

Capital Area MPO Intersection Feasibility & Impact Analyses

City of Creedmoor Intersections

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Prepared by:



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1.0 Introduction

The Capital Area Metropolitan Planning Organization (CAMPO) identified the need to conduct an intersection feasibility and impact analysis for NC 56/NC 50/US 15 in the City of Creedmoor, NC. CAMPO contracted with HDR Engineering of the Carolinas (HDR) to complete this work. This report outlines the major findings and recommendations of the Creedmoor Intersection Feasibility and Impact Analysis.

1.1 Project Background and Objectives

The Capital Area MPO initiated the Creedmoor Intersection Feasibility and Impact Analysis in an attempt to identify operational and safety improvements for four intersections located along NC 56, NC 50, and US 15 in the City of Creedmoor, NC.

With the development of the region's Comprehensive Transportation Plan (CTP), the unconstrained component of the 2040 Long Range Transportation Plan (LRTP), the City of Creedmoor was selected for additional study for future transportation improvements. The major findings and recommendations developed from this study will serve as the basis for CTP elements in the LRTP.

Several ongoing and recently completed efforts aim to improve transportation operations and safety in the City of Creedmoor. The NC 50 Corridor Study, stretching along NC 50 from Interstate 540 in Raleigh to NC 56 in Downtown Creedmoor, identifies both short and long-term mobility and safety enhancements that attempt to mitigate the expected growth in traffic congestion resulting from forecasted population growth in the region. Relevant to the current study and specific to Downtown Creedmoor, the NC 50 Corridor Study recommends a context-sensitive approach emphasizing pedestrian scale development including increased sidewalk connectivity and smaller block lengths. The upcoming Creedmoor Pedestrian Plan will continue these efforts by detailing specific short and long-term recommendations to enhance pedestrian mobility and safety in Downtown Creedmoor. These may include construction of additional sidewalks, greenways, crosswalks or other pedestrian enhancements.



Truck traffic along Lake Rd.

An additional concern related to future transportation operations and safety in Downtown Creedmoor is truck traffic. Population growth in the Triangle region has increased the demand for goods and services, which in turn has led to increased truck traffic volumes on NC roadways. Of particular concern for Downtown Creedmoor, truck traffic volumes have increased along NC 50 between I-85 and the City of Raleigh. The Creedmoor Connector (See **Figure 1-2**), proposed by the City of Creedmoor, would attempt to alleviate this issue by diverting regional truck traffic away from Downtown.

The Creedmoor Connector is a proposed bypass consisting of a four lane divided facility from NC 56 (near Butner) to NC 50 (south of Creedmoor) and a two-lane divided facility from NC 50 to Brassfield Road (SR 1700). The project seeks to divert truck traffic away from Downtown Creedmoor and is based on the region's commitment towards long-term transportation mobility and safety enhancements.

The purpose of the Creedmoor Intersection Feasibility and Impact Analysis is to:

- Document existing roadway conditions, land use, and built environment characteristics in the area immediately surrounding NC 56, NC 50, and US 15 in Creedmoor.
- Identify environmental, cultural, and historical concerns within the study area.
- Identify possible roadway safety issues based on historical crash data.
- Analyze existing and future traffic volumes within the study area in order to determine capacity deficiencies
- Evaluate access along NC 56, NC 50, and US 15 and provide applicable recommendations that improve future access management and safety within the study area.
- Identify short and long-term innovative roadway design strategies that enhance mobility and safety for motorists using the four intersections within the study area.

1.2 Study Area Description

According to the 2010 U.S. Census, the City of Creedmoor has a total population of 4,124 persons. The City is located in the southern portion of Granville County, approximately 25 miles north of Raleigh, NC. The primary study area for the Creedmoor Intersection Feasibility and Impact Analysis encompasses four intersections in Downtown Creedmoor (See

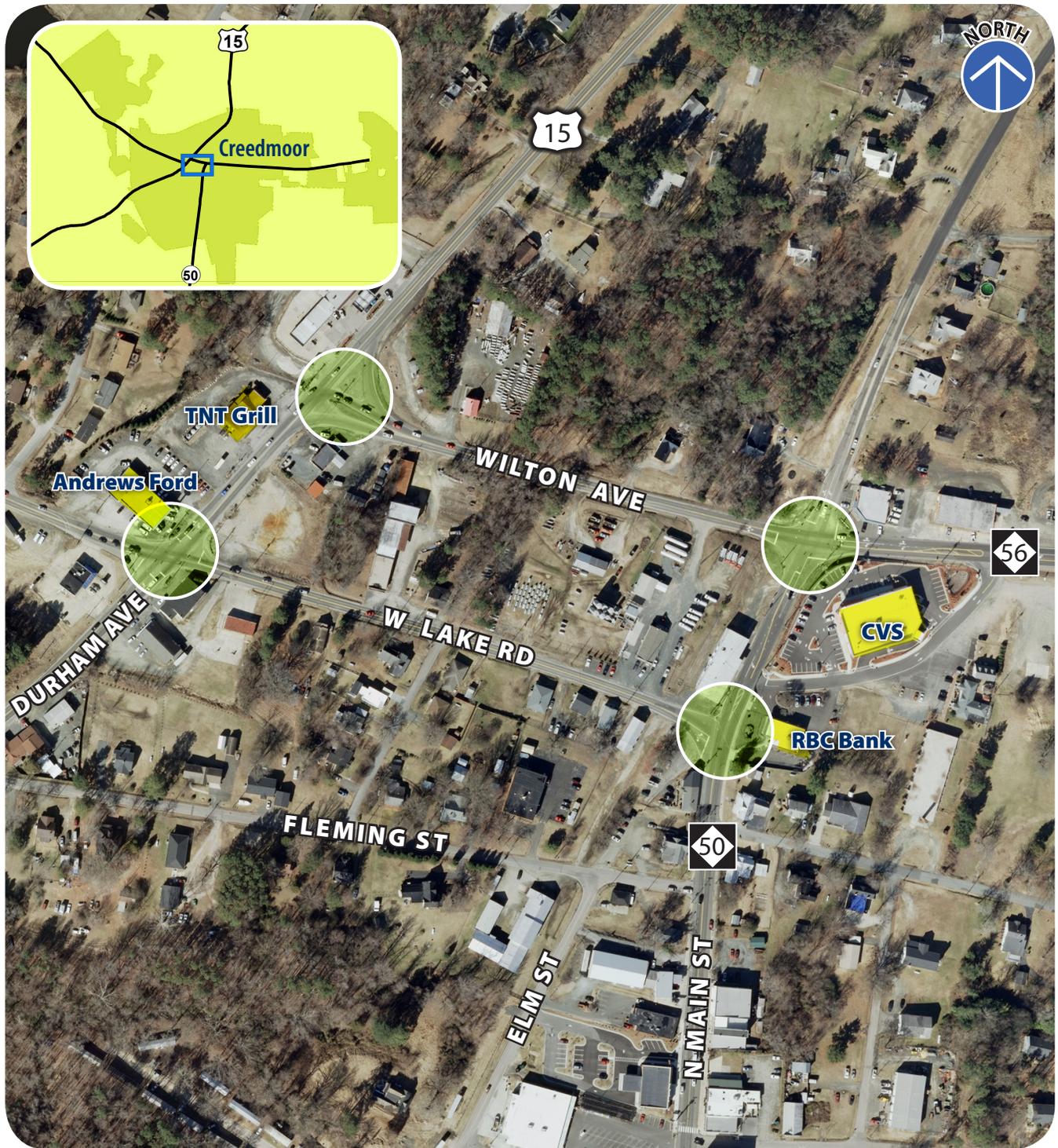
Figure 1-1):

- N. Main St. (NC 50) at Lake Rd.
- N. Main St. (NC 50) at Wilton Ave. (NC 56)
- N. Durham Ave. (US 15) at Wilton Ave. (NC 56)
- N. Durham Ave. (US 15) at Lake Rd. (NC 56)

1.2.1 Existing Roadway Conditions

Four primary travel corridors are within the study area: N. Main St. (NC 50), Wilton Ave. (NC 56), N. Durham Ave. (US 15), and Lake Rd (NC 56). Site observations revealed high volumes of truck traffic traveling through the study area. The observed truck traffic travel patterns revealed that many of these trucks appeared to be using Downtown Creedmoor as a means to travel between areas to the south in Wake County and areas to the north along the I-85 corridor. Observed vehicular travel patterns indicated that the study corridors functioned similar to a City block. **Table 1-1** summarizes the existing physical characteristics of the study area corridors.

Figure 1-1 | Creedmoor Study Area



Legend:  Study Intersection

Figure 1-2 | Proposed Creedmoor Connector



Source: City of Creedmoor Thoroughfare Plan. Prepared by the NCDOT Transportation Planning Branch, July 27, 2004.

- Legend:**
- Project Limits
 - Major Thoroughfare
 - Minor Thoroughfare
 - Proposed Major Thoroughfare
 - Proposed Minor Thoroughfare
 - Grade Separation
 - Proposed Interchange

Existing Corridor Conditions:

Table 1-1 | Existing Conditions

CORRIDOR NAME	ROUTE #	FROM	TO	LENGTH (FT)	RIGHT-OF-WAY (FT)	SPEED LIMIT (MPH)	SHOULDERS (FT)	SIDEWALKS	LANES	LANE WIDTH (FT)
N. Main Street	NC 50	Lake	Wilton	390	60	20	none	none	2	11
Wilton Avenue	NC 56	Durham	east of Main	1,560	60	35	none	none	2	10
Durham Avenue	US 15	Lake	Wilton	390	80	35	none	none	2	10
Lake Road	NC 56 (west of Durham Ave.)	Durham	Main	1,060	30	35	none	none	2	10

Other characteristics of the study area:

- N. Main St. has an 11 ft. wide turn lane for both the access road between RBC and CVS and Wilton Ave. that generally forms a continuous third lane between these intersections and has a small section of sidewalk located along the eastern portion of the roadway in front of the RBC Bank.
- Durham Ave. contains several commercial establishments, located along the southern and northern portions of the roadway, and also contain poorly marked and unpaved site access driveways that present numerous potential conflict points for roadway users along Durham Ave.
- Large power utility lines and poles are also located within the ROW on each corridor

1.2.2 Existing and Future Land Uses

A variety of commercial, industrial, and residential land uses surround the study area. The majority of land uses are commercial along Main St. and Durham Ave., including an RBC bank, CVS pharmacy, TNT Grill, and the Andrews Ford dealership (See **Figure 1-1**). Other commercial establishments include several gas stations and auto repair facilities. The most prominent industrial land use found within the study area is Creedmoor Fuel Services, located west of N. Main St. between Lake Rd. and Wilton Ave. Single-family residential units are located within the study area just south of Lake Rd.



Andrews Ford Dealership along Durham Ave.

The City of Creedmoor has drafted a downtown future land use plan. The plan will enhance the economic and social vitality of Creedmoor’s downtown core. The plan assumes incorporation of the recommendations found in the NC 50 Corridor Study and the Creedmoor Pedestrian Plan. As a whole, the plan concentrates commercial mixed-use development along the Main St. corridor. Additional mixed-use and high-density residential development is designated west of the Main St.

corridor along Elm St. Similarly, additional residential and open space land is designated for development to the east of Main St. Within the study area, the southwest corner of Lake Rd. and Main St. is designated for commercial mixed-use development and the southeastern corner of Lake Rd. and Main St. is designated for additional commercial office and residential development. This type of commercial mixed-use development will most likely surround the intersections in the study area as the next ring out from the Downtown core.

1.2.3 Future Water and Sewer Infrastructure

The location of future utility infrastructure will play a role in design aspects of possible improvements to the roadway network. In order to develop feasible solutions to improving the operation and safety of Downtown Creedmoor's four study area intersections, considerations must be made for existing and future underground water and sewer lines.

Several components of the future water and sewer infrastructure network impact the study area. According to data released by the City of Creedmoor, future water lines will run along the southern portion of Wilton Ave. east of Main St., extend to the southern portion of the CVS pharmacy property line, cross Main St. running briefly along the western portion of the street, and finally run the northern portion of Lake Rd. before briefly running along the eastern portion of Durham Ave. and continuing along the southern portion of Lake Rd. (See **Figure 1-3**). The future water line on Lake Rd. will replace an old 2 inch water line in the center of the pavement. Future sewer lines will run along the northern portion of Lake Rd. west of Durham Ave. before continuing north along the western portion of Durham Ave. (See **Figure 1-3**).

Future water and sewer locations are very important to potential design of any improvements within the study area. The location of the utilities may influence the design as the utilities need to be maintained and accessible with any new roadway improvements. Whether this means that the utilities are located in a utility strip or in the center of any new roadway will be left up to the designer at the time of the creation of construction drawings.

Figure 1-3 | Future Water and Sewer Infrastructure



2.0 Environmental and Cultural Resources Review

An environmental and cultural resources review provides a holistic overview of the study area. Undertaking a comprehensive inventory of potential environmental and cultural features of sensitivity ensures that potential negative impacts are identified and resulting sound operational and safety recommendations are offered for the study area intersections that avoid negative impacts to cultural and environmental resources.

2.1 Environmental Review

From an analysis perspective, no major direct environmental impacts are anticipated from the proposed project. The environmental review was done via a desktop analysis utilizing current GIS layers for environmental features such as wetlands, streams, floodways, etc.

2.1.1 Water Resources/Watershed Classification

The proposed project falls within the northern area of Falls Lake Watershed (a.k.a “Upper Falls”) in the Upper Neuse River Basin (See **Figure 2-1**). This watershed is classified as a WS-IV (water supply); and is also designated as Nutrient Sensitive Waters (NSW). As defined by DENR (Department of Environment and Natural Resources), Class WS-IV waters are used as sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. These waters are also protected for Class C uses. WS-IV waters are generally in moderately to highly developed watersheds or Protected Areas. NSW is a supplemental classification intended for waters needing additional nutrient management due to being subject to excessive growth of microscopic or macroscopic vegetation.

According to the National Wetlands Inventory (NWI) there are no wetlands within approximately 500 feet of the project area. From the USGS streams inventory, an unnamed tributary to Ledge Creek is located 250 feet due west of the intersection of Lake Rd. and Durham Ave.; the closest named stream is Whitaker Branch and is located over ½ mile away to the east and south of Lake Rd. We anticipate no additional requirements above the NCDOT standards related to erosion control measures and typical construction best management practices.

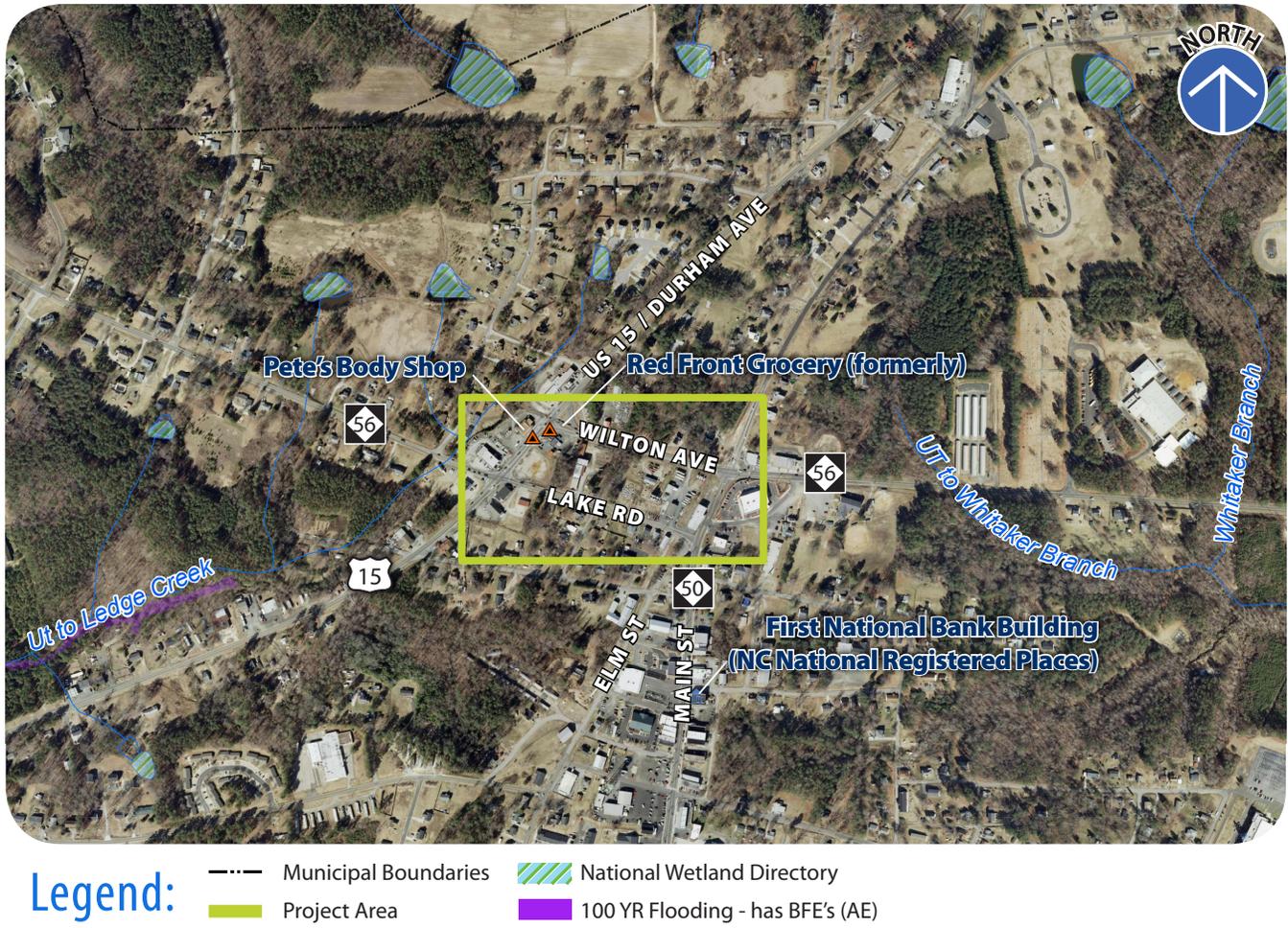
2.1.2 Regulated Floodplains

No FEMA regulated floodplains are located within a ¼ mile of the proposed project (See **Figure 2-1**).

2.1.3 Federally Protected Species

According to the latest NC Natural Heritage Program database, no federally protected species were recorded within 1 mile of the study area. The closest natural area of concern is Butner-Falls of Neuse Game Land, owned by the USACE, and located 1 mile southwest of the subject intersections. This area will not be affected by the proposed project.

Figure 2-1 | Environmental Features



2.1.4 Hazardous Waste Sites

According to the NC Hazardous Substance Disposal Sites GIS layer, no hazardous substance disposal sites exist within 1 mile of the proposed project (See **Figure 2-1**). The EPA's Office of Environmental Information (OEI) listed two facilities subject to environmental regulations in its online Facility Registry System (FRS): Pete's Body Shop at 504 Durham Ave. and (formerly) Red Front Grocery at 602 Durham Ave. Pete's Body Shop is a Conditionally Exempt Small Quantity Generator of Hazardous Waste according to the EPA and Red Front Grocery is listed by EPA as part of the State's UST Program. It is anticipated that neither location poses any issues with the future proposed projects.

2.2 Cultural Resources Review

The purpose of the cultural review is the identification of historic resources that may be affected by the proposed improvements within the study area. Results from the cultural review indicate no locally designated historic landmarks or districts in or near the study area. The cultural resources review was completed by CIRCA, Inc. on June 15, 2011.

2.2.1 Defined

For the purposes of this report, "historic properties" are those resources that are listed in the National Register of Historic Places (National Register), eligible for listing in the National Register (through a federal determination of eligibility or by placement on the North Carolina Study List), or designated as a historic landmark or district by local ordinance per NC General Statute 160A-400.1-400.14. The historic status of "surveyed properties" (shown on **Table 2-1**) is unknown; they have been entered into the State Historic Preservation Office's (HPO) statewide architectural inventory and have either been determined ineligible for the National Register or have not been evaluated for it.

2.2.2 Findings

The results from the cultural review indicate no locally designated historic landmarks or districts in or near the project limits; though several historically significant properties are located in the surrounding area. **Table 2-1** provides a listing of these properties. It is important to note that while not directly affected, these properties may face temporary impacts from the project such as the instance of temporary detours occurring during construction. Also please note the existence and/or condition of the properties listed below has not been confirmed in the field.

Table 2-1 | Historically Significant Properties

SITE #	NAME	STATUS
GV552	First National Bank	National Register
GV672	Creedmoor Historic District	NC Study List
GV519	Sion H. Rogers House	NC Study List
GV514	RH Flemming House	surveyed
GV563	Perry and Curl Buildings	surveyed
GV515	Lyon Family House	surveyed
GV517	Chappell Mule Dealership	surveyed
GV516	Badge Rogers House	surveyed
GV518	MP Davis House	surveyed
GV512	RH Rogers House	surveyed
GV511	Landis Davis House	surveyed

**Note: the existence and/or condition of properties listed above have not been confirmed by field observation*

Given the concentration of historic buildings in Creedmoor and the city’s origins as a late-nineteenth and early-twentieth century commercial center for bright leaf tobacco farmers in southern Granville County, it is possible an as yet unidentified National Register-eligible historic district exists along South Main Street. Granville County has not established a county-wide historic preservation commission, nor has the City of Creedmoor. Therefore there are no locally designated historic landmarks or districts in or near the project area. A preliminary review of aerial photographs in Google Earth did not reveal any other potentially historic resources other than those noted above.

3.0 Crash Analysis

The North Carolina Department of Transportation provided crash data for each of the four study area intersections between January 2008 and December 2010. Crash diagrams, included in Appendix A, provide visual illustrations of each crash type at the study area intersections. Several trends emerge related to the types of crashes observed at each intersection:

Durham Ave. (US 15) and Lake Rd. (NC 56):

A total of 6 crashes were documented at the intersection of Durham Ave. and Lake Rd. Four crashes involved vehicles who were rear-ended, which included incidents of vehicles traveling eastbound on Lake Rd., southbound on Durham Ave., and northbound on Durham Ave. Two crashes involved side swiping, which included an incident involving a vehicle turning out of the Andrews Ford driveway heading southbound on Durham Ave. and an incident with a vehicle traveling northbound on Durham Ave.

Table 3-1 | Summary of Crashes at Durham Ave. and Lake Rd.

CRASH NUMBER	TIME	ROAD SURFACE CONDITION	WEATHER CONDITION	INJURY?	FATALITY?
1	7:30am	Dry	Clear	No	No
2	7:30am	Dry	Clear	No	No
3	3:16pm	Dry	Clear	No	No
4	10:30pm	Dry	Cloudy	Yes (Type C)	No
5	12:00pm	Dry	Clear	No	No
6	6:52pm	Dry	Clear	No	No

Durham Ave. (US 15) and Wilton Ave. (NC 56):

Two crashes were documented at the intersection of Durham Ave. and Wilton Ave. Both crashes involved vehicles traveling westbound on Wilton Ave. attempting to make a left-hand turn to travel southbound on Durham Ave. In the first documented crash, the motorist collided with a vehicle traveling southbound on Durham Ave. attempting to make a left-hand turn onto eastbound Wilton Ave. In the second documented crash, the motorist collided with a vehicle traveling northbound on Durham Ave.

Table 3-2 | Summary of Crashes at Durham Ave. and Wilton Ave.

CRASH NUMBER	TIME	ROAD SURFACE CONDITION	WEATHER CONDITION	INJURY?	FATALITY?
7	7:10am	Dry	Clear	No	No
8	8:17am	Wet	Rain	No	No

Main St. (NC 50) and Lake Rd.:

Four crashes were documented at the intersection of Main St. and Lake Rd. All four crashes involved vehicles traveling eastbound on Lake Rd. attempting to make a right-hand turn onto southbound Main St. Three of the crashes were caused by motorists traveling eastbound on Lake Rd. who either side swiped or rear-ended motorists attempting to make the right-hand turn onto southbound Main St. The other reported crash involved a collision between the motorist making the right-hand turn onto southbound Main St. and a vehicle traveling southbound on Main St.

Table 3-3 | Summary of Crashes at Main St. and Lake Rd.

CRASH NUMBER	TIME	ROAD SURFACE CONDITION	WEATHER CONDITION	INJURY?	FATALITY?
9	5:50pm	Dry	Clear	Yes (Type C)	No
10	10:24am	Dry	Cloudy	No	No
11	4:54pm	Snow	Cloudy	No	No
12	2:01pm	Dry	Clear	No	No

Main St. (NC 50) and Wilton Ave. (NC 56):

Three crashes were documented at the intersection of Main St. and Wilton Ave. All crashes involved vehicles traveling either eastbound or westbound on Wilton Ave. Two crashes involved rear-end collisions, one with vehicles traveling eastbound and one with vehicles traveling westbound on Wilton Ave. A third crash involved a side swiping incident among vehicles traveling eastbound on Wilton Ave.

Table 3-4 | Summary of Crashes at Main St. and Wilton Ave.

CRASH NUMBER	TIME	ROAD SURFACE CONDITION	WEATHER CONDITION	INJURY?	FATALITY?
13	2:43pm	Dry	Clear	Yes (Type C)	No
14	7:37am	Dry	Clear	Yes (Type C)	No
15	8:46am	Dry	Clear	No	No

4.0 Capacity Analysis

One of the major components of the Creedmoor Intersection Feasibility and Impact Analysis is the capacity analysis for all four intersections within the study area. All support information for this section is included in Appendix B (Traffic Counts) and Appendix C (Capacity Analyses). This section includes:

- Traffic Counts and Projections
- Analysis of Existing (2011) Conditions
- Alternatives for Analysis
- Analysis of Alternatives with Design Year (2040) Traffic
- Comparison of Alternatives
- Conclusion

4.1 Traffic Counts

Traffic counts were taken at all four intersections in the study area. The counts were performed by GreenLight Traffic Services on Tuesday, May 24, 2011. Counts were collected during the AM Peak Period (7am-9am), the Mid-Day Peak Period (11am-1pm) and the PM Peak Period (4pm-6pm). Heavy vehicle and pedestrian movement counts were also collected during these time periods. All of the traffic counts data is located in Appendix B.

Figure 4-2 on the next page shows the existing turning volumes within the study area. **Figure 4-3** on the following page shows the existing laneage within the study area.

The following **Figure 4-1** is a snapshot from the 2009 daily volumes collected by NCDOT. Both the volumes collected by NCDOT and GreenLight Traffic Services for this study show a fair amount of traffic along Lake Rd. between Main St. and Durham Ave.

Figure 4-1 | 2009 NCDOT Collected AADT Counts

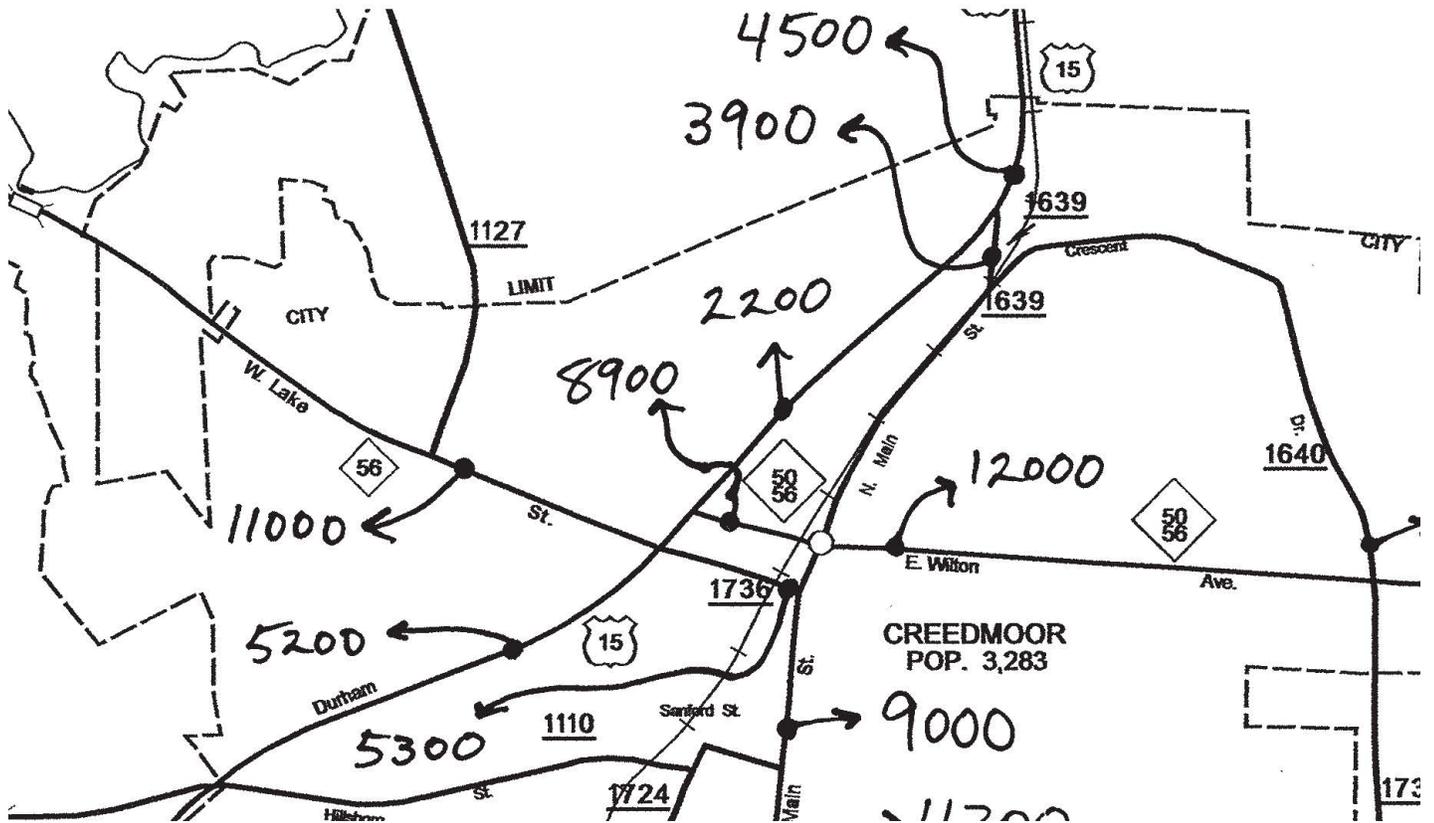


Figure 4-2 | Existing (2011) Volumes

LEGEND	
XX	AM Peak Hour
<XX>	Midday Peak Hour
(XX)	PM Peak Hour

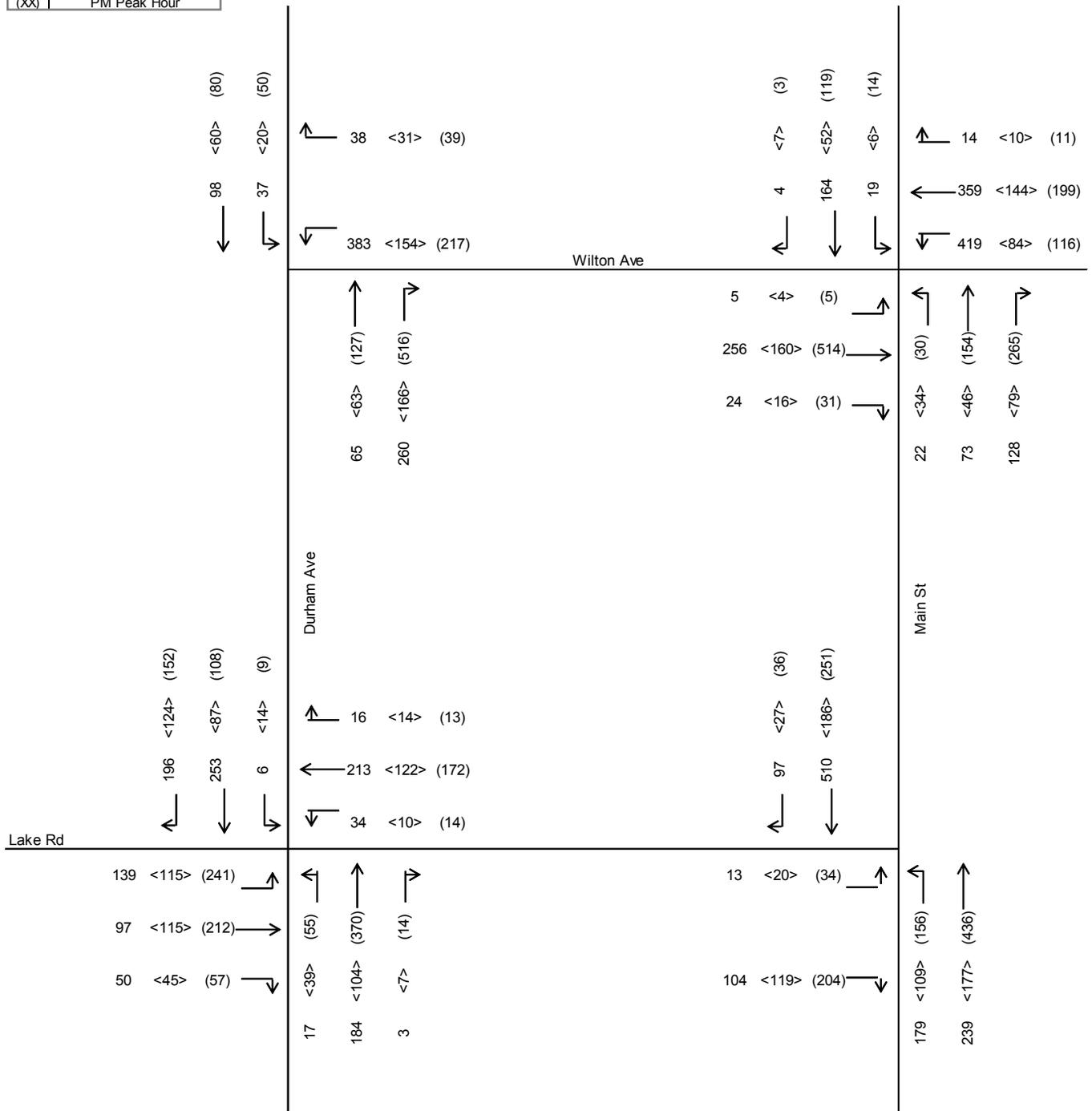
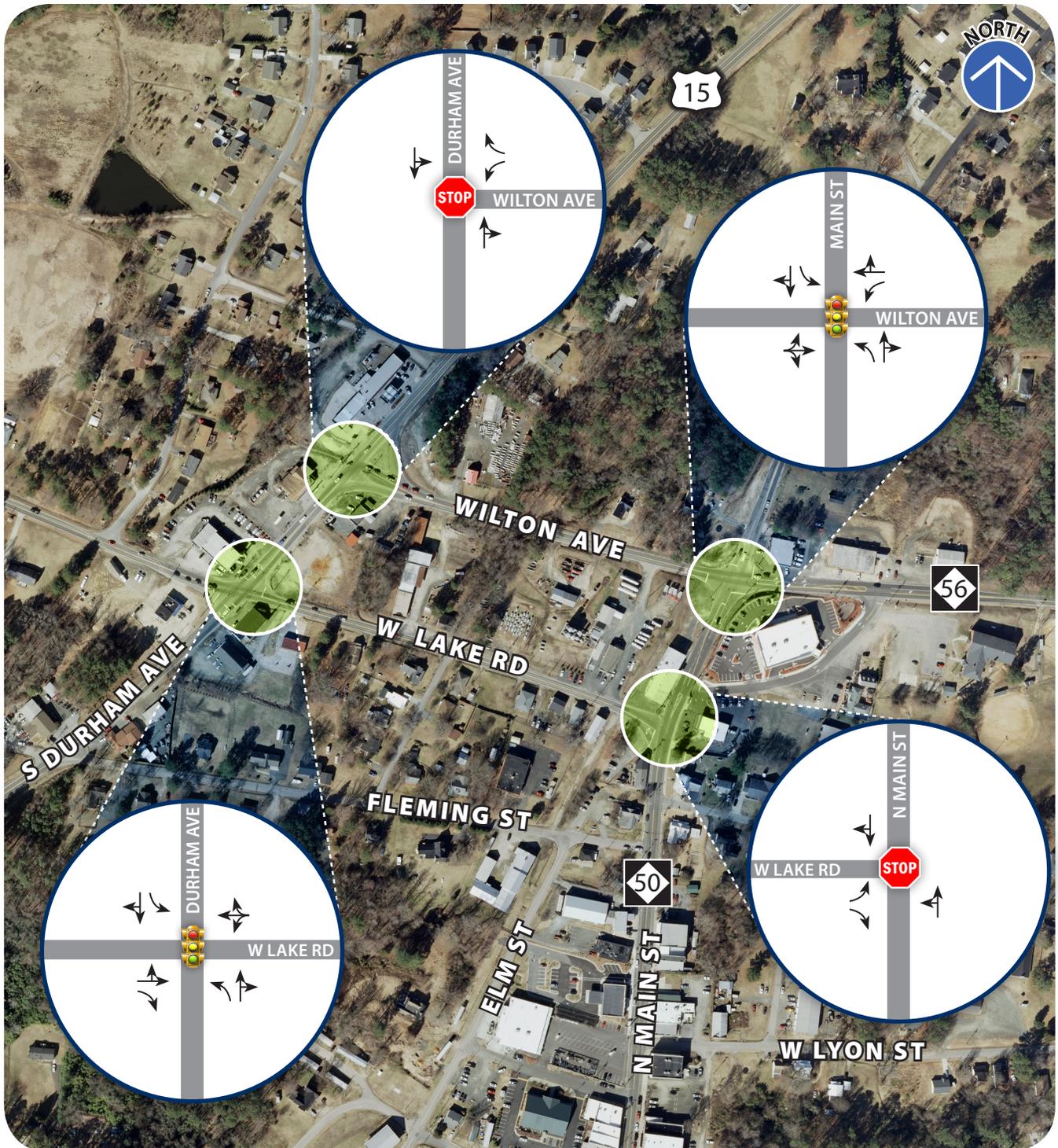


Figure 4-3 | Existing (2011) Laneage in the Study Area



Legend:

- ← Existing Laneage
- Proposed Laneage
-  Signalized Intersection
-  Unsignalized Intersection

4.2 Existing (2011) Conditions

Existing volumes, traffic flow characteristics, and intersection geometrics collected during field visits were used to determine the level of service. The level of service (LOS) is a measurement of average delay incurred at an intersection for a particular movement. LOS is defined by the Transportation Research Board’s Highway Capacity Manual (HCM). The following tables give the HCM criteria for both signalized (**HCM Exhibit 18-4**) and unsignalized intersections (**HCM Exhibit 19-1**).

HCM EXHIBIT 18-4	
Signalized Level of Service	Average delay per Vehicle (sec)
A	<10
B	> 10 and < 20
C	> 20 and < 35
D	> 35 and < 55
E	> 55 and < 80
F	> 80

HCM EXHIBIT 19-1	
Unsignalized Level of Service	Average delay per Vehicle (sec)
A	<10
B	> 10 and < 15
C	> 15 and < 25
D	> 25 and < 35
E	> 35 and < 50
F	> 50

The LOS analysis was completed through the use of Synchro, Version 7. The software package categorizes the LOS based on HCM methodology and criteria. According to industry standards, any signalized intersection or any approach of an unsignalized intersection is considered acceptable if average delay is at LOS D or better with the LOS A representing little or no delay. Any signalized intersection or approach with a LOS of E or F is considered substandard and may need improvements to improve the operational performance.

The following table (**Table 4-1**) shows the results for the existing traffic conditions analysis during all three time periods (AM, Mid-Day, and PM) when traffic counts were taken:

Table 4-1 | Existing (2011) Conditions: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)*	22.9	C	11.3	B	19.9	C
Lake Road (NC 56) & Durham Avenue (US 15/NC 56)	157.0	F	131.0	F	525.1	F
Wilton Avenue (NC 56) & Main Street (NC 50)	18.1	B	11.4	A	36.3	C
Lake Road & Main Street (NC 50)*	16.7	C	10.8	B	14.2	B

* - Designates Unsignalized intersection. Delay Represents the Highest Delayed Movement for the Intersection

As shown in **Table 4-1**, three of the four intersections were determined to be operating at acceptable levels of service during all time periods. At the signalized intersection of Lake Rd. and Durham Ave. the level of service was worse than D during all three time periods. It was determined through this analysis that the main cause of the delay at this intersection involved the split phasing of the signal timing, based on the lane configuration. Split phasing is used at this signal because the eastbound approach has a shared left-through lane. This lane assignment will not allow for eastbound and westbound lefts to be completed during the same phase of the signal cycle, as the through movement would create a conflict with the opposing left turns. This causes the green time at the intersection for the eastbound and westbound through movements to be split into different phases. The eastbound through and left movements are shared in part because of geometry at the intersection and the proximity of existing buildings to this intersection on the northwest and southeast corners.

4.3 Existing (2011) Conditions With Potential Improvements

Due to the deficiencies at the Lake Rd. and Durham Ave. intersection, potential improvements were studied to determine if conditions could be improved. The first improvement scenario included the rearranging of lane assignments on the east bound approach at the intersection. If the eastbound left turn was separated from the through movement, the green time could be reassigned and would improve the intersection operation. In order for this to work, the geometry at the intersection would need to change to align the through movements.

The second improvement scenario was the installation of roundabouts at both the Wilton Ave. & Durham Ave. and Lake Rd. & Durham Ave. intersections. The inclusion of a roundabout would have many benefits, especially for the three-legged intersection at Wilton Ave. and Durham Ave. A roundabout would create a gateway type feature for the City of Creedmoor from the north on Durham Ave. (US 15), a route used by many to enter the City. A roundabout would also potentially reduce delay and related emissions by allowing vehicles to proceed at a slower yield condition than at a stopped condition. This would also act as a traffic calming device for vehicles entering the downtown area as well as a way to assist pedestrian movements. This analysis was completed by using Sidra Intersection, Version 5, which is the preferred software package of NCDOT for roundabout analyses. The HCM criteria for level of service for roundabouts is the same as the criteria for an unsignalized intersection and is found as Exhibit 21-1 in the HCM.

Table 4-2 illustrates the findings for the two improvement scenarios for the 2011 Existing With Improvements Conditions. **Table 4-2** shows the operational improvement associated with the proposed modifications (lane additions or roundabouts). The potential improvements would bring the intersection at Lake Rd. and Durham Ave. to a satisfactory level of service, with the roundabouts offering the greatest operational improvement and the least delay.

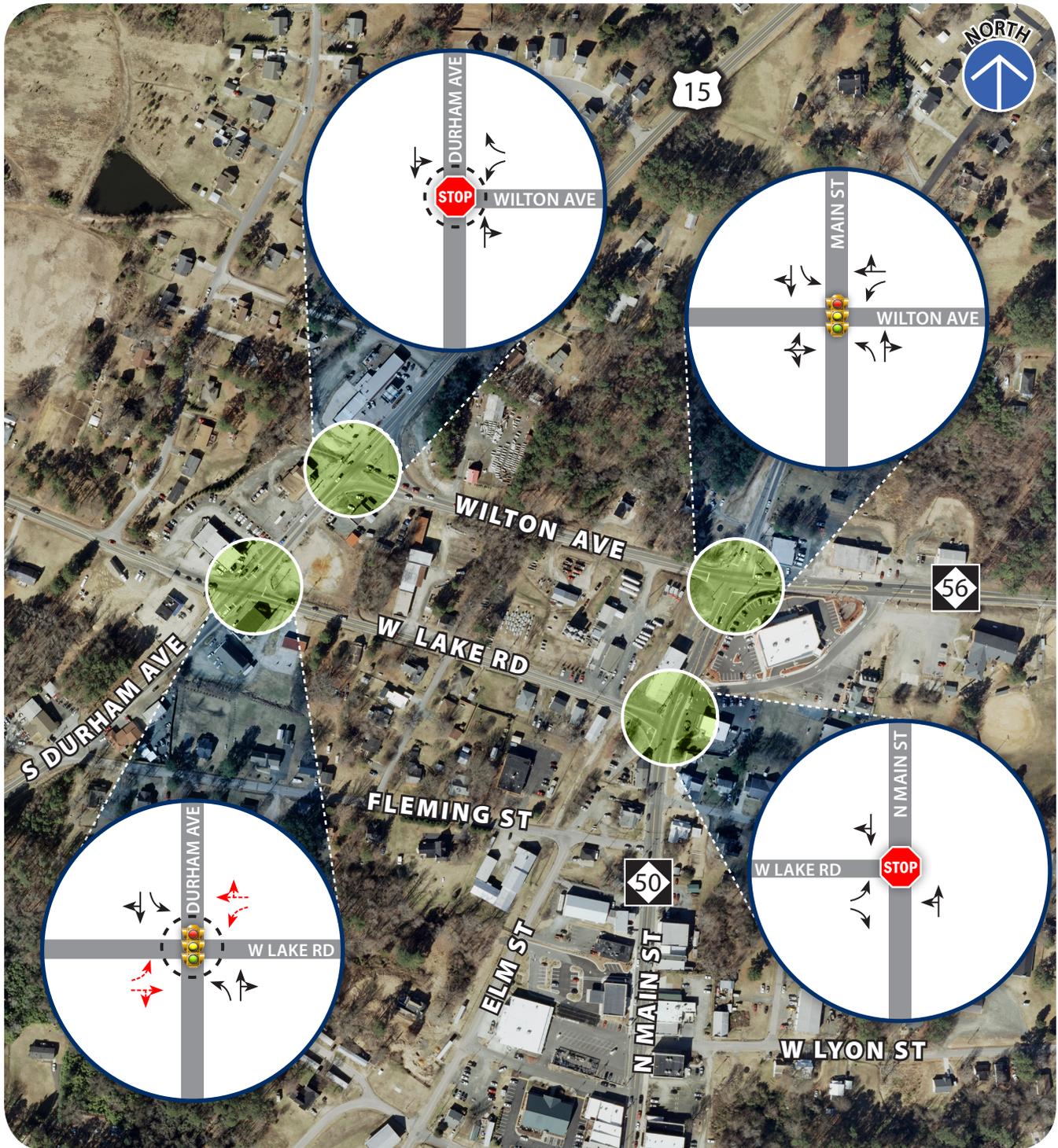
Table 4-2 | Existing (2011) Conditions With Potential Improvements: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Lake Road (NC 56) & Durham Avenue (US 15/NC 56) – Improved by change in lane arrangement and removal of split phasing	29.3	C	17.1	B	26.7	C
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)* – Single Lane Roundabout	10.1	B	9.1	A	8.9	A
Lake Road (NC 56) & Durham Avenue (US 15/NC 56)* – Single Lane Roundabout	7.7	A	7.8	A	9.5	A

* - Designates Unsignalized intersection. Delay Represents the Highest Delayed Movement for the Intersection

Figure 4-4 on the following page illustrates the proposed laneage to bring the study area up to a satisfactory level of service:

Figure 4-4 | Improvement Scenario 1 / Scenario 2 Laneage



Legend:

-  Existing Laneage
-  Signalized Intersection
-  Location for Potential Roundabouts
-  Proposed Laneage
-  Unsignalized Intersection

4.4 Existing (2011) Conditions With Potential Improvements - One-Way Pair Scenario

Besides the use of roundabouts, the project team evaluated an innovative solution that would not only enhance the operations of the intersections within the study area, but would also have other benefits such as space within the right-of-way for future utilities, greenways, and bike lanes. The solution that was developed included converting the east-west roadways in the study area to a one-way pair.

The one-way pair scenario would convert both Wilton Ave. and Lake Rd. into one-way streets in the study area, effectively creating a City block. The traffic patterns, as observed in the field, indicate this type of behavior by the drivers using these roadways already exists. Main St. and Durham Ave. would stay at a two-way operations, while Lake Rd. would run one-way eastbound and Wilton Ave. would run one-way westbound. **Table 3-3** illustrates the results for the 2011 one-way pair scenario analysis.

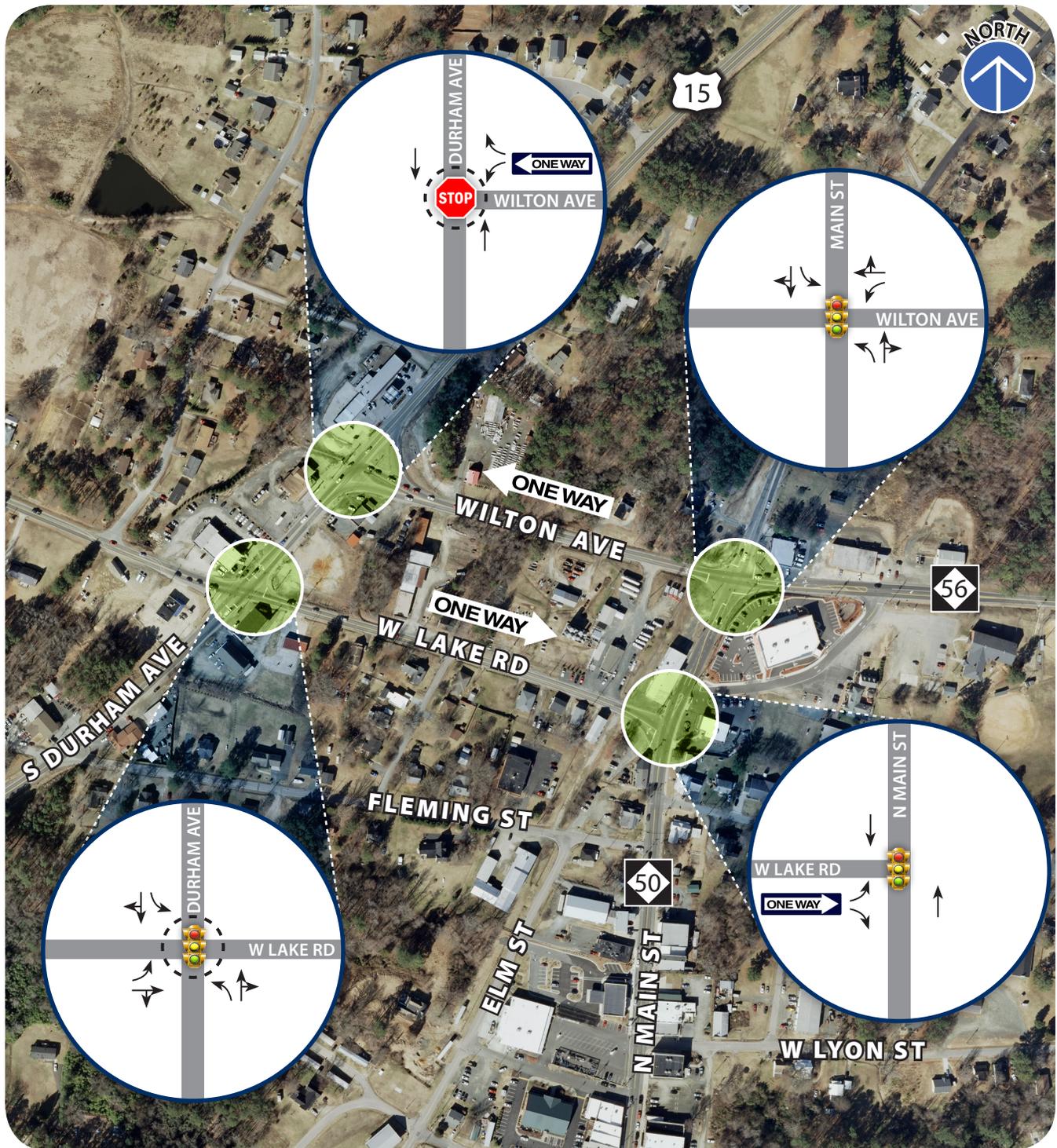
Table 4-3 | Existing (2011) Conditions With Potential Improvements – One-Way Pair Scenario: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)*	39.1	E	11.6	B	17.6	C
Lake Road (NC 56) & Durham Avenue (US 15/NC 56)	15.9	B	11.5	B	16.8	B
Wilton Avenue (NC 56) & Main Street (NC 50)	20.3	C	11.4	B	21.6	C
Lake Road & Main Street (NC 50)*	270.6	F	13.6	B	657.0	F
Lake Road & Main Street (NC 50) – Signalized	13.0	B	8.6	A	25.9	C
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)* – Single Lane Roundabout	12.0	B	10.7	B	11.1	B

* - Designates Unsignalized intersection. Delay Represents the Highest Delayed Movement for the Intersection

The two locations where there are deficiencies within this scenario include the intersections of Wilton Ave. and Durham Ave. as well as Lake Rd. and Main St., both unsignalized intersections. Further analysis shows that placing a signal at Lake Rd. And Main St. will immensely help the operation as well as also help sight distance issues and pedestrian movements. At Wilton Ave. and Durham Ave., while a LOS of E is less than standard, it is often common at unsignalized intersections. However, inclusion of a roundabout at this intersection will improve the operation as well as have the benefits discussed in the previous section. This scenario would provide improvement at Durham Ave. and Lake Rd. as the existing laneage would not need to be revised due to the existing split phase signalization. **Figure 4-5** illustrates the proposed laneage in the study area for the 2011 One-Way Pair Scenario.

Figure 4-5 | Existing (2011) Conditions With Potential Improvements Laneage (One-Way Pair Scenario)



Legend:

- Existing Laneage
- Signalized Intersection
- Location for Potential Roundabouts
- Proposed Laneage
- Unsignalized Intersection
- One-Way Street

4.5 Design Year (2040) No-Build Conditions

Since this report is leading to the 2040 Long Range Transportation Plan, the project team developed scenarios for the 2040 design year within the study area. Traffic projections were needed for the turning movements for the intersections. After discussions with the Planners at CAMPO and reviewing the Capital Area Regional Model, the project team decided that a straight line annual growth of 3% would be used to develop 2040 traffic projections. The 3% growth is in line with the standard being used in the CAMPO area as well as represents the growth within Creedmoor itself.

Table 4-4 shows the results of 2040 future no-build analyses (using existing roadway conditions):

Table 4-4 | Design Year (2040) No-Build Conditions: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)*	Err	F	50.3	F	Err	F
Lake Road (NC 56) & Durham Avenue (US 15/NC 56)	685.5	F	606.7	F	1648.9	F
Wilton Avenue (NC 56) & Main Street (NC 50)	251.2	F	20.9	C	431.9	F
Lake Road & Main Street (NC 50)*	Err	F	30.1	D	Err	F

* - Designates Unsignalized intersection. Delay Represents the Highest Delayed Movement for the Intersection

Err – Output from Synchro: Demand exceeds capacity, delay cannot be calculated.

As evident in **Table 4-4**, the existing laneage (no-build) will not be able to handle the projected 2040 traffic and maintain an acceptable level of service. Delay at Lake Rd. and Wilton Ave. will exceed 27 minutes in the AM & PM peak hours, and all intersections will fail operationally in the AM & PM peak hours.

4.6 Design Year (2040) Conditions With Potential Improvements

The improvements necessary to bring all of the intersections to an acceptable LOS of D or better are included on **Figure 4-6** and the level of service results are located in **Table 4-5**. The potential improvements include:

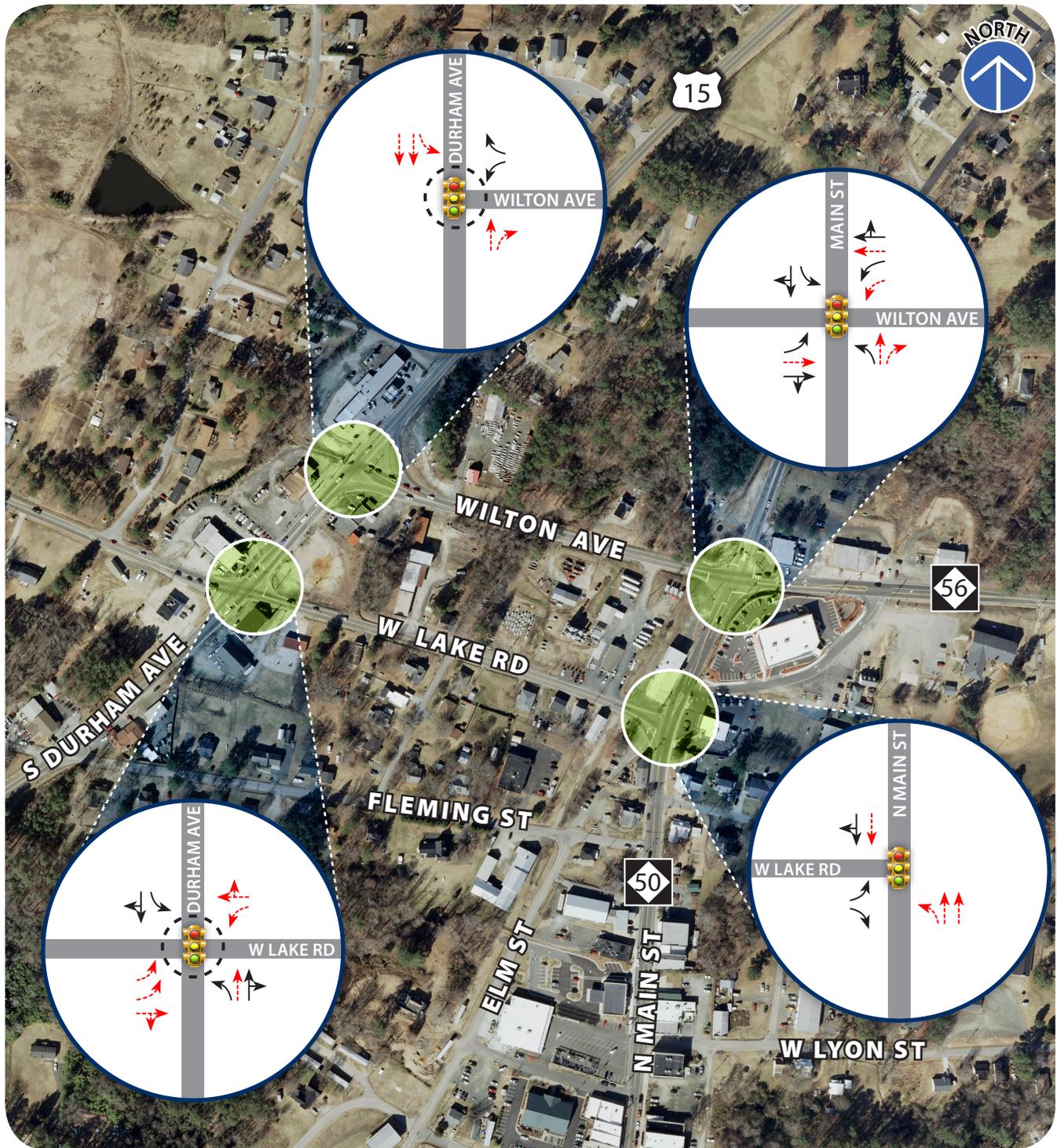
- Wilton Ave. and Durham Ave.
 - Signalize the intersection
 - Northbound Durham Ave.: exclusive right-turn lane
 - Southbound Durham Ave.: exclusive left-turn lane and an additional through lane
 - **OR** single-lane roundabout (no signal and no other laneage improvements)
- Lake Rd. and Durham Ave.
 - Northbound Durham Ave.: Additional through lane
 - Eastbound Lake Rd.: Exclusive Dual-left turn lanes and combine the through and right turns into a lane
 - Westbound Lake Rd.: Exclusive left-turn lane
 - **OR** Double-Lane Roundabout (would include 2 through lanes on Durham Ave., a 2 lane approach on eastbound Lake Rd., and removal of the signal)
- Wilton Ave. and Main St.
 - Northbound Main St.: Exclusive through lane and exclusive right-turn lane
 - Eastbound Wilton Ave.: Exclusive through lane
 - Westbound Wilton Ave.: Exclusive through lane and an additional exclusive left-turn lane to create dual-left lanes
- Lake Rd. and Main St.
 - Signalize the intersection
 - Northbound Main St.: Exclusive left-turn lane and 2 through lanes
 - Southbound Main St.: Exclusive through lane

The effect of dual roundabouts along Durham Ave. was also analyzed similarly to the 2011 scenario 2. The dual roundabouts show a marked improvement over the no-build scenario as well as necessary improvements to achieve the acceptable levels of service.

Table 4-5 | Design Year (2040) Conditions with Potential Improvements: Level Of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56) – Improved	29.8	C	17.1	B	22.5	C
Lake Road (NC 56) & Durham Avenue (US 15/NC 56) – Improved	52.1	D	29.1	C	39.5	D
Wilton Avenue (NC 56) & Main Street (NC 50) – Improved	44.9	D	28.1	C	38.3	D
Lake Road & Main Street (NC 50) – Improved	45.9	D	28.0	C	29.8	C
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56) – Single Lane Roundabout	42.4	D	7.7	A	9.8	A
Lake Road (NC 56) & Durham Avenue (US 15/NC 56) – Double Lane Roundabout	13.8	B	10.0	B	53.0	D

Figure 4-6 | Existing (2011) Conditions with Potential Improvements Laneage



Legend:

- ← Existing Laneage
- Proposed Laneage



Signalized Intersection



Unsignalized Intersection



Location for Potential Roundabouts

Figure 4-6 shows that improvements are necessary at all 4 intersections in the study area by 2040. While the projections show a large increase in traffic within the study area, it does not show any effect from the proposed Creedmoor Connector project (NC 56 By-Pass). The project team anticipates the Creedmoor Connector will impact the future traffic travelling through this area by diverting some traffic to the new corridor.

4.7 Design Year (2040) One-Way Pair Scenario

The project team analyzed the effect of installing the one-way pair scenario (similar to the 2011 Existing Analysis scenario 3) with the 2040 traffic projections. **Table 4-6** summarizes the results of this analysis:

Table 4-6 | Design Year (2040) One Way Pair Scenario: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56)*	Err	F	157.2	F	787.7	F
Lake Road (NC 56) & Durham Avenue (US 15/NC 56)	188.3	F	35.0	C	177.5	F
Wilton Avenue (NC 56) & Main Street (NC 50)	247.3	F	22.2	C	385.8	F
Lake Road & Main Street (NC 50)*	Err	F	931.0	F	Err	F

* - Designates Unsignalized intersection. Delay Represents the Highest Delayed Movement for the Intersection
 Err – Output from Synchro: Demand exceeds capacity, delay cannot be calculated.

Table 4-6 displays much of the same deficiencies in the study area as with the 2040 no-build. For the intersections to achieve an acceptable level of service, additional improvements would be necessary. Those improvements include:

- Wilton Ave. and Durham Ave.
 - Signalize the intersection
 - Westbound Wilton Ave.: Additional Exclusive left-turn lane to create dual-left lanes
 - **OR** double-lane roundabout (no signal)
- Lake Rd. and Durham Ave.
 - Northbound Durham Ave.: Exclusive right-turn lane
 - Southbound Durham Ave.: Exclusive right-turn lane
 - Eastbound Lake Rd.: Exclusive left turn lane and an exclusive through lane
- Wilton Ave. and Main St.
 - Northbound Main St.: An additional left-turn lane to create dual-left lanes and an additional right-turn lane to create dual-right lanes

- o Westbound Wilton Ave.: Exclusive through lane and an additional exclusive left-turn lane to create dual-left lanes
- Lake Rd. and Main St.
 - o Signalize the intersection
 - o Northbound Main St.: An additional through lane to create 2 through lanes
 - o Southbound Main St.: An additional through lane to create 2 through lanes
 - o Eastbound Lake Rd.: An additional left-turn lane to create dual-left lanes

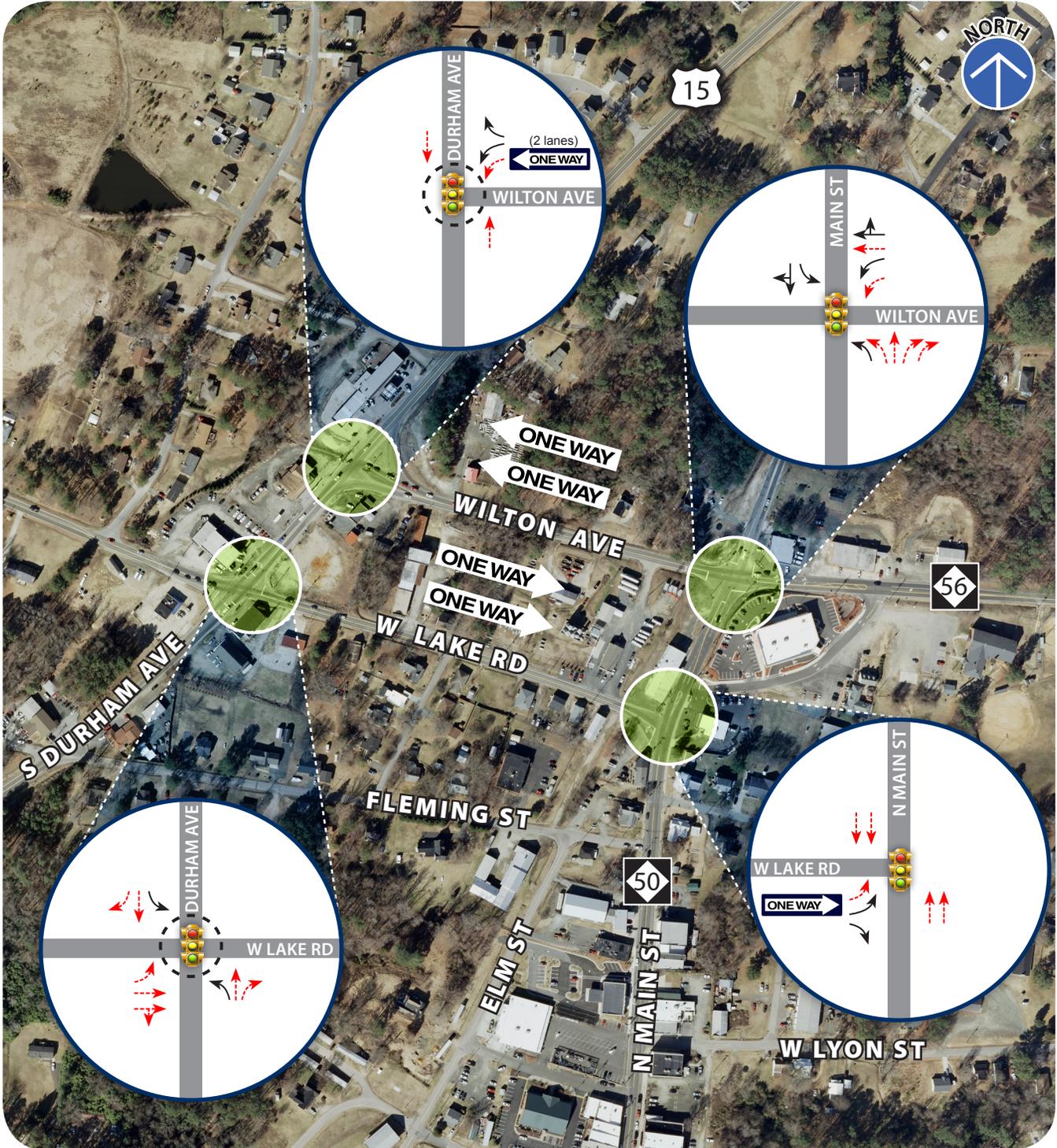
A roundabout at Wilton Ave. and Durham Ave. was included in the analysis, which shows it can be still used in tandem with the one-way pair scenario. **Table 4-7** shows the results from the analysis when all of the improvements in **Figure 4-7** are installed.

Table 4-7 | Design Year (2040) One Way Pair Scenario With Potential Improvements: Level of Service

INTERSECTION	AM PEAK HOUR		MIDDAY PEAK HOUR		PM PEAK HOUR	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56) – Improved	18.4	B	16.7	B	17.0	B
Lake Road (NC 56) & Durham Avenue (US 15/NC 56) – Improved	30.1	C	17.9	B	46.6	D
Wilton Avenue (NC 56) & Main Street (NC 50) – Improved	34.4	C	25.8	C	22.0	C
Lake Road & Main Street (NC 50) – Improved	13.2	B	22.8	C	37.0	D
Wilton Avenue (NC 50/NC 56) & Durham Avenue (US 15/NC 56) – Double Lane Roundabout	29.1	C	11.5	B	14.1	B

As shown in **Figure 4-7**, the one-way pair scenario will work with 2040 projected traffic if the one-way pairs are both 2 lanes. This is caused by the long storage areas for turn lanes at the signalized intersections as well as receiving lanes for dual movements. This also does not show the effect of the possible Creedmoor Connector, which will impact the future traffic travelling through this area by diverting some traffic to the new corridor.

Figure 4-7 | Design Year (2040) One Way Pair Scenario With Potential Improvements Laneage



Legend:

-  Existing Laneage
-  Signalized Intersection
-  Location for Potential Roundabouts
-  Proposed Laneage
-  Unsignalized Intersection

4.8 Capacity Analysis Conclusion

The project team completed the following capacity analyses:

1. Existing (2011) Conditions (with existing laneage)
2. Existing (2011) With Potential Improvements
 - a. Improvements at Durham Ave. and Lake Rd. intersection
 - b. Dual Single-Lane Roundabouts: Roundabouts at the two intersections along Durham Ave.
3. Existing (2011) Conditions With One-Way Pairs
 - a. Conversion of Lake Rd. (eastbound) and Wilton Ave. (westbound) to one-way pairs
 - b. Including a single-lane roundabout at Durham Ave. and Wilton Ave.
4. Design Year (2040) No-Build Conditions
5. Design Year (2040) Conditions With Potential Improvements
 - a. Improvements at all intersections
 - b. Dual Roundabouts: Single-Lane Roundabout at Durham Ave. and Wilton Ave. and a Double-Lane Roundabout at Durham Ave. and Lake Rd.
6. Design Year (2040) Conditions With One-Way Pairs
 - a. Conversion of Lake Rd. (eastbound) and Wilton Ave. (westbound) to 2 lane one-way pairs
 - b. Including a double-lane roundabout at Durham Ave. and Wilton Ave.



Vehicles traveling eastbound along Wilton Ave. With the installation of one-way pairs, traffic would only travel westbound on this section of roadway.

The Existing (2011) Analysis shows that there is currently one deficiency in the study area. The intersection of Durham Ave. (US 15) and Lake Rd. (NC 56) is currently operating at a level of service F during all periods analyzed. The deficiency is primarily caused by the necessity of a shared through-left lane on the eastbound approach due to geometric issues at the intersection. The shared lane causes the signal to operate as a split phase signal where instead of east and west through movements sharing green time, the eastbound through chares green with the eastbound left, while the westbound through is held at red. This causes longer red times for all movements and creates additional delay from an operational standpoint.

Two scenarios (Existing (2011) With Potential Improvements) were analyzed to address this deficiency. The first scenario involved improving the geometry of the intersection to create a stand alone eastbound left-turn lane. This would remove the split phase from the signal and make it more efficient. This would include major improvements at the intersection to make the geometry work, and may involve widening of Lake Road and or purchasing right of way at this intersection, where the buildings are close to the road.

The installation of one-way pairs for the east-west roadways was also analyzed. This would include the conversion of Lake Rd. to east only traffic (from Durham to Main) and Wilton Ave. to west only traffic (from Main to Durham). The conversion to one-way pairs will improve the operations within the study area, and eliminate the need for an additional turn lanes at the intersection of Durham Ave. and Lake Rd. and the associated potential need for additional right of way. The one-way pairs would each have one lane which would provide right-of-way to be used for utilities, greenways, and bike lanes. The one-way pair can also be used in tandem with a roundabout at Durham Ave. and Wilton Ave. to further reduce delay and improve operations. A signal will need to be added at Main St. and Lake Rd. for some additional costs, but a signal at this intersection will also improve sight distance issues and pedestrian movements. Whether or not the one-way pair is used, using dual roundabouts, as evidenced in the capacity analysis, is an option with a second roundabout located at Durham Ave. and Lake Rd. A roundabout at this location, contrary to the roundabout at Durham Ave. and Wilton Ave. will most likely involve right-of-way acquisition as part of the construction.

Since this report is leading to development of the 2040 LRTP, the project team also looked at scenarios using traffic projections to 2040. The traffic projections were determined by using a straight line growth rate for the study area of 3%, as discussed and agreed to by CAMPO. The increase in traffic for the 2040 design year showed deficiencies at all 4 intersections. Major improvements would be needed as well as signalization at each of the four analyzed intersections to keep up with the proposed traffic growth. The traffic projections are conservative as they do not take into account the effect of the proposed Creedmoor Connector (NC 56 By-Pass) project, which may impact the levels of traffic in 2040 by diverting traffic to the new corridor.

In conclusion, the conversion of the east-west streets within the study area to one-way pairs will operate at acceptable levels of service at the present time without needing to change geometry at any intersection. The one-way pairs will also create opportunities of the inclusion of other modes to produce complete streets within the study area. The inclusion of a roundabout at Durham and Wilton to the one-way pairs will benefit the City as both a gateway to the City and as a centerpiece to future development. It is recommended that as part of the development of the Creedmoor Connector, that these intersections are reviewed again if and when that corridor is constructed.

5.0 Access Management

Ensuring proper access management serves as a critical component in roadway operation and safety improvements. Access management entails the provision of safe and efficient access points between adjacent land uses and the roadway network. Techniques applied in access management include the construction of site driveways, reconfiguration or consolidation of existing driveways, construction of median break locations, and improvements made to site frontages including planter strips that provide separation between pedestrians and roadway traffic.



TNT Grill frontage on Durham Ave. (US 15)

Access management facilitates linkages between the land use and transportation system, which provides several benefits. These include improved roadway safety, reduced congestion, improved air quality, and enhanced aesthetic appeal of roadway corridors. Improvements to access management also provide benefits to surrounding businesses, which can include increases in site visibility as well as enhanced curbside appeal.

5.1 Access Management Recommendations

Improvements made in access management play a vital role in the operational and safety recommendations for the four intersections in the study area. The proposed recommendations in access management were crafted following consultation with existing NCDOT access management policies and practices.

Following an evaluation of access across the study area, two areas for proposed recommendations were identified. These included the western portion of Durham Ave. between Lake Rd. and Wilton Ave. as well as the northern portion of Wilton Ave. east of Main St.

5.1.1 Durham Ave.

Access management improvements are proposed for the southern portion of Durham Ave. between Lake Rd. and Wilton Ave. (See **Figure 5-1**). An evaluation of existing conditions revealed generally poor access management practices. These included poor sight visibility from the Andrews Ford driveway, existing crash data revealing accidents occurring at the Andrews Ford driveway site, and an absence of site frontage that creates no delineation between the roadway and parking area for the TNT Grill.

Figure 5-1 | Access Management on Durham Ave.



Legend:  Planting Strip
 Controlled Access Location

These existing access management deficiencies present numerous operational and safety challenges along Durham Ave. The following recommendations aim not only to improve access management along Durham Ave. but also improve the operation and safety of the Durham Ave and Wilton Ave. and Durham Ave. and Lake Rd. intersections (See **Figure 5-1**):

- Construction of a planting strip in front of the Andrews Ford and TNT Grill complexes in order to improve the delineation between the roadway and site frontages.
- Provision of enhanced landscaping, such as street trees, along the planting strip that complement planned investments in sidewalk infrastructure and improve area walkability.
- Consolidation of existing driveways in order to promote shared access points between the Andrews Ford and TNT Grill.

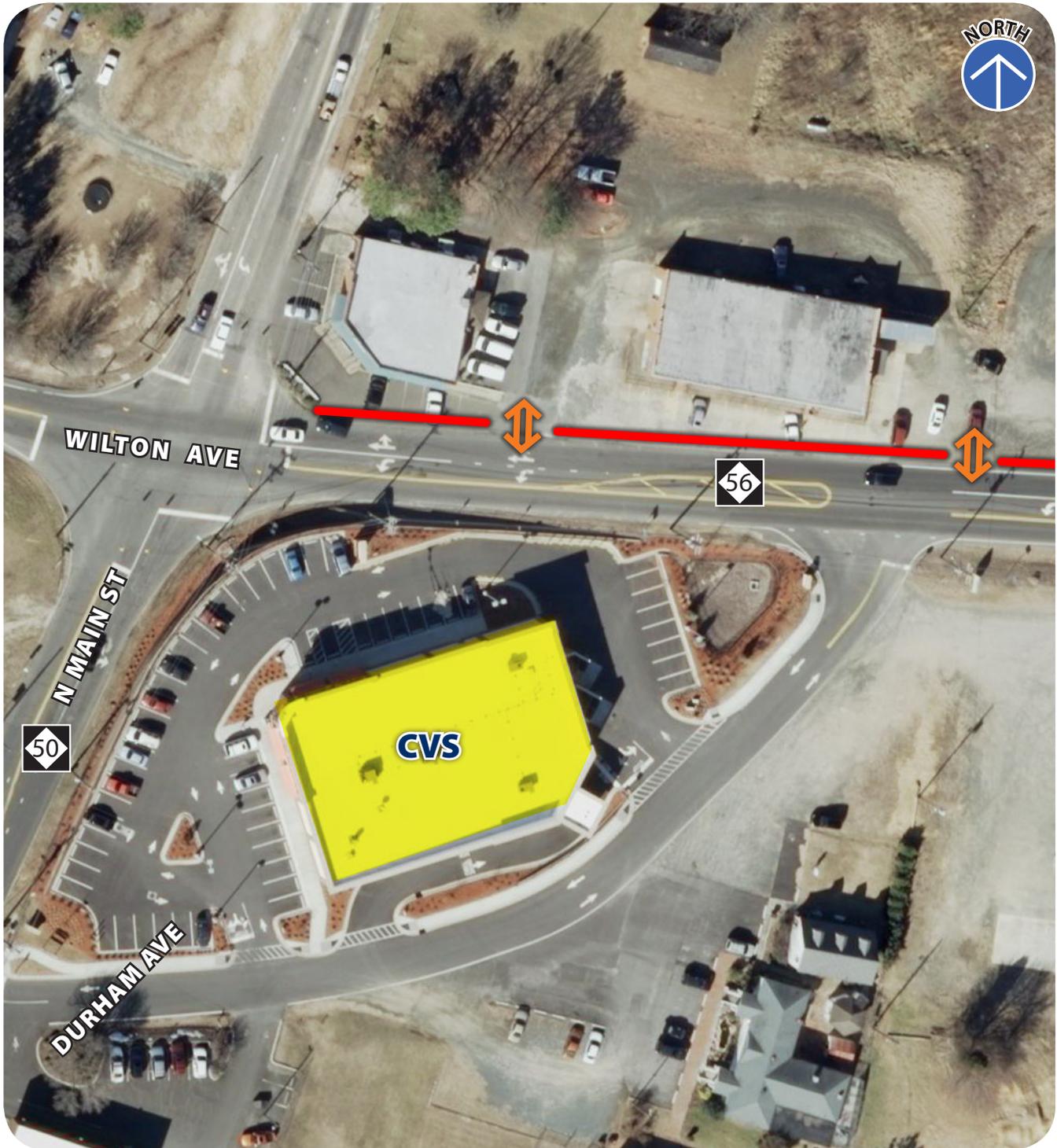
5.1.2 Wilton Ave.

Improvements in access management are also proposed for the northern portion of Wilton Ave. east of Main St. (See **Figure 5-2**). Existing conditions along the northern portion of Wilton Ave. reveal generally poor access management practices. An absence of site frontage along Wilton Ave. creates no delineation between the roadway and parking area for the two commercial strip shopping centers. In addition, current parking practices allow vehicles to park immediately perpendicular to the roadway. Both conditions create potential roadway hazards by increasing the number of conflict points with vehicles traveling along Wilton Ave.

Such deficiencies in access management present numerous operational and safety challenges along Wilton Ave. The following recommendations aim to improve access management along Wilton Ave., and also improve the operation and safety of the Main St. and Wilton Ave. intersection (See **Figure 5-2**):

- Construction of a planting strip along Wilton Ave. in order to improve the delineation between the roadway and the site frontages of the two commercial strip shopping centers.
- Provision of enhanced landscaping, such as street trees, along the planting strip that complement planned investments in sidewalk infrastructure and improve area walkability.
- Consolidation of existing driveways in order to promote shared access points between the two commercial strip shopping centers.
- Replacement of perpendicular parking practices with creation of on-street parking facilities along Wilton Ave. and moving on-site parking to the side or rear of the buildings.
- Complement on-street parking, planting strip, and sidewalk additions with a reduction in the speed limit along Wilton Ave. from 35 MPH to 20 MPH.

Figure 5-2 | Access Management on Wilton Ave.



Legend:  Planting Strip
 Controlled Access Location

6.0 Recommendations

The information gathered from each component of the Creedmoor Intersection Feasibility and Impact Analysis, including existing and future traffic conditions, environmental and cultural impacts, crash data analyses, and access management assessments aided in identifying a wide range of innovative solutions for the four intersections. These solutions include both low-cost near term options as well as future higher cost options encompassing the study area. Based on these considerations, the following recommendations are made:

6.1 Near-Term Intersection Improvements

Durham Ave. (US 15) and Lake Rd. (NC 56):

- When sidewalks are added to the cross streets, provide ADA compliant pedestrian crossings and amenities, such as timed signal crossings and clearly marked crosswalks, in an effort to slow vehicular speed along Durham Ave.
- Improve the sight distance along the western portion of Durham Ave. especially for vehicles traveling east along Lake Rd. Field observations revealed roadway signage, utility poles, and vehicles parked in front of the Andrews Ford site as potential obstructions. The additional right-of-way required for the planned construction of sidewalks, as well as the implementation of access management improvements shown in **Figure 5-1**, should be used as mechanisms to improve the sight distance for drivers along Lake Rd.



Durham Ave. and Lake Rd.

Durham Ave. (US 15) and Wilton Ave. (NC 56):

- When sidewalks are added to the cross streets, provide ADA compliant pedestrian crossings and amenities, such as clearly marked crosswalks, in an effort to slow vehicular speed along Durham Ave. and provide complete streets.
- Improve pavement markings along Durham Ave. and Wilton Ave. as well as signage. Some of the NC 50 and NC 56 signs do not have cardinal directions included on the sign. Include those directions on the sign.

Main St. (NC 50) and Lake Rd.:

- When sidewalks are added to the cross streets, provide ADA compliant pedestrian crossings and amenities including timed signal crossings (if a signal is installed) and clearly marked crosswalks.
- Reduce speed limits along Lake Rd. from 35 MPH to 20 MPH.
- Add reflective sheeting to increase visibility of the eastbound Lake Rd. stop sign.

- Improve pavement markings on the Lake Rd. approach at Main St. to create a perpendicular intersection. Add a small median of about 50 feet along Lake Rd. at the intersection to delineate two-way movement and create a pedestrian refuge within the crosswalk. Since this leg of the intersection is fairly wide, consider moving the curb in for a smaller cross-section.



Main St. and Lake Rd.

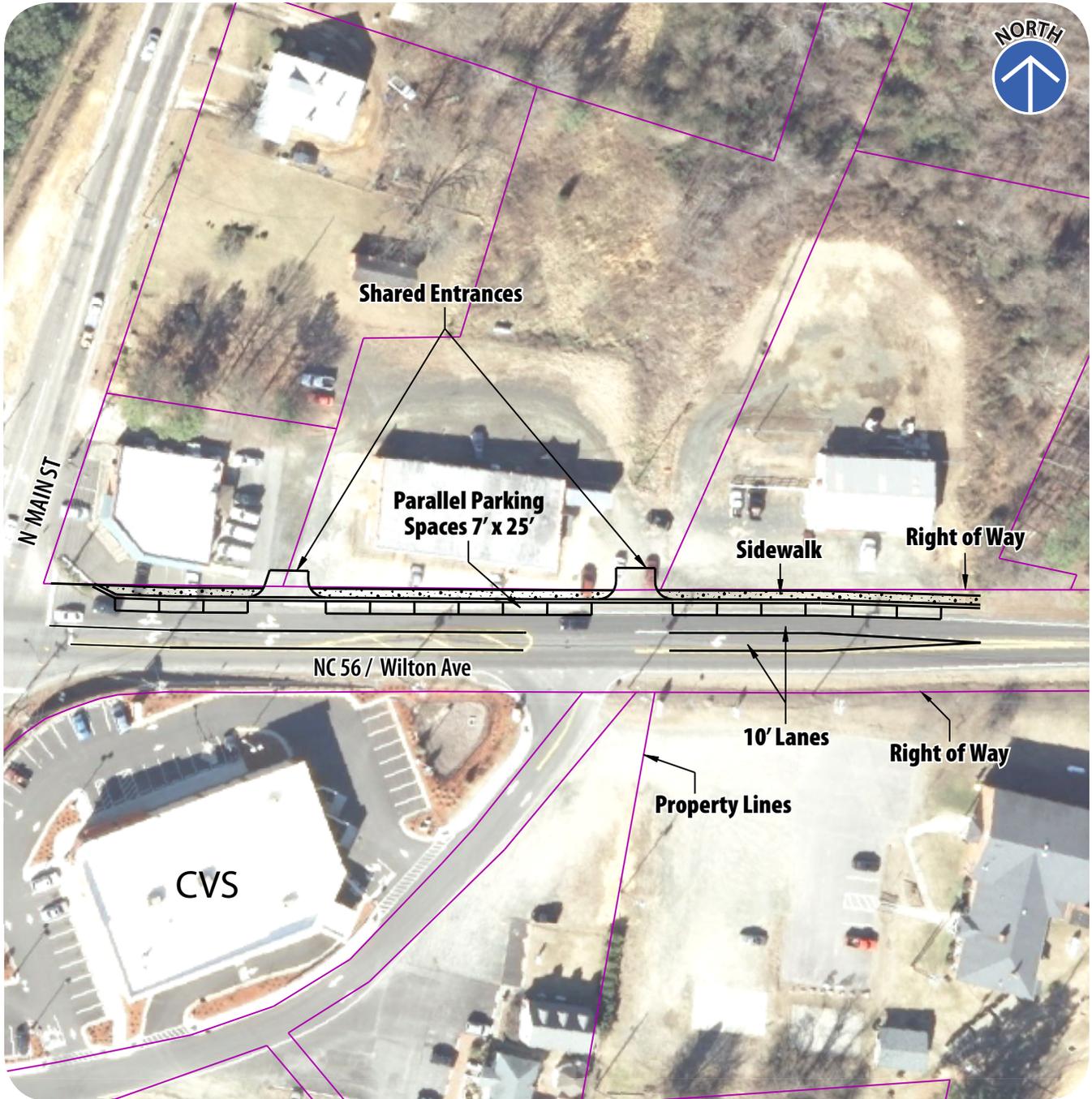
Main St. (NC 50) and Wilton Ave. (NC 56):

- When sidewalks are added to the cross streets, provide ADA compliant pedestrian crossings and amenities including timed signal crossings and clearly marked crosswalks.
- Reduce speed limits along Wilton Ave. from 35 MPH to 20 MPH. Include on-street parking and sidewalk. Improve access management by doing the following: (See **Figure 6-1**)
 - o Reduce the number of entrances and encourage shared entrances
 - o Remove the perpendicular parking in front of the businesses along Wilton Ave. east of Main St. and encourage parking in the side or rear of the businesses
 - o Provide on-street parallel parking (this involves narrowing the westbound through and left turn lanes to 10 feet)
 - o Provide sidewalk along the frontage next to the parallel parking spaces
- Field observations revealed potential sight obstructions, due to above-grade landscaping features and highway signage, at the northwest corner of the intersection. These observed sight obstructions impact vehicles attempting a westbound right onto Main St. Potential solutions include implementation of the one-way pair scenario or restricting both eastbound and westbound rights during red signal phases.
- Signage improvements would include the ending/beginning of NC 50 at this intersection. It is confusing to the driver that NC 50 makes a turn onto Wilton Ave. and then ends. Ending NC 50 at NC 56 would give NC 50 a logical ending/starting point for motorists.



Main St. and Wilton Ave.

Figure 6-1 | Access Management on Wilton Ave. (Including On-Street Parking and Sidewalk)



6.2 Near-Term Roadway Improvements for the Study Area

One-way pair scenario for Wilton Ave. and Lake Rd.:

The project team recommends construction of a one-way pair for Wilton Ave. and Lake Rd. Construction of the one-way pair would involve converting Wilton Ave. and Lake Rd. into one-way streets consisting of one lane each. Based on travel pattern observations made in the field, implementation of a one-way pair scenario would effectively create a City block among the four intersections. Several benefits would result with construction of the one-way pair. These include alleviating capacity concerns as well as improving general traffic flow throughout the study area. Furthermore, a one-way pair would provide additional right-of-way space, which could be used for the construction of greenways/sidewalks/bike lanes to facilitate bicycle and pedestrian movements.

Roundabout construction for the Durham Ave. and Wilton Ave. intersection:

The project team recommends construction of a roundabout for the Durham Ave. and Wilton Ave. intersection. Construction of a roundabout would provide numerous benefits for the study area as well as the City of Creedmoor. A roundabout at Durham Ave. and Wilton Ave. would improve traffic flow and circulation across the study area. In addition, since Durham Ave. is a major travel corridor into the City, the roundabout could serve a placemaking purpose and act as a gateway into the City of Creedmoor. The capacity analysis also showed that using this in tandem with either the one-way pair scenario or a possible roundabout at Durham Ave. and Lake Rd. will also improve the operation significantly. The inclusion of dual roundabouts sets up a centerpiece or showcase for the City for new development much like it has done in other places such as Davidson, NC.

See **Figure 6-2** for Preliminary Roundabout Design at Durham Ave. and Wilton Ave. The figure shows a two-lane roundabout for future expansion.

6.3 Long-Term Improvements for the Study Area

A straight line growth of 3% was used to create traffic projections for 2040 design year. The 2040 capacity analysis shows that even with the creation of one-way pairs, there are still many deficiencies. The one-way streets will need to be improved from one lane to two lanes and many other operational and geometric improvements will need to be included. Also, the roundabout at Durham Ave. and Wilton Ave. will need to be converted to a two-lane roundabout. While all of these improvements may be necessary, the analysis was conservative because it did not include the effect of the proposed Creedmoor Connector project (NC 56 By-Pass).

Figure 6-2 | Roundabout at Durham/Wilton



6.4 Potential Network Improvements

In addition to the 2040 improvements, the project team suggests other possible routes for NC 56 (See **Figure 6-3**) to improve network conditions. At the moment, to stay on NC 56 from either direction, the traveler must make two turns. These network improvements would make the transition through the City on NC 56 much smoother as well as create a single thoroughfare. Note that any of these improvements will also work with the one-way pair scenario.

These 2 options suggested for the NC 56 routes have been discussed throughout the history of NC 56 and have been shown on previous Transportation Improvement Programs. Option 1 is believed to be the original plan for NC 56. Option 3 would include moving Lake Rd. to the north to match up with the existing roadway behind the CVS for a transition to the east.

6.5 Funding Sources

The recommendations include combinations of roadway, bicycle, and pedestrian facility upgrades aimed at improving the operations and safety of the four intersections. Implementing these recommendations will require consideration of federal, state, and local transportation funding sources. Each potential project may be included in North Carolina's Transportation Improvement Program (TIP) or could be funded via the City of Creedmoor.

Similar small scale projects across North Carolina have utilized combinations of Federal, State, and local transportation funding sources:

6.5.1 Federal funding sources

Several potential sources of federal funding are authorized under the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Though the act expired in 2009, SAFETEA-LU has since been extended through September 2011 and is currently awaiting reauthorization by Congress.

- **Surface Transportation Program (STP) funds:**

The Surface Transportation Program includes STP-DA (direct-attributable) funds that could be used for both the construction and non-construction (pamphlets, brochures, etc.) of roadway (construction, maintenance, and widening) and non-roadway (bicycle and pedestrian) projects. Similarly, STP funds designated for Transportation Enhancements (TE) activities would provide another source of funding however these funds would be restricted to the proposed bicycle and pedestrian improvement recommendations for the study area (<http://www.fhwa.dot.gov>).

- **Congestion Mitigation and Air Quality (CMAQ) funds:**

CMAQ funds provide a source of transportation funding for projects that demonstrate quantifiable improvements to regional air quality through reductions in vehicle miles traveled (VMT). This source of funding would be restricted to the proposed bicycle and pedestrian improvement recommendations for the study area (<http://www.fhwa.dot.gov>).

Figure 6-3 | Potential Network Improvements for NC 56



- Legend:**
- Study Intersection
 - Optional Connections

- **Safe Routes to School Program (SR2S):**

The Safe Routes to School (SR2S) program promotes the health and wellness of school children by encouraging them to walk and bicycle to school. The program provides transportation funding for projects that improve walking and bicycling corridors to school locations. With Creedmoor Elementary School located along NC 56 just east of the Main St./Wilton Ave. intersection, this corridor could be eligible for pedestrian and bicycle improvements through the SR2S program.

<http://www.saferoutesinfo.org/>

- **Recreational Trails Program:**

The Recreational Trails Program provides funding for the development of motorized and non-motorized trails. This source of funding could be used for the proposed greenway paths within the study area.

<http://www.fhwa.dot.gov/environment/rectrails/>

- **Highway Safety Improvement Program (HSIP):**

The Highway Safety Improvement Program (HSIP) provides funding for traffic calming, pedestrian, and bicycle improvements. This source of funding could also be used for the installation and improvement of crossing signage.

<http://safety.fhwa.dot.gov/hsip/>

- **Land and Water Conservation Fund (LWCF):**

The Land and Water Conservation Fund (LWCF) provide federal funding for wildlife, park, and open space land acquisition. LWCF grants are often used by municipalities in the construction of park and recreation facilities, which includes funding the construction of adjacent greenway paths. This source of funding could be utilized in the construction of the proposed greenways along Wilton Ave. and Lake Rd.

<http://www.nps.gov/lwcf/>

6.5.2 State funding sources

State transportation funding involves a coordinated effort between NCDOT, regional MPO's, and local municipalities. State transportation revenue sources for roadway and non-roadway transportation improvements originate from the Highway Fund, Highway Trust Fund, and assorted federal funds. Highway Fund and Highway Trust Fund revenue streams are derived from statewide motor fuel taxes (~55%), DMV fees (~30%), and highway use taxes (~15%). Allocating funds to various transportation projects is completed through a cost/benefit prioritization process of all roadway and non-roadway projects as governed by the parameters of the TIP.

Several sources of state transportation funding could provide the necessary support for the proposed roadway, bicycle, and pedestrian improvements for the study area. For the roadway improvements on U.S. or NC Highways, NCDOT Highway

Fund and Highway Trust Fund revenues as allocated by the TIP process could be used to fund the necessary construction, maintenance, and widening costs. For roadway improvements on locally maintained streets, specifically Lake Rd., Powell Bill funds would provide coverage of these costs.

For the proposed bicycle and pedestrian recommendations, numerous statewide grant program opportunities exist that could provide additional funding for these improvements. The NCDOT Division of Pedestrian and Bicycle Transportation serves as the largest source for bicycle and pedestrian grant opportunities to support both construction and non-construction project costs. Other grant opportunities include the NCDOT Bicycle and Pedestrian Planning Grant Initiative (<http://www.ncdot.org/bikeped/planning>), North Carolina Safe Routes to School Program, North Carolina Recreational Trails Program, North Carolina Adopt-A-Trail Grant Program (<http://www.ncparks.gov>), Small Cities Community Development Block Grants (<http://portal.hud.gov>), and the North Carolina Health and Wellness Trust Fund (<http://www.healthwellinc.com>).

6.5.3 Local funding sources

Several local funding options exist that could aid in generating matching funds following the successful pursuit of federal and state revenue sources for the recommended roadway, bicycle, and pedestrian improvements. Often, local governments generate the necessary revenue to fund capital improvements through a variety of sources such as taxes, fees, bonds, and loans. Other innovative funding strategies also exist that have gained in popularity among local governments in North Carolina. These include the formation of public-private partnerships and utilizing grants from private foundations. The City of Creedmoor could pursue partnerships with local businesses and developers in order to market the potential economic, environmental, and social benefits the recommended improvements could have for their businesses and the City of Creedmoor as a whole. Seeking grants from private foundations, such as The Conservation Fund (<http://www.conservationfund.org>), could also provide additional sources of revenue to fund the recommended improvements.

6.6 Cost Estimates

The following **Table 6-1** contains cost estimates for the recommended improvements in the study area. These figures are based on preliminary designs and should be revisited at the functional design stage. The costs also assume that the costs of any utility relocation will be born by the owner.

Table 6-1 | Creedmoor Feasibility Study - Cost Estimates for Recommended Improvements

DESCRIPTION	LENGTH (FT)	ESTIMATED COST OF PLANNED IMPROVEMENTS (2011 DOLLARS)
Near-term improvements by intersection		
<u>Durham Ave. and Lake Rd.</u>		
<ul style="list-style-type: none"> • Pedestrian/Bicycle facility upgrades 		\$15,000
<u>Durham Ave. and Wilton Ave.</u>		
<ul style="list-style-type: none"> • Pedestrian/bicycle facility upgrades 		\$10,000
<ul style="list-style-type: none"> • Signage/pavement marking improvements – addition of on-street parking and sidewalk 	500	\$150,000
<u>Main St. and Lake Rd.</u>		
<ul style="list-style-type: none"> • Pedestrian/bicycle facility upgrades 		\$10,000
<ul style="list-style-type: none"> • Signage/pavement marking/curb and gutter improvements 	100	\$30,000
<u>Main St. and Wilton Ave.</u>		
<ul style="list-style-type: none"> • Pedestrian/bicycle facility upgrades 		\$10,000
Near-term improvements for the study area		
<u>One-way pair</u>		
<ul style="list-style-type: none"> • Wilton Ave. (includes signal improvements at Main St.) 	930	\$500,000
<ul style="list-style-type: none"> • Lake Rd. (includes signal at Main St. and signal improvements at Durham Ave.) 	1,020	\$600,000
<u>Roundabout</u>		
<ul style="list-style-type: none"> • Durham Ave. and Wilton Ave. 		\$300,000
Long-term improvements for the study area		
<u>Lane additions to One-Way Pairs</u>		
<ul style="list-style-type: none"> • Wilton Ave. 	930	\$500,000
<ul style="list-style-type: none"> • Lake Rd. 	1,020	\$750,000
<u>Roundabouts</u>		
<ul style="list-style-type: none"> • Durham Ave. and Wilton Ave. – lane add 		\$50,000
<ul style="list-style-type: none"> • Durham Ave. and Lake Rd. (including right-of-way taking) 		\$600,000

7.0 Conclusion

This report provides an intersection and feasibility impact analysis for NC 56/NC 50/US 15 intersections in the City of Creedmoor, NC. Both near-term and long-term improvement solutions were crafted following an in-depth investigation of existing and future traffic conditions, environmental and cultural impacts, crash data analyses, and access management assessments.

The outlined recommendations provide a foundation for the City of Creedmoor in assessing existing and future transportation conditions. These efforts will provide the City with additional insight in advance of the 2040 CTP and LRTP planning efforts. Furthermore, pursuing these recommendations will aid the City of Creedmoor's pursuit of enhancing community liveability, expanding economic development opportunity, and improving environmental quality and health.

[ITEMS TO BE INCLUDED]

Appendix A: Crash Diagrams

Appendix B: Traffic Counts

Appendix C: Capacity Analysis