I-440 Improvement Project
(STIP U-2719)

WBS No. 35869.1.2

Purpose and Need Statement

FINAL

September 2014

Prepared for:

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1. PURPOSE AND NEED STATEMENT

Note to Reader:

An environmental document is being prepared for the proposed project in accordance with the requirements set forth in the National Environmental Policy Act (NEPA) of 1969, as amended. The North Carolina Department of Transportation (NCDOT) and the Federal Highway Administration (FHWA) are joint lead agencies for the proposed action.

A summary of this Purpose and Need Statement will become Chapter 1 of the project's Environmental Assessment (EA). This statement describes the purpose of the project and why the proposed action is needed. The purpose and need will drive the development and evaluation of alternatives.

Supporting information includes a description of the existing roadway network and how it operates now and in the future; data on population and employment trends; discussion of other transportation modes; and review of area transportation and land use plans.

1.1. PROPOSED ACTION

The North Carolina Department of Transportation (NCDOT) proposes to widen I-440/US 1-64 in Wake County from south of Walnut Street (SR 1313) in the Town of Cary to north of Wade Avenue (SR 1728) in the City of Raleigh. The project also will include the modification and/or rehabilitation of interchanges and structures on I-440 within the project limits. A project location map is shown on **Figure 1**. The length of the proposed project is approximately five miles.

The project is included as Project U-2719 in NCDOT's adopted 2012-2020 *State Transportation Improvement Program (STIP)* (September 2013) with right of way programmed to begin in 2016 and construction programmed to begin in 2018.

1.2. NEED FOR PROJECT

The needs for the project are described below. These needs are supported by the existing and projected conditions in the study area, which are discussed in detail in **Section 1.5** through **Section 1.8**. A video tour of the project corridor that illustrates existing corridor deficiencies can be viewed at www.ncdot.gov/projects/i-440improvements.

- Capacity Deficiencies – The four-lane section of I-440 through the project study area forms a bottleneck between the six-lane sections to the north and south.

  Currently, the approximately five-mile segment of I-440 in the project study area is a four-lane divided controlled access freeway, with auxiliary lanes between some interchanges and a southbound collector-distributor road near I-40. These four through lanes form a "bottleneck" between the six through lanes to the north and south.

  Travelers on I-440/US 1-64 in the project study area regularly experience congestion, which is projected to worsen through 2035. Traffic volumes on I-440/US 1-64 within the project study area are projected to increase by 19 to 26 percent between 2012 and 2035. By 2035, levels of service along I-440/US 1-64 are projected to be almost all LOS E or F (the worst levels) during peak periods. Existing and future average travel speeds are well below the posted speed limit during morning and evening peak hours northbound and in the evening peak hours southbound.

- Geometric Deficiencies – The roadway and interchanges in the project study area have substandard design elements.

  Congestion experienced along I-440/US 1-64 in the project study area is a function of geometric deficiencies as well as capacity deficiencies. The roadway and interchanges in this section of I-440 have substandard design elements such as poor sight lines, narrow shoulders and medians, and short acceleration/deceleration lanes.

- Condition Deficiencies – Due to the age of the facility, pavement, structures, and interchanges along the project segment are in need of rehabilitation.

  I-440 in the project study area was constructed in the early 1960's and is the oldest section of the Raleigh Beltline. Due to the age of the facility, the pavement, structures, and interchanges are in need of rehabilitation.

1.3. PROJECT PURPOSE

The purpose of the project is to improve traffic flow and operational efficiency and enhance mobility on this segment of I-440. The project will address the need to increase capacity and improve design and condition deficiencies along this segment of I-440.

The environmental resource and regulatory agencies (the NEPA/Section 404 Merger Team) for the project concurred with the purpose and need for the project (Concurrence Point #1) on August 22, 2012. A copy of the concurrence form is included in **Appendix A**.

Performance measures will be used to screen various alternative concepts to evaluate their ability to meet the project's purpose. These measures, which may include the following, may be refined during the alternatives development and screening phase:

- Average travel speeds through the corridor during peak periods
- Vehicle miles traveled through the corridor during peak periods (Generally, scenarios with higher VMT represent a benefit to mobility, as more vehicles are able to travel greater distances along the corridor during the peak periods)
- Average travel delay and levels of service at interchange ramp termini during peak periods
- Ability to improve and/or rehabilitate roadway and interchange geometry in conformance with current design standards

1.4. PROJECT SETTING AND HISTORY OF I-440 IMPROVEMENTS

1.4.1. Project Setting and Context

> ***Project Setting***
>
> *The project corridor is in an established mixed-use urban area approximately 3 miles west of downtown Raleigh.*

As shown on **Figure 1**, the project is located in an established mixed-use urban area approximately three miles west of downtown Raleigh in east central North Carolina. Raleigh is in the eastern portion of the Triangle region (Raleigh, Durham, Chapel Hill, and surroundings). The project study area is primarily within the City of Raleigh's planning and service area boundaries. However, a small portion of the project study area south of I-40 is within the jurisdiction of the Town of Cary.

The Triangle region is associated with Research Triangle Park (RTP), a large business/research park established in the late 1950s. RTP is approximately ten miles northwest of the project area along I-40. RTP is home to numerous high-tech companies and enterprises attracted by the research facilities and educated workforce provided by the region's three major universities (North Carolina State University, University of North Carolina at Chapel Hill, and Duke University).

The university community is an important influence in the project area. The main campus of North Carolina State University (NCSU) is located to the east of the project area and several University facilities are located within the project area. Meredith College is also located in the project area in the northeast quadrant of the I-440/Hillsborough Street interchange. There is a large student population living in apartment complexes and homes in the project area, which increases the demand for bicycle, pedestrian, and transit facilities in the area.

Several regional resources are located in and around the project corridor that generate high volumes of traffic either during the week or for special events, as described in **Section 1.7.2**. In addition, Lake Johnson Park is a prominent recreational resource located east of I-440 and north of Jones Franklin Road. Many people use I-440/US 1-64 to access these resources.

According to Raleigh's 2030 Comprehensive Plan, long-term goals for future growth in the project area include redevelopment along the Western Boulevard corridor west of I-440, and mixed-use development around a proposed transit station at Hillsborough Street and Blue Ridge Road also west of I-440. In addition, there is potential for growth along the Jones Franklin Road corridor, especially in the office parks adjacent to the east side of I-440 just south of Lake Johnson.

1.4.2. History of I-440 Improvements

The four-lane section of I-440 through the project study area from I-40 to Hillsborough Street is the oldest section of the Raleigh Beltline. It was opened to traffic in approximately 1959-1960. By 1963, the Beltline was extended around the north side of Raleigh to Capital Boulevard, then to New Bern Avenue approximately one year later. By 1984, the loop was complete with the construction of I-40 around the south side of Raleigh. The I-440 designation was assigned by FHWA in 1991. The road was originally named the Cliff Benson Beltline to honor a developer and highway commissioner who played a major role in getting the road built. Beginning in 1991, Beltline widening had begun, and widening to six lanes was completed by 1997, except for the U-2719 project section.

> ***Corridor History***
>
> *The four-lane section of I-440 through the project study area is the oldest section of the Raleigh Beltline.*

A feasibility study to widen I-440 from Wade Avenue to I-40 in the project area was conducted in June 1994. There were plans to widen I-440 from Wade Avenue to I-40 in the 2000s, but the NCDOT's *2006-2012 STIP* did not include funding for the upgrade. The updated *2012-2018 STIP* programmed the widening of I-440 in the project area with right of way programmed to begin in 2016 and construction programmed to begin in 2018.

TABLE 1. Existing and Projected No-Build Traffic Volumes

I-440/US 1-64 Segment		2012 AADT*	2035 AADT*	Percent Change (2012-2035)
From	**To**			
Cary Parkway	Walnut Street (SR 1313)	118,000	145,600	23%
Walnut Street (SR 1313)	Crossroads Boulevard (partial interchange)	118,500	149,200	26%
Crossroads Boulevard (partial interchange)	I-40	134,200	169,600	26%
I-40	Jones Franklin Road (SR 5039)	79,200	96,400	22%
Jones Franklin Road (SR 5039)	Melbourne Road (SR 1445) (partial interchange)	81,200	98,700	22%
Melbourne Road (SR 1445) (partial interchange)	Western Boulevard (SR 2012)	85,000	105,500	24%
Western Boulevard (SR 2012)	Hillsborough Street (NC 54)	88,200	105,100	19%
Hillsborough Street (NC 54)	Wade Avenue (SR 1728)	94,800	117,600	24%
Wade Avenue (SR 1728)	Lake Boone Trail (SR 1676)	109,200	138,000	26%

*AADT – Annual Average Daily Traffic Volumes (vehicles per day)

Source: *Traffic Forecast for U-2719*, NCDOT, January 10, 2013

1.6.3. Existing and Future No-Build Traffic Conditions

Analysis Methodologies and Definitions

The analyses of existing and future no-build traffic operations were conducted in accordance with the NCDOT Congestion Management's *Capacity Analysis Guidelines* (January 2012). The operations analysis is documented in the *Traffic Operations Technical Memorandum – I-440 Improvement Project (STIP U-2719)* (Atkins, June 2014).

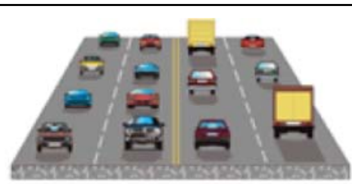
As described below, the analysis of traffic operations was conducted two ways – modeling of individual corridor segments and model simulation of the entire corridor using VISSIM. VISSIM is a traffic flow simulation program useful in modeling complex transportation projects such as freeway networks.

Individual corridor segments were evaluated for level of service (LOS) during the morning and evening peak hours based on the segment volumes from the traffic forecast. The *Highway Capacity Software 2010* (HCS) (McTrans), which is based on the *Highway Capacity Manual* (Transportation Research Board, 2012), was used to conduct the analysis.

The level of service (LOS) is a qualitative measure describing traffic flow conditions within a traffic stream. The LOS is defined with letter designations from A to F that can be applied to both roadway segments and intersections. LOS A represents the best operating conditions and LOS F the worst. Although LOS A to LOS F can be used to describe best to worse operating conditions for both roadway and intersections, the specific descriptions of each LOS for roadway segments and intersection are not the same.

Table 2 describes the traffic conditions experienced under each LOS designation for roadway segments. In Raleigh, it's the City's policy to try to maintain an overall LOS E or better on all roadways and intersections within the city, except where maintaining this LOS is infeasible or it conflicts with other goals (Raleigh 2030 Comprehensive Plan Policy T 2.10). LOS E occurs when traffic volumes are at or very near capacity.

TABLE 2. Definitions of Levels of Service for Roadway Segments

Level of Service	Representative Image	Description
A		Free flow. Individuals are unaffected by others in traffic stream. Freedom to select speed and maneuver is extremely high.
B		Free flow, but the presence of other vehicles begins to be noticeable. Slight decline in freedom to maneuver.
C		Stable flow, but the beginning of the range in which the influence of traffic density on operations becomes marked. Maneuvering requires substantial vigilance. Average travel speeds may begin to show some reduction.
D		High density flow in which ability to maneuver is severely restricted by increasing volumes. Only minor traffic disruptions can be absorbed without effect.
E		Flow at or near capacity. Unstable. Most traffic disruptions will cause queues to form and service to deteriorate.
F		Breakdown flow. Traffic exceeds capacity. Queues form behind such locations, which are characterized by extremely unstable stop-and-go waves.

Description Source: Highway Capacity Manual, Transportation Research Board, 2012.
Image Source: California DOT Website: www.dot.ca.gov/ser/forms.htm

In addition to evaluating the LOS for corridor segments, operations along the entire corridor (the corridor network) were simulated using the computer model VISSIM. Two-hour periods during the morning peak and evening peak were modeled. The VISSIM model provides peak period average travel speeds and vehicle miles traveled (VMT) along the corridor. Results for the 2-hour model periods and for 1-hour peak periods can be pulled from the model.

As a roadway corridor reaches and exceeds its capacity, average travel speeds decrease. The same effect applies to VMT. The peak hour corridor VMT is a measure of how many vehicles can travel through the corridor in the peak hour. As the roadway fills with vehicles, the VMT will continue to increase until the average travel speed begins to drop. As speed drops, the number of vehicles that can get through the corridor during the peak period decreases. Generally, scenarios with higher VMT represent a benefit to mobility as more vehicles are able to travel greater distances along the corridor during the peak periods.

Traffic Operations on I-440/US 1-64

Table 3 presents existing (2012) and future (2035) no-build morning and evening peak hour levels of service for segments along the corridor. Traffic flow is heaviest in the northbound direction in the mornings, switching to the southbound direction in the evenings.

Traffic Operations

By 2035, I-440/US 1-64 is projected to operate at mostly LOS E-F during peak periods. Average speeds are estimated to be well below the speed limit by 2035.

Under existing conditions, the most congestion occurs on the corridor segments between Jones Franklin Road and Wade Avenue, and as shown in the table, congestion is expected to worsen by 2035.

TABLE 3. Existing and Future No-Build Levels of Service During Peak Hours

I-440/US 1-64 Segment	2012 (Existing)				2035 (Future No-Build)			
	Northbound[1] Peak 1-Hour		Southbound[1] Peak 1-Hour		Northbound[1] Peak 1-Hour		Southbound[1] Peak 1-Hour	
	AM	PM	AM	PM	AM	PM	AM	PM
Cary Pkwy to Walnut St	D	C	C	D	F	D	D	F
Walnut St to I-40	E	D	C	D	F	F	C	D
I-40 to Jones Franklin Rd	F	C	C	D	F	F	D	E
Jones Franklin Rd to Melbourne Rd	F	D	D	F	F	F	F	F
Melbourne Rd to Western Blvd	F	E	C	E	F	F	E	F
Western Blvd to Hillsborough St	F	E	E	F	F	F	F	F
Hillsborough St to Wade Ave	F	E	E	E	F	F	F	F
Wade Ave to Lake Boone Trail	D	D	F	F	F	E	F	F
Direction of Travel	↓ NB ends here		↑ SB starts here		↓ NB ends here		↑ SB starts here	

Source: *Traffic Operations Technical Memorandum for I-440 Improvements Project STIP Number U-2719*, Atkins, June 2014

1. Northbound and southbound are the actual directions vehicles are traveling. For I-440, northbound is signed as I-440 east and southbound is signed as I-440 west.

NOTE: Red shaded cells indicate segments operating at an unacceptable level of service (LOS E of F). Yellow shading indicates LOS D, and green shading indicates LOS C or better.

A review of the northbound direction shows this direction is more congested in the morning peak period than in the evening peak period. As vehicles pass the I-40 interchange, the movements on and off I-440/US 1-64 at the I-40 interchange combine with a through lane ending just north of the interchange, creating the delays at this bottleneck location.

A review of the southbound direction shows that there is congestion beginning north of Wade Avenue where the number of through lanes reduces from three lanes to two lanes, and congestion generally continues to the I-40 interchange. At the I-40 interchange, additional capacity is provided by the collector-distributor road that takes traffic to the interchanges at I-40, Crossroads Boulevard, and Walnut Street, which lessens the congestion.

Peak hour average travel speeds and VMT along the corridor are presented in **Table 4**. In the northbound direction, existing average travel speeds are well below the 55-65 miles per hour (mph) posted speed limit in both the morning and evening peak hour (41-47 mph), and are expected to slow further by 2035 (39-41 mph). In the southbound direction, existing average travel speeds are close to the posted speed limit in the mornings (not the main commuting direction), and well below the posted speed limit in the evenings (the main commuting direction). Again, by 2035, the speeds are expected to get slower.

Table 4 also presents vehicle miles traveled through the corridor limits during the morning and evening peak 1-hour periods. As shown in the table, the peak hour corridor VMTs are predicted to decrease (i.e., less traffic can get through the corridor during the peak period), except for the southbound direction in the morning peak period (not the main commuting direction) where VMTs increase slightly. This is because in 2012, there is still some extra room on the road for more vehicles in the southbound direction (see **Table 3**) and the VMT continues to increase slightly through 2035 as this capacity is used up, even as the speed is decreasing.

TABLE 4. Average Travel Speeds and Vehicle Miles Traveled Along I-440

I-440/US 1-64 Direction	Morning (AM) Peak 1-Hour Period				Evening (PM) Peak 1-Hour Period			
	Speed (mph)		Vehicle Miles Traveled[1]		Speed (mph)		Vehicle Miles Traveled[1]	
	2012	2035	2012	2035	2012	2035	2012	2035
Northbound	41	39	21,940	19,280	47	41	20,270	17,880
Southbound	58	53	21,170	22,140	43	39	24,370	24,030

Source: *Traffic Operations Technical Memorandum for I-440 Improvements Project STIP Number U-2719*, Atkins, June 2014

1. Vehicle Miles Traveled (VMT) are the vehicle miles travelled along the corridor in the study area during the peak one-hour period. Higher VMT means more mobility (i.e., more vehicles are moving through the corridor during the analysis period).

1.6.4. Existing Crash Data

In addition to high traffic volumes creating congestion, incidents such as vehicle breakdowns or accidents occurring on I-440/US 1-64 can also cause back-ups and congestion. As discussed below, the project corridor experiences above average rates of crashes.

A crash analysis was performed to compare crash rates within the study area to other urban interstates in North Carolina, as well as to identify the types of crashes and to determine crash hot spots (*Traffic Operations Technical Memorandum for I-440 Widening STIP Number U-2719*, Atkins, June 2014).

> ***Crash Data***
>
> *The project corridor experiences above average rates of crashes. Rear-end crashes comprise more than half of the total crashes along the project corridor.*

Data provided by the NCDOT Traffic Survey Unit (*Traffic Engineering Accident Analysis System's Strip Analysis Report*) was used to evaluate the existing crash rates on the I-440/US 1-64 mainline between milepost 14.18 (Cary Parkway) and milepost 21.02 (Lake Boone Trail). Three years of crash history, from August, 2009 to July, 2012, were analyzed.

Table 5 presents a comparison of the crash rates on I-440/US 1-64 within the study area versus the average crash rate for all urban interstates in North Carolina, as well as the critical crash rate and the safety ratio (definitions are provided in the table footnotes).

TABLE 5. Comparison of Crash Rates

Crash Type	Study Area Actual Crash Rate[1]	NC Urban Interstate Crash Rate[1]	I-440 Study Area Critical Crash Rate[1,2]	Safety Ratio (Critical/ Actual)[1,3]
Total	324.30	101.82	117.40	**0.36**
Fatal	0.80	0.43	1.83	2.29
Non-Fatal Injury	60.60	29.43	38.00	**0.63**
Night	66.80	26.07	34.16	**0.51**
Wet	100.70	26.34	34.47	**0.34**
Run-Off-Road	18.40	28.89	37.38	2.03

Source: NCDOT Traffic Survey Unit *2009-2012 Three Year Crash Rates*

1. Crash Rate defined by crashes per 100 million miles traveled.
2. Critical crash rate – a statistically derived value based on statewide crash rates for a 95 percent confidence interval. The critical crash rate is compared against a calculated actual crash rate to see if the actual crash rate for a given segment is above an average far enough so that something besides chance must be the cause.
3. Safety ratio is the critical crash rate divided by the actual crash rate. A value less than 1 indicates an actual crash rate is above average far enough that there is a crash issue.

As shown in **Table 5**, I-440/US 1-64 through the project study area has a substantially higher rate of total crashes than the average rate for all urban interstates in North Carolina. For the project corridor, the total crash ratio is 0.36, which indicates a crash rate well above average. The crash ratio also is less than one for non-fatal injury crashes, night crashes, and wet crashes

For the period August 2009 through July 2012, there were 1,166 reported crashes along the project corridor. These incidents frequently affect travel on I-440/US 1-64 by causing traffic slowdowns, and sometimes lane closures and temporary detours onto the surrounding roadways. The three most common types of crashes are rear end, ran off road, and sideswipe, which together make up nearly 82 percent of the total crashes. Rear end crashes comprise more than half of the total crashes along the project corridor, and are typically caused by traffic slowing down due to congestion.

An analysis also was conducted to identify crash hot spots along I-440/US 1-64 for each direction of travel. Using the Sliding Window Method from the American Association of State Highway and Transportation Officials' (AASHTO) *Highway Safety Manual*, a 0.5-mile segment of the corridor was analyzed, moving at 0.1-mile increments along the length of the corridor. The safety ratio was calculated for each segment in the sliding window analysis. Poor segments were identified as having a safety ratio less than 1.0 (meaning the actual crash rate is higher than the critical crash rate for that segment).

The sliding window analysis safety ratios are shown on the Existing Conditions Diagrams in **Appendix B**. In general, safety ratios are better on the basic freeway segments between the interchanges and worse within the interchanges, where more lane changing maneuvers take place. Areas with poor safety ratios (less than 1.0) are listed below. Overall, the safety analysis identified more poor segments along the I-440 eastbound lanes.