DIN 01608

NC 54 Traffic Simulation 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.

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AA	Alternatives Analysis
AM	Ante meridian/before noon
DEIS	Draft Environmental Impact Statement
D-O	Durham-Orange
D-O LRT	Durham-Orange Light Rail Transit
EB	Eastbound
FHWA	Federal Highway Administration
I-40	Interstate 40
INRIX	A mobile computer application that pertains to road traffic
LOS	Level of Service
LPA	Locally Preferred Alternative
LRT	Light rail transit
MOE	Measures of Effectiveness
NB	Northbound
NC	North Carolina
NCDOT	North Carolina Department of Transportation
NCRR	North Carolina Railroad
NHC	New Hope Creek
PM	Post meridian/after noon
ROMF	Rail operations and maintenance facility
SB	Southbound
TRM	Triangle Regional Model
UNC	University of North Carolina
US	United States
VA	Veteran Affairs
WB	Westbound

1. Executive Summary

The study segments in this NC 54 Traffic Simulation Report includes the 1.07 mile long corridor of NC 54 (Raleigh Road) that runs just west of I-40 from Hamilton Road to East Barbee Chapel Road and the Meadowmont Lane corridor between NC 54 and Green Cedar Lane. The NC 54 corridor has four different alignment alternatives: C1/C1A, C2 and C2A. Due to the alignment similarities in this segment, the C1 and C1A alignments are analyzed as one alternative in this study. In each of these alternatives, the D-O LRT runs adjacent or parallel to NC 54 on the south side; meeting several roadways along the corridor at-grade. This report evaluates the traffic conditions along this section under both weekday AM and PM peak hours with the introduction of the proposed D-O LRT.

Traffic analysis was conducted using Vissim. The following scenarios were analyzed in this report:

- Existing Conditions
- 2040 No-Build Conditions
- Build LRT Conditions (C1/C1A, C2 and C2A)

It should be noted that under the Existing Conditions, the intersections of NC 54 with Rogerson Drive and East Barbee Chapel Road are full access signalized intersections, which would both be converted to right-in/right out under the No-Build Conditions. Also, the NC 54 corridor would be converted to a superstreet corridor as part of TIP U-5324A with an additional midblock U-turn between the intersections of NC 54 at West Barbee Chapel Road and NC 54 at Friday Center Drive/Meadowmont Lane.

All of the intersections along NC 54 include a state-maintained roadway and therefore the NCDOT Traffic Impact Criteria have been applied to those locations. The remaining locations are under the jurisdiction of the Town of Chapel Hill. However, the Town of Chapel Hill does not have established guidelines and, therefore, the NCDOT guidelines have been applied to these remaining locations. During the analysis, roadway modifications to improve traffic operations were incorporated into the LRT Build Alternative analysis model (C2A Alternative only). The recommended modifications proposed as part of the C2A LRT Alternative are presented in Table ES-1.

Table ES-1: LRT Alternatives Proposed Roadway Modifications

Intersection	Roadway Modification
West Barbee Chapel Road and NC 54	Add acceleration lane along NC 54 for northbound West Barbee Chapel Road right turn
East Barbee Chapel Road and NC 54	Add acceleration lane along NC 54 for southbound East Barbee Chapel Road right turn

The traffic analysis was conducted using the macro-level software Synchro for traffic signal optimization and the micro-simulation software Vissim was used to provide a comprehensive multimodal model capable of replicating traffic signal preemption and the interaction of vehicle, pedestrian and LRT operations. The 2040 No-Build and 2040 Build Alternatives were evaluated using Vissim. The overall intersection results of the No-Build versus Build LRT Alternatives Vissim analysis are shown in Table ES-2.

Table ES-2: VISSIM Overall Intersection Analysis Summary – 2040 LRT Alternatives vs. 2040 No-Build

Intersection	No-Build		C1/C1A		C2		C2A	
	AM	PM	AM	PM	AM	PM	AM	PM
Hamilton Road at NC 54	C	C	-	-	-	-	C	C
Rogerson Drive at NC 54	F	E	-	-	-	-	F	E
Finley Golf Course Road/Burning Tree Drive at NC 54	B	B	-	-	-	-	B	B
West Barbee Chapel Road at NC 54	C	B	C	B	B	B	C	B
NC 54 at U-Turn Midblock (West of Friday Center Drive)	B	C	B	C	B	C	B	C
Friday Center Drive/Meadowmont Lane at NC 54	B	B	B	B	B	B	B	B
Meadowmont Lane at Village Crossing Drive	A	A	A	A	-	-	A	A
Meadowmont Lane at Barbee Chapel Road	A	A	B	B	-	-	A	A
Meadowmont Lane at Sprunt Street	A	A	C	C	-	-	A	B
Meadowmont Lake at Green Cedar Lane	A	A	A	B	-	-	A	A
East Barbee Chapel Road at NC 54	F	F	-	-	F	F	B	C

Footnote:

Indicates Traffic Impact

As presented in Table ES-2, all of the C1/C1A Alternative overall intersections would meet NCDOT traffic impact criteria. All of the C1/C1A intersections are anticipated to operate at LOS C or better during the peak hours. As the D-O LRT is expected to have minimal impacts to the study intersections under the C1/C1A Alternative, no roadway modifications are recommended as part of this report.

Under the C2 Alternative, all intersections operate at LOS C or better with the exception of the intersection of NC 54 at East Barbee Chapel Road, which operates at LOS F in both the AM and PM peak hours, as it does in the No-Build Conditions. As the D-O LRT is expected to have minimal impacts to the

study intersections under the C2 Alternative, no roadway modifications are recommended as part of this report.

Under the C2A Alternative, all of the overall intersections LOS meet the NCDOT traffic impact criteria. The traffic operations along NC 54 at Rogerson Drive and East Barbee Chapel Road are anticipated to operate at LOS F in the AM peak hour and LOS E in the PM peak hour, however, the No-Build Conditions would experience the same LOS. It should be noted that NC 54 is a major connector in the study area carrying a heavy amount of traffic in addition to providing access to several residential and commercial developments. The heavy traffic demand along this corridor is expected to lead to over-saturated conditions regardless of the D-O LRT construction in this area.

Due to the proximity of the LRT at-grade alignment to NC 54 under the C2A Alternative, this alternative will affect more intersections along the NC 54 corridor than the other two Build LRT Alternatives. NC 54 signal coordination would be disrupted by LRT preemption events, and therefore, several movements along the corridor may experience moderate increases in delay and queuing. With the proposed modifications listed in Table ES-1, traffic operations under the C2A Alternative along the NC 54 corridor would be similar to No-Build Conditions and would meet intersection NCDOT thresholds.

2. Introduction

Through the Alternatives Analysis (AA) process completed in April 2012 prior to preliminary design, which included extensive public outreach, a Locally Preferred Alternative (LPA) was selected to address the purpose and need of the Durham-Orange (D-O) Corridor. The proposed project is a 17.1 mile double-track light rail transit (LRT) line with 17 proposed stations that will greatly expand transit service in Durham and Orange Counties. The Durham-Orange Light Rail Transit (D-O LRT) project extends from its western terminus at the University of North Carolina at Chapel Hill (UNC) at the UNC Hospitals Station to the eastern terminus in Durham at the Alston Avenue Station. The proposed D-O LRT Project improves public transportation access to a range of educational, medical, employment, and other important activity centers, in the D-O Corridor including: UNC; UNC Hospitals; the William and Ida Friday Center for Continuing Education; Duke University; Durham Veterans Affairs (VA) Medical Center and Duke University Medical Center (DUMC); downtown and east Durham.

2.1 Description of the Proposed D-O LRT

The proposed D-O LRT alignment generally follows North Carolina (NC) Highway 54 (NC 54), Interstate 40 (I-40), United States (US) 15-501, and the North Carolina Railroad (NCRR) Corridor in downtown Durham and east Durham. The proposed alignment begins in Chapel Hill at UNC Hospitals, parallels Fordham Boulevard, proceeds eastward adjacent to NC 54 (Raleigh Road), travels north along I-40, parallels US 15-501 before it turns east towards Duke University and runs within Erwin Road, and then follows the NCRR Corridor that parallels NC Highway 147 (NC 147) through downtown Durham, before reaching its eastern terminus in Durham near Alston Avenue. A total of 17 stations are planned, and approximately 5,000 parking spaces along the D-O LRT alignment will be provided. In addition, a rail operations and maintenance facility (ROMF) will be constructed to accommodate the D-O LRT fleet. It should be noted that the ROMF location is anticipated to generate minimal traffic during the peak hours. As such, those impacts were not evaluated as part of this report.

Bus routes will be modified to feed into the D-O LRT stations and headways will be adjusted to provide more frequent service and minimize transfer waiting times. These services will also connect LRT passengers with other area transportation hubs, including park-and-ride lots and transfer centers.

2.2 Proposed Project Alternatives

The Draft Environmental Impact Statement (DEIS) will examine the potential environmental impacts of the LRT alternative as well as a small number of alignment, station, and ROMF siting alternatives, including the following:

- Crossing of Little Creek between the Friday Center and the proposed Leigh Village Development (i.e., Alternatives C1, C1A, C2, C2A and associated station location)
- Crossing of New Hope Creek (NHC) and Sandy Creek between Patterson Place and South Square (i.e., NHC LPA, NHC Alternatives 1 and 2 and associated station locations)
- Station alternatives at Duke and Durham VA Medical Centers
- Five proposed locations for the ROMF

In addition to the LRT, the DEIS will consider a No-Build alternative, which includes the existing and programmed transportation network improvements, with the exception of planned rail improvements and associated bus network modifications.

2.3 Purpose of NC 54 Traffic Simulation Report

The roadway network is a critical element of the transportation network, serving as a means to safely move people and goods and to support the economic development of an area. In an effort to balance safety and mobility with economic development and access, many owners of public roads have developed standards for determining the impacts of development on the roadway network and the level to which those impacts must be mitigated. The standards and mitigation levels governing projects in Durham and Orange Counties of North Carolina have been identified in the *Traffic Analysis Methodology Report* included in Appendix A.

The purpose of this technical memorandum is to analyze the traffic operations along the NC 54 section of the proposed D-O LRT project in light of the policies identified in the *Traffic Analysis Methodology Report*.

The goal of the study is to provide decision makers with an evaluation of the ability of the transportation system to accommodate the future travel demand and to help determine which roadway network modifications are necessary to accommodate that demand and the LRT. As noted previously, modifications to the Build roadway network will be included in this evaluation to determine if reasonable mitigations can be made to accommodate the 2040 forecasted traffic volumes and the physical and operational changes from the LRT, in accordance with the guiding policies. This study will also aim to determine which projects are necessary to accommodate the background growth in traffic and which are necessary to mitigate additional impacts caused by the proposed D-O LRT project.

2.4 NC 54 Traffic Simulation Description

This report describes the approach and summarizes the findings and results of the traffic analysis conducted for the NC 54 section of the D-O LRT alignment.

Preliminary designs were developed for the proposed D-O LRT alignment, including three LRT stations: Hamilton Road Station, Friday Center Station and either the Meadowmont or Woodmont Station. These designs are included in the *Basis for Engineering Design* plans shown in Appendix B. The analysis evaluated both weekday AM and PM peak hour traffic volumes with the introduction of the proposed D-O LRT project. The LRT was assumed to operate in both directions with 10 minute peak period frequencies and 20 seconds of dwell time at each station for passenger boarding and alighting.

As shown in the *Basis for Engineering Design* plans, the NC 54 corridor has four different alternatives: C1/C1A, C2 and C2A. For the purposes of this analysis the C1 and C1A alignments are analyzed as one alternative. In each of these alignments, the D-O LRT runs adjacent or parallel to NC 54 on the south side, meeting several intersections along the corridor at-grade. A detailed description for each of the alternatives is provided in Section 3.0 of this report. Following are the intersections evaluated as part of this report, which are also shown in Figure 1:

- NC 54 at Hamilton Road
- NC 54 at Rogerson Drive
- NC 54 at Finley Golf Course Road

- NC 54 at West Barbee Chapel Road
- NC 54 at U-turn Midblock
- NC 54 at Friday Center Drive
- NC 54 at East Barbee Chapel Road
- Meadowmont Road at Village Crossing Drive
- Meadowmont Road at East Barbee Chapel Road
- Meadowmont Road at Sprunt Street
- Meadowmont Road at Green Cedar Lane

For the purposes of this analysis, it was assumed that the traffic signals at the following intersections will be programmed to operate with traffic signal preemption under the Build Alternatives:

- NC 54 at W Barbee Chapel Road (Build C2A Alternative only)
- NC 54 at Friday Center Drive/Meadowmont Lane (Build C2A Alternative only)
- NC 54 at Barbee Chapel Road (Build C2A Alternative only)
- Meadowmont Road at Village Crossing Drive (Build C1/C1A Alternative only)
- Meadowmont Road at Barbee Chapel Road (Build C1/C1A Alternative only)
- Meadowmont Road at Sprunt Street (Build C1/C1A Alternative only)
- Meadowmont Road at Green Cedar Lane (Build C1/C1A Alternative only)

Railroad crossing gates are proposed to be installed at these intersections to prevent conflicts between vehicular and LRT movements. Triangle Transit will work with NCDOT and the Town of Chapel Hill to develop signal plans for these intersections during the Engineering phase of the project. The traffic signal plans will incorporate signal preemption or transit signal priority, to accommodate LRT operations at signalized intersections. Signal preemption interrupts the normal signal operations by preemptively transferring the traffic control signal to a special operation mode under certain events such as an approaching train. Transit signal priority alters the normal signal operation process to better accommodate transit vehicles by extending a vehicle phase, e.g. green time will be lengthened by 15 seconds or red time will be reduced.

The proposed D-O LRT alignment along the NC 54 segment is at-grade and either crosses a leg or passes through the middle of the intersections. As trains approach one of these intersections, the normal traffic signal timing will be altered to allow the train to proceed uninhibited. While the train is in the intersection traffic crossing the tracks must stop while traffic traveling parallel to the tracks can proceed. This may be accomplished by lengthening or shortening the traffic signal phases, typically by no more than 30 to 45 seconds. Any difference in signal phase length as a result of the passing train is made up within one traffic signal cycle length after the train passes. A traffic signal cycle is all of the signal phases a particular traffic signal will go through before a signal phase is repeated. The existing cycle length at each intersection along NC 54 is 140 and 150 seconds in the AM and PM peak hours, respectively, which were maintained for the future No-Build and all Build Alternatives. The Existing Conditions, No-Build Conditions, and all Build Alternatives cycle lengths at each intersection along Meadowmont Lane are 70 seconds in both AM and PM peak hours.

For the purposes of this analysis, the No-Build Conditions will include TIP U-5324A. This separate project will be implemented by NCDOT to convert NC 54 to a superstreet corridor with an additional midblock U-turn between the NC 54 intersections with West Barbee Chapel Road and Friday Center Drive/Meadowmont Lane. Under the No-Build superstreet project, the NC 54 cross streets' northbound and southbound left turn and through movements would be prohibited at Rogerson Drive, Finley Golf

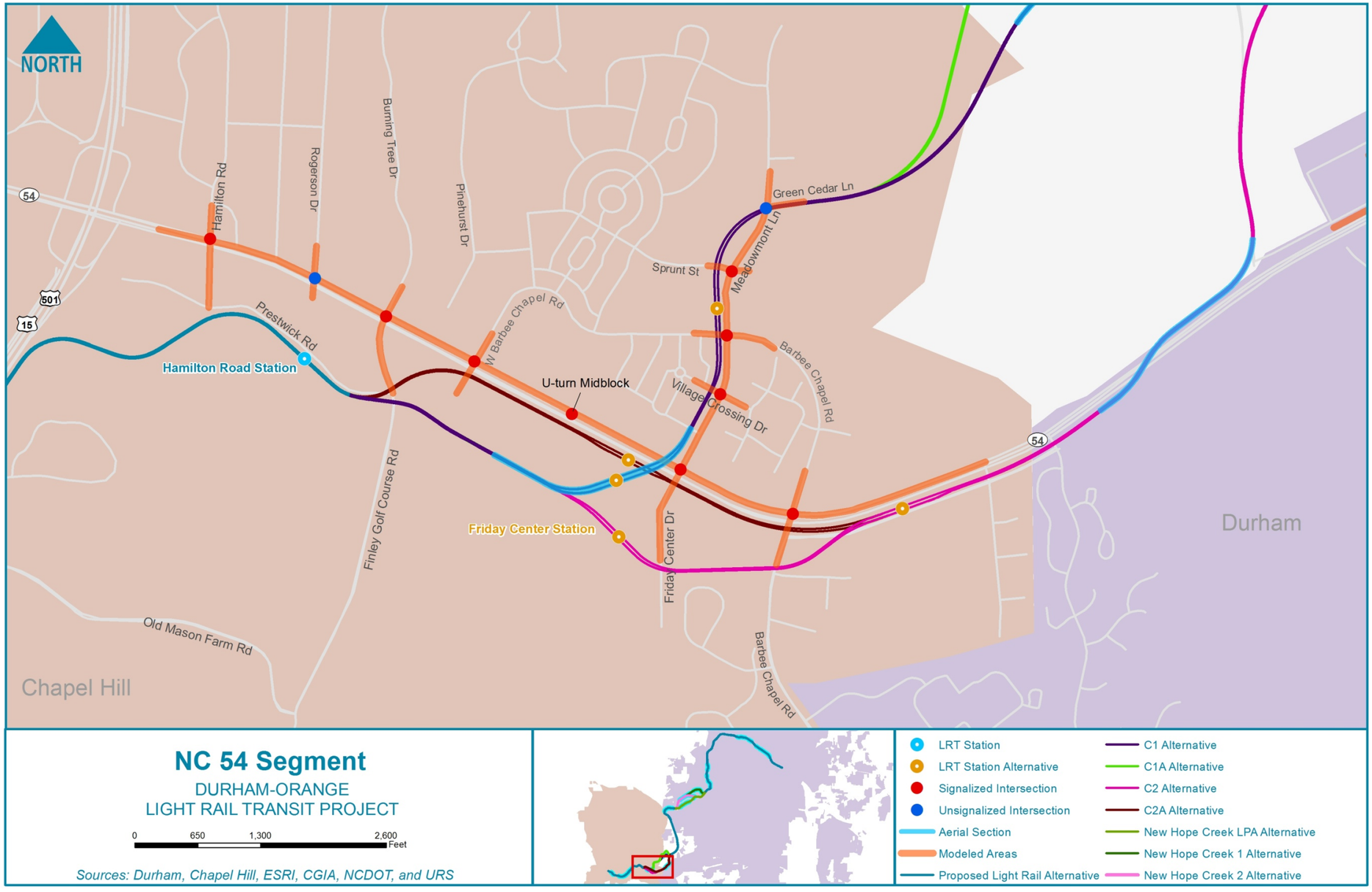
Course Road, West Barbee Chapel Road, Friday Center Drive/Meadowmont Lane, and East Barbee Chapel Road. The prohibited northbound and southbound left and through movement traffic would turn right onto NC 54 and then turn around at the next legal U-turn movement to reach their destinations.

For Alternatives C1/C1A and C2, the major difference between the No-Build and Build Alternatives is the construction of the D-O LRT Project. Three LRT stations: Hamilton Road Station, Friday Center Station and Woodmont Road Station, are proposed for implementation along this section of the project near NC 54. For Alternative C2A, which runs along NC 54 for a longer distance, the proposed specific roadway modifications for the NC 54 segment are listed in Table 1 for the LRT Build Alternative (C2A only).

Table 1: LRT C2A Alternative Proposed Roadway Modifications

Intersection	Roadway Modification
West Barbee Chapel Road and NC 54	Add acceleration lane along NC 54 for northbound West Barbee Chapel Road right turn
East Barbee Chapel Road and NC 54	Add acceleration lane along NC 54 for southbound East Barbee Chapel Road right turn

Figure 1: NC 54 Study Intersections



3. Description of Scenarios

Five scenarios were analyzed for this study. These scenarios included:

- Existing Conditions Scenario (2011 Base Year Scenario), also used for model calibration
- Future Year No-Build alternative
- Future Year Build alternative – C1/C1A Alternative
- Future Year Build alternative – C2 Alternative
- Future Year Build alternative – C2A Alternative

A brief description of the alternatives evaluated in Vissim, a comprehensive multimodal modeling software capable of replicating traffic signal preemption and the interaction of vehicle, pedestrian and LRT operations, for traffic operations is as follows.

3.1 2011 Base Year Scenario

The 2011 Base Year Scenario simulated traffic conditions as they existed in 2011. The goal of the 2011 Base Year Scenario was to develop a calibrated model that would serve as the basis for the creation of the models for the future year No-Build and Build alternatives. As discussed in the *Traffic Analysis Methodology Report*, travel time and speed were calibrated.

3.2 2040 No-Build Alternative

This alternative examined what the traffic operations would be in the vicinity of the proposed D-O LRT project assuming the proposed project is not constructed. The No-Build Alternative assumed the local transportation system would evolve as currently planned to include the NC 54 superstreet project, but without implementation of the proposed D-O LRT project.

3.3 2040 Build C1 / C1A Alternative

Under the C1/C1A Alternative, the LRT alignment would turn east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. The LRT would continue east approximately 500 feet south of NC 54 before elevating and turning north at the Friday Center Drive Station. The alignment would then cross over NC 54 via a bridge near the intersection of Friday Center Drive and would run at-grade near the following Meadowmont Lane intersections:

- Meadowmont Lane at Village Crossing Drive
- Meadowmont Lane at East Barbee Chapel Road
- Meadowmont Lane at Sprunt Street
- Meadowmont Lane at Green Cedar Lane

Railroad crossing gates are proposed to be installed at the above intersections to prevent conflicting LRT and vehicular movements. All of the NC 54 intersections listed in Section 2.4 that do not directly interact with the C1/C1A Alternative are also included in the corridor analysis for comparison purposes. Beyond Green Cedar Lane, the LRT turns east to continue towards Leigh Village Station. Preliminary designs for the C1/C1A Alternative are included in Appendix B.

3.4 2040 Build C2 Alternative

Under the C2 Alternative, the alignment would continue east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. In this alternative, the alignment would run at-grade several hundred feet south of NC 54 between the Hamilton Road Station and East Barbee Chapel Road and would cross the southern legs of the following intersections:

- NC 54 at Friday Center Drive/Meadowmont Lane
- NC 54 at East Barbee Chapel Road.

Railroad crossing gates are proposed to be installed at the above intersections to prevent conflicting LRT and vehicular movements. All other intersections listed in Section 2.4 that do not directly interact with the C2 Alternative are included in the corridor analysis for comparison purposes. Beyond East Barbee Chapel Road, the LRT would continue northeast and move closer to the south side of NC 54 with at-grade crossings of Littlejohn Road and Downing Creek Parkway. The LRT would then be constructed above grade to cross NC 54 west of Downing Creek Parkway and continue towards Leigh Village Station. Preliminary designs for the C2 Alternative are included in Appendix B.

3.5 2040 Build C2A Alternative

Under the C2A Alternative, the alignment would continue east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. The at-grade LRT would turn north toward NC 54 at Finley Golf Course Road. In this alternative, the alignment would run adjacent to the south side of NC 54 and would cross the southern legs of the following intersections:

- NC 54 at West Barbee Chapel Road
- NC 54 at Friday Center Drive/Meadowmont Lane
- NC 54 at East Barbee Chapel Road

Railroad crossing gates are proposed to be installed at the above intersections to prevent conflicting LRT and vehicular movements. All other intersections listed in Section 2.4 that do not directly interact with the C2A Alternative are also included in the corridor analysis for comparison purposes. Beyond East Barbee Chapel Road, LRT would continue northeast along the south side of NC 54 with at-grade crossings of Littlejohn Road and Downing Creek Parkway. The LRT would elevate to cross NC 54 above grade and continue towards Leigh Village Station. Preliminary designs for the C2A Alternative are included in Appendix B.

4. Methodology

The analysis followed the methodology documented in the *Traffic Analysis Methodology Report* for the Durham-Orange Light Rail Project developed in November 2013. Two traffic analytical software tools, Synchro and Vissim, were used to provide measures of effectiveness (MOE) necessary for the analysis. This study used Synchro Version 8.0 to develop optimized signal timing plans as input for microscopic simulation modeling.

The use of microscopic traffic simulation was completed using Vissim (version 5.4). Vissim is a microscopic, behavior-based multi-purpose traffic simulation program that evaluates each vehicle individually every model time step and then assigns the appropriate behavior logic according to the traffic operations that the specific vehicle encounters. For many engineering disciplines, simulation has become an indispensable instrument for the optimization of complex technical systems. This is also true for transportation planning and traffic engineering, where simulation is an invaluable and cost-reducing tool. The microscopic simulation model was developed for the studied section of the project and was based on a calibrated base model for the area.

The methodology for microscopic simulation begins with a base model developed from data collected for the transportation network. The base model is then calibrated against data measured in the field to arrive at a calibrated base model. Once the base model is calibrated, future year alternatives can be developed and analyzed for impact study. As in real-life operations, microscopic simulation models are constrained to the capacity of a given roadway, and as such the model can only load traffic up to the capacity of a facility, with excess vehicles being denied entry and queue up outside the model network. This can happen for future scenarios when demand has been forecasted to outgrow the capacity of the existing roadways.

4.1 Measures of Effectiveness

Measures of effectiveness (MOE) are system performance statistics that allow for comparisons between alternatives. The MOEs for microscopic simulation can be abundant due to the nature of the analysis. The primary MOEs for urban arterials are typically average speed and vehicle density for individual segments as well as average travel time and speed for individual origin-destination pairs within the network. On an overall network level MOEs such as average system speed, average system delay, and number of stops can provide overall indications of the operations of a network.

As discussed in the *Traffic Analysis Methodology Report*, corridor-level MOEs including average speed and travel time were used as the method for calibrating the base year model. Control delay, which is utilized to determine intersection LOS, and queuing were the MOEs for the future year models. The concept of Highway Capacity Manual's (HCM) Level of Service was adopted here for the purpose of simply categorizing the delays. Please note that the calculation methods of HCM delay and Vissim delay are different, as Vissim delay includes control delay as well as queue delay, whereas, HCM includes control delay only. The LOS grades are based on Vissim delays, which will provide a more conservative result than the HCM-based delays.

The acceptable levels for the future year MOEs were enumerated in the *Traffic Analysis Methodology Report*. The NCDOT traffic impact criteria were applied to all intersections studied in the NC 54 segment. The NCDOT has established guidelines that specify when chosen MOEs meet the required thresholds.

The NCDOT's "*Policy on Street and Driveway Access to North Carolina Highways (July 2003)*" states that when comparing base network conditions to project conditions, mitigation improvements to the roadway network are required if at least one of the following conditions exist:

- The total average delay at an intersection or an individual approach increases by 25% or greater, while maintain the same Level of Service
- The Level of Service degrades by at least one level
- Additionally, at intersections if the maximum queue for individual movements exceeds both its available storage space and its respective peak hour No-Build maximum queue length by 10 feet

For the purposes of this analysis, traffic impacts were considered for mitigation if the Build alternative delay was at or above a middle LOS D, or 45.0 seconds or greater for a signalized intersection. Those overall intersections or movements that reported delays greater than 45.0 seconds and experienced a LOS degradation or increase in delay greater than 25% compared to the No-Build alternative were highlighted in the Vissim LOS tables with orange. For those intersections or movements that reported a Build LOS better than middle D or less than 45.0 seconds, the impacts would not warrant roadway modifications and were highlighted with yellow.

The Town of Chapel Hill does not have established guidelines and, therefore, the NCDOT criteria noted above were followed. In summary, Table 2 shows the traffic impact criteria applied to the study area intersections.

As NCDOT is under NCDOT's jurisdiction, its traffic impact criteria have been applied to all intersections along this roadway. As Meadowmont Lane lies within the Town of Chapel Hill, NCDOT traffic impact criteria were also applied along this roadway. In summary, Table 2 shows the traffic impact criteria applied to the NC 54 and Meadowmont Lane study intersections.

Table 2: Application of Traffic Impact Criteria

Segment	Location	Criteria Applied
NC 54	All Intersections	NCDOT
Meadowmont Lane	All intersections	NCDOT

4.2 Network Development

4.2.1 Geometry

The basis for developing the geometric data was a combination of aerial photographs and contour maps. Aerial photography was used as a background to digitize the network into the simulation model. The three-dimensional attributes and grades were determined based on a contour map of the study area.

The geometry in the 2011 Base Year network is based on the existing geometry of the intersections analyzed in this report. The network was created using aerials from NC OneMap, Google Maps, field verification, and contour maps from the North Carolina Department of Transportation (NCDOT).

4.2.2 Traffic Control

Traffic signal and coordination plans were obtained from NCDOT for the intersections included in the study area. These plans were used to input timing, phasing, and detectors for the following intersections in the base year:

- Hamilton Road and NC 54
- Finley Golf Course Road/Burning Tree Drive and NC 54
- West Barbee Chapel Road and NC 54
- Friday Center Drive/Meadowmont Lane and NC 54
- East Barbee Chapel Road and NC 54
- Meadowmont Lane and Village Crossing Drive
- Meadowmont Lane and East Barbee Chapel Road
- Meadowmont Lane and Sprunt Street

Field verification of the signal timings were performed at each intersection. The existing signal timing plans and signal design files are located in Appendix C. For the future signal timings, minimum green times, yellow and all-red clearance intervals were based on build intersection geometry, the Institute of Transportation Engineers' pedestrian phasing formula, and recommended traffic settings documented in the NCDOT Congestion Management Capacity Analysis Guidelines.

The signalized intersections for the future year networks were input into Synchro for optimization prior to being input into VISSIM. The future No-Build and Build signalized intersections include the existing signalized intersections as well as the planned NC 54 midblock U-turn intersection, west of Friday Center Drive. The future year signal timings utilized the base year timings, which were re-optimized based on the 2040 forecasted traffic volumes and the No-Build and Build geometry.

It should be noted that under future No-Build Conditions, the NC 54 corridor is planned to be converted to a superstreet corridor. Current signal timing plans for these intersections were used to develop traffic signal timings for the superstreet No-Build Conditions. The cycle lengths at the intersections were kept constant for both No-Build and Build Alternatives (140 seconds and 150 seconds in AM and PM peak hours, respectively) while splits/offsets at the intersections were adjusted to accommodate the new intersection configurations.

4.2.3 Speed Data

Weekday peak periods speed data was collected from INRIX (a mobile application pertaining to road traffic). This data was used to determine the average speed during the peak periods from the approximate time the initial count data was collected. This data was used in calibration of the model. The desired speed distribution for turning vehicles at intersections was assumed to be 10 mph with a standard deviation of 3 mph for right turns and 15 mph with a standard deviation of 3 mph for left turns. The speed distributions used for NC 54 were based on posted speeds of 35 mph (west of West Barbee Chapel Road) and 45 mph (east of West Barbee Chapel road) with a range of 32 to 50 mph in Vissim. The speed distributions used for Meadowmont Lane were based on a 25 mph posted speed with a range of 20 to 30 mph in Vissim.

4.2.4 Driving Behavior Parameters

The driver behavior parameters were used to guide vehicles through the network during the simulation models. Both the car-following and lane-change models in Vissim use an extensive range of parameters. Some of these may be adapted by the user to change basic driving behavior. Vissim uses five driving behavior models, of which only one was used in the base model; Urban (motorized). The Urban (motorized) parameters were used to model the surface streets within the network and were based on the Wiedemann 74 model. The Wiedemann 74 model includes three parameters which can be calibrated based on the data collected. Default values were used in developing the base model and any modifications made to the parameters were documented in the calibration section of this report.

4.2.5 Estimated Traffic Volumes

Simulation models are capable of using unbalanced input volumes and their own internal algorithms to balance the network; however using this method of traffic volume input can produce inaccuracies in actual processed volumes at particular locations. To accurately model the network, the volumes were developed into a balanced network. The traffic volumes for the proposed project were based on peak hour turning movement count data. Traffic volumes for the NC 54 and Meadowmont Lane corridors were balanced keeping NC 54 at Friday Center Drive and Meadowmont Lane intersection as the control count.

Volumes for the 2011 Existing Conditions, the 2040 No-Build Conditions, and the 2040 Build Alternatives were created using the count data and the Triangle Regional Travel Demand Model (TRM) v5 as outlined in the *Traffic Analysis Methodology Report*. With NC 54 being converted to a super-street corridor per TIP U-5324A, volumes entering and exiting the side streets were accommodated at the adjacent U-turn locations as appropriate. It should be noted that NC 54 is a major connector in the study area carrying substantial traffic volumes in addition to providing access to several residential and commercial developments. The heavy traffic demand along this corridor would lead to over-saturated conditions regardless of the D-O LRT project. The balanced peak hour volumes for all scenarios (2011 Existing, 2040 No-Build, and 2040 Build) are shown in Appendix D. In general, there were no changes in travel patterns between the 2040 No-Build and all 2040 Build Alternatives. Therefore, traffic volumes between the No-Build and Build LRT Alternatives remained the same.

4.2.6 Simulation Settings and Repetitions

Each simulation was run for one hour with 15 minutes of seeding time for the network to load.

The number of simulation runs was based on the process described in Appendix B of the Federal Highway Administration (FHWA) Traffic Analysis Toolbox Volume III. The average speed of each simulation run was used as a basis for determining the number of required repetitions, with a confidence level of 95% and a confidence interval of 5 mph. It was calculated that each alternative would need to be run with 10 random seeds each for both the AM and PM peak periods.

4.2.7 Output

The output data was extracted from the model using the Travel Time evaluation and Data Collection. The Travel Time evaluation provided average travel times for user defined start and end points within the network. The Intersection Node module provided several outputs including vehicle volume, movement and intersection delay, and average/maximum queues which were utilized to determine intersection LOS.

4.2.8 Base Year Calibration

The 2011 Existing conditions base year model was calibrated by comparing modeled travel times versus historic INRIX speed data as described in the *Traffic Analysis Methodology Report*. INRIX speed data is collected by utilizing vehicle probes that collect and transmit the locations of probe vehicles within the network. Speed calibration targets of +/- 2.5 mph (desirable) and +/- 5 mph (acceptable) were set as described in the *Traffic Analysis Methodology Report*. No changes to the base Vissim parameters were made for calibrating the base year model to replicate the current existing conditions.

5. Simulation Results

Based on the above model network elements and the methodologies defined under MOEs, the results from VISSIM can be determined.

5.1 2011 Base Year Scenario

The 2011 Base Year Scenario simulated traffic conditions as they existed in 2011. The goal of the 2011 Base Year Scenario was to develop a calibrated model that would serve as the basis for the creation of the models for future year No-Build and Build scenarios. As discussed in the *Traffic Analysis Methodology Report*, travel time and speed were calibrated.

Based on the data included in Table 3 the base model is considered to be calibrated and can be utilized as the basis for developing the all future year alternatives. Two of the four values were in acceptable range the other two values were within the desirable range.

Table 3: 2011 Existing Conditions - Calibrated Base Model Summary

Direction	Length (miles)	Peak Period	Calibrated Model		INRIX		Travel Time Difference (min)	Speed Difference (MPH)	Calibration Range
			Average Travel Time (min)	Average Speed (MPH)	Average Travel Time (min)	Average Speed (MPH)			
Eastbound (EB) Travel Time Summary									
EB Corridor Wide	1.07	AM	1.99	32.26	2.19	29.31	-0.20	2.95	Within acceptable
		PM	2.10	30.57	2.34	27.38	-0.24	3.19	Within acceptable
Westbound (WB)Travel Time Summary									
WB Corridor Wide	1.07	AM	2.15	29.92	2.15	29.92	0.00	0.01	Within desirable
		PM	1.84	34.87	1.94	33.09	-0.10	1.78	Within desirable

5.2 2040 No-Build Alternative

The 2040 No-Build Alternative model was developed based on the calibrated Existing Conditions model. The network geometry was modified to include the background projects described in Section 2.4, and the 2040 No-Build volumes were then input into the model.

The Highway Capacity Manual defines LOS for signalized and unsignalized intersections as a function of the average vehicle control delay. LOS may be calculated per movement or per approach for any intersection configuration, but LOS for the intersection as a whole is only defined for signalized and all-way stop configurations. Table 4 and Table 5 demonstrate the different levels of service for signalized and unsignalized intersections based on delay and volume to capacity ratio.

Table 4: Level of Service - Signalized Intersections

Level of Service	Delay (seconds)	Description
A	≤10	This level is typically assigned when the volume-to capacity ratio is low and either progression is exceptionally favorable or the cycle length is very short. If it is due to favorable progression, most vehicles arrive during the green indication and travel through the intersection without stopping.
B	>10-20	This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.
C	>20-35	This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. This number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.
D	>35-55	This level is typically assigned when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.
E	>55-80	This level is typically assigned when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.
F	>80	This level is typically assigned when the volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

Source: Highway Capacity Manual, 2010

Table 5: Level of Service - Unsignalized Intersections

Level of Service	Delay (seconds)
A	≤10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

Source: Highway Capacity Manual, 2010

Table 6 lists Vissim turning movement volumes, delays, and LOS at intersections along NC 54 and Meadowmont Lane during the AM and PM peak hours under the 2040 No-Build Conditions.

Table 6: 2040 No-Build VISSIM Model Summary

Intersection	Movement	AM Peak			PM Peak		
		Volume (VPH)	Delay (sec)	LOS	Volume (VPH)	Delay (sec)	LOS
Hamilton Road and NC 54	NBL	171	64.1	E	132	64.3	E
	NBT	50	50.2	D	43	58.1	E
	NBR	251	18.3	B	304	37.8	D
	SBL	187	75.6	E	126	66.6	E
	SBT	62	68.4	E	40	56.3	E
	SBR	63	50.7	D	39	28.9	C
	EBL	53	173.0	F	71	97.3	F
	EBT	2091	31.9	C	3012	23.4	C
	EBR	172	30.6	C	35	24.4	C
	WBU	196	47.9	D	137	68.0	E
	WBL	179	48.2	D	205	69.9	E
	WBT	3322	15.1	B	2700	12.5	B
	WBR	71	16.1	B	114	13.6	B
	Overall	**6867**	**27.7**	**C**	**6958**	**24.6**	**C**
Rogerson Drive and NC 54 (Unsignalized Intersection)	NBR	20	14.0	B	74	39.1	E
	SBR	23	165.6	F	25	30.1	D
	EBT	2608	2.1	A	3474	4.0	A
	EBR	97	8.3	A	101	3.2	A
	WBT	3799	16.1	C	3148	5.3	A
	WBR	4	8.3	A	5	3.3	A
	Overall	**6551**	**165.6**	**F**	**6826**	**39.1**	**E**

Table 6: 2040 No-Build VISSIM Model Summary - Continued

Intersection	Movement	AM Peak			PM Peak		
		Volume (VPH)	Delay (sec)	LOS	Volume (VPH)	Delay (sec)	LOS
Finley Golf Course Road/Burning Tree Drive and NC 54	NBR	194	16.7	B	344	86.6	F
	SBR	252	63.7	E	216	18.6	B
	EBL	48	33.3	C	141	76.6	E
	EBT	2473	6.7	A	3391	3.2	A
	EBR	109	7.0	A	11	5.2	A
	WBU	46	36.9	D	14	62.9	E
	WBL	107	40.7	D	61	65.2	E
	WBT	3592	14.1	B	2938	6.4	A
	WBR	92	13.9	B	172	6.9	A
	Overall	**6912**	**13.9**	**B**	**7287**	**11.0**	**B**
West Barbee Chapel Road and NC 54	NBR	14	13.0	B	400	63.9	E
	SBR	137	39.2	D	214	12.2	B
	EBU	18	86.6	F	90	67.9	E
	EBL	114	80.5	F	164	67.0	E
	EBT	2587	6.4	A	3251	12.4	B
	EBR	24	3.7	A	227	6.5	A
	WBL	245	67.9	E	73	65.9	E
	WBT	3683	24.1	C	2888	8.9	A
	WBR	61	12.1	B	35	5.8	A
	Overall	**6882**	**20.2**	**C**	**7342**	**16.0**	**B**
NC 54 and U-Turn (West of Friday Center Drive)	EBU	3	83.1	F	186	57.0	E
	EBT	2599	2.0	A	3456	15.3	B
	WBU	289	65.5	E	925	65.0	E
	WBT	4037	14.6	B	2817	5.5	A
	Overall	**6928**	**18.0**	**B**	**7384**	**20.2**	**C**

Table 6: 2040 No-Build VISSIM Model Summary - Continued

Intersection	Movement	AM Peak			PM Peak		
		Volume (VPH)	Delay (sec)	LOS	Volume (VPH)	Delay (sec)	LOS
Friday Center Drive/ Meadowmont Lane and NC 54	NBR	141	0.7	A	1128	7.5	A
	SBR	312	2.1	A	398	2.7	A
	EBL	200	63.0	E	243	49.5	D
	EBT	2182	10.5	B	3966	7.7	A
	EBR	469	9.3	A	164	2.3	A
	WBU	207	54.7	D	315	69.5	E
	WBL	305	53.7	D	30	59.1	E
	WBT	4069	11.9	B	3368	12.8	B
	WBR	32	2.0	A	82	2.2	A
	Overall	**7915**	**14.8**	**B**	**9691**	**12.3**	**B**
Meadowmont Lane and Village Crossing Drive	NBL	93	7.1	A	101	6.7	A
	NBT	134	3.4	A	191	3.4	A
	NBR	7	2.9	A	28	4.0	A
	SBL	2	6.6	A	11	4.2	A
	SBT	250	3.1	A	320	3.1	A
	SBR	1	3.9	A	5	3.2	A
	EBL	2	7.8	A	2	8.8	A
	EBT	0	0.0	A	4	12.5	B
	EBR	24	0.6	A	51	1.0	A
	WBL	39	11.0	B	28	0.4	A
	WBT	6	11.4	B	1	7.6	A
	WBR	5	5.8	A	4	5.3	A
	Overall	**562**	**4.4**	**A**	**745**	**3.5**	**A**

Table 6: 2040 No-Build VISSIM Model Summary - Continued

Intersection	Movement	AM Peak			PM Peak		
		Volume (VPH)	Delay (sec)	LOS	Volume (VPH)	Delay (sec)	LOS
Meadowmont Lane and East Barbee Chapel Road	NBL	5	10.1	B	61	11.9	B
	NBT	137	7.5	A	136	7.2	A
	NBR	1	4.3	A	1	2.2	A
	SBL	135	10.9	B	126	11.1	B
	SBT	250	8.5	A	247	8.6	A
	SBR	182	6.0	A	70	5.6	A
	EBL	117	11.1	B	66	12.4	B
	EBT	3	7.7	A	93	10.3	B
	EBR	4	4.0	A	87	5.5	A
	WBL	0	0.0	A	3	13.4	B
	WBT	18	10.9	B	88	11.3	B
	WBR	228	12.5	B	172	12.2	B
	Overall	**1080**	**9.4**	**A**	**1147**	**9.6**	**A**
Meadowmont Lane and Sprunt Street	NBL	115	7.6	A	206	7.8	A
	NBT	354	6.9	A	144	5.7	A
	NBR	12	8.8	A	23	5.9	A
	SBL	0	0.0	A	1	3.5	A
	SBT	198	11.7	B	239	11.4	B
	SBR	7	7.7	A	9	5.7	A
	EBL	21	14.1	B	8	12.8	B
	EBT	12	12.9	B	29	16.9	C
	EBR	341	7.5	A	177	7.3	A
	WBL	28	12.6	B	27	16.0	C
	WBT	4	17.4	B	2	9.6	A
	WBR	0	0.0	A	1	4.2	A
	Overall	**1093**	**8.5**	**A**	**865**	**8.8**	**A**

Table 6: 2040 No-Build VISSIM Model Summary - Continued

Intersection	Movement	AM Peak			PM Peak		
		Volume (VPH)	Delay (sec)	LOS	Volume (VPH)	Delay (sec)	LOS
Meadowmont Lane and Green Cedar Lane (Unsignalized Intersection)	NBT	322	0.3	A	146	0.1	A
	NBR	53	0.9	A	7	0.4	A
	SBL	0	0.0	A	0	0.0	A
	SBT	186	0.0	A	219	0.0	A
	WBL	19	7.5	A	29	7.1	A
	WBR	0	0.0	A	0	0.0	A
	Overall	**580**	**7.5**	**A**	**401**	**7.1**	**A**
East Barbee Chapel Road and NC 54 (Unsignalized Intersection)	NBR	825	2.7	A	234	8.5	A
	SBR	253	105.4	F	379	174.8	F
	EBT	2398	0.1	A	4566	1.0	A
	EBR	131	0.9	A	836	4.2	A
	WBT	4379	4.0	A	3368	3.0	A
	WBR	432	2.0	A	471	2.0	A
	Overall	**8418**	**105.4**	**F**	**9854**	**174.8**	**F**

As shown in Table 6, a number of movements are expected to operate at LOS E or F in the future No-Build Conditions. This is not unexpected as the corridor is near or at capacity under current conditions. Although the conversion of NC 54 to a super-street design potentially increases the corridor-wide safety, it also shifts turning traffic along NC 54 as the number of left turn opportunities from and to the cross streets are limited. Several business and commercial developments are located along NC 54 and the turning traffic to access these properties would increase with the super-street design.

A 2040 No-Build Synchro based model was developed to provide an initial set of future optimized signal timings for input into Vissim. The proposed network geometry and the 2040 No-Build volumes were then input into the model. The Synchro reports for all scenarios can be found in Appendix D.

Synchro, however, cannot realistically model advanced signal timing operations including Traffic Signal Preemption or Transit Signal Priority. As such, the delays caused to general traffic by signal preemption events cannot be measured by Synchro and therefore those intersections equipped with this special signal operation would underreport vehicle delays.

Based on the results of the Vissim analysis, the following intersections are anticipated to operate at LOS E or LOS F in at least one No-Build peak hour:

- Rogerson Drive and NC 54*
- NC 54 and East Barbee Chapel Road*

* - *Indicates unsignalized intersection with at least one movement operating at LOS F conditions.*

It is important to note that these are No-Build background issues that should be addressed regardless of the potential D-O LRT project. This expected No-Build congestion may make it more difficult to meet the thresholds stated in NCDOT's "Policy on Street and Driveway Access to North Carolina Highways." Queue lengths that may already be lengthy in the No-Build condition could cause additional queuing resulting from the Build Conditions to exceed the available storage space for a particular lane group.

5.3 2040 Build C1/C1A Alternative

Under the C1/C1A Alternative, the LRT alignment would turn east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. The LRT would continue east approximately 500 feet south of NC 54 before elevating and turning north at the Friday Center Drive Station. The alignment would then cross over NC 54 via a bridge near the intersection of Friday Center Drive and would run at-grade near the following Meadowmont Lane intersections:

- Meadowmont Lane at Village Crossing Drive
- Meadowmont Lane at East Barbee Chapel Road
- Meadowmont Lane at Sprunt Street
- Meadowmont Lane at Green Cedar Lane

Traffic results at the following intersections are reported specifically for the C1/C1A Alternative.

- NC 54 at West Barbee Chapel Road

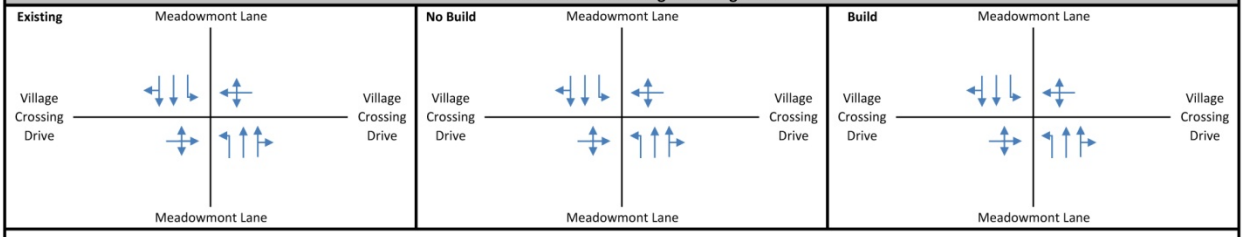
- NC 54 at Midblock U-Turn
- NC 54 at Friday Center Drive/Meadowmont Lane
- Meadowmont Road at Village Crossing Drive
- Meadowmont Road at East Barbee Chapel Road
- Meadowmont Road at Sprunt Street
- Meadowmont Road at Green Cedar Lane

The intersections of NC 54 at Finley Golf Course Road and NC 54 at East Barbee Chapel Road would operate similar to the No-Build Conditions. The intersection of NC 54 at Finley Golf Course Road would not be impacted under the C1/C1A Alternative due to its distance from the LRT crossing of Finley Golf Course Road and the nearby intersections NC 54 would not be equipped with signal preemption due to the elevated alignment. Similarly, the intersection of NC 54 and East Barbee Chapel Road is expected to operate without build impacts due to the elevated LRT alignment that crosses NC 54 at Friday Center Drive and proceeds north along Meadowmont Lane avoiding the intersection of NC 54 and East Barbee Chapel Road.

Intersection signal timing changes from 1) Existing to No-Build and from 2) No-Build to Build are shown in Table 7 for the 2040 LRT C1/C1A Alternative along Meadowmont Lane. Table 7 also includes the lane configuration modifications that are proposed between Existing to No-Build and No-Build to Build C1/C1A Conditions.

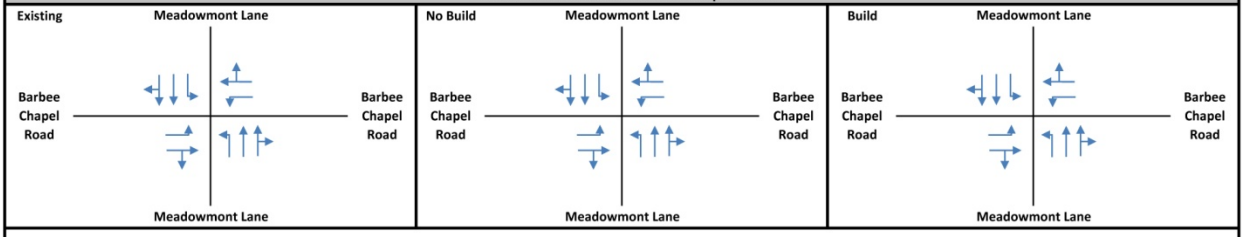
Table 7: 2040 LRT C1/C1A Alternative Signal & Lane Configuration Modifications

Meadowmont Lane at Village Crossing Drive



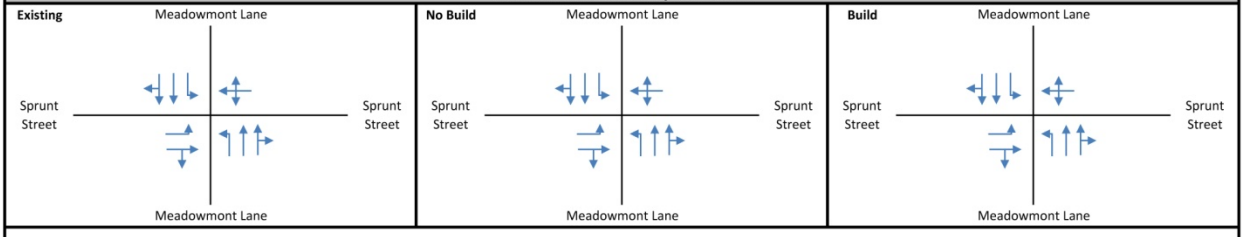
AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	No change.	Existing to No Build	No change.	No change.
No Build to Build		Transit Signal Preemption.	No Build to Build		Transit Signal Preemption.

Meadowmont Lane at Barbee Chapel Road



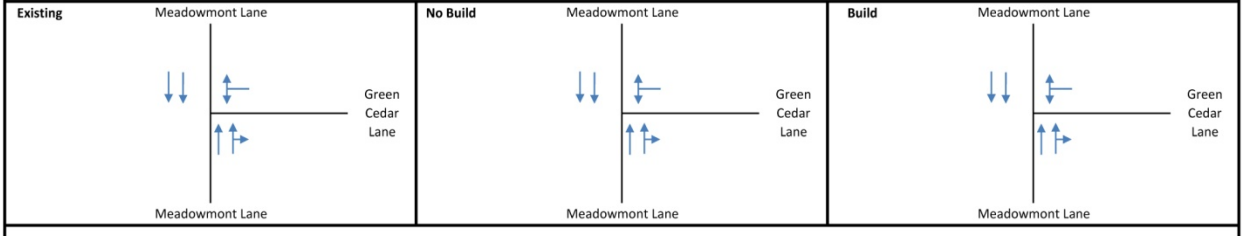
AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	No change.	Existing to No Build	No change.	No change.
No Build to Build		Transit Signal Preemption.	No Build to Build		Transit Signal Preemption.

Meadowmont Lane at Sprunt Street



AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	No change.	Existing to No Build	No change.	No change.
No Build to Build		Transit Signal Preemption.	No Build to Build		Transit Signal Preemption.

Meadowmont Lane at Green Cedar Lane



AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	Unsignalized intersection.		Existing to No Build	Unsignalized intersection.	
No Build to Build	Unsignalized intersection.	Transit gates installed.	No Build to Build	Unsignalized intersection.	Transit gates installed.

5.4 2040 Build C2 Alternative

Under the C2 Alternative, the alignment would continue east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. In this alternative, the alignment would run at-grade several hundred feet south of NC 54 between the Hamilton Road Station and East Barbee Chapel Road and would cross the southern legs of the following intersections:

- NC 54 at Friday Center Drive/Meadowmont Lane
- NC 54 at Barbee Chapel Road

Traffic results at the following intersections are reported for the C2 Alternative.

- NC 54 at West Barbee Chapel Road
- NC 54 at Midblock U-Turn
- NC 54 at Friday Center Drive/Meadowmont Lane
- NC 54 at East Barbee Chapel Road

At all other intersections, traffic operations along NC 54 under Alternative C2 are anticipated to be similar to the No-Build alternative as the D-O LRT runs parallel and south of the roadway at a distance of approximately 500 feet and therefore would have minimal impacts on its traffic operations. Due to its alignment, Alternative C2 would not impact the Meadowmont Lane segment and would report results similar to the No-Build Conditions.

5.5 2040 Build C2A Alternative

Under the C2A Alternative, the alignment would continue east from Fordham Boulevard to meet the Hamilton Road Station and run along the northern edge of Finley Golf Course. The at-grade LRT would turn north toward NC 54 at Finley Golf Course Road. In this alternative, the alignment would run adjacent to the south side of NC 54 and would cross the southern legs of the following intersections:

- West Barbee Chapel Road at NC 54
- Friday Center Drive/Meadowmont Lane at NC 54
- East Barbee Chapel Road at NC 54

Traffic operations for all intersections listed in Section 2.4 are reported.

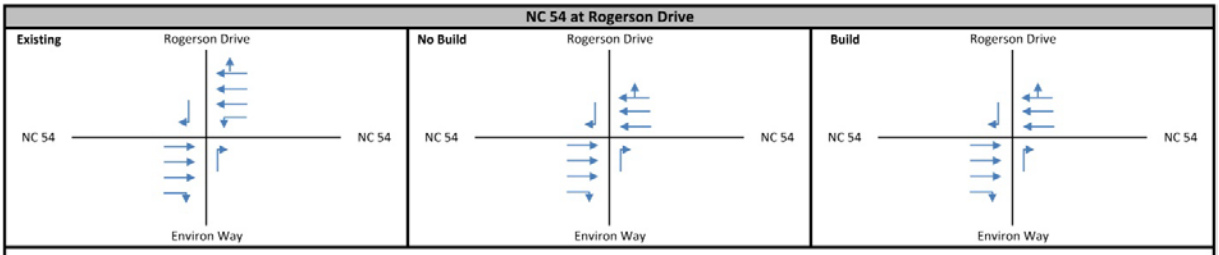
The D-O LRT is at-grade and adjacent to the all of the intersections along NC 54 between West Barbee Chapel Road and Downing Creek Parkway. As a result of special preemption operations, the NC 54 corridor coordination would be disrupted, and therefore, several movements of the at-grade intersections may be affected.

In addition, the NC 54 intersections would be reconfigured as part of the No-Build Conditions super-street design by prohibiting all cross street northbound and southbound left turn and through movements. These movement bans would add substantial volume to the northbound and southbound right turn movements at all intersections. Acceleration lanes on NC 54 for the northbound West Barbee Chapel Road right turn and the southbound East Barbee Chapel Road right turn are recommended to improve traffic operations at these two intersections for Alternative C2A.

Intersection signal timing changes from 1) Existing to No-Build and from 2) No-Build to Build are shown in Table 8 for the 2040 LRT C2/C2A Alternatives along NC 54. Table 8 also includes the lane configuration modifications that are proposed between Existing to No-Build and No-Build to Build C2/C2A conditions. These incorporate the roadway medications recommended above.

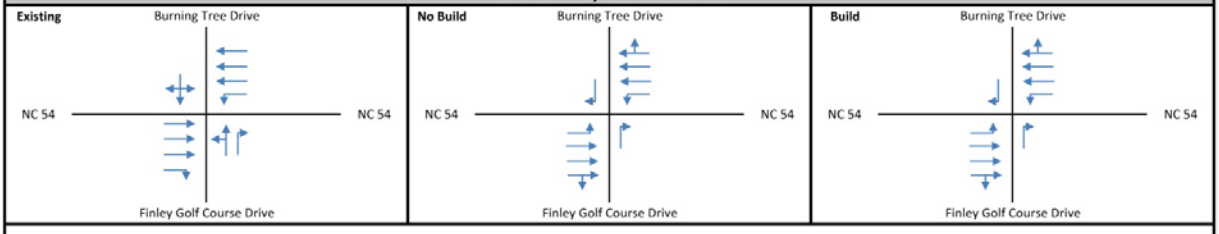
Table 8: 2040 LRT C2/C2A Alternative Signal & Lane Configuration Modifications

NC 54 at Rogerson Drive



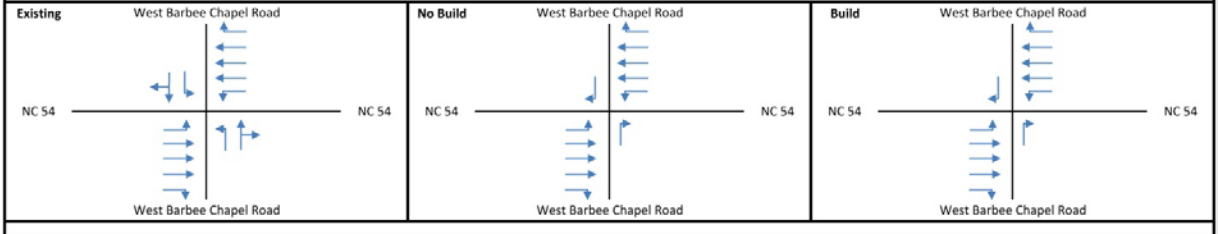
AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	Signal removed under No Build.		Existing to No Build	Signal removed under No Build.	
No Build to Build	Unsignalized intersection.		No Build to Build	Unsignalized intersection.	

NC 54 at Finley Golf Course Drive



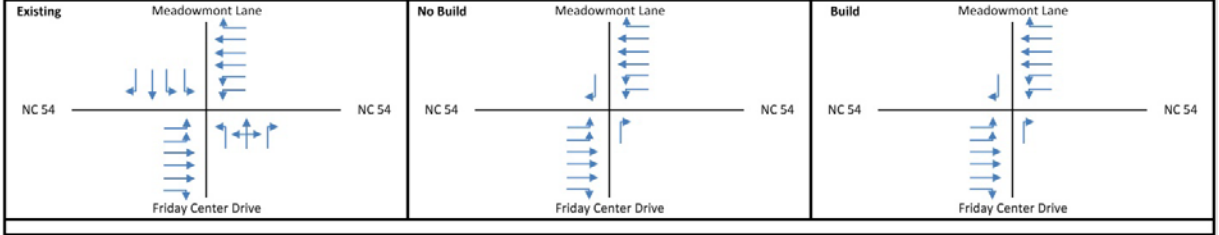
AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	NBR/WBL and SBR/EBL overlap. Left-turning movements protected under No Build.	Existing to No Build	No change.	NBR/WBL and SBR/EBL overlap. Left-turning movements protected under No Build.
No Build to Build		No change.	No Build to Build		EBL and WBL phases run concurrently under Build.

NC 54 at West Barbee Chapel Road



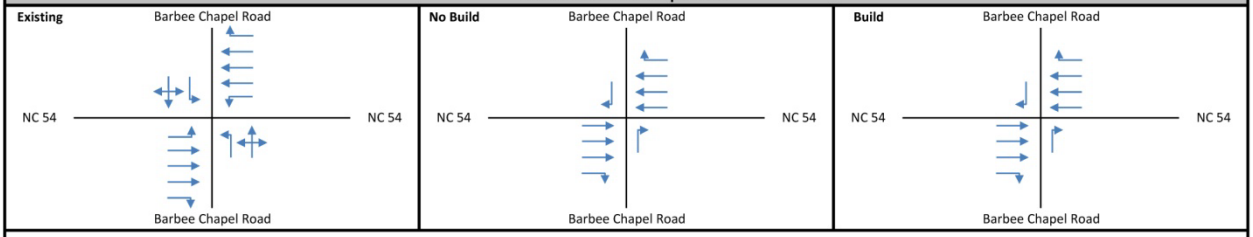
AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	NBR/WBL and SBR/EBL overlap. Left-turning movements protected under No Build.	Existing to No Build	No change.	NBR/WBL and SBR/EBL overlap. Left-turning movements protected under No Build.
No Build to Build		EBL and WBL phases run concurrently under Build. Transit Signal Preemption.	No Build to Build		EBL and WBL phases run concurrently under Build. Transit Signal Preemption.

NC 54 at Meadowmont Lane



AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	No change.	NBR and SBR free under No Build.	Existing to No Build	No change.	WBL phasing changed from lag to lead, NBR and SBR free under No Build.
No Build to Build		WBL phasing changed from lag to lead. Transit Signal Preemption.	No Build to Build		Transit Signal Preemption.

NC 54 at Barbee Chapel Lane



AM	Cycle Length	Phasing	PM	Cycle Length	Phasing
Existing to No Build	Signal removed under No Build.		Existing to No Build	Signal removed under No Build.	
No Build to Build	Unsignalized intersection.	Transit gates installed.	No Build to Build	Unsignalized intersection.	Transit gates installed.

6. Summary of Results

The following section summarizes the VISSIM simulation results for the 2040 No-Build versus the three 2040 Build LRT Alternatives in a side by side manner. The tables include the Vissim individual movement and overall intersection delays, LOS and queuing information as reported by Vissim for all future scenarios. Tables 9 and 10 present the 2040 C1/C1A Alternative AM and PM peak hours Vissim results. Tables 11 and 12 provide the C2 Alternative AM and PM peak hours Vissim results, and Tables 13 and 14 provide the C2A Alternative AM and PM peak hour Vissim results.

Table 9: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
West Barbee Chapel Road and NC 54[1]	NBR	14	14	14	14	11.0	13.0	-1.9	-14.9%	B	B	0	0	0	0%	890	0	0	0	0%
	SBR	137	137	137	137	37.4	39.2	-1.8	-4.5%	D	D	3	3	0	-3%	930	105	104	1	1%
	EBU	21	14	21	18	104.1	86.6	17.6	20.3%	F	F	126	72	54	75%	320	332	332	0	0%
	EBL	118	99	118	114	91.4	80.5	10.8	13.5%	F	F	122	72	50	69%	320	332	332	0	0%
	EBT	2630	2556	2630	2587	6.7	6.4	0.2	3.6%	A	A	44	33	10	30%	740	740	737	3	0%
	EBR	26	25	26	24	5.2	3.7	1.5	39.7%	A	A	43	13	30	237%	200	588	580	7	1%
	WBL	260	239	260	245	62.8	67.9	-5.0	-7.4%	E	E	187	165	22	14%	390	800	794	6	1%
	WBT	3908	3685	3908	3683	25.0	24.1	0.8	3.4%	C	C	310	241	68	28%	730	816	810	6	1%
	WBR	65	63	65	61	13.4	12.1	1.2	10.1%	B	B	203	146	58	40%	170	635	627	8	1%
	All	7179	6831	7179	6882	20.6	20.2	0.4	1.8%	C	C	130	95	35	37%		816	810	6	1%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	2	2	2	3	89.6	83.1	6.5	7.8%	F	F	5	4	1	33%	330	236	111	125	112%
	EBT	2642	2566	2642	2599	2.4	2.0	0.4	19.3%	A	A	5	4	1	33%	725	236	111	125	112%
	WBU	297	290	297	289	65.8	65.5	0.3	0.5%	E	E	222	214	8	4%	650	1148	1142	6	1%
	WBT	4231	3796	4231	4037	15.7	14.6	1.1	7.2%	B	B	222	214	8	4%	935	1148	1142	6	1%
	All	7172	6653	7172	6928	19.2	18.0	1.2	6.7%	B	B	222	109	113	104%		1148	1142	6	1%
Friday Center Drive/Meadowmont Lane and NC 54[1]	NBR	141	141	141	141	0.6	0.7	-0.1	-8.7%	A	A	0	0	0	0%	1665	0	0	0	0%
	SBR	316	310	316	312	2.9	2.1	0.8	36.8%	A	A	0	0	0	0%	580	9	0	9	0%
	EBL	210	192	210	200	60.8	63.0	-2.2	-3.4%	E	E	45	53	-8	-15%	510	180	225	-44	-20%
	EBT	2011	2169	2257	2182	10.7	10.5	0.2	2.2%	B	B	50	55	-5	-10%	975	468	471	-2	0%
	EBR	472	464	472	469	8.5	9.3	-0.8	-8.2%	A	A	50	55	-5	-10%	400	468	471	-2	0%
	WBU	220	196	220	207	54.7	54.7	0.0	0.0%	D	D	102	99	3	3%	720	366	364	2	1%
	WBL	311	305	311	305	54.0	53.7	0.3	0.6%	D	D	102	99	3	3%	720	366	364	2	1%
	WBT	4186	4073	4186	4069	12.5	11.9	0.5	4.3%	B	B	230	376	-146	-39%	840	922	1025	-103	-10%
	WBR	33	33	33	32	4.7	2.0	2.7	134.5%	A	A	200	376	-176	-47%	670	846	1025	-179	-17%
	All	7900	7882	8146	7915	15.0	14.8	0.2	1.2%	B	B	71	124	-53	-43%		922	1025	-103	-11%

Table 9: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Village Crossing Drive[1]	NBL	96	89	96	93	14.2	7.1	7.1	101.1%	B	A	6	2	3	139%	75	137	145	-8	-5%
	NBT	138	130	138	134	3.4	3.4	0.0	0.6%	A	A	6	2	3	139%	575	137	145	-8	-5%
	NBR	9	8	9	7	2.9	2.9	0.0	-1.4%	A	A	1	1	0	84%	575	81	89	-8	-9%
	SBL	2	2	2	2	6.4	6.6	-0.2	-2.7%	A	A	1	2	-1	-60%	150	89	78	10	13%
	SBT	253	248	253	250	3.1	3.1	0.0	1.3%	A	A	2	2	0	4%	360	89	78	11	14%
	SBR	1	1	1	1	5.8	3.9	1.9	49.5%	A	A	0	2	-2	-95%	360	22	78	-56	-72%
	EBL	2	2	2	2	8.9	7.8	1.1	14.5%	A	A	1	0	0	614%	685	33	21	12	56%
	EBT	0	0	0	0	0.0	0.0	0.0	0.0%	A	B	1	0	0	614%	685	33	21	12	56%
	EBR	23	23	23	24	4.3	0.6	3.7	593.5%	A	A	1	0	1	0%	685	33	0	33	0%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	40	39	40	39	16.1	11.0	5.0	45.7%	B	B	4	2	1	58%	620	78	61	17	29%
	WBT	5	6	5	6	15.6	11.4	4.2	37.0%	B	B	4	2	1	58%	620	78	61	17	29%
	WBR	5	5	5	5	4.7	5.8	-1.0	-17.7%	A	A	0	0	0	0%	620	17	8	9	106%
	WB LRT	6	6	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	574	553	574	562	6.1	4.4	1.7	38.9%	A	A	2	1	0	27%		137	145	-8	-6%
Meadowmont Lane and East Barbee Chapel Road[1]	NBL	6	118	6	5	9.3	10.1	-0.7	-7.1%	A	B	5	4	2	49%	85	95	117	-22	-19%
	NBT	137	6	137	137	0.1	7.5	-7.4	-98.9%	A	A	0	4	-4	-100%	400	0	117	-117	-100%
	NBR	2	1	2	1	4.9	4.3	0.6	14.7%	A	A	0	0	0	38%	400	22	41	-19	-47%
	SBL	136	135	136	135	10.6	10.9	-0.3	-2.7%	B	B	15	13	2	13%	85	146	139	6	5%
	SBT	252	249	252	250	8.4	8.5	-0.1	-1.6%	A	A	15	13	2	13%	430	146	139	6	5%
	SBR	182	185	182	182	8.7	6.0	2.7	45.0%	A	A	12	0	12	8679%	430	150	48	102	214%
	EBL	117	117	117	117	14.5	11.1	3.4	30.7%	B	B	2	6	-4	-73%	80	74	100	-27	-27%
	EBT	3	4	3	3	9.4	7.7	1.7	21.7%	A	A	2	6	-4	-73%	680	74	100	-27	-27%
	EBR	4	4	4	4	6.3	4.0	2.3	56.6%	A	A	2	0	1	1273%	680	74	35	38	109%
	EB LRT	6	6	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	21	14	6	44%	100	191	158	33	21%
	WBT	19	19	19	18	15.1	10.9	4.2	38.5%	B	B	21	14	6	44%	800	191	158	33	21%
	WBR	227	227	227	228	16.1	12.5	3.6	28.7%	B	B	21	14	6	44%	800	191	158	33	21%
	WB LRT	6	6	-	-	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	1085	1064	1085	1080	11.2	9.4	1.8	19.2%	B	A	10	8	2	32%		191	158	33	17%

Table 9: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Sprunt Street[1]	NBL	113	110	113	115	29.8	7.6	22.2	292.4%	C	A	21	10	12	125%	115	140	125	15	12%
	NBT	355	339	355	354	6.9	6.9	0.0	-0.7%	A	A	21	10	12	125%	415	140	125	15	12%
	NBR	13	12	13	12	7.7	8.8	-1.0	-11.6%	A	A	10	10	1	9%	415	107	125	-19	-15%
	SBL	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	10	8	2	25%	85	107	82	24	30%
	SBT	196	198	196	198	14.6	11.7	2.9	24.6%	B	B	10	8	2	25%	570	107	82	24	30%
	SBR	9	7	9	7	11.1	7.7	3.4	44.9%	B	A	1	0	1	176%	570	37	49	-13	-26%
	EBL	19	21	19	21	19.4	14.1	5.3	37.5%	B	B	8	5	3	54%	70	218	161	56	35%
	EBT	12	12	12	12	21.4	12.9	8.5	65.7%	C	B	8	5	3	54%	1115	218	161	56	35%
	EBR	345	343	345	341	11.5	7.5	4.0	53.5%	B	A	8	1	7	535%	1115	218	124	93	75%
	EB LRT	6	6	-	-	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	29	30	29	28	20.7	12.6	8.1	63.8%	C	B	3	2	1	28%	845	53	53	0	0%
	WBT	4	2	4	4	13.8	17.4	-3.7	-20.9%	B	B	3	2	1	28%	845	53	53	0	0%
	WBR	0	1	0	0	7.5	0.0	7.5	0.0%	A	A	3	0	3	13000%	845	53	11	42	390%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	1095	1075	1095	1093	19.9	8.5	11.4	135.4%	B	A	8	5	3	64%		218	161	56	26%
Meadowmont Lane and Green Cedar Lane[1] (Unsignalized Intersection)	NBT	315	311	315	322	3.9	0.3	3.6	1171.0%	A	A	5	0	5	0%	600	122	0	122	0%
	NBR	59	50	59	53	4.5	0.9	3.6	418.4%	A	A	5	0	5	0%	600	122	0	122	0%
	SBL	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	2	0	2	0%	730	56	0	56	0%
	SBT	186	186	186	186	2.5	0.0	2.5	0.0%	A	A	2	0	2	0%	730	56	0	56	0%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	19	19	19	19	10.0	7.5	2.5	33.0%	A	A	0	0	0	0%	925	25	0	25	0%
	WBR	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	0	0	0	0%	925	25	0	25	0%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	579	565	579	580	10.0	7.5	2.5	33.0%	A	A	2	0	2	0%		122	0	122	100%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

Table 10: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
West Barbee Chapel Road and NC 54[1]	NBR	410	358	410	400	65.1	63.9	1.1	1.8%	E	E	264	154	110	71%	890	634	661	-27	-4%
	SBR	214	213	214	214	23.8	12.2	11.6	94.5%	C	B	10	1	9	893%	930	146	89	58	65%
	EBU	99	92	99	90	66.9	67.9	-1.0	-1.5%	E	E	114	114	0	0%	320	548	559	-11	-2%
	EBL	169	166	169	164	64.4	67.0	-2.6	-3.8%	E	E	114	114	0	0%	320	548	559	-11	-2%
	EBT	3446	3293	3446	3251	18.2	12.4	5.8	47.0%	B	B	148	87	62	71%	740	682	706	-24	-3%
	EBR	249	237	249	227	9.9	6.5	3.4	52.4%	A	A	148	87	62	71%	200	682	706	-24	-3%
	WBL	73	67	73	73	65.1	65.9	-0.8	-1.2%	E	E	25	28	-2	-8%	390	145	188	-42	-22%
	WBT	3009	2908	3009	2888	9.6	8.9	0.6	7.2%	A	A	69	46	23	51%	730	496	487	9	2%
	WBR	37	33	37	35	3.7	5.8	-2.0	-35.2%	A	A	69	46	23	51%	170	496	487	9	2%
	All	7706	7367	7706	7342	19.0	16.0	2.9	18.3%	B	B	107	75	32	42%		682	706	-24	-3%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	207	188	207	186	61.3	57.0	4.3	7.5%	E	E	290	299	-8	-3%	330	841	853	-12	-1%
	EBT	3649	3448	3649	3456	22.3	15.3	7.0	46.1%	C	B	290	299	-8	-3%	725	841	853	-12	-1%
	WBU	917	860	917	925	67.6	65.0	2.6	3.9%	E	E	218	223	-5	-2%	650	592	620	-28	-5%
	WBT	3021	2832	3021	2817	5.2	5.5	-0.3	-4.9%	A	A	218	223	-5	-2%	935	592	620	-28	-5%
	All	7794	7328	7794	7384	24.3	20.2	4.1	20.4%	C	C	254	261	-6	-2%		841	853	-12	-1%
Friday Center Drive/Meadowmont Lane and NC 54[1]	NBR	1140	1132	1140	1128	6.3	7.5	-1.1	-15.2%	A	A	0	0	0	0%	1665	62	5	57	1180%
	SBR	401	365	401	398	11.6	2.7	9.0	338.5%	B	A	2	0	2	8000%	580	134	28	106	380%
	EBL	258	236	258	243	54.6	49.5	5.1	10.3%	D	D	55	44	11	25%	510	203	210	-7	-3%
	EBT	4140	3894	4140	3966	12.2	7.7	4.5	58.2%	B	A	211	144	67	47%	975	1023	1018	5	1%
	EBR	168	162	168	164	2.8	2.3	0.5	20.6%	A	A	211	144	67	47%	400	1023	1018	5	1%
	WBU	347	340	347	315	69.5	69.5	0.0	0.0%	E	E	177	143	34	24%	720	614	431	184	43%
	WBL	32	31	32	30	51.9	59.1	-7.2	-12.1%	D	E	177	143	34	24%	720	614	431	184	43%
	WBT	3428	3344	3428	3368	6.5	12.8	-6.3	-48.9%	A	B	31	113	-82	-73%	840	461	864	-403	-47%
	WBR	78	79	78	82	2.4	2.2	0.2	9.0%	A	A	31	113	-82	-73%	670	461	864	-403	-47%
	All	9992	9582	9992	9691	12.5	12.3	0.2	1.3%	B	B	81	94	-13	-13%		1023	1018	5	1%

Table 10: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Village Crossing Drive[1]	NBL	106	107	106	101	20.0	6.7	13.3	198.1%	B	A	11	2	9	446%	75	176	126	50	40%
	NBT	199	181	199	191	6.4	3.4	3.0	89.3%	A	A	11	2	9	446%	575	176	126	50	40%
	NBR	9	26	31	28	4.9	4.0	0.9	23.4%	A	A	6	1	5	803%	575	140	94	45	48%
	SBL	11	10	11	11	0.4	4.2	-3.8	-89.6%	A	A	0	1	-1	-98%	150	18	85	-66	-78%
	SBT	322	314	322	320	2.5	3.1	-0.6	-19.3%	A	A	2	3	-1	-25%	360	80	89	-9	-10%
	SBR	5	5	5	5	2.3	3.2	-0.9	-28.5%	A	A	6	0	5	3218%	360	124	46	78	169%
	EBL	2	1	2	2	5.2	8.8	-3.6	-40.9%	A	A	0	0	0	32%	685	33	33	0	0%
	EBT	3	1	3	4	9.5	12.5	-3.0	-24.0%	A	B	0	0	0	32%	685	33	33	0	0%
	EBR	51	23	51	51	7.8	1.0	6.8	708.3%	A	A	0	0	0	0%	685	33	1	32	2218%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	28	28	28	28	3.5	0.4	3.1	863.9%	A	A	1	0	1	0%	620	39	10	29	291%
	WBT	1	1	1	1	15.0	7.6	7.4	96.6%	B	A	1	0	1	850%	620	39	32	7	21%
	WBR	4	4	4	4	7.9	5.3	2.6	49.9%	A	A	1	0	1	0%	620	39	10	29	291%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	741	702	763	745	6.5	3.5	3.0	84.4%	A	A	3	1	2	233%		176	126	50	28%
Meadowmont Lane and East Barbee Chapel Road[1]	NBL	47	57	47	61	18.0	11.9	6.2	52.0%	B	B	7	5	2	43%	85	117	121	-4	-4%
	NBT	157	128	157	136	9.5	7.2	2.3	31.9%	A	A	7	5	2	43%	400	117	121	-4	-4%
	NBR	1	1	1	1	5.8	2.2	3.6	167.6%	A	A	2	2	1	42%	400	92	100	-7	-7%
	SBL	124	122	124	126	11.8	11.1	0.7	6.3%	B	B	13	11	1	13%	85	133	128	4	3%
	SBT	247	240	247	247	9.3	8.6	0.7	8.3%	A	A	13	11	1	13%	430	133	128	4	3%
	SBR	72	68	72	70	8.6	5.6	3.0	54.0%	A	A	11	2	10	620%	430	149	97	52	54%
	EBL	65	66	65	66	14.9	12.4	2.5	20.3%	B	B	3	8	-5	-65%	80	105	119	-14	-12%
	EBT	92	93	92	93	10.5	10.3	0.2	2.2%	B	B	3	8	-5	-65%	680	105	119	-14	-12%
	EBR	88	87	88	87	7.7	5.5	2.2	38.9%	A	A	3	1	2	187%	680	105	87	19	21%
	EB LRT	6	6	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	3	3	3	3	14.9	13.4	1.5	10.9%	B	B	21	15	6	42%	100	209	174	35	20%
	WBT	83	87	83	88	14.9	11.3	3.5	31.2%	B	B	21	15	6	42%	800	209	174	35	20%
	WBR	175	171	175	172	15.8	12.2	3.7	29.9%	B	B	21	15	6	42%	800	209	174	35	20%
	WB LRT	6	6	-	-	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	1154	1123	1154	1147	11.7	9.6	2.2	22.7%	B	A	9	8	1	11%		209	174	35	17%

Table 10: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C1/C1A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Sprunt Street[1]	NBL	219	202	219	206	30.9	7.8	23.1	296.2%	C	A	37	7	29	390%	115	261	144	117	81%
	NBT	152	141	152	144	5.9	5.7	0.3	4.4%	A	A	37	7	29	390%	415	261	144	117	81%
	NBR	26	22	26	23	6.1	5.9	0.2	2.9%	A	A	12	7	4	55%	415	105	144	-39	-27%
	SBL	1	1	1	1	5.9	3.5	2.4	68.5%	A	A	12	10	2	21%	85	105	94	11	12%
	SBT	236	239	236	239	14.1	11.4	2.7	23.9%	B	B	12	10	2	21%	570	105	94	11	12%
	SBR	11	9	11	9	9.7	5.7	4.0	70.7%	A	A	1	1	0	42%	570	70	61	9	15%
	EBL	8	8	8	8	14.0	12.8	1.2	9.1%	B	B	3	5	-2	-31%	70	136	139	-3	-2%
	EBT	28	29	28	29	18.1	16.9	1.2	6.9%	B	C	3	5	-2	-31%	1115	136	139	-3	-2%
	EBR	179	177	179	177	10.3	7.3	3.0	41.3%	B	A	3	1	2	228%	1115	136	102	34	33%
	EB LRT	6	6	-	-	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	28	15	28	27	21.6	16.0	5.7	35.4%	C	C	2	2	-1	-29%	845	43	55	-12	-21%
	WBT	2	1	2	2	12.3	9.6	2.7	27.9%	B	A	2	2	-1	-29%	845	43	55	-12	-21%
	WBR	1	0	1	1	0.0	4.2	-4.2	-100.0%	A	A	0	0	0	-33%	845	5	7	-2	-25%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	891	843	891	865	21.0	8.8	12.2	137.6%	C	A	11	5	6	119%		261	144	117	45%
Meadowmont Lane and Green Cedar Lane[1] (Unsignalized Intersection)	NBT	152	143	152	146	4.4	0.1	4.3	4777.8%	A	A	2	0	2	0%	600	78	0	78	0%
	NBR	9	7	9	7	7.6	0.4	7.2	1900.0%	A	A	2	0	2	0%	600	78	0	78	0%
	SBL	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	3	0	3	0%	730	79	0	79	0%
	SBT	219	219	219	219	4.4	0.0	4.4	44100.0%	A	A	3	0	3	0%	730	79	0	79	0%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	29	29	29	29	12.3	7.1	5.2	73.3%	B	A	1	0	1	0%	925	44	14	31	225%
	WBR	0	0	0	0	0.0	0.0	0.0	0.0%	A	A	1	0	1	0%	925	44	14	31	225%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	409	398	409	401	12.3	7.1	5.2	73.3%	B	A	2	0	2	0%		79	14	66	83%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

Table 11: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2 Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
West Barbee Chapel Road and NC 54[1]	NBR	14	14	14	14	9.9	13.0	-3.1	-23.8%	A	B	0	0	0	0%	890	0	0	0	0%
	SBR	137	135	137	137	36.3	39.2	-2.9	-7.3%	D	D	2	3	-1	-36%	930	90	104	-14	-14%
	EBU	21	20	21	18	94.5	86.6	7.9	9.1%	F	F	82	72	9	13%	320	326	332	-6	-2%
	EBL	118	119	118	114	91.3	80.5	10.8	13.4%	F	F	82	72	9	13%	320	326	332	-6	-2%
	EBT	2630	2606	2630	2587	6.5	6.4	0.1	1.4%	A	A	39	33	6	18%	740	589	737	-147	-20%
	EBR	26	25	26	24	4.5	3.7	0.7	19.8%	A	A	38	13	26	201%	200	589	580	9	2%
	WBL	260	242	260	245	61.4	67.9	-6.5	-9.5%	E	E	161	165	-4	-2%	390	804	794	10	1%
	WBT	3908	3685	3908	3683	23.4	24.1	-0.8	-3.2%	C	C	242	241	1	0%	730	820	810	10	1%
	WBR	65	65	65	61	10.4	12.1	-1.7	-14.4%	B	B	242	146	97	66%	170	629	627	2	0%
	All	7179	6911	7179	6882	19.7	20.2	-0.5	-2.4%	B	C	114	95	20	21%		820	810	10	1%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	2	2	2	3	70.0	83.1	-13.1	-15.8%	E	F	5	4	1	19%	330	184	111	73	66%
	EBT	2642	2619	2642	2599	2.8	2.0	0.7	36.6%	A	A	5	4	1	19%	725	184	111	73	66%
	WBU	297	283	297	289	66.4	65.5	0.9	1.4%	E	E	205	214	-9	-4%	650	1014	1142	-128	-11%
	WBT	4231	3801	4231	4037	13.6	14.6	-1.1	-7.2%	B	B	205	214	-9	-4%	935	1014	1142	-128	-11%
	All	7172	6704	7172	6928	17.2	18.0	-0.8	-4.5%	B	B	205	109	96	89%		1014	1142	-128	-13%
Friday Center Drive/Meadowmont Lane and NC 54[1]	NBR	141	141	141	141	0.7	0.7	0.0	-4.3%	A	A	0	0	0	0%	1665	0	0	0	0%
	SBR	316	313	316	312	2.2	2.1	0.1	2.9%	A	A	0	0	0	0%	580	4	0	4	0%
	EBL	210	200	210	200	58.4	63.0	-4.6	-7.3%	E	E	44	53	-9	-17%	510	196	225	-28	-13%
	EBT	2011	2187	2257	2182	11.5	10.5	1.0	9.7%	B	B	49	55	-6	-11%	975	469	471	-1	0%
	EBR	472	477	472	469	9.3	9.3	0.0	0.3%	A	A	49	55	-6	-11%	400	469	471	-1	0%
	WBU	220	201	220	207	54.6	54.7	-0.1	-0.2%	D	D	98	99	-1	-1%	720	337	364	-26	-7%
	WBL	311	290	311	305	55.0	53.7	1.3	2.5%	D	D	98	99	-1	-1%	720	337	364	-26	-7%
	WBT	4186	4069	4186	4069	11.6	11.9	-0.3	-2.8%	B	B	263	376	-113	-30%	840	934	1025	-91	-9%
	WBR	33	30	33	32	4.7	2.0	2.7	133.0%	A	A	263	376	-113	-30%	670	934	1025	-91	-9%
	All	7900	7907	8146	7915	14.7	14.8	-0.1	-0.4%	B	B	96	124	-27	-22%		934	1025	-91	-10%

Table 11: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2 Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
East Barbee Chapel Road and NC 54[1] (Unsignalized Intersection)	NBR	829	824	829	825	1.9	2.7	-0.9	-31.5%	A	A	0	0	0	0%	1260	0	0	0	0%
	SBR	310	247	310	253	115.1	105.4	9.7	9.2%	F	F	331	256	75	29%	740	804	795	10	1%
	EBT	2457	2396	2457	2398	0.1	0.1	0.0	40.0%	A	A	0	0	0	0%	890	0	0	0	0%
	EBR	135	133	135	131	1.0	0.9	0.1	14.1%	A	A	0	0	0	0%	890	0	0	0	0%
	WBT	4440	4358	4440	4379	4.1	4.0	0.0	1.0%	A	A	56	72	-16	-22%	1090	834	890	-56	-6%
	WBR	435	435	435	432	2.0	2.0	0.0	1.0%	A	A	45	55	-10	-18%	200	714	760	-46	-6%
	All	8606	8392	8606	8418	115.1	105.4	9.7	9.2%	F	F	72	64	8	13%		834	890	-56	-7%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

Table 12: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2 Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
West Barbee Chapel Road and NC 54[1]	NBR	410	360	410	400	72.7	63.9	8.7	13.6%	E	E	248	154	94	61%	890	641	661	-20	-3%
	SBR	214	214	214	214	14.5	12.2	2.2	18.2%	B	B	1	1	0	0%	930	79	89	-10	-11%
	EBU	99	95	99	90	61.3	67.9	-6.6	-9.7%	E	E	99	114	-15	-13%	320	445	559	-115	-20%
	EBL	169	153	169	164	62.6	67.0	-4.4	-6.6%	E	E	99	114	-15	-13%	320	445	559	-115	-20%
	EBT	3446	3253	3446	3251	15.1	12.4	2.7	21.7%	B	B	95	87	8	9%	740	609	706	-97	-14%
	EBR	249	241	249	227	8.6	6.5	2.2	33.1%	A	A	95	87	8	9%	200	609	706	-97	-14%
	WBL	73	65	73	73	66.2	65.9	0.4	0.5%	E	E	25	28	-3	-9%	390	162	188	-26	-14%
	WBT	3009	2917	3009	2888	7.3	8.9	-1.7	-18.5%	A	A	43	46	-3	-7%	730	437	487	-50	-10%
	WBR	37	33	37	35	2.7	5.8	-3.0	-52.6%	A	A	19	46	-27	-1	170	337	487	-149	-31%
	All	7706	7330	7706	7342	16.5	16.0	0.5	3.2%	B	B	80	75	5	7%		641	706	-65	-10%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	207	184	207	186	52.9	57.0	-4.1	-7.2%	D	E	238	299	-61	-20%	330	818	853	-35	-4%
	EBT	3649	3416	3649	3456	19.6	15.3	4.3	28.3%	B	B	238	299	-61	-20%	725	818	853	-35	-4%
	WBU	917	865	917	925	66.7	65.0	1.7	2.6%	E	E	217	223	-6	-3%	650	609	620	-11	-2%
	WBT	3021	2770	3021	2817	4.5	5.5	-1.0	-17.7%	A	A	217	223	-6	-3%	935	609	620	-11	-2%
	All	7794	7235	7794	7384	21.3	20.2	1.1	5.4%	C	C	217	261	-44	-17%		818	853	-35	-4%
Friday Center Drive/Meadowmont Lane and NC 54[1]	NBR	1140	1127	1140	1128	8.4	7.5	1.0	13.3%	A	A	0	0	0	0%	1665	71	5	66	1370%
	SBR	401	365	401	398	10.7	2.7	8.0	303.0%	B	A	2	0	2	8500%	580	130	28	102	366%
	EBL	258	236	258	243	54.6	49.5	5.1	10.4%	D	D	54	44	10	23%	510	208	210	-2	-1%
	EBT	4140	3874	4140	3966	10.7	7.7	3.0	38.3%	B	A	153	144	9	7%	975	1027	1018	10	1%
	EBR	168	162	168	164	2.5	2.3	0.2	9.6%	A	A	153	144	9	7%	400	1027	1018	10	1%
	WBU	347	340	347	315	67.5	69.5	-2.0	-2.9%	E	E	162	143	19	13%	720	569	431	138	32%
	WBL	32	32	32	30	51.2	59.1	-7.9	-13.4%	D	E	162	143	19	13%	720	569	431	138	32%
	WBT	3428	3347	3428	3368	6.1	12.8	-6.7	-52.3%	A	B	29	113	-84	-74%	840	421	864	-443	-51%
	WBR	78	79	78	82	2.6	2.2	0.4	16.1%	A	A	21	113	-92	-81%	670	380	864	-483	-56%
	All	9992	9560	9992	9691	11.9	12.3	-0.5	-3.8%	B	B	82	94	-12	-13%		1027	1018	10	1%

Table 12: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2 Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
East Barbee Chapel Road and NC 54[1] (Unsignalized Intersection)	NBR	234	234	234	234	3.9	8.5	-4.6	-54.2%	A	A	0	0	0	-100%	1260	0	77	-77	-100%
	SBR	424	320	424	379	95.5	174.8	-79.3	-45.4%	F	F	441	963	-522	-54%	740	596	1822	-1226	-67%
	EBT	4762	4520	4762	4566	0.7	1.0	-0.4	-35.0%	A	A	2	0	2	768%	890	149	86	63	74%
	EBR	865	817	865	836	8.3	4.2	4.1	97.6%	A	A	2	0	2	768%	890	149	86	63	74%
	WBT	3461	3034	3461	3368	1.4	3.0	-1.6	-53.0%	A	A	0	4	-4	-97%	1090	51	366	-315	-86%
	WBR	473	469	473	471	1.8	2.0	-0.2	-10.7%	A	A	0	0	0	-100%	200	0	57	-57	-100%
	All	10219	9393	10219	9854	95.5	174.8	-79.3	-45.4%	F	F	133	145	-12	-9%		596	1822	-1226	-206%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

Table 13: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Hamilton Road and NC 54[1]	NBL	172	175	171	175	58.4	64.1	-5.7	-9%	E	E	73	84	-11	-13%	170	481	561	-80	-14%
	NBT	51	49	50	49	51.5	50.2	1.3	3%	D	D	73	84	-11	-13%	615	481	561	-80	-14%
	NBR	251	252	251	252	16.3	18.3	-2.1	-11%	B	B	16	23	-7	-29%	170	362	442	-80	-18%
	SBL	197	190	187	190	74.1	75.6	-1.4	-2%	E	E	120	124	-4	-3%	60	540	542	-2	0%
	SBT	56	59	62	59	66.8	68.4	-1.6	-2%	E	E	120	124	-4	-3%	950	540	542	-2	0%
	SBR	59	61	63	61	46.1	50.7	-4.7	-9%	D	D	63	68	-5	-7%	950	466	469	-2	-1%
	EBL	54	55	53	55	143.0	173.0	-30.0	-17%	F	F	557	421	136	32%	200	1459	1342	117	9%
	EBT	2073	2145	2091	2145	39.7	31.9	7.8	24%	D	C	557	424	133	31%	1900	1459	1345	114	8%
	EBR	162	177	172	177	39.0	30.6	8.4	27%	D	C	509	371	138	37%	1900	1411	1294	117	9%
	WBU	198	212	196	212	38.7	47.9	-9.2	-19%	D	D	423	585	-162	-28%	365	1048	1051	-3	0%
	WBL	186	194	179	194	40.3	48.2	-8.0	-17%	D	D	423	585	-162	-28%	365	1048	1051	-3	0%
	WBT	3321	3602	3322	3602	13.4	15.1	-1.7	-11%	B	B	423	585	-162	-28%	880	1048	1051	-3	0%
	WBR	74	79	71	79	12.8	16.1	-3.3	-21%	B	B	360	517	-157	-30%	880	970	973	-3	0%
	All	6854	7250	6867	7250	28.4	27.7	0.7	3%	C	C	252	270	-18	-7%		1,459	1,345	114	8%
Rogerson Drive and NC 54[1] (Unsignalized Intersection)	NBR	20	20	20	20	20.9	14.0	6.9	49%	C	B	0	0	0	0%	575	0	0	0	0%
	SBR	25	25	23	25	69.8	165.6	-95.8	-58%	F	F	2	10	-8	-84%	500	49	91	-43	-47%
	EBT	2621	2700	2608	2700	4.3	2.1	2.2	109%	A	A	1	1	1	115%	800	127	132	-5	-4%
	EBR	96	99	97	99	1.6	8.3	-6.7	-81%	A	A	0	211	-210	-100%	90	104	657	-553	-84%
	WBT	3810	4062	3799	4062	11.8	16.1	-4.4	-27%	B	C	162	211	-49	-23%	560	658	657	2	0%
	WBR	4	5	4	5	6.1	8.3	-2.3	-27%	A	A	162	211	-49	-23%	560	658	657	2	0%
	All	6576	6911	6551	6911	69.8	165.6	-95.8	-58%	F	F	41	54	-13	-24%		658	657	2	0%

Table 13: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Finley Golf Course Road/Burning Tree Drive and NC 54[1]	NBR	193	193	194	193	15.0	16.7	-1.7	-10%	B	B	0	1	0	-20%	560	39	62	-22	-36%
	SBR	259	262	252	262	49.7	63.7	-14.0	-22%	D	E	31	61	-30	-49%	710	318	414	-96	-23%
	EBL	51	49	48	49	46.7	33.3	13.5	40%	D	C	100	64	36	56%	425	787	773	14	2%
	EBT	2506	2554	2473	2554	8.1	6.7	1.4	20%	A	A	100	64	36	56%	550	787	773	14	2%
	EBR	120	117	109	117	7.4	7.0	0.4	5%	A	A	76	42	34	81%	550	727	714	14	2%
	WBU	46	48	46	48	38.7	36.9	1.9	5%	D	D	268	312	-45	-14%	365	889	872	18	2%
	WBL	103	117	107	117	54.9	40.7	14.2	35%	D	D	268	312	-45	-14%	365	889	872	18	2%
	WBT	3573	3805	3592	3805	11.8	14.1	-2.3	-16%	B	B	268	312	-45	-14%	730	889	872	18	2%
	WBR	95	96	92	96	11.8	13.9	-2.2	-15%	B	B	268	312	-45	-14%	730	889	872	18	2%
	All	6945	7241	6912	7241	13.0	13.9	-1.0	-7%	B	B	153	165	-11	-7%		889	872	18	2%
West Barbee Chapel Road and NC 54[1]	NBR	14	14	14	14	4.7	13.0	-8.2	-63%	A	B	0	0	0	0%	890	26	0	26	0%
	SBR	136	137	137	137	41.5	39.2	2.3	6%	D	D	5	3	1	47%	930	130	104	26	25%
	EBU	21	21	18	21	46.1	86.6	-40.5	-47%	D	F	33	72	-39	-55%	320	263	332	-69	-21%
	EBL	121	118	114	118	40.9	80.5	-39.7	-49%	D	F	33	72	-39	-55%	320	263	332	-69	-21%
	EBT	2550	2630	2587	2630	10.3	6.4	3.9	61%	B	A	61	33	28	84%	740	741	737	5	1%
	EBR	24	26	24	26	10.6	3.7	6.8	183%	B	A	61	13	49	381%	200	741	580	161	28%
	EB LRT	6	6	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	248	260	245	260	61.1	67.9	-6.8	-10%	E	E	196	165	32	19%	500	860	794	66	8%
	WBT	3667	3908	3683	3908	22.7	24.1	-1.4	-6%	C	C	294	241	53	22%	730	866	810	56	7%
	WBR	65	65	61	65	10.1	12.1	-2.0	-16%	B	B	294	146	149	102%	170	866	627	239	38%
	WB LRT	6	6	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	6846	7179	6882	7179	20.0	20.2	-0.2	-1%	C	C	112	95	17	18%	-	866	810	56	6%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	2	2	3	2	49.2	83.1	-34.0	-41%	D	F	19	4	15	389%	330	478	111	367	330%
	EBT	2559	2642	2599	2642	5.1	2.0	3.0	150%	A	A	19	4	15	389%	725	478	111	367	330%
	WBU	276	297	289	297	64.5	65.5	-1.0	-1%	E	E	169	214	-44	-21%	650	1011	1142	-131	-11%
	WBT	4017	4231	4037	4231	12.5	14.6	-2.2	-15%	B	B	169	214	-44	-21%	935	1011	1142	-131	-11%
	All	6853	7172	6928	7172	15.8	18.0	-2.2	-12%	B	B	58	109	-51	-47%		1,011	1,142	-131	-13%

Table 13: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Friday Center Drive/ Meadowmont Lane and NC 54[1]	NBR	141	141	141	141	2.7	0.7	2.0	294%	A	A	2	0	2	0%	1665	93	0	93	0%
	SBR	311	316	312	316	2.1	2.1	0.0	2%	A	A	0	0	0	0%	580	0	0	0	0%
	EBL	202	210	200	210	44.8	63.0	-18.2	-29%	D	E	34	53	-19	-36%	510	172	225	-52	-23%
	EBT	2146	2257	2182	2257	14.7	10.5	4.2	40%	B	B	70	55	15	27%	975	520	471	50	11%
	EBR	454	472	469	472	13.6	9.3	4.3	46%	B	A	70	55	15	27%	400	520	471	50	11%
	EB LRT	6	6	-	-	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBU	197	220	207	220	46.1	54.7	-8.6	-16%	D	D	79	99	-21	-21%	720	335	364	-29	-8%
	WBL	301	311	305	311	43.9	53.7	-9.8	-18%	D	D	79	99	-21	-21%	720	335	364	-29	-8%
	WBT	4002	4186	4069	4186	15.7	11.9	3.8	32%	B	B	230	376	-145	-39%	840	968	1025	-57	-6%
	WBR	29	33	32	33	4.8	2.0	2.8	139%	A	A	230	376	-145	-39%	670	968	1025	-57	-6%
	WB LRT	6	6	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	7785	8146	7915	8146	17.1	14.8	2.3	16%	B	B	72	124	-52	-42%		968	1,025	-57	-6%
Meadowmont Lane and Village Crossing Drive[1]	NBL	91	96	93	96	5.8	7.1	-1.3	-18%	A	A	2	2	-1	-24%	75	113	145	-32	-22%
	NBT	130	138	134	138	2.8	3.4	-0.6	-17%	A	A	2	2	-1	-24%	575	113	145	-32	-22%
	NBR	7	9	7	9	2.1	2.9	-0.9	-30%	A	A	0	1	0	-64%	575	56	89	-33	-37%
	SBL	2	2	2	2	3.2	6.6	-3.4	-52%	A	A	2	2	0	-22%	150	75	78	-3	-4%
	SBT	249	253	250	253	2.4	3.1	-0.7	-22%	A	A	2	2	0	-22%	360	75	78	-3	-4%
	SBR	1	1	1	1	2.4	3.9	-1.5	-38%	A	A	0	2	-2	-100%	360	13	78	-65	-83%
	EBL	2	2	2	2	9.2	7.8	1.4	17%	A	A	0	0	0	0%	685	22	21	1	6%
	EBT	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	0%	685	22	21	1	6%
	EBR	23	23	24	23	0.5	0.6	-0.1	-16%	A	A	0	0	0	0%	685	0	0	0	0%
	WBL	39	40	39	40	12.4	11.0	1.3	12%	B	B	3	2	0	12%	620	67	61	6	10%
	WBT	6	5	6	5	11.1	11.4	-0.3	-2%	B	B	3	2	0	12%	620	67	61	6	10%
	WBR	5	5	5	5	5.1	5.8	-0.7	-12%	A	A	0	0	0	0%	620	9	8	1	13%
	All	556	574	562	574	3.8	4.4	-0.6	-13%	A	A	1	1	0	-25%		113	145	-32	-28%

Table 13: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and East Barbee Chapel Road[1]	NBL	5	6	5	6	13.2	10.1	3.2	31%	B	B	3	4	0	-13%	85	96	117	-21	-18%
	NBT	129	137	137	137	7.3	7.5	-0.2	-3%	A	A	3	4	0	-13%	400	96	117	-21	-18%
	NBR	1	2	1	2	1.5	4.3	-2.8	-66%	A	A	0	0	0	-54%	400	24	41	-16	-40%
	SBL	135	136	135	136	10.3	10.9	-0.6	-6%	B	B	13	13	0	-3%	85	125	139	-14	-10%
	SBT	249	252	250	252	8.4	8.5	-0.2	-2%	A	A	13	13	0	-3%	430	125	139	-14	-10%
	SBR	183	182	182	182	6.2	6.0	0.2	3%	A	A	0	0	0	-21%	430	37	48	-11	-23%
	EBL	117	117	117	117	13.1	11.1	2.0	18%	B	B	7	6	1	26%	80	108	100	8	8%
	EBT	3	3	3	3	12.2	7.7	4.5	58%	B	A	7	6	1	26%	680	108	100	8	8%
	EBR	4	4	4	4	4.2	4.0	0.2	5%	A	A	0	0	0	55%	680	42	35	7	20%
	WBL	0	0	0	0	0.0	0.0	0.0	0%	A	A	14	14	0	-2%	100	152	158	-6	-4%
	WBT	18	19	18	19	11.6	10.9	0.7	6%	B	B	14	14	0	-2%	800	152	158	-6	-4%
	WBR	228	227	228	227	11.9	12.5	-0.6	-5%	B	B	14	14	0	-2%	800	152	158	-6	-4%
	All	1073	1085	1080	1085	9.4	9.4	0.0	0%	A	A	8	8	0	-1%		152	158	-6	-4%
Meadowmont Lane and Sprunt Street[1]	NBL	113	113	115	113	7.6	7.6	0.0	0%	A	A	17	10	7	77%	115	130	125	4	3%
	NBT	351	355	354	355	5.7	6.9	-1.2	-17%	A	A	17	10	7	77%	415	130	125	4	3%
	NBR	12	13	12	13	6.0	8.8	-2.7	-31%	A	A	17	10	7	77%	415	130	125	4	3%
	SBL	0	0	0	0	0.0	0.0	0.0	0%	A	A	9	8	0	3%	85	77	82	-6	-7%
	SBT	198	196	198	196	12.2	11.7	0.5	4%	B	B	9	8	0	3%	570	77	82	-6	-7%
	SBR	7	9	7	9	5.3	7.7	-2.3	-31%	A	A	0	0	0	15%	570	43	49	-6	-12%
	EBL	21	19	21	19	14.0	14.1	-0.2	-1%	B	B	5	5	0	5%	70	150	161	-11	-7%
	EBT	12	12	12	12	17.6	12.9	4.6	36%	B	B	5	5	0	5%	1115	150	161	-11	-7%
	EBR	343	345	341	345	7.6	7.5	0.1	1%	A	A	1	1	0	-2%	1115	115	124	-10	-8%
	WBL	29	29	28	29	15.9	12.6	3.2	26%	B	B	2	2	0	7%	845	61	53	8	15%
	WBT	4	4	4	4	14.0	17.4	-3.4	-20%	B	B	2	2	0	7%	845	61	53	8	15%
	WBR	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	150%	845	16	11	6	51%
	All	1089	1095	1093	1095	9.8	8.5	1.4	16%	A	A	7	8	-1	-7%		150	161	-11	-7%

Table 13: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build AM Peak Hour 8:00 – 9:00 AM

Intersection	Movement	Volumes (VPH)				Delay (sec)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Difference Absolute	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Green Cedar Lane[1] (Unsignalized Intersection)	NBT	320	315	322	315	0.2	0.3	-0.1	-32%	A	A	0	0	0	0%	600	0	0	0	0%
	NBR	52	59	53	59	0.4	0.9	-0.5	-55%	A	A	0	0	0	0%	600	0	0	0	0%
	SBL	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	0%	730	0	0	0	0%
	SBT	186	186	186	186	0.0	0.0	0.0	0%	A	A	0	0	0	0%	730	0	0	0	0%
	WBL	19	19	19	19	7.6	7.5	0.0	1%	A	A	0	0	0	0%	925	0	0	0	0%
	WBR	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	0%	925	0	0	0	0%
	All	577	579	580	579	7.6	7.5	0.0	1%	A	A	0	0	0	0%		0	0	0	0%
East Barbee Chapel Road and NC 54[1] (Unsignalized Intersection)	NBR	824	829	825	829	9.5	2.7	6.8	251%	A	A	66	0	66	0%	1260	917	0	917	0%
	SBR	309	310	253	310	12.0	105.4	-93.4	-89%	B	F	0	256	-256	-100%	740	72	795	-722	-91%
	EBT	2361	2457	2398	2457	0.2	0.1	0.1	80%	A	A	4	0	4	0%	890	116	0	116	0%
	EBR	131	135	131	135	6.0	0.9	5.2	607%	A	A	4	0	4	0%	890	116	0	116	0%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBT	4255	4440	4379	4440	10.1	4.0	6.1	152%	B	A	110	72	38	53%	1090	1042	890	151	17%
	WBR	426	435	432	435	2.7	2.0	0.7	33%	A	A	94	55	39	71%	200	931	760	171	22%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	8306	8606	8418	8606	12.0	105.4	-93.4	-89%	B	F	35	64	-29	-46%		1,042	890	151	15%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

Table 14: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (seconds)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Absolute Difference	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Hamilton Road and NC 54[1]	NBL	135	138	132	138	60.5	64.3	-3.8	-6%	E	E	83	88	-5	-6%	170	405	489	-84	-17%
	NBT	45	44	43	44	55.6	58.1	-2.5	-4%	E	E	83	88	-5	-6%	615	405	489	-84	-17%
	NBR	299	305	304	305	35.7	37.8	-2.1	-6%	D	D	62	69	-7	-11%	170	379	465	-86	-18%
	SBL	129	135	126	135	64.7	66.6	-1.9	-3%	E	E	58	61	-2	-4%	60	298	330	-32	-10%
	SBT	31	29	40	29	60.9	56.3	4.6	8%	E	E	58	61	-2	-4%	950	298	330	-32	-10%
	SBR	45	42	39	42	26.2	28.9	-2.8	-10%	C	C	43	44	-1	-2%	950	278	308	-30	-10%
	EBL	65	76	71	76	127.5	97.3	30.2	31%	F	F	1,171	993	178	18%	200	1,701	1,693	8	0%
	EBT	2842	3188	3012	3188	26.7	23.4	3.4	14%	C	C	1,171	993	178	18%	1,900	1,701	1,693	8	0%
	EBR	31	35	35	35	25.3	24.4	0.9	4%	C	C	1,171	993	178	18%	1,900	1,701	1,693	8	0%
	WBU	158	162	137	162	55.5	68.0	-12.5	-18%	E	E	238	342	-105	-31%	365	915	1,006	-91	-9%
	WBL	220	235	205	235	54.8	69.9	-15.1	-22%	D	E	238	342	-105	-31%	365	915	1,006	-91	-9%
	WBT	2743	2802	2700	2802	11.2	12.5	-1.3	-11%	B	B	238	342	-105	-31%	880	915	1,006	-91	-9%
	WBR	106	111	114	111	11.4	13.6	-2.2	-16%	B	B	238	342	-105	-31%	880	915	1,006	-91	-9%
	All	6850	7302	6958	7302	24.9	24.6	0.3	1%	C	C	368	366	2	0%		1,701	1,693	-40	-2%
Rogerson Drive and NC 54[1] (Unsignalized Intersection)	NBR	72	74	74	74	41.1	39.1	1.9	5%	E	E	5	2	3	141%	575	89	81	8	10%
	SBR	25	25	25	25	18.9	30.1	-11.2	-37%	C	D	0	0	0	-84%	500	13	27	-14	-51%
	EBT	3307	3677	3474	3677	3.3	4.0	-0.7	-18%	A	A	15	13	2	18%	800	528	692	-164	-24%
	EBR	99	113	101	113	2.1	3.2	-1.0	-33%	A	A	15	13	2	18%	90	528	692	-164	-24%
	WBT	3208	3285	3148	3285	2.7	5.3	-2.6	-49%	A	A	8	17	-10	-57%	560	363	326	37	11%
	WBR	5	5	5	5	1.7	3.3	-1.6	-49%	A	A	8	17	-10	-57%	560	363	326	37	11%
	All	6716	7179	6826	7179	41.1	39.1	1.9	5%	E	E	8	10	-2	-19%		528	692	-40	-8%

Table 14: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (seconds)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Absolute Difference	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Finley Golf Course Road/Burning Tree Drive and NC 54[1]	NBR	298	360	344	360	89.8	86.6	3.2	4%	F	F	318	268	49	18%	560	524	734	-210	-29%
	SBR	215	216	216	216	16.1	18.6	-2.5	-14%	B	B	5	8	-3	-34%	710	117	148	-31	-21%
	EBL	130	148	141	148	69.1	76.6	-7.5	-10%	E	E	152	71	81	115%	425	562	553	9	2%
	EBT	3216	3590	3391	3590	8.6	3.2	5.3	166%	A	A	152	71	81	115%	550	562	553	9	2%
	EBR	11	13	11	13	9.5	5.2	4.4	85%	A	A	152	71	81	115%	550	562	553	9	2%
	WBU	13	13	14	13	63.8	62.9	0.9	1%	E	E	52	101	-50	-49%	365	419	617	-198	-32%
	WBL	48	51	61	51	60.1	65.2	-5.1	-8%	E	E	52	101	-50	-49%	365	419	617	-198	-32%
	WBT	3002	3074	2938	3074	4.9	6.4	-1.6	-25%	A	A	52	101	-50	-49%	730	419	617	-198	-32%
	WBR	175	184	172	184	5.3	6.9	-1.6	-23%	A	A	35	101	-66	-65%	730	394	617	-223	-36%
	All	7109	7649	7287	7649	12.1	11.0	1.1	10%	B	B	108	99	8	8%		562	734	-40	-7%
West Barbee Chapel Road and NC 54[1]	NBR	393	410	400	410	16.9	63.9	-47.0	-74%	B	E	238	154	83	54%	890	429	661	-232	-35%
	SBR	214	214	214	214	16.9	12.2	4.7	38%	B	B	2	1	1	138%	930	109	89	20	23%
	EBU	89	99	90	99	59.0	67.9	-8.9	-13%	E	E	153	114	39	34%	320	883	559	324	58%
	EBL	151	169	164	169	60.2	67.0	-6.8	-10%	E	E	153	114	39	34%	320	883	559	324	58%
	EBT	3054	3446	3251	3446	23.6	12.4	11.2	91%	C	B	308	87	221	254%	740	893	706	187	27%
	EBR	218	249	227	249	18.1	6.5	11.6	178%	B	A	308	87	221	254%	200	893	706	187	27%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBL	70	73	73	73	57.3	65.9	-8.6	-13%	E	E	20	28	-8	-27%	500	153	188	-34	-18%
	WBT	2947	3009	2888	3009	8.9	8.9	0.0	-1%	A	A	62	46	16	35%	730	730	487	244	50%
	WBR	32	37	35	37	5.2	5.8	-0.6	-11%	A	A	62	46	16	35%	170	730	487	244	50%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	7167	7706	7342	7706	18.3	16.0	2.2	14%	B	B	119	75	44	58%	-	893	706	-40	-5%
NC 54 and U-Turn (West of Friday Center Drive)[1]	EBU	184	207	186	207	54.1	57.0	-2.9	-5%	D	E	251	299	-48	-16%	330	842	853	-11	-1%
	EBT	3243	3649	3456	3649	19.0	15.3	3.8	25%	B	B	251	299	-48	-16%	725	842	853	-11	-1%
	WBU	911	917	925	917	54.5	65.0	-10.5	-16%	D	E	178	223	-45	-20%	650	630	620	10	2%
	WBT	2881	3021	2817	3021	8.0	5.5	2.5	45%	A	A	178	223	-45	-20%	935	630	620	10	2%
	All	7218	7794	7384	7794	20.9	20.2	0.7	3%	C	C	143	261	-118	-45%		842	853	-40	-5%

Table 14: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (seconds)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Absolute Difference	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Friday Center Drive/ Meadowmont Lane and NC 54[1]	NBR	1137	1140	1128	1140	7.0	7.5	-0.4	-6%	A	A	44	0	44	0%	1,665	654	5	649	13441%
	SBR	371	401	398	401	1.8	2.7	-0.8	-31%	A	A	0	0	0	-100%	580	0	28	-28	-100%
	EBL	229	258	243	258	48.7	49.5	-0.8	-2%	D	D	42	44	-2	-3%	510	191	210	-18	-9%
	EBT	3743	4140	3966	4140	12.2	7.7	4.5	58%	B	A	172	144	29	20%	975	1,115	1,018	97	10%
	EBR	156	168	164	168	5.1	2.3	2.8	122%	A	A	172	144	29	20%	400	1,115	1,018	97	10%
	EB LRT	6	6	-	-	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBU	318	347	315	347	60.4	69.5	-9.1	-13%	E	E	121	143	-22	-15%	720	452	431	22	5%
	WBL	31	32	30	32	40.3	59.1	-18.8	-32%	D	E	121	143	-22	-15%	720	452	431	22	5%
	WBT	3426	3428	3368	3428	8.1	12.8	-4.7	-36%	A	B	40	113	-73	-64%	840	514	864	-349	-40%
	WBR	78	78	82	78	2.4	2.2	0.2	7%	A	A	40	113	-73	-64%	670	514	864	-349	-40%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	9487	9992	9691	9992	12.1	12.3	-0.2	-2%	B	B	69	94	-25	-27%		1,115	1,018	97	9%
Meadowmont Lane and Village Crossing Drive[1]	NBL	105	106	101	106	4.9	6.7	-1.8	-27%	A	A	1	2	-1	-33%	75	106	126	-21	-16%
	NBT	176	199	191	199	1.9	3.4	-1.5	-43%	A	A	1	2	-1	-33%	575	106	126	-21	-16%
	NBR	26	9	28	31	1.6	4.0	-2.4	-60%	A	A	0	1	0	-42%	575	74	94	-21	-22%
	SBL	11	11	11	11	0.3	4.2	-3.9	-93%	A	A	0	1	-1	-93%	150	37	85	-48	-56%
	SBT	320	322	320	322	1.6	3.1	-1.5	-47%	A	A	1	3	-2	-52%	360	81	89	-8	-9%
	SBR	6	5	5	5	1.2	3.2	-2.0	-63%	A	A	0	0	0	-41%	360	37	46	-9	-20%
	EBL	1	2	2	2	6.0	8.8	-2.8	-32%	A	A	0	0	0	8%	685	39	33	5	16%
	EBT	1	3	4	3	10.4	12.5	-2.2	-17%	B	B	0	0	0	8%	685	39	33	5	16%
	EBR	23	51	51	51	5.1	1.0	4.2	434%	A	A	0	0	0	0%	685	0	1	-1	-100%
	WBL	28	28	28	28	0.3	0.4	0.0	-11%	A	A	0	0	0	0%	620	17	10	7	69%
	WBT	1	1	1	1	9.9	7.6	2.3	30%	A	A	0	0	0	67%	620	36	32	4	11%
	WBR	4	4	4	4	5.1	5.3	-0.2	-4%	A	A	0	0	0	0%	620	17	10	7	69%
	All	701	741	745	763	2.3	3.5	-1.2	-36%	A	A	0	1	0	-45%		106	126	-21	-19%

Table 14: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (seconds)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Absolute Difference	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and East Barbee Chapel Road[1]	NBL	41	47	61	47	11.0	11.9	-0.9	-8%	B	B	5	5	0	7%	85	109	121	-12	-10%
	NBT	139	157	136	157	9.1	7.2	1.9	26%	A	A	5	5	0	7%	400	109	121	-12	-10%
	NBR	1	1	1	1	1.4	2.2	-0.7	-33%	A	A	2	2	0	-6%	400	88	100	-12	-12%
	SBL	126	124	126	124	11.1	11.1	0.0	0%	B	B	12	11	1	6%	85	116	128	-12	-10%
	SBT	247	247	247	247	9.0	8.6	0.4	5%	A	A	12	11	1	6%	430	116	128	-12	-10%
	SBR	70	72	70	72	5.9	5.6	0.3	6%	A	A	2	2	0	8%	430	85	97	-12	-13%
	EBL	65	65	66	65	13.0	12.4	0.6	5%	B	B	7	8	0	-4%	80	107	119	-12	-10%
	EBT	93	92	93	92	9.2	10.3	-1.1	-10%	A	B	7	8	0	-4%	680	107	119	-12	-10%
	EBR	87	88	87	88	5.4	5.5	-0.1	-2%	A	A	1	1	0	-15%	680	75	87	-12	-13%
	WBL	3	3	3	3	9.4	13.4	-4.1	-30%	A	B	14	15	-1	-6%	100	183	174	9	5%
	WBT	87	83	88	83	10.9	11.3	-0.4	-4%	B	B	14	15	-1	-6%	800	183	174	9	5%
	WBR	171	175	172	175	11.7	12.2	-0.5	-4%	B	B	14	15	-1	-6%	800	183	174	9	5%
	All	1128	1154	1147	1154	9.6	9.6	0.1	1%	A	A	8	8	0	-1%		183	174	9	5%
Meadowmont Lane and Sprunt Street[1]	NBL	208	219	206	219	7.8	7.8	0.0	0%	A	A	25	7	18	237%	115	144	144	0	0%
	NBT	144	152	144	152	4.8	5.7	-0.9	-16%	A	A	25	7	18	237%	415	198	144	54	38%
	NBR	23	26	23	26	5.7	5.9	-0.2	-4%	A	A	25	7	18	237%	415	198	144	54	38%
	SBL	1	1	1	1	6.1	3.5	2.6	75%	A	A	10	10	1	10%	85	93	94	0	0%
	SBT	238	236	239	236	12.4	11.4	1.1	9%	B	B	10	10	1	10%	570	93	94	0	0%
	SBR	9	11	9	11	6.3	5.7	0.6	10%	A	A	1	1	0	20%	570	59	61	-2	-3%
	EBL	8	8	8	8	17.2	12.8	4.4	34%	B	B	5	5	0	3%	70	133	139	-6	-4%
	EBT	29	28	29	28	17.3	16.9	0.4	2%	B	B	5	5	0	3%	1,115	133	139	-6	-4%
	EBR	177	179	177	179	7.1	7.3	-0.2	-2%	A	A	1	1	0	-3%	1,115	96	102	-6	-5%
	WBL	28	28	27	28	17.3	16.0	1.4	9%	B	B	2	2	0	6%	845	53	55	-1	-2%
	WBT	2	2	2	2	12.6	9.6	3.0	31%	B	A	2	2	0	6%	845	53	55	-1	-2%
	WBR	1	1	1	1	4.1	4.2	0.0	-1%	A	A	0	0	0	-33%	845	7	7	0	2%
	All	868	891	865	891	12.4	8.8	3.6	40%	B	A	9	5	5	96%		198	144	54	27%

Table 14: D-O LRT: NC 54 Segment – Vissim Intersection Analysis Output Summary – 2040 Build C2A Alternative vs. 2040 No Build PM Peak Hour 5:00 – 6:00 PM

Intersection	Movement	Volumes (VPH)				Delay (seconds)				LOS		Average Queue Length (ft)				Maximum Queue Length (ft)				
		Build		No-Build		Build	No-Build	Absolute Difference	Difference %	Build	No-Build	Build	No-Build	Difference Absolute	Difference %	Storage Space Available	Build	No-Build	Difference Absolute	Difference %
		Model	Demand	Model	Demand															
Meadowmont Lane and Green Cedar Lane[1] (Unsignalized Intersection)	NBT	147	152	146	152	0.1	0.1	0.0	-33%	A	A	0	0	0	0%	600	0	0	0	0%
	NBR	7	9	7	9	0.3	0.4	-0.1	-26%	A	A	0	0	0	0%	600	0	0	0	0%
	SBL	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	0%	730	0	0	0	0%
	SBT	219	219	219	219	0.0	0.0	0.0	0%	A	A	0	0	0	0%	730	0	0	0	0%
	WBL	29	29	29	29	7.0	7.1	-0.1	-2%	A	A	0	0	0	0%	925	11	14	-3	-22%
	WBR	0	0	0	0	0.0	0.0	0.0	0%	A	A	0	0	0	0%	925	11	14	-3	-22%
	All	401	409	401	409	7.0	7.1	-0.1	-2%	A	A	0	0	0	0%		11	14	-3	-29%
East Barbee Chapel Road and NC 54[1] (Unsignalized Intersection)	NBR	234	234	234	234	7.2	8.5	-1.3	-15%	A	A	8	0	8	1739%	1,260	187	77	111	144%
	SBR	404	424	379	424	20.5	174.8	-154.3	-88%	C	F	12	963	-951	-99%	740	274	1,822	-1,548	-85%
	EBT	4397	4762	4566	4762	0.8	1.0	-0.2	-23%	A	A	40	0	40	15976%	890	564	86	478	559%
	EBR	803	865	836	865	10.7	4.2	6.4	153%	B	A	40	0	40	15976%	890	564	86	478	559%
	EB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WBT	3036	3461	3368	3461	1.2	3.0	-1.8	-60%	A	A	0	4	-3	-96%	1,090	54	366	-312	-85%
	WBR	471	473	471	473	1.8	2.0	-0.2	-10%	A	A	0	0	0	-100%	200	0	57	-57	-100%
	WB LRT	6	6	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	All	9345	10219	9854	10219	20.5	174.8	-154.3	-88%	C	F	10	145	-135	-93%		564	1,822	-1258	-223%

Footnote: [1] **- NCDOT Traffic Impact Criteria is applied**

[2] **- City of Durham Traffic Impact Criteria is applied**

Indicates LRT Movement

Indicates Traffic Impact

Indicates Traffic Impact below Mid-D

6.1 Analysis of LOS Thresholds

As the C2A alignment runs at-grade parallel and adjacent to NC 54 longer than the other two Build Alternatives, this Alternative would have the greatest number of direct impacts. As the C1/C1A and C2 LRT alignments are offset from the NC 54 corridor, their overall effects on traffic operations would be lesser than the C2A Alternative and would not exceed NCDOT thresholds. It should be noted that the C1/C1A alignment, beyond the NC 54 corridor, would run at-grade along Meadowmont Lane. Meadowmont Lane is a local road with lower traffic volumes when compared to NC 54. Impacts to the traffic operations along this roadway due to the C1/C1A alignment are not substantial, with all intersections along Meadowmont Lane expected to operate at LOS C or better in both peak hours of this alternative.

6.1.1 NC 54 at Hamilton Road

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and Hamilton Road, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection would operate at LOS C during both No-Build Conditions peak hours. For all three Build Alternatives, C1/C1A, C2 and C2A, the intersection geometry at this intersection would remain the same as the No-Build Conditions. This intersection is a full access signalized intersection under all alternatives.

For both the C1/C1A and C2 Alternatives, the LRT alignment would not impact the intersection operations of NC 54 and Hamilton Road as the LRT is evaluated along NC 54 under the C1/C1A Alternative and the nearest intersection equipped with signal preemption under Alternative C2 would be at NC 54 and Friday Center Drive/Meadowmont Lane. Therefore the traffic operations at the intersection of NC 54 and Hamilton Road for Alternatives C1/C1A and C2 would be similar to the No-Build Conditions and would not result in any traffic impacts.

For Build Alternative C2A, the LRT alignment would include traffic signal preemption at several intersections along NC 54 starting with West Barbee Chapel Road to the east of NC 54 and Hamilton Road. Under the 2040 Build C2A Alternative, the overall intersection operates at LOS C during both the AM and PM peak hours. For the 2040 Build C2A Alternative, the overall intersection delays during both peak hours would meet the NCDOT thresholds.

Due the signal preemption activities and substantial volumes, the eastbound NC 54 left turn for Alternative C2A during the PM peak hour would experience an increase in delay greater than 25%, which is considered a traffic impact according to NCDOT criteria. However, the volume for this movement is a relatively low volume of approximately 75 vehicles per hour.

For Build Alternative C2A, the maximum queue length for the following movement will exceed both its available storage and the respective peak hour No-Build maximum queue length by more than 10 feet:

- Eastbound NC 54 left turn exceeds the storage space by 1,259 feet in the AM

Although the eastbound left turn maximum queue length exceeds the left turn storage bay, the overall eastbound approach would contain the queue. Additionally, the maximum queue events are considered infrequent occurrences, whereas the movement's average queue is expected to be much shorter and would be contained within the storage bay. Therefore, no additional roadway modifications recommended for Alternative C2A.

6.1.2 NC 54 at Rogerson Drive

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and Rogerson Drive, which would be unsignalized in all future scenarios, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection operates at LOS F and E during the No-Build Conditions AM and PM peak hours. For all three alignments, C1/C1A, C2 and C2A, the intersection geometry at this intersection remains the same. As part of the superstreet project, this intersection would provide eastbound and westbound NC 54 through and right turn movements while the northbound and southbound Rogerson Drive movements would be limited to right turns only under all alternatives. Under Alternative C1/C1A, the LRT would be elevated along NC 54 and cross the roadway at Friday Center Drive/Meadowmont Lane without impacting this intersection. Since the nearest LRT at-grade crossing is near Friday Center Drive for Alternative C2, there is no direct LRT interaction with this intersection. Therefore, the traffic operations for both Alternatives C1/C1A and C2 are expected to be similar to the No-Build Conditions and would meet NCDOT criteria.

Under the 2040 Build C2A Alternative, the overall intersection would operate at LOS F and E during the AM and PM peak hours, respectively. The overall intersection and individual movements' LOS and delay are similar to the No-Build Conditions results and therefore meet NCDOT criteria. For the 2040 C2A Alternative, there are no maximum queue length impacts expected at this intersection. Therefore, no roadway modifications are recommended for any Build Alternative at this intersection.

6.1.3 NC 54 at Finley Golf Course Road / Burning Tree Road

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and Finley Golf Course Road/Burning Tree Road, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection would operate at LOS B during the No-Build Conditions AM and PM peak hours. For all three alignments, C1/C1A, C2 and C2A, the intersection geometry remains the same. As part of the No-Build superstreet project, this intersection would provide full movements for the NC 54 approaches and northbound and southbound right turns from the cross street under all alternatives. Under Build Alternative C1/C1A, the LRT would be elevated along NC 54 and cross the roadway at Friday Center Drive/Meadowmont Lane without impacting this intersection. Since the nearest LRT at-grade crossing is near Friday Center Drive for Alternative C2, there is no direct LRT interaction with this intersection. Therefore, the traffic operations for both Alternatives C1/C1A and C2 are expected to be similar to the No-Build Conditions and would meet NCDOT criteria.

Under the 2040 Build C2A Alternative, the overall intersection would continue to operate at the same LOS B as the No-Build Conditions during both peak hours, thereby meeting NCDOT criteria.

During the Alternative C2A AM peak hour, the eastbound NC 54 left turn would experience a degradation in LOS from C in the No-Build Conditions to LOS D. The westbound NC 54 left turn would also experience an increase in delay greater than 25% for Alternative C2A in the AM peak hour, which is also considered a traffic impact according to NCDOT criteria.

Under the 2040 Build C2A Alternative, the maximum queue lengths for the following movements will exceed both their available storage and the respective peak hour No-Build maximum queue lengths by more than 10 feet:

- Eastbound NC 54 left turn exceeds the storage space by 362 feet in the AM only

- Eastbound NC 54 through movement exceeds the storage space by 237 feet in the AM only
- Eastbound NC 54 right turn exceeds the storage space by 177 feet in the AM only
- Westbound NC 54 U-turn and left turn exceeds the storage space by 524 feet in the AM only
- Westbound NC 54 through movement exceeds the storage space by 159 feet in the AM only
- Westbound NC 54 right turn exceeds the storage space by 159 feet in the AM only

As stated above, the eastbound and westbound through movements' maximum queue lengths may extend beyond the respective upstream intersections due to disruptions of the normally coordinated east-west approaches. Although the eastbound approach maximum queue length may extend beyond the upstream intersection of NC 54 and Rogerson Drive, in all future scenarios this intersection would be unsignalized. The maximum queue events are also considered infrequent occurrences, whereas of the impacted movements' average queues are expected to be much shorter and contained within the respective storage spaces. Therefore, no additional roadway modifications were recommended for this intersection as part of the C2A Alternative design.

6.1.4 NC 54 at West Barbee Chapel Road

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and West Barbee Chapel Road, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection would operate at LOS C and B during the No-Build Conditions AM and PM peak hours, respectively. As part of the No-Build Conditions superstreet project, this intersection would provide all movements for the NC 54 approaches and northbound and southbound right turns from the cross street under all alternatives.

As the D-O LRT is located approximately 500 feet south of the intersection under C1/C1A and C2 alignment, the train crossing would not have noticeable impacts on the intersection operations as shown in Tables 9 and 10 and Tables 11 and 12. The lane configuration and traffic signal timings under the C1/C1A and C2 Alternatives at this intersection are the same as under the No-Build Conditions. Therefore, the traffic operations for the C1/C1A and C2 Alternatives are similar to No-Build Conditions and would meet NCDOT criteria. No other roadway modifications are recommended as a part of this report for the C1/C1A and C2 Alternatives.

Under the C2A Alternative, the D-O LRT is adjacent to the intersection and would cause changes to intersection operations. With the preemption equipped at this intersection, the LRT gate operation would disrupt the coordination along NC 54 and result in increased queues and delays. However, the overall intersection would operate at LOS C in the AM peak hour and LOS B in the PM peak hour, which are the same results reported for the respective No-Build Conditions overall intersection. Therefore, under Alternative C2A, there are no expected overall intersection or individual movement delay or LOS impacts at NC 54 and West Barbee Chapel Road.

In order to meet NCDOT delay, LOS, and queue criteria, a proposed acceleration lane on the east side of eastbound NC 54 for the northbound West Barbee Chapel Road right turn is recommended, which would provide LOS B or better operations during peak hours. In the future, this intersection would only allow right turn movements from West Barbee Chapel Road (under superstreet design). As a result of this increased traffic on an already saturated roadway, providing an acceleration lane for the

northbound right turn would allow vehicles to merge into the NC 54 traffic more efficiently, and thereby, reduce the corresponding delay.

Under Alternative C2A, the maximum queue lengths for the following movements will exceed both their available storage and the respective peak hour No-Build maximum queue lengths by more than 10 feet:

- Eastbound NC 54 U-turn/left turn exceed the storage space by 563 feet in the PM only
- Eastbound NC 54 through movement exceeds the storage space by 153 feet in the PM only
- Eastbound NC 54 right turn exceeds the storage space by 541 feet in the AM and 693 in the PM
- Westbound NC 54 left turn exceeds the storage space by 360 feet in the AM only
- Westbound NC 54 through movement exceeds the storage space by 136 feet in the AM only
- Westbound NC 54 right turn exceeds the storage space by 696 feet in the AM and 560 feet in the PM

The eastbound and westbound NC 54 through movement maximum queue lengths extend beyond their respective approaches and may reach the upstream signalized intersections due to disruptions in the east-west signal coordination caused by signal preemption activities. However, the overall intersection delays under the Build C2A Alternative would operate at LOS C or better during the peak hours. Additionally, the maximum queue events are considered infrequent occurrences, whereas the movement's average queue are expected to be much shorter and contained within the respective storage areas. Therefore, an acceleration lane on eastbound NC 54 for the northbound West Barbee Chapel Hill Road right turn is the only recommended roadway modification for this intersection under Alternative C2A only.

6.1.5 NC 54 at Friday Center Drive/ Meadowmont Lane

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and Friday Center Drive/Meadowmont Lane, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection would operate at LOS C and B during the No Build Conditions AM and PM peak hours, respectively. This intersection would provide full movements for the NC 54 approaches and northbound and southbound right turns from the cross street under all alternatives as part of the No-Build superstreet project.

As the D-O LRT is elevated for Alternative C1/C1A and would be located approximately 500 feet south of the intersection under the C2 Alternative, the LRT crossing would not have impacts on the intersection operations for either of these Build Alternatives as shown in Table 9 and 10 for the former and Tables 11 and 12 for the latter. The lane configuration and traffic signal timings under C1/C1A and C2 Alternatives at this intersection are the same as the No-Build Conditions. Therefore, the traffic operations for the C1/C1A and C2 Alternatives are similar to No-Build Conditions and would meet NCDOT criteria. No other roadway modifications are recommended for the C1/C1A and C2 Alternatives.

Under the C2A Alternative, the D-O LRT would run adjacent to this intersection. With signal preemption and railroad crossing gate operations, the east/west coordination would be disrupted. However, the overall intersection would operate at LOS B in both peak hours, which are the same results reported for the respective No-Build Conditions. Therefore, under Alternative C2A, there are no expected overall

intersection or individual movement delay or LOS impacts at NC 54 and Friday Center Drive/ Meadowmont Lane.

Under Alternative C2A, the maximum queue lengths for the following movements will exceed both their available storage and the respective peak hour No-Build maximum queue lengths by more than 10 feet:

- Eastbound NC 45 through movement exceeds the storage space by 140 feet in the PM only
- Eastbound NC 54 right turn exceeds the storage space by 120 feet in the AM and 715 in the PM

The eastbound and westbound NC 54 through movement maximum queue lengths extend beyond their respective approaches and may reach the upstream signalized intersections due to disruptions in the east-west signal coordination caused by signal preemption activities. However, the maximum queue events are considered infrequent occurrences, whereas the movements' average queues expected to be much shorter and contained within the storage area. Also, the eastbound movements operate at LOS B or better during the peak hours. Therefore, no roadway modifications are recommended for this intersection under Alternative C2A.

6.1.6 NC 54 at East Barbee Chapel Road

The NCDOT traffic impact criteria are applied to the future unsignalized intersection of NC 54 and East Barbee Chapel Road, as NC 54 is under NCDOT jurisdiction. As shown in Table 6, the overall intersection would operate at LOS F during the both No-Build Conditions peak hours. As part of the No-Build superstreet project, this intersection would be unsignalized by providing eastbound/westbound NC 54 through and right turn movements and the northbound/southbound East Barbee Chapel movements would be limited to right turns only under all alternatives.

Under the C1/C1A Alternative, the D-O LRT crosses NC 54 via a bridge near the Friday Center Drive intersection, therefore, no interaction with the NC 54 and East Barbee Chapel Road intersection would occur and the operations would be similar to the No-Build Conditions. As the D-O LRT would be located approximately 300 feet south of the intersection under the C2 Alternative, the train crossing would not have major impacts on the intersection operations as can be seen in Tables 11 and 12. Therefore, traffic operations for the C2 Alternative are similar to the No-Build Conditions and meet NCDOT criteria. No roadway modifications are recommended at this intersection for either theC1/C1A or C2 Alternative.

Under the C2A Alternative, the D-O LRT would be at-grade and run just south of the intersection. With signal preemption and railroad crossing gate operations, the east/west coordination would be disrupted. As a result, the southbound right turning movement experiences increase in delay. This intersection allows right turn movements only from East Barbee Chapel Road (under superstreet design). Therefore, providing an acceleration lane for this movement would allow them to merge into the NC 54 traffic more efficiently, and thereby, reducing the corresponding delay.

In order to meet NCDOT delay, LOS, and queue criteria, a proposed acceleration lane on the west side of westbound NC 54 for the southbound East Barbee Chapel Road right turn is recommended, which would provide LOS C or better operations during peak hours. In the future, this intersection would only allow right turn movements from East Barbee Chapel Road (under superstreet design). As a result of this increased traffic on an already saturated roadway, providing an acceleration lane for the southbound right turn would allow vehicles to merge into the NC 54 traffic more efficiently, and thereby, reduce the corresponding delay.

Under Alternative C2A, the maximum queue length for the following movement will exceed both its available storage and the respective peak hour No-Build maximum queue length by more than 10 feet:

- Westbound NC 54 right turn exceeds the storage space by 731 feet in the AM peak hour

Although the westbound right turn maximum queue length may extend past its storage bay, the queue would be contained by the overall westbound approach before reaching the upstream intersection. Also, the maximum queue events are considered infrequent occurrences, whereas the movement's average queue is expected to be much shorter and contained within the storage area. Therefore, an acceleration lane on westbound NC 54 for the southbound East Barbee Chapel Hill Road right turn is the only recommended roadway modification for this intersection under Alternative C2A only.

6.1.7 Meadowmont Lane at Village Crossing Drive

The NCDOT traffic impact criteria are applied to the intersection of NC 54 and Village Crossing Drive, as the intersection lies within the Town of Chapel Hill. As shown in Table 6, the overall intersection would operate at LOS A during both No-Build peak hours. This intersection is assumed to be a full intersection under all alternatives.

Under the C1/C1A alignment, the D-O LRT would be at-grade at this intersection running parallel to Meadowmont Lane on the west side. Traffic accessing the west leg of Village Crossing Drive would be stopped to allow LRT movements. The C1/C1A Alternative traffic signal timings at this intersection are the same as under the No-Build Conditions. However, the volumes in this area are relatively low and, thus, no delay or LOS impacts are caused to the overall or individual intersection movements as a result of LRT operations.

Under Alternative C1/C1A, the maximum queue length for the following movement will exceed both its available storage and the respective peak hour No-Build maximum queue length by more than 10 feet:

- Northbound Meadowmont Lane left turn exceeds storage space by 101 feet in the PM only

However, the northbound left turn maximum queue would be contained by the northbound approach before reaching the upstream intersection at NC 54. Therefore, no roadway modifications are recommended at Meadowmont Lane and Village Crossing Drive for Alternative C1/C1A.

The D-O LRT does not interact with this intersection under the C2 and C2A Alternatives. The lane configuration and traffic signal timings under the C2 and C2A Alternatives at this intersection are the same as the No-Build conditions. Therefore, traffic operations under C2 and C2A Build alternatives are similar to No-Build Conditions as shown in Tables 13 and 14. As both C2 and C2A Alternatives meet all NCDOT traffic impact criteria, no additional roadway modifications recommended for either alternative at this intersection.

6.1.8 Meadowmont Lane at East Barbee Chapel Road

The NCDOT traffic impact criteria are applied to the intersection of Meadowmont Lane at East Barbee Chapel Road, as the intersection is located in the Town of Chapel Hill. As shown in Table 6, the overall intersection would operate at LOS A during the No-Build Conditions AM and PM peak hours. This signalized intersection would provide all movements under all alternatives. Under the C1/C1A Alternative, the D-O LRT would be at-grade at this intersection running parallel to Meadowmont Lane on

the west side. Traffic accessing the west leg of Barbee Chapel Road would be stopped to allow LRT movements. The traffic signal timings at this intersection are the same as under the No-Build Conditions. However, the volumes in this area are relatively low and, therefore, no delay or LOS impacts are caused to the overall or individual intersection movements as a result of LRT operations.

For the C1/C1A Alternative only, the maximum queue length for the following movement will exceed both its available storage and the respective peak hour No-Build maximum queue length by more than 10 feet:

- Westbound East Barbee Chapel left turn exceeds storage space by 91 feet in the AM and 109 feet in the PM

However, the westbound left turn maximum queue would be contained by the westbound approach before it may reach the upstream intersection. Therefore, no roadway modifications are recommended at Meadowmont Lane and East Barbee Chapel Road for Alternative C1/C1A.

The D-O LRT does not interact with Meadowmont Lane and East Barbee Chapel Road under the C2 and C2A Alternatives. The lane configuration and traffic signal timings under the C2 and C2A Alternatives at this intersection are the same as the No-Build conditions. Therefore, traffic operations under C2 and C2A Build alternatives are similar to No-Build Conditions as shown in Tables 13 and 14. As both C2 and C2A Alternatives meet all NCDOT traffic impact criteria, no additional roadway modifications recommended for either alternative at this intersection.

6.1.9 Meadowmont Lane at Sprunt Street

The NCDOT traffic impact criteria are applied to the intersection of Meadowmont Lane at Sprunt Street, as the intersection is located in the Town of Chapel Hill. As shown in Table 6, the overall intersection would operate at LOS A during the No-Build Conditions AM and PM peak hours. This intersection would provide full signalized movements under all alternatives.

Under the C1/C1A Alternative, the D-O LRT would be at-grade at this intersection running parallel to Meadowmont Lane on the west side. Traffic accessing the west leg of Sprunt Street would be stopped to allow LRT movements to proceed with minimal delay. The traffic signal timings at this intersection are the same as under the No-Build Conditions. However, the volumes in this area are relatively low and, therefore, no delay or LOS impacts are expected at the intersection movements as a result of LRT operations.

For the C1/C1A Alternative only, the maximum queue length for the following movement will exceed both their available storage and the respective peak hour No-Build maximum queue lengths by more than 10 feet:

- Northbound Meadowmont Lane left turn exceeds storage space by 25 feet in the AM and 146 feet in the PM
- Southbound Meadowmont Lane left turn exceeds storage space by 22 feet in the AM and 20 feet in the PM
- Eastbound Sprunt Street left turn exceeds storage space by 148 feet in the AM only

However, all three left turn maximum queues would be contained within their respective approaches without reaching the upstream intersections. Therefore, no roadway modifications are recommended at Meadowmont Lane and Sprunt Street for Alternative C1/C1A.

The D-O LRT does not interact with this intersection under C2 and C2A Alternatives. The lane configuration and traffic signal timings under the C2 and C2A Alternatives at this intersection are the same as the No-Build Conditions. Therefore, traffic operations under C2 and C2A Build alternatives are similar to the No-Build Conditions and meet NCDOT criteria. No additional roadway modifications are recommended at this intersection for any Build Alternative.

6.1.10 Meadowmont Lane at Green Cedar Lane

The NCDOT traffic impact criteria are applied to the unsignalized intersection of Meadowmont Lane at Green Cedar Lane, as the intersection is located in the Town of Chapel Hill. As shown in Table 6, the overall intersection operates at LOS A during the No-Build Conditions AM and PM peak hours. This intersection is assumed to be a full access unsignalized T-intersection under the No-Build and Build Alternatives.

Under the C1/C1A Alternative, the D-O LRT would be at-grade at this intersection crossing Meadowmont Lane on the south side. All traffic movements at this intersection would be stopped by railroad crossing gates to prevent conflicts between LRT and vehicular traffic. However, the volumes in this area are relatively low, and therefore, no traffic LOS, delay, or queue impacts are expected at this intersection. Therefore Alternative C1/C1A would meet all NCDOT traffic impact criteria and no roadway improvements are recommended at this intersection for this alternative.

The D-O LRT does not interact with this intersection under the C2 and C2A Alternatives. The lane configuration and traffic control under the C2 and C2A Alternatives at this intersection are the same as the No-Build conditions. Therefore, traffic operations under C2 and C2A Build alternatives are similar to No-Build Conditions as shown in Tables 13 and 14. As both C2 and C2A Alternatives meet all NCDOT traffic impact criteria, no additional roadway modifications recommended for either alternative at this intersection.

7. Conclusions/Recommendations

The D-O LRT primarily has three different alignments in the vicinity of NC 54 (Raleigh Road): C1/C1A, C2, and C2A. The C1/C1A Alternative would have minimal interactions with NC 54 as its alignment would be elevated crossing the roadway. The C1/C1A Alternative would differ from the other two alternatives by having the LRT run north along Meadowmont Lane instead of continuing east on NC 54 and turning north at Huntingridge Road. For the C2 Alternative, the alignment would run adjacent or parallel to NC 54 on the south side crossing two intersections at-grade while the C2A Alternative would have a similar alignment it would cross three intersections at-grade. This section also has three proposed stations: Hamilton Road Station, Friday Center Station and either the Meadowmont or Woodmont Station. As part of the No-Build Conditions, NC 54 would be converted to a superstreet design which would reconfigure intersections from Rogerson Drive to Littlejohn Road.

Traffic operations under the No-Build Conditions indicate several intersections along the NC 54 corridor that are anticipated to operate at LOS E or F during at least one peak hour. It should be noted that the NC 54 corridor is a major connector in the study area carrying heavy amounts of traffic, in addition to providing access to several residential and commercial properties. The substantial forecasted vehicular demand along the NC 54 corridor would lead to over-saturated conditions regardless of the D-O LRT being constructed in this area. For the No-Build Conditions, all intersections along Meadowmont Lane are anticipated to operate at LOS C or better during both peak hours.

The C1/C1A Alternative is anticipated to be similar to the No-Build Alternative along NC 54 as the alignment would run 500 feet south of NC 54 before elevating and crossing NC 54 at Friday Center Drive/Meadowmont Lane. The LRT would have minimal effects on the NC 54 intersections and would meet all NCDOT criteria along this corridor. As the alignment would be at-grade along the Meadowmont Lane corridor, several intersections would experience increased delays when compared to the No-Build Conditions. However, these increases do not exceed NCDOT criteria and all intersections along Meadowmont Lane would operate at LOS C or better during both peak hours. There are several intersection turning movements with maximum queue lengths that would exceed their respective storage bays, but the queues would be contained by the overall approaches before impacting upstream intersections. Therefore no roadway modifications are recommended as part of the C1/C1A Alternative.

For Alternative C2, the D-O LRT would avoid the more congested intersections along NC 54 to the west. The LRT would also cross Friday Center Drive and East Barbee Chapel several hundred feet from the intersections, thereby minimizing train crossing impacts to the intersection traffic operations. Generally, the traffic operations for the C2 Alternative are similar to the No-Build Alternative. With no delay, LOS, or queue impacts expected, the C2 Alternative meets all NCDOT criteria and therefore no roadway improvements are recommended.

As the C2A alignment would run at-grade, parallel and adjacent to NC 54 longer than the other Build Alternatives, this alignment would affect traffic operations more than the C2 and C1/C1A alignments. Due to the proximity of the proposed at-grade crossings to NC 54 under this alternative, the NC 54 corridor coordination would be disrupted by light rail preemption events, and therefore, several movements along the corridor would experience increases in delay and queuing. However, all of the overall intersections would meet NCDOT delay and LOS criteria.

In order to adhere to the NCDOT LOS and delay thresholds, the following roadway modifications are recommended under the C2A Alternative:

- Add acceleration lane along eastbound NC 54 for the northbound West Barbee Chapel Road right turn
- Add acceleration lane along westbound NC 54 southbound Barbee Chapel Road right turn

With the recommended improvements, traffic operations along the NC 54 corridor would have minimal individual movement impacts.

Appendices

Appendix A
Traffic Analysis Methodology Report

TRAFFIC ANALYSIS METHODOLOGY

Durham-Orange Light Rail Transit Project

November 2013

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List of Figures

1. Introduction

The proposed Triangle Transit Durham-Orange Light Rail Transit Draft Environmental Impact Statement (D-O LRT Draft EIS) will address existing and future transportation conditions along the proposed corridor and quantify the transportation impacts of the No-Build and Build Alternatives as well as some transportation system management (TSM) improvements. For the purposes of this study the No-Build and TSM scenarios will be combined. The project will potentially have transportation and traffic impacts that will include impacts to streets and highways, bikeways, parking, railroad operations, and public transit.

Following is a description of the proposed methodology for evaluating the potential impacts to traffic and transportation services and facilities that could occur due to the implementation of the proposed D-O LRT. This proposal includes analysis methodologies used to describe existing and future travel patterns and the transportation environment, estimation of forecast year traffic volumes under the No-Build and Build Alternatives, and the analysis of impacts of the light rail operations at intersections and railroad/highway at-grade crossings.

Generally, data required for the traffic and transportation analyses will be developed by the study team, or will be provided by either Triangle Transit, the Town of Chapel Hill, City of Durham, Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), or the North Carolina Department of Transportation (NCDOT). Data from other agencies, if needed, is noted in the task descriptions. Triangle Transit will provide information on existing and planned transit services and performance. Existing conditions traffic data from the previous Alternatives Analysis (AA) study will be utilized for the base year analysis and future year volumes will be developed based on travel demand analysis completed by other members of the project teams. The analysis will include both regional travel demand data as well as specific transit route ridership forecasts. The base year for the analysis will be 2011 and the design year will be 2040 in order to be consistent with the DCHC MPO's *2040 Metropolitan Transportation Plan*.

The project team will use the Triangle Regional Travel Demand Model V5 (TRTDM) for this project. The model is based on the traditional four-step travel demand process of trip generation, trip distribution, mode split, and traffic assignment. Documentation for the model development and calibration process is maintained by NCDOT and the Institute for Transportation Research and Engineering (ITRE).

2. Existing Conditions

Following is a description of the elements that will be used to define existing transportation conditions, and the procedures to be used in developing that definition.

Calibrated base models will be constructed and validated using VisSim. The calibration and validation process is described below. For this study 2011 will serve as the base year for analysis.

2.1 Identification Of Simulation Areas

Specific segments of the D-O LRT corridor where the proposed LRT interacts with the roadway network will be analyzed. Along much of the D-O LRT corridor the track is not at grade or is routed in areas that are not near the roadway network. As such, there is no interaction between the proposed D-O LRT and the current or planned roadway network. The segments that are proposed for analysis are as follows:

- Mason Farm Road – East Drive to US 15-501
- NC 54 – Hamilton Road to Downing Creek including Prestwick Road and Meadowmont Lane (Alternative C-1)
- Leigh Village – Includes crossings of proposed Leigh Village as well as Ephesus Church Road and Farrington Road intersection if needed
- Patterson Place – McFarland Drive from Mt. Moriah Road to Witherspoon Boulevard as well as any crossing of Garrett Road
- South Square – Including University Drive from Snow Creek Trail to Shannon Road, Shannon Road from University Drive to US 15-501, and Tower Road from US 15-501 northbound ramps to Pickett Road
- Cornwallis Road – At Grade crossing near US 15/501 (as needed)
- Erwin Road – Cameron Drive to Anderson Street/15th Street, Fulton Street and Trent Drive, and Elba Street as needed
- Pettigrew Street – Erwin Road/9th Street to Sumter Street and Chapel Hill Street to Alston Avenue and proximate intersections as needed
- Peabody Street – Gregson Street to Duke Street

Maps of the proposed simulation areas and intersections are shown in Figures 1 and 2. The selection of the studied areas and intersection was based on the results from the AA. Potential changes to alignment and sunsequently crossings may require revision and correction of the current selection.

2.2 Balanced Volume Data

For the traffic analysis portion of the D-O LRT Draft EIS we will employ the data collected as part of the AA phase of the project, including peak hour turning movements for all intersections identified. Traffic counts from 2008 or before will be increased based on the growth of background traffic to represent base year conditions. If significant changes in street configuration or roadway geometry have occurred since the count was taken then newer counts in these areas reflecting such changes will be collected and used for the traffic anysis.

Background growth will be based on data from the NCDOT traffic volume maps (http://www.ncdot.gov/travel/statemapping/trafficvolumemaps/). After developing the raw peak hour turning volumes for the base year, the volumes will be balanced across the networks. Sink and source nodes will be added where necessary to account for mid-block changes in traffic volumes due to major origins or destinations. Input data for the loading points will be developed based on the balanced volumes.

2.3 Model Development

For the development of the base model in VisSim, the following will be completed:

- Develop base data including acceleration, speed distributions, vehicle classes, vehicle distributions, and link behavior types
- Develop link geometric data
- Input traffic demand data based on outcome of previous step
- Input origin-destination routing
- Input traffic control data at intersections, including signal timings
- Input traffic operations and management data for links
- Input driver behavior data
- Set simulation run control
- Code network outputs

Data Needs:

Signal Plans from Chapel Hill, Durham, and NCDOT

2.4 Pedestrian And Bicycle Volumes

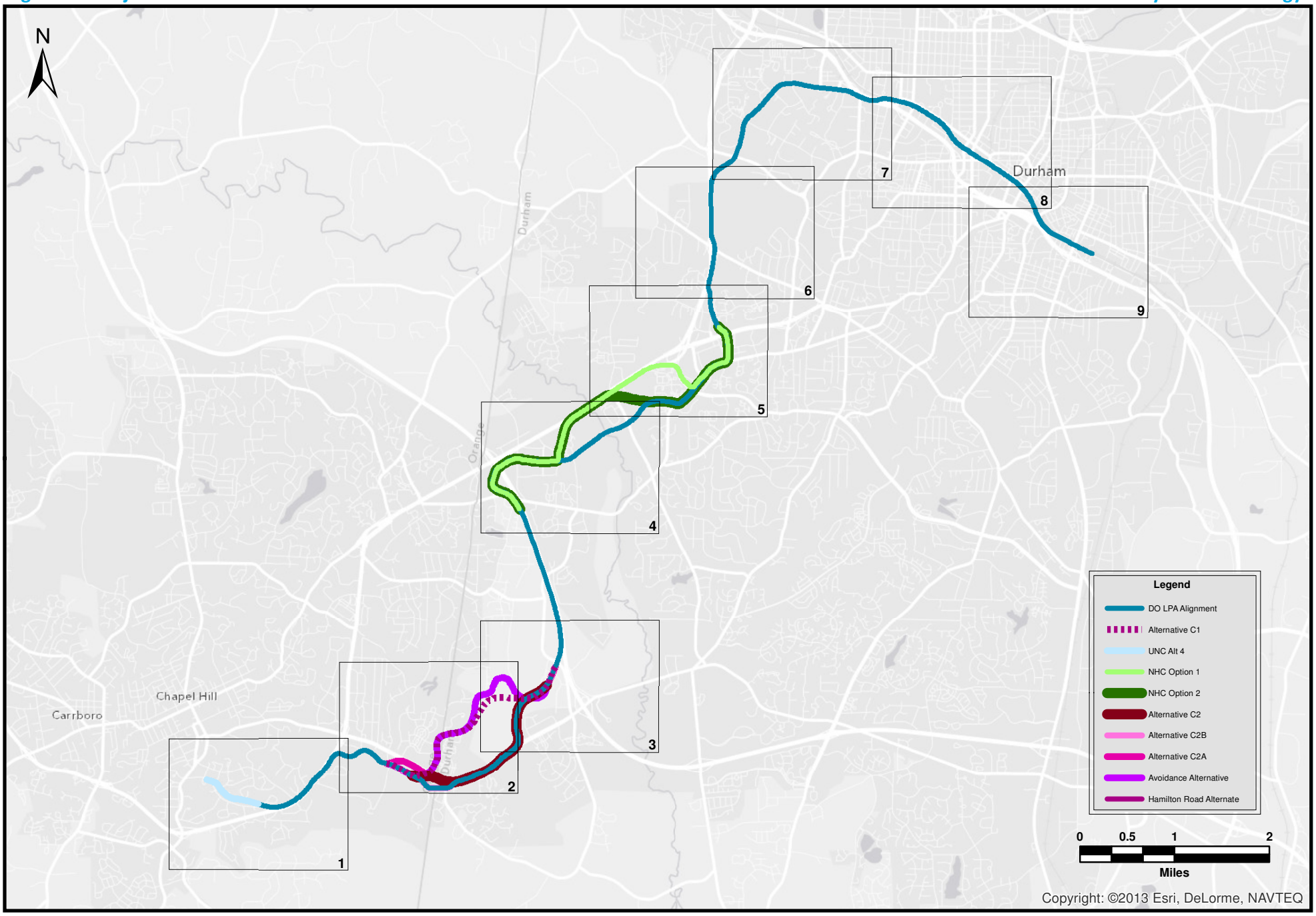
Where necessary, pedestrian and bicycle data will be collected and utilized in the model stream. To guide this effort, *Effects of Pedestrians on Capacity of Signalized Inersections* by Milazzo et al published in Transportation Research Record 1646 was reviewed. This article serves as the basis for determining the impact of pedestrians on saturation flow rates at signalized intersections as described in chapter 31 of the *2010 Highway Capacity Manual* published by the Transportation Research Board. In that review it was found that pedestrian conflicts reduce saturation flow in a linear manner from 0 to 1000 conflicting pedestrians per hour of green time. The reduction in saturation flow at 1000 conflicting pedestrains per hour of green time is 50%. A threshold of 20% reduction in saturation flow rate will be utilized for this analysis based on the previously referenced items. This 20% reduction

threshold corresponds to 400 conflicting pedestrians per hour of green time. If a conservative assumption is made that turning movements are provided green time equal to 25% of the cycle length, then we can interpolate that for a 20% reduction in turning movement saturation flow rate there must be at least 100 conflicting pedestrians for that particular movement in the peak hour. As such, we are proposing to include only pedestrian movements in the simulation where pedestrian volumes are greater than 100 conflicting pedestrians in the peak hour. To reach that threshold either the volume of conflicting pedestrians on a single crosswalk must be greater than 100 pedestrians in the peak hour or the combined volume of conflicting pedestrians of two adjacent crosswalks must be greater than 100 pedestrians in the peak hour.

A partial field review was conducted to determine locations where pedestrian and bicycle volumes were above the 100 pedestrians per hour threshold. Initial review of the proposed areas revealed that the intersection of Erwin Road and Fulton Street meets this threshold in the base year. Additional examination will be conducted later.

2.5 Calibration Of Model

Once the model is created and visually validated, model data will be extracted to ensure that the model is accurately representing base year conditions. The model will be pre-loaded for 15 minutes with volumes that are 75% of those anticipated for the peak hour. Model outputs will be compared to INRIX traffic data from the base year to ensure relatively similar travel times. The models will be considered calibrated when the travel speeds are within 5 mph of the data obtained from INRIX. That said, reasonable efforts will be made to reduce the difference between model travel time speeds and INRIX data to be within 2.5 mph. Given that INRIX data is aggregated over a period of time and that the model run is for one specific day it may not be possible to achieve the narrower band for the purposes of calibration. The model will be run for a sufficient number of iterations to ensure calibration based on Federal Highway Administration (FHWA) guidelines. The number of iterations necessary to achieve calibration for each corridor will be recorded and future year models will be run utilizing the same number of iterations. Models will be run using static trip assignment.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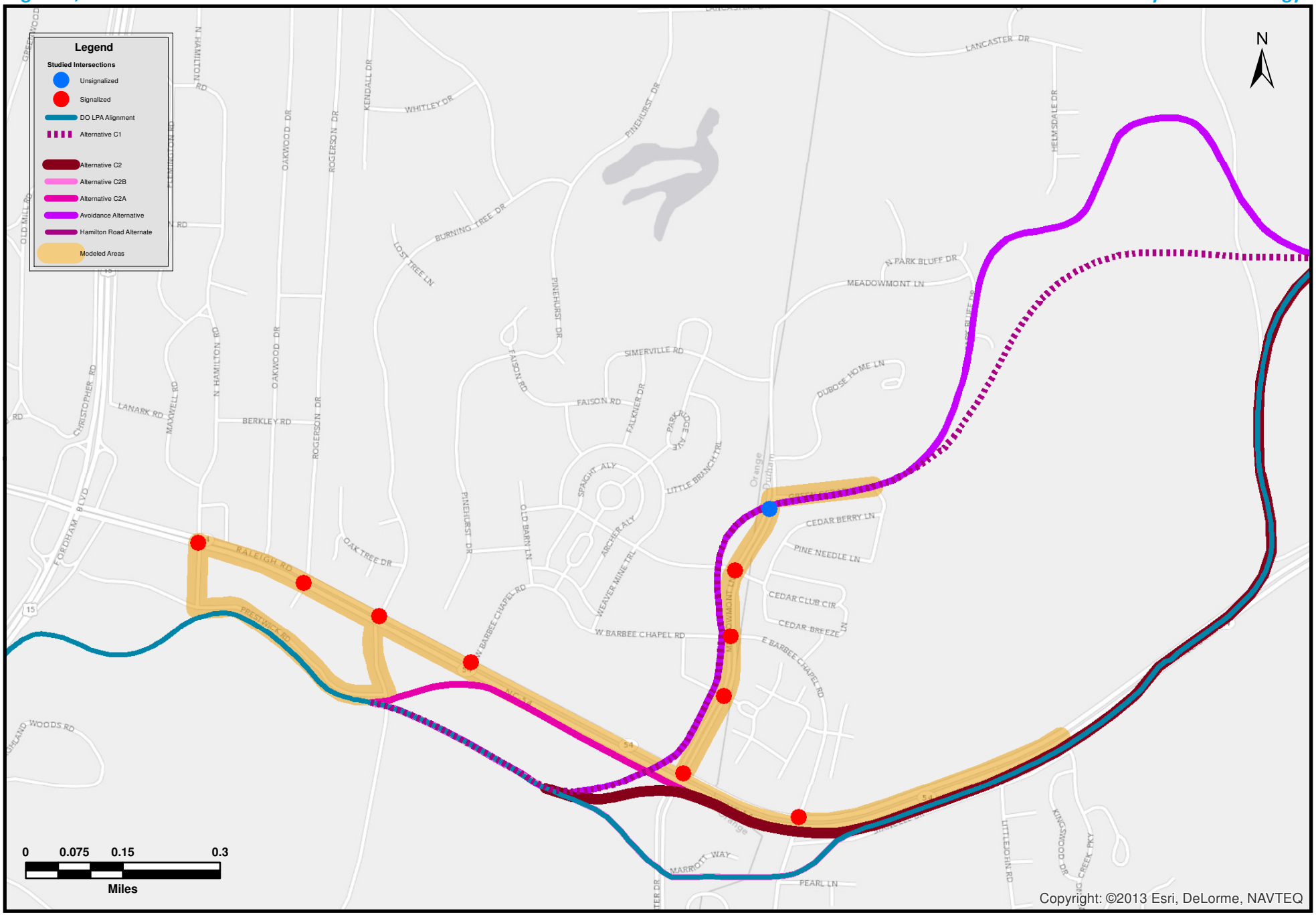
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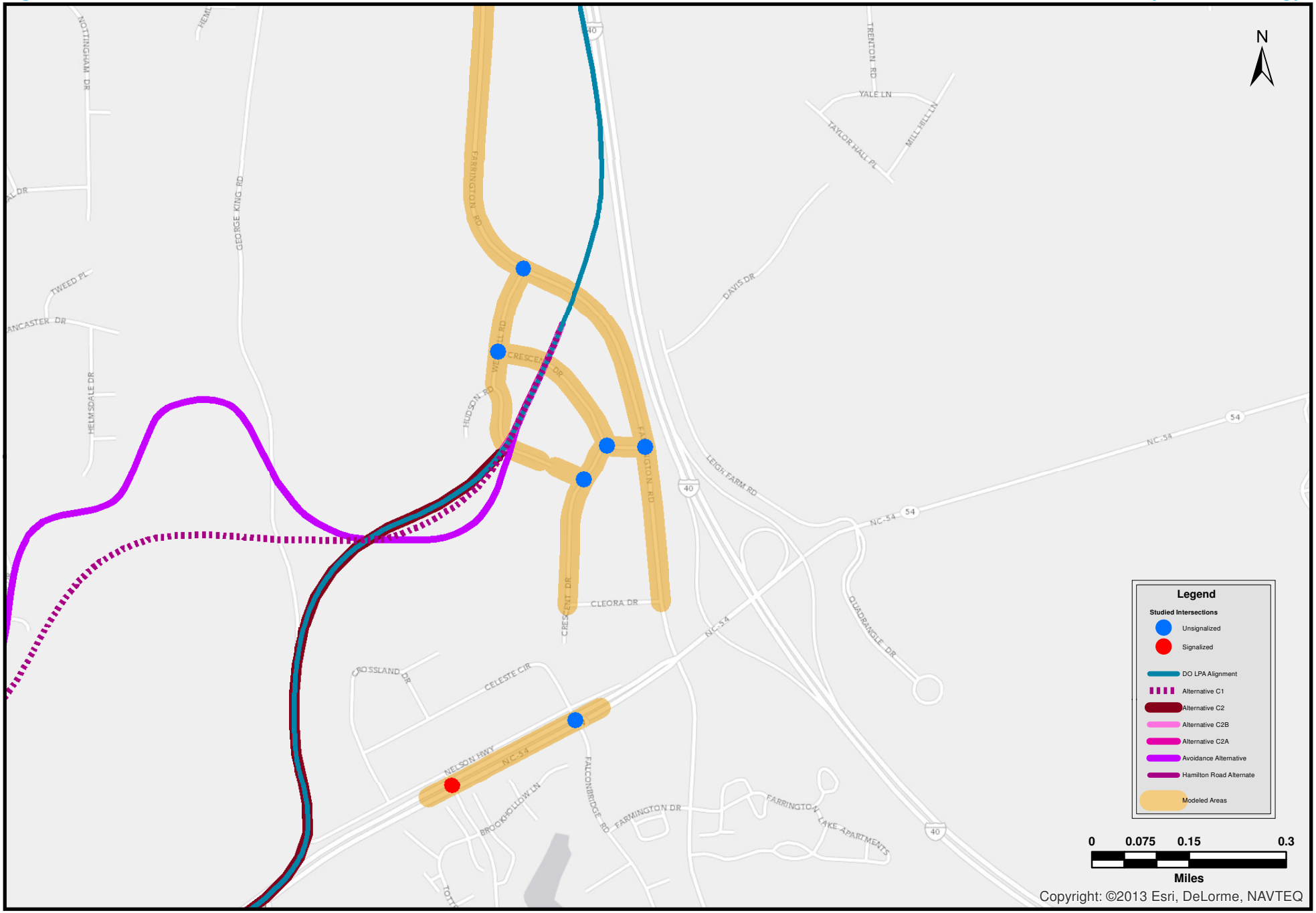
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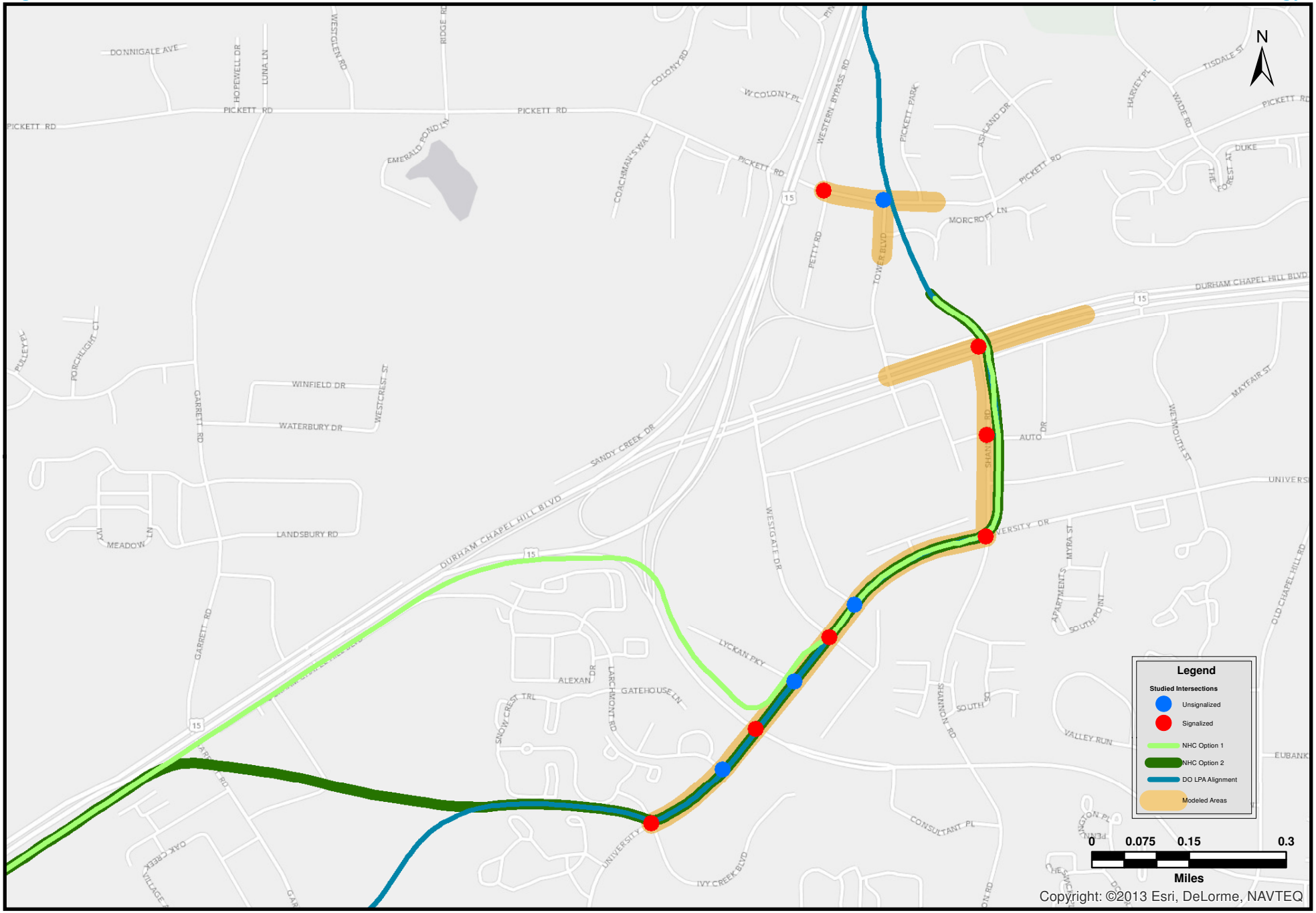
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LUNA LN
WESTGLEN RD
RIDGE RD
COLONY RD
W COLONY PL
WESTERN BYPASS RD
PICKETT PARK
ASHLAND DR
HARVEY PL
TISDALE ST
WADE RD
DUKE
THE FOREST AT
EMERALD POND LN
COACHMAN'S WAY
MORCROFT LN
PETTY RD
TOWER BLVD
DURHAM CHAPEL HILL BLVD
15
PULLEY PL
PORCHLIGHT CT
WINFIELD DR
WESTCREST ST
WATERBURY DR
GARRETT RD
SANDY CREEK DR
AUTO DR
MAYFAIR ST
WEYMOUTH ST
MEADOW LN
LANDSBURY RD
WESTGATE DR
MYRA ST
APARTMENTS
SOUTH POINT
OLD CHAPEL HILL RD
LYCKAN PKY
ALEXAN DR
LARCHMONT RD
GATEHOUSE LN
SNOW CREST TRL
SHANNON RD
VALLEY RUN
CONSULTANT PL
UNIVERSITY
IVY CREEK BLVD
OAK CREEK


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Copyright: ©2013 Esri, DeLorme, NAVTEQ
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FRANK BASSETT DR
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EVANS ST
WELCOME CIR
EASTIS DR
RIDGE RD
TRYON RD
GRANDIFLORA DR
WESTERN BYPASS
WOODBURN RD
PINECREST RD
SEVIER ST
MARION AVE
MCDOWELL RD
SCOTT PL
LEARNED PL
HEATH PL
MONTGOMERY ST
SPENCER ST
GREYMAR DR
FRIENDSHIP RD
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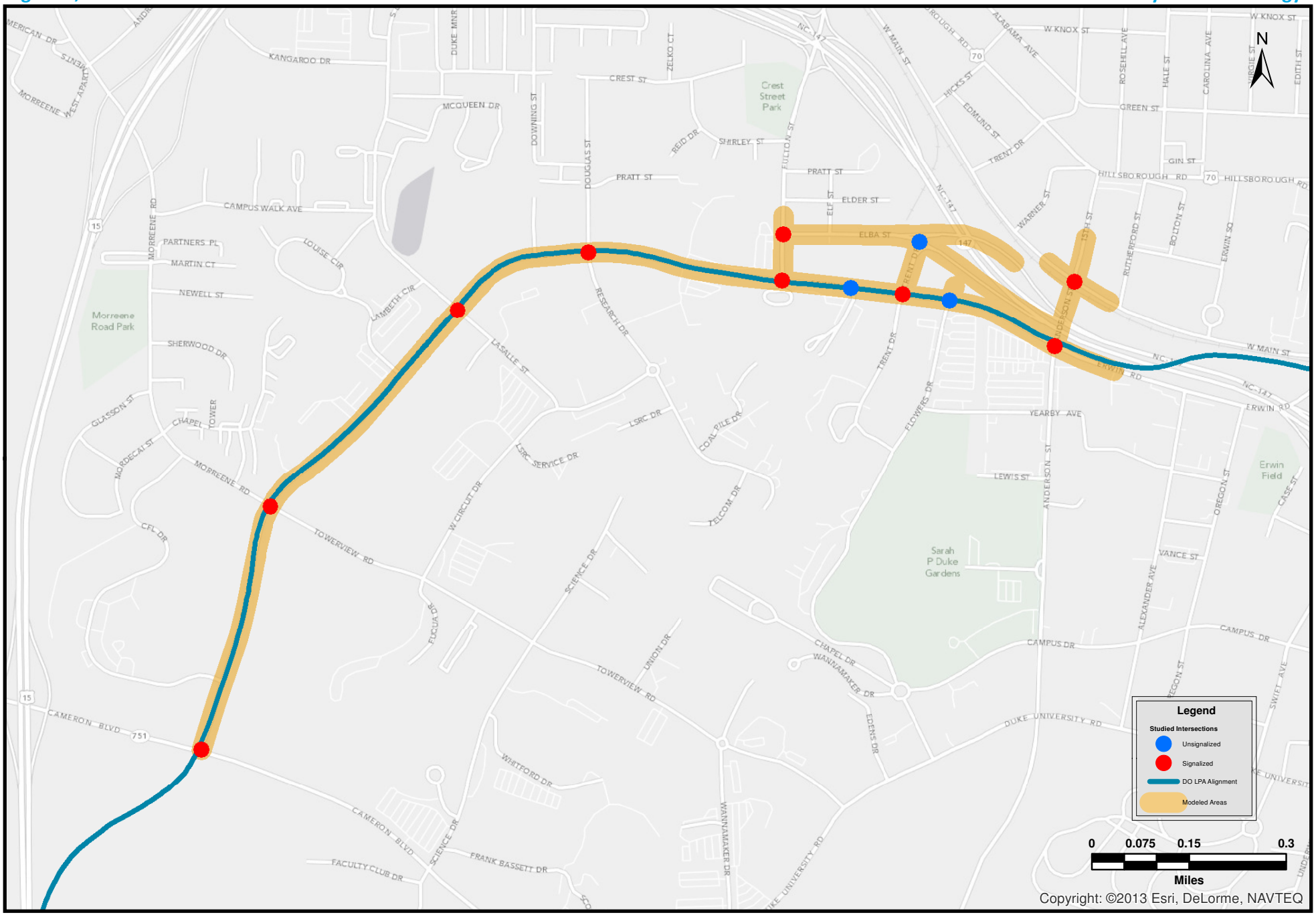
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Crest Street Park
Morreene Road Park
Sarah P Duke Gardens
Erwin Field
W KNOX ST
KANGAROO DR
MCQUEEN DR
CREST ST
SHIRLEY ST
PRATT ST
ELDER ST
ELBA ST
HILLSBOROUGH RD
GIN ST
GREEN ST
W MAIN ST
ERWIN RD
YEARBY AVE
CAMPUS WALK AVE
PARTNERS PL
MARTIN CT
NEWELL ST
SHERWOOD DR
GLASSON ST
CHAPEL TOWER
MORDECAI ST
MORREENE RD
LOUISE CIR
LAMBETH CIR
LASALLE ST
RESEARCH DR
LSRC DR
LSRC SERVICE DR
COAL PILE DR
TELCOM DR
W CIRCUIT DR
TOWERVIEW RD
SCIENCE DR
FUCUA DR
UNION DR
CFL DR
CAMERON BLVD
751
WHITFORD DR
FACULTY CLUB DR
FRANK BASSETT DR
WANNAMAKER DR
CHAPEL DR
EDENS DR
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CAMPUS DR
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LEWIS ST
TRENT DR
FLOWERS DR
ANDERSON ST
OREGON ST
ALEXANDER AVE
SWIFT AVE
CASE ST
ROSEHILL AVE
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HICKS ST
EDMUND ST
TRENT DR
WARNER ST
ROTHERFORD ST
BOLTON ST
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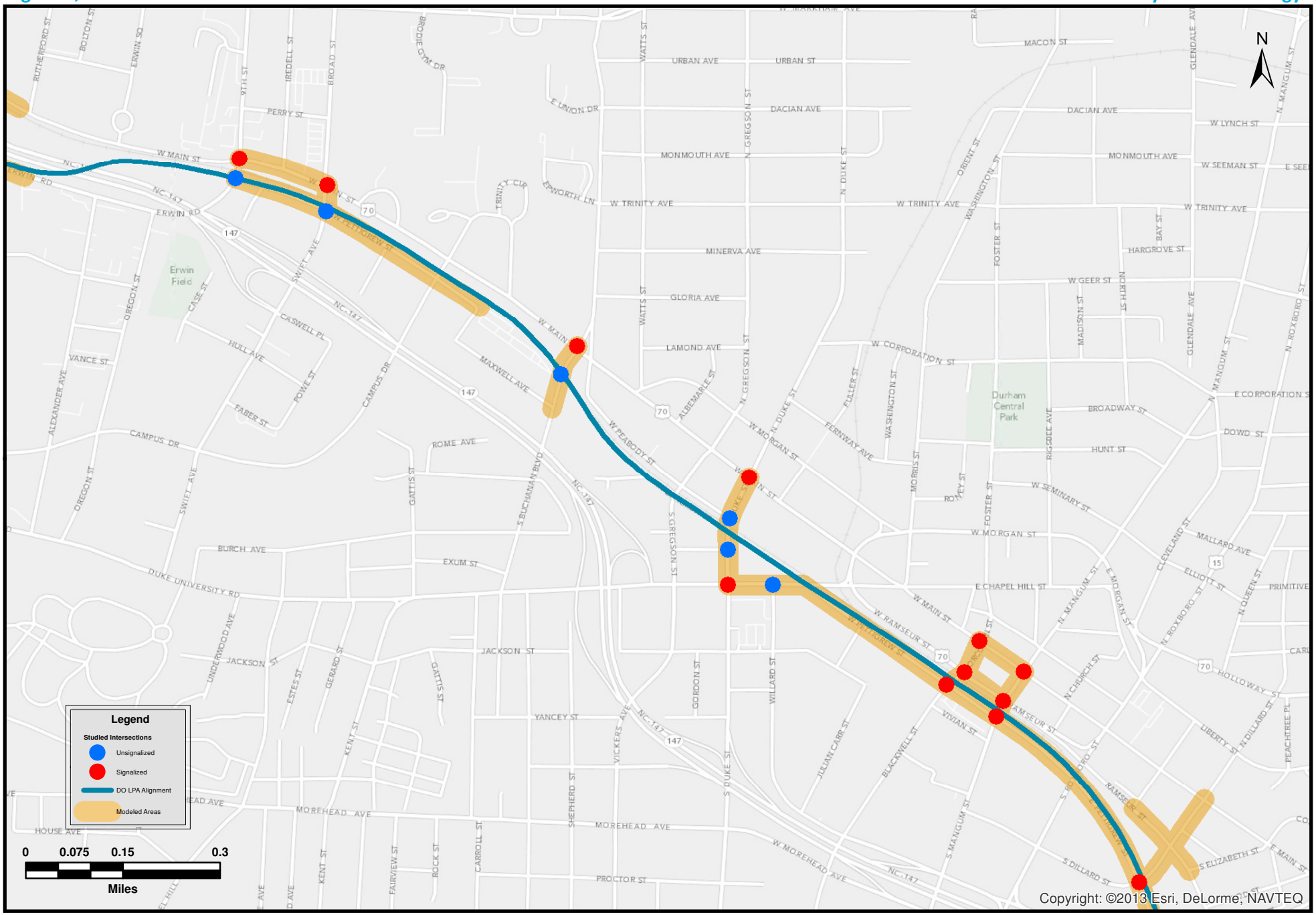
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MINERVA AVE
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LAMOND AVE
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E CORPORATION ST
BROADWAY ST
HUNT ST
W SEMINARY ST
W MORGAN ST
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W RAMSEUR ST
E MORGAN ST
MACON ST
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HARGROVE ST
W GEER ST
MALLARD AVE
ELLIOTT ST
HOLLOWAY ST
LIBERTY ST
PRIMITIVE
PERRY ST
E UNION DR
TRINITY CIR
EPWORTH LN
MAXWELL AVE
W PEABODY ST
ROME AVE
EXUM ST
BURCH AVE
DUKE UNIVERSITY RD
CAMPUS DR
CASWELL PL
HULL AVE
FABER ST
POWE ST
VANCE ST
ALEXANDER AVE
OREGON ST
SWIFT AVE
CASE ST
GATTIS ST
S BUCHANAN BLVD
JACKSON ST
UNDERWOOD AVE
ESTES ST
GERARD ST
KENT ST
YANCEY ST
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HOUSE AVE
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GORDON ST
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VICKERS AVE
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ROCK ST
CARROLL ST
JULIAN CARR ST
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FERNWAY AVE
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ROXEY ST
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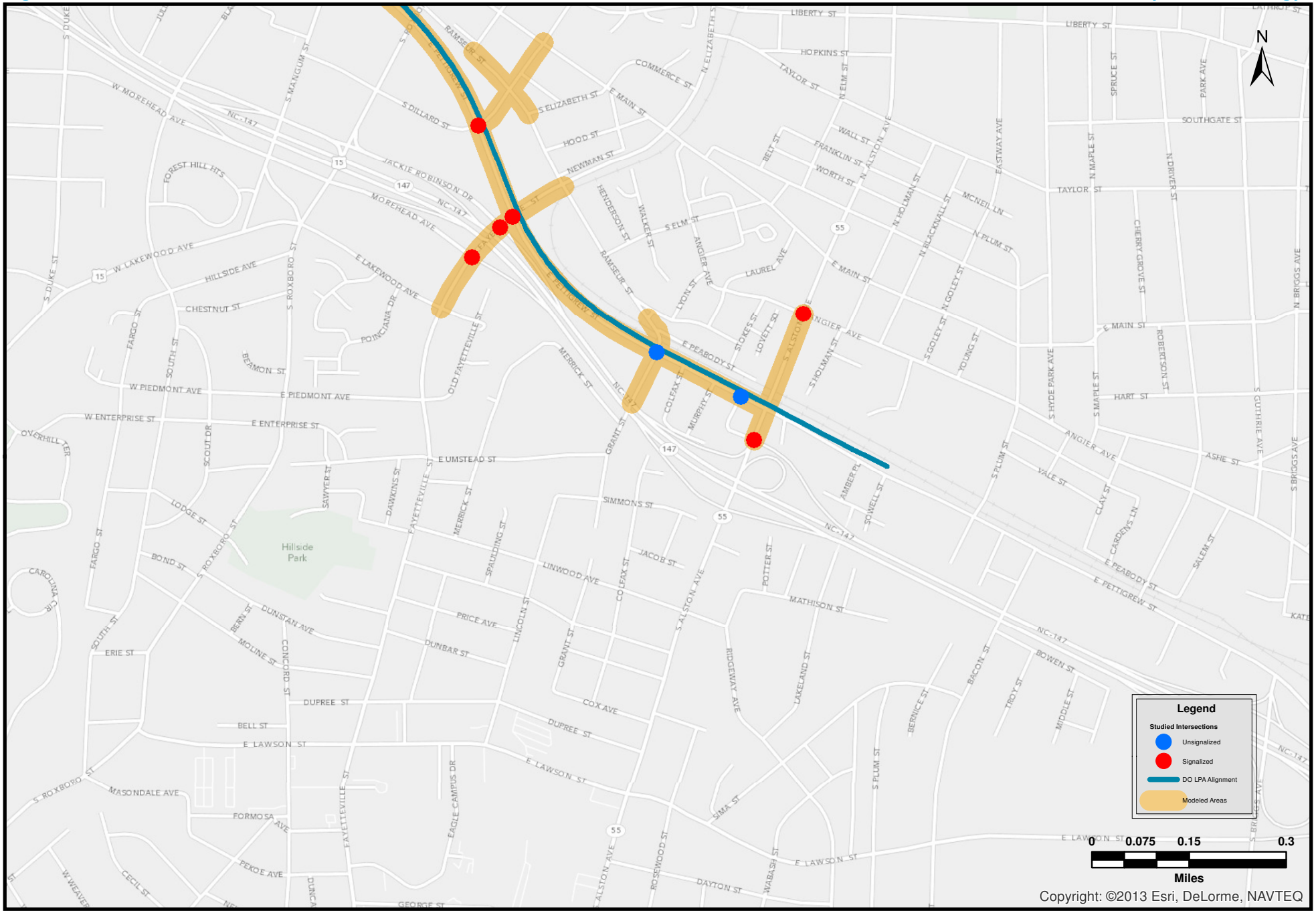
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COMMERCE ST
TAYLOR ST
SOUTHGATE ST
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S ELIZABETH ST
S DILLARD ST
HOOD ST
NEWMAN ST
WALL ST
FRANKLIN ST
WORTH ST
MCNEILL ST
N PLUM ST
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E LAKEWOOD AVE
HILLSIDE AVE
CHESTNUT ST
POINCIANA DR
W PIEDMONT AVE
E PIEDMONT AVE
W ENTERPRISE ST
E ENTERPRISE ST
E UMSTEAD ST
E PEABODY ST
ANGIER AVE
LAUREL AVE
HART ST
ASHE ST
VALE ST
SIMMONS ST
LINWOOD AVE
JACOB ST
MATHISON ST
E PETTIGREW ST
BOWEN ST
PRICE AVE
DUNBAR ST
DUNSTAN AVE
BOND ST
LODGE ST
ERIE ST
BELL ST
DUPREE ST
COX AVE
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MASONDALE AVE
FORMOSA AVE
PEKOE AVE
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S ALSTON AVE
S HOLMAN ST
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N GOLEY ST
YOUNG ST
S HYDE PARK AVE
S MAPLE ST
N MAPLE ST
CLAY ST
CARDENS LN
SALEM ST
S BRIGGS AVE
N BRIGGS AVE
CHERRY GROVE ST
ROBERTSON ST
S GUTHRIE AVE
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PARK AVE
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LYON ST
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RIDGEWAY AVE
LAKELAND ST
BACON ST
TROY ST
MIDDLE ST
BERNICE ST
SIMA ST
ROSEWOOD ST
WABASH ST
EAGLE CAMPUS DR
CECIL ST
W WEAVER
JACKIE ROBINSON DR
FOREST HILL HTS
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3. Future Year No-Build/TSM Model

The No-Build and TSM alternatives are being combined as the traffic volumes are expected to be roughly similar. A future year No-Build/TSM model will be developed for each of the areas identified in section 2.1. These models will examine future conditions that could occur if the D-O LRT line were not constructed. As part of this analysis some projected deficiencies of the roadway network could be discovered. This analysis will not aim to categorize those deficiencies or to develop mitigation strategies. This analysis will be limited to determining likely future year conditions.

3.1 Develop Future Year No-Build/Tsm Volume Data

The balanced volumes developed for the base year analysis will be employed as the starting point for developing the future year No-Build/TSM volume data. Based on the balanced base-year peak-hour turning-movement, data link volumes will be generated for both the AM and PM peak hours. Data from the TRTDM will be used to obtain an appropriate growth factor for every link and this growth factor will be applied to base year link volumes to forecast future year No-Build/TSM peak-hour link volumes for the AM and PM peak hours. Data utilized for this will include daily volume growth, daily percentage growth, peak hour volume growth, and peak hour percentage growth. It will be critical to examine the peak hour data as well as the daily volume data as some peak spreading is likely to occur along the D-O LRT corridor given the developed nature of the corridor and the limited right-of-way available for additional roadway expansion. Engineering judgment will be employed to ensure that appropriate growth rates are extracted from the model.

Growth rates and projected link volumes will be reviewed in light of planned improvements in the area including projected development and changes to parking and transit operations. The model will be reviewed to determine which changes may have already been included within the socio-economic assumptions in the TRTDM. Forecasted link volumes will then be adjusted as necessary to reflect known changes that were not captured in the TRTDM.

Peak-hour turning volumes will be forecasted based on the peak-hour link volumes. Using the *TurnsW32* program (http://www.kittelson.com/toolbox/turnsw32) and the future year peak-hour link volumes and the base-year turning movements as input data, future year turning movements will be generated. These volumes will then be balanced in a manner similar to that used in the base year, although this process is likely to be less intensive.

Lastly, the sink and source nodes developed for the base year will be revisited. Based on existing development, planned development, and, to a lesser extent, sink and source nodes for the future year, a No-Build/TSM scenario will be developed.

3.2 Pedestrian And Bicycle Volumes

Local pedestrian and bicycle plans will be examined and proposed improvements that intersect the corridor will be noted. Qualitative estimates of the extent to which pedestrian and bicycle traffic will interact with the roadway network will be developed based on base year conditions and proposed developments. For this analysis cyclists will be assumed to cross at crosswalks and will not be included in the vehicular flow. At those locations where pedestrian and bicycle traffic is expected be above the 100 conflicting pedestrians per hour data will be developed and added to the model. The intersection Erwin Road and Fulton Street will include pedestrian or bicycle flow data in keeping with the base year calibration process. Additional intersections, particularly in downtown Durham or near either of the major college campuses, may also include pedestrian data in the future year No-Build/TSM analysis.

3.3 Future Year No-Build/Tsm Model Development

The base year model will be updated based on expected improvements to the roadway network. For this process the State Transportation Improvement Plan (STIP), the Metropolitan Transportation Improvement Plan (MTIP), various Capitol Improvement Plans (CIP), and bond packages will be reviewed to ensure that anticipated improvements are included in the future year model network. Unsignalized intersections will be given a cursory examination to determine if signalization is appropriate for future year conditions based on the volumes developed in the previous steps.

Signal timings will be updated using either Synchro or Vistro and the projected volumes and geometries. These new timings will be added to the model. Regardless of the development of pedestrian and bicycle data from the previous step all signals will be optimized to allow for safe pedestrian crossings.

Lastly routing information will be updated as needed to reflect changes in the roadway network based on proposed changes.

3.4 Model Simulation And Output Extraction

Upon developing the future year No-Build/TSM model, the model will run for the number of iterations necessary to achieve base year calibration. Models will be run using static trip assignments. The following data will be extracted and analyzed:

- Intersection Level of Service (LOS)
- Queuing
- Control delay
- Travel time
- Travel speeds
- Network delay (total and average per vehicle)

3.5 Comparison To Synchro

The Synchro analysis completed in the Alternative Analysis phase will be updated with new traffic volumes. The data from Synchro will be compared to the VisSim output. Differences will be noted and explained.

4. Future Year Build Models

A future year Build model will be developed for each of the areas identified in section 2.1. As noted in section 3.0 this analysis may reveal potential deficiencies in the future year roadway network. Only those areas negatively impacted above a certain threshold will be identified as part of this analysis. Areas anticipated to be deficient regardless of construction of the D-O LRT will not be identified nor will any potential mitigation strategy be developed.

4.1 Develop Future Year Build Volume Data

The balanced volumes developed for the future year No-Build/TSM analysis will be used as the starting point for developing the future year build volume data. Based on the balanced future-year No-Build/TSM turning-movement data, peak-hour link volumes will be generated for both the AM and PM peak hours. Data from the TRTDM will be used to obtain an appropriate diversion factor for every link for the AM and PM peak hours. Data utilized for this will include daily volume diversion, daily percentage diversion, peak hour volume diversion, and peak hour percentage diversion. It will be critical to examine the peak hour data as well as the daily data as some peak spreading is likely to occur along the D-O LRT corridor given the developed nature of the corridor and the limited right-of-way available for additional roadway expansion. Engineering judgment will be employed to ensure that appropriate growth rates are extracted from the model. A check will also be done between the Build and No-Build/TSM volume data to see if patterns suggested by the TRTDM are reflected in the volume data.

Growth rates and projected link volumes will be reviewed in light of planned improvements in the area including projected development and changes to parking and transit operations. The model will be reviewed to determine which changes may have already been included within the socio-economic assumptions in the TRTDM. Forecasted link volumes will then be adjusted as necessary to reflect known changes that were not captured in the TRTDM.

Peak-hour turning volumes will be forecast based on the peak-hour link volumes. Using the *TurnsW32* program (http://www.kittelson.com/toolbox/turnsw32) and the future year peak hour link volumes and the base year turning movements as input data future year turning movements will be generated. These volumes will then be balanced in a manner similar to that used in the base year, although this process is likely to be less intensive.

Lastly, the sink and source nodes developed for the base year will be revisited. Based on existing development, planned development, and, to a lesser extent, sink and source nodes for the future year, a Build scenario will be developed.

4.2 Pedestrian And Bicycle Volumes

In addition to data collected in section 3.2, station area data and ridership information will be examined to determine which areas may need to include pedestrian and bicycle flows in the analysis. The increase in pedestrian traffic due to the proposed D-O LRT will be above and beyond any increase due to future year land use. Qualitative estimates of pedestrian and bicycle flows will be developed based on base year conditions and proposed developments. In keeping with the future year No-Build/TSM analysis cyclists will be assumed to cross at crosswalks and will not be included in the vehicular flow. At those locations where pedestrians and bicycles are expected to be above the 100 conflicting pedestrians in the peak hour, data will be developed and added to the model.

4.3 Future Year Build Model Development

The future year Build model will be updated based on the proposed D-O LRT. Unsignalized intersections will be given a cursory examination to determine if signalization is appropriate for future year conditions based on the volumes developed in the previous steps.

Prior to signal optimization the project team will meet with local officials to discuss preferred interactions between the LRT and nearby signals. This will include discussions of both transit signal priority (TSP) and pre-emption. An interaction strategy for each individual signal will be identified.

Signal timings will be updated utilizing either Synchro or Vistro and the projected volumes and geometries and interaction strategy. These new timings will be added to the model. Regardless of the development of pedestrian and bicycle data from the previous step all signals will be optimized to allow for safe pedestrian crossings.

Lastly routing information will be updated as needed to reflect changes in the roadway network based on proposed changes.

4.4 Model Simulation And Output Extraction

Upon developing the future year Build model, the model will run for the number of iteration necessary to achieve base year calibration. Models will be run utilizing static trip assignment. The following data will be extracted and analyzed:

- Intersection LOS
- Queuing
- Control delay
- Travel time
- Travel speeds
- Network delay (total and average per vehicle)

4.5 Identify D-O LRT Impacts

Future year build output will be compared to future year no-build data. Those intersections that are expected to increase delay above a certain threshold will be identified. For the purposes of this study NCDOT's Policy on Street and Driveway, Chapter 5, Section J will be used to identify intersections on facilities owned by NCDOT and in the Town of Chapel Hill. The *Durham Comprehensive Plan Policy 8.1.2a, Traffic Level of Service (LOS) Standards* from the City of Durham will be applied to identify intersections on facilities owned by the City of Durham. Mitigation strategies to address the degradation in LOS and control delay will be developed for those identified intersections in the next phase of the project.

5. Friday Center Drive and Barbee Chapel Road Grade Separation Analysis

A grade separation analysis will be conducted to determine the benefit of grade separating the LRT crossings at Friday Center Drive and Barbee Chapel Road, both near NC 54. These locations were determined based on an analysis completed during the AA portion of the project and due to recent adjustments to the proposed D-O LRT alignment. The AA included a high level review of grade-separated and at-grade crossings and made definitive recommendations for the other crossings. The analysis for the Friday Center Drive and Barbee Chapel Road crossings could not be completed during the AA phase because of the more limited data available in this phase. This analysis will include altering the future year build network in the area to include a grade separated LRT crossing at Friday Center Drive. The model will then be re-run and new data will be extracted. The new model run data will be compared to the previous future year build data to determine the benefits of grade separating at this crossing. If necessary the analysis will review both alternative C1 and C2 to determine the benefits of grade separation.

6. Mitigation Plan

As noted above, a list of intersections expected to experience an increase in control above given thresholds will be developed. To reduce the impact of the D-O LRT, mitigation strategies will be identified for these locatoins. Such strategies could include additional turn lanes, improvements to alternative paths, alterations to travel patterns reducing delay, and improvements that do not add capacity such as improved wayfinding. These strategies will be tested utilizing VisSim to the extent possible. The modeled networks will be altered to include the roadway improvements or, in the case of strategies that alter travel patterns, the routing and volume data will be adjusted to reflect those new paths. The effectiveness of the strategies will be determined based on model results.

While the sections simulated are generally corridors, it is possible that some mitigation strategies may include the creation or improvement of alternative paths. Such an improvement may require the use of dynamic traffic assignment. A previously proposed mitigation strategy that would create an alternative path is the conversion of the Trent Drive and Elba Street intersection from the current configuration to a roundabout. Currently traffic on northbound Trent Drive cannot continue to westbound Elba Street. The conversion of this intersection to a roundabout would allow traffic on northbound Trent Drive to continue to westbound Elba Street. This conversion would provide an alternative path to the right-turning traffic from westbound Erwin Road to northbound Fulton Street, thus allowing this stream of traffic the opportunity to bypass the Erwin Road and Fulton Street intersection.

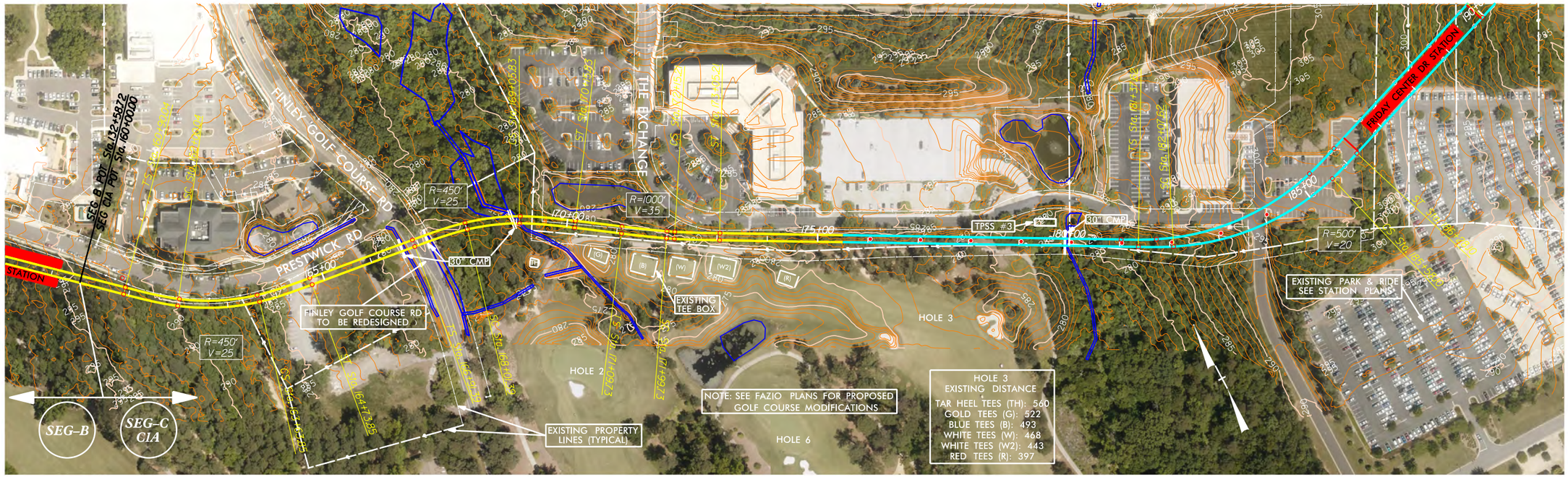
For this potential improvement, as well as similar improvements that create alternative paths, we are proposing to continue the use of static traffic assignment. Routing decisions will be updated such that traffic will be diverted to the new route and the model will be re-run and data on travel times extracted. The congested travel time of the new path will be compared to the existing path for the runs with the shifted traffic. If the travel time for the new path is still less than that for the existing path then no additional analysis will be required. In a case like this dynamic traffic assignment would shift all traffic to the new path as it is the shortest path. If the travel time for the new path is greater than the travel time for the existing path then dynamic traffic assignment will be used to provide the appropriate balance between traffic that will use the new path and traffic that will use the existing path. It is under this, and only this, condition that dynamic traffic assignment would be employed.

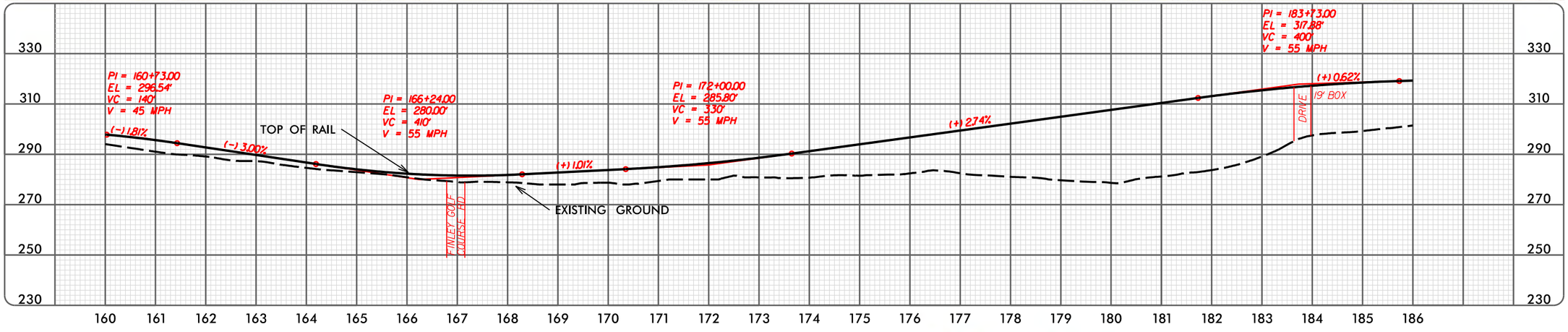
Appendix B
Basis for Engineering Plans
(LRT Alternatives Design Plans)

Build C1/C1A
Build C2
Build C2A

SEGMENT C - C1A ALTERNATIVE

FINLEY GOLF COURSE TO FRIDAY CENTER – CIA ALTERNATIVE





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PROFILE (VERTICAL): 20 10 0 20 40

CONCEPT PLANS ONLY
DO NOT USE FOR CONSTRUCTION

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

LEGEND

- BRIDGE PIERS
- AT-GRADE TRK
- ELEVATED TRK
- WETLANDS
- STATION

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PLAN AND PROFILE

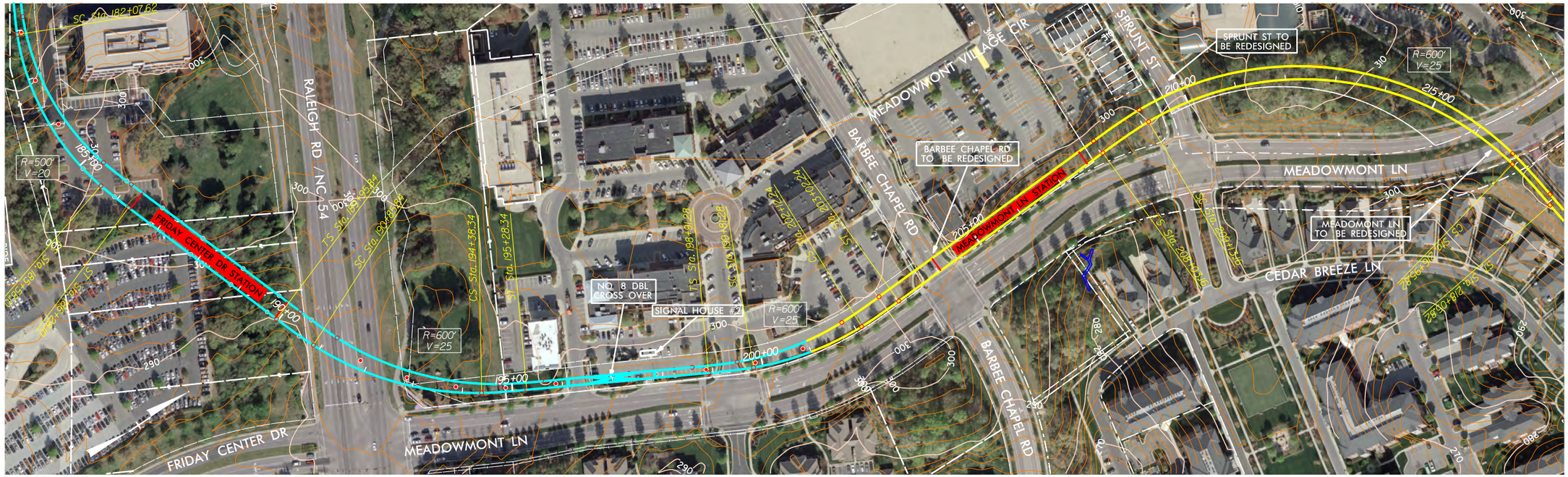
SEGMENT C

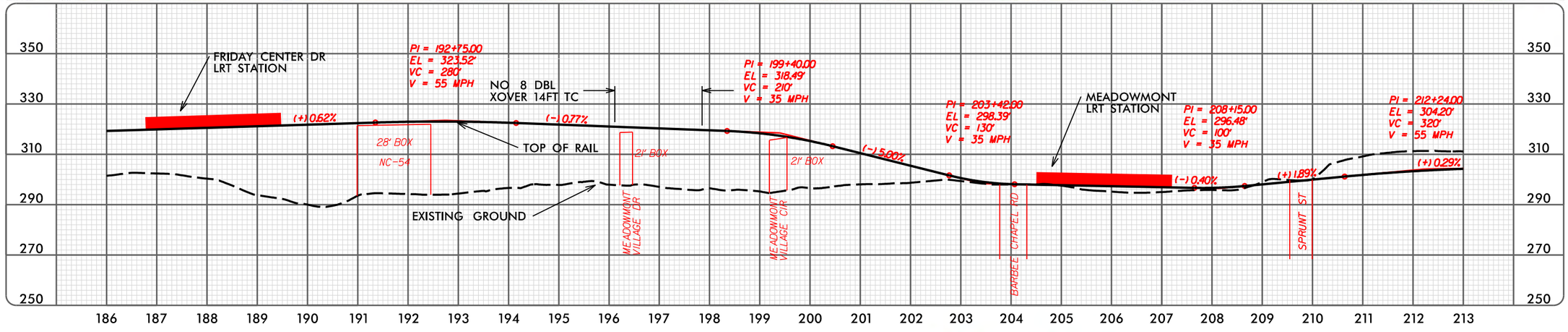
PLAN & PROFILE

SHEET: CIA – 01

2/27/2015

FRIDAY CENTER TO GREEN CEDAR LANE – C1A ALTERNATIVE





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PLAN AND PROFILE

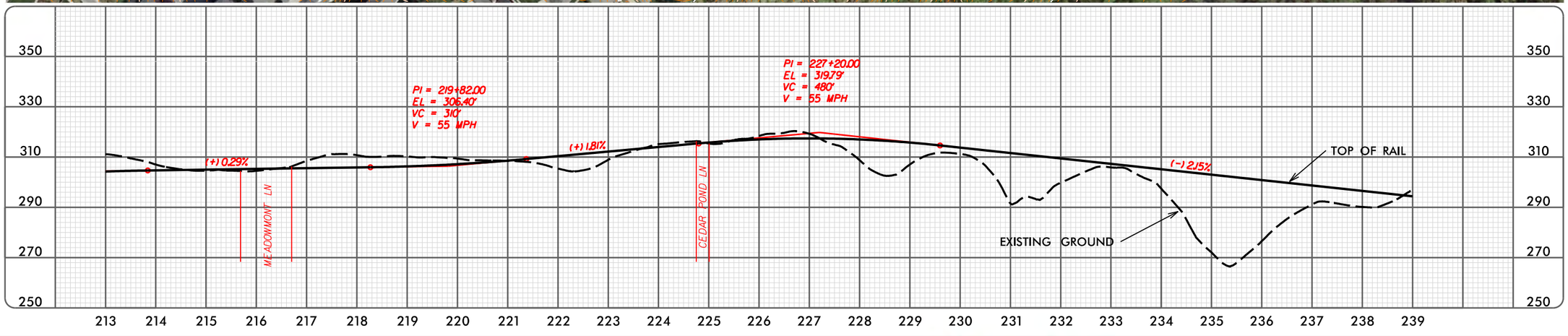
SEGMENT C

PLAN & PROFILE

SHEET: C1A – 02

2/27/2015

GREEN CEDAR LANE TO IRON MOUNTAIN ROAD – C1A ALTERNATIVE



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LEGEND

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PLAN AND PROFILE

SEGMENT C

PLAN & PROFILE

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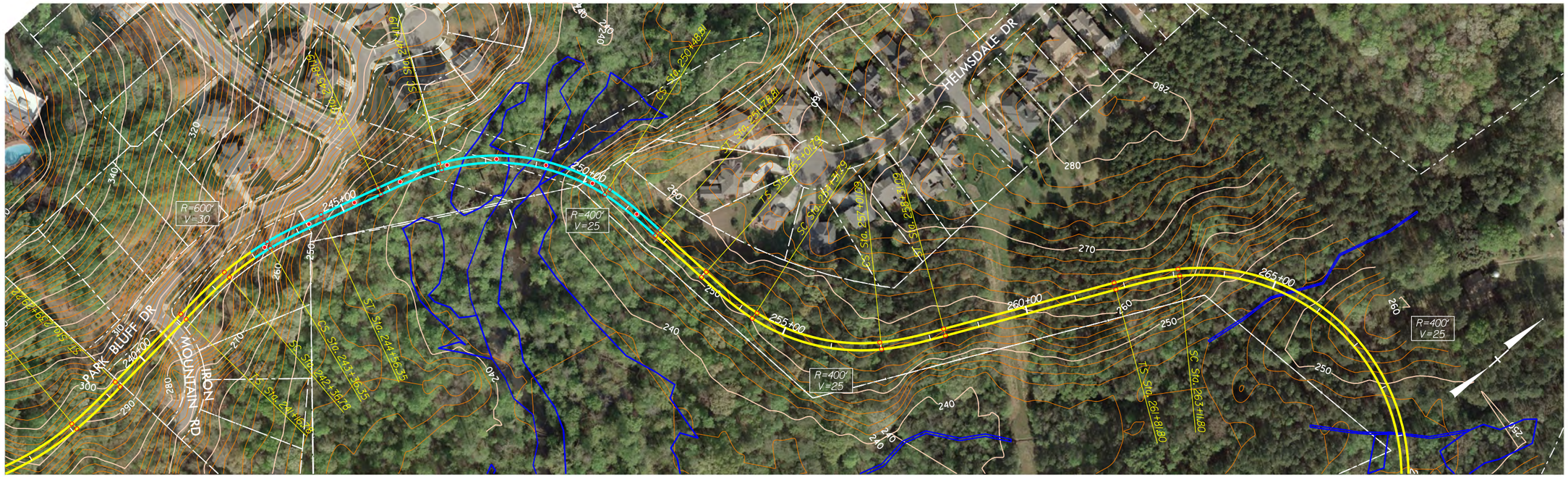
2/27/2015

OPTION AROUND ACOE LAND – CIA ALTERNATIVE



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LEGEND

- BRIDGE PIERS
- AT-GRADE TRK
- ELEVATED TRK
- WETLANDS
- STATION

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PLAN AND PROFILE

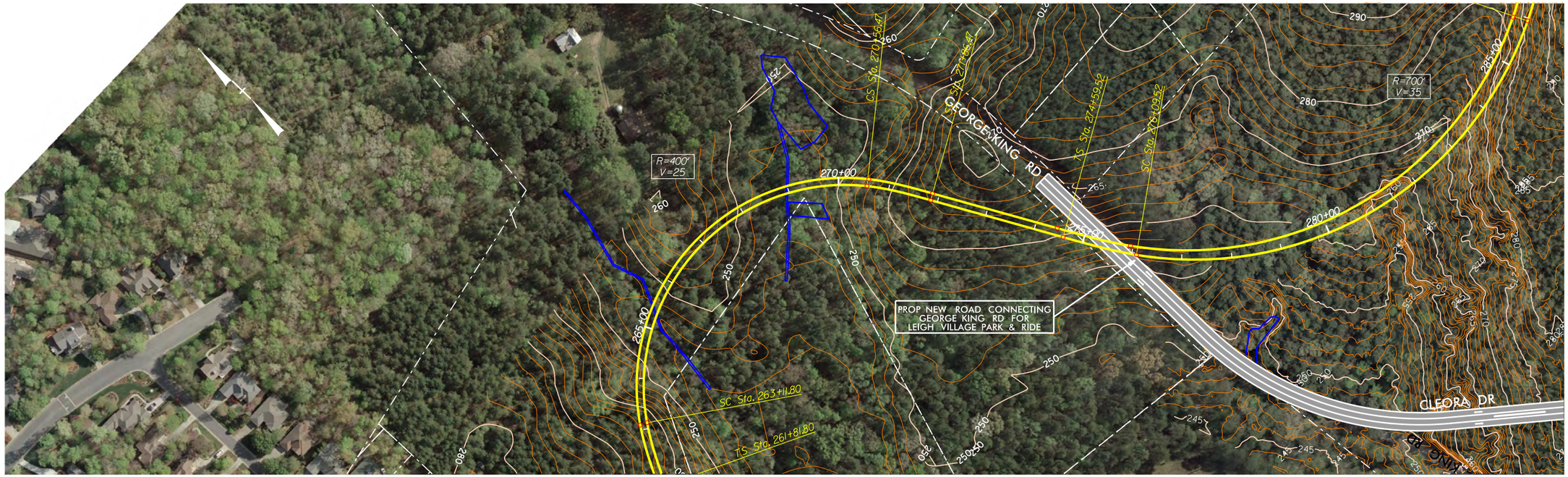
SEGMENT C

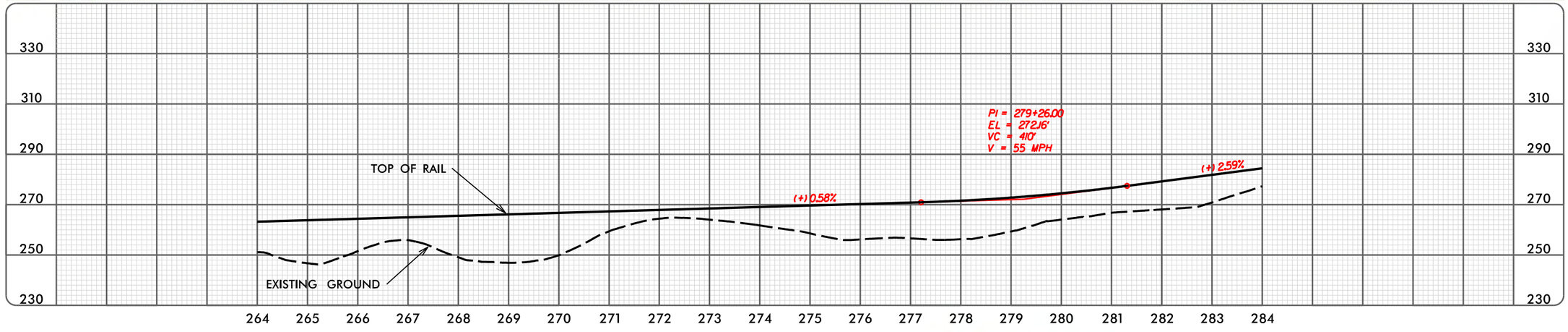
PLAN & PROFILE

SHEET: CIA – 04

2/27/2015

OPTION AROUND ACOE LAND – CIA ALTERNATIVE





GRAPHIC SCALES

PLAN: 100 0 100 200

PROFILE (HORIZONTAL): 100 0 100 200

PROFILE (VERTICAL): 20 10 0 20 40

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PLAN AND PROFILE

SEGMENT C

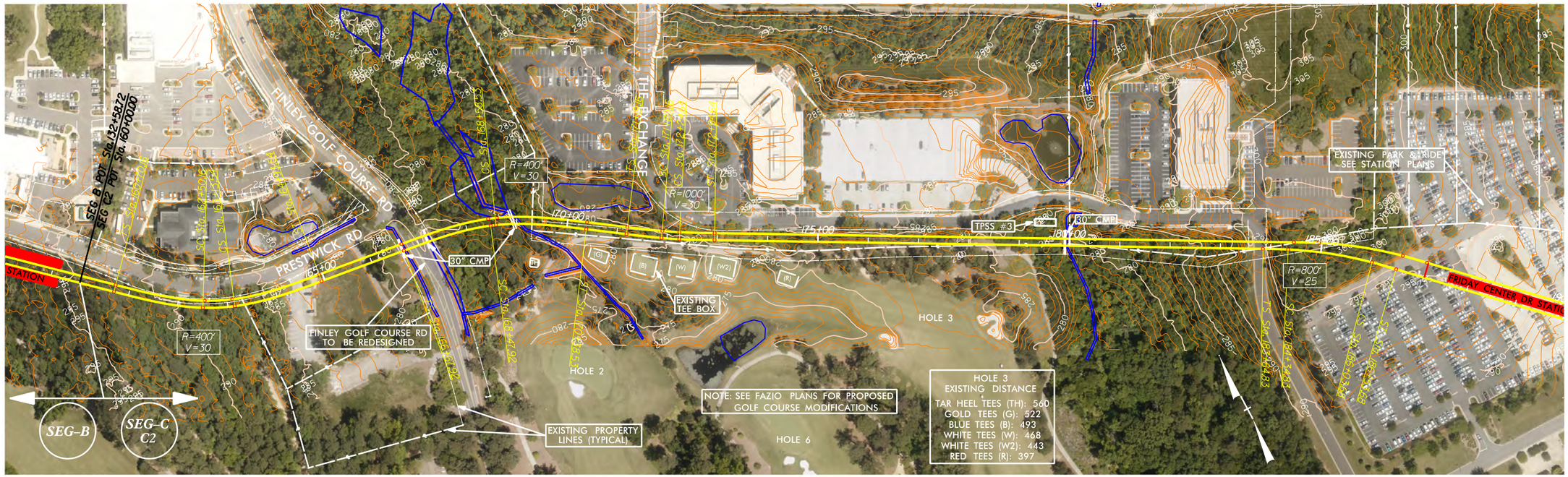
PLAN & PROFILE

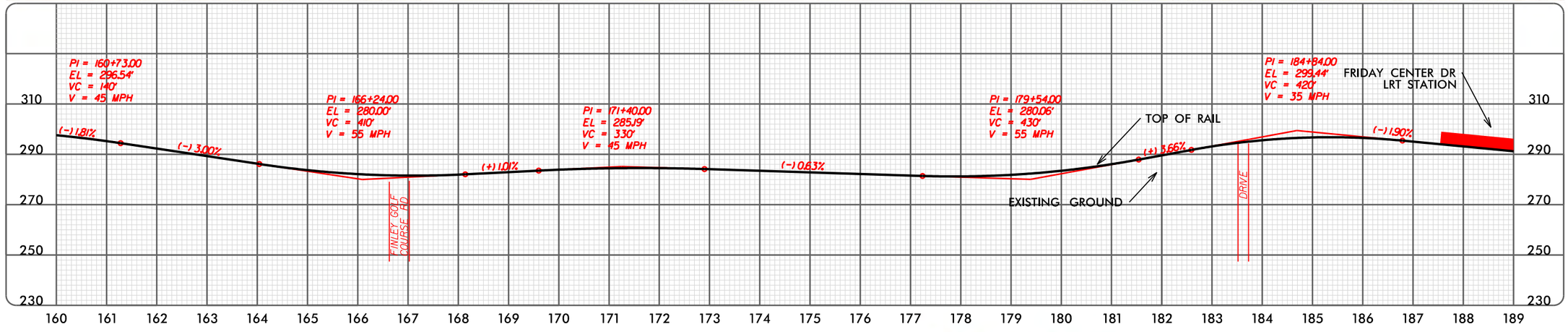
SHEET: CIA – 05

2/27/2015

SEGMENT C – C2 ALTERNATIVE

FRIDAY CENTER STATION – C2 ALTERNATIVE





GRAPHIC SCALES

PLAN: 100 0 100 200

PROFILE (HORIZONTAL): 100 0 100 200

PROFILE (VERTICAL): 20 10 0 20 40

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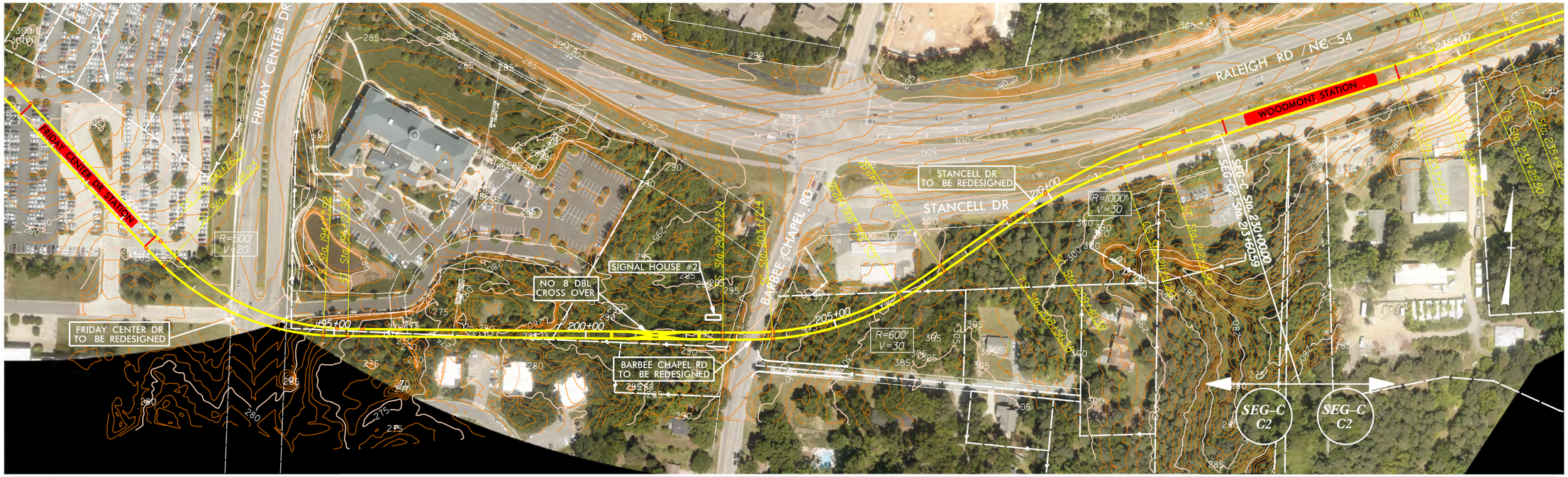
SEGMENT C

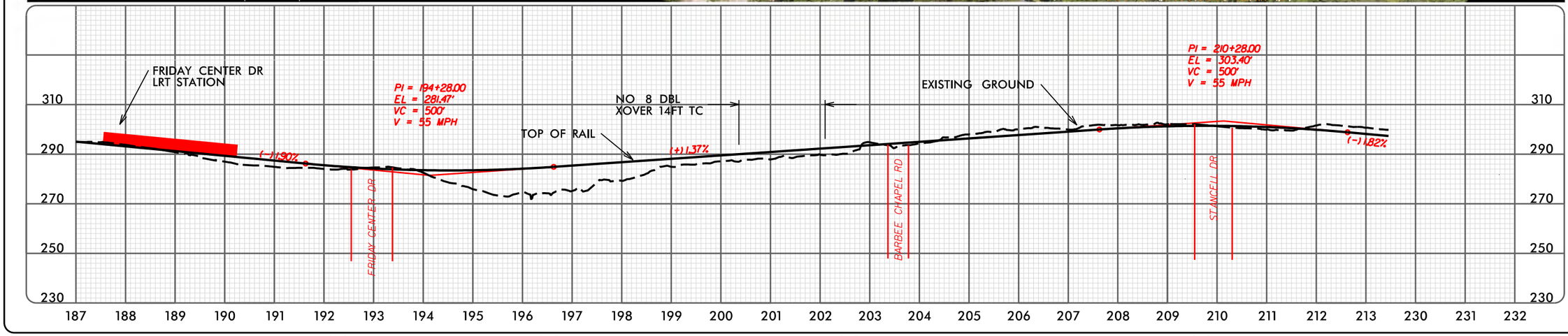
PLAN & PROFILE

SHEET: C2 – 01

2/27/2015

FRIDAY CENTER STATION – C2 ALTERNATIVE





GRAPHIC SCALES

PLAN: 100 0 100 200

PROFILE (HORIZONTAL): 100 0 100 200

PROFILE (VERTICAL): 20 10 0 20 40

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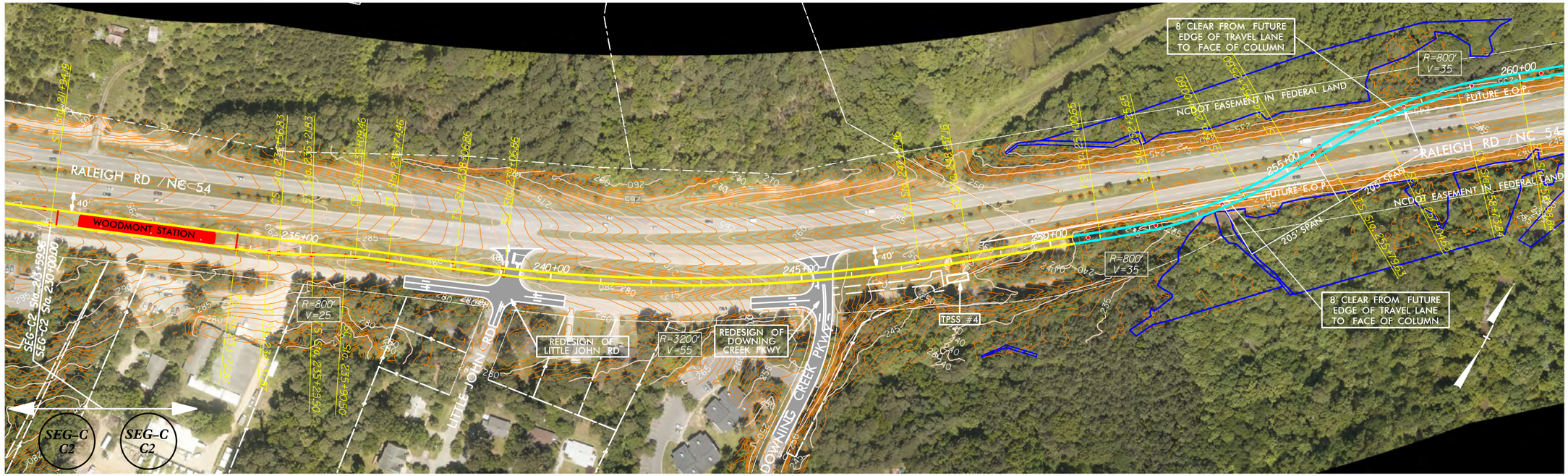
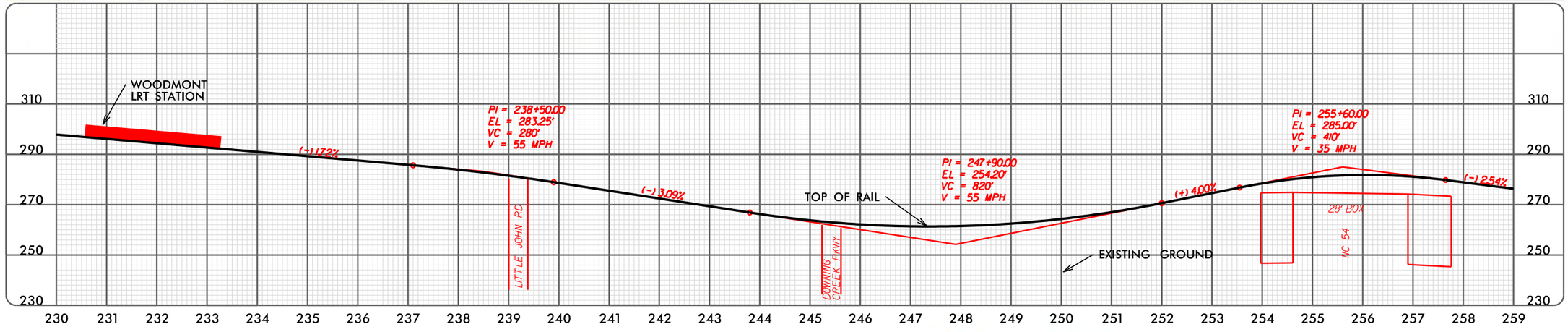
SHEET: C2 – 02

2/27/2015

WOODMONT STATION ALONG NC 54 – C2 ALTERNATIVE





GRAPHIC SCALES

PLAN: 100 0 100 200

PROFILE (HORIZONTAL): 100 0 100 200

PROFILE (VERTICAL): 20 10 0 20 40

CONCEPT PLANS ONLY
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SEGMENT C

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SHEET: C2 – 03

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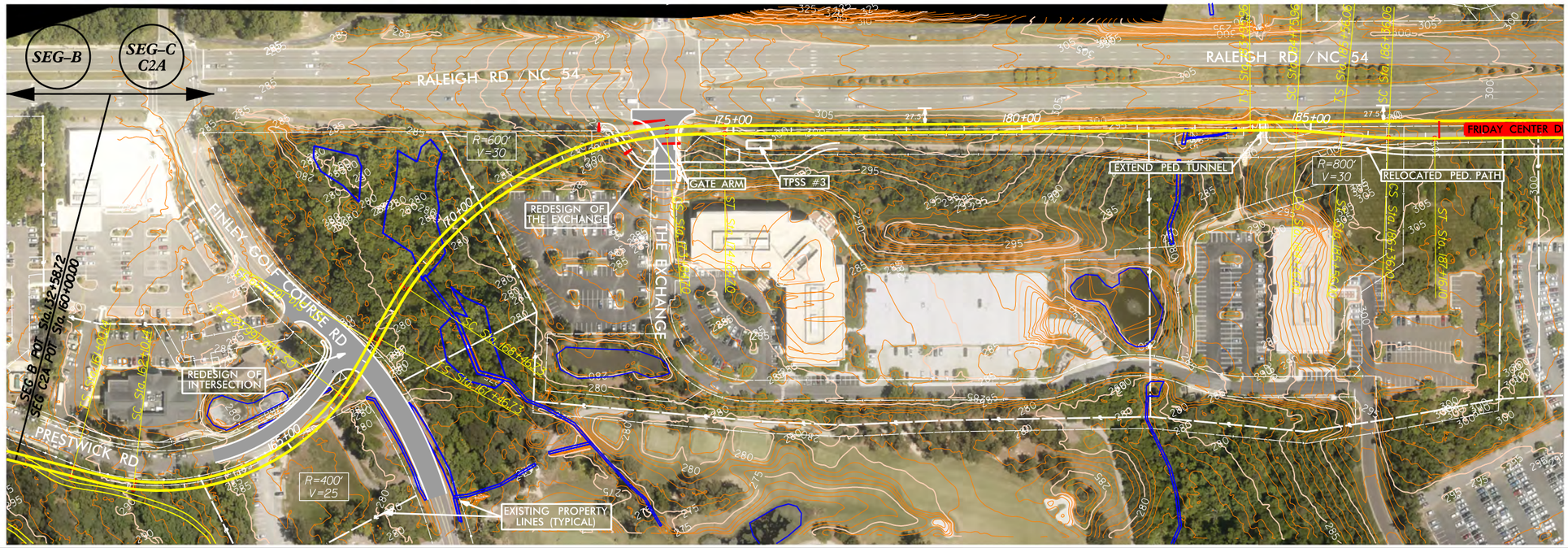
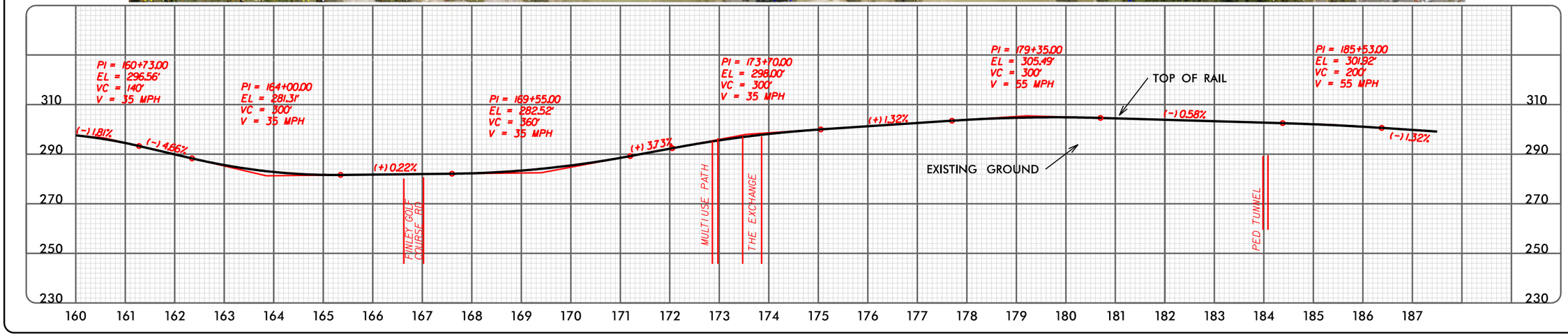
SEGMENT C – C2A ALTERNATIVE

FRIDAY CENTER STATION – C2A ALTERNATIVE





GRAPHIC SCALES

100 0 100 200
PLAN

100 0 100 200
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

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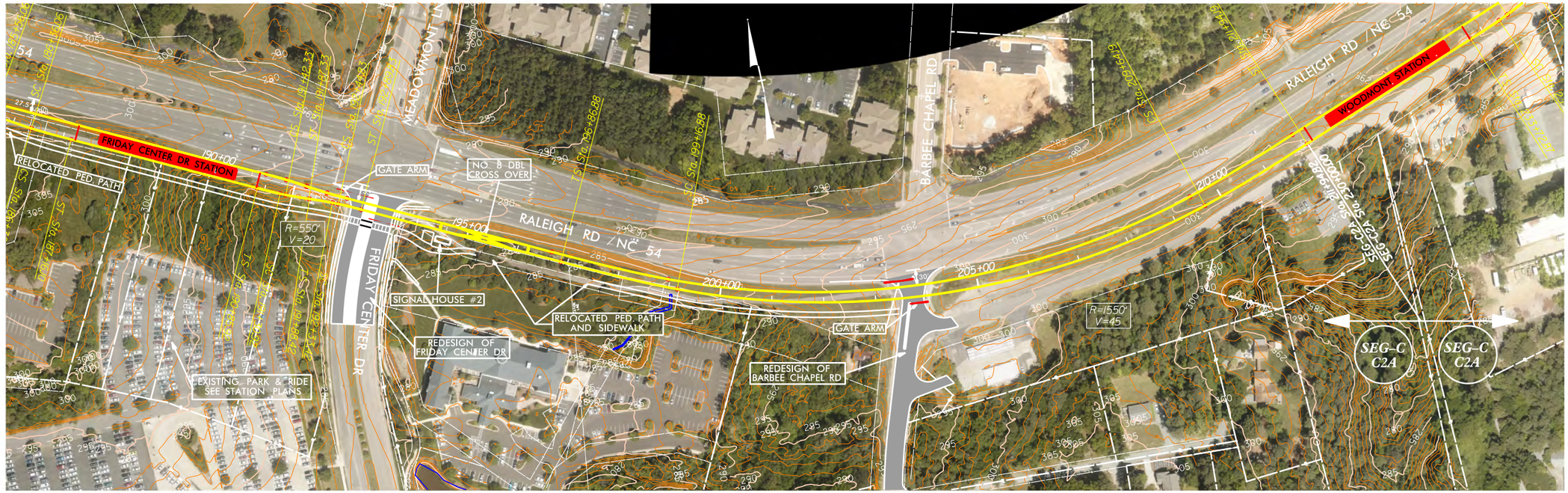
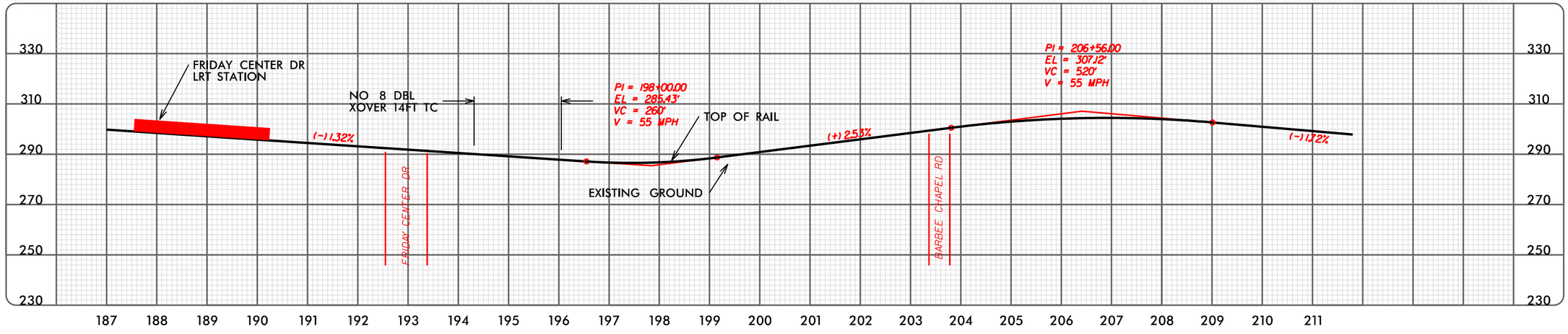
SEGMENT C

	PLAN & PROFILE	SHEET: C2A – 01

2/27/2015

FRIDAY CENTER STATION – C2A ALTERNATIVE





GRAPHIC SCALES

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PROFILE (HORIZONTAL): 100 0 100 200

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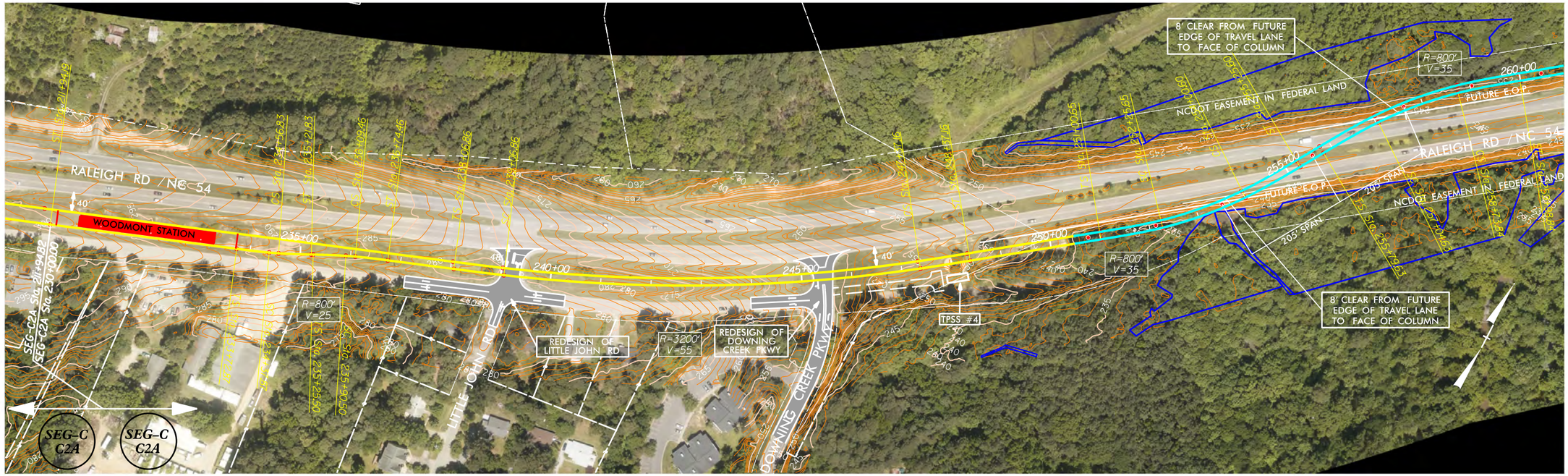
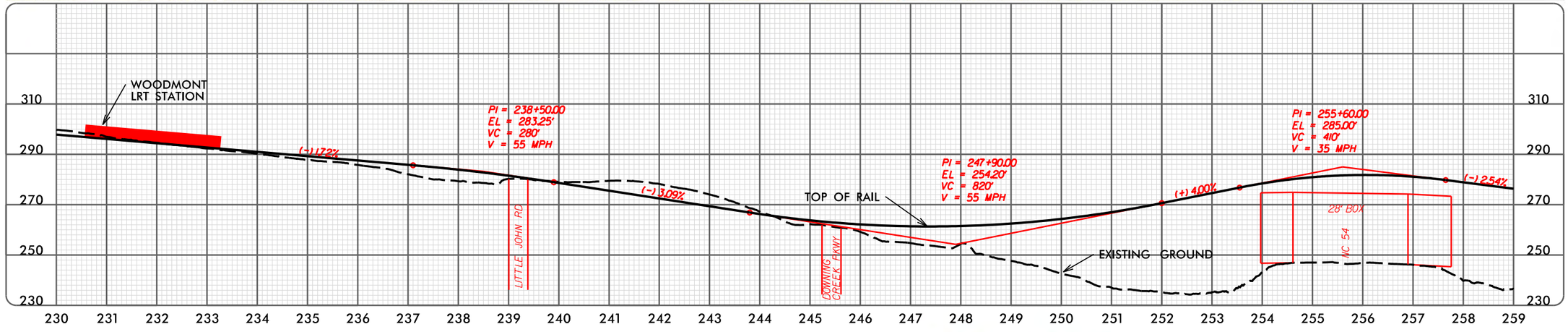
SHEET: C2A – 02

2/27/2015

WOODMONT STATION ALONG NC 54 – C2A ALTERNATIVE





GRAPHIC SCALES

PLAN: 100 0 100 200

PROFILE (HORIZONTAL): 100 0 100 200

PROFILE (VERTICAL): 20 10 0 20 40

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SEGMENT C

PLAN & PROFILE

SHEET: C2A – 03

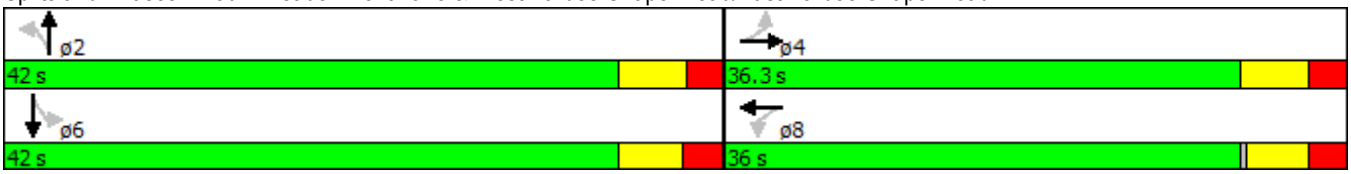
2/27/2015

Appendix C
Existing Traffic Signal Timing Plans

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	10	41	5	139	47	45	56	34
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	10.0	10.0	10.0	10.0
Minimum Split (s)	36.3	36.3	36.0	36.0	27.2	27.2	27.2	27.2
Total Split (s)	36.3	36.3	36.0	36.0	42.0	42.0	42.0	42.0
Total Split (%)	46.4%	46.4%	46.0%	46.0%	53.6%	53.6%	53.6%	53.6%
Yellow Time (s)	4.0	4.0	3.7	3.7	3.9	3.9	3.7	3.7
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.3	6.3	6.0	6.0	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min

Intersection Summary
Cycle Length: 78.3
Actuated Cycle Length: 31.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated

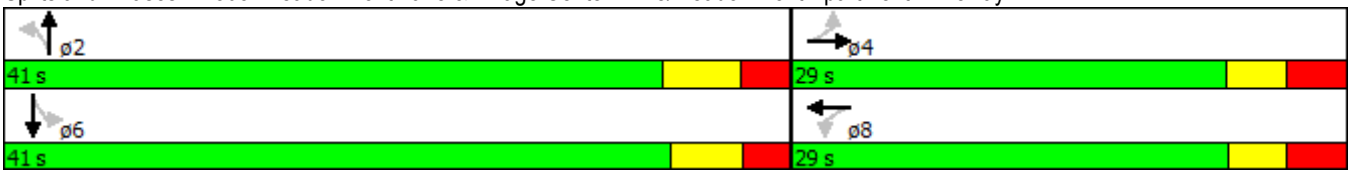
Splits and Phases: 507: Meadowmont Lane & West Barbee Chapel Road/East Barbee Chapel Road



Lane Group	ø2	ø4	ø6	ø8
Lane Configurations				
Volume (vph)				
Turn Type				
Protected Phases	2	4	6	8
Permitted Phases				
Detector Phase				
Switch Phase				
Minimum Initial (s)	10.0	7.0	10.0	7.0
Minimum Split (s)	24.7	32.4	24.3	33.3
Total Split (s)	41.0	29.0	41.0	29.0
Total Split (%)	59%	41%	59%	41%
Yellow Time (s)	4.0	3.2	3.7	3.1
All-Red Time (s)	2.7	3.2	2.6	3.2
Lost Time Adjust (s)				
Total Lost Time (s)				
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	Min	None	Min	None

Intersection Summary
Cycle Length: 70
Actuated Cycle Length: 31.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 508: Meadowmont Lane & Village Center Drive/Meadowmont Apartment Driveway



Lane Group	ø2	ø4	ø5	ø6	ø8
Lane Configurations					
Volume (vph)					
Turn Type					
Protected Phases	2	4	5	6	8
Permitted Phases					
Detector Phase					
Switch Phase					
Minimum Initial (s)	10.0	7.0	7.0	10.0	7.0
Minimum Split (s)	30.3	35.4	13.3	26.3	36.8
Total Split (s)	45.0	25.0	15.0	30.0	25.0
Total Split (%)	64%	36%	21%	43%	36%
Yellow Time (s)	3.1	3.3	3.0	3.3	3.0
All-Red Time (s)	3.2	3.1	3.3	3.0	4.8
Lost Time Adjust (s)					
Total Lost Time (s)					
Lead/Lag			Lead	Lag	
Lead-Lag Optimize?			Yes	Yes	
Recall Mode	Min	None	None	Min	None

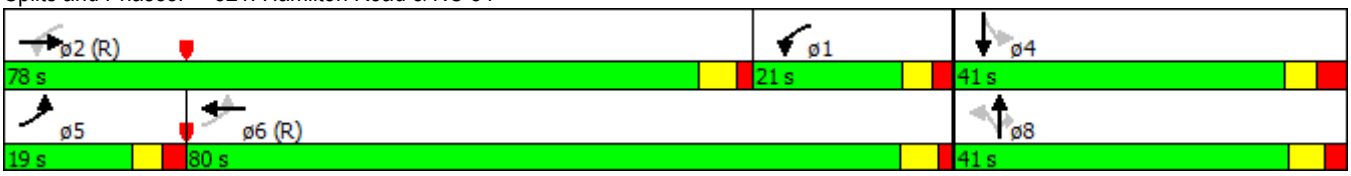
Intersection Summary
Cycle Length: 70
Actuated Cycle Length: 31.3
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 509: Meadowmont Lane & Sprunt Street/Cedar Club Circle

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Volume (vph)	15	1566	58	1945	180	31	84	36	41
Turn Type	D.P+P	NA	D.P+P	NA	Perm	NA	Perm	Perm	NA
Protected Phases	5	2	1	6		8			4
Permitted Phases	6		2		8		8	4	
Detector Phase	5	2	1	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	7.0	10.0	7.0	10.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	12.6	28.7	12.4	25.9	41.0	41.0	41.0	39.6	39.6
Total Split (s)	19.0	78.0	21.0	80.0	41.0	41.0	41.0	41.0	41.0
Total Split (%)	13.6%	55.7%	15.0%	57.1%	29.3%	29.3%	29.3%	29.3%	29.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.7	3.7	3.7	3.2	3.2
All-Red Time (s)	2.6	1.7	2.4	1.7	2.6	2.6	2.6	3.4	3.4
Lost Time Adjust (s)	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-1.0	-4.0	-4.0
Total Lost Time (s)	1.6	1.7	1.4	1.7	2.3	2.3	5.3	2.6	2.6
Lead/Lag	Lead	Lead	Lag	Lag					
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	Min	Min	Min	Min	Min

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 31 (22%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated

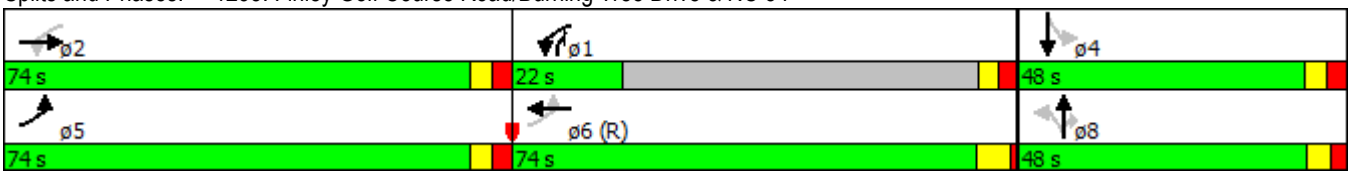
Splits and Phases: 521: Hamilton Road & NC 54



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Volume (vph)	14	1625	98	1929	11	15	158	37	18
Turn Type	D.P+P	NA	D.P+P	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	5	2	1	6		8	1		4
Permitted Phases	6		2		8		8	4	
Detector Phase	5	2	1	6	8	8	1	4	4
Switch Phase									
Minimum Initial (s)	12.0	12.0	7.0	12.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	29.2	29.2	12.9	29.2	47.2	47.2	12.9	45.3	45.3
Total Split (s)	74.0	74.0	22.0	74.0	48.0	48.0	22.0	48.0	48.0
Total Split (%)	37.8%	37.8%	11.2%	37.8%	24.5%	24.5%	11.2%	24.5%	24.5%
Yellow Time (s)	3.0	3.0	3.0	4.9	3.7	3.7	3.0	3.2	3.2
All-Red Time (s)	2.9	2.9	2.9	1.3	2.5	2.5	2.9	3.1	3.1
Lost Time Adjust (s)	-3.0	-3.0	-3.0	-3.0		-3.0	-1.0		-3.0
Total Lost Time (s)	2.9	2.9	2.9	3.2		3.2	4.9		3.3
Lead/Lag	Lead	Lead	Lag	Lag			Lag		
Lead-Lag Optimize?									
Recall Mode	None	None	None	C-Max	Min	Min	None	Min	Min

Intersection Summary
Cycle Length: 196
Actuated Cycle Length: 196
Offset: 29 (15%), Referenced to phase 6:EBWB, Start of Green
Natural Cycle: 140
Control Type: Actuated-Coordinated

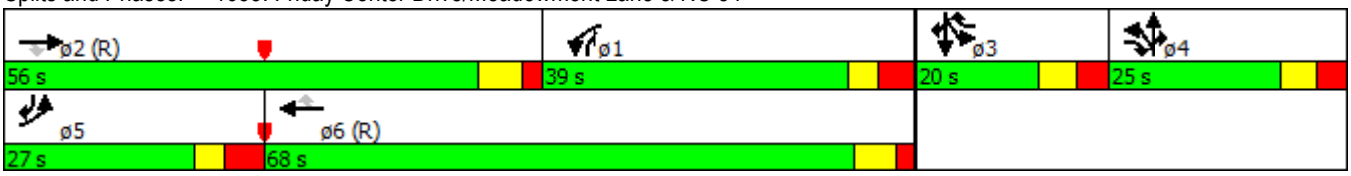
Splits and Phases: 1238: Finley Golf Course Road/Burning Tree Drive & NC 54



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	112	1257	145	647	1935	96	42	12	9	105	20	76
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Split	NA	pt+ov	Split	NA	pt+ov
Protected Phases	5	2	4	1	6	3	4	4	4 1	3	3	3 5
Permitted Phases			2			6						
Detector Phase	5	2	4	1	6	3	4	4	4 1	3	3	3 5
Switch Phase												
Minimum Initial (s)	7.0	12.0	7.0	3.0	12.0	7.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	16.0	42.0	18.0	16.0	42.0	18.0	18.0	18.0		18.0	18.0	
Total Split (s)	27.0	56.0	25.0	39.0	68.0	20.0	25.0	25.0		20.0	20.0	
Total Split (%)	19.3%	40.0%	17.9%	27.9%	48.6%	14.3%	17.9%	17.9%		14.3%	14.3%	
Yellow Time (s)	3.2	4.6	3.7	3.1	4.4	4.0	3.7	3.7		4.0	4.0	
All-Red Time (s)	4.0	2.0	3.4	4.0	2.1	3.3	3.4	3.4		3.3	3.3	
Lost Time Adjust (s)	-5.0	-4.0	-5.0	-5.0	-4.0	-5.0	-5.0	-5.0		-5.0	-5.0	
Total Lost Time (s)	2.2	2.6	2.1	2.1	2.5	2.3	2.1	2.1		2.3	2.3	
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead	Lag	Lag		Lead	Lead	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	Min	None	C-Max	Min	Min	Min		Min	Min	

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 103 (74%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated

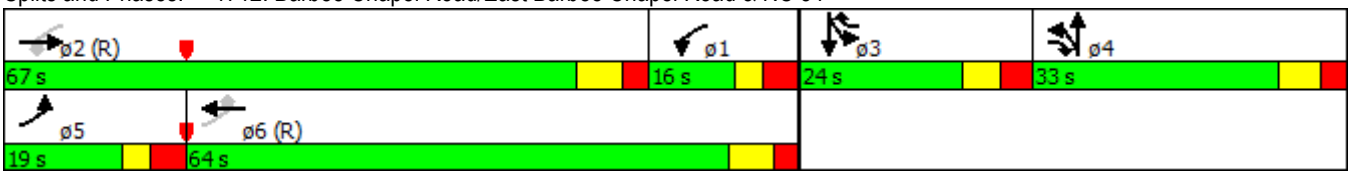
Splits and Phases: 1655: Friday Center Drive/Meadowmont Lane & NC 54



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	6	1382	95	23	2190	174	505	72	112	19
Turn Type	D.P+P	NA	pm+ov	D.P+P	NA	pm+ov	Split	NA	Split	NA
Protected Phases	5	2	4	1	6	3	4	4	3	3
Permitted Phases	6		2	2		6				
Detector Phase	5	2	4	1	6	3	4	4	3	3
Switch Phase										
Minimum Initial (s)	7.0	12.0	7.0	7.0	12.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	16.0	30.0	18.0	16.0	30.0	20.0	18.0	18.0	20.0	20.0
Total Split (s)	19.0	67.0	33.0	16.0	64.0	24.0	33.0	33.0	24.0	24.0
Total Split (%)	13.6%	47.9%	23.6%	11.4%	45.7%	17.1%	23.6%	23.6%	17.1%	17.1%
Yellow Time (s)	3.0	4.8	4.3	3.0	4.8	3.9	4.3	4.3	3.9	3.9
All-Red Time (s)	3.8	2.7	2.9	4.0	2.7	3.3	2.9	2.9	3.3	3.3
Lost Time Adjust (s)	-4.2	-3.8	-4.0	-4.0	-3.8	-4.2	-4.0	-4.0	-4.2	-4.2
Total Lost Time (s)	2.6	3.7	3.2	3.0	3.7	3.0	3.2	3.2	3.0	3.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead	Lag	Lag	Lead	Lead
Lead-Lag Optimize?										
Recall Mode	None	C-Min	None	None	C-Min	None	None	None	None	None

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 103 (74%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 125
Control Type: Actuated-Coordinated

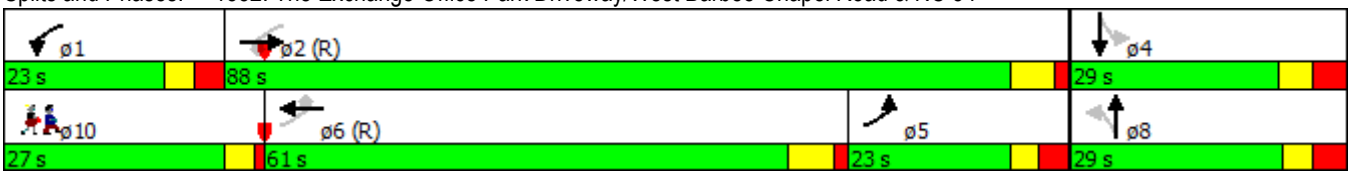
Splits and Phases: 1712: Barbee Chapel Road/East Barbee Chapel Road & NC 54



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	ø10
Lane Configurations											
Volume (vph)	137	1615	104	116	2049	14	18	3	6	10	
Turn Type	D.P+P	NA	Perm	D.P+P	NA	Perm	Perm	NA	Perm	NA	
Protected Phases	5	2		1	6			8		4	10
Permitted Phases	6		2	2		6	8		4		
Detector Phase	5	2	2	1	6	6	8	8	4	4	
Switch Phase											
Minimum Initial (s)	7.0	12.0	12.0	7.0	12.0	12.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	13.3	27.3	27.3	13.3	18.3	18.3	13.8	13.8	14.3	14.3	27.0
Total Split (s)	23.0	88.0	88.0	23.0	61.0	61.0	29.0	29.0	29.0	29.0	27.0
Total Split (%)	16.4%	62.9%	62.9%	16.4%	43.6%	43.6%	20.7%	20.7%	20.7%	20.7%	19%
Yellow Time (s)	3.0	4.7	4.7	3.0	4.7	4.7	3.0	3.0	3.5	3.5	3.0
All-Red Time (s)	3.3	1.6	1.6	3.3	1.6	1.6	3.8	3.8	3.8	3.8	1.0
Lost Time Adjust (s)	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	
Total Lost Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.8	2.8	3.3	3.3	
Lead/Lag		Lag	Lag	Lead	Lag	Lag					Lead
Lead-Lag Optimize?											Yes
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	Min	Min	Min	Min	None

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 18 (13%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

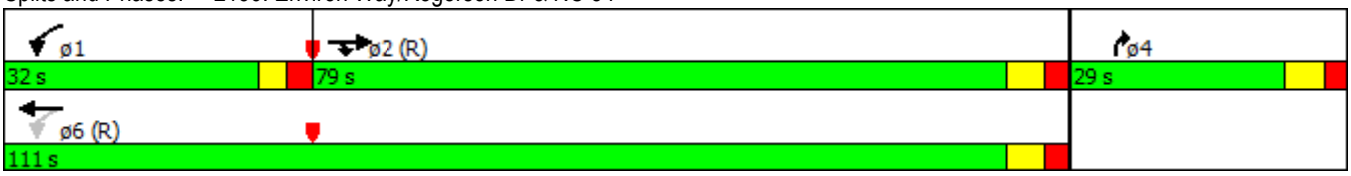
Splits and Phases: 1882: The Exchange Office Park Driveway/West Barbee Chapel Road & NC 54



Lane Group	EBR	WBL	NBR	ø6
Lane Configurations				
Volume (vph)	49	50	9	
Turn Type	Prot	pm+pt	Prot	
Protected Phases	2	1	4	6
Permitted Phases		6		
Detector Phase	2	1	4	
Switch Phase				
Minimum Initial (s)	10.0	7.0	7.0	10.0
Minimum Split (s)	27.6	31.6	29.0	16.6
Total Split (s)	79.0	32.0	29.0	111.0
Total Split (%)	56.4%	22.9%	20.7%	79%
Yellow Time (s)	4.0	3.0	4.0	4.0
All-Red Time (s)	2.6	2.6	2.6	2.6
Lost Time Adjust (s)	0.0	0.0	0.0	
Total Lost Time (s)	6.6	5.6	6.6	
Lead/Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes		
Recall Mode	C-Max	None	Min	C-Max

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 16 (11%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

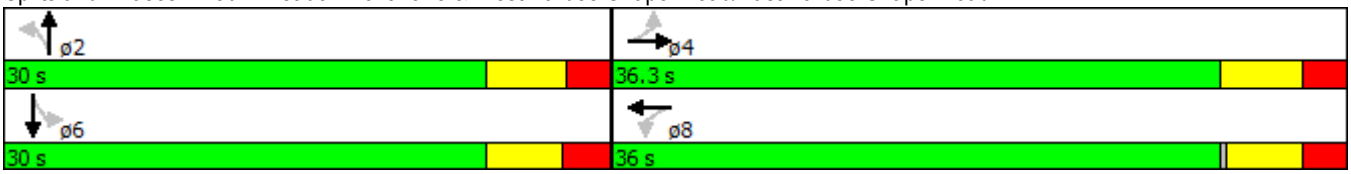
Splits and Phases: 2136: Environ Way/Rogerson Dr & NC 54



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	17	156	4	101	75	51	30	59
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	10.0	10.0	10.0	10.0
Minimum Split (s)	36.3	36.3	36.0	36.0	27.2	27.2	27.2	27.2
Total Split (s)	36.3	36.3	36.0	36.0	30.0	30.0	30.0	30.0
Total Split (%)	54.8%	54.8%	54.3%	54.3%	45.2%	45.2%	45.2%	45.2%
Yellow Time (s)	4.0	4.0	3.7	3.7	3.9	3.9	3.7	3.7
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.3	6.3	6.0	6.0	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min

Intersection Summary
Cycle Length: 66.3
Actuated Cycle Length: 31
Natural Cycle: 65
Control Type: Actuated-Uncoordinated

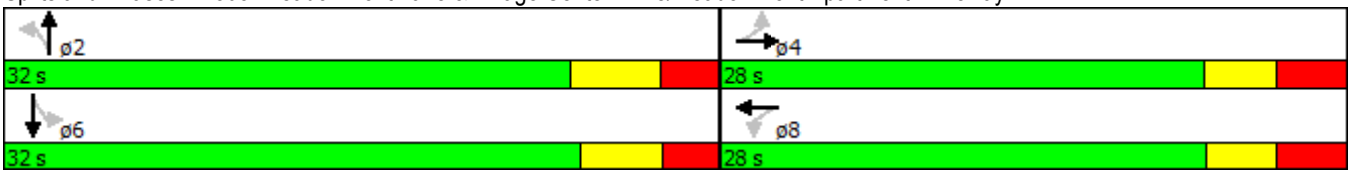
Splits and Phases: 507: Meadowmont Lane & West Barbee Chapel Road/East Barbee Chapel Road



Lane Group	ø2	ø4	ø6	ø8
Lane Configurations				
Volume (vph)				
Turn Type				
Protected Phases	2	4	6	8
Permitted Phases				
Detector Phase				
Switch Phase				
Minimum Initial (s)	10.0	7.0	10.0	7.0
Minimum Split (s)	24.7	32.4	24.3	33.3
Total Split (s)	32.0	28.0	32.0	28.0
Total Split (%)	53%	47%	53%	47%
Yellow Time (s)	4.0	3.2	3.7	3.1
All-Red Time (s)	2.7	3.2	2.6	3.2
Lost Time Adjust (s)				
Total Lost Time (s)				
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	Min	None	Min	None

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 31.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 508: Meadowmont Lane & Village Center Drive/Meadowmont Apartment Driveway



Lane Group	ø2	ø4	ø5	ø6	ø8
Lane Configurations					
Volume (vph)					
Turn Type					
Protected Phases	2	4	5	6	8
Permitted Phases					
Detector Phase					
Switch Phase					
Minimum Initial (s)	10.0	7.0	7.0	10.0	7.0
Minimum Split (s)	30.3	35.4	13.3	26.3	36.8
Total Split (s)	35.0	25.0	14.0	21.0	25.0
Total Split (%)	58%	42%	23%	35%	42%
Yellow Time (s)	3.1	3.3	3.0	3.3	3.0
All-Red Time (s)	3.2	3.1	3.3	3.0	4.8
Lost Time Adjust (s)					
Total Lost Time (s)					
Lead/Lag			Lead	Lag	
Lead-Lag Optimize?			Yes	Yes	
Recall Mode	Min	None	None	Min	None

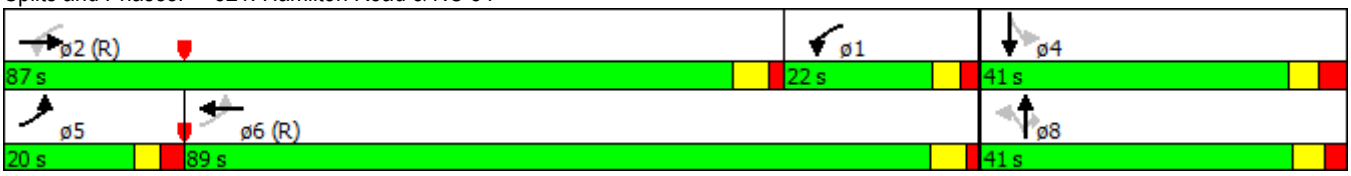
Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 31.3
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 509: Meadowmont Lane & Sprunt Street/Cedar Club Circle

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Volume (vph)	57	2100	91	1720	218	55	105	61	19
Turn Type	D.P+P	NA	D.P+P	NA	Perm	NA	Perm	Perm	NA
Protected Phases	5	2	1	6		8			4
Permitted Phases	6		2		8		8	4	
Detector Phase	5	2	1	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	7.0	10.0	7.0	10.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	12.6	28.7	12.4	25.9	41.0	41.0	41.0	39.6	39.6
Total Split (s)	20.0	87.0	22.0	89.0	41.0	41.0	41.0	41.0	41.0
Total Split (%)	13.3%	58.0%	14.7%	59.3%	27.3%	27.3%	27.3%	27.3%	27.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.7	3.7	3.7	3.2	3.2
All-Red Time (s)	2.6	1.7	2.4	1.7	2.6	2.6	2.6	3.4	3.4
Lost Time Adjust (s)	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-1.0	-4.0	-4.0
Total Lost Time (s)	1.6	1.7	1.4	1.7	2.3	2.3	5.3	2.6	2.6
Lead/Lag	Lead	Lead	Lag	Lag					
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	Min	Min	Min	Min	Min

Intersection Summary
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 138 (92%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 105
Control Type: Actuated-Coordinated

Splits and Phases: 521: Hamilton Road & NC 54



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Volume (vph)	50	2210	93	1473	46	20	162	21	6
Turn Type	D.P+P	NA	D.P+P	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	5	2	1	6		8	1		4
Permitted Phases	6		2		8		8	4	
Detector Phase	5	2	1	6	8	8	1	4	4
Switch Phase									
Minimum Initial (s)	4.0	12.0	4.0	12.0	7.0	7.0	4.0	7.0	7.0
Minimum Split (s)	8.0	31.2	8.0	31.2	47.2	47.2	8.0	45.3	45.3
Total Split (s)	8.0	79.0	8.0	79.0	48.0	48.0	8.0	48.0	48.0
Total Split (%)	5.9%	58.5%	5.9%	58.5%	35.6%	35.6%	5.9%	35.6%	35.6%
Yellow Time (s)	3.5	4.9	3.5	4.9	3.7	3.7	3.5	3.2	3.2
All-Red Time (s)	0.5	1.3	0.5	1.3	2.5	2.5	0.5	3.1	3.1
Lost Time Adjust (s)	-3.0	-3.0	-3.0	-3.0		-3.0	-1.0		-3.0
Total Lost Time (s)	1.0	3.2	1.0	3.2		3.2	3.0		3.3
Lead/Lag	Lead	Lead	Lag	Lag			Lag		
Lead-Lag Optimize?	Yes		Yes				Yes		
Recall Mode	None	C-Max	None	C-Max	Min	Min	None	Min	Min

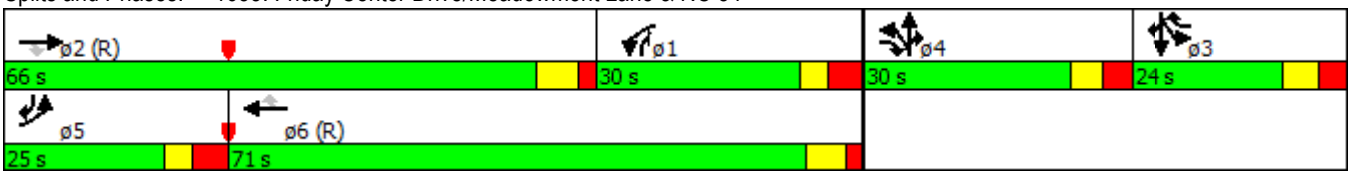
Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 135
Offset: 113 (84%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 1238: Finley Golf Course Road/Burning Tree Drive & NC 54

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	1894	87	48	1392	80	120	110	535	165	11	113
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Split	NA	pt+ov	Split	NA	pt+ov
Protected Phases	5	2	4	1	6	3	4	4	4 1	3	3	3 5
Permitted Phases			2			6						
Detector Phase	5	2	4	1	6	3	4	4	4 1	3	3	3 5
Switch Phase												
Minimum Initial (s)	7.0	12.0	7.0	3.0	12.0	7.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	16.0	42.0	18.0	16.0	42.0	18.0	18.0	18.0		18.0	18.0	
Total Split (s)	25.0	66.0	30.0	30.0	71.0	24.0	30.0	30.0		24.0	24.0	
Total Split (%)	16.7%	44.0%	20.0%	20.0%	47.3%	16.0%	20.0%	20.0%		16.0%	16.0%	
Yellow Time (s)	3.2	4.6	3.7	3.1	4.4	4.0	3.7	3.7		4.0	4.0	
All-Red Time (s)	4.0	2.0	3.4	4.0	2.1	3.3	3.4	3.4		3.3	3.3	
Lost Time Adjust (s)	-5.0	-4.0	-5.0	-5.0	-4.0	-5.0	-5.0	-5.0		-5.0	-5.0	
Total Lost Time (s)	2.2	2.6	2.1	2.1	2.5	2.3	2.1	2.1		2.3	2.3	
Lead/Lag	Lead	Lead	Lead	Lag	Lag	Lag	Lead	Lead		Lag	Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	Min	None	C-Max	Min	Min	Min		Min	Min	

Intersection Summary
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 60 (40%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 125
Control Type: Actuated-Coordinated

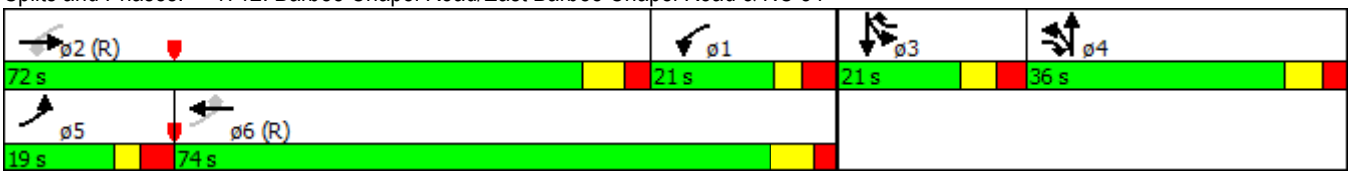
Splits and Phases: 1655: Friday Center Drive/Meadowmont Lane & NC 54



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	6	1791	913	160	1434	158	198	66	101	152
Turn Type	D.P+P	NA	pm+ov	D.P+P	NA	pm+ov	Split	NA	Split	NA
Protected Phases	5	2	4	1	6	3	4	4	3	3
Permitted Phases	6		2	2		6				
Detector Phase	5	2	4	1	6	3	4	4	3	3
Switch Phase										
Minimum Initial (s)	7.0	12.0	7.0	7.0	12.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	16.0	30.0	18.0	16.0	30.0	20.0	18.0	18.0	20.0	20.0
Total Split (s)	19.0	72.0	36.0	21.0	74.0	21.0	36.0	36.0	21.0	21.0
Total Split (%)	12.7%	48.0%	24.0%	14.0%	49.3%	14.0%	24.0%	24.0%	14.0%	14.0%
Yellow Time (s)	3.0	4.8	4.3	3.0	4.8	3.9	4.3	4.3	3.9	3.9
All-Red Time (s)	3.8	2.7	2.9	4.0	2.7	3.3	2.9	2.9	3.3	3.3
Lost Time Adjust (s)	-4.2	-3.8	-4.0	-4.0	-3.8	-4.2	-4.0	-4.0	-4.2	-4.2
Total Lost Time (s)	2.6	3.7	3.2	3.0	3.7	3.0	3.2	3.2	3.0	3.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead	Lag	Lag	Lead	Lead
Lead-Lag Optimize?										
Recall Mode	None	C-Min	None	None	C-Min	None	None	None	None	None

Intersection Summary
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 59 (39%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 115
Control Type: Actuated-Coordinated

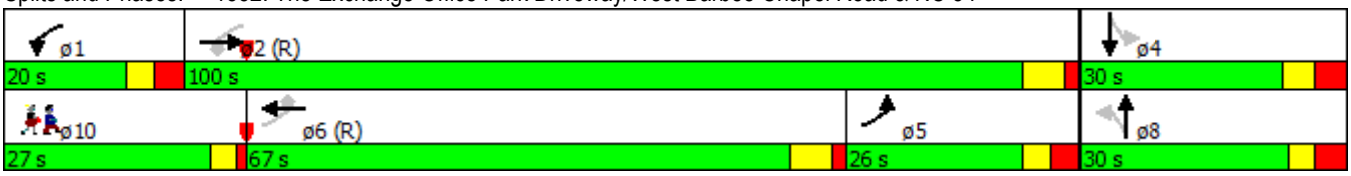
Splits and Phases: 1712: Barbee Chapel Road/East Barbee Chapel Road & NC 54



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	ø10
Lane Configurations											
Volume (vph)	216	2061	38	3	1843	11	113	30	11	8	
Turn Type	D.P+P	NA	Perm	D.P+P	NA	Perm	Perm	NA	Perm	NA	
Protected Phases	5	2		1	6			8		4	10
Permitted Phases	6		2	2		6	8		4		
Detector Phase	5	2	2	1	6	6	8	8	4	4	
Switch Phase											
Minimum Initial (s)	7.0	12.0	12.0	7.0	12.0	12.0	7.0	7.0	7.0	7.0	4.0
Minimum Split (s)	16.0	44.0	44.0	16.0	44.0	44.0	18.0	18.0	18.0	18.0	27.0
Total Split (s)	26.0	100.0	100.0	20.0	67.0	67.0	30.0	30.0	30.0	30.0	27.0
Total Split (%)	17.3%	66.7%	66.7%	13.3%	44.7%	44.7%	20.0%	20.0%	20.0%	20.0%	18%
Yellow Time (s)	3.0	4.7	4.7	3.0	4.7	4.7	3.0	3.0	3.5	3.5	3.0
All-Red Time (s)	3.3	1.6	1.6	3.3	1.6	1.6	3.8	3.8	3.8	3.8	1.0
Lost Time Adjust (s)	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	
Total Lost Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.8	2.8	3.3	3.3	
Lead/Lag		Lag	Lag	Lead	Lag	Lag					Lead
Lead-Lag Optimize?											Yes
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	Min	Min	Min	Min	None

Intersection Summary
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 128 (85%), Referenced to phase 2:EBWB and 6:EBWB, Start of Green
Natural Cycle: 115
Control Type: Actuated-Coordinated

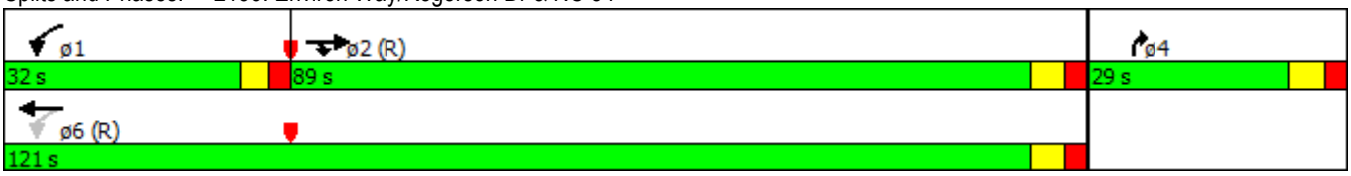
Splits and Phases: 1882: The Exchange Office Park Driveway/West Barbee Chapel Road & NC 54



Lane Group	EBR	WBL	NBR	SBR	ø6
Lane Configurations					
Volume (vph)	40	42	50	4	
Turn Type	Prot	pm+pt	Prot	Free	
Protected Phases	2	1	4		6
Permitted Phases		6		Free	
Detector Phase	2	1	4		
Switch Phase					
Minimum Initial (s)	10.0	7.0	7.0		10.0
Minimum Split (s)	27.6	31.6	29.0		16.6
Total Split (s)	89.0	32.0	29.0		121.0
Total Split (%)	59.3%	21.3%	19.3%		81%
Yellow Time (s)	4.0	3.0	4.0		4.0
All-Red Time (s)	2.6	2.6	2.6		2.6
Lost Time Adjust (s)	0.0	0.0	0.0		
Total Lost Time (s)	6.6	5.6	6.6		
Lead/Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes			
Recall Mode	C-Max	None	Min		C-Max

Intersection Summary
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 94 (63%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

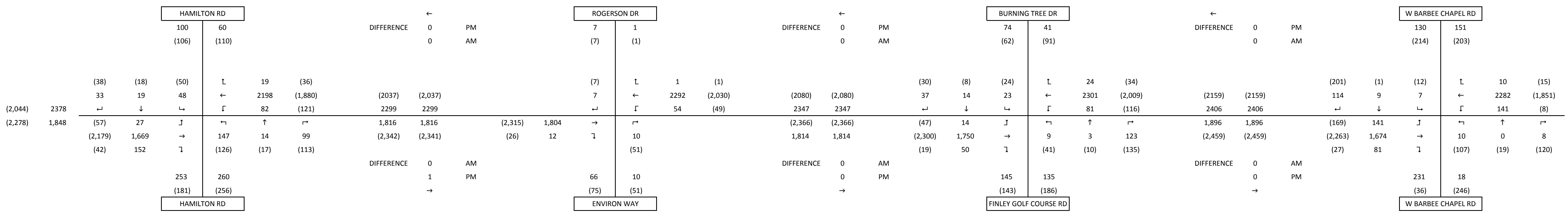
Splits and Phases: 2136: Environ Way/Rogerson Dr & NC 54



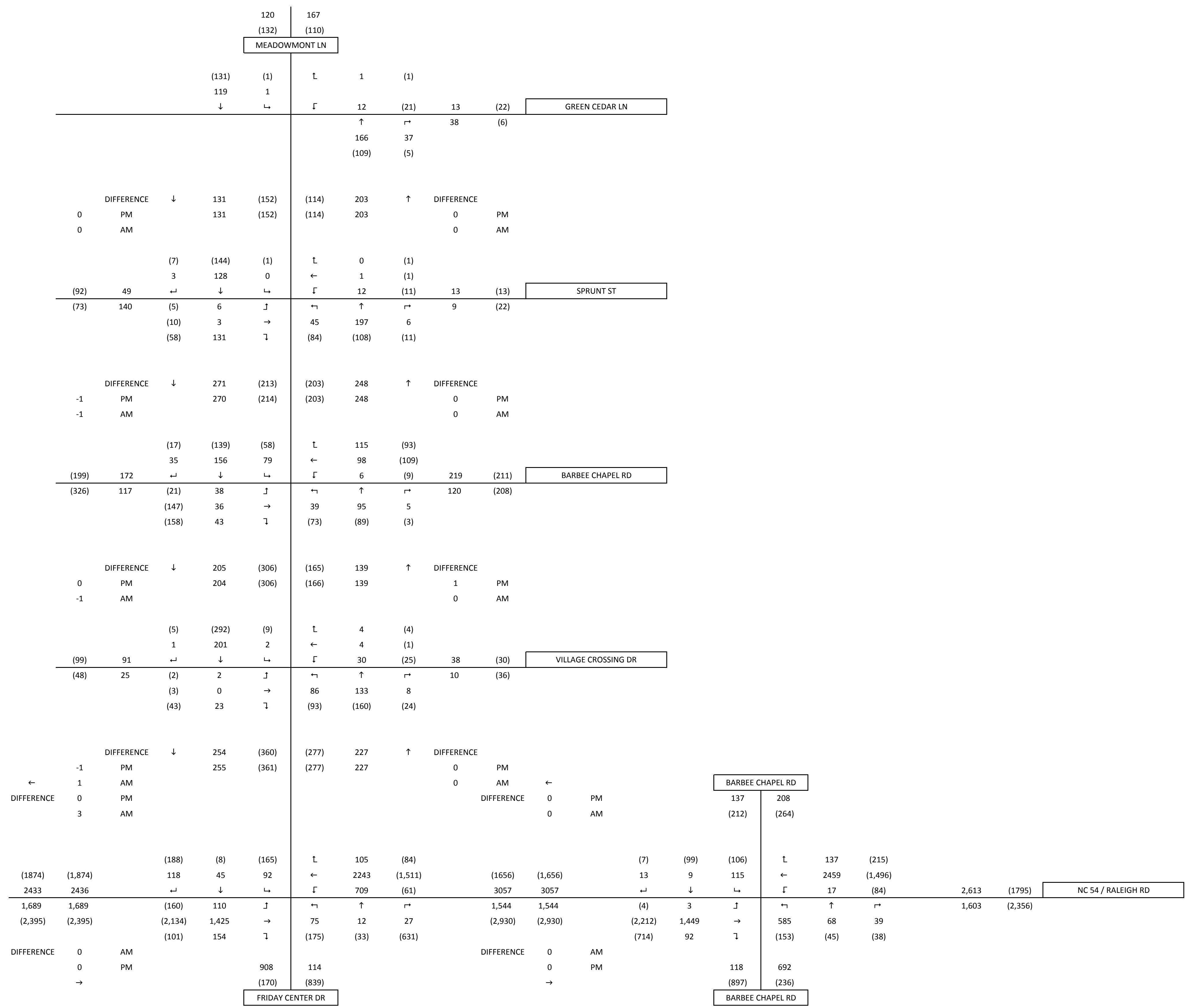
Appendix D
Balanced Peak Hour Volumes

2011 Base Year AM
2011 Base Year PM
2040 No-Build AM
2040 No-Build PM
2040 Build AM
2040 Build PM

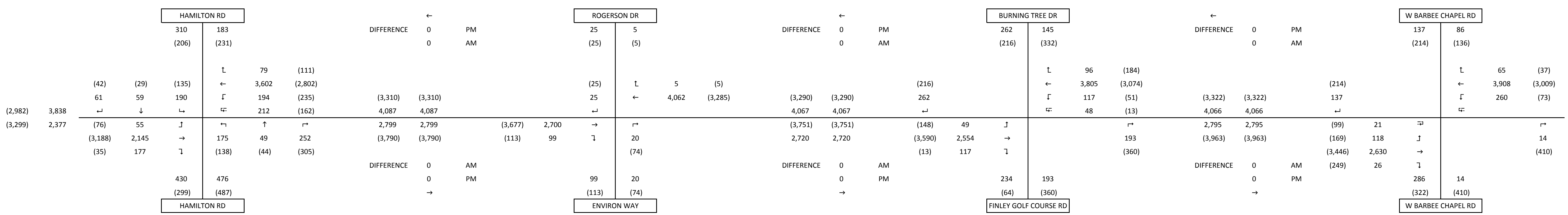
2011 Existing Balanced Volumes



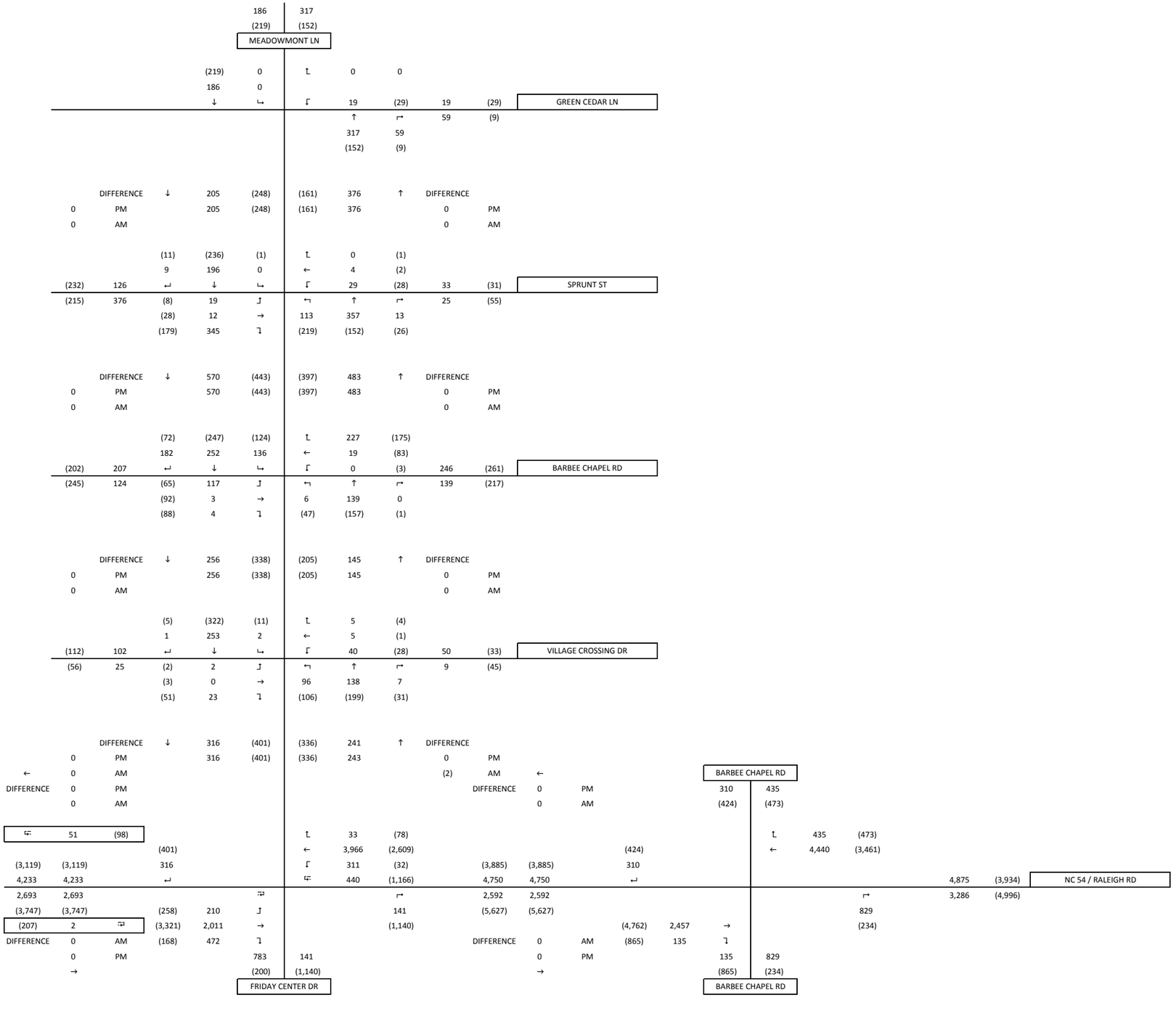
2011 Existing Balanced Volumes



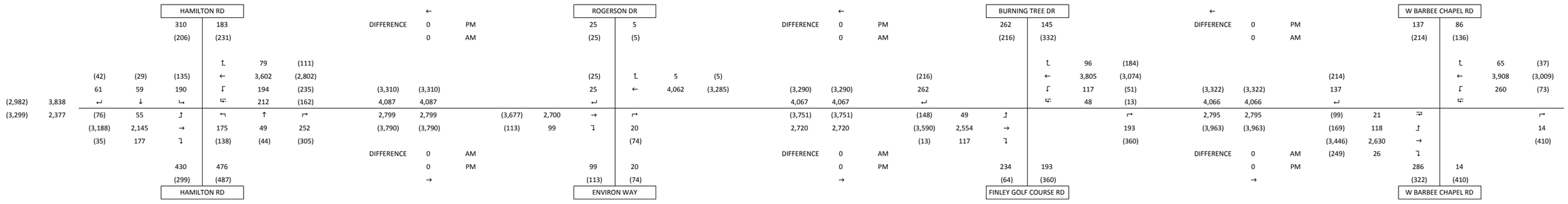
2040 No Build / TSM Scenario Balanced Volumes



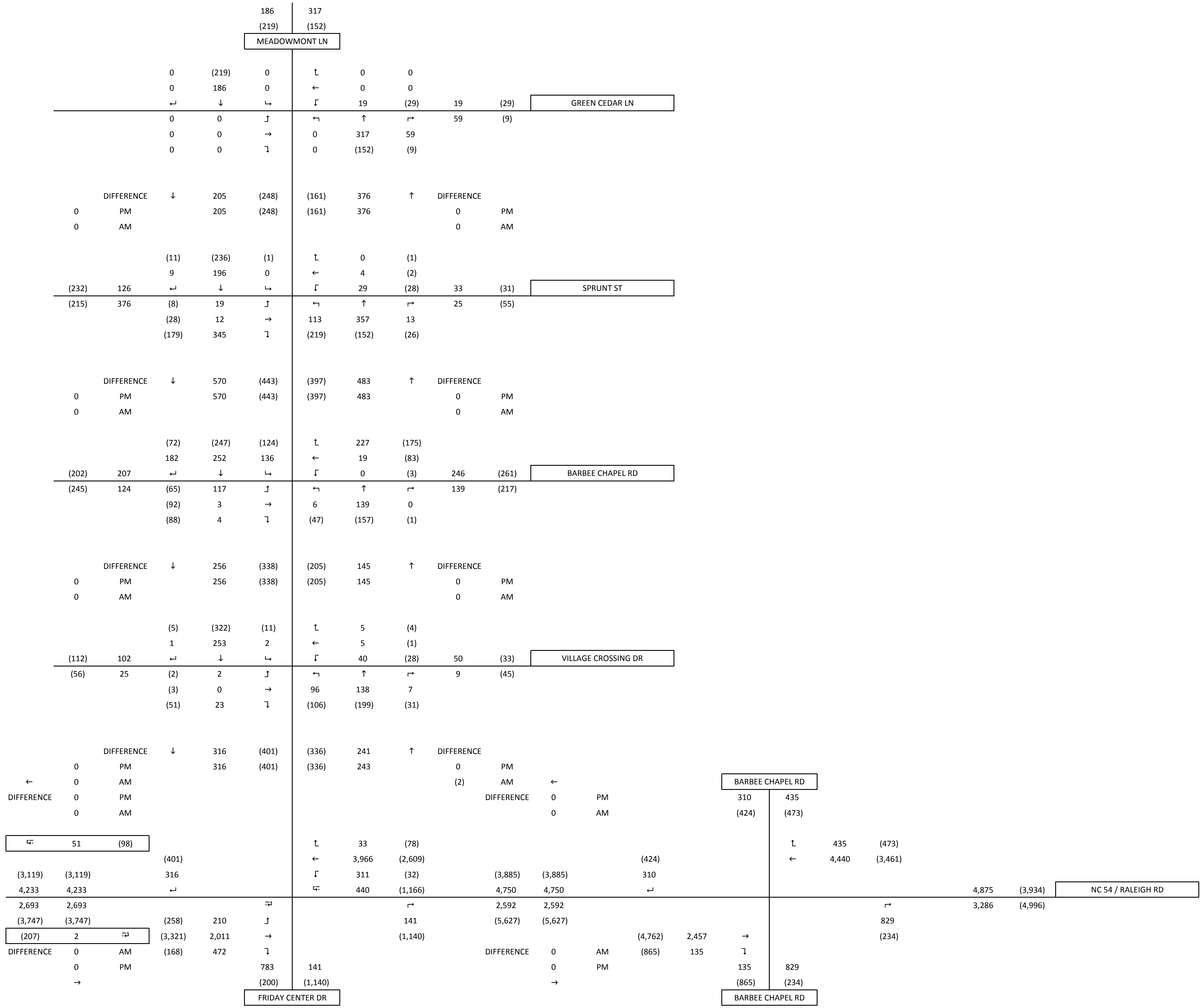
2040 No Build / TSM Scenario Balanced Volumes



2040 Build Scenario Balanced Volumes



2040 Build Scenario Balanced Volumes



Appendix E
2040 Synchro Outputs

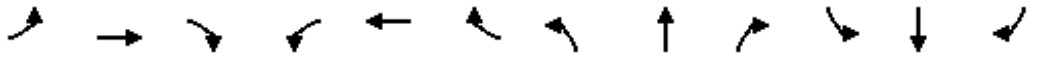
2040 No-Build AM
2040 No-Build PM

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	55	2145	177	212	194	3602	79	175	49	252	190	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		1%				-3%			1%			-1%
Total Lost time (s)	3.0	3.0			3.0	3.0		3.0	3.0	6.0	3.0	3.0
Lane Util. Factor	1.00	0.91			1.00	0.91		1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99			1.00	1.00		1.00	1.00	0.98	1.00	0.99
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.99	1.00	1.00	0.99	1.00
Frt	1.00	0.99			1.00	1.00		1.00	1.00	0.85	1.00	0.92
Flt Protected	0.95	1.00			0.95	1.00		0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1761	4927			1796	5137		1750	1853	1538	1761	1700
Flt Permitted	0.95	1.00			0.95	1.00		0.44	1.00	1.00	0.65	1.00
Satd. Flow (perm)	1761	4927			1796	5137		812	1853	1538	1212	1700
Peak-hour factor, PHF	0.89	0.92	0.70	1.00	0.84	0.93	0.79	0.76	0.60	0.80	0.85	0.68
Adj. Flow (vph)	62	2332	253	212	231	3873	100	230	82	315	224	87
RTOR Reduction (vph)	0	10	0	0	0	2	0	0	0	0	0	0
Lane Group Flow (vph)	62	2575	0	0	443	3971	0	230	82	315	224	187
Confl. Peds. (#/hr)	5		33		33		5	7		9	9	
Confl. Bikes (#/hr)			1				1			1		
Turn Type	Prot	NA		Prot	Prot	NA		Perm	NA	Perm	Perm	NA
Protected Phases	5	2		1	1	6			8			4
Permitted Phases								8		8	4	
Actuated Green, G (s)	2.4	57.6			34.4	89.6		27.0	27.0	27.0	27.0	27.0
Effective Green, g (s)	6.4	61.6			38.4	93.6		31.0	31.0	28.0	31.0	31.0
Actuated g/C Ratio	0.05	0.44			0.27	0.67		0.22	0.22	0.20	0.22	0.22
Clearance Time (s)	7.0	7.0			7.0	7.0		7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0			2.0	3.0		1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)	80	2167			492	3434		179	410	307	268	376
v/s Ratio Prot	0.04	c0.52			0.25	c0.77			0.04			0.11
v/s Ratio Perm								c0.28		0.20	0.18	
v/c Ratio	0.78	1.19			0.90	1.16		1.28	0.20	1.03	0.84	0.50
Uniform Delay, d1	66.1	39.2			49.0	23.2		54.5	44.4	56.0	52.1	47.7
Progression Factor	1.00	1.00			0.89	0.76		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	33.7	89.8			2.3	70.7		163.7	0.1	58.2	18.9	0.4
Delay (s)	99.8	129.0			46.1	88.3		218.2	44.5	114.2	71.0	48.1
Level of Service	F	F			D	F		F	D	F	E	D
Approach Delay (s)		128.3				84.1			143.3			60.5
Approach LOS		F				F			F			E

Intersection Summary			
HCM 2000 Control Delay	101.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	113.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	61
Ideal Flow (vphpl)	1900
Grade (%)	
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.61
Adj. Flow (vph)	100
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	7
Confl. Bikes (#/hr)	3
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↱		↑↑↑				↱			↱
Volume (veh/h)	0	2700	99	0	4062	5	0	0	20	0	0	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			-4%			0%			0%	
Peak Hour Factor	1.00	1.00	0.77	0.75	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.50
Hourly flow rate (vph)	0	2700	129	0	4062	5	0	0	21	0	0	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		927			662							
pX, platoon unblocked	0.25			0.58			0.46	0.46	0.58	0.46	0.46	0.25
vC, conflicting volume	4067			2829			4104	6767	900	4985	6893	1356
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2765			1630			0	3295	0	0	3570	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	97	100	100	82
cM capacity (veh/h)	35			230			382	4	631	453	3	271

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	900	900	900	129	1625	1625	817	21	50
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	129	0	0	5	21	50
cSH	1700	1700	1700	1700	1700	1700	1700	631	271
Volume to Capacity	0.53	0.53	0.53	0.08	0.96	0.96	0.48	0.03	0.18
Queue Length 95th (ft)	0	0	0	0	0	0	0	3	17
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.9	21.3
Lane LOS								B	C
Approach Delay (s)	0.0				0.0			10.9	21.3
Approach LOS								B	C

Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	88.6%	ICU Level of Service		E
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	49	2554	117	48	117	3805	96	0	0	193	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	11	11	12	12	12	10	10
Grade (%)		-4%				-1%			2%			0%
Total Lost time (s)	4.0	4.0			4.0	4.0				6.0		
Lane Util. Factor	1.00	0.91			1.00	0.91				1.00		
Frpb, ped/bikes	1.00	1.00			1.00	1.00				1.00		
Flpb, ped/bikes	1.00	1.00			1.00	1.00				1.00		
Frt	1.00	0.99			1.00	1.00				0.86		
Flt Protected	0.95	1.00			0.95	1.00				1.00		
Satd. Flow (prot)	1805	5119			1778	4917				1595		
Flt Permitted	0.95	1.00			0.95	1.00				1.00		
Satd. Flow (perm)	1805	5119			1778	4917				1595		
Peak-hour factor, PHF	0.78	0.92	0.53	1.00	0.66	0.85	0.75	0.68	0.50	0.76	0.58	0.50
Adj. Flow (vph)	63	2776	221	48	177	4476	128	0	0	254	0	0
RTOR Reduction (vph)	0	6	0	0	0	2	0	0	0	73	0	0
Lane Group Flow (vph)	63	2991	0	0	225	4602	0	0	0	181	0	0
Confl. Peds. (#/hr)	1		13		13		1	12				
Turn Type	Prot	NA		Prot	Prot	NA				Over		
Protected Phases	5	2		1!	1	6				1!		
Permitted Phases												
Actuated Green, G (s)	22.0	106.0			20.0	104.0				20.0		
Effective Green, g (s)	25.0	109.0			23.0	107.0				21.0		
Actuated g/C Ratio	0.18	0.78			0.16	0.76				0.15		
Clearance Time (s)	7.0	7.0			7.0	7.0				7.0		
Vehicle Extension (s)	3.0	6.0			3.0	6.0				3.0		
Lane Grp Cap (vph)	322	3985			292	3757				239		
v/s Ratio Prot	0.03	0.58			0.13	c0.94				0.11		
v/s Ratio Perm												
v/c Ratio	0.20	0.75			0.77	1.22				0.76		
Uniform Delay, d1	48.9	8.3			56.0	16.5				57.1		
Progression Factor	1.06	1.03			1.09	1.30				1.00		
Incremental Delay, d2	0.1	0.4			7.7	102.8				12.8		
Delay (s)	51.9	8.8			68.5	124.3				69.9		
Level of Service	D	A			E	F				E		
Approach Delay (s)		9.7				121.7			69.9			362.4
Approach LOS		A				F			E			F

Intersection Summary			
HCM 2000 Control Delay	93.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	101.4%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	262
Ideal Flow (vphpl)	1900
Lane Width	10
Grade (%)	
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1504
Flt Permitted	1.00
Satd. Flow (perm)	1504
Peak-hour factor, PHF	0.55
Adj. Flow (vph)	476
RTOR Reduction (vph)	72
Lane Group Flow (vph)	404
Confl. Peds. (#/hr)	12
Turn Type	Over
Protected Phases	5
Permitted Phases	
Actuated Green, G (s)	22.0
Effective Green, g (s)	23.0
Actuated g/C Ratio	0.16
Clearance Time (s)	7.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	247
v/s Ratio Prot	c0.27
v/s Ratio Perm	
v/c Ratio	1.64
Uniform Delay, d1	58.5
Progression Factor	1.00
Incremental Delay, d2	303.9
Delay (s)	362.4
Level of Service	F
Approach Delay (s)	
Approach LOS	

Intersection Summary

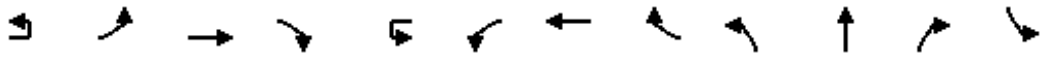
Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	21	118	2630	26	260	3908	65	0	0	14	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)			5%			-2%			6%			-6%
Total Lost time (s)		3.0	3.0	3.0	3.0	3.0	3.0			6.0		
Lane Util. Factor		1.00	0.91	1.00	1.00	0.91	1.00			1.00		
Frpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00			0.99		
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00			1.00		
Frt		1.00	1.00	0.85	1.00	1.00	0.85			0.86		
Flt Protected		0.95	1.00	1.00	0.95	1.00	1.00			1.00		
Satd. Flow (prot)		1725	4958	1544	1787	5136	1599			1544		
Flt Permitted		0.95	1.00	1.00	0.95	1.00	1.00			1.00		
Satd. Flow (perm)		1725	4958	1544	1787	5136	1599			1544		
Peak-hour factor, PHF	1.00	0.78	0.79	0.68	0.75	0.96	0.69	0.81	0.50	0.60	0.69	0.67
Adj. Flow (vph)	21	151	3329	38	347	4071	94	0	0	23	0	0
RTOR Reduction (vph)	0	0	0	11	0	0	7	0	0	0	0	0
Lane Group Flow (vph)	0	172	3329	27	347	4071	87	0	0	23	0	0
Confl. Peds. (#/hr)								26		13	13	
Turn Type	Prot	Prot	NA	Perm	Prot	NA	Perm			pm+ov		
Protected Phases	5!	5	2		1	6				1		
Permitted Phases				2			6			6		
Actuated Green, G (s)		6.0	95.0	95.0	31.0	120.0	120.0			133.0		
Effective Green, g (s)		10.0	99.0	99.0	35.0	124.0	124.0			134.0		
Actuated g/C Ratio		0.07	0.71	0.71	0.25	0.89	0.89			0.96		
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	7.0			7.0		
Vehicle Extension (s)		1.0	6.0	6.0	1.0	6.0	6.0			1.0		
Lane Grp Cap (vph)		123	3506	1091	446	4549	1416			1544		
v/s Ratio Prot		c0.10	c0.67		0.19	c0.79				0.00		
v/s Ratio Perm				0.02			0.05			0.01		
v/c Ratio		1.40	0.95	0.02	0.78	0.89	0.06			0.01		
Uniform Delay, d1		65.0	18.3	6.1	48.9	4.4	1.0			0.1		
Progression Factor		1.06	1.27	1.00	1.10	1.06	1.30			1.00		
Incremental Delay, d2		211.8	5.8	0.0	3.0	1.2	0.0			0.0		
Delay (s)		280.6	28.9	6.1	56.7	5.9	1.3			0.1		
Level of Service		F	C	A	E	A	A			A		
Approach Delay (s)			40.9			9.7			0.1			5.4
Approach LOS			D			A			A			A

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	105.8%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	137
Ideal Flow (vphpl)	1900
Grade (%)	
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frpb, ped/bikes	0.98
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1625
Flt Permitted	1.00
Satd. Flow (perm)	1625
Peak-hour factor, PHF	0.79
Adj. Flow (vph)	173
RTOR Reduction (vph)	8
Lane Group Flow (vph)	165
Confl. Peds. (#/hr)	26
Turn Type	pm+ov
Protected Phases	5!
Permitted Phases	2
Actuated Green, G (s)	101.0
Effective Green, g (s)	103.0
Actuated g/C Ratio	0.74
Clearance Time (s)	7.0
Vehicle Extension (s)	1.0
Lane Grp Cap (vph)	1265
v/s Ratio Prot	0.01
v/s Ratio Perm	0.09
v/c Ratio	0.13
Uniform Delay, d1	5.4
Progression Factor	1.00
Incremental Delay, d2	0.0
Delay (s)	5.4
Level of Service	A
Approach Delay (s)	
Approach LOS	

Intersection Summary



Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (vph)	2	0	2642	0	51	0	4231	0	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)			-1%				-2%			0%		
Total Lost time (s)	7.0		7.0		7.0		7.0					
Lane Util. Factor	1.00		0.91		0.97		0.91					
Frt	1.00		1.00		1.00		1.00					
Flt Protected	0.95		1.00		0.95		1.00					
Satd. Flow (prot)	1778		5111		3467		5136					
Flt Permitted	0.95		1.00		0.95		1.00					
Satd. Flow (perm)	1778		5111		3467		5136					
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	0	2872	0	55	0	4599	0	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	2	0	2872	0	55	0	4599	0	0	0	0	0
Turn Type	Prot		NA		Prot		NA					
Protected Phases	5		2		1		6					
Permitted Phases												
Actuated Green, G (s)	1.2		119.5		6.5		124.8					
Effective Green, g (s)	1.2		119.5		6.5		124.8					
Actuated g/C Ratio	0.01		0.85		0.05		0.89					
Clearance Time (s)	7.0		7.0		7.0		7.0					
Vehicle Extension (s)	3.0		3.0		3.0		3.0					
Lane Grp Cap (vph)	15		4362		160		4578					
v/s Ratio Prot	0.00		0.56		c0.02		c0.90					
v/s Ratio Perm												
v/c Ratio	0.13		0.66		0.34		1.00					
Uniform Delay, d1	68.9		3.4		64.7		7.6					
Progression Factor	1.06		2.69		0.95		1.40					
Incremental Delay, d2	1.4		0.3		0.4		8.8					
Delay (s)	74.7		9.5		61.9		19.5					
Level of Service	E		A		E		B					
Approach Delay (s)			9.5				20.0			0.0		
Approach LOS			A				B			A		

Intersection Summary			
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	87.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBT	SBR
Lane Configurations		
Volume (vph)	0	0
Ideal Flow (vphpl)	1900	1900
Grade (%)	0%	
Total Lost time (s)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Peak-hour factor, PHF	0.92	0.92
Adj. Flow (vph)	0	0
RTOR Reduction (vph)	0	0
Lane Group Flow (vph)	0	0
Turn Type		
Protected Phases		
Permitted Phases		
Actuated Green, G (s)		
Effective Green, g (s)		
Actuated g/C Ratio		
Clearance Time (s)		
Vehicle Extension (s)		
Lane Grp Cap (vph)		
v/s Ratio Prot		
v/s Ratio Perm		
v/c Ratio		
Uniform Delay, d1		
Progression Factor		
Incremental Delay, d2		
Delay (s)		
Level of Service		
Approach Delay (s)	0.0	
Approach LOS	A	

Intersection Summary

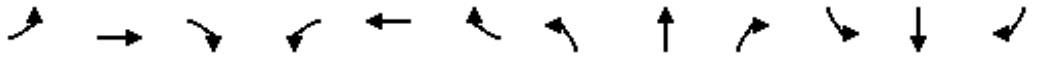
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	210	2011	472	440	311	3966	33	0	0	141	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	12	12	12	12	12	12	12	12	12
Grade (%)		-1%				1%			3%			-2%
Total Lost time (s)	2.0	3.0	2.0		2.0	3.0	2.0			2.0		
Lane Util. Factor	0.97	0.91	1.00		0.97	0.91	1.00			1.00		
Frpb, ped/bikes	1.00	1.00	0.97		1.00	1.00	0.99			0.99		
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00			1.00		
Frt	1.00	1.00	0.85		1.00	1.00	0.85			0.86		
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00			1.00		
Satd. Flow (prot)	3450	5111	1437		3416	5060	1554			1564		
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00			1.00		
Satd. Flow (perm)	3450	5111	1437		3416	5060	1554			1564		
Peak-hour factor, PHF	0.83	0.94	0.53	1.00	0.71	0.90	0.69	0.79	0.30	0.86	0.75	0.69
Adj. Flow (vph)	253	2139	891	440	438	4407	48	0	0	164	0	0
RTOR Reduction (vph)	0	0	27	0	0	0	5	0	0	0	0	0
Lane Group Flow (vph)	253	2139	864	0	878	4407	43	0	0	164	0	0
Confl. Peds. (#/hr)	1		14		14		1			8	8	
Turn Type	Prot	NA	Perm	Prot	Prot	NA	Perm			Perm		
Protected Phases	5	2		1	1	6						
Permitted Phases			2				6			1 2		
Actuated Green, G (s)	9.0	97.0	97.0		29.0	117.0	117.0			140.0		
Effective Green, g (s)	14.0	101.0	102.0		34.0	121.0	122.0			140.0		
Actuated g/C Ratio	0.10	0.72	0.73		0.24	0.86	0.87			1.00		
Clearance Time (s)	7.0	7.0	7.0		7.0	7.0	7.0					
Vehicle Extension (s)	1.0	6.0	6.0		3.0	6.0	6.0					
Lane Grp Cap (vph)	345	3687	1046		829	4373	1354			1564		
v/s Ratio Prot	0.07	0.42			0.26	c0.87						
v/s Ratio Perm			c0.60				0.03			0.10		
v/c Ratio	0.73	0.58	0.83		1.06	1.01	0.03			0.10		
Uniform Delay, d1	61.2	9.3	12.9		53.0	9.5	1.2			0.0		
Progression Factor	1.06	1.19	1.38		1.00	1.00	1.00			1.00		
Incremental Delay, d2	5.7	0.6	6.3		48.1	15.5	0.0			0.0		
Delay (s)	70.7	11.7	24.2		101.1	25.0	1.2			0.0		
Level of Service	E	B	C		F	C	A			A		
Approach Delay (s)		19.6				37.3			0.0			0.1
Approach LOS		B				D			A			A

Intersection Summary			
HCM 2000 Control Delay	28.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	102.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	316
Ideal Flow (vphpl)	1900
Lane Width	12
Grade (%)	
Total Lost time (s)	2.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1627
Flt Permitted	1.00
Satd. Flow (perm)	1627
Peak-hour factor, PHF	0.76
Adj. Flow (vph)	416
RTOR Reduction (vph)	0
Lane Group Flow (vph)	416
Confl. Peds. (#/hr)	
Turn Type	pm+ov
Protected Phases	5
Permitted Phases	6
Actuated Green, G (s)	126.0
Effective Green, g (s)	136.0
Actuated g/C Ratio	0.97
Clearance Time (s)	7.0
Vehicle Extension (s)	1.0
Lane Grp Cap (vph)	1627
v/s Ratio Prot	0.03
v/s Ratio Perm	0.23
v/c Ratio	0.26
Uniform Delay, d1	0.1
Progression Factor	1.00
Incremental Delay, d2	0.0
Delay (s)	0.1
Level of Service	A
Approach Delay (s)	
Approach LOS	

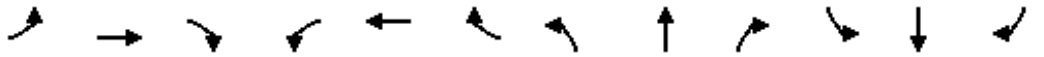
Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	23	40	5	5	96	138	9	2	253	1
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.87			0.99		1.00	0.99		1.00	1.00	
Flt Protected		1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1538			1673		1660	3289		1693	3385	
Flt Permitted		0.97			0.75		0.58	1.00		0.65	1.00	
Satd. Flow (perm)		1494			1310		1011	3289		1156	3385	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	2	0	26	44	6	6	107	153	10	2	281	1
RTOR Reduction (vph)	0	26	0	0	6	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	50	0	107	160	0	2	282	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		5.1			5.1		50.9	50.9		50.9	50.9	
Effective Green, g (s)		5.1			5.1		50.9	50.9		50.9	50.9	
Actuated g/C Ratio		0.07			0.07		0.73	0.73		0.73	0.73	
Clearance Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Vehicle Extension (s)		2.0			2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)		108			95		735	2391		840	2461	
v/s Ratio Prot								0.05			0.08	
v/s Ratio Perm		0.00			c0.04		c0.11			0.00		
v/c Ratio		0.02			0.53		0.15	0.07		0.00	0.11	
Uniform Delay, d1		30.1			31.3		2.9	2.7		2.6	2.8	
Progression Factor		1.00			1.00		4.24	3.59		0.33	0.35	
Incremental Delay, d2		0.0			2.8		0.3	0.0		0.0	0.1	
Delay (s)		30.2			34.1		12.7	9.9		0.9	1.1	
Level of Service		C			C		B	A		A	A	
Approach Delay (s)		30.2			34.1			11.0			1.1	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	9.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.18		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		

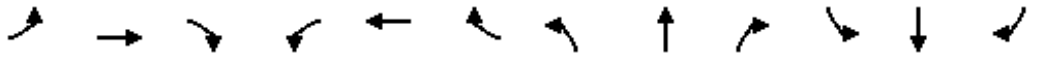
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	117	3	4	0	19	227	6	137	2	136	252	182
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.86		1.00	1.00		1.00	0.94	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	1613			1520		1660	3313		1693	3174	
Flt Permitted	0.46	1.00			1.00		0.48	1.00		0.65	1.00	
Satd. Flow (perm)	807	1613			1520		833	3313		1166	3174	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	130	3	4	0	21	252	7	152	2	151	280	202
RTOR Reduction (vph)	0	3	0	0	203	0	0	1	0	0	80	0
Lane Group Flow (vph)	130	4	0	0	70	0	7	153	0	151	402	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	13.6	13.6			13.6		42.4	42.4		42.4	42.4	
Effective Green, g (s)	13.6	13.6			13.6		42.4	42.4		42.4	42.4	
Actuated g/C Ratio	0.19	0.19			0.19		0.61	0.61		0.61	0.61	
Clearance Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Vehicle Extension (s)	2.0	2.0			2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	156	313			295		504	2006		706	1922	
v/s Ratio Prot		0.00			0.05			0.05			0.13	
v/s Ratio Perm	c0.16						0.01			c0.13		
v/c Ratio	0.83	0.01			0.24		0.01	0.08		0.21	0.21	
Uniform Delay, d1	27.1	22.8			23.8		5.5	5.7		6.3	6.2	
Progression Factor	1.00	1.00			1.00		0.41	0.39		0.88	0.82	
Incremental Delay, d2	28.9	0.0			0.2		0.1	0.1		0.6	0.2	
Delay (s)	56.0	22.8			24.0		2.3	2.3		6.2	5.3	
Level of Service	E	C			C		A	A		A	A	
Approach Delay (s)		54.3			24.0			2.3			5.5	
Approach LOS		D			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

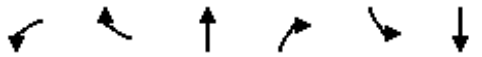
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	12	345	29	4	0	113	355	13	0	196	9
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)	7.0	7.0			7.0		7.0	7.0			7.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95			0.95	
Frt	1.00	0.85			1.00		1.00	0.99			0.99	
Flt Protected	0.95	1.00			0.96		0.95	1.00			1.00	
Satd. Flow (prot)	1676	1509			1690		1660	3302			3364	
Flt Permitted	0.73	1.00			0.36		0.95	1.00			1.00	
Satd. Flow (perm)	1295	1509			635		1660	3302			3364	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	21	13	383	32	4	0	126	394	14	0	218	10
RTOR Reduction (vph)	0	326	0	0	0	0	0	2	0	0	4	0
Lane Group Flow (vph)	21	70	0	0	36	0	126	406	0	0	224	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8						6		
Actuated Green, G (s)	10.5	10.5			10.5		12.4	45.5			26.1	
Effective Green, g (s)	10.5	10.5			10.5		12.4	45.5			26.1	
Actuated g/C Ratio	0.15	0.15			0.15		0.18	0.65			0.37	
Clearance Time (s)	7.0	7.0			7.0		7.0	7.0			7.0	
Vehicle Extension (s)	3.0	3.0			3.0		2.0	3.0			3.0	
Lane Grp Cap (vph)	194	226			95		294	2146			1254	
v/s Ratio Prot		0.05					c0.08	c0.12			0.07	
v/s Ratio Perm	0.02				c0.06							
v/c Ratio	0.11	0.31			0.38		0.43	0.19			0.18	
Uniform Delay, d1	25.7	26.5			26.8		25.6	4.9			14.7	
Progression Factor	1.00	1.00			1.00		0.89	1.24			1.00	
Incremental Delay, d2	0.2	0.8			2.5		0.4	0.2			0.3	
Delay (s)	26.0	27.3			29.3		23.2	6.3			15.1	
Level of Service	C	C			C		C	A			B	
Approach Delay (s)		27.3			29.3			10.3			15.1	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		

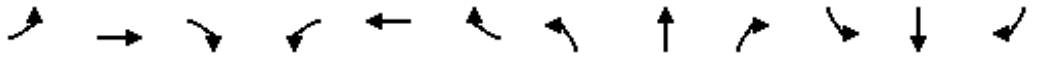
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	19	0	315	59	0	186
Sign Control	Stop		Free			Free
Grade	0%		2%			-2%
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	21	0	350	66	0	207
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			606			
pX, platoon unblocked						
vC, conflicting volume	486	208			416	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	486	208			416	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	100			100	
cM capacity (veh/h)	510	798			1140	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	21	233	182	69	138
Volume Left	21	0	0	0	0
Volume Right	0	0	66	0	0
cSH	510	1700	1700	1140	1700
Volume to Capacity	0.04	0.14	0.11	0.00	0.08
Queue Length 95th (ft)	3	0	0	0	0
Control Delay (s)	12.4	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.4	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	21.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↱		↑↑↑	↱			↱			↱
Volume (veh/h)	0	2457	135	0	4440	435	0	0	829	0	0	310
Sign Control		Free			Free			Stop			Stop	
Grade		3%			-3%			2%			-1%	
Peak Hour Factor	0.50	0.83	0.94	0.93	0.90	0.76	0.80	0.83	0.65	0.81	0.88	0.71
Hourly flow rate (vph)	0	2960	144	0	4933	572	0	0	1275	0	0	437
Pedestrians		3			4							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		4.0			4.0							
Percent Blockage		0			0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		1046										
pX, platoon unblocked				0.80			0.80	0.80	0.80	0.80	0.80	
vC, conflicting volume	5506			3104			5044	8466	991	7199	8037	1647
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	5506			2745			5184	9485	89	7893	8947	1647
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	0	0	100	0
cM capacity (veh/h)	10			114			0	0	755	0	0	88

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	987	987	987	144	1644	1644	1644	572	1275	437
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	144	0	0	0	572	1275	437
cSH	1700	1700	1700	1700	1700	1700	1700	1700	755	88
Volume to Capacity	0.58	0.58	0.58	0.08	0.97	0.97	0.97	0.34	1.69	4.97
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	1794	Err
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	331.5	Err
Lane LOS									F	F
Approach Delay (s)	0.0				0.0				331.5	Err
Approach LOS									F	F

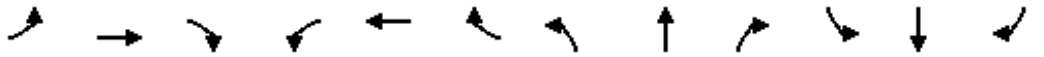
Intersection Summary			
Average Delay	463.9		
Intersection Capacity Utilization	112.0%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	76	3188	35	162	235	2802	111	138	44	305	135	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		1%				-3%			1%			-1%
Total Lost time (s)	3.0	3.0			3.0	3.0		3.0	3.0	6.0	3.0	3.0
Lane Util. Factor	1.00	0.91			1.00	0.91		1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00			1.00	1.00		1.00	1.00	0.98	1.00	0.98
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.99	1.00	1.00	0.99	1.00
Frt	1.00	1.00			1.00	0.99		1.00	1.00	0.85	1.00	0.91
Flt Protected	0.95	1.00			0.95	1.00		0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1761	5040			1796	5118		1747	1853	1536	1760	1673
Flt Permitted	0.95	1.00			0.95	1.00		0.58	1.00	1.00	0.66	1.00
Satd. Flow (perm)	1761	5040			1796	5118		1061	1853	1536	1228	1673
Peak-hour factor, PHF	0.89	0.92	0.70	1.00	0.84	0.93	0.79	0.76	0.60	0.80	0.85	0.68
Adj. Flow (vph)	85	3465	50	162	280	3013	141	182	73	381	159	43
RTOR Reduction (vph)	0	1	0	0	0	3	0	0	0	0	0	0
Lane Group Flow (vph)	85	3514	0	0	442	3151	0	182	73	381	159	112
Confl. Peds. (#/hr)	5		33		33		5	7		9	9	
Confl. Bikes (#/hr)			1				1			1		
Turn Type	Prot	NA		Prot	Prot	NA		Perm	NA	Perm	Perm	NA
Protected Phases	5	2		1	1	6			8			4
Permitted Phases								8		8	4	
Actuated Green, G (s)	6.0	74.0			28.0	96.0		27.0	27.0	27.0	27.0	27.0
Effective Green, g (s)	10.0	78.0			32.0	100.0		31.0	31.0	28.0	31.0	31.0
Actuated g/C Ratio	0.07	0.52			0.21	0.67		0.21	0.21	0.19	0.21	0.21
Clearance Time (s)	7.0	7.0			7.0	7.0		7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0			2.0	3.0		1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)	117	2620			383	3412		219	382	286	253	345
v/s Ratio Prot	0.05	c0.70			c0.25	0.62			0.04			0.07
v/s Ratio Perm								0.17		c0.25	0.13	
v/c Ratio	0.73	1.34			1.15	0.92		0.83	0.19	1.33	0.63	0.32
Uniform Delay, d1	68.7	36.0			59.0	21.7		57.0	49.1	61.0	54.2	50.6
Progression Factor	1.00	1.00			1.01	1.06		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.2	156.2			77.4	1.6		21.8	0.1	171.5	3.5	0.2
Delay (s)	85.9	192.2			137.2	24.5		78.8	49.2	232.5	57.7	50.8
Level of Service	F	F			F	C		E	D	F	E	D
Approach Delay (s)		189.7				38.4			167.5			54.9
Approach LOS		F				D			F			D

Intersection Summary			
HCM 2000 Control Delay	116.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.29		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	128.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	42
Ideal Flow (vphpl)	1900
Grade (%)	
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.61
Adj. Flow (vph)	69
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	7
Confl. Bikes (#/hr)	3
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↱		↑↑↑				↱			↱
Volume (veh/h)	0	3677	113	0	3285	5	0	0	74	0	0	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			-4%			0%			0%	
Peak Hour Factor	1.00	1.00	0.77	0.75	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.50
Hourly flow rate (vph)	0	3677	147	0	3285	5	0	0	77	0	0	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		927			662							
pX, platoon unblocked	0.29			0.49			0.55	0.55	0.49	0.55	0.55	0.29
vC, conflicting volume	3290			3824			4822	6967	1226	4590	7111	1098
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	377			3129			0	2757	0	0	3021	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	86	100	100	84
cM capacity (veh/h)	346			49			471	11	535	479	7	318

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	1226	1226	1226	147	1314	1314	662	77	50
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	147	0	0	5	77	50
cSH	1700	1700	1700	1700	1700	1700	1700	535	318
Volume to Capacity	0.72	0.72	0.72	0.09	0.77	0.77	0.39	0.14	0.16
Queue Length 95th (ft)	0	0	0	0	0	0	0	13	14
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	18.4
Lane LOS								B	C
Approach Delay (s)	0.0				0.0			12.9	18.4
Approach LOS								B	C

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	148	3590	13	13	51	3074	184	0	0	360	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	11	11	12	12	12	10	10
Grade (%)		-4%				-1%			2%			0%
Total Lost time (s)	4.0	4.0			4.0	4.0				6.0		
Lane Util. Factor	1.00	0.91			1.00	0.91				1.00		
Frpb, ped/bikes	1.00	1.00			1.00	1.00				1.00		
Flpb, ped/bikes	1.00	1.00			1.00	1.00				1.00		
Frt	1.00	1.00			1.00	0.99				0.86		
Flt Protected	0.95	1.00			0.95	1.00				1.00		
Satd. Flow (prot)	1805	5180			1778	4886				1595		
Flt Permitted	0.95	1.00			0.95	1.00				1.00		
Satd. Flow (perm)	1805	5180			1778	4886				1595		
Peak-hour factor, PHF	0.78	0.92	0.53	1.00	0.66	0.85	0.75	0.68	0.50	0.76	0.58	0.50
Adj. Flow (vph)	190	3902	25	13	77	3616	245	0	0	474	0	0
RTOR Reduction (vph)	0	0	0	0	0	5	0	0	0	61	0	0
Lane Group Flow (vph)	190	3927	0	0	90	3856	0	0	0	413	0	0
Confl. Peds. (#/hr)	1		13		13		1	12				
Turn Type	Prot	NA		Prot	Prot	NA				Over		
Protected Phases	5	2		1!	1	6				1!		
Permitted Phases												
Actuated Green, G (s)	29.0	102.0			34.0	107.0				34.0		
Effective Green, g (s)	32.0	105.0			37.0	110.0				35.0		
Actuated g/C Ratio	0.21	0.70			0.25	0.73				0.23		
Clearance Time (s)	7.0	7.0			7.0	7.0				7.0		
Vehicle Extension (s)	3.0	6.0			3.0	6.0				3.0		
Lane Grp Cap (vph)	385	3626			438	3583				372		
v/s Ratio Prot	0.11	c0.76			0.05	c0.79				0.26		
v/s Ratio Perm												
v/c Ratio	0.49	1.08			0.21	1.08				1.11		
Uniform Delay, d1	51.9	22.5			44.8	20.0				57.5		
Progression Factor	1.35	0.49			1.27	1.63				1.00		
Incremental Delay, d2	0.1	37.9			0.2	38.5				79.6		
Delay (s)	70.1	49.0			57.0	71.1				137.1		
Level of Service	E	D			E	E				F		
Approach Delay (s)		50.0				70.8			137.1			140.4
Approach LOS		D				E			F			F

Intersection Summary			
HCM 2000 Control Delay	67.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	107.2%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	216
Ideal Flow (vphpl)	1900
Lane Width	10
Grade (%)	
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1504
Flt Permitted	1.00
Satd. Flow (perm)	1504
Peak-hour factor, PHF	0.55
Adj. Flow (vph)	393
RTOR Reduction (vph)	64
Lane Group Flow (vph)	329
Confl. Peds. (#/hr)	12
Turn Type	Over
Protected Phases	5
Permitted Phases	
Actuated Green, G (s)	29.0
Effective Green, g (s)	30.0
Actuated g/C Ratio	0.20
Clearance Time (s)	7.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	300
v/s Ratio Prot	0.22
v/s Ratio Perm	
v/c Ratio	1.10
Uniform Delay, d1	60.0
Progression Factor	1.00
Incremental Delay, d2	80.4
Delay (s)	140.4
Level of Service	F
Approach Delay (s)	
Approach LOS	

Intersection Summary

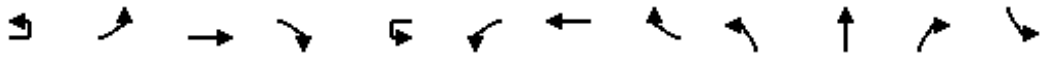
Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	99	169	3446	249	73	3009	37	0	0	410	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)			5%			-2%			6%			-6%
Total Lost time (s)		3.0	3.0	3.0	3.0	3.0	3.0			6.0		
Lane Util. Factor		1.00	0.91	1.00	1.00	0.91	1.00			1.00		
Frpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00			0.99		
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00			1.00		
Frt		1.00	1.00	0.85	1.00	1.00	0.85			0.86		
Flt Protected		0.95	1.00	1.00	0.95	1.00	1.00			1.00		
Satd. Flow (prot)		1725	4958	1544	1787	5136	1599			1541		
Flt Permitted		0.95	1.00	1.00	0.95	1.00	1.00			1.00		
Satd. Flow (perm)		1725	4958	1544	1787	5136	1599			1541		
Peak-hour factor, PHF	1.00	0.78	0.79	0.68	0.75	0.96	0.69	0.81	0.50	0.60	0.69	0.67
Adj. Flow (vph)	99	217	4362	366	97	3134	54	0	0	683	0	0
RTOR Reduction (vph)	0	0	0	44	0	0	9	0	0	9	0	0
Lane Group Flow (vph)	0	316	4362	322	97	3134	45	0	0	674	0	0
Confl. Peds. (#/hr)								26		13	13	
Turn Type	Prot	Prot	NA	Perm	Prot	NA	Perm			pm+ov		
Protected Phases	5!	5	2		1	6				1		
Permitted Phases				2			6			6		
Actuated Green, G (s)		35.0	116.0	116.0	20.0	101.0	101.0			101.0		
Effective Green, g (s)		39.0	120.0	120.0	24.0	105.0	105.0			102.0		
Actuated g/C Ratio		0.26	0.80	0.80	0.16	0.70	0.70			0.68		
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	7.0			7.0		
Vehicle Extension (s)		1.0	6.0	6.0	1.0	6.0	6.0			1.0		
Lane Grp Cap (vph)		448	3966	1235	285	3595	1119			1047		
v/s Ratio Prot		0.18	c0.88		0.05	c0.61				0.09		
v/s Ratio Perm				0.21			0.03			0.35		
v/c Ratio		0.71	1.10	0.26	0.34	0.87	0.04			0.64		
Uniform Delay, d1		50.3	15.0	3.8	56.0	17.3	6.9			13.7		
Progression Factor		0.80	0.37	0.74	1.16	0.62	0.96			1.00		
Incremental Delay, d2		1.4	46.6	0.2	0.1	1.9	0.0			1.0		
Delay (s)		41.8	52.1	3.0	65.2	12.7	6.7			14.7		
Level of Service		D	D	A	E	B	A			B		
Approach Delay (s)			47.9			14.1			14.7			4.4
Approach LOS			D			B			B			A

Intersection Summary			
HCM 2000 Control Delay	32.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	101.6%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	SBR
Lane Configurations	
Volume (vph)	214
Ideal Flow (vphpl)	1900
Grade (%)	
Total Lost time (s)	6.0
Lane Util. Factor	1.00
Frpb, ped/bikes	0.95
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1583
Flt Permitted	1.00
Satd. Flow (perm)	1583
Peak-hour factor, PHF	0.79
Adj. Flow (vph)	271
RTOR Reduction (vph)	6
Lane Group Flow (vph)	265
Confl. Peds. (#/hr)	26
Turn Type	pm+ov
Protected Phases	5!
Permitted Phases	2
Actuated Green, G (s)	116.0
Effective Green, g (s)	117.0
Actuated g/C Ratio	0.78
Clearance Time (s)	7.0
Vehicle Extension (s)	1.0
Lane Grp Cap (vph)	1234
v/s Ratio Prot	0.05
v/s Ratio Perm	0.12
v/c Ratio	0.21
Uniform Delay, d1	4.4
Progression Factor	1.00
Incremental Delay, d2	0.0
Delay (s)	4.4
Level of Service	A
Approach Delay (s)	
Approach LOS	

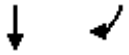
Intersection Summary



Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (vph)	207	0	3649	0	98	0	2912	0	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)			-1%				-2%			0%		
Total Lost time (s)	7.0		7.0		7.0		7.0					
Lane Util. Factor	1.00		0.91		0.97		0.91					
Frt	1.00		1.00		1.00		1.00					
Flt Protected	0.95		1.00		0.95		1.00					
Satd. Flow (prot)	1778		5111		3467		5136					
Flt Permitted	0.95		1.00		0.95		1.00					
Satd. Flow (perm)	1778		5111		3467		5136					
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	225	0	3966	0	107	0	3165	0	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	225	0	3966	0	107	0	3165	0	0	0	0	0
Turn Type	Prot		NA		Prot		NA					
Protected Phases	5		2		1		6					
Permitted Phases												
Actuated Green, G (s)	20.0		126.0		10.0		116.0					
Effective Green, g (s)	20.0		126.0		10.0		116.0					
Actuated g/C Ratio	0.13		0.84		0.07		0.77					
Clearance Time (s)	7.0		7.0		7.0		7.0					
Vehicle Extension (s)	3.0		3.0		3.0		3.0					
Lane Grp Cap (vph)	237		4293		231		3971					
v/s Ratio Prot	c0.13		c0.78		0.03		0.62					
v/s Ratio Perm												
v/c Ratio	0.95		0.92		0.46		0.80					
Uniform Delay, d1	64.5		8.6		67.4		10.0					
Progression Factor	0.88		0.55		0.92		0.51					
Incremental Delay, d2	8.5		0.5		1.1		1.3					
Delay (s)	65.2		5.2		63.1		6.5					
Level of Service	E		A		E		A					
Approach Delay (s)			8.4				8.3			0.0		
Approach LOS			A				A			A		

Intersection Summary			
HCM 2000 Control Delay	8.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	SBT	SBR
Lane Configurations		
Volume (vph)	0	0
Ideal Flow (vphpl)	1900	1900
Grade (%)	0%	
Total Lost time (s)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Peak-hour factor, PHF	0.92	0.92
Adj. Flow (vph)	0	0
RTOR Reduction (vph)	0	0
Lane Group Flow (vph)	0	0
Turn Type		
Protected Phases		
Permitted Phases		
Actuated Green, G (s)		
Effective Green, g (s)		
Actuated g/C Ratio		
Clearance Time (s)		
Vehicle Extension (s)		
Lane Grp Cap (vph)		
v/s Ratio Prot		
v/s Ratio Perm		
v/c Ratio		
Uniform Delay, d1		
Progression Factor		
Incremental Delay, d2		
Delay (s)		
Level of Service		
Approach Delay (s)	0.0	
Approach LOS	A	

Intersection Summary

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	258	3321	168	1166	32	2609	78	0	0	1140	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	12	12	12	12	12	12	12	12	12
Grade (%)		-1%				1%			3%			-2%
Total Lost time (s)	2.0	3.0	2.0		2.0	3.0	2.0			2.0		
Lane Util. Factor	0.97	0.91	1.00		0.97	0.91	1.00			1.00		
Frpb, ped/bikes	1.00	1.00	0.97		1.00	1.00	0.99			0.99		
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00			1.00		
Frt	1.00	1.00	0.85		1.00	1.00	0.85			0.86		
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00			1.00		
Satd. Flow (prot)	3450	5111	1435		3416	5060	1554			1564		
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00			1.00		
Satd. Flow (perm)	3450	5111	1435		3416	5060	1554			1564		
Peak-hour factor, PHF	0.83	0.94	0.53	1.00	0.71	0.90	0.69	0.79	0.30	0.86	0.75	0.69
Adj. Flow (vph)	311	3533	317	1166	45	2899	113	0	0	1326	0	0
RTOR Reduction (vph)	0	0	65	0	0	0	19	0	0	0	0	0
Lane Group Flow (vph)	311	3533	252	0	1211	2899	94	0	0	1326	0	0
Confl. Peds. (#/hr)	1		14		14		1			8	8	
Turn Type	Prot	NA	Perm	Prot	Prot	NA	Perm			Perm		
Protected Phases	5	2		1	1	6						
Permitted Phases			2				6			1 2		
Actuated Green, G (s)	17.0	107.0	107.0		29.0	119.0	119.0			150.0		
Effective Green, g (s)	22.0	111.0	112.0		34.0	123.0	124.0			150.0		
Actuated g/C Ratio	0.15	0.74	0.75		0.23	0.82	0.83			1.00		
Clearance Time (s)	7.0	7.0	7.0		7.0	7.0	7.0					
Vehicle Extension (s)	1.0	6.0	6.0		3.0	6.0	6.0					
Lane Grp Cap (vph)	506	3782	1071		774	4149	1284			1564		
v/s Ratio Prot	0.09	c0.69			c0.35	0.57						
v/s Ratio Perm			0.18				0.06			0.85		
v/c Ratio	0.61	0.93	0.24		2.92dl	0.70	0.07			0.85		
Uniform Delay, d1	60.0	16.4	5.8		58.0	5.7	2.4			0.0		
Progression Factor	1.04	0.51	0.14		1.00	1.00	1.00			1.00		
Incremental Delay, d2	0.7	2.7	0.2		260.4	1.0	0.1			4.5		
Delay (s)	63.4	11.2	1.1		318.4	6.7	2.5			4.5		
Level of Service	E	B	A		F	A	A			A		
Approach Delay (s)		14.3				96.0			4.5			0.1
Approach LOS		B				F			A			A

Intersection Summary			
HCM 2000 Control Delay	46.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	179.8%	ICU Level of Service	H
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

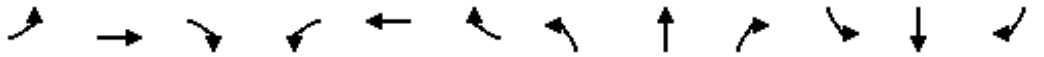
Movement	SBR
Lane Configurations	
Volume (vph)	401
Ideal Flow (vphpl)	1900
Lane Width	12
Grade (%)	
Total Lost time (s)	2.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1627
Flt Permitted	1.00
Satd. Flow (perm)	1627
Peak-hour factor, PHF	0.76
Adj. Flow (vph)	528
RTOR Reduction (vph)	0
Lane Group Flow (vph)	528
Confl. Peds. (#/hr)	
Turn Type	pm+ov
Protected Phases	5
Permitted Phases	6
Actuated Green, G (s)	136.0
Effective Green, g (s)	146.0
Actuated g/C Ratio	0.97
Clearance Time (s)	7.0
Vehicle Extension (s)	1.0
Lane Grp Cap (vph)	1627
v/s Ratio Prot	0.05
v/s Ratio Perm	0.28
v/c Ratio	0.32
Uniform Delay, d1	0.1
Progression Factor	1.00
Incremental Delay, d2	0.0
Delay (s)	0.1
Level of Service	A
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	3	51	28	1	4	106	199	31	11	322	5
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.88			0.98		1.00	0.98		1.00	1.00	
Flt Protected		1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1543			1666		1660	3253		1693	3378	
Flt Permitted		0.99			0.83		0.53	1.00		0.59	1.00	
Satd. Flow (perm)		1525			1438		934	3253		1059	3378	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	2	3	57	31	1	4	118	221	34	12	358	6
RTOR Reduction (vph)	0	53	0	0	4	0	0	10	0	0	1	0
Lane Group Flow (vph)	0	9	0	0	32	0	118	245	0	12	363	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		4.5			4.5		41.5	41.5		41.5	41.5	
Effective Green, g (s)		4.5			4.5		41.5	41.5		41.5	41.5	
Actuated g/C Ratio		0.08			0.08		0.69	0.69		0.69	0.69	
Clearance Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Vehicle Extension (s)		2.0			2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)		114			107		646	2249		732	2336	
v/s Ratio Prot								0.08			0.11	
v/s Ratio Perm		0.01			c0.02		c0.13			0.01		
v/c Ratio		0.08			0.30		0.18	0.11		0.02	0.16	
Uniform Delay, d1		25.8			26.3		3.3	3.1		2.9	3.2	
Progression Factor		1.00			1.00		1.00	1.00		0.43	0.45	
Incremental Delay, d2		0.1			0.6		0.6	0.1		0.0	0.1	
Delay (s)		25.9			26.8		3.9	3.2		1.3	1.6	
Level of Service		C			C		A	A		A	A	
Approach Delay (s)		25.9			26.8			3.4			1.6	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	5.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.19		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

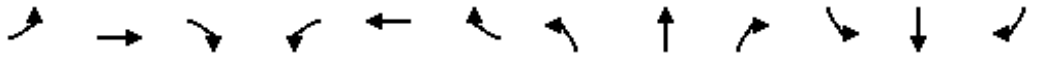
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	65	92	88	3	83	175	47	157	1	124	247	72
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	1635		1676	1585		1660	3317		1693	3272	
Flt Permitted	0.44	1.00		0.63	1.00		0.54	1.00		0.64	1.00	
Satd. Flow (perm)	775	1635		1116	1585		943	3317		1143	3272	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	72	102	98	3	92	194	52	174	1	138	274	80
RTOR Reduction (vph)	0	78	0	0	162	0	0	0	0	0	29	0
Lane Group Flow (vph)	72	122	0	3	124	0	52	175	0	138	325	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	9.9	9.9		9.9	9.9		36.1	36.1		36.1	36.1	
Effective Green, g (s)	9.9	9.9		9.9	9.9		36.1	36.1		36.1	36.1	
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.60	0.60		0.60	0.60	
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	127	269		184	261		567	1995		687	1968	
v/s Ratio Prot		0.07			0.08			0.05			0.10	
v/s Ratio Perm	c0.09			0.00			0.06			c0.12		
v/c Ratio	0.57	0.45		0.02	0.48		0.09	0.09		0.20	0.17	
Uniform Delay, d1	23.1	22.6		21.0	22.7		5.0	5.0		5.4	5.3	
Progression Factor	1.00	1.00		1.00	1.00		0.65	0.69		2.28	2.62	
Incremental Delay, d2	3.4	0.4		0.0	0.5		0.3	0.1		0.6	0.2	
Delay (s)	26.5	23.1		21.0	23.2		3.6	3.5		13.0	14.0	
Level of Service	C	C		C	C		A	A		B	B	
Approach Delay (s)		24.0			23.2			3.5			13.7	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	16.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		

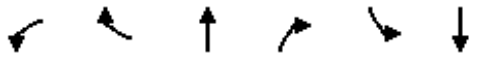
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	28	179	28	2	1	219	152	26	1	236	11
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Grade (%)		0%			0%			2%			-2%	
Total Lost time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.87			1.00		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	1536			1681		1660	3246		1693	3364	
Flt Permitted	0.73	1.00			0.56		0.95	1.00		0.63	1.00	
Satd. Flow (perm)	1297	1536			976		1660	3246		1118	3364	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	9	31	199	31	2	1	243	169	29	1	262	12
RTOR Reduction (vph)	0	171	0	0	1	0	0	11	0	0	5	0
Lane Group Flow (vph)	9	59	0	0	33	0	243	187	0	1	269	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8						6		
Actuated Green, G (s)	8.5	8.5			8.5		11.5	37.5		19.0	19.0	
Effective Green, g (s)	8.5	8.5			8.5		11.5	37.5		19.0	19.0	
Actuated g/C Ratio	0.14	0.14			0.14		0.19	0.62		0.32	0.32	
Clearance Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0			3.0		2.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	183	217			138		318	2028		354	1065	
v/s Ratio Prot		c0.04					c0.15	0.06			c0.08	
v/s Ratio Perm	0.01				0.03					0.00		
v/c Ratio	0.05	0.27			0.24		0.76	0.09		0.00	0.25	
Uniform Delay, d1	22.3	23.0			22.9		23.0	4.5		14.0	15.2	
Progression Factor	1.00	1.00			1.00		0.83	1.43		1.00	1.00	
Incremental Delay, d2	0.1	0.7			0.9		9.3	0.1		0.0	0.6	
Delay (s)	22.4	23.7			23.8		28.4	6.5		14.0	15.8	
Level of Service	C	C			C		C	A		B	B	
Approach Delay (s)		23.6			23.8			18.6			15.8	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

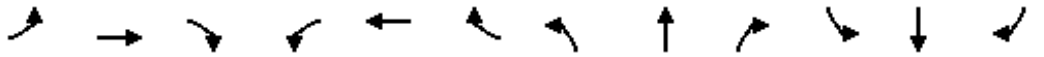
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	29	0	152	9	0	219
Sign Control	Stop		Free			Free
Grade	0%		2%			-2%
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	32	0	169	10	0	243
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			606			
pX, platoon unblocked						
vC, conflicting volume	296	89			179	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	296	89			179	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	100			100	
cM capacity (veh/h)	672	951			1394	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	32	113	66	81	162
Volume Left	32	0	0	0	0
Volume Right	0	0	10	0	0
cSH	672	1700	1700	1394	1700
Volume to Capacity	0.05	0.07	0.04	0.00	0.10
Queue Length 95th (ft)	4	0	0	0	0
Control Delay (s)	10.6	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	10.6	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	16.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↱		↑↑↑	↱			↱			↱
Volume (veh/h)	0	4762	865	0	3461	473	0	0	234	0	0	424
Sign Control		Free			Free			Stop			Stop	
Grade		3%			-3%			2%			-1%	
Peak Hour Factor	0.50	0.83	0.94	0.93	0.90	0.76	0.80	0.83	0.65	0.81	0.88	0.71
Hourly flow rate (vph)	0	5737	920	0	3846	622	0	0	360	0	0	597
Pedestrians		3			4							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		4.0			4.0							
Percent Blockage		0			0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		1046										
pX, platoon unblocked				0.29			0.29	0.29	0.29	0.29	0.29	
vC, conflicting volume	4468			6658			7619	10205	1916	6122	10503	1285
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	4468			11830			15097	23882	0	10010	24894	1285
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	0	0	100	0
cM capacity (veh/h)	28			0			0	0	318	0	0	155

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	1912	1912	1912	920	1282	1282	1282	622	360	597
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	920	0	0	0	622	360	597
cSH	1700	1700	1700	1700	1700	1700	1700	1700	318	155
Volume to Capacity	1.12	1.12	1.12	0.54	0.75	0.75	0.75	0.37	1.13	3.85
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	363	Err
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	127.4	Err
Lane LOS									F	F
Approach Delay (s)	0.0				0.0				127.4	Err
Approach LOS									F	F

Intersection Summary				
Average Delay	498.0			
Intersection Capacity Utilization	113.6%	ICU Level of Service	H	
Analysis Period (min)	15			