

NC56

CORRIDOR STUDY

Final Report



Submitted to: NC Capital Area MPO
December 2015

Executive Summary

Study Purpose

The NC 56 Corridor Study is a collaborative project between the Capital Area MPO, the Town of Butner, the City of Creedmoor, Granville County, NCDOT, and the Kerr-Tarr RPO, focusing on a 4.5-mile section of NC 56 between 33rd Street in Butner and Darden Drive in Creedmoor. The goal is to enhance a vital connection between these two municipalities that accommodates the travel needs of residents in the area and adds value to adjacent land and to the broader region. Objectives considered and balanced against each other include:

- Safety
- Access to goods, services, and residences
- Reliable mobility
- Economic vitality/opportunity
- Environmental/community preservation
- Consideration of all travel modes, including bicycle, pedestrian, and freight
- Funding constraints

This study clarifies the long-term vision for the corridor, while identifying opportunities to address existing needs over a shorter timeframe. This study reassesses current plans to widen this portion of NC 56 to four lanes by 2040, and considers lower-cost projects that advance long-range plans while providing more immediate benefits with minimal disruption to existing residents, businesses, and the environment. An integrated strategy of short-term operational improvements, long-term infrastructure investments, and coordinated policies is identified, with the goal of preserving and enhancing environmental resources and the economic vitality of the corridor, and of the surrounding communities it supports.

Study Context

NC 56 is designated as a Boulevard/Major Thoroughfare in the Granville County Comprehensive Transportation Plan (CTP). Its federal functional classification was updated from Rural Major Collector to Minor Arterial status. Primarily a two-lane facility, NC 56 provides east-west connectivity across southern Granville County, serving the Town of Butner and City of Creedmoor, in particular. Access to I-85 via NC 56 is especially important, since the next interchange to the north is nearly 11 miles away. Competing with this critical mobility role, however, is the access provided to adjacent commercial, institutional, and residential development.

Average Annual Daily Traffic volumes (AADTs) on NC 56 typically range from 9,000 to 15,000 vehicles per day (vpd), with the highest volumes in the immediate vicinity of the I-85 interchange. There has been little traffic growth over the last decade, and volumes are generally lower now than they were at their high point in 2007. Traffic

growth over the next 25 years is anticipated to be moderate, averaging an estimated 2.2% increase annually. This translates to about 72% more traffic by 2040.

Key characteristics of the NC 56 corridor are not consistent throughout the study area. Traffic volumes, cross-sections, terrain, driveway/intersection spacing, crash frequency and causes, adjacent land uses, and anticipated development all vary significantly. For that reason, this study treats the NC 56 corridor as three distinct but related segments described below, and illustrated in Figure ES-1.

1. Western Segment

This portion of the corridor falls within the jurisdiction of the Town of Butner, extending approximately 1.4 miles between 33rd Street and Mill Stream Circle. The predominant cross-section is two travel lanes and a center two-way left-turn lane (TWLTL). This segment serves Butner's commercial center, primarily highway retail with some institutional and light industrial development fronting or accessing NC 56.

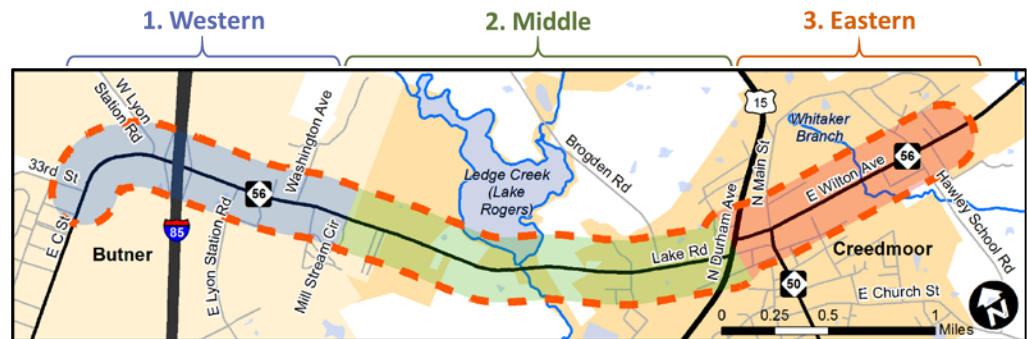
2. Middle Segment

The 1.85 mile segment between Mill Stream Circle and US 15/North Durham Avenue crosses the boundary between Butner and Creedmoor. This roadway consists entirely of two-lane ribbon pavement with side ditches. Adjacent land use is primarily rural-residential, with substantial undeveloped parcels. Lake Rogers Park is a significant feature of this corridor segment, which includes a bridge over Ledge Creek.

3. Eastern Segment

This 1.2 mile segment within the City of Creedmoor extends from US 15 to Darden Drive, and includes a short dogleg through downtown Creedmoor that NC 56 shares with US 15. While primarily a two-lane roadway, this segment includes several lengthy left-turn lanes and center left-turn lanes. Surrounding land use is characterized by mixed-use commercial development, transitioning eastward to more institutional/residential development, dominated by Creedmoor Elementary School and South Granville High School.

Figure ES-1: NC 56 Corridor Study Subareas



Study Process

The study was conducted over nine month period beginning in September 2014 and concluding in June 2015. The study was overseen by a Core Technical Team (CTT), composed of staff of the municipalities and organizations with jurisdiction over the corridor, and a Stakeholder Oversight Team (SOT), composed of professional staff, elected leaders, business owners, and other civic leaders with interest in the corridor. The CTT had five stand-alone meetings and four meetings that were combined with the SOT. The SOT met four times, in combination with the CTT members. Two Public Workshops were held, the first to explain the study and to gather input on needs and objectives, and the second to explain and gather feedback on alternatives developed to address identified needs and objectives.

Extensive data collection and analyses were performed as part of this study, along with thorough review of previous plans and studies. Every effort was made to coordinate with the ongoing Butner Gateway Study, as well as implementation of the Cross City Trail and other greenway projects.

Critical Issues

Crashes

Travel safety is a major concern in the corridor, based both on public perception and crash history analysis. Although crash rates for the corridor as a whole are lower than the statewide average for similar facilities, over half of the crashes occurred between West Lyon Station and East Lyon Station Roads, a segment representing only 10 percent of the study corridor. This concentration of crashes is attributable to the

density of driveways (20 in one-quarter mile) and the large number of conflicts they generate. Trucks, speeding, pedestrians, and school traffic were also cited by the public and study team members as concerns; these were supported to varying degrees by available data.

Congestion

Although congestion in the study corridor is not particularly severe, persistent, or widespread, there are locations where capacity-related delay is a recurring problem. Surges in traffic associated with school schedules or shift changes can trigger localized congestion and long vehicle queues, especially during the evening peak period. Hot spot locations include the I-85 interchange east to Campus Drive; west of the US 15 intersection; and at the elementary and high schools. Perhaps of greater concern is the potential worsening of congestion as new development occurs and background traffic volumes increase.

Access

Accessibility concerns typically focused on anticipated impacts of future roadway improvements—such as medians—rather than on existing conditions. (However, some participants noted that the difficulty in making left turns at some establishments was a deterrent to patronage.) Business owners in particular expressed worries that improvements to NC 56 would reduce accessibility for potential customers, hurting their bottom lines. Some homeowners were also concerned about potential inconvenience resulting from a median in front of their driveway.

Pedestrians and Bicycles

The demonstrable lack of bicycle and pedestrian connectivity throughout the corridor was frequently cited as a major source of concern and frustration. While ongoing plans and projects are beginning to address this deficiency, there are fears the resulting increase in pedestrian and bicycle trips could lead to more crashes involving people travelling by these modes. Support for greater continuity, convenience, and safety for bicycle and pedestrian travel options has grown, a trend that appears likely to continue.

Aesthetics

Aside from a strictly aesthetic/quality-of-life perspective, the current appearance of the corridor was cited as a possible deterrent to economic development.

Wayfinding

Confusion among drivers unfamiliar with the area was identified as a problem, especially along the commercial strip at I-85. Several possible contributing factors include inadequate signing, numerous driveways, and sensory overload/distraction to drivers.

Implementation

Given the current level of competition for limited/uncertain funding, there is great interest in maximizing the attractiveness of projects for funding and programming prioritization, and to minimize risk and life-cycle costs. While a long-range vision is still valued, there is a desire for more immediate returns on public investment, and greater cost-effectiveness, especially with regard to preserving existing infrastructure investments.

Study Recommendations

The NC 56 Corridor Study recommends a wide-ranging but integrated package of improvements summarized in the following sections.

Corridor-Level

Recommended changes to the ultimate cross-section of NC 56 are described below, organized according to the three segments defined previously and depicted in Figure ES-2. Representative cross-sections are also illustrated.

Western Segment

- Widen the existing roadway to a 3-lane segment from 33rd Street to the at-grade railroad crossing west of West Lyon Station Road. The center lane can vary between a two-way left-turn lane (Figure ES-3) or a landscaped median (Figure ES-4).

- Widen the existing roadway to a 4-lane divided section beginning at the at-grade railroad crossing, and ultimately extending east to approximately the Butner Town Limits (Figure ES-5). The initial phase extends only as far east as South Campus Drive. The portion east of South Campus Drive could be widened initially to three lanes, to be widened further as warranted by development and traffic.
- Widen the bridge over I-85 to 5 lanes, as follows:
 - Four through lanes across the bridge
 - Back-to-back left-turn lanes with a narrow raised concrete island separating the two directions of travel
 - Sidewalks on both sides of the road along with a standard two-foot shoulder between the travel lane and curb

Middle Segment

- Widen the existing roadway to a 3-lane section with a two-way left-turn lane or landscaped median from approximately the Butner Town Limits east to Brogden Road (Figure ES-3 and Figure ES-4).

Figure ES-2: Proposed Corridor Segment Improvements



Eastern Segment

- Widen the existing roadway to a 4-lane section (2 eastbound, 1 westbound, 1 turn-lane from Brogden Road to a point approximately 800 feet east of North Main Street (Figure ES-6). A portion of this road will continue on new alignment west of US 15. This extension straightens out the existing “dog-leg” movement at US 15. Although a second westbound lane would provide additional benefits, it may not be feasible due to right-of-way constraints, and intersections can operate at acceptable levels with a single westbound lane.
- Widen the existing roadway to a 3-lane segment with a two-way left-turn lane or landscaped median from approximately 800 feet east of North Main Street to Darden Drive (Figure ES-3).

Figure ES-3: Three-Lane Cross-Section (With a TWLTL)

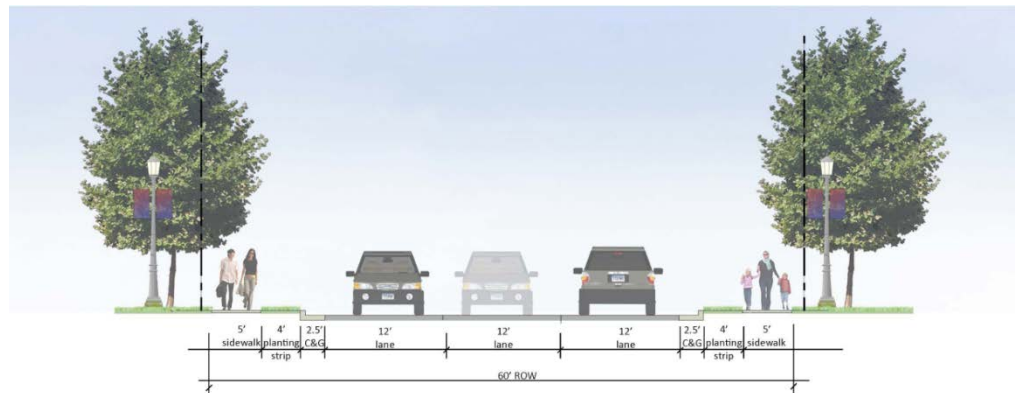


Figure ES-4: Three-Lane Cross-Section (With a Landscaped Median)

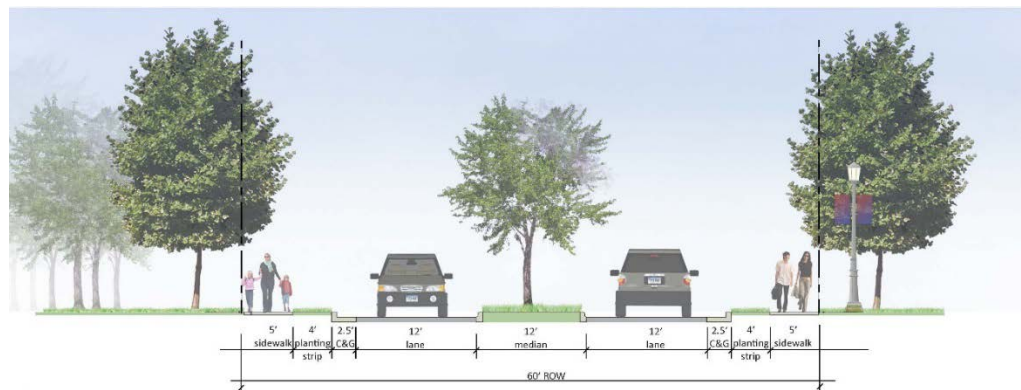


Figure ES-5: Four-Lane Cross-Section (With a Landscaped Median)

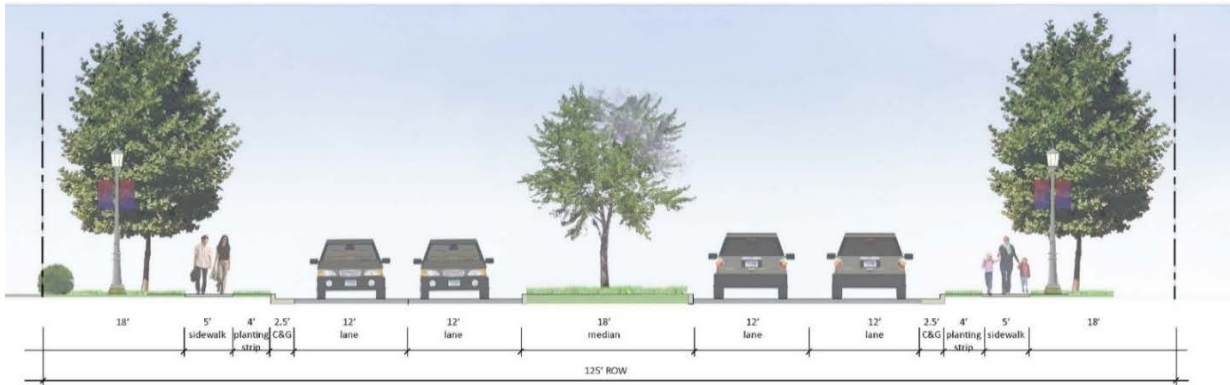
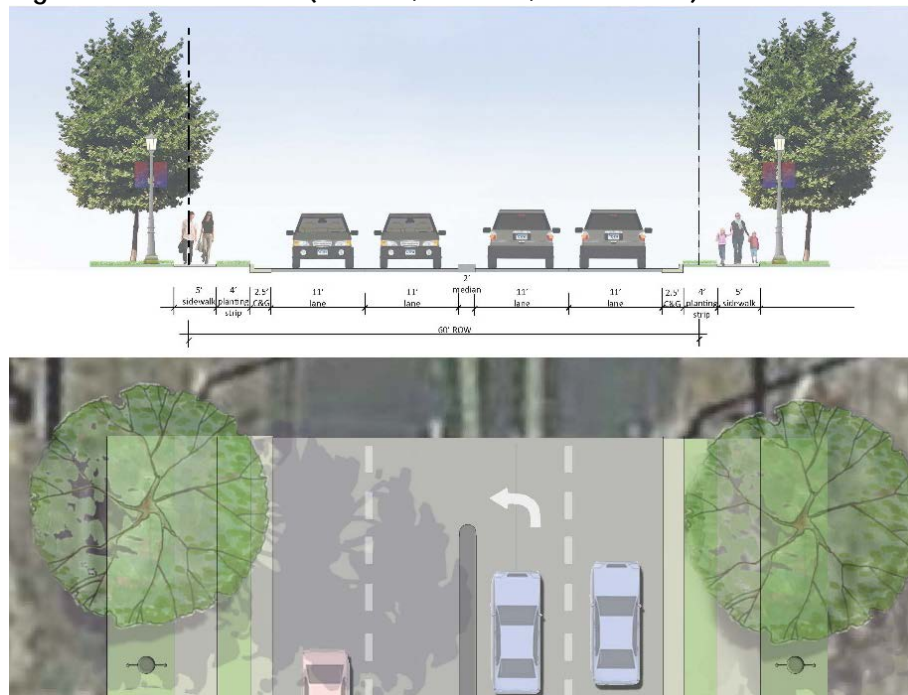


Figure ES-6: Four-Lane (Two EB, One WB, 1 Turn Lane) Cross-Section



- Figure ES-7 shows the recommended extension and realignment of NC 56/West Lake Road, combined with a roundabout at US 15 and NC 56. This configuration eliminates the existing “dogleg” condition while minimizing impacts on existing properties, allowing for future redevelopment, and providing opportunities for non-motorized travel.

Figure ES-7: NC 56 Extension with Roundabout at US 15

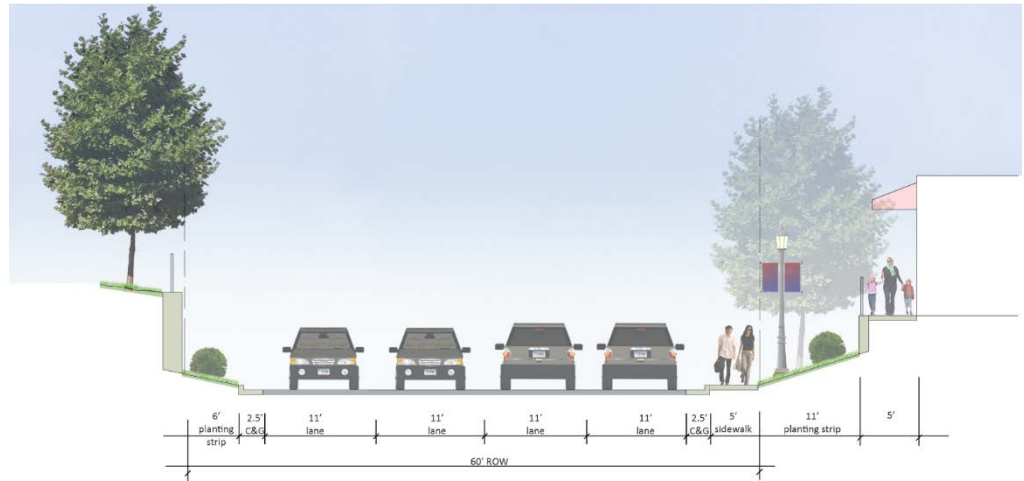


- Figures ES-8 and ES-9 illustrate changes to NC 56 immediately east of North Main Street (NC 50), indicating the loss of some on-street parking and the consolidation of access to serve connected off-street parking.
- TIP project R-5707 will improve the three US 15, NC 50, and NC 56 intersections to improve traffic flow, pedestrian mobility, access, safety, and appearance. More detailed study and design will be underway by 2017, with completion anticipated by 2020.

Figure ES-8: NC 56 East of North Main Street



Figure ES-9: 4-Lane (2 eastbound, 2 westbound) Cross-Section



Intersections

Details of individual intersection improvements are addressed in the main body of this report. All such improvements are associated with the overall corridor widening, although some may be implemented in advance of the ultimate widening.

Pedestrian and Bicycle Improvements

Accommodations for safe and convenient bicycle and pedestrian travel are explicitly incorporated in all roadway and intersection improvements recommended as part of this study. A top priority has been to seamlessly integrate existing bicycle, pedestrian, and greenway plans with all recommendations. Additional options and features have also been identified where appropriate. However, since many roadway project design decisions will impact the final design of proposed bicycle and pedestrian facilities, bicycle and pedestrian recommendations focus on the intent of the improvements, more than the specific location, dimensions, and design elements. Most critically, roadway projects must respect existing and planned non-motorized facilities, advancing and enhancing them where ever practical. Roadway projects should avoid creating additional barriers or precluding future pedestrian and bicycle improvements.

Other Recommendations

Creedmoor Elementary School Improvements

Queuing associated with the loading operations of the school can affect NC 56 during morning drop-off and afternoon pick-up periods. The school requires an estimated 925 to 1,200 feet of stacking, with only 665 presently available. To help address this concern a School Transportation Management Plan (TMP) is recommended. The TMP will evaluate internal traffic operations and physical constraints in detail. Possible options for increasing on-site vehicle stacking capacity include switching the student and bus areas or widening the existing carpool line to accommodate double stacking.

Access Road System between I-85 and East Lyon Station Road

The widening of NC 56 to a 4-lane divided cross-section between I-85 Northbound and East Lyon Station Road would affect access for existing businesses, eliminating most left-turns and requiring U-turns in their place. To mitigate this impact, a network of “backage” roads is recommended to provide signal-controlled access without U-turns. The new roads depicted on the north side of NC 56 in Figure ES-10 provide a minimal functional network that directs left-turn maneuvers to an improved East Lyon Station Road signal. Interconnected driveways already exist between businesses on the south side, but would be improved as needed.

This additional street network should serve low volumes of traffic, typically requiring two-lane roads, with two-way, left-turn lanes required only for high left-turn volumes. The enhanced access network illustrated in Figure ES-11 also provides the starting point for longer-term roadway connections as property develops or re-develops in the future. With such a network of streets in place, drivers, pedestrians, and bicyclists will have safer, more efficient options for travel that reduce congestion on NC 56.

Streetscape Enhancements

Details of landscaping, hardscape elements, signage/wayfinding, lighting, and other streetscape amenities are beyond the scope of a corridor plan of this type. However, the recommended design concepts intentionally provide flexible opportunities for incorporating such treatments, depending on the location, budget, and purpose of the improvement project. The plans and profiles included in this report offer generic examples of a range of streetscape enhancements. Note that the placement of sidewalks and street trees / streetscaping enhancements can be reversed from the layout shown in the design concepts in order to provide more buffer between the roadway and the sidewalk, depending on constraints and local preferences.

Figure ES-10: Initial “Backage” Road Phase

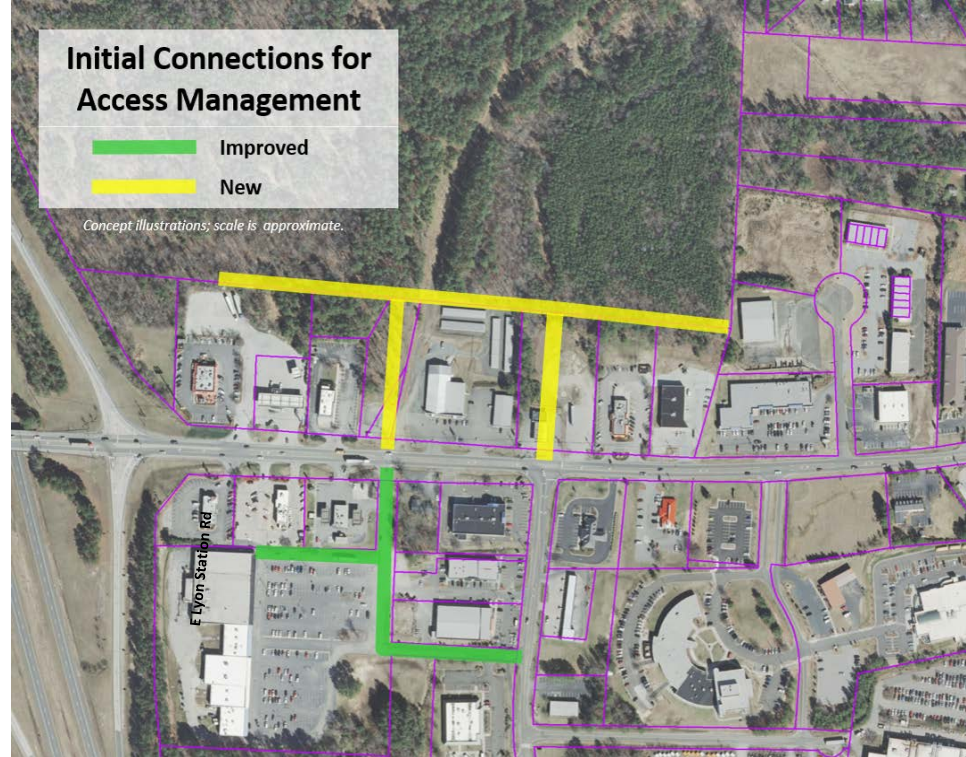
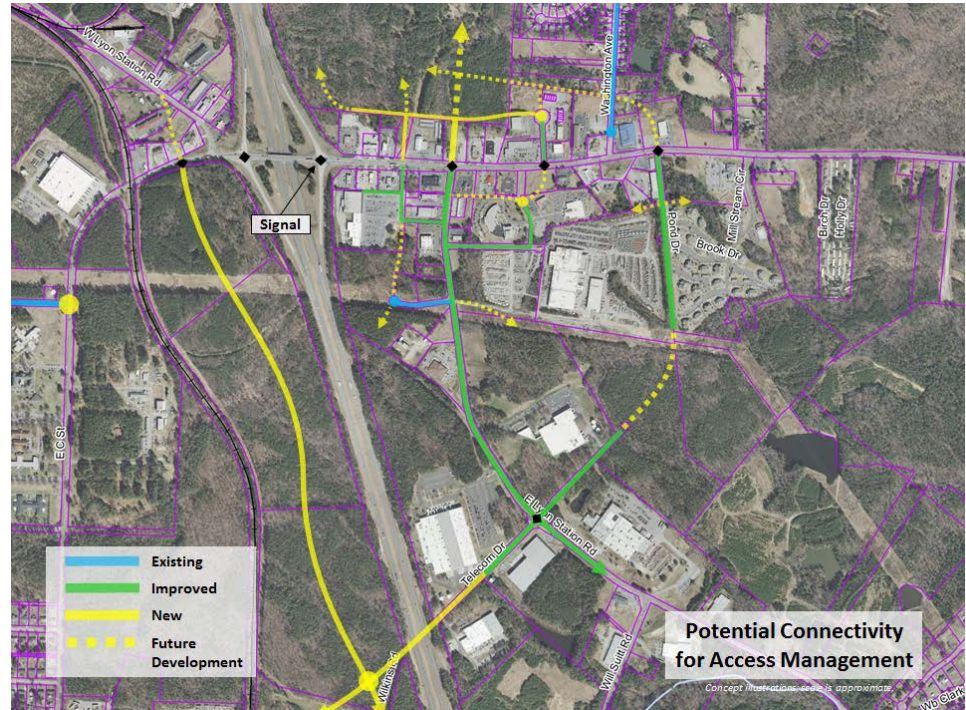


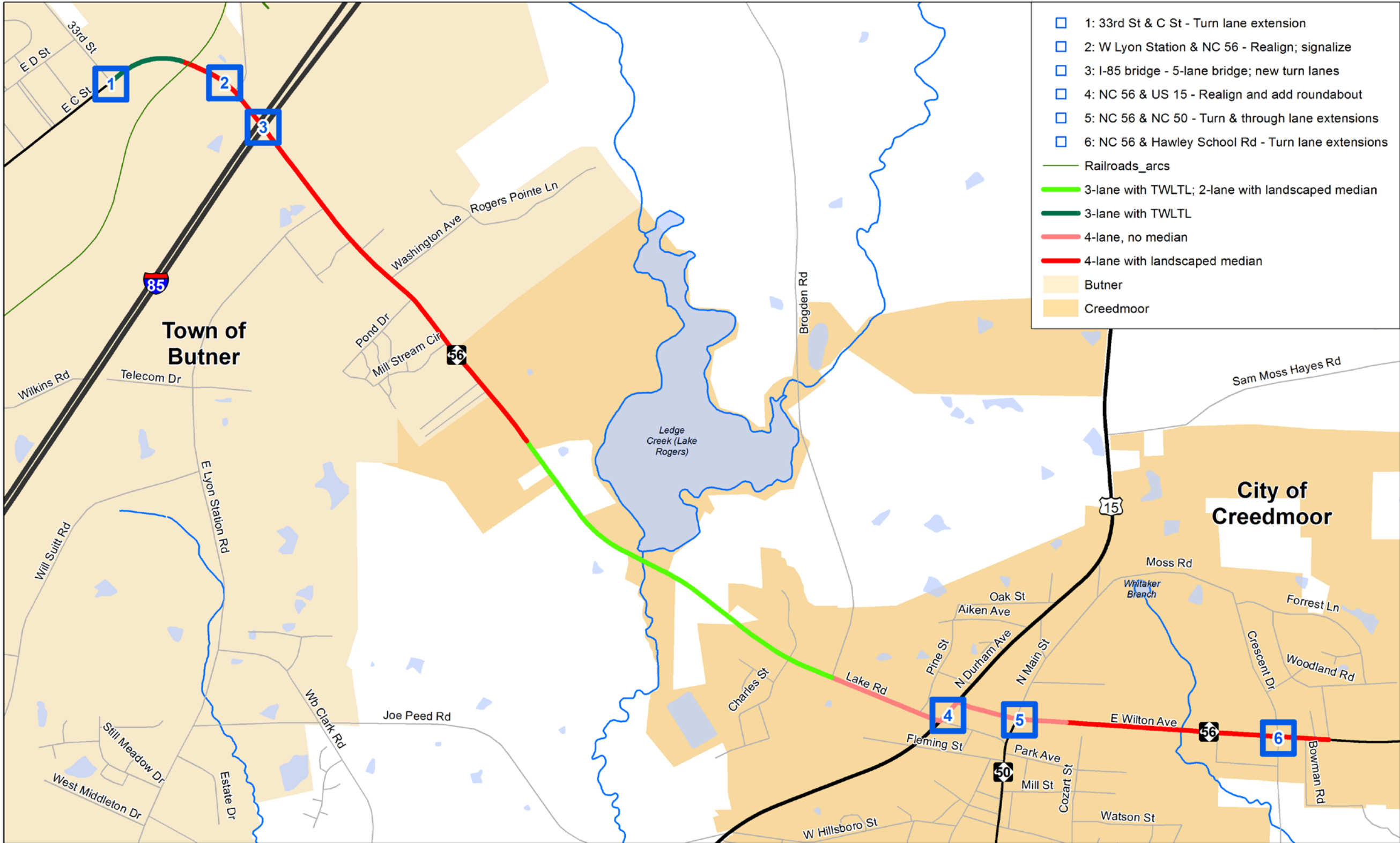
Figure ES-11: Conceptual Access Network Connections



Full Corridor 2040 Vision

The full build out vision for the horizon year 2040 is shown in Figure ES-12. This includes the cross section profiles for all of NC 56 as well as the expected intersection improvements that would accompany the identified widening program.

Figure ES-12: Full Corridor Recommendation Overview



NC 56 Corridor Study - Year 2040 Recommendations Overview

0 0.25 0.5 1 Miles



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Introduction

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The base speed limit throughout the corridor is 35 mph. There is a 25-mph school zone at the elementary and high schools, from 7:00 – 8:55 AM and 2:00 – 4:00 PM on school days. Just east of the study corridor, the speed limit increases to 45 mph; immediately to the west there is a special 25 mph zone past the Murdoch Center.

Passing is prohibited through the entire length of the study corridor. Although cross-sections vary, the typical section is two lanes, but there are some three lane sections. Travel lanes are generally 10 feet wide throughout the two-lane segments that comprise the majority of the corridor.

Considering the variations in roadway characteristics and surrounding land uses, it is helpful to divide the study corridor into three segments (see Figure 1):

1. Western Segment

This portion of the corridor falls within the jurisdiction of the Town of Butner, extending approximately 1.4 miles from 33rd Street to Mill Stream Circle. The cross-section consists of two travel lanes and a center two-way left-turn lane (TWLTL) along almost the entire segment. This segment serves Butner's commercial center, primarily highway retail with some institutional and light industrial development fronting or accessing NC 56. This segment contains the only highway interchange and the only at-grade rail crossing in the study corridor.

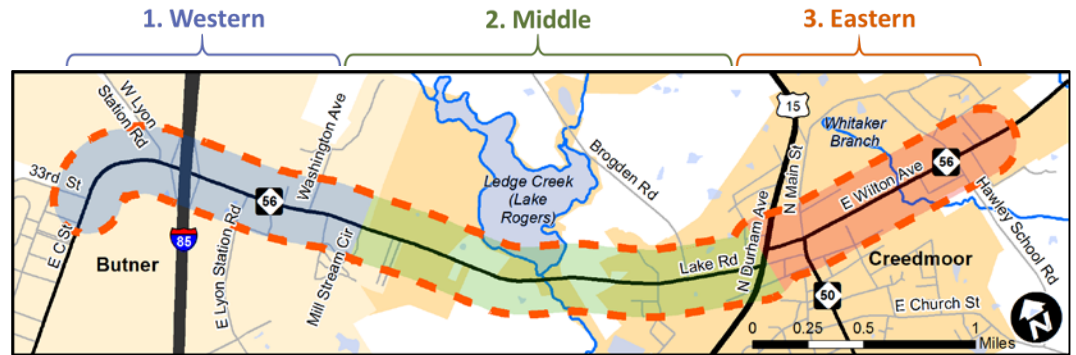
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This 1.2 mile segment within the City of Creedmoor extends from US 15 to Darden Drive, and includes a short (approximately 400 feet) dogleg through downtown Creedmoor that NC 56 shares with US 15. While primarily a two-lane roadway, this segment includes several lengthy left-turn lanes, and center left-turn lanes between Hawley School Road/Crescent Drive and Darden Drive. The corridor intersects Main Street at the northern end of the downtown commercial district. Surrounding land use is characterized by mixed-use commercial development, transitioning eastward to more institutional/residential development, dominated by Creedmoor Elementary School and South Granville High School.

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Existing Conditions

Transportation Infrastructure

NC 56 Roadway Design Elements

This section summarizes vertical and horizontal alignments, cross-sections, and other significant physical features of the NC 56 roadway for each of the three corridor subarea segments.

1. Western Segment

This portion of the corridor extends about 1.4 miles from 33rd Street to Mill Stream Circle. The cross-section consists of two travel lanes and a center two-way left-turn lane (TWLTL) along essentially the entire segment. While there is a very small amount of curb-and-gutter fronting some more recent development, for all practical purposes the typical section is ribbon pavement with swales and no shoulder or sidewalks.

The alignment is relatively flat from the high point at the I-85 overpass, with estimated average downhill grades of less than one percent to the west of the overpass, and from South Campus Drive to Mill Stream Circle. Except for a long curve between 33rd Street and West Lyon Station Road, the alignment is also relatively straight.



Looking West at East Lyon Station Road

Driveways are numerous and closely-spaced, many with wide, sweeping radii. There is little interconnectivity, and many establishments have multiple access points - not all of which are clearly defined. There are five signalized intersections, with no cross

walks or pedestrian signals. This segment contains the only highway interchange and the only at-grade rail crossing in the study corridor.

Driveway conflicts are a significant issue in this corridor segment, which includes nearly 40 driveways, 20 of which occur within a span of less than 1500 feet just east of the northbound I-85 ramp. There is little connectivity or shared parking among individual parcels, several of which have multiple and/or poorly-defined driveways.



Driveway traffic conflicts

2. Middle Segment

This 1.85 mile segment between Mill Stream Circle and US 15/North Durham Avenue consists entirely of two-lane ribbon pavement with side ditches. Travel lanes are approximately 10 feet wide, with no significant shoulders. There are no sidewalks or side paths, and no signalized intersections until the end of this segment at US 15.

In the approximately 0.85 miles between Mill Stream Circle and the Ledge Creek Bridge, elevation drops over 80 feet, yielding an estimated average grade of just under two percent. While this grade is not problematic in itself, its presence on a long curve can lead to vehicle speeds that exceed desirable visibility ranges. The alignment then climbs again for just over one-half-mile, rising approximately 100 feet before cresting between Charles Street/Recovery Road and Brogden Road. Combined with reverse curves and more frequent driveways and intersections, the resulting estimated average slope of three percent yields greater potential for significant speed and visibility problems. The road descends at about a two percent grade over a relatively straight alignment to the intersection with US 15.



Looking east near Holly Drive



Looking west at Lake Rogers Park



Looking west from US 15

3. Eastern Segment

This 1.2 mile segment extends from US 15 to Darden Drive, and includes a short (approximately 400 foot) dogleg that NC 56 shares with US 15. While primarily a two-lane roadway, this segment includes several lengthy left-turn lanes, and TWLTLs between Hawley School Road/Crescent Drive and Darden Drive. Most of this segment has no functional shoulders, and travel lanes are 10 to 12 feet wide, with the narrower lanes typical of the older, unimproved portions. This corridor segment consists of relatively straight alignments, with some undulating vertical curves between Main Street and Hawley School Road/Crescent Drive.

Large utility lines and frequent poles are located close to the roadway, and particularly along the western portion of this segment there are numerous driveways, some unpaved. In several locations, driveways extend as continuous aprons along the entire frontage of an establishment, including around the corners of intersecting roadways. Such configurations have negative impacts on traffic capacity and safety for both vehicles and pedestrians.

Although sidewalks have been recently constructed along most of this segment, they are present on only one side of the road, alternating sides four times. The distance of these sidewalks from the edge of pavement varies considerably; curb-and-gutter has been installed in some locations, with sidewalk either against the back of curb or within two feet.



Looking north at West Lake Road



Looking west towards US 15



Lack of access management, looking west towards North Main Street



New development, northwest corner of NC 56 & North Main Street



Driveway and pedestrian issues, northeast corner of North Main Street & NC 56



Looking east from Creedmoor Gymnasium & Activity Center

NC 56 Intersections

NC 56 currently intersects 25 public streets along the corridor study area, including both sets of ramps at the I-85 interchange. Eight are signalized; for all but one of the remainder, the intersecting road is STOP-controlled. The one exception is the intersection at North Durham Avenue (US 15) and East Wilton Avenue (NC 50), where NC 56 makes one of two right-angle turns along a short stretch of US 15 (North Durham Avenue). At this location, westbound NC 56 (East Wilton Avenue) is STOP-controlled.

As part of traffic analysis, peak-period turning-movement counts were collected at all of the signalized intersections, as well as the unsignalized North Durham Avenue (US 15) and East Wilton Avenue (NC 50) intersection.

Signalized Intersections

- 33rd Street (SR 1112)
- I-85 southbound ramps
- I-85 northbound ramps
- West Lyon Station Road (SR 1237)
- East Lyon Station Road (SR 1108)
- North Durham Avenue (US 15)/Lake Road (SR 1736)
- North Main Street (NC 50/SR 1639)
- Crescent Drive (SR 1640)/Hawley School Road (SR 1733)

Unsignalized Intersections

- South Campus Drive
- Capitol Drive
- Washington Drive (SR 1672)
- Pond Drive
- Mill Stream Circle
- Birch Drive
- Holly Drive
- Recovery Road/Charles Street
- Stem Road/Brogden Road (SR 1127)
- Pine Street
- Douglass Drive
- Crescent Heights Drive
- Bowman Road (SR 1729)
- Ascot Drive
- North Durham Avenue (US 15) at East Wilton Avenue (NC 50)
- Darden Drive (SR 1733)

Bridges

NC 56 crosses two bridges in the study corridor:

Ledge Creek Bridge

As of June 2014, this bridge is listed with a Sufficiency Rating of 65.7 percent, with no load limitations. However, it has been recently posted with a 38 ton limit. Built in 1967, it has been determined to be Functionally Obsolete - meaning that while it may not be unsafe or structurally unsound, its design does not allow it to function adequately under current conditions and standards. Such deficiency may be attributed to narrow width, lack of emergency shoulders, inadequate traffic capacity, occasional flooding, lack of pedestrian/bicycle accommodations, or load limitations. In this particular case, the bridge railings, approach guardrails and guardrail ends, and transitions all fail to meet currently acceptable standards. In 2012, the deck, superstructure, and substructure were all rated in fair or satisfactory condition. Due to narrow width, low guardrails, and high traffic volumes and speeds, this bridge is unsuitable for pedestrian access.



Ledge Creek Bridge, looking west (L) and east (R)

I-85 Bridge

This bridge, constructed in 1969 is listed on the NCDOT website as having a Sufficiency Rating of 90.5 percent as of June 2014. In 2012, the condition of the deck,



I-85 Bridge, looking east

superstructure, and substructure were all rated as fair. Although the bridge deck itself is wide enough to accommodate pedestrian/bicycle facilities, the transitions across wide ramp intersections, low guardrails, lack of connectivity, and high traffic volumes and speeds render this bridge unsuitable for pedestrian use in its present condition.

Sidewalks, Pathways, & Crosswalks

With the exception of relatively new sidewalks and crosswalks in the Eastern Segment, most of the corridor lacks sidewalks or other pathways, crosswalks, and pedestrian signs or signals. The new sidewalks (fronting Creedmoor Elementary School, South Granville High School, and the recently-constructed Walgreens) are close to curb in some places, and are not continuous. They appear somewhat further disjointed due to sharply varying setback distances. These sidewalks are present on only one side of the road, but that side alternates, requiring two unsignalized crosswalks east of North Main Street. Neither crosswalk is at a major intersection. The sidewalk in front of Walgreens on NC 56 does not currently connect with other sidewalks.



Looking east at midblock crossing at Creedmoor Elementary



Sidewalk, looking east from Douglass Drive



Pedestrian issues, looking west at North Main Street



Looking west at Hawley School Road

Bicycle Facilities

There are currently no bicycle facilities along this portion of NC 56, either on-street or off-street. In its present condition, NC 56 is not conducive to safe or comfortable on-road bicycle travel due to narrow lanes and inadequate shoulders, high traffic speeds and volumes, and frequent driveway conflicts.

At-Grade Rail Crossings

The only at-grade rail crossing of NC 56 (FRA Crossing #734902H) is near the western end of the study area, approximately 800 feet west of West Lyon Station Road. This Norfolk Southern main line typically sees one freight train daily, with a maximum speed of 25 mph through the crossing. The crossing surface is asphalt and flange.

The crossing has advanced warning signs, stop bars and railroad crossing pavement markings, two pairs of mast mounted flashers, and two gate arms. There is no interconnection with nearby traffic signals.

No train-related crashes have been recorded at this crossing since 1984. An estimated 14 school bus crossings occur on a typical school day.

System Connectivity

Drivers traveling east-west have few options other than NC 56, due to a lack of continuous parallel routes and connectivity between local roads and collectors that intersect NC 56. This is due in part to the effect of I-85 and Ledge Creek/Lake Rodgers as barriers to road construction. On the other hand, the absence of other convenient interchanges for accessing I-85 tends to funnel additional traffic onto NC 56. As a result of this lack of connectivity (at both regional and local scales), many trips using NC 56 are taking somewhat indirect routes, using NC 56 as a link between two other roads. This creates high proportions of turning movements along NC 56, reducing capacity and increasing congestion, delay, and conflicts that lead to crashes.

Planned & Committed Improvements

The following sections describe a number of projects that directly or indirectly affect – or are affected by – travel in the NC 56 corridor.

Current STIP Projects

The Final 2016-2025 State Transportation Improvement Program (STIP) recently released by the NCDOT includes several projects of critical relevance to the NC 56 Corridor Study. The nature, purpose, and schedule of each project is summarized below. Also included are several projects from earlier STIPs which are currently being implemented.

U-5829 – 26th St/Telecom Drive Connector

This 0.77-mile project improves and extends Telecom Drive from East Lyon Station Road westward via a new I-85 overpass, ultimately connecting with improved and realigned 26th Street/Wilkins Road. This project would relieve traffic on NC 56, improve access to potential development on both sides of I-85, and provide safer, more convenient bicycle and pedestrian connectivity. Construction is scheduled for FY 2022.

The proposed design is for a 35 mph major collector with a two-lane, undivided, curb-and-gutter cross-section with 12-foot travel lanes and 4-foot paved shoulders. Bike lanes and sidewalks are also included.

R-5707 – NC 56 Improvements at US 15 & NC 50 Intersections

Building on the 2011 Creedmoor Intersection Study, this project realigns and reconfigures three intersections to improve traffic flow, pedestrian mobility, and safety for all modes. Enhanced access and appearance will also support redevelopment plans in this portion of Creedmoor’s urban core. Construction is scheduled for FY 2019.

C-5166 – Creedmoor Greenway (NC 56)

Already underway, this project continues Creedmoor’s bicycle/pedestrian system along the NC 56 Corridor. Work is scheduled for completion in FY 2016.

This project complements two others already under construction, part of the **Cross City Trail (C-5144)** and the **“Hike and Bike” Spur (C-5114)**.

C-5567 – East Lyon Station Greenway

Part of the Town of Butner Greenway System, this extension will be completed in 2016.

U-5530KA – Butner to Creedmoor Greenway

This project is currently in design with construction anticipated for 2017. The project will include a proposed greenway connection between the existing greenway that ends at Pond Drive and Lake Rodgers Park, connecting in with project C-5166. The project will include a bridge over Ledge Creek.

Candidate STI Projects

The following projects are not in the current STIP, but have been submitted as part of the Strategic Transportation Investment (STI) process. All are from adopted plans or have been submitted by NCDOT Division 5, and are anticipated to remain priorities.

NC 56 Widening between I-85 & US 15

This project would widen NC 56 to a four-lane curb-and-gutter 45 mph facility with a 23-foot raised median, bike lanes, and sidewalks from US 15 through the I-85 interchange—a distance of 2.8 miles. Travel lanes would be 12 feet wide, with 4-foot paved shoulders.

This project would increase safety and mobility for all modes, but would involve some constraints to vehicular access. Streetscape elements could also enhance the appearance of the corridor.

Hawley School Road Safe-Routes-to-School

This project would construct a greenway/multi-use path along Hawley School Road from Brassfield Road to US 56, and would require a pedestrian/bicycle crossing of NC 56 to connect with existing facilities.

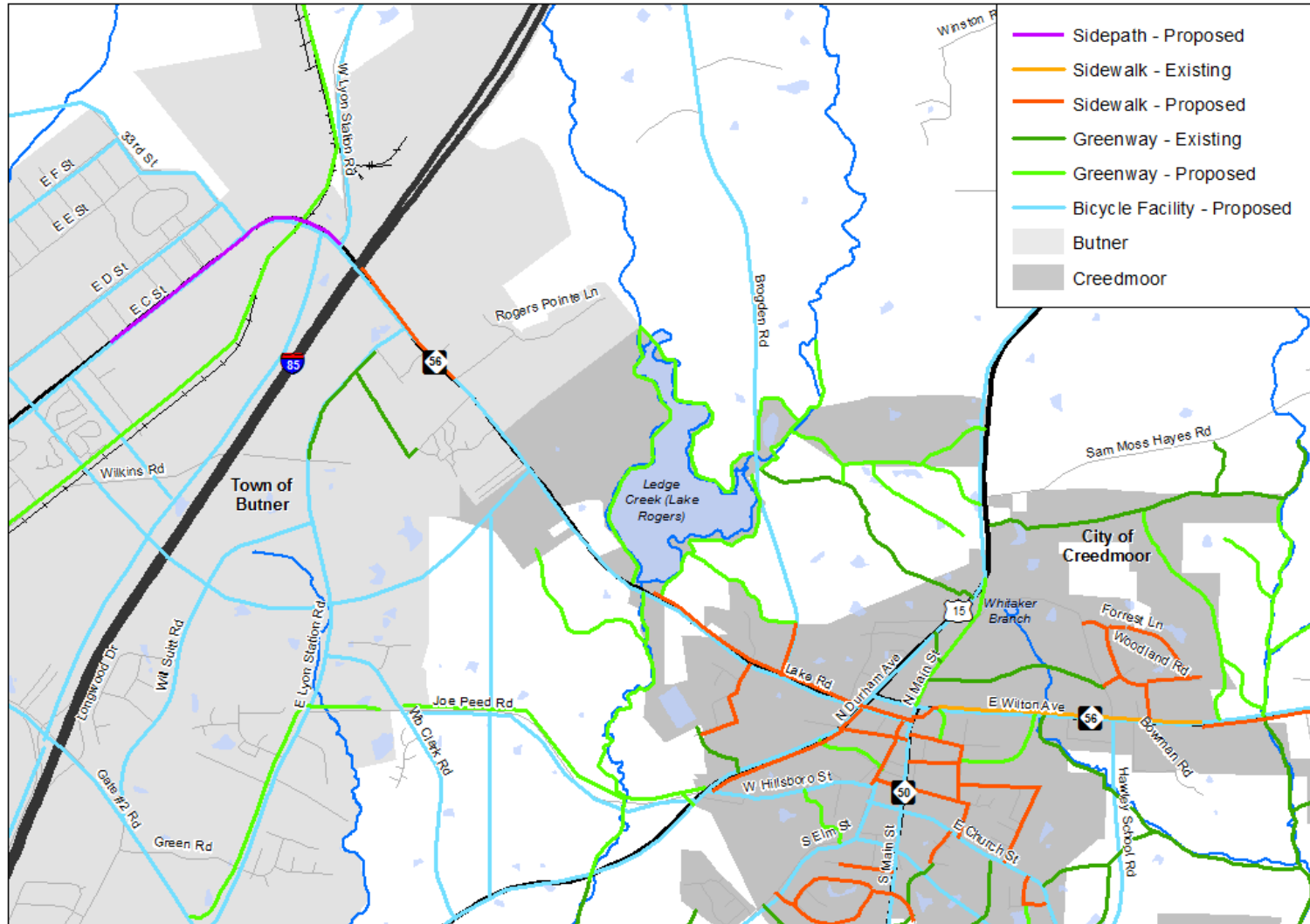
Figure 2 shows existing and planned pedestrian and bicycle facilities in the area.

Other Projects

West Lyon Station Road Realignment

This project proposes realigning West Lyon Station Road at NC 56 so that the intersection occurs west of the current location. The new intersection would be roughly halfway between the rail corridor and the I-85 ramps. Butner has begun securing right-of-way and has an approved preliminary design. The realignment will improve operations at this intersection and ease conflicts with the I-85 ramps which are currently too close to the existing intersection. The realignment also opens an opportunity to create a fourth leg to the intersection, providing access to the vacant parcels south of the intersection that are proposed to be part of the Butner Gateway development project.

Figure 2: Existing and Planned Pedestrian and Bicycle Facilities



Bicycle and Greenway Facilities

0 0.25 0.5 1 Miles



Corridor Travel Demand Characteristics

This section summarizes characteristics of travel in the study corridor, including historic and current average annual daily traffic volumes (AADTs) and associated trends; truck/heavy vehicle volumes; traffic speeds; time-of-day characteristics; peak-period turning movements at signalized intersections; and relevant attributes of pedestrian, bicycle, transit, and rail modes.

Historic Traffic Volumes (AADTs)

NCDOT's count program provides a consistent source of data for assessing traffic volume trends over a sustained period. Six NC 56 count locations were identified in the study area, in most cases yielding at least semi-annual data points between 2000 and 2013. These results are summarized in Table 1 and Figure 3.

The most significant trend for traffic volumes on NC 56 is the apparent lack of any persistent trend. Specific locations experienced both increases and decreases in traffic volumes since 2002, with the overall trend being one of slight traffic reduction. For each location, the highest traffic volumes occurred in 2006 or 2007, and 2007 was the year in which the volume of traffic along the entire corridor peaked. Volumes generally fell until 2010, and have been somewhat erratic since then. However, all 2013 traffic volumes remain significantly lower than peak 2006-2007 volumes.

This trend is not limited to traffic on NC 56. Table 2 and Figure 4 provide comparable summaries of AADT trends for roads intersecting NC 56 in the study corridor. The results are similar, with minor annual variations and an overall flat trend. The major difference is the lack of a distinct peak in traffic volumes in 2006-2007 (or any other period); there is much less "noise" in this data.

Similar patterns have been observed in other regions, and across the nation as a whole. While partly attributable to the 2008 economic downturn, growing evidence supports the existence of a more sustained shift in travel behavior, both nationally and regionally. This shift results from the convergence of long-term demographic, social, technological, and economic trends. However, major changes in local land use, economic development, and transportation infrastructure or service can generate localized impacts that run counter to these more generalized trends.

Figure 5 contrasts the linear-regression trend line derived from averaged historic NC 56 AADTs with corresponding averaged volumes from the Triangle Regional Model. Clearly, the trend line forecast is unrealistically low, but it also appears that the model volumes may be too high — at least in the near/medium term — unless significant new development occurs. The takeaway is that long-range forecasting of traffic volumes is

becoming more difficult and uncertain, requiring a careful, strategic approach incorporating validation of assumptions, sensitivity analysis and scenario testing.

Table 1: NC 56 Historic AADT Trends (by location)

Location	2002	2004	2006	2007	2008	2010	2012	2013
W of W Lyon Sta	13,000	13,000	14,000	14,000	12,000	11,000	13,000	11,000
W of I-85	13,000	13,000	15,000	20,000	14,000	--	13,000	15,000
E of I-85	16,000	16,000	17,000	17,000	15,000	14,000	15,000	13,000
E of Brogden	11,000	10,000	11,000	12,000	11,000	10,000	11,000	9,700
E of US 15	--	6,800	10,000	8,700	8,600	7,300	8,900	8,500
E of N Main	9,000	7,800	11,000	12,000	11,000	9,500	12,000	12,000

Figure 3: NC 56 Historic Traffic Trends (by location)

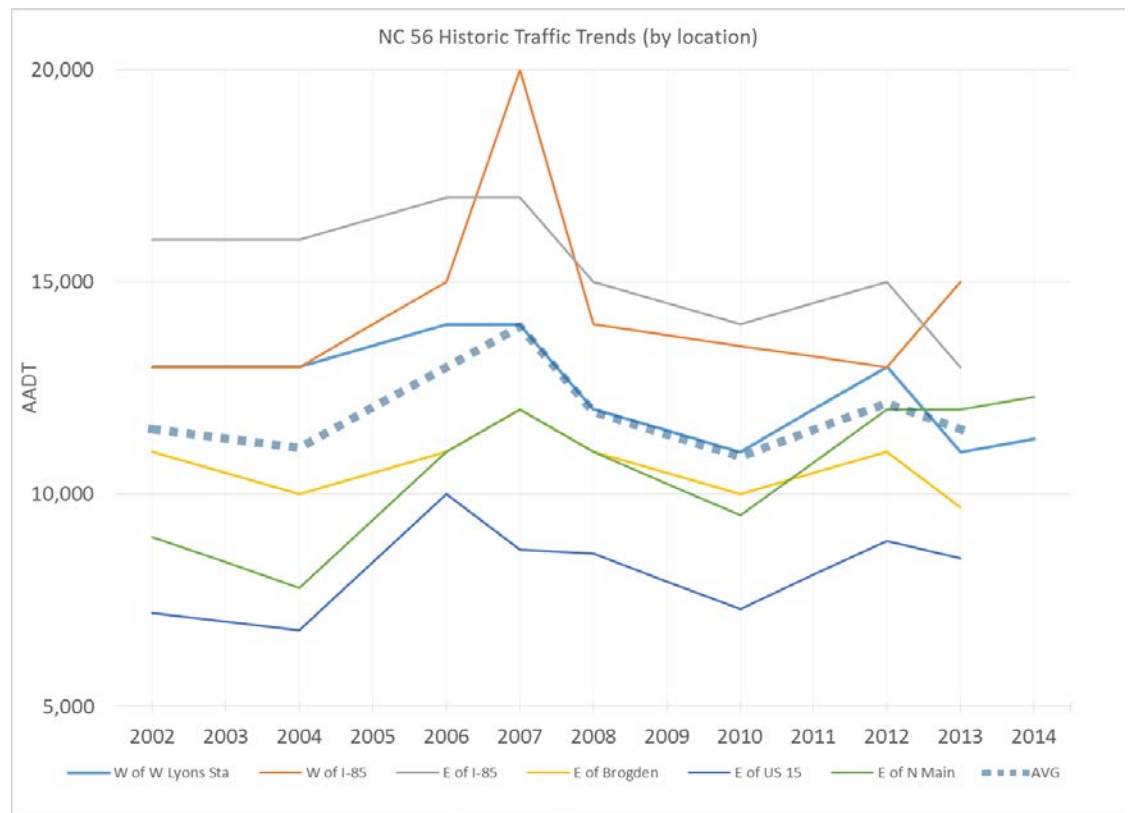


Table 2: Historic AADT Trends for Roads Intersecting NC 56

Road	Location	2002	2004	2006	2007	2008	2010	2012	2013
Lake Rd	E of US 15	5,900	5,400	5,800	5,600	5,300	4,600	5,200	--
I-85	N of NC 56	33,000	29,000	31,000	31,000	28,000	30,000	28,000	32,000
	S of NC 56	33,000	29,000	30,000	30,000	28,000	30,000	29,000	32,000
US 15	N of N Main	3,200	5,400	4,700	4,600	4,500	4,600	4,200	4,500
	N of Wilton	3,200	3,200	2,400	2,200	2,300	2,500	2,100	2,200
	S of Lake	5,700	4,500	5,000	5,000	5,100	4,200	5,200	6,000
NC 50	S of Lake	11,000	10,000	11,000	10,000	11,000	10,000	11,000	10,000
Brogden Rd	N of NC 56	1,300	1,300	1,400	--	1,400	1,300	1,300	--
Hawley School	S of NC 56	830	510	1,100	1,200	1,200	550	1,300	--

Figure 4: Historic Traffic Trends for Roads Intersecting NC 56

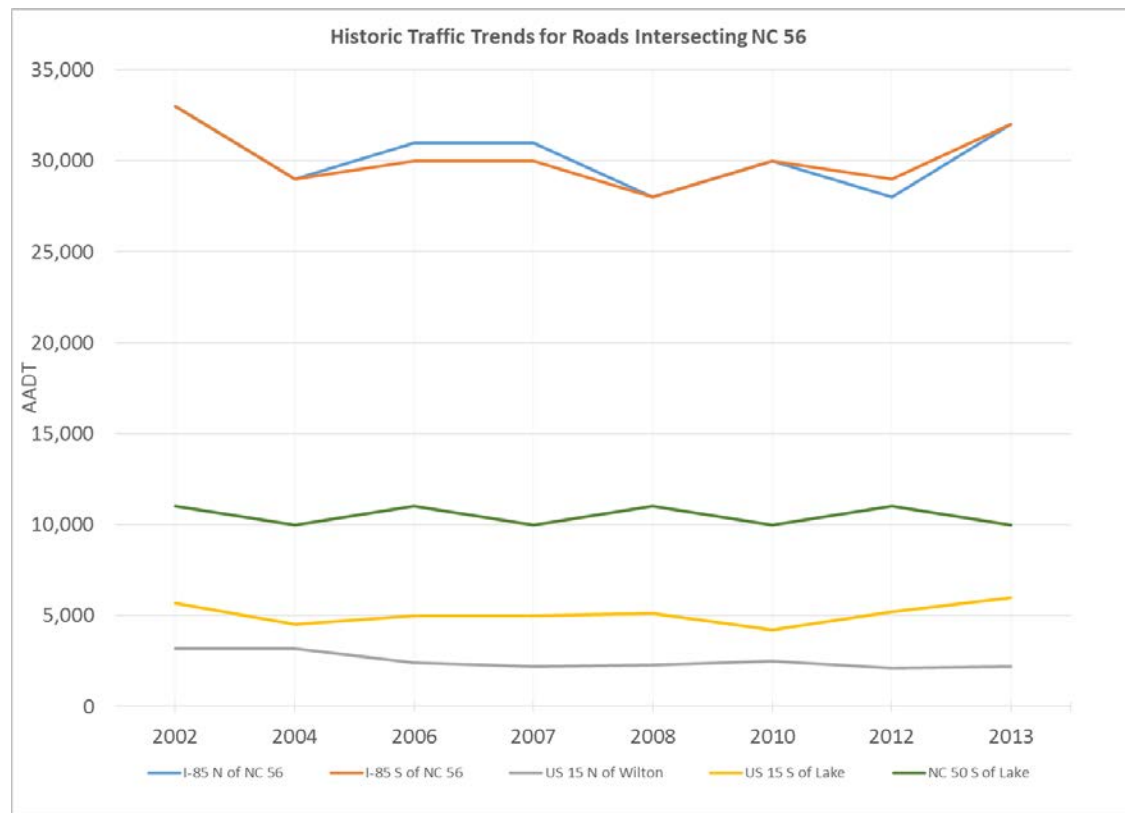
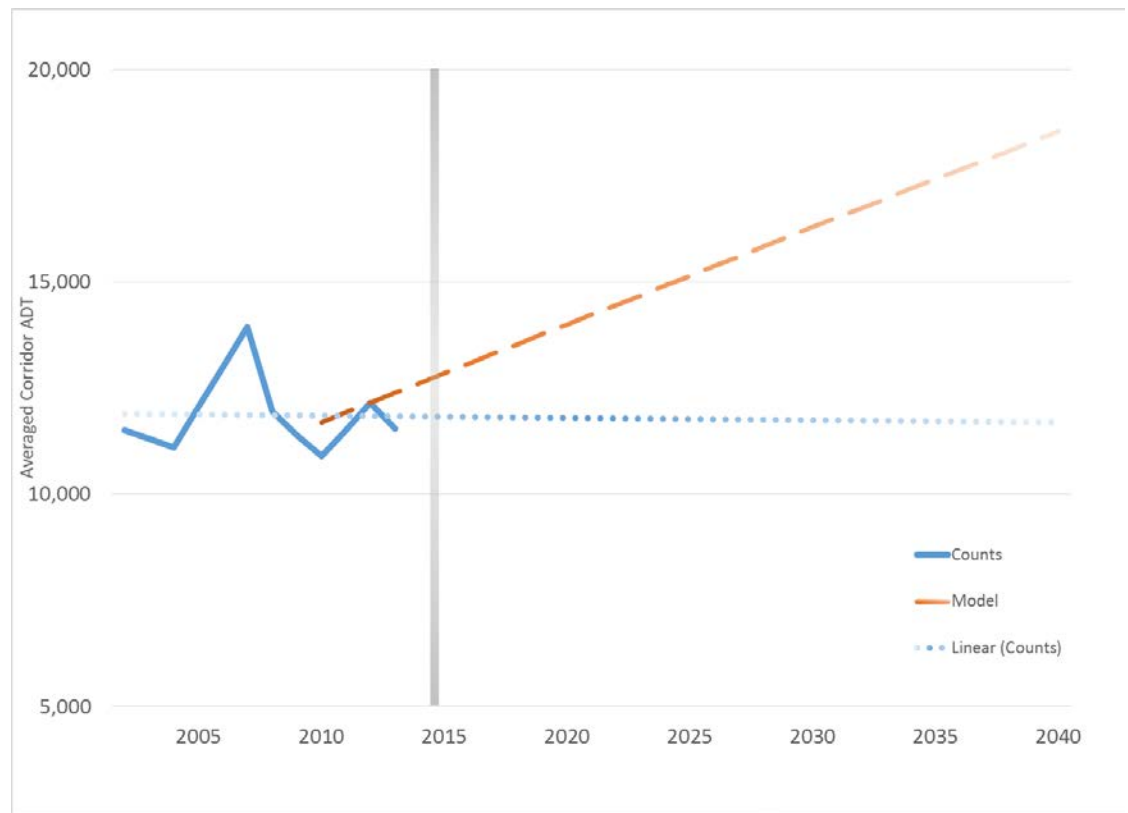


Figure 5: NC 56 Corridor Traffic Trends & Forecasts



Current Traffic Data

VHB collected traffic data at a number of locations along the corridor in November and December 2014. This data is summarized and discussed below.

Traffic Characteristics

2014 Average Annual Daily Traffic (AADT) Volumes

Tube counters were placed at the following five locations:

1. US 56, between 33rd Street and the railroad crossing
2. US 56, approximately 2,200 feet west of the Ledge Creek Bridge
3. US 56, approximately 100 feet east of Main Street
4. US 15, approximately 250 feet north of Sunset Street
5. US 56, just east of Darden Drive

The resulting traffic counts were adjusted using the appropriate NCDOT seasonal and day-of-week factors to obtain annual daily traffic volumes (AADTs). Table 3

summarizes the results, and compares them against 2013 NCDOT counts at nearby locations. Overall, the NC 56 counts at these locations grew between 2.0 percent and 2.7 percent between 2013 and 2014, averaging about 2.5 percent overall. Traffic growth on US 15 just north of NC 56 was higher in percentage terms, but given the much lower volumes at this location, the difference is not significant.

Table 3: 2014 AADTs (tube counts)

Location	2013	2014*
1. NC 56 west of Railroad Tracks ¹	11,000	11,300
2. NC 56 west of Ledge Creek ²	9,800	10,000
3. US 15 north of East Wilton Street ²	2,200	2,500
4. NC 56 west of Creedmoor Elementary ²	12,000	12,300
5. NC 56 east of Darden Drive ¹	---	9,800

* Includes counts collected first week of 2015

¹ Collected Tuesday, 12/02/2014 – Wednesday, 12/03/2014

² Collected Tuesday, 01/06/2015 – Wednesday, 01/07/2015

Peaking Characteristics

The 48-hour counts obtained using the tube counters at the above locations also yield valuable information about the hourly distribution of traffic (its peaking characteristics), as well as directional variations in demand. Figure 6 depicts the variations in total (two-way) traffic volumes throughout the day at three locations (one in each segment), and corridor-wide composite or average hourly distribution.

The location east of NC 50 (between North Main Street and Creedmoor Elementary School) exhibits a very high spike in the morning, with a distinctive midday “saddle” shape and a long, gradual increase into the evening. In contrast, the more westerly portions the corridor have substantially lower morning peaks, and midday traffic levels meet or exceed volumes during the morning peak. These variations are attributable to differences in surrounding land uses. Highway retail establishments are concentrated to the west because of convenient access to I-85 and to large numbers of employees (and more recently, community college students). The resulting lunchtime trips explain the midday surge in traffic; shift work and interstate traffic patterns also contribute. To the east, the schools and development that is more residential and less commercial, lead to a very different pattern of traffic peaks.

Total traffic volumes do not tell the entire story, however. Directional variations can also have significant impacts on traffic congestion. Figure 7 through Figure 9 depict traffic levels in opposing directions throughout the day at each of the three locations shown in Figure 6. At the corridor’s western end, westbound traffic is much heavier than eastbound in the morning; the situation reverses in the evening.

Figure 6: NC 56 Traffic Peaking Characteristics

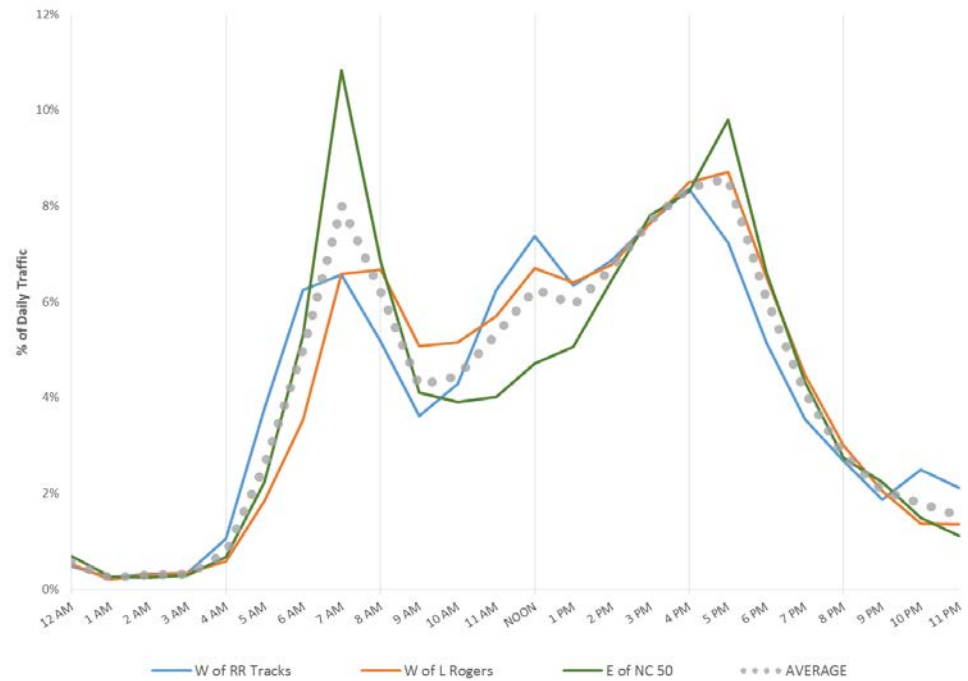


Figure 7: NC 56 Traffic Peaking by Direction (west of rail crossing)

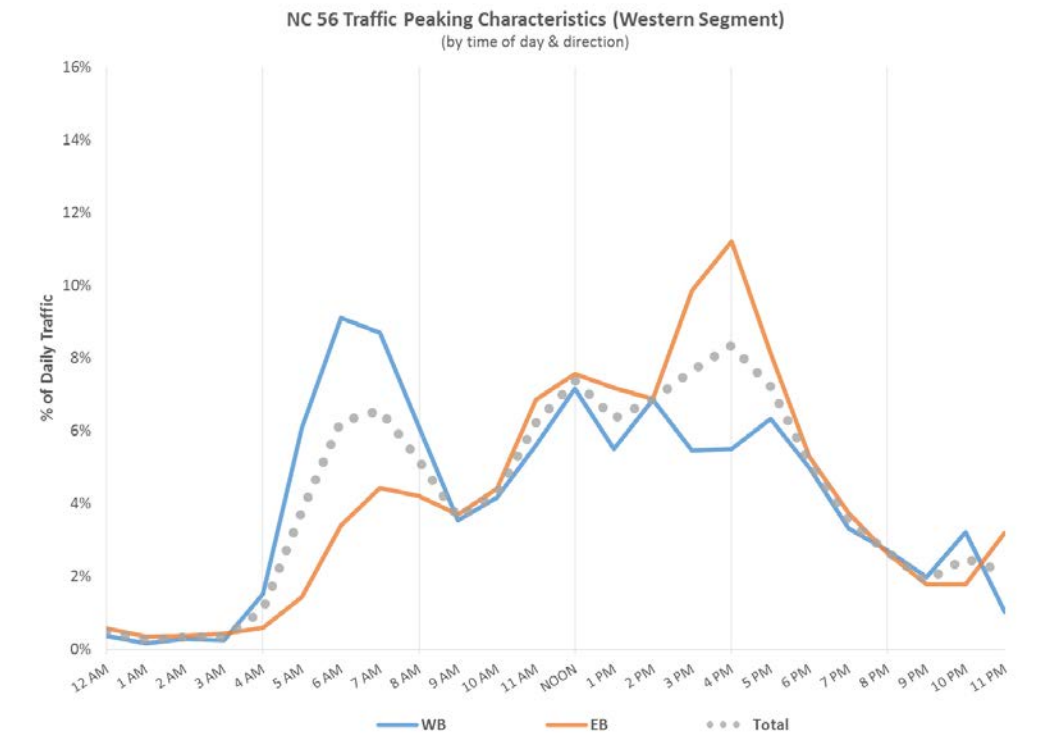


Figure 8: NC 56 Traffic Peaking by Direction (west of Lake Rogers)

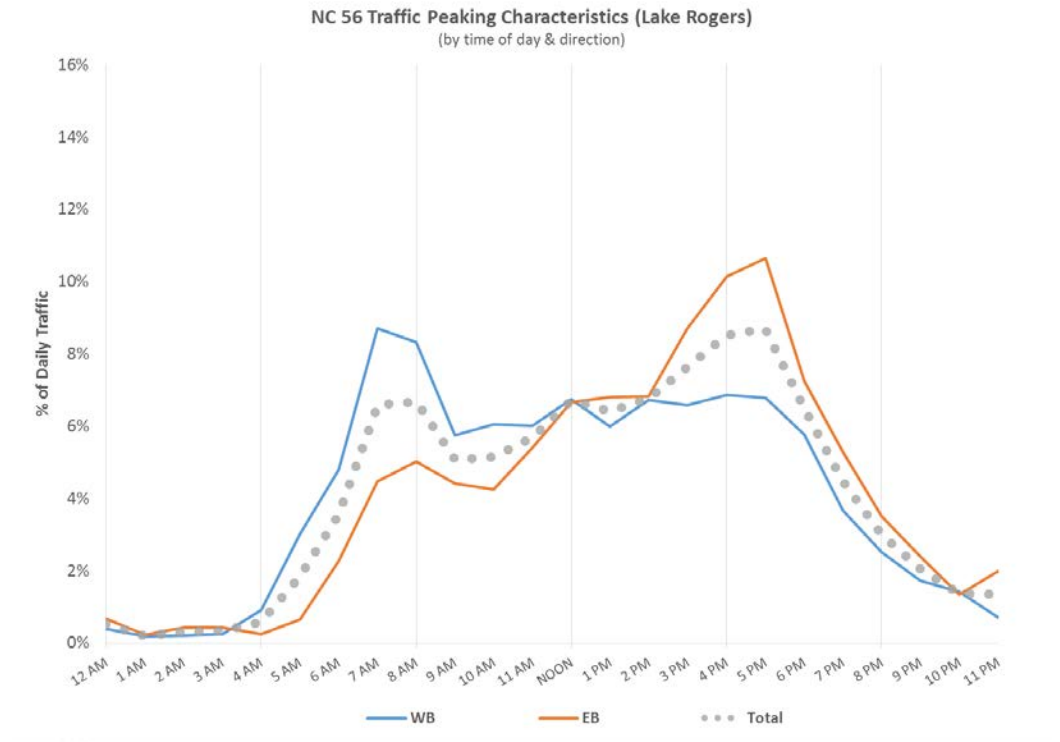
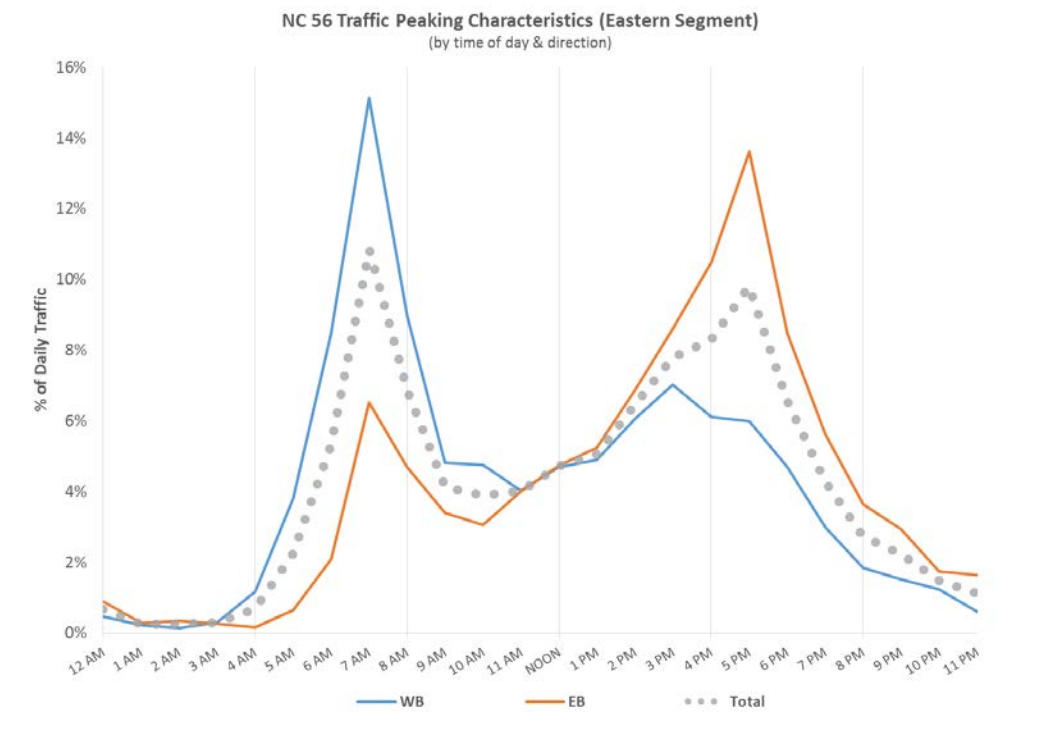


Figure 9: NC 56 Traffic Peaking by Direction (east of North Main Street)



Although the combined (two-way) midday peak is higher than in the morning, it is almost evenly split by direction; midday directional peaks are much lower than corresponding morning or evening peaks. The middle segment exhibits a similar pattern, though less directionally imbalanced, while the easternmost portion of the corridor experiences the most extreme directionality in traffic demand.

The variation in these travel demand patterns suggests different traffic volume scenarios or peak periods may need to be considered when performing capacity analysis, and in designing potential solutions. With respect to traffic peaking characteristics, the corridor is not uniform throughout its length. The degree to which this characteristic persists into the future depends largely on land use changes, both inside and outside the corridor. Assumptions regarding the location, nature, and magnitude of must be carefully considered in forecasting design year traffic volumes.

Vehicle Speeds

Vehicle speeds were recorded at two locations along NC 56, throughout two mid-week days in early December 2014. Both locations are posted at 35 mph, but the second site is 600 feet from a 25 mph school zone. Speed data was also collected at two other locations along NC 56 – just east of 33rd Street, and just east of Darden Drive. However, various constraints—including nearby intersections, driveways, pedestrian crossings, railroad crossings and speed zone transitions, as well as some significant horizontal/vertical curvature—resulted in travel speeds well below the posted limits in these locations, so they are not included in this discussion.

- Location 1 is approximately 2,200 feet west of the Ledge Creek Bridge. Being on a long grade in a relatively undeveloped stretch of the corridor, it was anticipated that speeds here would be among the highest.
- Location 2 is approximately 100 feet east of Main Street, and about 600 feet west of the school zone. It was assumed that speed here would be more moderate. In addition. The effect of the school zone on travel speeds was checked by comparing speeds when the 25-mph limit was in effect (7:00 – 8:55 AM and 2:00 – 4:00 PM) against those recorded when it was not. Only a slight impact was measured.

As expected, the speeds recorded at Location 1 were significantly higher than those at Location 2, although both exhibited mean speeds and 85th-percentile speeds well above the posted 35 mph limit. (The 85th-percentile speed is the speed exceeded by 15 percent of observed vehicles; 85 percent of traffic travels at speeds below the 85th-percentile speed. This value has historically been considered a reasonable speed limit.) Interestingly, speeds were slightly higher in the westbound (uphill) direction. This may be attributable to the curve at the bottom of the hill and the narrow bridge suppressing eastbound (downhill) speeds. Overall, the 85th-percentile speed at this location was 46 mph, a value more typical of a road with a 45 mph speed limit.

At Location 2, it was not surprising to see slightly higher westbound speeds, since these vehicles would be exiting the school zone, while eastbound traffic would be expected to brake upon approaching the schools. Here again, the 85th-percentile speed of 43 mph is significantly higher than the posted speed. When the 25 mph limit was in effect, the 85th-percentile speed was about 1 mph lower. Figure 10 and Figure 11 represent the distribution of observed speeds at each location, by direction.

Figure 10: NC 56 Speed Distribution, East of Ledge Creek

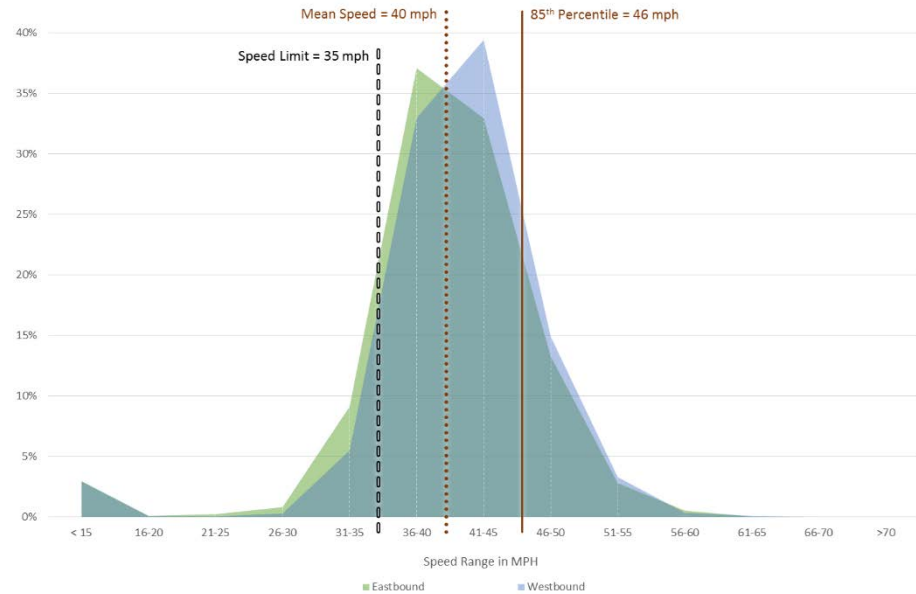
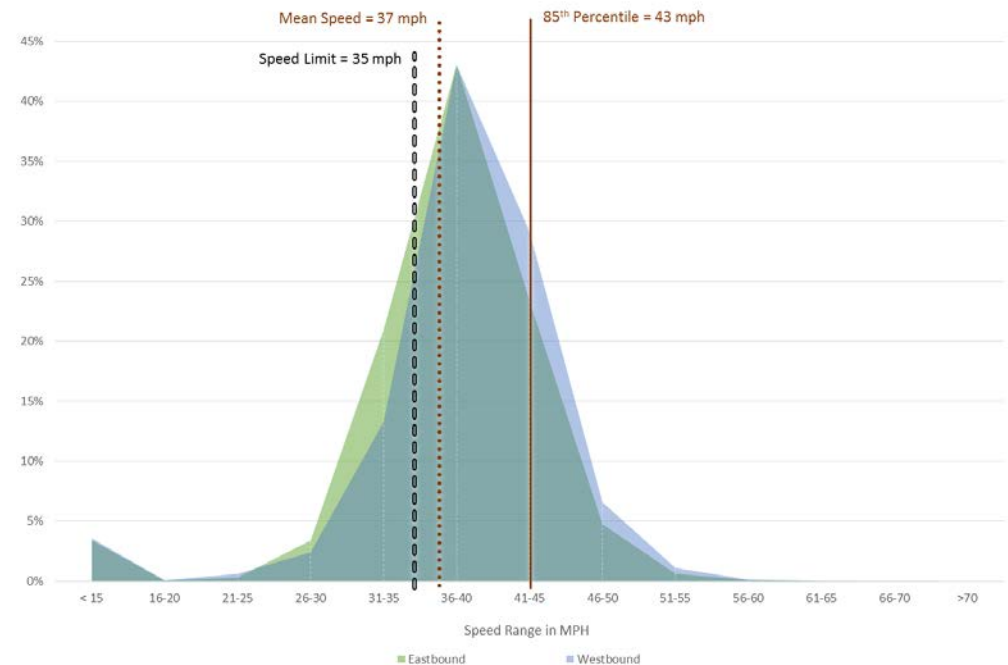


Figure 11: NC 56 Speed Distribution, West of Main Street



Truck Volumes / Freight Movement

Two methods were used to collect truck (or heavy vehicle) volumes. Tubes were placed at three locations, recording vehicle classification counts (axle counts) over a period of two weekdays in early December 2014. Data is divided into single unit trucks, which have two or more axles but no towed trailer, and truck tractor semitrailers (TTST), which are trucks towing separate trailer units.

Table 4 summarizes the results of this data collection effort.

Table 4: Truck Percentages (tube counts)

Location	Single Unit	TTST	All Trucks
1. NC 56 west of Railroad Tracks	5.0%	2.3%	7.3%
2. NC 56 west of Ledge Creek	5.2%	1.6%	6.8%
3. US 15 north of East Wilton Street	6.9%	5.2%	12.1%
4. NC 56 west of Creedmoor Elementary	5.5%	2.0%	7.5%
5. NC 56 east of Darden Drive	7.5%	2.1%	9.6%

Trucks were also counted as part of the turning movement data collected at nine signalized intersections. Table 5, shows truck percentages during the peak periods only.

Table 5: NC 56 Truck Percentages (intersection counts)

Location	Single Unit	TTST	All Trucks
NC 56 east of 33 rd St ¹	2.3%	2.2%	4.5%
NC 56 west of I-85 ¹	2.0%	2.2%	4.2%
NC 56 east of I-85 ¹	2.4%	2.0%	4.4%
NC 56 west of US 15 ²	1.2%	1.5%	2.7%
NC 56 east of US 15 ²	6.0%	2.3%	8.3%
NC 56 east of Crescent Dr ¹	2.1%	2.2%	4.3%

1 Collected 7 AM – 9 AM, 11 AM – Noon, and 4 PM - 6 PM

2 Collected 7 AM – 6 PM

Altec Industries, on Aerial Drive, is probably the largest single generator of truck traffic in the corridor, due not only to the scale of its production, but also because each of the tracks assembled there must be road-tested. Other light-industrial establishments off of East Lyon Station Road also contribute to truck volumes in the corridor, as do deliveries to various retail, commercial, and institutional establishments throughout the corridor. A large share of the truck traffic on this portion of NC 56, however, consist of trips through the corridor, going to/from I-85.

Intersection Turning Movement Counts

VHB collected intersection turning movement counts in November, 2014, at nine locations along NC 56. All but one of the intersections (US 15/North Durham Avenue and NC 56/East Wilton Avenue) are signalized. Detailed summary of the traffic counts can be found in Appendix I.

Intersection turning movement counts were collected in two groups. The first group consisted of manual counts performed on Wednesday, November 19 or Thursday November 20, during three two-hour peak periods: 7:00 AM – 9:00 AM (morning); 11:00 AM – 1:00 PM (midday); and 4:00 PM – 6:00 PM (evening). This group consisted of the following signalized intersections with NC 56:

- 33rd Street (SR 1112)
- I-85 southbound ramps
- I-85 northbound ramps
- West Lyon Station Road (SR 1237)
- East Lyon Station Road (SR 1108)
- Crescent Drive (SR 1640)/Hawley School Road (SR 1733)

The second group of turning movement counts were obtained using MioVison cameras recording continuously from 7:00 AM until 6:00 PM on Wednesday, November 5, 2014, at the following NC 56 intersections:

- North Durham Avenue (US 15)/Lake Road (SR 1736)
- North Durham Avenue (US 15) (unsignalized)
- North Main Street (NC 50/SR 1639)

The existing AM, Midday, and PM peak hour turning movement volumes are shown in Figure 12 and Figure 13.

Figure 12: Base Year (2014) Peak Hour Turning Movement Volumes (Western Segment)

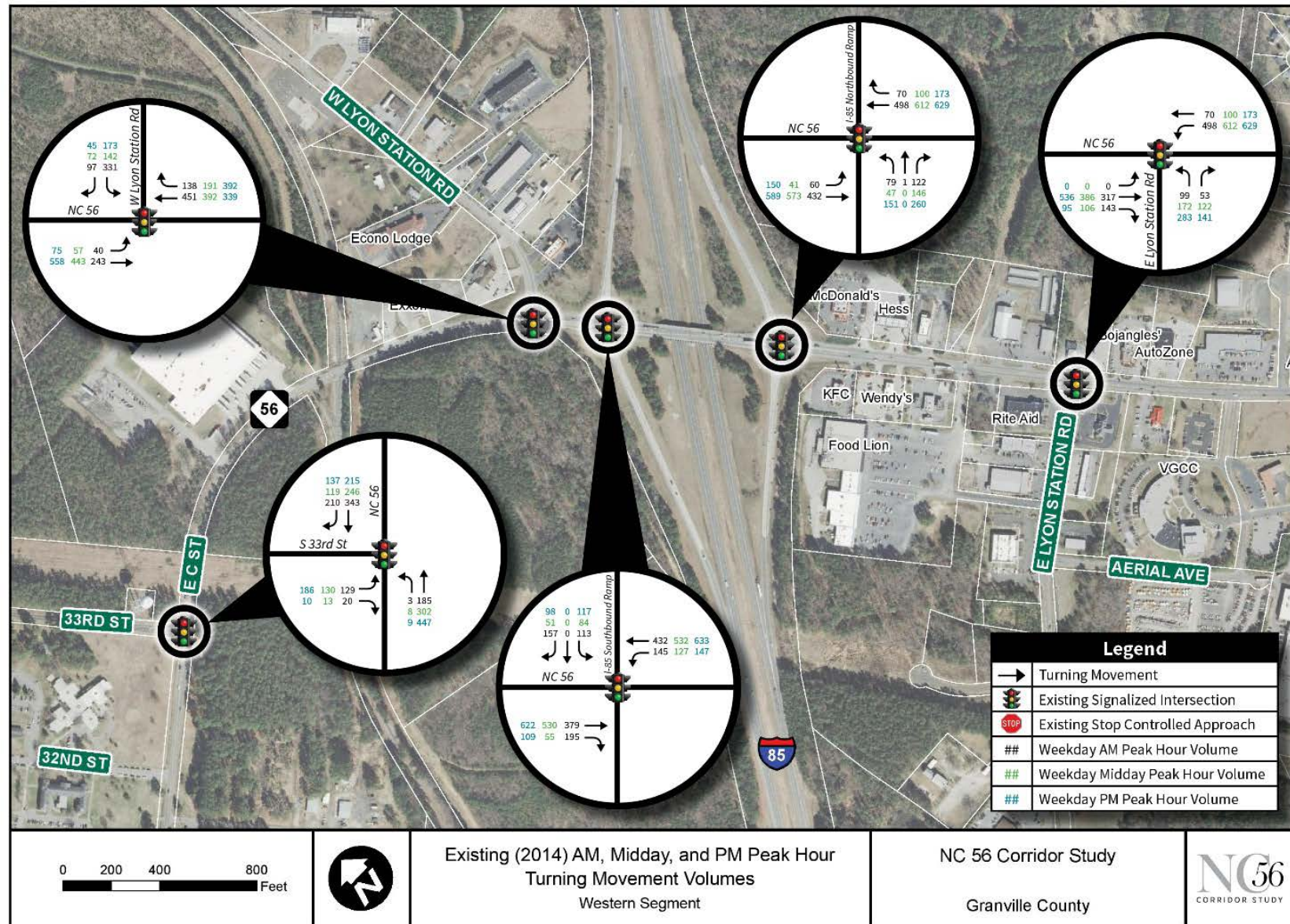
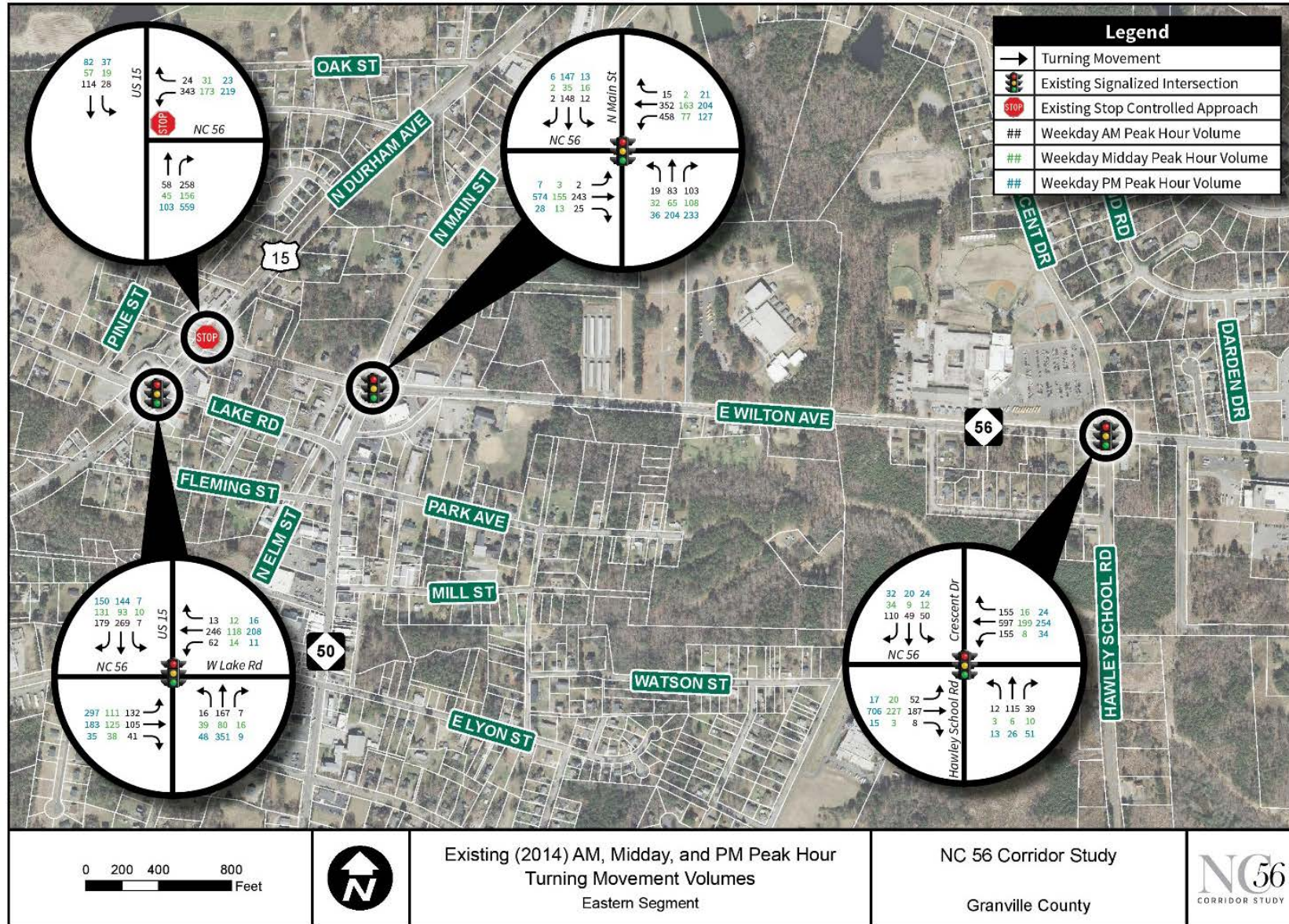


Figure 13: Base Year (2014) Peak Hour Turning Movement Volumes (Eastern Segment)



Pedestrian and Bicycle Trips

No data on pedestrian and bicycle travel was collected as part of this study, unless captured in the intersection turning movement counts. It is unlikely that even if collected, such data would prove useful in assessing demand for such travel, due to the lack of safe, convenient, and continuous pedestrian facilities, or of fixed-route bus service. However, there is certainly latent demand for pedestrian, bicycle, and transit trips, given the presence of significant potential generators of such trips along the NC 56 corridor, including:

- South Granville Public Library
- Vance-Granville Community College – South Campus
- South Granville Medical Center
- Various churches
- Lake Rogers Park
- South Granville Senior Center, Creedmoor Gymnasium & Activity Center, and Battle C. Roberts Ballfield
- Creedmoor Elementary School
- South Granville High School
- Downtown Creedmoor

While the current lack of pedestrian and bicycle facilities obviously hinders the potential success of increased transit service, the main obstacle to effective transit is probably the low density of current development patterns. Although a number of residential units, retail establishments, and various service providers are present in the corridor, most are in dispersed suburban-style neighborhoods and isolated or strip-highway commercial developments. There is little residential stock in the immediate vicinity of the corridor's commercial core. However, a variety of local planning efforts (including land use, comprehensive, small area, and parks and recreation plans cited later in this report) all recommend steps that would encourage more walkable, mixed-use development where appropriate, as well as a comprehensive system of greenways connecting expanded park and recreation facilities.

Transit Service

Kerr Area Regional Transit System (KARTS) is the transit provider for the four counties that are members of the Kerr Area Transportation Authority – Granville, Vance, Warren, and Franklin counties – which includes the NC 56 Corridor study area. The service is primarily a demand-response service, focusing on the needs of seniors, individuals with disabilities, and low-income individuals. Most of these demand-response trips are contracted services – frequently medical and social services trips. KARTS also operates deviated fixed-route services in the Town of Henderson and Town of Oxford. Service hours for ride scheduling are 8:00 AM to

5:00 PM, with previous day notice needed for scheduling a ride. General public fares are distance based and range from \$8 to \$25. In 2010, 127,836 passenger trips were made using the demand-response service, and 21,396 passenger trips were made using the deviated fixed-route service.

Rail

On a typical day, the Norfolk Southern rail line crossing NC 56 between 33rd Street and West Lyon Road carries a single freight train.

Traffic Operations and Quality of Service

There are a variety of ways to measure the performance of a transportation facility. Transportation professionals typically rely on guidance from the Highway Capacity Manual, which describes performance from the traveler point of view that is designed to be useful to roadway operators, decisions makers and members of the community. Individuals may travel along NC 56 via personal vehicle, walking, bicycling, or via transit, each of which can be quantitatively measured using standard criteria such as delay, average speed, percent time spent following or other measures. The dominant form of transportation currently along NC 56 is by vehicles, either personal vehicle or commercial trucks. As a result, this section covers traffic operations along the corridor on both a corridor basis as well as an intersection basis. Given the low volume of pedestrian and bicycle trips, and the lack of dedicated facilities, no meaningful assessment of bicycle operations is available.

Corridor-Level

There are two main classes for two-lane highways, Class I and Class II, and an alternative class, Class III. A Class III highway normally serves moderately developed areas, may pass through small towns or developed recreational areas, and high speeds are not expected along Class III highways. The three segments have been classified as a Class III Two-Lane Highway for this study.

As stated earlier, this corridor has been divided into three individual subareas, or segments. The three segments were all assessed as a Class III two-lane highway using Highway Capacity Software Plus (HCS+). The western segment of this corridor is more developed and contains more access points and intersections per mile than the middle and eastern segments. For those reasons, the western segment was evaluated using SimTraffic in addition to the HCS assessment.

Segmental corridor analyses were conducted using the Highway Capacity Software Plus (HCS+) software package. Segmental corridor level of service results are a reflection of daily operations, however, peak hour parameters are taken into account. To analyze segments, various parameters are accounted for including daily volume, lane width, shoulder width, peak hour directional split, terrain type, access point density and truck percentages. Table 6 summarizes the level of service criteria as it relates to percent time-spent following (PTSF) for Class I and II facilities, and percent of free-flow speed (PFFS) for Class III facilities.

Table 7 summarizes the two-lane highway corridor level of service HCS analysis results of each segment during the AM, Midday and PM peak hours. For this study, the determination of level of service (LOS) is dependent on percent free-flow speed, as vehicles do not have the opportunity to pass other vehicles on this highway.

Table 6: Level of Service Description for Two-Lane Highways

Level of Service	Class I Highways		Class II Highways	Class III Highways
	ATS (mi/h)	PTSF (%)	PTSF (%)	PFFS (%)
A	>55	<=35%	<= 40	>91.7
B	>50 - 55	35% - 50%	>40-55	>83.3-91.7
C	>45 - 50	50% - 65%	>55-70	>75.0-83.3
D	>40 - 45	65% - 80%	>70-85	>66.7-75.0
E	<= 40	>80%	>85	<=66.7
F	Flow rate exceeds segment capacity	Flow rate exceeds segment capacity	Flow rate exceeds segment capacity	Flow rate exceeds segment capacity

Table 7: Corridor Level of Service Summary for NC 56

Location	AM Peak			Midday Peak			PM Peak		
	Segment LOS	Ave. Speed (mph)	PFFS (%)	Segment LOS	Ave. Speed (mph)	PFFS (%)	Segment LOS	Ave. Speed (mph)	PFFS (%)
Western Segment	D	28.5	72.2	D	27.0	68.5	E	25.1	63.7
Middle Segment	C	31.5	76.7	D	30.4	74.1	D	29.0	70.4
Eastern Segment	C	29.2	75.3	C	31.0	79.9	D	26.7	68.7

As stated previously, the western segment of this corridor is more developed and was therefore evaluated using SimTraffic simulation software, to further investigate the operations during each peak hour. During the simulation, severe queuing that greatly increased the travel time and delay for drivers traveling eastbound during the AM and PM peak hours was observed at the intersection of the I-85 southbound ramps and NC 56. Table 8 summarizes the SimTraffic results, specifically travel time and delay, for the western segment during the AM, Midday and PM peak hours. Figure 14 and Figure 15 graphically show the corridor travel time and delay traveling eastbound and westbound along NC 56.

Table 8: Travel Time and Delay for NC 56 (Western Segment)

Location	AM Peak		Midday Peak		PM Peak	
	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)
Eastbound	435.9	286.3	222.1	74.7	750.0	599.3
Westbound	233.2	71.6	222.6	63.6	260.5	99.5

Figure 14: Corridor Travel Time (Western Segment)

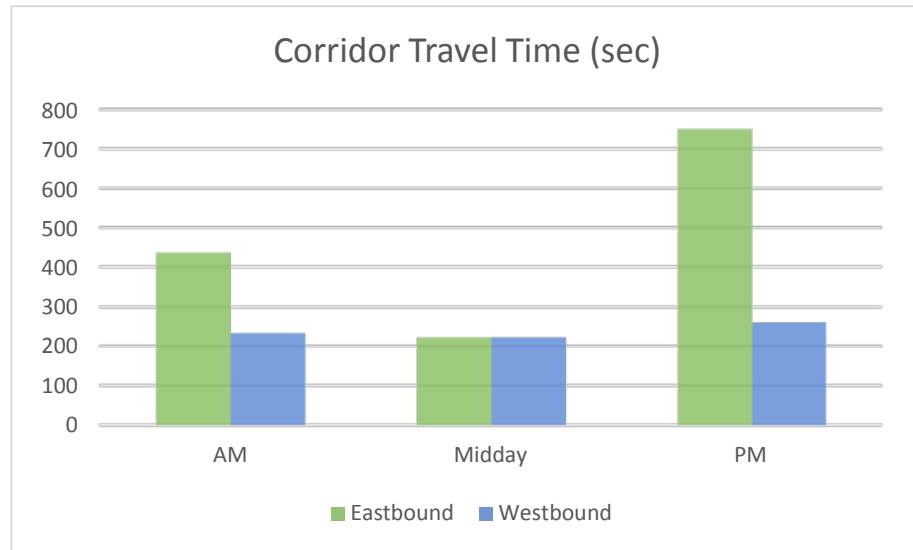
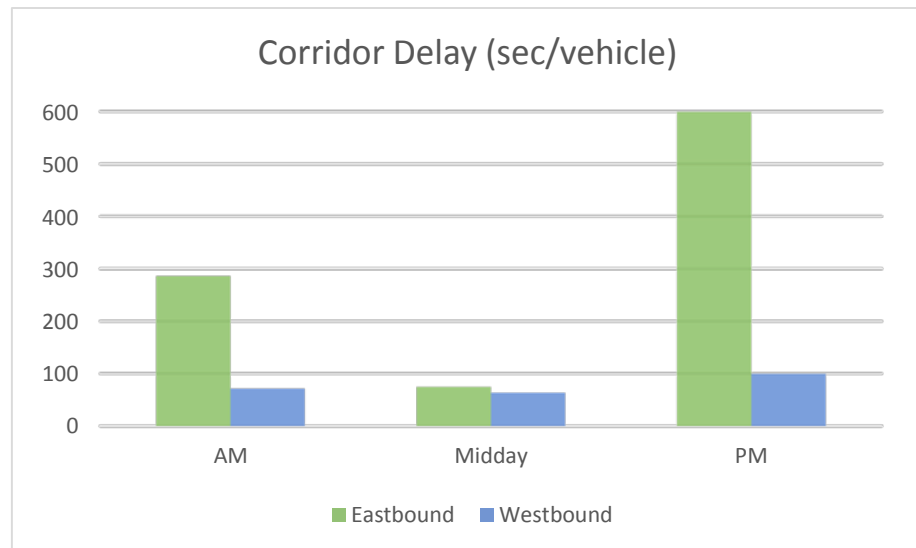


Figure 15: Corridor Delay (Western Segment)



Intersections

Peak hour LOS measures the adequacy of the intersection geometrics and traffic controls of a particular intersection or approach for the given turning volumes. Existing lane geometrics and lane traffic controls are further illustrated in Figures 16 and 17. Levels of service range from A through F, based on the average control delay experienced by vehicles traveling through the intersection during the peak hour. Control delay represents the portion of total delay attributed to traffic control devices (e.g., signals or stop signs). The engineering profession generally accepts LOS D as an

acceptable operating condition for signalized intersections in urban areas, and LOS C for rural areas.

At unsignalized intersections, LOS E is generally considered acceptable only if the side street encounters delay. Nevertheless, side streets sometimes function at LOS F during peak traffic periods; however, the traffic volumes often do not warrant a traffic signal to assist side street traffic. Table 9 provides a general description of various levels of service categories and delay ranges.

Table 9: Level of Service Description for Intersections

Level of Service	Description	Signalized	Unsignalized
A	Little or no delay	<= 10 sec.	<= 10 sec.
B	Short traffic delay	10-20 sec.	10-15 sec.
C	Average traffic delay	20-35 sec.	15-25 sec.
D	Long traffic delay	35-55 sec.	25-35 sec.
E	Very long traffic delay	55-80 sec.	35-50 sec.
F	Unacceptable delay	> 80 sec.	> 50 sec.

Level of Service Analysis

Intersection LOS analyses were performed for the typical weekday AM, Midday, and PM peak hours using *Synchro/SimTraffic Professional Version 7*. The Existing (2014) scenario analysis utilized the existing signal plans from the NCDOT. The intersection cycle lengths were optimized, and in some cases, where the optimized cycle length fell below the recommended minimum, the cycle length was set manually at the NCDOT minimum cycle length. A summary of the findings for the Existing (2014) scenario level of service analysis can be found in Table 10 and Table 11, and the full *Synchro/HCS* output can be found in Appendix II.

As reported in Table 10 and Table 11, most intersections are operating at acceptable overall LOS during all peak hours.

Figure 16: Existing Lane Geometrics and Traffic Control (Western Segment)

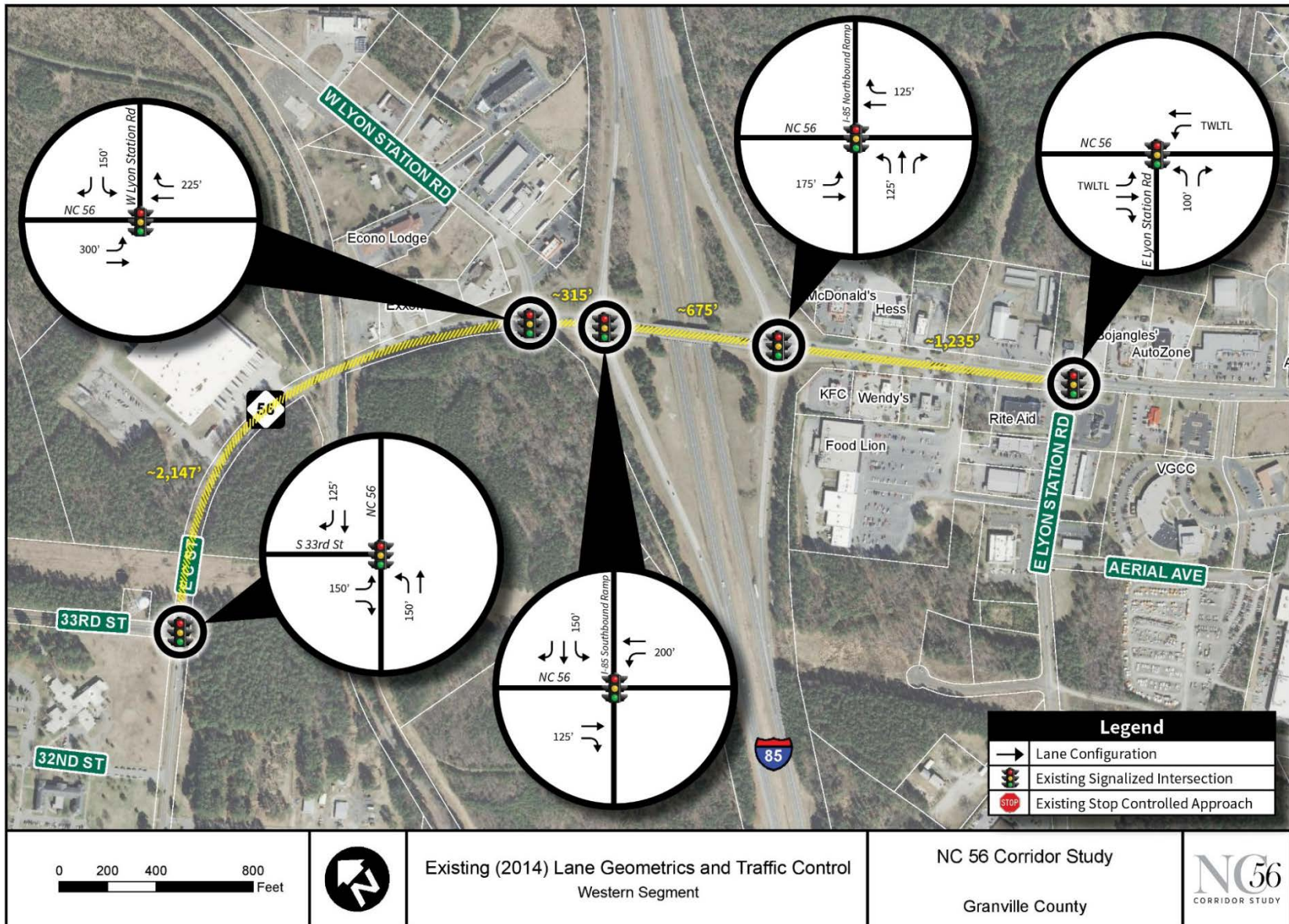


Figure 17: Existing Lane Geometrics and Traffic Control (Eastern Segment)

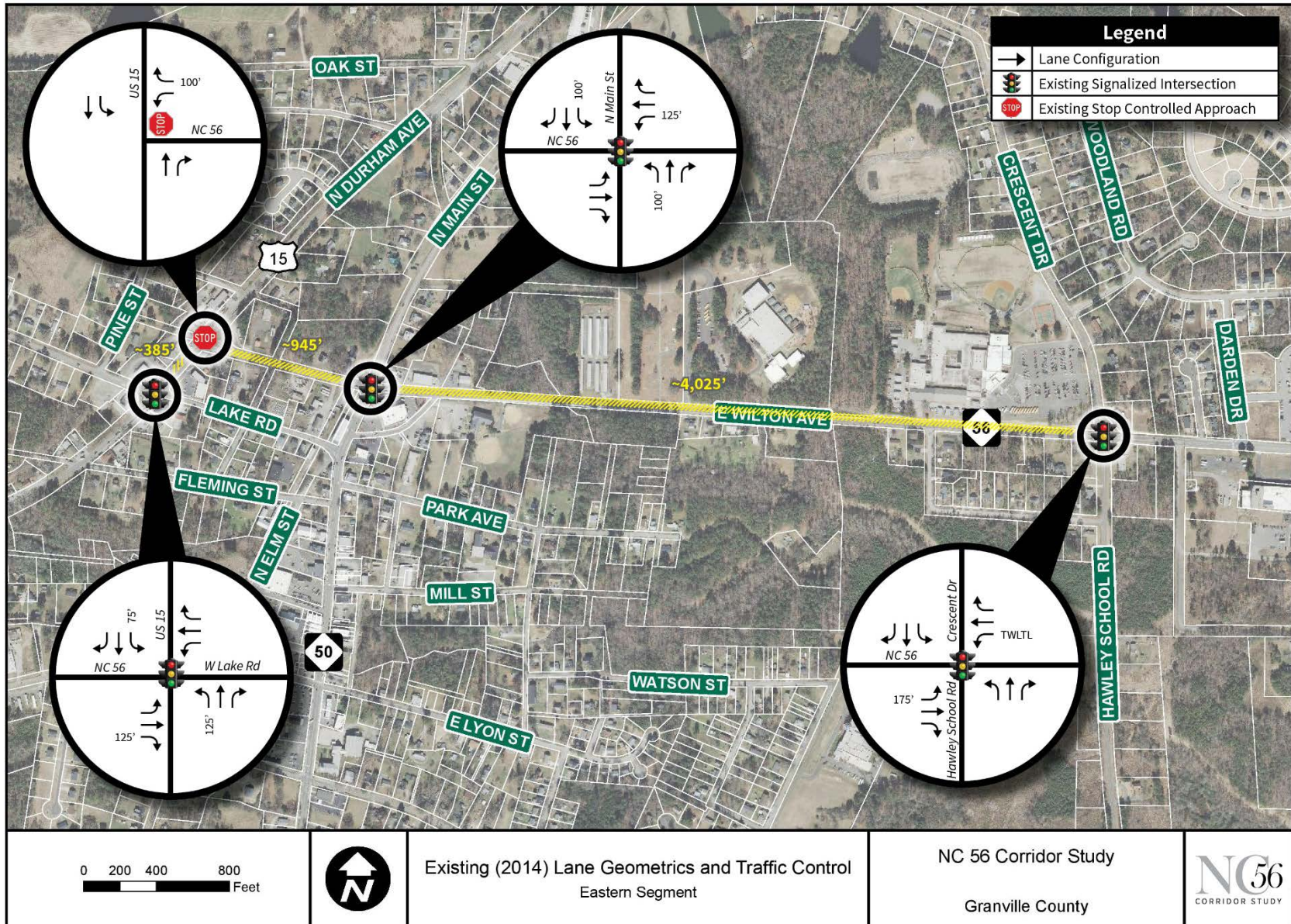


Table 10: Intersection LOS (Western Segment)

Intersection and Approach	Traffic Control	Base Year (2014)		
		AM	MID	PM
NC 56 and 33rd Street	Signalized	A (7.4)	A (7.3)	A (9.8)
Eastbound		A-7.8	A-8.1	B-11
Westbound		A-6.1	A-5.2	A-4.8
Northbound		---	---	---
Southbound		B-12.1	B-11	B-15.9
NC 56 and W Lyon Station Road	Signalized	C (20.5)	B (13.4)	B (16)
Eastbound		B-14	B-10.5	B-13.1
Westbound		B-11.1	A-6.2	A-9.4
Northbound		---	---	---
Southbound		D-37.7	D-39.6	D-46.9
NC 56 and I-85 Southbound Ramp	Signalized	C (21.2)	B (18.9)	B (18.8)
Eastbound		C-24.8	C-26.9	C-21
Westbound		B-13.5	A-9.3	B-10.5
Northbound		---	---	---
Southbound		C-30.2	C-31.2	D-41.1
NC 56 and I-85 Northbound Ramp	Signalized	B (12.3)	B (14.2)	C (26.4)
Eastbound		A-1.6	A-6	B-10.2
Westbound		B-10.5	B-11.4	C-24.1
Northbound		D-43.3	D-50.3	E-59.8
Southbound		---	---	---
NC 56 and E Lyon Station Road	Signalized	A (9.2)	B (15.4)	C (20.9)
Eastbound		A-3.7	A-6.1	B-12.6
Westbound		A-4.1	A-5.9	A-9.2
Northbound		D-43.3	D-46.2	D-47
Southbound		---	---	---

Table 11: Intersection LOS (Eastern Segment)

Intersection and Approach	Traffic Control	Base Year (2014)		
		AM	MID	PM
NC 56 and N Durham Ave/Lake Rd	Signalized	D (37)	C (23.8)	D (40)
Eastbound		D-43.6	C-23.8	D-38.9
Westbound		D-42.2	C-26.3	D-47.2
Northbound		C-20.7	C-20.2	D-39.9
Southbound		D-36.3	C-24.5	D-36.2
NC 56 and N Durham Ave/Lake Rd	Unsignalized	-	-	-
Eastbound		---	---	---
Westbound		C-17.4	B-10.1	B-14.7
Northbound		B-12.9	A-8.9	E-39.3
Southbound		B-10.8	A-8.7	B-10.5
NC 56 and N Main Street	Signalized	B (18.5)	B (13.5)	D (35.2)
Eastbound		C-28.2	B-16.2	D-38.6
Westbound		A-9.9	A-6.7	B-10.1
Northbound		C-32.8	B-18.7	D-53.0
Southbound		C-28.3	B-15.2	C-25.5
NC 56 and Crescent Dr/ Hawley School Rd	Signalized	C (23.7)	A (6.3)	B (12.7)
Eastbound		A-5.9	A-3.9	B-10.2
Westbound		C-22.5	A-6.9	B-10.4
Northbound		D-35.0	B-12.5	C-23.4
Southbound		D-40.5	B-12.1	C-23.7

Safety

Analysis of crashes reported along the study corridor from October 2009 through September 2014 reveals that overall crash rates for this portion of NC 56 are lower than rates on comparable roadway types in North Carolina, as indicated in Table 12.

Table 12: Crash Rate Comparison (2009-2011 NC Data, per 100M veh-miles)

Road Type	Total	Fatal	Non-Fatal Injury	Night	Wet
Rural 2-Lane Undivided	194.56	1.90	60.43	73.20	29.94
Urban 2-Lane Undivided	238.77	0.75	74.55	50.10	37.36
Rural 2-Lane TWLT-Lane	343.48	2.54	109.08	117.71	59.36
Urban 2-Lane TWLT-Lane	1131.17	4.15	365.30	242.84	180.57
<i>NC 56 (Study Corridor)</i>	<i>117.84</i>	<i>0.91</i>	<i>29.23</i>	<i>33.80</i>	<i>21.94</i>
<i>NC 56 (2-Ln Segment – West)</i>	<i>14.18</i>	<i>0.00</i>	<i>14.18</i>	<i>2.84</i>	<i>5.67</i>
<i>NC 56 (3-Ln Segment)</i>	<i>418.18</i>	<i>5.04</i>	<i>70.54</i>	<i>141.07</i>	<i>85.65</i>
<i>NC 56 (2-Ln Segment – East)</i>	<i>161.85</i>	<i>0.00</i>	<i>51.32</i>	<i>31.58</i>	<i>19.74</i>
Rural 4-Lane TWLT-Lane	138.98	1.27	43.61	40.58	21.17
Urban 4-Lane TWLT-Lane	305.80	1.00	99.57	57.06	50.21
Rural 4-lane Divided ¹	139.34	0.66	44.71	20.72	20.72
Urban 4-lane Divided ²	332.15	0.88	107.62	68.39	58.14
Rural 4-lane Divided ¹	128.03	1.43	40.29	41.36	19.52
Urban 4-lane Divided ²	182.11	0.67	62.04	43.24	34.36

¹ No access control.

² Partial access control.

However, this finding does not guarantee that the corridor is free of significant safety issues. Closer inspection reveals that most of the crashes in the corridor are clustered between West Lyon Station and East Lyon Station Roads, a segment that includes the I-85 intersection ramps. Although this segment comprises only about 10 percent of the length of the study corridor, it generates over 53 percent of the crashes. As shown in Table 12, the crash rate for the three-lane portion of the corridor is substantially higher than the eastern and western two-lane segments and exceeds the statewide rates for rural three lane segments. This translates into a much higher crash rate, as NCDOT's 2012 High Frequency Crash Locations listing appears to confirm. The I-85 ramp intersections with NC 56 had the third and eleventh highest crash frequencies in Granville County, while the East Lyon Station Road and West Lyon Station Road intersections rank fourth and fifth.

Throughout the corridor, rear-end collisions are by far the most frequent, accounting for 40 percent of all crashes. Crashes occurring as a result of left turns are the next most frequent type, at 19 percent. Interestingly, all of these types of crashes occurred between East Lyon Station Road and South Campus Drive. There is another large

drop-off to the third most common type of crashes --those caused by animals-- which represent nine percent of the total. Right turns contribute seven percent. Given that much of the corridor is characterized by narrow lane widths, lack of shoulders, and somewhat curvy/hilly alignments, it may be surprising that only five percent of crashes are attributable to running off the road. This could be related to another potentially surprising finding: excessive speeds were rarely cited in the crash reports.

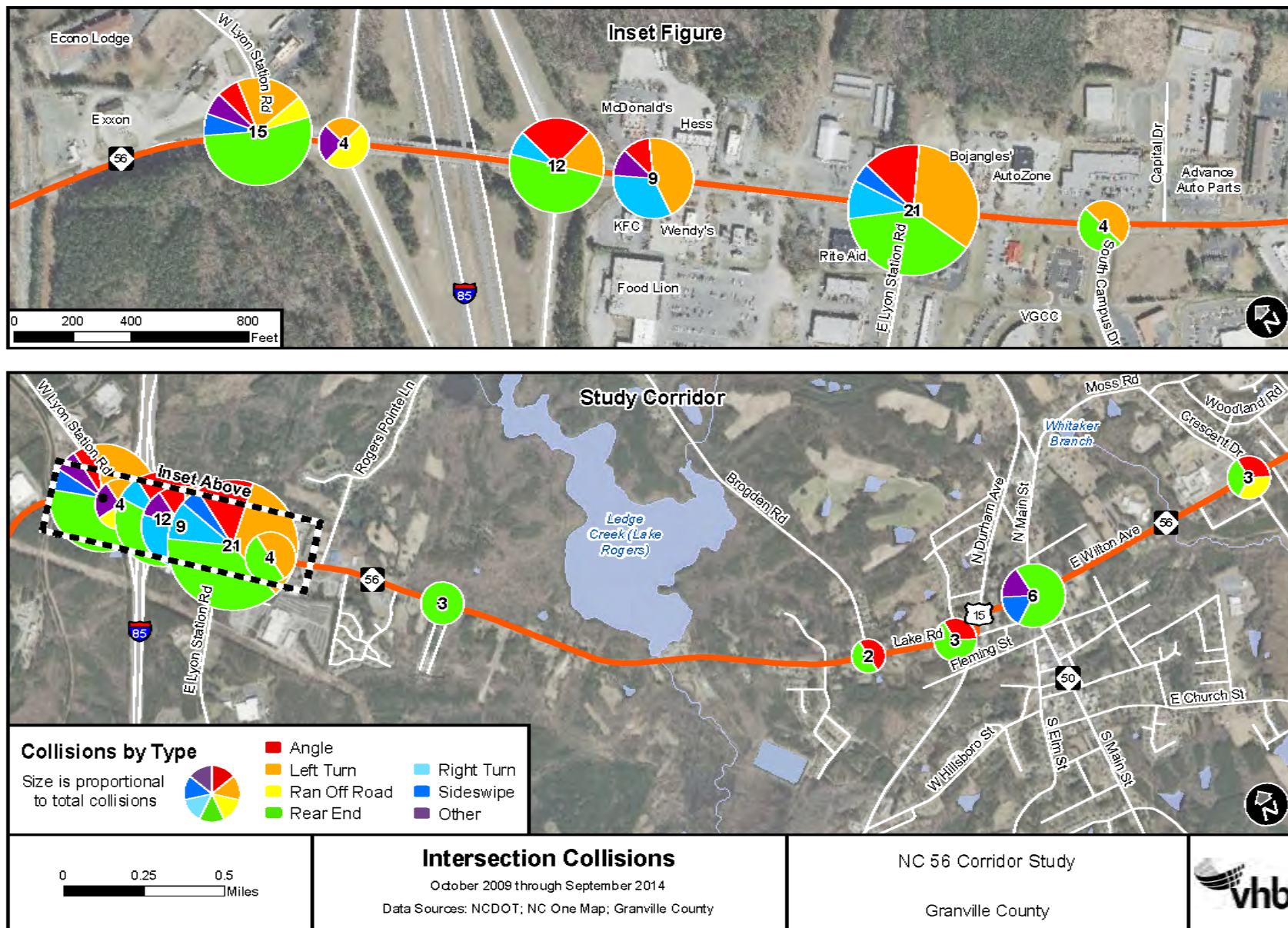
The 245 vehicles involved in 129 reported crashes included only seven trucks, and only one of these was a tractor trailer. So while trucks make up nearly eight percent of the traffic on NC 56, they represent less than three percent of the vehicles involved in crashes, which seems to suggest that trucks have not been major contributors to crashes.

No bicycles were involved in any crashes, and only a single pedestrian crash was reported. However, this was a fatality, occurring as the pedestrian crossed NC 56 at night, between Pond Drive and Washington Avenue. In addition to this fatality, 53 people were injured in 32 crashes; only one of these injuries was a Class A (or debilitating) injury.

Based on the nature of the crashes and study of the roadway, several factors appear to interact in contributing to the cluster of crashes at the western end of the corridor. Problems start with a long horizontal curve that makes a 90 degree turn while climbing a slight grade that crests on the I-85 bridge. This curve begins at 33rd Street and ends at West Lyon Station Road, and includes a railroad crossing and several wide driveways. This combination of vertical and horizontal curvature could affect sight distance and driver perception of speed and distance, especially significant issues due to high volumes of turning traffic, including slow-moving trucks. Furthermore, pavement width and lane configurations change through the curve, and the transition between rural two-lane road and three-lane commercial strip with multiple signalized intersections and frequent, sometimes poorly-defined driveways, is abrupt. These factors combine to create an unexpected and confusing situation.

This explanation is supported by the fact that 75 percent of the crashes between 33rd Street and West Lyon Station Road are rear-end collisions. Farther to the east, the proportion of crash types changes. Between East and West Lyon Station Roads, nearly 60 percent of crashes are classified as turning, angle, or sideswipe collisions. This pattern is more indicative of conflicts resulting from heavy volumes of traffic turning in/out of frequent driveways, especially with a center two-way left-turn lane present.

Figure 18: NC 56 Intersection Collisions (by crash type)



Environmental Context

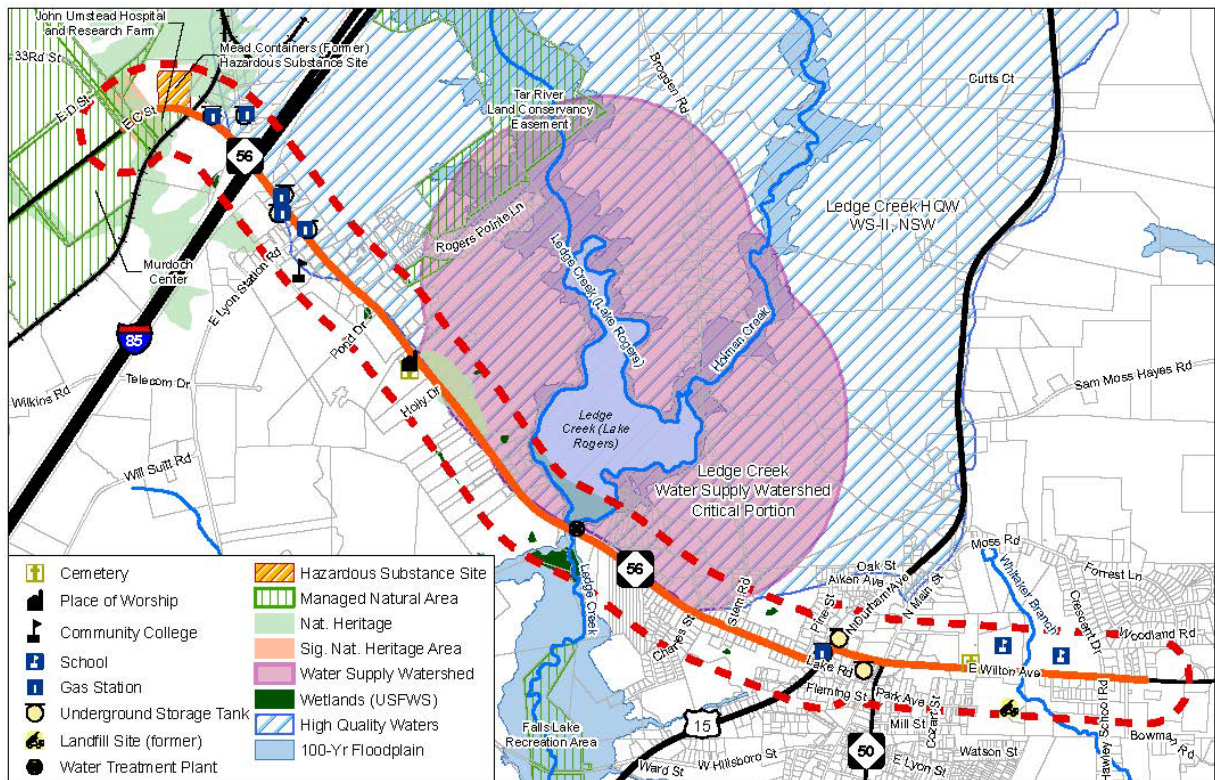
An environmental screening was completed for the project study area utilizing existing GIS resources. This screening analysis indicated areas of possible environmental concern, including streams and wetland areas, community resources, and locations of hazardous waste sites. Figure 19 illustrates the known environmental features present within the project study area as indicated by the environmental screening process.

This summary references environmental features that are located within the:

- Project corridor
- Project study area
- Vicinity of the project study area

The project corridor refers to the right-of-way, which varies between 60-120 feet wide along the entire corridor. The project study area refers to an 800-foot buffer (1,600 feet total width) of the existing roadway centerline, displayed as a red-dashed line in Figure 19. Features within the vicinity of the project study area are located beyond the 800-foot buffer, however still relevant because they are nearby or downstream of the roadway.

Figure 19: NC 56 Environmental Screening



Built Environment

The built environment in the study area is primarily rural with the majority of the area being residential. There are commercial, highway retail, retail, and industrial developments at the eastern and western ends of the study area. Overall, the study area is low density.

Land Use

Development Patterns

The majority of the study vicinity is low density residential. The east and west ends of the study area are commercial development with some industrial uses. The middle portion of the study area is primarily residential. The overall study area is low density and has a rural character, punctuated by commercial developments at either end of the study area.

Residential

Most homes in the study area are single-family homes. The western portion of the corridor is primarily commercial but there are some residential developments, including a large subdivision, mobile home park, and apartment complex. The eastern portion of the study area under Creedmoor jurisdiction features mostly agricultural and single-family zoning, which are low-density residential designations. Near downtown Creedmoor there is also Main Street Residential zoning which is a higher density residential designation for areas bordering downtown Creedmoor.

Commercial/Retail/Service

The western portion of the study area under Butner jurisdiction is zoned primarily for highway business uses near the I-85 interchange. This area has a number of fast food restaurants and retail stores. The area around downtown Creedmoor is designated for commercial use and features a number of retail establishments.

Institutional

There is one identified church, Pine Grove Baptist Church, located along the study corridor, near its intersection with Mill Stream Circle. There are two cemeteries within the project study area. Pine Grove Church Cemetery is located directly behind the church. Creedmoor Cemetery is located at 301 E Wilton Ave, near the elementary school at the eastern end of the project. The cemetery property is adjacent to NC 56 on the north side of the roadway. This portion of NC 56 is two-lanes, with a two-foot paved shoulder and ditch/swale drainage than abuts the cemetery property. Buried fiber optic utilities are present along the north side. The opposite side of the roadway (south) features curb-and-gutter and a sidewalk.

Three public schools are present within the project study area. Creedmoor Elementary and South Granville High schools are both located just west of Crescent Drive, near the eastern end of the project corridor. The Early College High School is located in the western part of the study area.

Vance-Granville Community College is located within the project study area, near the west end of the corridor. The campus has two entry points, a signalized intersection located at East Lyon Station Road, and non-signalized access from NC 56 onto South Campus Drive. The South Branch of the Granville County Public Library is also located in the western part of the study area, across from the community college and on the same parcel as the Early College High School.

Industrial

There is light industrial and office and industrial zoning in the western portion of the study area under Butner jurisdiction, primarily areas not fronting NC 56 near the I-85 interchange. There are a number of industrial businesses in this area including a Sunoco trucking warehouse and an Altec Industries parts facility. There is some industrial development in the far eastern end of the study area as well.

Historic Properties

A review of cultural resources in the vicinity of the study area identified one State (NC) Study List feature within the project study area. Being placed on the State Study List is the first step towards nomination to the National Register of Historic Places (NRHP). The gravesite of Mr. Joe Cephus Coley (ID GV0533) was added to the State Study List in 2001 and is located within the Pine Grove Baptist Church cemetery. The cemetery is located between 125 and 250 feet off of the existing NC 56 roadway and behind the Pine Grove Baptist Church.

There are no designated NRHP properties within the project study area.

Hazardous Materials

According to the most recently available NC Department of Environment and Natural Resources Division of Waste Management GIS data, there is one hazardous material substance disposal site located within the project study area. This site is the former Mead Containers Butner PLT, located approximately one quarter-mile west of West Lyon Station Road, adjacent to the railroad tracks. This site is currently owned by Tegrant Diversified Brands, Inc.

There are no inactive hazardous waste sites within the project study area.

The only listed NPDES facility located within the project study area is the Creedmoor Water Treatment Plant, located along the Ledge Creek, one mile west of US 15/Durham Ave. There is an existing two-lane (27 feet wide) bridge over Ledge Creek at this treatment plant.

There are seven identified gas stations located along the project corridor. Five gas stations are located near the I-85 interchange, and two additional stations are located along US 15/Durham Ave. One of these sites may have been abandoned; however, the concrete pad above the underground tanks is still visible. There is no current indication that these tanks pose an environmental threat.

The site of the former Creedmoor dump is in the vicinity of the study area, off of Park Avenue near the eastern end of the project.

Conservation Areas

The City of Creedmoor owns two recreation areas within the project study area, adjacent to the project corridor. Lake Rogers Park is located along NC 56 in the center of the study corridor. BC Roberts Ball Field is approximately 800 feet east of Main Street, and 0.8 miles west of the project corridor end.

There are no dedicated nature preserves or federally owned lands within the project study area. The Murdoch Center – Butner Compound is a 1,206 acre managed natural area on the west side of the study area. The five acre John Umstead Hospital – Butner Compound and the 1,016 acre Umstead Research Farm – Butner Compound are managed natural areas which are both located to the west side of the study area.

Located two miles downstream of the project study area is the Falls Lake Recreation Area, which is hydrologically connected to Ledge Creek and Whitaker Branch. Best management practices to control sediment runoff during construction will prevent any potential future impact to Falls Lake.

Socio-Economics/Demographics

There are five block groups which encompass the study area and are located within Granville County. According to Census data, the population of the study area block groups is 8,377 as of 2010, an increase of 3.9 percent per year from 2000 (note the geography of the Census 2000 block groups is different from the geography of the Census 2010 block groups). This compares to a 2.1 percent annualized growth rate for Granville County and 1.7 percent growth per year for North Carolina as a whole.

The population in study area block groups is 62.0 percent white, which is similar to that of Granville County (60.0 percent). About 29.0 percent of the population of the study area block groups is black or African-American. Approximately 10.5 percent of

the population of the study area block groups is Hispanic, which is slightly higher than the Granville County population (7.5 percent).

Approximately 16.0 percent of the study area block group population is below the poverty level, which is comparable to the Granville County population. About 3.0 percent of the study area block group population does not have access to a vehicle at home, which is slightly lower than the 5.4 percent for Granville County.

Table 13 shows the key demographic information for the study area and Granville County.

Table 13: Key Demographic Information

Location	Study Area Level	Granville County Level
Population	8,377	59,916
Population Change (2000-2010)	3.9%	2.1%
Minority Population	37.7%	39.6%
Hispanic Population	10.5%	7.5%
Below Poverty Population	16.2%	14.3%

Natural Environment

The natural environment of the study area has a number of important water and endangered species features. Most importantly, the study area is just upstream of the Falls Lake recreational area; subsequently, the entire study area is a protected water supply watershed, and the portion around Lake Rogers is designated as a critical water supply watershed.

Water Quality

The Division of Water Resources (DWR), a subset of the NC Department of the Environment and Natural Resources, is responsible for the protection, classification and enhancement of all streams and water bodies within North Carolina. The project study area is located within the Neuse River Basin of North Carolina.

There are two existing blue line stream crossings within the study area—Ledge Creek and Whitaker Branch—both of which are tributaries of Falls Lake and the Neuse River. Ledge Creek is a Class CA stream (critical area protected for drinking purposes), classified as High Quality Water (HQW), and considered nutrient sensitive (NSW).

Two additional (potentially) intermittent streams are located within the study area, but would need to be field-verified as development may have altered their drainage

patterns. These are tributaries of Ledge Creek, and both appear to cross NC 56 near its intersection with Pine St based on USGS topo maps.

A designated 100-year floodplain represents an area along a stream that has a one percent annual chance of flooding based on previous storm events. It may also be thought of as the highest elevation a stream has risen in the previous 100-years of recorded rainfall events. This storm event may have occurred as recently as one year ago, and likewise this same amount of flooding may occur again next year. There are areas of designated 100-year within the project study area associated with Lake Rogers and the water supply reservoir along Ledge Creek. The existing corridor covers 105 linear feet of 100-year floodplain. There are no designated areas of 500-year floodplains (which represent areas with a 0.2 percent annual chance of flooding) within the project study area.

The project study area is located in the Upper and Middle Falls Lake watersheds, both drain into the Falls Lake recreation area, and forms the Neuse River further downstream. The Lake Rogers watershed (59 percent of the project corridor length) has an established local watershed plan (2003) in coordination with DWR. This watershed improvement plan is necessary because of the Creedmoor Water Treatment Plant, located along Ledge Creek.

The entire study area is located within a protected water supply watershed. A majority of surrounding lands within Granville, Durham, and Wake Counties, in fact, are within a protected water supply watershed because they drain into Falls Lake reservoir. A portion of this protected water supply is designated as critical, representing 0.5 miles upstream (north) of the water treatment plant. This area is displayed as dark pink on Figure 19. A 1.3 mile segment of the existing NC 56 corridor serves as the boundary of this critical water supply watershed, between Mill Stream Circle and Recovery Road.

Wildlife Resources

There are two natural areas within the project study area, having been designated by the Natural Heritage Program as a Natural Area (Site IDs 786, and 1231), which “contains terrestrial or aquatic sites that are of special biodiversity significance.” Within this natural area are several known occurrences of, or habitat for, a number of threatened or endangered plant species, as detailed in Table 14.

One natural area site is located along the north side of the NC 56 corridor, extending from Pine Grove Church to the southeast approximately 0.3 miles. The other natural area site is located along the north side of the Murdoch complex and straddles both sides of the project corridor, and includes an overhead utility easement utilized by Duke Energy.

While it is not expected that the project would directly impact these plant species, best management strategies during construction must be implemented to protect aquatic habitats within and downstream of the project study area.

Table 14: Threatened and Endangered Species

Species Common Name	Species Type	NC Threat Level	Location
Serpentine Aster	Plant	Endangered	Within Study Area
Prairie Blue Wild Indigo	Plant	Endangered	Within Study Area
Hoary Puccoon	Plant	Threatened	Within Study Area
Carolina Birdfoot-trefoil	Plant	Special Concern	Within Study Area
Earle's Blazing-star	Plant	Special Concern	Within Study Area

Relevant Plans

This section summarizes relevant planning and policy efforts, focusing on the most recent transportation-related plans, and on those specific elements that affect the NC 56 Corridor Study, or which could be affected by it.

Pedestrian and Bicycle Plans

City of Creedmoor Bicycle & Pedestrian Transportation Plan (2011)

This plan describes a number of improvements related to NC 56, many of which have moved forward. Initial phases of the Cross City Trail have already been constructed, and Phase III (a multi-use path on the north side of NC 56 between Main Street and Lake Rogers Park) is programmed for construction. Part of the Wilton Avenue sidewalk has been constructed along the frontage of the new Walgreens.

Numerous sidewalk and greenway projects (including sidewalk along US 15 and a multi-use trail on Hawley School Road) will tie into the east-west NC 56 “spine,” creating a connected network that increase the overall attractiveness of the pedestrian system. Other facilities, such as the Northwest and Southwest Creedmoor Lake Trails will offer alternative parallel routes.

The Creedmoor Pedestrian Plan also identifies specific improvements to NC 56 intersections, including Main Street, Hawley School Road, and both US 15 intersections.

Bicycle recommendations for NC 56 made in City of Creedmoor Bicycle & Pedestrian Transportation Plan (2011) include bike lanes (between US 15 and Darden Drive) and multi-use paths and or paved shoulders, bike lanes, or shared lane markings to the west. All of the bicycle and pedestrian recommendations are coordinated with Butner and Granville County plans.

Butner Pedestrian Transportation Plan (2011)

The Butner Pedestrian Transportation Plan recommended two projects relevant to this study:

- Project #2 – Constructs a multi-use side path on the south side of NC 56 from West Lyon Station Road to 27th Street, where it would connect with other pedestrian and bicycle facilities.
- Project #3 – Improves pedestrian accommodation along both sides of NC 56 from I-85 to Washington Avenue. Recommendations include:

- Sidewalks on both sides of NC 56
- Driveway consolidation and reduction in width and turning radii where appropriate
- High-visibility crosswalks at intersections (specifically I-85 ramps and both East and West Lyon Station Road), and at appropriate mid-block locations
- Countdown pedestrian signals and warning signs as warranted
- Connectivity with Creedmoor greenway system and with other elements of the Butner Pedestrian Plan, including sidewalk on West Lyon Station Road and greenways on the south side of NC 56
- ADA-compliant curb ramps
- Reduced speed limit

Granville County Greenway Master Plan (2005)

The Granville County Greenway Master Plan provides a framework for the subsequent and more detailed Butner and Creedmoor plans described above. Key recommendation affecting this study include a multi-use path or greenway along the NC 56 corridor connecting northern Butner with Wilton Avenue and a more southerly east-west connection between central Butner and Creedmoor, north of Gate 2 Road and US 15, in the general vicinity of Joe Peed Rd.

Regional/Long Range Transportation Plans

2008 Granville County Comprehensive Transportation Plan (CTP)

This plan identifies the staged widening of NC 56 to a four-lane divided boulevard facility from I-85 to Franklin County as a priority. Ancillary on-road and off-road pedestrian and bicycle routes are recommended as part of this project, and this corridor is recommended for future bus service. A number of intersections included in the NC 56 Corridor Study are also identified in the CTP for further study due to high crash rates. These intersections are West Lyon Station Road, I-85 (high priority), Stem Road, US 1/NC 50, and Hawley School Road.

Other relevant project proposals include:

- Construct the Creedmoor Connector, a four-lane divided boulevard on new location that would create a bypass or partial loop around western and southern Creedmoor. This facility would connect from NC 56 just west of Rogers Lake to Brassfield Road (SR 1700) just east of Hawley School Road. On-street bicycle facilities are included in this recommendation. Impacts of this project on travel and land use patterns would dramatically impact NC 56.
- Widen NC 15 south of NC 56 to a four-lane divided boulevard as part of a larger regional project.

- Study a new I-85 interchange north of NC 56. This project could have significant impacts on development and traffic demand within the NC 56 Corridor study area.
- Widen and improve East Lyon Station Road to a four-lane raised median curb-and-gutter facility with bicycle and pedestrian accommodations (from Gate 2 Road to NC 56).
- Widen West Lyon Station Road to a two-lane/three-lane facility with bike accommodations, and realign for better intersection with NC 56 and proposed service road. Extend West Lyon Station Road south across NC 56, possibly as a four-lane divided facility.
- Extend 24th Street in Butner across I-85 to provide a two-lane connection with bicycle and pedestrian accommodations to East Lyon Station Road.
- Widen Brogden Road to a two-lane/three-lane facility with bike accommodations from NC 56 to Stem Road.
- Construct new service roads with bicycle accommodations west of I-85 between Gate 2 Road and NC 56.
- Widen Joe Peed Road to a two-lane/three-lane facility with bike accommodations.
- Possible improvements to Moss Road.
- Build a multi-use path or greenway along the NC 56 corridor connecting northern Butner with Wilton Avenue and NC Bike Route 1 in Creedmoor.
- Build an east-west route between central Butner and Creedmoor, north of Gate 2 Road and US 15, in the general vicinity of Joe Peed Rd.
- Initiate transit service between Butner and Creedmoor along NC 56.

2040 CAMPO Metropolitan Transportation Plan (2013)

The most recent update to the CAMPO MTP includes the widening of NC 56 between I-85 and US 15 as a 2040 project. This is a shorter project than described in the Granville County CTP. This project was not included in 2035 CAMPO MTP, although several other projects from the CTP which had been in the 2035 MTP have been moved beyond 2040, this project was reprioritized due to funding constraints and the competitive nature of the STI legislation. The new I-85 interchange remains as 2030 project, pending study.

Corridor and Intersection Studies

Creedmoor Intersection Analysis (2011)

This study considered transportation safety and operations at four intersections, three of which are included in the NC 56 Corridor Study:

- NC 56 (Lake Road) at US 15 (North Durham Avenue)
- NC 56 (Wilton Avenue) at US 15 (North Durham Avenue)
- NC 56 (Wilton Avenue) at NC 50 (North Main Street)
- NC 50 (North Main Street) at Lake Road

A range of alternatives were evaluated with respect to traffic operations, safety, and environmental and community impacts, over both short and long range timeframes. These scenarios included improving existing conditions, adding roundabouts, and implementing one-way pairs. Access management and pedestrian and bicycle accommodations were considered in all instances. Also discussed were long-standing concepts for rerouting NC 56 on new alignment to provide a continuous route through town on a single thoroughfare. Specific recommendations include:

- Near-Term
 - Consolidate driveways
 - Add planting strips to better define driveway locations
 - Add sidewalks and ADA compliant crossings, signals and other amenities
 - Improve signage and pavement markings
 - Remove obstructions in sight-triangles
 - Reduce some speed limits
- Long-Term
 - Implement one-way pair
 - Convert the intersection of North Durham and Wilton Avenues to a roundabout

The study did not consider the potential for the future Creedmoor Connector (NC 56 Bypass) to reduce traffic volumes, and assumed a rather aggressive/conservative annual traffic growth rate of three percent through 2040. By comparison, annual growth rates for these facilities according to the Triangle Regional Model range from less than 1.0 percent to less than 2.5 percent, yielding a composite average annual growth rate under 1.5 percent.

NC 56 Access Management Corridor Study (2003)

The scope of this study is approximately the segment of NC 56 between the railroad crossing and Pond Drive with a focus on reducing crash rates and delay due to congestion. Alternatives considered reflect the goal of reducing conflicts, both in the short term and over a longer time horizon, in anticipation of additional development and future background traffic growth. Prioritized recommendations include:

- Convert NC 56 to a median-divided four-lane facility to:
 - Improve traffic flow (increase vehicle speeds)
 - Enhance traffic operations (reduce congestion)
 - Increase traffic safety (reduce crash rates)
- Consolidate and align driveways, and interconnect parcels to reduce the number of conflict points and increase the distance between them
- Create a parallel network of local/collector roads
- Restrict allowable turning movements
- Improve intersections via: :
 - Auxiliary and turn lanes
 - Longer storage lengths
 - Traffic signal timing modifications and coordination
- Improve number, placement, and visibility of directional and regulatory signage, pavement markings, and signals
- Assess and improve sight distance triangles at all intersections and driveways

Pedestrian, bicycle, and transit modes were not included in this study, nor was any explicit consideration given to commercial vehicles, freight movement, land use changes, travel demand management, or environmental and community impacts.

NC 50 Corridor Study (2011)

The northern terminus of the NC 50 Corridor Study is the intersection with NC 56 (West Lake Road). Specific recommendations relevant to this study include streetscaping, intersection treatments, lighting, crosswalks bicycle accommodations, and other improvements in support of downtown development, safety, and transportation service.

Other, more general recommendations that could relate to the NC 56 Corridor Study include the implementation or further study of:

- Special overlay districts
- Rideshare programs
- Park-and-ride, express bus, and other transit service
- Access management techniques
- Best management practices for runoff control
- Wayfinding

Overall, the study reflects stakeholders' emphasis on:

- Pedestrian and bicycle connectivity and supportive amenities
- Water quality
- Traffic safety
- Habitat and community preservation
- Complete streets/context-sensitive design

- Economic sustainability
- Innovative funding and implementation mechanisms.

Other Plans, Studies, Policies, and Documents

Butner Gateway Small Area Plan (2013)

This sketch plan laid the groundwork for a more detailed study which is currently underway. The NC 56 Corridor Study will coordinate with this effort to ensure consistency in assumptions and outcomes, and to maximize efficiency.

Key issues include changes in traffic volumes and patterns (including truck and rail traffic); potential for new pedestrian, bicycle, and transit trips; new/realigned roads intersecting NC 56 immediately west of I-85; and a new road passing over I-85 to connect 26th Street with Telecom Drive.

Town of Butner 2020 Comprehensive Plan (2009)

Butner's 2020 Comprehensive Plan recommends: widening NC 56; implementing access management and interconnected parking; enhancing the streetscape; and improving pedestrian and bicycle accommodation. It also recommends realigning West Lyon Station Road at NC 56 to increase safety and capacity, and to better align with a future connector or service road paralleling I-85 to the west, and extending south to Gate 2 Road. Other recommendations include an overpass of I-85 to connect 26th Street and Telecom Drive, and improvements associated with access to future development off of, and across NC 56 from, East Lyon Station Road.

Creedmoor City Plan 2030 Plan (2012)

This land use and comprehensive master plan provides a framework that supports the transportation-related recommendations embodied in the other plans cited in this discussion. Particular attention is paid to bicycle and pedestrian connections; a broader approach to roadway design that considers factors beyond levels of traffic service; and the importance of broad accessibility to economic vitality and quality of life.

The Plan's land use recommendations are critical to understanding future travel demands, and to understanding potential constraints on expanding roadway capacity. Elements of special interest to the NC 56 study include the Main Street core business district and the Gateway Business Area (off of West Lake Road), and the importance of existing and future utility/infrastructure locations (water, sewer, and gas) in directing growth, and as possible obstacles to road construction. The Plan also goes into considerable detail regarding watershed restrictions and the need to

preserve other environmental and cultural resources, and describes zoning regulations, development ordinances, and other tools for achieving these ends.

I-85 Interchange Study (2013)

This study, undertaken by CAMPO, evaluated the possibility of a new interchange on I-85 in Granville County between Exit 191 (NC 56) and Exit 202 (US 15). This eleven-mile stretch of I-85 currently does not have any exits which raises safety concerns due to lack of access to the Interstate for emergency vehicles. Additionally, there are no alternative routes available for vehicles in case of emergencies. Further, operational benefits and economic benefits could be seen with a new interchange.

The study examined five possible locations, concluding that a location at Brogden Road (SR 1127) presented the best opportunity for a new interchange. This location, two miles north of the NC 56 interchange, scored highest for economic development potential and access to high crash areas. However, the study further concluded that mobility benefits of a new interchange would likely be limited in the foreseeable future leading to the conclusion that a new interchange would not be constructed prior to 2040.

Creedmoor Recreation Master Plan (2014)

Several general and specific recommendations from this plan that are relevant to the NC 56 Corridor Study are quoted below.

- *Develop a well-connected open space system in the downtown area that provides improved opportunities for pedestrians and bicyclists, promotes economic vitality of the City's center, and reflects the unique character of the area.*
- *Expand Lake Rogers Park to include improved lake access, expanded public open space, amphitheater, environmental education opportunities, lake loop trail, and landscape enhancements. The design and program should focus on the park as the western gateway into the City through streetscape improvements and orientation to Highway 56.*
- *Continue to prioritize bike / pedestrian linkages that connect major destinations like schools, downtown core and Lake Rogers to each other.*
- *Add the link that connects two of Creedmoor's cemeteries to B.C. Roberts Ballfields and the Gymnasium and Activity Center to the plan as part of the greenway and trail system. This can be accomplished by adding signage and providing paved connections between short gaps.*

The Plan supports implementation of projects identified in the Creedmoor Pedestrian and Bicycle Transportation Plan and the Granville County Greenway Plan. Implementation and funding are addressed in detail, including references to potential transportation-related funding sources, such as Safe Routes to School and MAP-21's Transportation Alternatives Program.

NCDOT Complete Streets Standards (2010)

In 2010, the North Carolina Department of Transportation revised the typical highway cross sections for all roads to include bicycle and pedestrian components, adopting an approach more consistent with Complete Street principals.

Critical Issues

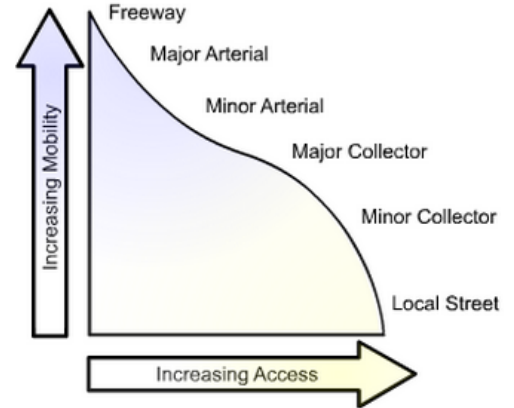
Safety and Access Management

Vehicular as well as pedestrian and bicycle safety is a primary concern along this roadway. This issue has been raised by members of the Stakeholder Oversight Team, Core Technical Team, and by the public during meetings throughout the study. The issue is also evident in the historic crash data gathered for this study. As reported previously, there have been 129 crashes along the corridor within a five-year period; most of the crashes in the corridor are clustered between West Lyon Station and East Lyon Station Roads, a segment that includes the I-85 intersection ramps. Although this segment comprises only about 10 percent of the length of the study corridor, it generates over 53 percent of the crashes. The section immediately east of I-85 also contains a substantial number of relatively high volume driveways. Figure 20 illustrates the high level of access along this section of NC 56 and how the crashes correspond with these driveways. In addition, the majority of the left-turn crashes along the corridor, which are often one of the more severe types of crashes, occur within this section.

Figure 20: NC 56 Intersection Collisions from I-85 NB Ramps to Pond Drive (by type)



NC 56 has a current federal functional classification as a Minor Arterial. The need for increasing mobility is critical as NC 56 continues to provide east-west connectivity across southern Granville County, serving the Town of Butner and City of Creedmoor as well as accessing I-85. Promoting good access management promotes the safe and efficient use of the transportation network access. Managing access spacing, adding safe turning lanes, and employing median treatments will help reduce crashes as well as increase roadway capacity and shorten travel time for motorists.



Conceptual Roadway Functional Hierarchy

Congestion

Traffic Forecasts

The current adopted Triangle Regional Model (TRMv5) developed by the TRM Service Bureau was used to develop traffic forecasts for this study. The version of model used for this analysis was: v5-TRM-2010-09042013. Socio-economic data in the TRM for the years 2015 and 2040 was reviewed, and three TAZs were split to refine trip generation and distribution in the study area. Socio-economic data were split between old and new TAZs based on existing and anticipated development patterns, with input from local staff. Road networks for both the 2015 and 2040 models were also edited to include additional local roads and modified centroid connector locations to provide more accurate loading and distribution of traffic.

Figure 21 shows the 2015 daily traffic estimated for the study corridor. A representative 2.2 percent annual growth rate (derived from analysis of TRM loadings) was applied to the existing volumes along the corridor, with some smoothing and balancing as needed. This growth results in an overall increase in daily traffic volumes of 72 percent by 2040.

Figure 22 depicts 2040 conditions without the proposed I-85 interchange at Brogden Road, or the grade-separated crossing of I-85 between 26th Street and Telecom Drive. Figure 23 shows 2040 daily traffic without the interchange, but including the overpass, which significantly reduces traffic on the western portion of NC 56, while slightly increasing traffic on East Lyon Station Road. With the Brogden Road interchange added, the 2040 daily volumes decrease substantially at the intersection of West Lyon Station Road and the I-85 southbound ramps, as shown in Figure 23: 2040 Daily Traffic (Overpass without Interchange)

Figure 24. The decrease along West Lyon Station Road is approximately 8,600 vpd, shifting from West Lyon Station Road to I-85 north of the study corridor.

Overall, traffic growth is anticipated to be relatively moderate and steady throughout the study corridor. However, new residential or commercial development could trigger significant localized traffic increases. Of particular interest due to their traffic generating potential are the Butner Gateway project, large vacant parcels immediately east of I-85 (especially north of NC 56), and redevelopment in the northwestern portion of central Creedmoor. Outside the study area, continued development (primarily residential) eastward along NC 56 is expected to add new trips to NC 56.

Among planned transportation projects that will affect the study corridor, the most significant by far is the I-85/Brogden Road interchange. By providing more direct access to I-85, this project will divert a significant number of trips from the NC 56 corridor, trips that do not want or need to be on NC 56. The greatest benefit to the

NC 56 corridor will be dramatically reduced congestion between West Lyon Station Road and the I-85 interchange. Any traffic reductions to the east will be far more modest, and will have less significant impacts on the level of traffic service.

The connection between 26th Street and Telecom Drive will also divert some traffic from NC 56, but its most important contribution will be to greatly enhance the safety and convenience of bicycle and pedestrian trips across the I-85 barrier. Combining the overpass with the proposed service road connecting NC 56 and Gate 2 Road adds accessibility benefits for all modes of travel. In particular, the service road encourages more efficient use of the NC 56 and Gate 2 Road interchanges along I-85.

Figure 25 and Figure 26 illustrate the AM, Midday and PM peak hour turning movement volumes for the future No-Build scenario.

Figure 21: 2015 Daily Traffic

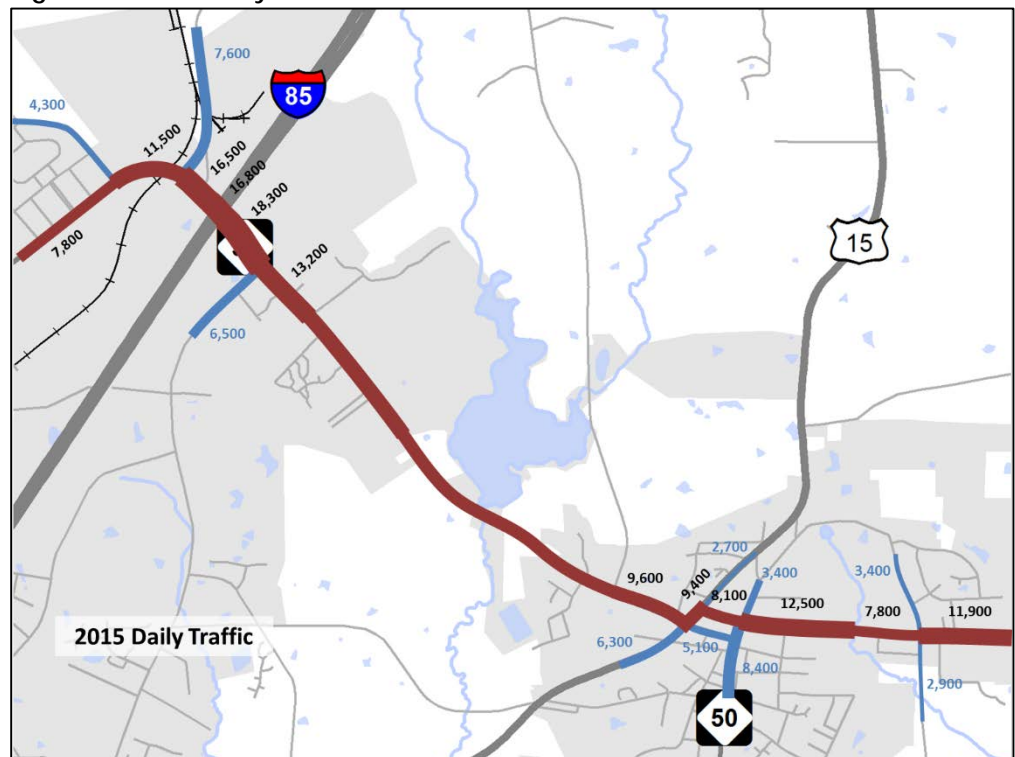


Figure 22: 2040 Daily Traffic (No Interchange or Overpass)

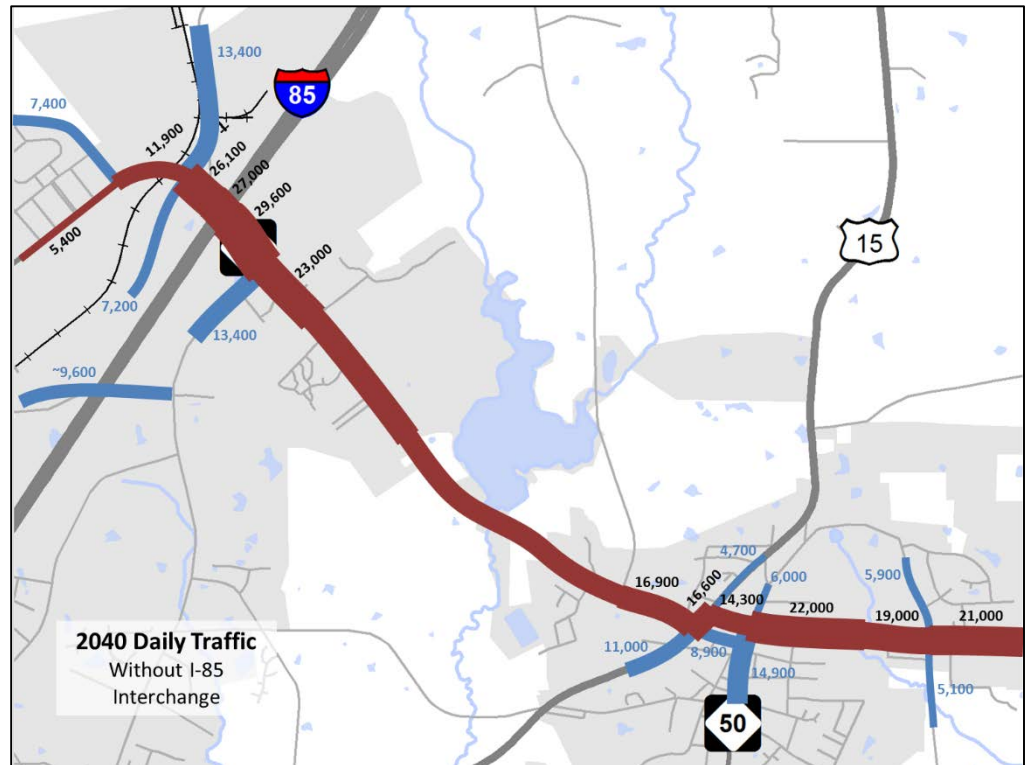


Figure 23: 2040 Daily Traffic (Overpass without Interchange)

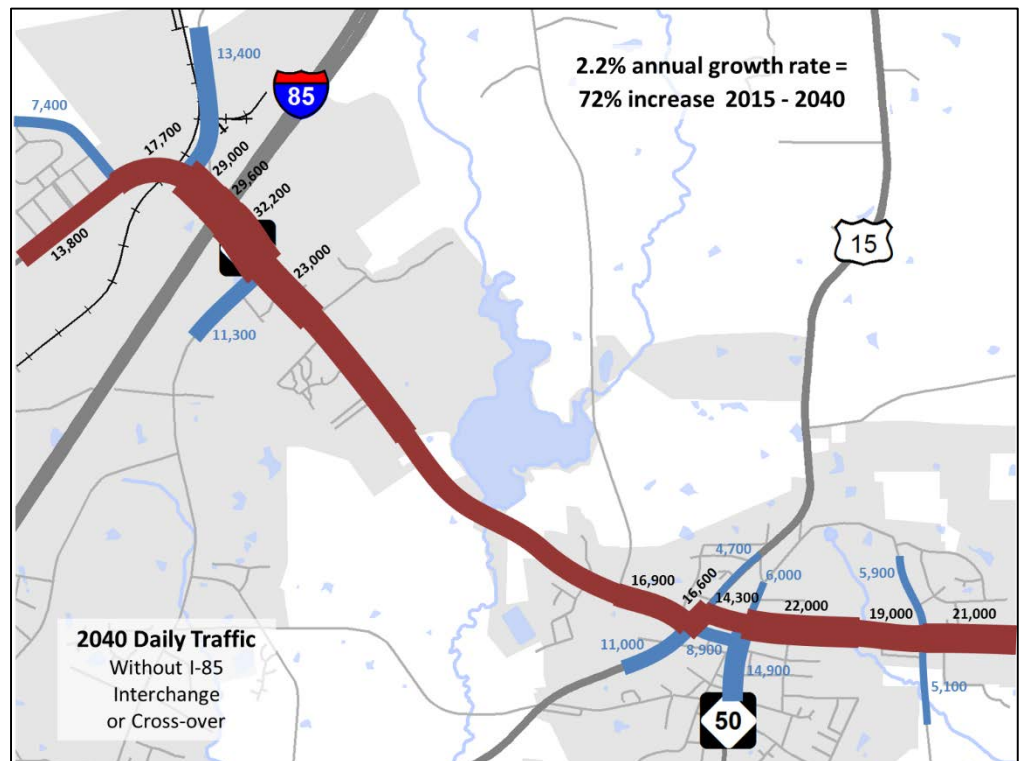


Figure 24: 2040 Daily Volume (With Interchange + Overpass)

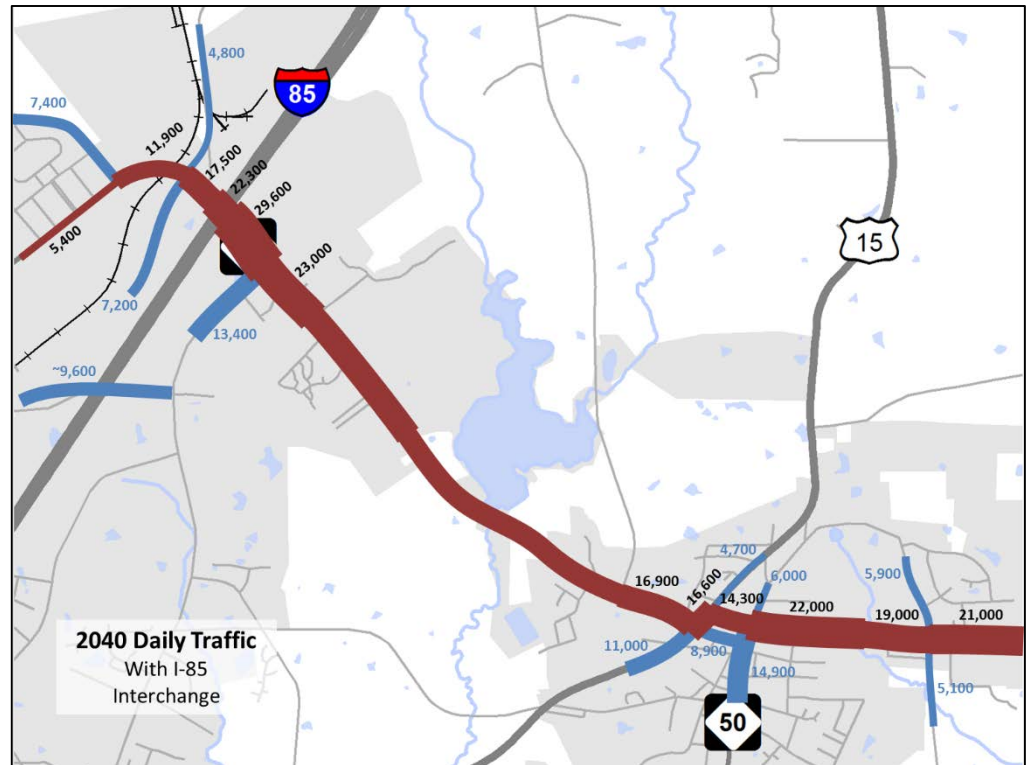


Figure 25: No-Build (2040) Peak Hour Turning Movement Volumes (Western Segment)

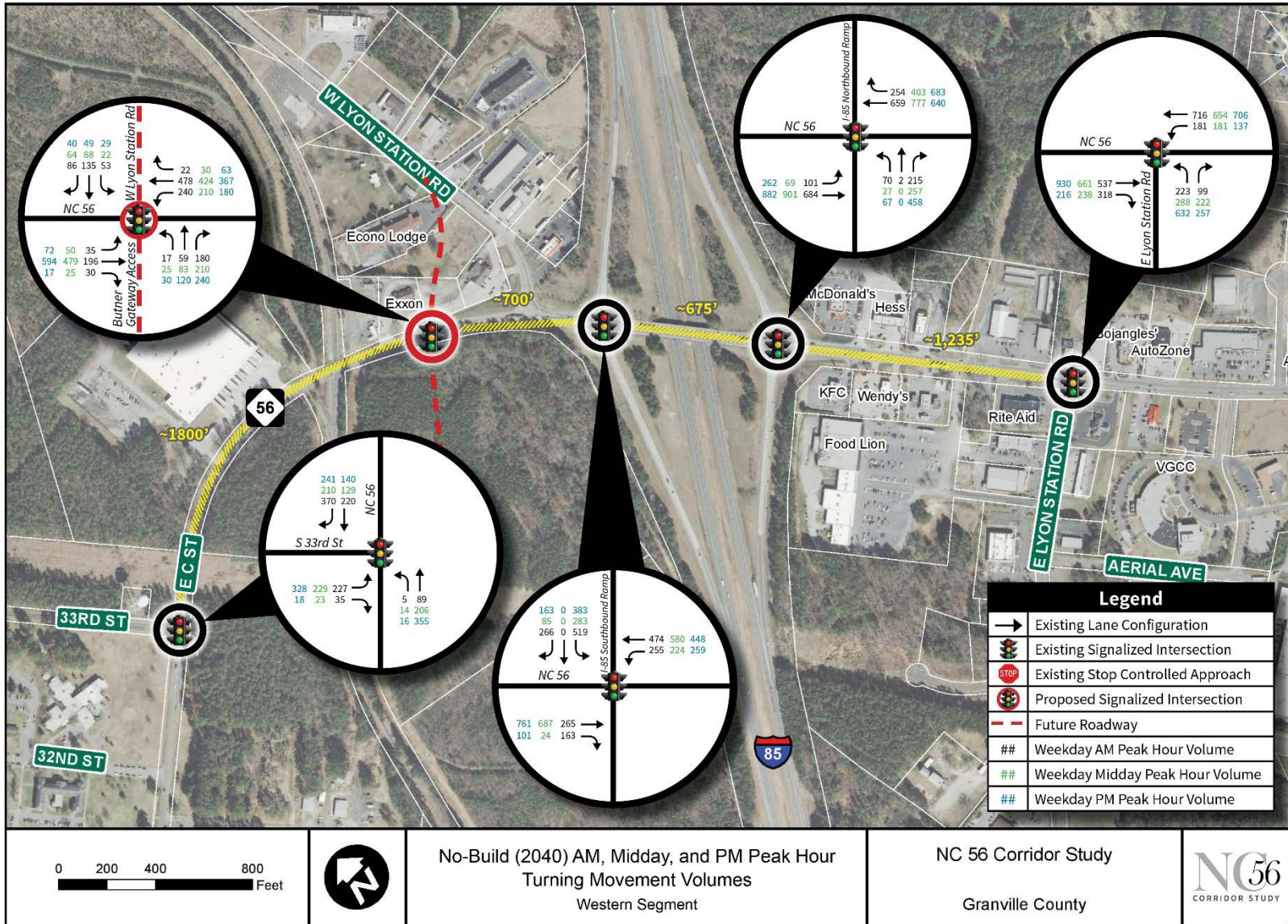
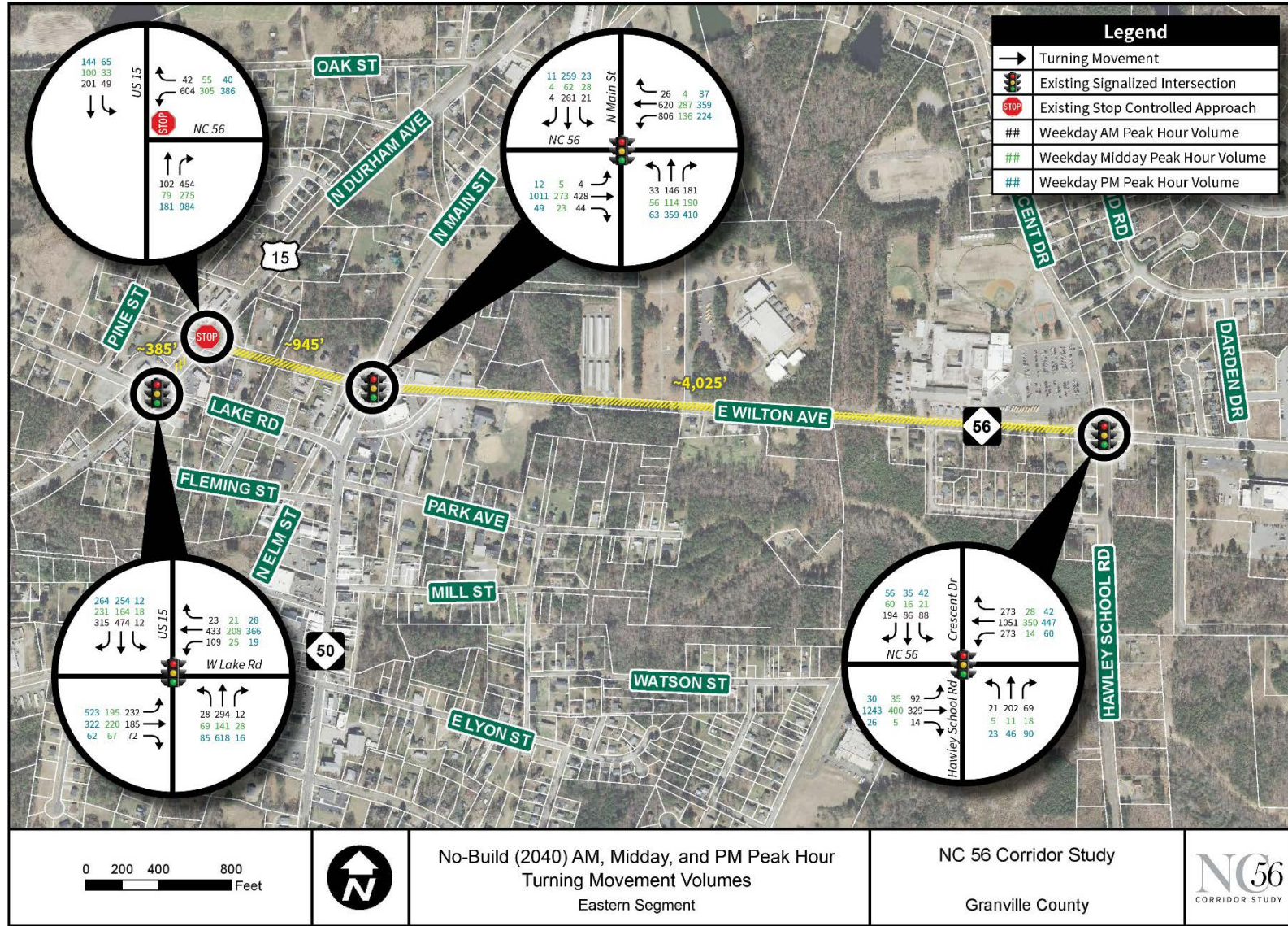


Figure 26: No-Build (2040) Peak Hour Turning Movement Volumes (Eastern Segment)



Corridor-Level

As stated earlier, this corridor has been divided into three individual subareas, or segments. The three segments were all assessed as a Class III two-lane highway using Highway Capacity Software Plus (HCS+). The western segment of this corridor is more developed and contains more access points, intersections, per mile than the middle and eastern segments. For those reasons, the western segment was evaluated using SimTraffic in addition to the HCS assessment.

As with the Existing (2014) scenario, segmental corridor analyses were conducted for the No-Build (2040) scenario using the Highway Capacity Software Plus (HCS+) software package. Table 15 summarizes the two-lane highway, corridor level of service, HCS analysis results of each segment during the AM, Midday and PM peak hours. As noted in the table below, most of the segments are projected to operate at poor levels of services and considerably lower speeds than existing conditions.

Table 15: No-Build (2040) Corridor Level of Service Summary for NC 56

Location	AM Peak			Midday Peak			PM Peak		
	Segment LOS	Ave. Speed (mph)	PFFS (%)	Segment LOS	Ave. Speed (mph)	PFFS (%)	Segment LOS	Ave. Speed (mph)	PFFS (%)
Western Segment	E	25.5	64.1	E	23.3	58.6	E	22.6	56.7
Middle Segment	D	27.8	69.8	D	29.3	73.7	E	24.7	61.9
Eastern Segment	E	23.3	60.1	D	28.9	74.5	E	21.1	54.4

As stated previously, the western segment of this corridor is more developed and was therefore evaluated using SimTraffic, a simulation software, to further investigate the operations during each peak hour. The intersection improvements committed by the Butner Gateway project at NC 56 and West Lyon Station Road as well as NC 56 and I-85 southbound ramps were incorporated into the Synchro files. These improvements as well as the lane configurations and traffic control assumptions for the corridor for this scenario are illustrated in Figure 27 and Figure 28. The phasing at the intersection of East Lyon Station Road and NC 56 was also updated to protected and permitted for the westbound left-turn lane.

Figure 27: No-Build (2040) Lane Geometrics and Traffic Control (Western Segment)

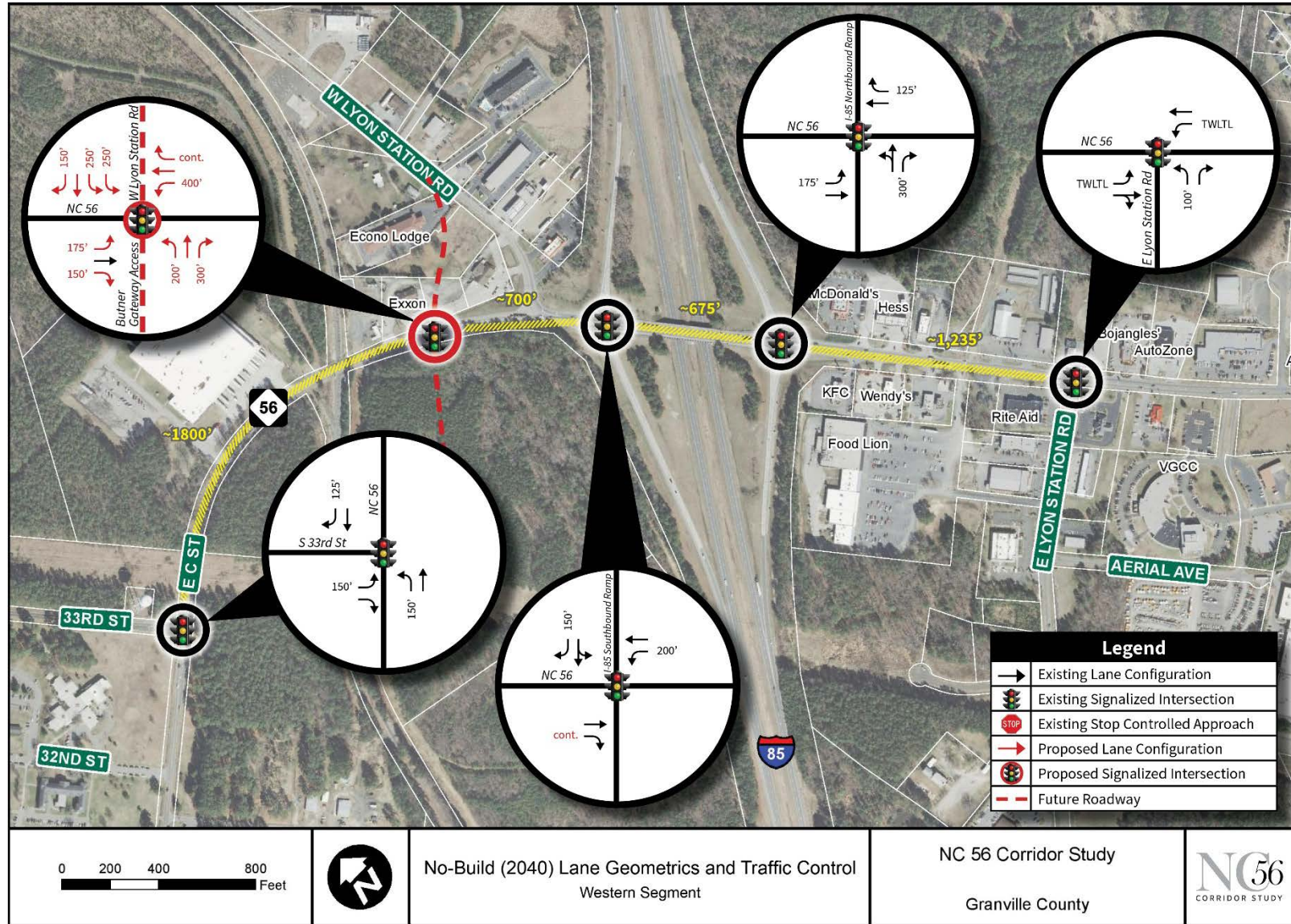
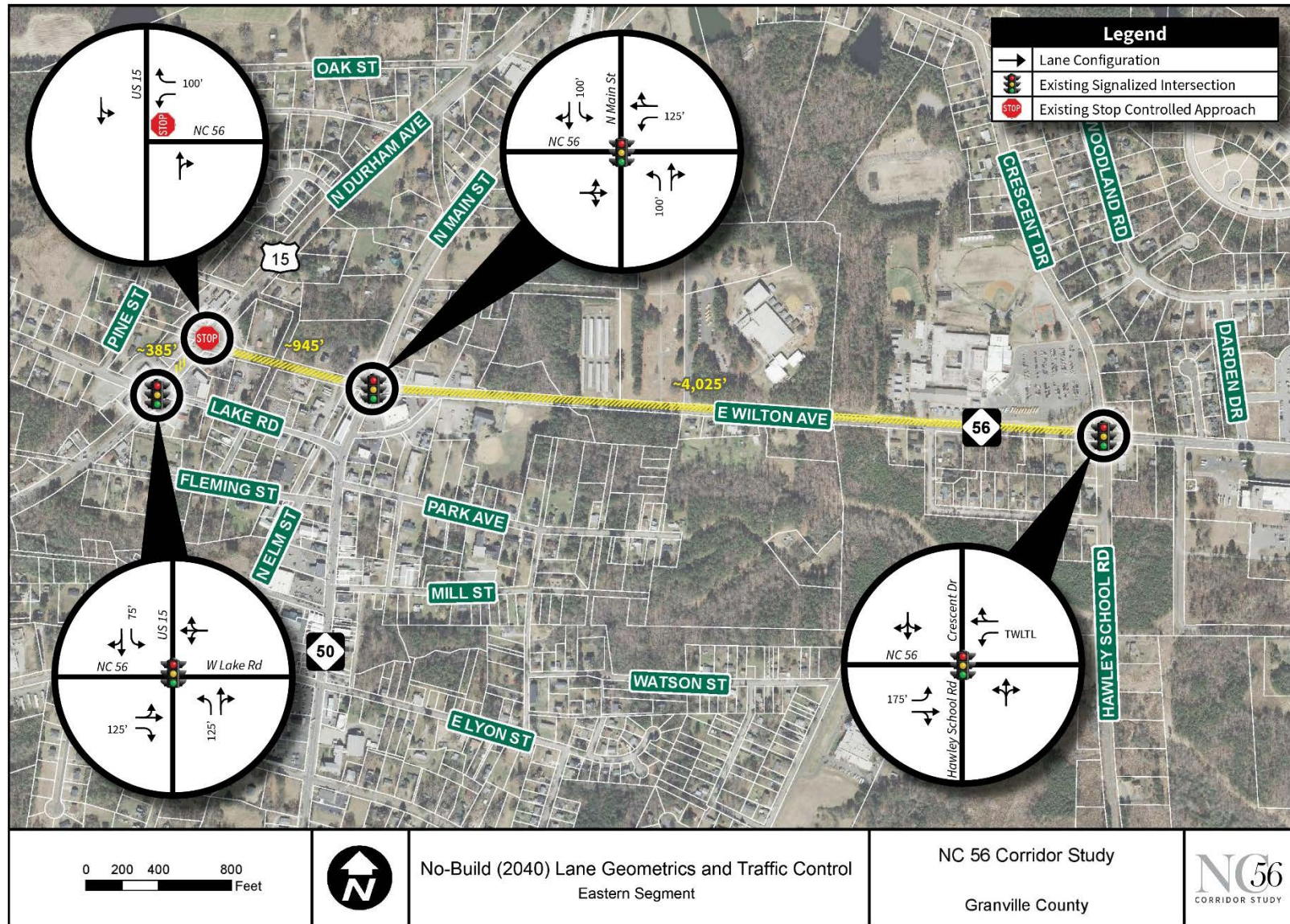


Figure 28: No-Build (2040) Lane Geometrics and Traffic Control (Eastern Segment)



During the simulation, queuing that greatly increased the travel time and delay for drivers traveling westbound during all peak hours, was observed at the intersection of E Lyon Station Rd at NC 56 and the I-85 southbound ramps at NC 56. Table 16 summarizes the SimTraffic results, specifically travel time and delay, for the western segment during the AM, Midday and PM peak hours. Figure 29 and Figure 30 graphically show the corridor travel time and delay traveling eastbound and westbound along NC 56.

Table 16: No-Build (2040) Travel Time and Delay for NC 56 (Western Segment)

Location	AM Peak		Midday Peak		PM Peak	
	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)
Eastbound	284.3	102.6	342.1	163.1	361.8	181.3
Westbound	278.9	99.5	260.7	82.3	320.9	141.4

Figure 29: No-Build (2040) Corridor Travel Time (Western Segment)

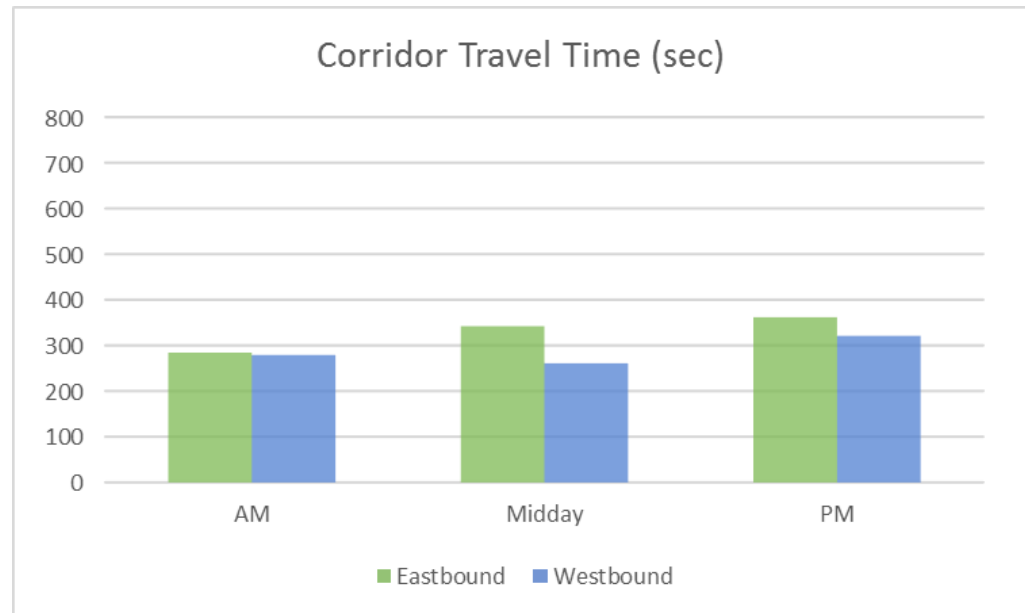
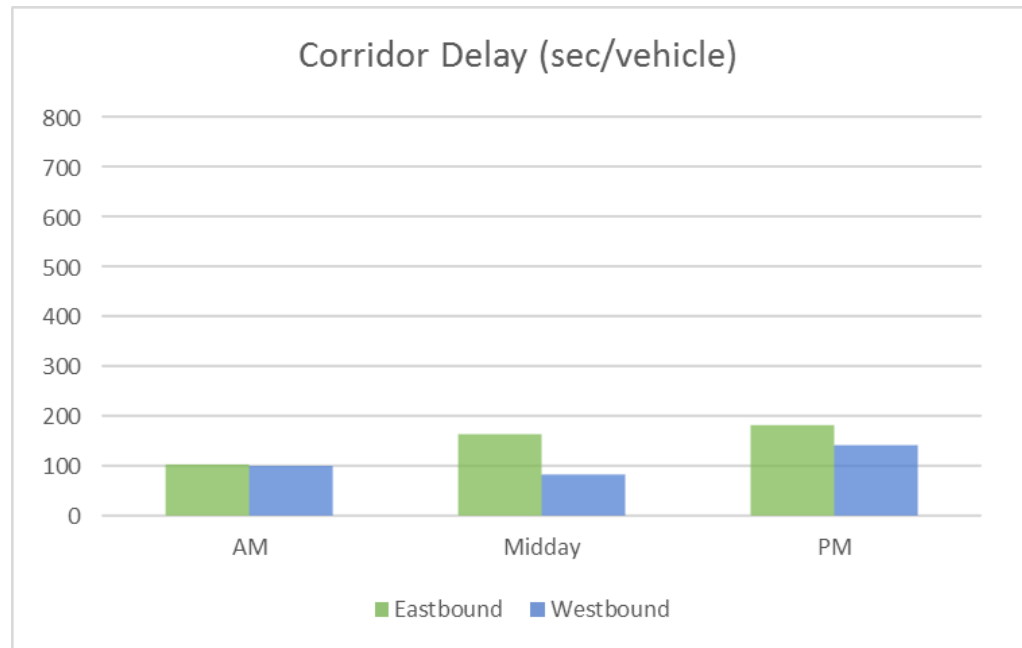


Figure 30: No-Build (2040) Corridor Delay (Western Segment)



Intersections

Intersection LOS analyses were performed for the typical weekday AM, Midday and PM peak hours using *Synchro/SimTraffic Professional Version 7*. The No-Build (2040) intersection cycle lengths and splits were optimized. A summary of the findings for the No-Build (2040) scenario level of service analysis can be found in Table 17 and Table 22, and the full Synchro/HCS output can be found in Appendix II.

As reported in Table 17 and Table 18, the overall level of service at the intersection of NC 56 and I-85 Southbound Ramp intersection degrades from LOS B to LOS E during the PM peak hour. In addition, the intersection of NC 56 and I-85 Northbound Ramp degrades from LOS B to LOS E during the Midday peak hour and from LOS C to LOS F during the PM peak hour. During the Midday peak hour the intersection of NC 56 and E Lyon Station Rd degrades from LOS B to LOS F, and degrades from LOS C to LOS F during the PM peak hour. The overall level of service at the intersection of NC 56 and N Durham Ave/Lake Rd degrades from LOS D to LOS F during the AM and PM peak hours. The westbound NC 56 approach at N Durham Ave/Lake Rd degrades from LOS C to LOS F during the AM peak hour and from LOS B to LOS E during the PM peak hour. The northbound N Durham Ave/Lake Rd approach at NC 56 degrades from LOS B to LOS F during the AM peak hour and from LOS E to LOS F during the PM peak hour. The intersection of NC 56 and N Main St degrades from LOS B to LOS E and from LOS D to LOS F during the AM and PM peak hours, respectively. The intersection NC 56 and Crescent Drive/Hawley School Road

degrades from LOS C to LOS F and from LOS B to LOS E during the AM and PM peak hours, respectively.

Table 17: No-Build (2040) Intersection LOS (Western Segment)

Intersection and Approach	Traffic Control	No-Build (2040)		
		AM	MID	PM
NC 56 and 33rd Street	Signalized	C (21.2)	C (28.3)	C (28.8)
Eastbound		A-8.9	A-6.4	B-11.3
Westbound		A-3.8	A-2.5	A-1.4
Northbound		---	---	---
Southbound		E-64.8	F-82	E-77.8
NC 56 and W Lyon Station Road	Signalized	C (24.6)	C (26.2)	D (47.3)
Eastbound		C-24.3	C-27.4	D-36.9
Westbound		C-25.2	C-26.3	D-38.6
Northbound		C-20.0	C-23.6	E-72.7
Southbound		C-27.2	C-27.3	E-68.9
NC 56 and I-85 Southbound Ramp	Signalized	D (50.1)	D (47.6)	E (68.0)
Eastbound		E-62.8	E-60.4	D-41.3
Westbound		D-49.6	C-28.3	C-20.0
Northbound		---	---	---
Southbound		D-43.6	E-65.1	F-172.4
NC 56 and I-85 Northbound Ramp	Signalized	C (25.8)	E (74.5)	F (197.0)
Eastbound		A-4.9	B-19.9	F-145.6
Westbound		C-23.0	F-107.6	F-180.4
Northbound		F-91.8	F-123.6	F-351.1
Southbound		---	---	---
NC 56 and E Lyon Station Road	Signalized	C (23.6)	F (144.9)	F (207.1)
Eastbound		B-10.9	C-21.0	C-29.4
Westbound		B-12.2	B-16.8	F-101.0
Northbound		F-88.8	F-502.6	F-536.4
Southbound		---	---	---

Table 18: No-Build (2040) Intersection LOS (Eastern Segment)

Intersection and Approach	Traffic Control	Base Year (2014)		
		AM	MID	PM
NC 56 and N Durham Ave/Lake Rd	Signalized	F (141.6)	D (47.3)	F (243.3)
Eastbound		F-160.0	D-48.5	F-566.9
Westbound		F-173.9	D-54.1	F-82.2
Northbound		D-44.6	D-35.8	E-67.0
Southbound		F-147.9	D-48.3	D-53.8
NC 56 and N Durham Ave/Lake Rd	Unsignalized	-	-	-
Eastbound		---	---	---
Westbound		F-186.3	C-17.6	E-39.1
Northbound		F-74.7	B-14.3	F-488.4
Southbound		C-18.5	B-11.0	C-15.1
NC 56 and N Main Street	Signalized	E (69.5)	C (34.8)	F (223.6)
Eastbound		E-77.4	C-20.3	F-138.5
Westbound		E-60.7	A-8.9	B-11.7
Northbound		F-95.1	E-73.0	F-543.8
Southbound		E-69.0	D-51.9	E-73.8
NC 56 and Crescent Dr/ Hawley School Rd	Signalized	F (149.2)	B (16.1)	E (64.5)
Eastbound		D-35.6	A-4.2	E-63.1
Westbound		F-181.3	A-6.7	D-53.0
Northbound		E-65.8	E-72.5	E-63.7
Southbound		F-222.1	F-87.6	F-100.7

Bicycle and Pedestrian Issues

The demonstrable lack of bicycle and pedestrian connectivity throughout the corridor was frequently cited by public workshop attendees and study team members as a major source of concern and frustration. While ongoing plans and projects are beginning to address this deficiency, there are fears the resulting increase in pedestrian and bicycle trips could lead to more crashes involving people travelling by these modes. Support for greater continuity, convenience, and safety for bicycle and pedestrian travel options has grown, a trend that appears likely to continue. Concerns were also expressed that widening and other improvements to NC 56 could require demolition and reconstruction of recently built sidewalks and sidepaths, a potentially wasteful course of action.

Creedmoor Elementary School Congestion

Congestion associated with the Creedmoor Elementary School student carpool area was mentioned by Stakeholders as an operational and safety issue that regularly affects NC 56. Vehicles waiting in the carpool line will often extend back onto NC 56 during the morning drop-off and afternoon pick-up times. Since there is just a single through lane in each direction, there is no space for through traffic to safely pass stopped vehicles. As a result, this creates a bottleneck and potentially unsafe conditions for motorists as well as pedestrians walking to the school or the adjacent high school. This queues quickly dissipate after the carpool starts and traffic at this location is minimal outside of the peaks and when school is not in session.

Figure 31: Creedmoor Elementary School Aerial



The NCDOT Municipal School Transportation Assistance (MSTA) School Traffic Calculator is used to estimate queues for different types of schools. Vehicle trips and queues are estimated based on the enrollment of the school using data from across the state. This calculator recommends queue stacking areas of between 925 and 1,200 feet for an elementary school of this size. The current stacking available is only 665 feet presently. As a result, expansion of the driveway stacking through widening or re-routing within their site is necessary to fully contain their carpool queue.

Recommendations

Committed Improvements

There are a number of transportation improvements already planned along this corridor. The most significant are in current 2016-2025 STIP. Some are associated with development projects, and others are already in the process of being implemented.

2016-2025 NC State Transportation improvement Plan

U-5829 – 26th St/Telecom Drive Connector

This 0.77-mile project improves and extends Telecom Drive from East Lyon Station Road westward via a new I-85 overpass, ultimately connecting with improved and realigned 26th Street/Wilkins Road. This project would relieve traffic on NC 56, improve access to potential development on both sides of I-85, and provide safer, more convenient bicycle and pedestrian connectivity. Construction is scheduled for FY 2022.

The proposed design is for a 35 mph major collector with a two-lane, undivided, curb-and-gutter cross-section with 12-foot travel lanes and 4-foot paved shoulders. Bike lanes and sidewalks are also included.

R-5707 – NC 56 Improvements at US 15 & NC 50 Intersections

Building on the 2011 Creedmoor Intersection Study, this project realigns and reconfigures three intersection to improve traffic flow, pedestrian mobility, and safety for all modes. Enhanced access and appearance will also support redevelopment plans in this portion of Creedmoor's urban core. Construction is scheduled for FY 2019.

Butner Gateway Project

On the western end of the corridor, several improvements are expected to be built in conjunction with the Butner Gateway project. The new development itself and associated improvements planned along Gate 2 Road will affect flow and traffic demand along NC 56. Three intersections along NC 56 are expected to also receive physical widening in order to accommodate new vehicle demand. The specific improvements identified and recommended in the Butner Gateway Small Area Plan Traffic Impact Study (dated May 19, 2015) are as follows:

NC 56 and West Lyon Station Road (SR 1237)

- Realign West Lyon Station Road to intersect NC 56 approximately 350 feet west of current alignment.
- Construct dual southbound left-turn lanes with 250 feet of full storage and an exclusive right-turn lane with 150 feet of full storage.
- Construct an exclusive eastbound right-turn lane with 150 feet of full storage and an exclusive eastbound left-turn lane with 175 feet of full storage.
- Construct a westbound exclusive left-turn lane with 400 feet of full storage and an exclusive westbound right-turn lane.
- Construct the northbound approach to provide for one ingress lane and three egress lanes – a left-turn lane with 200 feet of full storage, a through lane, and a right-turn lane with 300 feet of full storage.

NC 56 and I-85 Southbound Ramps

- Widen the eastbound right-turn lane to provide continuous storage back to the realigned West Lyon Station Road. This widening will serve as a second receiving lane needed to accommodate the dual southbound left-turns from West Lyon Station Road.

NC 56 and I-85 Northbound Ramps

- Lengthen the exclusive northbound right-turn lane to 300 feet of full storage.

Greenways and Sidewalks

Construction of a network of sidewalks and greenways serving the study corridor has already begun. The City of Creedmoor is currently constructing the Cross City Trail, which runs east-west through most of the City along NC 56. This multi-purpose trail will be a part of the larger Granville Greenway system, which aims to link neighborhoods, schools parks and municipal areas throughout Granville County. The project is split into three phases as shown in Figure 32. Phase I is already complete and Phases II & III are scheduled to begin construction in 2016.

The Creedmoor/Butner Greenway is a greenway project that will connect to the end of the Cross City Trail Phase III and provide a 10-foot wide greenway west to Pond Drive in Butner. It will connect to an existing greenway at Pond Drive that runs to East Lyon Station Road and then south to Ivac Way. Figure 33 displays the extents of this proposed greenway. The project includes a bridge section over Ledge Creek at Lake Roger's Park as well as a crosswalk across NC 56. Construction of the greenway is expected to begin in 2016. With the Creedmoor/Butner Greenway and Cross City Trail in place, there will be over five miles of continuous greenway in southern Granville connecting destinations such as the South Granville Campus of Vance

Granville Community College, library, and commercial destinations in Butner to commercial, residential as well as Creedmoor Elementary and South Granville High School in Creedmoor.

Figure 32: City of Creedmoor Cross City Trail

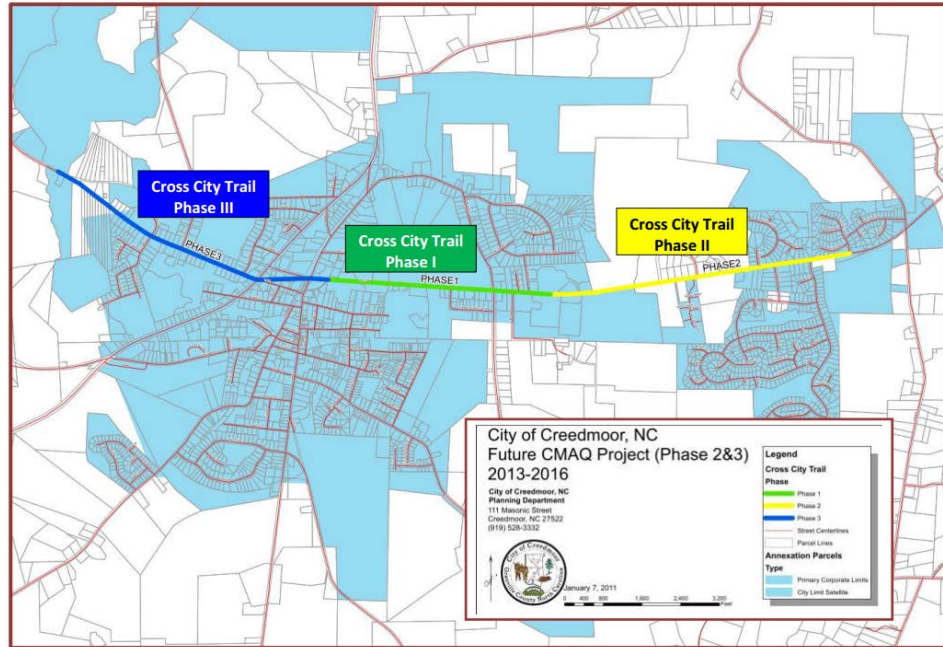
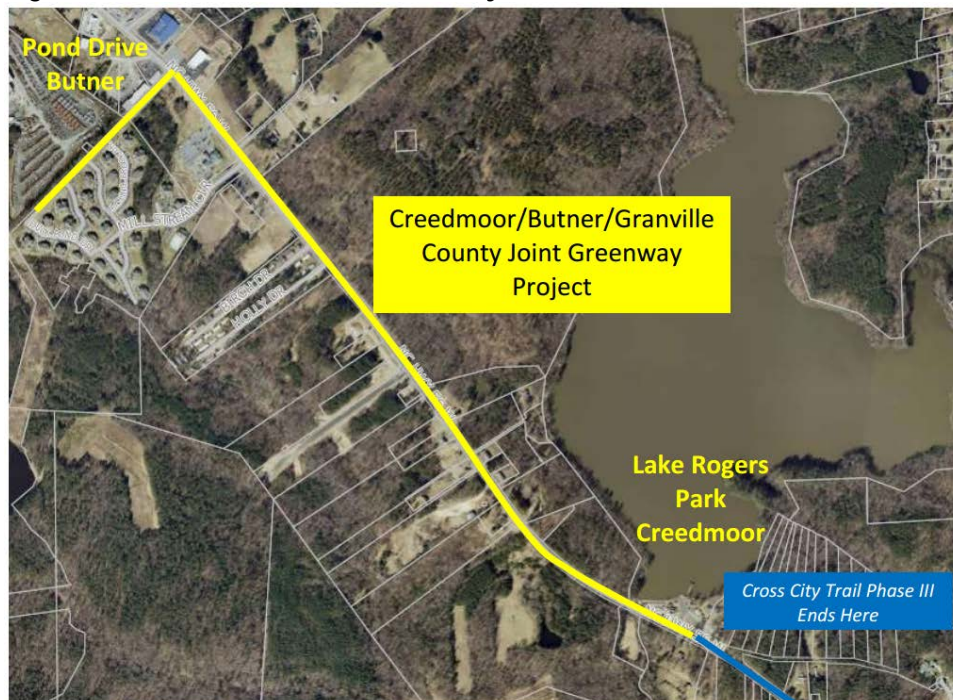


Figure 33: Creedmoor/Butner Greenway



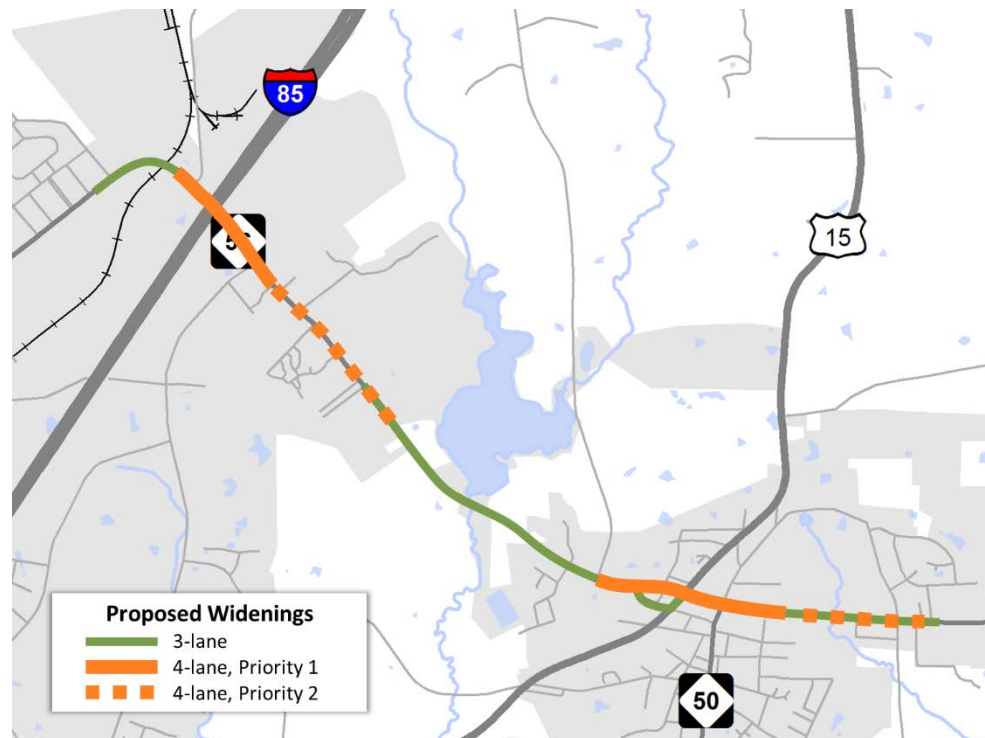
Recommended Improvements

Improvement recommendations are described below, starting with more general, corridor-level measures, followed by specific major intersections and other associated recommendations.

Corridor-Level

Intersection capacity analyses were conducted to determine the number of lanes necessary to accommodate the projected future vehicle demands. The corridor will require two lanes in each direction within the highest volume segments. Lower volumes segments of the corridor can operate with fewer through lanes, however will require left-turn lanes in order to allow the slower turning vehicles space to decelerate and wait for gaps in the opposing direction. A snapshot of the extents of the three-lane and four-lane segments are illustrated in Figure 34. Detailed discussion of the corridor widen plans are found on the following pages with the corridor cross-sections shown in Figure 35 to Figure 38.

Figure 34: Corridor Segment Recommendations



Western Segment

- Widen the existing roadway to a 3-lane segment from 33rd Street to the at-grade railroad crossing located west of West Lyon Station Road. The center lane can vary between a two-way left-turn lane (Figure 35) or a landscaped median (Figure 36) depending on the number of higher volume intersections or driveways.
- Widen the existing roadway to a 4-lane (2 eastbound, 2 westbound) divided segment from the at-grade railroad crossing to the roadway stub located 1,000 feet east of Holly Drive (Figure 37). The priority four-lane section extends from the railroad tracks to South Campus Drive. A system of backage roads would be implemented at the same time, allowing back access to parcels. The portion east of South Campus Drive could be widened initially as three-lane segment and then widened to a four-lane divided road as traffic demand warrants.
- Widen the bridge over I-85 to a 5-lane bridge according to following:
 - Four through lanes across the bridge.
 - Back-to-back left-turn lanes with a narrow raised concrete island separating the two directions of travel.
 - Sidewalks on both sides of the road along with a standard two-foot shoulder between the travel lane and curb.

Figure 35: Three-Lane Cross-Section (With a TWLTL)

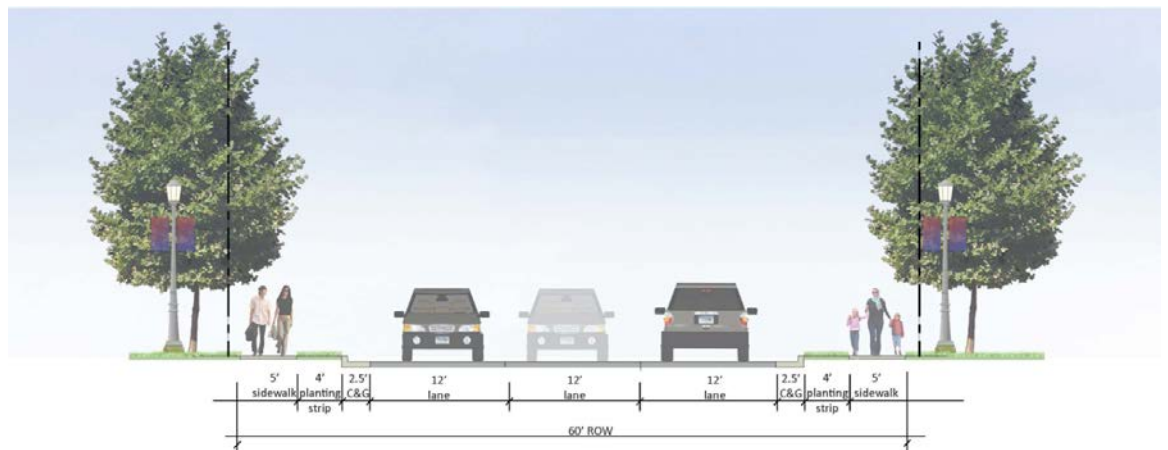


Figure 36: Three-Lane Cross-Section (With a Landscaped Median)

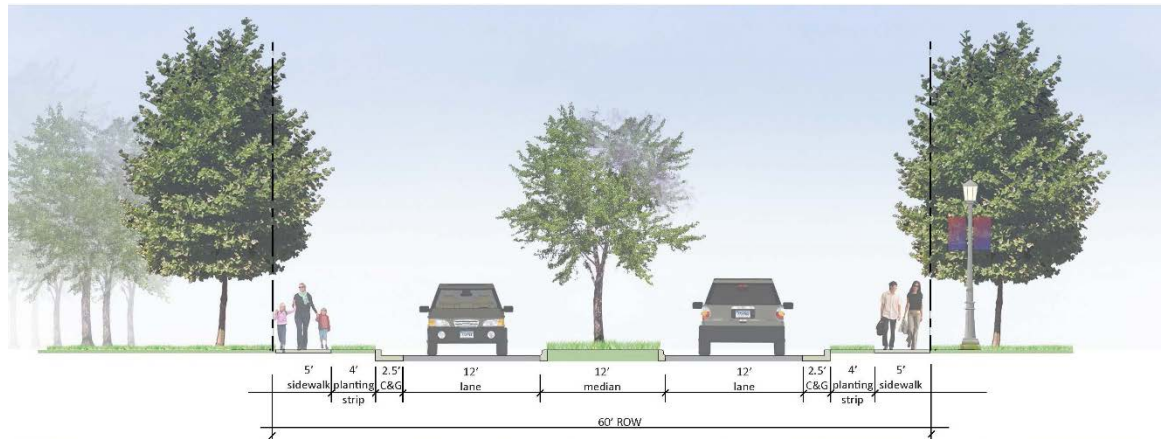
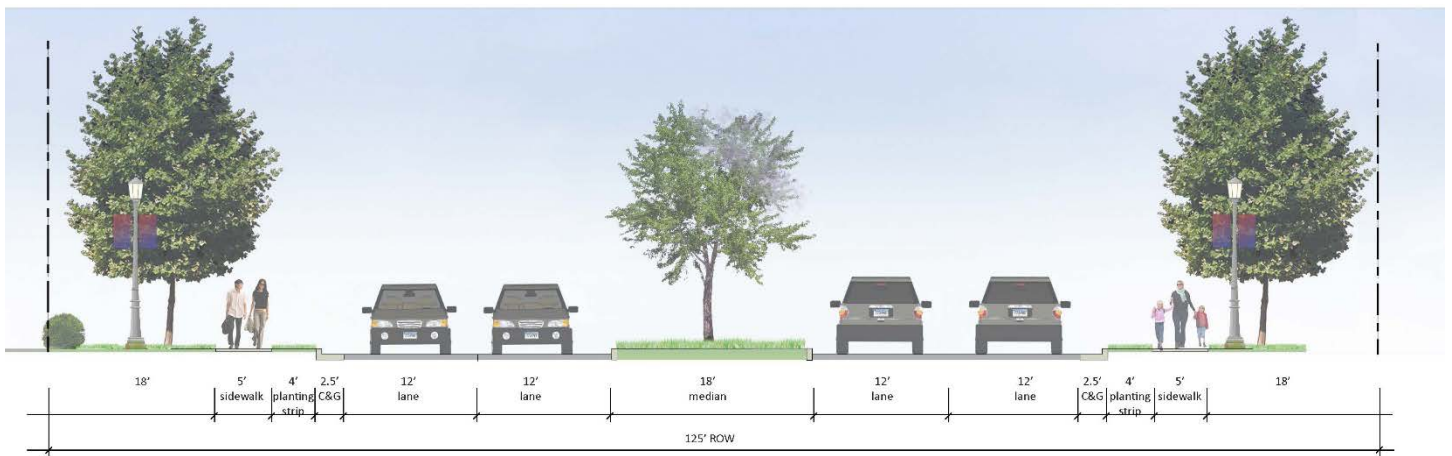


Figure 37: Four-Lane Cross-Section (With a Landscaped Median)



Middle Segment

- Widen the existing roadway to a 3-lane segment with a two-way left-turn lane or landscaped median from approximately 1,000 feet east of Holly Drive to Brogden Road (Figure 35 or Figure 36).

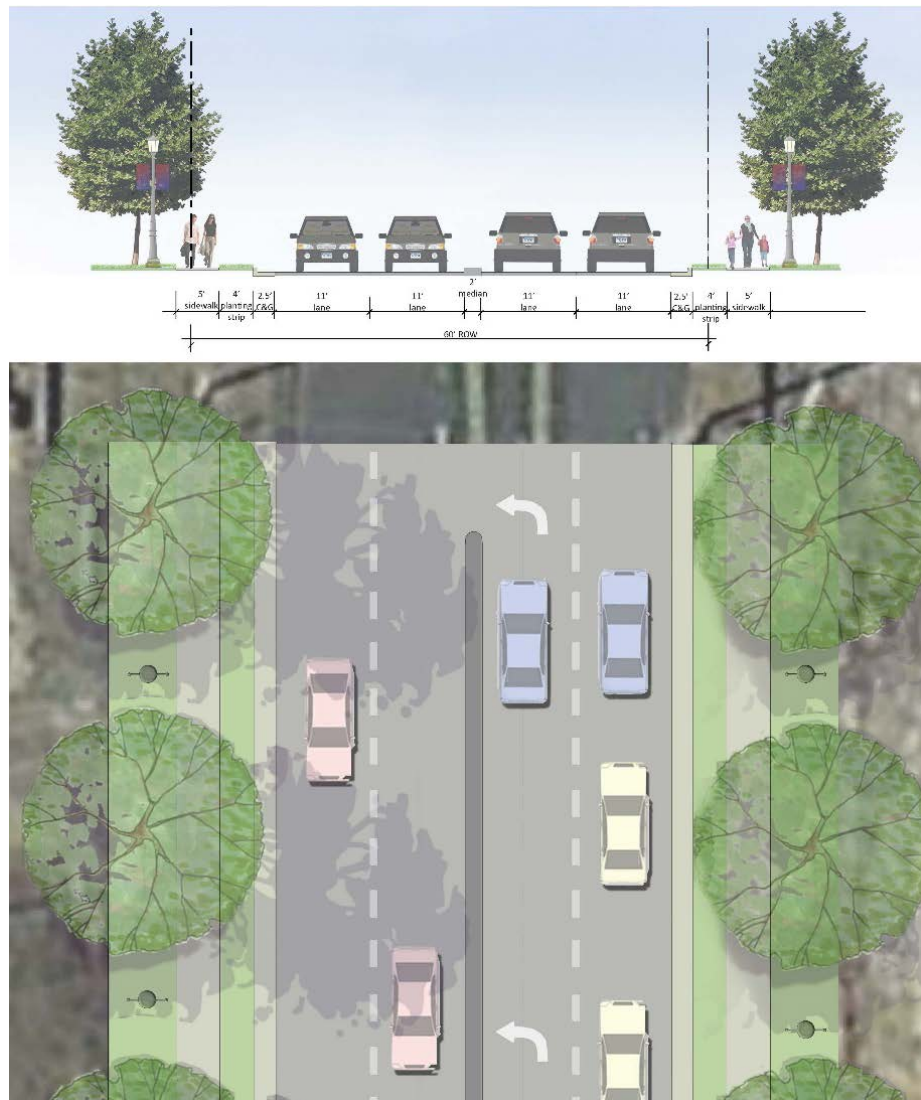
Eastern Segment

- Widen the existing roadway to a 4-lane (2 eastbound, 1 westbound, 1 turn-lane) segment from Brogden Road to a point approximately 800 feet east of N Main Street (Figure 38). A portion of this road will continue on new alignment west of US 15. This extension straightens out the existing “dog-leg” movement at US 15. Although a second westbound lane would provide additional benefits, it may not be feasible due to right-of-way constraints

through Creedmoor. The operational analysis indicated that intersections can operate at acceptable levels with just a single westbound lane.

- Widen the existing roadway to a 3-lane section with a two-way left-turn lane or landscaped median from approximately 800 feet east of N Main St to Darden Drive.
- Although a the 3-lane treatment described above provides acceptable levels of service and minimizes ROW impacts, lengthening vehicle queues at the intersection of NC 56 and Crescent Drive/Hawley School Road, may eventually warrant widening the roadway to a multi-lane (4-lane) section from Darden Drive to N Main Street.

Figure 38: Four-Lane (Two EB, One WB, 1 Turn Lane) Cross-Section



Intersections

This section summarizes the recommendations at each of the study area intersections.

NC 56 and 33rd Street (SR 1112)

- Extend southbound left-turn lane to 250 feet (minimum) of full storage with appropriate taper.
- Provide sidewalk/side path along western/northern side of NC 56, at a minimum.
- Provide crosswalks and pedestrian signage and/or signals for 33rd Street at a minimum.

NC 56 and West Lyon Station Road (SR 1237)

- Realign West Lyon Station Road to intersect NC 56 approximately 350 feet west of its current alignment.
- Construct dual southbound left-turn lanes with 250 feet (minimum) of full storage with appropriate taper, a through lane and an exclusive right-turn lane with 150 feet (minimum) of full storage with appropriate taper.
- Construct an additional eastbound thru lane with 400 feet (minimum) of full storage with appropriate taper. As well as an eastbound exclusive right-turn lane with 150 feet (minimum) of full storage with appropriate taper, and an eastbound exclusive left-turn lane with 175 feet (minimum) of full storage with appropriate taper.
- Construct a westbound exclusive left-turn lane with 400 feet (minimum) of full storage with appropriate taper and a westbound right-turn lane with continuous storage back to the I-85 southbound ramps.
- Construct the northbound approach to provide for one ingress lane and three egress lanes – an exclusive left-turn lane with 200 feet (minimum) of full storage with appropriate taper, a through lane and an exclusive right-turn lane with 300 feet (minimum) of full storage with appropriate taper.
- Continue sidewalk along north side of NC 56 from 33rd Street through West Lyon Station Road.
- Provide appropriate crosswalks, signage, and signalization at realigned West Lyon Station Road.

NC 56 and I-85 Southbound Ramps

- Construct an additional exclusive southbound left-turn lane with 250 feet (minimum) of full storage with appropriate taper and lengthen the southbound right-turn lane to 250 feet of full storage.
- Lengthen the exclusive westbound left-turn lane to 225 feet (minimum) of full storage and appropriate taper.
- Construct an additional lane on NC 56 in each direction.

NC 56 and I-85 Northbound Ramps

- Lengthen the exclusive westbound right-turn lane to 250 feet, the exclusive eastbound left-turn lane to 300 feet, and the exclusive northbound right-turn lane to 450 feet (minimum) of full storage and appropriate taper in addition to the eastbound and westbound through lanes.

NC 56 and East Lyon Station Road (SR 1108)

- Construct a new southbound approach with one ingress lane and two egress lanes – an exclusive left-turn lane and a thru/right lane.
- Construct an exclusive westbound right-turn lane with 150 feet (minimum) of full storage and appropriate taper. Lengthen the westbound left-turn lane to 250 feet (minimum) of full storage and appropriate taper.
- Construct an exclusive right-turn lane and left-turn lane with 150 feet (minimum) of full storage and appropriate taper.
- Provide sidewalks along both sides of NC 56, including appropriate crosswalks, signage, and signalization.

NC 56 and Future Greenway Crossing (Pond Drive)

- Provide pedestrian/bicycle crossing, including appropriate signage and signalization.

NC 56 and Brogden Road

- Add southbound left-turn lane on Brogden Road.
- Provide pedestrian/bicycle crossing(s), including appropriate signage and signalization.

NC 56 Realignment west of US 15¹

- Construct an extension of NC 56 west of US 15 creating a fourth leg at the existing unsignalized NC 56 (East Wilton Avenue)/US 15 intersection. This new road will extend west for approximately 1,000 feet before returning to the existing NC 56 (West Lake Road) alignment.
- Extend and realign West Lake Road so that it T's into the NC 56 connector.



¹ TIP Project R-5707 will evaluate this intersection and determine final design.

- Signalize the new intersection created by the two realigned roads, with two eastbound lanes and a single westbound lane on realigned West Lake Road, and two eastbound and one westbound lane on the new NC 56 alignment.
- Provide continuous sidewalk/side path on at least the northern side of NC 56 extension, including crosswalks and appropriate signage and signalization.

NC 56 Extension/East Wilton Avenue (NC 56) and North Durham Avenue (US 15)¹

- Construct a roundabout at this intersection.
- Construct an eastbound thru/right-turn and thru/left-turn lane, a northbound thru/left-turn lane and exclusive right-turn lane, as well as a southbound and westbound left/thru/right lane.
- Provide continuous sidewalk/side path on at least the northern side of NC 56 and the western side of US 15, including crosswalks and appropriate signage and signalization

West Lake Road and North Durham Avenue (US 15)

- Construct an exclusive westbound left-turn lane with 100 feet (minimum) of full storage and appropriate taper, as well as an exclusive eastbound left-turn lane with 100 feet (minimum) of full storage and appropriate taper.
- Provide continuous sidewalk/side path on at least the northern side of West Lake Road, including crosswalks and appropriate signage and signalization.

NC 56 and North Main Street (NC 50/SR 1639)¹

- Construct an eastbound thru/right-turn lane, an exclusive northbound right-turn lane with 400 feet (minimum) of full storage and appropriate taper, as well as lengthen the westbound left-turn lane to 500 feet (minimum) of full storage and appropriate taper.
- Consolidate driveways for managing access to off-street parking.
- Provide appropriate crosswalks, signage, and signalization.

Crescent Drive (SR 1640)/Hawley School Road (SR 1733)

- Construct a two-way left-turn lane for the eastbound and westbound approaches, an exclusive westbound right-turn lane with 250 feet (minimum) of full storage and appropriate taper, as well as a northbound and southbound exclusive left-turn lane with 100 feet (minimum) of full storage and appropriate taper.



¹ TIP Project R-5707 will evaluate this intersection and determine final design.

- As traffic volumes grow, peak-period vehicle queues will lengthen to the point that they may become problematic, even though LOS may remain within acceptable ranges. If vehicle queues become a persistent problem, or as traffic volumes approach 24,000-25,000 vehicles/day, consideration should be given to adding another through lane, creating a 4-lane undivided section through this segment.

Figure 39 and Figure 40 illustrate the lane configurations and traffic control recommendations at study area intersections.

Bicycle and Pedestrian Improvements

Accommodations for safe and convenient bicycle and pedestrian travel are explicitly incorporated in all roadway and intersection improvements recommended as part of this study. A top priority has been to seamlessly integrate existing bicycle, pedestrian, and greenway plans with all recommendations. Additional options and features have also been identified where appropriate. However, since many roadway project design decisions will impact the final design of proposed bicycle and pedestrian facilities, bicycle and pedestrian recommendations focus on the intent of the improvements, more than the specific location, dimensions, and design elements.

Figure 39: Build (2040) Lane Geometrics and Traffic Control (Western Segment)

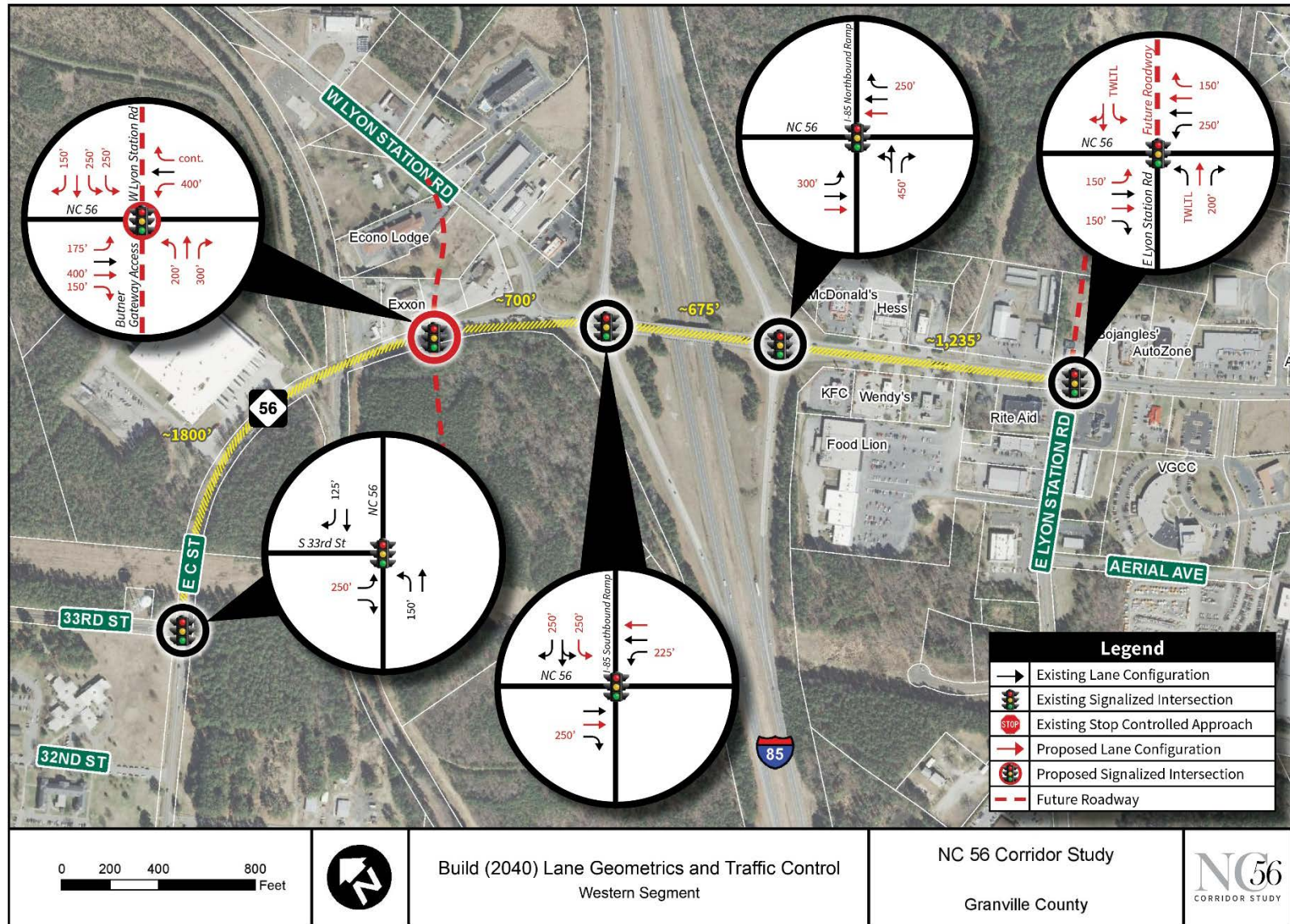
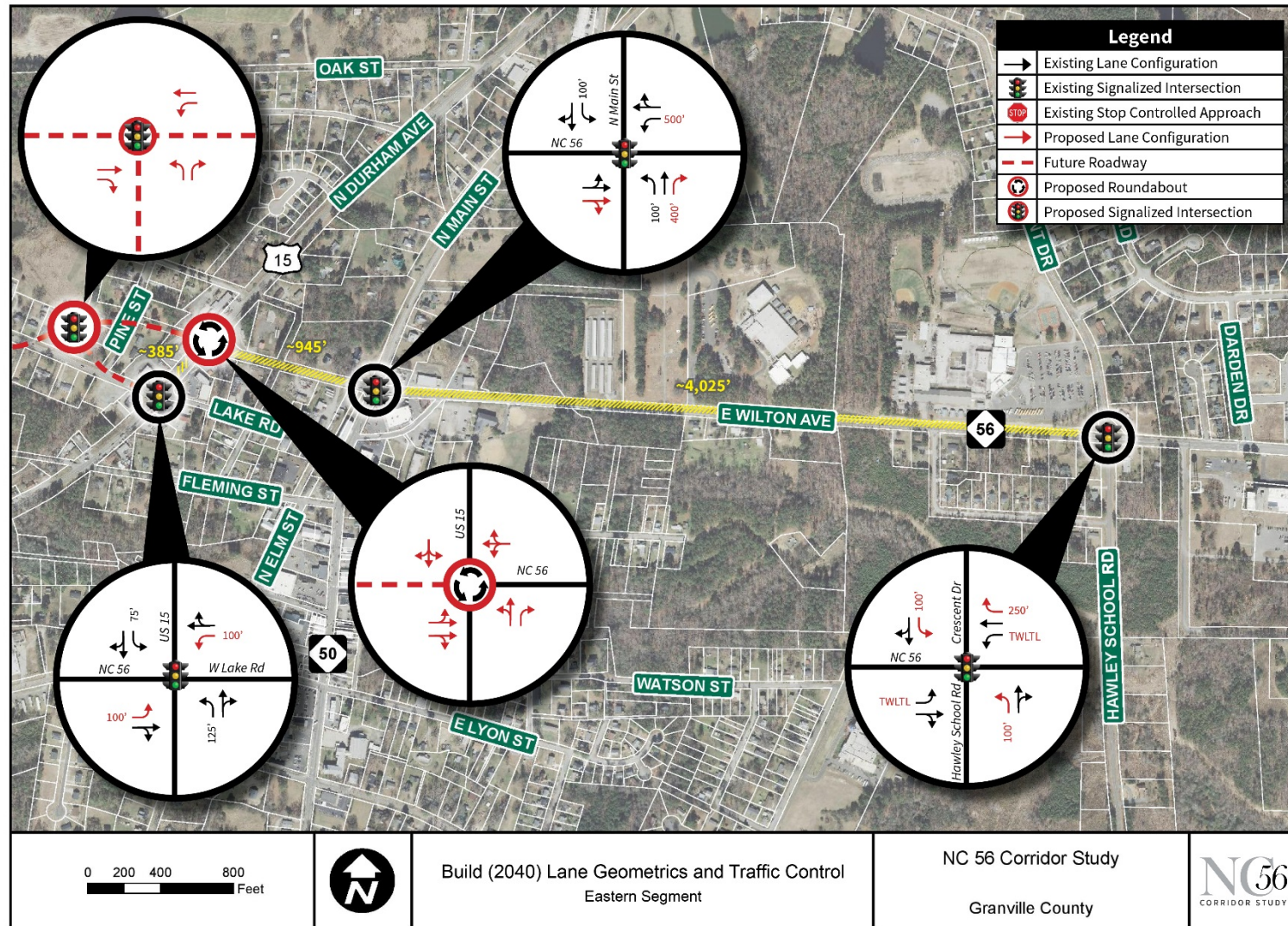


Figure 40: Build (2040) Lane Geometrics and Traffic Control (Eastern Segment)



Other Improvements

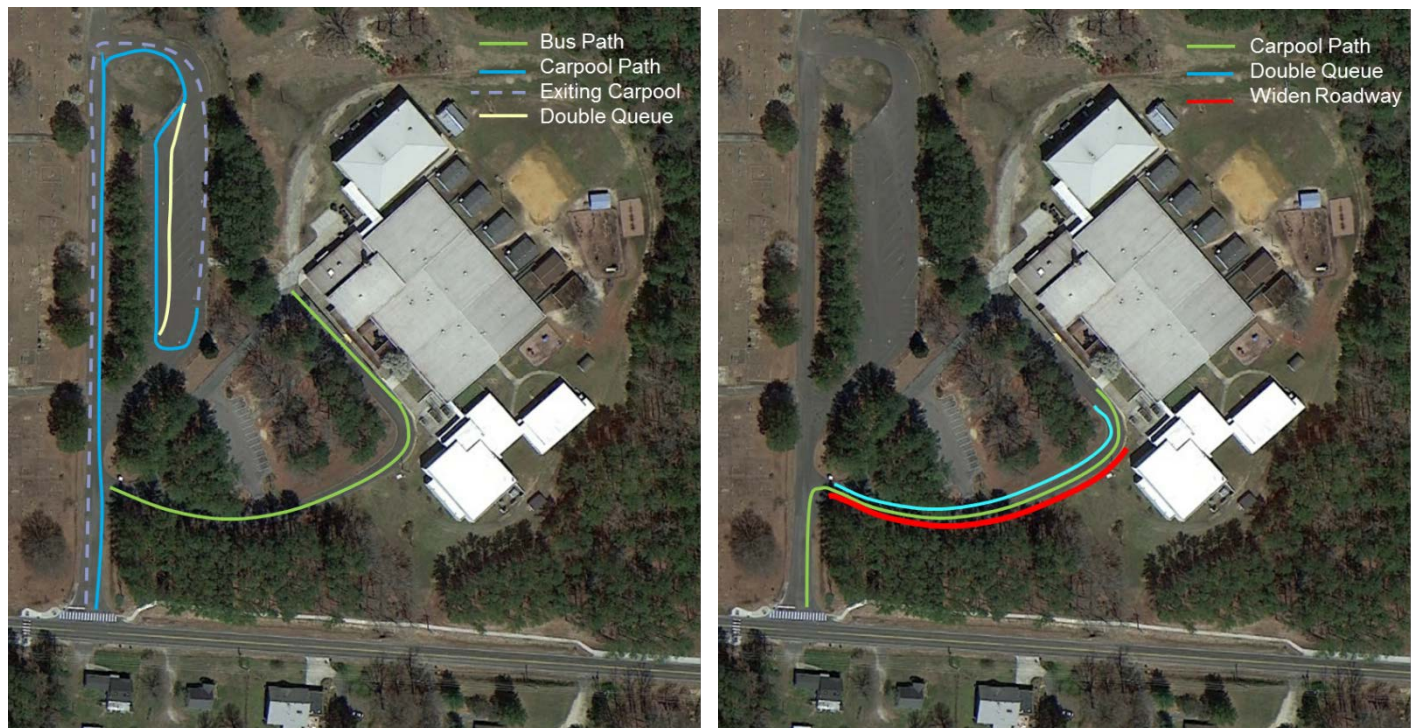
Creedmoor Elementary School Improvements

As mentioned previously in the study, queuing associated with the loading operations of the school can affect NC 56 during morning drop-off and afternoon pick-up periods. Based on estimates using the NCDOT MSTTA calculator, the school requires between 925 and 1,200 feet of stacking, whereas only 665 is presently available. As a result, the following is recommended to help address this concern:

- Conduct a School Transportation Management Plan (TMP) for this site.

The TMP will evaluate internal traffic operations of all modes; carpool, staff, bus, pedestrian, and bicycle. Both physical constraints as well as the loading operations should be reviewed in detail. One option for increasing stacking within the site is switching the student and bus areas, yielding approximately 1,250 feet of stacking. Another option would be to widen the existing carpool line to accommodate double stacking, which could provide another 400 feet of stacking (see Figure 41).

Figure 41: Alternate Circulation Schemes for Creedmoor Elementary



Access Road System between I-85 and East Lyon Station Road

Improving both mobility and safety along the corridor is the primary objective of this study. Use of access management techniques, specifically addition of a median as proposed for the four-lane divided sections, will eliminate vehicle conflict points that contribute to collision activity and disruptions in traffic flow along the mainline. As shown in the illustration to the right, a full access intersection has 32 different points as vehicles turn left, right or through from all four directions. The introduction of a median reduces the conflict points to just four and eliminates the crossing and left-turn conflicts which tend to result in the most severe types of crashes.

Eliminating left-turn and cross movements typically requires additional downstream U-turn maneuvers to accommodate those movements. In some cases along the corridor, property owners also have the option of using driveways that connect to existing side streets that have signalized or full access to NC 56. In other cases, property owner access these side streets via driveway interconnections to other properties or through the use of frontage or backage roads.

As part of this project, the segment between the I-85 Northbound Ramps and East Lyon Station Road was identified as an area where backage roads could be installed in conjunction with the NC 56 widening in order to give businesses a means to connect to an existing signal and avoid any U-turn maneuvers. The yellow lines illustrated in Figure 43 show possible connections that could be made in conjunction with widening and median installation along NC 56. With such a connection in place, businesses such as the McDonalds, Hess, and Bojangles could connect to this street system in order to make left-turn maneuvers at the existing East Lyon Station Road signal. Interconnected driveways already exist between businesses on the south side but could be improved as necessary to accommodate some additional travel demand.

Figure 42: Conflict Point Comparison

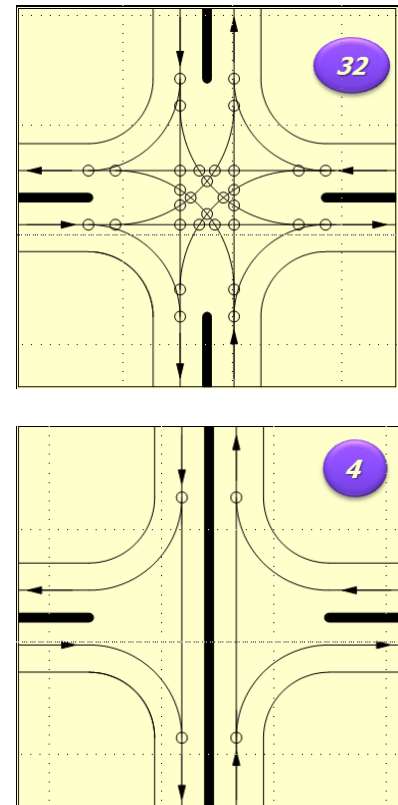
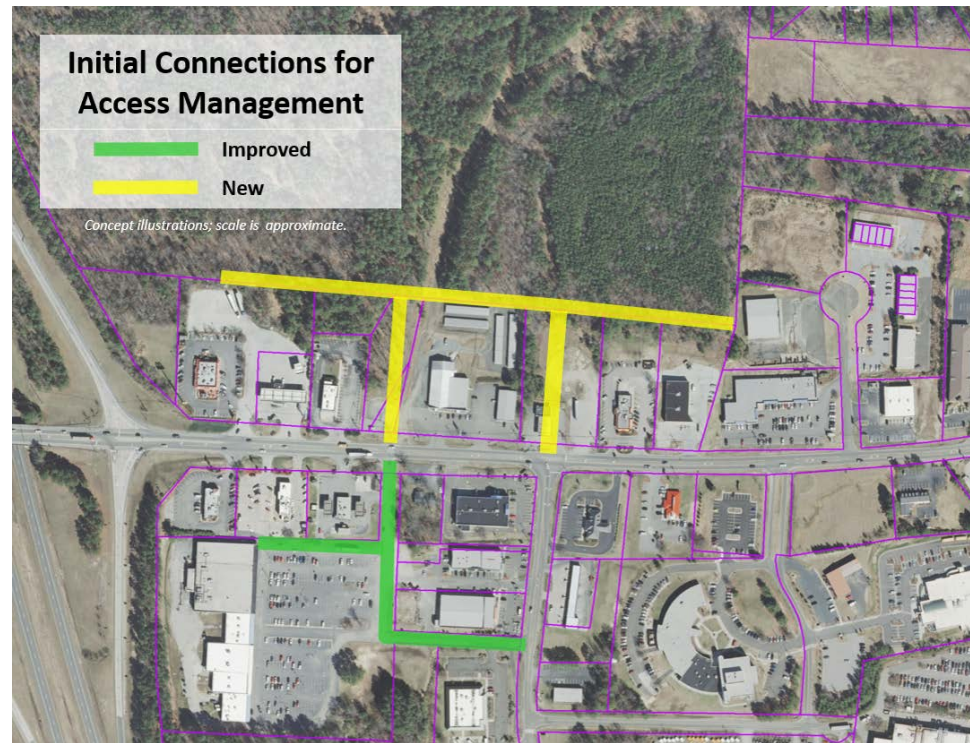


Figure 43: Initial Access Connections



The additional street network should carry a relatively low volume and would likely only require two-lane roads with a two-way, left-turn lane only if high left-turn volumes were expected. Adjacent sidewalks are recommended however to accommodate and encourage pedestrian movement between the businesses as well as connections to sidewalks along NC 56. Figure 44 provides a conceptual cross-section for these access roads. The enhanced street network illustrated in Figure 43 also may provide the starting point for longer-term roadway connections as property develops or re-develops in the future.

Figure 45 provides an example of street connections may continue to be made in the future in conjunction with future development. Figure 46 shows the broader regional network. With a new network of streets south and west of NC 56 in places, drivers will have a variety of choices travelling through this area, which promotes more efficient travel in this part of the county.

Figure 44: Access Road Cross-Section

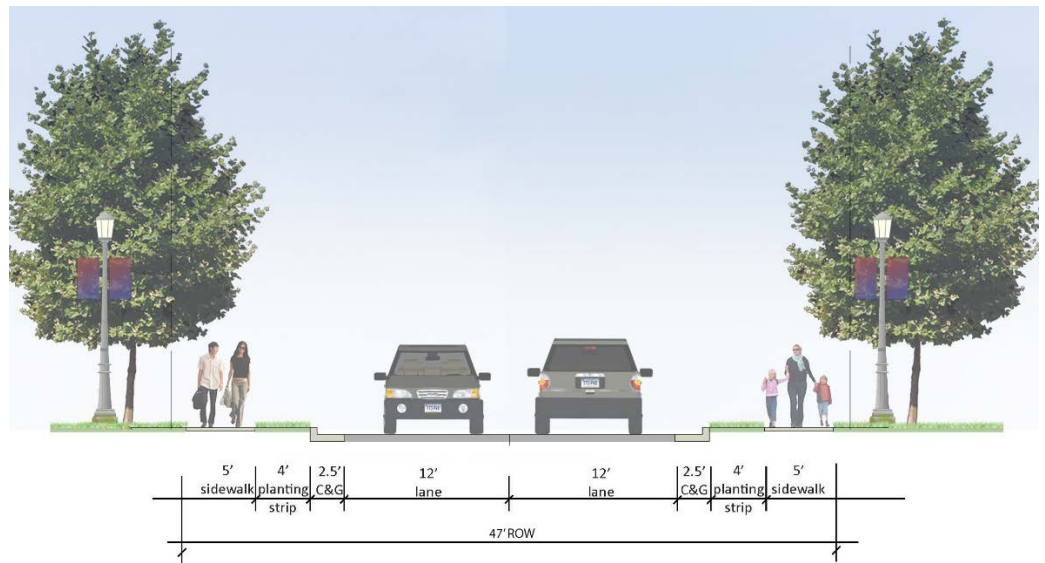


Figure 45: Future Development Street Framework

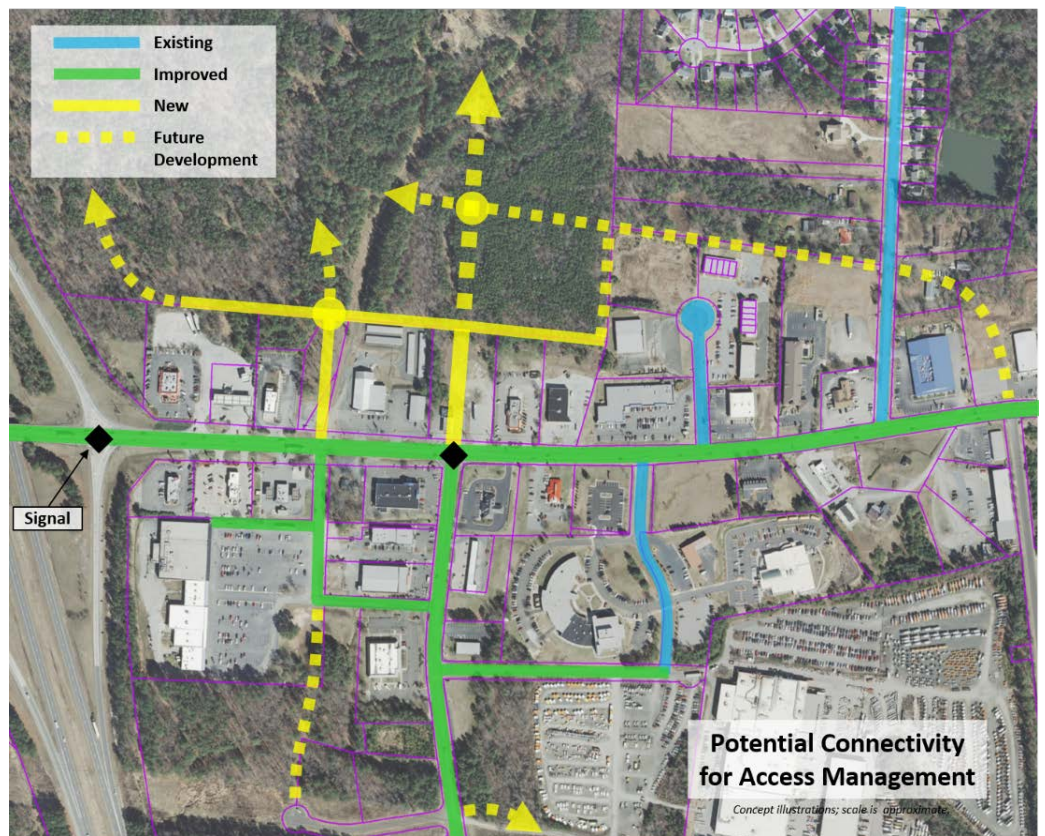
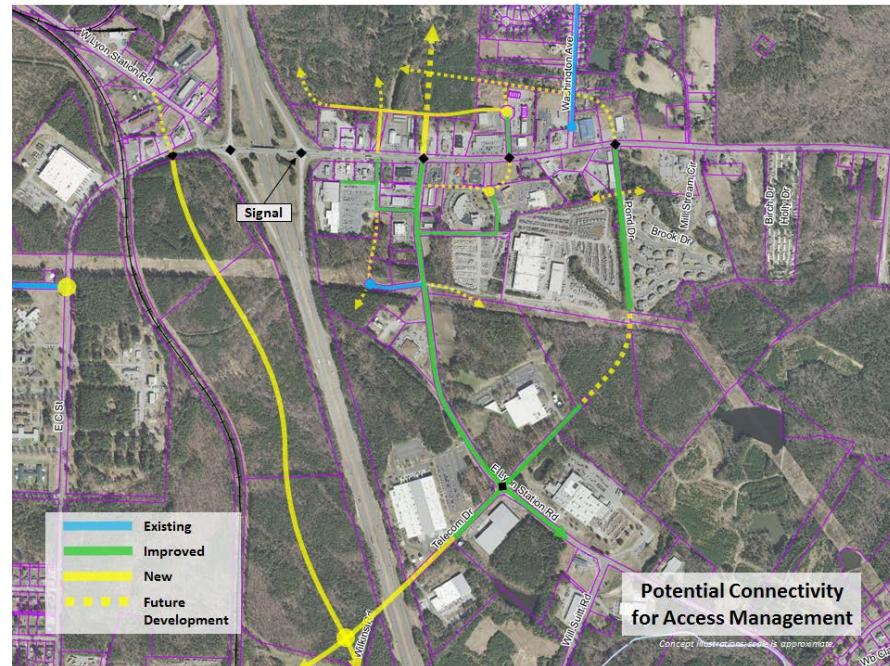


Figure 46: Long-Term Regional Street Network



Streetscape Enhancements

Details of landscaping, hardscape elements, signage and wayfinding, lighting, and other streetscape amenities are beyond the scope of this level of corridor plan. However, the recommended design concepts intentionally provide flexible opportunities for incorporating such treatments, depending on the location, budget, and purpose of the improvement project. The plans and cross-sections included in this report offer general examples of a range of streetscape enhancements, including:

- Plantings (median and roadside)
- Lighting (functional and decorative)
- Hardscape (pavers and other pavement treatments)
- Unified signage and wayfinding
- Furnishings (benches, trash containers, etc.)
- Relocation of overhead utilities underground

Plantings and other elements should be appropriate for their location, low maintenance, and durable. They must not obstruct sight lines or create crash hazards for any mode of travel. Ideally, plans and other features can be used to communicate transitions in area type, and to help “channelize” pedestrians to desirable crossing locations by discouraging crossing at riskier locations. Strong enforcement of sign and other streetscape regulations is recommended to help keep illegal signage from making it harder to for drivers that are new to the area to find their way. Cost-effective, context-appropriate streetscape investments can be targeted to high-visibility locations, rather than being applied throughout the entire corridor.

Note that the placement of sidewalks and street trees / streetscaping enhancements can be reversed from the layout shown in the design concepts in order to provide more streetscape buffer between the roadway and the sidewalk. The resulting design concept would have plantings, benches, street furniture, lighting, and other streetscape enhancements in an expanded buffer zone between the sidewalk and the roadway. However, this alternative configuration may not be feasible in all locations and is dependent on engineering, right-of-way, line of sight, environmental, stormwater, local preference, and other considerations.

Alternatives Considered

There were areas along the corridor where the study team developed a variety of options. The following section describes the potential design variations within specific locations along the corridor.

Creedmoor Area Improvements

The signalized NC 56 intersection with US 15 and West Lake Road is the most congested intersection along the corridor. It is also the one intersection where all eastbound NC 56 traffic is required to make a left-turn, which adds considerable delay to this intersection. A variety of options considered bypassing this intersection with a realignment of NC 56 on new location and others widened the street network within the existing alignment. A series of sketches were prepared for the final public meeting, which allowed the public and stakeholders to view the potential options through this area. The options studied were:

Without the NC 56 Extension

- Install a signal at the intersection of NC 56 and US 15 (Figure 47).
- Install a roundabout at the intersection of NC 56 and US 15 (Figure 48).

Figure 47: Signal at NC 56 and US 15 (Without NC 56 Extension)



Figure 48: Roundabout at NC 56 and US 15 (Without NC 56 Extension)



With the NC 56 Extension

- Install a signal at the intersection of NC 56 and US 15 (Figure 49).
- Install a roundabout at the intersection of NC 56 and NC 56 Extension (Figure 50).

Figure 49: NC 56 Extension with Signal at US 15



Figure 50: NC 56 Extension with Roundabout at US 15 (Recommended)



NC 56 and 33rd Street (SR 1112)

An alternative improvement at this location would be the conversion of the intersection to a roundabout. Traffic capacity operational analysis indicated that the intersection could operate at acceptable levels of service as a single lane roundabout. Construct a roundabout at the intersection of NC 56 and 33rd Street (SR 1112).

I-85 Bridge

The I-85 bridge is approximately 52 feet wide and carries three travel lanes with two eight-foot paved shoulders on both sides. The



minimum widening necessary to achieve an acceptable level of service would be the addition of an eastbound through lane. This could be added to the existing bridge structure, however would nearly eliminate the available shoulder space, which is useful as a walking or bicycling space as well as a breakdown lane. There would also be limited space for a center island to separate the two directions of travel. Despite the higher cost, widening to a full five-lane bridge with a curb and raised sidewalk was recommended as the long-term solution. Figure 51 shows a conceptual sketch of the two potential options for the bridge.

Figure 51: I-85 Bridge Options



NC 56 and North Main Street (NC 50)

The NC 56 segment immediately east of N. Main Street has a narrow 60-foot right-of-way with buildings and associated parking located very close to NC 56 on both sides of the road. The CVS is at a much higher elevation than the street, which is separated by a retaining wall. The commercial building on the north side has perpendicular parking in front of the building that requires vehicles to back out onto NC 56 while pulling out of the site.



The study team conducted a more detailed review of this location to determine if NC 56 could be widened through this narrow section without taking these businesses or substantially altering their access and available parking. A second eastbound lane is required at this location to accommodate the heavy eastbound through volume, which conflicts with a high westbound left-turn volume. This additional lane as well as sidewalks could be added without substantially affecting either business. Right-of-way acquisition is necessary, however elimination of a median and planting strips would reduce the required acquisition. Parking for the retail business would likely need to be shifted to the sides or rear of the property as shown in (Figure 52). Another possibility would be to introduce parallel parking, however the parking maneuvers would impact traffic flow at this intersection (Figure 53). Figure 54 and Figure 55 provides an illustration of cross-section at this location.

Figure 52: Conceptual Plan East of North Main Street (Option 1)



Figure 53: Conceptual Plan East of North Main Street (Option 2)



Figure 54: 4-Lane (West of NC 50) Cross-Section

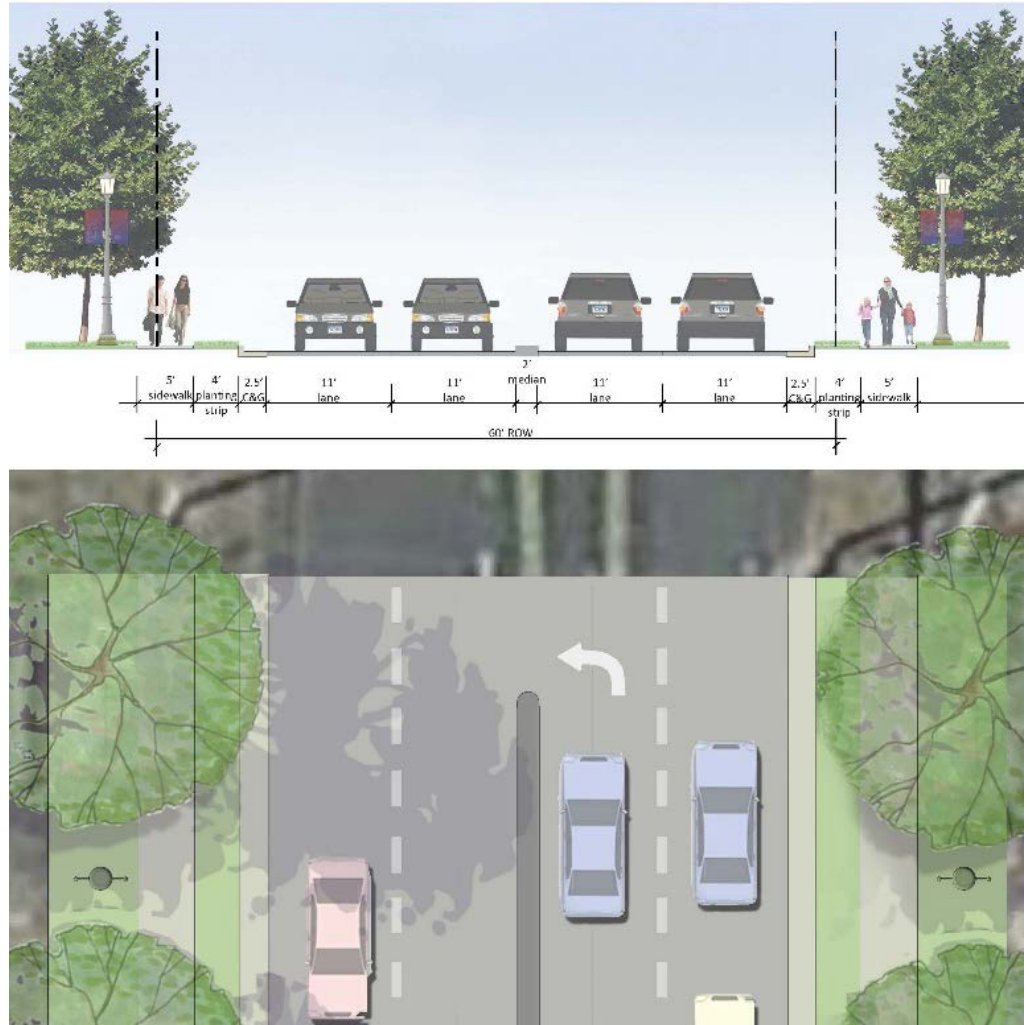
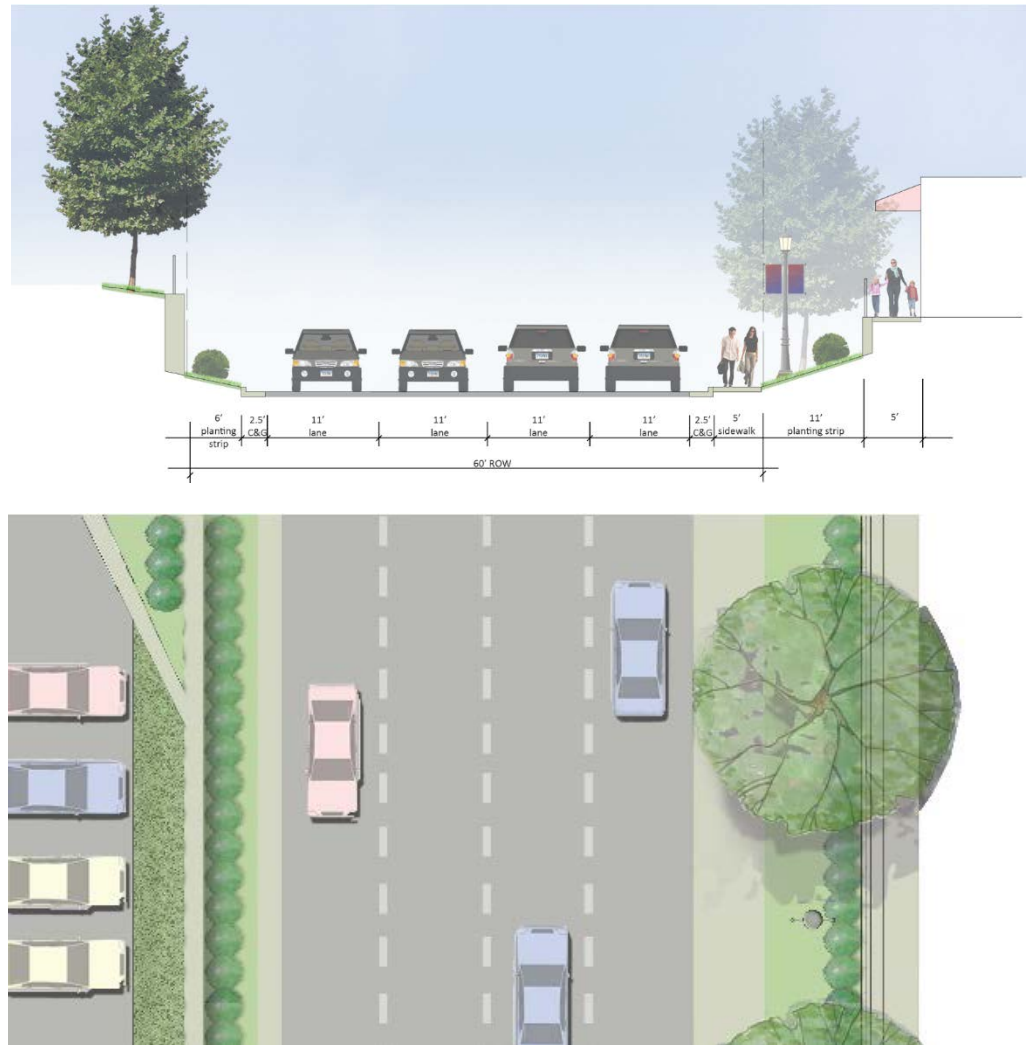


Figure 55: 4-Lane (east of NC 50) Cross-Section



Level of Service Analysis

Corridor-Level

Segmental corridor analyses were conducted for the Build (2040) scenario using the Highway Capacity Software Plus (HCS+) software package. The western segment was analyzed as a multilane facility with two through lanes in each direction. As a multilane facility, the intersection is expected to operate at LOS B or better during all three peak periods. Within the middle section, the roadway will continue to have a single through lane in each direction, however operations are improved as a result of the wider lanes and a two-way left-turn lane. With these improvements in place, the corridor functions at a LOS D or better during all three peaks.

Within most of the eastern segment, there are two eastbound lanes and one westbound lane. Therefore the road operates with different densities and capacities depending on the direction travelled. As a result, the actual corridor operations of this section is largely dictated by the delay experienced at the four (4) signals along this section operating at LOS B to LOS D as reported in the following section. If ultimately widened to provide two lanes in each direction, the corridor levels of service are A in the midday and B in the AM and PM peaks.

Table 19 provides the results of the segment analysis for Build conditions.

Table 19: Build (2040) Corridor Level of Service Summary for NC 56

Location	Analysis Methodology	AM Peak		Midday Peak		PM Peak	
		Segment LOS	PFFS (%)	Segment LOS	PFFS (%)	Segment LOS	PFFS (%)
Western Segment	Multilane	A	-	B	-	B	-
Middle Segment	Two-Lane	D	73.8	C	77.2	D	67.0
Eastern Segment	Multilane (ultimate)	B	-	A	-	B	-

As with the Existing (2014) and No-Build (2040) scenarios, the western segment of this corridor was evaluated using SimTraffic, simulation software, to further investigate the operations during each peak hour under the Build (2040) conditions. This scenario includes the recommendations made for this segment of NC 56. Table 20 summarizes the SimTraffic results, specifically travel time and delay, for the western segment during the AM, Midday and PM peak hours. Figure 56 and Figure 57 graphically show the corridor travel time and delay traveling eastbound and westbound along NC 56.

Table 20: Build (2040) Travel Time and Delay for NC 56 (Western Segment)

Location	AM Peak		Midday Peak		PM Peak	
	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)	Travel Time (s)	Delay (s/veh)
Eastbound	256.3	85.1	237.8	64.2	250.6	80.0
Westbound	253.8	57.6	255.1	63.7	284.1	88.2

Figure 56: Build (2040) Corridor Travel Time (Western Segment)

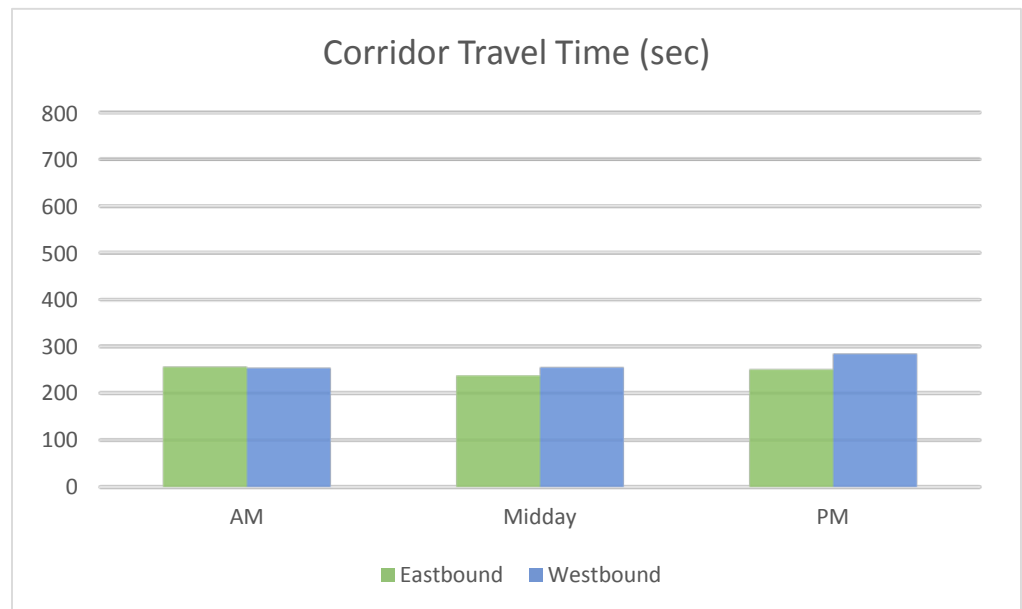
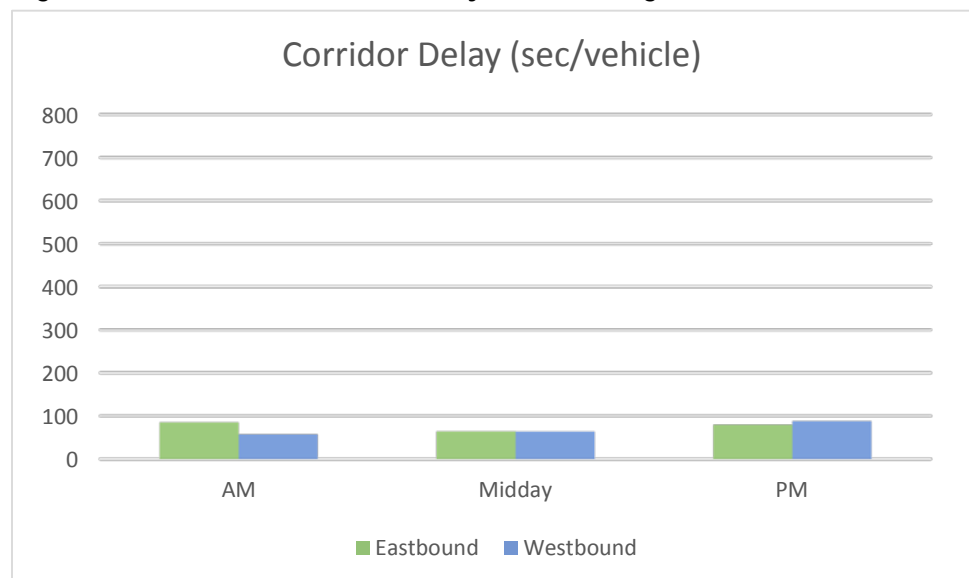


Figure 57: Build (2040) Corridor Delay (Western Segment)



Comparison tables for the Existing (2014), No-Build (2040), and Build (2040) scenario, eastbound and westbound, travel time and delay during the PM peak hour can be found in Figure 58 and Figure 59. As shown in the figures, the Existing (2014) eastbound PM peak hour delay and travel time is greater than the No-Build (2040) and Build (2040). This can be attributed to the improvements from the Butner Gateway Plan that were implemented at the intersection of W Lyon Station Rd and NC 56.

Figure 58: PM Peak Hour Travel Time Comparison

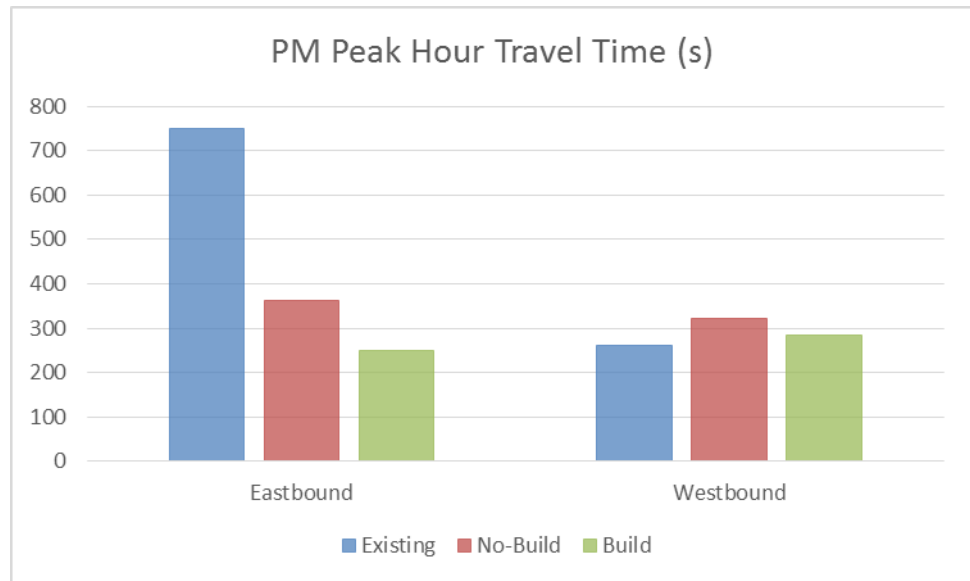
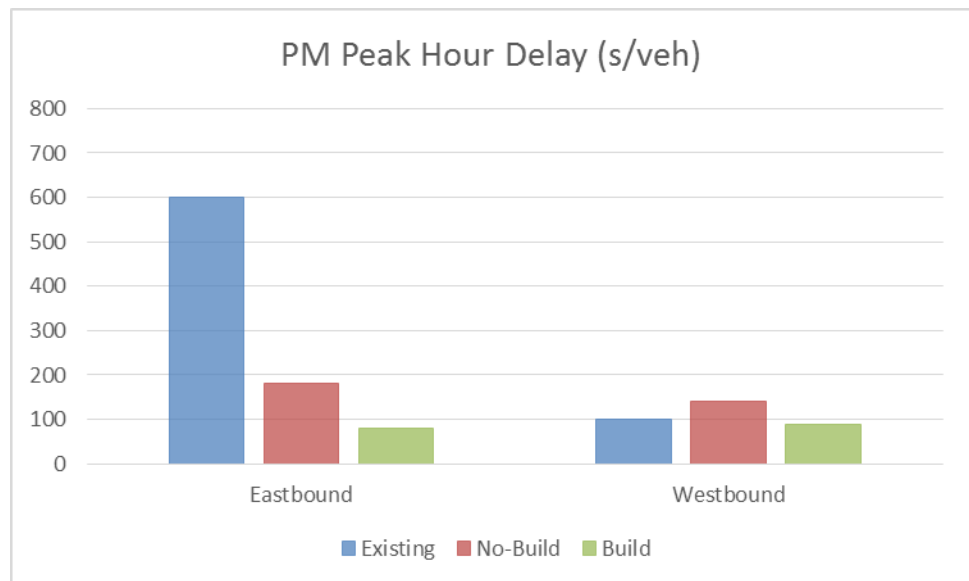


Figure 59: PM Peak Hour Delay Comparison



Intersections

Intersection LOS analyses were performed for the typical weekday AM, Midday and PM peak hours using *Synchro/SimTraffic Professional Version 7*. The Build (2040) intersection cycle lengths and splits were optimized. A summary of the findings for the Build (2040) scenario level of service analysis can be found in Table 21 and Table 22, and the full Synchro/HCS output can be found in Appendix II. As reported in Table 21 and Table 22, all of the intersections are operating at acceptable overall LOS during all peak hours with 2040 improvements in place. There are still approaches at individual intersections which operate at unacceptable levels of service. The northbound I-85 ramp approach at NC 56 operates at a LOS F during the PM peak hour. This can be attributed to the high volume of vehicles attempting to turn right being forced to yield to the high volume of vehicles traveling eastbound at this intersection.

The northbound Hawley School Road and southbound Crescent Drive approaches at NC 56 operate at poor levels of service during the AM peak hour. With just a single westbound through lane, most of the cycle's green time must be used for the westbound through movement in order to reduce vehicle queuing. This results as high delays on the side street approaches. Further widening to four through lanes at this intersection, as recommended in the long-term, will substantially reduce both mainline queuing and side-street delay. This improvement should be considered when if vehicle queues become a persistent problem, or when AADTs approach the 24,000 to 25,000 range. Intersection peak hour volumes are shown in Figure 60 and Figure 61.

Table 21: Build (2040) Intersection LOS (Western Segment)

Intersection and Approach	Traffic Control	Base Year (2014)		
		AM	MID	PM
NC 56 and 33rd Street	Signalized	A (6.4)	A (7.6)	B (11.1)
Eastbound		A-8.1	A-9.5	B-12.2
Westbound		A-3.9	A-3.4	A-3.6
Northbound		---	---	---
Southbound		B-11.5	B-11.6	B-18.4
NC 56 and W Lyon Station Road	Signalized	C (25.1)	C (23.4)	C (26.4)
Eastbound		C-21	B-19.4	C-22.1
Westbound		C-21.6	C-20.5	C-23.4
Northbound		C-27.8	C-30.7	D-36.6
Southbound		D-35.7	C-33.3	C-34.3
NC 56 and I-85 Southbound Ramp	Signalized	C (22.6)	C (21.1)	C (22.2)
Eastbound		C-31.2	C-21.7	C-23.7
Westbound		C-22.3	B-19.6	B-18.1
Northbound		---	---	---
Southbound		B-18.2	C-23.3	C-25.3
NC 56 and I-85 Northbound Ramp	Signalized	A (9.3)	B (11.5)	D (43.6)
Eastbound		A-7.9	A-7.8	C-31.7
Westbound		A-6.7	A-9.6	D-36.4
Northbound		C-21.3	C-32.3	F-87.8
Southbound		---	---	---
NC 56 and E Lyon Station Road	Signalized	B (15.0)	B (19.6)	C (32.0)
Eastbound		A-7.7	B-11.1	B-17.7
Westbound		B-15.7	B-17.8	C-26.1
Northbound		C-25.8	C-31.5	D-54.0
Southbound		D-42.7	D-43.3	D-49.5

Table 22: Build (2040) Intersection LOS (Eastern Segment)

Intersection and Approach	Traffic Control	Build (2040)		
		AM	MID	PM
NC 56 and NC 56 Realignment	Roundabout	B (10.2)	A (6.7)	B (11.4)
Eastbound		A-5.6	A-5.6	A-8.4
Westbound		C-15.5	A-8.4	B-12.9
Northbound		B-10.8	A-7.2	C-17.2
Southbound		---	---	---
NC 56 and N Durham Ave/Lake Rd	Signalized	B (19.7)	B (10.2)	C (21.7)
Eastbound		B-16.4	B-10.5	C-23.4
Westbound		C-21.9	B-10.2	C-27.6
Northbound		B-15.9	B-10.1	C-20.7
Southbound		C-20.9	B-10.1	B-16.0
NC 56 and N Durham Ave/Lake Rd	Roundabout	C (18.6)	A (7.4)	C (19.5)
Eastbound		B-10.1	A-5.9	B-11.3
Westbound		D-28.7	A-9.7	C-15.4
Northbound		A-7.2	A-5.2	D-31.3
Southbound		C-20.6	A-7.5	B-11.1
NC 56 and N Main Street	Signalized	C (29.4)	B (17.4)	C (28.6)
Eastbound		D-47.1	A-8.6	C-25.3
Westbound		C-20.2	A-2.9	B-11.9
Northbound		C-23.8	D-36.8	D-41.6
Southbound		D-53.9	D-37.6	D-38.9
NC 56 and Crescent Dr/ Hawley School Rd	Signalized	D (50.3)	A (9.4)	D (38.8)
Eastbound		A-9.4	A-2.5	D-44.1
Westbound		D-44.4	A-7.4	B-18.0
Northbound		E-66.8	D-35.9	D-50.4
Southbound		F-108.9	D-39.7	D-50.5

Figure 60: Build (2040) Peak Hour Turning Movement Volumes (Western Segment)

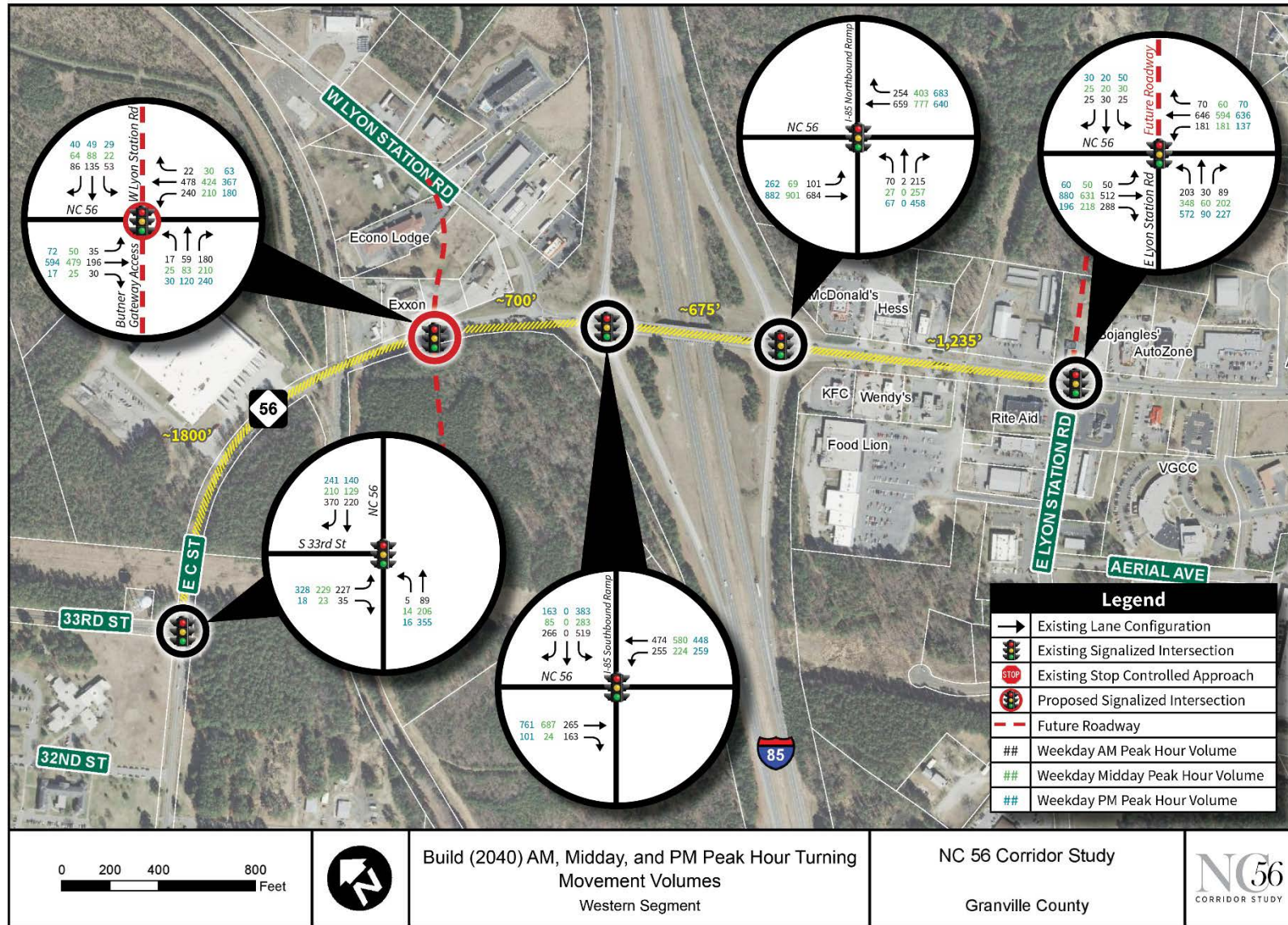
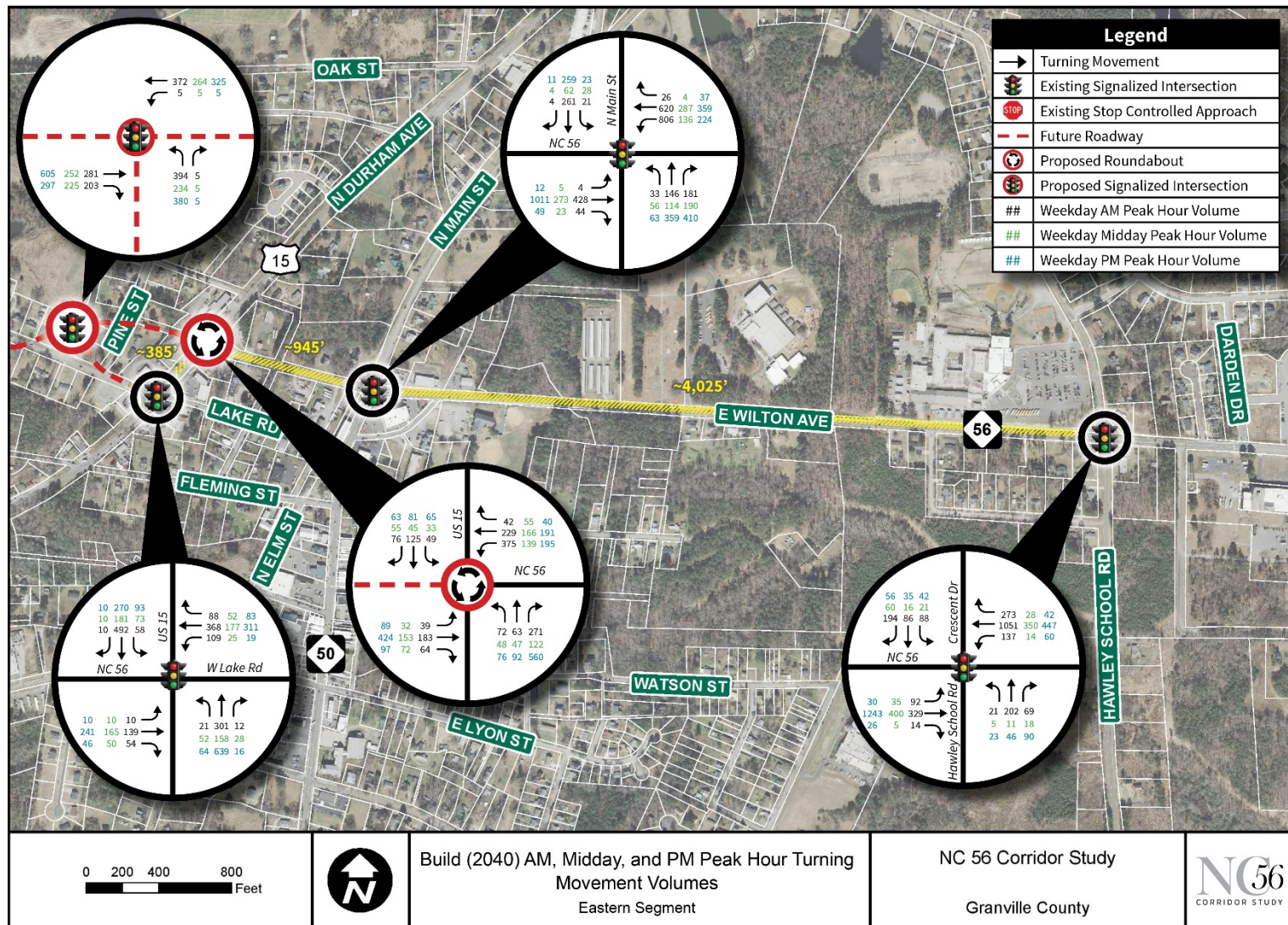


Figure 61: Build (2040) Peak Hour Turning Movement Volumes (Eastern Segment)



Falls Watershed Rules

The Falls Lake Water Supply Nutrient Strategy was implemented in January 2011 to restore water quality in Falls Lake by reducing the amount of pollution entering upstream. The rules focus on reducing nutrient discharges from various sources, including stormwater from new and existing development. The Nutrient Strategy requires new developments above minimum size requirements to develop stormwater management plans that ensure best management practices (BMP) to handle stormwater and outflows of nitrogen and phosphorus. These plans must be approved before new development is allowed. Similarly, there are nutrient load reduction targets for existing developments as well. In addition to requirements for development activity, there are requirements for stormwater BMP for new or improved roadway sections to ensure that increased roadway surfaces do not increase nutrient loads.

These rules and requirements are proven strategies to improve water quality downstream in Falls Lake. They also impose new costs on development by adding costly stormwater management strategies. This can increase the time for approval of site plans as well as increasing development costs and reducing the amount of land on a parcel which can be developed. Further, it may lead to changes in roadway design to accommodate stormwater BMP. The roadway improvements envisioned in this plan were not evaluated specifically in response to the Falls Nutrient Strategy; this will need to be considered and implemented in the design phase for any roadway improvements.

NC 56 Council of Planning

The governing bodies with jurisdiction in or near the NC 56 Corridor may elect to form a Council of Planning to help implement the ideas contained in this report and aid in the full implementation of the final NC 56 Corridor. The basic premise of a Council of Planning is a voluntary group comprised of staff from the local jurisdictions who work cooperatively with developers to ensure their developments are compatible with the planned roadway improvements. For a NC 56 Council of Planning, staff from Creedmoor, Butner, CAMPO, Kerr-Tarr RPO, NCDOT, and Granville County would meet on an as-needed basis to review new development plans. The review would examine development site plans to ensure that they are compatible with the planned roadway cross-section for NC 56 at the site of the development, including examining building location, parking configuration, ingress/egress, site landscaping, stormwater management, and other site design elements. The Council of Planning makes any recommendations regarding the site plan and forwards these to the local government with jurisdiction for their consideration. This review would not aim to be a regulatory hurdle and would not give Council of Planning members authority to approve or deny development applications in other jurisdictions. In no way would a Council of Planning restrict or remove development approval authority from the local jurisdiction. The US 1 Corridor in Wake and Franklin counties uses a Council of Planning, which has been successful.

Local Ordinances and Statutes

Successfully implementing the proposed set of recommendations for the NC 56 Corridor requires, in part, coordinating land use and transportation together and managing project costs. Allowing development to occur uncoordinated with roadway improvements can lead to higher costs in the long run, project delays, and complications. Many municipalities require developers to construct parts of roadways during rezoning or site plan approval processes, or at the very least to tailor site plans to accommodate future roadway plans. This can be accomplished without antagonizing developers or dampening development, and can even be positive for developers by ensuring their developments will be viable even when changes to the roadway occur.

There are several different policies, strategies, and local ordinance examples that have been successful at getting developer exactions and making sure new development is compatible with long-term roadway plans. The times when municipalities have the most leverage to require developers to make concessions or accommodate future roadway plans are at the time of rezoning and during site plan review. An important note is that any concessions required should be rational and proportional to the size and scale of the development, so as not to discourage development. The table below includes several examples of these policies and ordinances, but the specifics of policies and the mix of policies will be up to local jurisdictions to find those that best fit their situation and goals.

These are only brief descriptions of several policies and ordinances that could help a municipality exact some roadway improvements from a developer. These are not meant to overburden the developer but rather to protect existing and future residents by making sure new development does not place an undue burden on shared public resources. The exact mix of policies and ordinances will need to be decided by the each regulatory entity, but the goal is to create collaborative processes that offer developers incentives in exchange for land, site configuration, or infrastructure.

Policy/Ordinance	Description
Require traffic studies at rezoning	Rezoning is the time when municipalities have the most leverage to ask for concessions from developers. Requiring a traffic study allows municipalities to negotiate for transportation improvements before a site plan is even created. For a developer, traffic studies at this stage allow for greater transparency at the site plan review stage.
Require traffic management plans for large developments	New developments that meet certain unit, acreage, or square footage levels could be required to complete traffic management plans which may include constructing elements of roads in accordance with plans.
Require CTP improvements at time of site or subdivision plan	A developer may be required to tailor their development to construct CTP road improvements or at least to accommodate future CTP road improvements at the time of site plan review in order to have the site plan accepted.
Transportation development fees	The legality of some transportation development fees has been challenged recently, but there still may be instances when a developer could be asked to provide funds for transportation as part of development approval.
Create an Access Management Overlay District	A new zoning type that could be overlaid on a district could carry with it additional access management requirements that would trigger during development or redevelopment.
Driveway delineation, consolidation, or permitting	NCDOT has driveway guidance and the municipality could work to enforce driveways during zoning or site plan review by requiring permitting or negotiating for driveway consolidation.
Require stub out streets for developments	Aimed primarily at subdivisions, requiring stub out streets (incomplete and unconnected street ends) can improve future connectivity as more greenfield parcels develop and new roads connect to the stubs.
Site design guidelines	Guidelines could be set for a variety of site criteria that may affect future road improvements, but common requirements are for layout, building orientation, parking configuration, landscaping, screening, and lighting.
Shared stormwater management	Instead of requiring individual parcels and developments construct stormwater management systems for their own parcels, fees could be paid by several developments to construct joint stormwater systems, potentially saving money and creating better stormwater management.
Land swaps	Right of way or municipal land could be swapped with a developer in exchange for the development providing right of way for the planned roadway improvements.
Density bonuses	Allowing a developer to build at higher densities in exchange for constructing infrastructure is a common tit-for-tat that municipalities can offer. This can be good for both developers and cities as the developers are allowed to construct more units (at lower marginal costs) and the municipality gets infrastructure.

Implementation

Implementation Matrix

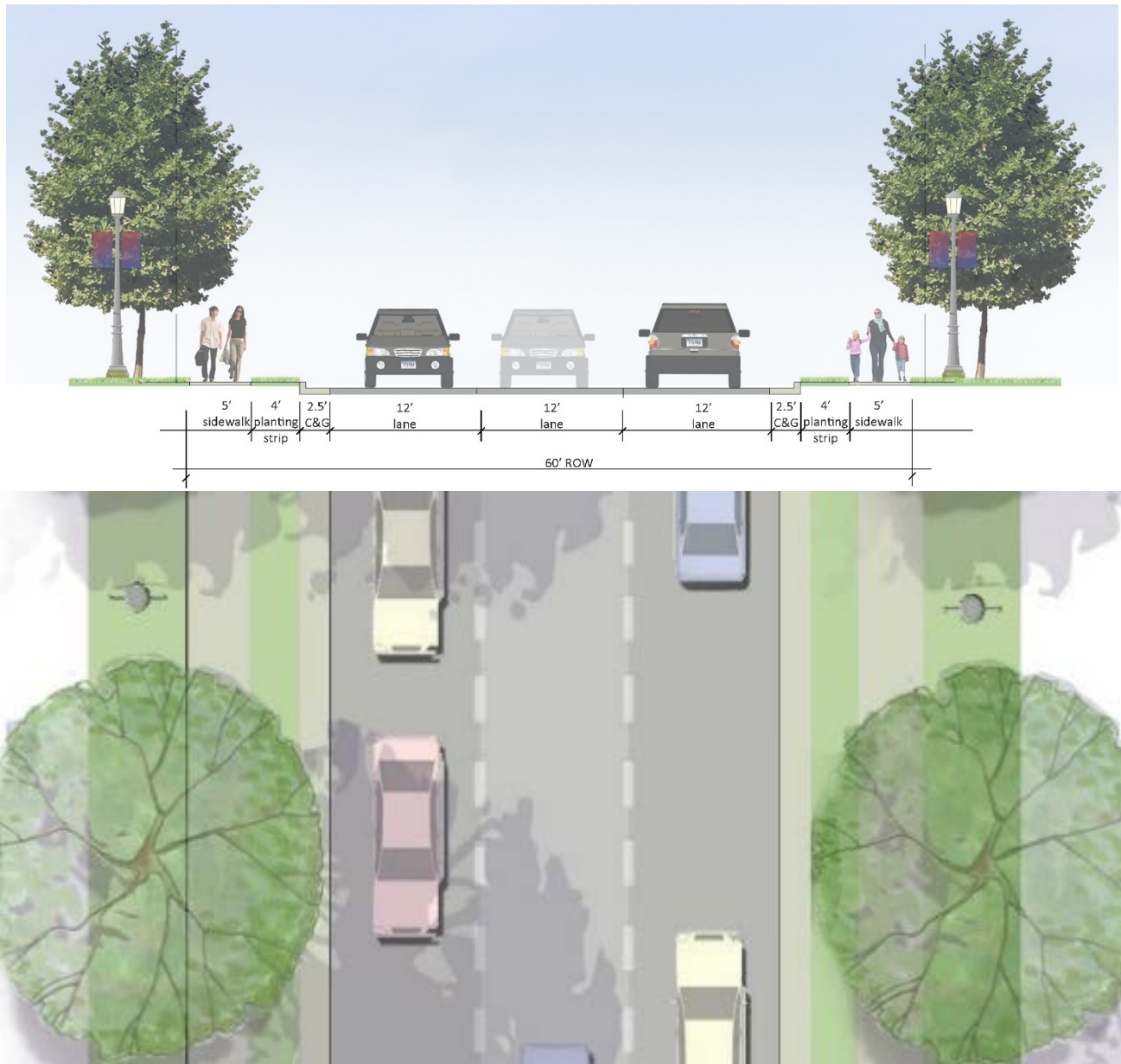
To help evaluate the projects and alternatives that were considered for the NC 56 Corridor Study, a matrix of the projects and their timing, priority, effects, dependencies, and ease of implementation was created (Table 23). The goal of the matrix is to help understand the phasing, timing, and relative merits and needs of each component project and alternative. The matrix should be helpful as an implementation tool providing background information on what the effects may be and whether implementing a particular project is dependent on another project or development occurring. The assessment of the project particulars is based primarily on professional judgment and an understanding of the project background including existing conditions and forecasting/modeling of future conditions. A description of each of the matrix elements follows.

- **ID** – The ID number is sequential moving from west to east in the project corridor and used to reference projects in other sections of the matrix. Projects that have an either/or alternative are labeled with “Alt” and placed in italics. This “Alt” label identifies the project as one that is not a part of the final proposed NC 56 Corridor, but is an alternative project that could be considered instead of the project with the same number. Projects that are labeled with letters A and B are sequential projects where implementation is envisioned to be phased. The “A” project is intended to be implemented first and the “B” project implemented later once project dependencies or triggers are met.
- **Location** – A description of the project location.
- **Type** – A short description of the type of improvements that would be made as part of the project.
- **Name** – A shorthand descriptive name for the project.
- **Description** – A more detailed description of the improvements that would be made as part of the project.
- **Jurisdiction** – the entity with jurisdiction over the implementation.
- **Recommended Cross Section** – If applicable, the proposed cross section for the implemented project.
- **Length** – The approximate distance for the project.
- **Priority** – A generalized assessment of the need for the project. Can be high, medium, or low priority, which is determined based on issues addressed and project dependencies and triggers.
- **Timeframe** – the approximate timeframe for implementing the improvements. Short roughly refers to implementation by 2025. Medium roughly refers to implementation by 2035. Long roughly refers to implementation by 2040, or later.

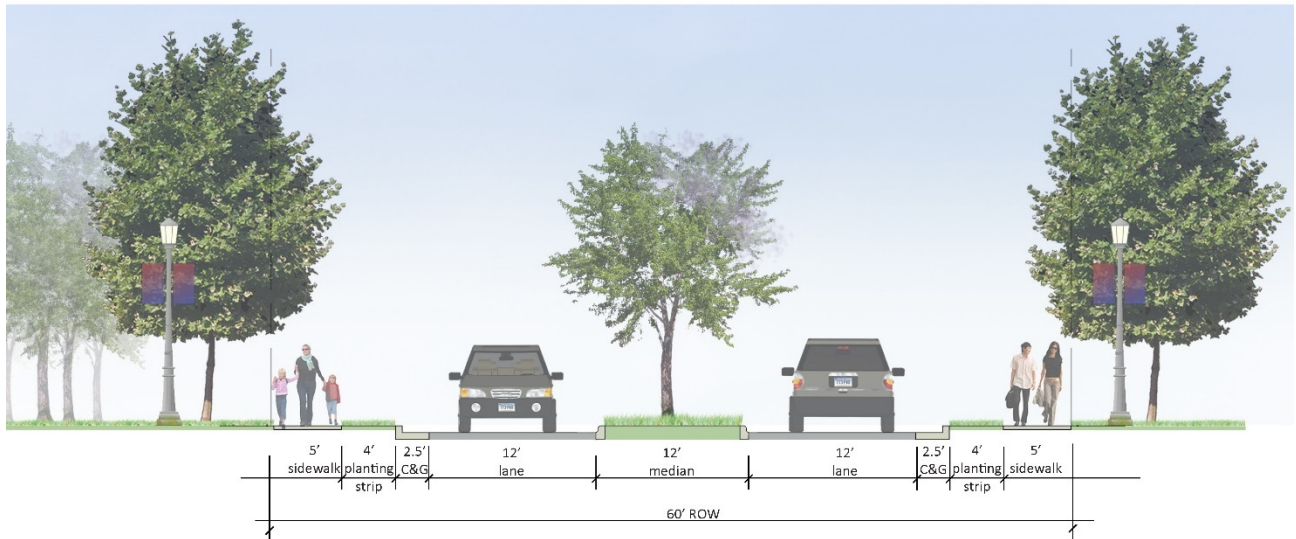
- **Development-Related** – This is a determination of whether the project is dependent on new development occurs in the project area. The timing of development determines the timing of the project improvements.
- **Project Dependencies or Triggers** – An assessment of whether the project interacts with other projects, thereby tying implementation of the proposed project to the implementation of the other projects.
- **Issues Addressed or Improvements Made** – A zero to three scale of whether the improvement addresses each of five major issue areas. The issue areas were identified through public outreach as the areas of primary concern in the corridor. The zero to three scale is an assessment of the magnitude of effect on the issue area where a zero represents no measurable impact and a three represents a strong impact. A negative number indicates that the impact is detrimental rather than an improvement, using a similar negative one to negative three scale for the magnitude of the negative impact.
- **Ease of Implementing** – A high-level and subjective assessment of how easily a project can be implemented. This assesses various criteria such as whether new right-of-way may be needed, ease of coordinating with homeowners and businesses, complications arising from environmental or stormwater impacts, coordinating with local governments and agencies.

The matrix references four cross sections. These are described below. These are only the most common permutations of cross sections throughout the corridor and exact cross sections would depend on final roadway designs, driveways, right-of-way available, environmental concerns, and topographical constraints. Note that the placement of sidewalks and street trees / streetscaping enhancements can be reversed from the layout shown in the design concepts in order to provide more buffer between the roadway and the sidewalk, depending on constraints and local preferences. The matrix follows after the cross sections.

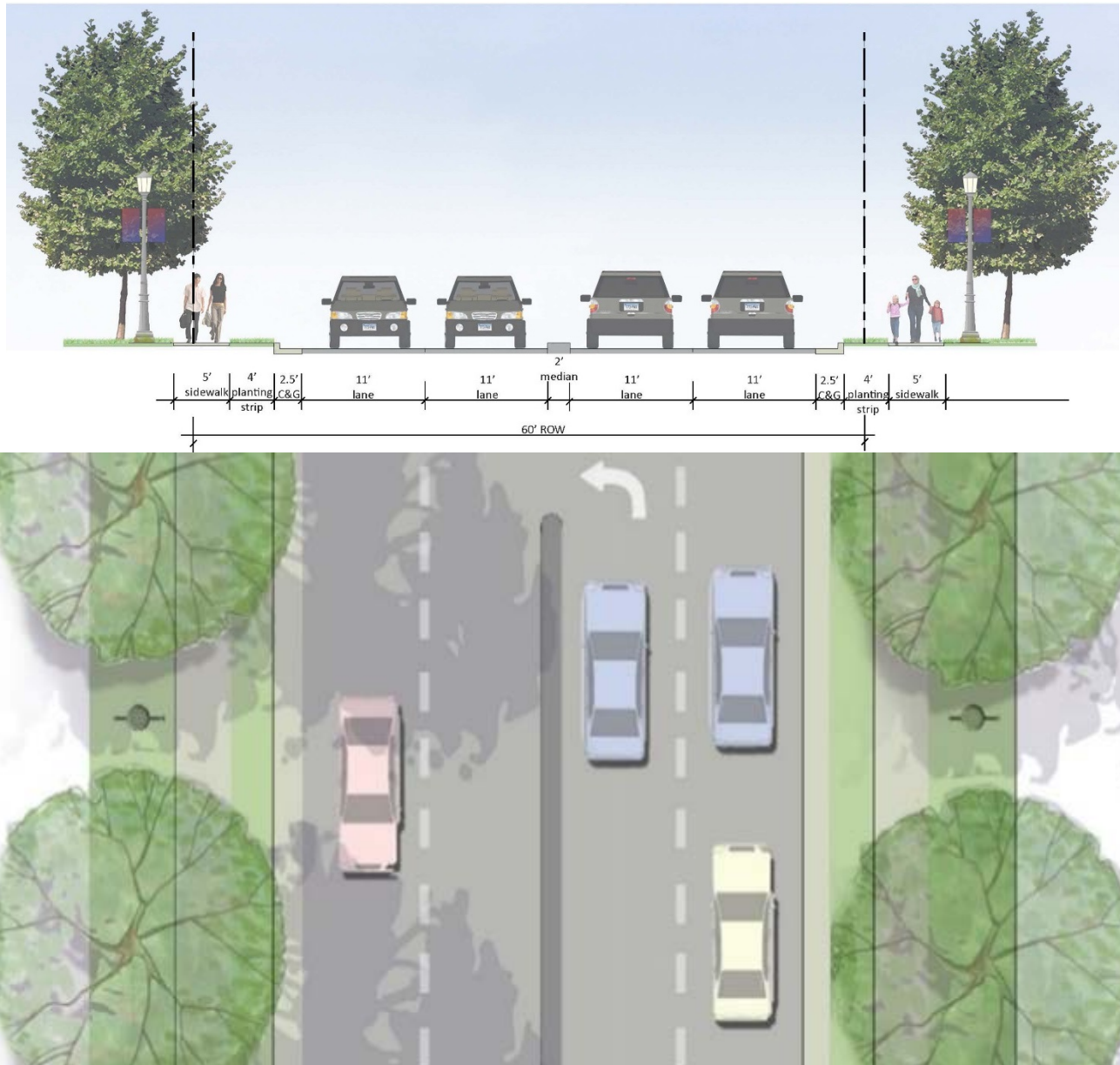
- **Cross Section A (Three-Lane with Two-Way Left Turn Lane (TWLTL))** – This cross section has two 12-foot through travel lanes, one in each direction, with a shared, 12-foot, TWLTL in the middle for left turn access to driveways. The cross section has 2.5-feet of curb and gutter and drainage/stormwater management on each side. The cross section also shows five-foot sidewalks on both sides, but difficulties acquiring enough right-of-way may limit pedestrian infrastructure to one side of the road only. The total right-of-way needed for this cross section is 60 feet.



- **Cross Section B (Two-Lane with Median)** – This cross section has the same 60-foot right-of-way as Cross Section A and would be implemented in the same areas, but implemented in places where driveways are non-existent or limited. The cross section is the same as Cross Section A with the exception that the center TWLTL is replaced by a 12-foot planted median.



- Cross Section C (Four-Lane, Undivided)** – This cross section can also be implemented in a more limited 60-foot right-of-way. There are two 11-foot travel lanes in each direction. Alternatively, there can be two, 11-foot travel lanes in one direction and one 11-foot travel lane and one 11-foot left-turn lane in the other direction. This would be implemented in a few select areas with limited right-of-way and strong left-turn movements, primarily downtown Creedmoor and the I-85 bridge. The cross section also includes 2.5-feet of curb and gutter, a four-foot planting strip, and a five-foot sidewalk on each side. A small raised concrete median barrier could be added to restrict left turn movements from occurring mid-block.



- Cross Section D (Four Lane with Median)** – This cross section requires 125 feet of right-of-way. There are four 12-foot, through travel lanes, two in each direction and an 18-foot planted median. Each side features 2.5-feet of curb and gutter, a four-foot planting strip, a five-foot sidewalk, and an 18-foot lighting and planted buffer on each side. In places with limited right-of-way the lighting and planted buffer outside the sidewalks could be reduced or eliminated.

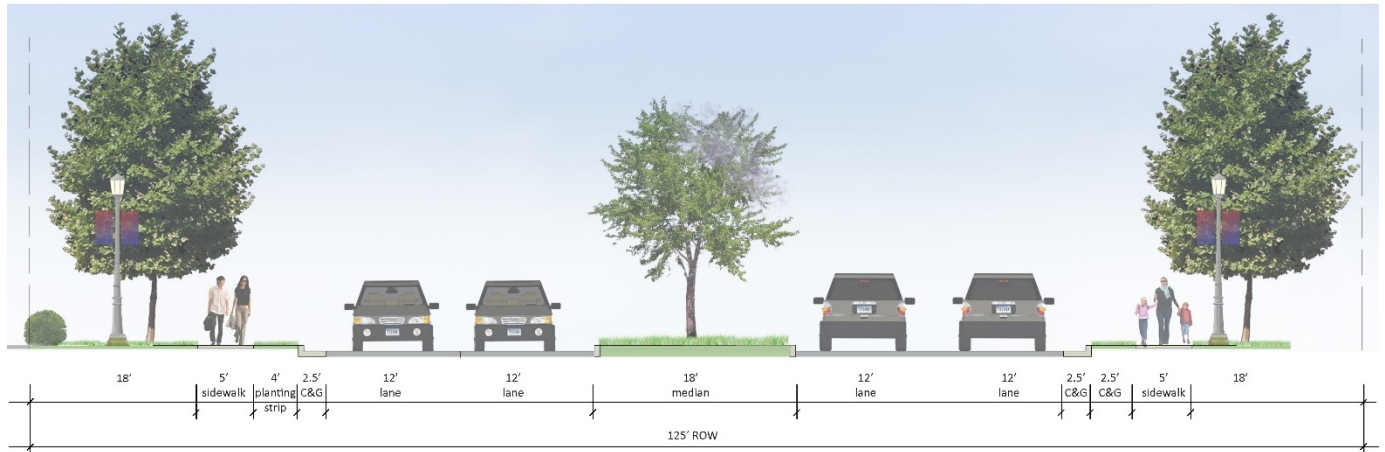


Table 23: Implementation Matrix

ID	Location	Type	Name	Description	Jurisdiction	Recommended Cross Section	Length	Priority	Timeframe	Development-related?	Project Dependencies or Triggers	Issues Addressed or Improvements Made					Implementation
												Capacity	Safety	Access Management	Bike/Ped	Livability-Aesthetics	
1	NC 56 & 33rd Street	Signalized intersection improvements	33rd St Signal Improvements	Lengthen left turn storage; add crosswalks	Town of Butner	N/A	<500 ft	Low	Medium	No		1	1	0	2	0	High
1 Alt	NC 56 & 33rd Street	Roundabout	33rd St Roundabout	Convert to roundabout; add crosswalks	Town of Butner	N/A	<500 ft	Low	Medium	No		1	2	0	1	2	(lower)
2	NC 56 & W Lyon Station Rd	Realignment & widening, plus new signal	West Lyon Station Rd Improvements	Widen NC 56 to 4 lanes plus turn lanes between RR crossing and I-85 SB ramps. Realign W Lyon St with new service road & construct new signal with ped crossings	Town of Butner	N/A	~1,200 ft	High	Medium	Some	#3.1, Butner Gateway	2	2	2	1	1	Medium
3A	I-85 Interchange	Restriping & signal improvements	I-85 Bridge Reconfiguration	Restripe existing bridge deck for 4 lanes, plus associated signal improvements	Town of Butner	C	~700 ft	High	Medium	No	#2, #3.2	2	0	0	-1	0	High
3B	I-85 Interchange	Bridge widening & signal improvements	I-85 Bridge Widening	Widen bridge deck to 5 lanes, plus associated signal & ped/bike enhancements	Town of Butner	D	~700 ft	High	Long	No	#2, #3.2	3	3	0	3	1	Low
4	NC 56: I-85 - S Campus Dr	Widening with access management & intersection + ped/bike improvements	NC 56 Widening (West, Phase 1)	Widen to 4-lane divided with signalized intersection improvements, pedestrian accommodations, and access management	Town of Butner	D	~2,200 ft	High	Medium	No	#3.1, #3.3	3	3	3	2	3	Low
5	Serving NC 56 frontage: I-85 - Capitol Dr	Access roads	Phase 1 connectivity enhancements	Provide alternate NC 56 access for parcels to north (& south)	Town of Butner	N/A	N/A	High	Short	Possible		2	3	3	3	2	Medium
6A	NC 56: S Campus Dr - Butner Town Limits	Widening with access management & intersection + ped/bike improvements	NC 56 Widening (West, Phase 2)	Widen to 2-lane divided/TwLTL, plus intersection improvements, pedestrian accommodations, and access management	Town of Butner	A/B	~3,800 ft	Medium	Medium	No	#3.2	2	2	3	1	1	Medium
6B	NC 56: S Campus Dr - Butner Town Limits	Widening with access management & intersection + ped/bike improvements	NC 56 Widening (West, Phase 3)	Widen to 4-lane divided, plus intersection improvements, pedestrian accommodations, and access management	Town of Butner	D	~3,800 ft	Low	Long	Possible	#3.2	3	3	3	2	3	Low
7	Serving NC 56 frontage: Capitol - Pond Dr	Access roads	Phase 2 connectivity enhancements	Provide alternate NC 56 access for parcels to north (& south)	Town of Butner	N/A	N/A	Low	Medium	Yes		2	3	3	2	1	Medium
8	NC 56: Butner Town Limits - Brogden Rd	Widening with ped/bike improvements	NC 56 Widening (Central)	Widen to 2-lane divided/TwLTL plus ped/bike accommodations	City of Creedmoor	A/B	~1.2 mi	Medium	Long	Possible	#4, #7	2	2	1	2	2	Medium
9	NC 56: Brogden Rd - N Main St	Widening, new alignment, & intersection + ped/bike improvements	NC 56 / US 15 / NC 50 realignment, widening & intersection improvements	Extend & realign NC 56 & W Lake Rd. Widen NC 56 & US 15. Improve intersections and ped/bike accommodations	City of Creedmoor	C	~4,500 ft	High	Short	No	#6, #8	3	2	3	3	2	Low
9 Alt	NC 56: Brogden Rd - N Main St	Widening & intersection + ped/bike improvements	NC 56 / US 15 / NC 50 widening & intersection improvements	Widen NC 56 & US 15. Improve intersections and ped/bike accommodations	City of Creedmoor	C	~3,800 ft	High	Short	No	#6, #8	2	2	3	3	2	Low
10	NC 56: N Main St - Darden Dr	Widening & intersection + ped/bike improvements	NC 56 Widening (East)	Widen to 2-lane divided/TwLTL plus ped/bike accommodations	City of Creedmoor	A/B	~4,100 ft	Medium	Medium	No	#8	2	2	0	2	1	Medium
11	NC 56: N Main St - Darden Dr	Widening & intersection + ped/bike improvements	NC 56 Widening (East)	Widen to 4-lane undivided plus ped/bike accommodations	City of Creedmoor	D	~4,100 ft	Low	Long	No	#10	3	2	1	1	2	Low
12	Creedmoor Elementary School	On-site / operational improvements	School pick-up/drop-off improvements	Modify bus and carpool routing to minimize spillback on NC 56	City of Creedmoor	N/A	N/A	High	Short	No		2	3	0	1	0	High
Other projects not a direct part of the NC 56 Corridor Study																	
13	New I-85 interchange at Brogden Rd	New interchange	Brogden Rd Interchange	New interchange	NCDOT	N/A	N/A	High	Long	No		2	2	0	1	2	Low
14	Ivac Way - Pond Dr		Ivac Way - Pond Dr Connection	Collector street upgrade & extension with bike/ped accommodations	Town of Butner	N/A	~1,500 ft	Medium	Long	Some	26th St - Telecom Dr Connection	1	1	1	3	1	Medium
15	Realigned W Lyon Station Rd to Gate 2 Rd		I-85 Frontage Rd	New collector street	Town of Butner	N/A	~2.3 mi	Low	Medium	Yes	#2, Butner Gateway	2	1	1	3	1	Medium

Estimates of Probable Costs

Probable costs have been estimated for the entire set of recommendations for the NC 56 Corridor Study. The basic cost consists of construction, design, modernization, contingency and other costs directly related to roadway widening, intersection improvements, signalization, bridge replacement, traffic control devices, and sidewalks. Some variance is indicated, reflecting the impact of final implementation and sidewalk decisions. More details are provided in the project phases described below, and in the Appendices.

For the purposes of these calculations, new sidewalks are assumed on both sides of all improvements, a very minimal expense relative to overall project costs. Although committed greenway/sidewalk projects will be in place along at least one side of portions of the project corridor, until designs are completed for the recommended widenings, impacts on existing sidewalks and greenways are uncertain. The slightly conservative assumption seems prudent in light of this uncertainty. However, the possibility that the current greenway/sidewalk projects along the middle segment of the corridor are adequate and unaffected was considered; potential cost reductions resulting from this assumption are indicated in the relevant estimates by project segment and phase.

\$35.0-\$37.2 million – Basic cost

Not included in these estimates are costs associated with purchasing rights-of-way and residential or commercial structures, or relocations or loss of use. However, the number of parcels potentially affected and the number of structures taken are estimated, subject to refinement pending more detailed design. Note that where improvements are phased, both near-term and subsequent long-term (additional) parcel and structure impacts are identified.

59/53 – Parcels potentially affected (short or medium term/long term)

5/4 – Anticipated structures taken (short or medium term/long term)

Costs associated with enhanced landscaping and burial of overhead utilities are not included in estimating probable basic costs. For informational purposes, a scenario was assumed representing likely types and locations of landscaping. For utility relocation, a standard \$1 million/mile rate was applied to segments considered suitable candidates for such treatment. Additional details are available in the individual project segment descriptions, and in the Appendices.

~\$1.1 million – Landscaping

~\$2.3 million – Relocate utilities underground

The following subsections break the recommendations down segment and phase, corresponding with the implementation program described above.

Intersection Improvements and Widening: 33rd Street to Rail Crossing

This project consists of intersection and widening improvements.

\$1,000,000 – Basic cost

2/0 – Parcels potentially affected (short or medium term/long term)

0/0 – Anticipated structures taken (short or medium term/long term)

Optional Costs

\$64,000 – Landscaping (30% of segment length)

Widening and Access Roads: Rail Crossing to Capitol Drive

This set of improvements includes widening of NC 56, including the I-85 overpass, intersection improvements at both East Lyon Station Road and West Lyon Station Road, and new access (“backage”) roads needed for effective access management along NC 56. Consistent with its role as a gateway commercial corridor, more intensive landscaping and overhead utility burial are assumed in estimating optional costs.

\$10,000,000 – Basic cost (widening and intersection improvements)

\$2,200,000 – Basic cost (access/backage roads)

\$12,200,000 – Basic cost (total)

7/0 – Parcels potentially affected (short or medium term/long term)

0/0 – Anticipated structures taken (short or medium term/long term)

Optional Costs

\$390,000 – Landscaping (50% of NC 56 project length only, median & roadside)

\$770,000 – Relocate utilities underground (NC 56 corridor only)

Widening: Capitol Drive to 1000' East of Holly Drive

This later phase extending the above widening of NC 56 eastward affects more parcels, due to narrower existing ROW. Optional costs still include potential utility burial, but less intensive landscaping. Potential cost reductions resulting from the

assumption that sidewalk/greenway projects already underway replace some of the sidewalks in this project are indicated below.

\$4,800,000 – Basic cost (widening and intersection improvements)

0/23 – Parcels potentially affected (short or medium term/long term)

0/1 – Anticipated structures taken (short or medium term/long term)

Note: Eliminating all new sidewalks and relying instead on Creedmoor/Butner Greenway reduces costs by ~\$240,000.

Optional Costs

\$135,000 – Landscaping (30% of project length, median only)

\$730,000 – Relocate utilities underground

Widening: 1000' East of Holly Drive to Brogden Road

Existing ROW should be adequate for this set of improvements. Replacement of the Ledge Creek bridge represents a significant cost. Potential cost reductions resulting from the assumption that sidewalk/greenway projects already underway replace some of the sidewalks in this project are indicated. No utility burial and less intensive landscaping are assumed in estimating optional costs.

\$5,600,000 – Basic cost (widening and intersection improvements)

0/0 – Parcels potentially affected (short or medium term/long term)

0/0 – Anticipated structures taken (short or medium term/long term)

Note: Eliminating new sidewalks and relying instead on Cross-City Trail and Creedmoor/Butner Greenway reduces costs by ~\$520,000.

Optional Costs

\$80,000 – Landscaping (20% of project length, median only)

Widening/New Alignment: Brogden Road to East of North Main Street

This complex set of improvements combines widenings with new alignments, intersection improvements, and a roundabout. ROW and structural impacts are significant, and somewhat uncertain pending more detailed design. Burial of overhead utilities and intensive landscaping are assumed in the optional cost calculations.

\$3,300,000 – Basic cost (widening)

\$4,200,000 – Basic cost (new alignment)

\$7,500,000 – Basic cost (total)

52/0 – Parcels potentially affected (short or medium term/long term)

5/0 – Anticipated structures taken (short or medium term/long term)

Optional Costs

\$320,000 – Landscaping (100% of project length, roadside and some median)

\$790,000 – Relocate utilities underground

Widening: East of North Main Street to Darden Drive

ROW impacts and takings are insignificant for the initial widening to 3 lanes. Should 4 lanes become necessary, these impacts increase substantially. The cost impacts of widening to 4 lanes initially are compared against staged implementation. It is assumed that new sidewalks are needed in any case.

\$3,400,000 – Basic cost (initial 3-lane cross-section)

\$2,700,000 – Basic cost (increase to 4-lane cross-section)

\$6,100,000 – Basic cost (ultimate)

0/20 – Parcels potentially affected (short or medium term/long term)

0/3 – Anticipated structures taken (short or medium term/long term)

Note: Cost for widening initially to 4 lanes is \$4,700,000, saving \$1,400,000.

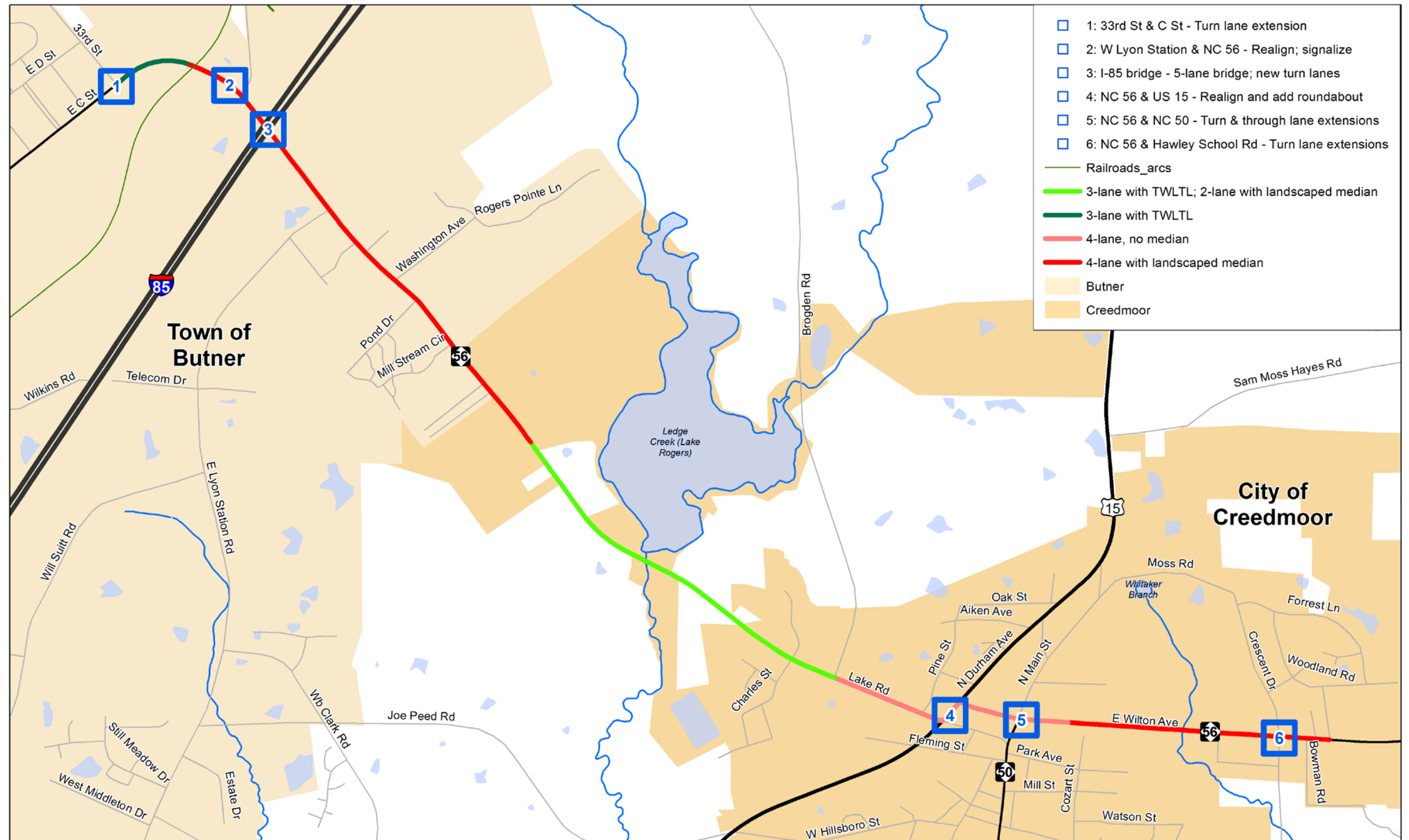
Optional Costs

\$80,000 – Landscaping (25% of project length, roadside only)

Full Corridor 2040 Vision

The complete set of recommendations for improvements to the corridor by the horizon year 2040 is included in Figure 61. This includes the recommended final cross section profile for the NC 56 corridor and the identified intersection improvements.

Figure 62: Full Corridor 2040 Vision



NC 56 Corridor Study - Year 2040 Recommendations Overview

0 0.25 0.5 1 Miles



Public Input

The project team has solicited public input on this project by including a stakeholder oversight team which is composed of community and business leaders and will meet throughout the project. The project team has created a website, www.nc56corridorstudy.com, which provides project updates. There were two public workshops for this project, the first held on January 26, 2015, and the second held on May 12, 2015. The project team also conducted focus group style interviews with several key stakeholders along the corridor.

Stakeholder Interviews

Four meetings were held with stakeholders from the community to gain a better understanding of the unique issues faced by these organizations along the NC 56 corridor. The participants were grouped together by organizational type, and the stakeholder interviews were conducted like focus groups. Each meeting involved several participants and lasted roughly one and a half hours. The project team presented a short background of key issues identified to-date, and then each group discussed the issues and solutions as they and their organization see them. The following organizations participated:

Group 1 – Public Health and Safety

- Granville County Emergency Management
- Creedmoor Police
- Butner Public Safety

Group 2 – School, Institutional, and Governmental

- Creedmoor Elementary
- Murdoch Center
- Granville Health System

Group 3 – Businesses

- Granville Chamber of Commerce
- Granville Economic Development
- Altec Industries
- Simply Delicious
- M&H Tire
- Vance-Granville Community College
- Property Owner

Group 4 – Freight

- Food Lion

➤ Greenville County Schools

The discussion in each focus group focused on issues and potential solutions along the NC 56 Corridor. The main points raised in these meetings are shown below.

Key Issues:

- Lack of traffic controls in front of hospital, EMS
- Issues related to people being lost (either off the Interstate or near the community college)
- Safety and congestion at the schools
- Impacts to businesses if turning movements are reduced
- No anchor to drive community and economic development
- Many facilities sharing the same access point with no traffic controls
- Emergency services and planning – one crash can back up the entire area

Solutions:

- Wayfinding signs
- Turn lane near the school
- Traffic control at community college/Altec/library
- Limit or share driveways to use existing access more efficiently
- Caution light outside of hospital, EMS
- Curb-and-gutter

Priorities to be Addressed:

- Safety
- Aesthetics
- Low-cost/short term solutions

Key Areas of Concern:

- Immediately off the I-85
- In front of the community college

Public Workshop #1

The first public meeting was held on January 26, 2015 from 3:30 to 6:30 PM at the Vance-Granville Community College South Campus, located on the NC 56 corridor. Forty-six attendees signed in and participated. The meeting also included paper and online versions of a survey on existing conditions and priorities for the future; as of February 18, 56 surveys have been completed.

The format of the public meeting was an open house combined with a short presentation every hour on the hour. There were four stations for participants to visit:

- Where do you live/work?
- Problem identification
- Issue prioritization
- Transportation tool box

The first station was also the sign-in area and featured a map of the region where participants could place a dot where they live and where they work. In total, 28 dots were placed on the board showing that 10 people work along the corridor and 7 live along the corridor. Most other selections were for living and/or working in either Town of Butner limits or the City of Creedmoor limits.



The second station focused on problem identification within the corridor. Meeting participants were provided three aerials – one of each study segment – and asked to identify areas where they experience the most issues or have the most concern. Participating attendees were provided stickers and markers and provided feedback directly on the aerial. The survey also asked participants to list problems that they experience in the corridor. The following are the most common comments received:

Western Segment:

- Traffic congestion is bad around restaurants
- Turning into and out of restaurants is dangerous
- Too many driveways
- Pedestrian access to businesses is difficult/dangerous

Middle Segment:

- Bridge over Ledge Creek should be elevated and widened to accommodate pedestrians
- Speeding is common

Eastern Segment:

- Traffic backs up around US 15 intersection
- The school area experiences significant congestion and safety issues during school begin or end times
- Crosswalk near the school is unsafe

Additional Comments:

- Any minor roadwork and trash collection cause significant delays
- Not enough turn lanes at intersections
- Actual travel speeds are high
- Speed limits are too low in sections
- Need more lanes
- Current road is not aesthetically pleasing/not a good gateway for Butner or Creedmoor



The online and paper survey also asked participants to list what works well in the corridor currently. Some of the most common comments received are:

- Traffic lights (at I-85 and by the Walgreens and CVS in particular) have helped traffic flow
- The stretch between Creedmoor and Butner generally has good traffic flow
- There is a good concentration of businesses and restaurants on the western end of the corridor

The third station asked participants to rank various issues to help prioritize the most important items to address in the corridor. Meeting participants were provided a list of previously identified issues and stickers to select one issue as the most important. The same issues were available for selection on the survey, but participants could select whether they felt the issue was very important, somewhat important, slightly important, or not important. Fifteen people participated in the meeting board. Forty-four participated in the survey. The breakdown of responses is shown in Table 24.



Table 24: Issue Prioritization Results Summary

Issue	Top Priority Sticker at Public Meeting		Very Important in Survey		Somewhat Important or Slightly Important in Survey		Not Important in Survey	
	#	%	#	%	#	%	#	%
Safety	1	7%	33	90%	4	11%	0	0%
Congestion	3	20%	32	74%	11	26%	0	0%
Freight Access	1	7%	9	26%	22	63%	4	11%
Environmental Preservation	0	0%	12	36%	18	55%	3	9%
Access to Businesses	3	20%	23	66%	11	31%	1	3%
Bicycle Safety and Access	1	7%	11	37%	15	50%	4	13%
Pedestrian Safety and Access	4	27%	21	64%	11	33%	1	3%
Wayfinding / Directional Signs	2	13%	10	35%	16	55%	3	10%
Aesthetics / Appearance	0	0%	8	22%	24	67%	4	11%

Although slightly different feedback was received from the survey and public meeting, the top issues that were selected were safety, congestion, access to businesses, and pedestrian safety and access.

The final station at the public meeting focused on potential solutions to problems and suggestions for addressing the identified issues and deficiencies. This station allowed meeting participants to select stickers representing different infrastructure improvements and provide suggestions for ways to improve the corridor. Aerials of the three study segments were provided. The survey also asked for suggestions on improvements. The following represent the most common comments received.

Western Segment:

- Preserve access to business
- Improve pedestrian safety
- Add traffic light
- Add access to parcel behind McDonalds and Bojangles

Middle Segment:

- Lower speeds
- Raise the speed limit to 45 mph
- Widen NC 56
- Do not widen NC 56
- Add sidewalks or side paths

Eastern Segment:

- Add traffic light around US 15 and NC 56
- Improve traffic flow around dog leg intersection

Additional Comments:

- Add bypass around this area
- Widen NC 56
- Improve access to businesses around interstate

Public Workshop #2

The second public meeting was held on May 12, 2015 from 3:30 to 6:30 pm at the Vance-Granville Community College, South Campus, located on the NC 56 corridor. Thirty-six attendees signed-in and participated in the meeting. The format of the meeting was an open house style combined with presentations. Project staff gave two presentations reviewing the material at the meeting and the development of that material.

Participants were also invited to visit stations with the material, ask questions of project staff, and provide comments on the alternatives presented. There were four stations that provided information for participants to review and comment on:

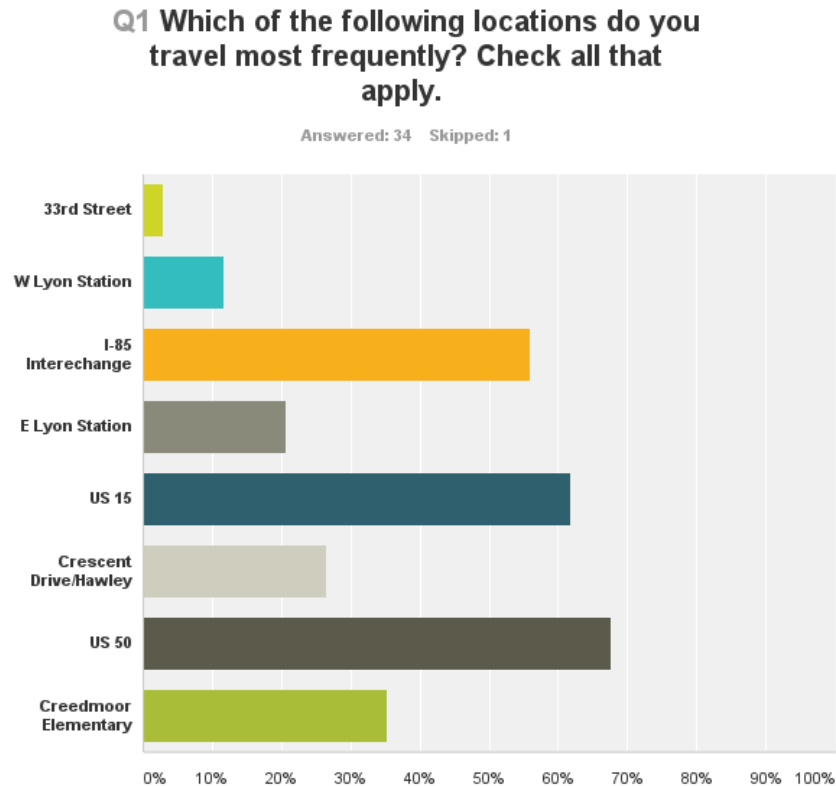
- An overview map showing the full corridor and proposed lane configurations with inset images of key intersections
- The western section with alternatives for 33rd Street, W Lyon Station Road, the I-85 interchange, E Lyon Station Road, and access management in the western section
- Alternative configurations for the US 15 / NC 56 intersection and the cross sections of proposed 3-lane sections
- Eastern section options for cross sections and school circulation alternatives

The public meeting included a paper survey form and an electronic version of that survey was completed. As of May 29, 2015, 35 surveys had been completed. These surveys contained several key findings.



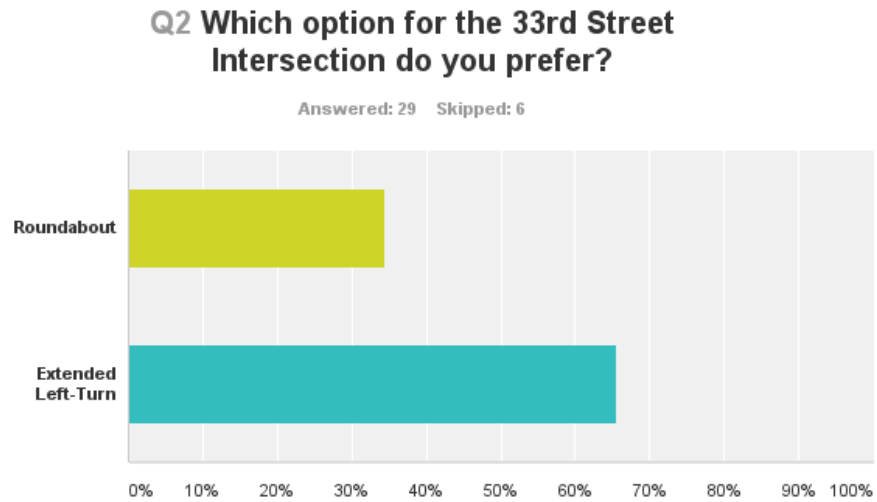
The first question on the survey regarded which locations in the corridor are used most frequently. Respondents could check more than one location, so there were 96 responses from the 35 respondents. Respondents mostly use the corridor between the I-85 interchange and Creedmoor Elementary School. The results of question 1 are shown in Figure 63.

Figure 63: Survey Responses to Corridor Locations that are Most Frequently Traveled



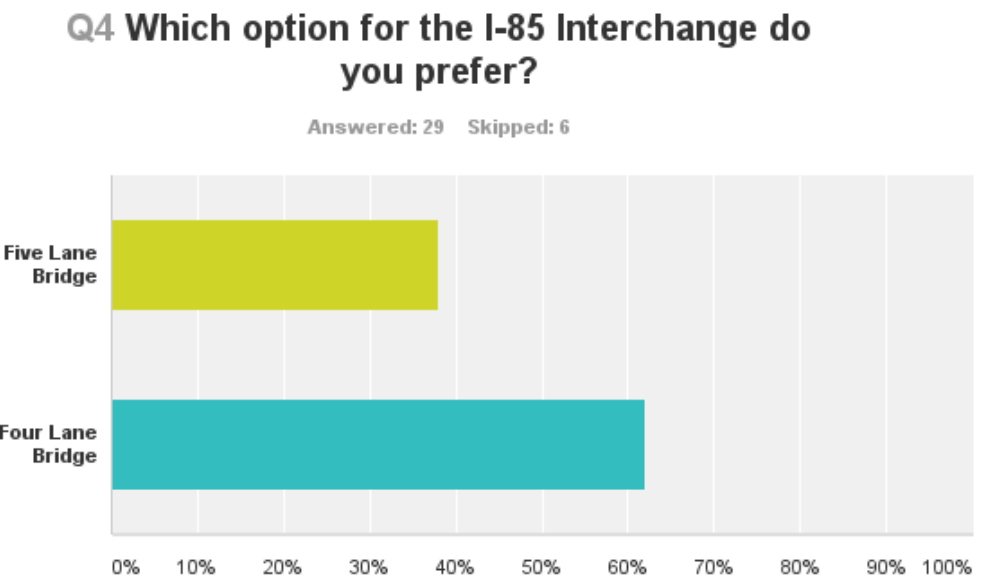
For the 33rd Street intersection with NC 56 in Butner, two options were presented, a roundabout and an extended left-turn lane to handle expected turning volumes. The extended turn lane was the preferred option with roughly 2/3 of respondents choosing this alternative. Figure 64 shows the responses to question 2.

Figure 64: Responses for preferred 33rd Street Intersection Treatment



Two alternatives were also presented for the I-85 interchange: a 4-lane bridge over I-85 and a 5-lane bridge. Slightly under 2/3 of respondents chose the 4-lane bridge option, which is the cheaper option as it does not require the existing bridge to be replaced. Figure 65 shows respondent answers on preferred I-85 bridge alternative.

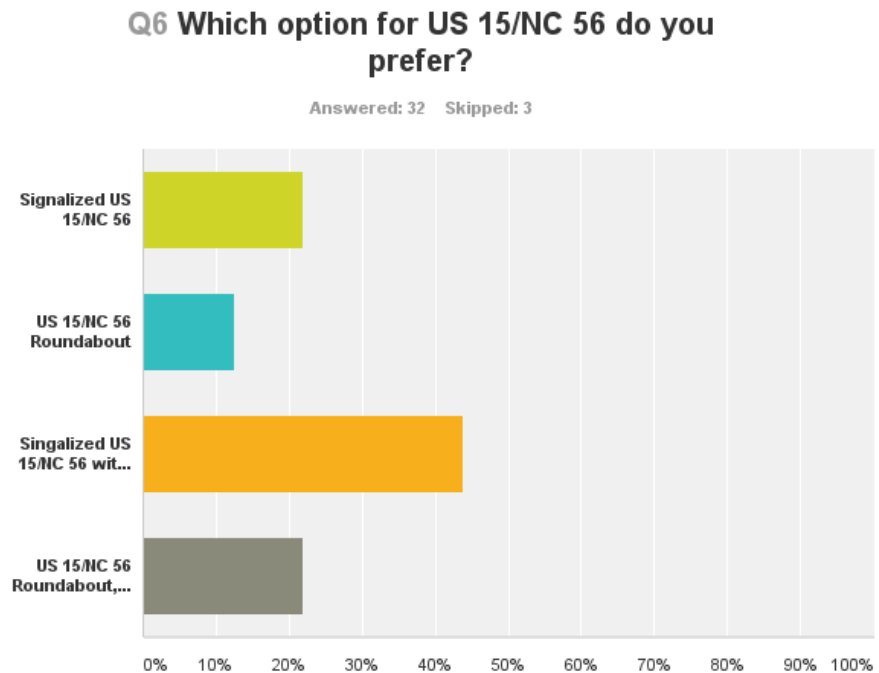
Figure 65: Responses for Preferred I-85 Interchange Alternative



Four options were presented for the US 15 / NC 56 pair of intersections in Creedmoor: 1) signaling the northern intersection, 2) a roundabout at the northern intersection, 3) a signal at the northern intersection, plus extending NC 56 from this intersection to join the existing alignment west of Pine Street, and 4) a roundabout at the northern

intersection, plus extending NC 56 from this intersection to join the existing alignment west of Pine Street. The third option was the top choice with about 45% of respondents favoring this alternative. However, the first and fourth alternatives both received about 20% of the votes, and the second alternative got a little more than 10% of the votes. Figure 66 shows the responses to the preferred US 15 / NC 56 alternative.

Figure 66: Responses for Preferred US 15 / NC 56 Intersection Treatment



In addition to these structured questions, open ended comments were solicited both at the meeting and via the surveys. Of the comments heard, the majority seemed to be in favor of the structure of the widening plan. Of the additional comments, some of the major themes were:

- If left-turn access is limited or removed for the “restaurant row” area, then alternative access at the rear of the parcels is critical to ensure business success.
- Many respondents were in favor of a median in the “restaurant row” area. Many participants in the meeting stressed that something needed to be done to make the area feel safer.
- Several respondents were categorically against roundabouts in any location and in favor of any alternative that does not involve a roundabout.