2016 Traffic Signal System Performance Metrics Update

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Executive Summary: The purpose of this biennial report is to provide an update on the traffic signal system performance metrics. This report also discusses new initiatives related to the traffic signal system, including development of timing plans for football games and the variable message sign project. We continue to improve the signal system performance by installing various traffic signal measures such as new phasing, timing plans, lead pedestrian interval, and bicycle detection where needed. The system performance continued to improve on major corridors by reducing number of stops and delay to overall intersection traffic including pedestrian and bicycle operations. The next report for signal system performance will be evaluated starting October 2017.

History: In partnership with the North Carolina Department of Transportation, the Town completed the installation of a new traffic signal system in Chapel Hill and Carrboro in September 2012. This system was designed to improve the efficiency of traffic flow throughout the town by reducing congestion and bottlenecks during the busiest travel times throughout the day. The project included the following key elements:

- Installation of fiber optic communication cable for the signal system
- Replacement of existing cabinets and controllers with new cabinets and controllers
- Development of a Traffic Management Center located at the Town Operations Center
- Installation of closed-circuit television (CCTV) equipment for traffic monitoring at 16 locations
- Installation of new/revised signal phasing on major corridors
- Installation of pedestrian countdown displays at locations with existing pedestrian signals
- Installation of bicycle-activated loops at 40 signalized intersections in Chapel Hill
- Installation of system detectors for the traffic-responsive system and revised traffic signal design plans

Other Measures Implemented: Since completing the signal system in 2012, the following additional measures have been implemented:

- Changes to signal phases including implementing a flashing arrow for left-turns at several intersections (improves travel time)
- Lead Pedestrian Interval for pedestrian phases, which turns all signals to red for the first 5 seconds of the pedestrian phase (improves safety, may slow vehicular traffic)
- Installed Accessible Pedestrian Signals (APS) equipment – including vibrating and audible - at several signals (accommodates pedestrians with low/ no vision)

Performance Measures: In an effort to understand the level of improvement resulting from the traffic signal system, the following metrics were selected for monitoring and modeling:

- Travel time (average total time for a vehicle to drive from Point A to Point B) runs through all major corridors
- Total delay (total time each vehicle is stopped or required to slow, such as at signal light intersections, from Point A to Point B) experienced by drivers throughout each major corridor and at individual intersections
- Stopped delay (total time each vehicle is stopped from Point A to Point B) experienced by drivers throughout each major corridor and at individual intersections
- Fuel consumption (total fuel consumed for all vehicles in gallons per hour)
    - This metric was developed as a projection of possible benefits based on modeled activity under the new traffic signal system. This metric is also used to report greenhouse gas emissions reduction.
- Emissions (tons of greenhouse gas emissions for all vehicles per hour)

The study area for data collection includes traffic signals located along the following corridors:

- Fordham Blvd, from Estes Dr. to I-40 (study completed before start of the Ephesus Fordham area construction)
- Martin Luther King Jr Blvd (NC 86), from Whitfield Rd. to Hillsborough St.
- NC 54, from East Barbee Chapel Rd. to Hamilton Rd.

Staff and signal timing consultants has completed three reports on the above metrics based on data collected at the following times:

- Baseline Data Collected in Spring 2012 (before the system upgrade in September 2012)
- Fall 2013 Report – Comparison Data Collected in Spring 2013
- Fall 2016 Report – Comparison Data Collected in Spring 2016

Results of Before-and-After Studies: The main findings of this study update were as follows:

- Improved synchronization of traffic signals
- Overall travel time was reduced during peak and off-peak hours
- Reduced travel delay for motorists on all corridors for both peak and off-peak hours
- Reduction of fuel consumed and greenhouse gas emissions

Results are included as attachments to this report.

New Signal System Initiatives

Timing Plans for UNC Games: Working with the Town staff, the University consultant developed timing plans for football games in Fall 2016. Town staff implemented these plans before and after the games using the signal system software. These timing plans reduced the number of law enforcement officers needed at several signalized intersections before and after the games. The University is working with the Town to develop timing plans for basketball games.

Lastly, the traffic-monitoring camera system is being used daily in conjunction with signal system elements to help implement temporary signal timing plans tailored for construction, major incidents and special events.

Variable Message Sign Project: In partnership with the North Carolina Department of Transportation and the University, the Town is designing variable message signs to be incorporated into the signal system. The goals of the variable message signs are to:

- Provide real-time traveler information
- Provide an agile system for ease of integration and future enhancements
- Support traffic management during events around town
- Eliminate the need for portable message signs and create a permanent solution that can be used throughout the year
- Support incident management
- Integrate with existing wayfinding and special event plans

A copy of the most recent report on the variable message sign project is attached. The report includes the possible locations and different designs of the variable message signs. NCDOT and UNC provided comments and we are scheduling the report for review by TACAB and Council in September 2017.

Next Steps

We will be providing this report to the public via the Town's website. As part of this effort, we will continue to seek public input on the site and via the following email address: traffic@townofchapelhill.org.

In fall of 2017, Town staff and the signal timing consultant will review the timing plans for all major corridors, including the downtown, in a continued attempt to optimize and improve traffic flows throughout the Town. Based on these additional changes, we will then develop and provide another before-and-after comparison report in spring 2018. This effort will be coordinated with the staff from the Police Department and Transit Department

Attachments:

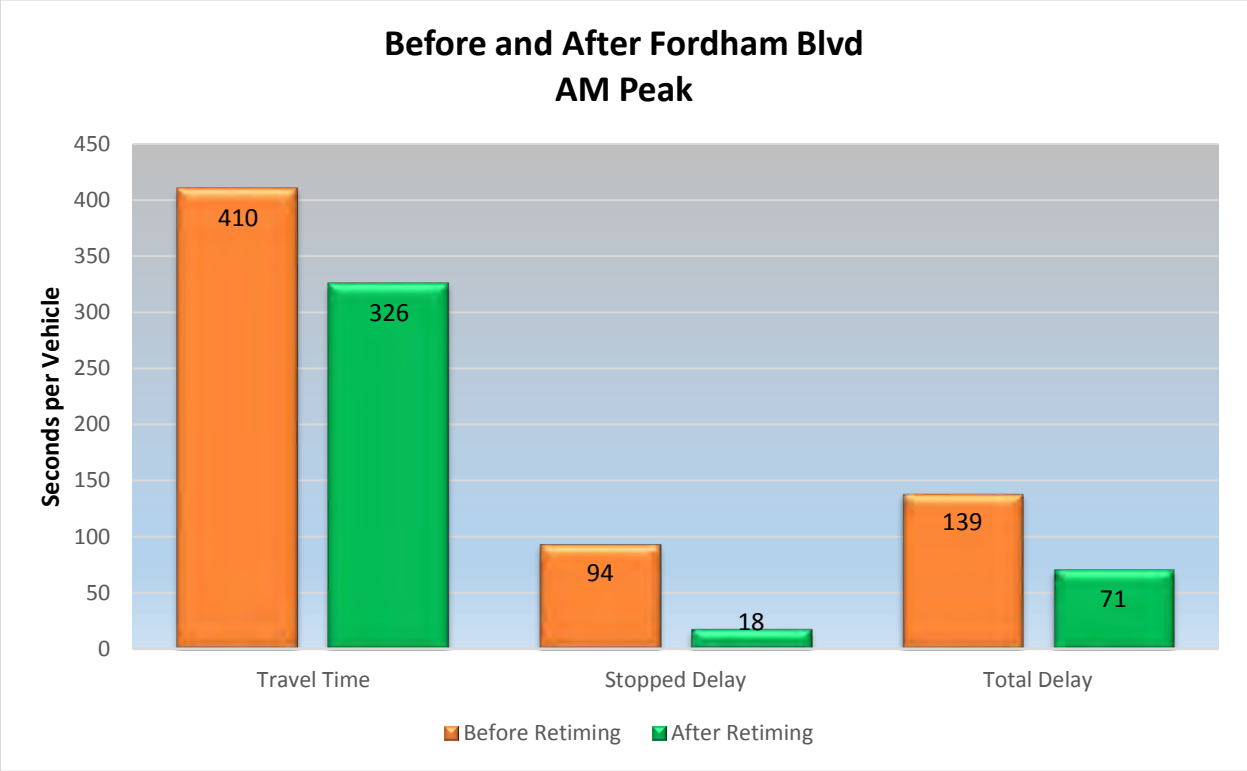
1. Before-and-After Signal Timing Study - Fordham Blvd
2. Before-and-After Signal Timing Study – NC 86/Martin Luther King Jr Blvd
3. Before-and-After Signal Timing Study - NC 54
4. Projected Fuel Consumption
5. Traffic Signal System - Map of Fiber Optic Cable Lines
6. Traffic Signal System - Maps of Signal Locations on Studied Corridors

Appendix A

Fordham Blvd Before and After Signal Timing Study

AM Peak Data Analysis

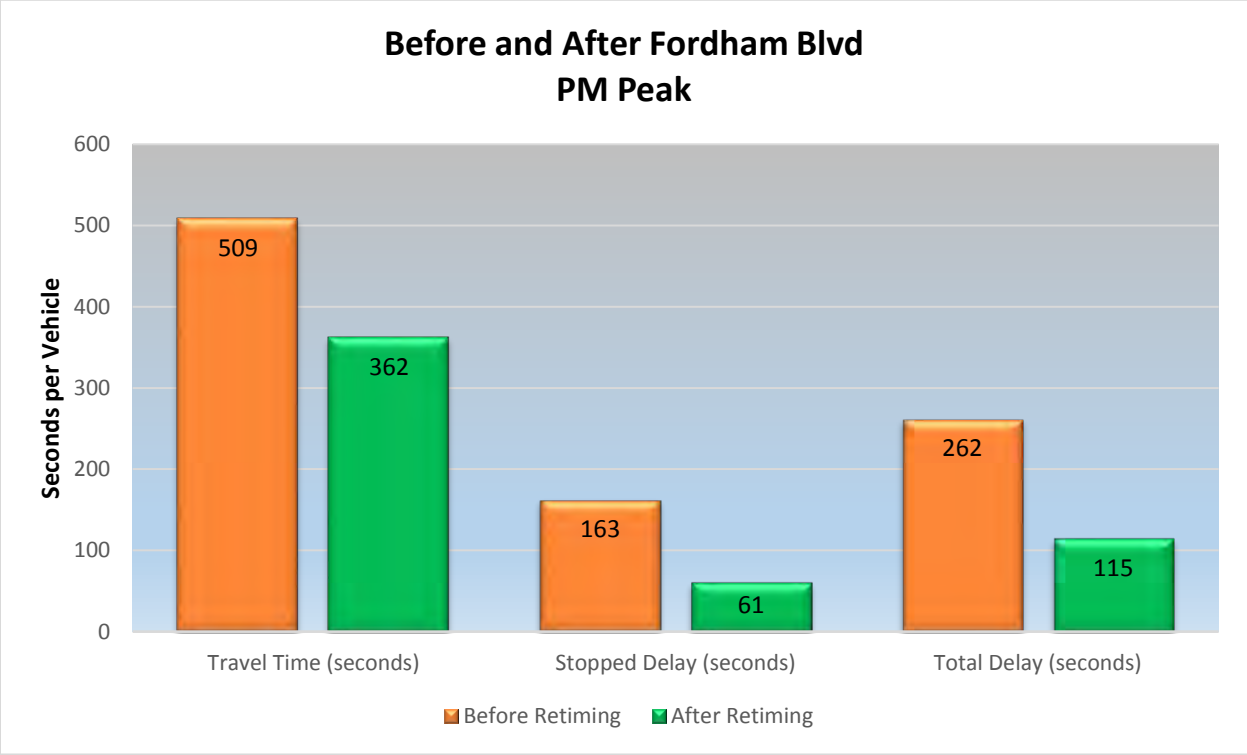
Before and After Fordham Blvd. – AM Peak Hour (7AM – 9AM) Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	410	94	139
After Retiming	326	18	71
Improvement (Before-After)	84	76	68
Percent Difference	**20%**	**8%**	**49%**



Fordham Blvd. Before and After Signal Timing Study

PM Peak Data Analysis

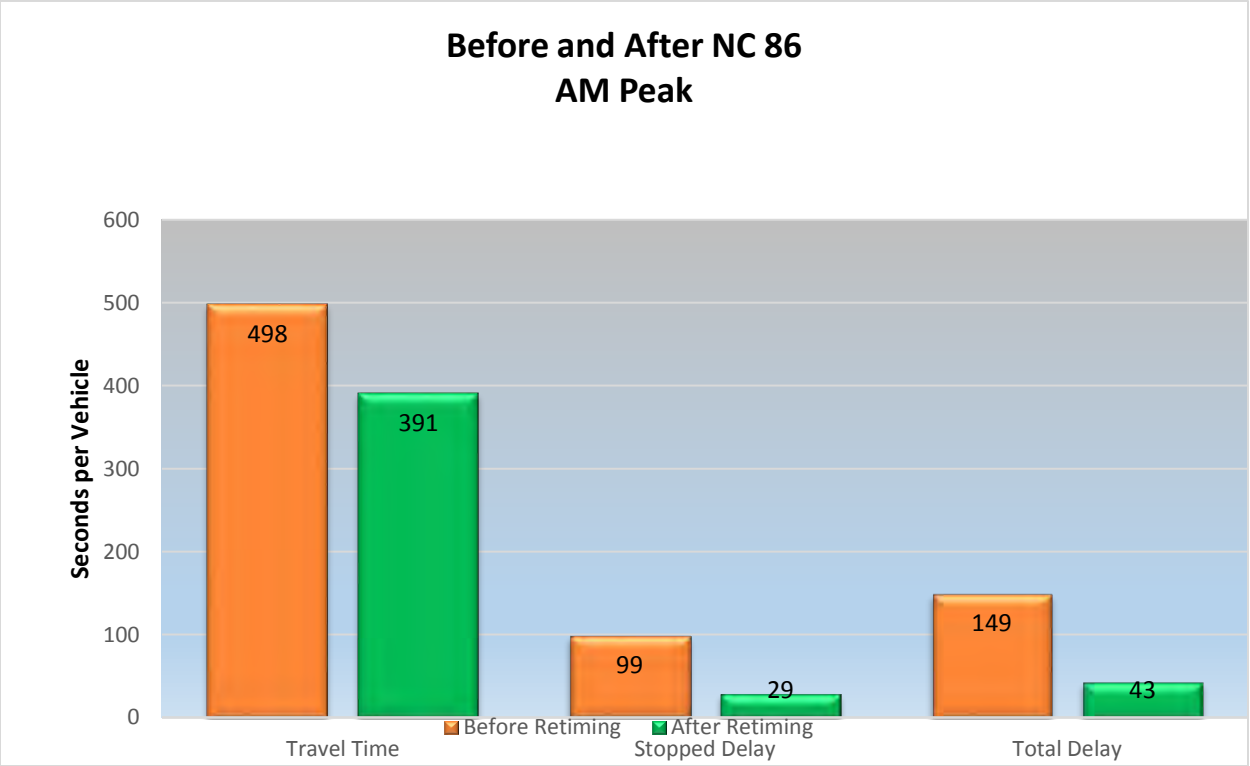
Before and After Fordham Blvd. – PM Peak Hour (4PM – 6PM) Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	509	163	262
After Retiming	362	61	115
Improvement (Before-After)	147	103	147
Percent Difference	**29%**	**63%**	**56%**



MLK Jr Blvd. (NC 86) Before and After Signal Timing Study

AM Peak Data Analysis

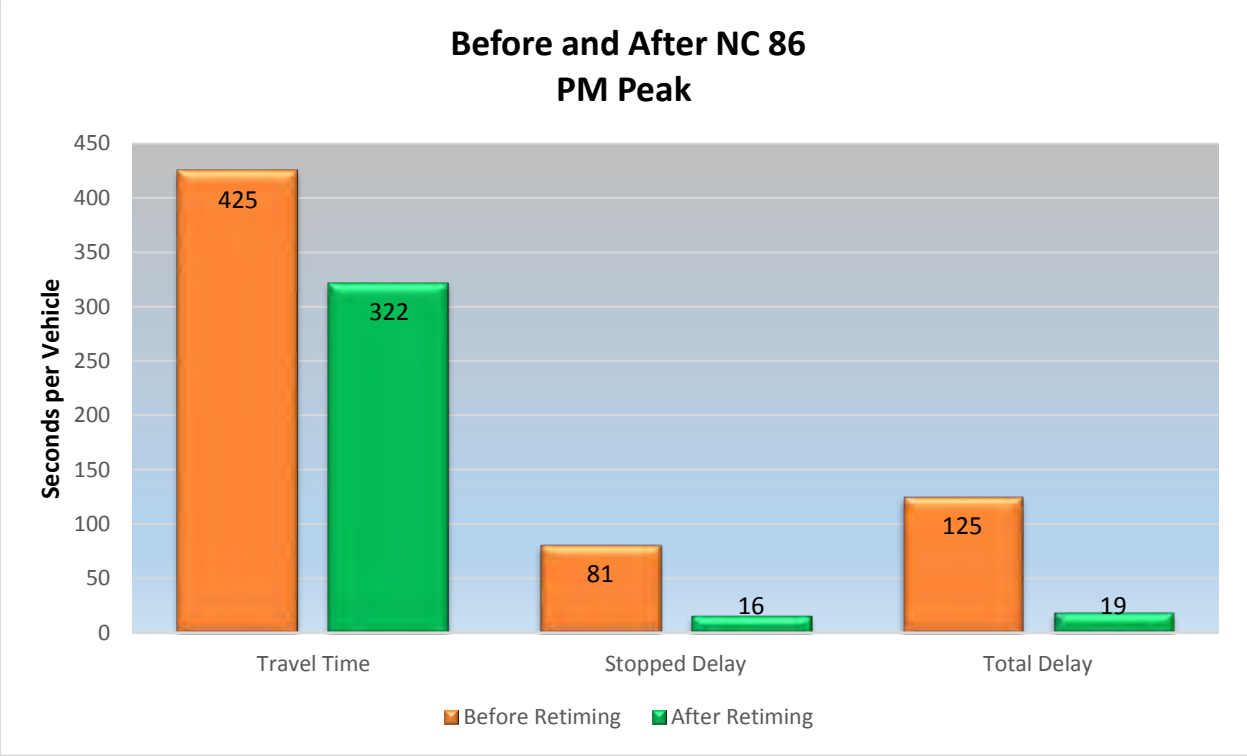
Before and After NC 86 – AM Peak Hour (7AM – 9AM) Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	498	99	149
After Retiming	391	29	43
Improvement (Before-After)	107	70	106
Percentage Difference	**21%**	**70%**	**71%**



MLK Jr Blvd. (NC 86) Before and After Signal Timing Study

PM Peak Data Analysis

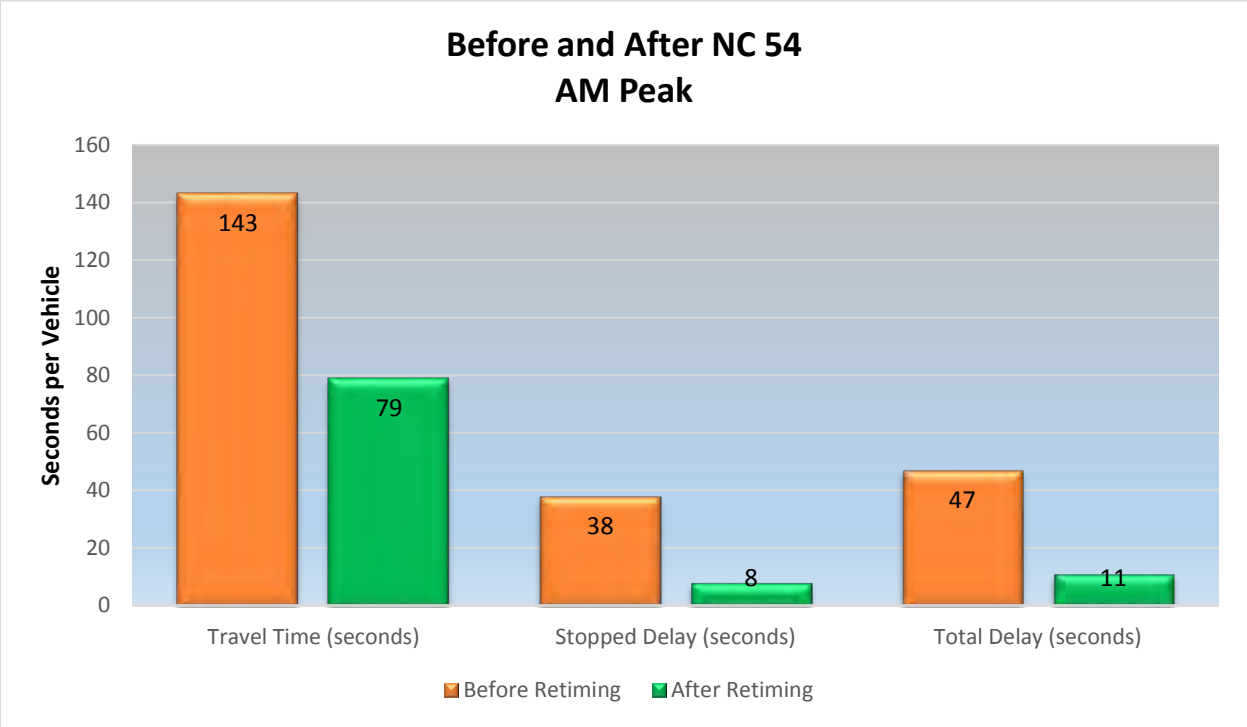
Before and After NC 86 – PM Peak Hour (4PM – 6PM) Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	425	81	125
After Retiming	322	16	19
Improvement (Before-After)	103	64	107
Percentage Difference	**24%**	**79%**	**85%**



NC 54 Before and After Signal Timing Study

AM Peak Data Analysis

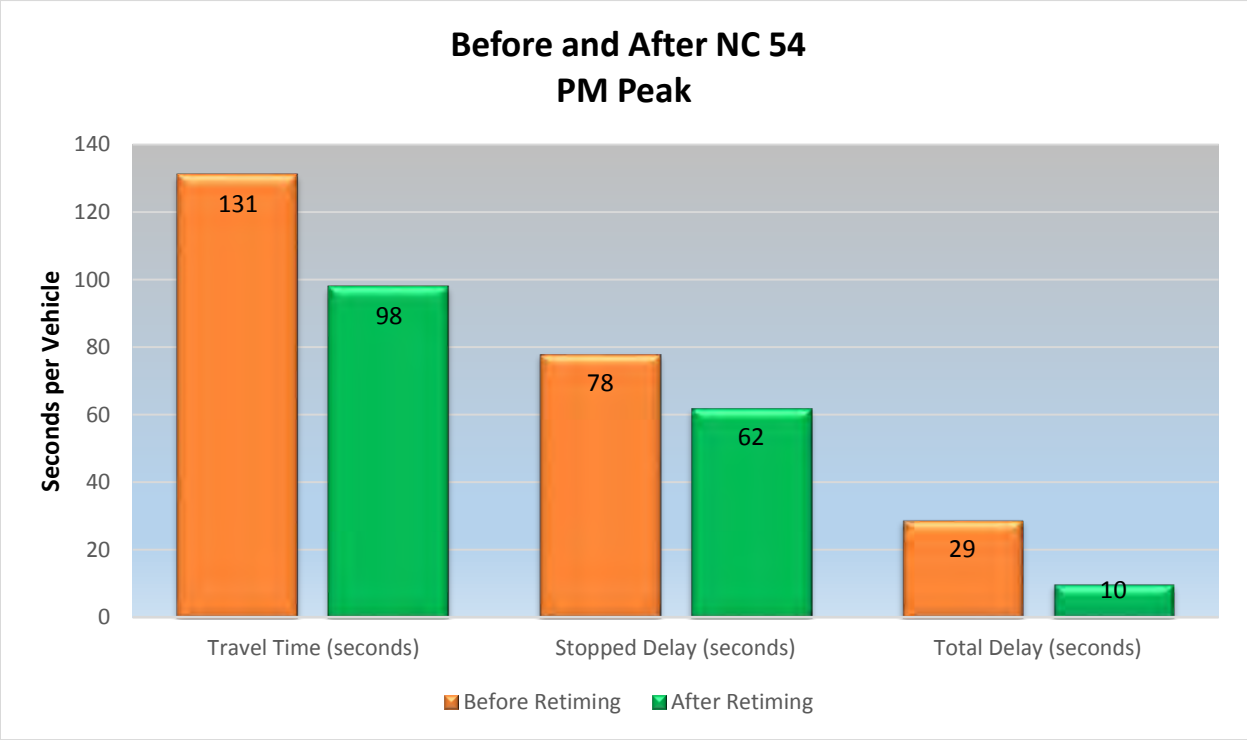
Before and After NC 54 – AM Peak Hour (7AM – 9AM) Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	143	38	47
After Retiming	79	8	11
Improvement (Before-After)	64	30	36
Percentage Difference	**45%**	**79%**	**76%**



NC 54 Before and After Signal Timing Study

PM Peak Data Analysis

Before and After NC 54 - PM Peak (4PM – 6PM) Hour Travel Time & Delay			
	Travel Time (seconds)	**Stopped Delay (seconds)**	**Total Delay (seconds)**
Before Retiming	131	78	29
After Retiming	98	62	10
Improvement (Before-After)	43	16	19
Percentage Difference	**33%**	**20%**	**65%**



Fuel Consumption and Greenhouse Gas Emissions

Fordham Blvd

Peak	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Emission Reduction/Hr*	
	Before	After	Savings	Tons of Emissions (CO2)	Equivalent to
AM Peak	983	941	42	0.41	895 miles driven by an average passenger vehicle
PM Peak	1,673	1,561	112	1.1	2,385 miles driven by an average passenger vehicle

MLK Jr Blvd. (NC 86)

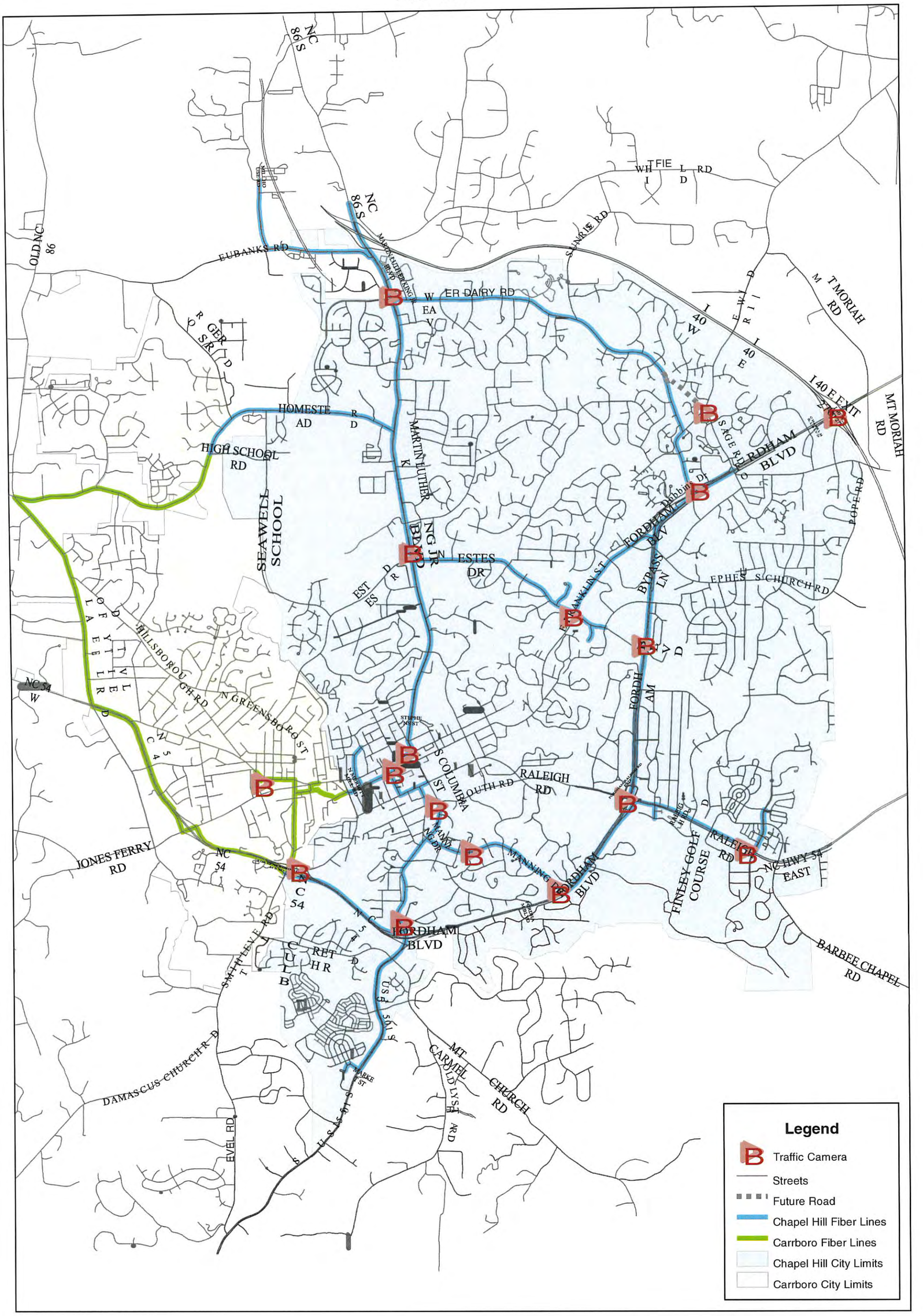
Peak	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Emission Reduction/Hr*	
	Before	After	Savings	Tons of Emissions (CO2)	Equivalent to
AM Peak	1020	907	113	1.1	2,407 miles driven by an average passenger vehicle
PM Peak	1,210	1,132	78	0.76	1,661 miles driven by an average passenger vehicle

NC 54

Peak	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Fuel Consumed (gal/hr)	Emission Reduction/Hr*	
	Before	After	Savings	Tons of Emissions (CO2)	Equivalent to
AM Peak	473	384	89	0.87	1,896 miles driven by an average passenger vehicle
PM Peak	532	517	15	0.15	319 miles driven by an average passenger vehicle

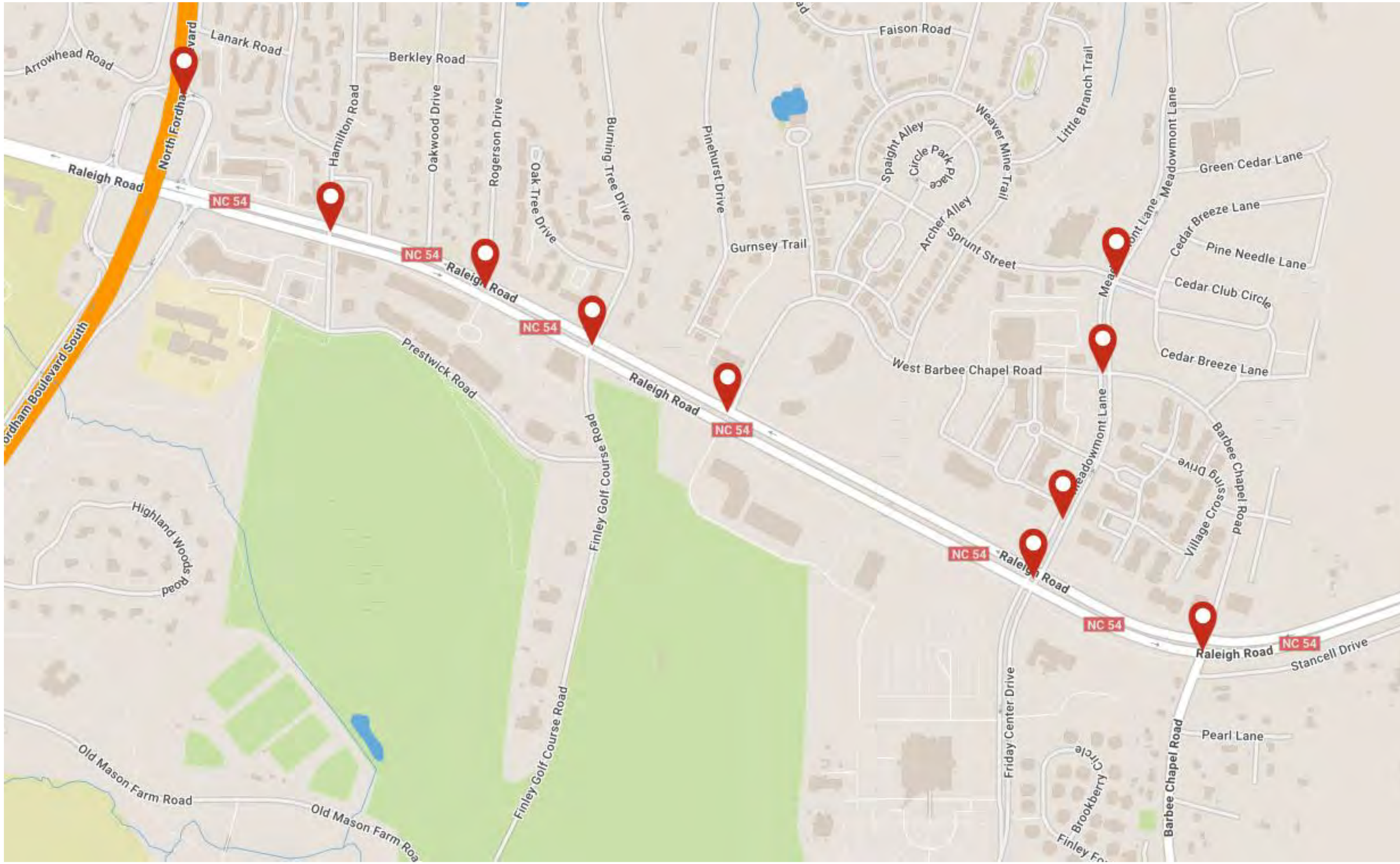
*Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Attachment 5

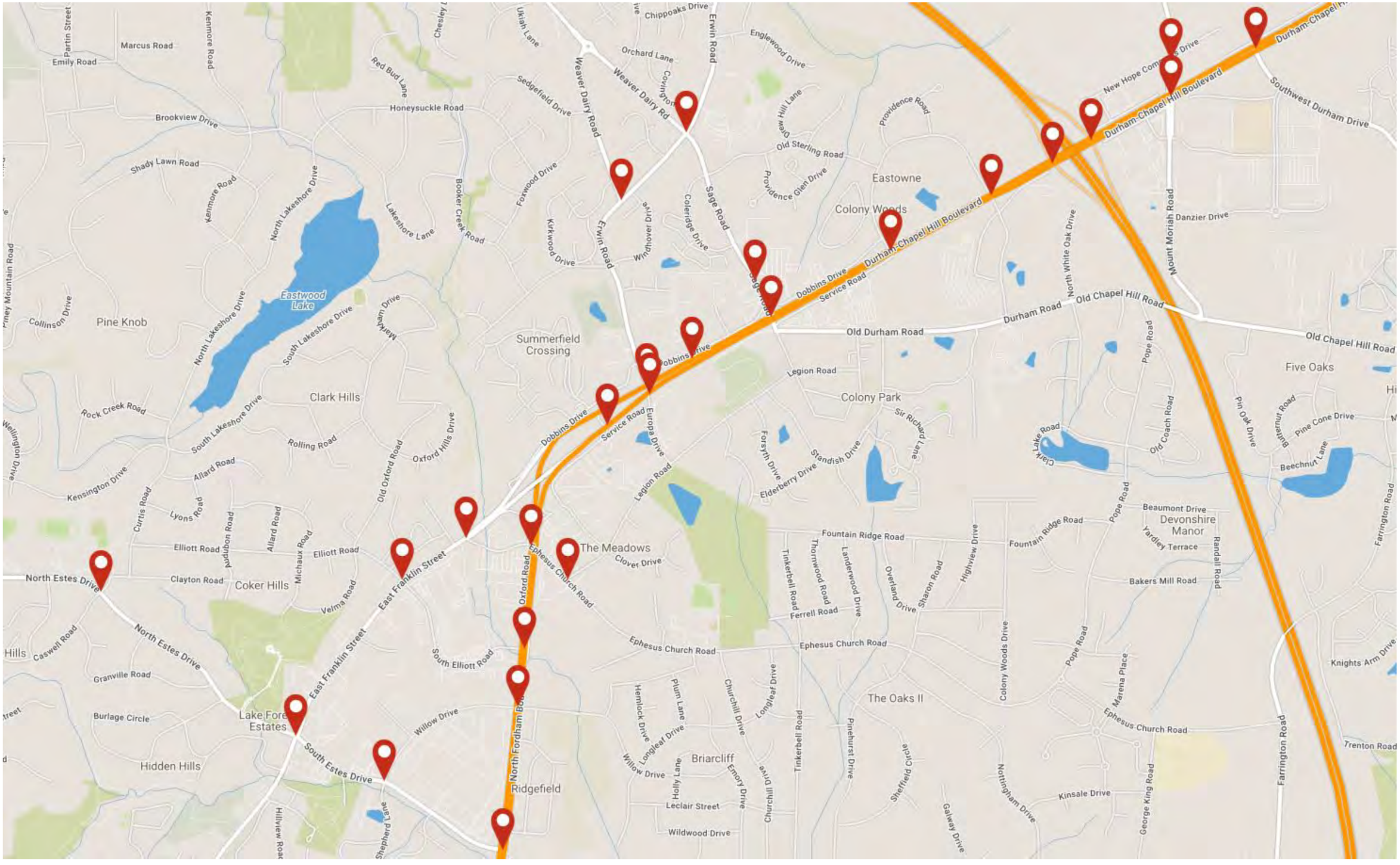
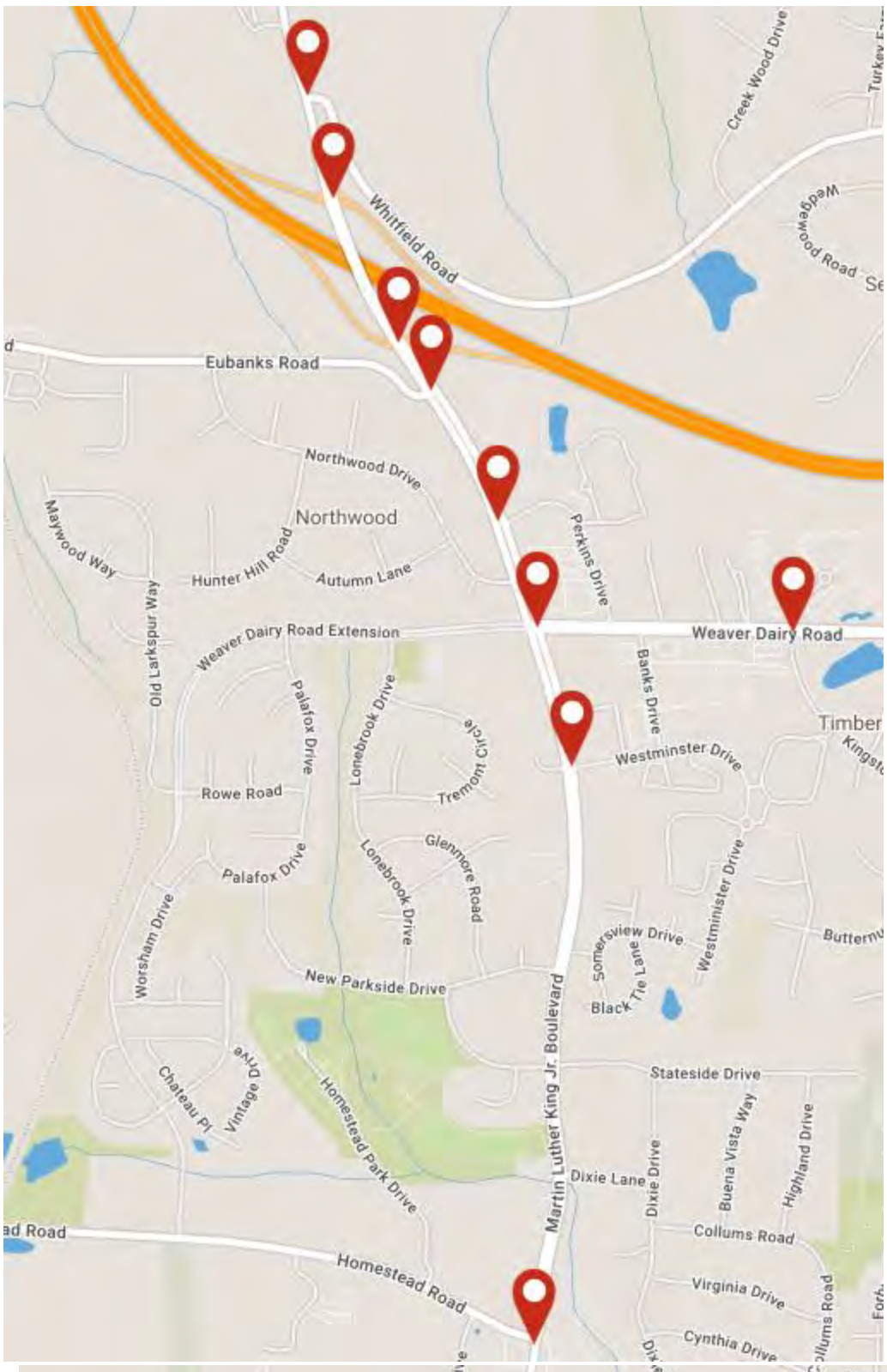
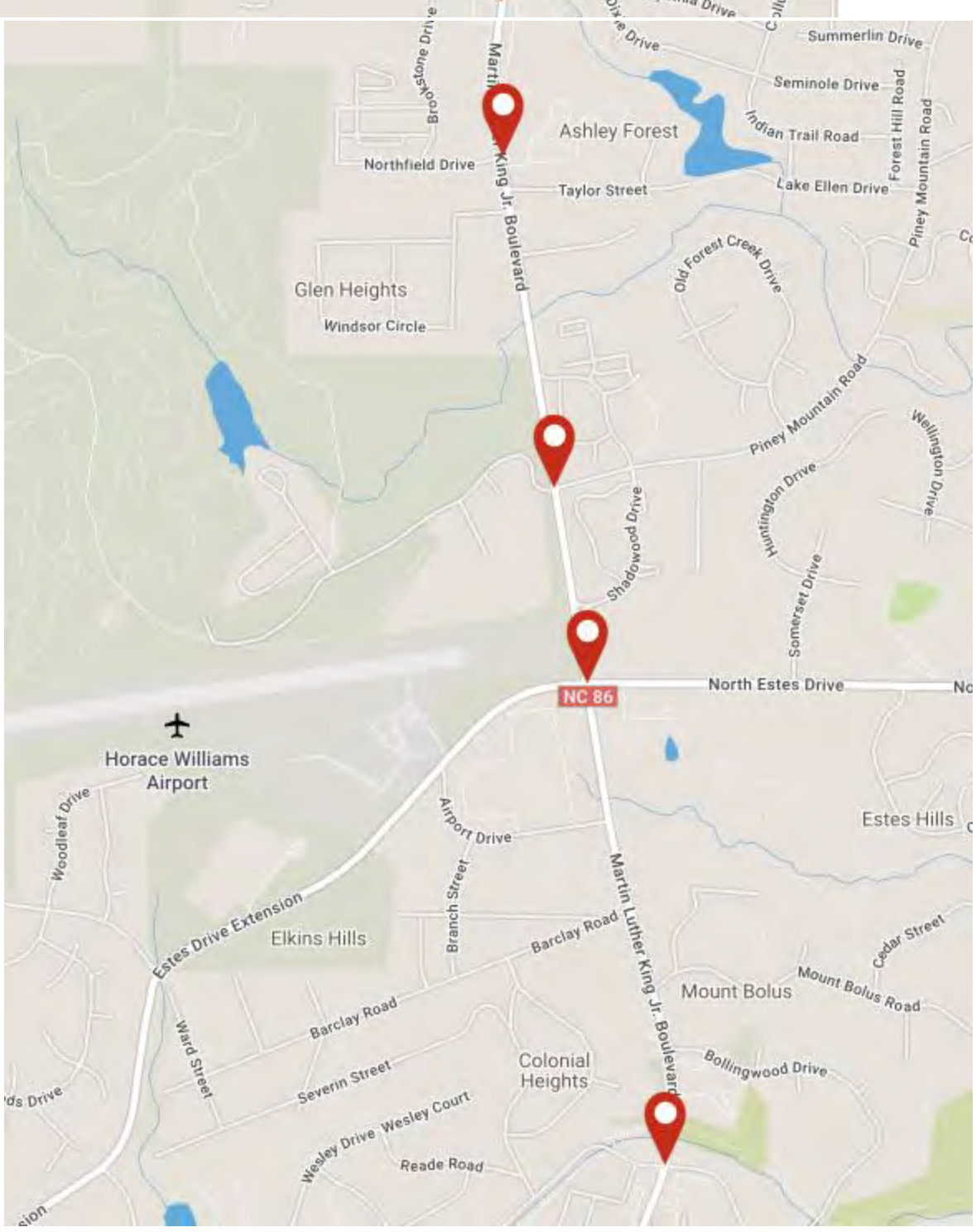


Traffic Signal Fiber Map for Chapel Hill/Carrboro

Signal Locations on NC 54 (Raleigh Rd)



Signal Locations on 15-501/Fordham/Franklin/Estes



Signal Locations along NC 86 (MLK Blvd)