URS DIN 01623

Travel Demand Methodology and Results Report

Durham-Orange Light Rail Transit Project

July 24, 2015

The NEPA Preferred Alternative for the D-O LRT Project would generally follow NC 54, I-40, US 15-501, and the North Carolina Railroad (NCRR) Corridor in downtown Durham and east Durham. The alignment would begin at UNC Hospitals, parallel Fordham Boulevard, proceed east on NC 54, travel north on I-40, parallel US 15-501 before it turns east toward the Duke University campus along Erwin Road, and then follow the NCRR Corridor parallel to NC 147 through downtown Durham, before reaching its eastern terminus near Alston Avenue. The alignment would consist of at-grade alignment, fill and cut sections, and elevated structures. In two sections of the alignment, Little Creek and New Hope Creek, multiple Light Rail Alternatives are evaluated in the DEIS.

This technical report contains information for all alternatives analyzed in the DEIS. However, pursuant to MAP 21, the Moving Ahead for Progress in the 21st Century Act (P.L. 112-141), a NEPA Preferred Alternative has been developed, which recommends C2A in the Little Creek section of the alignment, NHC 2 in the New Hope Creek section of the alignment, the Trent/Flowers Drive station, and the Farrington Road Rail Operations and Maintenance Facility.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AA	Alternatives Analysis
CAMPO	Capital Area Metropolitan Planning Organization
CAT	Capital Area Transit
CHT	Chapel Hill Transit
Civtt	Coefficient of In-Vehicle Time
Covtt	Coefficient of Out-of-Vehicle Time
CS	Cambridge Systematics
C-Tran	Cary Transit
DATA	Durham Area Transit Authority
DCHC MPO	Durham-Chapel Hill-Carrboro Metropolitan Planning Organization
DEIS	Draft Environmental Impact Statement
D-O	Durham-Orange
D-O LRT	Durham-Orange Light Rail Transit
FTA	Federal Transit Administration
HBO	home-based other
HBSc	home-based school
HBSh	home-based shopping
HBU	home-based university
HBW	home-based work
HOV	high occupancy vehicle
HOV2	high occupancy vehicle for two persons
HOV3+	high occupancy vehicle for three or more persons
I-40	Interstate 40
LPA	Locally Preferred Alternative
LRT	light rail transit
mphps	miles per hour per second
MPO	Metropolitan Planning Organization
MTP	Metropolitan Transportation Plan
NC	North Carolina
NCSU	North Carolina State University
NHB	non-home-based
NHBW	non-home-based work
NHC	New Hope Creek
NHNW	Non-home-based-non-work
NHBNW	non-home-based non-work
RMSE	root-mean-square error
RTP	Research Triangle Park
TRM	Triangle Regional Model
TRMSB	Triangle Regional Model Service Bureau
UNC	University of North Carolina
US	United States

Acronym/Abbreviation	Definition
VMT	vehicle miles traveled
VOT	Value of Time
WBNH	Work-based non-home

1. Introduction

This report documents the assumptions and methodology for performing travel demand forecasting for the Draft Environmental Impact Statement (DEIS) of the Durham-Orange Light Rail Transit (D-O LRT). Chapter 1 provides some background for this study. Chapter 2 presents an overview of the Triangle regional travel demand forecasting model. Chapter 3 discusses the mode choice portion of the model in greater detail and its consistency with Federal Transit Administration (FTA) recommendations and standards. Chapter 4 covers model enhancements, calibration, and validation.

1.1 Study Background

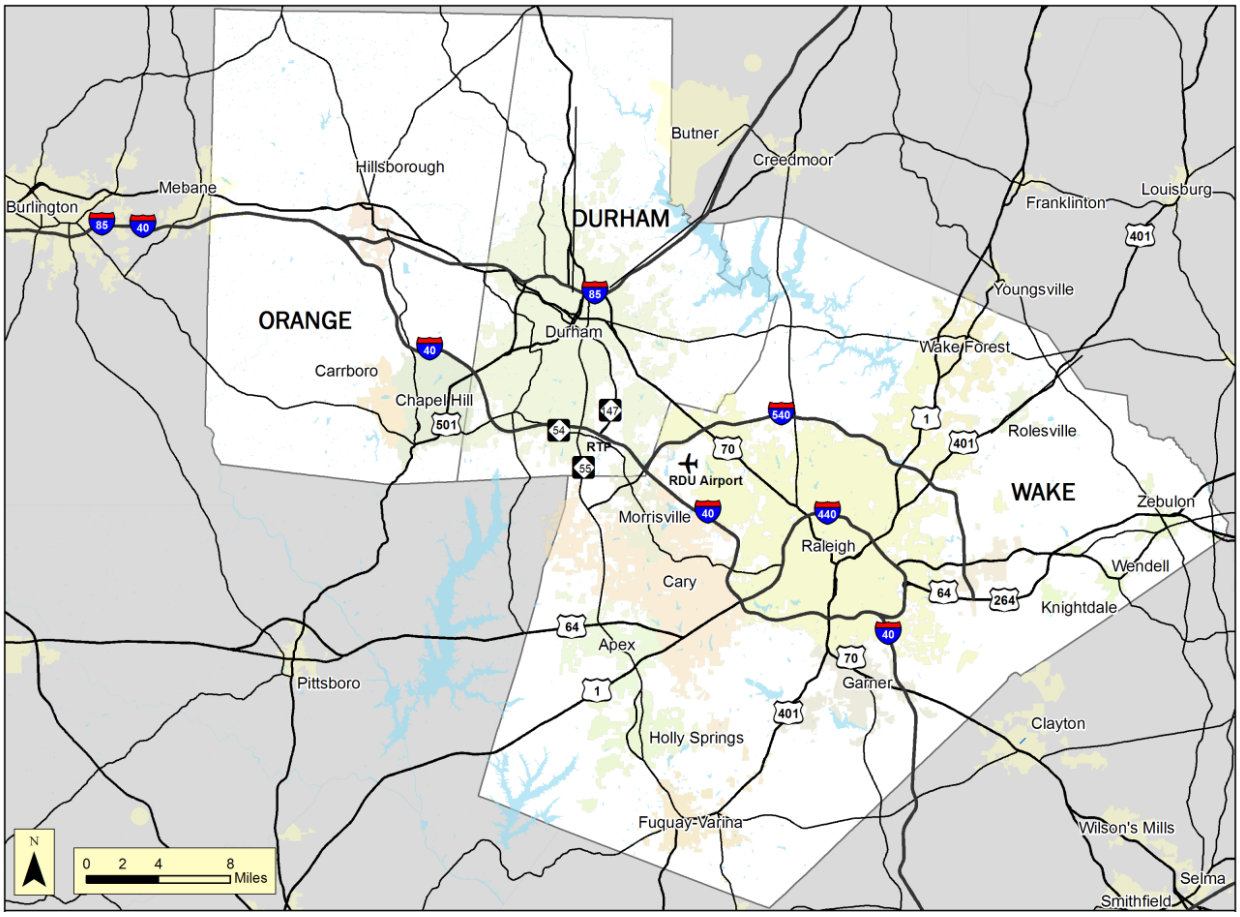
The Triangle region has a polycentric urban pattern that includes several sizeable downtowns, four major universities, three major medical centers, and many satellite communities, with travel and economic patterns linking them across the region's core counties of Durham, Orange, and Wake. Raleigh-Durham International Airport (RDU) and the Research Triangle Park (RTP) draw traffic to the center of the region (see Figure 1-1).

The following agencies currently provide transit service in the Triangle region:

- Capital Area Transit (CAT)
- Chapel Hill Transit (CHT)
- C-Tran (Cary Transit)
- Durham Area Transit Authority (DATA)
- Duke University Transit
- North Carolina State University (NCSU) Transportation (WolfLine)
- Triangle Transit

In 2006, a transit onboard survey found that approximately 80,000 transit trips occurred per day in the Triangle region (slightly less than 1.5 percent of total travel).

Figure 1-1: The Triangle Region



1.2 Description of the Study Corridor

The D-O Corridor is located within the Triangle region. It extends roughly 17 miles from southwest Chapel Hill to east Durham, and includes several educational, medical, and other key activity centers which generate a large number of trips each day. The land uses in the D-O Corridor are supported by a network of major highways including NC 54, I-40, US 15-501, Erwin Road, and NC 147. Additional detail regarding the study corridor is included in the *Durham-Orange Light Rail Transit Project DEIS*, chapters 1 and 2.

1.3 Alternatives Considered

- No-Build Alternative
- Light Rail Alternatives

In addition to the Light Rail Alternatives, the DEIS considers a No-Build Alternative comprised of the existing and programmed transportation network improvements without the planned rail improvements and associated bus network modifications.

Ridership forecasts were developed for 24 light rail alternatives, based on the combinations of the four Little Creek Alternatives (C1, C1A, C2, and C2A), the three New Hope Creek (NHC) Alternatives (NHC LPA,

NHC 1, and NHC 2) and the two Duke/VA Medical Centers Station Alternatives (Duke Eye Center and Trent/Flowers Drive). Additional detail regarding the alternatives considered is included in the *Durham-Orange Light Rail Transit Project DEIS*, chapter 2.

1.4 Recent Project Studies

In 2011, Triangle Transit conducted Alternative Analyses (AA) for three priority corridors to evaluate and screen alternative alignments, station locations, and technologies. Evaluation criteria, including ridership forecasts, were developed and used to select the locally preferred alternatives (LPA) to be adopted by the appropriate Metropolitan Planning Organizations (MPO). The study design permitted one or more LPAs to advance to the next implementation phase of preliminary design and the required environmental impact analysis. A single LPA in the Durham-Orange (D-O) Corridor was advanced for submission through the New Starts process.

Triangle Transit subsequently submitted a New Starts Application for the D-O Corridor for entry to the Project Development phase. In February 2014, the FTA approved Triangle Transit's request to enter Project Development on the 17-mile D-O LRT Project.

2. Review of the Triangle Regional Model

The Triangle Regional Model Service Bureau (TRMSB), in cooperation with regional stakeholders (Durham-Chapel Hill-Carrboro Metropolitan Planning Organization [DCHC MPO], Capital Area Metropolitan Planning Organization (CAMPO), North Carolina Department of Transportation, and Triangle Transit, performs travel modeling for the region. The TRMSB is housed at the NCSU Institute for Transportation Research and Education.

2.1 Regional Modeling Tools

The adopted official Triangle Regional Model (TRM), Version 5, is used for travel demand forecasting for this DEIS. TRM Version 5 operates in TransCAD 5.0 Build 1880, with a base year of 2005 for model development, a base year of 2010 for model calibration and validation, and a horizon year of 2040. Development of TRM Version 5 was performed in close coordination with the Non-Motorized Model Development project sponsored by DCHC MPO and conducted by Cambridge Systematics (CS) in 2010 and Triangle Transit's AA and New Starts project in 2012. The version of the model resulting from the DCHC MPO project (hereinafter referred to as "TRM Version 4 Enhanced" or "TRM4E.1") included re-estimated and calibrated trip generation and destination choice models using the latest household travel survey and enhanced treatment for non-motorized trips. Triangle Transit's study team elected to use TRM4E.1 as the base model for the AA and New Starts submittal and made project-specific enhancements; the final version of this model is called TRM4E.2. The TRM4E.2 model development process included expanded calibration and validation efforts; in particular it included the use of the 2006 household travel survey and the 2006 transit onboard survey. Major refinements focused on the mode choice model and associated components for the AA and the New Starts forecasting.

TRM Version 5 incorporated the enhancements that were developed as part of TRM4E.1 and TRM4E.2 and additional enhanced model features under the expanded geography. TRM Version 5 includes the following major features:

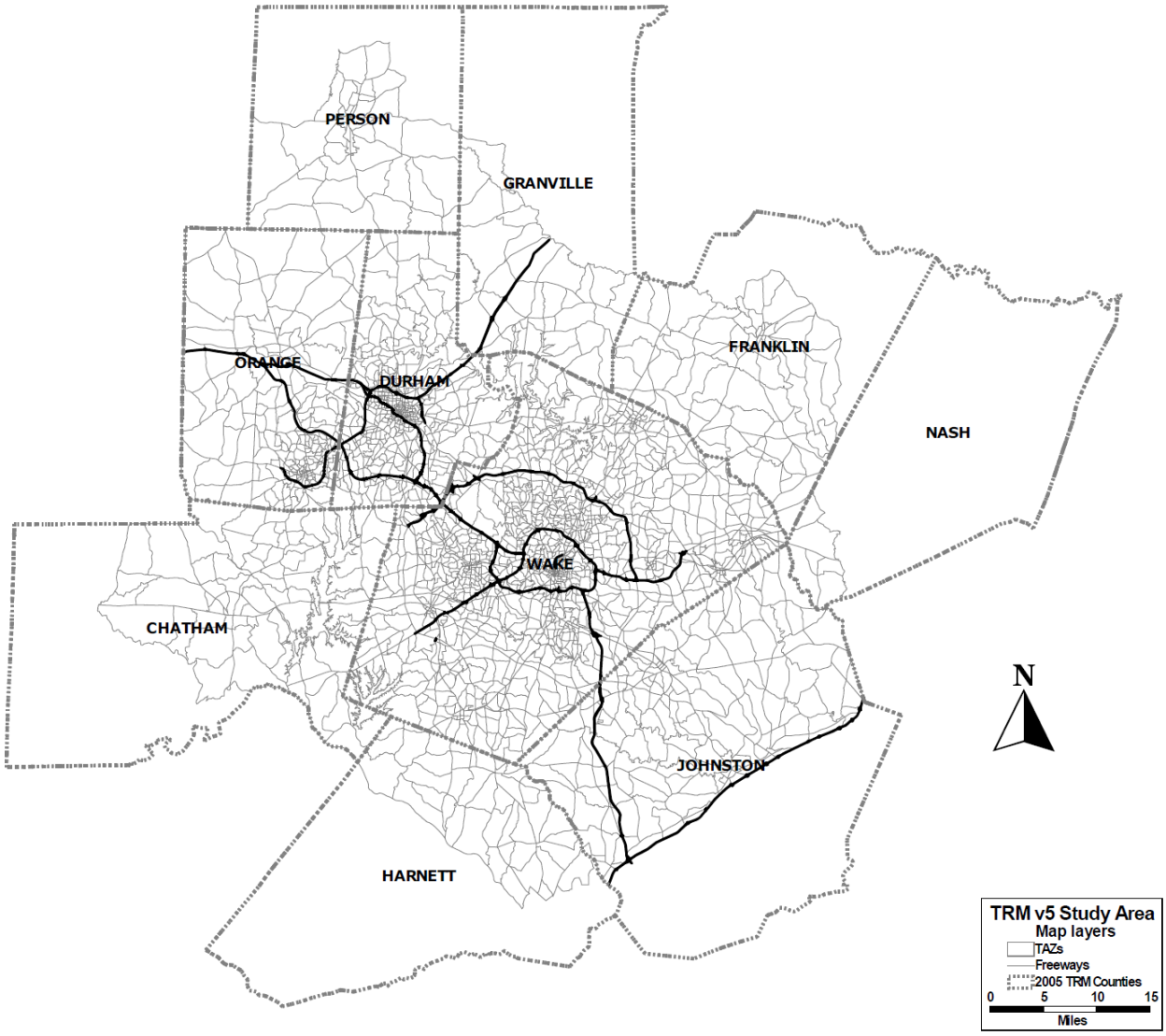
- A multinomial-logit-based trip production model and trip attraction share model with seven trip purposes (home-based work [HBW], home-based shopping [HBSh], home-based school [HBSc], home-based other [HBO], non-home-based work [NHBW], and non-home-based non-work [NHBNW]), in addition to home-based university [HBU]
- A multinomial-logit-based destination choice model with logsum feedback from the mode choice model
- Non-motorized trips estimated through a binary choice model used to split non-motorized and motorized trips, after destination choice, with bicycle trips and walk trips together
- A nested-logit-based mode choice model, with a special trip type called auto-intercept, three private transportation modes (single occupancy vehicles, high occupancy vehicles (HOV) for two persons [HOV2], HOV for three or more persons [HOV3]), three public transportation modes (local bus, express bus, and rail), and three modes of access (walk access, park and ride, and drop off)
- Commercial vehicle trips modeled for three vehicle types, including autos, pick-ups, and trucks
- A multimodal multiclass user equilibrium highway assignment and pathfinder transit assignment, with an iterative feedback mechanism through the destination choice, non-motorized trip split, mode choice, and assignment modules

- Tolls reflected in all the steps of the model, except for trip generation, with tolls incorporated with travel times via the value of time to form generalized costs
- Passengers' traveling to and from the Raleigh-Durham Airport explicitly modeled as home-based, work-based, private-residence-based, and non-home non-work based categories
- Three time periods (morning peak, evening peak, and off-peak) for highway assignment (for transit assignment, peak and off-peak levels of service and assignments are used)

2.2 Geographic Area Coverage

The TRM Version 5 Enhanced models cover the Triangle region, which includes CAMPO, DCHC MPO, and portions of several surrounding counties including Chatham, Harnett, Johnston, Franklin, Nash, Person, and Granville. Durham, Orange, and Wake counties are included completely within the model region; only a portion of the other seven counties are within the model region. The major geographic divisions include transportation analysis zones (TAZ), model analysis districts, and counties. Figure 2-1 shows the TRM Version 5 modeling domain and jurisdictions.

Figure 2-1: TRM Version 5 Modeling Domain



Source: Triangle Regional Model Service Bureau, 2012, Triangle Regional Model Version 5.

Based on the 2013 population estimates from the U.S. Census Bureau, the major centers in the Triangle Region are the City of Raleigh, with a population of approximately 430,000; the City of Durham, with a population of approximately 245,000; the Town of Cary, with an estimated population of approximately 151,000; and the Town of Chapel Hill, with an estimated population of approximately 60,000.

As of 2005, the model region covered a population of 1.388 million and approximately 716,000 jobs. By 2040, both the number of residents and the number of jobs in the region are expected to double, with 50 percent of the population growth and 70 percent of the employment growth occurring in the rail corridors[1] currently being studied.

[1] Broadly defined to include any modeling district containing the Light Rail Alternatives.

2.3 Travel Markets

In this section, characteristics of travel markets in the region are briefly summarized and used as background and useful information for model validation and reasonableness checking. The regional travel patterns can be characterized in the following terms:

- Three primary counties – Wake, Durham, and Orange
- Three primary urban districts – Chapel Hill, Durham, and Raleigh
- Three primary trip purposes – HBU, HBW, and NHBW/NHBNW

Regional travel patterns are dominated by the three primary counties, with Wake County comprising more than half of regional travel. Most travel in the region occurs within a single county (intracounty travel). Transit trips echo these overall patterns, and the largest intercounty transit market is between Durham and Orange counties. Table 2-1 breaks down HBW travel at the county level based on the 2006 Household Travel Survey, while Table 2-2 uses the 2006 Transit On Board survey to analyze regional transit travel patterns for HBW.

Table 2-1: Travel Patterns by County (2006 Household Travel Survey)

	Chatham	Durham	Franklin	Granville	Harnett	Johnston	Orange	Wake	Total
Chatham	3,648	3,957	-	-	-	-	4,792	2,629	15,026
Durham	776	131,571	-	1,602	-	-	26,735	22,016	182,700
Franklin	-	2,931	2,628	1,301	-	416	434	13,128	20,839
Granville	182	4,804	338	4,643	-	-	-	4,745	14,712
Harnett	184	288	-	-	1,914	-	204	5,636	8,227
Johnston	-	1,924	-	166	709	14,245	-	27,612	44,656
Orange	480	26,820	201	-	-	-	62,656	8,261	98,417
Wake	904	79,206	1,925	862	949	3,136	10,138	416,932	514,052
Total	**6,174**	**251,501**	**5,092**	**8,574**	**3,572**	**17,797**	**104,959**	**500,960**	**898,629**

Table 2-2: Transit Travel Patterns by County (2006 Transit On Board Survey)

	Chatham	Durham	Franklin	Granville	Harnett	Johnston	Orange	Wake	Total
Chatham	-	12	-	-	-	-	99	10	120
Durham	6	5,271	-	-	-	-	1,857	154	7,288
Franklin	-	5	-	-	-	-	-	7	12
Granville	-	26	-	-	-	-	-	14	40
Harnett	-	4	-	-	-	-	-	-	4
Johnston	-	-	-	-	-	-	-	1	1
Orange	-	620	-	-	-	-	4,572	61	5,253
Wake	-	775	-	-	-	1	492	4,524	5,792
Total	**6**	**6,712**	**-**	**-**	**-**	**1**	**7,021**	**4,771**	**18,511**

Data source: 2006 Transit On Board Survey.

At the small area level, the three urban centers of Raleigh, Durham, and Chapel Hill are major centers for transit travel in the Triangle region.

Transit trips in the region serve three major purposes, which account for almost 90 percent of transit travel: commuter trips (HBW), university trips (HBU), and NHBW/NHBNW (primarily university related travel). For all three purposes, intracounty travel is dominant. Although HBU and Non Home Based Trips (NHB), which include NHBW and NHBNW, have almost 90 percent of their transit trips as intracounty trips, HBW is somewhat lower at 74 percent. Overall, university-related trips are the most significant element of the regional transit market, accounting for almost 60 percent of total transit trips in the region. As shown in Table 2-3, the NCSU Wolfline and CHT are dominated by HBU trips, whereas C-Tran, Triangle Transit, and CAT primarily serve work trips. NHB trips are particularly important for Duke University Transit, which may be related to the number of transit trips taken between the two Duke campuses.

Table 2-3: Trip Purpose by Transit Operator

Purpose	Triangle Transit	CAT	CHT	DATA	Wolfline	Duke	C-Tran	Total
HBW	62%	46%	28%	37%	4%	22%	63%	28%
HBSh	1%	9%	2%	10%	-	-	17%	3%
HBSc	-	1%	-	3%	1%	-	4%	1%
HBO	6%	21%	4%	21%	-	3%	8%	7%
NHB	12%	17%	14%	21%	27%	42%	8%	23%
HBU	20%	6%	51%	8%	67%	33%	-	38%

A significant portion of low-income and transit-dependent riders use the various transit systems in the Triangle region. Regionally, 39 percent of transit trips are attributable to riders with household incomes below $15,000. This holds true for the university bus services as well as the more traditional transit operators. The exceptions are C-Tran and Triangle Transit, which each have only 20 percent of riders with incomes below $15,000. Transit dependency is also a driving force for transit usage in the Triangle region: 27 percent of riders report no household vehicles, and an additional 13 percent report living in households with fewer vehicles than workers.

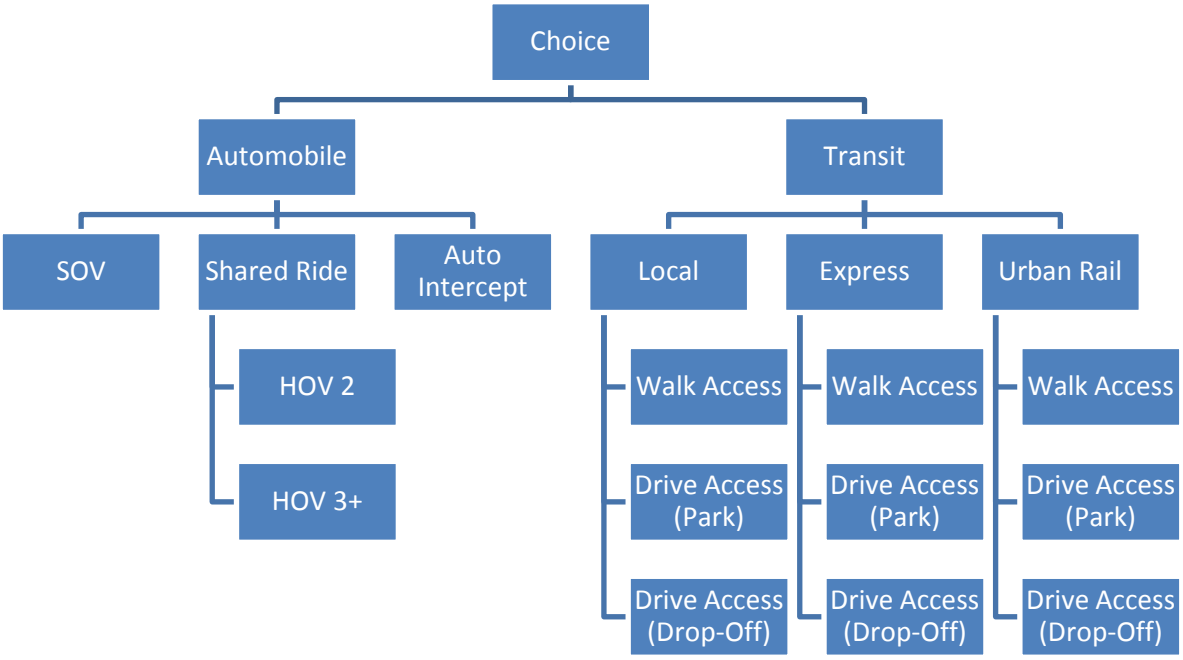
3. Review of the Mode Choice Model and Transit Elements

This section details the mode choice model, which is most directly related to forecasting transit ridership in the major travel markets. The structure of the mode choice model is explained, with a focus on how the TRM Version 5 is consistent with FTA recommendations and guidance.

3.1 Structure

The mode choice model of TRM has a nested logit model structure, with motorized trips split into auto and transit at the top level, as shown on Figure 3-1. As recommended by FTA, no non-logit decision rules are used within the TRM.

Figure 3-1: Mode Choice Model Structure



The auto mode is further split into single-occupancy vehicles, shared ride (two-person occupancy vehicles and three-plus person occupancy vehicles), and auto intercept. Auto intercept is a mode in which, due to parking restraints at the University of North Carolina at Chapel Hill (UNC), drivers must park at satellite parking lots and take a shuttle bus to campus. The transit mode includes three submodes (local bus, express bus, and rail) and three modes of access (walk access, park-and-ride, and kiss-and-ride [drop off]).

Market segmentation for mode choice includes seven trip purposes (HBW, HBSh, HBSc, HBU, HBO, NHBW, and NHBNW), two time periods (peak and off-peak), and five socioeconomic strata. Peak trip tables are split into morning peak and evening peak after the mode choice process for assignment to the highway network. The five socioeconomic strata are defined as follows:

- Strata 1 – Households with no vehicles (of all income levels)
- Strata 2 – Low income households with at least one vehicle
- Strata 3 – Low-medium and high-medium income households with fewer vehicles than workers, but with some vehicles

- Strata 4 – Low-medium and high-medium income households with vehicles equal to or more than workers
- Strata 5 – High-income households with at least one vehicle

3.2 Coefficients

The mode choice model coefficients are asserted coefficients, as early household travel survey and onboard survey data were not adequate for model estimation. Table 3-1 summarizes the coefficients for the key explanatory variables by purpose.

Table 3-1: Coefficients of Explanatory Variables in the Model

Item	HBW	HBSh	HBSc	HBO	HBU	NHB
In-vehicle time	-0.025	-0.01	-0.01	-0.01	-0.025	-0.02
First wait	-0.05	-0.025	-0.025	-0.025	-0.05	-0.05
Transfer wait	-0.05	-0.025	-0.025	-0.025	-0.05	-0.05
Walk time	-0.0625	-0.025	-0.025	-0.025	-0.625	-0.05
Drive time	-0.05	-0.025	-0.025	-0.025	-0.05	-0.05
Cost, Strata 1	-0.00439	-0.00176	-0.00176	-0.00176	-0.00439	-0.00351
Cost, Strata 2	-0.00545	-0.00218	-0.00218	-0.00218	-0.00545	-0.00436
Cost, Strata 3	-0.00188	-0.00075	-0.00075	-0.00075	-0.00188	-0.00150
Cost, Strata 4	-0.00175	-0.00070	-0.00070	-0.00070	-0.00175	-0.00140
Cost, Strata 5	-0.00086	-0.00034	-0.00034	-0.00034	-0.00086	-0.00069

3.2.1 Coefficient of In-Vehicle Time (Civtt)

FTA recommends that the Civtt for HBW trips fall within the range $0.03 < \text{Civtt} < 0.02$ and there are no variations by mode. In TRM Version 5, the Civtt of -0.025 for HBW and HBU and -0.02 for NHB are within this recommended range. The Civtt of -0.01 for HBSh, HBSc, and HBO is half of Civtt for HBW trips, which is within the FTA recommended range. The Civtt are the same across all the various transit submodes as recommended by FTA.

3.2.2 Coefficient of Out-of-Vehicle Time (Covtt)

FTA recommendations indicate that Covtt is dependent on Civtt such that:

$$2.0 < \frac{Covtt}{Civtt} < 3.0$$

As shown in Table 3-1, Covtt/Civtt is equal to 2 for HBW and HBU, except for walk time, which has a ratio of 2.5, and 2.5 for NHB, HBSh, HBSc, and HBO. These asserted values are within the FTA recommended range.

3.2.3 Implicit Value of Time (VOT=Civtt/Ccost)

FTA recommends that value of time (VOT), calculated as Civtt divided by the coefficient of cost (Ccost), should be within the range:

$$\frac{AverageWage}{4} < \frac{Civtt}{Ccost} < \frac{AverageWage}{3}$$

Therefore, large cost-related differences will not be observed in the utilities of different alternatives.

TRM Version 5 has cost coefficients segmented by strata (a combination of auto availability and household income), with values devised based on average household income and values of time. The value of time is assumed to equal one-third of the hourly wage, consistent with FTA recommendations.

3.2.4 Alternative-Specific Constants

The TRM Version 5 mode choice model has alternative-specific constants specified by trip purpose, by time period (peak and off-peak), by mode (transit, share ride, auto intercept, HOV3+), and by five socioeconomic strata.

Consistent with FTA recommendations, no geography-based constants are used in the model. In addition, the constants for line-haul modes (specifically express bus) remain constant across all strata. Strata-based constants are applied to mode nests (i.e., auto, transit), auto nests (i.e., drive alone, shared ride, and auto intercept), and transit access mode nests (i.e., walk access, park and ride, and drop off).

The transit constants, as documented on pages 5-8 to 5-18 in the *Triangle Regional Model Version 5: Model Documentation Report (available on the project website)*, are mostly negative. The few positive values are associated with socioeconomic Strata 1 (households with no vehicles) and logically indicate a strong preference for transit. The highly negative transit constants indicate a strong preference for not using transit and are mostly associated with the highest income households (Strata 5) and households with access to many vehicles (Strata 4), as would be expected. Generally, the transit constants by strata show a plausible pattern for the majority of trip purpose/time period combinations, although there are a few anomalies.

Conventional travel demand modeling includes quantifiable variables that affect travelers' mode choice behavior in terms of time and cost. A major factor that seems to impact the demand for transit is the preference for the trip maker to use a premium transit mode such as fixed-guideway projects (LRT and Bus Rapid Transit [BRT]). However, the unmeasured attributes affecting the choice of mode by the trip maker cannot be directly addressed with level-of-service variables. The aggregate effects of those variables that cannot be quantified are typically reflected by constants in the mode choice model. These constants are usually calibrated using local transit survey data. As typical of a region without an operating fixed-guideway, the Triangle region's travel demand model was developed and calibrated on transit surveys of the current bus users, which did not reflect the potential attractiveness of a fixed-guideway service to riders if one were introduced to the market.

FTA has issued guidance regarding appropriate levels of constants to consider when representing potential unmeasured attributes of fixed-guideway modes. Three categories of attributes are recognized for credits, including guideway-like characteristics, span of good service, and passenger amenities. Two types of adjustments can be made for unmeasured attributes of fixed guideway in the areas where a new fixed guideway would be introduced. First, FTA assigns a credit in terms of equivalent minutes of travel time savings to increase the attractiveness of the new guideway for guideway trips. Second, a discount on the weight applied to in-vehicle travel time on the guideway is determined to increase the attractiveness of guideway travel. FTA assigns specific values for these two types of credits, based on the specific characteristics of a project in each of the three categories of unmeasured attributes. The maximum values are 15 minutes of time savings for each rider and a 20 percent discount on the travel time weight.

As the forecasting methodology was refined for the New Starts application, refined credits were implemented in the mode choice model in TRM Version 5 to accommodate two different credits for two types of trips – guideway-only trips and guideway-plus-local-bus trips. At the same time, a discount on

the travel time weight for guideway trip travel time was incorporated. The rationale for accounting guideway-like characteristics for these credits/discounts are presented in Table 3-2. These credits and discounts are subject to the FTA's review for approval.

3.3 Transit System

The transit networks represented in TRM Version 5 are based on the long-range planning transit networks that reflect the 2040 Metropolitan Transportation Plan (2040 MTP), adopted in December 2012. The 2040 MTP transit networks have been updated based on the service plans proposed for the D-O LRT under study, with refined feeder bus networks to better serve the corridor. Other proposed rail services in other corridors were not included in the network for this study.

Table 3-2: Unmeasured Attributes of Guideway Transit

Guideway Attributes	Max credit	Existing Local Bus/No Build	D-O LRT
Guideway-like characteristics	8		
1. Reliability of vehicle arrival	4	▪ No exclusive guideway and not grade-separated. ▪ No signal priority or pre-emption at grade locations. ▪ Operate in mixed traffic, with frequent stops.	▪ Exclusive guideway and grade-separated, except in select locations. ▪ Plan to implement signal priority or pre-emption at grade locations. ▪ Long station spacing: 1 mile per station, higher than the median of existing LRT systems as of 2002 (0.83). ▪ Proposed Credit: 2.0
2. Branding/ visibility/ learnability	2	Four transit providers operate in the corridor, including CHT, DATA, Triangle Transit, and Duke University.	▪ Stations, vehicles, and fixed guideways are distinctive and the system is easy to identify and use. ▪ Transit referendum was carried out in Durham County in November 2011 and Orange County in November 2012, increasing the awareness and visibility of the proposed fixed guideway projects in the Triangle region. ▪ Proposed Credit: 2.0
3. Schedule-free service	2	Headways: peak 15 minutes, off-peak 60 minutes	▪ Headways: peak 10 minutes, off-peak 20 minutes. ▪ Proposed Credit: 1.5

Guideway Attributes	Max credit	Existing Local Bus/No Build	D-O LRT
Span of good service	3	Operation hours vary by providers and routes, and some examples are as follows: Triangle Transit: 6:00 a.m. to 10:30 p.m. DATA: 5:30 a.m. to 12:30 a.m. CHT: 5:00 a.m. to 1:15 a.m. Duke: 7:20 a.m. to 3:55 a.m.	▪ Operation hours from 5:30 a.m. to 12:00 a.m., and headways in off-peak hours are 20 minutes. Service span would be vastly increased during off-peak times and particularly weekends, which is far superior than is provided today in the corridor. ▪ Proposed Credit: 3.0
Passenger amenities at stations/stops	4		
1. Physical characteristics	3	No station amenities.	▪ Station amenities include the following: ○ Safety and security features such as good lighting ○ Modern good-looking shelters to protect from bad weather ○ Good maintenance and cleanliness ○ Comfortable benches ○ Spacious platform with good visibility and sightlines ○ Provision of bicycle storage at park-and-ride lots ○ Information kiosks ▪ Proposed Credit: 1.5
2. Dynamic schedule information	1	Triangle Transit has recently provided real-time arrival predictions for six transit providers in the region.	▪ Provision of real-time information on vehicle arrivals – Signs show minutes until next arrival/ departure. Transit routes and schedules are clearly posted. Service change information is posted and announced. ▪ Triangle Transit has provided real-time arrival predictions for six transit providers in the region. ▪ Proposed Credit: 1.0
TOTAL Lump Sum Credit	15		***Proposed Credit: 11***

4. Model Refinements, Calibration, and Validation

The TRM Version 5 model development process included expanded calibration and validation efforts, including the following:

- The mode choice model constants were recalibrated using the 2006 household and transit-onboard travel surveys.
- Highway assignment results were calibrated and validated to 2005 and 2010.
- Transit assignment results were calibrated and validated to 2005 and 2010.
- The whole model chain was calibrated and validated to 2005 and 2010.
- Sensitivity testing and reasonableness checks were conducted, including comparison of the 2035 LRTP scenario between TRM Version 5 and Version 4, comparing growth trends, high land use density test, highway lane/capacity reduction test, high and low transit headway tests, high rail speed test, high parking cost test, non-motorized path density test, and low average block size test.

4.1 Model Refinements

For the DEIS ridership forecasting, major refinements to the TRM Version 5 mode choice model and associated components included the following:

- Drive access link coding was limited to 45 minutes for auto intercept lots and rail termini, and 30 minutes for the remaining lots.
- The alternative specific constants for fixed guideways were modified to comply with further FTA guidance on representing two types of adjustments that can be made for unmeasured attributes of fixed guideways in the areas where a new fixed guideway would be introduced.
  - First, a credit in terms of equivalent minutes of travel time savings is given to increase the attractiveness of the new guideway for all guideway trips.
  - Second, a discount on the weight applied to in-vehicle travel time on the guideway is determined to increase the attractiveness of guideway travel, favoring those with a long guideway travel time.

  A distinction was made for guideway-only and guideway-and-local-bus trips; a full credit was given to the drive-access guideway-only trips, and a partial credit was given to guideway-and-local-bus trips and non-drive-access guideway-only trips.
- To account for expanded pre-paid transit services and programs since 2005/2010, the model validation years, appropriate average fare model inputs were estimated based on recent data.

4.2 Model Validation Summary

Estimated travel time values were compared with observed travel time values for both highway and transit. The simulated bus run time matches reasonably well with the scheduled bus travel time. A simple regression between the simulated and scheduled values indicates that the model explains 90 percent of the variations. Overall, the simulated bus run time is slightly lower than the schedule run time. Similarly, simulated highway travel time for select freeway and arterial segments tends to be lower than the observed travel time.

Transit and mode choice validation summaries for the base years 2005 and 2010 are shown in Table 4-1 through Table 4-5. As shown in Table 4-1, the model slightly underestimates 2005 transit ridership, with a deviation of 1.9 percent for the region's transit systems as a whole. The model estimates compared well with the observed ridership at the provider level, with deviations of 10 percent or less, except for C-Tran in Cary, which had a very small ridership in 2005. Table 4-2 shows that the model slightly overestimates 2010 transit ridership by 3.2 percent for the region's transit systems as a whole. Again at the provider level, the percent deviation from the observed ridership is mostly 10 percent or less, except for C-Tran in Cary, which had a small ridership in 2010[2].

Table 4-3 tabulates the comparison of model-estimated and observed transit trip shares by trip purposes, showing similar distributions of transit trips among the seven trip purposes.

Table 4-4 compares the observed mode shares from the 2006 household travel survey with the model's estimated 2005 mode shares. On a regional basis, the percent splits are similar between estimated and observed transit shares for all six modes.

Table 4-1: Assigned versus Observed Transit Ridership for 2005

Transit Operator	Observed Ridership	Modeled Peak Ridership	Modeled Off-Peak Ridership	Modeled All Ridership	Modeled Percentage Deviation
Triangle Transit	4,472	3,944	1,002	4,946	10.6%
CAT	13,912	7,677	6,073	13,750	-1.2%
CHT	26,201	12,561	11,268	23,830	-9.0%
DATA	14,241	6,371	8,322	14,693	3.2%
NCSU	11,272	4,788	5,497	10,284	-8.8%
Duke	13,985	6,915	7,164	14,079	0.7%
C-Tran	297	512	672	1,184	298.7%
Total	**84,380**	**42,768**	**39,998**	**82,766**	**-1.9%**

Table 4-2: Assigned versus Observed Transit Ridership for 2010

Transit Operator	Observed Ridership	Modeled Peak Ridership	Modeled Off-Peak Ridership	Modeled All Ridership	Modeled Percentage Deviation
Triangle Transit	5,918	4,007	1,332	5,339	-9.8%
CAT	15,816	8,712	8,051	16,763	6.0%
CHT	27,273	14,235	12,715	26,949	-1.2%
DATA	15,965	7,937	9,760	17,697	10.8%
NCSU	12,070	5,669	6,558	12,227	1.3%
Duke	13,985	6,872	7,190	14,062	0.6%
C-Tran	490	623	813	1,436	193.1%

[2] C-Tran introduced fixed route bus service in 2006. Ridership on C-Tran's fixed route service increased 375 percent between 2007 (first full year of revenue service) and 2012 (most recent data available through National Transit Database http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2007/agency_profiles/4143.pdf, and http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2012/agency_profiles/4143.pdf).

Transit Operator	Observed Ridership	Modeled Peak Ridership	Modeled Off-Peak Ridership	Modeled All Ridership	Modeled Percentage Deviation
Total	**91,517**	**48,055**	**46,419**	**94,473**	**3.2%**

Table 4-3: Transit Trips by Trip Purposes (2005)

Trip Purpose	Peak	Off Peak	Daily	Estimated Percentage Total	Observed Percentage Total
HBW	11,794	5,793	17,587	26.8%	27.0%
HBSh	1,086	1,295	2,381	3.6%	3.4%
HBSch	330	257	587	0.9%	0.9%
HBO	2,199	2,929	5,128	7.8%	7.8%
WBNH	1,464	1,862	3,326	5.1%	5.3%
NHNW	2,630	5,368	7,998	12.2%	11.7%
HBU	13,431	15,273	28,704	43.7%	44.0%
Total	**32,934**	**32,777**	**65,711**	**100%**	**100%**

Table 4-4: Observed (2006) and Estimated (2005) Mode Shares of Motorized Travel

Trip Purpose	SOV	HOV2	HOV3+	Auto Intercept	Local Bus	Express Bus
Strata 1	17.3%	58.3%	1.7%	0.5%	20.7%	1.5%
Strata 2	54.0%	32.1%	12.0%	0.0%	1.8%	0.1%
Strata 3	34.1%	35.1%	27.4%	0.0%	3.2%	0.2%
Strata 4	57.2%	26.8%	15.6%	0.0%	0.4%	0.0%
Strata 5	54.8%	29.0%	16.1%	0.0%	0.2%	0.0%
Total Estimated	**53.6%**	**29.8%**	**15.1%**	**0.0%**	**1.3%**	**0.1%**
Total Observed	**53.9%**	**29.6%**	**15.0%**	**0.0%**	**1.3%**	**0.1%**

Highway assignment results were summarized and evaluated for the study area (Table 4-5). The highway assignments in the study area compared reasonably well with the observed traffic volumes in 2010, with slight over-simulation for freeways and major arterials and under-simulation for lower classes of roadways. Transit assignment results for the bus routes in the corridor were compared with observed ridership for 2005 and 2010. With a less than 10 percent difference for the corridor bus routes as a whole between the observed and model estimated, the base year models for 2005 and 2010 appear to represent the transit market in the corridor reasonably well.

Detailed model validation at the district and corridor level was conducted for the Triangle Regional Transit Program AA and the Durham-Chapel Hill Corridor LRT New Starts application. Details can be found in the Travel Demand Methodology Report, which is part of the Supporting Documentation and Technical Reports, for the D-O LRT New Starts Submissions in September 2012.

Table 4-5: Observed and Estimated Daily Traffic Volumes (2010) by Functional Class Group

Functional Class Group	Model Estimates	Observed	% Deviation	%RMSE
Freeway	1,526,235	1,394,000	9%	23%
Major arterial	999,567	890,400	12%	39%
Minor arterial	1,508,810	1,647,870	-8%	38%
Collector	222,885	257,090	-13%	50%
Local road	245,763	297,460	-17%	63%
Total	**4,503,260**	**4,486,820**	**0%**	**37%**

5. Model Application for Ridership Forecasting

The refined and validated TRM Version 5 model was used to develop ridership forecasts for the D-O LRT Project. The 2040 No-Build and Light Rail Alternatives were modeled based on the definitions of alternatives as described in the EIS, and according to the Transit Operating Plan. The base 2040 transportation network reflects the 2040 MTP, which was adopted by the DCHC MPO and CAMPO. The 2040 MTP has significant expansion of the region's transit network with revenues from the recently approved sales tax referendum and vehicle registration fees, including the D-O LRT Project in its transit network and regional commuter rail between Raleigh and Durham. The 2040 MTP transportation network was modified in defining this project's No-Build Alternative and Light Rail Alternatives.

The 2040 No-Build alternative network has the following modifications, with the details discussed in the *Transit Operating Plan*:

- Proposed rails (D-O LRT and regional commuter rail) were removed.
- Several feeder routes associated with the D-O LRT were removed.
- Several Triangle Transit routes were removed.
- Several routes were added to the 2040 No-Build network, including Triangle Transit Routes 400A and 400B, Triangle Transit Routes 700 and DRX, and Bull City Connector.

The Light Rail Alternatives consist of LRT service from UNC Hospitals in Chapel Hill to Alston Avenue in Durham, with 17 stations proposed along this 17-mile alignment. The Transit Operating Plan (Appendix G of the EIS) has detailed descriptions of the alignment by segment, station locations, estimated LRT travel times, the proposed service plan, and estimated operating requirements.

- The 2040 Light Rail Alternatives have alignment variations for several segments, including Little Creek Segment (C) between Hamilton Road Station and Leigh Village Station, NHC Segment between Patterson Place Station and Martin Luther King Jr. Parkway Station, and Duke/VA Medical Centers Station.
- The proposed service frequencies are every 10 minutes for peak and every 20 minutes for off-peak on a weekday.
- Station-to-station travel times were developed and coded for the 2040 Light Rail Alternatives, with the C1A Alternative longer than C2A by 50 seconds and NHC 1 shorter than NHC 2 by 34 seconds.
- To account for the pre-paid transit pass program, a weighted average fare input was developed for each service provider using available data on average fare paid. For the Light Rail Alternatives, the estimated fare used was calculated based on the expected market penetration of pre-paid fares.
- To integrate with the LRT, bus systems were modified for Triangle Transit, DATA, and CHT routes in the corridor, including elimination of competing bus services, modifications to the background bus network to work with the LRT, and introduction of new feeder bus routes.

Travel times were calculated for the Light Rail Alternatives based on operational and alignment characteristics such as horizontal curves, vertical grades, and operating environment (i.e., exclusive right-of-way versus mixed traffic). The calculations assume a 20 second dwell time for each station stop and a 3.0 miles per hour per second (mphps) acceleration and deceleration rate. Potential delays when crossing at-grade intersections were estimated with the assistance of project engineers, considering

intersections likely to have full priority given to LRT (i.e., gated crossings or full signal preemption) and those assumed to have partial signal preemption.

Given the similarities among the combinations of three segment variations, seven representative alternatives were selected for network coding and model runs. These model runs generated the results that showed relative differences among the three types of variations, which were used to derive ridership estimates for the remaining alternatives.

The 2040 ridership forecasts were prepared for 24 alternatives. Ridership forecasts are also summarized by boardings and deboardings at the station level, by modes of access at the station level, by trip purposes, and by transit-dependents.

Travel times were calculated for the alternatives based on operational and alignment characteristics such as horizontal curves, vertical grades, and operating environment. Travel times for each alternative are presented in the Transit Operating Plan.

Given the similarities among the combinations of three segment variations, seven representative alternatives were selected for network coding and model runs. These model runs generated the results that showed relative differences among the three types of variations, which were used to derive ridership estimates for the remaining alternatives.

Table 5-1 shows a summary of 2040 ridership forecasts for all 24 alternatives. Ridership forecasts are also summarized by boardings and deboardings at the station level, by modes of access at the station level, by trip purposes, and by transit-dependents. Table 5-2 presents the 2040 ridership forecast for C1A-NHC 2-Duke Eye Center alternative, the lowest ridership alternative, and the incremental ridership gain by selecting various alternatives. It also includes daily corridor bus ridership and vehicle miles traveled (VMT) forecasts. Table 5-3 shows the shares of LRT ridership forecasts by trip purposes and transit-dependent population for one alternative; the results are similar for other alternatives. Station-level activities for boardings and deboardings by directions are displayed in Tables 5-4 through 5-27.

Some of the major findings are as follows:

- Ridership forecasts for the D-O LRT range from 21,840 to 23,200 boardings for an average weekday for alternatives under consideration.
- Differences in daily LRT ridership were estimated to be 300 between C2A and C2 alignments. C1 and C1A were forecast to generate a lower ridership than C2A and C2, with the biggest difference being 1,020 boardings between C1A and C2A.
- The three different alignments for Segment NHC were estimated to generate similar ridership forecasts, with a difference of less than 200 in daily ridership, with NHC LPA as the highest and NHC 2 as the lowest.
- The differences as a result of two Duke/VA Medical Centers Station alternatives were estimated to be small, with less than 200 in daily ridership differences, with the Trent/Flowers Alternatives providing slightly higher ridership.
- The Light Rail Alternatives will have VMT reductions relative to the 2040 No-Build scenario, mostly in the range of 70,000 to 90,000.
- Work-related trips (home-based work and work-based non-home trips) were estimated to account for almost half of the total estimated LRT ridership, and home-based university student trips were forecast to share 15 percent of total daily ridership.

- Zero-vehicle households were estimated to take 40 percent of the total daily ridership, while low-income households with any vehicle will share a quarter of the total daily ridership.
- On a daily basis, walk access was forecast to account for more than half of the total ridership, with the remaining split between drive access and bus transfers.
- Major attraction stations include UNC Hospitals, Duke/VA Medical Centers, and Durham Stations, with the largest numbers of deboardings in the morning peak period.
- Major production stations include Alston Avenue, Leigh Village, Friday Center Drive, and Durham, with the largest numbers of boardings in the morning peak period.

Table 5-1: 2040 Daily Ridership Forecasts by Modes of Access by Alternatives

Alternatives	Walk Access	Bus Transfers	Drive Access	Total
C1 NHC LPA Trent/Flowers Drive	11,830	5,490	5,410	22,640
C1A NHC LPA Trent/Flowers Drive	11,770	5,170	5,310	22,180
C2 NHC LPA Trent/Flowers Drive	12,160	5,610	5,290	22,900
C2A NHC LPA Trent/Flowers Drive	12,300	5,700	5,300	23,200
C1 NHC 1 Trent/Flowers Drive	11,760	5,470	5,410	22,580
C1A NHC 1 Trent/Flowers Drive	11,700	5,150	5,310	22,120
C2 NHC 1 Trent/Flowers Drive	12,090	5,590	5,290	22,840
C2A NHC 1 Trent/Flowers Drive	12,230	5,680	5,300	23,140
C1 NHC 2 Trent/Flowers Drive	11,710	5,430	5,370	22,460
C1A NHC 2 Trent/Flowers Drive	11,650	5,110	5,270	22,000
C2 NHC 2 Trent/Flowers Drive	12,040	5,550	5,250	22,720
C2A NHC 2 Trent/Flowers Drive	12,180	5,640	5,260	23,020
C1 NHC LPA Duke Eye Center	11,660	5,470	5,380	22,480
C1A NHC LPA Duke Eye Center	11,600	5,150	5,280	22,020
C2 NHC LPA Duke Eye Center	11,990	5,590	5,260	22,740
C2A NHC LPA Duke Eye Center	12,130	5,680	5,270	23,040
C1 NHC 1 Duke Eye Center	11,590	5,450	5,380	22,420
C1A NHC 1 Duke Eye Center	11,530	5,130	5,280	21,960
C2 NHC 1 Duke Eye Center	11,920	5,570	5,260	22,680
C2A NHC 1 Duke Eye Center	12,060	5,660	5,270	22,980
C1 NHC 2 Duke Eye Center	11,540	5,410	5,340	22,300
C1A NHC 2 Duke Eye Center	11,480	5,090	5,240	21,840
C2 NHC 2 Duke Eye Center	11,870	5,530	5,220	22,560
C2A NHC 2 Duke Eye Center	12,010	5,620	5,230	22,860

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-2 presents the 2040 ridership forecasts for the alternatives considered. The No-Build Alternative ridership is presented in the first column. The combination of alternatives which would have the lowest light rail ridership, including the common segments of the Light Rail Alternative, C1A, NHC 2, and Duke Eye Center Alternative, is presented in the second column and the subsequent columns indicate the incremental ridership gain if other alternatives were selected. The selection of the ROMF alternative is not anticipated to affect ridership.

Table 5-2: 2040 Daily Ridership and VMT Forecasts Comparison

Ridership	No-Build Alt.	Lowest Ridership Alternative	Additional Ridership with each Alternative (Lowest Ridership Alternative + Little Creek Alternative + New Hope Creek Alternative + Duke/VA Medical Centers)					
			Little Creek Alternatives			New Hope Creek Alternatives		Duke/ VA Medical Centers
		C1A NHC 2 Duke Eye Center	C1 Alt.	C2 Alt.	C2A Alt.	NHC-LPA Alt.	NHC 1 Alt.	Trent/ Flowers Alt.
2040 Daily Ridership Forecast		21,840	+460	+720	+1,020	+180	+120	+160
2040 Daily Corridor Bus Boarding Forecast	20,240	17,550	-440	-1,310	-480	+60	-0	-80
2040 Daily VMT Forecast	81,508,987	81,441,000	1,000	3,000	-7,000	-14,000	-6,000	-5,000

Table 5-3: 2040 Daily Ridership Forecasts by Trip Purposes and Transit-Dependent Populations

Alternative	Trip Purposes	Share (%)
C2A NHC 2 Trent/Flowers Drive	Work (Home-Based Work)	39%
	Shopping (Home-Based Shopping)	12%
	School (Home-Based School)	2%
	Other (Home-Based Other)	11%
	Work-Based Non-Home Trips	9%
	Non-Home-Based Non-Work Trips	12%
	College (Home-Based University)	15%
	Zero Vehicle Households	40%
	Low-Income Households with any Car	25%

Table 5-4: 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC LPA-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,630	0	0	2,630

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
Mason Farm Road	1,010	50	50	1,010
Hamilton Road	220	80	80	220
Friday Center Drive	540	1,010	1,010	540
Meadowmont	310	260	260	310
Leigh Village	510	1,190	1,190	510
Gateway	610	610	610	610
Patterson Place	590	680	680	590
Martin Luther King Jr. Parkway	750	850	850	750
South Square	890	470	470	890
LaSalle Street	630	770	770	630
Duke Trent/Flowers	970	600	600	970
Ninth Street	340	210	210	340
Buchanan Boulevard	260	260	260	260
Durham	730	1,620	1,620	730
Dillard Street	330	1,250	1,250	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,320	11,320	11,320	11,320

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-5: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC LPA-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,460	0	0	2,460
Mason Farm Road	1,000	50	50	1,000
Hamilton Road	210	60	60	210
Friday Center Drive	530	1,030	1,030	530
Meadowmont	300	250	250	300
Leigh Village	510	1110	1110	510
Gateway	620	580	580	620
Patterson Place	580	670	670	580
Martin Luther King Jr. Parkway	700	590	590	700
South Square	900	650	650	900
LaSalle Street	630	760	760	630
Duke Trent/Flowers	980	600	600	980
Ninth Street	350	210	210	350
Buchanan Boulevard	260	260	260	260
Durham	730	1,610	1,610	730
Dillard Street	330	1,250	1,250	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,090	11,090	11,090	11,090

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-6: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC LPA- Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,700	0	0	2,700
Mason Farm Road	1,000	30	30	1,000
Hamilton Road	200	80	80	200
Friday Center Drive	600	710	710	600
Woodmont	310	400	400	310
Leigh Village	530	1,420	1,420	530
Gateway	620	620	620	620
Patterson Place	580	700	700	580
Martin Luther King Jr. Parkway	750	860	860	750
South Square	890	480	480	890
LaSalle Street	630	770	770	630
Duke Trent/Flowers	970	610	610	970
Ninth Street	340	210	210	340
Buchanan Boulevard	260	250	250	260
Durham	740	1,640	1,640	740
Dillard Street	330	1,260	1,260	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,450	11,450	11,450	11,450

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-7: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC LPA- Trent/Flowers Drive

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,750	0	0	2,750
Mason Farm Road	1,050	50	50	1,050
Hamilton Road	200	80	80	200
Friday Center Drive	690	980	980	690
Woodmont	300	400	400	300
Leigh Village	510	1,260	1,260	510
Gateway	610	630	630	610
Patterson Place	580	700	700	580
Martin Luther King Jr. Parkway	750	870	870	750
South Square	890	480	480	890
LaSalle Street	630	780	780	630
Duke Trent/Flowers	970	610	610	970
Ninth Street	340	210	210	340
Buchanan Boulevard	260	250	250	260
Durham	740	1,630	1,630	740
Dillard Street	330	1,260	1,260	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,600	11,600	11,600	11,600

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-8: 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC 1-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,630	0	0	2,630
Mason Farm Road	1010	50	50	1010
Hamilton Road	220	80	80	220
Friday Center Drive	540	1010	1010	540
Meadowmont	310	260	260	310
Leigh Village	500	1190	1190	500
Gateway	560	590	590	560
Patterson Place	620	650	650	620
Martin Luther King Jr. Parkway	750	880	880	750
South Square	880	490	490	880
LaSalle Street	630	760	760	630
Duke Trent/Flowers	980	600	600	980
Ninth Street	340	210	210	340
Buchanan Boulevard	260	260	260	260
Durham	730	1620	1620	730
Dillard Street	330	1240	1240	330
Alston Avenue	0	1400	1400	0
TOTAL	11,290	11,290	11,290	11,290

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-9: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC 1-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,460	0	0	2,460
Mason Farm Road	1000	50	50	1000
Hamilton Road	210	60	60	210
Friday Center Drive	530	1030	1030	530
Meadowmont	300	250	250	300
Leigh Village	500	1110	1110	500
Gateway	570	560	560	570
Patterson Place	610	640	640	610
Martin Luther King Jr. Parkway	700	620	620	700
South Square	890	670	670	890
LaSalle Street	630	750	750	630
Duke Trent/Flowers	990	600	600	990
Ninth Street	350	210	210	350
Buchanan Boulevard	260	260	260	260
Durham	730	1610	1610	730
Dillard Street	330	1240	1240	330
Alston Avenue	0	1400	1400	0
TOTAL	11,060	11,060	11,060	11,060

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-10: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC 1- Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,700	0	0	2,700
Mason Farm Road	1000	30	30	1000
Hamilton Road	200	80	80	200
Friday Center Drive	600	710	710	600
Woodmont	310	400	400	310
Leigh Village	520	1420	1420	520
Gateway	570	600	600	570
Patterson Place	610	670	670	610
Martin Luther King Jr. Parkway	750	890	890	750
South Square	880	500	500	880
LaSalle Street	630	760	760	630
Duke Trent/Flowers	980	610	610	980
Ninth Street	340	210	210	340
Buchanan Boulevard	260	250	250	260
Durham	740	1640	1640	740
Dillard Street	330	1250	1250	330
Alston Avenue	0	1400	1400	0
TOTAL	11,420	11,420	11,420	11,420

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-11: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC 1-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,750	0	0	2,750
Mason Farm Road	1,050	50	50	1,050
Hamilton Road	200	80	80	200
Friday Center Drive	690	980	980	690
Woodmont	300	400	400	300
Leigh Village	500	1,260	1,260	500
Gateway	560	610	610	560
Patterson Place	610	670	670	610
Martin Luther King Jr. Parkway	750	900	900	750
South Square	880	500	500	880
LaSalle Street	630	770	770	630
Duke Trent/Flowers	980	610	610	980
Ninth Street	340	210	210	340
Buchanan Boulevard	260	250	250	260
Durham	740	1,630	1,630	740
Dillard Street	330	1,250	1,250	330
Alston Avenue	0	1,400	1,400	0
TOTAL	11,570	11,570	11,570	11,570

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-12: 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC 2-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,630	0	0	2,630
Mason Farm Road	1010	50	50	1010
Hamilton Road	220	80	80	220
Friday Center Drive	530	1010	1010	530
Meadowmont	310	260	260	310
Leigh Village	490	1200	1200	490
Gateway	550	600	600	550
Patterson Place	600	660	660	600
Martin Luther King Jr. Parkway	750	820	820	750
South Square	890	460	460	890
LaSalle Street	630	760	760	630
Duke Trent/Flowers	970	590	590	970
Ninth Street	340	210	210	340
Buchanan Boulevard	250	260	260	250
Durham	730	1610	1610	730
Dillard Street	330	1250	1250	330
Alston Avenue	0	1410	1410	0
TOTAL	11,230	11,230	11,230	11,230

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-13: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC 2-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,460	0	0	2,460
Mason Farm Road	1000	50	50	1000
Hamilton Road	210	60	60	210
Friday Center Drive	520	1030	1030	520
Meadowmont	300	250	250	300
Leigh Village	490	1120	1120	490
Gateway	560	570	570	560
Patterson Place	590	650	650	590
Martin Luther King Jr. Parkway	700	560	560	700
South Square	900	640	640	900
LaSalle Street	630	750	750	630
Duke Trent/Flowers	980	590	590	980
Ninth Street	350	210	210	350
Buchanan Boulevard	250	260	260	250
Durham	730	1600	1600	730
Dillard Street	330	1250	1250	330
Alston Avenue	0	1410	1410	0
TOTAL	11,000	11,000	11,000	11,000

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-14: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC 2-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,700	0	0	2,700
Mason Farm Road	1000	30	30	1000
Hamilton Road	200	80	80	200
Friday Center Drive	590	710	710	590
Woodmont	310	400	400	310
Leigh Village	510	1430	1430	510
Gateway	560	610	610	560
Patterson Place	590	680	680	590
Martin Luther King Jr. Parkway	750	830	830	750
South Square	890	470	470	890
LaSalle Street	630	760	760	630
Duke Trent/Flowers	970	600	600	970
Ninth Street	340	210	210	340
Buchanan Boulevard	250	250	250	250
Durham	740	1630	1630	740
Dillard Street	330	1260	1260	330
Alston Avenue	0	1410	1410	0
TOTAL	11,360	11,360	11,360	11,360

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-15: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC 2-Trent/Flowers

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,750	0	0	2,750
Mason Farm Road	1,050	50	50	1,050
Hamilton Road	200	80	80	200
Friday Center Drive	680	980	980	680
Woodmont	300	400	400	300
Leigh Village	490	1,270	1,270	490
Gateway	550	620	620	550
Patterson Place	590	680	680	590
Martin Luther King Jr. Parkway	750	840	840	750
South Square	890	470	470	890
LaSalle Street	630	770	770	630
Duke Trent/Flowers	970	600	600	970
Ninth Street	340	210	210	340
Buchanan Boulevard	250	250	250	250
Durham	740	1,620	1,620	740
Dillard Street	330	1,260	1,260	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,510	11,510	11,510	11,510

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-16: 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC LPA-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,650	0	0	2,650
Mason Farm Road	1010	50	50	1010
Hamilton Road	220	80	80	220
Friday Center Drive	540	1010	1010	540
Meadowmont	310	260	260	310
Leigh Village	510	1200	1200	510
Gateway	610	600	600	610
Patterson Place	600	670	670	600
Martin Luther King Jr. Parkway	750	860	860	750
South Square	890	470	470	890
LaSalle Street	600	740	740	600
Duke Eye Center	840	570	570	840
Ninth Street	410	300	300	410
Buchanan Boulevard	250	260	260	250
Durham	720	1510	1510	720
Dillard Street	330	1250	1250	330
Alston Avenue	0	1410	1410	0
TOTAL	11,240	11,240	11,240	11,240

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-17: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC LPA-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,480	0	0	2,480
Mason Farm Road	1,000	50	50	1,000
Hamilton Road	210	60	60	210
Friday Center Drive	530	1,030	1,030	530
Meadowmont	300	250	250	300
Leigh Village	510	1,120	1,120	510
Gateway	620	570	570	620
Patterson Place	590	660	660	590
Martin Luther King Jr. Parkway	700	600	600	700
South Square	900	650	650	900
LaSalle Street	600	730	730	600
Duke Eye Center	850	570	570	850
Ninth Street	420	300	300	420
Buchanan Boulevard	250	260	260	250
Durham	720	1,500	1,500	720
Dillard Street	330	1,250	1,250	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,010	11,010	11,010	11,010

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-18: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC LPA-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,720	0	0	2,720
Mason Farm Road	1000	30	30	1000
Hamilton Road	200	80	80	200
Friday Center Drive	600	710	710	600
Woodmont	310	400	400	310
Leigh Village	530	1430	1430	530
Gateway	620	610	610	620
Patterson Place	590	690	690	590
Martin Luther King Jr. Parkway	750	870	870	750
South Square	890	480	480	890
LaSalle Street	600	740	740	600
Duke Eye Center	840	580	580	840
Ninth Street	410	300	300	410
Buchanan Boulevard	250	250	250	250
Durham	730	1530	1530	730
Dillard Street	330	1260	1260	330
Alston Avenue	0	1410	1410	0
TOTAL	11,370	11,370	11,370	11,370

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-19: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC LPA-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,770	0	0	2,770
Mason Farm Road	1,050	50	50	1,050
Hamilton Road	200	80	80	200
Friday Center Drive	690	980	980	690
Woodmont	300	400	400	300
Leigh Village	510	1,270	1,270	510
Gateway	610	620	620	610
Patterson Place	590	690	690	590
Martin Luther King Jr. Parkway	750	880	880	750
South Square	890	480	480	890
LaSalle Street	600	750	750	600
Duke Eye Center	840	580	580	840
Ninth Street	410	300	300	410
Buchanan Boulevard	250	250	250	250
Durham	730	1,520	1,520	730
Dillard Street	330	1,260	1,260	330
Alston Avenue	0	1,410	1,410	0
TOTAL	11,520	11,520	11,520	11,520

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-20: 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC 1-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,650	0	0	2,650
Mason Farm Road	1010	50	50	1010
Hamilton Road	220	80	80	220
Friday Center Drive	540	1010	1010	540
Meadowmont	310	260	260	310
Leigh Village	500	1200	1200	500
Gateway	560	580	580	560
Patterson Place	630	640	640	630
Martin Luther King Jr. Parkway	750	890	890	750
South Square	880	490	490	880
LaSalle Street	600	730	730	600
Duke Eye Center	850	570	570	850
Ninth Street	410	300	300	410
Buchanan Boulevard	250	260	260	250
Durham	720	1510	1510	720
Dillard Street	330	1240	1240	330
Alston Avenue	0	1400	1400	0
TOTAL	11,210	11,210	11,210	11,210

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-21: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC 1-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,480	0	0	2,480
Mason Farm Road	1,000	50	50	1,000
Hamilton Road	210	60	60	210
Friday Center Drive	530	1,030	1,030	530
Meadowmont	300	250	250	300
Leigh Village	500	1120	1120	500
Gateway	570	550	550	570
Patterson Place	620	630	630	620
Martin Luther King Jr. Parkway	700	630	630	700
South Square	890	670	670	890
LaSalle Street	600	720	720	600
Duke Eye Center	860	570	570	860
Ninth Street	420	300	300	420
Buchanan Boulevard	250	260	260	250
Durham	720	1,500	,1500	720
Dillard Street	330	1,240	1,240	330
Alston Avenue	0	1,400	1,400	0
TOTAL	10,980	10,980	10,980	10,980

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-22: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC 1-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,720	0	0	2,720
Mason Farm Road	1000	30	30	1000
Hamilton Road	200	80	80	200
Friday Center Drive	600	710	710	600
Woodmont	310	400	400	310
Leigh Village	520	1430	1430	520
Gateway	570	590	590	570
Patterson Place	620	660	660	620
Martin Luther King Jr. Parkway	750	900	900	750
South Square	880	500	500	880
LaSalle Street	600	730	730	600
Duke Eye Center	850	580	580	850
Ninth Street	410	300	300	410
Buchanan Boulevard	250	250	250	250
Durham	730	1530	1530	730
Dillard Street	330	1250	1250	330
Alston Avenue	0	1400	1400	0
TOTAL	11,340	11,340	11,340	11,340

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-23: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC 1-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,770	0	0	2,770
Mason Farm Road	1050	50	50	1050
Hamilton Road	200	80	80	200
Friday Center Drive	690	980	980	690
Woodmont	300	400	400	300
Leigh Village	500	1270	1270	500
Gateway	560	600	600	560
Patterson Place	620	660	660	620
Martin Luther King Jr. Parkway	750	910	910	750
South Square	880	500	500	880
LaSalle Street	600	740	740	600
Duke Eye Center	850	580	580	850
Ninth Street	410	300	300	410
Buchanan Boulevard	250	250	250	250
Durham	730	1520	1520	730
Dillard Street	330	1250	1250	330
Alston Avenue	0	1400	1400	0
TOTAL	11,490	11,490	11,490	11,490

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-24 2040 Daily Ridership Forecasts by Stations for Alternative C1- NHC 2-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,650	0	0	2,650
Mason Farm Road	1010	50	50	1010
Hamilton Road	220	80	80	220
Friday Center Drive	530	1010	1010	530
Meadowmont	310	260	260	310
Leigh Village	490	1210	1210	490
Gateway	550	590	590	550
Patterson Place	610	650	650	610
Martin Luther King Jr. Parkway	750	830	830	750
South Square	890	460	460	890
LaSalle Street	600	730	730	600
Duke Eye Center	840	560	560	840
Ninth Street	410	300	300	410
Buchanan Boulevard	240	260	260	240
Durham	720	1500	1500	720
Dillard Street	330	1250	1250	330
Alston Avenue	0	1410	1410	0
TOTAL	11,150	11,150	11,150	11,150

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-25: 2040 Daily Ridership Forecasts by Stations for Alternative C1A- NHC 2-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,480	0	0	2,480
Mason Farm Road	1,000	50	50	1,000
Hamilton Road	210	60	60	210
Friday Center Drive	520	1,030	1,030	520
Meadowmont	300	250	250	300
Leigh Village	490	1,130	1,130	490
Gateway	560	560	560	560
Patterson Place	600	640	640	600
Martin Luther King Jr. Parkway	700	570	570	700
South Square	900	640	640	900
LaSalle Street	600	720	720	600
Duke Eye Center	850	560	560	850
Ninth Street	420	300	300	420
Buchanan Boulevard	240	260	260	240
Durham	720	1,490	1,490	720
Dillard Street	330	1,250	1,250	330
Alston Avenue	0	1,410	1,410	0
TOTAL	10,920	10,920	10,920	10,920

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-26: 2040 Daily Ridership Forecasts by Stations for Alternative C2- NHC 2-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,720	0	0	2,720
Mason Farm Road	1000	30	30	1000
Hamilton Road	200	80	80	200
Friday Center Drive	590	710	710	590
Woodmont	310	400	400	310
Leigh Village	510	1440	1440	510
Gateway	560	600	600	560
Patterson Place	600	670	670	600
Martin Luther King Jr. Parkway	750	840	840	750
South Square	890	470	470	890
LaSalle Street	600	730	730	600
Duke Eye Center	840	570	570	840
Ninth Street	410	300	300	410
Buchanan Boulevard	240	250	250	240
Durham	730	1520	1520	730
Dillard Street	330	1260	1260	330
Alston Avenue	0	1410	1410	0
TOTAL	11,280	11,280	11,280	11,280

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.

Table 5-27: 2040 Daily Ridership Forecasts by Stations for Alternative C2A- NHC 2-Duke Eye Center

Station	UNC-Alston Boardings	UNC-Alston Deboardings	Alston-UNC Boardings	Alston-UNC Deboardings
UNC Hospitals	2,770	0	0	2,770
Mason Farm Road	1050	50	50	1050
Hamilton Road	200	80	80	200
Friday Center Drive	680	980	980	680
Woodmont	300	400	400	300
Leigh Village	490	1280	1280	490
Gateway	550	610	610	550
Patterson Place	600	670	670	600
Martin Luther King Jr. Parkway	750	850	850	750
South Square	890	470	470	890
LaSalle Street	600	740	740	600
Duke Eye Center	840	570	570	840
Ninth Street	410	300	300	410
Buchanan Boulevard	240	250	250	240
Durham	730	1510	1510	730
Dillard Street	330	1260	1260	330
Alston Avenue	0	1410	1410	0
TOTAL	11,430	11,430	11,430	11,430

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals.