

98 CORRIDOR STUDY

NC CAMPO • DCHC MPO • NCDOT

North Carolina Capital Area Metropolitan Planning Organization,
Durham Chapel Hill Metropolitan Planning Organization
& North Carolina Department of Transportation

NC 98 CORRIDOR STUDY



October 2018

CAMPO
NC Capital Area Metropolitan Planning Organization

DCHC
Metropolitan Planning Organization
Planning Tomorrow Today



ACKNOWLEDGEMENTS

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DCHC MPO
NCDOT



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Town of Wake Forest
Town of Rolesville
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NC 98 CORRIDOR STUDY REPORT

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EXECUTIVE SUMMARY

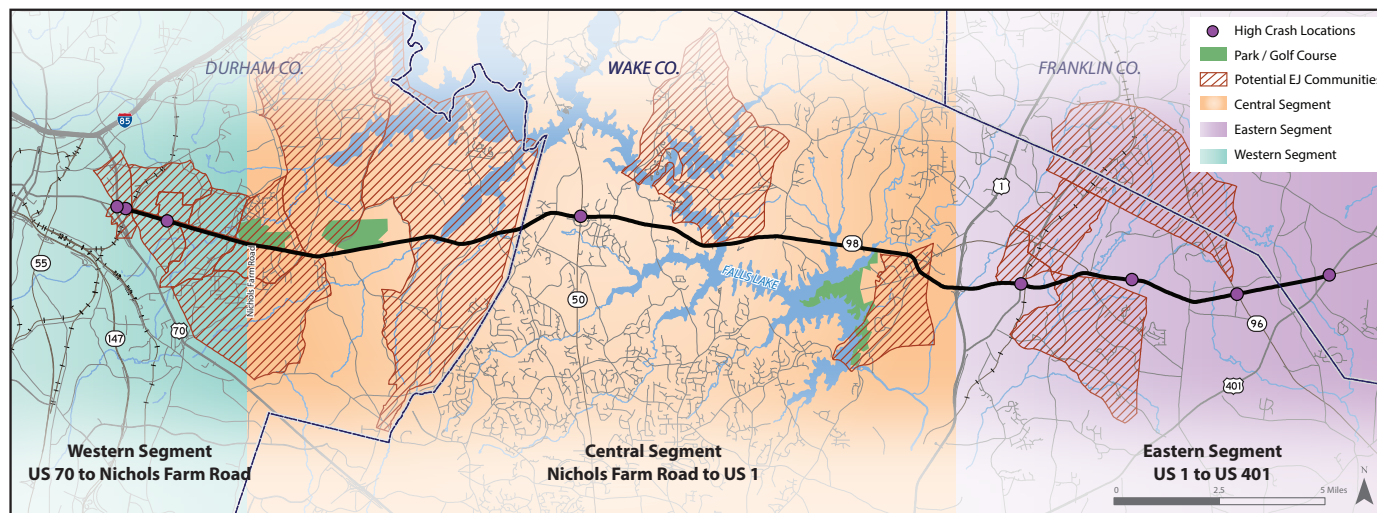
STUDY PURPOSE

The Capital Area Metropolitan Planning Agency (CAMPO) in conjunction with the Durham Chapel Hill Carrboro Metropolitan Planning Organization (DCHC MPO) and the North Carolina Department of Transportation (NCDOT) commissioned a study of the NC 98 corridor from U.S. 70, in Durham County through Wake County to U.S. 401 in Franklin County, North Carolina. This study evaluates safety and mobility, planned and existing roads, bicycle and pedestrian facilities and transit uses along NC 98 and recommends future improvements. The project study area includes approximately one-quarter mile (1/4) on either side of NC 98, but varies at critical areas. Additionally, significant destinations where commuters use NC 98 are given special attention.

STUDY CONTEXT

The NC 98 corridor is an important regional east-west transportation corridor connecting Franklin, Wake, and Durham Counties. Although NC 98 is programmed in the CAMPO and DCHC MPO 2040 Metropolitan Transportation Plan (MTP) as a 4-lane divided roadway, this study aims to develop Context Sensitive Solutions (CSS) that respect the diversity of communities and land uses along NC 98. At the beginning of the study, the corridor was divided into three segments: west, central, and east. The corridor was initially divided into segments because the different sections of the corridor varied greatly and required improvements that were sensitive to the unique characteristics of those segments. It was apparent that the more urban area of Durham would differ from the environmentally sensitive area of Falls Lake and from the more rural character near US 401. Figure 1 highlights the differences between these segments.

Figure 1: Corridor Segment Map



STUDY PROCESS

The study was conducted over an 18-month period beginning in December 2016 and ending in July 2018. A Core Technical Team (CTT), which was comprised of staff from the municipalities and counties along the corridor and staff from NCDOT, CAMPO, and DCHC who oversaw the study. In addition, there was a Study Oversight Team (SOT) comprised of elected officials, advisory board members, community members, and other relevant stakeholders. A robust public involvement process was another key component of the study process.

STUDY RECOMMENDATIONS

With support from the CTT, SOT, and the public, the conceptual designs presented at the last round of public meetings were established as the recommended improvements for NC 98. The recommendations were separated into short-term and long-term improvements.

Short Term Improvements

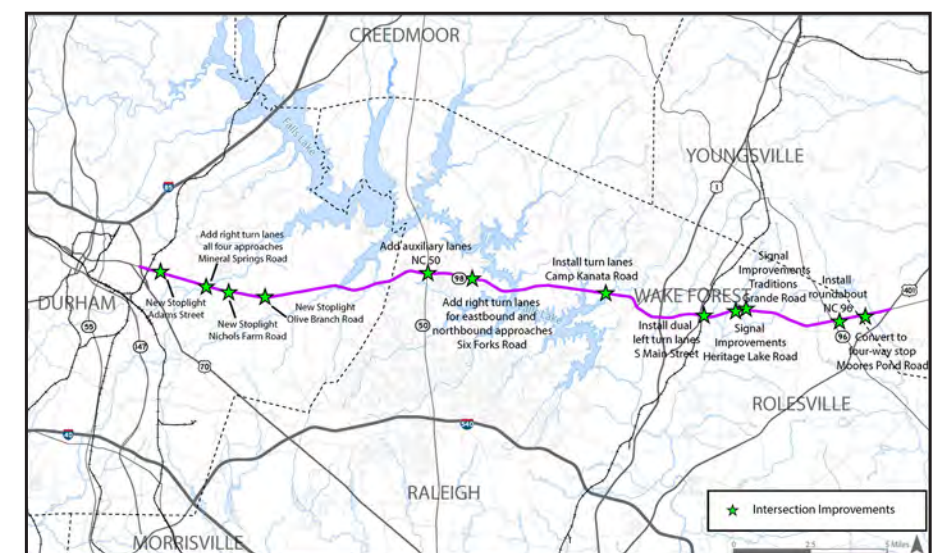
- New Stoplight – Adams Street
- Add right turn lanes at all four approaches – Mineral Springs Road
- New Stoplight – Nichols Farm Road
- New Stoplight – Olive Branch Road
- Add auxiliary lanes – NC 50
- Add right turn lanes for eastbound and northbound approaches – Six Forks Road
- Install turn lanes – Camp Kanata Road
- Install dual left turn lanes – S Main Street
- Signal Improvements – Heritage Lake Road
- Signal Improvements – Traditions Grande Road
- Convert to four-way stop – Moores Pond Road

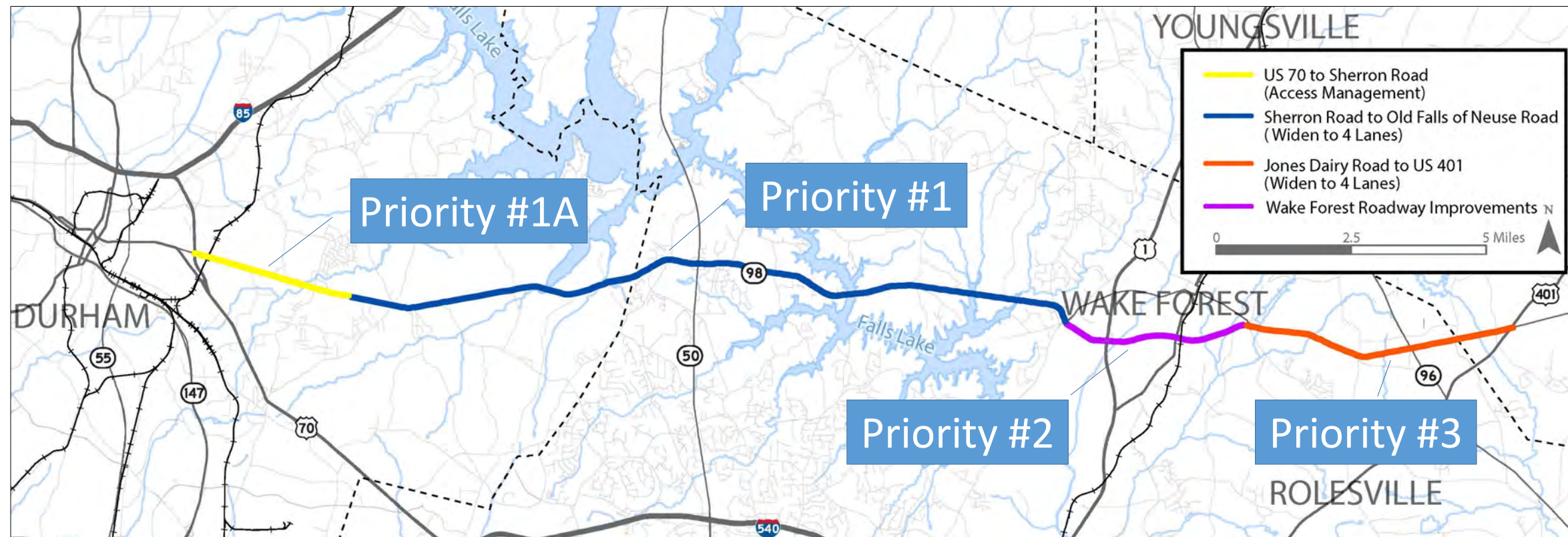
Long Term Improvements

- Priority #1a – US 70 to Sherron Road – 4 lane urban cross section with median
- Priority #1 – Sherron Road to Old Falls of Neuse Road – Widen to 4 lanes
- Priority #2 – Old Falls of Neuse to Jones Dairy Road – Wake Forest Roadway Improvements
- Priority #3 – Jones Dairy Road to US 401 – Widen to 4 lanes

The short-term improvements could help alleviate some of the current issues along NC 98 before the long-term improvements are implemented. The improvements aim to increase capacity to accommodate current and future volumes and provide design improvements (i.e. median and turn lanes) to improve safety concerns throughout the corridor.

Figure 2: Short Term Improvements





Junction to Sherron – Access Management

4 Lane Widening – Potential Cross Section

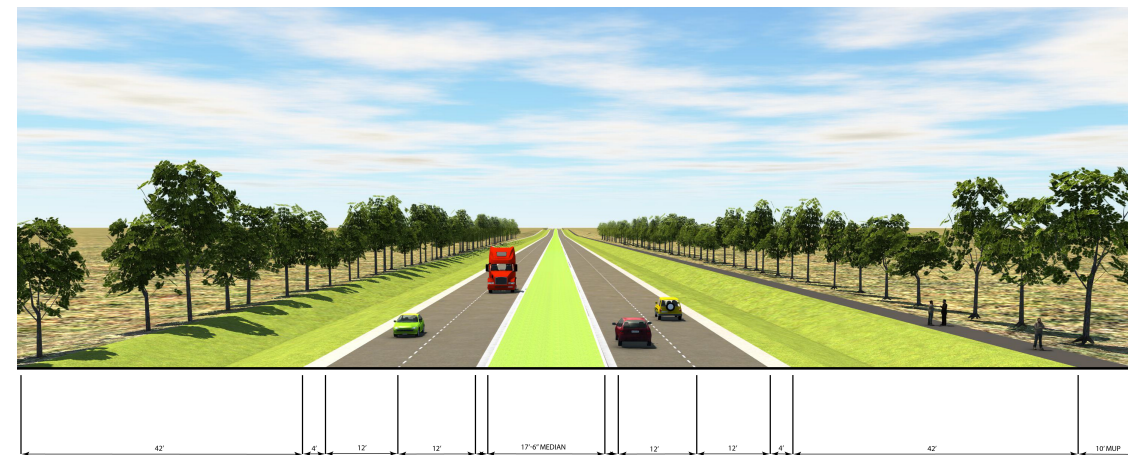


Figure 3: Long-Term Improvements

1 CONTEXT

1.1 STUDY PURPOSE

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1.2 STUDY CONTEXT

The NC 98 corridor is an important regional east-west transportation corridor connecting Franklin, Wake, and Durham Counties. Although NC 98 is programmed in the CAMPO and DCHC MPO 2040 Metropolitan Transportation Plan (MTP) as a 4-lane divided roadway, this study aims to develop Context Sensitive Solutions (CSS) that respect the diversity of communities and land uses along NC 98. At the beginning of the study, the corridor was divided into three segments: west, central, and east. The corridor was initially divided into segments because the different sections of the corridor varied greatly and required improvements that were sensitive to the unique characteristics of those segments. It was apparent that the more urban area of Durham would differ from the environmentally sensitive area of Falls Lake and from the more rural character near US 401. Figure 4 highlights the three segments.

1.2.1 West Segment

The West Segment runs from US 70 to Nichols Farm Road in Durham. This segment is mainly residential, comprised of single-family housing and apartment complexes, low density retail at major crossroads, and numerous community resources located along the corridor. Despite being mostly residential and having transit routes along NC 98, this segment has limited pedestrian facilities and no bicycle facilities. This segment is a 4-lane, undivided roadway with limited access management due to the large number of driveways along NC 98.

1.2.2 Central Segment

The Central Segment runs from Nichols Farm Road to US 1. This segment is primarily a two-lane roadway, but transitions to a 4-lane roadway near US 1. While mainly residential throughout this corridor, housing is not as dense as the western segment. There are more subdivisions set back from NC 98, with entrances along NC 98. This part of the segment is key to accessing regional recreational areas (such as Falls Lake). The roadway crosses Fall Lake and often serves as a connection for cyclists, despite no bicycle facilities. There are also no pedestrian or transit facilities along this segment.

1.2.3 East Segment

The East Segment runs from US 1 to US 401. This portion of NC 98 is mostly residential and transitions to more rural and agricultural land uses the further east it goes. The Town of Wake Forest is included in this segment and is a rapidly developing municipality. East of Wake Forest, the four-lane roadway transitions back to a two-lane roadway. This segment has limited pedestrian facilities and no bicycle facilities.

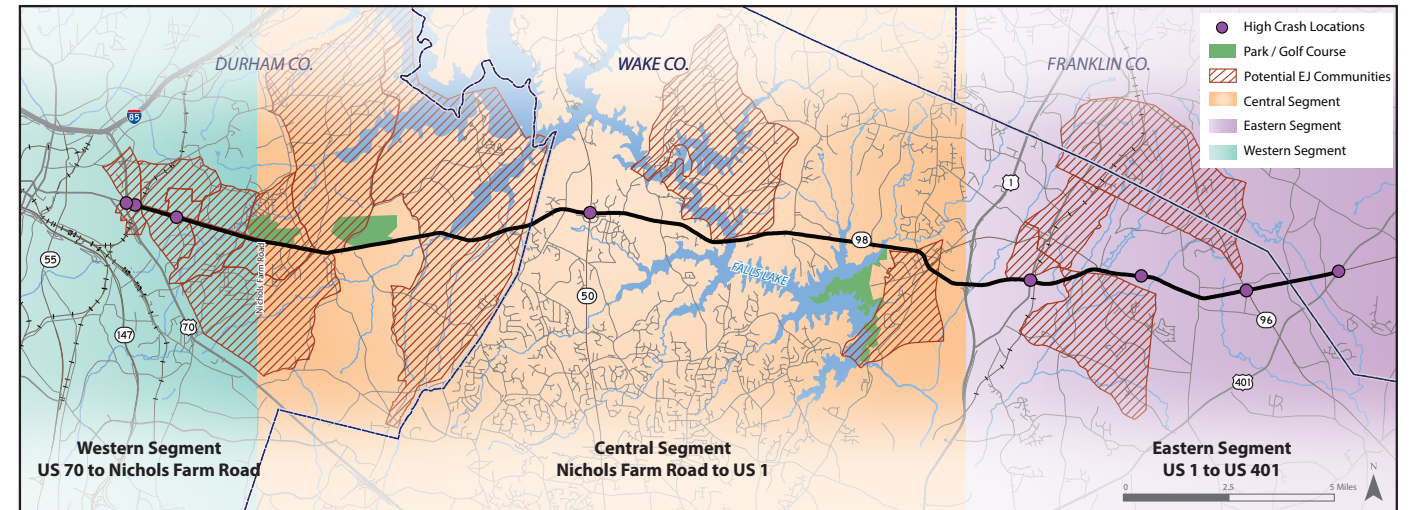


Figure 4: NC 98 Corridor Sections

1.3 STUDY PROCESS

The study was conducted over an 18-month period beginning in December 2016 and ending in July 2018. A Core Technical Team (CTT), which was comprised of staff from the municipalities and counties along the corridor and staff from NCDOT, CAMPO, and DCHC who oversaw the study. In addition, there was a Study Oversight Team (SOT) comprised of elected officials, advisory board members, community members, and other relevant stakeholders. A robust public involvement process was another key component of the study process. Figure 5 below, outlines the schedule of the study, highlighting the public involvement throughout the study.

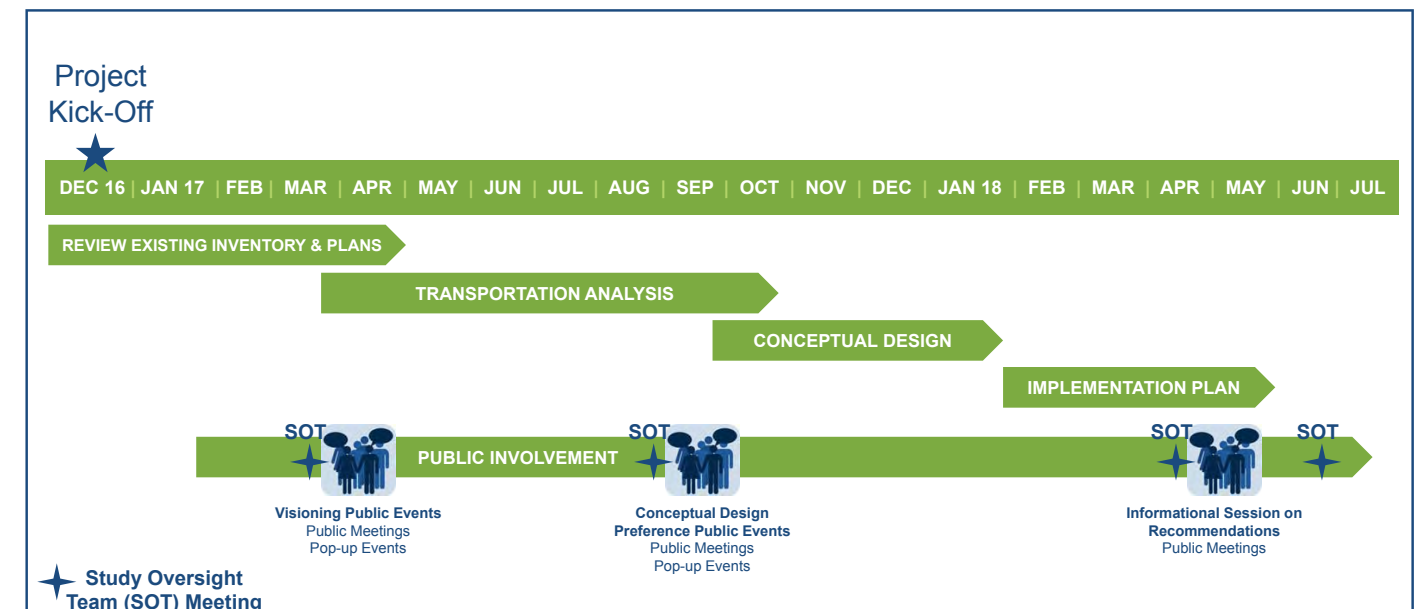


Figure 5: Study Schedule

1.4 ENVIRONMENTAL

1.4.1 Human Environment

Understanding the corridor from the perspective of the human environment was important in the design of the proposed improvements. Knowing that commercial activities are heavily concentrated at intersections, allows the design to focus on improving intersections. Several schools along the corridor lacked pedestrian and bicycle facilities for surrounding neighborhoods, therefore; adding those improvements were top priorities. Understanding these and other unique characteristics described below, enables context sensitive solutions to be developed for the corridor.

1.4.1.1 Commercial Development

Commercial development is scattered along the corridor, with the most intense concentration being in Wake Forest. Various shopping centers and commercial uses exist along, or just off NC 98, in Wake Forest, before commercial activity tapers off east of Wake Forest. A few businesses are scattered along NC 98 in Durham, but most commercial activity is present at intersections. From Sherron Road to Old Falls of Neuse Road, little commercial exists, except for the shopping center at Old Creedmoor Road.

1.4.1.2 Institutional Facilities

There are three schools directly on the corridor. Neal Middle School, Oak Grove Elementary School, and Reaching All Minds Academy.

- Neal Middle School is at the corner of NC 98 and Baptist Road in Durham. During the 2016-2017 school year, Neal Middle School had 759 students enrolled.
- Oak Grove Elementary School is located on NC 98, at the corner of Mineral Springs Road in Durham. During the 2016-2017 school year, Oak Grove Elementary School had 603 students enrolled.
- Reaching All Minds Academy is a charter school open to student's grades K-5 and located on NC 98 at North Adams Street. During the 2015-2016 school year, Reaching All Minds Academy had 127 students enrolled.

Wake County's Site 8 Convenience Center is located on NC 98 in Wake Forest, across from Falls Cove Lane. The convenience center is a trash and recycling drop-off open to all Wake County residents.

The Durham East Regional Library is located on NC 98, just east of Oak Grove Elementary School between Mineral Springs Road and Sherron Road.

Numerous churches exist along NC 98 and within the study area. There is one cemetery on NC 98. It is associated with Olive Branch Baptist Church which is located at the intersection of NC 98 with Olive Branch Road. The cemetery is located behind the church, approximately 600 feet from NC 98.

1.4.1.3 Emergency Services

Durham County Emergency Medical Station (EMS) Station 4 is located on Holloway Street (NC 98) between Rochelle Street and S Woodcrest Street. Wake County operates a dual EMS and fire station at Stony Hill Station, which is located on Stony Hill Road approximately 900 feet from NC 98. Wake Forest's Fire Department Station 1 is located on Franklin Street in Wake Forest, approximately 3,500 feet from NC 98. Station 1 is the headquarters for Wake Forest's Fire Department. The Durham County Sheriff's Office has an office next to Neal Middle School along NC 98. The main entrance is located along NC 98.

1.4.1.4 Cultural and Historic Sites

An online GIS analysis from the North Carolina Historic Preservation Office showed that there are no current properties in the study area eligible for the National Register of Historic Places. The Raleigh and Gaston Rail Corridor is a 60-mile corridor that is determined to be eligible for the National Register. This corridor runs underneath NC 98, just east of Main Street. One property across from Baya Vista Way is on the study list, meaning it is taking steps towards obtaining nomination to the National Register.

1.4.1.5 Transit

Transit service along the corridor is primarily located in Durham. GoDurham operates two routes along NC 98 up to Mineral Springs Road. There are 20 stops along NC 98 for these GoDurham routes. In Wake Forest, there are two routes operated in a partnership between the Town of Wake Forest, GoTriangle, GoRaleigh, and the City of Raleigh. One route is an express route from Wake Forest to Raleigh during weekday commute hours, while the other is a circulator around Wake Forest. Both travel along NC 98 in Wake Forest, but neither have stops located along NC 98.

1.4.2 Natural Environment

Knowing what natural resources are present along the corridor is crucial in understanding the corridor and what improvements are feasible. Considering the importance of Falls Lake within the region and the environmentally sensitive nature of the surrounding land helps guide the design in a direction that is compatible with the natural resources along the corridor. Falls Lake is a big recreation area in the region that lacks pedestrian and bicycle facilities. From the beginning, this informed the study that these facilities should be considered for central section of NC 98. The natural environment also dictates the type and intensity of future development along the corridor, particularly in the central portion, where the soils and watershed rules dictate large lot subdivisions.

1.4.2.1 Natural Resources

Falls Lake is a 12,400-acre reservoir located in northern Wake County and eastern Durham County and is managed by the US Army Corps of Engineers (USACE). Falls Lake, which is in the Neuse River Basin, provides drinking water for municipalities in Wake County including Raleigh, Garner, Knightdale, Rolesville, Wake Forest, Wendell and Zebulon.

There are five water supply watersheds within 1,000 feet of the corridor: Falls Lake (Protected), Falls Lake (Critical), Little River (Protected), Neuse River (Protected), and Smith Creek (Critical). These surface water channels crossing NC 98 are also considered Nutrient Sensitive Waters (NSW) and must adhere to the Falls Lake Buffer Rules and Neuse River Riparian Buffer Rules. The Smith Creek watershed and the Little River watershed are also considered High Quality Waters. The NC 98 corridor runs almost entirely within a water supply watershed. The majority of the corridor, from US 70 to Falls of Neuse Road, is within either of the two Falls Lake water supply watersheds.

Along with the water supply watersheds, the environmental constraints highlight the wetlands, prime farmlands, Natural Heritage Natural Areas (NHNA) and Managed Areas. The NHNA areas include areas like the Lick Creek Bottomlands, with the Managed Areas include North Carolina Department of Transportation Mitigation Sites and Wake County Open Space Easements.

1.4.2.2 Parks

Falls Lake State Recreation Area is in Durham and Wake counties surrounding Falls Lake. The state recreation area includes seven access areas: Sandling Beach, Beaverdam, Holly Point, B.W. Wells, Shinleaf, Rolling View, and Highway 50. Falls Lake State Recreation Area allows fishing, boating, camping, swimming, hiking, biking and other outdoor recreation activities. There are over 300 campsites and five swim beaches. Several of the access areas provide

boat-launching ramps, some exclusively for boats with non-gasoline motors. The Mountains-to-Sea Trail runs through parts of Falls Lake State Recreation Area. In addition to Falls Lake State Recreation Area, Rollingview Marina, is a privately managed concession near the Rolling View access area, which offers boat launching, slips and mooring, and kayak and canoe rentals.

Forest Ridge Park is a park currently under construction. A small section of the park is adjacent to NC 98, but the entrance will be from Old NC 98, which is off Old Falls of Neuse Road, approximately 600 feet southwest of NC 98. The park is slated to open in the Summer of 2017.

Blue Jay County Park is a 236-acre park located less than a mile south of NC 98. The park is located on Pleasant Union Church Road, which is off Six Forks Road. The park's facilities include the Blue Jay Center for Environmental Education, an overnight lodge, and playgrounds. Activities in the park includes fishing, hiking, and picnicking. The park also hosts the Go Ape Treetop Adventure Course.

1.4.2.3 Greenways and Trails

Dunn Creek Greenway in Wake Forest, runs along Dunn Creek and crosses under NC 98, approximately 400 feet west of Heritage Lake Road. The greenway begins approximately a mile south at the Smith Creek Soccer Center.

There is a multi-use path that makes a loop around the Gateway Commons Shopping Center. The path runs along NC 98 between Heritage Lake Road and Jones Dairy Road. The path is operated by Gateway Commons Shopping Center.

On Durham Road (NC 98 Business) there is a paved, multi-use path which begins west of Retail Drive and stops at NC 98. This multi-use path is operated by the Town of Wake Forest.

The Mountains to Sea Trail runs along Falls Lake and crosses NC 98 between Falls Glen Court and the bridge over Falls Lake on NC 98. The trail follows NC 98 for approximately 250 feet before following the lake again.



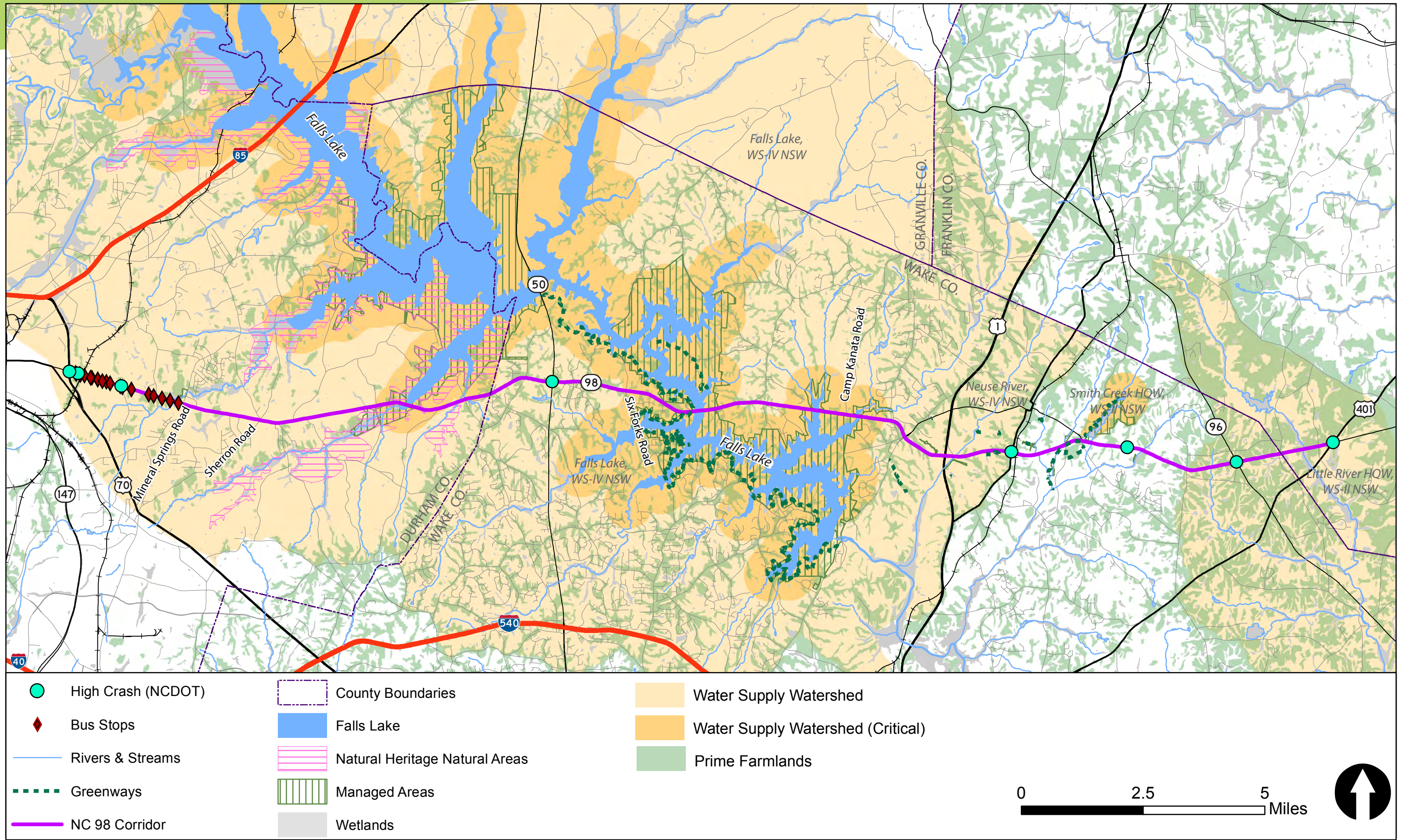


Figure 6: Environmental Constraints Map

1.5 LAND USE

1.5.1 Existing Land Use Patterns

Existing land use along the NC 98 corridor varies from east to west. The western end of the corridor contains medium density residential and commercial, which gives way to rural and recreational land uses in the middle of the corridor. The eastern end is low-density residential and commercial near Wake Forest, before becoming mostly rural.

1.5.2 Future Land Use Patterns

Future land use patterns is anticipated to follow existing land use patterns and are constrained by natural resources. An economic analysis, performed as part of this study and detailed in Section 1.6, showed that the largest growth is expected in Wake Forest, which has seen significant growth in recent years.

1.5.3 Land Use and Zoning Constraints

Durham County, from the Wake County line to Olive Branch Road, is zoned mostly Residential Rural (RR) and Residential Suburban (RS-20), which allows about 2.2 dwelling units per acre. RR zoning provides for agricultural activities and residential lots on an acre or greater to preserve the open and rural character of the area. Commercial and industrial uses are generally prohibited in this zone. The RS-20 runs along NC 98, covering an approximately 500-foot buffer from the centerline, with the RR zoning continuing on either side of the RS-20 zones. RS-20 allows for suburban residential development, with a limited number of nonresidential uses permitted. West of Olive Branch, many more zones begin to emerge with commercial and medium density residential uses.

Wake County, from Falls of Neuse Road to east of NC 50, is zoned mostly Residential-80W (R-80W) District, which only allows very low density residential development to minimize pollution of a water supply watershed from stormwater runoff. From NC 50, to the Durham County line and from the Town of Wake Forest's city limits to the Franklin County line, the zoning is Residential-40W (R-40W) District. This zoning allows for low density residential development to minimize pollution of a water supply watershed from stormwater runoff. Both R-80W and R-40W zones, have limits on the amount of impervious surface developments can have.

Franklin County is zoned Water Supply Watershed District I (R-40) along NC 98. The goal of this zoning is to protect the water quality in the drainage basin of the water supply watershed. This zone allows single-family dwellings and low density nonresidential uses, such as churches or agricultural production.

1.6 ECONOMICS

HR&A Advisors completed an economic analysis for the NC 98 corridor. For this analysis, the corridor was divided into three segments: west, central, and east. These segments are similar to the segments mentioned earlier, but were developed based on census tracts. US 1 is still the dividing line between the central and east segments, but the dividing line between west and central is further east in the segments below. Figure 7 shows where those segments are located along the corridor. The purpose of the economic analysis was to examine:

- Current real estate market conditions
- Projections
- Impact of transportation investments on market conditions

Development along the Highway 98 corridor is guided by existing high traffic locations between Durham and Wake Forest.

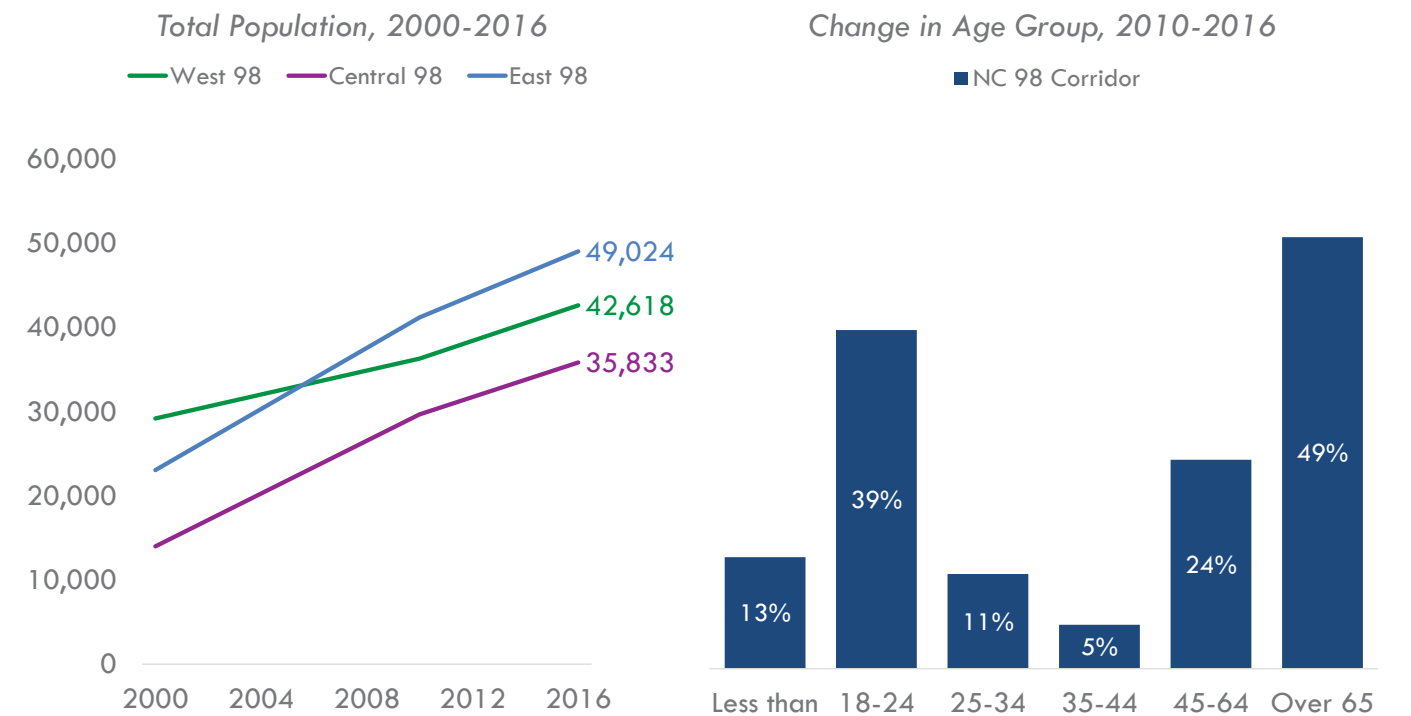


Figure 7: NC 98 Economic Segments

1.6.1 Current Real Estate Market Conditions

The NC 98 Corridor has seen significant growth since 2000, most notably in the Central and East sections. The age group composed of individuals over 65 experienced the most growth (49 percent) from 2010-2016. The total population within five miles of NC 98 is 290,000. Single family housing within the corridor includes a diverse range of products and prices. Sherron Farms in the west, Hassentree in the central, and Holding Village in the east were observed as a sample for available housing along the corridor with observed prices ranging from \$250,000 to \$674,000. Median home values in 2016 ranged from \$162,932 in the west, \$392,861 in the central, and \$217,582 in the east. Most of the new development of multifamily housing units are concentrated in Wake Forest, where recent office projects are also concentrated. There is also new retail development in Wake Forest and near NC 50.

The NC 98 Corridor has seen significant growth since 2000, most notably in the Central and East sections, with senior age groups growing fastest overall.



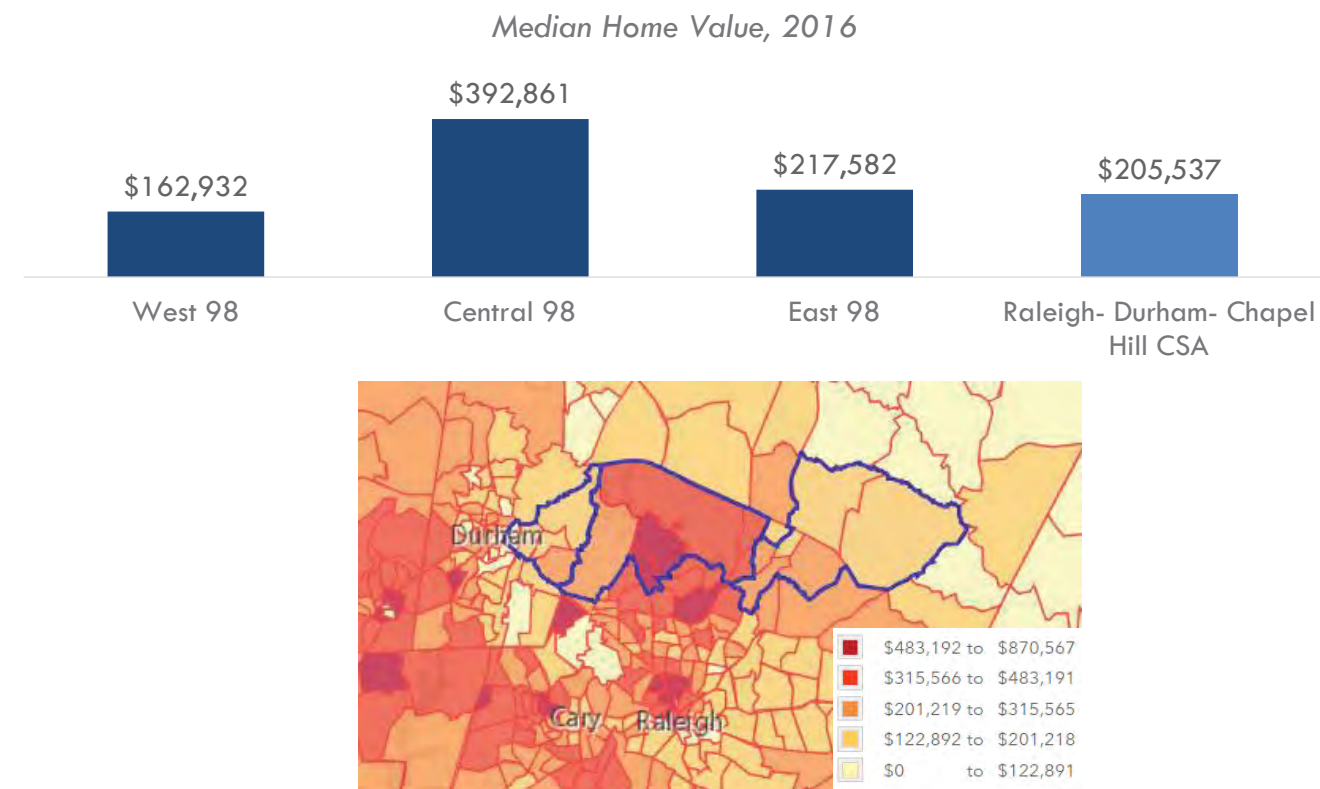
Source: ESRI Business Analyst

Figure 8: Economic Growth

1.6.2 Projections

When looking at the future of NC 98 in 2040, the eastern segment of the corridor, which includes Wake Forest, drives much of the growth. The corridor is expected to add over 50,000 people by 2040, with over 25,000 new residents in the eastern segment. This population growth could equate to 20,000 new housing units, 17,000 new jobs and an additional one million square feet in commercial office space, with most that job growth being in the eastern segment. Commercial development is limited in the central segment due to watershed regulations.

Median home values are highest in Central 98, with West 98 falling below the Triangle median.



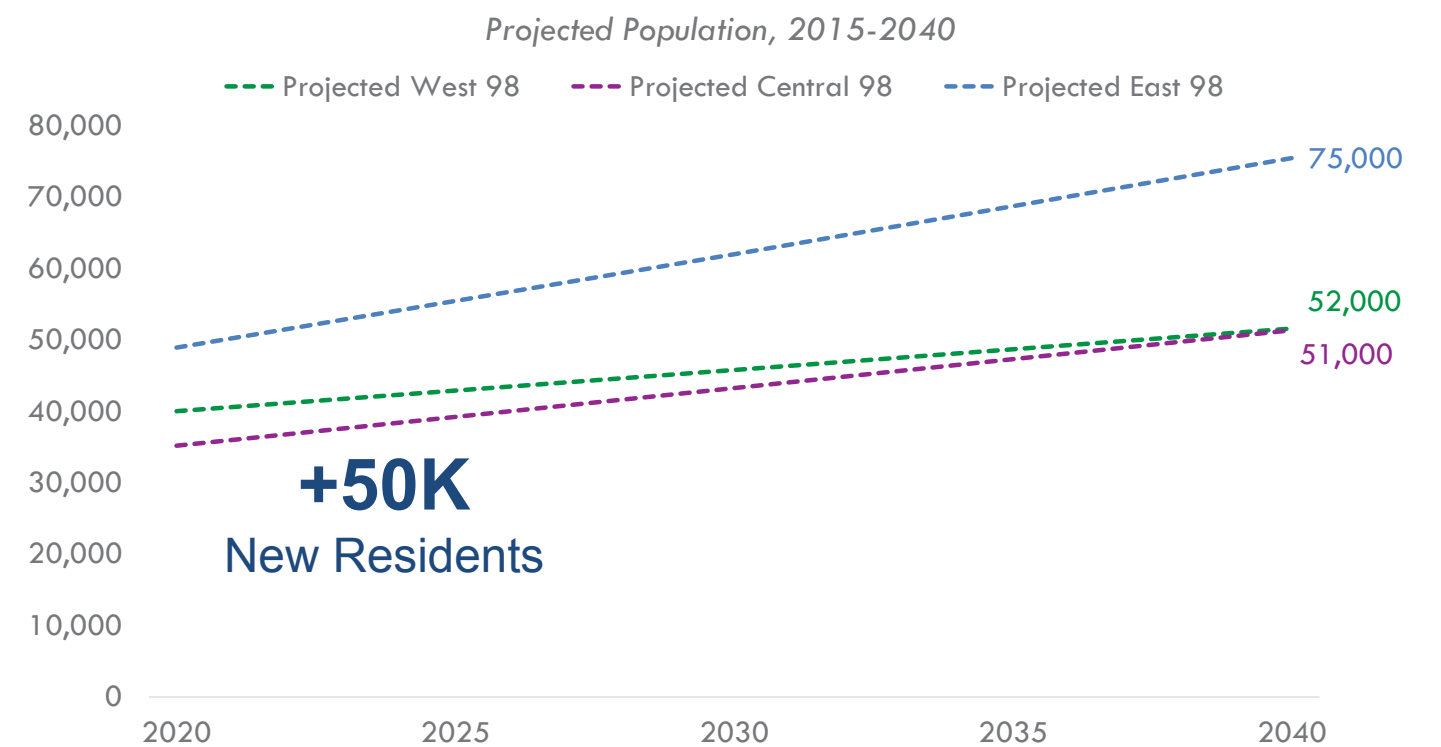
Source: Zillow, ESRI Business Analyst

Figure 9: Median Home Values Projections

1.6.3 Impacts of Transportation Investments on Market Conditions

Projected population growth within the corridor will continue to drive residential and retail development. Improving accessibility and walkability within the western segment could help facilitate denser development. In the central segment, road improvements will likely contribute to population growth, but retail development is likely to be focused near existing clusters of retail. Road widening improvements and access management could limit retail development along the corridor, unless access is preserved near key intersections. For the western segment, roadway improvements could help promote denser development and continue to encourage retail development at intersections.

Based on CAMPO projections, the corridor is expected to add over 50,000 people by 2040, primarily driven by over 25,000 new residents in East 98.



Source: ESRI Business Analyst, CAMPO, DCHC

Figure 10: Projected Population Growth

1.6.4 Conclusions

The analysis from HR&A Advisors summarized the findings for each section of the corridor. In the west, the inclusion of a median and sidewalks could help increase development interest and encourage denser development. In the central section, widening NC 98 can help increase population growth and encourage retail development in existing clusters. The environmental constraints in this section will likely limit overall development. In the east, widening NC 98 will encourage growth in various sections (residential, office and retail) and could encourage more dense development in Wake Forest.

Residential growth and transportation improvements will incentivize additional retail development near existing clusters and at key intersections.

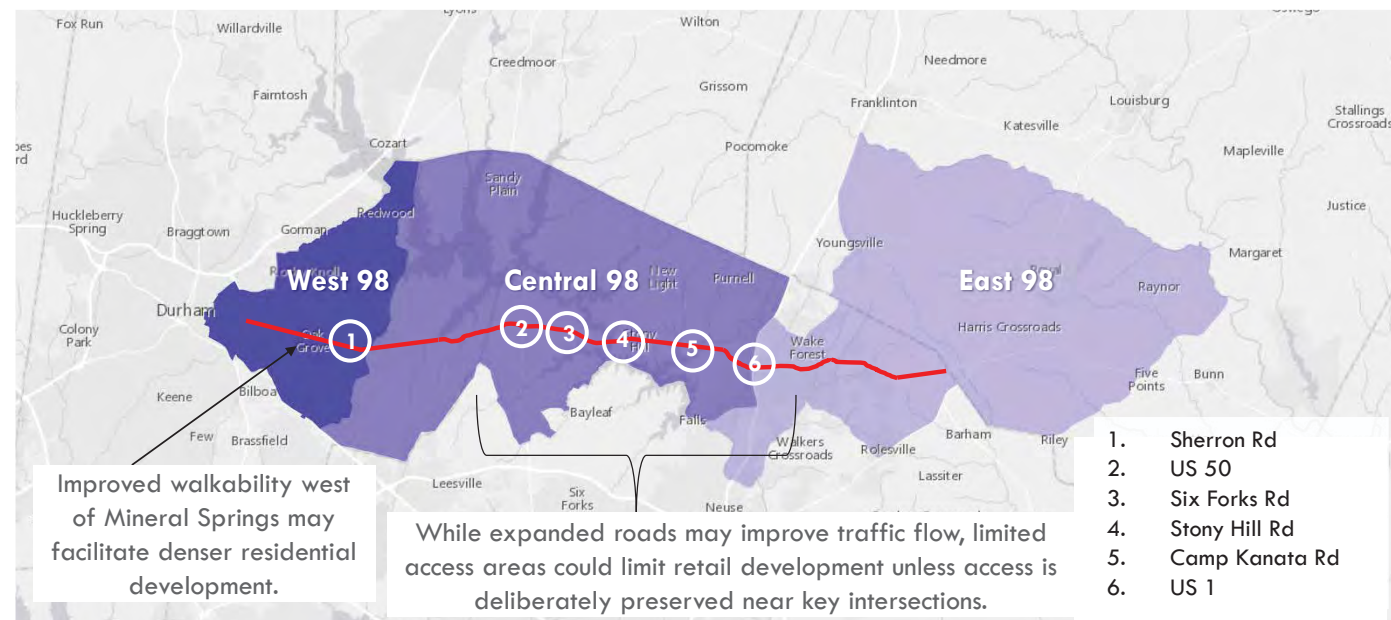


Figure 11: Projected Growth and Transportation Improvement

1.7 DEMOGRAPHICS

The Demographic Study Area (DSA) represents any block group that is adjacent to NC 98. DSA for the corridor contained 27 block groups and accounted for a population of approximately 83,000 along the corridor within Durham, Wake and Franklin counties. Table X shows the demographics and Figure 12 illustrates demographics at the block group level along the NC 98 corridor. The figure shows variations of different demographic categories along the corridor by showing the percent within each block group. The western end of the corridor stands out as having higher concentrations of low income and minority populations, some of which pass the threshold for Environmental Justice determination for low-income and/or minority populations.

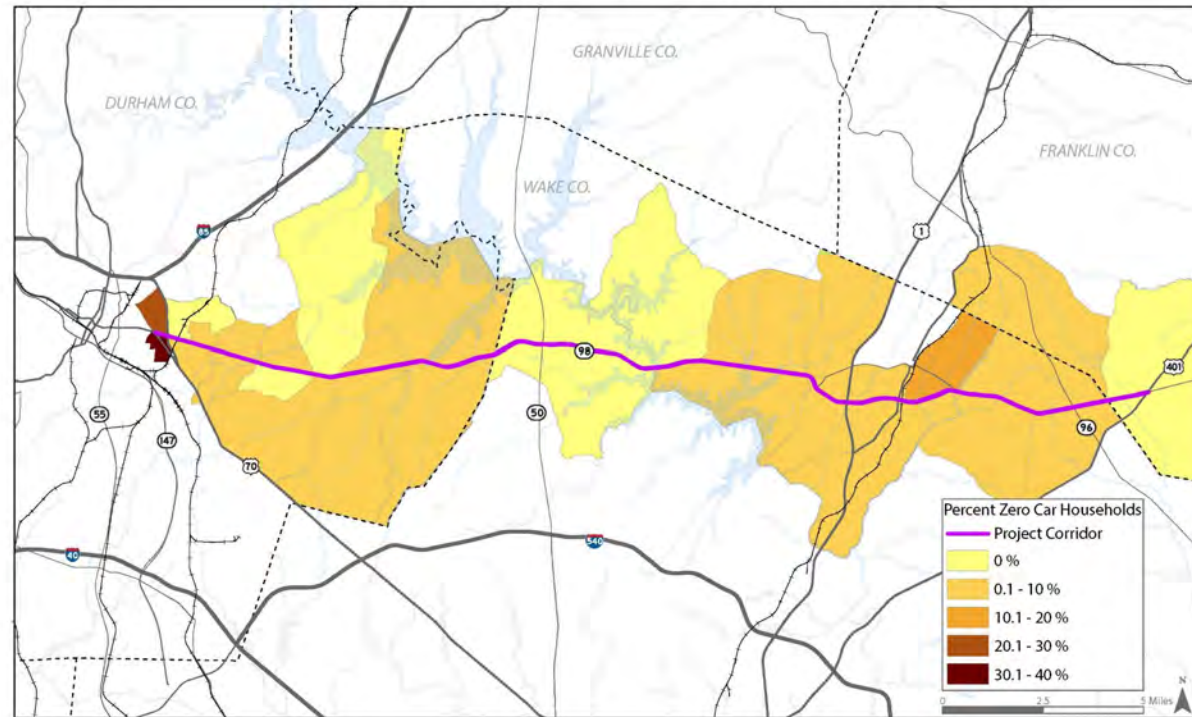
| | Study Area Level | Durham County | Wake County | Franklin County |
|---------------------------------|------------------|---------------|-------------|-----------------|
| Population | 83,000 | 267,587 | 900,993 | 60,619 |
| Minority Population | 39% | 58% | 38% | 36% |
| Hispanic Population | 19% | 13% | 10% | 8% |
| Below Poverty Population | 11% | 19% | 11% | 16% |

Figure 12: Block Group Demographics Percentages

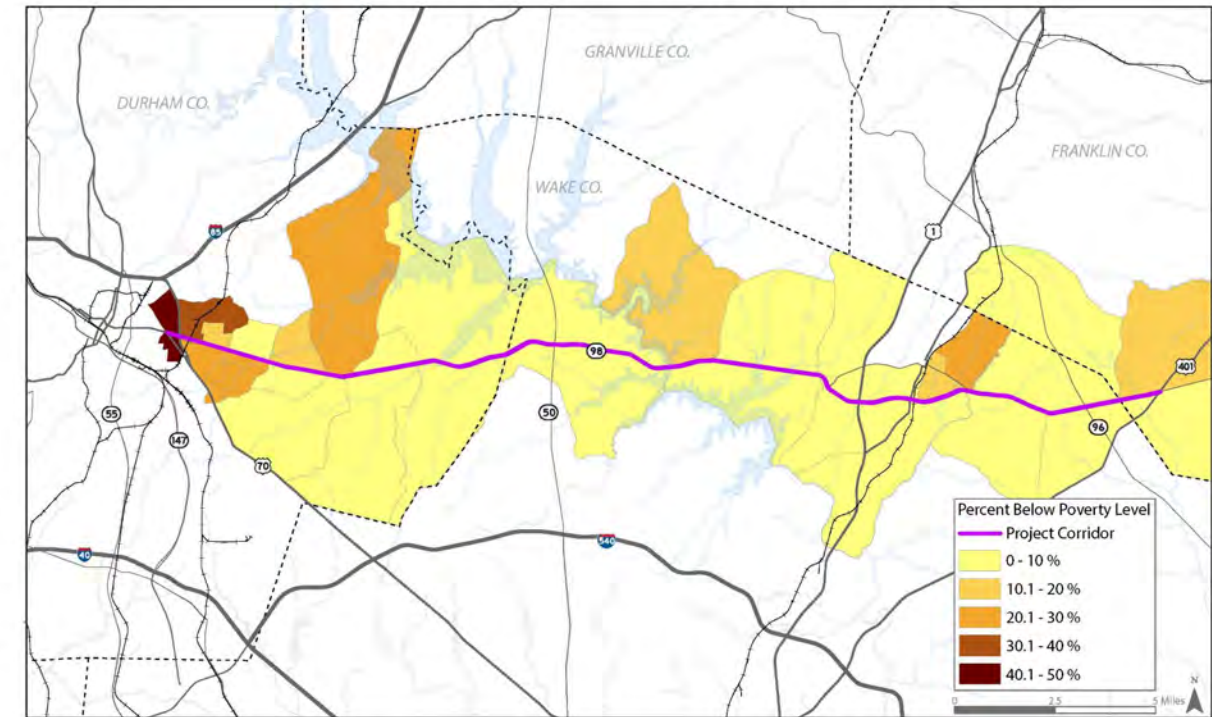
Census data indicates a notable presence of minority and low-income populations meeting the criteria for Environmental Justice within the Demographic Study Area (DSA). Census data also indicates a Spanish language-speaking population that meets or exceeds the US Department of Justice Limited English Proficiency (LEP) Safe Harbor threshold within the DSA. Census data also indicates Indo-Euro, Asian/Pacific, and Other language-speaking populations that exceed 50 persons within the DSA that may require language assistance. During the field visit, multiple Hispanic stores and community resources were observed.

DEMOGRAPHICS ALONG NC 98 CORRIDOR

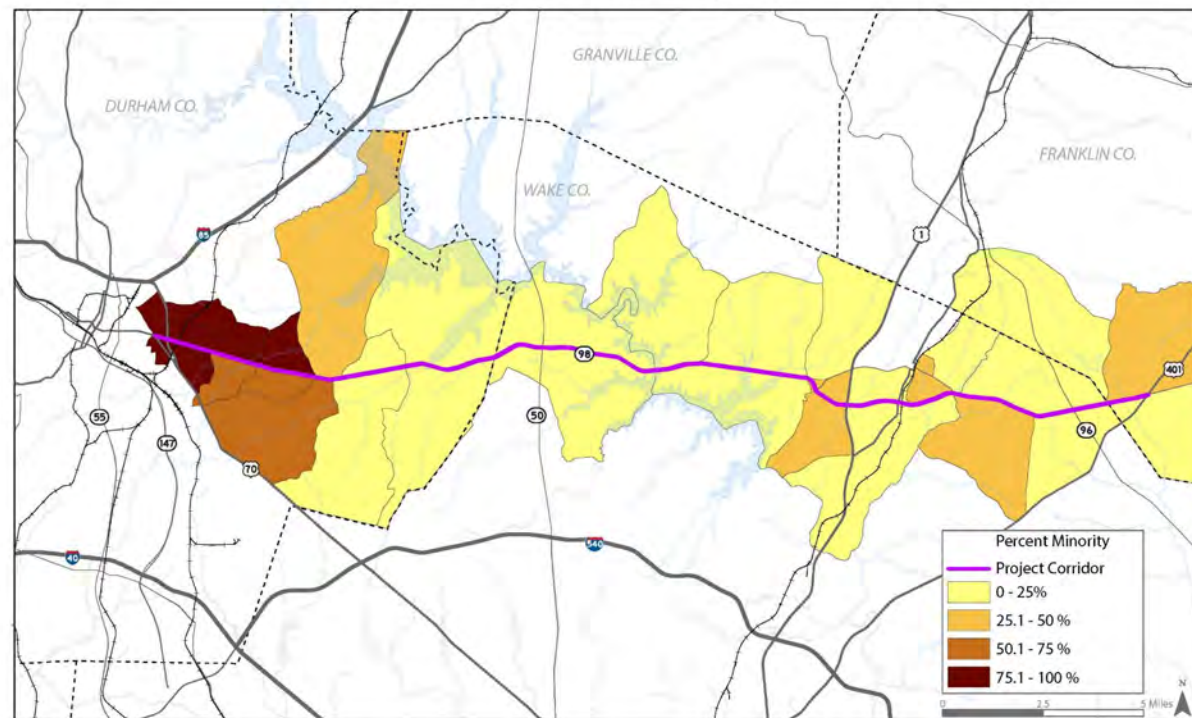
Percent Zero Car Households



Percent Below Poverty Level



Percent Minority



Percent Hispanic

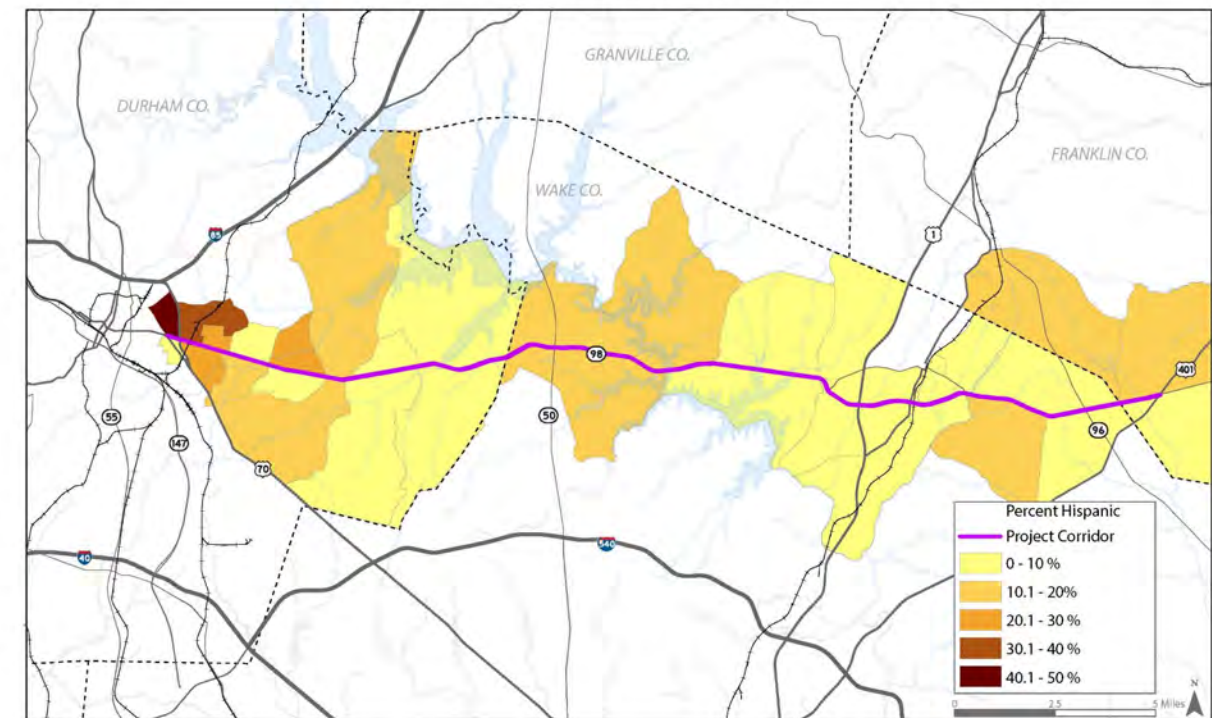


Figure 13: Demographics along NC 98 Corridor

1.8 EXISTING TRANSPORTATION NETWORK

1.8.1 Volumes

While 2005 and 2010 vehicular traffic volumes were similar throughout the corridor, increases in traffic volumes throughout the entire corridor were seen in 2015. Areas along the corridor, particularly from NC 50, east to Old Falls of Neuse, are already above the capacity for an undivided, two-lane roadway with the 2015 traffic volumes. The capacity for a two-lane, undivided roadway is 16,000. Table 1 shows the 2010 and 2015 traffic volumes for the corridor.

Table 1: 2010 and 2015 Traffic Volumes

| LOCATION | 2010 TRAFFIC VOLUMES | 2015 TRAFFIC VOLUMES | PERCENT CHANGE |
|--|----------------------|----------------------|----------------|
| WEST OF US 70 | 12,000 | 14,000 | 17% |
| EAST OF US 70 | 24,000 | 28,000 | 17% |
| WEST OF JUNCTION RD | 23,000 | 26,000 | 13% |
| EAST OF JUNCTION RD | 20,000 | 23,000 | 15% |
| WEST OF CLAYTON RD | 15,000 | 17,000 | 13% |
| EAST OF MINERAL SPRINGS | 11,000 | 12,000 | 9% |
| WEST OF PATTERSON RD/SHERRON RD | 16,000 | 18,000 | 13% |
| WEST OF BAPTIST RD | 12,000 | 15,000 | 25% |
| WEST OF NC 50 | 11,000 | 15,000 | 36% |
| EAST OF NC 50 | 15,000 | 19,000 | 27% |
| WEST OF STONY HILL RD | 14,000 | 18,000 | 29% |
| EAST OF OLD FALLS OF THE NEUSE RD/BUS 98 | 13,000 | 19,000 | 46% |
| WEST OF US 1 (CAPITAL BOULEVARD) | 18,000 | 19,000 | 6% |
| EAST OF US 1 (CAPITAL BOULEVARD) | 21,000 | 31,000 | 48% |
| EAST OF S MAIN ST/ ALT 1 | 19,000 | 22,000 | 16% |
| WEST OF WAIT AVE/JONES DAIRY AVE | 12,000 | 17,000 | 42% |
| EAST OF NC 96 | 7,100 | 9,000 | 27% |
| WEST OF NC 401 | 5,600 | 7,100 | 27% |
| EAST OF NC 401 | 3,900 | 8,100 | 108% |

In addition to traffic volumes, level of service (LOS) is used to show how well traffic functions in a given area. LOS is expressed as a letter between A and F, with those letters relating to delay per vehicle (in seconds) that is experienced traveling through a given area. LOS is shown in Table 2.

Some areas in this section of the NC 98 corridor experience high level of delays and low levels of service (LOS). On average, the intersection of NC 98 and Six Forks Road/New Light Road experiences a 55 second delay in the morning and operates at a LOS D. In the evening, that delay jumps to 76 seconds and operates at a LOS E. Going eastbound on NC 98 in the evening, that intersection experiences a delay over 100 seconds and operates at a LOS F. These delays are in addition to the normal stop time when the traffic signal is red. This intersection, along with the intersection of Old Falls of Neuse, is shown in detail on Table 3 and Table 4 shows the average delay and LOS for other intersections throughout the corridor. Multiple comments during the public involvement process noted congestion along NC 98, with the section of NC 98 between NC 50 and Old Falls of Neuse Road being a main area of concern.

Table 2: Level of Service (LOS)

| Signalized Intersections | | Unsignalized Intersections | |
|--------------------------|-----------------------------|----------------------------|-----------------------------|
| LOS | Delay per Vehicle (seconds) | LOS | Delay per Vehicle (seconds) |
| A | ≤10 | A | ≤10 |
| B | >10 and ≤20 | B | >10 and ≤15 |
| C | >20 and ≤35 | C | >15 and ≤25 |
| D | >35 and ≤55 | D | >25 and ≤35 |
| E | >55 and ≤80 | E | >35 and ≤50 |
| F | >80 | F | >50 |

Table 3: Six Forks Road/New Light Road and Neuse Road Intersection LOS

| Intersection | Approach | Existing (2017) | | | | |
|--|------------|----------------------------|------|-----------------|-------|---|
| | | AM Peak | | PM Peak | | |
| | | Delay (Seconds) | LOS | Delay (Seconds) | LOS | |
| NC 98 (Durham Rd) @ Six Forks Road / New Light Road | Signalized | Intersection Average | 54.7 | D | 75.9 | E |
| | | EB- NC 98 | 25.2 | C | 104.8 | F |
| | | WB - NC 98 | 52.0 | D | 13.9 | B |
| | | NB - Six Forks Rd | 42.0 | D | 72.9 | E |
| | | SB - New Light Rd | 98.6 | F | 70.0 | E |
| NC 98 (Durham Rd) @ Old Falls of Neuse Rd / NC 98 Business | Signalized | Intersection Average | 36.1 | D | 37.6 | D |
| | | EB - NC 98 | 40.4 | D | 39.6 | D |
| | | WB - NC 98 | 42.1 | D | 36.8 | D |
| | | NB - Old Falls of Neuse Rd | 34.7 | C | 39.0 | D |
| | | SB - NC 98 Business | 32.6 | C | 35.4 | D |

1.8.2 Crash Data

The exhibits below highlight crash data for the corridor from 2012 to 2016. There were a total of 1,907 crashes along the corridor in the five-year period. Key intersections are highlighted and show the breakdown of crashes by accident type (i.e. rear end, angle, etc.). In a 2.5 mile stretch between US 70 and Mineral Springs Road, 23 percent of the crashes occurred, including 3 of the 8 fatal crashes. Three of the fatal crashes included crashes with pedestrians and cyclists. Rear-end crashes accounted for 37 percent of all crashes along the corridor.

This crash data also helps to shape proposed roadway improvements. The data highlights which improvements could help alleviate some of these crashes. The high number of rear-end crashes between US 70 and Mineral Springs Road, where there are few turn lanes and limited access management, may be reduced by including adding additional turn lanes. Including bicycle and pedestrian infrastructure, where feasible, that separate pedestrians and cyclist from vehicular traffic could alleviate the number of pedestrian and cyclist crashes. Similar concepts were applied throughout the entire corridor. The crash types indicated that, additional roadway capacity, as opposed to roadway alignment, could also help alleviate crashes along the corridor.

Table 4: Intersection LOS

| INTERSECTION WITH NC 98 | APPROACH | | EXISTING (2017) | | | |
|---|---------------------|----------------------|-----------------|----------|--------------|----------|
| | | | AM Peak | | PM Peak | |
| | | | Delay (sec) | LOS | Delay (sec) | LOS |
| US 70 (SOUTHBOUND RAMPS) | Signalized | Intersection Average | 15.8 | B | 20.9 | C |
| US 70 (NORTHBOUND RAMPS) | Signalized | Intersection Average | 7.5 | A | 6.9 | A |
| MINERAL SPRINGS ROAD | Signalized | Intersection Average | 41.2 | D | 34.5 | C |
| SHERRON RD / PATTERSON RD | Signalized | Intersection Average | 32.6 | C | 44.3 | D |
| NC 50 (SOUTHBOUND OFF-RAMPS) | Unsignalized | Intersection Average | 2.0 | A | 21.3 | C |
| NC 50 (NORTHBOUND OFF-RAMPS) | Unsignalized | Intersection Average | 3.7 | A | 58.0 | F |
| SIX FORKS ROAD / NEW LIGHT ROAD | Signalized | Intersection Average | 54.7 | D | 75.9 | E |
| OLD FALLS OF NEUSE RD / NC 98 BUSINESS | Signalized | Intersection Average | 36.1 | D | 37.6 | D |
| S. MAIN ST. (US 1A) | Signalized | Intersection Average | 42.8 | D | 49.1 | D |
| JONES DAIRY RD / TRADITIONS BOULEVARD | Signalized | Intersection Average | 41.8 | D | 30.2 | C |
| NC 96 (ZEBULON RD) * | Unsignalized (AWSC) | Intersection Average | 127.5 | F | 131.5 | F |
| NC 98 (WAIT AVE) @ US 401 | Signalized | Intersection Average | 12.0 | B | 12.6 | B |

* Prior to the newly installed roundabout at NC 96

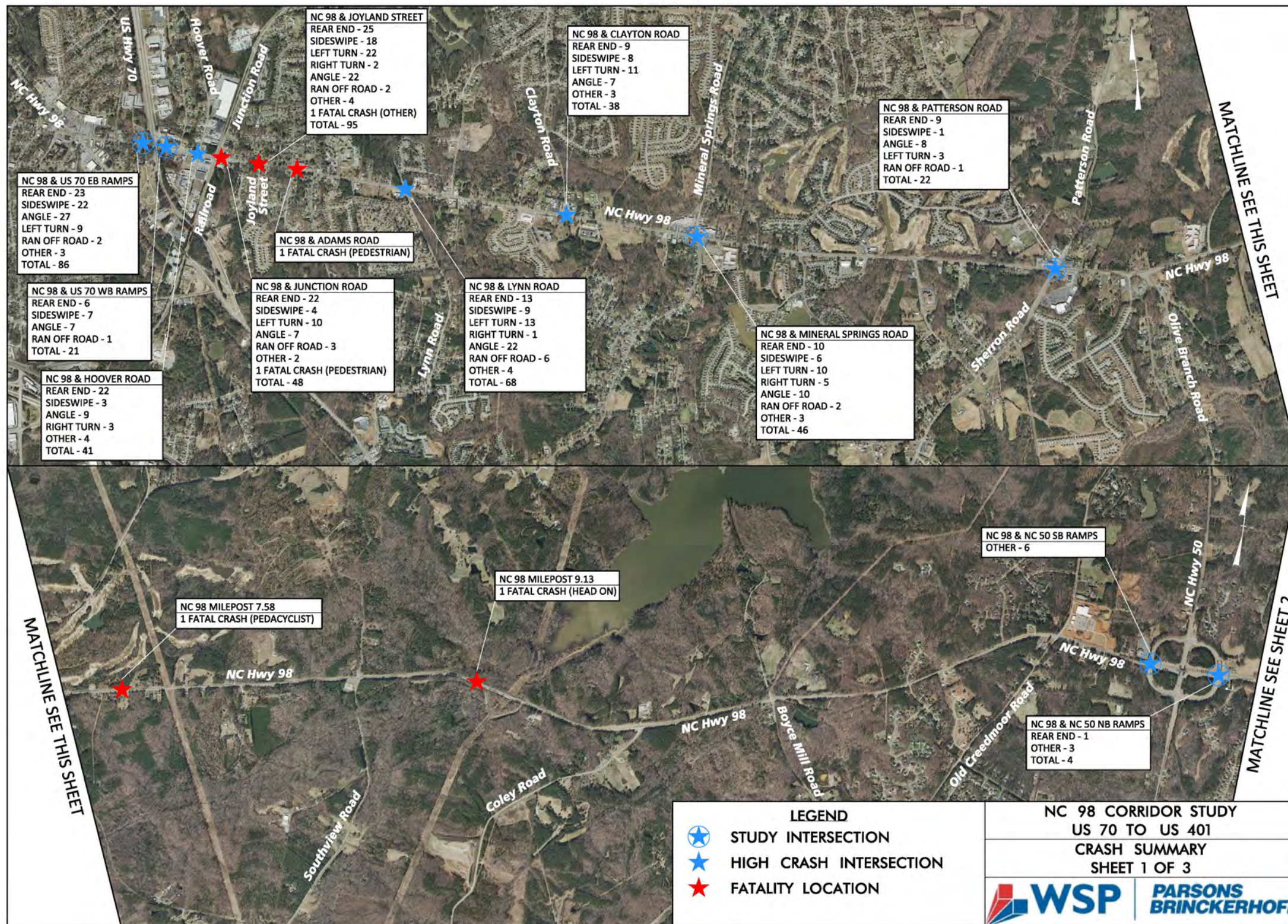


Figure 14-1: NC 98 Corridor Crash Summary



Figure 14-2: NC 98 Corridor Crash Summary



Figure 14-3: NC 98 Corridor Crash Summary

1.8.3 Current Lane Configurations

Due to environmental constraints from Falls Lake, NC 98 serves as the only east-west thoroughfare in eastern Durham County and northern Wake County. NC 98 is approximately five miles north of I-540, which serves as another east-west route for the area. NC 98 serves as the main connection between Durham and Wake Counties in that area and connects the City of Durham to smaller communities, like the Town of Wake Forest, Town of Rolesville and Town of Youngsville.

From US 70 to Sherron Road and from Old Falls of Neuse Road to Jones Dairy Road, NCDOT classifies NC 98 as a principal arterial. From Sherron Road to Old Falls of Neuse Road and from Jones Dairy Road to US 401, NC 98 is classified as a minor arterial.

Typical sections throughout the corridor vary. From west to east the corridor can be broken down by the following segments:

- US 70 to Nichols Farm Drive – 4-lane undivided roadway with 35 mph posted speed limit (45 mph from Chandler Road to Nichols Farm Drive)
- Nichols Farm Drive to Thompson Mill Road – 2-lane roadway with 55 mph posted speed limit (45 mph from Nichols Farm Drive to Robbins Road)
- Thompson Mill to Jones Dairy Road – 4-lane divided roadway with 55 mph posted speed limit
- Jones Dairy Road to Deerfield Crossing Drive – 2-lane roadway with 45 mph posted speed limit
- Deerfield Crossing Drive to US 401 – 2-lane roadway with 55 mph posted speed limit

1.9 BIKE/PED

1.9.1 Existing Conditions

As part of this study, Toole Design evaluated bicycle and pedestrian facilities to determine the existing conditions along with opportunities for future improvements. There is currently a lack of connectivity for bicycles and pedestrians along the NC 98, specifically due to the minimal available facilities. The NC 98 corridor crosses a variety of land use contexts, including but not limited to urban, suburban, and rural environments. Future road improvements should consider the context of the corridor and adjacent land uses during the design and construction of non-motorized improvements.

Existing infrastructure is limited to pedestrian facilities, primarily on the western side of the corridor in Durham County. Pedestrian facilities include sidewalks and curb ramps; however, there are a variety of locations where maintenance and/or upgrades are needed to comply with ADA standards. Furthermore, there is clear pedestrian activity in places where sidewalks do not exist based upon the paths that have developed. Much of the corridor has multiple travel lanes and speed limits that exceed 45 MPH. These conditions are not comfortable for bicycles and pedestrians without clear separation. In Wake Forest, the right-of-way widens to increase the vehicular capacity as NC 98 approaches US 1. The NC 98 corridor becomes a major barrier for bicycles and pedestrians in the Town of Wake Forest and for much of the study area. Improved connectivity is one element of this corridor study and recommendations will be targeted to enhance the bicycle and pedestrian environment.



1.9.2 Key Considerations

There are a variety of current conditions and plans that highlight the need to develop bicycle and pedestrian facilities. First, there are several schools that are located on or near NC 98. Enhanced bicycle and pedestrian infrastructure is essential to provide students and families a safe route to bike or walk to school. Next, greenway plans developed by the Town of Wake Forest envision a crossing of NC 98 near Old Falls of Neuse Road. Current conditions of NC 98 would make it difficult to provide an at grade crossing; however, future improvements to the corridor should consider targeted crossing locations that align with previous planning efforts. In addition to planned facilities, two of the North Carolina State Bicycle Routes (NC 1 and NC 2) travel along or across the NC 98 corridor within the study area. In these areas, bicycle improvements have been analyzed to enhance safety for individuals who, by choice or necessity, are on foot or by bicycle along these routes. Lastly, there currently appears to be a variety of users that cross NC 98 for recreational bicycling. These areas have been identified by reviewing data collected by popular activity tracking applications (i.e., Strava, Map My Ride, etc.). The highest concentration of users appears to travel along NC 98 in two primary sections. The first is between Kemp Road and Sherron Road and the second is between Old Creedmoor Road and Stony Hill Road (NC 1 and NC 2 respectively).

The proximity of schools along the corridor, previous greenway plans for the Town of Wake Forest, presence of State Bicycle Routes, and the existing concentration of users are key considerations in developing bicycle and pedestrian recommendations. Although recommendations of this study will not have proposed new bicycle and pedestrian facilities along the entire corridor, future improvements should consider the surrounding context and how to enhance connectivity and extend any existing facilities.

1.9.3 Design Considerations

1.9.3.1 On Street Facilities

On street bicycle facilities and sidewalks provide dedicated travelling space to cyclists and pedestrians. For bicycle facilities, there are three types of on street facilities: bike lanes, painted buffer bike lanes, and physically separated facilities. Each facility type should provide minimum 5' of travel width to ensure that cyclists have adequate separation from motor vehicles. Buffered bike lanes expand upon that separation by providing an extra 2' (minimum) painted area between cyclists and vehicles. Physically separated facilities provide the most protection for cyclists along routes and at intersections by reducing the number of conflict points between cyclists and traffic.

For pedestrian facilities, sidewalks provide a safe and comfortable place for pedestrians to travel between destinations. They should be at least 5' wide, or, if the sidewalk is directly beside traffic, 6 - 8 feet. When possible, the sidewalks should be further separated from traffic by at least two feet of curbed/green space.

All on street facilities should be clear of obstructions that would require the user to enter the roadway, including storm water controls, debris, or damaged/uneven sidewalks. Each facility design is specific to its context, but in general, these types of facilities are best suited for roads that have lower speed limits and fewer travel lanes (2-3 lanes total).

1.9.3.2 Off Street Facilities

Off street bicycle and pedestrian facilities include shared use paths, trails/greenways and side paths, and these facilities provide mobility connections for cyclists and pedestrians who are not comfortable using facilities next to traffic to bike and walk to destinations or for recreation. These facilities allow for multiple types of users to utilize the facility at the same time; to accommodate for multiple users, the paths should be at least 12' for two-way travel and 8' wide for one-way travel. A minimum of 4' of buffer should be between the path and vehicular traffic. Shared

use paths and side paths are best applied in rural or small-town settings. Side paths are appropriate for higher speed roads that have high traffic volumes, four lanes or more, and/or limited access roads.

1.9.3.3 Intersections

Intersections are the most obvious opportunities for crashes between active transportation users and vehicular traffic; the guiding principles for bicycle and pedestrian facility improvements are improving visibility, slowing speeds for all road users and minimizing conflict points. Certain intersection improvements can help calm traffic speeds, such as smaller turning radii, curb extensions, and narrowed lane widths. Slowing road users' speeds increases both response times and ability to see and avoid collisions. Some traffic calming measures such as curb extensions also minimize the distance that vulnerable road users must cross vehicular traffic.

To further increase visibility, crosswalks should also be 8' wide at minimum and highlighted with reflective white paint. Faded or missing crosswalks may not clearly indicate where cyclists and pedestrians have dedicated space. Sidewalks should connect seamlessly with crosswalks into intersections with ADA compliant ramps.

1.10 REVIEW OF EXISTING PLANS

1.10.1 Comprehensive Plans / Land Use Plans

CAMPO | Northeast Area Study | 2014

The *Northeast Area Study (NEAS)* focuses on an area in Wake and Franklin counties that is an area attractive for growth and development. This area includes the communities of Wake Forest, Knightdale, Raleigh, Wendell, Zebulon, Rolesville, Bunn, Franklinton, and Youngsville. The study aims to develop a sustainable transportation strategy for the study area. The study indicates that future traffic volumes in the horizon year 2040 would cause NC 98 to operate at LOS "F", if no improvements are made. The study proposes NC 98 to be a four-lane major thoroughfare between Jones Dairy Road to Louisburg Road (US 401). The purpose of the widening is to reduce congestion so NC 98 operates at LOS "D" or better in 2040. The plan also highlights that the desired design would have wide shoulders and a multi-use path.

1.10.2 Transportation and Corridor Plans

Wake County | Transportation Plan | 2003

The *Wake County Transportation Plan* addresses mobility concerns in unincorporated areas of Wake County. The plan aims to serve as a guide and a tool for implementing future Wake County transportation improvements. For the NC 98 corridor, the Wake County Transportation Plan recommends widening NC 98 to four lanes with a landscaped median and wide outside lanes from the NC 98 Bypass to the Wake County/Durham County line.

Wake Forest | Transportation Plan Update | 2010

The *Wake Forest Transportation Plan Update* builds upon the 2003 Wake Forest Transportation Plan, which recommended strategies and improvements to accommodate growth in Wake Forest. The update amended the 2003 plan to incorporate changes and reflect recent planning efforts by the Town. For the NC 98 corridor, the Wake Forest Transportation Plan Update recommends that NC 98 east of Wake Forest be a median-divided 4-lane section with wide outside lanes. It also recommends that NC 98 west of Thompson Mill Rd be a median-divided 4-lane section with paved shoulders.

CAMPO | US 1 Corridor Study – Phase II | 2012

The *US 1 Corridor Study – Phase II* is a continuation of the US 1 Corridor Study Phase 1. The study corridor runs from I-540 in Raleigh to US 1A (Park Avenue) in Youngsville. The plan aims to provide improvements and policy recommendations to maintain mobility and safety for all travel modes along US 1. The recommendations for NC 98 were limited, but the plan proposes an express bus along NC 98 from Wake Forest to Franklinton by 2035.

NCDOT | U-4721 Feasibility Study | 2014

The *U-4721 Feasibility Study* is a feasibility study for a new roadway from I-540 in Raleigh to US 501 (Roxboro Road) in Durham. Often called the Aviation Parkway Extension or Northern Durham Parkway, U-4721 would provide a new connector between Raleigh and Durham and as an alternate to US 501 and US 70. The proposed alignment for U-4721 in this study crosses over NC 98 at its intersection with Mineral Springs Road. NC 98 is the break point between Section AB and Section AC. The two alternatives for proposed improvement include:

- Alternative 1: Four-lane divided curb and gutter section, 92 feet from face to face of curb, with 12-foot lanes, a 30-foot raised grass median, 5-foot bike lanes, 5-foot sidewalks, and 15-foot berms on 130 feet of right of way.
- Alternative 2: Four-lane divided freeway section, 104 feet from edge of pavement to edge of pavement, with 12-foot lanes, a 46-foot depressed grass median, 5-foot paved inside shoulders, and 10-foot paved outside shoulders on 250 feet of right of way.

1.10.3 Pedestrian and Bicycle Plans

City of Raleigh | Comprehensive Pedestrian Plan | 2012

The *Comprehensive Pedestrian Plan* lays out strategies to improve walkability throughout Raleigh. The plan also lists a prioritized list of sidewalk improvements. There is one proposed improvement in the plan that intersects NC 98. Old Falls of Neuse Road from NC 98 to Mountain High Road is listed as a minor street project that could also include curb and gutter, minor widening, and bike lanes.

Wake Forest | Pedestrian Plan | 2006

The *Town of Wake Forest Pedestrian Plan* is a guide to creating a safe and accessible pedestrian network in Wake Forest. The plan had several recommendations for the NC 98 corridor including:

- Creating an east-west pedestrian path and bike route on each side of the corridor, with connections across NC 98 to pedestrian networks north and south of the corridor.
- Potential for a greenway underpass under NC 98 to extend the Richland Creek Greenway to US 1 (Capital Boulevard).

City of Durham | Durham Trails and Greenways Master Plan | 2011

The *Durham Trails and Greenways Master Plan* serves as a guide to developing a comprehensive trail system in Durham, including policies to guide how trails should be developed. There are four future greenways within the plan that intersect NC 98, including:

- Little Lick Creek Greenway which would cross over NC 98 as it follows Lick Creek, just west of Mineral Springs Road
- Birchwood Trail begins on the south side of NC 98 at Junction Road and travels 2.7 miles until it connects with the Little Lick Creek Greenway
- Oak Grove Trail which would connect NC 98 to Holder Road, just east of Lick Creek Lane
- Cheek Road – NC 98 Power Line Trail connects the Panther Creek Rail Trail to Lick Creek Trail and crosses NC 98 between Baptist Road and Southview Road

City of Durham | Durham Bike+Walk Implementation Plan | 2017

The *Durham Bike+Walk Implementation Plan* updates previous plans adopted in 2006. The plan highlights projects and practices the City of Durham plan to implement to improve conditions for cyclists and pedestrians. The plan recommends complete sidewalks along the north side of NC 98 from Junction Road to Chandler Road. The long-term recommendation is to construct a multi-use path for facilitate travel for both cyclists and pedestrians.

Several other plans were examined but had no major mention of NC 98.

City of Durham | Parks and Recreation Master Plan | 2013 and City of Durham | Eastern Durham Open Space Plan | 2007

These two plans identify several existing and future parks, trail systems, wildlife habitat and recreation areas in the NC 98 study area. Only a few of these features are along NC 98, but the roadway still provides the principal access to these community and regional scale attractions.

1.10.4 Future Transportation Projects

Future transportation projects were considered and highlighted prior to developing recommendations. The Metropolitan Transportation Plan (MTP) for both DCHC and CAMPO, along with each MPO’s Comprehensive Transportation Plans (CTP) were considered. Projects at the local municipality level and at the state (NCDOT) level were also considered. Those projects are shown in Figure 15. The table below highlights each project and where each project is in the development process.

Table 5: Future Transportation Projects

| TIP NUMBER (OR IMPROVEMENT NAME) | ROUTE | PROJECT LIMITS | IMPROVEMENT TYPE | FUNDING STATUS | SCHEDULE |
|----------------------------------|-------------------------------------|--|--|----------------|-----------------------------------|
| I-5729 | I-85 | US 501 to Midland Terrace Road | Pavement Rehabilitation | | <i>Under construction</i> |
| U-4721 | New route (Northern Durham Parkway) | I-540 to US 501 | Construct a new route | | <i>Unfunded</i> |
| U-0071 | New Route (East End Connector) | NC 147 to north of NC 98 | New route (4-lane divided freeway) | | <i>Under construction</i> |
| U-5720A | US 70 | Lynn Road to South Miami Boulevard/ Sherron Road | Convert to freeway | Funded | 2022 – ROW 2022 – Construction |
| U-5720B | US 70 | South Miami Boulevard/ Sherron Road to Page Road | Convert to freeway | Funded | 2025 – ROW 2027 – Construction |
| U-5702C | US 70 | South Miami Boulevard to Page Road Extension | Convert to Freeway | Funded | 2025 – ROW 2027 – Construction |
| B-5512 | Kemp Road | | Replace bridge no. 89 over Lick Creek | Funded | 2019 – ROW 2020 – Construction |
| U-5518B | US 70 | T.W. Alexander | Convert at-grade intersection to interchange | Funded | 2019 – ROW 2021 – Construction |
| U-5518A | US 70 | West of T.W. Alexander Drive to I-540 | Corridor upgrade | Funded | 2019 – ROW 2021 – Construction |
| U-5891 | NC 50 (Creedmoor Road) | I-540 to north of NC 98 | Widen to multilane divided roadway. | | 2022 – ROW 2025 – Construction |
| I-5710 | I-540 | Leesville Road to Falls of Neuse Road | Install ramp meters at various interchanges | | <i>Completed</i> |
| U-5307A/B/C | US 1 | I-540 to Franklin County Line | Widening | | 2021 – ROW 2021 – Construction |
| EB-5896 | Wake Forest Bypass Greenway | NC 98 to Heritage Lake Road | Construct Greenway | | 2025 – Construction |
| B-5113 | Oak Grove Church Road | | Replace bridge no. 157 over Smith Creek | | <i>Completed</i> |
| R-2814C | US 401 | NC 96 to Flat Church Road/ Clifton Pond Road | | | <i>Under Construction</i> |

Other Transportation Projects Along NC 98 Corridor

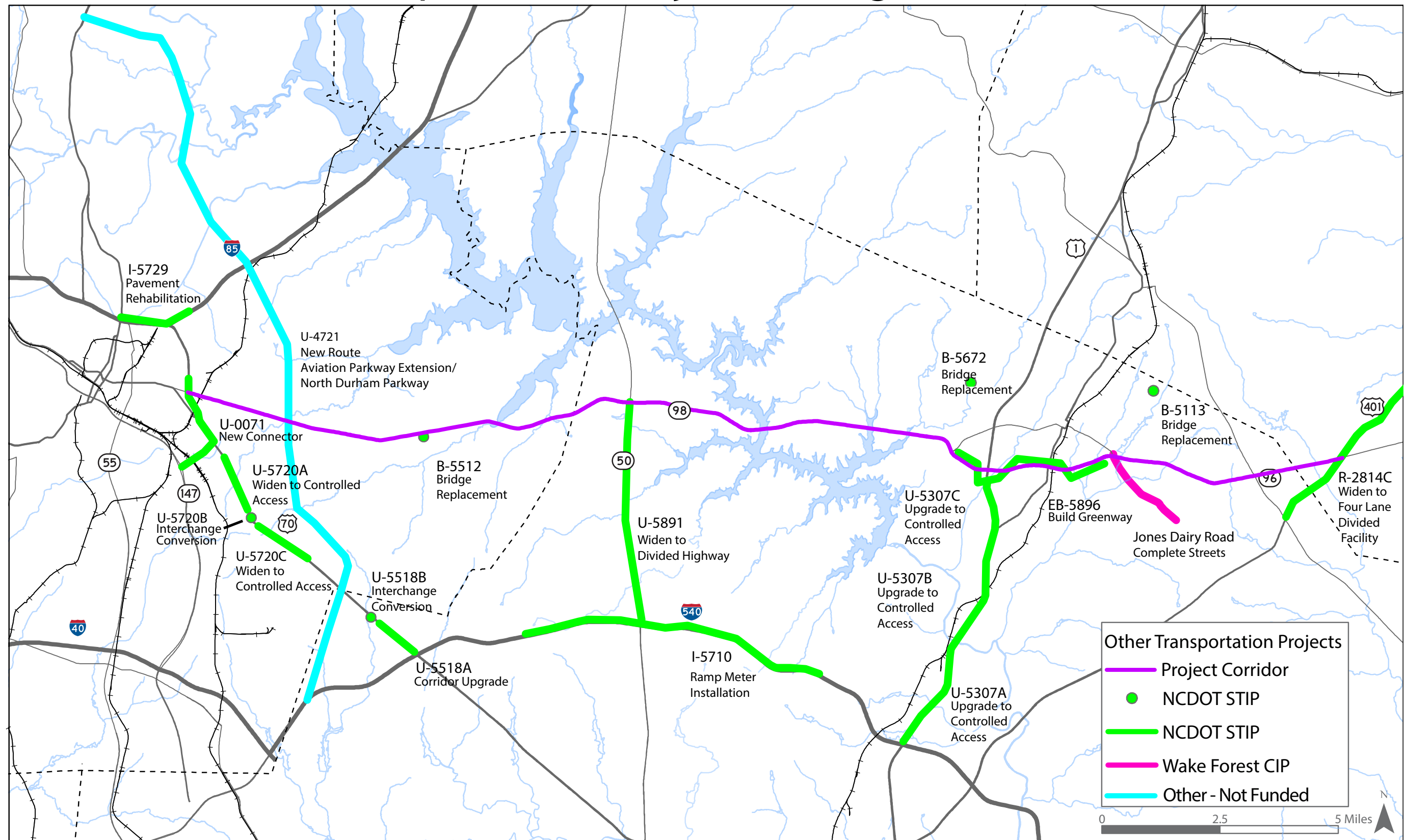


Figure 15: Future Transportation Project Locations

2 PUBLIC ENGAGEMENT

2.1 PROJECT COORDINATION TEAMS

2.1.1 Study Oversight Team

The Study Oversight Team (SOT) provided stakeholder oversight and feedback to the project team. The SOT was comprised of representatives from the CTT agencies including local stakeholders and elected officials.

The first SOT meeting was held on March 9, 2017 at Faith Harvest (4737 Willeva Drive, Wake Forest) from 4 – 6 p.m. A presentation was given to introduce the study to the SOT members. The Project Team solicited feedback from the SOT attendees on methods for distribution of project materials to the public. The SOT members also were invited to participate in a mapping activity to identify challenges and opportunities along the corridor. Their comments were added to the interactive crowdsourcing map.

The second SOT meeting was held on August 31, 2017 at Faith Harvest from 4 – 5 p.m. A presentation informed attendees of project work to date as well as the results from the first round of public meetings. SOT members were asked to help distribute information regarding the upcoming public workshops within their networks. The public workshop materials were setup for feedback and review by the SOT. This included the identified intersections for improvement and the alternative intersection design options for each intersection.

The third SOT meeting was held on March 27, 2018 at Durham Regional Library from 3 – 4:30 p.m. Boards and maps were laid out to mimic the layout for the upcoming public meetings. The boards showed project history, short and long-term improvements, and potential funding sources. The maps showed the long-term improvements in detail. SOT members were asked to walk through the setup, reviewing the material and providing any feedback of changes. SOT members were asked to help distribute information regarding the upcoming public workshops within their networks.

2.1.2 Core Technical Team

The Core Technical Team (CTT) convened on a monthly basis to provide technical analysis and help manage the project. The CTT consisted of staff from CAMPO, DCHC MPO, NCDOT, City of Durham, Durham County, Town of Wake Forest, City of Raleigh, Town of Rolesville, Franklin County, and Wake County. 17 CTT meetings were conducted over the course of 18 months.

2.2 PUBLIC OUTREACH

Public and stakeholder involvement have been a key component of this project in defining the community vision, and corridor deficiencies and opportunities. The study limits extend through three counties (Durham, Wake, and Franklin), four municipalities, and two MPOs (CAMPO and DCHC MPO) planning areas. Commuters were included as a target population as this corridor is heavily utilized by commuters. The Study Team conducted numerous outreach and engagement methods to effectively reach the wide range of audiences impacted by this corridor. Outreach methods included:

- Media outreach and press releases;
- Project website announcements;
- Project eblasts (mass emails to citizens who elected to receive project information);

- Social media posts (CAMPO and DCHC MPO social media accounts were utilized to distribute project communications in both English and Spanish);
- Stakeholder outreach;
- Informational flyer and project business card distribution to businesses and community organizations along the corridor;
- Yard signs;
- Pop-up events (two held on each end of the corridor prior to each round of public workshops); and,
- Corridor Outreach (Southern High School football game, businesses, and churches).



Project materials were available in both English and Spanish as there is a large Spanish-speaking population along the corridor. In addition to the project communication methods, the Project Team incorporated CAMPO's and DCHC MPO's existing communication channels to promote the project and public participation opportunities.

2.3 ONLINE ENGAGEMENT

Online public engagement techniques were incorporated to compliment traditional methods of public involvement and expand the project reach. The following information details online engagement for the NC 98 Corridor Study.

2.3.1 Website

A project website (www.NC98Corridor.com) was launched on February 23, 2017. The website served as a tool to provide the public with project information and a forum to submit questions and comments at the public's convenience. The Project Team monitored the incoming comments and responded as needed. A table of comments can be found in the Appendix. Project information was updated regularly throughout the project to provide the most accurate and timely information. Website content was also provided in Spanish to reach Limited English Proficiency (LEP) populations.



2.3.2 Social Media

Social media publicized public participation opportunities and project information. The NC 98 Corridor Study Project Team capitalized on CAMPO and DCHC MPO's existing followers by using their existing social media accounts. Information

was posted throughout the project to maintain contact with the public.

The chart below shows the online engagement statistics over the course of the study.

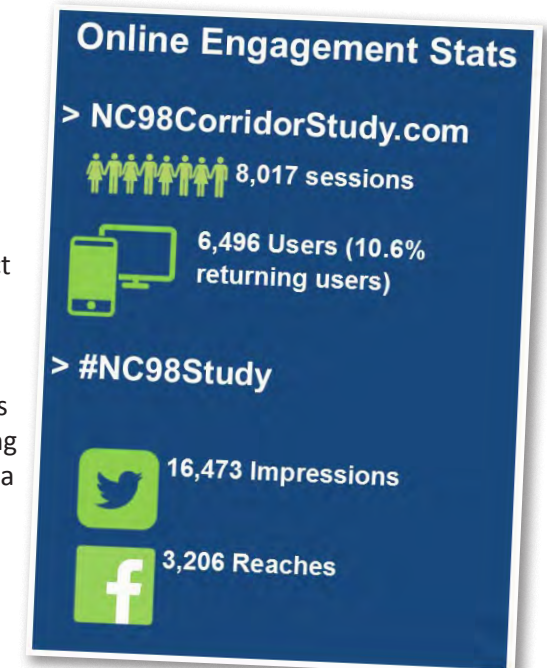


Figure 16: Online Engagement Statistics

2.3.3 Interactive Crowdsourcing Map

The goal of the first phase of public engagement was to garner public input concerning corridor constraints and opportunities. The project website featured an interactive crowdsourcing map tool that captured the public's comments regarding corridor concerns, areas in need of improvement, and public perception for opportunities. The map allowed the public to post their comments in the geographical location to which the comment was applicable. Map comments received during the Stakeholder Oversight Team meeting were added to the online crowdsourcing map to start conversation. Over 550 comments were received on the map from its launch until the end of the public comment period (February 23 – April 6, 2017).

The common themes on the crowdsourcing map are shown in the Top Crowdsourcing Map Themes image. The project team reviewed this information and developed proposed improvements based on public feedback and the traffic analysis. The interactive crowdsourcing map can be reviewed at this link: <http://www.nc98corridor.com/crowdsourcing/map>.

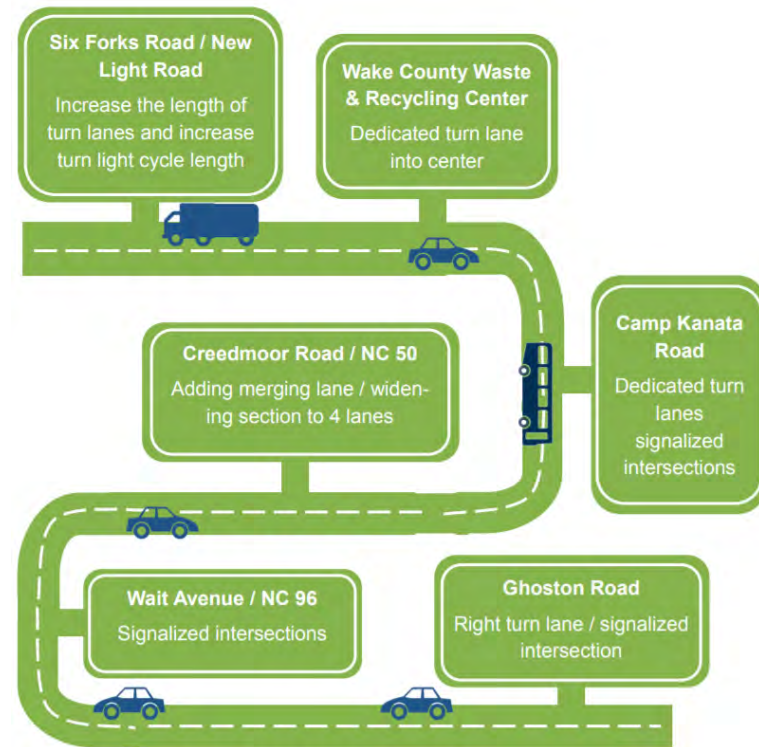
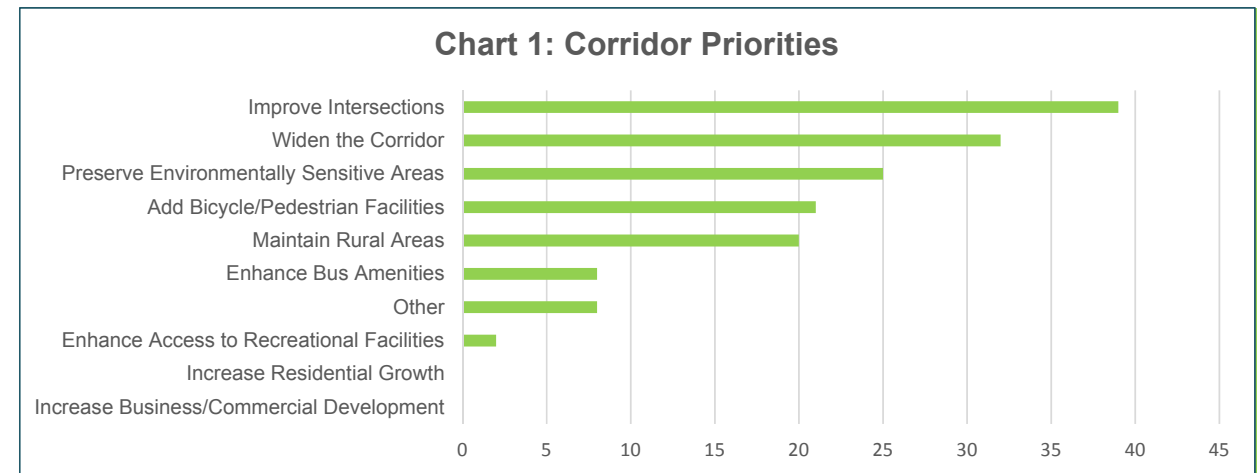


Figure 17: Top Crowdsourcing Map Themes



The "Other" responses included:

- Noise barriers (Wake Forest)
- Stop developing (Wake Forest)
- Turning lanes (Wake Forest)
- Keep as is (Wake Forest)
- School flashing light and decrease speed limit by school to 25 miles per hour (Durham)
- Traffic light at Adams and Holloway for the school children and staff (Durham)

All public comments written on the maps during the workshop were added to the interactive crowdsourcing map for those who were not able to attend in person so see all the comments.

The comment form asked a series of questions about the corridor with multiple choice answers. The chart below details the results.



2.4 PUBLIC WORKSHOPS

2.4.1 Public Workshop 1: Visioning

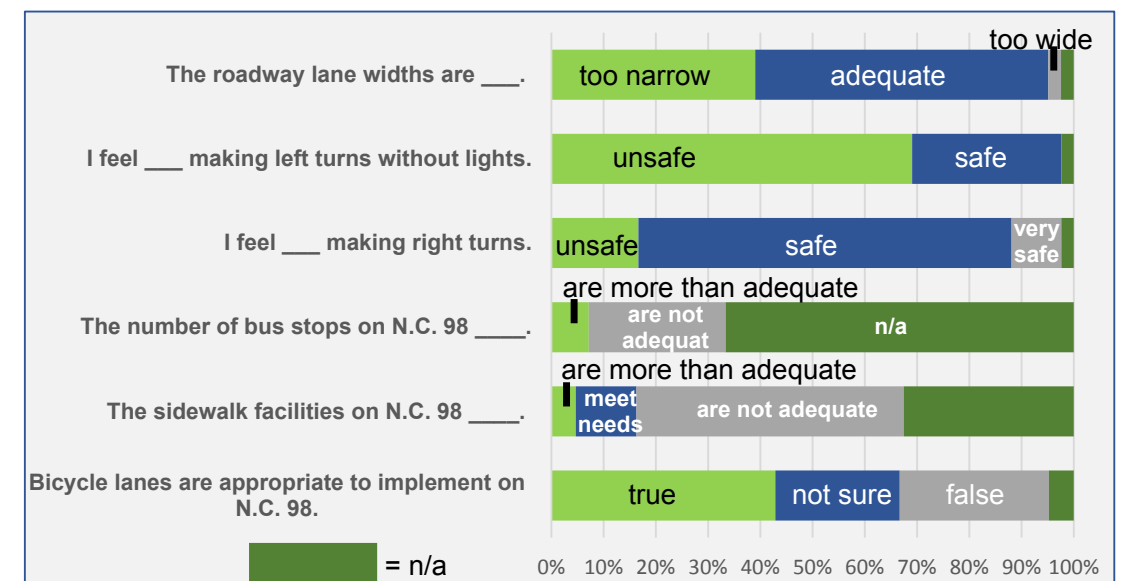
The first phase of public engagement activities centered around visioning and data collection of the public's concerns and opinions on corridor opportunities. The first round of Public Workshops was held on March 21, 2017 in Wake Forest and March 23, 2017 in Durham. A total of 73 citizens attended the Wake Forest Town Hall (62 participants) and the Reaching All Minds Academy (11 participants) in Durham. The public workshop provided attendees with the opportunity to review

project information, ask questions, and participate in a mapping activity, which solicited public input regarding concerns and opportunities along the corridor (see section 1.3.2 Interactive Crowdsourcing Map). Upon arrival attendees received a comment form and three stickers to "vote" for their top three corridor priorities (out of a possible ten priorities listed) on the Priority Board.

The top corridor priorities as recorded at both workshops are as shown in Chart 1.

The public comment period extended until April 6, 2017 (two weeks past the public meeting) to allow citizens to submit their comments following the public workshops. During that time, an additional 45 comment forms were received by the project team.

Chart 2: Comment Form Results



2.4.2 Public Workshop 2: Conceptual Recommendations

The second round of public workshops were held on September 19, 2017 in Wake Forest and September 21, 2017 in Durham. A total of 63 citizens attended the two public workshops at the Wake Forest Town Hall meeting (34 participants) and the Durham Regional Library meeting (29 participants). The purpose of the second phase of public engagement was to present conceptual designs for improvements along the corridor and garner public feedback. The widening of NC 98 between Sherron Road to Old Falls of Neuse Road, and Jones Dairy Road to US 401 was identified as a long-term recommendation. Additionally, the following seven intersections were identified for long-term improvements:

| | | | | | | |
|----------------------|--------------|-------|----------------|-------------------------|-------------------|------------------|
| Mineral Springs Road | Sherron Road | NC 50 | Six Forks Road | Old Falls of Neuse Road | South Main Street | Jones Dairy Road |
|----------------------|--------------|-------|----------------|-------------------------|-------------------|------------------|

The public workshops provided attendees with the opportunity to review conceptual intersection and roadway designs, project information, ask questions, and participate in activities regarding potential improvements. Upon arrival attendees received a comment form and stickers to select their preferred intersection treatments along the corridor.

Stickers were also used to “vote” on trade-offs along the corridor. The trade-offs were tailored to gain information on what was most important to the public concerning the corridor. For example, one trade-off asked attendees if they would rather have a faster travel time and eliminate left turns at intersections or if they would rather have left turns but experience traffic delays. Asking these types of questions enabled the project team to see what type of intersection treatments the public would prefer most. The trade-offs and responses are shown in Chart 3 and 4.

Chart 3: Wake Forest Trade-Off Responses

| Trade-Off Option 1 | Very Strong | | Neutral | | Very Strong | Trade-Off Option 2 |
|---|-------------|---|---------|---|-------------|---|
| Traffic Flow vs Accessibility | | | | | | |
| I would rather have faster travel times even if it means that left turns at intersections will be eliminated. | 11 | 1 | 1 | 1 | 0 | I would rather have left turns at intersections even if it means that I will experience traffic delays. |
| Property Impacts vs Pedestrian & Bicycle Accommodations | | | | | | |
| I want as little impacts to property owners as possible even if it means no bicycle and pedestrian facilities. | 0 | 0 | 1 | 3 | 9 | I want separate facilities for pedestrians and bicycles even if it requires taking property. |
| Traffic Safety & Flow vs Pedestrian Accessibility | | | | | | |
| I want to improve safety and capacity for vehicles even if it means the intersection is not pedestrian friendly. | 2 | 8 | 0 | 0 | 3 | I would rather have an intersection that is pedestrian friendly even if it impacts traffic flow and capacity. |
| Travel Time vs Property Access | | | | | | |
| I would rather have shorter travel times even if it means access to driveways will be limited to increase mobility. | 7 | 6 | 0 | 0 | 1 | I would rather have access to driveways even if it means that travel time will increase. |

Chart 4: Durham Trade-Off Responses

| Trade-Off Option 1 | Very Strong | | Neutral | | Very Strong | Trade-Off Option 2 |
|---|-------------|---|---------|---|-------------|---|
| Traffic Flow vs Accessibility | | | | | | |
| I would rather have faster travel times even if it means that left turns at intersections will be eliminated. | 2 | 1 | 1 | 2 | 6 | I would rather have left turns at intersections even if it means that I will experience traffic delays. |
| Property Impacts vs Pedestrian & Bicycle Accommodations | | | | | | |
| I want as little impacts to property owners as possible even if it means no bicycle and pedestrian facilities. | 8 | 0 | 1 | 1 | 6 | I want separate facilities for pedestrians and bicycles even if it requires taking property. |
| Traffic Safety & Flow vs Pedestrian Accessibility | | | | | | |
| I want to improve safety and capacity for vehicles even if it means the intersection is not pedestrian friendly. | 3 | 0 | 0 | 1 | 3 | I would rather have an intersection that is pedestrian friendly even if it impacts traffic flow and capacity. |
| Travel Time vs Property Access | | | | | | |
| I would rather have shorter travel times even if it means access to driveways will be limited to increase mobility. | 1 | 0 | 0 | 2 | 8 | I would rather have access to driveways even if it means that travel time will increase. |

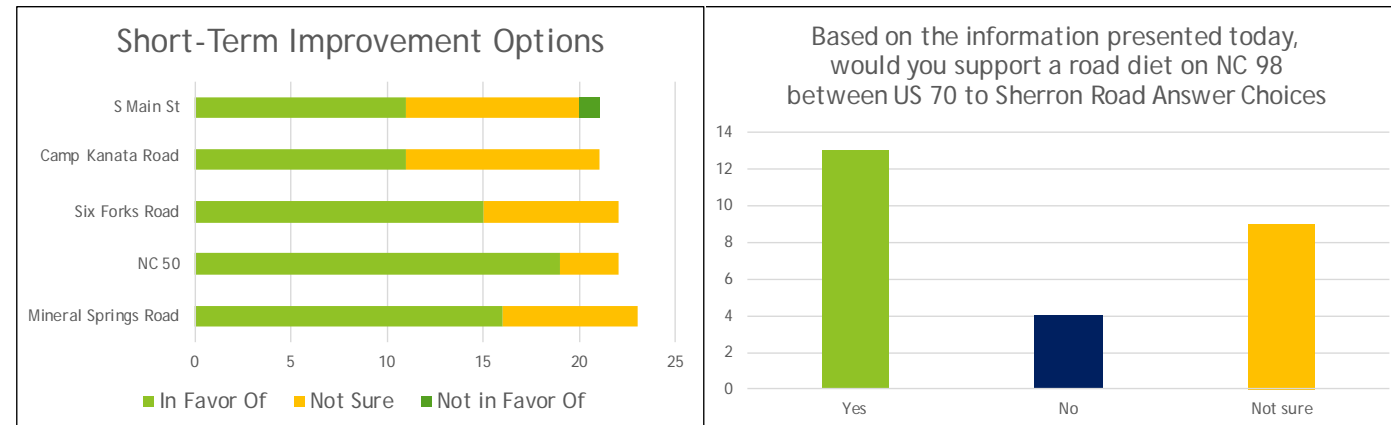
Chart 5: Trade-Off Responses Combined

| Trade-Off Option 1 | Preferred | Neutral | Preferred | Trade-Off Option 2 |
|---|-----------|---------|-----------|---|
| Traffic Flow vs Accessibility | | | | |
| I would rather have faster travel times even if it means that left turns at intersections will be eliminated. | 33 | 13 | 26 | I would rather have left turns at intersections even if it means that I will experience traffic delays. |
| Property Impacts vs Pedestrian & Bicycle Accommodations | | | | |
| I want as little impacts to property owners as possible even if it means no bicycle and pedestrian facilities. | 23 | 5 | 47 | I want separate facilities for pedestrians and bicycles even if it requires taking property. |
| Traffic Safety & Flow vs Pedestrian Accessibility | | | | |
| I want to improve safety and capacity for vehicles even if it means the intersection is not pedestrian friendly. | 40 | 1 | 25 | I would rather have an intersection that is pedestrian friendly even if it impacts traffic flow and capacity. |
| Travel Time vs Property Access | | | | |
| I would rather have shorter travel times even if it means access to driveways will be limited to increase mobility. | 41 | 7 | 23 | I would rather have access to driveways even if it means that travel time will increase. |

The comment form asked a series of questions about the corridor with multiple choice answers, focusing short term improvements and the proposed road diet on the western section of NC 98. The chart below details the results.

An online survey was posted for those unable to attend the public meetings. Forty-six people participated in the online survey. Information about how public input informed the recommendations is available in section 3.2.2 *Intersection Alternatives*.

Chart 6: Comment Form Results (Workshop #2)



2.4.3 Public Workshop 3: Final Recommendations

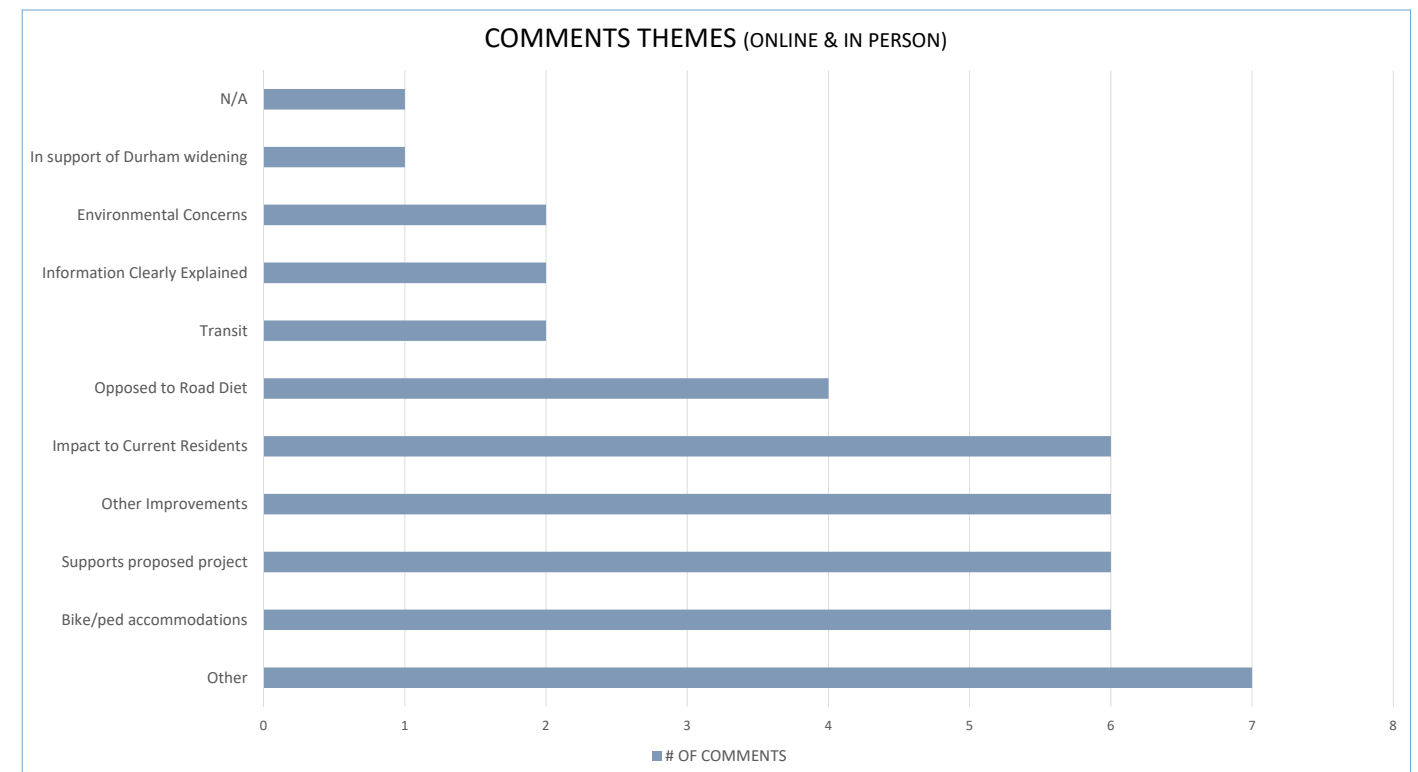
The third round of public workshops were held on April 12, 2018 in Wake Forest and April 16, 2018 in Durham. A total of 85 citizens attended the two public workshops at the Wake Forest Town Hall meeting (36 participants) and the Durham Regional Library meeting (49 participants). The purpose of the third phase of public engagement was to present an overview of the corridor study, short and long-term improvements along the corridor, and garner public feedback. A conceptual design of the long-term improvements along the entire corridor were laid out in detail for the public to view. The following were identified as long-term recommendations:

- **Priority #1a:** US 70 to Sherron Road – Road Diet or 4-lane widening
- **Priority #1:** Sherron Road to Old Falls of Neuse Road – Widen to 4 lanes
- **Priority #2:** Old Falls of Neuse to Jones Dairy Road – Wake Forest Roadway Improvements
- **Priority #3:** Jones Dairy Road to US 401 – Widen to 4 lanes



Figure 18: Top Comments (Workshop 3)

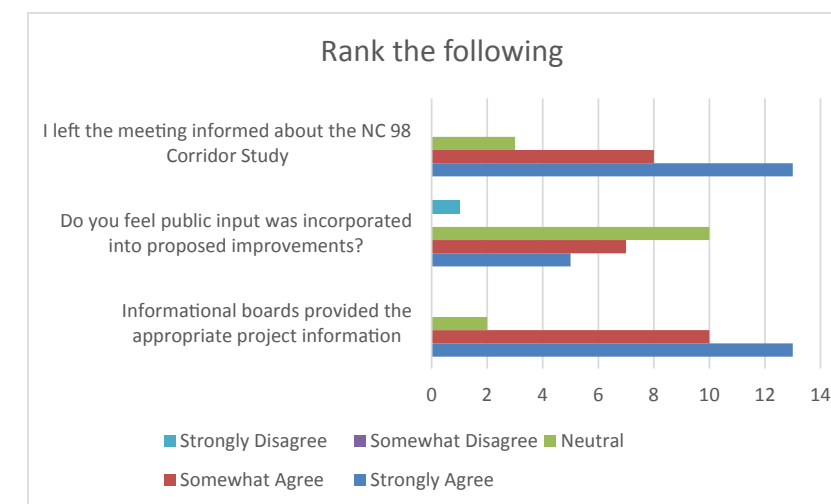
Chart 7: Comment Form Results (Workshop #3)



Comment forms were handed out at both public meetings. Comments were also accepted through the corridor study website and via email for those who were unable to attend the public meetings. Forty-one comment forms were received between the two meetings and via the website.

The comment form asked if there were any comments, questions, concerns after reviewing the material presented at the meeting. Chart 7 highlights the common themes in those comments. Chart 8 shows how community members ranked statements about the project and information provided at the meeting.

Chart 8: Comment Form Results Workshop #3



3 ALTERNATIVES

The first set of public meetings laid the foundation for developing alternatives along the corridor. After presenting existing conditions found during the first phase of the study, the first public meetings asked members of the public to tell the project team about NC 98 and what priorities they have for NC 98. As mentioned above, the most common priorities heard at the public meetings were to improve intersections and widen the corridor, followed by preserve environmentally sensitive areas and add bicycle/pedestrian facilities. Keeping these priorities in mind, the project team began the transportation analysis phase of the study looking at crash data, traffic data, and various roadway designs to begin developing alternatives.

3.1 TRAFFIC ANALYSIS

Critical to the evaluation of the NC 98 project was the ability to evaluate the future impact of automobile traffic along the corridor. The approach taken for the NC 98 project was a unique three-tiered approach, as highlighted in Figure 19. The approach applied various analysis tools to allow for maximum integration with the funding processes in place at the State and regional level while simultaneously informing the planning and operational efforts for NC 98.

The analysis at each level is presented in the remainder of this section.

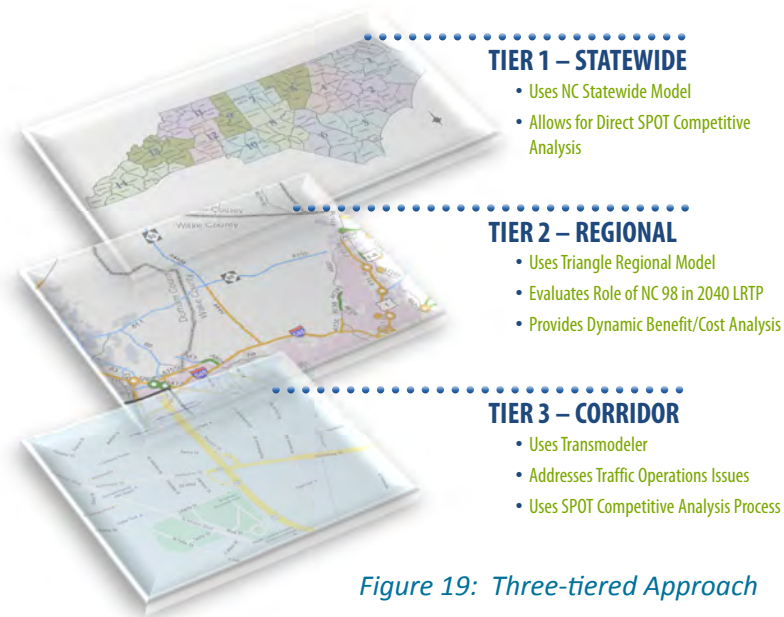


Figure 19: Three-tiered Approach

3.1.1 Statewide Tier Analysis

The statewide tier (Tier 1) used the North Carolina Statewide Transportation Model (NCSTMv2) to test different corridor-level solutions using the SPOT P4 travel time savings (TTS) procedures. The application of the processes used in P4 allowed for comparison of the NC 98 project segments to the known P4 prioritization TTS results to inform the study team of the competitiveness for funding of each project segment. The comparison does not guarantee that the NC 98 segments would rank in this location for future editions of the SPOT prioritization process given its constant revisions, however it guided the evaluation of the segments to allow for the NC 98 segment with the most potential for funding to be put forward.

For the purposes of the analysis, a decision to segment NC 98 into the five approximate sections shown in Figure 20 was made. These sections were evaluated for the TTS over a 10 year period and the results of the analysis are in Table 6. Section 25505 is the road diet and as expected creates a negative TTS. The segments from west to east then produce the best savings in TTS. When combined, the best benefit was the central segments of the project.

To put in perspective the benefit of the combined project segments and the potential for funding at the State level, a quick comparison was done to the TTS results of the existing P4 project analysis. NC 98 compared to other projects that were submitted resulted in NC 98 being very competitive. As shown in Table 7, NC 98 would rank competitively with projects like NC 42, NC 50 and the upgrading of US 1.

Figure 20: Five Analysis Segments

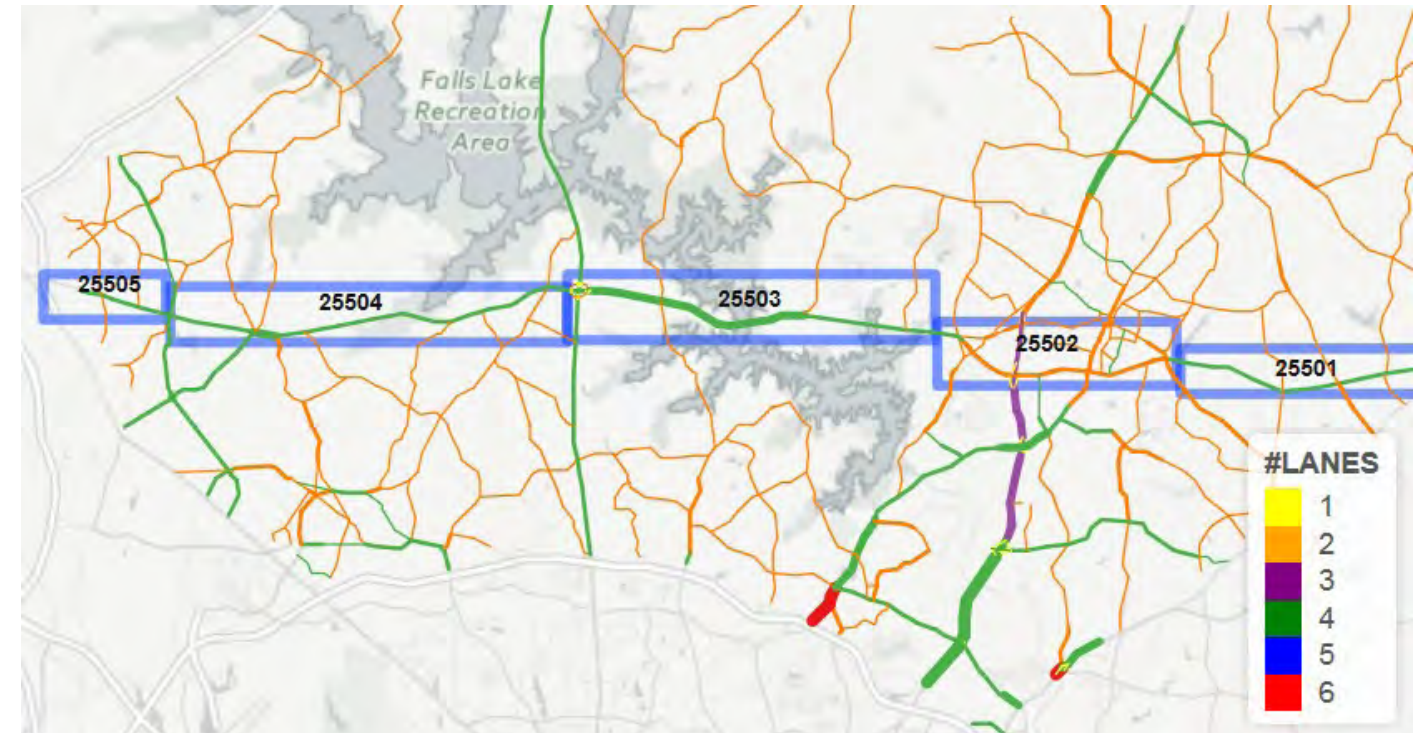


Table 6: TTS Results

| Segment ¹ | Proposed Treatment | TTS Total Base Year (Hrs) | TTS Total Future Year (Hrs) | TTS Total over 10 years - NCSTM (Hrs) | TTS Total over 10 years - NCSTM (\$) |
|---|--------------------|---------------------------|-----------------------------|---------------------------------------|--------------------------------------|
| Thompson Mill Road to Jones Dairy Road (25502) | Widening | 1,963 | 7,042 | 45,023 | 665,763 |
| NC 50 to Thompson Mill Road (25503) | Widening | 60,086 | 118,369 | 892,277 | 13,481,926 |
| Mineral Springs Road to NC 50 (25504) | Widening | 73,966 | 124,449 | 992,073 | 14,263,389 |
| Lynn Road to Mineral Springs Road (25505) | Road Diet | - 55,263 | 127,235 | - 912,492 | - 12,609,415 |
| Mineral Springs Road to Thompson Mill Road (NC98_503_504) | Widening | 163,176 | 295,733 | 2,294,543 | 33,605,146 |

¹Section 25501 was removed from the analysis because the increase in capacity and the current volumes that are way under capacity overstated the benefits based on the change in speed that was used.

Table 7: State Project Rankings

| SPOT ID | TIP | Route | From / Cross Street | To | Description | TTS Total Base Year | TTS Total Future Year | TTS Total over 10 years - NCSTM (hrs) | TTS Total over 10 years - NCSTM (\$) |
|--------------|----------|--------------|--------------------------------|--|----------------------------------|---------------------|-----------------------|---------------------------------------|--------------------------------------|
| H090967-B | U-5307B | US 1 | North of SR 2006 (Durant Road) | North of SR 2045 (Burlington Mills Road) | Upgrade Roadway to Freeway. | 148,057 | 167,561 | 1,578,092 | \$24,995,051 |
| H090227-B | R-3410B | NC 42 | US 70 Bypass | US 70 Business | Widen to Multi-Lanes | 138,320 | 204,772 | 1,715,458 | \$26,375,570 |
| H090577 | FS-1205D | NC 50 | I-540 | NC 98 | Widen from 2 to 4 Lanes. | 189,488 | 213,235 | 2,013,613 | \$29,447,373 |
| NC98_503_504 | | | | | | 163,176 | 295,733 | 2,294,543 | \$33,605,146 |
| H111022-C | | US 1 | NC 55 | US 64 | Widen Roadway to 6 Lanes. | 229,255 | 255,255 | 2,422,550 | \$38,056,119 |
| H150720 | | I-495, US 64 | I 440 | US 64 Business | Widen roadway from 6 to 8 lanes. | 151,584 | 469,959 | 3,107,715 | \$44,520,678 |

3.1.2 Regional Tier Analysis

Given the roadway resolution present in the NCSTM, it is practical to use the NCSTM to maintain consistency in comparing all projects of statewide significance, but it does not allow for detailed analysis nor evaluation of project interaction at a more refined level of geography.

Therefore, the regional tier (Tier 2) analysis was used to understand the unique travel markets and flow patterns specific to the NC 98 corridor. The use of a regional analysis tool, like the Triangle Regional Model (TRMV6)², allows for the quantification of system-level impacts and interactions of NC 98 with other regionally significant projects.

The TRMV6 focused on a regional calibration of parameters and highway volumes, therefore careful application of the model is required. Analysis of the existing regional model volumes determined additional refinements to the travel patterns were required to improve confidence in the use of the model outputs for the regional tiered evaluation. Details of that analysis and the subsequent refinements made to the model can be found in the Appendix.

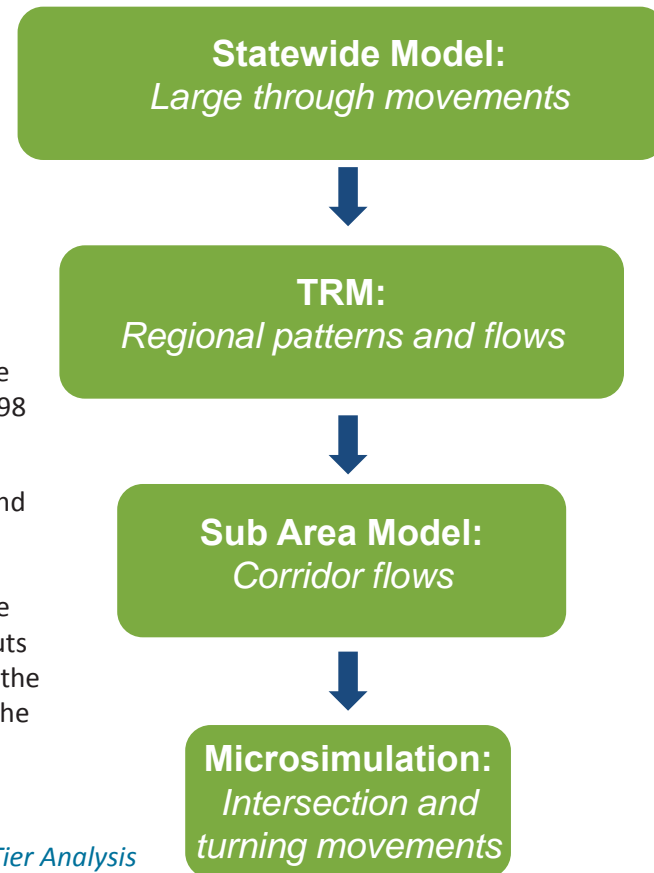


Figure 21: Regional Tier Analysis

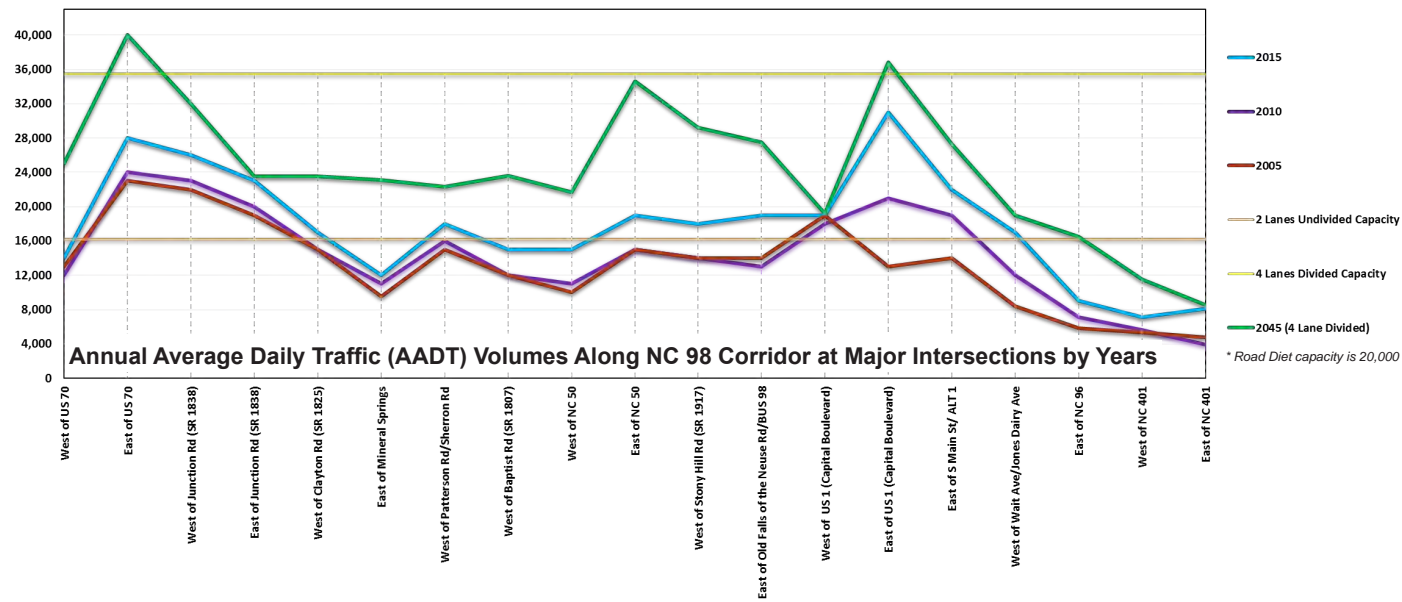
²The model used was the officially adopted and calibrated model for the region. All inputs and outputs for TRMV6 were provided by CAMPO as a part of the analysis and were not developed by the consultant for this study.

Table 8: Historic Traffic Volumes

| LOCATION | HISTORIC VOLUMES | | FUTURE VOLUMES | |
|--|----------------------|----------------------|-----------------------|-------------------------|
| | 2010 Traffic Volumes | 2015 Traffic Volumes | 2045 (4 Lane Divided) | 2045 (2 Lane Road Diet) |
| West of US 70 | 12,000 | 14,000 | 25,000 | 25,000 |
| East of US 70 | 24,000 | 28,000 | 40,000 | 40,000 |
| West of Junction Rd (SR 1838) | 23,000 | 26,000 | 32,000 | 24,500 |
| East of Junction Rd (SR 1838) | 20,000 | 23,000 | 23,500 | 15,100 |
| West of Clayton Rd (SR 1825) | 15,000 | 17,000 | 23,500 | 15,200 |
| East of Mineral Springs | 11,000 | 12,000 | 23,100 | 17,500 |
| West of Patterson Rd/Sherron Rd | 16,000 | 18,000 | 22,300 | 16,700 |
| West of Baptist Rd (SR 1807) | 12,000 | 15,000 | 23,600 | N/A |
| West of NC 50 | 11,000 | 15,000 | 21,700 | N/A |
| East of NC 50 | 15,000 | 19,000 | 34,600 | N/A |
| West of Stony Hill Rd (SR 1917) | 14,000 | 18,000 | 29,200 | N/A |
| East of Old Falls of the Neuse Rd/BUS 98 | 13,000 | 19,000 | 27,500 | N/A |
| West of US 1 (Capital Boulevard) | 18,000 | 19,000 | 19,200 | N/A |
| East of US 1 (Capital Boulevard) | 21,000 | 31,000 | 36,800 | N/A |
| East of S Main St/ ALT 1 | 19,000 | 22,000 | 27,300 | N/A |
| West of Wait Ave/Jones Dairy Ave | 12,000 | 17,000 | 19,000 | N/A |
| East of NC 96 | 7,100 | 9,000 | 16,500 | N/A |
| West of NC 401 | 5,600 | 7,100 | 11,500 | N/A |
| East of NC 401 | 3,900 | 8,100 | 8,500 | N/A |

Table 8 shows the historic traffic volumes for the corridor. As specified in the Appendix, the refinements included the development of a sub-area model specific to the NC 98 corridor. The resulting volumes from that sub-area model were used to generate the future forecasted volumes in Table 8. The future volumes are based on proposed roadway improvements from the CAMPO and DCHC 2040 Metropolitan Transportation Plan (MTP) where NC 98 is programmed as a 4-lane roadway. In addition, a road diet was considered for the western portion of the corridor, so future volumes for the road diet are displayed where applicable.

Figure 22: Future Year Analysis



The future year analysis of NC 98 as a 4-lane facility is presented in Figure 22. The lines show historic traffic volumes, along with anticipated future traffic volumes. The capacity of an undivided, two-lane roadway and a divided, four-lane roadway are shown on the chart for comparison. This chart is a good visual representation, showing that NC 98 is over, or near, capacity in much of the central segment and that traffic volumes are expected to continue growing until 2045. The regional model analysis supports the MTP suggestion of a 4-lane facility for NC 98.

Table 9: Alternatives Tested

| Scenario | Year | NC 98 Cross Section | Sherron Road Cross Section | Northern Durham Parkway |
|----------|------|---------------------|----------------------------|-------------------------|
| 1 | 2013 | 2 | 2 | No |
| 2 | 2045 | 2 | 4 | Yes |
| 3 | 2045 | 4 | 4 | Yes |
| 4 | 2045 | 4 | 2 | No |
| 5 | 2045 | 2 | 4 | Yes |
| 6 | 2045 | 2 | 2 | No |

The regional analysis suggests that most of the facility needed to be four lanes but additional analysis was performed to understand the impacts of the proposed road diet. A total of 6 scenarios were conducted using the subarea tool to produce future traffic estimates. The testing of the alternatives served the purpose of understanding the impacts to NC 98 given changes

to the surrounding regionally planned network. This analysis used Sherron Road as the key pivot point for potential impacts due to existing projects in the long range plans for widening Sherron and the inclusion of the Northern Durham Parkway. The alternatives tested are shown in Table 9 above.

Table 10 shows the results of the scenarios and the impacts on the NC 98 travel patterns. Without the widening of Sherron and without the Parkway in place, NC 98 would be congested and not likely functional. The volumes east of Sherron Road remain consistent in all scenarios and highlight that the road diet has minimal effect on NC 98 east of Sherron. As shown by the numbers in Table 10, the success of the road diet hinges on the widening of Sherron Road and the inclusion of the Parkway. Scenario 5 produces approximately 17,000 vehicles per day (vpd) which is at the top of the functional operation for a two lane properly designed road diet facility. This forces many of the other roadways near the corridor to handle the displacement of the extra vehicles and increases the congestion on those facilities.

If NC 98 is left as a 4-lane facility with the Parkway removed and Sherron road not widened then NC 98 is completely operational with no concerns and the volume increase is noted. This suggests that more travelers will have to use NC 98 given limited options for other travel paths. The increase in volume also suggests that the through movements increase and that with the road diet in place, less through movement occurs.

Table 10: Sherron Road Projected Volumes

| Cross Section ³ | 2045 Volume W of Sherron | 2045 Volume E of Sherron |
|--|--------------------------|--------------------------|
| Scenario 3: 4 Lane (median) of NC 98 | 22,000 | 33,000 |
| Scenario 5: 2 Lane NC 98 (Road Diet) | 17,000 | 32,600 |
| Scenario 4: 4 Lane (median)- No Parkway & 2 lane Sherron | 28,000 | 35,000 |
| Scenario 6: 2 Lane- No Parkway & 2 lane Sherron | 20,000 | 32,000 |

The road diet changes the north-south travel movements to spread out and use other facilities like Stallings Road, Mineral Springs Road, Sherron and the Parkway.

The regional analysis also involved a process of ranking the reduction in delay of the various segments of NC 98. The process used to perform this analysis is outlined in the Appendix. The segmentation

of NC 98 in this analysis followed the Statewide tiered analysis for consistency (see figure 21). Table 11 shows that the western most portion of NC 98 will produce the highest reduction in hours of travel delay. In general, the delay reduction benefit decreases from west to east along NC 98. The other regional projects were included in this analysis and suggest that Sherron road improvements and the Parkway are critical in the region.

Table 11: Daily Delay Reduction

| ProjID | Road | From | To | Base Lanes | Proj Lanes | Daily Delay Reduction (hrs) |
|--------|-------------------|-------------------|------------------|------------|------------|-----------------------------|
| 25504 | NC 98 | N. Durham Parkway | NC 50 | 2 | 4 | 1300 |
| 25503 | NC 98 | NC 50 | NC 98 Bypass | 2 | 4 | 920 |
| 25501 | NC 98 | NC 98 Bypass | US 401 | 2 | 4 | 400 |
| A445b | NC 50 | Beaver Creek Rec | Old Weaver Trail | 2 | 4 | 60 |
| A445a | NC 50 | NC 98 Bypass | Beaver Creek Rec | 2 | 4 | 65 |
| 83 | N. Durham Parkway | I-40 | I-85 | 0 | 4 | 2500 |
| 96.1 | Sherron Rd | Mineral Springs | NC 98 | 2 | 4 | 650 |

The initial round of public meetings showed support for widening in the existing two-lane sections of the corridor. In addition, the traffic analysis showed that much of the existing two lane portions of the corridor are already at capacity.

3.1.3 Corridor Tier Analysis

The first two tiers provide important context for the entire project corridor, as well as a general idea of the right size and segmentation desired for long range planning. For a long-range plan, this would be enough, but a corridor study affords the opportunity to address specific points of concern like access management, operations and interchange/intersection treatments. The corridor tier approach used micro-simulations tools Synchro, TransModeler, and CapX

to perform a detailed analysis of intersections and operations along the corridor. This level of analysis is important, because it allowed testing of proposed intersection layouts like turn lanes and timings to measure improvements in travel time and reliability throughout the corridor. In addition, it allowed for short-term improvements to be developed and merged into the overall corridor level plan.

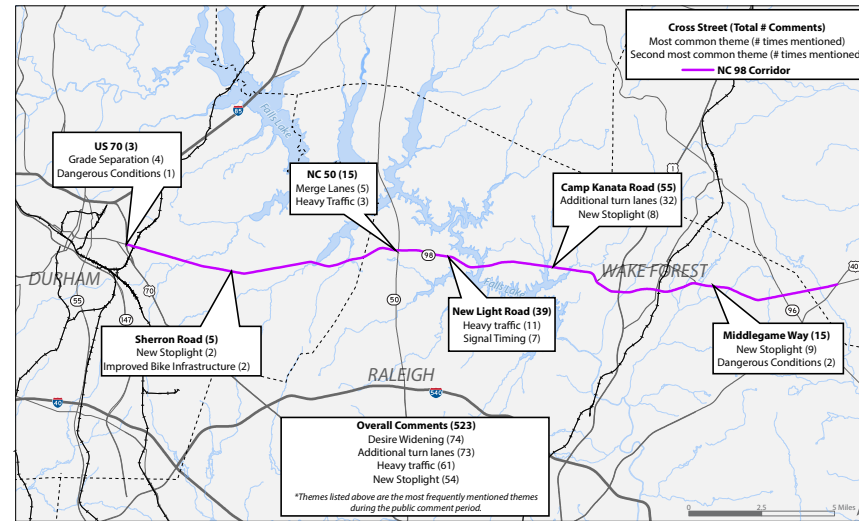
3.1.4 General Alternatives

3.1.4.1 Short-Term Alternatives

In addition to long-term alternatives, short-term alternatives were recommended. These short-term alternatives aim to ease current traffic issues in the more immediate future before the long-term alternatives are implemented. These improvements were developed from concerns seen on the crowdsourcing map, areas with high levels of congestion, and improvements that could be quickly implemented. Figure 23 shows how comments were organized by the area of concern. At the public meeting in Wake Forest, Camp Kanata Road and Six Forks Road (New Light Road) were two of the most mentioned locations on the corridor. Adding turn lanes at these locations could help allow traffic to continue moving on NC 98, while those wanting to turn, can stop within dedicated turn lanes, as opposed to stopping all through traffic. In Durham, there were concerns about crashes along the corridor and excessive speed near Reaching All Minds Academy. Installing a stoplight at Adams Street, can help allow better access in and out of the school and surrounding neighborhoods. Additional turn lanes at Mineral Springs can help prevent rear-end crashes that are frequently seen in this part of the corridor. The short-term improvements are shown on Figure 24 and listed below alphabetically:

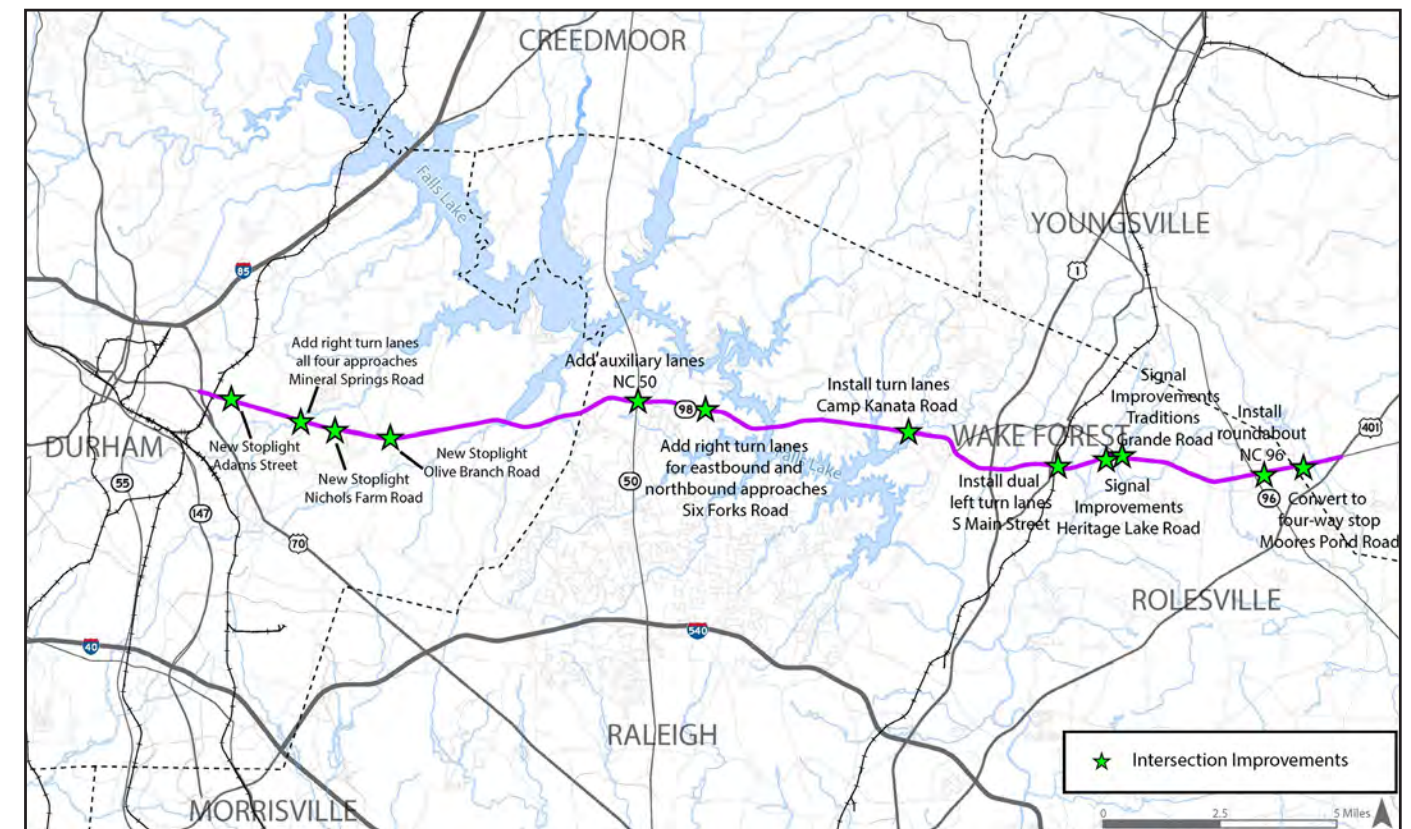
- A.** Adams Street – New Stoplight
 - This provides better access management from cross streets and surrounding neighborhoods. This might also help slow speed and allow better pedestrian access in front of Reaching All Minds Academy.
- B.** Mineral Springs Road – Add right turn lanes at all four approaches
 - This provides more storage at the intersection, helping to alleviate congestion.
- C.** Nichols Farm Road – New Stoplight
 - This provides better access management from neighborhoods.
- D.** Olive Branch Road – New Stoplight
 - This provides better access management from this cross street.
- E.** NC 50 – Add auxiliary lanes
 - This provides longer distances for merging, helping to alleviate congestion.
- F.** Six Forks Road – Add right turn lanes for eastbound and northbound approaches
 - This provides more storage at the intersection, helping to alleviate congestion.

Figure 23: Areas of Concern



- G.** Camp Kanata Road – Install turn lanes
 - This provides more storage at the intersection, helping alleviate congestion. It also removes stopped traffic, turning left, from the travel lanes, also alleviating congestion.
- H.** S Main Street – Install dual left turn lanes
 - This provides more storage at the intersection, helping alleviate congestion.
- I.** Heritage Lake Road – Signal Improvements
 - This adjusts signal timing to help alleviate congestion.
- J.** Traditions Grande Road – Signal Improvements
 - This adjusts signal timing to help alleviate congestion.
- K.** Moores Pond Road – Convert to four-way stop
 - This provides better access management for cars traveling across NC 98.

Figure 24: Short-term Improvements

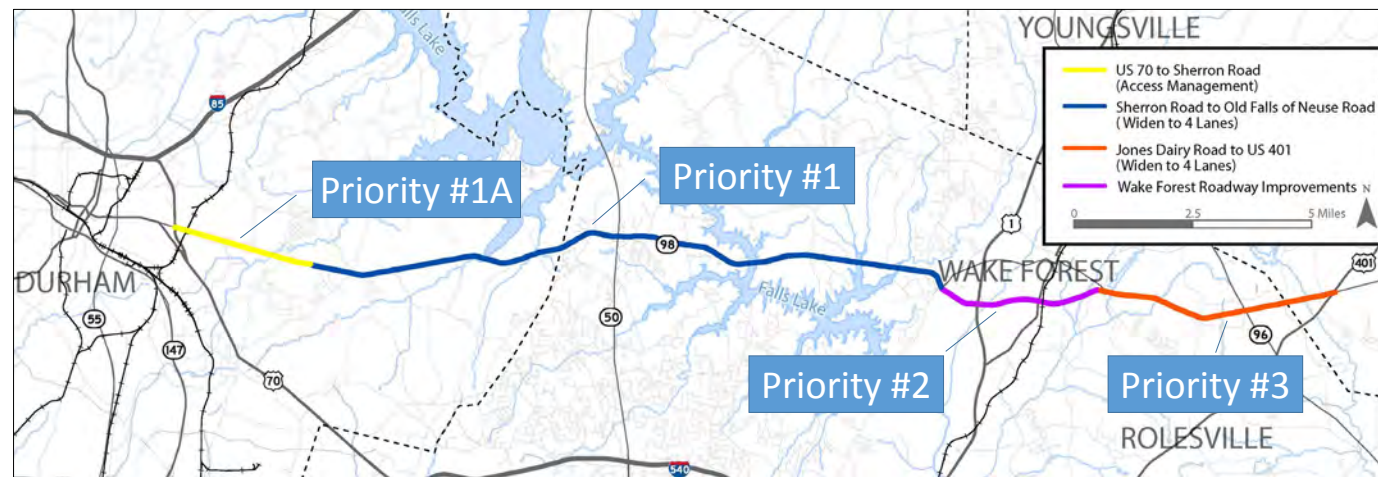


3.1.4.2 Long-Term Alternatives

After the first round of public meetings and studying the traffic analysis and travel modeling, preliminary long-term alternatives were developed. Those alternatives included:

- Road Diet or 4-lane widening (Junction Road to Sherron Road)
- Widen NC 98 from 2-lanes to 4-lanes (Sherron Road to Old Falls of Neuse Road)
- Widen NC 98 from 2-lanes to 4-lanes (Jones Dairy Road to US 401)

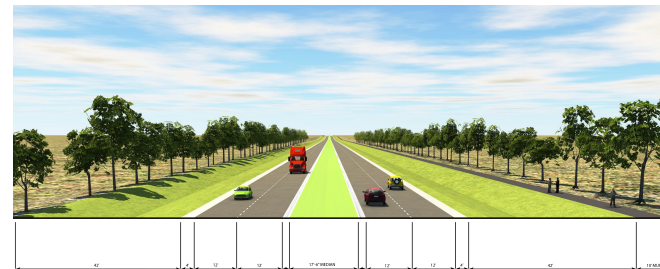
Figure 25: Long-term Improvements



Junction to Sherron – Access Management



4 Lane Widening – Potential Cross Section



Once it was decided to widen throughout most of the corridor, the cross section of what that widening would look like needed to be decided. Drawing on existing conditions inventory and plans was key in developing this cross section. Knowing there was limited ROW in Durham and wanting to avoid a high level of impacts to Falls Lake and the surrounding environmentally sensitive land, the design began to take shape on existing alignment. Input from stakeholders and the field visit showed that the Durham side of the corridor lacked pedestrian and bicycle infrastructure, but that this corridor was often used by both cyclists and pedestrians. The crash data also showed a large percentage of rear-end crashes. This led the design to prioritize bicycle and pedestrian infrastructure along NC 98 from Junction Road to Sherron Road, with improvements like turn lanes to improve those safety concerns. Towards the Durham and Wake County lines, there were numerous driveways along NC 98. With access management being a concern, the cross section in this section of the corridor began to involve more median u-turns at cross streets and a median throughout the widening to limit the left turns onto NC 98. This same concept was used

throughout the entire widening of the corridor, where low-density residential is scattered throughout. It was also discovered that the middle section of the corridor is often used by cyclists and contains crossings of the Mountains-to-Sea Trail. Despite lower volumes of pedestrians and cyclists, NC 98 around Falls Lake was discovered to be a critical regional connection for cycling routes and hiking. As the only east-west connection over Falls Lake, the design needed to include accommodations for these cyclists and pedestrians. Given projected speeds and volumes, it was decided that a multi-use path along this section of the corridor would be the safest option to accommodate non-motorized traffic along the corridor.

Using the existing conditions inventory and input from the public meeting, allowed the cross-section to begin to take shape. In some places, the future traffic volumes indicate that NC 98 is close to the capacity of a 4-lane road necessitating a conversation about whether NC 98 should be widened to 6-lanes in some locations. Due to the residential nature of the corridor and the environmental constraints, the CTT did not desire to widen NC 98 to 6 lanes. This drove the improvements towards alternative intersection designs that could help address various concerns at key locations throughout the corridor.

3.1.5 Intersection Alternatives

The first step in looking at alternative intersection design was to determine the efficiency of various intersection designs for each intersection along the corridor. A capacity analysis was performed using Synco, TransModeler, and CapX by looking at the ability of the intersection to handle both existing and future traffic volumes.

The same eight intersection designs were tested for each intersection. The result of the analysis focused on the volume to capacity ratio (V/C). A V/C ratio less than one indicates that there is more capacity within the intersection than there is volume of traffic traveling through that intersection. A V/C ratio equal to one indicates that the volume of traffic traveling through the intersection is the capacity of that intersection. A V/C ratio greater than one indicates that the volume of traffic is greater than the capacity of the intersection. The intersection designs were then ranked based on the V/C ratios. This analysis was performed for the following intersections:

- NC 98 and Mineral Springs Road
- NC 98 and Sherron Road/Patterson Road
- NC 98 and NC 50
- NC 98 and Six Forks/New Light Road
- NC 98 and Old Falls of Neuse Road
- NC 98 and S Main Street
- NC 98 and Jones Dairy Road

The rankings from the capacity analysis were the starting point in determining the recommended intersection designs at the intersection design throughout the corridor. The top five intersections treatments for these intersections were presented to the CTT. Figure 26 shows the table presented to the CTT. It also highlights short-term improvements and the current LOS for these intersections.

Figure 26: Capacity Analysis Rankings presented to the CTT

| Intersection | Approach | Existing (2017) | | | | SHORT - TERM IMPROVEMENTS | LONG - TERM IMPROVEMENTS (2045 volumes) | TOP 4 PROJECTS | |
|--|--------------|------------------------------|------|-------------|-------|---------------------------|---|---|---|
| | | AM | | PM | | | | | |
| | | Delay [sec] | LOS | Delay [sec] | LOS | | | | |
| NC 98 (Wake Forest Hwy) @ Mineral Springs Road | Signalized | Intersection | 41.2 | D | 34.5 | C | Add right turn lanes on all 4 approaches | 4 | |
| | | EB - NC 98 | 35.5 | D | 32.2 | C | | | |
| | | WB - NC 98 | 39.3 | D | 26.4 | C | | | |
| | | NB - Mineral Springs Rd | 35.7 | D | 32.2 | C | | | |
| NC 98 (Wake Forest Hwy) @ Sherron Rd / Patterson Rd | Signalized | Intersection | 32.6 | C | 44.3 | D | Add Aux lanes on NC 98; between Old Creedmor Rd & Ghoston Rd | 1 | |
| | | EB - NC 98 | 36.7 | D | 46.0 | D | | | |
| | | WB - NC 98 | 25.3 | C | 20.5 | C | | | |
| | | NB - Sherron Rd | 46.1 | D | 59.9 | E | | | |
| NC 98 (Durham Rd) @ NC 50 Southbound Off-Ramps | Unsignalized | Intersection Average | 2.0 | A | 21.3 | C | 1. DDI 2. At-Grade CFI (Full) | 1 | |
| | | EB - NC 98 | 0.0 | A | 0.0 | A | | | |
| | | WB - NC 98 | 0.0 | A | 0.0 | A | | | |
| | | NC 50 SB Off-Ramp - NC 98 EB | 11.4 | B | 133.2 | F | | | |
| NC 98 (Durham Rd) @ NC 50 Northbound Off-Ramps | Unsignalized | Intersection | 3.7 | A | 58.0 | F | Right-turn lane/overlap for EB and NB approaches | 2 | |
| | | EB - NC 98 | 0.0 | A | 0.0 | A | | | |
| | | WB - NC 98 | 0.0 | A | 0.0 | A | | | |
| | | NC 50 NB Off-Ramp - NC 98 EB | 12.1 | B | 418.1 | F | | | |
| NC 98 (Durham Rd) @ Six Forks Road / New Light Road | Signalized | Intersection Average | 54.7 | D | 75.9 | E | 1. CFI (Full) 2. Quadrant (SE) 3. Quadrant (SW) 4. CFI (E-W) 5. Median U-Turn (E-W) | 3 | |
| | | EB - NC 98 | 25.2 | C | 104.8 | F | | | |
| | | WB - NC 98 | 52.0 | D | 13.9 | B | | | |
| | | NB - Six Forks Rd | 42.0 | D | 72.9 | E | | | |
| NC 98 (Durham Rd) @ Old Falls of Neuse Rd / NC 98 Business | Signalized | Intersection Average | 36.1 | D | 37.6 | D | Dual NB left turn lanes | 1. CFI (Full) 2. CFI (N-S) 3. CFI (E-W) 4. Median U-Turn (E-W) 5. Quadrant (SE) | 3 |
| | | EB - NC 98 | 40.4 | D | 39.6 | D | | | |
| | | WB - NC 98 | 42.1 | D | 36.8 | D | | | |
| | | NB - Old Falls of Neuse Rd | 34.7 | C | 39.0 | D | | | |
| NC 98 @ S. Main St. (US 1A) | Signalized | Intersection Average | 42.8 | D | 49.1 | D | 1. CFI (Full) 2. CFI (N-S) 3. CFI (E-W) 4. Quadrant (SW) 5. Quadrant (SE) | 3 | |
| | | EB - NC 98 | 38.8 | D | 47.5 | D | | | |
| | | WB - NC 98 | 43.9 | D | 57.2 | E | | | |
| | | NB - S. Main St. | 47.0 | D | 47.8 | D | | | |
| NC 98 (Dr. Calvin Jones Hwy) @ Jones Dairy Rd / Traditions Boulevard | Signalized | Intersection Average | 41.8 | D | 30.2 | C | 1. CFI (Full) 2. CFI (N-S) 3. CFI (E-W) 4. Quadrant (SW) 5. Quadrant (SE) | 3 | |
| | | EB - NC 98 | 34.8 | C | 26.4 | C | | | |
| | | WB - NC 98 | 42.9 | D | 30.1 | C | | | |
| | | NB - Jones Dairy Rd | 43.2 | D | 38.6 | D | | | |
| NC 98 (Durham Rd) @ Old Falls of Neuse Rd / NC 98 Business | Signalized | Intersection Average | 36.1 | D | 37.6 | D | Dual NB left turn lanes | 1. CFI (Full) 2. CFI (N-S) 3. CFI (E-W) 4. Median U-Turn (E-W) 5. Quadrant (SE) | 3 |
| | | EB - NC 98 | 40.4 | D | 39.6 | D | | | |
| | | WB - NC 98 | 42.1 | D | 36.8 | D | | | |
| | | NB - Old Falls of Neuse Rd | 34.7 | C | 39.0 | D | | | |

Rose color indicates high congestion i.e. LOS E or F.

The top several intersection types were chosen for each intersection to present at the next public meeting. V/C ratio alone cannot determine which intersection type is best for each intersection, so a matrix was created highlighting other concerns about the project and how each intersection fared with those concerns. Concerns included how much right-of-way (ROW) would be needed, impacts to current development, bike/pedestrian accommodations, cost and the ease of constructability. The matrix presented at the public meeting is shown in Figure 27. In addition to the matrix, all of the potential designs presented in the matrix were presented as conceptual designs at the public meeting. Using the matrix and conceptual design of all intersection types, the public meeting allowed community members to vote on which intersection they would like to see at each of the intersections.

In addition, to the matrix and conceptual designs, diagrams showing intersection treatments were presented to highlight the benefits of the different intersection types being brought to the public. Public feedback and the

Figure 27: Impact Matrix

| Long - Term | ROW Impacts | Development Impacts | Constructability Effort | Construction Costs | Bike/Ped Accommodations | Traffic Operations |
|--|---------------------|---------------------|------------------------------|--------------------|-----------------------------|-----------------------|
| 2045 Volumes | Low, Moderate, High | Low, Moderate, High | Minimal, Moderate, Difficult | \$ - \$\$\$ | Very Poor, Poor, Fair, Good | Volume/Capacity Ratio |
| Mineral Springs Road | | | | | | |
| Quadrant (SW) | High | Moderate | Moderate | \$\$ | Good | 0.89 |
| Partial Continuous Flow Intersection (CFI) (N-S) | High | High | Difficult | \$\$ | Poor | 0.91 |
| Median U-Turn (E-W) | Moderate | Low | Moderate | \$\$ | Fair | 0.92 |
| Sherron Road | | | | | | |
| CFI (FULL) | High | Moderate | Difficult | \$\$\$ | Very Poor | 0.84 |
| Quadrant | Moderate | Low | Minimal | \$\$ | Good | 0.98 |
| Partial CFI (N-S) | Moderate | Moderate | Moderate | \$\$ | Poor | 0.88 |
| NC 50 | | | | | | |
| PARTCLOVER B | Low | Low | Minimal | \$\$\$ | NA | 0.57 |
| Diverging Diamond Interchange | Low | Low | Minimal | \$\$\$ | NA | 0.71 |
| Six Forks Road | | | | | | |
| CFI (Full) | High | Low | Moderate | \$\$\$ | Very Poor | 0.88 |
| Quadrant | Moderate | Low | Minimal | \$\$ | Good | 0.9 |
| Partial CFI (E-W) | Moderate | Low | Moderate | \$\$ | Poor | 0.92 |
| Old Falls of Neuse Road | | | | | | |
| CFI (Full) | Moderate | Moderate | Moderate | \$\$\$ | Very Poor | 0.6 |
| Partial CFI | Moderate | Moderate | Moderate | \$\$ | Poor | 0.75 |
| Quadrant (SW) | Moderate | Moderate | Minimal | \$\$ | Fair | 0.79 |
| S. Main Street | | | | | | |
| CFI (Full) | Moderate | High | Difficult | \$\$\$ | Very Poor | 0.71 |
| Quadrant (SW) | High | Low | Difficult | \$\$\$ | Good | 0.83 |
| Partial CFI (E-W) | Moderate | Moderate | Difficult | \$\$ | Poor | 0.88 |
| Jones Dairy Road / Traditions Grande Blvd | | | | | | |
| CFI (Full) | Moderate | High | Difficult | \$\$\$ | Very Poor | 0.49 |
| Partial CFI | Moderate | High | Difficult | \$\$ | Poor | 0.62 |
| Quadrant (SW) | High | High | Minimal | \$\$ | Good | 0.76 |

transportation analysis highlighted some of the issues seen in the two-lane section of NC 98 within the central segment. Traffic is often slowed down or stopped when vehicles turn left or right from NC 98. When through traffic is heavy along NC 98, it takes a long time for vehicles to turn left, blocking all traffic and creating backups. This was echoed at the public meetings and can be seen on NC 98 with signs telling vehicles not to pass on the shoulders. The intersection types presented at the public meetings focused on keeping the through traffic on NC 98 free-flowing and creating limited situations where through traffic would have to stop. Figure 28 shows the most frequent intersection types presented at the public meeting. These three intersection types, continuous flow intersection, quadrant intersection, and median U-turn intersection, can all be described as indirect left-turn treatments. Indirect left-turns are used to:

- Remove left-turning vehicles from the flow of traffic without causing them to stop in a through-traffic lane
- Improve safety by reducing the number of conflict points
- Reduce the number of signal phases to provide more green time for traffic
- Increase capacity

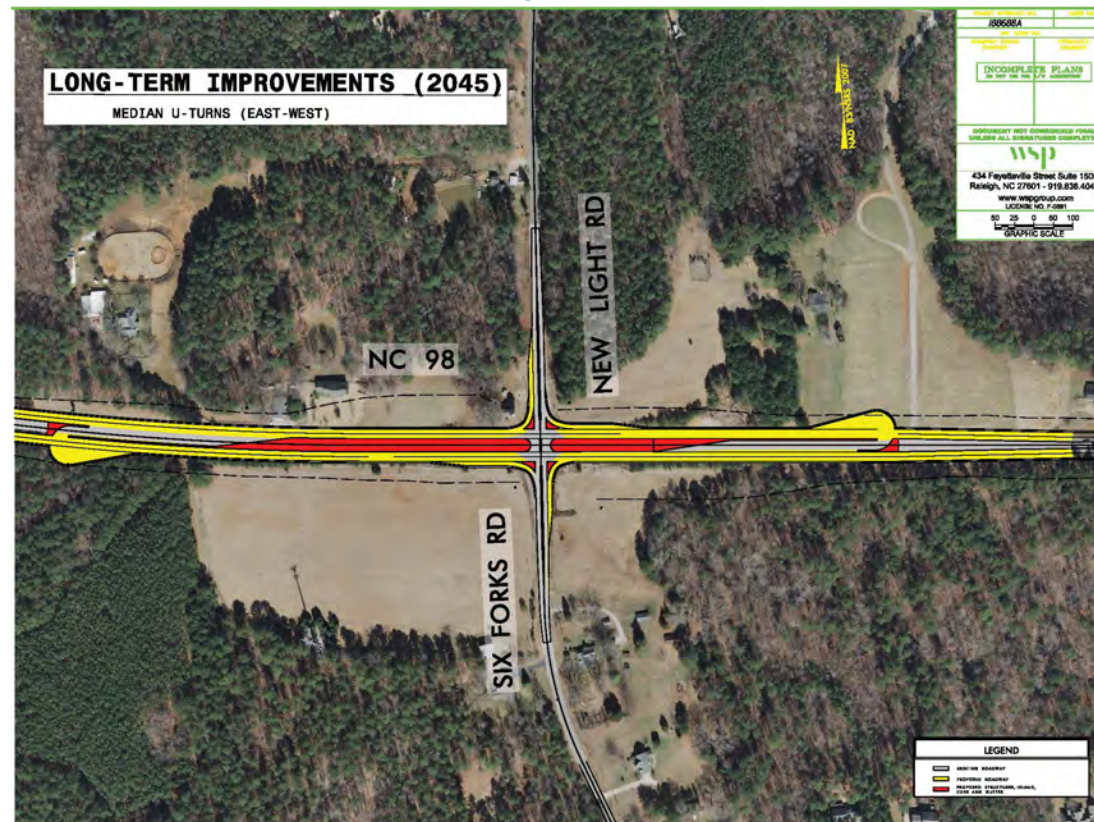
In addition to the matrix and overall descriptions of the different long-term intersection treatment types, each intersection option was presented to the public as a conceptual design. This allowed the public to visualize what each treatment would look like if it was part of the recommended widening. The public was asked to vote on which design they preferred. Figures 29 and 30 show a median u-turn and continuous flow intersection design presented at the public meeting.

Figure 28: Intersection Conflict Points

| | | | | |
|------------------------------|---------------------------------|-------------------------------------|------------------------------|----------------------|
| | | | | |
| | Traditional Intersection | Continuous Flow Intersection | Quadrant Intersection | Median U-turn |
| Total Conflict Points | 32 | 30 | 28 | 16 |

After determining the top alternative intersection design from the public meetings, those designs were added to the widening alternative to determine feasibility with the design, particularly with incorporating bicycle and pedestrian accommodations into the design. Any necessary changes were made to present a full, recommended design for long-term improvements to the CTT.

Figure 29



For the third, and last round of public meetings, this full long-term design was shown to the public and SOT. All the long-term recommendations were full detail along the entire corridor. On the Durham end of the corridor, both the road diet and widening were shown for the section from Junction Road to Sherron Road. Laying out all the long-term recommendations allowed the public to envision what the corridor would look like from Durham to Franklin

Figure 30

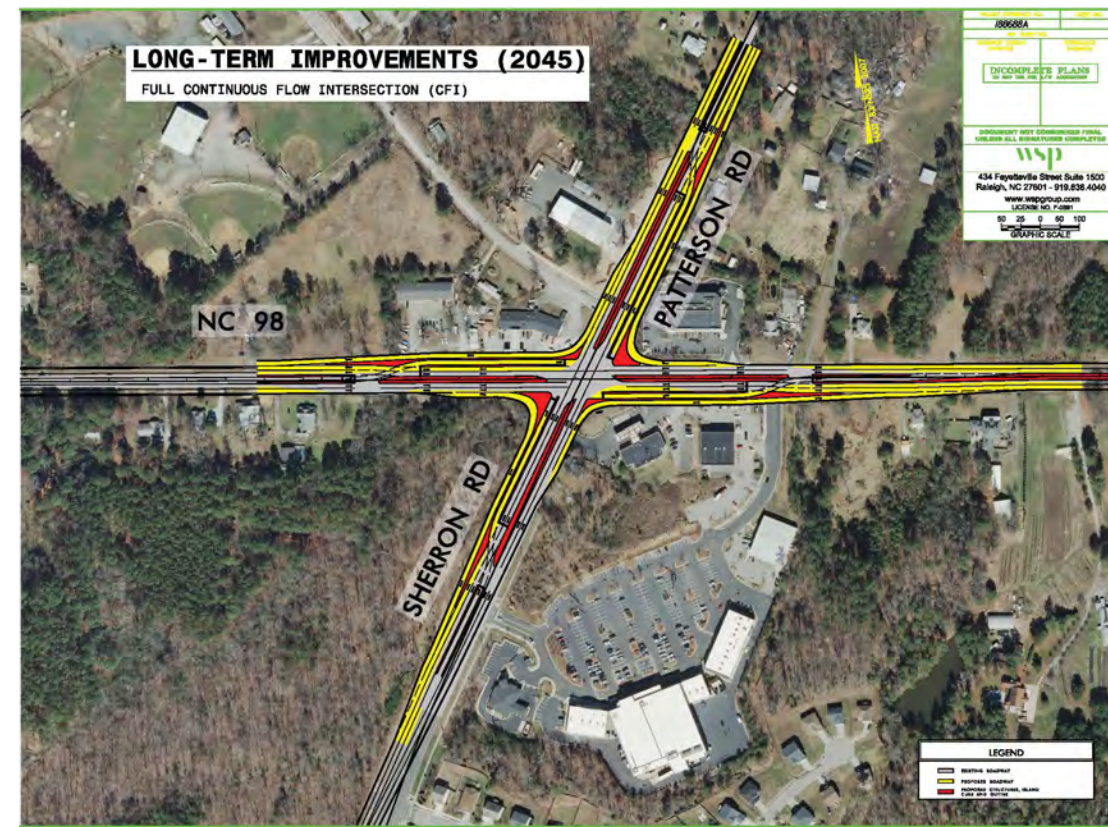
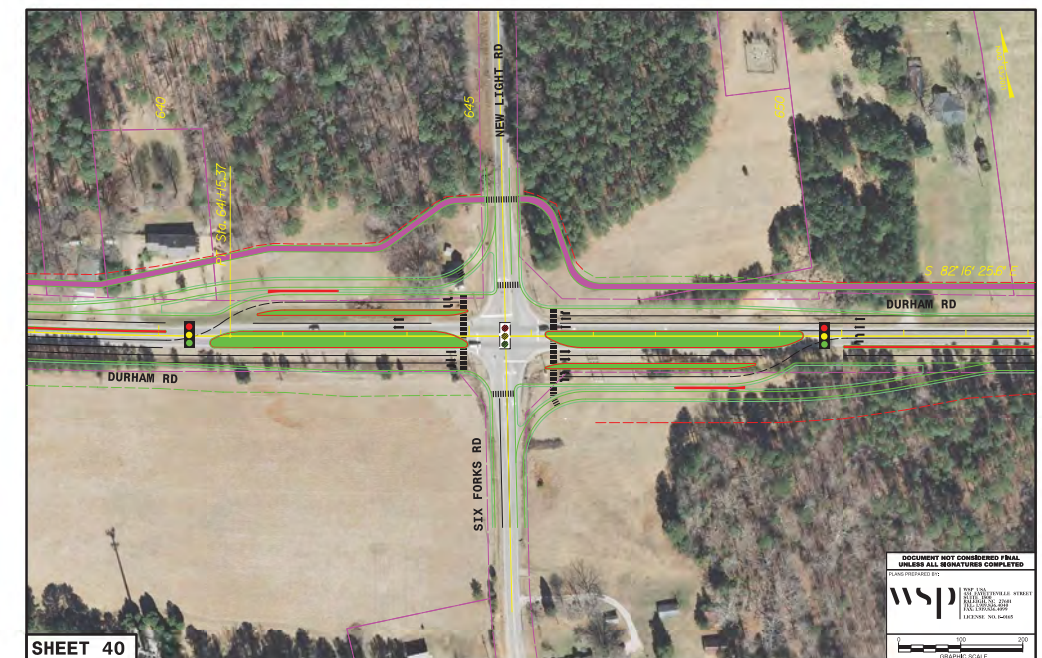


Figure 31

County once the long-term improvements were implemented. One of the design sheets presented at the public meetings is shown in Figure 31. The full design can be found in the Appendix.



4 RECOMMENDATIONS

4.1 SHORT AND LONG-TERM IMPROVEMENTS

With support from the CTT, SOT, and the public, the conceptual designs presented at the last round of public meetings were established as the recommended improvements for NC 98. The recommendations were separated into short-term and long-term improvements.

Short Term Improvements

- New Stoplight – Adams Street
- Add right turn lanes at all four approaches – Mineral Springs Road
- New Stoplight – Nichols Farm Road
- New Stoplight – Olive Branch Road
- Add auxiliary lanes – NC 50
- Add right turn lanes for eastbound and northbound approaches – Six Forks Road
- Install turn lanes – Camp Kanata Road
- Install dual left turn lanes – S Main Street
- Signal Improvements – Heritage Lake Road
- Signal Improvements – Traditions Grande Road
- Convert to four-way stop – Moores Pond Road

Long Term Improvements

- Priority #1a – US 70 to Sherron Road – 4 lanes with median and sidewalks
- Priority #1 – Sherron Road to Old Falls of Neuse Road – Widen to 4 lanes
- Priority #2 – Old Falls of Neuse to Jones Dairy Road – Wake Forest Roadway Improvements
- Priority #3 – Jones Dairy Road to US 401 – Widen to 4 lanes

The short-term improvements could help alleviate some of the current issues along NC 98 before the long-term improvements are implemented. The improvements aim to increase capacity to accommodate current and future volumes and provide design improvements (i.e. median and turn lanes) to improve safety concerns throughout the corridor. Cross-sections were developed for each of the long-term improvements and are presented below.

4.2 BICYCLE AND PEDESTRIAN RECOMMENDATIONS

To ensure the NC 98 corridor supports all types of transportation modes, bicycle and pedestrian facility improvements for NC 98 were driven by two principles: (1) improving user comfort and safety, and (2) connectivity. Facilities that are designed with user safety in mind are inherently more comfortable for users; if facilities are safe for all ages and abilities, more people will be encouraged and enabled to use NC 98 for active transportation. Similarly, facilities that connect people to important places with safe travel options will also attract new users and provide for the safety of existing users.

The bicycle and pedestrian improvements are divided into sections. There are two options for the first section between the western study boundary and Sherron Road. The first option includes a shared use path that is several feet from the roadway on each side as a substitute for bicycle lanes and a sidewalk. The second option does not include the shared use paths but instead has bicycle lanes and a sidewalk on each side. The local community prefers the shared use path option because it is safer and more attractive to travelers that are expected to go to the schools, library and retail establishments in this area. It should be noted that given current state funding policy, the shared use path is likely to require a larger local (i.e., City of Durham and Durham County) funding match because the bicycle lanes would be funded entirely by non-local funding and maintained

Figure 32a: Shared Use Paths



Figure 32b: Bicycle Lanes and Sidewalks



Figure 33: 4-Lane Widening



by NCDOT. On the other hand, the shared use path would require that approximately 75% of the construction funding be local, and local governments would have to maintain both the sidewalks and paths.

Shared use paths are proposed in the next two sections along the NC 98 corridor. The first section is between Sherron Road and Kemp Road to provide bicycle and pedestrian accommodations for students of nearby schools and recreational bicycle riding, and the second section is between Old Creedmoor Road and Stony Hill Road. The shared use path is recommended along the north side of the NC 98 corridor to increase safety and connectivity for recreational riders, visitors of Falls Lake State Recreation Area, or travelers along the NC State Bicycle Routes. Improvements for intersections are key to enhancing safety and connectivity. The success of the bicycle and pedestrian improvements depends upon the quality of the intersection improvements that are implemented. The following sections provide critical information to consider during the design and implementation for on- and off-street bicycle facilities as well as intersection improvements.

4.3 DEVELOPING RECOMMENDED DESIGNS

As mentioned earlier, developing the cross sections for the corridor included special considerations of those sections of the corridor. The final design for the long-term improvements included numerous considerations for what was needed in that section of the corridor and displays how the existing conditions inventory, transportation analysis and public involvement all come together to make the final recommendations. Below highlights sections along the corridor (from west to east) where this input was used.

Sherron Road

Figure 34 shows the improvements proposed at Sherron Road. After the second round of public meetings a CFI intersection design was being considered. But a closer look at bicycle and pedestrian activity in this section of the corridor, indicated that the CFI might not be best for accommodating these modes. One of the other options presented at the public meeting, a quadrant intersection design, was then chosen. This design still assisted left bound turns from NC 98 onto Sherron Road. The traffic modeling showed that this movement was a significant movement through the intersection and increased in the future once Northern Durham Parkway is built. This design also addressed concerns about the proximity of Stallings Road to the intersection, by creating a cul-de-sac along Stallings Road. Instead of through traffic along Stallings Road to Patterson Road, traffic would take the new quadrant roadway to the light at NC 98 or the light at Patterson Road. After altering the design of the intersection, a multi-use path was added in order to provide a connection from the intersection to Neal Middle School. There were also concerns about how cyclists would travel through the intersection and access the multi-use path. An extended curb was created to allow cyclists to transition from the on-street bike lane to the sidewalk, where they are then able to cross NC 98 to the multi-use path.

Figure 34: Proposed intersection treatment at Sherron Road



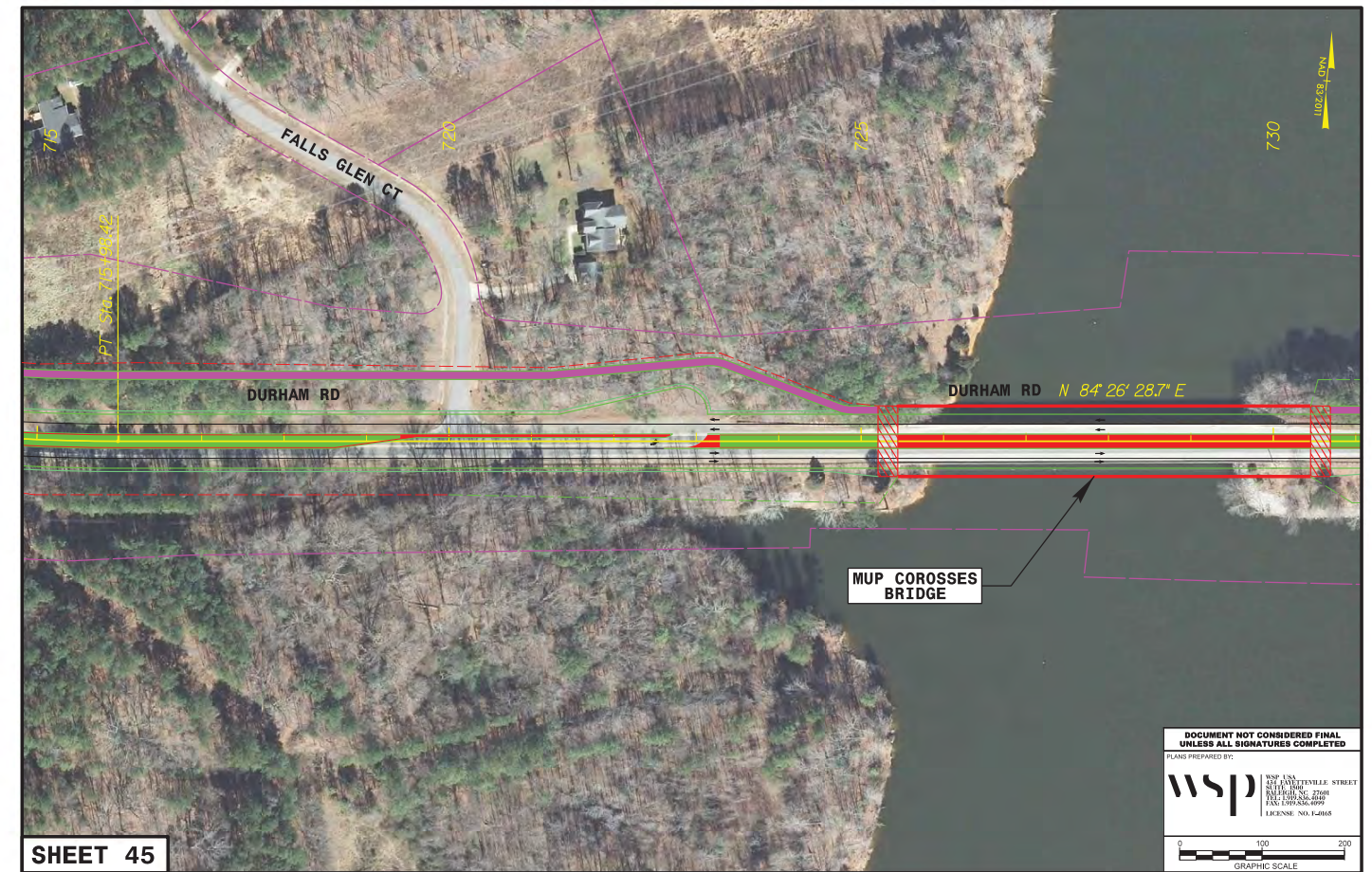
Figure 35: Proposed treatment at NC 50



NC 50

The multi-use path in the middle of the corridor starts at Old Creedmoor Road. As an interchange, NC 50 presented challenges to getting pedestrians and cyclists across. With the numerous ramps onto and off NC 50, it was decided to have a pedestrian crossing north of NC 98 at the ramps with NC 50. Instead of increasing the width of the bridge and having a path directly next to the travel lanes, the design incorporated the multi-use path in a way that provides access over NC 50, but doesn't add a major cost, like widening the bridge even more. The multi-use path on the south side of NC 50 would connect to the future NC 50 project.

Figure 36: Proposed treatment crossing Falls Lake



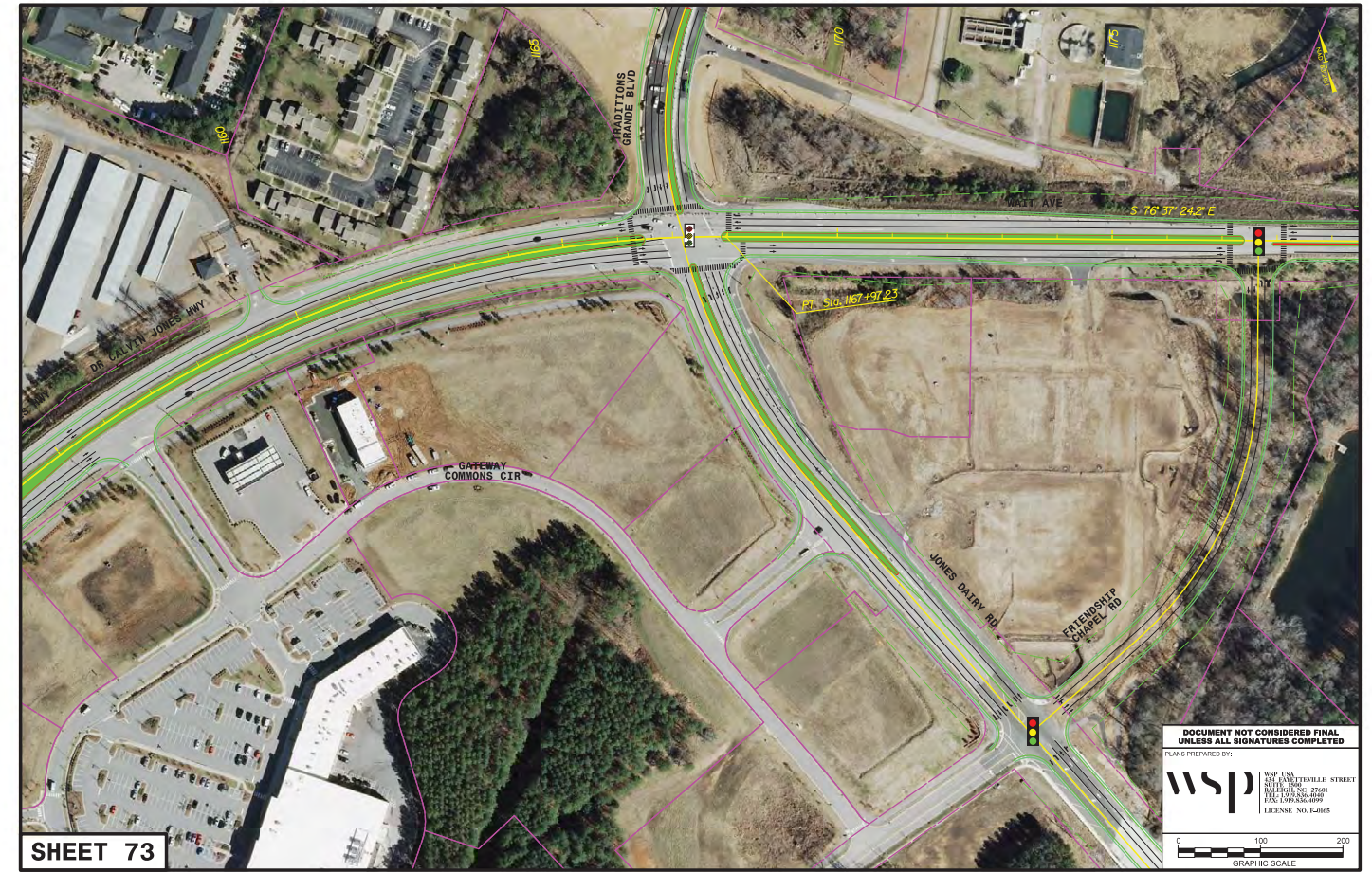
Falls Lake Bridge

Just east of Falls Glen Court, NC 98 crosses a section of Falls Lake on a bridge. In this stretch of NC 98, the Mountains-to-Sea trail crosses NC 98, While it was not feasible to put a pedestrian crossing across NC 98 in this section of the corridor, the multi-use path runs along NC 98 and crosses the bridge, providing access for pedestrians and cyclists to use NC 98. It is also noted that when the bridge is replaced, it will be important to consider the possibility of running the Mountains-to-Sea trail underneath the bridge to allow a grade-separated crossing of NC 98.

Figure 37: Proposed intersection treatment at Old Falls of Neuse Road



Figure 38: Proposed intersection treatment at Jones Dairy Road



Old Falls of Neuse Road

After the second round of public meetings, a CFI intersection was chosen for NC 98 at Old Falls of Neuse Road. This design maximizes the time for through traffic along NC 98, while shortening the amount of time that through traffic is stopped, helping to alleviate congestion seen at this intersection. However, this design can be challenging for pedestrians due to the number of lanes to cross. Looking at the planned greenways in Wake Forest, there is a planned Sanford Creek Greenway running along Old Falls of Neuse from NC 98 north. South of NC 98, Old Falls of Neuse is considered a greenway corridor. Wanting to incorporate this planned greenway and create a connection between the greenway and the greenway corridor to the south, a pedestrian bridge was added to the design. This bridge would allow for a grade-separated crossing over NC 98 and provide the opportunity to create an iconic entryway into the Town of Wake Forest.

Jones Dairy Road

While NC 98 through Wake Forest is already a widened to 4-lanes and separated by a median, this study looked at intersection designs within this section of the corridor to see what improvements could be recommended. Due to traffic volumes, many intersections were good candidates for alternative intersection designs. At Jones Dairy Road, a quadrant intersection was chosen. Jones Dairy Road provides access to Gateways Commons, but currently the entrances in and out are not signalized. This quadrant intersection allows signalized access to and from Gateway Commons, but also prioritizes through movements along NC 98 by limiting the amount of time through traffic is stopped to allow turning movements from cross streets.

Table 13 below show the preliminary cost estimates and right-of-way (ROW) impacts along the corridor. Included in the table is the widening of Junction Road to Sherron Road compared to the road diet for the same stretch. As noted above, the road diet is only feasible with other regional roadway improvements. The road diet was first proposed due to lower traffic volumes after these regional improvements and due to the limited existing right-of-way within this portion of the corridor. But after further discussion with the CTT and input from the third public meeting, the widening alternative was chosen.

Table 13: ROW Cost Estimates

| | Junction Road to Sherron Road (widening) | Junction Road to Sherron Road (Road Diet) | Sherron Road to Old Falls of Neuse Road | Old Falls of Neuse Road to US 401 |
|-----------------------|--|---|---|-----------------------------------|
| Cost | \$18 million | \$10 million | \$57 million | \$29 million |
| Partial ROW (Parcels) | 232 | 192 | 254 | 187 |
| Whole ROW (Parcels) | 23 | 11 | 42 | 15 |

5 IMPLEMENTATION

5.1 PROJECT FUNDING

The study team identified six major sources of funding for the short- and long-term projects identified by the study:

NCDOT Transportation Improvement Program (TIP) – This source is for major transportation projects, such as major intersection upgrades and roadway widening. Any projects considered for this source would have to be submitted to NCDOT through the prioritization process for scoring, which includes input from the NCDOT Division and the MPO.

Other NCDOT Funds – This source includes a variety of programs administered by NCDOT that includes state and federal funds. Projects allocated to this source are generally focused on low cost – high impact projects such as intersection improvements, turn lanes, and auxiliary lanes.

MPO Local Project Funds – Both DCHC MPO and CAMPO provide federal funds to municipalities through a locally administered projects program (called LAPP at CAMPO). The DCHC MPO typically focuses on pedestrian and bicycle infrastructure, while the CAMPO LAPP program provides for a wider variety of projects. These funds must be applied for and administered by a municipality. Projects allocated to this source are also generally focused on short term, but high impact projects.

Municipal Funds – A wide variety of projects can be funded utilizing municipal funds. Projects allocated to this source are typically those that do not score well in the NCDOT prioritization process, but are important to a municipality.

Grants – There are a wide variety of grant programs available for transportation funding, with many focusing on pedestrian, bicycle, and transit improvements. Therefore, the projects allocated to this source fall within those categories.

Developer – Roadway improvements are routinely required by NCDOT and municipalities as a condition of approval for private development projects. They are typically limited to intersection improvements or small sections of new roadway. Projects allocated to this source are those that travel through or are adjacent to undeveloped, but rapidly developing parcels.

The short and long term projects developed through this study were examined by the project team and the CTT and were allocated the five sources, with several falling within multiple categories, as shown in the table below. It should be noted that projects may be funded via a variety of sources and/or led by varying agencies, and could also be segmented differently than listed.

An important point of consideration was the section of NC 98 from Junction Road to Sherron Road. Typically, road diets do not score well in the NCDOT prioritization process, as they are seen as reducing capacity. The City of Durham could implement the road diet through resurfacing but this would not include the construction of the median or sidewalks, which would need to be completed under another project. Therefore, the project team allocated the road diet alternative to the municipal or MPO funding source, but allocated the other projects needed to decrease traffic on NC 98 to enable the road diet to the NCDOT TIP source. If the widening of NC 98 from Junction to Sherron is ultimately pursued by the City of Durham and the DCHC MPO, this project would most likely be funded through the NCDOT TIP.

5.2 NC 98 PROJECT SEGMENTATION AND PRIORITIZATION

Per the NCDOT:

“Passed in 2013, the Strategic Transportation Investments (STI) law, allows the NC Department of Transportation to use its funding more efficiently and effectively to enhance the state’s infrastructure, while supporting economic growth, job creation and a higher quality of life. STI also established the Strategic Mobility Formula, which allocates available revenues based on data-driven scoring and local input”

Table 14: Potential Project Funding

| NCDOT Transportation Improvement Program | Other NCDOT Funds | MPO Local Project Funds | Municipal Funds | Grants | Developer |
|---|--|---|--|---|--|
| <ul style="list-style-type: none"> Sherron Road to Old Falls of Neuse Widening Old Falls of Neuse Road to Jones Dairy Road Intersection Upgrades Jones Dairy Road to US 401 Widening Sherron Road Widening NC 98 to US 70 (needed for road diet) Northern Durham Parkway NC 98 to US 70 (needed for road diet) | <ul style="list-style-type: none"> Left turn lanes at Camp Kanata Left turn lanes at Six Forks Road Turn lanes at Mineral Springs Road Traffic signal at Adams Street Auxiliary Lanes on NC 98 at NC 50 | <ul style="list-style-type: none"> Sidewalk improvements from US 70 to Sherron Road Sherron Road to Neal Middle School Multi-use Path Intersection improvements at S. Main Street Intersection improvements at Jones Dairy Road and Traditions Grande Intersection improvements at Old Falls of Neuse Road Turn lanes at Six Forks Road | <ul style="list-style-type: none"> US 70 to Sherron Road road diet option Signal improvements at Heritage Lake Road and Traditions Grande Pedestrian bridge over NC 98 Oak Grove Elementary School Sidewalk Gap Transit stop improvements | <ul style="list-style-type: none"> Pedestrian bridge over NC 98 Sidewalk improvements from US 70 to Sherron Road Transit stop improvements | <ul style="list-style-type: none"> Quadrant Roadway at Sherron Road Turn lanes at Camp Kanata Road Intersection improvements from Old Falls of Neuse Road to Jones Dairy Road Friendship Chapel Road extension |

* Projects may be funded via a variety of sources and/or led by varying agencies

One of the primary driver of this data driven approach is the cost/benefit ratio of a project, which for highway projects compares the travel time savings of a project to the overall project cost. Given that the NC 98 corridor considered for this project is 28 miles long, it is unreasonable to expect that the entire corridor could be funded as one project through the NCDOT TIP. Therefore, a key consideration for the project team was how to segment the project in a manner such that each section would have independent utility, would be available when needed, and could be funded.

To determine this, the project team utilized the Triangle Regional Model to analyze the travel time savings of various segments of NC 98. These segments were then coupled with the cost of each segment and compared with projects that were funded in the latest round of prioritization SPOT 4.0. Of specific consideration were:

- The 4-lane undivided segment of NC 98 in Durham is a major contributor to congestion on the corridor and has a high crash rate;
- The 4-lane widening alternative from Junction Road to Sherron Road will score better in prioritization than the road diet alternative
- The portion of the corridor between NC 50 and Six Forks Road is one of the areas with the highest recurring congestion along the entire corridor, therefore this area would show the greatest travel time savings from widening;
- The widening of the bridge and causeway over Falls Lake is one of the largest contributors to the overall project cost;
- The section of NC 98 along the Wake Forest Bypass (Old Falls of Neuse Road to Jones Dairy Road), while needing improvement by the horizon year, currently functions with reasonable levels of delay;
- The section of NC 98 east of NC 96 is not forecast to have volumes requiring a 4-lane facility by the horizon year.

Based on this analysis and the considerations above the project team developed the following priorities:

Priority 1:

- Junction Road to Sherron Road
- Sherron Road to Old Falls of Neuse Road

Priority 2:

- Old Falls of Neuse to approximately Jones Dairy (NC 98 may need to be widened from Jones Dairy Road to NC 98 depending on development)

Priority 3:

- Jones Dairy Road to NC 401

In keeping with these priorities, CAMPO has submitted the section of NC 98 from Old Creedmoor Road to Six Forks Road and the upgrade of the Six Forks Road intersection to NCDOT for consideration in SPOT 5.0. DCHC has also submitted the section of NC 98 from Junction Road to Lynn Road as an access management project to construct safety improvements and widen to add median, bicycle lanes, sidewalks, transit stop improvements, and traffic signals where needed.

5.3 GENERAL IMPLEMENTATION GUIDELINES

Prior to the widening of NC 98, particularly in the sections that are currently 4-lane undivided and 2-lane divided, care should be taken to set up future developments to accommodate the future widening to a 4-lane median divided section. This includes ensuring that sufficient right of way is available (this is not an issue in the majority of the corridor) as well as placing driveway access in a location that provides safe and efficient movement relative to the proposed median locations. Developers should be made aware that the expectation is that NC 98 will not have full-movement signals and any traffic impact analyses should consider superstreet and other alternative intersection designs for future access. Additionally, no monument signs or other structures should be placed within or

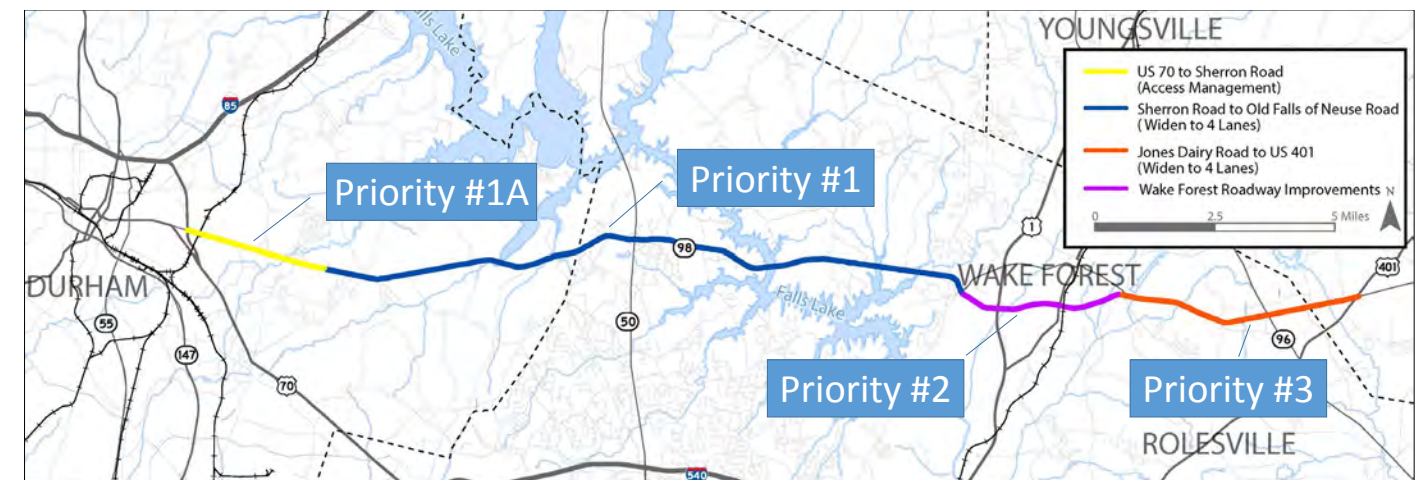
immediately adjacent to the existing right-of-way to ease future construction and future development design should consider providing sufficient room for construction to minimize the impact of construction easements.

In the Durham section, future developments should dedicate the additional right-of-way necessary to accommodate the future widening section and should include the construction of sidewalks to ease future construction. The number and types of access should also be tightly controlled, to minimize the driveways onto the future widening section, as the number of current driveways is a key contributor to the high number of crashes in the current 4-lane undivided section.

In Wake Forest, future developments should consider the plan to have non-full movement intersections along NC 98, particularly at locations that are currently signalized. Traffic impact analyses for future developments should consider this directive, as well as the intersection alternatives included in this report. However, as future traffic volumes change or specific developments create large changes in the distribution of turning movements at a particular intersection, other alternative intersection designs may become more desirable.

East of Wake Forest, where the right-of-way becomes more constrained, future developments should be required to dedicate sufficient right-of-way for the future 4-lane median divided section, and should plan for intersection types other than full movement signalized intersections. However, realizing that the widening of this section is not likely until closer to the horizon year of this study, in the interim, full movement-signalized intersections may operate with reasonable levels of service and delay with appropriate auxiliary turn lanes.

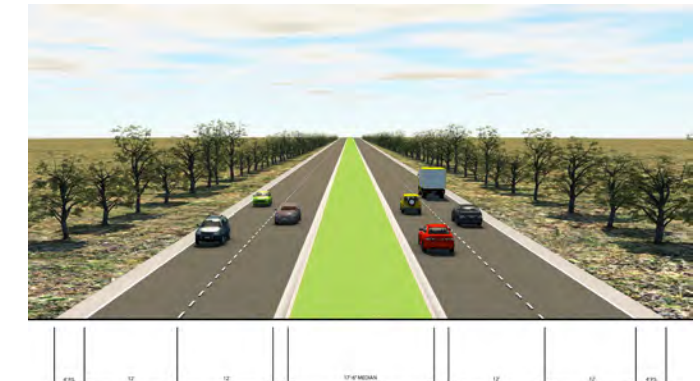
Figure 39: Long-Term Improvements



Junction to Sherron – Access Management



4 Lane Widening – Potential Cross Section





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