%	5.8%	5.1%	6.8%	7.4%	6.3%	5.3%	8.5%	5.8%
13:00	5.9%	5.6%	6.5%	8.1%	4.4%	5.3%	5.0%	6.1%	5.8%	6.0%	9.2%	6.7%	6.5%	7.5%	7.3%	6.3%
14:00	5.6%	5.7%	6.5%	6.9%	4.3%	5.3%	5.2%	5.4%	6.7%	5.7%	8.9%	6.1%	6.5%	7.2%	5.2%	5.9%
15:00	6.0%	6.0%	7.2%	6.0%	4.5%	5.9%	5.5%	4.8%	7.4%	5.6%	5.4%	6.8%	6.9%	5.8%	5.6%	6.0%
16:00	6.9%	6.8%	7.8%	6.4%	6.3%	7.1%	6.8%	5.8%	7.7%	6.9%	5.8%	8.4%	6.8%	7.9%	7.2%	6.9%
17:00	7.6%	7.8%	8.0%	7.2%	10.6%	10.0%	9.6%	8.7%	7.4%	8.2%	7.7%	8.9%	7.3%	7.8%	9.2%	8.4%
18:00	8.5%	9.0%	7.3%	8.7%	13.2%	12.0%	11.7%	9.0%	6.9%	12.7%	6.2%	6.7%	6.8%	10.5%	6.0%	8.7%
19:00	7.7%	7.8%	5.2%	6.6%	6.9%	6.3%	6.4%	6.9%	5.2%	8.2%	5.7%	4.8%	6.4%	6.7%	3.3%	6.2%
20:00	5.3%	4.6%	3.8%	4.1%	3.2%	3.4%	3.2%	3.5%	3.5%	4.0%	2.9%	3.4%	5.8%	4.4%	2.2%	3.8%
21:00	3.9%	3.4%	3.0%	3.0%	2.0%	2.4%	2.4%	2.2%	2.6%	2.5%	1.7%	2.6%	4.4%	3.3%	1.8%	2.8%
22:00	3.3%	3.1%	1.9%	2.5%	1.7%	1.9%	1.9%	1.3%	1.8%	2.1%	1.1%	1.7%	3.7%	2.5%	1.3%	2.2%
23:00	2.3%	2.2%	1.2%	1.8%	1.0%	1.3%	1.3%	0.9%	1.0%	1.0%	0.9%	1.3%	2.6%	1.7%	1.0%	1.5%
Total Day	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

[1] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.



Source: 7-Day Supplemental Traffic Counts in November-December, 2006

NORTH CAROLINA Turnpike Authority

AVERAGE HOURLY TRAFFIC ON NC 55

FIGURE 2-6

Table 2-8
Traffic Variations by Time Period at Selected Locations

Location	Percent of Average Daily Traffic				
	AM Peak 6 - 10 AM	Midday 10 AM- 3 PM	PM Peak 3 - 7 PM	Off-Peak 7 PM - 6 AM	Total Day
NC 55 Business south of Sunset Lake Road	17.5%	26.9%	29.0%	26.5%	100%
NC 55 Bypass south of NC 55 Business	18.3%	27.0%	29.6%	25.1%	100%
NC 55 West Williams Street south of Old Jenks Road	20.8%	31.0%	30.3%	18.2%	100%
NC 55 south of Sedwick Drive	18.4%	32.4%	28.3%	21.1%	100%
NC 147 west of TW Alexander Drive [(1)]	26.0%	22.8%	34.6%	16.8%	100%
NC 751 south of Fayetteville Road	22.3%	25.5%	35.0%	17.1%	100%
NC 751 south of Luther Road	25.0%	24.3%	33.6%	17.0%	100%
Davis Drive south of NC 54 [(1)]	26.4%	28.4%	28.3%	16.6%	100%
Davis Drive south of Old Jenks Road	23.6%	29.4%	29.4%	17.7%	100%
Green Level Church Road north of Secluded Acres Road	20.8%	26.9%	33.4%	18.8%	100%
Hopson Road east of Davis Drive	24.0%	36.8%	25.1%	14.3%	100%
McCrimmon Parkway west of Church Street	21.9%	30.7%	30.8%	16.6%	100%
Morrisville-Carpenter Road west of Church Street	14.3%	31.0%	27.8%	26.8%	100%
South Alston Avenue south of NC 54	17.7%	28.9%	32.0%	21.4%	100%
South Miami Boulevard south of NC 54 [(1)]	26.9%	32.4%	28.0%	12.6%	100%
Average	**21.7%**	**28.9%**	**30.1%**	**19.3%**	**100%**

[(1)] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.

Table 2-9
Vehicle Classifications at Supplemental Traffic Count Locations

Location	Passenger Vehicles	Light & Medium Trucks	Heavy Trucks	Total Trucks
NC 55 Business south of Sunset Lake Road	95.7%	3.6%	0.7%	4.3%
NC 55 Bypass south of NC 55 Business	90.8%	6.2%	3.1%	9.3%
NC 55 West Williams Street south of Old Jenks Road	88.7%	4.4%	6.9%	11.3%
NC 55 south of Sedwick Drive	90.2%	8.3%	1.5%	9.8%
NC 147 west of TW Alexander Drive [(1)]	95.4%	3.4%	1.2%	4.6%
NC 751 south of Fayetteville Road	90.9%	7.3%	1.8%	9.1%
NC 751 south of Luther Road	92.3%	5.5%	2.2%	7.7%
Davis Drive south of NC 54 [(1)]	87.8%	10.0%	2.1%	12.1%
Davis Drive south of Old Jenks Road	87.4%	5.7%	6.9%	12.6%
Green Level Church Road north of Secluded Acres Road	90.6%	8.4%	1.0%	9.4%
Hopson Road east of Davis Drive	95.7%	3.5%	0.9%	4.4%
McCrimmon Parkway west of Church Street	92.8%	3.5%	3.7%	7.2%
Morrisville-Carpenter Road west of Church Street	91.2%	7.4%	1.4%	8.8%
South Alston Avenue south of NC 54	94.8%	4.6%	0.6%	5.2%
South Miami Boulevard south of NC 54 [(1)]	87.1%	4.7%	8.2%	12.9%
Average	**90.9%**	**5.8%**	**3.3%**	**9.1%**

[(1)] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.

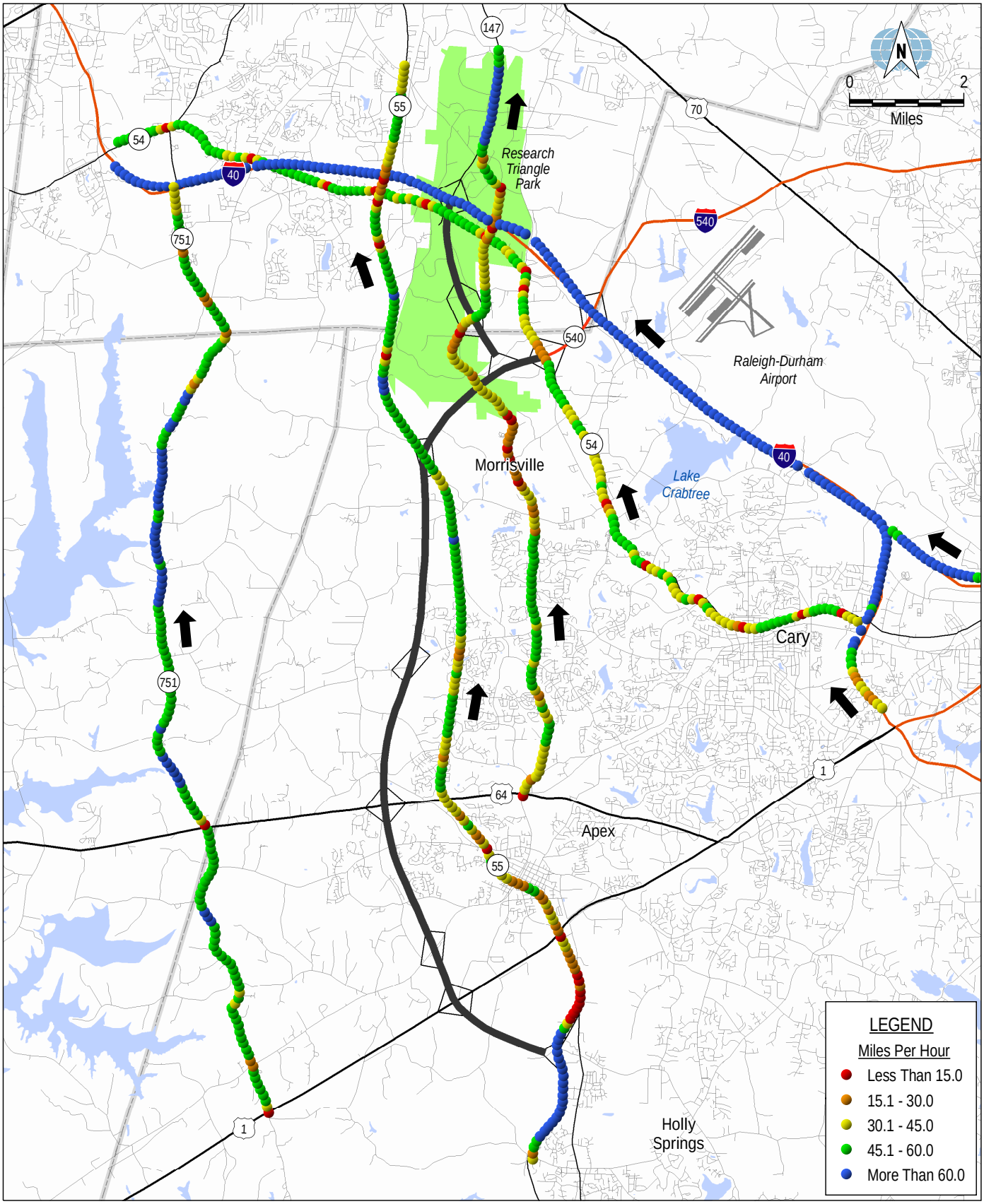
Northbound – Southbound Routes:
- NC 55
- NC 147
- NC 751
- Davis Drive

Eastbound – Westbound Routes:
- I-40
- I-440/US 64/US 1/I-40
- NC 54 / Chapel Hill Road

The results of this data collection are summarized in Table 2-10.

Observed travel speeds collected during typical AM peak period speed and delay studies in the northbound and westbound direction are shown in Figure 2-7. Southbound and eastbound data are shown in Figure 2-8. The figures show reduced speeds on Davis Drive within the Research Triangle Park, and on NC 54 eastbound and westbound approaching the Research Triangle Park. Additionally, there appears to be reduced speeds on NC 55 northbound, south of US 64. Figures 2-7 and 2-8 also show that I-40, NC 147 and NC 751 appear to be generally at free-flow speeds. These observations are borne out by the average observed travel speeds presented in Table 2-10. However, AM peak travel westbound from the Raleigh area to Research Triangle Park is frequently subjected to significant delays that were not observed during these speed and delay studies.

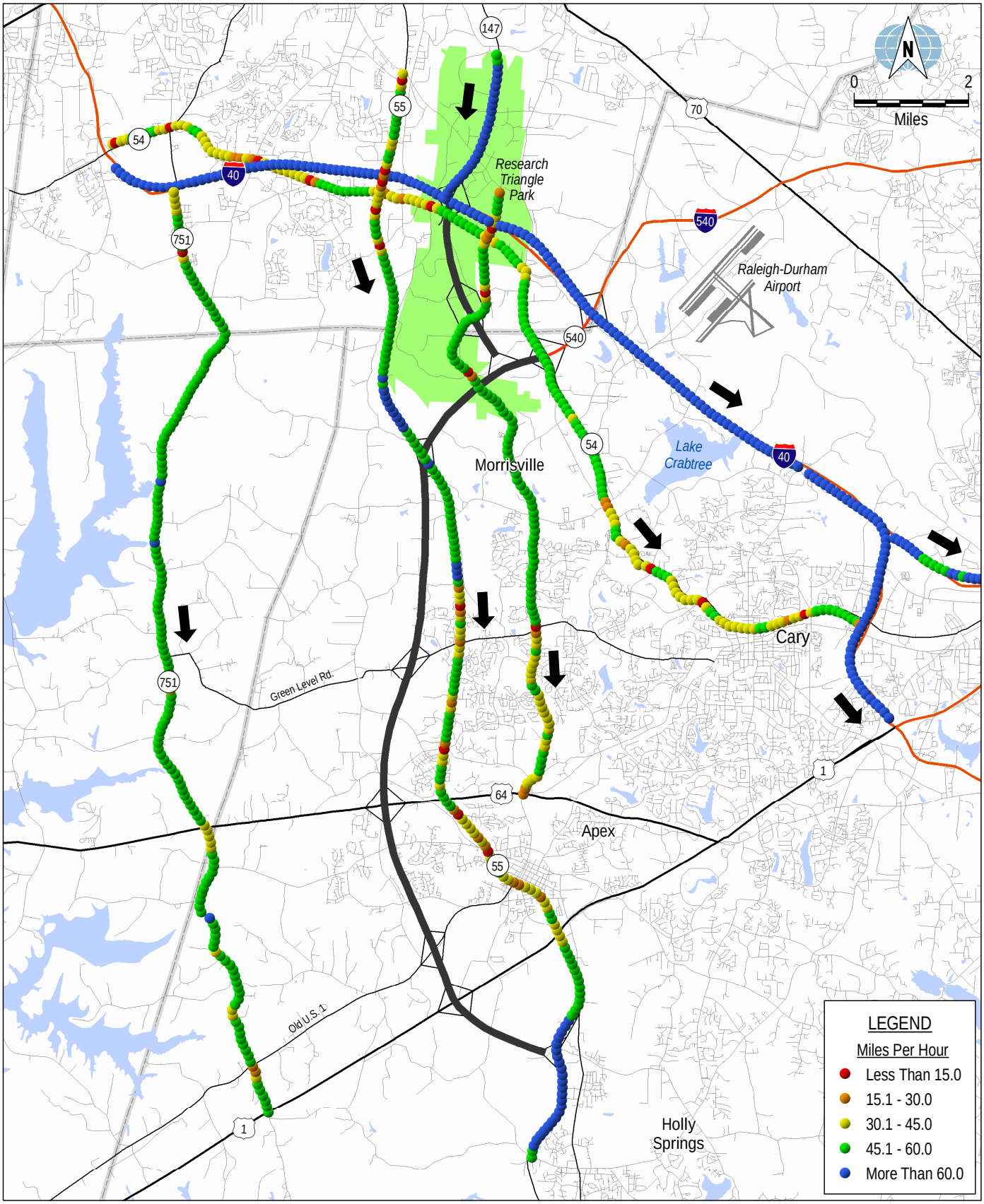
Travel speed data was collected on the same roadways during the PM peak period. Figure 2-9 presents the observed travel speeds collected during the PM peak period in the southbound and eastbound direction; Figure 2-10 presents the northbound and westbound data. Congestion is clearly visible on I-40 eastbound in the PM peak period from Aviation Parkway to just south of NC 54, while I-40 westbound appears to be at free-flow speeds. Additionally, there is some congestion in both directions on NC 54 from McCrimmon Parkway into the Town of Cary. NC 55 also shows some reduced speeds in the southbound direction from just north of Okelley Chapel Road to High House Road. The speeds observed on these roadways would suggest that the source of congestion within the study corridor is due to commuters travelling to and from the Research Triangle Park. Figures 2-9 and 2-10 also show that NC 147, NC 751, and NC 55 northbound appear to be generally at free-flow speeds. These observations are borne out by the average travel speeds presented in Table 2-10.



NORTH CAROLINA Turnpike Authority

OBSERVED AM PEAK PERIOD TRAVEL SPEEDS, NORTHBOUND AND WESTBOUND (NOV.-DEC., 2006)

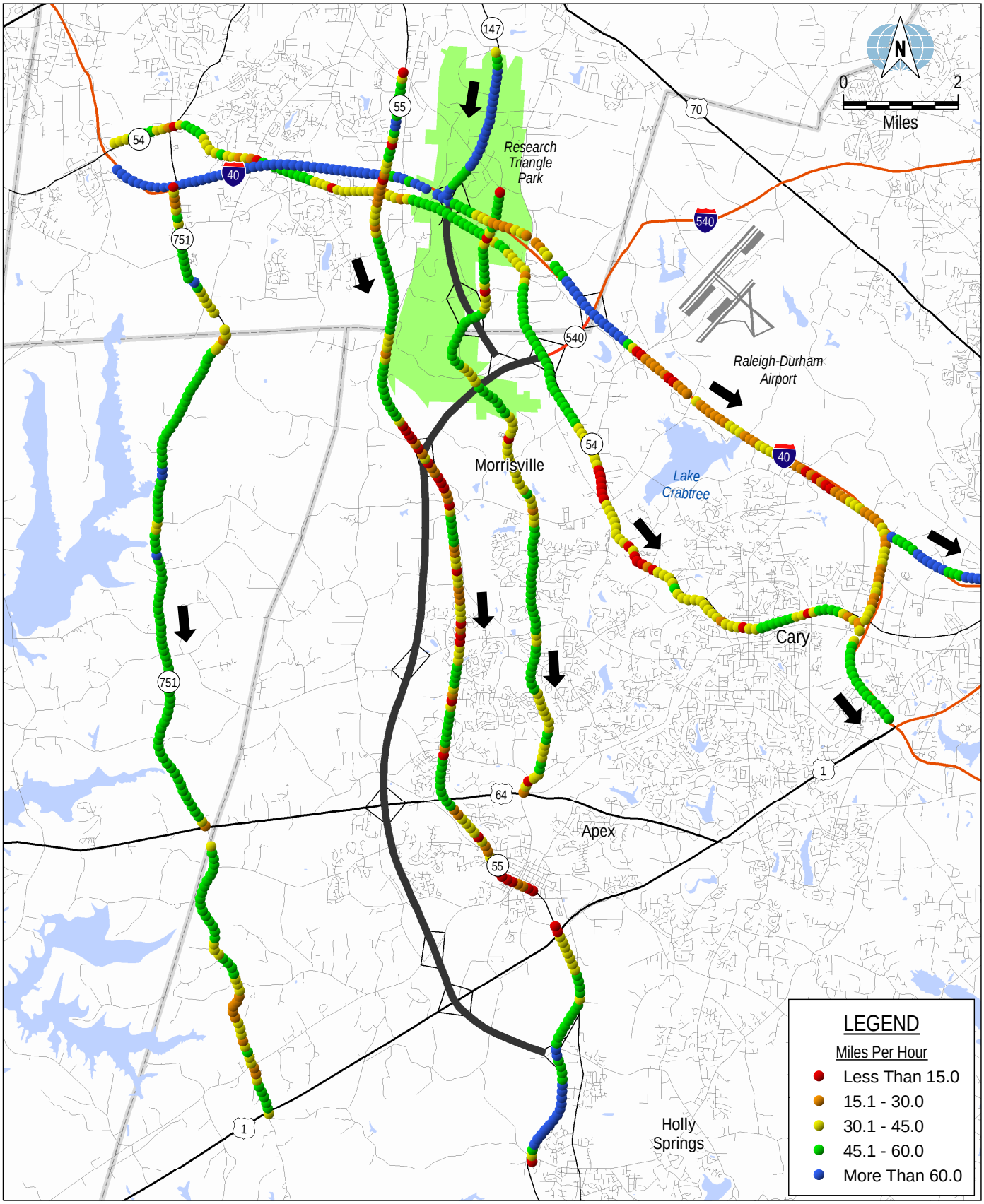
FIGURE 2-7



NORTH CAROLINA Turnpike Authority

OBSERVED AM PEAK PERIOD TRAVEL SPEEDS, SOUTHBOUND AND EASTBOUND (NOV.-DEC., 2006)

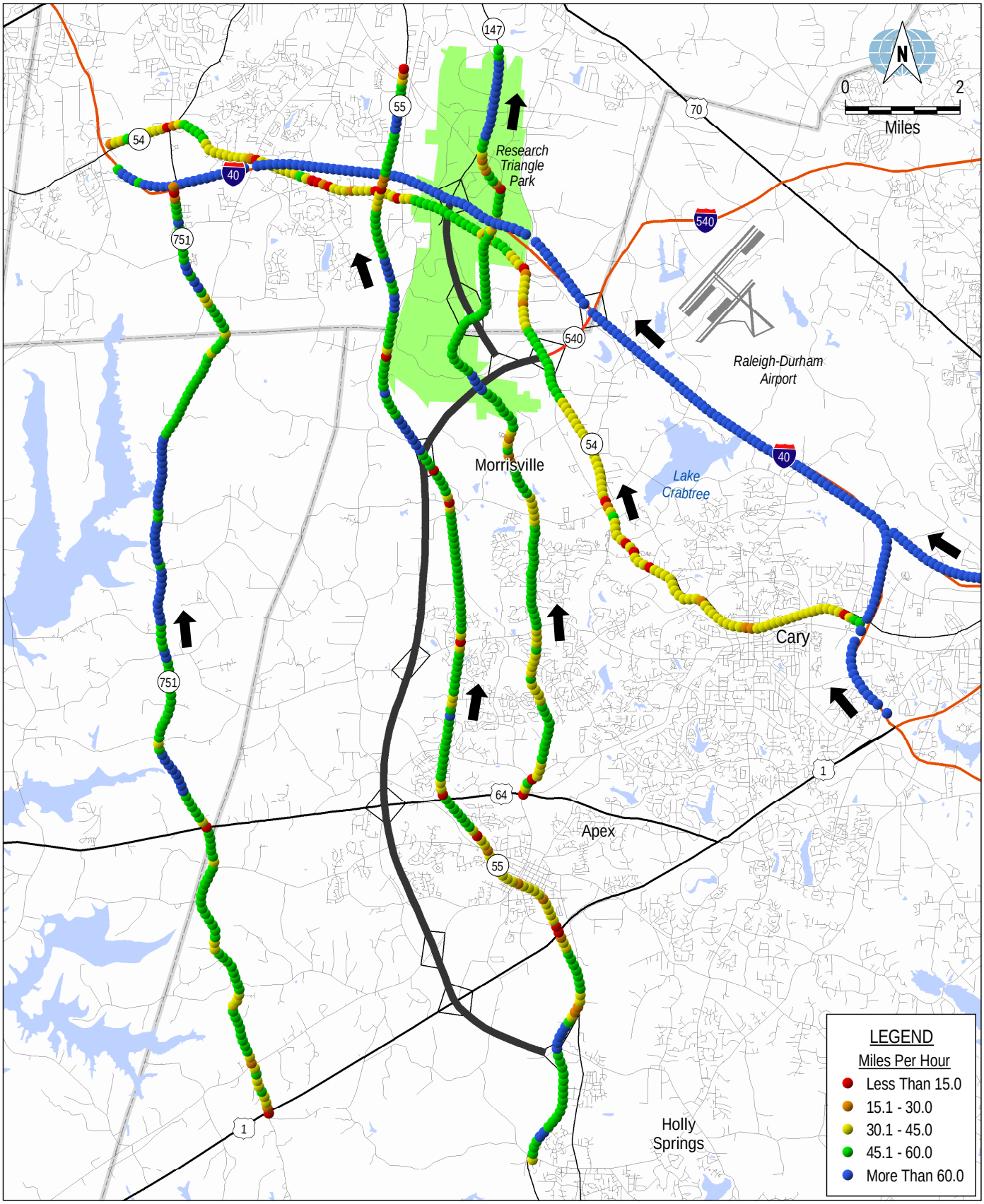
FIGURE 2-8



NORTH CAROLINA Turnpike Authority

OBSERVED PM PEAK PERIOD TRAVEL SPEEDS, SOUTHBOUND AND EASTBOUND (NOV.-DEC., 2006)

FIGURE 2-9



NORTH CAROLINA Turnpike Authority

OBSERVED PM PEAK PERIOD TRAVEL SPEEDS, NORTHBOUND AND WESTBOUND (NOV.-DEC., 2006)

FIGURE 2-10

Table 2-10
Speed and Delay Studies on Selected Roads

Segment Start	Segment End	Distance (miles)	Observed Travel Speeds (MPH) Northbound AM	Northbound PM	Southbound AM	Southbound PM
NC 55						
East Cornwallis Road	I-40	1.9	42.7	49.2	35.0	27.8
I-40	T W Alexander Drive	1.9	32.2	34.3	30.8	37.8
T W Alexander Drive	Morrisville Carpenter Road	4.5	46.7	47.0	55.8	32.1
Morrisville Carpenter Road	High House Road	2.3	42.1	43.4	42.6	37.1
High House Road	US 64	2.8	40.9	40.7	39.3	38.0
US 64	US 1	3.1	25.4	25.0	30.8	16.2
US 1	New Hill Road	4.3	34.8	45.1	56.8	51.9
	Total Distance/ Average Speed	**20.7**	**36.5**	**39.1**	**41.7**	**31.0**
NC 147						
Ellis Road	I-40	2.9	41.8	47.1	65.3	55.9
NC 751						
I-40	Fayetteville Road	2.2	36.7	36.1	47.2	38.6
Fayetteville Road	US 64	10.0	51.4	52.0	51.2	46.8
US 64	US 1	5.4	40.8	47.3	45.3	43.3
	Total Distance/ Average Speed	**17.6**	**45.5**	**47.9**	**48.8**	**44.6**
Davis Drive						
East Cornwallis Road	NC 54	0.9	18.6	25.4	20.2	26.5
NC 54	Morrisville Carpenter Road	5.8	27.9	42.9	47.1	32.9
Morrisville Carpenter Road	High House Road	2.0	44.4	37.5	35.9	45.6
High House Road	US 64	3.0	38.2	41.1	39.5	31.8
	Total Distance/ Average Speed	**11.7**	**30.8**	**39.3**	**39.0**	**33.6**

Segment Start	Segment End	Distance (miles)	Observed Travel Speeds (MPH) Eastbound AM	Eastbound PM	Westbound AM	Westbound PM
I-40						
NC 54	NC 147	6.2	67.4	67.2	68.3	68.2
NC 147	I-540	2.7	69.3	53.0	69.5	70.3
I-540	Aviation Parkway	1.0	71.7	45.1	70.2	69.9
Aviation Parkway	I-440/US 64/US 1/I-40	6.7	68.6	27.8	69.6	71.3
I-440/US 64/US 1/I-40	US 1	2.7	68.2	44.5	42.6	67.0
	Total Distance/ Average Speed	**19.3**	**68.4**	**41.3**	**63.7**	**69.5**
I-440/US 64/US 1/I-40						
Exit 289	US1	3.0	56.9	59.2	62.5	66.0
NC 54 / Chapel Hill Road						
I-40 (Exit 273)	NC 55	5.2	34.8	27.9	31.7	33.0
NC 55	Hopson Road	3.3	27.1	37.6	19.2	22.3
Hopson Road	Aviation Parkway	4.1	40.2	23.8	33.7	34.7
Aviation Parkway	I-40	5.6	31.0	21.0	29.3	28.1
	Total Distance/ Average Speed	**18.2**	**32.8**	**25.5**	**28.0**	**29.2**

Source: Speed and Delay Studies, July 25 - 26, 2007

EXISTING TRANSIT SERVICES IN THE STUDY AREA

TRANSIT AGENCIES

Several major transit agencies operate within the Triangle region. Many of these agencies are operated by local governments. Capital Area Transit (CAT) is operated by the City of Raleigh. Chapel Hill Transit (CHT) is operated by the City of Chapel Hill. The City of Cary offers fixed route service through Cary Transit (C-Tran). The Durham Area Transit Authority (DATA) is operated by the City of Durham.

More rural areas are served by county-wide agencies that provide demand-response services. Orange County Public Transportation (OPT) operates within Orange County. It recently began operating one fixed-route bus service in cooperation with the Triangle Transit Authority. The Chatham Transportation Network (CTN) operates within Chatham County.

The Wolfline is a bus service operated by North Carolina State University (NCSU) for the NC State Community. Wolfline buses are open to the public and operate every day that classes are in session serving all three campuses, two park and ride lots, and official NCSU housing. No university ID, pass or fare is required to ride.

The Triangle Transit Authority (TTA) is the only regional transit agency within the study area. It operates bus lines, vanpooling, and other ride-sharing services within Wake, Durham and Orange Counties.

Table 2-11 contains data on the transit agencies within the study area, as provided by the National Transit Database. Of the six agencies included in the database, TTA is the largest with a service area of 1,525 square miles and a fleet of 146 vehicles. Despite this, CHT and NCSU carry more bus passengers per hour than the other agencies. This may be due to the fact that CHT and NCSU are free services. TTA provides the longest average bus trips, at 8.58 miles, presumably due to its large service area and express bus service. TTA is also the only agency to provide vanpooling statistics.

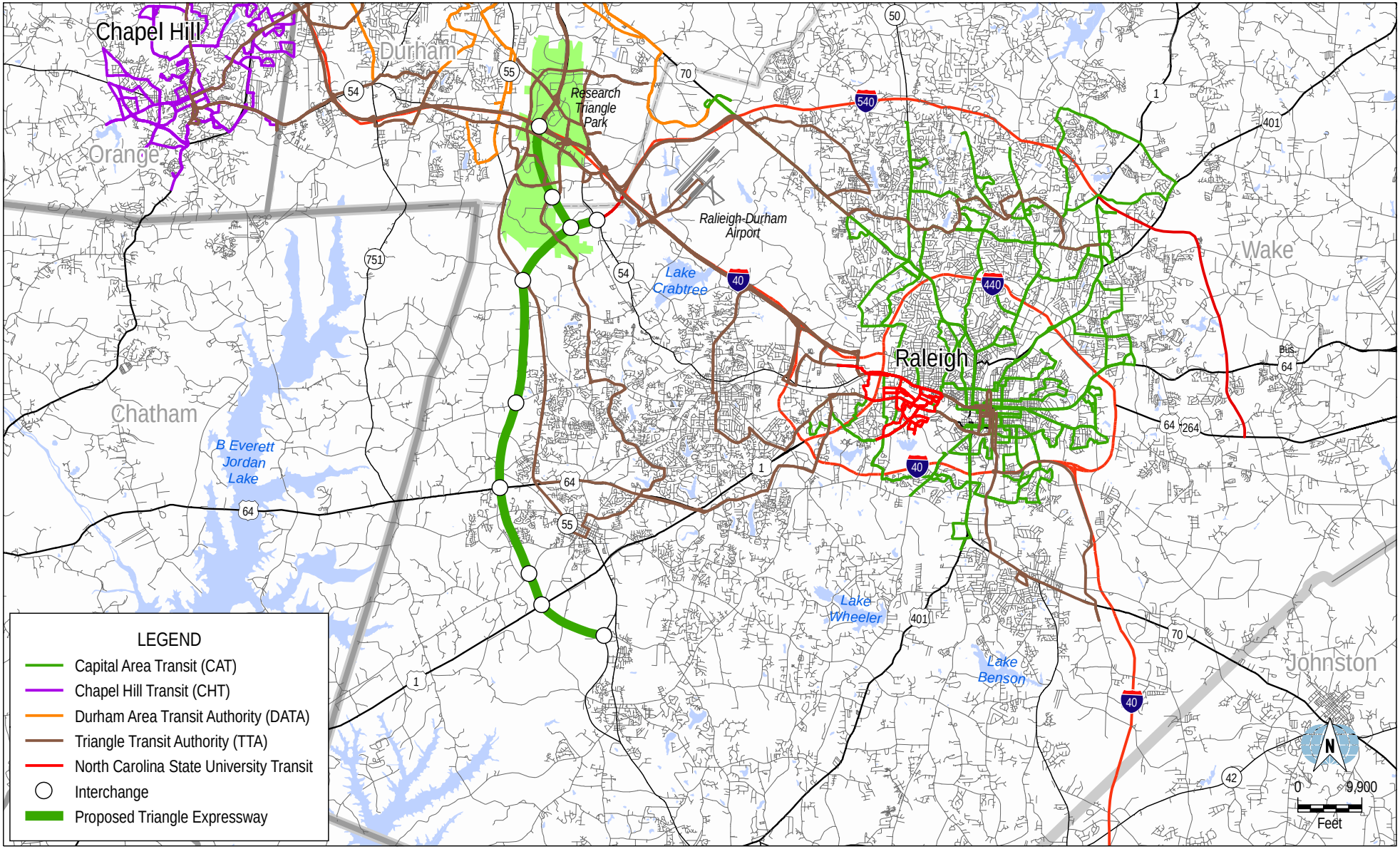
TRANSIT SERVICES

Figure 2-11 displays the routes of study area transit providers in 2005. TTA provides express and local bus service, and ridesharing programs throughout the Triangle Region. The Town of Cary is served by TTA and C-Tran. In the City of Chapel Hill, the University of North Carolina and downtown business district form a major regional employment center, which is served by CHT and TTA. Likewise, downtown Durham and Duke University, including the academic centers and the hospital, which

Table 2-11
Statistics for Transit Agencies in the Triangle Region
2005

Statistics	CAT	C-Tran	CHT	DATA	NCSU	TTA
Service Area (sq. mi.)	125	50	25	93	9	1525
Service Area Population [1]	311,053	107,973	52,440	179,000	40,000	1,002,876
Overall Service						
Fleet Size	86	18	97	91	25	146
Annual Passenger Miles	14,139,346	367,245	14,979,244	18,572,131	2,323,170	17,730,060
Annual Unlinked Trips	3,702,432	52,682	5,783,800	4,519,449	1,767,209	1,052,052
Passenger Miles Per Unlinked Trip	3.82	6.97	2.59	4.11	1.31	16.85
Bus						
Fleet Size	68		83	49	25	67
Annual Passenger Miles	13,387,657		14,620,347	18,043,241	2,323,170	6,204,180
Annual Unlinked Trips	3,546,761		5,711,073	4,443,568	1,767,209	723,184
Passenger Miles Per Unlinked Trip	3.77		2.56	4.06	1.31	8.58
Demand Response						
Fleet Size	18	18	14	42		5
Annual Passenger Miles	751,689	367,245	358,897	528,890		127,164
Annual Unlinked Trips	155,671	52,682	72,727	75,881		8,072
Passenger Miles Per Unlinked Trip	4.83	6.97	4.93	6.97		15.75
Vanpool						
Fleet Size						74
Annual Passenger Miles						11,398,716
Annual Unlinked Trips						320,796
Passenger Miles Per Unlinked Trip						35.53

[1] Urbanized Area (UZA) Statistics - 2000 Census
Source: 2005 National Transit Database (NTD)



NORTH CAROLINA Turnpike Authority

TRANSIT ROUTES 2005

FIGURE 2-11

are located within the City, are major centers for employment. DATA, TTA and Duke University all provide transit services to this area. In the City of Raleigh, CAT and TTA serve the downtown area. North Carolina State University's Wolfline serves the three NCSU campuses, two park and ride lots, and official housing.

Several routes are of particular significance in that they operate within the Triangle Expressway study area. These transit routes only operate Monday through Friday. Moreover, some of them only operate during the AM and PM peak periods. TTA Routes 105, 107, 201 and 205 are express routes; the others are local.

Table 2-12 provides a list of selected transit routes with comparable roadway traffic. The transit ridership in the Triangle Expressway corridor is extremely small in comparison to the vehicular traffic. For example, TTA Route 311, which operates on NC 55 parallel to the proposed Triangle Expressway, carried 100 passengers per day in 2005. Vehicular traffic on NC 55 was between 19,000 and 38,000 vehicles per day.

In the study area, standard fares vary from free to $2.50 per ride. Triangle Transit is the most expensive service, with differing fares for local and express service. Several agencies also offer monthly passes, which are generally less expensive per ride and encourage commuting. Regional passes are also available, which provide unlimited rides on and transfers between all DATA routes, CAT routes, and TTA local routes. A regional pass costs $4.00 for 1 day and $64.00 for 30 days. Table 2-13 provides the 2007 fixed-route fare structure for the transit agencies in the study area.

VANPOOL SERVICES

The Triangle Transit Authority (TTA) offers vanpool service in Wake, Durham, and Orange Counties. A vanpool is made up of 10 commuters or more who live and work near each other and who share approximately the same work hours. TTA pays for gas and insurance, and arranges, oversees, and pays for all van maintenance. In addition, TTA provides potential users with a list of current vanpool routes and schedules; workers can join a current route by finding one that operates near home and work, or start a new one. Table 2-14 lists some of the current TTA vanpool routes in the Triangle Expressway study area. Riders pay a monthly fare based on average daily round-trip mileage and the number of riders. Table 2-15 provides an overview of the TTA vanpooling fare structure.

Table 2-12
Ridership on Selected Transit Routes and Comparable Roadway Traffic Volumes
2005

Service Provider	Route Number	Origin	Destination	Major Roadways	Daily Ridership (Person Trips)	Lowest AADT in Corrdior (Vehicles)	Highest AADT in Corrdior (Vehicles)
DATA	12	Durham	RTP	NC54 / NC55	21	13,000	26,000
TTA	105	Raleigh	RTP	I-40	226	132,000	153,000
TTA	107	Raleigh	RTP	I-40	190	132,000	156,000
TTA	201	New Hope	RTP	I-540 / US70	75	38,000	74,000
TTA	202	Brookhaven	RTP	I-540	19	52,000	74,000
TTA	301	Raleigh	RTP	I-40 / NC54	255	10,000	153,000
TTA	302	Raleigh	RTP	Davis Drive	139	13,000	15,000
TTA	311	Apex	RTP	US64 / NC55	100	19,000	38,000
TTA	402	Durham	RTP	NC147	342	52,000	54,000
TTA	403	Durham	RTP	NC147	353	52,000	54,000
TTA	412	Chapel Hill	RTP	NC54 / NC147	359	13,000	55,000
TTA	413	Durham	RTP	NC147	362	52,000	54,000

Source: Triangle Transit Authority, Durham Area Transit Authority

Table 2-13
Fixed Route Fare Structure
2007

Agency	One-Way Adult Cash Fare[1]	Senior/Disabled Persons Cash Fare[1]	Monthly Pass[2]
Capital Area Transit	$1.00	$0.50	$36.00
Cary Transit	$1.00	$0.50	$30.00
Chapel Hill Transit	Free	Free	N/A
Duke Transit	Free	Free	N/A
Durham Area Trans. Authoriy	$1.00	Free	$36.00
NCSU Transit	Free	Free	N/A
Triangle Transit Authority Local Route	$2.00	$1.00	$80.00
Triangle Transit Authority Express Route	$2.50	$1.25	$80.00

[1] Transfer between an agency's routes is free

[2] The Triangle Transit Authority Monthly Pass is accepted on express and local routes

Note: Orange County Public Transportation has the same fare structure as the Triangle Transit Authority

Source: Fare Information is published online by the various transit agencies.

Table 2-14
Triangle Transit Authority Vanpool Routes and Schedules in Study Area

ID#	Origin	Destination	Work Hours
1863	Chapel Hill	SAS (Cary)	8:45am - 5:00pm
1867	Garner	Research Tri. Park	7:30am - 4:30pm
1868	Apex	Wyeth Vaccines (Stanford)	8:00am - 4:30pm
1871	Apex	UNC-Chapel Hill	
1883	Cary	UNC-Chapel Hill	8:00am - 4:30pm
1900	Chapel Hill/Carrboro	Research Triandgle (EPA)	8:00am - 5:00pm
1901	Chapel Hill	Research Triandgle (EPA)	8:00am - 5:00pm
1915	Garner	Wyeth Vaccines (Stanford)	7:30am - 4:30pm
1927	Cary	Wyeth Vaccines (Stanford)	8:00am - 4:30pm
1935	Stanford	Research Tri. Park/Durham	7:00am - 4:00pm
1936	North Raleigh	Durham VA Medical Center	8:00am - 4:30pm

Source: Triangle Transit Authority

Table 2-15
Triangle Transit Authority Vanpool Fares
2006

Daily Round Trips (Miles)	Monthly Lease	Rider Fare 14 Riders	Rider Fare 12 Riders	Rider Fare 10 Riders
20	$554.20	$39.59	$46.18	$55.42
25	602.50	43.04	50.21	60.25
30	650.80	46.49	54.23	65.08
35	699.10	49.94	58.26	69.91
40	747.40	53.39	62.28	74.74
45	795.70	56.84	66.31	79.57
50	844.00	60.29	70.33	84.00
65	988.90	70.64	82.41	98.89
70	1037.20	74.09	86.43	103.72
75	1085.50	77.54	90.46	108.55
80	1133.80	80.99	94.84	113.38
85	1182.10	84.44	98.51	118.21
90	1230.40	87.89	102.53	123.04
95	1278.70	91.34	106.56	127.87
100	1237.00	94.79	110.58	132.70
110	1423.60	101.69	118.63	142.36
120	1520.20	108.59	126.68	152.02
130	1616.80	115.49	134.73	161.68
140	1713.40	122.39	142.78	171.34
150	1810.00	129.29	150.83	181.00

Source: Triangle Transit Authority

JOURNEY TO WORK

The study area for the Triangle Expressway incorporates portions of Chatham, Durham, Orange and Wake Counties. The majority of commuters living in those counties chose to drive alone to work. Orange County, where Chapel Hill Transit (CHT) is a free service, has the largest percentage of workers using public transportation to commute to work (4.2 percent), as well as the largest percentages of people bicycling (1.8 percent) and walking (7.0 percent) to work. Durham County has the largest percentage of people choosing to carpool to work (15.9 percent). Wake County, as the most populous of the four counties, has the most commuters using public transportation (4,153) and carpooling (37,823). The means of travel to work in Chatham, Durham, Orange and Wake Counties, as reported by the 2000 Census, is provided Table 2-16. For the four-

Table 2-16
Transportation to Work Mode
2000

Mode	Chatham County		Durham County		Orange County		Wake County		Four County Area	
	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers
Drove Alone	18,966	76.9%	84,063	74.8%	42,668	70.1%	274,674	81.1%	420,371	78.3%
Carpooled	3,902	15.8%	17,927	15.9%	7,149	11.7%	37,823	11.2%	66,801	12.5%
Public Transportation	54	0.2%	3,384	3.0%	2,566	4.2%	4,153	1.2%	10,157	1.9%
Motorcycle	16	0.1%	115	0.1%	108	0.2%	306	0.1%	545	0.1%
Bicycle	47	0.2%	396	0.4%	1,124	1.8%	643	0.2%	2,210	0.4%
Walked	357	1.4%	2,959	2.6%	4,263	7.0%	5,847	1.7%	13,426	2.5%
Other Means	207	0.8%	539	0.5%	295	0.5%	2,419	0.7%	3,460	0.6%
Worked at Home	1,108	4.5%	3,050	2.7%	2,687	4.4%	12,737	3.8%	19,582	3.6%
Total	24,657	100%	112,433	100%	60,860	100%	338,602	100%	536,552	100%

Source: 2000 Census Data

county area, approximately 91 percent of workers either drove alone or carpooled to work. Less than 2 percent used public transportation.

Commuter travel time is influenced by several factors, such as the location of major employment centers, county size, and population. Table 2-17 provides 2000 travel time data for Chatham, Durham, Orange and Wake counties. Durham County has the lowest average travel time (23 minutes), while Chatham County has the highest average travel time (29 minutes). Of the four counties, Orange County has the highest percentage of commuters traveling less than 15 minutes to work (30.9 percent).

Table 2-18 shows vehicle occupancy data for Chatham, Durham, Orange and Wake Counties collected during the 2000 Census. Chatham and Durham Counties had the highest average vehicle occupancy (1.27 and 1.28 persons, respectively). Conversely, Wake County had the largest percentage of motorists choosing to drive alone to work (321,497).

TRAVEL PATTERN SURVEYS

As part of this study effort, travel pattern surveys were conducted between November and early December 2006 at 13 locations in the vicinity of the proposed Triangle Expressway. The travel patterns observed from the survey served as integral inputs into the travel demand model for the Triangle Expressway traffic and toll revenue forecast. The key findings of the travel pattern surveys are summarized below.

METHODOLOGY AND PROCEDURES

Thirteen survey locations were selected for the travel pattern survey in order to provide an adequate representation of study area traffic. The survey team coordinated with county and local jurisdictions to ensure that safety concerns were taken into consideration. Figure 2-12 depicts the locations of the 13 survey stations. As shown in the figure, all surveys were conducted in a single direction of travel at signalized intersections in accordance with an operation and safety plan developed for each location.[(1)] The survey was conducted in such a manner as to minimize impact on traffic flow and maximize safety to motorists and survey personnel.

The survey questionnaire was distributed in the form of a postage-paid business-reply card. Figure 2-13 shows the mail-back, handout survey questionnaire**.** The survey contained nine questions that queried motorists about their trip origin and destination; residence status; trip purpose; trip

(1) During later survey processing, observed one-way trips were "reversed" in order to provide estimates of daily travel patterns in each direction.

Table 2-17
Travel Time to Work
2000

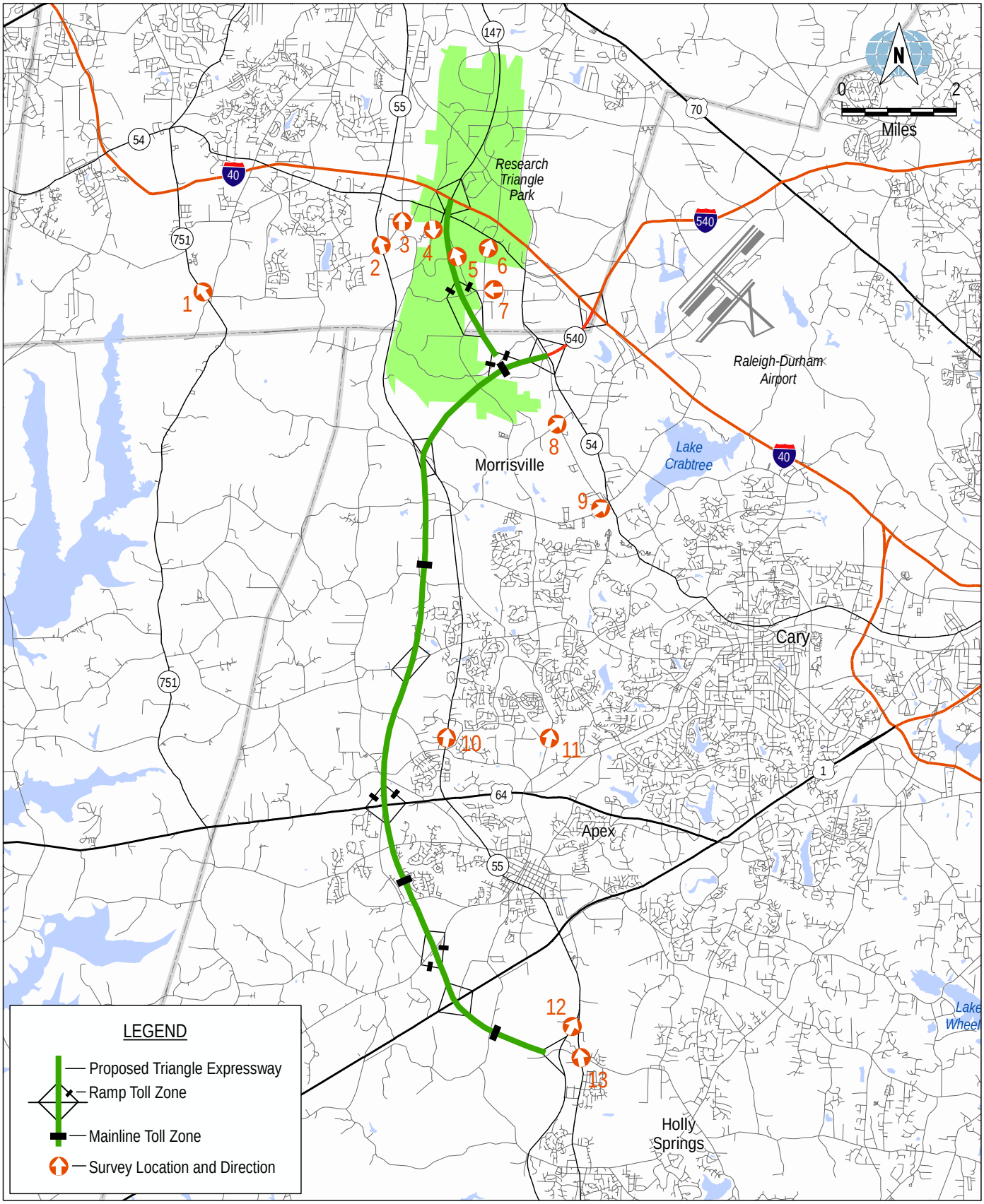
	Chatham County		Durham County		Orange County		Wake County		Four County Areaa	
Trip Length	**Commuters**	**% of Total Commuters**	**Commuters**	**% of Total Commuters**	**Commuters**	**% of Total Commuters**	**Commuters**	**% of Total Commuters**	**Commuters**	**% of Total Commuters**
Less than 5 minutes	713	3.0%	2,301	2.1%	1,484	2.6%	7,151	2.2%	11,649	3.6%
5 to 9 minutes	2,283	9.7%	10,330	9.4%	6,283	10.8%	27,154	8.3%	46,050	14.1%
10 to 14 minutes	2,613	11.1%	18,979	17.4%	10,212	17.6%	42,047	12.9%	73,851	22.7%
15 to 19 minutes	3,048	12.9%	25,376	23.2%	9,991	17.2%	52,957	16.3%	91,372	28.0%
20 to 24 minutes	3,283	13.9%	19,238	17.6%	9,724	16.7%	57,773	17.7%	90,018	27.6%
25 to 29 minutes	1,449	6.2%	6,435	5.9%	4,102	7.1%	24,749	7.6%	36,735	11.3%
30 to 34 minutes	3,654	15.5%	14,373	13.1%	8,163	14.0%	54,366	16.7%	80,556	24.7%
35 to 39 minutes	1,055	4.5%	2,069	1.9%	1,651	2.8%	10,921	3.4%	15,696	4.8%
40 to 44 minutes	1,133	4.8%	2,136	2.0%	1,690	2.9%	11,403	3.5%	16,362	5.0%
45 to 59 minutes	2,687	11.4%	4,739	4.3%	3,027	5.2%	21,899	6.7%	32,352	9.9%
60 to 89 minutes	1,169	5.0%	2,145	2.0%	1,190	2.0%	9,990	3.1%	14,494	4.4%
90 or more minutes	462	2.0%	1,262	1.2%	656	1.1%	5,455	1.7%	7,835	2.4%
Total	23,549	100%	109,383	100%	58,173	100%	325,865	100%	516,970	159%
Average Travel Time	29		23		24		26		25	

Source: 2000 Census Data

Table 2-18
Commuter Vehicle Occupancy
2000

	Chatham County		Durham County		Orange County		Wake County		Four County Area	
Trip Length	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**
Drove alone	18,966	82.9%	84,063	82.4%	42,668	85.6%	274,674	87.9%	420,371	86.3%
2-person carpool	2,641	11.5%	12,117	11.9%	5,267	10.6%	27,874	8.9%	47,899	9.8%
3-person carpool	784	3.4%	3,218	3.2%	1,100	2.2%	5,863	1.9%	10,965	2.3%
4-person carpool	269	1.2%	1,525	1.5%	459	0.9%	2,204	0.7%	4,457	0.9%
5- or 6-person carpool	131	0.6%	749	0.7%	224	0.4%	1,483	0.5%	2,587	0.5%
7-or-more-person carpool	77	0.3%	318	0.3%	99	0.2%	399	0.1%	893	0.2%
Total	22,868	100%	101,990	100%	49,817	100%	312,497	100%	487,172	100%
Average Vehicle Occupancy	1.27		1.28		1.21		1.18		1.21	

Source: 2000 Census Data



NORTH CAROLINA Turnpike Authority

TRAVEL PATTERN SURVEY LOCATIONS

FIGURE 2-12

6 7 8 9 10 11 12 13 14 15 16 17

Dear Motorist:
The North Carolina Turnpike Authority (NCTA) is undertaking an important transportation initiative to improve mobility in the Triangle Region. NCTA is requesting your assistance and is asking for information about the one-way trip that you made today when you received this questionnaire. Please complete the questionnaire and drop it into the mail at your earliest convenience. Postage is pre-paid. All information is confidential and will not be used for any purpose other than for this study. Thank you for your participation. This information is critical as NCTA plans future highway improvements in the area.

A. Where did you start your trip today? (In this direction) Please be as specific as possible. If you do not know the street address, please identify the nearest intersection, shopping area, subdivision, etc.

_____
Street Address, nearest intersection or location

_____
City or town State Zip Code (if known)

B. Where did you end this trip today? (In this direction) Please be as specific as possible. If you do not know the street address, please identify the nearest intersection, shopping area, subdivision, etc.
The answer should not be the same as your answer for Question A. Please do not describe a round trip such as home to work and then home. Please describe the trip only in the direction you were going when you received this card.

_____
Street Address, nearest intersection or location

_____
City or town State Zip Code (if known)

C. Did you or will you use any of the following roads during this specific one-way trip? (Circle all that apply)

1. I-40 2. I-540 3. NC 55 4. NC 54 5. NC 751 6. Did not use any of these roads

D. Please indicate the main purpose of your one-way trip. (Circle one)

1. To or from work
2. Company business
3. School
4. Shopping
5. Recreation
6. Social event and/or visit
7. Other personal business

E. How many times per week do you make this one-way trip? (Circle one)

Less than 1 1 2 3 4 5 6 or more

F. How many people, including yourself and any children, were in your vehicle? (Circle one)

1 2 3 4 5 6 or more

G. Please identify the type of vehicle you were driving. (Circle one)

1. Two-axle, Four-tire Passenger Car, SUV or Pickup Truck
2. 2-axle, 6 tire Truck
3. 3-axle Truck
4. Four-axle Truck
5. Truck with Five or More Axles
6. Motorcycle

H. What is the zip code of your primary residence? _____

I. OPTIONAL - If you would like to participate in an internet-based survey of transportation options, please provide your e-mail address. (This information will be used only for the internet survey and will not be used for any other purpose.)

E-mail address _____

	DAY	DIR	HR	C	D	E	F	G	H	I

NORTH CAROLINA Turnpike Authority

SAMPLE SURVEY CARD

FIGURE 2-13

frequency; and vehicle occupancy. An optional question was included asking if motorists wished to participate in an internet-based survey of transportation options.

Of the 21,276 surveys distributed, a total of 2,501 valid surveys were returned or 11.8 percent of the total. Table 2-19 indicates the dates on which the surveys were conducted, the number of surveys distributed and the return rate for each location. Upon receipt, the completed questionnaires were filtered for validity and entered into a Geographic Information Systems (GIS) database. This database was a valuable tool in constructing the Triangle Expressway travel demand model, ensuring that appropriate trip tables reflected current usage patterns of the highway system in the study area.

Survey Trip Characteristics

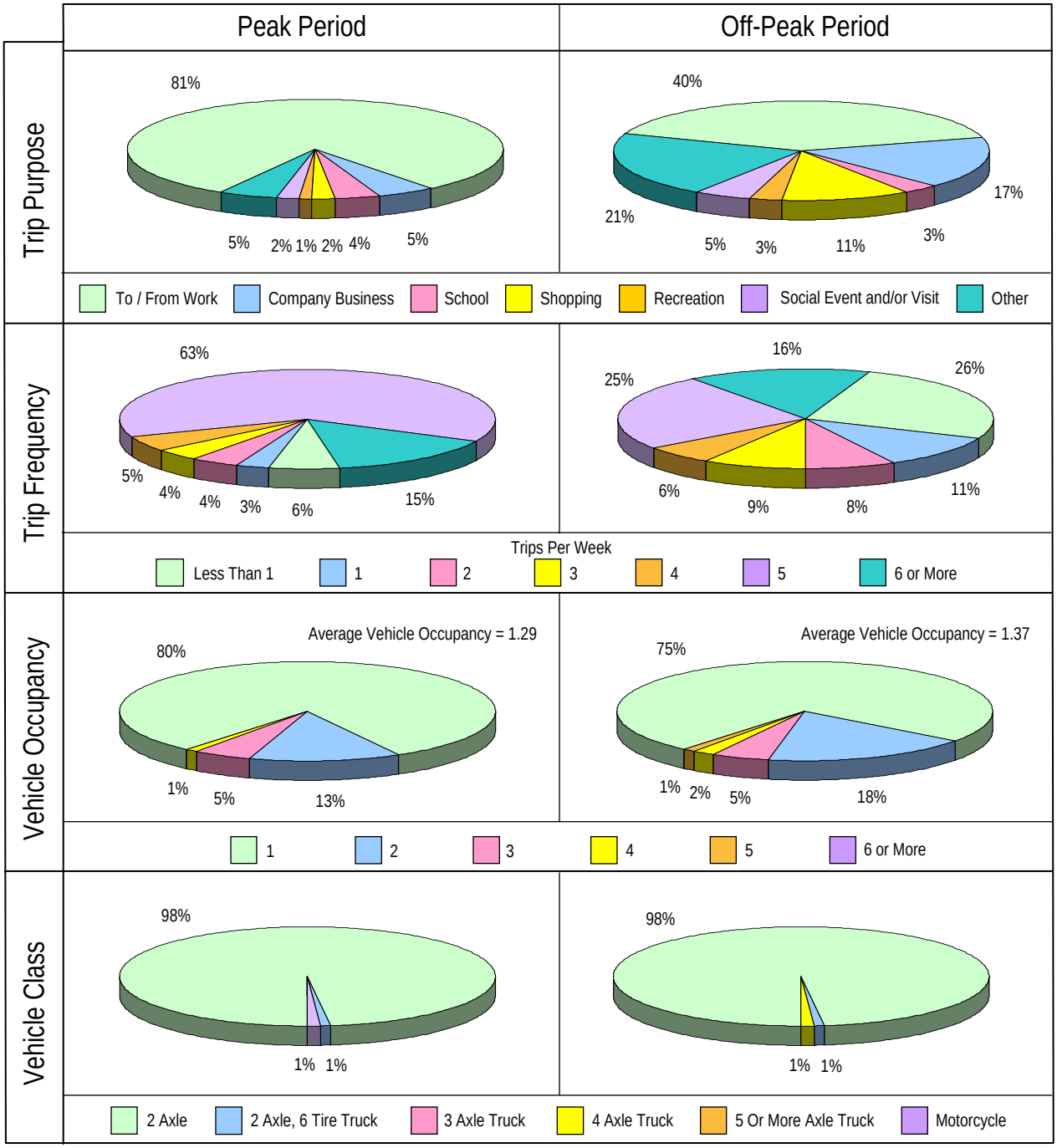
The travel pattern survey results illustrated several trends in trip characteristics in the Raleigh-Durham area. Motorists were asked to identify the roads they used on their one-way trip. Of the surveys returned, 2,501 respondents provided usable information regarding road choice. Road choice usage was broken down by peak and off-peak periods. Although travel was greatly reduced in the off-peak hours, the percentage of road usage remained almost identical. For example, 28 percent of motorists used NC 55 during peak hours as compared to 27 percent using the same road during off-peak hours. Other major roads listed on the survey include I-40, I-540, NC 54 and NC 751. This analysis helped identify competing routes to the proposed toll road, from which traffic could be diverted to the proposed Triangle Expressway (especially during peak periods when these roads could be less attractive because of congestion).

Questions regarding trip purpose were also included in the travel pattern survey. As shown in Figure 2-14, the overwhelming majority of surveyed motorists (81 percent) traveling in the study area during peak periods were commuters traveling "to and from work." When combined with the "company business" category, work related trips accounted for 86 percent of total trips. During off-peak periods as indicated in Figure 2-14, work related trips were reduced to 57 percent, with shopping and other trip purposes comprising the bulk of off-peak travel.

Figure 2-14 also provides information collected from the survey regarding trip frequency. During the peak period, 78 percent of survey respondents indicated that they make similar trips a minimum of 5 times per week. This roughly corresponds to the percentage of "To and From Work" trips described by the Trip Purpose pie chart, suggesting that a large percentage

Table 2-19
Motorist Survey Sample Size

Survey Station	Date	Location	Direction	Number of Surveys Distributed	Number of Valid Surveys Returned	Passing Traffic	Percent of Passing Traffic Surveyed	Percent of Valid Surveys Returned
1	11/29/2006	NC 751 Hope Valley Road South of Fayetteville	Northbound	665	126	4,847	13.7	18.9
2	11/29/2006	NC 55 South of Sedwick Drive	Northbound	1,370	97	4,189	32.7	7.1
3	11/29/2006	South Alston Avenue South of NC 54	Northbound	1,040	100	2,231	46.6	9.6
4	11/29/2006	NC 147 West of TW Alexander Drive	Southbound	1,799	372	6,072	29.6	20.7
5	11/30/2006	Davis Drive South of NC 54	Northbound	2,029	225	6,482	31.3	11.1
6	11/30/2006	South Miami Boulevard South of NC 54	Northbound	2,827	237	7,428	38.1	8.4
7	11/30/2006	Hopson Road South of NC 54	Westbound	1,072	155	4,750	22.6	14.5
8	12/5/2006	McCrimmon Parkway West of Church Street	Eastbound	1,561	176	3,269	47.8	11.3
9	12/5/2006	Morrisville Carpenter Road West of Railroad Lin	Eastbound	3,340	435	4,029	82.9	13.0
10	12/6/2006	NC 55 West Williams Street South of Old Jenks	Northbound	1,508	94	8,498	17.7	6.2
11	12/6/2006	Davis Road South of Old Jenks Road	Northbound	360	65	3,055	11.8	18.1
12	12/7/2006	Bypass NC 55 South of NC 55 Junction	Northbound	3,379	376	8,212	41.1	11.1
13	12/7/2006	NC 55 Main Street South of Sunset Lake Road	Northbound	326	43	4,952	6.6	13.2
			Total	**21,276**	**2,501**	**68,014**	**31.3**	**11.8**



Note: Charts represent sum of all survey locations.

of trips are made by weekly commuters. During off-peak periods, trip frequencies of 4 or less times per week were predominant, accounting for 60 percent of the trips made within the study area.

Vehicle occupancy rates for the various types of users in the project study area are also displayed in Figure 2-14. As shown, 80 percent of peak hour surveyed respondents and 75 percent of off-peak hour respondents indicated that trips were made by single occupancy vehicles (SOV). Only 13 to 18 percent of respondents traveled with one passenger. Overall, the survey indicates average vehicle occupancy of between 1.3 to 1.4 persons per vehicle.

The overwhelming majority of survey respondents, (98 percent) stated that they were traveling in passenger cars.

Trip Origins and Destinations

A majority of survey respondents, over 90 percent, indicated that they began their trip in Apex, Cary, Holly Springs, Morrisville, Durham, Fuquay-Varina and Raleigh. The most prevalent destination cities included Durham, Cary, Chapel Hill, Research Triangle Park (RTP) and Apex. The relatively low percent of destination trips attributable to the Research Triangle Park (RTP) is because several destinations in the RTP have Durham addresses as defined by the United States Postal Service. Table 2-20 shows the percent distribution of trips by origin city and by destination city. The origin towns and cities help to identify the market area of the proposed Triangle Expressway.

Detailed origin-destination analysis for some frequent origins and destinations was conducted using “factored” trips data. The survey database containing valid trips was “factored up” to traffic counts conducted at the same time as the surveys. This “factoring” process is a method by which each survey record is associated with a multiplying factor representing the number of trips for that particular origin-destination movement at average weekday levels.

Table 2-21 shows the number of “factored” trips in the peak and off-peak periods for some of the common traffic movements identified from the surveys. Only origin-destination pairs that had over 1,000 trips per day are depicted in the table. The most popular trips surveyed were from Apex, Holly Springs, Cary, Morrisville and Durham, to destinations such as Durham, RTP and Cary. The two most prevalent origin-destination pairs, Apex-Durham and Holly Springs-Durham, accounted for more than 25 percent of all the trips shown in the table.

Table 2-20
Trips by Origin and Destination City

Origin City	Total Trips	Percent
Apex	15,053	18.9%
Holly Springs	12,750	16.0%
Cary	12,672	15.9%
Morrisville	11,349	14.2%
Durham	10,724	13.4%
Fuquay-Varina	5,999	7.5%
Raleigh	4,489	5.6%
Research Triangle Park	4,881	6.1%
Sanford	671	0.8%
Chapel Hill	638	0.8%
Pittsboro	536	0.7%
TOTAL	79,762	100.0%

Destination City	Total Trips	Percent
Durham	39,497	48.2%
Cary	8,448	10.3%
Chapel Hill	7,720	9.4%
Research Triangle Park	6,760	8.2%
Apex	5,356	6.5%
Hillsborough	3,304	4.0%
Mebane	3,124	3.8%
Raleigh	2,184	2.7%
Morrisville	2,380	2.9%
Roxboro	1,325	1.6%
Burlington	831	1.0%
Cedar Grove	556	0.7%
Butner	527	0.6%
TOTAL	82,013	100.0%

Source: Factored trips from travel pattern survey in November and December 2006.

Table 2-21
Trips for Common Origin-Destination Pairs

Origin City or Town	Destination City or Town	Trips			Percent Share of Trips		
		Peak	Off-Peak	Total	Peak	Off-Peak	Total
Apex	Cary	491	699	1,190	7.4	12.5	9.7
	Chapel Hill	922	705	1,628	13.9	12.6	13.3
	Durham	4,793	3,392	8,185	72.1	60.5	66.8
	RTP	441	807	1,248	6.6	14.4	10.2
	Total	6,647	5,604	12,251	100.0	100.0	100.0
Cary	Cary	551	755	1,306	11.1	16.1	13.5
	Chapel Hill	753	1,176	1,928	15.2	25.0	20.0
	Durham	3,095	1,959	5,054	62.4	41.7	52.3
	RTP	560	811	1,371	11.3	17.2	14.2
	Total		4,700	9,659	100.0	100.0	100.0
Durham	Cary	604	553	1,157	15.9	14.9	15.4
	Durham	2,539	2,364	4,903	66.6	63.6	65.2
	RTP	668	797	1,465	17.5	21.5	19.5
	Total	3,811	3,714	7,525	100.0	100.0	100.0
Fuquay-Varina	Durham	1,219	1,371	2,590	100.0	100.0	100.0
Holly Springs	Cary	689	324	1,013	12.1	8.5	10.7
	Chapel Hill	763	264	1,027	13.4	7.0	10.8
	Durham	3,679	2,724	6,403	64.5	71.9	67.4
	RTP	571	480	1,051	10.0	12.7	11.1
	Total	5,702	3,792	9,494	100.0	100.0	100.0
Morrisville	Cary	622	700	1,322	14.4	16.6	15.4
	Chapel Hill	582	588	1,171	13.4	13.9	13.7
	Durham	3,128	2,935	6,064	72.2	69.5	70.9
	Total	4,332	4,224	8,556	100.0	100.0	100.0
Raleigh	Durham	1,129	1,133	2,262	100.0	100.0	100.0
RTP	Durham	1,079	1,043	2,122	100.0	100.0	100.0

Table 2-21 also shows that peak traffic was higher than off-peak traffic even though the peak periods account for only eight hours of the day. All trips heading to Durham clearly show a higher percentage of trips in the peak periods than in the off-peak. Peak and off-peak travel patterns differ for trips originating from Apex, Cary and Holly Springs and having destinations in Cary, Durham and Chapel Hill. The higher share of off-peak traffic for trips heading to the RTP from Apex, Cary, Durham and Holly Springs may be due to the fact that many locations in the RTP have mailing addresses in Durham and Morrisville. All of this data suggests a strong commuting pattern within the study area.

Road Choice

Figure 2-15 graphically shows the popular route choices for common origin-destination pairs. NC 55 emerges as a major roadway within the study area, favored by 55 percent of motorists making trips from Apex to Durham. NC 55 is also used by motorists traveling to Durham from Cary and Holly Springs. Another significant route in the study area is NC 54, which is used by motorists traveling from Cary to Durham and the majority of motorists traveling from Morrisville to Durham. Additionally, a majority of surveyed motorists, 43 percent, traveling from Raleigh to Durham indicated that they use a combination of I-40 and I-540. As Figure 2-15 indicates, other origin-destination pairs favor NC 54 and NC 55 for east-west movements and NC 55, I-40 or a combination of I-40 and NC 55 for north-south movements.

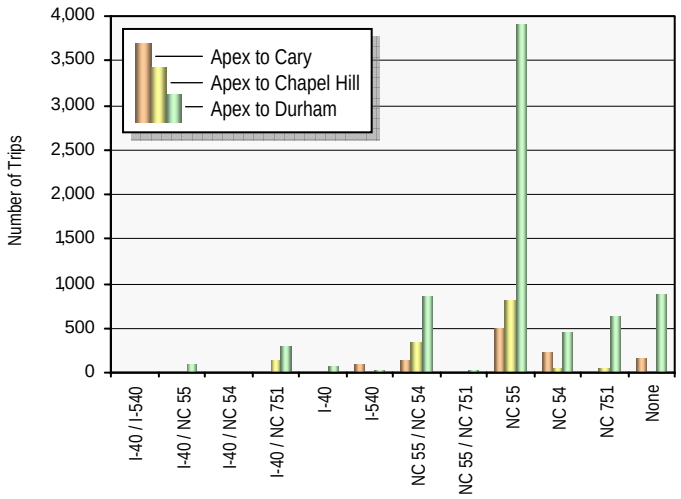
Trip Purpose

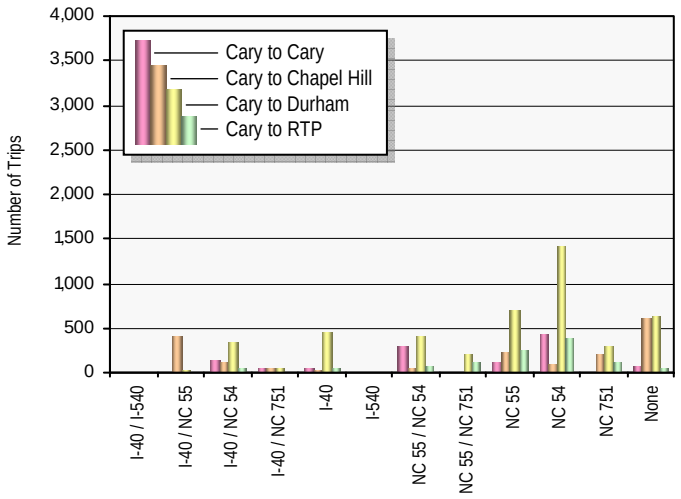
Figure 2-16 depicts the distribution of trips by trip purpose for common origin-destination pairs. The most common trip purpose for the frequent origin-destination pairs was to and from work. Combined with company business trips, work trips accounted for nearly two-thirds of all origin-destination trips.

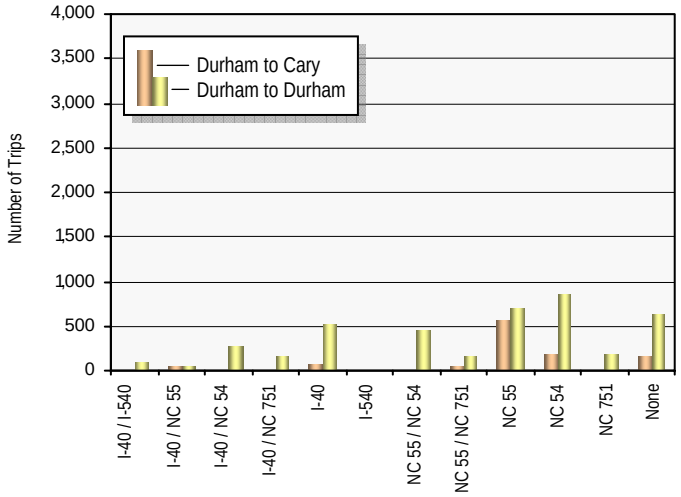
Figure 2-16 also identifies a few other trip patterns. Twenty-eight (28) percent of trips between Apex and Chapel Hill are shopping trips. A significant number of trips, about 20 percent, are school trips (likely trips made by students to the University of North Carolina.) Similarly, the Cary-Chapel Hill and Holly Springs-Chapel Hill origin-destination pairs show a significant number of school trips, 17 and 12 percent, respectively, of all trips between the origin-destination pairs.

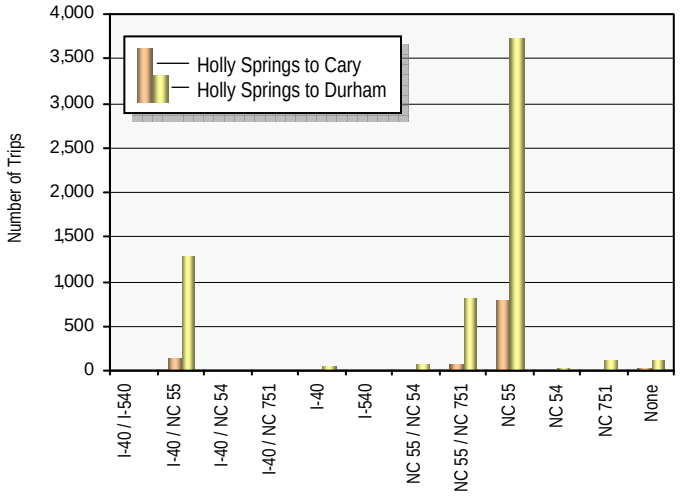
Trip Frequency

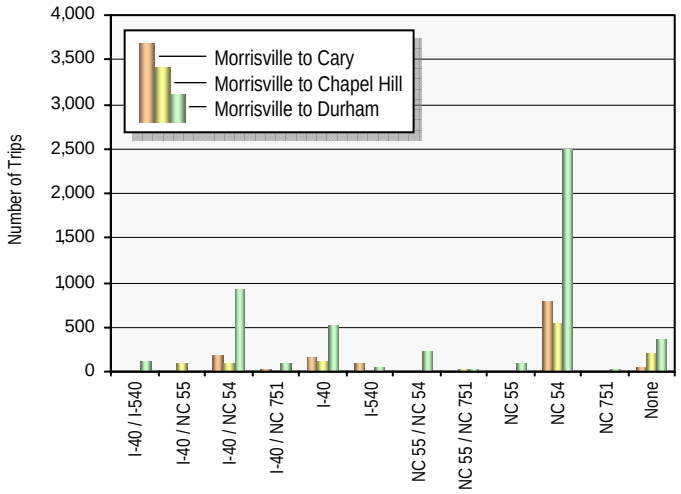
Figure 2-17 indicates the frequency between common origin and destination pairs. Of the 63,000 origin-destination trips between the most frequent origin and destination cities, 58 percent of trips were made five times or

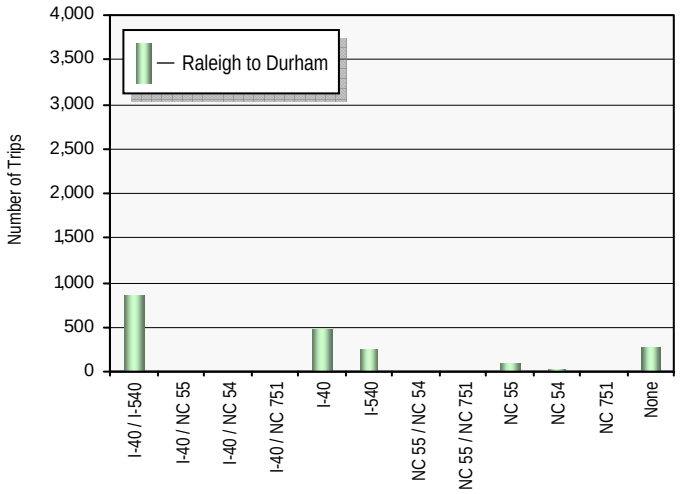












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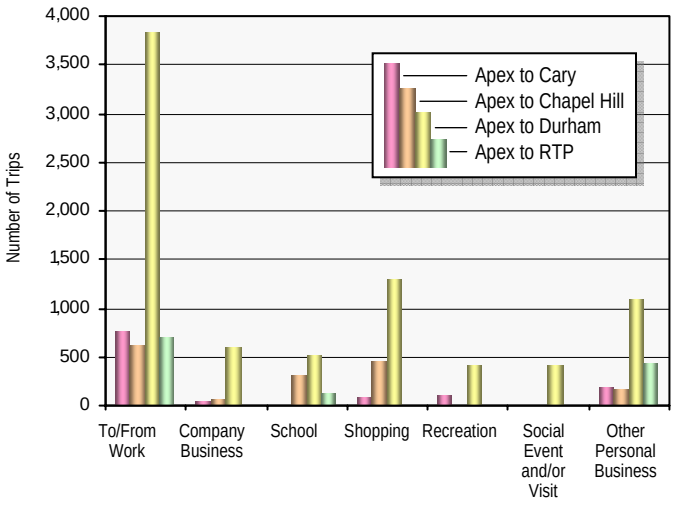
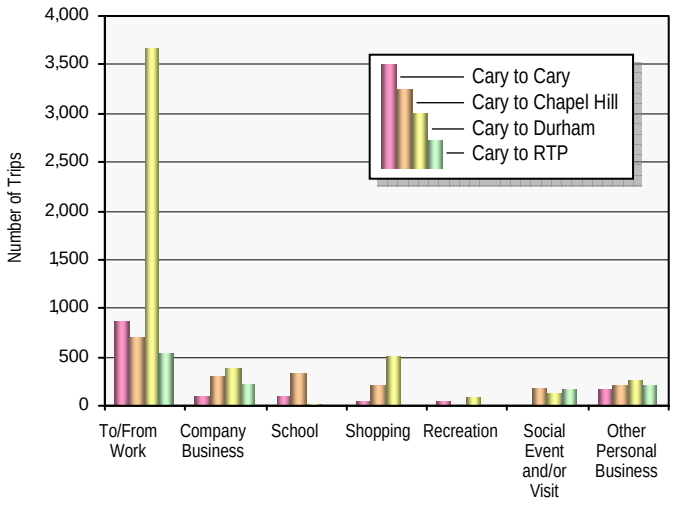
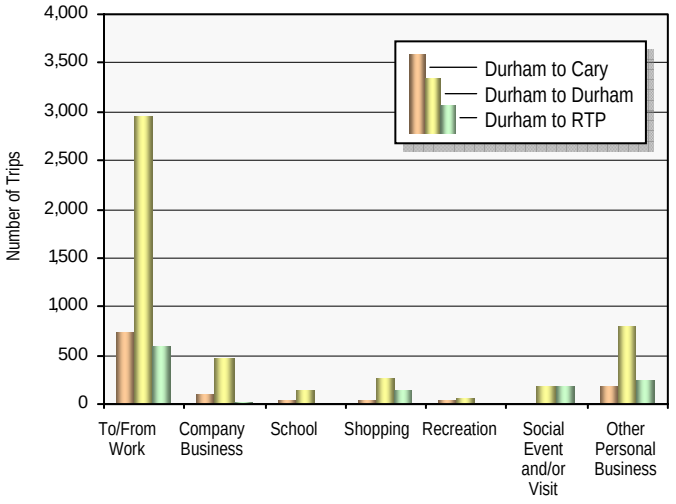
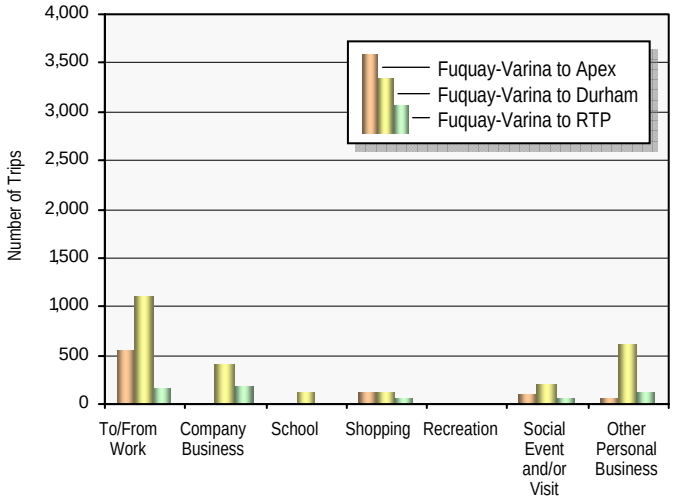
ROAD CHOICE FOR COMMON ORIGIN-DESTINATION PAIRS

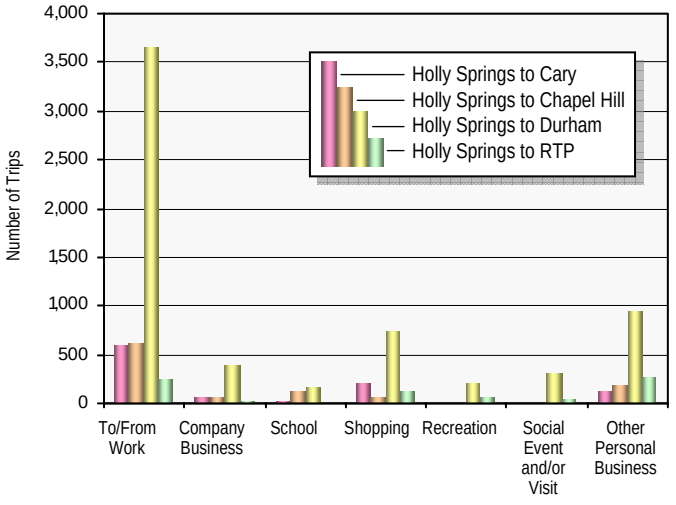
FIGURE 2-15

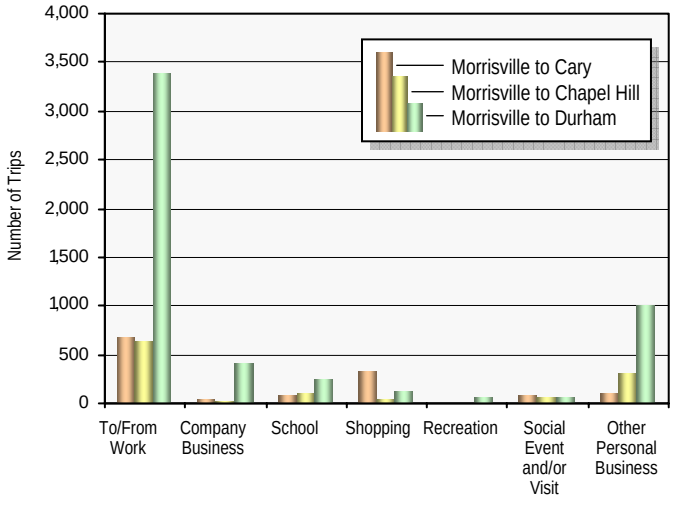








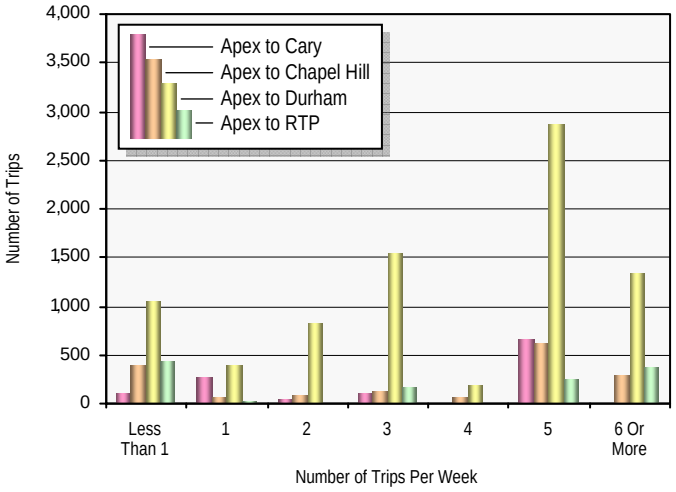


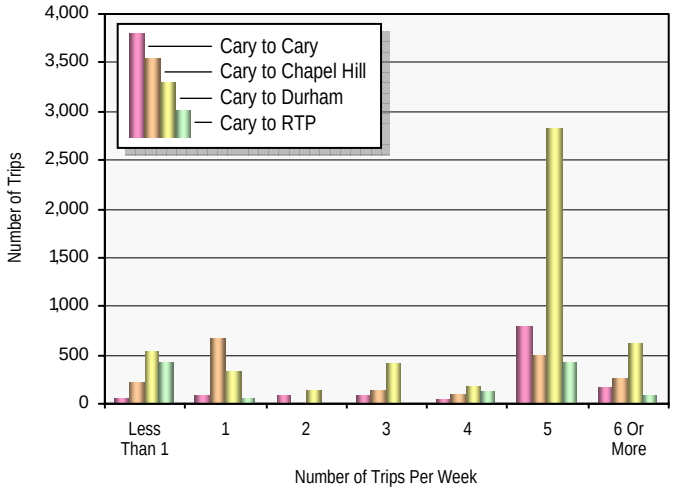


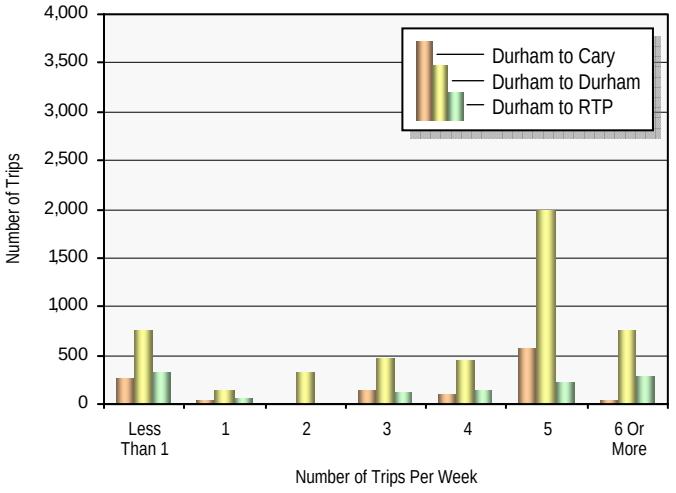
NORTH CAROLINA Turnpike Authority

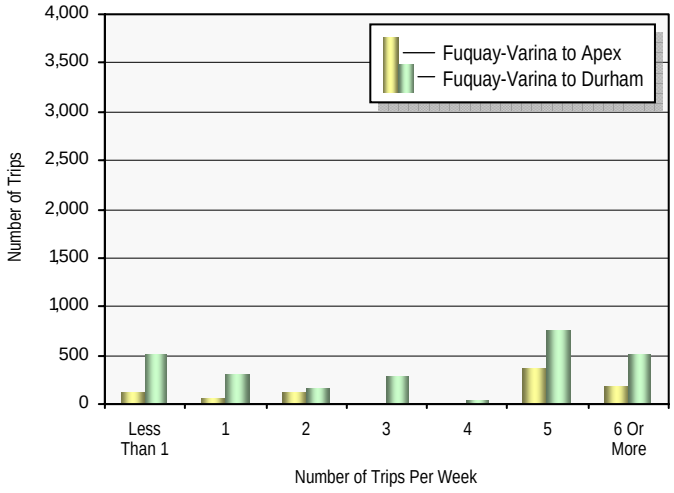
TRIP PURPOSE FOR COMMON ORIGIN-DESTINATION PAIRS

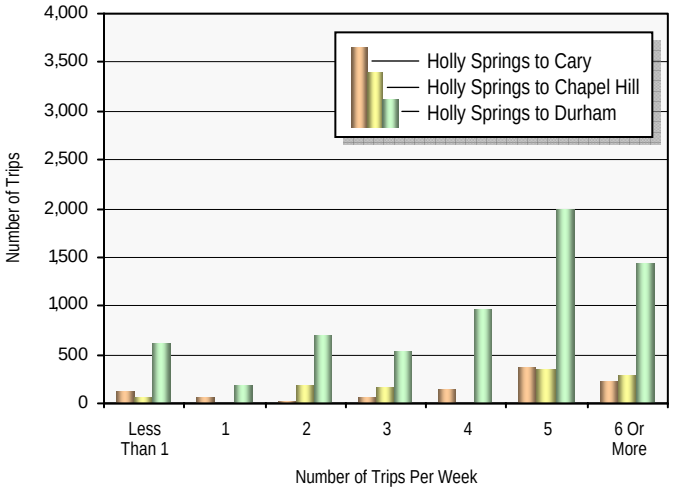
FIGURE 2-16

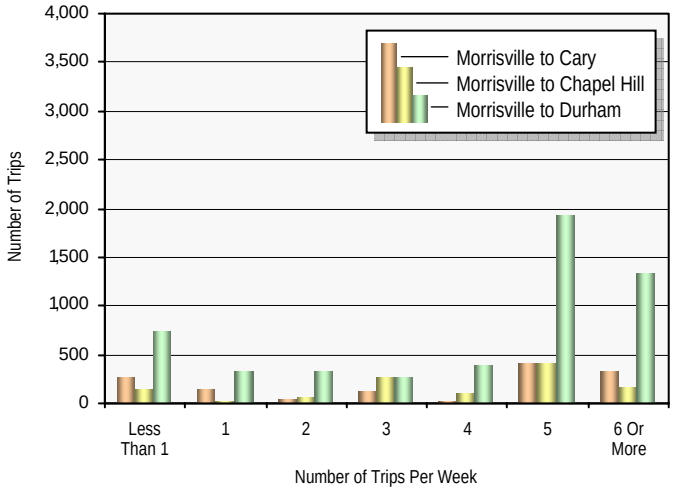












NORTH CAROLINA Turnpike Authority

TRIP FREQUENCY FOR COMMON ORIGIN-DESTINATION PAIRS

FIGURE 2-17

more every week. Of these, 17 percent of surveyed motorists make the trip six or more times a week. This corresponds to the percentage of motorists who indicated that they were making the trip to or from work.

A more detailed analysis of the trip characteristics of common origin and destination pairs is provided in a technical memorandum that details the travel patterns for some common origin-destination pairs in the Raleigh-Durham area.

CHAPTER 3

STATED PREFERENCE SURVEYS

The Triangle Expressway Stated Preference Survey was conducted by Resource Systems Group (RSG) for Wilbur Smith Associates and the North Carolina Turnpike Authority (NCTA). The objective of the stated preference survey was to estimate reliable values of the toll sensitivity, or "values of time," of travelers in the proposed Triangle Expressway study area. The survey was designed to provide sufficient detail to allow analyses of traveler responses to different toll structures and toll collection options; and to allow analysis of toll sensitivities by trip type sufficient to support route diversion modeling. The inputs and results of the stated preference survey are documented in a technical memorandum.

APPROACH

The stated preference survey instrument was programmed using customized software developed by RSG for field intercept administration using laptop computers and for online administration through RSG's SurveyCafe.com website. Respondents for this survey were recruited from several sources, including email invitation to those travel pattern survey respondents expressing interest in participating in follow-up surveys, workers with jobs in the study area, local shopping centers and motor vehicle departments.

The customized computer-based survey software adapts to the trip characteristics of each respondent, making the survey realistic for them. By performing calculations behind the scenes, it allowed for the presentation of complex ideas in a simple manner. Electronic validation of each question eliminated item non-response and prevented the entry of invalid inputs. Responses were stored directly into a database after every question, reducing data entry costs and eliminating transcription error.

SURVEY QUESTIONNAIRE

The survey questionnaire briefly introduced the purpose of the survey and then asked questions grouped into four sections: trip description, stated preference section with questions about travel time and toll cost, stated preference follow-up questions, and demographic questions.

TRIP DESCRIPTION

Respondents were screened to ensure that they had made trips recently within the Triangle Expressway study area. Each was asked to provide details of their trip, including day of the week, the purpose of their trip, the time period in which their trip began, the roads they used during their trip, and where their trip began and ended. These data were used to validate the Triangle Expressway as a possible alternative for the respondent's reported trip and as inputs to build the alternatives described in the stated preference scenarios.

After entering origin and destination information, respondents were asked for additional details about their trips, including, trip duration, amount of travel delay experienced, vehicle occupancy and how many times a week they make the particular trip (trip frequency).

STATED PREFERENCE SECTION

Before beginning the stated preference exercises, respondents were presented with more specific information about the proposed Triangle Expressway. Respondents were also given a description of the toll collection methods that likely would be used on the new facility.

Definition of Alternatives - The stated preference section consisted of eight hypothetical scenarios, with each scenario presenting two alternatives for traveling between the respondent's trip origin and destination. The first alternative presented the respondent's reported travel time using a toll-free rate. The second alternative presented the estimated travel time and toll cost based on the calculated use of Triangle Expressway for the identical trip. Figure 3-1 shows an example stated preference experiment.

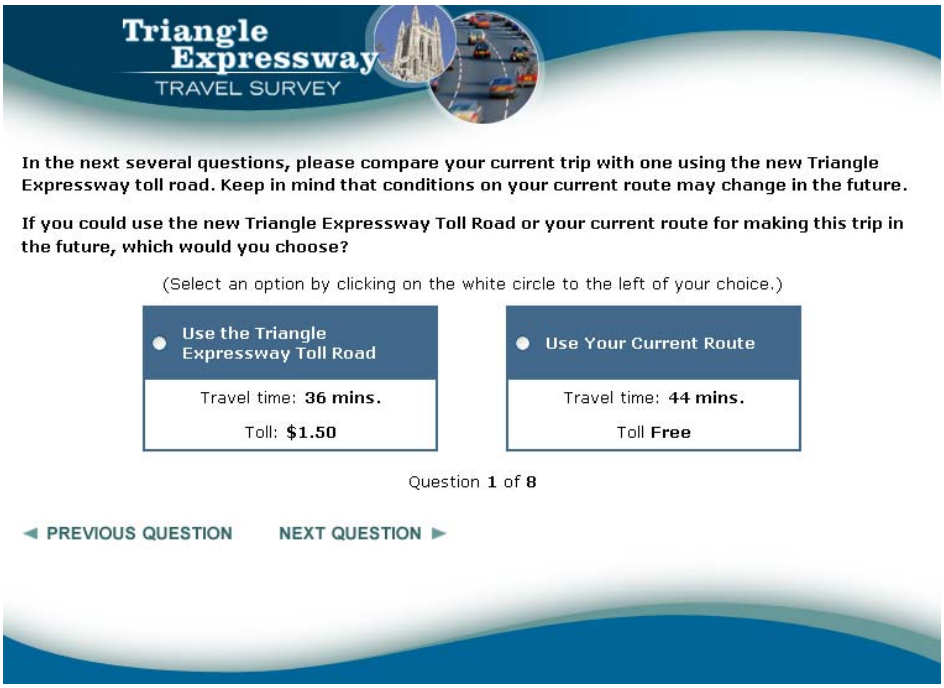


Figure 3-1

Definition of Attributes and Levels **-** Travel times for the respondent's current route, as well as travel times and toll costs for the Triangle Expressway alternative, were presented at different values or "levels" in eight scenarios for each respondent. The combination of times and costs presented in each scenario were selected using a fractional factorial orthogonal experimental design, a commonly used experimental design method. The experimental design consisted of 32 scenarios, and each respondent saw 8 of the 32 scenarios in a randomized order.

To ensure that the Triangle Expressway scenarios were believable to the respondent, the values for travel times and toll costs were based on characteristics of the respondent's own trip: the respondent's likely route for their trip using the Triangle Expressway was estimated based on the stated origin and destination for their trip. Calculations of the most likely entrance and exit ramps determined the respondent's hypothetical access times to, egress times from, and total distance along the Expressway. Times spent on the Expressway and toll costs were varied by travel speed and toll cost per mile, respectively, to provide values meeting the experimental design criteria. By varying the travel times and tolls shown in each scenario, the respondent was presented with different time costs and saving amounts for each scenario, allowing the demonstration of travel preferences across a range of values of time.

STATED PREFERENCE FOLLOW-UP

Directly following the stated preference section, respondents who did not select the Triangle Expressway alternative in any of the eight stated preference scenarios were asked to indicate their primary reason for not choosing the toll road. Respondents who chose the Triangle Expressway option at least once were asked their likelihood of acquiring an electronic toll collection (ETC) device as well as their familiarity with these devices. Those respondents who were not "very likely" to acquire an ETC device were asked if a reduced toll would increase their likelihood of ETC use. Respondents who still were not interested in ETC devices were asked why they were unlikely to open an ETC account.

The final follow-up section of the survey asked about their opinions of the project and their primary reason for support or opposition. Finally, respondents were asked a few attitudinal questions regarding tolling in general.

DEMOGRAPHICS

The final section of the survey contained a series of questions to collect data such as county of residence, household size, number of children, number of household vehicles, gender, age, employment status, and income. This information was used to determine differences in responses among traveler market segments, such as trips to and from Research Triangle Park, non-work trips, and airport trips.

SURVEY RESULTS

SAMPLE OVERVIEW

Stated preference data from 4,597 respondents were used to estimate the choice models presented in the following section of this report. Approximately 13 percent of these responses were recruited at intercept sites; 10 percent were recruited from the origin-destination survey email list; and 77 percent were recruited via business recruiting efforts. The intercept surveys were conducted at North Carolina Department of Motor Vehicles offices, area shopping centers, and other public locations:

- North Carolina Department of Motor Vehicles – west Raleigh, east Durham;
- Cary Towne Center Mall - Cary;
- Streets at Southpoint Mall – Durham;
- Raleigh-Durham Airport – Morrisville; and
- Cary West Regional Library – Cary.

While the majority of the sample came from one sample source, there are sufficient data from each sample source to provide unbiased results for a range of traveler market segments.

Respondent Characteristics

The sample was comprised of 34 percent women and 66 percent men. The median age was between 35 and 44 years of age. Most respondents (80 percent) were residents of Wake County, with 11 percent from Durham County and the remainder from other counties such as Orange and Chatham. The median household size was three people, and median vehicle ownership was two vehicles per household.

Ninety (90) percent of respondents were employed full time, and five (5) percent were employed part-time or were self-employed. Of those three groups, 82 percent were employed in the RTP. The majority of those working in the RTP (80 percent) were employed in professional or technical positions. The job types of non-RTP employees were more diverse, with 47 percent in professional or technical jobs, 16 percent in executive or managerial jobs, 11 percent in manufacturing jobs, and the remaining 26 percent doing other types of work.

The sample's median annual household income was in the $100,000–$149,999 per year bracket. It was clear that the median income of those employed within the RTP was higher than those employed elsewhere. The income of the respondents who were employed outside the RTP more closely resembled the median income reported in the census. To address this, variations in income by zone were applied within the tolling analysis.

Trip Characteristics

The multi-method sampling approach used for the survey allowed respondents who made a diverse range of trips to be recruited. Of those respondents who were recruited at intercept sites, 27 percent described work commute trips and the remainder described social or recreational trips, shopping trips and other personal business trips. Surveys completed by employees of businesses in the study area and travel pattern survey respondents largely described work related travel; in both these groups, less than a quarter of respondents described a non-work trip.

Over three quarters (86 percent) of respondents indicated that their trip began at home. Most respondents described trips that used I-40 (60 percent of respondents), Davis Drive (40 percent of respondents), and/or NC-55 (40 percent of respondents).

The median travel time in the sample was between 30 and 39 minutes. Over 90 percent of trips were less than an hour in duration (see Figure 3-2).

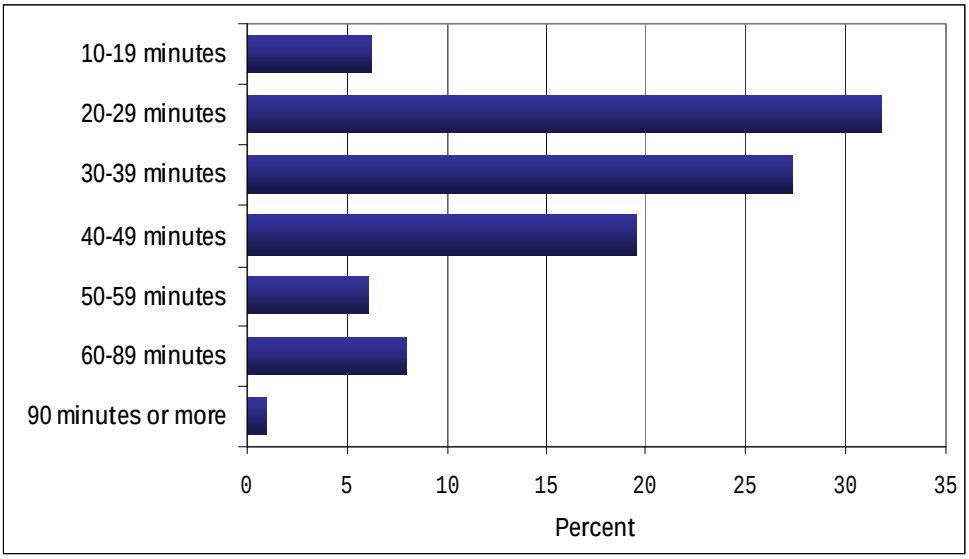


Figure 3-2 - Current Total Travel Time

Around two-thirds of the trips took place during the peak periods. About two-thirds of peak period travelers and one-third of off-peak travelers experienced some delay. A slightly higher proportion of PM peak travelers than AM peak travelers experienced delays of 10 minutes or more.

ETC Familiarity

Although there are no toll roads in North Carolina, 82 percent of respondents said that they were familiar with electronic toll collection (ETC). A significant number of respondents (16 percent) currently own or have owned an ETC device in another state; for most respondents that device was an E-ZPass transponder.

MODEL ESTIMATION

Data from the stated preference alternatives were expanded into a dataset that contained eight observations for each of the 4,597 usable surveys, yielding a total of 36,776 observations that were used to complete model estimation. The statistical estimation and specification testing was completed using a conventional maximum likelihood procedure that estimated

a single set of coefficients for a multinomial logit model. These coefficients were used to estimate the value of travel time savings for travelers in the proposed Triangle Expressway study area. The value-of-time estimates were input into the travel demand model to estimate traffic and revenue for the proposed Triangle Expressway.

Model Coefficients By Market Segment

Model coefficients were estimated for the nine different market segments listed below:

- Peak Work Trips to/from RTP;
- Peak Work Trips Outside RTP;
- Peak Non-work Trips;
- Off-peak Work Trips;
- Off-peak Non-work Trips;
- Business-related Trips;
- Airport Pick-up/Drop-off Trips;
- Airport Business-related Trips; and
- Airport Non-Business related Trips.

The final model structures are provided in the full report from RSG included in a technical memorandum. For most of the market segments, value-of-time was determined to be sensitive to income and total trip distance. That is, people with higher incomes tended to have higher values of time and those with longer travel distances also tended to value their time more.

The value-of-time for the different market segments based on a household income of $70,000 (the median for the region) and a trip length of 20 miles is shown in Table 3-1. It should be noted that these values were chosen to be representative but the actual values used were localized for each traffic analysis zone in the model.

Table 3-1
Estimated Value of Time

Market Segment	Value-of-time ($ per hour) [1]
Peak Work to/from RTP	$16.51
Peak Work Outside RTP	13.24
Peak Non-Work	14.51
Off-peak Work	13.03
Off-peak Non-work	9.85
Business-related	12.97
Airport Pick-up/Drop-off	11.99
Airport Business	20.97
Airport Non-Business	16.20

[1] Estimated at $70,000 per year household income and 20 miles total trip length.

APPLICATION TO MODEL FOR TRAFFIC AND REVENUE FORECAST

A weighted average value-of-time was calculated for each traffic analysis zone within the travel demand model used for the traffic and revenue analysis for this project. The estimated value-of-time for each zone was weighted based on the trip purpose distribution for trips originating within the zone, the household income for the zone, and the average length of trips from the zone that would potentially use the Triangle Expressway. This matrix was used as input to the traffic assignments for the project under a variety of tolling conditions.

CHAPTER 4

STUDY AREA GROWTH REVIEW

Economic growth is an important factor in evaluating the viability of any start-up toll facility such as the proposed Triangle Expressway. Given the strong nature of past and current employment-related growth in the Triangle Region, anticipated economic activity is particularly important.

This study will be used in support of project financing; therefore, it was important to conduct an independent analysis of the expected economic growth of the region. This "Study Area Growth Review" provides independently-developed socioeconomic forecasts of all parameters that were used in the regional travel demand model to predict future travel in the region rather than relying on the parameters developed by the two metropolitan planning organizations (MPOs) as was the case for the preliminary level traffic and revenue studies.

The independent economist for this study was the Kenan Institute of Private Enterprise of the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill. The Kenan team of economists had no affiliation with the forecasts developed by the MPOs or any affiliation with local governments or developers in the area. Thus Kenan could provide an unbiased review of regional economic growth and the independently-derived data sets that were needed for the travel demand models to forecast future traffic at the Transportation Analysis Zone (TAZ) level.

METHODOLOGY

The details of the Kenan study are contained in a technical memorandum. This chapter contains a brief overview of the Kenan approach.

Kenan reviewed the original (2002) socioeconomic forecasts that were used in the preliminary traffic and revenue studies for the Triangle Expressway and a newer (2007) set of draft forecasts developed by the MPOs as part of the new regional travel demand model (TDM). This new TDM

was in development during this study, therefore the newer draft socioeconomic forecasts were not officially adopted by the MPOs before the beginning of the transportation modeling and toll diversion analysis. Through discussions with the MPOs, it was determined that the draft socioeconomic forecasts of June 2007 were expected to be close to the final forecasts, which would be officially adopted later in the year. Slightly modified forecasts and projections were adopted by the Capitol Area MPO (CAMPO) in August 2007 and by the Durham-Chapel Hill-Carrboro MPO (DCHC) in September 2007. The differences between the draft forecasts and the official forecasts are small.

Kenan employed two methods in preparing the regional socioeconomic forecast that were used for this traffic and revenue study. The results of these two methods were then reconciled to create the individual forecasts at the TAZ level for use in the transportation demand model.

The first method was a top-down approach that began with overall forecast for the region using economic model-driven parameters to allocate population and employment throughout the region. Trend analysis was performed to determine the reasonableness of economic growth rates in relation to the new MPO draft forecasts, other forecasting organizations, and individual experts.

The second method was a bottom-up approach that reviewed the new draft forecasts coordinated by the two MPOs on behalf of the member jurisdictions. The MPO process involves local envisioning and inter-municipality discussions subject to broad constraints. The MPOs' forecasts are based on current planning assumptions in each member's jurisdiction. Kenan evaluated the basic assumptions upon which the MPOs jurisdictions forecast socioeconomic parameters and conducted interviews with local planners, developers, and others to assess the contingencies that affect the projections.

Finally, Kenan reconciled the top-down and bottom-up methods by relying on the top-down method for regional and county-wide control totals and the bottom-up method, informed by historical precedent, for distribution to the TAZ level in the model.

COMPARISON WITH PREVIOUS FORECASTS

The Kenan socioeconomic forecasts form the basis for the toll traffic and revenue forecasts presented in this report. The preliminary traffic and revenue studies used the MPOs' 2002 socioeconomic forecasts. As discussed

previously, the MPOs prepared new socioeconomic forecasts in 2007 as part of the development of a new regional travel demand model. These three forecasts differ; and it was important to compare them, to identify major changes, and to point to the potential effect on the toll traffic and revenue forecasts.

Direct comparison at the regional level was difficult because the MPOs' 2007 draft forecasts cover a larger geographic area than the 2002 forecasts. The older travel demand model, which was used for both the preliminary and comprehensive traffic and revenue studies, covers the smaller geographic area. However, comparisons can be made for the Triangle Expressway study area by converting the data that uses the new TAZ system boundaries to the older TAZ boundaries and then concentrating only on the study area as illustrated in a later figure in this chapter.

Tables 4-1 and 4-2 contain comparisons of the population and employment forecasts, respectively, in the Triangle Expressway study area. All three forecasts are shown for the study area: the 2002 forecasts used in the preliminary studies, the 2007 draft forecasts prepared by the MPOs, and the forecasts prepared by Kenan, the independent economist. Figures 4-1 and 4-2 depict the three forecasts graphically.

Population in the Triangle Expressway Study Area

The three population forecasts for the study area vary considerably, particularly in the later years of the forecast. In each case the independent economist population forecasts are lower than the MPOs' forecasts. The MPOs' 2007 draft population forecasts for the study area in 2010 are 3.5 percent higher than the MPOs' 2002 forecasts; whereas, the Kenan forecasts are slightly lower. By 2020, the MPOs' 2007 draft population forecasts are lower that the 2002 forecasts by 2.4 percent; and the Kenan forecasts are 11 percent lower, which represents a lower growth expectation by Kenan than by the MPOs. The Kenan population forecasts for 2030 are also significantly lower than the MPOs' 2002 and 2007 draft forecasts. The 2007 MPO draft population forecast for 2030 is nearly 49,000 residents less (-11 percent) than the MPOs' 2002 forecasts, and the Kenan forecast is 70,000 residents less (-16 percent).

However, while the population growth estimates for the study area were reduced, the changes in traffic zones proximate to the proposed Expressway were positive in some cases. Hence, the net impact of the changes in population forecasts on the traffic estimates for the Expressway was not as significant.

Table 4-1
Comparison of Population Projections
Triangle Expressway Study Area

Year	2002 MPO Population[1]	2007 MPO[2] Population	2007 MPO[2] Change from Preliminary Study	Independent Economist[3] Population	Independent Economist[3] Change from Preliminary Study
2010	213,862	221,443	3.5%	213,510	-0.2%
2020	327,723	319,826	-2.4%	291,656	-11.0%
2030	435,140	386,276	-11.2%	364,849	-16.2%

(1) Proposed Western and Southern Wake Freeways Preliminary Traffic and Revenue Study, June 16, 2006 using MPO socioeconomic forecasts contained in the Regional Transportaton Demand Model adopted at the time of the study.

(2) Draft forecasts prepared by Capital Area MPO and Durham-Chapel Hill-Carrboro MPO through June 2007 for new Regional Transportation Demand Model.

(3) Forecasts prepared by Kenan Insitute of Private Enterprise based on review of 2007 MPO forecasts.

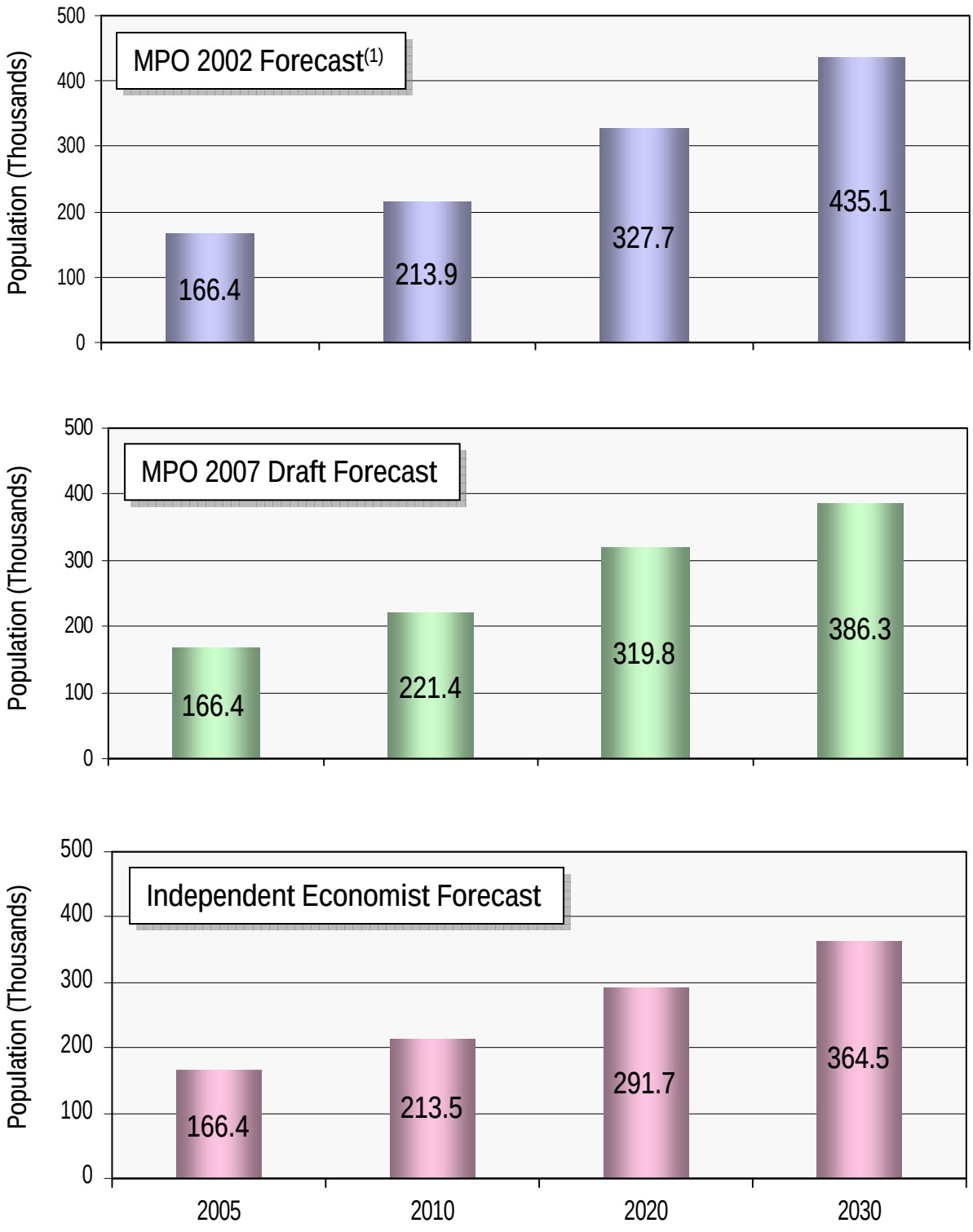
Table 4-2
Comparison of Employment Projections
Triangle Expressway Study Area

Year	2002 MPO Employment[1]	2007 MPO[2] Employment	2007 MPO[2] Change from Preliminary Study	Independent Economist[3] Employment	Independent Economist[3] Change from Preliminary Study
2010	153,685	141,248	-8.1%	140,589	-8.5%
2020	246,350	195,195	-20.8%	184,596	-25.1%
2030	341,549	242,231	-29.1%	222,669	-34.8%

(1) Proposed Western and Southern Wake Freeways Preliminary Traffic and Revenue Study, June 16, 2006 using MPO socioeconomic forecasts contained in the Regional Transportaton Demand Model adopted at the time of the study.

(2) Draft forecasts prepared by Capital Area MPO and Durham-Chapel Hill-Carrboro MPO through June 2007 for new Regional Transportation Demand Model.

(3) Forecasts prepared by Kenan Insitute of Private Enterprise based on review of 2007 MPO forecasts.



(1) Used in Preliminary Study

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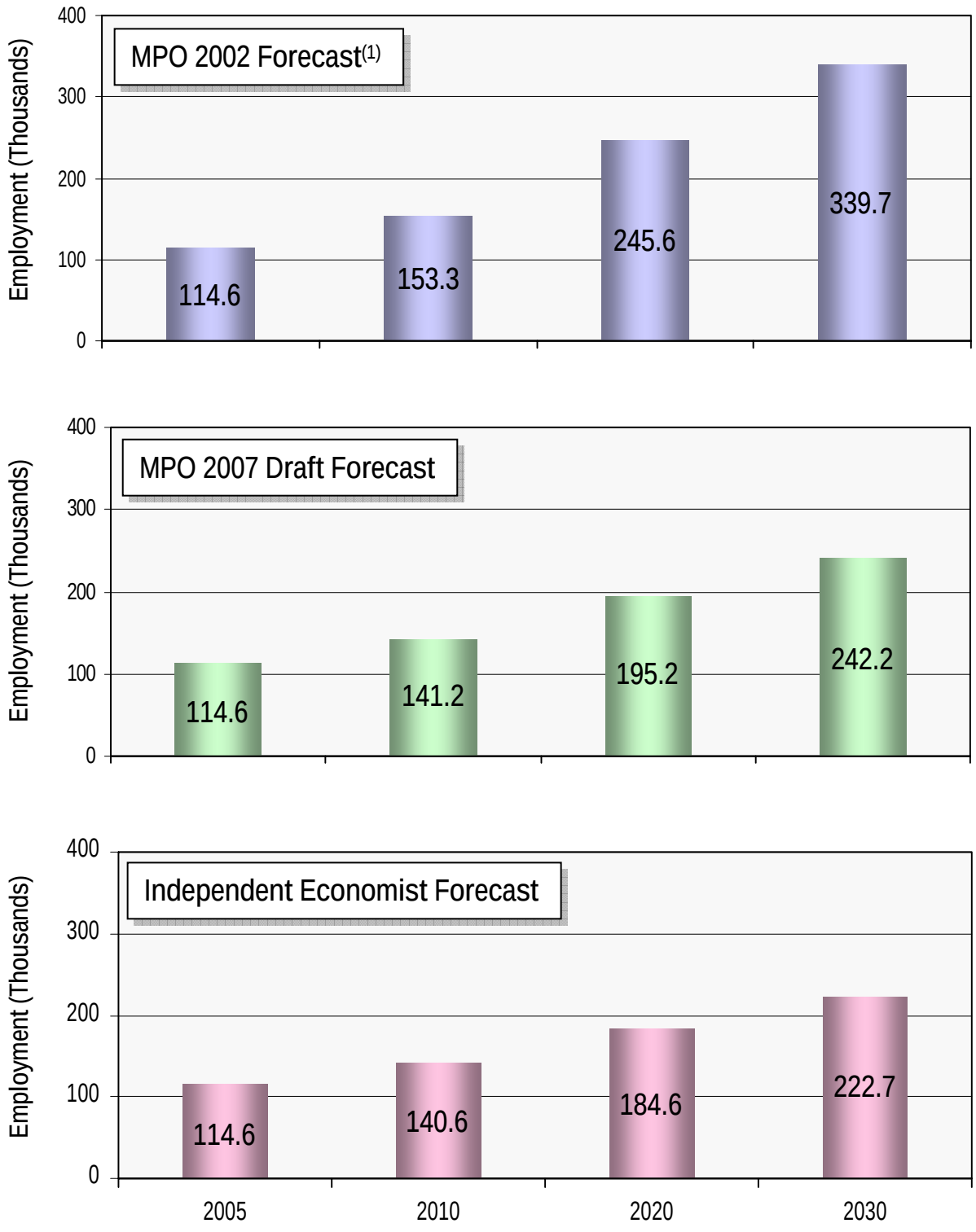
COMPARISON OF POPULATION PROJECTIONS
IN TRIANGLE EXPRESSWAY STUDY AREA

FIGURE 4-1



(1) Used in Preliminary Study

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COMPARISON OF EMPLOYMENT PROJECTIONS
IN TRIANGLE EXPRESSWAY CORRIDOR

FIGURE 4-2

EMPLOYMENT IN THE TRIANGLE EXPRESSWAY STUDY AREA

Table 4-2 shows the comparisons for employment in the study area. The MPOs' 2007 draft forecasts and Kenan forecasts are much lower than the forecast prepared by the MPOs' in 2002. By 2030, the MPOs' 2007 draft employment forecast is 29 percent lower, and the Kenan forecast is 35 percent lower than the 2002 forecasts. The difference between the Kenan forecast and the 2002 forecast, which was used in the preliminary traffic and revenue study, is nearly 119,000 jobs. These differences are due to lower expectations of growth in the study area; as employment is now expected to grow more rapidly in other areas of the Triangle Region.

Like population, adjustments in employment estimates in the immediate vicinity of the proposed Expressway were less negative than for the study area, and in some cases were positive. Most negative adjustments were made in the outlying sections of the study area.

GROWTH PROJECTIONS

These updated forecasts in the Triangle Expressway study area were analyzed further in order to identify specifically where the changes in growth are expected. Figure 4-3 depicts the 20 geographic sectors within the Triangle Expressway study area. The Triangle Expressway is also shown to orient the sectors to the proposed toll road.

The population and employment within the vicinities of the Western and Southern Wake Freeways are expected to grow extensively over the next three decades based on the forecasts made by the MPOs and the independent economist.

POPULATION FORECASTS

Table 4-3 summarizes population growth within the Triangle Expressway study area using the Kenan forecasts and the TAZ structure in the older travel demand model and compares the study area growth to growth for the rest of the Triangle Region.

In 2005, the Triangle Region had approximately 1.2 million residents with nearly 166,000 people (13.5 percent) residing within the Triangle Expressway study area. By 2030, the regional population is forecast to grow to about 2.1 million people, and the study area's population will grow to more than 365,000 people. By that time the study area's share of the population is expected to be 17.8 percent of the regional population, which means that the study area population is growing faster than the regional population. In fact, the average annual growth rate for the study area is

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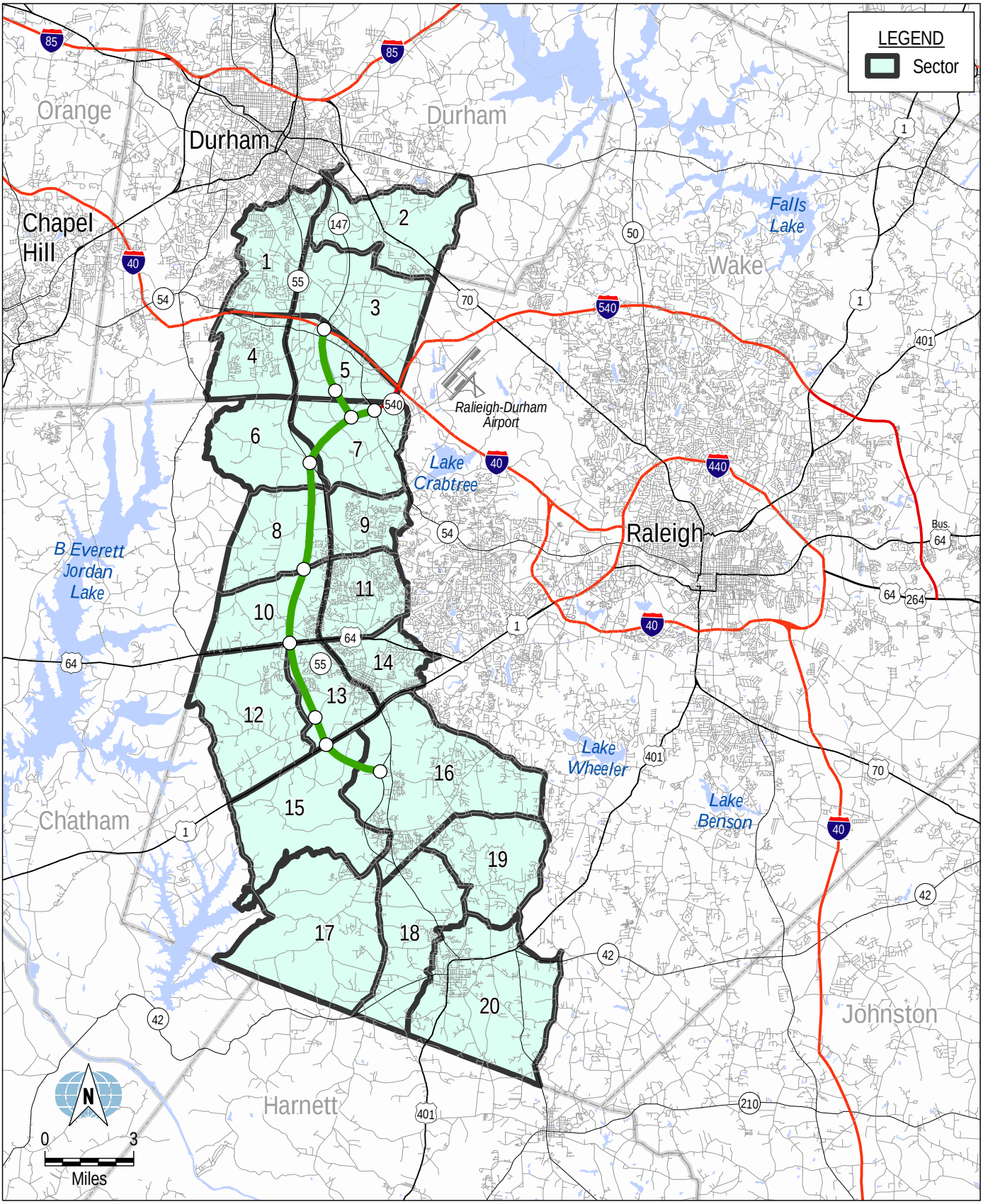

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STUDY AREA SECTOR MAP

FIGURE 4-3

Table 4-3
Study Area Population Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	19,745	1.4%	21,161	1.3%	24,050	1.0%	26,611	1.2%	34.8%
2	6,210	10.0%	9,984	5.1%	16,372	2.7%	21,370	5.1%	244.2%
3	4,678	6.0%	6,252	3.4%	8,772	1.9%	10,610	3.3%	126.8%
4	9,896	1.7%	10,750	1.3%	12,282	0.8%	13,244	1.2%	33.8%
5	1,485	2.3%	1,667	9.1%	3,977	4.4%	6,130	5.8%	312.8%
6	504	68.1%	6,753	9.5%	16,726	3.8%	24,390	16.8%	4742.1%
7	7,003	10.5%	11,538	1.1%	12,840	0.7%	13,726	2.7%	96.0%
8	4,078	23.9%	11,927	2.7%	15,494	1.9%	18,760	6.3%	360.1%
9	11,950	0.5%	12,270	-0.8%	11,368	0.3%	11,684	-0.1%	-2.2%
10	3,085	10.1%	5,000	2.9%	6,668	2.4%	8,447	4.1%	173.8%
11	21,246	1.6%	23,012	0.2%	23,500	1.0%	26,080	0.8%	22.8%
12	5,390	3.8%	6,494	5.7%	11,276	4.5%	17,573	4.8%	226.0%
13	9,267	0.4%	9,434	5.1%	15,572	2.8%	20,534	3.2%	121.6%
14	10,820	1.3%	11,515	1.0%	12,693	1.7%	15,024	1.3%	38.9%
15	1,869	11.4%	3,205	11.5%	9,562	3.9%	14,023	8.4%	650.1%
16	19,509	5.2%	25,104	3.3%	34,752	2.4%	43,983	3.3%	125.4%
17	3,777	9.3%	5,884	5.5%	10,049	3.1%	13,582	5.3%	259.6%
18	5,827	3.7%	6,992	4.8%	11,144	3.0%	14,942	3.8%	156.4%
19	7,934	3.7%	9,514	1.7%	11,240	1.8%	13,411	2.1%	69.0%
20	12,142	4.4%	15,053	4.5%	23,318	2.8%	30,724	3.8%	153.0%
Total Study Area Population	166,416	5.1%	213,510	3.2%	291,656	2.3%	364,849	3.2%	119.2%
Percent of Triangle Region	13.5%		15.2%		16.9%		17.8%		
Triangle Region Population	1,235,663	2.6%	1,403,428	2.1%	1,722,332	1.8%	2,050,416	2.0%	65.9%

Study Area Sector	Population Change 2005-2010	2010-2020	2020-2030	2010-2030
1	1,416	2,888	2,561	6,866
2	3,774	6,388	4,998	15,161
3	1,574	2,520	1,837	5,932
4	854	1,531	962	3,347
5	182	2,310	2,153	4,645
6	6,249	9,973	7,664	23,887
7	4,535	1,302	887	6,723
8	7,849	3,567	3,266	14,683
9	320	-902	315	-266
10	1,915	1,668	1,779	5,362
11	1,766	488	2,580	4,834
12	1,103	4,783	6,297	12,183
13	166	6,138	4,962	11,267
14	696	1,178	2,331	4,205
15	1,336	6,356	4,462	12,154
16	5,595	9,647	9,232	24,474
17	2,107	4,165	3,533	9,805
18	1,165	4,153	3,797	9,115
19	1,580	1,727	2,171	5,477
20	2,911	8,265	7,406	18,581
Total Study Area Population Change	47,095	78,146	73,193	198,433
Triangle Region Population Change	167,765	318,903	328,084	814,753

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone

expected to be 3.2 percent annually over the 2005-2030 period, whereas the entire region is expected to grow at only 2 percent annually.

The table also shows the study area sectors where the greatest population growth is expected to occur. Three sectors are expected to have population growth rates exceeding 6 percent per year. Figure 4-4 highlights the growth by percentage in the study area. At the southern end of the study area, nearly all of the sectors are expected to grow at rates exceeding 3 percent with some sectors exceeding 5 percent. The western side of the study area exhibits the highest growth rates with all geographic sectors exceeding 4 percent. These rates, although somewhat lower than the MPOs' 2002 forecasts, nevertheless represent significant growth of population within the study area.

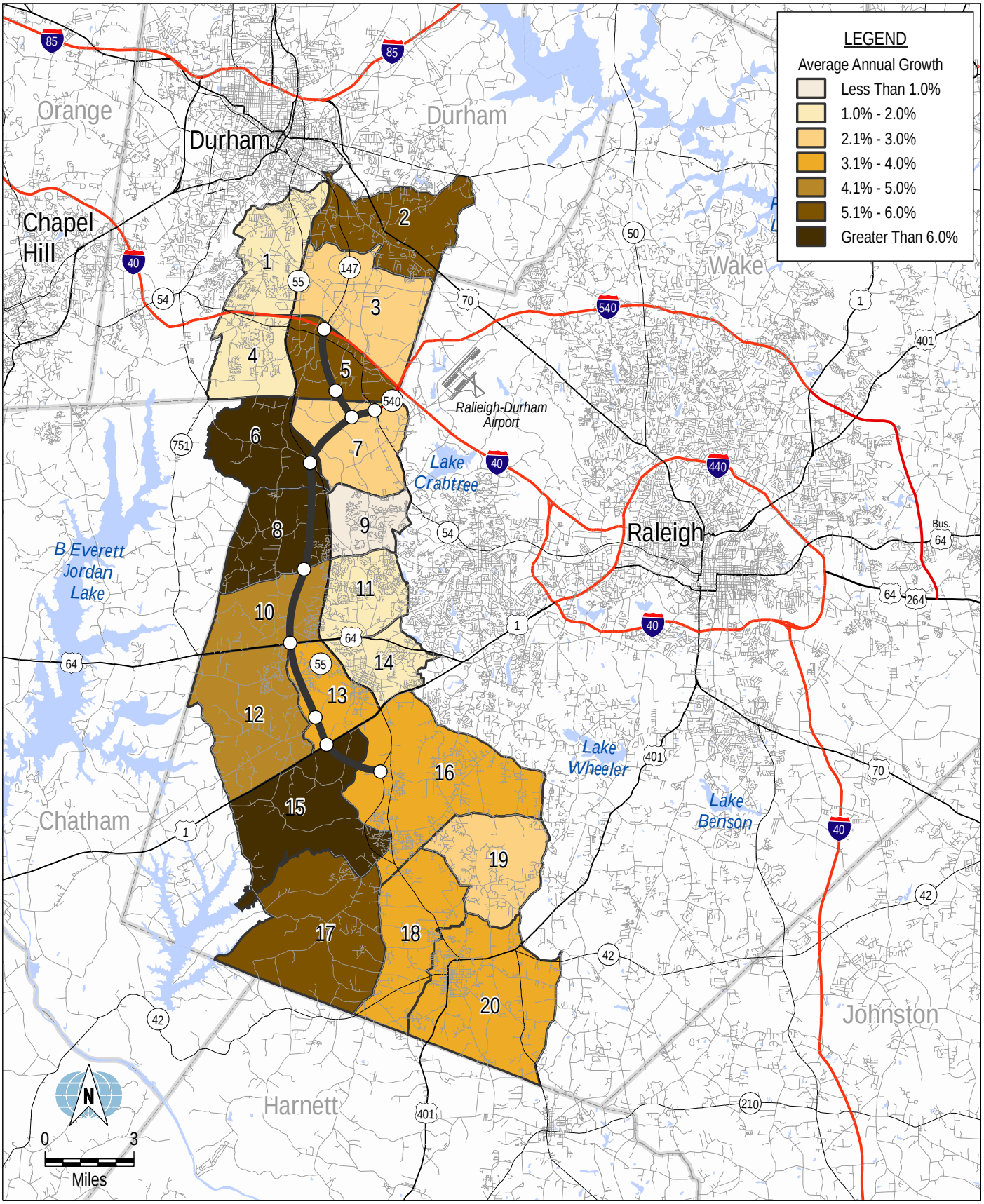
Employment Forecasts

As shown in Table 4-4 and Figure 4-5, employment in the Triangle Expressway study area represented 19 percent of regional employment in 2005 and is expected to increase to 22 percent by 2030. This growth from 115,000 employees in 2005 to nearly 223,000 employees in 2030 represents a 2.7 percent average annual growth rate. The regional growth rate of 2.1 percent per annum is forecast to increase employment from 603,000 persons in 2005 to more than 1 million in 2030.

Figure 4-5 illustrates the projected employment growth between 2005 and 2030 for each sector of the study area. While significant employment growth is exhibited throughout the study area, the western and southern sectors are expected to have the highest growth. These areas generally have growth rates that exceed 4 percent per year. The more mature sectors in the northern part of the study area such as the sectors around the highly developed northern portion of RTP have lower expected growth rates. The less developed southern sectors and areas southwest of RTP are expected to grow significantly.

Number of Households

The growth in the number of households in the study area is relative to the expected population growth. Table 4-5 summarizes the households as contained in the Kenan forecasts. In 2005, the number of households in the study area was estimated at over 62,000, which is a 13 percent share of the regional number of households. By 2030 the study area is forecast to increase in households to over 144,000, which would be 17 percent of the region's households. This growth rate of 3.4 percent annually between 2005 and 2030 is significantly higher than the 2.2 percent annual growth



STUDY AREA POPULATION GROWTH 2005-2030

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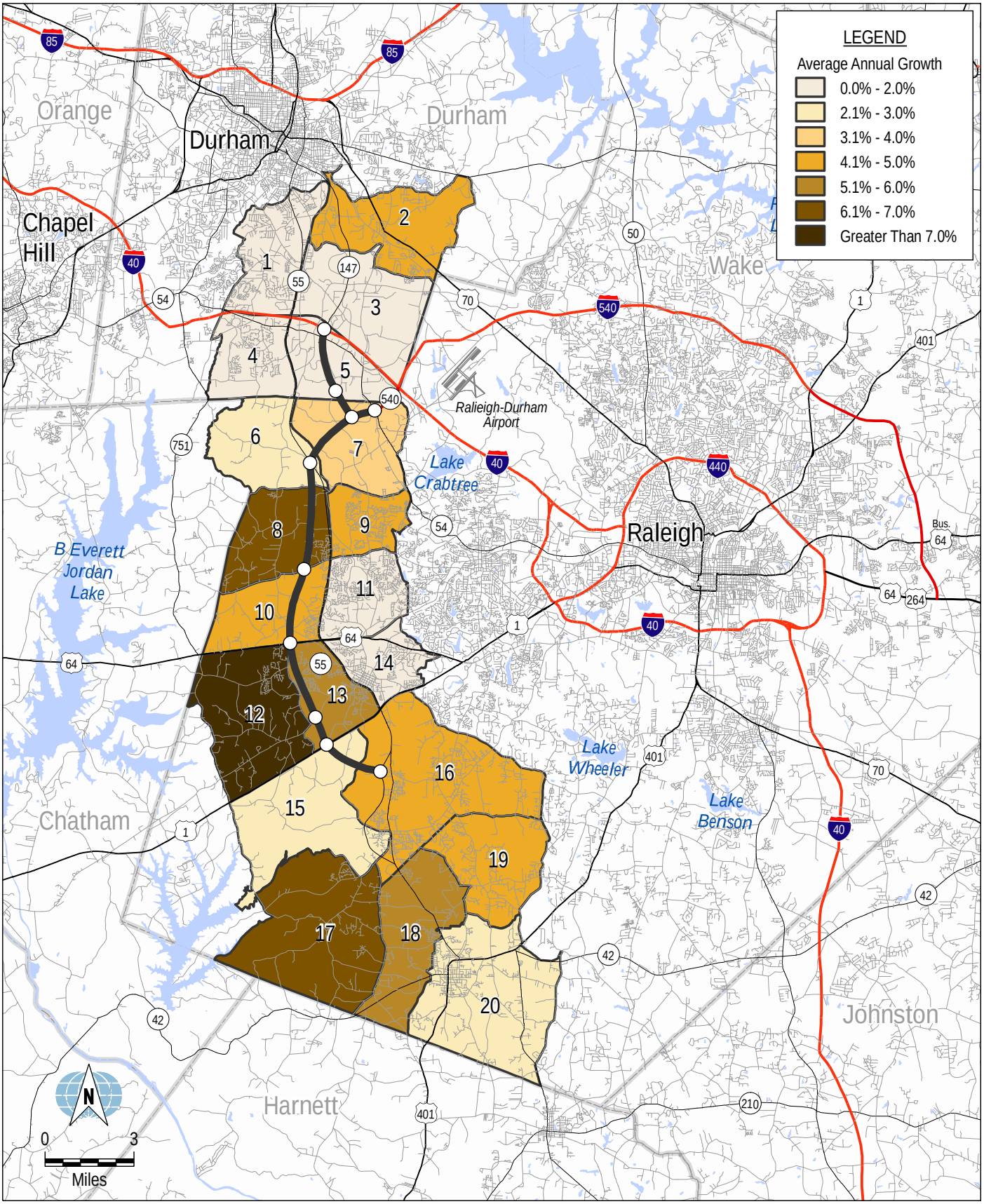
FIGURE 4-4

Table 4-4
Study Area Employment Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	5,886	2.6%	6,699	2.1%	8,254	1.4%	9,485	1.9%	61.1%
2	3,044	2.6%	3,464	2.1%	4,269	7.0%	8,397	4.1%	175.9%
3	29,466	2.3%	33,006	1.9%	39,749	0.3%	41,072	1.3%	39.4%
4	2,876	1.5%	3,094	1.3%	3,506	2.2%	4,373	1.7%	52.1%
5	20,436	3.0%	23,661	2.3%	29,840	0.4%	30,965	1.7%	51.5%
6	6,890	3.5%	8,178	1.9%	9,852	1.9%	11,906	2.2%	72.8%
7	11,997	5.7%	15,845	3.3%	21,876	2.6%	28,197	3.5%	135.0%
8	583	13.1%	1,077	6.2%	1,974	3.6%	2,818	6.5%	383.4%
9	1,699	9.0%	2,608	4.8%	4,181	3.2%	5,712	5.0%	236.3%
10	939	7.3%	1,338	4.1%	2,001	2.9%	2,667	4.3%	183.8%
11	2,284	2.9%	2,637	1.5%	3,046	1.7%	3,589	1.8%	57.1%
12	485	20.6%	1,235	7.9%	2,647	4.1%	3,946	8.7%	713.7%
13	2,363	9.6%	3,743	5.1%	6,149	3.3%	8,476	5.2%	258.8%
14	6,508	2.9%	7,509	1.4%	8,656	1.6%	10,184	1.8%	56.5%
15	5,392	4.7%	6,771	2.7%	8,796	2.3%	11,023	2.9%	104.4%
16	5,978	9.0%	9,188	4.8%	14,727	3.2%	20,129	5.0%	236.7%
17	691	12.8%	1,261	6.2%	2,291	3.6%	3,265	6.4%	372.5%
18	1,446	9.4%	2,271	5.0%	3,705	3.2%	5,094	5.2%	252.2%
19	1,204	7.2%	1,708	4.1%	2,545	2.9%	3,388	4.2%	181.5%
20	4,387	3.8%	5,296	2.1%	6,531	2.0%	7,981	2.4%	81.9%
Total Study Area Employment	114,553	4.2%	140,589	2.8%	184,596	1.9%	222,669	2.7%	94.4%
Percent of Triangle Region	19.0%		20.1%		22.1%		22.2%		
Triangle Region Employment	602,563	3.0%	699,675	1.8%	836,563	1.8%	1,001,494	2.1%	66.2%

Study Area Sector	Employment Change 2005-2010	2010-2020	2020-2030	2010-2030
1	813	1,556	1,231	3,599
2	420	805	4,128	5,353
3	3,540	6,743	1,323	11,606
4	218	413	867	1,497
5	3,225	6,179	1,125	10,529
6	1,288	1,674	2,054	5,016
7	3,848	6,031	6,321	16,199
8	494	897	844	2,235
9	909	1,573	1,532	4,014
10	399	663	666	1,727
11	354	409	543	1,305
12	750	1,412	1,299	3,461
13	1,381	2,406	2,327	6,114
14	1,001	1,146	1,529	3,676
15	1,380	2,025	2,227	5,632
16	3,209	5,539	5,403	14,151
17	570	1,030	974	2,574
18	825	1,435	1,389	3,648
19	504	838	843	2,185
20	910	1,235	1,450	3,595
Total Study Area Employment Change	26,035	44,007	38,072	108,115
Triangle Region Employment Change	97,112	136,888	164,932	398,931

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone



STUDY AREA EMPLOYMENT GROWTH 2005-2030

NORTH CAROLINA Turnpike Authority

FIGURE 4-5

Table 4-5
Study Area Households Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	7,982	1.7%	8,693	1.4%	10,026	1.1%	11,160	1.3%	39.8%
2	2,384	10.2%	3,874	5.2%	6,446	2.8%	8,475	5.2%	255.5%
3	1,855	6.1%	2,495	3.5%	3,532	2.0%	4,293	3.4%	131.4%
4	3,964	2.0%	4,374	1.5%	5,074	0.8%	5,516	1.3%	39.2%
5	566	2.7%	647	9.2%	1,561	4.5%	2,422	6.0%	328.2%
6	202	66.6%	2,588	9.8%	6,581	4.0%	9,722	16.8%	4714.0%
7	2,702	11.0%	4,543	1.3%	5,184	0.8%	5,616	3.0%	107.9%
8	1,542	24.5%	4,610	2.9%	6,150	2.1%	7,550	6.6%	389.8%
9	4,642	0.9%	4,867	-0.5%	4,625	0.4%	4,817	0.1%	3.8%
10	1,167	10.6%	1,931	3.2%	2,643	2.5%	3,395	4.4%	191.0%
11	7,158	2.0%	7,905	0.5%	8,314	1.2%	9,383	1.1%	31.1%
12	2,036	4.2%	2,504	5.9%	4,456	4.7%	7,035	5.1%	245.5%
13	3,465	0.8%	3,603	5.3%	6,022	2.9%	8,027	3.4%	131.6%
14	3,954	1.6%	4,291	1.2%	4,840	1.8%	5,798	1.5%	46.6%
15	681	11.7%	1,184	11.8%	3,610	4.0%	5,363	8.6%	687.7%
16	7,063	5.6%	9,292	3.6%	13,183	2.5%	16,906	3.6%	139.4%
17	1,376	9.8%	2,192	5.8%	3,842	3.2%	5,264	5.5%	282.5%
18	2,171	4.1%	2,659	5.0%	4,351	3.1%	5,920	4.1%	172.7%
19	2,934	4.1%	3,585	2.0%	4,352	1.9%	5,270	2.4%	79.6%
20	4,671	4.8%	5,903	4.7%	9,369	2.9%	12,512	4.0%	167.9%
Total Study Area Number of Households	62,513	5.5%	81,740	3.4%	114,161	2.4%	144,444	3.4%	131.1%
Percent of Triangle Region	12.8%		14.5%		16.2%		17.1%		
Triangle Region Number of Households	488,982	2.9%	564,177	2.2%	702,823	1.8%	843,133	2.2%	72.4%

Study Area Sector	Number of Households Change 2005-2010	2010-2020	2020-2030	2010-2030
1	711	1,333	1,134	3,178
2	1,490	2,573	2,028	6,091
3	640	1,037	761	2,438
4	411	700	442	1,552
5	81	913	862	1,857
6	2,386	3,992	3,142	9,520
7	1,841	641	432	2,914
8	3,069	1,539	1,400	6,008
9	225	-242	192	175
10	764	712	752	2,228
11	747	410	1,068	2,225
12	468	1,952	2,580	4,999
13	138	2,419	2,005	4,562
14	337	550	958	1,844
15	503	2,426	1,754	4,682
16	2,229	3,891	3,723	9,843
17	815	1,650	1,423	3,888
18	488	1,692	1,569	3,749
19	652	767	917	2,336
20	1,232	3,466	3,143	7,841
Total Study Area Number of Households Change	19,227	32,421	30,284	81,931
Triangle Region Number of Households Change	75,194	138,646	140,311	354,151

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone

rate anticipated for the region. The highest growth rate in the number of households is expected to occur in the southern and western sectors of the study area.

HOUSEHOLD INCOME

Median household incomes by location are summarized in Table 4-6. All values shown are in 2002 dollars. In 2005, the median household income in the region was estimated at $57,667. The Triangle Expressway study area had a 17 percent higher median household income ($67,586) than the region. By 2030, the forecast median household income in the study area is estimated to be 6.5 percent higher than the regional median.

The relatively high household income correlates with the study area's high incidence of residents with college degrees. According to 2000 census data, 44 percent of the study area's population age 25 and older has achieved an education level of Bachelor's Degree or higher compared to the national average of around 24 percent. This important statistic is likely related to the higher skill and knowledge level required by much of the employment in the region, especially that which is affiliated with Research Triangle Park.

RESEARCH TRIANGLE PARK

The Research Triangle Park (RTP) is a major economic driver in the region. The RTP reports that its corporate occupants employ approximately 44,000 staff and contractors. This employment is expected to grow to 85,000 as the Park builds out its remaining space over the next 20 years. Employees of Park companies are expected to be potential customers of the proposed toll road.

The RTP occupies approximately 7,000 acres with around two thirds of the Park lying south of I-40. The southern portion of RTP is less developed than the northern portion and will accommodate the extensive growth that is anticipated as the Park develops its remaining 1,100 acres. The proposed Triangle Expressway would provide a limited access roadway into the southern portion of the RTP.

Table 4-6
Study Area Median Household Income
Proposed Triangle Expressway
2002 Dollars

Study Area Sector	2005	2010	2020	2030
1	$49,609	$49,626	$49,511	$49,287
2	51,855	51,068	50,944	51,280
3	60,349	60,654	59,827	58,288
4	70,543	71,354	72,305	72,431
5	56,502	64,746	56,614	52,078
6	64,761	55,984	53,263	53,134
7	54,425	49,204	49,704	51,474
8	69,549	63,933	59,698	56,818
9	89,962	88,288	87,726	87,394
10	85,456	86,404	83,632	80,135
11	87,073	86,850	85,210	83,640
12	63,701	64,197	60,113	56,811
13	66,530	67,043	61,423	60,924
14	78,485	76,093	73,618	71,519
15	65,334	59,584	56,775	54,833
16	64,762	61,816	59,302	57,676
17	61,565	54,617	53,514	52,889
18	58,137	57,152	55,055	54,818
19	89,120	80,093	77,016	75,343
20	49,015	48,518	49,802	50,597
Total Study Area Median Income	$67,583	$64,837	$61,576	$60,082
Percent of Triangle Region	117.2%	113.0%	108.7%	106.5%
Triangle Region Median Income	$57,667	$57,372	$56,640	$56,402

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone

ADJUSTMENTS TO TRIANGLE REGIONAL MODEL (TRM)

As discussed earlier, socioeconomic forecasts prepared by the Kenan Institute independent economist were used in the trip generation process for this study. That is, the transportation network representation, trip distribution procedure, and mode choice procedure used in the MPOs' older regional travel demand model (TDM) were used to develop toll traffic forecast for this study; but the socioeconomic data used in the generation, distribution, and mode choice procedures to estimate future traffic are from the forecasts prepared by the independent economist.

Finally, the review of the structure and size of the traffic analysis zones (TAZs) contained in the MPOs' older regional TDM revealed that certain zones along the Expressway study area were not adequate to provide reliable estimates of traffic through proposed tolling locations. In effect, certain TAZs were deemed too large geographically to reflect traffic at the level of detail necessary for the traffic and revenue analysis.

Accordingly, certain TAZs in the northern sectors of the study area near RTP were disaggregated into multiple zones, as were select TAZs in the northern sectors of the Western Wake Freeway. These new zones were coded into the network.

SOCIOECONOMIC CONCLUSIONS

In general, the study area is forecast to exhibit strong economic growth despite the reductions made by both the MPOs and the independent economist. Further analysis revealed that growth is still particularly strong in the southern and western sectors of the study area as well as in the sectors south of RTP. Traffic that represents potential customers for the Triangle Expressway is still expected to be significant despite these reductions. A more detailed discussion of corridor economics is provided in the report of the Independent Economist, included in the technical memorandum.

CHAPTER 5

TOLL COLLECTION AND VEHICLE CLASSIFICATION

The preliminary studies considered a tolling system that would provide both ETC and cash payment options on the assumption that providing both options would attract more customers. Estimates of net operating revenue were made on the assumption that 75 percent of the transactions would be by ETC and that 25 percent would be by cash. No discounts were assumed for either ETC or cash payments.

However, the toll industry is moving more toward a cashless open road tolling (ORT) system, particularly for newer facilities. In the current study, the concept of a cashless system was examined in detail using a series of assumptions based on the preliminary work. The North Carolina Turnpike Authority subsequently decided to implement an open road tolling system instead of the ETC and cash concept assumed for the preliminary studies.

OPEN ROAD TOLLING ANALYSIS

An open road tolling analysis was conducted to provide guidance on continuing with a cash option or converting to a cashless system in which all payments would be by ETC or by video identification. Since the earlier study was based on an ETC/cash system, a set of assumptions was developed to estimate the proportion of traffic that would use the system if cash payment was no longer an option.

The customer base was divided into several components for this analysis:

- **Open Road Tolling Customers** – These are ETC or video tolling customers.

- **Cash Customers** – These customers would pay cash if that option is available. However, if the cash option is not available, this group would be divided into:
  - Those who would switch to ETC or video tolling, and
  - Those who would choose not to use the toll road and whose revenue would be "lost."

Assumptions were made regarding the percentage of ETC and video customers, the percentage of cash customers who would divert to the ETC or video if cash payment is not available, and the percentage of cash customers who would not be willing to purchase an ETC devise or pay the premium tolls associated with video.

The analysis yielded estimates of annual transactions and toll revenue under a cashless system, which were compared to the estimates of annual transactions and revenue from the preliminary studies. Under the cashless system, total transactions would be reduced by approximately 15 percent in the early years to approximately 5 percent in the later years in comparison to the ETC/cash system. However, the reduction in transactions was offset by the higher charges for video tolling, which resulted in slightly higher revenues under the cashless system than under the ETC/cash system.

Based on this analysis, the NCTA decided to implement the Triangle Expressway as an open road tolling facility with no cash collection.

VEHICLE CLASSIFICATION SYSTEM AND PAYMENT PREMIUMS

The NCTA decided to use a simplified vehicle classification system as follows:

- **Class 1, Light Vehicles** – Included in this class are automobiles, pickup trucks, passenger and service vans, sports utility vehicles, and motor cycles.
- **Class 2, Medium Vehicles** – Included in this class are single unit trucks larger than pickup trucks including 2-axle, 6-tire vehicles; passenger buses; recreational vehicles and any Class 1 vehicle that is towing a trailer.
- **Class 3, Heavy Trucks** – Included in this class are all multi-unit vehicles with five or more axles and all oversize vehicles.

The recommended premiums for Class 2 and Class 3 vehicles are based on a review of the premiums that are charged by other toll agencies for such vehicles. Table 5-1 contains a summary of the rates for a 3-axle and 4-axle single unit truck for 22 urban toll roads. The average rate is between two and three times the passenger vehicle rates. The rates for five-axle trucks are 3.75 times the passenger rate on average. Accordingly the following premiums were selected for the Triangle Expressway:

- **Class 1, Light Vehicles** – A base rate on which the rates for the other vehicle classes are based;
- **Class 2, Medium (Single-unit) Vehicles** – Two times the Class 1 rate; and
- **Class 3, Heavy (Multi-unit) Trucks** – Four times the Class 1 rate.

It is expected that the majority of the Triangle Expressway customers would pay by electronic toll collection (ETC). The ETC rate would be the base rate, and the video rates would be a premium over the ETC rates. Video customers would be identified using digital video capture techniques. Video customers that register with the NCTA would be charged a higher amount than the ETC customers because of the cost to identify and match license plates against the NCTA database. Users that did not register would be considered potential customers and offered a chance to pay before their transaction is classified as a violation. However, the cost to this set of potential customers would be higher than for the registered video customers because of the cost to identify and match license plates against the Department of Motor Vehicles database. Based on discussions with the NCTA and others, the following premiums are recommended for ETC and video toll collection:

- **Electronic Toll Collection** – A base rate on which the rates for the other collection methods classes are based;
- **Registered Video** – Two times the ETC rate; and
- **Unregistered Video** – Three times the ETC rate.

The actual rates for each vehicle class and payment type were determined through toll rate sensitivity tests as described in Chapter 6, which contains recommended rates by vehicle class, payment type, and tolling zone.

Table 5-1
Electronic Toll Collection Rates by Toll Agency and Number of Axles

		Vehicle Type													
		Passenger Car		3-Axle Truck/Bus			4-Axle Truck			5-Axle Truck			6-Axle Truck		
Agency and Facility Name	Length (Miles)	Toll	Cost/ Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile
Florida Turnpike Enterprise - Beachline (SR 528) (Orlando)	8.2	$0.50	$0.061	$1.00	$0.122	200%	$1.50	$0.183	300%	$2.00	$0.244	400%	$2.50	$0.305	500%
Florida Turnpike Enterprise - Sawgrass Expressway (Broward County)	20.8	$1.50	$0.072	$3.00	$0.144	200%	$4.50	$0.216	300%	$6.00	$0.288	400%	$7.50	$0.361	500%
Florida Turnpike Enterprise - Seminole Expressway (Orlando)	17.0	$1.50	$0.088	$3.00	$0.177	200%	$4.50	$0.265	300%	$6.00	$0.354	400%	$7.50	$0.442	500%
Florida Turnpike Enterprise - Veterans Expressway (Tampa)	16.0	$1.25	$0.078	$2.50	$0.156	200%	$3.75	$0.234	300%	$5.00	$0.313	400%	$6.25	$0.391	500%
Harris County Toll Road Authority - Hardy Toll Road	21.7	$2.50	$0.115	$6.00	$0.276	240%	$8.00	$0.369	320%	$12.00	$0.553	480%	$15.00	$0.691	600%
Harris County Toll Road Authority - Sam Houston Toll Road	67.0	$9.75	$0.146	$22.75	$0.340	233%	$31.25	$0.466	321%	$39.00	$0.582	400%	$57.50	$0.858	590%
Harris County Toll Road Authority - Westpark Tollway	11.0	$2.50	$0.227	$6.00	$0.545	240%	$8.00	$0.727	320%	$10.00	$0.909	400%	$13.00	$1.182	520%
Miami-Dade Expressway Authority - Don Shula (South Dade) Expressway - SR 874	7.3	$1.00	$0.137	$2.00	$0.274	200%	$3.00	$0.411	300%	$4.00	$0.548	400%	$5.00	$0.685	500%
Miami-Dade Expressway Authority - East-West (Dolphin) Expressway - SR 836	11.0	$1.00	$0.091	$2.00	$0.182	200%	$3.00	$0.273	300%	$4.00	$0.364	400%	$5.00	$0.455	500%
Miami-Dade Expressway Authority - Gratigny Parkway - SR 924	5.4	$1.00	$0.185	$2.00	$0.370	200%	$3.00	$0.556	300%	$4.00	$0.741	400%	$5.00	$0.926	500%
Miami-Dade Expressway Authority - Miami Airport Expressway - SR 112	4.2	$1.00	$0.238	$2.00	$0.476	200%	$3.00	$0.714	300%	$4.00	$0.952	400%	$6.00	$1.429	600%
North Texas Tollway Authority - Dallas North Tollway (DNT)	21.0	$1.80	$0.086	$2.85	$0.136	158%	$3.60	$0.171	200%	$4.35	$0.207	242%	$5.10	$0.243	283%
North Texas Tollway Authority - President George Bush Turnpike (PGBT)	26.0	$3.00	$0.115	$6.00	$0.231	200%	$9.00	$0.346	300%	$12.00	$0.462	400%	$15.00	$0.577	500%
Orlando-Orange County Expressway Authority - Beachline Expressway (SR 528)	24.0	$2.00	$0.083	$3.75	$0.156	188%	$4.75	$0.198	238%	$6.00	$0.250	300%	$6.00	$0.250	300%
Orlando-Orange County Expressway Authority - Central Florida Greeneway	38.0	$3.25	$0.086	$6.00	$0.158	185%	$7.95	$0.209	245%	$9.75	$0.257	300%	$7.50	$0.197	231%
Orlando-Orange County Expressway Authority - East-West Expressway	22.0	$2.50	$0.114	$4.50	$0.205	180%	$5.25	$0.239	210%	$6.75	$0.307	270%	$6.75	$0.307	270%
Osceola County, FL - Osceola Parkway	13.0	$1.00	$0.077	$1.50	$0.115	150%	$2.00	$0.154	200%	$2.50	$0.192	250%	$2.50	$0.192	250%
Tampa-Hillsborough Expressway - Lee Roy Selmon Crosstown Expressway	14.0	$2.50	$0.179	$5.00	$0.357	200%	$7.50	$0.536	300%	$10.00	$0.714	400%	$12.50	$0.893	500%
Transportation Corridor Agencies - Route 133	4.6	$1.25	$0.272	$2.50	$0.543	200%	$2.50	$0.543	200%	$5.00	$1.087	400%	$5.00	$1.087	400%
Transportation Corridor Agencies - Route 241 (1)	24.0	$4.25	$0.177	$8.50	$0.354	200%	$8.50	$0.354	200%	$17.00	$0.708	400%	$17.00	$0.708	400%
Transportation Corridor Agencies - Route 261 (1)	6.6	$1.25	$0.189	$2.50	$0.379	200%	$2.50	$0.379	200%	$5.00	$0.758	400%	$5.00	$0.758	400%
Transportation Corridor Agencies - San Joaquin, Route 73 (1)	15.0	$4.25	$0.283	$8.50	$0.567	200%	$8.50	$0.567	200%	$17.00	$1.133	400%	$17.00	$1.133	400%
Average			$0.141		$0.285	200%		$0.369	250%		$0.542	375%		$0.640	450%

(1) Tolls for peak conditions shown.
Source: Toll Agency Web Sites

CHAPTER 6

TRAFFIC AND REVENUE ANALYSIS

Chapter 6 presents a summary of the traffic and revenue analysis conducted for the proposed Triangle Expressway. In addition to an overview of the travel demand modeling process, this chapter also presents information on the regional highway improvement program, basic assumptions upon which the traffic and revenue forecasts are based, a toll rate sensitivity analysis, and the traffic and revenue forecasts for the proposed toll road.

ANALYTICAL METHODOLOGY

This section describes the general procedures followed to prepare the forecasts of annual toll traffic and gross toll revenue. Figure 6-1 depicts the process schematically.

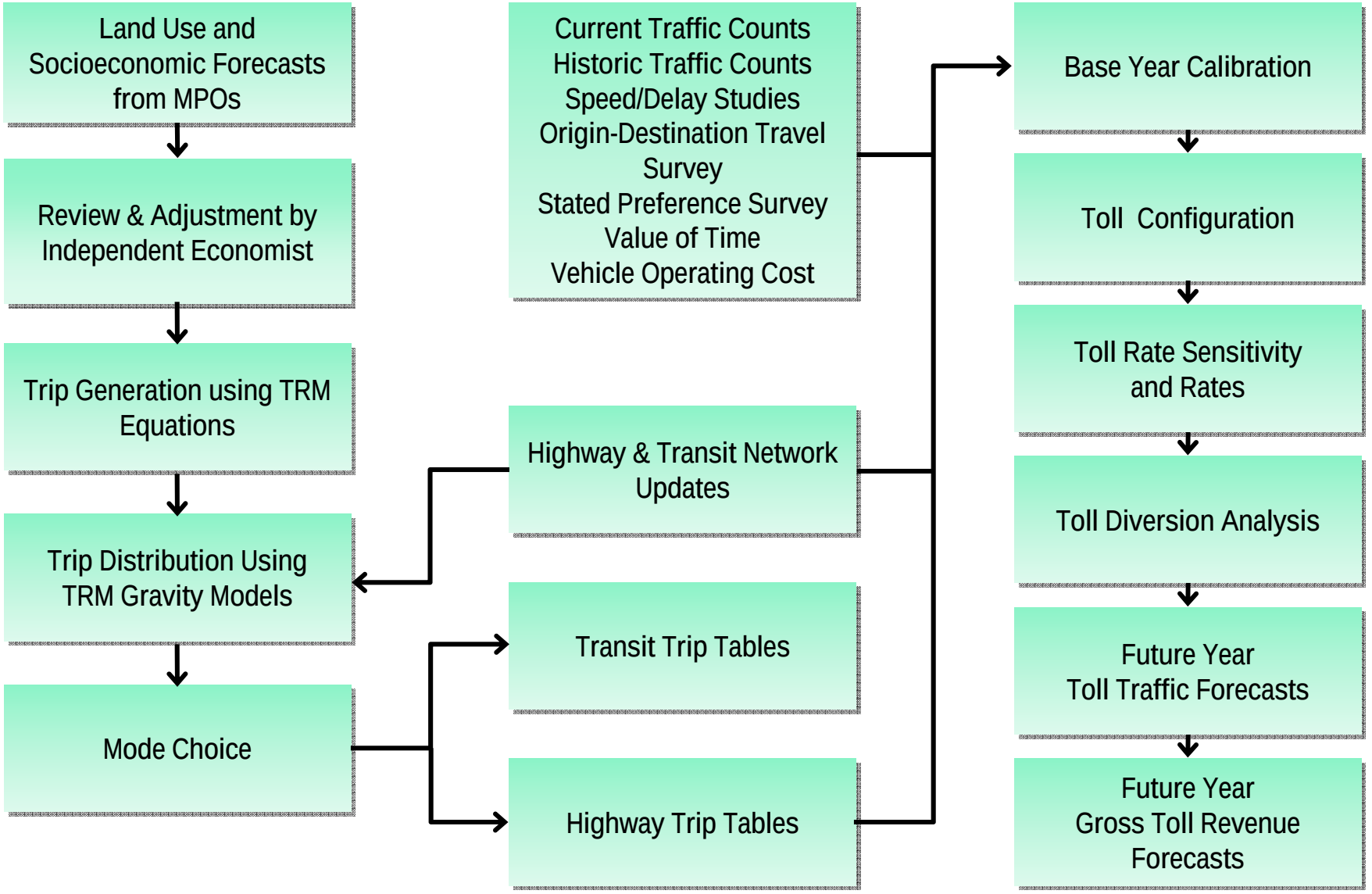
TRIANGLE REGIONAL TRANSPORTATION DEMAND MODEL

The two Metropolitan Planning Organizations (MPOs) in the region maintain a regional travel demand model, referred to as the Triangle Regional Model (TRM) that was used for this traffic and revenue analysis.

The current TRM, which was last updated in November 2006, was used to forecast traffic for this comprehensive traffic and revenue analysis. The two MPOs are in process of adopting a new TRM using different software and have updated the land use and socioeconomic data used in the trip generation process. However, the new model platform was not ready in time to use in this analysis.

The following steps were used in the modeling process:

- **Model Software and Network** – The same model framework and software that was used for the preliminary study was used for this study. Changes to the highway and transit networks to reflect plans adopted after completion of the preliminary study were incorporated.



NORTH CAROLINA Turnpike Authority

TOLL TRAVEL DEMAND MODELING PROCESS

FIGURE 6-1

- **Land Use and Socioeconomic Data Used for the Trip Generation Process** – Land use and socioeconomic data prepared by the MPOs in 2007 was reviewed by the independent economist. Adjustments to the socioeconomic data in the TRM were made by the economist for use in the trip generation process for this comprehensive study.

Transportation Analysis Zones

The new TRM will use different traffic analysis zones (TAZs) than the current TRM, which was used for this study. Consequently, extensive checking was performed to ensure that the updated socioeconomic data prepared by the independent economist under the new TAZ structure was allocated properly to the TAZ structure used in current TRM. In addition some of the TAZs were disaggregated into smaller TAZs to allow for a better representation of the roadway system within the study area. Trip tables were disaggregated accordingly to fit this revised TAZ structure.

Future Roadway and Transit Network Review

Highways and transit routes proposed for future improvement in the model were compared with proposed roadway and transit improvements in the Transportation Improvement Plans and Long Range Plans adopted by the two MPOs. In addition the commuter rail service planned for travel between Raleigh and Durham was removed from the network since funding for this project was withdrawn. Special attention was paid to proposed roadway and transit improvements in the Triangle Expressway study area. Detailed coding was added to represent the locations of proposed interchanges and tolling zones.

Trip Generation, Distribution, and Mode Choice

Three standard steps – trip generation, distribution and mode choice – were followed in the modeling process because the socioeconomic data and some highway and transit facilities and services had changed since the preliminary study. In the earlier study, the highway vehicle trip tables prepared by the MPOs formed the basis for the forecasts. In the current study, new vehicle trip tables were prepared based on the updated networks and socioeconomic data.

Model Calibration

The model was calibrated in the vicinity of the proposed Triangle Expressway by comparing model results with traffic volumes and travel speeds observed in the study area. Screenline analyses in the study area resulted in adjustments to travel speeds and trip tables for some movements in order to calibrate the model.

VEHICLE OPERATING COST

Updates were made to the assumed operating costs of passenger vehicles and trucks using available data from AAA and other sources.

VALUE OF TIME

Estimates of the value of time were calculated using updated median income information at the TAZ level and results of the stated preference survey described earlier. Values of time differed by trip purpose and TAZ.

TRAFFIC DIVERSION ANALYSIS

Following calibration of the model, a series of traffic assignments were generated for the future years of 2011, 2012, 2015, 2020, 2025, 2030, 2035, and 2040 under no build, toll free, and tolled conditions. Several toll rates were tested for the years 2011/2012 and 2030 in order to estimate the optimum toll rates. A toll diversion analysis was conducted using trips tables divided by time period, trip purpose, vehicle type, and toll payment class.

Toll traffic assignments were generated using a diversion assignment technique. This process involved comparing travel time and distance for trips on the Triangle Expressway with trips on the best toll-free alternative routes. The estimated traffic that would be expected to use the Expressway is a function of travel time and distance savings, the assumed monetary value of these savings, and the toll rate being tested in any given assignment. In general, as the total costs to use the proposed toll road increased, the traffic decreased.

The model also recognizes capacity constraints on roadways. Speeds for future year forecasts were lowered to reflect increasing congestion on both the proposed toll facility and existing toll free roads.

BASIC ASSUMPTIONS

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

1. The Triangle Parkway (NC 147 to NC 540) will open to traffic and NC 540 (NC 54 to NC 55) will convert to a toll section by December 30, 2010. The Western Wake Freeway (NC 55 near Morrisville to NC 55 Bypass near Holly Springs) will open to traffic by January 1, 2012;

2. The existing southern terminus of NC-147 at T.W. Alexander Drive will close upon the completion of the first section of the Triangle Expressway in December 2010;

3. Improvements in the current Transportation Improvement Program, including the widening of some existing toll free routes and construction of HOV lanes on I-40, will be implemented by 2030;

4. Tolls would be charged for three vehicle classes and three payment types and will be increased annually. The toll rates and tolling zone locations will be as shown later in this chapter;

5. No new toll-free facilities or additional capacity will be constructed during the projection period, other than those in the current Transportation Improvement Plan;

6. The system will operate in a cashless environment. Both electronic toll collection and video tolling will be used. Video tolling will be further divided into a registered and unregistered component;

7. The percentage of ETC and video customers will be as described later in this chapter;

8. Revenue "shrinkage" due to unreadable or uncollectible ETC or video transactions, or any transactions that can not be processed and payment collected will occur. The shrinkage 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. Economic growth in the project study area and associated travel demand would occur as forecast by the independent economist;

10. The inflation will average 2.5 percent per year;

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

12. Motor fuel will remain in adequate supply, fuel price increases will not significantly exceed overall inflation in the long term, and 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 proposed Triangle Expressway.

FUTURE ROADWAY IMPROVEMENTS

People's travel behavior and the number of vehicles that would use the proposed Triangle Expressway would be heavily influenced by the operating conditions on other area roadways in the study area. The process of transportation project development and funding makes it impossible to know with certainty which proposed transportation improvements will be implemented and when. However, it is important that reasonable assumptions are made regarding future improvements, since such improvements could have a considerable effect on the number of vehicles that would use the Expressway.

The current TRM contains all future highway improvements listed in the two MPOs' fiscally constrained 2030 transportation improvement programs. A list of the planned road improvements that could affect traffic volumes on the Triangle Expressway is provided in Table 6-1. The improvements that would have the most significant impact on the operation of the Expressway and the year that they are programmed in the TRM include:

- **Model Year 2011**
  - Widening of T.W. Alexander Drive, Davis Drive, and NC 55;

- **Model Year 2020**
  - New roads – Airport Boulevard Extension, McCrimmon Parkway from Airport Boulevard to Aviation Parkway and from Davis Drive to NC 55, Extension of T.W. Alexander from US 70 to Leesville Road;
  - Widening of T.W. Alexander Drive, Davis Drive, McCrimmon Parkway, Morrisville Parkway, NC 54, US 401, I-40 (South), and Ten-Ten Road;

- **Model Year 2030**
  - I-40 – Widening and HOV/HOT Lanes;
  - Other new roads – Extensions of Kit Creek Road and McCrimmon Parkway; and Western Parkway (NC 55 to US 401); and

Table 6-1
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Garner Road	Walnut Creek Bridge to Martin Luther King Jr., 2-Lanes to 3-Lanes	2011
Edwards Mill Road Extension-Part II	Trinity Road to Chapel Hill Road, New 4-Lane	2011
Davis Drive	Morrisville - Carpenter Road to Farm Pond Road, 2-Lane to 4-Lane	2011
Davis Drive	Morrisville - Carpenter Road to Durham County line, 2-Lane to 4-Lane	2011
South Loop Road	Louis Stephan Drive to Davis Drive, New 4-Lane	2011
NC 54	Trinity Road to Maynard Road, 2-Lane to 4-Lane	2011
High House Road	Davis Drive to NC 55, 2 Lane to 4 Lane	2011
US 70 (Clayton) Bypass	I-40 (South) to US 70 Business, 4 New Lanes	2011
US 1-64	US 64 to Walnut Street, 4-Lanes to 6-Lanes	2011
Louis Stephens Drive Extension	Morrisville Parkway to High House Road, new 2-Lane	2011
Tryon Road	Keisler to Cary Parkway, 2-Lane to 4-Lane	2011
Tryon Road	Cary Parkway to Jones Franklin Road, 2-Lane to 4-Lane	2011
Tryon Road	Jones Frankin Road to Dillard Drive, 2-Lane to 4-Lane	2011
Tryon Road	Gorman Street to Lake Wheeler Road, 2-Lane to 4-Lane	2011
Tryon Road	Norfolk Southern Rail to Existing Tryon Road, 2-Lane to 4-Lane	2011
Tryon Road	New Tryon Road Alignment to South Wilmington Street	2011
County Line Road	North of O'Kelly Chapel to Yates Store Road	2011
NC 55	Carpenter Fire Station Road to Durham County line, 2-Lane to 4-Lane	2011
NC 55	Carpenter Fire Station Road to High House Road, 2-Lane to 4-Lane	2011
NC 55	High House Road to US 64, 2-Lane to 4-Lane	2011
NC 55	Holly Springs Bypass to Wake Chapel Road, 2-Lane to 4-Lane	2011
Airport Boulevard Extension	NC 54 to Davis Drive, New 4-Lane	2020
Timber Drive East	White Oak Road to New Rand Road, New 4-Lane	2020
Hillsborough Street Safety	Gorman Street to Woodburn Road, 4 Lane to 2-Lane	2020
Sunset Lake Road Connector	NC 55 to Optimist Farm Road, 2-Lane to 4-Lane	2020
Davis Drive	Farm Pond Road to US 64, 2-Lane to 4-Lane	2020
Trinity Road	Edwards Mill Road Extension to Trenton Road, 2-Lane to 4-Lane	2020
S.W. Maynard Road	W. Gatham Street to Kildare Farm Pond, 2-Lane to 4-Lane	2020
Old Apex Road	High House Road to Cary Parkway, 2-Lane to 4-Lane	2020
Morrisville Parkway	Davis Drive to NC 55, 2-Lane to 4-Lane	2020
Ten-Ten Road	Holly Springs Road to US 1, 2-Lane to 4-Lane	2020
Blue Ridge Road	Duraleigh Road to Glen Eden Drive, 2-Lane to 4-Lane	2020

(continued)

Table 6-1 (cont'd.)
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Holly Springs Road	Sunset Lake Road to Old Holly Springs Apex., 2-Lane to 4-Lane	2020
Center Street/1010	US 1 to Apex Peakway, 2-Lane to 4-Lane	2020
Lake Wheeler Road	I-40/I-440 to Tryon Road, 2-Lane to 4-Lane	2020
Tryon Road	Lake Wheeler Road to Norfolk Southern Rail, 2-Lane to 4-Lane	2020
Tryon Road Extension	Garner Road to Rock Quarry Road, New 4-Lane	2020
McCrimmon Parkway	Airport Boulevard to Aviation Parkway, New 4-Lane	2020
NC 55	Olive Chapel Road to US 64, 2-Lane to 4 Lane	2020
NC 55	Apex Peakway (South) to Olive Chapel Road, 2-Lane to 4-Lane	2020
Evans Road	NW Maynard Road to Dynasty Drive, 2-Lane to 4-Lane	2020
I-40 (South)	US 70 to East Parkway, 4-Lane to 6-Lane	2020
I-40 (South)	US 1/64 to Wade Avenue, 4-Lane to 6-Lane	2020
I-40 (South)	I-440 to US 70, 4-Lane to 8-Lane	2020
I-40(South)	US 70 to NC 42, 4-Lane to 8-Lane	2020
Smithfield Road	Carrington Drive to Forestville Road, 2-Lane to 4-Lane	2020
Cary Parkway Extension	Harrison Avenue to Trinity Road, New 2-Lane	2020
Jones Franklin Road	I-440 to Western Boulevard, 2-Lane to 4-Lane	2020
Johnson Pond Road	US 401 to North to Bells Lake Road, 2-Lane to 3-Lane	2030
Ten-Ten Road	Holly Springs Road to Bells Lake Road, 2-Lane to 4-Lane	2030
Kit Creek Road	NC 55 to Green Level to Durham, New 4-Lane	2030
Kit Creek Road	Davis Drive to NC 54, 2-Lane to 3-Lane	2030
Green Level Road to Durham	Green Level West to Jenks Road, 2-Lane to 4-Lane	2030
Green Level Road to Durham	Green Level West to Durham County Line, 2-Lane to 4-Lane	2030
Kelly Road	Jenks Road to Old US 1, 2-Lane to 4-Lane	2030
Olive Chapel Road	Kelly Road to NC 55, 2-Lane to 4-Lane	2030
Apex Peakway	NC 55 to NC 55, 4 New Lanes	2030
Reedy Creek Road	NE Maynard Road to Harrison Avenue, 2-Lane to 3-Lane	2030
New Hope Road	Old Pool Road to Rock Quarry Road, 2-Lane to 4-Lane	2030
NC 55	NC 42 to Harnett County, 2-Lanes to 4-Lanes	2030
Bells Lake Road	Ten-Ten Road to Johnson Pond Road, 2-Lane to 4-Lane	2030
Sunset Lake Road	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
Sunset Lake Road	Hilltop-Needmore Road to Optimist Farm Road, 2-Lane to 4-Lane	2030
Creech/Jones Sausage Connector	Creech Road to Jones Sausage Road, 4 New Lanes	2030

(continued)

Table 6-1 (cont'd.)
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Rock Quarry Road	New Hope Road to Battle Bridge Road, 2-Lane to 4-Lane	2030
NC 54	NE Maynard Road to NW Maynard Road	2030
East Garner Road	Rock Quarry Road to Shotwell Road, 2-Lane to 4-Lane	2030
Bethlehem Road	Smithfield Road to Grasshopper Road, 2-Lane to 4-Lane	2030
Old Holly Springs Apex Road	Holly Springs Road to Jessi Drive, 2-Lane to 4-Lane	2030
Jessi Drive Part (NL)	Ten-Ten Road to Holly Springs Road, 2-Lane to 4-Lane	2030
Western Boulevard	Gorman Street to Avent Ferry Road, 4-Lane to 6-Lane	2030
Louis Stephens Drive Extension (Part NL)	Durham County Line to O'Kelly Chapel Road, 2-Lane to 4-Lane	2030
Dillard Drive	Jones Franklin Road to Walnut Street, 2-Lane to 4-Lane	2030
Dillard Drive	Tryon Road to Jones Franklin Road, 2-Lane to 4-Lane	2030
Eastern Parkway	US 401 to US 401, New 4-Lane	2030
Hilltop-Needmore Extension (Part NL)	NC 55 (Broad Street) to US 401 New 3-Lane	2030
Western Parkway (Fuquay Varina)	NC 55 to US 401, New 4-Lane	2030
Rock Quarry Road	Old Birch Road to New Hope Road, 2-Lane to 4-Lane	2030
Kildaire Farm Road	Ten-Ten Road to Kildaire Farm Connector, 2-Lane to 4-Lane	2030
Lake Pond Drive/Old Raleigh Road	Cary Parkway to Apex Peakway, 2-Lane to 4-Lane	2030
Penny Road	Ten-Ten Road to Holly Springs Road, 2-Lane to 4-Lane	2030
NC 55 (Main Street)	Holly Springs Road to Bobbitt Road, 2-Lane to 4-Lane	2030
Trinity Road Extension	NC 54 to Cary Town Boulevard, New 4-Lane	2030
New Rand Road	NC 50 to Old Garner Road, 2-Lanre to 4-Lane	2030
I-40 HOV/HOT Project	Durham County Line to I-440/US 1-64	2030
I-40 HOV/HOT Project	I-440/US 1/64 to Johnson County	2030
Morrisville Carpenter Road	NC 54 to Davis Drive, 2-Lane to 4-Lane	2030
Morrisville Carpenter Road	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
Holly Springs Road	Cary Parkway to Penny Road, 2-Lane to 6-Lane	2030
Holly Springs Road	Penny Road to Ten-Ten Road, 2-Lane to 6-Lane	2030
Holly Springs Road	Ten-Ten Road to Kildaire Farm Connector, 2-Lane to 6-Lane	2030
McCrimmon Parkway Extension	Townhall Drive to Louis Stevens Road, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Louis Stevens Rd. to NC 55, New 4-Lane	2030
McCrimmon Parkway Extension	NC 55 to Triangle Expressway, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Green Level to Durham to Durham County line, New 2-Lane	2030
NC 54	Cary Parkway to McCrimmon Parkway, 2-Lane to 4-Lane	2030

Source: Capital Area Metropolitan Planning Organization, 2030 Long Range Transportation Plan, September, 15, 2004
Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, FY 2006-2012 Metropolitan Transportation Improvement Program

- Widening of Morrisville Carpenter Road, NC 147, NC 54, and Ten-Ten Road.

Several of these highway improvements would compete directly with the proposed Triangle Expressway. For example, the widening of NC 55 parallel to the Expressway would affect toll road traffic by increasing free road capacity within the study area. Other new roads would complement the proposed toll road by providing better access to the toll road interchanges. Examples of complementary roads include the extension or widening of Kit Creek Road and Green Level Road.

FUTURE TRANSIT IMPROVEMENTS

Transit service providers, headways, fares and service type data were reviewed for 2010, 2015, 2020, 2025, 2030, and 2035 according to the regional long range transportation plans and transportation improvement programs. Changes to the TRM transit network models were made as necessary to reflect new information.

A regional commuter rail system, proposed by the Triangle Transit Authority, (TTA) was removed from the TRM for this study. It was part of the transit network for the preliminary study. The 28-mile system was planned to connect Chapel Hill and Durham to the Research Triangle Park. However, in August 2006, the TTA decided not to proceed with federal funding for the project. CAMPO and DCHC appointed a Joint MPO Special Transit Advisory Commission (STAC) to draft a Regional Transit Vision Plan to examine goals and objectives for investments in regional transit and make recommendations for future transit projects. With funding for the regional commuter rail project uncertain and regional transit priorities being studied by the STAC, the rail project was not included in any of the transit networks for the current study.

- **Model Year 2010** - The 2010 network was reviewed using information provided by CAMPO and information contained in the DCHC LRTP and TIP. Overall, 21 new routes were added to the regional transit network, primarily to DATA and CHT. None are in the immediate area of the Triangle Expressway.

- **Model Year 2015** - The 2015 network was updated in a similar way to the 2010 network. The 2010 network was used as a base, assuming that no routes established in 2010 would be eliminated. Thirty-two new routes were added by 2015, with the majority being operated by DATA and therefore not expected to affect Triangle Expressway traffic forecasts.

- **Model Year 2020** - The 2020 transit network included both service changes and changes to existing routes. Fifteen routes were added to the 2020 transit network, with the majority of them being operated by CHT. Two new peak period routes extending from Lillington in Harnett County to the Research Triangle Park were added by TTA. Additionally, the headways of seven routes was reduced by 50 percent.

- **Model Years 2030 and 2035** - The 2030 and 2035 transit networks include 72 additional transit routes throughout the region plus changes to headways.

TOLL STRUCTURE

As discussed in more detail in Chapter 5, the recommended toll structure includes three vehicle classes each with three payment types. Each was modeled separately for this study in order to identify traffic and revenue for each class and payment type.

VEHICLE CLASSES

Three vehicle classes are recommended in order to simplify the public's understanding of the payment system. Revenues will depend upon an appropriate vehicle identification system that is able to detect the vehicle type and match it against toll account data or records from the DMV or other agencies. The three vehicle classes are as follows;

- **Class 1, Light Vehicles** – Included in this class are automobiles, pickup trucks, passenger and service vans, sports utility vehicles, and motorcycles.

- **Class 2, Medium Vehicles** – Included in this class are single unit trucks larger than pickup trucks, passenger buses, recreational vehicles and any Class 1 vehicle that is towing a trailer. Class 2 toll rates are two times the Class 1 rates.

- **Class 3, Heavy Trucks** – Included in this class are all multi-unit vehicles with five or more axles and all oversize vehicles. Class 3 toll rates are four times the Class 1 rates.

PAYMENT TYPES

Three types of payment will be established for the collection of tolls on the Triangle Expressway. Two types will rely upon vehicle and account information provided by the customer (or other toll agencies) to the North Carolina Turnpike Authority. One type will rely upon vehicle registration

information provided by the Department of Motor Vehicles. The Authority will not collect cash payments for tolls.

Electronic Toll Collection (ETC) – This payment type involves the use of an electronic transponder or tag, which identifies the vehicle as it passes through each tolling zone and debits the user's account accordingly. ETC will be the preferred methodology for toll collection on the Expressway. ETC is considered highly reliable and is the most convenient and economical method for collecting tolls. It is expected that ETC will be strongly promoted by the North Carolina Turnpike Authority. Other types of payment will be incrementally higher as discussed below.

Registered Video (RV) – This payment type requires customers to register their vehicle license plate numbers with the Turnpike Authority in order to establish accounts. When a registered video customer uses the toll road, an image of the license plate is captured and matched against the registered video accounts, and the video account is charged for the use of the facility. Users of registered video accounts are expected to be occasional toll road users who do not wish to open an ETC account. Registered video rates are two times the ETC rates because of the higher cost associated with the video matching of the license plates.

Unregistered Video (URV) – Customers who use the Triangle Expressway but do not have an ETC or a registered video account will be processed as unregistered video accounts. An image of their license plates will be captured using video, and the Authority will attempt to identify the user via DMV records either from North Carolina or other states. URV users would receive an invoice for use of the toll road. Toll rates for unregistered video users are three times the ETC rates because of both the cost of the video capture and the cost of identifying users not in the Turnpike's database.

Toll Collection Percentages by Payment Type

Table 6-2 shows the model input assumptions of electronic toll users, registered video users and unregistered video users for each modeling year. These "input" are shown separately for passenger cars and trucks. The "input" percentages were used as a starting point to apportion the total trip matrices into theoretical market segments. Each market segment was assigned to the proposed toll road reflecting the progressively higher toll rates discussed previously. Then, the model iteratively adjusted the proportion of each market segment which would use the toll road based on the diversion analysis.

Table 6-2
Toll Collection Percentages of Total Transactions
Triangle Expressway

	Model Input Assumptions - Class 1					Model Input Assumptions - Classes 2 and 3				
Year	ETC	RV	URV	Subtotal Video	Video After Diversion Analysis	ETC	RV	URV	Subtotal Video	Video After Diversion Analysis
2011	66.3%	22.5%	11.3%	33.8%	20.8%	82.5%	14.0%	3.5%	17.5%	7.4%
2012	68.5%	21.0%	10.5%	31.5%	18.2%	85.0%	12.0%	3.0%	15.0%	5.1%
2015	73.8%	17.5%	8.8%	26.3%	14.2%	90.0%	8.0%	2.0%	10.0%	2.9%
2020	81.3%	12.5%	6.3%	18.8%	8.9%	95.0%	4.0%	1.0%	5.0%	1.0%
2025	85.0%	10.0%	5.0%	15.0%	6.9%	95.0%	4.0%	1.0%	5.0%	1.3%
2030	88.8%	7.5%	3.8%	11.3%	4.5%	95.0%	4.0%	1.0%	5.0%	1.2%
2035	88.8%	7.5%	3.8%	11.3%	4.5%	95.0%	4.0%	1.0%	5.0%	1.2%

The fifth column of Table 6-2, under each category of vehicles, shows the "output" percentages of video users, after subjecting each of these travel markets to the progressively higher toll rates discussed above. This reflects the output distribution of traffic assigned to the proposed toll facility. Since registered and unregistered video users would be subjected to considerably higher toll rates, their diversion percentages are somewhat lower than ETC users; hence, the end result proportion of video users is lower than the input assumptions. Conversely, the proportion of actual users on the Triangle Expressway with ETC will be higher than the nominal input assumptions.

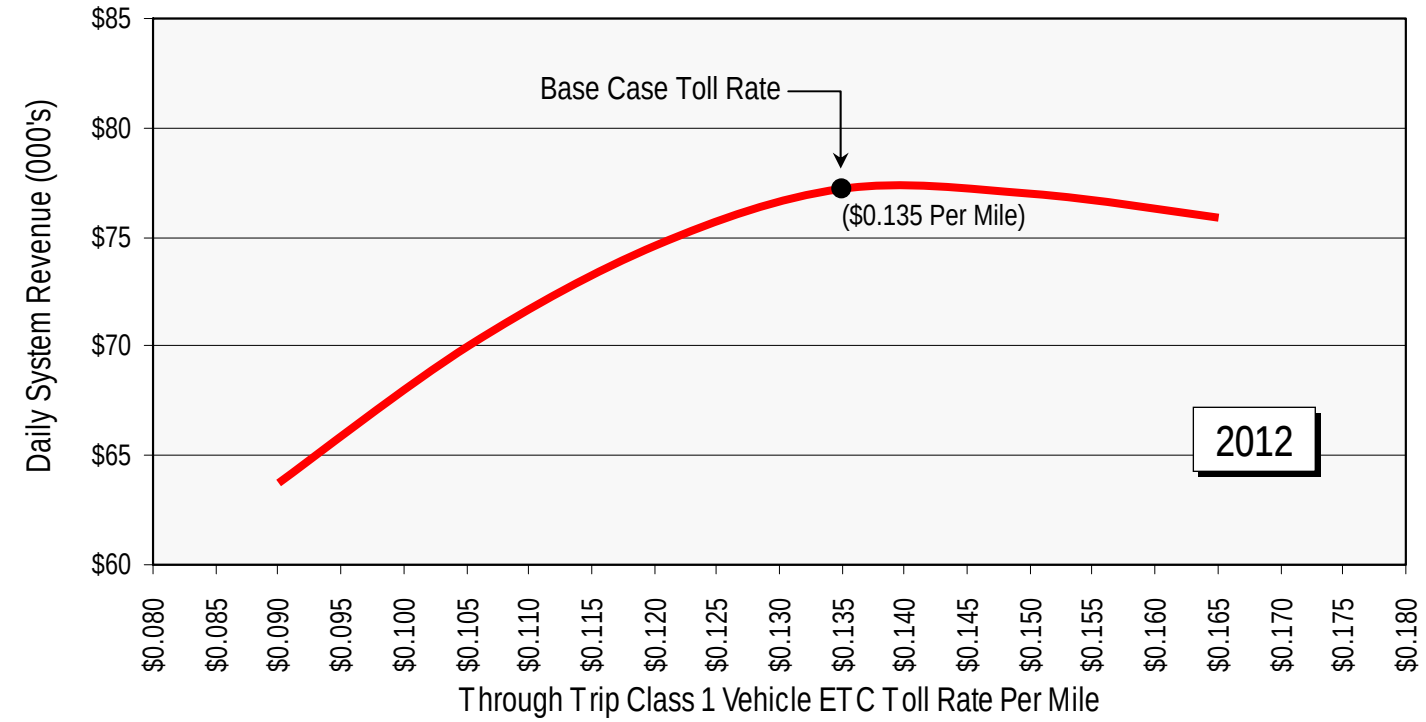
TOLL RATE SENSITIVITY

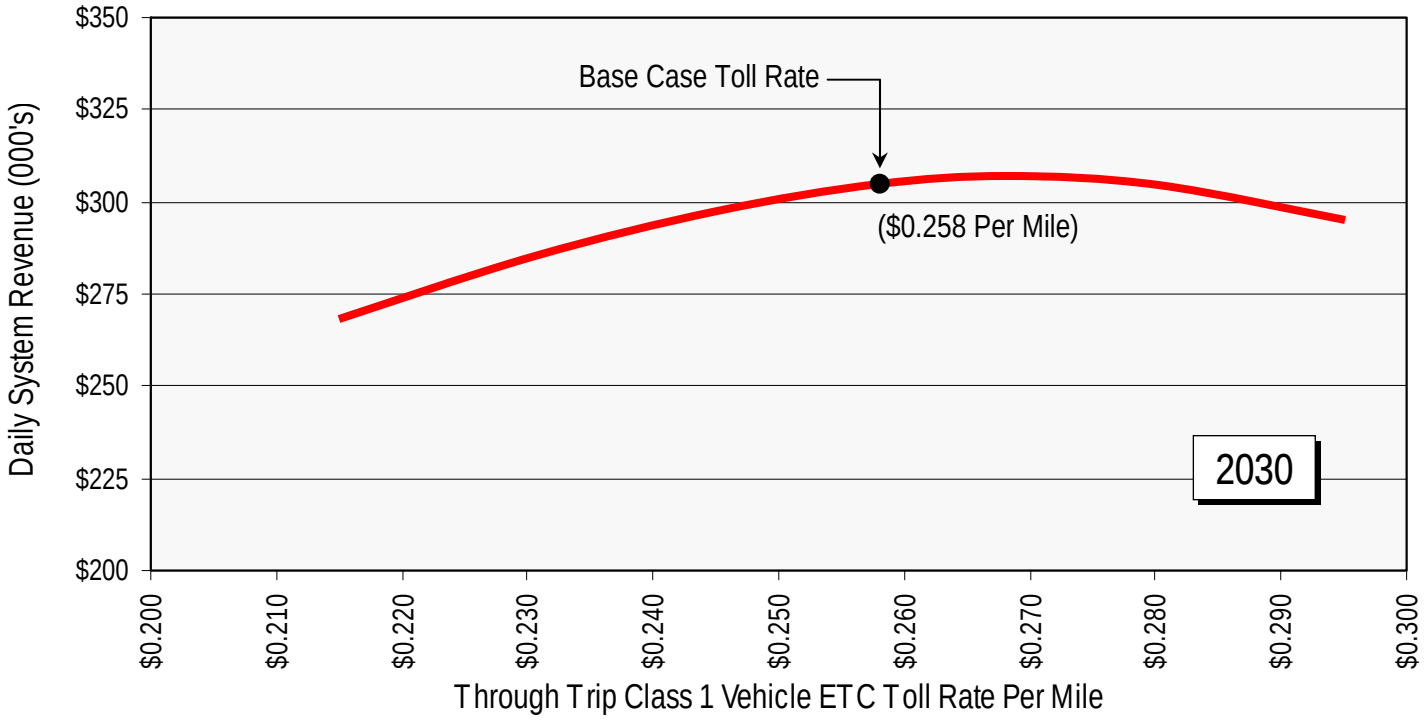
Figure 6-2 shows toll sensitivity curves for Years 2012 and 2030. Year 2012 is the first year in which the entire Triangle Expressway would be in operation, and is used to determine the optimum base case toll rate. As shown in the upper portion of the figure, the opening year base-case toll rate per mile for a Class 1 vehicle traveling from NC 55 Bypass near Holly Springs to NC 147 at RTP using ETC is approximately $0.135. Tolls would be collected, electronically, for this "through trip" as the vehicle passes each toll collection zone. Toll amounts collected in each zone would be based on the maximum length of travel supported by each toll location.

The base ETC toll rate is slightly below the rate which would maximize toll revenue. In addition to providing a limited "margin of safety," it also recognizes that tolls charged for video tolling would be higher than the base ETC rate.

By 2030, optimum toll rates would increase significantly. The toll rate shown on the curve for 2030 reflects "actual" rates in future year dollars and is not subject to additional inflation.

By 2030, the ETC base toll rate would be just over $0.258 per mile for Class 1 vehicles making a through trip using ETC. This reflects a slight increase in "real terms" as compared to the opening-year optimum toll, indicating optimum rates increase at a rate slightly greater than the nominal assumed rate of inflation. A nominal inflation rate of 2.5 percent per year was assumed for purposes of this study. Average annual toll increases over the first 18 years of the project would average about 3.6 percent per year. The increase in "real terms" is driven by the increasingly competitive position of the toll road as traffic and congestion increases on toll-free routes in the study area.





NORTH CAROLINA Turnpike Authority

ESTIMATED 2012 AND 2030
SYSTEM TOLL SENSITIVITY CURVES

FIGURE 6-2

Table 6-3 compares the toll rate for the Triangle Expressway in 2012 with current toll rates for ETC at other comparable toll road facilities. At $0.135 per mile, the Triangle Expressway ETC rates for passenger vehicles would be approximately in the mid-range of ETC rates for comparable urban toll roads. The current average is $0.141 per mile.

RECOMMENDED TOLL RATES BY LOCATION

Table 6-4 shows annual electronic toll rates for the base vehicle (Class 1 vehicles) and payment type (ETC) for each tolling zone in the opening year and extending through 2035. Since the Triangle Expressway will operate a cashless toll collection system, tolls can be increased relatively easily. In the preliminary study, tolls were assumed to be increased every five years beginning in 2015. However, in the current study, small annual increases in toll rates were assumed, rather than large increases every five years.

A Class 2 vehicle would be charged a rate double the Class 1 vehicle rate; and a Class 3 vehicle would be charged four times the Class 1 vehicle rate. Registered video and unregistered video rates would be two and three times the ETC rates, respectively.

Figure 6-3 graphically displays toll rates in opening year and 2030 at each tolling zone location for Class 1, Class 2 and Class 3 vehicles. All toll rates in Figure 6-3 reflect ETC rates; higher rates would be charged to registered and unregistered video users. The opening-year toll for a full-length trip involving four toll payments on the Triangle Expressway would be $2.40 for Class 1 vehicles, rising to $4.60 by 2030.

All rates are in future-year dollars; that is, already adjusted for inflation, which is assumed for this study to average 2.5 percent per year. The increase in tolls between the opening year and the later years of operation is slightly greater than the direct effect of inflation, reflecting both inflationary pressures and significant increases in traffic demand resulting in the need for some level of "real increase" in rates beyond inflation.

The four proposed mainline tolling zones are indicated in Figure 6-3:

- Between US 1 and NC 55 Bypass;
- Between US 64 and Old US 1;
- Between NC 55 and Green Level Road; and
- Within the interchange of the Triangle Parkway and NC 540.

Table 6-3

Comparison of Per-mile Electronic Toll Collection Rates
for Selected Urban Toll Roads In Other States
Class 1

Agency and Facility Name	Length (Miles)		ETC Toll	Cost/ Mile
Transportation Corridor Agencies - San Joaquin, Route 73	15.0	(1)	$4.25	$0.283
Transportation Corridor Agencies - Route 133	4.6		$1.25	$0.272
Miami-Dade Expressway Authority - Miami Airport Expressway - SR 112	4.2		$1.00	$0.238
Harris County Toll Road Authority - Westpark Tollway	11.0		$2.50	$0.227
Transportation Corridor Agencies - Route 261	6.6	(1)	$1.25	$0.189
Miami-Dade Expressway Authority - Gratigny Parkway - SR 924	5.4		$1.00	$0.185
Tampa-Hillsborough Expressway Authority - Lee Roy Selmon Crosstown Expressway	14.0		$2.50	$0.179
Transportation Corridor Agencies - Route 241	24.0	(1)	$4.25	$0.177
Harris County Toll Road Authority - Sam Houston Toll Road	67.0		$9.75	$0.146
Miami-Dade Expressway Authority - Don Shula (South Dade) Expressway - SR 874	7.3		$1.00	$0.137
North Carolina Turnpike Authority - Triangle Expressway (2)	**17.8**	**(2)**	**$2.40**	**$0.135**
North Texas Tollway Authority - President George Bush Turnpike (PGBT)	26.0		$3.00	$0.115
Harris County Toll Road Authority - Hardy Toll Road	21.7		$2.50	$0.115
Orlando-Orange County Expressway Authority - East-West Expressway	22.0		$2.50	$0.114
Miami-Dade Expressway Authority - East-West (Dolphin) Expressway - SR 836	11.0		$1.00	$0.091
Florida Turnpike Enterprise - Seminole Expressway (Orlando)	17.0		$1.50	$0.088
North Texas Tollway Authority - Dallas North Tollway (DNT)	21.0		$1.80	$0.086
Orlando-Orange County Expressway Authority - Central Florida Greeneway	38.0		$3.25	$0.086
Orlando-Orange County Expressway Authority - Beachline Expressway (SR 528)	24.0		$2.00	$0.083
Florida Turnpike Enterprise - Veterans Expressway (Tampa)	16.0		$1.25	$0.078
Osceola County, FL - Osceola Parkway	13.0		$1.00	$0.077
Florida Turnpike Enterprise - Sawgrass Expressway (Broward County)	20.8		$1.50	$0.072
Florida Turnpike Enterprise - Beachline (SR 528) (Orlando)	8.2		$0.50	$0.061
Average of other agencies				$0.141

(1) Tolls for peak conditions.

(2) Maximum distance from NC 147 at I-40 to NC 55 Bypass at Holly Springs.

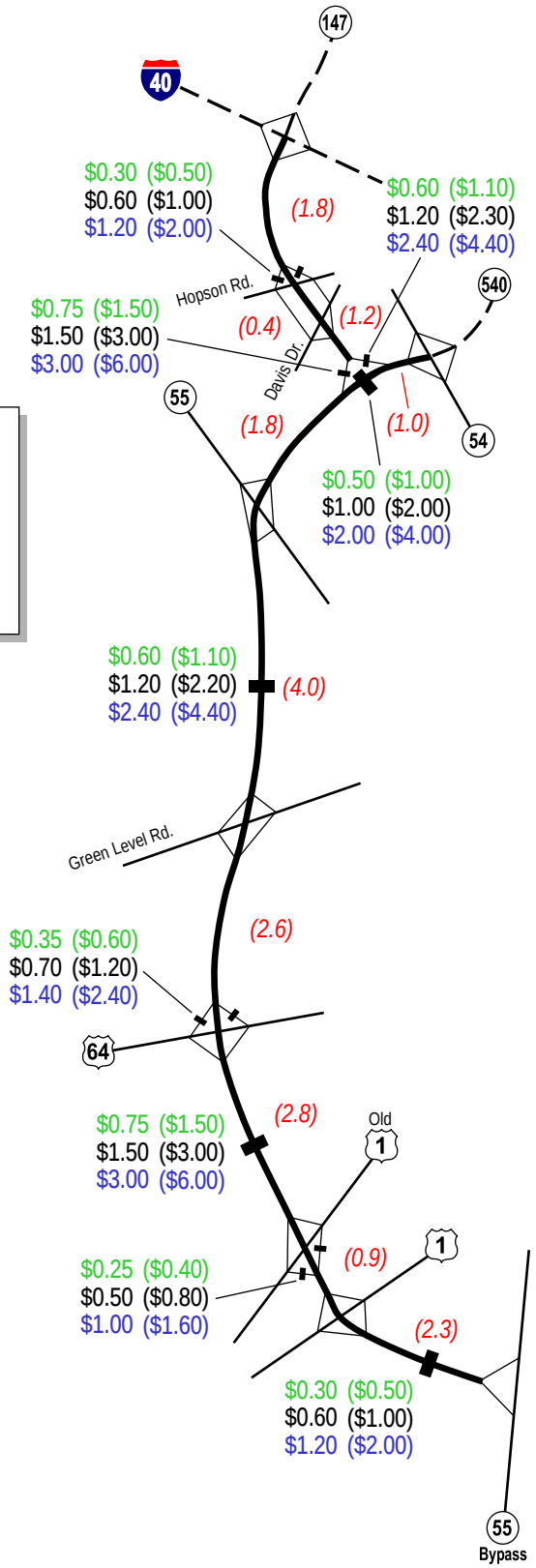
Source: Toll Agency Web Sites

Table 6-4
Recommended Annual Toll Rates by Tolling Zone
Class 1 - ETC

Year	Hopson Road/ Davis Drive Ramps	Triangle Parkway Ramp to NC 540/NC 54	Triangle Parkway Ramp to NC 540/NC 55	Mainline Zone 1: NC 540 Between Triangle Parkway	Mainline Zone 2: Between NC 55 & Green Level Road	US 64 Ramps	Mainline Zone 3: Between US 64 & Old US 1	Old US 1 Ramps	Mainline Zone 4: Between US 1 & NC 55 Bypass
2011	$0.30	$0.60	$0.75	$0.50	$0.60	$0.35	$0.75	$0.25	$0.30
2012	0.30	0.60	0.75	0.50	0.60	0.35	0.75	0.25	0.30
2013	0.31	0.63	0.79	0.53	0.63	0.36	0.79	0.26	0.31
2014	0.32	0.66	0.83	0.56	0.66	0.37	0.83	0.27	0.32
2015	0.34	0.69	0.87	0.59	0.69	0.38	0.87	0.28	0.34
2016	0.35	0.72	0.91	0.62	0.72	0.39	0.91	0.29	0.35
2017	0.36	0.74	0.96	0.64	0.74	0.40	0.96	0.30	0.36
2018	0.38	0.76	1.00	0.66	0.76	0.41	1.01	0.30	0.38
2019	0.39	0.78	1.05	0.68	0.78	0.43	1.06	0.30	0.39
2020	0.40	0.80	1.10	0.70	0.80	0.45	1.10	0.30	0.40
2021	0.41	0.83	1.14	0.73	0.83	0.47	1.14	0.31	0.41
2022	0.42	0.86	1.18	0.76	0.86	0.49	1.18	0.32	0.42
2023	0.43	0.89	1.22	0.79	0.89	0.51	1.22	0.33	0.43
2024	0.44	0.92	1.26	0.82	0.92	0.53	1.26	0.34	0.44
2025	0.45	0.95	1.30	0.85	0.95	0.55	1.30	0.35	0.45
2026	0.46	0.98	1.34	0.88	0.98	0.56	1.34	0.36	0.46
2027	0.47	1.01	1.38	0.91	1.01	0.57	1.38	0.37	0.47
2028	0.48	1.04	1.42	0.94	1.04	0.58	1.42	0.38	0.48
2029	0.49	1.07	1.46	0.97	1.07	0.59	1.46	0.39	0.49
2030	0.50	1.10	1.50	1.00	1.10	0.60	1.50	0.40	0.50
2031	0.51	1.13	1.54	1.03	1.13	0.62	1.54	0.41	0.51
2032	0.52	1.16	1.58	1.06	1.16	0.64	1.58	0.42	0.52
2033	0.53	1.19	1.62	1.09	1.19	0.66	1.62	0.43	0.53
2034	0.54	1.22	1.66	1.12	1.22	0.68	1.66	0.44	0.54
2035	0.55	1.25	1.70	1.15	1.25	0.70	1.70	0.45	0.55

Note:
Class 2 tolls are two times the Class 1 tolls.
Class 3 tolls are four times the Class 1 tolls.
Registered video toll rates are two times the electronic rate.
Unregistered video toll rates are three times the electronic rate.

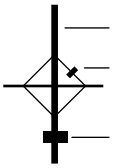
Schematic
Not To Scale



Maximum Electronic Toll in 2012

	Via Triangle Parkway		Via NC 540	
Vehicle Class	Toll	Toll Per Mile	Toll	Toll Per Mile
Class 1	$2.40	$0.135	$2.15	$0.140
Class 2	$4.80	$0.270	$4.30	$0.280
Class 3	$9.60	$0.540	$8.60	$0.560

LEGEND



Proposed Triangle Expressway
Ramp Toll Zone
Mainline Toll Zone
(0.0) Distance Between Interchanges (Miles)

2011 / 2012	2030	
$0.00	($0.00)	- Class 1
$0.00	($0.00)	- Class 2
$0.00	($0.00)	- Class 3

NORTH CAROLINA Turnpike Authority

COMPARISON OF TOLL RATE ASSUMPTIONS

FIGURE 6-3

Tolling zones would be established on ramps to and from the south on Old US 1; and to and from the north at the Hopson Road/Davis Drive Interchange and US 64. Tolling zones would be established on the ramps to and from the Triangle Parkway also. The interchanges at NC 55 Bypass near Holly Springs, NC 54 and I-40/NC 147 would not have tolling zones.

ESTIMATED WEEKDAY TRAFFIC VOLUMES

Estimates of weekday traffic volumes in the opening year are shown in Figure 6-4. The highest volume would occur between NC 55 and Green Level Road where traffic is estimated at 21,800 vehicles per day in 2012. The lowest volume would occur between US 1 and NC 55 Bypass where 14,600 vehicles per day are expected. Traffic along the Triangle Parkway between NC 540 and NC 147 is generally estimated in the range of 24,000 vehicles per day. The traffic volumes shown do not reflect downward "ramp-up" adjustments, which are incorporated later in the annual forecasts.

Figures 6-5 and 6-6 show estimated weekday traffic volumes in Year 2020 in Year 2030, respectively. 2030 is the most distant year actually modeled for purposes of the analysis. Traffic volumes in 2030 are estimated to reach 65,000 vehicles per day along one section of the project. This is well within the available capacity of the planned six-lane toll road.

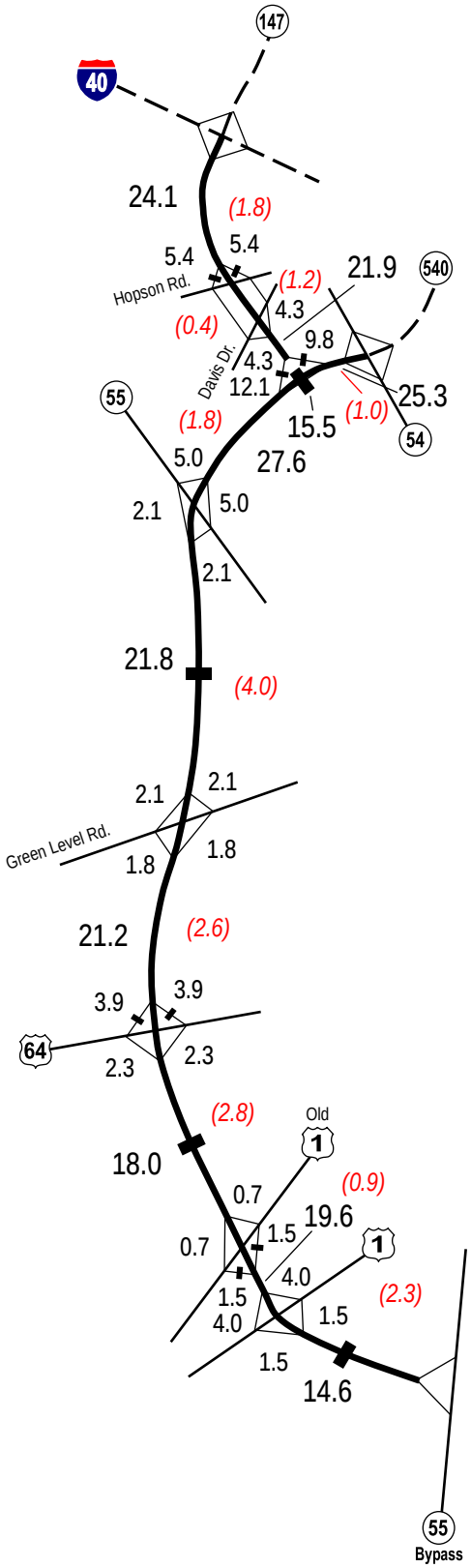
ESTIMATED ANNUAL TRAFFIC AND REVENUE

ANNUALIZATION OF 2012 WEEKDAY TRANSACTIONS AND REVENUE

Weekday traffic by vehicle class and payment type was calculated for each tolling zone and multiplied by the recommended toll to develop estimates of weekday revenue at each tolling zone. The weekday revenue estimates were then annualized. Table 6-5 shows the toll transactions and gross revenue projections by vehicle class and payment type for 2012.

Year 2012 will be the first year of full operation of the Triangle Expressway. The weekday traffic would be expected to produce about 36.2 million transactions and $24.9 million in 2012, assuming a full year of operation and no adjustment for ramp-up. This annualization is based on 319 equivalent weekdays per year, and assumes lower weekend and holiday traffic.

Schematic
Not To Scale



LEGEND

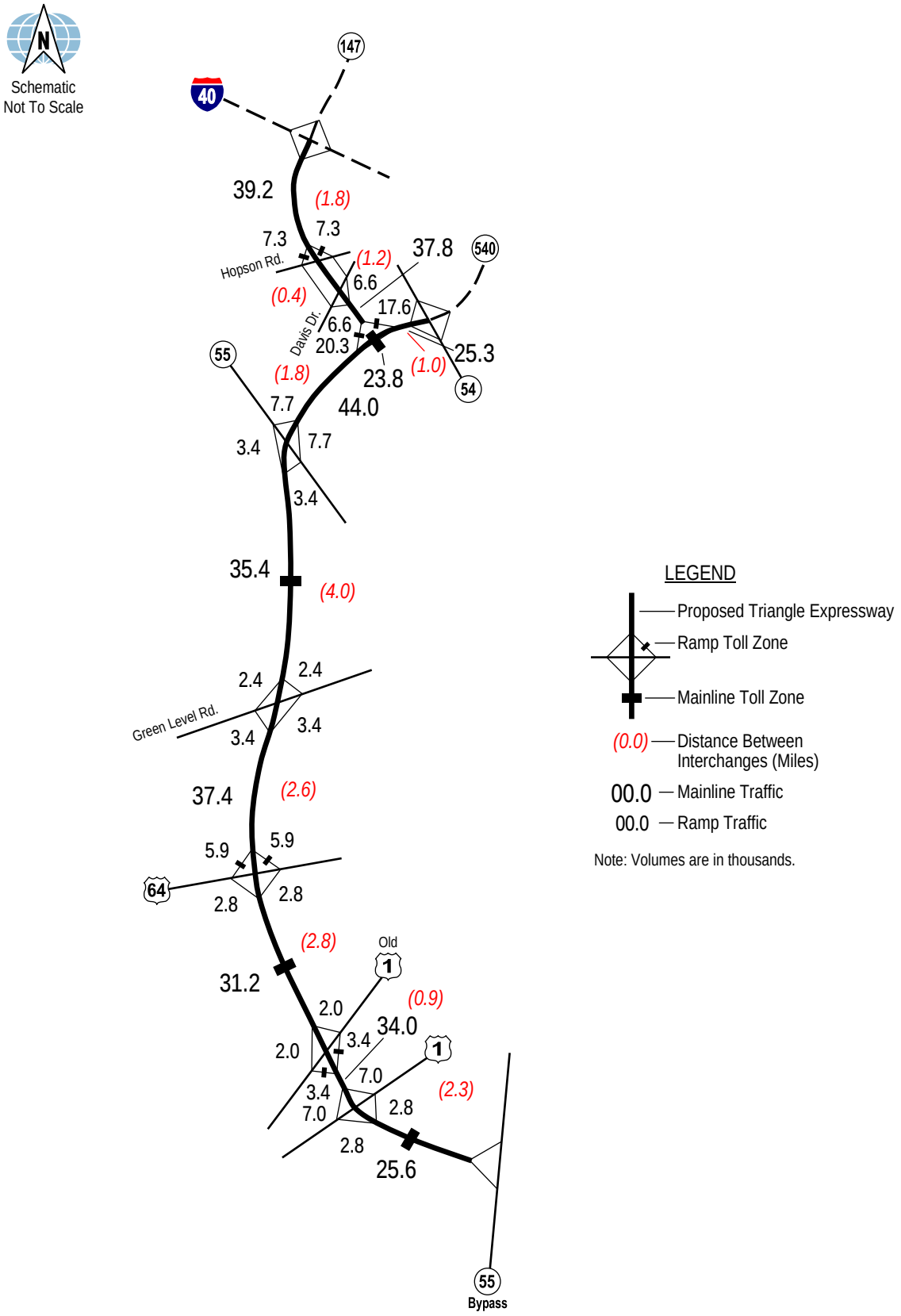
- Proposed Triangle Expressway
- Ramp Toll Zone
- Mainline Toll Zone
- (0.0) Distance Between Interchanges (Miles)
- 00.0 Mainline Traffic
- 00.0 Ramp Traffic

Note: Volumes are in thousands.

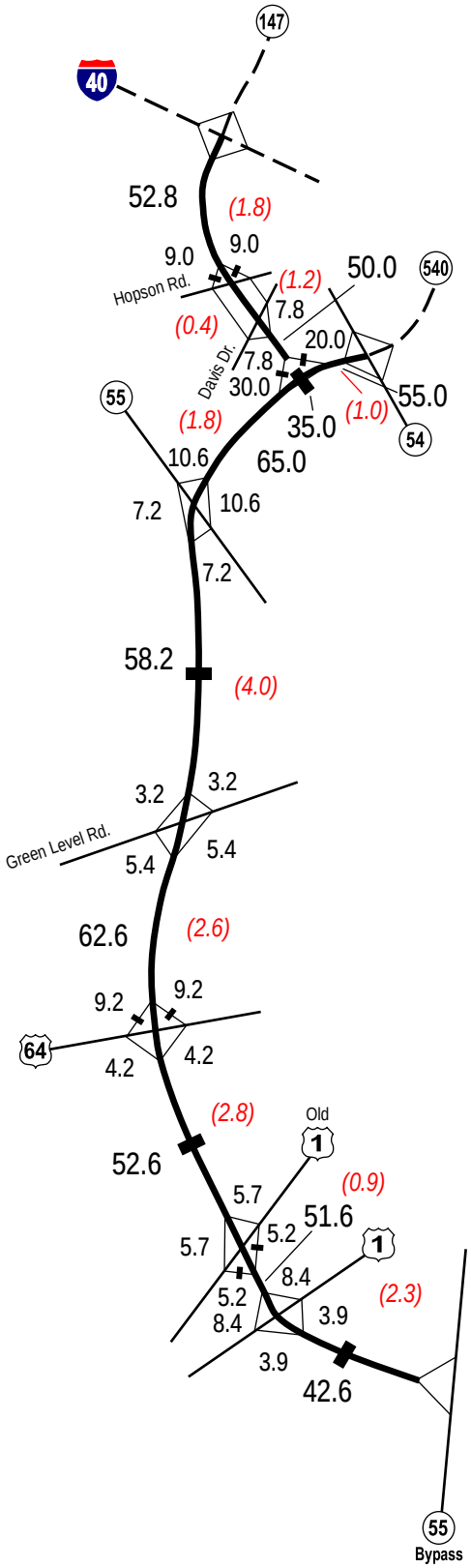
NORTH CAROLINA Turnpike Authority

ESTIMATED WEEKDAY TRAFFIC - 2012

FIGURE 6-4


N
Schematic
Not To Scale
147
40
39.2
(1.8)
7.3
7.3
Hopson Rd.
(1.2)
37.8
540
6.6
(0.4)
17.6
Davis Dr.
6.6
20.3
55
(1.8)
23.8
(1.0)
25.3
54
7.7
44.0
3.4
7.7
3.4
35.4
(4.0)
2.4
2.4
Green Level Rd.
3.4
3.4
37.4
(2.6)
5.9
5.9
64
2.8
2.8
(2.8)
Old
1
31.2
2.0
(0.9)
34.0
2.0
3.4
1
7.0
3.4
(2.3)
7.0
2.8
2.8
25.6
55
Bypass
LEGEND
Proposed Triangle Expressway
Ramp Toll Zone
Mainline Toll Zone
(0.0) Distance Between Interchanges (Miles)
00.0 Mainline Traffic
00.0 Ramp Traffic
Note: Volumes are in thousands.

Schematic
Not To Scale



LEGEND

- Proposed Triangle Expressway
- Ramp Toll Zone
- Mainline Toll Zone
- (0.0) Distance Between Interchanges (Miles)
- 00.0 Mainline Traffic
- 00.0 Ramp Traffic

Note: Volumes are in thousands.

NORTH CAROLINA Turnpike Authority

ESTIMATED WEEKDAY TRAFFIC - 2030

FIGURE 6-6

Table 6-5
Toll Transactions and Gross Toll Revenue Estimates, 2012
Triangle Expressway

	Payment Class									
	Class 1			Class 2			Class 3			
Toll Zone (Opening Year)	**ETC**	**Registered Video**	**Unregistered Video**	**ETC**	**Registered Video**	**Unregistered Video**	**ETC**	**Registered Video**	**Unregistered Video**	**Total**
					Weekday Transactions					
Hopson Road/Davis Drive Ramps (2011)	8,072	1,862	645	128	11	3	72	6	1	10,800
Triangle Parkway Ramp to NC 540/NC 54 (2011)	7,998	1,338	316	89	5	1	50	3	1	9,801
Triangle Parkway Ramp to NC 540/NC 55 (2011)	9,829	1,368	251	400	15	4	223	8	2	12,100
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps (2011)	11,682	2,389	716	434	19	5	242	11	3	15,501
Mainline Zone 2: Between NC 55 & Green Level Road (2012)	17,297	2,702	600	738	27	7	412	15	4	21,802
US 64 Ramps (2012)	6,267	979	217	204	10	2	114	5	1	7,799
Mainline Zone 3: Between US 64 & Old US 1 (2012)	13,718	2,535	679	654	26	6	365	14	4	18,001
Old US 1 Ramps (2012)	2,260	525	161	33	1	0	19	1	0	3,000
Mainline Zone 4: Between US 1 & NC 55 Bypass (2012)	11,127	2,190	647	388	17	4	216	9	2	14,600
Weekday Total Transactions	88,250	15,888	4,232	3,068	131	32	1,713	72	18	113,404
					Toll					
Hopson Road/Davis Drive Ramps (2011)	$0.30	$0.60	$0.90	$0.60	$1.20	$1.80	$1.20	$2.40	$3.60	
Triangle Parkway Ramp to NC 540/NC 54 (2011)	0.60	1.20	1.80	1.20	2.40	3.60	2.40	4.80	7.20	
Triangle Parkway Ramp to NC 540/NC 55 (2011)	0.75	1.50	2.25	1.50	3.00	4.50	3.00	6.00	9.00	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps (2011)	0.50	1.00	1.50	1.00	2.00	3.00	2.00	4.00	6.00	
Mainline Zone 2: Between NC 55 & Green Level Road (2012)	0.60	1.20	1.80	1.20	2.40	3.60	2.40	4.80	7.20	
US 64 Ramps (2012)	0.35	0.70	1.05	0.70	1.40	2.10	1.40	2.80	4.20	
Mainline Zone 3: Between US 64 & Old US 1 (2012)	0.75	1.50	2.25	1.50	3.00	4.50	3.00	6.00	9.00	
Old US 1 Ramps (2012)	0.25	0.50	0.75	0.50	1.00	1.50	1.00	2.00	3.00	
Mainline Zone 4: Between US 1 & NC 55 Bypass (2012)	0.30	0.60	0.90	0.60	1.20	1.80	1.20	2.40	3.60	
					Weekday Gross Toll Revenue					
Hopson Road/Davis Drive Ramps (2011)	$2,422	$1,117	$581	$77	$13	$5	$86	$14	$4	$4,319
Triangle Parkway Ramp to NC 540/NC 54 (2011)	4,799	1,606	569	107	12	4	120	14	7	7,238
Triangle Parkway Ramp to NC 540/NC 55 (2011)	7,372	2,052	565	600	45	18	669	48	18	11,387
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps (2011)	5,841	2,389	1,074	434	38	15	484	44	18	10,337
Mainline Zone 2: Between NC 55 & Green Level Road (2012)	10,378	3,242	1,080	886	65	25	989	72	29	16,766
US 64 Ramps (2012)	2,193	685	228	143	14	4	160	14	4	3,445
Mainline Zone 3: Between US 64 & Old US 1 (2012)	10,289	3,803	1,528	981	78	27	1,095	84	36	17,921
Old US 1 Ramps (2012)	565	263	121	17	1	0	19	2	0	988
Mainline Zone 4: Between US 1 & NC 55 Bypass (2012)	3,338	1,314	582	233	20	7	259	22	7	5,782
Weekday Total Gross Toll Revenue	$47,197	$16,471	$6,328	$3,478	$286	$105	$3,881	$314	$123	$78,183
Annualization Factor (days)										319
First Year Ramp-up Factor										0.610
Second Year Ramp-up Factor										0.813
Annual Transactions Before Ramp-up (rounded to thousands)										36,176,000
Annual Gross Toll Revenue Before Ramp-up (rounded to thousands)										$24,940,000
2012 Annual Transactions After Ramp-up (rounded to thousands) - Section Open in 2011										12,505,000
2012 Annual Transactions After Ramp-up (rounded to thousands) - Section Open in 2012										12,687,000
Total 2012 Annual Transactions After Ramp-up (rounded to thousands)										**25,192,000**
2012 Annual Revenue After Ramp-up (rounded to thousands) - Section Open in 2011										$8,634,000
2012 Annual Revenue After Ramp-up (rounded to thousands) - Section Open in 2012										8,736,000
Total 2012 Annual Revenue After Ramp-up (rounded to thousands) [1]										**$17,370,000**

[1] **Excludes Any Allowance For Uncollectible Revenue**

ADJUSTMENTS FOR RAMP-UP

The annualized transactions and revenues in Year 2012 were further adjusted to reflect "ramp-up." Ramp-up is the phenomenon experienced on most new start-up toll facilities in which high levels of growth may be experienced over the first three years or so of operation as the motoring public gradually becomes aware of the facility and begins using it.

There are a number of reasons for the "ramp-up" phenomenon. For example, not all motorists who will use the facility are from the local area, therefore it may take several months before certain travelers are aware that the roadway is there, or where it goes. It will also take several months for the project to begin appearing on new maps and for motorists to become accustomed to using the facility. The duration and level of ramp-up adjustments can be directly affected by a well-conceived promotion and signing program.

For purposes of this study, a 36-month ramp-up period was assumed. The nominal traffic and revenue estimates prepared for the opening three years are adjusted downward to reflect the time it will take to gradually build up demand. Since the Triangle Expressway is expected to open in two phases, the ramp-up factors were applied separately to each section for the first three years of operation. Table 6-6 shows the ramp-up factors and the years and locations to which they apply.

Table 6-6
Annual Ramp-up Factors

Section Opening in 2011

Year	Factor [(1)]	Tolling Zones
2011	0.610	Hopson Road/Davis Drive Ramps
2012	0.813	Triangle Parkway Ramp to NC 540/NC 54
2013	0.945	Triangle Parkway Ramp to NC 540/NC 55
2014 +	1.000	Mainline 1: NC 540 Between Triangle Parkway Ramps

Section Opening in 2012

Year	Factor [(1)]	Tolling Zones
2012	0.610	Mainline Zone 2: Between NC 55 & Green Level Road
2013	0.813	US 64 Ramps
2014	0.945	Mainline 3: Between US 64 & Old US 1
2015+	1.000	Old US 1 Ramps
		Mainline 4: Between US 1 & NC 55 Bypass

(1) Average yearly factor applied to forecast of total traffic before ramp-up.

After applying these ramp-up factors, the Triangle Expressway is estimated to produce 25.2 million transactions and $17.4 million in gross toll revenue in 2012 as shown in Table 6-5.

Annualization of 2020 and 2030 Transactions and Revenue

Tables 6-7 and 6-8 show the anticipated transactions and gross toll revenue for 2020 and 2030, respectively, based on the weekly traffic estimates contained in Figures 6-5 and 6-6. In both of these cases, no ramp-up adjustments were made.

ESTIMATED ANNUAL TOLL TRANSACTIONS AND REVENUE

Annual Transactions

Estimated annual toll transactions by vehicle class and year are shown in Table 6-9 and in Figure 6-7. Annual transactions are expected to increase from about 25.2 million in 2012, the first full year of operation of the entire Expressway, to 86 million by 2030. Traffic estimates for 2011 through 2014 were adjusted downward to reflect the impact of successive three year ramp-up periods as discussed above and shown in Table 6-6.

Electronic toll transactions are expected to be the largest proportion of users and are estimated to increase from about 77 percent in the opening year to nearly 96 percent by about 2030. Note that transaction estimates through 2030 are based on a detailed modeling analysis. Growth between 2030 and 2035 was based on a review of modeled growth between 2025 and 2035. Subsequent to 2035, nominal system-wide growth rates were applied. Transactions were assumed to grow at 1.5 percent per year through 2040, and at 1 percent per year through 2050.

Annual Toll Revenue

Annual revenue estimates are provided in Table 6-10 and illustrated in Figure 6-7. Revenue estimates are presented for each vehicles class by payment type. The total annual gross revenue is expected to increase from about $17.4 million in 2012 to more than $97.3 million by 2030. This reflects the impact of both traffic growth and periodic toll adjustments. Again, revenue estimates during the first four years of operation were adjusted to reflect a progressive ramp-up pattern.

Electronic tolls are expected to account for generally between 70 and 92 percent of total revenue. This is a slightly lower percentage than the proportion of transactions, but reflects the fact that video users are assessed a significant premium toll charge.

Table 6-7
Toll Transactions and Gross Toll Revenue Estimates, 2020
Triangle Expressway

Toll Zone	Class 1 ETC	Class 1 Registered Video	Class 1 Unregistered Video	Class 2 ETC	Class 2 Registered Video	Class 2 Unregistered Video	Class 3 ETC	Class 3 Registered Video	Class 3 Unregistered Video	Total
Hopson Road/Davis Drive Ramps	12,243	1,416	443	314	4	1	175	2	1	14,599
Triangle Parkway Ramp to NC 540/NC 54	15,733	1,176	266	269	3	1	150	2	0	17,600
Triangle Parkway Ramp to NC 540/NC 55	18,001	1,090	150	613	2	1	342	1	0	20,200
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	20,355	1,864	497	684	9	2	382	5	1	23,799
Mainline Zone 2: Between NC 55 & Green Level Road	31,149	2,105	380	1,123	8	2	626	4	1	35,398
US 64 Ramps	10,393	747	180	304	3	1	169	2	0	11,799
Mainline Zone 3: Between US 64 & Old US 1	27,061	2,094	457	1,011	7	2	564	4	1	31,201
Old US 1 Ramps	5,798	666	217	74	2	0	41	1	0	6,799
Mainline Zone 4: Between US 1 & NC 55 Bypass	22,052	2,039	560	604	4	1	337	2	1	25,600
Weekday Total Transactions	162,785	13,197	3,150	4,996	42	11	2,786	23	5	186,995
Toll										
Hopson Road/Davis Drive Ramps	$0.40	$0.80	$1.20	$0.80	$1.60	$2.40	$1.60	$3.20	$4.80	
Triangle Parkway Ramp to NC 540/NC 54	0.80	1.60	2.40	1.60	3.20	4.80	3.20	6.40	9.60	
Triangle Parkway Ramp to NC 540/NC 55	1.10	2.20	3.30	2.20	4.40	6.60	4.40	8.80	13.20	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	0.70	1.40	2.10	1.40	2.80	4.20	2.80	5.60	8.40	
Mainline Zone 2: Between NC 55 & Green Level Road	0.80	1.60	2.40	1.60	3.20	4.80	3.20	6.40	9.60	
US 64 Ramps	0.45	0.90	1.35	0.90	1.80	2.70	1.80	3.60	5.40	
Mainline Zone 3: Between US 64 & Old US 1	1.10	2.20	3.30	2.20	4.40	6.60	4.40	8.80	13.20	
Old US 1 Ramps	0.30	0.60	0.90	0.60	1.20	1.80	1.20	2.40	3.60	
Mainline Zone 4: Between US 1 & NC 55 Bypass	0.40	0.80	1.20	0.80	1.60	2.40	1.60	3.20	4.80	
Weekday Gross Toll Revenue										
Hopson Road/Davis Drive Ramps	$4,897	$1,133	$532	$251	$6	$2	$280	$6	$5	$7,112
Triangle Parkway Ramp to NC 540/NC 54	12,586	1,882	638	430	10	5	480	13	0	16,044
Triangle Parkway Ramp to NC 540/NC 55	19,801	2,398	495	1,349	9	7	1,505	9	0	25,573
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	14,249	2,610	1,044	958	25	8	1,070	28	8	20,000
Mainline Zone 2: Between NC 55 & Green Level Road	24,919	3,368	912	1,797	26	10	2,003	26	10	33,071
US 64 Ramps	4,677	672	243	274	5	3	304	7	0	6,185
Mainline Zone 3: Between US 64 & Old US 1	29,767	4,607	1,508	2,224	31	13	2,482	35	13	40,680
Old US 1 Ramps	1,739	400	195	44	2	0	49	2	0	2,431
Mainline Zone 4: Between US 1 & NC 55 Bypass	8,821	1,631	672	483	6	2	539	6	5	12,165
Weekday Total Gross Toll Revenue	$121,456	$18,701	$6,239	$7,810	$120	$50	$8,712	$132	$41	$163,261
Annualization Factor (days)										319
Annual Transactions (rounded to thousands)										59,654,000
Annual Gross Toll Revenue (rounded to thousands) (1)										$52,086,000

(1) EXCLUDES ANY ALLOWANCE FOR UNCOLLECTIBLE REVENUE

Table 6-8
Toll Transactions and Gross Toll Revenue Estimates, 2030
Triangle Expressway

Toll Zone	Payment Class									Total
	Class 1			Class 2			Class 3			
	ETC	Registered Video	Unregistered Video	ETC	Registered Video	Unregistered Video	ETC	Registered Video	Unregistered Video	
Hopson Road/Davis Drive Ramps	15,130	917	275	423	10	2	236	5	1	16,999
Triangle Parkway Ramp to NC 540/NC 54	17,534	711	154	317	4	1	177	2	1	18,901
Triangle Parkway Ramp to NC 540/NC 55	26,947	726	91	660	5	1	368	3	1	28,802
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	30,211	1,297	309	815	7	2	455	4	1	33,101
Mainline Zone 2: Between NC 55 & Green Level Road	50,995	1,556	242	1,342	8	2	748	5	1	54,899
US 64 Ramps	16,147	595	132	334	3	1	186	1	0	17,399
Mainline Zone 3: Between US 64 & Old US 1	45,833	1,607	315	1,238	8	2	691	4	1	49,699
Old US 1 Ramps	9,006	478	173	90	2	0	50	1	0	9,800
Mainline Zone 4: Between US 1 & NC 55 Bypass	36,994	1,624	438	665	3	1	371	2	0	40,098
Weekday Total Transactions	248,797	9,511	2,129	5,884	50	12	3,282	27	6	269,698
	Toll									
Hopson Road/Davis Drive Ramps	$0.50	$1.00	$1.50	$1.00	$2.00	$3.00	$2.00	$4.00	$6.00	
Triangle Parkway Ramp to NC 540/NC 54	1.10	2.20	3.30	2.20	4.40	6.60	4.40	8.80	13.20	
Triangle Parkway Ramp to NC 540/NC 55	1.50	3.00	4.50	3.00	6.00	9.00	6.00	12.00	18.00	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	1.00	2.00	3.00	2.00	4.00	6.00	4.00	8.00	12.00	
Mainline Zone 2: Between NC 55 & Green Level Road	1.10	2.20	3.30	2.20	4.40	6.60	4.40	8.80	13.20	
US 64 Ramps	0.60	1.20	1.80	1.20	2.40	3.60	2.40	4.80	7.20	
Mainline Zone 3: Between US 64 & Old US 1	1.50	3.00	4.50	3.00	6.00	9.00	6.00	12.00	18.00	
Old US 1 Ramps	0.40	0.80	1.20	0.80	1.60	2.40	1.60	3.20	4.80	
Mainline Zone 4: Between US 1 & NC 55 Bypass	0.50	1.00	1.50	1.00	2.00	3.00	2.00	4.00	6.00	
	Weekday Gross Toll Revenue									
Hopson Road/Davis Drive Ramps	$7,565	$917	$413	$423	$20	$6	$472	$20	$6	$9,842
Triangle Parkway Ramp to NC 540/NC 54	19,287	1,564	508	697	18	7	779	18	13	22,891
Triangle Parkway Ramp to NC 540/NC 55	40,421	2,178	410	1,980	30	9	2,208	36	18	47,290
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	30,211	2,594	927	1,630	28	12	1,820	32	12	37,266
Mainline Zone 2: Between NC 55 & Green Level Road	56,095	3,423	799	2,952	35	13	3,291	44	13	66,665
US 64 Ramps	9,688	714	238	401	7	4	446	5	0	11,503
Mainline Zone 3: Between US 64 & Old US 1	68,750	4,821	1,418	3,714	48	18	4,146	48	18	82,981
Old US 1 Ramps	3,602	382	208	72	3	0	80	3	0	4,350
Mainline Zone 4: Between US 1 & NC 55 Bypass	18,497	1,624	657	665	6	3	742	8	0	22,202
Weekday Total Gross Toll Revenue	$254,116	$18,217	$5,578	$12,534	$195	$72	$13,984	$214	$80	$304,990
Annualization Factor (days)										319
Annual Transactions (rounded to thousands)										86,035,000
Annual Gross Toll Revenue (rounded to thousands) [1]										$97,290,000

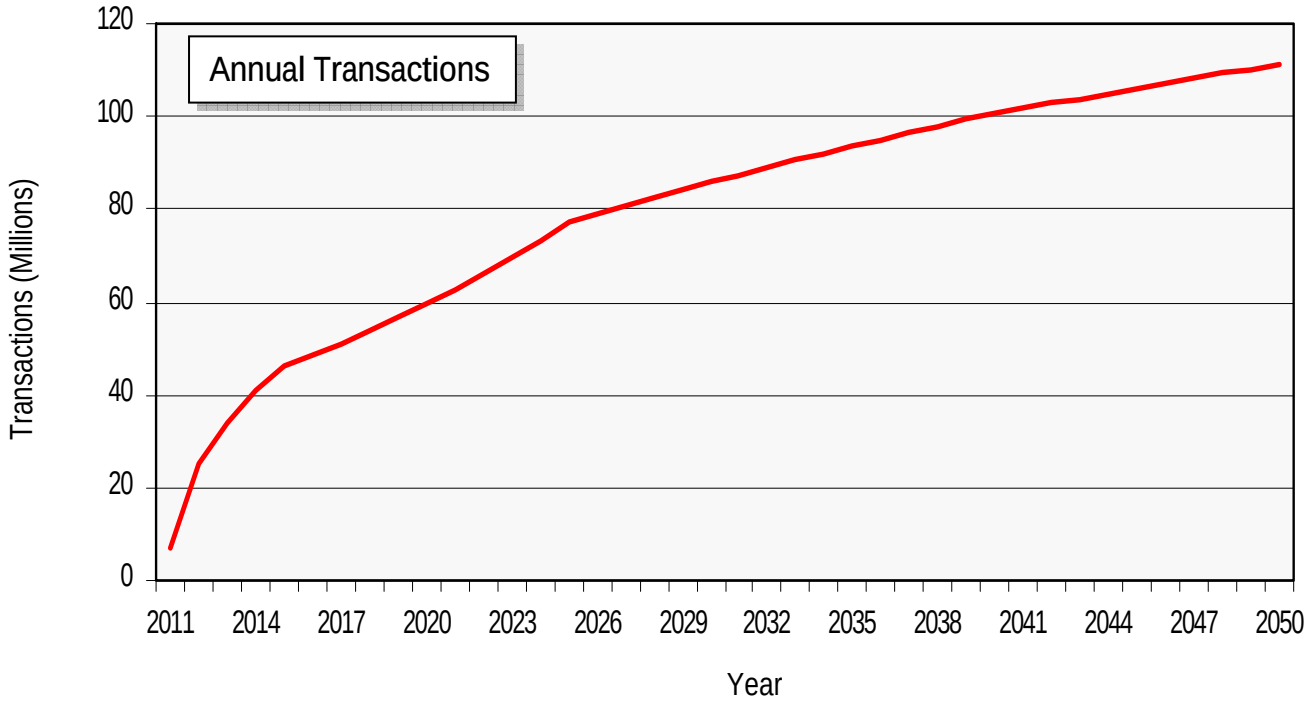
[1] **EXCLUDES ANY ALLOWANCE FOR UNCOLLECTIBLE REVENUE**

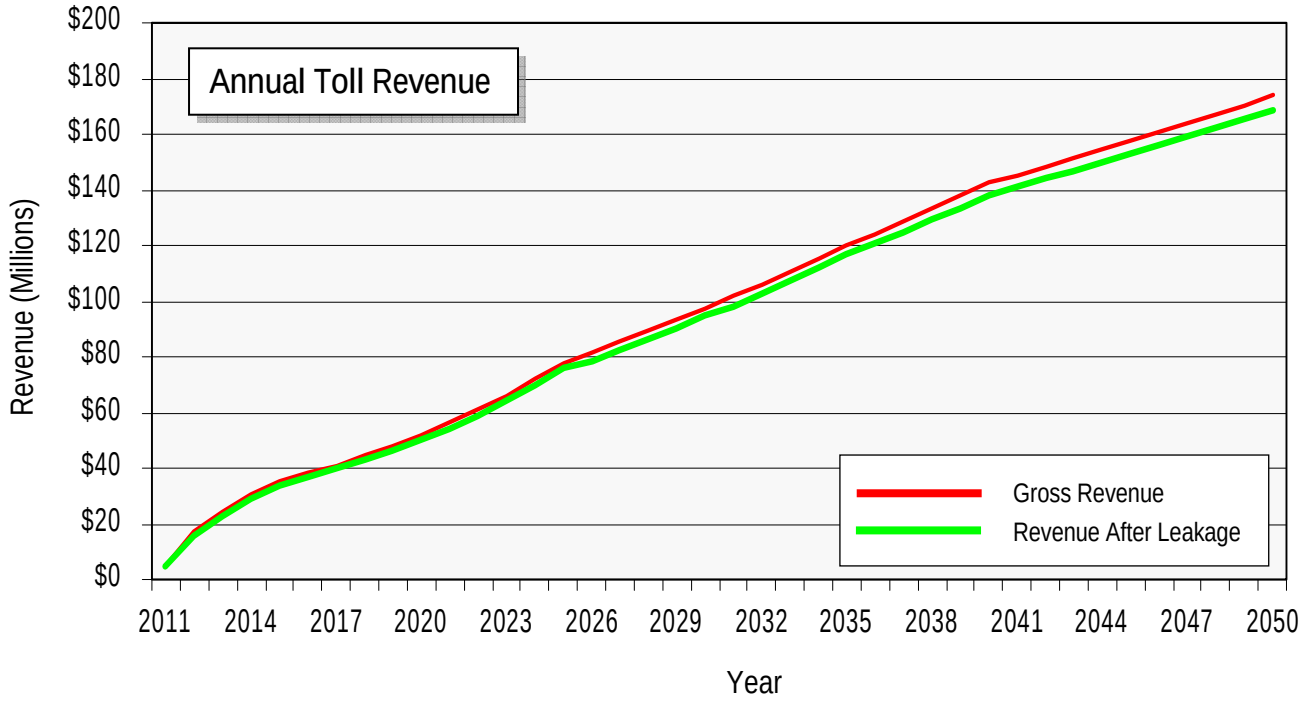
Table 6-9
Annual Toll Transactions
Triangle Expressway
(Thousands)

	Class 1				Class 2				Class 3					
Year	ETC	Registered Video	Unregistered Video	Total Class 1	ETC	Registered Video	Unregistered Video	Total Class 2	ETC	Registered Video	Unregistered Video	Total Class 3	Total Transactions	Percent ETC
2011 [(1)]	5,045	1,151	362	6,558	113	10	2	125	63	5	1	69	6,752	77.3%
2012 [(2)]	19,610	3,543	948	24,101	665	28	7	700	371	16	4	391	25,192	82.0%
2013	26,965	4,379	1,144	32,488	922	33	8	963	514	18	5	537	33,988	83.6%
2014	33,156	4,845	1,237	39,238	1,136	33	8	1,177	633	19	5	657	41,072	85.0%
2015	37,852	4,982	1,247	44,081	1,294	32	8	1,334	722	18	4	744	46,159	86.4%
2016	40,312	4,815	1,193	46,320	1,349	27	7	1,383	752	15	4	771	48,474	87.5%
2017	42,937	4,655	1,142	48,734	1,406	22	6	1,434	784	13	3	800	50,968	88.5%
2018	45,740	4,501	1,094	51,335	1,466	19	5	1,490	817	11	3	831	53,656	89.5%
2019	48,733	4,352	1,048	54,133	1,528	16	4	1,548	852	9	2	863	56,544	90.4%
2020	51,929	4,210	1,005	57,144	1,594	14	3	1,611	889	8	2	899	59,654	91.2%
2021	55,161	4,031	982	60,174	1,616	15	4	1,635	901	8	2	911	62,720	92.0%
2022	58,617	3,861	959	63,437	1,639	17	4	1,660	914	9	2	925	66,022	92.7%
2023	62,314	3,701	939	66,954	1,662	18	5	1,685	927	10	3	940	69,579	93.3%
2024	66,268	3,550	919	70,737	1,686	21	5	1,712	940	11	3	954	73,403	93.9%
2025	70,499	3,407	901	74,807	1,711	23	6	1,740	954	13	3	970	77,517	94.4%
2026	72,167	3,326	849	76,342	1,742	21	5	1,768	972	12	3	987	79,097	94.7%
2027	73,886	3,248	801	77,935	1,775	20	5	1,800	990	11	3	1,004	80,739	94.9%
2028	75,658	3,174	757	79,589	1,808	18	5	1,831	1,008	10	3	1,021	82,441	95.2%
2029	77,484	3,103	717	81,304	1,842	17	4	1,863	1,027	9	2	1,038	84,205	95.4%
2030	79,367	3,034	679	83,080	1,877	16	4	1,897	1,047	9	2	1,058	86,035	95.6%
2031	80,713	3,085	690	84,488	1,909	16	4	1,929	1,065	9	2	1,076	87,493	95.6%
2032	82,084	3,136	701	85,921	1,942	16	4	1,962	1,083	9	2	1,094	88,977	95.7%
2033	83,480	3,188	712	87,380	1,975	16	4	1,995	1,101	9	2	1,112	90,487	95.7%
2034	84,902	3,241	724	88,867	2,009	17	4	2,030	1,120	9	2	1,131	92,028	95.7%
2035	86,349	3,295	736	90,380	2,043	17	4	2,064	1,139	9	2	1,150	93,594	95.7%
2036	87,644	3,344	747	91,735	2,074	17	4	2,095	1,156	10	2	1,168	94,998	95.7%
2037	88,959	3,394	758	93,111	2,105	17	4	2,126	1,174	10	2	1,186	96,423	95.7%
2038	90,293	3,445	769	94,507	2,137	18	4	2,159	1,191	10	2	1,203	97,869	95.7%
2039	91,647	3,497	781	95,925	2,169	18	4	2,191	1,209	10	3	1,222	99,338	95.7%
2040	93,022	3,549	793	97,364	2,201	18	5	2,224	1,227	10	3	1,240	100,828	95.7%
2041	93,952	3,585	801	98,338	2,223	18	5	2,246	1,240	10	3	1,253	101,837	95.7%
2042	94,892	3,621	809	99,322	2,245	19	5	2,269	1,252	10	3	1,265	102,856	95.7%
2043	95,841	3,657	817	100,315	2,268	19	5	2,292	1,265	10	3	1,278	103,885	95.7%
2044	96,799	3,693	825	101,317	2,291	19	5	2,315	1,277	11	3	1,291	104,923	95.7%
2045	97,767	3,730	833	102,330	2,313	19	5	2,337	1,290	11	3	1,304	105,971	95.7%
2046	98,745	3,768	841	103,354	2,337	19	5	2,361	1,303	11	3	1,317	107,032	95.7%
2047	99,732	3,805	850	104,387	2,360	20	5	2,385	1,316	11	3	1,330	108,102	95.7%
2048	100,729	3,843	858	105,430	2,384	20	5	2,409	1,329	11	3	1,343	109,182	95.7%
2049	101,737	3,882	867	106,486	2,407	20	5	2,432	1,342	11	3	1,356	110,274	95.7%
2050	102,754	3,921	876	107,551	2,431	20	5	2,456	1,356	11	3	1,370	111,377	95.7%

[(1)] Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54.
[(2)] Full project open.

Note: Forecasts for 2011 - 2013 reflect an assumed ramp-up to full traffic volumes beginning in 2014 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for 2012 - 2014 reflect an assumed ramp-up to full traffic volumes beginning in 2015 for Western Wake Freeway.





NORTH CAROLINA Turnpike Authority

ANNUAL TOLL
TRANSACTIONS AND REVENUE

FIGURE 6-7

Table 6-10
Annual Gross Toll Revenue
Triangle Expressway
(Thousands)

Year	Class 1 ETC	Class 1 Registered Video	Class 1 Unregistered Video	Total Class 1	Class 2 ETC	Class 2 Registered Video	Class 2 Unregistered Video	Total Class 2	Class 3 ETC	Class 3 Registered Video	Class 3 Unregistered Video	Total Class 3	Total Gross Revenue [3]	Percent ETC
2011 [1]	$2,705	$1,200	$549	$4,454	$132	$21	$8	$161	$147	$24	$9	$180	$4,795	62.2%
2012 [2]	10,509	3,670	1,412	15,591	756	62	23	841	843	69	26	938	17,370	69.7%
2013	15,175	4,761	1,779	21,715	1,097	74	28	1,199	1,223	83	31	1,337	24,251	72.1%
2014	19,536	5,510	2,001	27,047	1,412	79	30	1,521	1,575	88	33	1,696	30,264	74.4%
2015	23,375	5,934	2,101	31,410	1,683	78	29	1,790	1,877	87	33	1,997	35,197	76.5%
2016	25,974	5,966	2,087	34,027	1,828	68	26	1,922	2,039	76	28	2,143	38,092	78.3%
2017	28,760	5,977	2,065	36,802	1,980	59	22	2,061	2,208	66	25	2,299	41,162	80.0%
2018	31,834	5,991	2,048	39,873	2,142	52	19	2,213	2,389	57	22	2,468	44,554	81.6%
2019	35,178	5,988	2,022	43,188	2,315	45	17	2,377	2,582	50	19	2,651	48,216	83.1%
2020	38,745	5,966	1,991	46,702	2,491	39	15	2,545	2,779	44	16	2,839	52,086	84.5%
2021	42,751	5,950	2,030	50,731	2,621	45	17	2,683	2,923	50	19	2,992	56,406	85.6%
2022	47,130	5,931	2,070	55,131	2,754	52	20	2,826	3,072	58	22	3,152	61,109	86.7%
2023	51,918	5,909	2,111	59,938	2,891	61	23	2,975	3,224	68	25	3,317	66,230	87.6%
2024	57,151	5,884	2,152	65,187	3,032	71	27	3,130	3,381	79	30	3,490	71,807	88.5%
2025	62,870	5,857	2,195	70,922	3,176	83	31	3,290	3,542	92	35	3,669	77,881	89.4%
2026	66,230	5,852	2,103	74,185	3,330	78	29	3,437	3,714	87	32	3,833	81,455	90.0%
2027	69,724	5,845	2,015	77,584	3,489	73	27	3,589	3,891	81	31	4,003	85,176	90.5%
2028	73,356	5,836	1,932	81,124	3,653	69	26	3,748	4,075	77	29	4,181	89,053	91.1%
2029	77,134	5,825	1,853	84,812	3,823	65	24	3,912	4,264	72	27	4,363	93,087	91.5%
2030	81,063	5,812	1,778	88,653	3,999	61	23	4,083	4,460	68	26	4,554	97,290	92.0%
2031	84,659	6,066	1,855	92,580	4,178	64	24	4,266	4,659	71	27	4,757	101,603	92.0%
2032	88,356	6,328	1,934	96,618	4,361	67	25	4,453	4,864	74	28	4,966	106,037	92.0%
2033	92,155	6,597	2,015	100,767	4,550	69	26	4,645	5,075	77	29	5,181	110,593	92.0%
2034	96,061	6,874	2,098	105,033	4,745	72	27	4,844	5,291	81	30	5,402	115,279	92.0%
2035	100,075	7,158	2,183	109,416	4,944	75	28	5,047	5,514	84	31	5,629	120,092	92.0%
2036	103,577	7,408	2,260	113,245	5,117	78	29	5,224	5,707	87	33	5,827	124,296	92.0%
2037	107,203	7,667	2,339	117,209	5,296	80	30	5,406	5,907	90	34	6,031	128,646	92.0%
2038	110,955	7,936	2,421	121,312	5,482	83	31	5,596	6,114	93	35	6,242	133,150	92.0%
2039	114,838	8,214	2,506	125,558	5,674	86	32	5,792	6,328	96	36	6,460	137,810	92.0%
2040	118,857	8,501	2,593	129,951	5,872	89	33	5,994	6,549	100	37	6,686	142,631	92.0%
2041	121,234	8,671	2,645	132,550	5,990	91	34	6,115	6,680	102	38	6,820	145,485	92.0%
2042	123,659	8,844	2,698	135,201	6,110	93	35	6,238	6,814	104	39	6,957	148,396	92.0%
2043	126,132	9,021	2,752	137,905	6,232	95	36	6,363	6,950	106	40	7,096	151,364	92.0%
2044	128,655	9,202	2,807	140,664	6,356	97	36	6,489	7,089	108	40	7,237	154,390	92.0%
2045	131,228	9,386	2,863	143,477	6,483	99	37	6,619	7,231	110	41	7,382	157,478	92.0%
2046	133,853	9,574	2,920	146,347	6,613	100	38	6,751	7,375	112	42	7,529	160,627	92.0%
2047	136,530	9,765	2,979	149,274	6,745	102	38	6,885	7,523	114	43	7,680	163,839	92.0%
2048	139,260	9,960	3,038	152,258	6,880	105	39	7,024	7,673	117	44	7,834	167,116	92.0%
2049	142,046	10,160	3,099	155,305	7,018	107	40	7,165	7,827	119	45	7,991	170,461	92.0%
2050	144,886	10,363	3,161	158,410	7,158	109	41	7,308	7,983	121	45	8,149	173,867	92.0%

Note: Forecasts for 2011 - 2013 reflect an assumed ramp-up to full traffic volumes beginning in 2014 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for 2012 - 2014 reflect an assumed ramp-up to full traffic volumes beginning in 2015 for Western Wake Freeway.

(1) Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54.

(2) Full project open.

(3) Excludes Any Allowance For Uncollectible Revenue

REVENUE LEAKAGE

Revenue leakage can be a significant issue if the toll system design and agency's operational policies and procedures are not adequate to minimize the potential for shrinkage. During the initial years (early 1990s) of ETC in the industry, the issue of revenue leakage was greater that today due to the implementation of then cutting edge technology that did not provide high performance accuracies. In recent years, ETC subsystems have become much more robust and video technology is now a proven technology.

The system being developed for the Triangle Expressway is an adaptation of two toll collection systems: ORT using ETC supplemented by automated video capture that would serve both as a primary collection system for some accounts and as a violation enforcement system for the open road tolling system.

The lane-level hardware required for implementing ORT and video enforcement/toll collection includes vehicle mounted transponders, overhead antennas, and roadside equipment such as readers, controllers, transmission equipment, electrical circuit protection and distribution, vehicle detection trigger devices, cameras, and supplemental lighting, as well as image processors and transmission equipment housed in an environmentally controlled roadside cabinet. Taken together with the necessary software and procedures, an open road tolling collection system can be quite complex and can result in lost revenue unless appropriate technology is used and procedures followed.

The accuracy of ETC and video equipment is key to the success of an open road toll collection system. The ETC equipment accuracy is quoted by vendors at between 99.95 and 99.99 percent. Video capture rates are quoted by vendors in the 96 to 98 percent range for non-obscured plates. These rates are not achieved in practice and are dependent for example, on proper transponder installation for vehicles as well as proper lane and tolling zone configurations. For this analysis, the accuracy rates were discounted by 10 percent to reflect field conditions.

Even though the accuracy rates for ETC and Video Tolling are very high, there remains some percentage of system failures that the agency will need to anticipate and prepare for in order to achieve as much revenue as possible. The largest numbers of toll customers are expected to use ETC technology. If the ETC system fails to capture an ETC transaction, the video system will be available for backup processing. Within the video system, both an automatic and a manual process can be implemented in order to accurately identify vehicles and process transactions.

Uncollectible revenue was estimated for three account types: ETC, Registered Video (RV), and Unregistered Video (URV). For the latter category, Unregistered Video, it was assumed that the NCTA will treat the vehicles in this category as potential customers for a reasonable time period before they are deemed to be violations. The system will identify as many of these potential customers as possible and receive payments from some, however a number of the URV are expected to remain unidentified due to unreadable or out-of-state license plates.

No system can collect payment on all accounts. Therefore allowances for "bad" accounts by payment type were included and assumed to decrease over a three-year ramp-up/familiarization period.

By definition, the Unregistered Video category would be unknown to the NCTA, and thus collection would be harder for this customer category. This category would contain the one-time, out-of-state users, occasional users, and others who for whatever reason did not chose to register with the NCTA. Enforcement is the key factor for this category.

Enforcement methods that the agency may employ could include, for example, annual registration holds on identified vehicles, police enforcement on the toll road itself, vehicle profiling, interstate DMV reciprocity, interagency reciprocity, and aggressive collection efforts for egregious violators. However, as stated above, for this analysis it is assumed that some URV users would remain unidentified, therefore, a lower collection rate was assumed for this payment category

The overall rates of transactions for which payment is not expected are summarized in Table 6-11 for the three payment types for Class 1 vehicles for the first three ramp-up years and for Year 4 onward. The rates ETC gradually reduce from 9.1 percent in Year 1 to 3.1 percent beginning in Year 4. The Registered Video rates are higher than ETC rates because of the expected lower accuracy level in vehicle identification. Unregistered Video loss rates are even higher because of the difference in accuracy and because of the lower collection rates for bad accounts. Figure 6-7 presented earlier illustrates the gross revenue and the revenue after leakage.

Table 6-11
Summary of Transaction Leakage Rates
Class 1 Vehicles

	Ramp-up			
Payment Class	**Year 1**	**Year 2**	**Year 3**	**Year 4 +**
ETC	9.1%	7.1%	5.1%	3.1%
Registered Video	12.4%	10.5%	8.6%	6.7%
Unregistered Video	23.8%	21.0%	18.1%	15.3%

Table 6-12 contains the estimated gross revenue stream presented earlier and compares it to the amount of uncollectible revenue resulting from the collection process described above. The early years reflect the assumed ramp-up, which results in an estimated 9.2 percent revenue lost the opening year and a stabilized loss of 3.0 to 3.9 percent as the system matures.

DISCLAIMER

Current professional practices and procedures were used in the development of these traffic and revenue study findings. However, there is considerable uncertainty inherent in future traffic and revenue forecasts for any toll facility. There may sometimes be differences between forecasted and actual results caused by events and circumstances beyond the control of the forecasters. These differences could be material. Also, it should be recognized that traffic and revenue forecasts in this document are intended to reflect the overall estimated long-term trend. Actual experience in any given year may vary due to economic conditions and other factors.

Table 6-12
Annual Toll Transactions and Revenue Forecasts
Triangle Expressway
(Thousands)
Revised April 18, 2008

Year	Total Transactions	Gross Revenue	Uncollectible Revenue	Revenue After Leakage
2011 [1]	6,752	$4,795	$442	$4,353
2012 [2]	25,192	17,370	1,680	15,690
2013	33,988	24,251	1,781	22,470
2014	41,072	30,264	1,533	28,731
2015	46,159	35,197	1,196	34,001
2016	48,474	38,092	1,504	36,588
2017	50,968	41,162	1,532	39,630
2018	53,656	44,554	1,553	43,001
2019	56,544	48,216	1,580	46,636
2020	59,654	52,086	1,603	50,483
2021	62,720	56,406	1,956	54,450
2022	66,022	61,109	1,973	59,136
2023	69,579	66,230	1,994	64,236
2024	73,403	71,807	2,014	69,793
2025	77,517	77,881	2,033	75,848
2026	79,097	81,455	2,727	78,728
2027	80,739	85,176	2,722	82,454
2028	82,441	89,053	2,712	86,341
2029	84,205	93,087	2,696	90,391
2030	86,035	97,290	2,677	94,613
2031	87,493	101,603	3,304	98,299
2032	88,977	106,037	3,375	102,662
2033	90,487	110,593	3,438	107,155
2034	92,028	115,279	3,503	111,776
2035	93,594	120,092	3,562	116,530
2036	94,998	124,296	3,687	120,609
2037	96,423	128,646	3,816	124,830
2038	97,869	133,150	3,949	129,201
2039	99,338	137,810	4,086	133,724
2040	100,828	142,631	4,228	138,403
2041	101,837	145,485	4,315	141,170
2042	102,856	148,396	4,403	143,993
2043	103,885	151,364	4,492	146,872
2044	104,923	154,390	4,579	149,811
2045	105,971	157,478	4,671	152,807
2046	107,032	160,627	4,765	155,862
2047	108,102	163,839	4,858	158,981
2048	109,182	167,116	4,955	162,161
2049	110,274	170,461	5,058	165,403
2050	111,377	173,867	5,156	168,711

Note: Forecasts for 2011 - 2013 reflect an assumed ramp-up to full traffic volumes beginning in 2014 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for 2012 - 2014 reflect an assumed ramp-up to full traffic volumes beginning in 2015 for Western Wake Freeway.

[1] Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54.

[2] Full project open.

CHAPTER 7
SENSITIVITY TESTS

A series of tests were conducted to provide a measure of the sensitivity of annual transactions and revenue to changes in key study assumptions. The sensitivity tests were conducted for Years 2012, 2020, and 2030 with the exception of a commuter rail test and a toll road extension test, which were conducted for Years 2020 and 2030 only. The results of the sensitivity tests are presented in Table 7-1 and illustrated in Figure 7-1. The sensitivity tests included the following assumptions:

- **MPO Socioeconomic Forecasts** – The updated socioeconomic forecasts from CAMPO and DCHC form the basis for future travel demand instead of the forecasts from the independent economist;
- **Revised Long Term Economic Growth** – The base trip table rate of growth increases and decreases plus or minus 30 percent from the baseline growth rate;
- **Value of Time (VOT)** – 20 percent increases and decreases in base VOT's;
- **Electronic Toll Collection (ETC) Participation** – Higher and lower participation rates of ETC have a correspondingly lower and higher rate of video tolling;
- **Higher Motor Fuel Prices** – Five percent reduction in regional travel demand;
- **Longer Ramp-up Period** – Traffic levels will gradually build up to full demand over a five-year "ramp up" period instead of the three-year period used for the base case;
- **Express Bus Service on Triangle Expressway** – Express buses on the parallel NC 55 are routed via the Triangle Expressway non-stop between NC 55 Bypass at Holly Springs and NC 55 near Morrisville;
- **Commuter Rail in Triangle Expressway Corridor** – Commuter rail service is available within the Triangle Expressway study area between NC 55 Bypass and the transit center east of the Davis Drive and Hopson Road Interchange; and

Table 7-1
Annual Toll Transactions and Gross Revenue Forecasts
Sensitivity Tests
Triangle Expressway
(Thousands)

Test	2012 [1] Transactions	2012 [1] Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**25,192**	**$17,370**				
Sensitivity Test						
MPO Economic Forecast	25,636	17,805	444	$435	1.8%	2.5%
30 Percent Higher Traffic Growth	31,322	21,529	6,130	4,159	24.3%	23.9%
30 Percent Lower Traffic Growth	22,477	15,456	-2,715	-1,914	-10.8%	-11.0%
20 Percent Higher Value of Time	26,723	19,027	1,531	1,657	6.1%	9.5%
20 Percent Lower Value of Time	22,797	15,249	-2,395	-2,121	-9.5%	-12.2%
20 Percent Higher ETC Share	26,740	17,021	1,548	-349	6.1%	-2.0%
20 Percent Lower ETC Share	23,625	17,929	-1,567	559	-6.2%	3.2%
Higher Fuel Costs, 5 Percent Traffic Reduction	22,983	15,953	-2,209	-1,417	-8.8%	-8.2%
Express Buses on Triangle Expressway	25,192	17,370	---------- Negligible ----------			

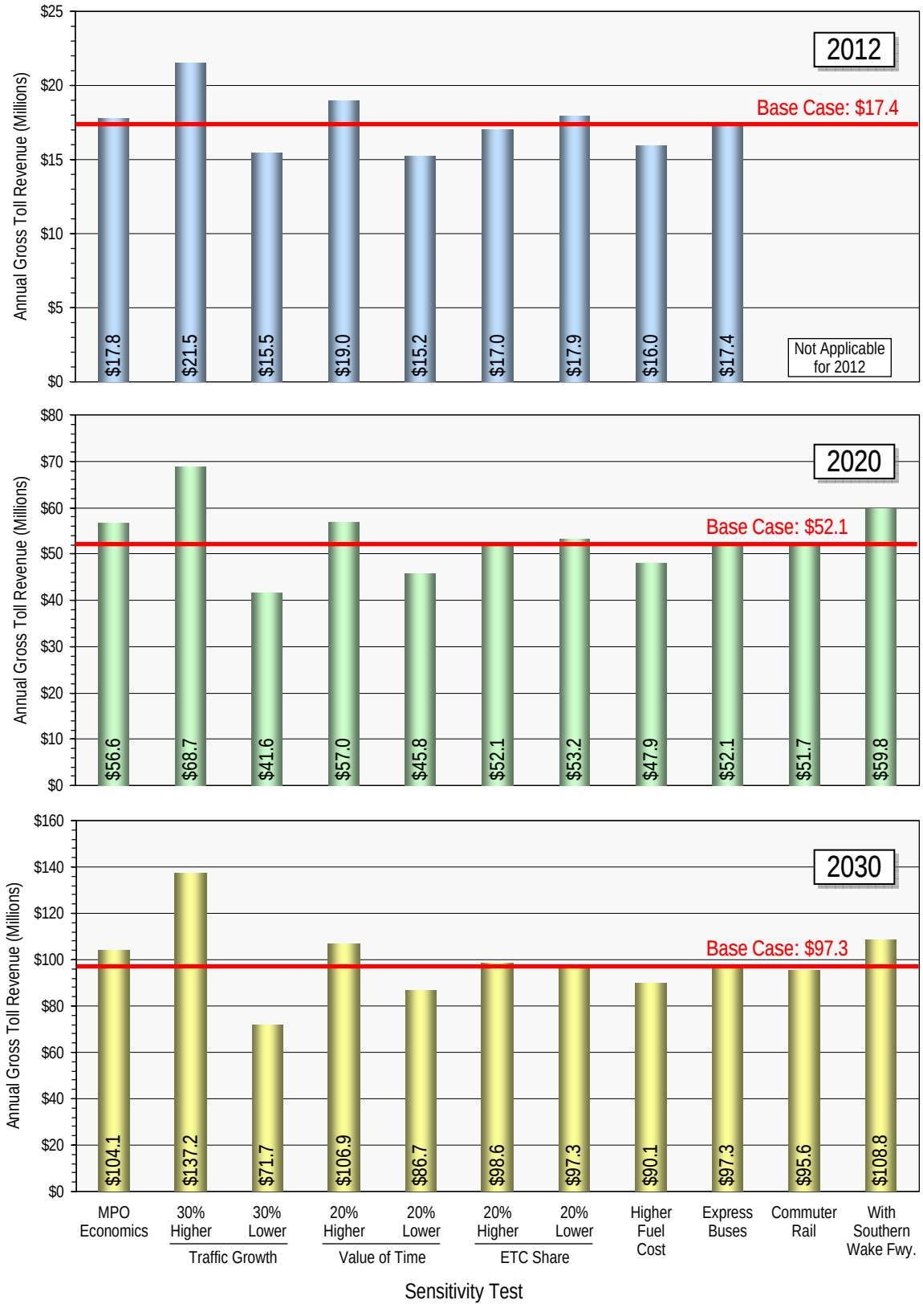
Test	2020 Transactions	2020 Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**59,654**	**$52,086**				
Sensitivity Test						
MPO Economic Forecast	65,246	56,597	5,592	$4,511	9.4%	8.7%
30 Percent Higher Traffic Growth	77,761	68,746	18,107	16,660	30.4%	32.0%
30 Percent Lower Traffic Growth	47,936	41,643	-11,718	-10,443	-19.6%	-20.0%
20 Percent Higher Value of Time	63,650	56,961	3,996	4,875	6.7%	9.4%
20 Percent Lower Value of Time	54,150	45,827	-5,504	-6,259	-9.2%	-12.0%
20 Percent Higher ETC Share	63,071	52,121	3,417	35	5.7%	0.1%
20 Percent Lower ETC Share	57,833	53,194	-1,821	1,108	-3.1%	2.1%
Higher Fuel Costs, 5 Percent Traffic Reduction	54,858	47,906	-4,796	-4,180	-8.0%	-8.0%
Express Buses on Triangle Expressway	59,654	52,086	---------- Negligible ----------			
Commuter Rail In Triangle Expressway Study Area	59,122	51,741	-532	-345	-0.9%	-0.7%
Southern Wake Freeway as Toll Road [3]	66,843	59,808	7,189	7,722	12.1%	14.8%

Test	2030 Transactions	2030 Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**86,035**	**$97,290**				
Sensitivity Test						
MPO Economic Forecast	91,882	104,067	5,847	6,777	6.8%	7.0%
30 Percent Higher Traffic Growth	118,160	137,248	32,125	39,958	37.3%	41.1%
30 Percent Lower Traffic Growth	64,344	71,679	-21,691	-25,611	-25.2%	-26.3%
20 Percent Higher Value of Time	92,511	106,881	6,476	9,591	7.5%	9.9%
20 Percent Lower Value of Time	77,396	86,656	-8,639	-10,634	-10.0%	-10.9%
20 Percent Higher ETC Share	89,901	98,627	3,866	1,337	4.5%	1.4%
20 Percent Lower ETC Share	82,836	97,304	-3,199	14	-3.7%	0.0%
Higher Fuel Costs, 5 Percent Traffic Reduction	79,823	90,063	-6,212	-7,227	-7.2%	-7.4%
Express Buses on Triangle Expressway	86,035	97,290	---------- Negligible ----------			
Commuter Rail In Triangle Expressway Study Area	84,414	95,564	-1,621	-1,726	-1.9%	-1.8%
Southern Wake Freeway as Toll Road [3]	93,502	108,838	7,467	11,548	8.7%	11.9%

[1] Forecasts for 2012 reflect an assumed ramp-up to full trafic volumes beginning in 2014 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville and to full ltraffic volumes beginning in 2015 for Western Wake Freeway.

[2] **EXCLUDES ANY ALLOWANCE FOR UNCOLLECTIBLE REVENUE.**

[3] Transactions and Revenue For Triangle Expressway only. Excludes revenue from Southern Wake Freeway.



Note: Excludes any allowance for uncollectible revenue.

NORTH CAROLINA Turnpike Authority

ANNUAL GROSS REVENUE FORECASTS SENSITIVITY TESTS

FIGURE 7-1

- **Southern Wake Freeway** – The Triangle Expressway is extended from the proposed southern terminus at NC 55 Bypass near Holly Springs to I-40 south of Raleigh.

MPO SOCIOECONOMIC FORECASTS

The base case traffic and revenue forecasts for this study were calculated using the socioeconomic forecasts that were prepared by the independent economist rather than those prepared by the two MPOs in the region, CAMPO and DCHC. The MPOs' socioeconomic forecasts for the Triangle region were somewhat higher than those developed by the independent economist as discussed in more detail in Chapter 4. For this sensitivity test, the travel demand model was recoded using the MPO socioeconomic forecast in the trip generation step of the model. This resulted in gross toll revenues that were 2.5 percent higher for 2012, 8.7 percent higher for 2020, and 7.0 percent higher in 2030 than the revenue for the base case. In the early years, the two sets of socioeconomic forecasts are similar. However, the forecasts diverge in the later years, and the differences are correspondingly larger between the base case and the MPO forecast sensitivity test.

LOWER OR HIGHER LONG TERM TRAFFIC GROWTH

Increases and decreases in the long term regional traffic growth rates were tested to examine the effects of such delays or accelerations on annual transactions and revenues. This was emulated by adjusting the rate of trip growth in the trip tables by plus or minus 30 percent from the base case forecast.

INCREASED GROWTH

This test assumed that the total traffic growth rate in the base-year trip tables would increase by 30 percent. For example, a 4.0 percent annual growth rate for a specific movement in the base case was increased to 5.2 percent annual growth in the sensitivity test. Under this higher growth rate test, the gross toll revenue increased by approximately 24 percent in 2012 and over 41 percent by 2030.

DECREASED GROWTH

Conversely, the lower traffic growth sensitivity test assumed a 30 percent decrease for each movement in the trip tables. As indicated in Table 7-1, the reduction in gross toll revenue is 11 percent in 2010 and about 26 percent in 2030.

Based on this analysis of higher and lower traffic growth rates, it appears that the gross revenue is more sensitive to higher traffic growth than lower traffic growth.

VALUE OF TIME

Individual value-of-time (VOT) is a critical parameter in the toll diversion model because a driver's decision to use a toll road is heavily influenced by the travel time saved by using a toll road relative to the toll charged. Values of time for individual movements are based on the stated preference (SP) survey results, the estimates of median household income and the annual hours worked by traffic analysis zone (TAZ). In these two sensitivity tests, the base case value-of-time for each movement was increased and decreased by 20 percent.

HIGHER VALUE OF TIME

Higher values of time would favor the Triangle Expressway because more drivers would be willing to pay a toll to save travel time in comparison to the base case. This test increased the median VOT for all trip purposes in the traffic assignment process by 20 percent. Under this scenario, as presented in Table 7-1, the total annual gross revenue increased by 9.4 to 9.9 percent for the test years: 2012, 2020, and 2030.

LOWER VALUE OF TIME

Lowering the base case value-of-time by 20 percent had the opposite effect on the Triangle Expressway because fewer people would be willing to pay a toll to save travel time. The reduction in gross toll transactions in comparison to the base case is estimated at between 11 and 12 percent for each of the test years.

Thus the forecast model is slightly more sensitive to lower values-of-time than to higher values-of-time.

ELECTRONIC TOLL COLLECTION PARTICIPATION

The base case assumptions for ETC participation are that participation rates would increase as drivers become more familiar with the lower costs and convenience of ETC. Conversely the use of video tolling would decrease over the years as ETC increases.

Two sensitivity tests were conducted. The first test assumed higher levels of initial ETC participation and the second test assumed lower levels of

ETC participation. Table 7-2 shows the percentages of ETC and video participation for the base case and for the two sensitivity tests.

HIGHER ETC PARTICIPATION

This test assumes that 2012 base case ETC participation would increase from 68.5 percent to 82.2 percent for Class 1 vehicles and from 85.0 percent to 93.5 percent for Class 3 vehicles. The toll diversion model indicates that this increase would have minimal impact on gross toll revenues. The 2012 revenue is estimated to be 2 percent less than the base case revenue. By 2020, the impact is negligible, and by 2030 the revenue would increase slightly over the base case. These results are not surprising because of the toll price differentials between ETC and video tolling. With higher ETC participation, the percentage of video tolling customers would decrease. Since these video tolling customers would pay substantially more than ETC customers, the revenue effects of higher ETC participation would tend to be offset.

REDUCED ETC PARTICIPATION

Similarly, an assumed reduction in ETC participation also has little effect on gross toll revenues because of the price differential of the payment types.

Although these two sensitivity tests indicate that changes in the share of ETC participation have little impact on gross toll revenue, this analysis did not include any allowances for revenue losses due to uncollectible video tolling charges. Under the lower ETC share sensitivity test, more video tolling would occur, which means that more revenue would be lost due to leakage than with the base case.

INCREASED FUEL COST

This sensitivity test was based on the assumption that significantly higher fuel prices would result in fewer vehicles using the Triangle Expressway. Therefore, in order to reflect gas price increases in the range of 50 to 100 percent, the 2012, 2020, and 2030 base trip tables were reduced by 5 percent. Under this hypothetical scenario, total annual revenues were reduced by approximately 7 to 8 percent for each of the test years.

Table 7-2
Toll Collection Percentages of Total Transactions - Sensitivity Tests
Triangle Expressway

Base Case

	Model Input Assumptions - Class 1				Model Input Assumptions - Class 2/3			
Year	ETC	RV	URV	Subtotal Video	ETC	RV	URV	Subtotal Video
2012	68.5%	21.0%	10.5%	31.5%	85.0%	12.0%	3.0%	15.0%
2020	81.3%	12.5%	6.2%	18.7%	95.0%	4.0%	1.0%	5.0%
2030	88.8%	7.5%	3.7%	11.2%	95.0%	4.0%	1.0%	5.0%

Higher ETC Participation

	Model Input Assumptions - Class 1				Model Input Assumptions - Class 2/3			
Year	ETC	RV	URV	Subtotal Video	ETC	RV	URV	Subtotal Video
2012	82.2%	11.9%	5.9%	17.8%	93.5%	5.2%	1.3%	6.5%
2020	93.5%	4.3%	2.2%	6.5%	99.8%	0.1%	0.1%	0.2%
2030	97.7%	1.5%	0.8%	2.3%	99.8%	0.1%	0.1%	0.2%

Lower ETC Participation

	Model Input Assumptions - Class 1				Model Input Assumptions - Class 2/3			
Year	ETC	RV	URV	Subtotal Video	ETC	RV	URV	Subtotal Video
2012	54.8%	30.1%	15.1%	45.2%	76.5%	18.8%	4.7%	23.5%
2020	69.1%	20.6%	10.3%	30.9%	90.3%	7.8%	1.9%	9.7%
2030	79.9%	13.4%	6.7%	20.1%	90.3%	7.8%	1.9%	9.7%

LONGER RAMP-UP PERIOD

In the base case, it was assumed that full traffic potential would be realized after a three-year period in which the traffic would build up from a 50 percent level the first month of operation to a 100 percent level in month 36. The sensitivity test assumed a five-year ramp-up period, which would result in lower annual traffic and revenue forecasts in comparison to the base case.

The annual ramp-up factors for the three-year and the five-year ramp-ups are listed in Table 7-3. For example, in the first year of operation, the traffic and revenue forecasts are 61 percent of the full annual forecasts in the three-year ramp-up and 58.3 percent of the full annual forecasts in the five-year ramp-up.

Table 7-3

Annual Ramp-up Factors - Sensitivity Test

Year	3-year Factor (1)	5-year Factor (1)
1	0.610	0.583
2	0.813	0.730
3	0.945	0.837
4	1.000	0.922
5	1.000	0.984
6 +	1.000	1.000

(1) Average yearly factor applied to forecast of total traffic before ramp-up.

The total transactions and gross revenues for the three-year and five-year ramp-up periods are compared in Table 7-4 for years 2011 through 2016. The revenues for the five-year ramp-up period are between 4.5 and 11 percent lower than the revenues for the base case depending upon the year of operation. The Triangle Parkway and NC 540 sections of the toll road were assumed to open in 2011, and the ramp-up was assumed to cover 2011 – 2015 for this test. The Western Wake Freeway segment was assumed to open in 2012, and its ramp-up was assumed to cover 2012 – 2016 for this sensitivity test. After 2017, the traffic volumes would be the same in both the three-year and the five-year ramp-up cases.

Table 7-4
Annual Toll Transactions and Gross Revenue Forecasts
Five-year Ramp-up Sensitivity Test
Triangle Expressway
(Thousands)

	Base Case (3-year Ramp-up) [1]		Sensitivity Test (5-year Ramp-up) [2]		Difference from Base Case		Percent Difference from Base Case	
Year	Transactions	Revenue	Transactions	Revenue	Transactions	Revenue	Transactions	Revenue
2011	6,752	$4,795	6,447	$4,579	-305	-$216	-4.5%	-4.5%
2012	25,192	17,370	23,342	16,090	-1,850	-1,280	-7.3%	-7.4%
2013	33,988	24,251	30,314	21,629	-3,674	-2,622	-10.8%	-10.8%
2014	41,072	30,264	37,015	27,284	-4,057	-2,980	-9.9%	-9.8%
2015	46,159	35,197	43,746	33,385	-2,413	-1,812	-5.2%	-5.1%
2016	48,474	28,092	48,009	37,735	-465	9,643	-1.0%	34.3%
2017 - 2050	No Change							

[1] Forecasts for 2011-2013 reflect an assumed ramp-up to full trafic volumes beginning in 2014 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville.
Forecasts for 2012-2014 reflect an assumed ramp-up to full trafic volumes beginning in 2015 for Western Wake Freeway.

[2] Forecasts for 2011-2015 reflect an assumed ramp-up to full trafic volumes beginning in 2016 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville.
Forecasts for 2012-2016 reflect an assumed ramp-up to full trafic volumes beginning in 2017 for Western Wake Freeway

EXPRESS BUS SERVICE ON TRIANGLE EXPRESSWAY

The regional transportation model includes bus services in accordance with the MPOs' long range transportation plans. The services in the area of the proposed Triangle Expressway include bus routes along NC 55 from Apex to a location on Page Road near the Research Triangle Park. In later years, bus service would be extended south to include Fuquay-Varina in Wake County and Lillington in Harnett County.

In this transit sensitivity test, the segment of the bus routes between Old US 1 and NC 55 near Morrisville were re-routed to the Triangle Expressway. The routes would still originate and terminate in the same locations as in the base case, but there would not be bus service on NC 55 between Old US 1 and NC 55 near Morrisville. Figure 7-2 depicts the bus service in this sensitivity test. The headways for these express buses would be:

- 2012: 30 minutes peak (1 route), no off-peak service;
- 2020: 30 minutes peak (2 routes), 60 minutes off-peak (1 route); and
- 2030: 30 minutes peak (2 routes), 60 minutes off-peak.

Since the express buses operating along the Triangle Expressway would offer more rapid service to and from the Research Triangle Park area than buses operating along NC 55, it might be expected that some diversion from automobiles to public transit would occur. Consequently the reduction of automobiles on the Triangle Expressway might lead to a reduction in gross toll revenue. However, this is not the case. The re-routing of buses to the Triangle Expressway would have little effect on gross toll revenue because the Triangle Regional Model (TRM) forecasts little ridership on buses along NC 55 in the study area. In fact, according to 2005 ridership data from the Triangle Transit Authority, the average daily transit ridership on the only bus route on NC 55 in the study area was 100. [(1)] Average annual daily vehicle traffic along NC 55 ranged from 19,000 vpd to 38,000 vpd in 2005. The TRM was run to determine any mode diversions associated with the re-routing of bus services using the headways listed above. The model indicated low future transit ridership with or without the Triangle Expressway.

Because of the low current and forecast transit ridership in the corridor, any diversion of automobile users to transit using the Triangle Expressway would have minimal traffic or gross revenue impact.

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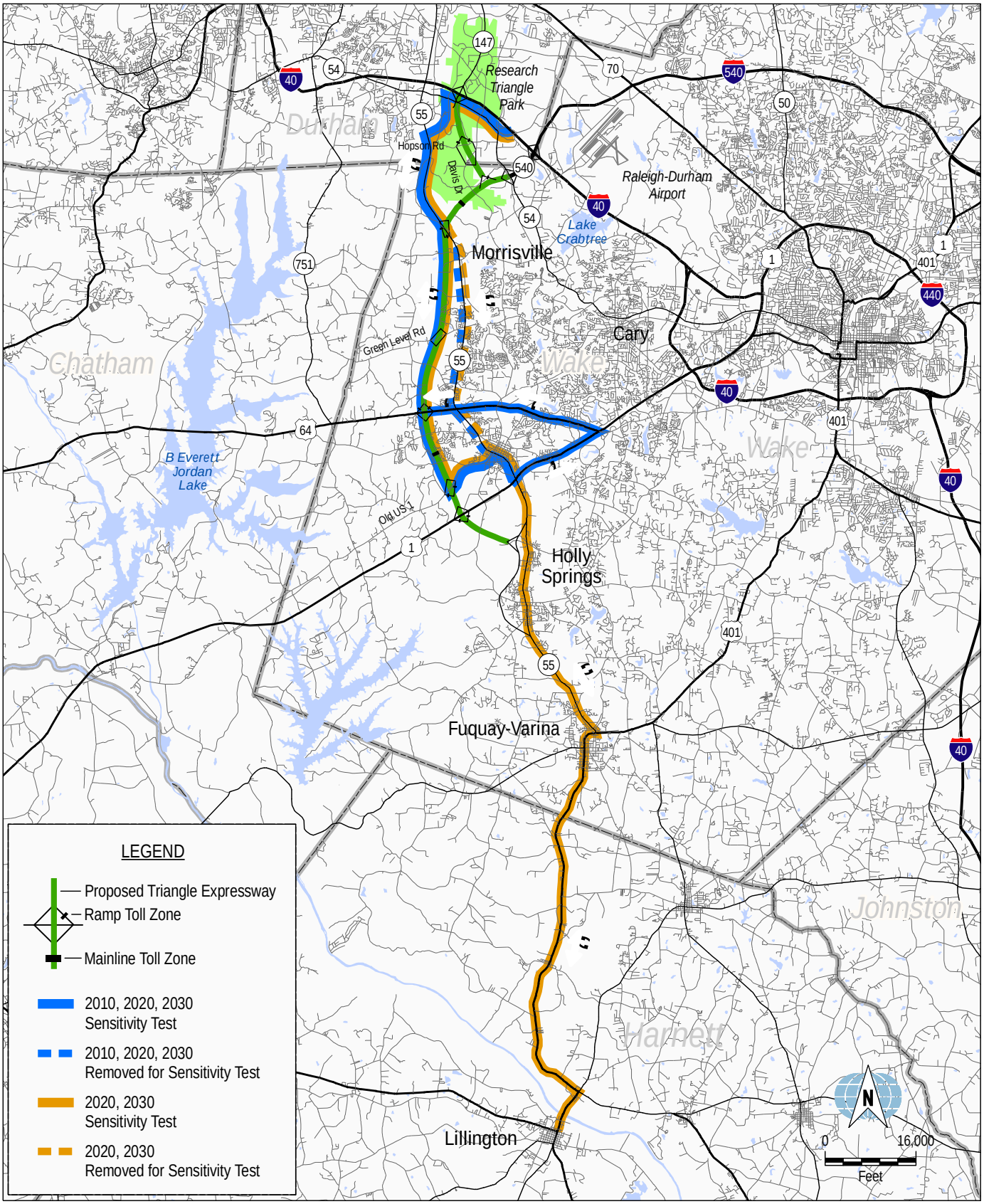
(1) See Table 2-12.



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BUS SENSITIVITY TEST ROUTES

FIGURE 7-2

However, it should be noted that this sensitivity test is reflective of the current transportation mode choice model, the currently-modeled levels of transit service in the study area, and the expected modal splits between cars and buses. If the bus levels of service and routings were increased substantially and road traffic conditions and costs deteriorated significantly, then some diversion from automobile to bus transit in the study area could be expected, which could lead to reduction of toll revenue to some degree.

COMMUTER RAIL IN TRIANGLE EXPRESSWAY CORRIDOR

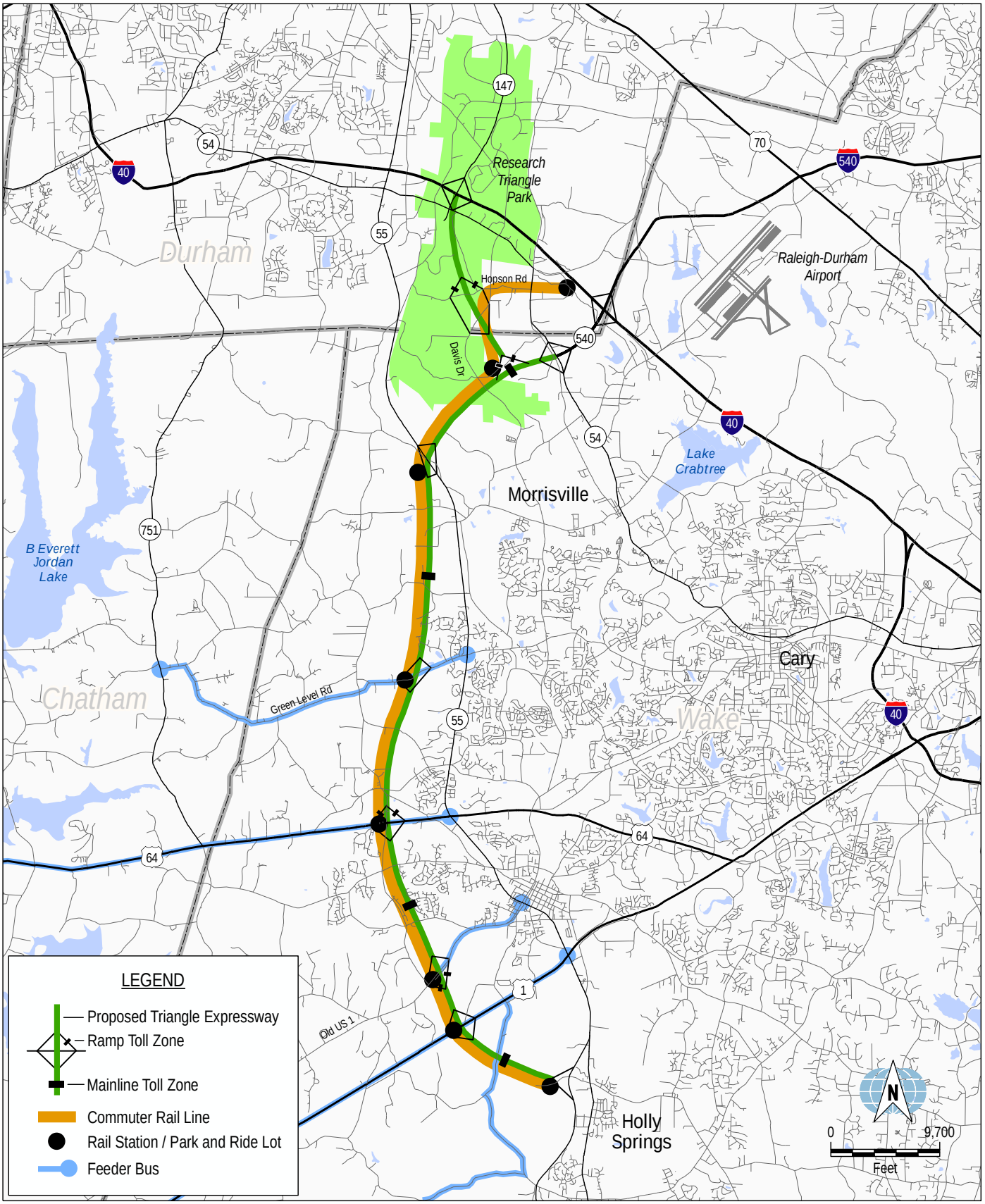
In this sensitivity test, a commuter rail line would closely parallel the Triangle Expressway. It would have stops at each interchange and feeder bus lines to connect the rail line to NC 55, the closest major north-south toll-free road. As shown in Figure 7-3, the commuter line would extend from NC 55 Bypass at Holly Springs to the bus transit center on Page Road.

This theoretical rail line would have service characteristics similar to the commuter line that was not approved by the US DOT in 2006: [(2)]

- Rail Headways - 10 minutes peak and 20 minutes off-peak;
- Feeder Bus Headways - 20 minutes peak and 40 minutes off-peak;
- Average Speeds - up to 45 miles per hour depending on distances between stations (average 36 miles per hour);
- Rail Fares - $2.00 flat fare in opening year, same as the fare in the earlier rail project for the same distance;
- Feeder Bus Fares - $0.75 in opening year; and
- Park and Ride Lots - at each station.

Some potential toll road commuters could be attracted to this line for all or portions of certain trips, but the slower speed of the rail line and transfer times between feeder buses and rail would tend to favor the toll road. The average speed of the toll road would be approximately 65 mph, and the average speed over the commuter rail line would be 36 mph. As indicated in Table 7-1, the expected gross toll revenue would be 0.7 percent lower than the base case in 2020 and 1.8 percent lower in 2030. Clearly other factors such as significantly higher fuel costs, congestion on the area road

[(2)] This sensitivity test is theoretical in the sense that neither an engineering nor a financial feasibility analysis was conducted to confirm that the rail line could be placed near the Triangle Expressway. The purpose of the sensitivity test was to estimate the effects on the Triangle Expressway gross toll revenue if such a rail line were implemented.


Research Triangle Park
Durham
Raleigh-Durham Airport
Hopson Rd
Davis Dr
Lake Crabtree
Morrisville
B Everett Jordan Lake
Chatham
Green Level Rd
Cary
Wake
Old US 1
Holly Springs
147
54
40
55
70
540
751
64
1
N
0
9,700
Feet
LEGEND
Proposed Triangle Expressway
Ramp Toll Zone
Mainline Toll Zone
Commuter Rail Line
Rail Station / Park and Ride Lot
Feeder Bus

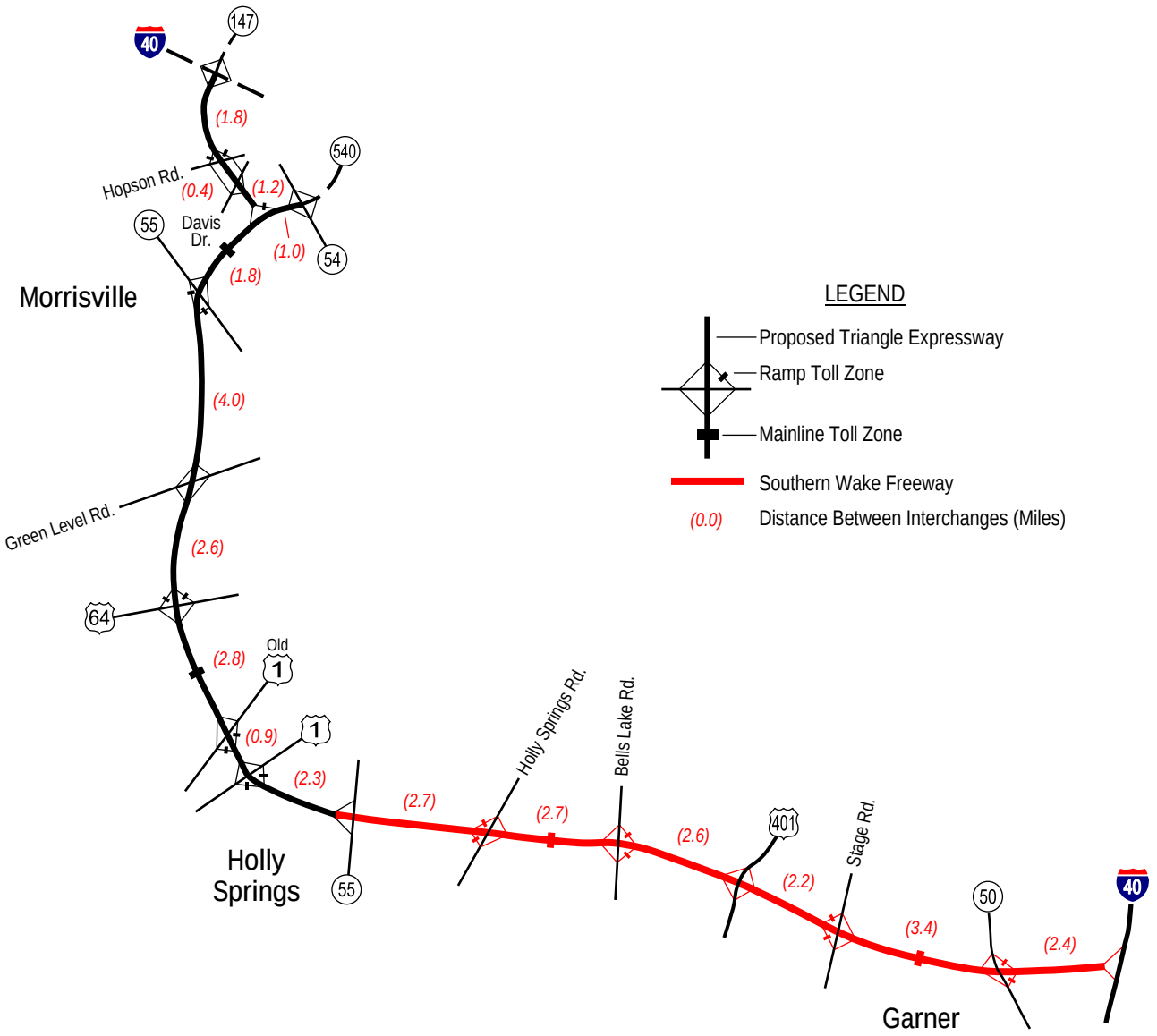
network, and reduction of available parking in the RTP area would contribute to higher rail usage.

SOUTHERN WAKE FREEWAY

The preliminary traffic and revenue study included an analysis of both the Western Wake and the Southern Wake Freeways. [3] However, this comprehensive study does not include the Southern Wake Freeway. A sensitivity test was conducted to estimate the potential impact on Triangle Expressway traffic and toll revenue if the Southern Wake Freeway were available. The Western and Southern Wake Freeways would provide enhanced connectivity for travelers in western and southern Wake County. Figure 7-4 depicts a toll road that includes the Southern Wake Freeway.

The incremental revenue on the Triangle Expressway due to the additional Southern Wake traffic is forecast to be approximately 15 percent higher than the base case in 2020 and 12 percent in 2030. This revenue is incremental and does not include the revenue for traffic passing through tolling zones on the Southern Wake Freeway itself. It includes only revenue impacts on the Triangle Expressway tolling zones and is used as a basis of comparison to illustrate the effects of the enhanced connectivity offered by the Southern Wake Freeway.

[3] Proposed Western and Southern Wake Parkways Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, June 16, 2006.



Schematic
Not To Scale

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SENSITIVITY TEST TOLL CONFIGURATION
TRIANGLE EXPRESSWAY WITH SOUTHERN WAKE FREEWAY

FIGURE 7-4